# RCRA Part Appendix A-P
# For

# Main Base

**Hawthorne Army Depot**
**Hawthorne, Nevada**

**Volume 2**

**JUNE 2012**

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX A

Revised
May 2012

HAWTHORNE ARMY DEPOT

# WASTE HANDLING

# INTERNAL OPERATING PROCEDURE

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# 1.0 INTRODUCTION

## 1.1 PURPOSE AND SCOPE

This Internal Operating Procedure (IOP) is written to provide guidance to SOC Nevada, LLC Environmental Office personnel handling hazardous material/waste. Procedures within this document are designed to assure proper handling, which ensures the integrity of the material, safety of personnel, protection of the environment and regulatory compliance.

## 1.2 BACKGROUND

SOC Nevada, LLC Environmental Office maintains responsibility for the pickup and storage of all hazardous material/waste for disposal generated at or on Hawthorne Army Depot (HWAD). This includes hazardous wastes generated by Tenant Activities. Facilities/locations covered by this IOP may include working facilities, which include any and all buildings in which work is being performed, and the pickup of medical waste from the medical clinic. Other remote locations include any and all storage magazines or any locations where incidental waste generation may occur.

## 1.3 DEFINITIONS

RCRA - - Resource Conservation and Recovery Act

PCB - - Polychlorinated Biphenyls

WAP - - Waste Analysis Plan

PPE - - Personal Protective Equipment

SCBA - - Self-Contained Breathing Apparatus

HEPA - - High Efficiency Particulate Apparatus

HWAD - - Hawthorne Army Depot

WADF- - Western Area Demilitarization Facility

MSDS - - Material Safety Data Sheet

# 2.0 PICKUP LOCATIONS

## 2.1 PRODUCTION BUILDINGS

Production buildings are all buildings in the 117-Area (WADF), buildings in use in the 101 area, 108 area, and 103 area.

## 2.2 INDUSTRIAL BUILDINGS

These buildings are located on the Main Base and the Munition and Logistics area, which include but are not limited to buildings 10, 11, 63, 64, 7, 26, and 102-52.

## 2.3 MEDICAL CLINIC

The medical clinic is located in building 102-54.

## 2.4 OTHER LOCATIONS

Other locations may include storage magazines, the truck lot, vehicle maintenance lot, New Bomb, Black Beauty, and any other active site on HWAD property.

# 3.0 STORAGE PROCEDURES

## 3.1 MARKING OF CONTAINERS

All containers will be marked as to their contents, either stenciled or marked with marking pen.

## 3.2 LABELING OF CONTAINERS

All containers will have affixed to them the proper label required by Code of Federal Regulations (CFR) title 49 part 172.101 and 40 CFR part 262.

## 3.3 DOCUMENTATION OF CONTAINERS

All containers will be logged into a building log book DZB Form 108-E and on the logbook spreadsheet, and then have attached to them, a container tracking form, HWAD 68.

### 3.4 PERSONAL PROTECTIVE EQUIPMENT

During storage operations the following PPE will be worn:

- Safety glasses with side shields
- Steel toe shoes
- Leather or leather palm gloves

### 3.5 WASTE LOCATION PROCEDURES

#### 3.5.1 Storage Cells

All containers of waste will be stored in individual cells as outlined in Appendix G. At no time will the maximum allowable number of drums for a cell be exceeded.

#### 3.5.2 Compatibility Chart

Before storing a waste within a cell, the compatibility chart (Appendix H) for the building will be consulted. At no time will incompatible wastes be stored within the same cell.

## 4.0 PAPER TRAIL OF MATERIAL

### 4.1 STORAGE DOCUMENTS

Upon arrival of material at storage site, a container tracking form HWAD 68 will be affixed to the container with all information required. The container will be logged into building logbook (DZB Form 108-E).

## 5.0 POLYCHLORINATED BIPHENYLS (PCBs)

### 5.1 HIGH VOLTAGE TRANSFORMERS

A PCB label will be affixed to the transformer, along with form HWAD 68, and be logged into log book (Form 108-E). A sample of oil from the transformer will be analyzed if the concentration level of PCBs is unknown.

## 5.2 CAPACITORS

Capacitors will be placed into storage with the PCBs label affixed to the capacitor, and logged into log book. No sample is required; these are sealed items.

## 5.3 TRANSFORMER OILS

Transformer oils that have been used will have a sample analyzed for concentrations of PCBs. Drums will be logged into log book and labeled with a HWAD 68 tracking form.

# 6.0 ANALYSIS OF RESULTS

Analytical data is examined for the presence of known constituents, and then compared to Resource Conservation and Recovery Act (RCRA) standards in adherence to the Waste Analysis Plan. The results allow the determination to be made as to whether or not the material is a RCRA controlled waste or a non-regulated hazardous material.

# 7.0 PROCEDURE FOR PICKUP OF HAZARDOUS MATERIAL/WASTE

Environmental staff will receive a telephone call from the location that has material for pickup.

Proceed to location of material, and transport to the appropriate building for each particular waste.

Proceed to proper storage site: see Appendix H for a complete description of storage locations and compatibility charts for each location.

- 106-22 – bulk liquids, used oils, battery fluids, etc.
- 106-23 – paints, thinners, flammable material, etc.
- 115-9 – explosive contaminated material, pressed sludge, spent carbon, etc.
- 113-73A – dry explosive contaminated material, explosive contaminated soil, etc.
- 116 group magazine – hazardous waste munition items.

Upon arrival at proper building for material, unload stake truck with electric fork. Once in building, weigh material, log material into log book, and complete HWAD 68 tracking form with all information required: weight of material, container number, date received, accumulation start date, waste origination, and description of material. Attach form HWAD 68 to container, then place container into proper storage.

# 8.0 PROCEDURES FOR LOGBOOKS, WASTE DETERMINIZATION AND LABELING

## 8.1 HAZARDOUS WASTE STORAGE BUILDINGS

Waste container information will be entered on logbook form 108-E (weight of material, container number, date received, accumulation start date, waste origination, and description of material) and also into the computer spreadsheet. Containers will be identified using the Julian Date and a sequential identifier.

The electronic master copy of the building logbooks will be maintained on a laptop used in the storage buildings. Written logbooks will be used to reconcile with the electronic master copy of building logbooks to check for discrepancies. Discrepancies in logbooks will be corrected immediately.

Waste will be categorized as RCRA (hazardous waste) or non-hazardous waste per the Waste Analysis Plan. The profile number for a particular waste will be written on the HWAD 68 tracking label.

If a waste is determined to be hazardous, a “HAZARDOUS WASTE” label will be placed on the container with the information completed on the label (Example shown in Appendix C).

If a waste is determined to be hazardous, the appropriate DOT Warning Label will be placed on the container (example shown in Appendix D).

If waste analysis needs to be completed per the Waste Analysis Plan, an “Analysis Pending” label will affixed to the container until waste determination has been completed. A “p” will be written into the “RCRA/Non-RCRA” column while analysis is pending. The sample date will be entered into the logbooks.

For shipping containers out of buildings, Logbook (form 108-E) and electronic master copy of building logbooks will track manifest shipping number and date item is shipped out. Profile numbers will be written on the containers before shipping out.

Once written logbook sheets (108-E) are completed. The completed forms will be removed from the logbook and maintained on file in the Environmental Department.

## 8.2 HAZARDOUS WASTE MUNITIONS STORAGE BUILDINGS

**NO MATERIAL WILL BE MOVED IN OR OUT OF THE HAZARDOUS WASTE MUNITIONS STORAGE BUILDINGS WITHOUT ENVIRONMENTAL PERSONNEL PRESENT TO UPDATE LOGBOOKS, MANIFEST, AND LABEL AS REQUIRED.**

**WHEN CONTACTED FOR MOVEMENT OF MATERIAL IN OR OUT OF THE HAZARDOUS WASTE MUNITIONS STORAGE BUILDINGS, ENVIRONMENTAL PERSONNEL MUST RESPOND AS SOON AS POSSIBLE TO THE LOCATION TO UPDATE LOGBOOKS, MANIFEST, AND LABEL AS REQUIRED.**

Waste container information will be entered on logbook form 108-E and also into the computer spreadsheet. Containers will be identified using the Julian Date and a sequential identifier. Complete pallets and large containers will be indentified as one item.

The electronic master copy of the building logbooks will be maintained on a laptop used in the storage buildings. Written logbooks will be used to reconcile with the electronic master copy of building logbooks to check for discrepancies. Discrepancies in logbooks will be corrected immediately.

Waste will be categorized as RCRA (hazardous waste D003 typically for reactive) waste per the Waste Analysis Plan.

A “HAZARDOUS WASTE” label will be placed on the container with the information completed on the label (Example shown in Appendix C) if a Hazardous Waste label is not visible.

For shipping, the appropriate DOT Warning Label will be placed on the container (example shown in Appendix D).

For shipping containers out of buildings, Logbook (form 108-E) and electronic master copy of building logbooks will track manifest shipping number and date item is shipped out. DOT Hazardous Waste Labels will be applied as required for shipping and the profile number will be written on the container.

Once written logbook sheets (108-E) are completed, the completed forms will be removed from the logbook and maintained on file in the Environmental Department.

## 9.0 TRAINING

Environmental personnel will complete training for:

A. 49 CFR Hazardous Materials Transportation
B. RCRA Regulations for Hazardous Waste

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# APPENDIX A

## HWAD 68 FORMS

# CONTAINER TRACKING FORM

| |
|---|
| Date Received/Drum Number |
| Drum Weight |
| Sample Date/Number |
| NSN # |
| Contents Description: |
| Comments: |

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# APPENDIX B

## HAZARDOUS WASTE LABEL

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# HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL.

IF FOUND, CONTACT THE NEAREST POLICE, OR PUBLIC SAFETY AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY.

GENERATOR INFORMATION:

NAME Hawthorne Army Depot

ADDRESS 39 South maine PHONE 775-945-7359

CITY Hawthorne STATE NV ZIP 89415

EPA ID NO./ MANIFEST DOCUMENT NO. NV1210090006 /

ACCUMULATION START DATE _____ EPA WASTE NO. D003

Waste Cartridges
1.2E UN0321 Pg II

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

## HANDLE WITH CARE!

STYLE WM6

Printed by Labelmaster, An American Labelmark Co., Chicago, IL 60646 (800) 621-5808

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# APPENDIX C

## CLASSIFICATION LABEL

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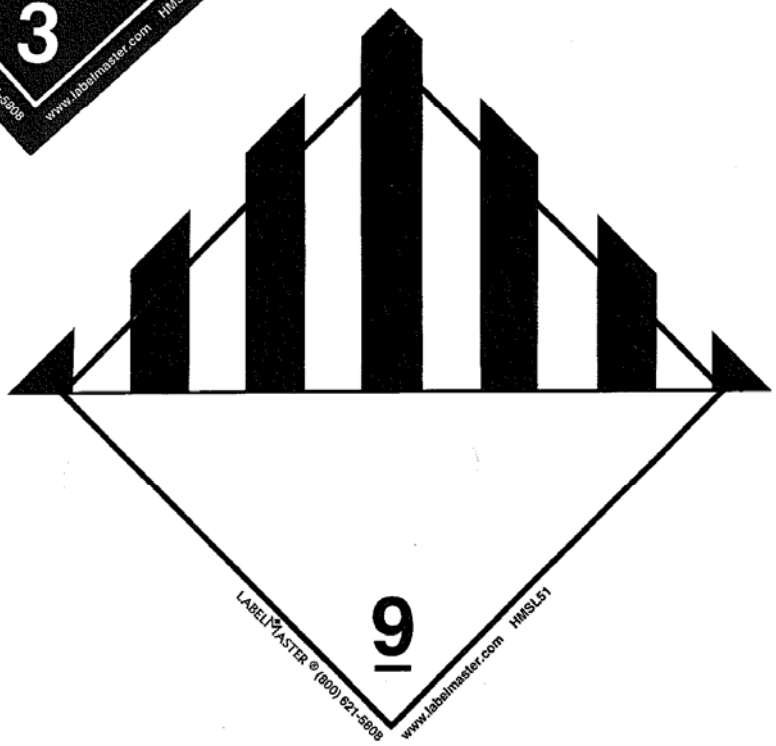

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# APPENDIX D

## WASTE TRACKING LOG

## Form 108-E

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**Table II – 21G**

| BUILDING# | |
|---|---|

| DATE RECEIVED | BLDG # FROM | DRUM TRACKING# | DRUM WT. LBS | ACCUMULATION DATE | SAMPLE #, AND DATE | PICKUP ORDER # | DATE PICKED UP | MANIFEST # | RCRA/ NON RCRA | CUM TOTAL (LBS) | CUM TOTAL DRUMS | CONTENTS WASTE STREAM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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Form 108-E

Revised
November 2010

# APPENDIX E

## WASTE STORAGE FACILITIES FLOOR PLAN

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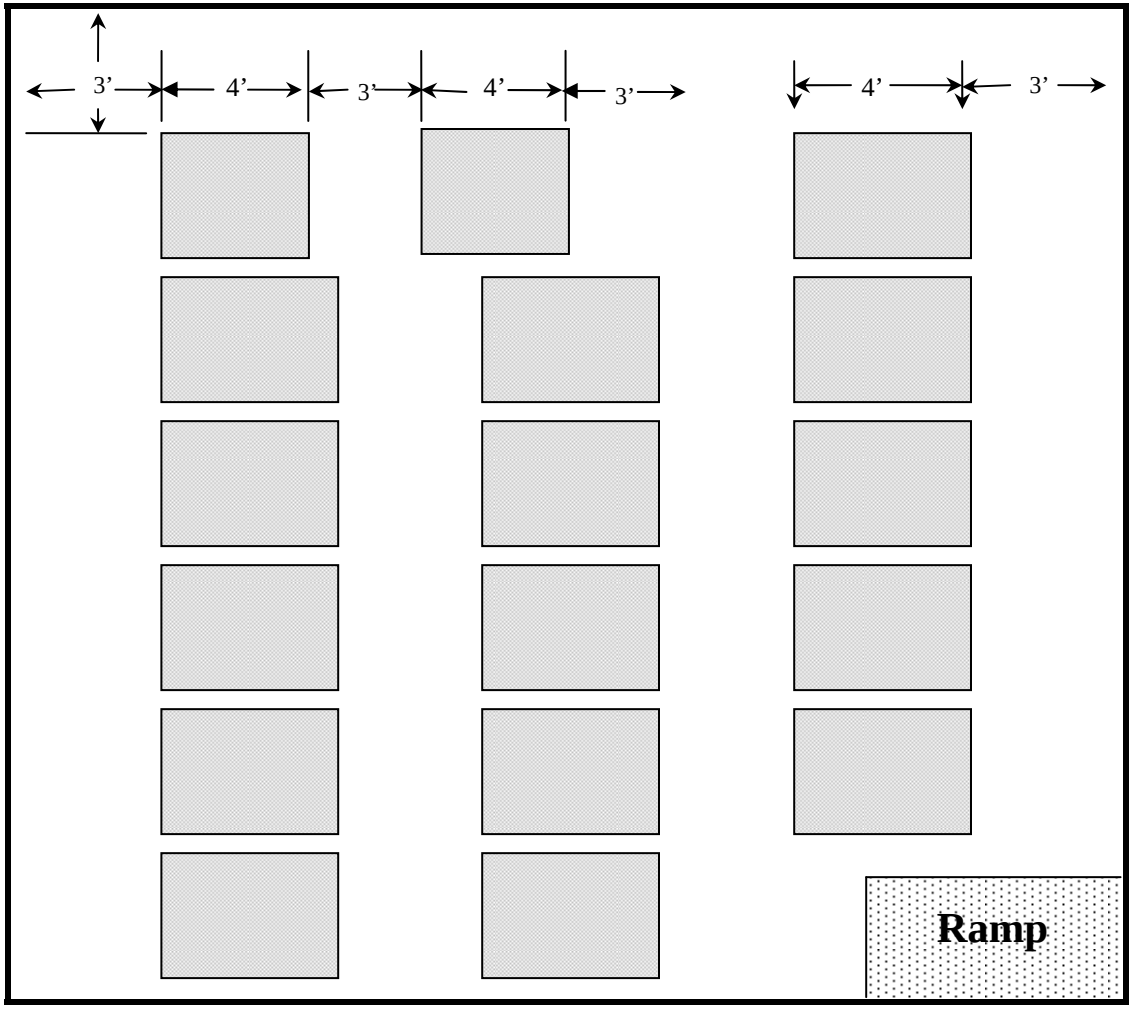
November 2010

# BLDG. 106-22, Cell #1




2 Layers high for a maximum total of 136 drums.

CELL #1 – 24’ x 27’

All measurements approximate

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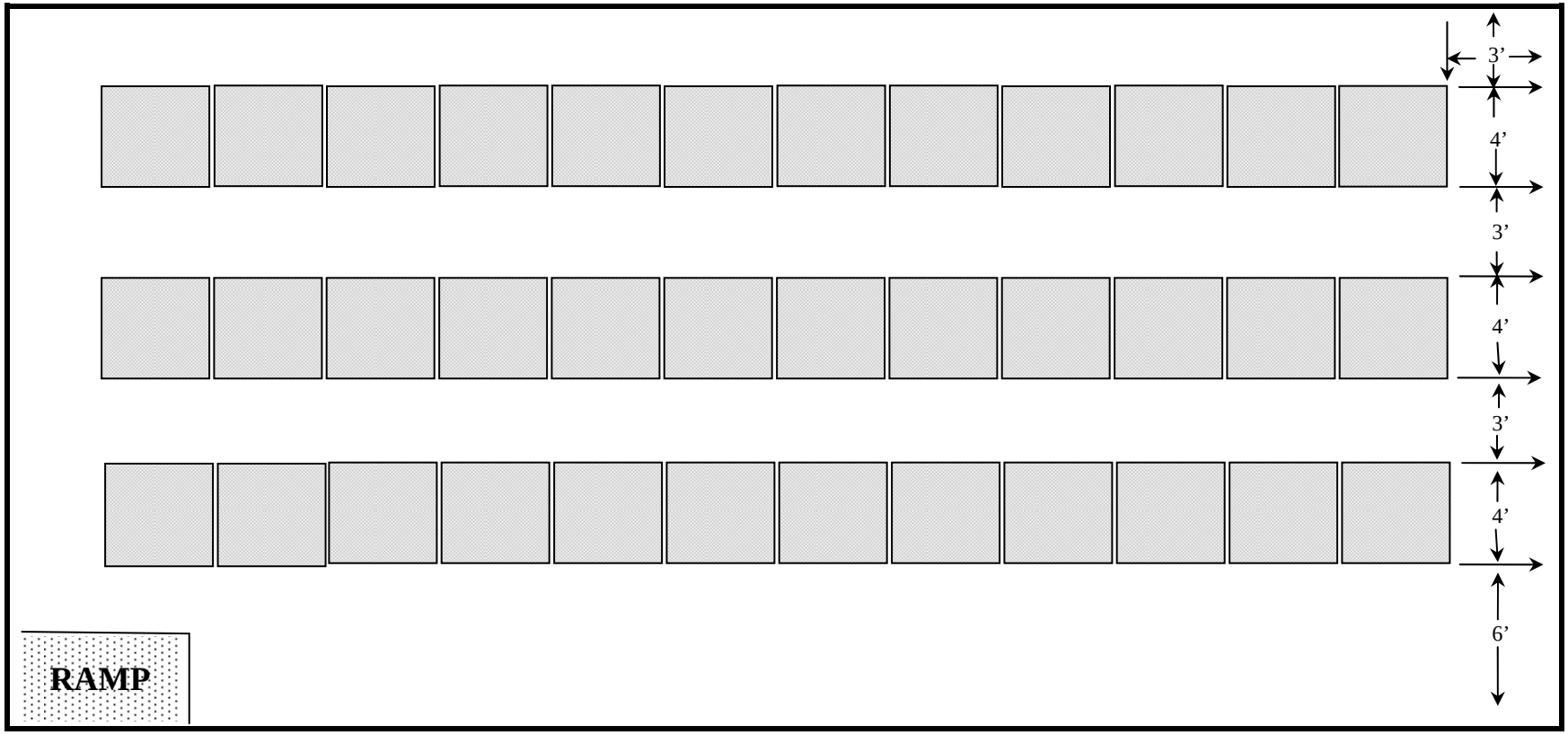
# BLDG. 106-22, Cell #2




2 layers high for a maximum total of 288 drums.

CELL # 2 – 54’ x 27’

All measurements approximate

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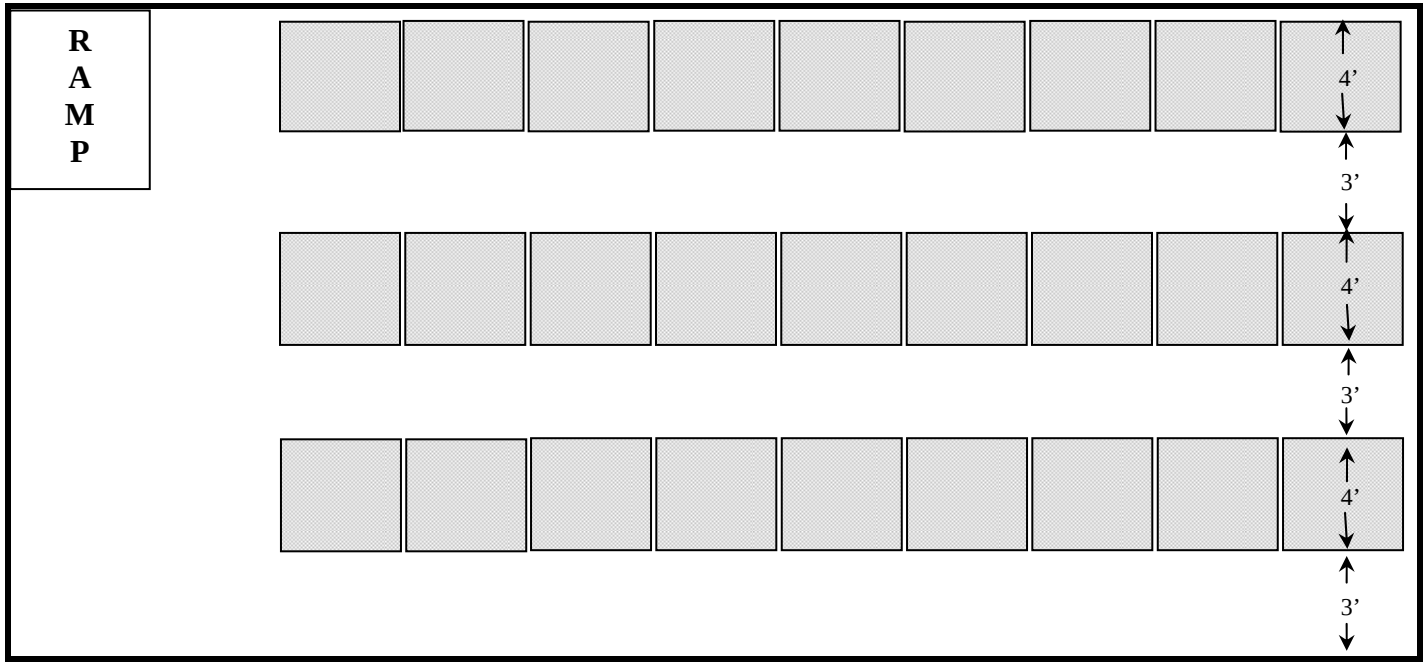
# BLDG. 106-22, Cell # 3




2 layers high for a maximum total of 216 drums.

CELL #3 – 43’ x 21’

All measurements approximate

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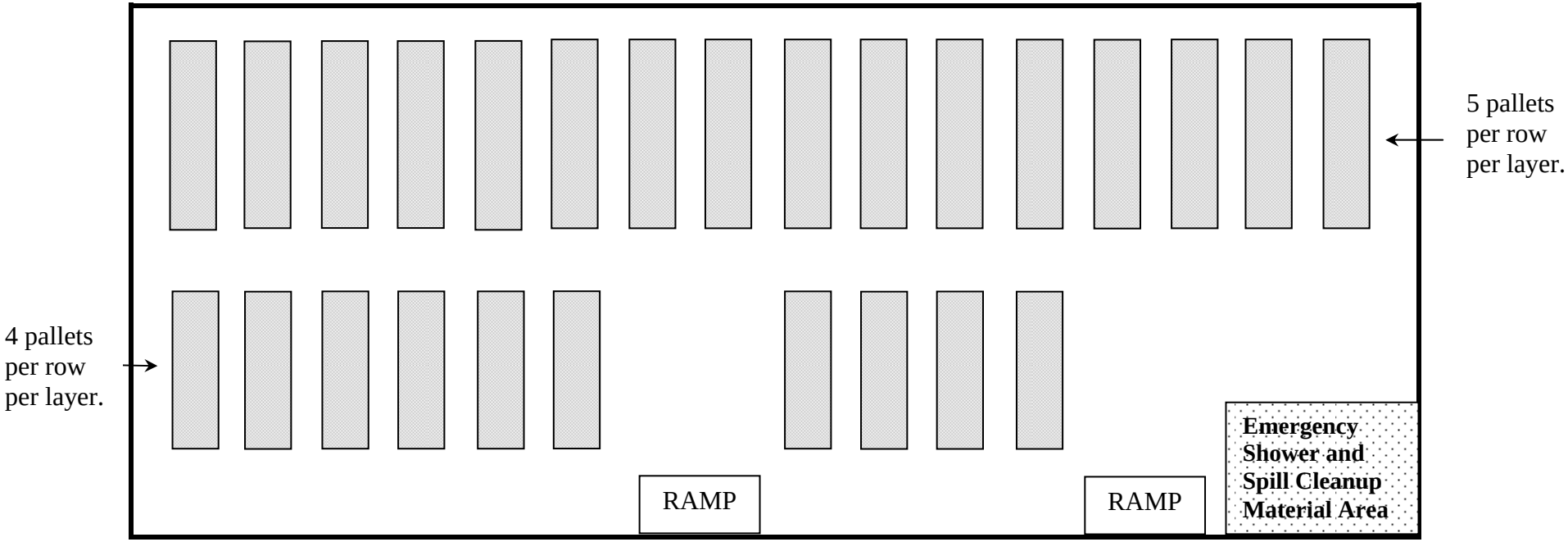
# BLDG. 106-22, Cell # 4




There is a minimum of 3’ around each row.

2 layers high for a maximum total of 980 drums.

All measurements approximate

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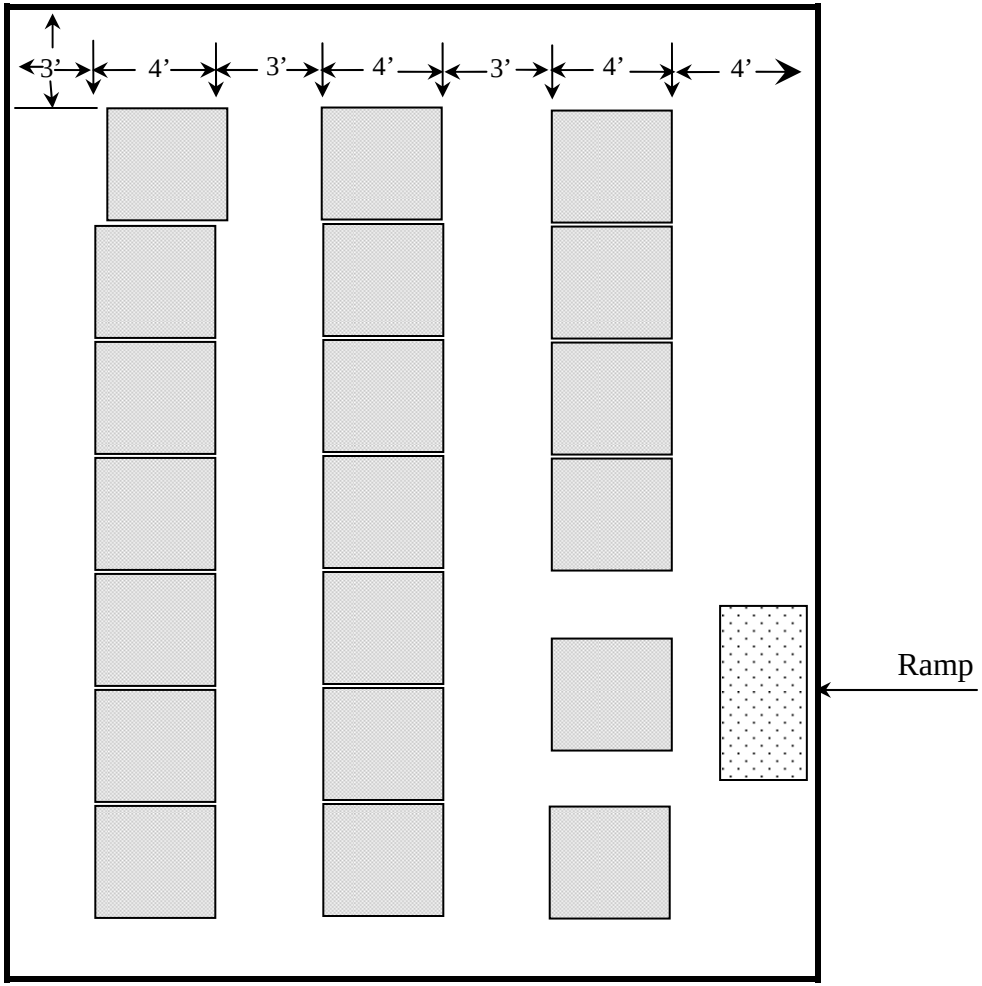
# BLDG. 106-23, Cell #1




2 layers high for a maximum total of 160 drums.

CELL #1 – 25’ x 34’

All measurements approximate

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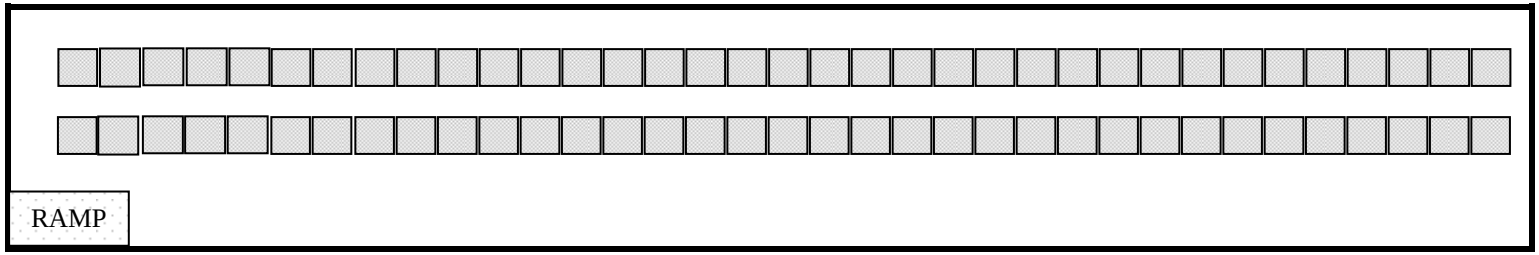
# BLDG. 106-23, Cell #2




Minimum of 3’ around all sides of each row.

CELL # 2 – 148’ x 18’6”

2 layers high for a maximum total of 560 drums.

All measurements approximate

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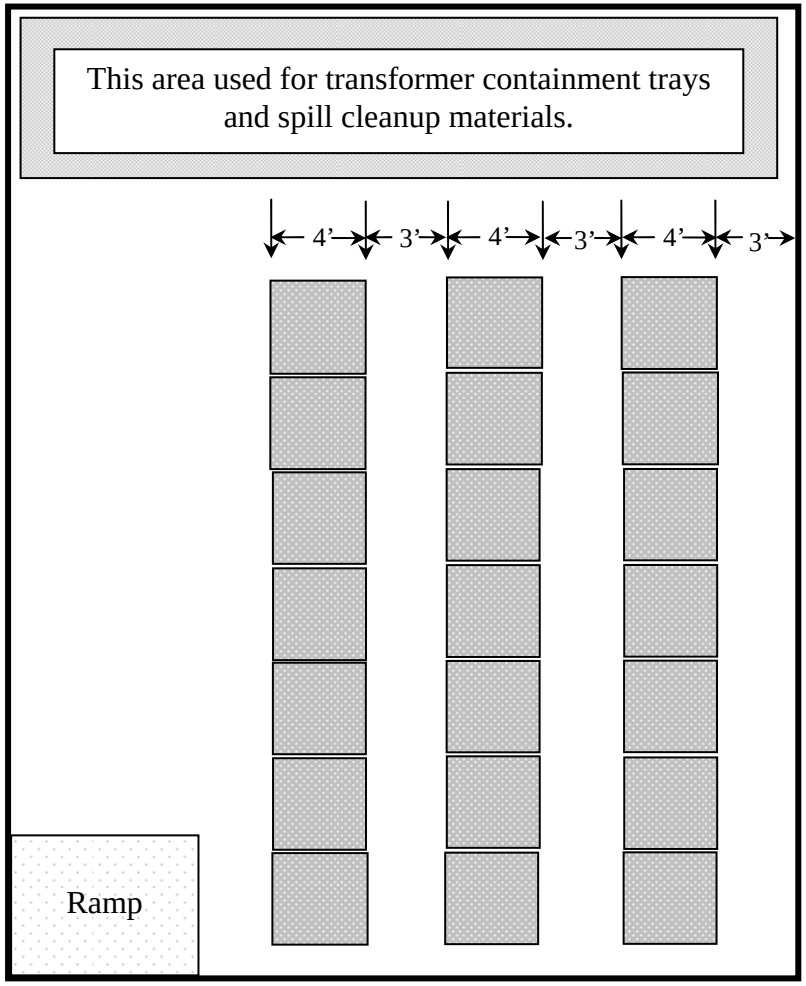
# BLDG. 106-23, Cell # 3
# Cell # 3, PCB Storage Area




All measurements approximate

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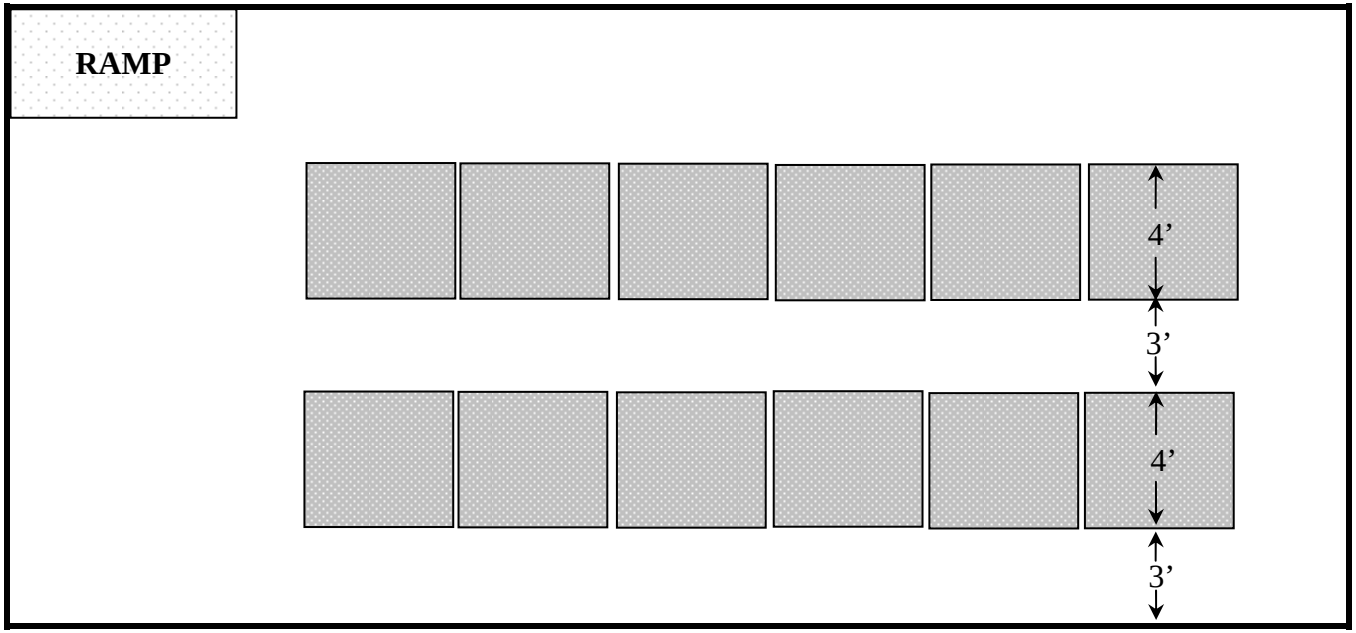
# BLDG. 106-23, Cell # 4




2 layers high for a maximum total of 96 drums.

CELL # 4 – 19’ x 30’6”

All measurements approximate

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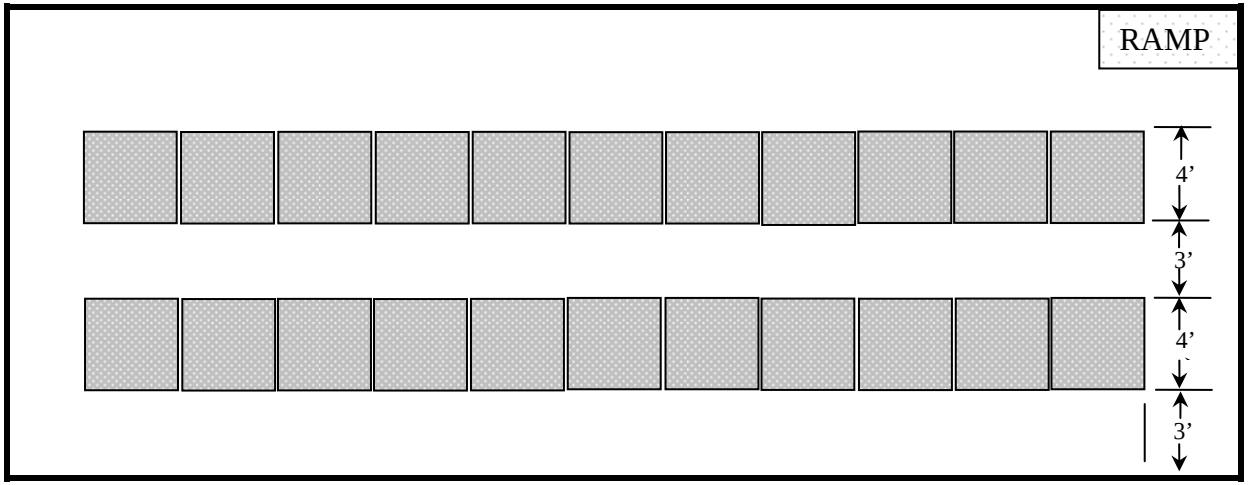
# BLDG. 106-23, Cell # 5




2 layers high for a maximum total of 176 drums.

CELL # 5 -19’ x 50’6”

All measurements approximate

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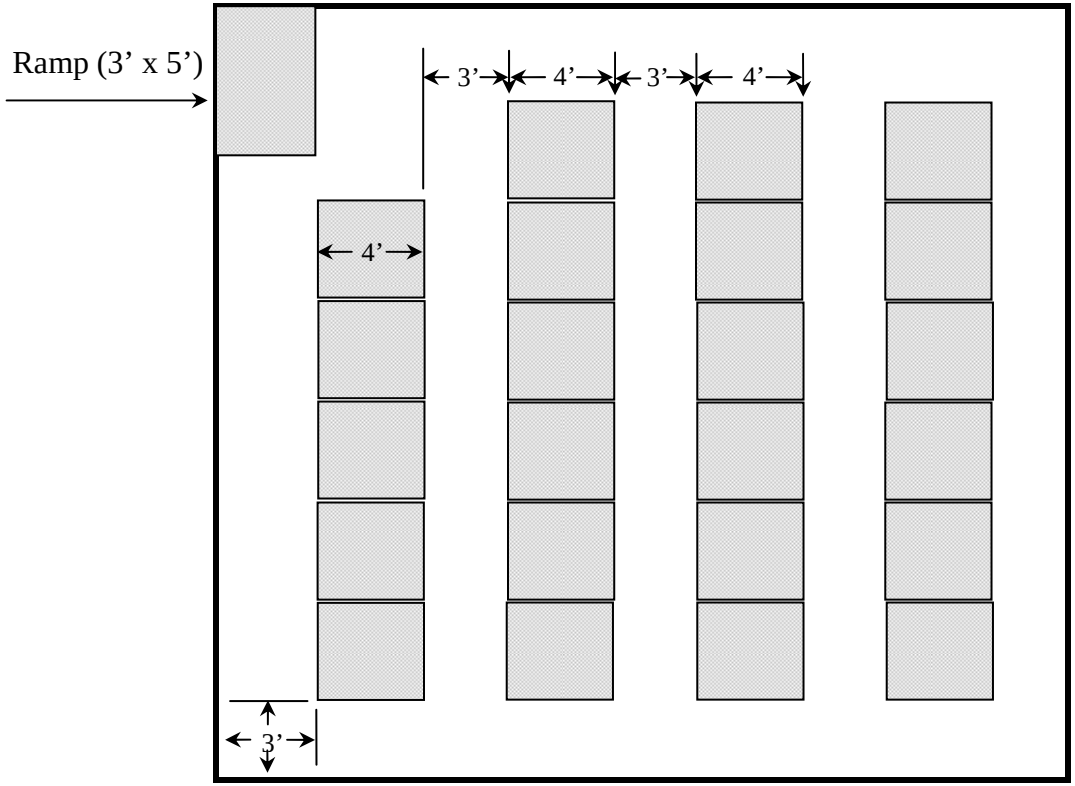
# BLDG. 106-23, Cell # 6




2 layers high for a maximum total of 184 drums.

CELL # 6, 31’ x 30’6”

All measurements approximate

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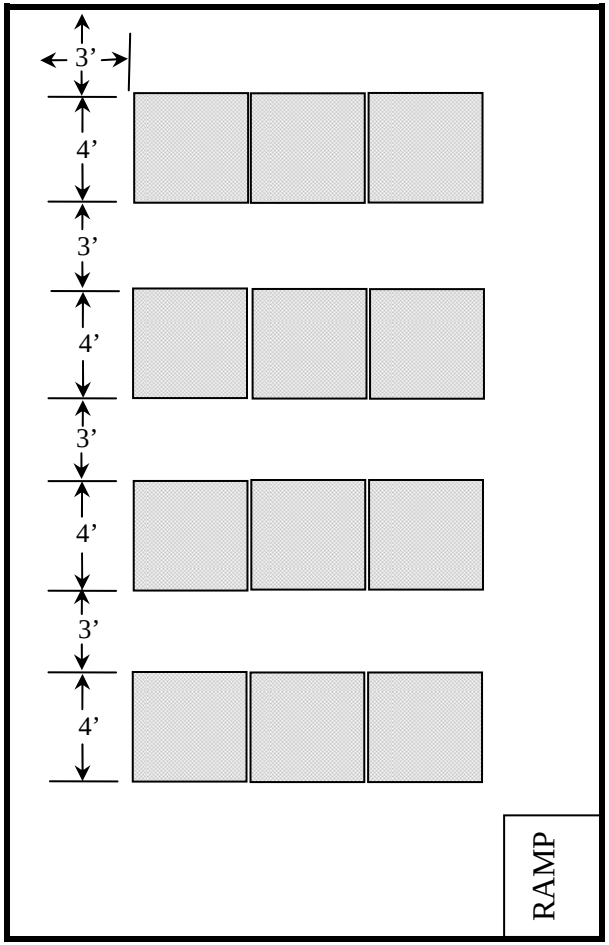
# BLDG. 115-9, Cell # 1




2 layers high for a maximum total of 96 drums.

CELL # 1 X 33’6”

All measurements approximate

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# BLDG. 115-9, Cell # 2

2 layers high for a maximum total of 192 drums.

CELL # 2 – 25’ x 39’

All measurements approximate

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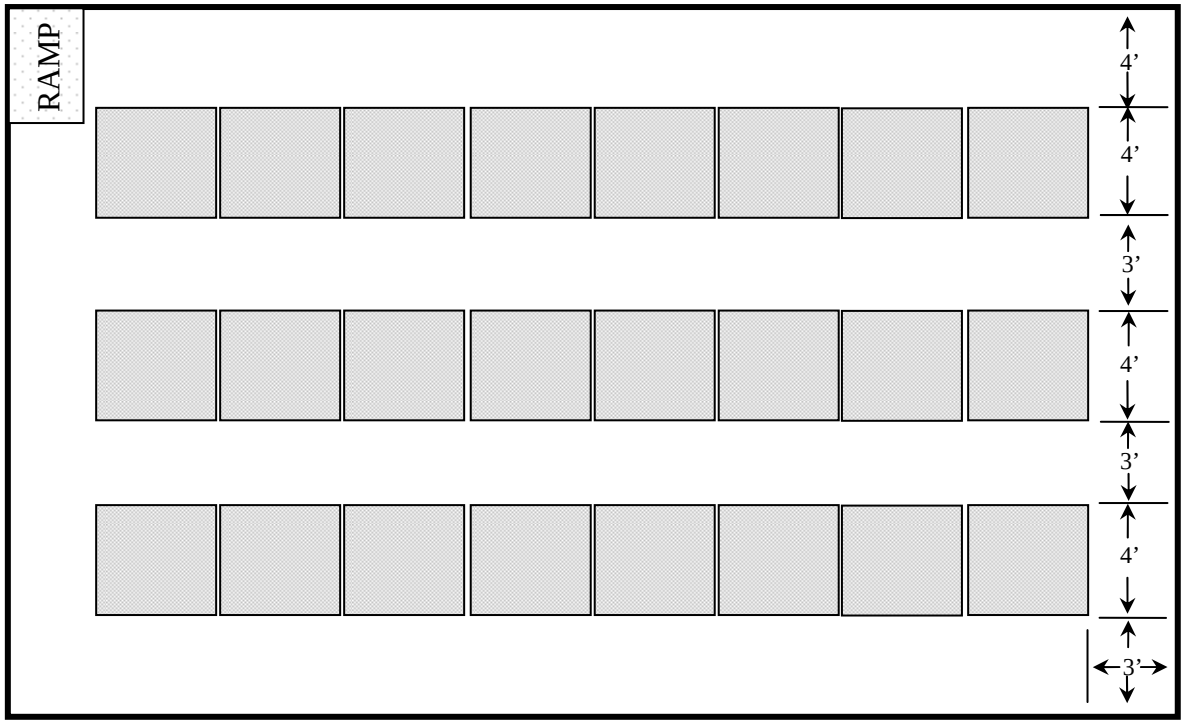
# BLDG. 115-9, Cell # 3




2 layers high for a maximum total of 192 drums.

CELL # 3 -25’ x 39’

All measurements approximate

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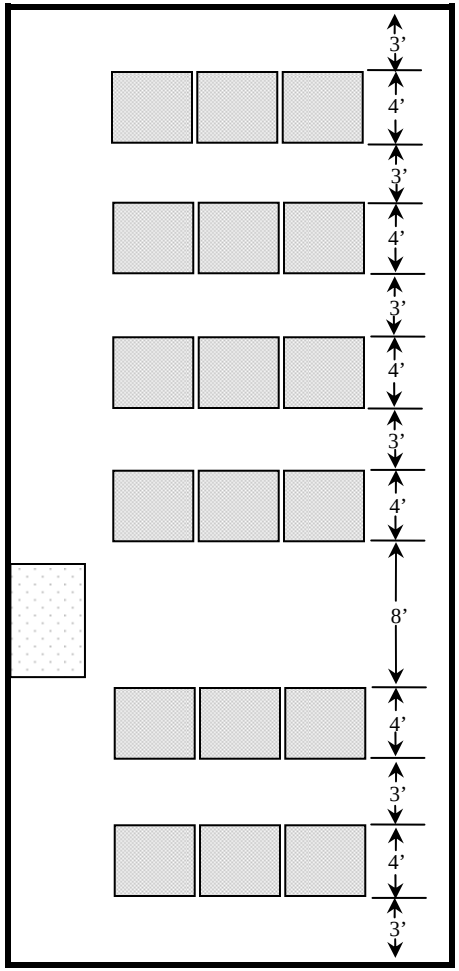
# BLDG. 115-9, Cell # 4




2 layers high for a maximum total of 144 drums.

CELL # 4 – 19’ x 50’

All measurements approximate

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# APPENDIX F

## COMPATIBILITY CHART FOR STORAGE FACILITIES

Table II-4a outlines specific compounds which may be contained in wastes generated by operations at HWAD. This table also outlines in which container storage facility the compound (waste) maybe stored. Tables II-4b and II-4c are waste compatibility charts for container storage facilities 106-22 and 106-23 respectively. These charts will be used to determine which wastes (compounds) can be stored together in individual cells. In general only like wastes (compounds) can be stored together in individual cells. Wastes (compounds) will be stored together in individual cells only as a last resort due to lack of available storage space.

Table II-4a Waste Storage Outline

| Compound | Waste Codes | Building # |
|---|---|---|
| 1. Mineral Acids: | | 106-22 |
| - Sulfuric | D002 | |
| - Nitric | D002 | |
| - Hydrochloric | D002 | |
| - Phosphoric | D002 | |
| - Boric | D002 | |
| - Chromic | D002/D007 | |
| 2. Organic Acids: | | 106-22 |
| - Acetic | D002 | |
| 3. Alcohols/Glycols: | | 106-23 |
| - Isopropanol | D001 | |
| - Methanol | D001/F003 | |
| - Ethanol | D001 | |
| - Ethylene Glycol | | |
| 4. Caustics: | | 106-22 |
| - Sodium Hydroxide | D001 | |
| - Potassium Hydroxide | D001 | |
| - Ammonium Hydroxide | D001 | |
| - Ammonia | D001 | |
| 5. Cyanides: | | 106-22 |
| - Sodium Cyanide | D007/P006 | |
| - Potassium Cyanide | D003/P098 | |
| 6. Ether: | | 106-23 |
| - Ethyl Ether | D001/U117 | |

| Compound | Waste Codes | Building # |
|---|---|---|
| 7. Aromatic Hydrocarbons | | 106-23 |
| - Benzene | D001/U109 | |
| - Toluene | D001/U220/F005 | |
| - Xylene | D001/U239/F003 | |
| 8. Halogenated Organics: | | 106-23 |
| - Chloroform | D022/U044 | |
| - Trichloroethylene | U228/F002 | |
| 9. Ketones: | | 106-23 |
| - Acetone | D001/F003/U002 | |
| 10. Metals: | | 106-22 |
| - Arsenic | D004 | |
| - Barium | D005 | |
| - Cadmium | D006 | |
| - Chromium | D007 | |
| - Lead | D008 | |
| - Mercury | D009 | |
| - Selenium | D010 | |
| - Silver | D011 | |
| 11. Nitro Organic Compounds or Explosives: | | 115-9 |
| - TNT | D003 | |
| - RDX | D003 | |
| - Ammonium Picrate | D003/D009 | |
| - HMX | D003 | |
| - Smokeless Powder | D003 | |
| - 2, 4, -Dinitrotoluene | D030/D003/U105 | 106-22 |
| 12. Nitrates: | | 106-23 |
| - Acetonitrite | U003 | |
| 13. Mercaptans and Other Organic Sulfides: | | 106-23 |
| - Carbon Disulfide | F005 | |
| 14. Misc. Combustible and Flammable: | | 106-23 |
| - Gasoline | D001 | |
| - Kerosine | D001 | |
| - Lacquer Thinner | D001 | |
| - Mineral Spirts | D001 | |
| - Stoddard Solvent | ------ | |

Table II-4b Waste Compatibility Chart For Building 106-22

| | 1. Mineral Acids | 2. Organic Acids | 4. Caustics | 5. Cyanides | 10. Metals |
|---|---|---|---|---|---|
| **1. Mineral Acids** | X | X | O | O | O |
| **2. Organic Acids** | X | X | O | O | O |
| **4. Caustics** | O | O | X | X | X |
| **5. Cyanides** | O | O | X | X | X |
| **10. Metals** | O | O | X | X | X |

X = Compatible – OK to store together
O = Incompatible – Do not store together

Waste (compounds) not routinely allowed in Building 106-22:

- Alcohols/Glycols
- Ethers
- Aromatic Hydrocarbons
- Halogenated Organics
- Ketones
- Explosives
- Nitrites
- Mercaptans/Organic Sulfides
- Combustible/Flammables

Table II-4c Waste Compatibility Chart For Building 106-23

| | 3. Alcohol/Glycols | 6. Ethers | 7. Aromatic Hydrocarbons | 8. Halogenated Organics | 9. Ketones | 12. Nitrates | 13. Mercaptans/Sulfide | 14. Combustible/Flammable |
|---|---|---|---|---|---|---|---|---|
| 3. Alcohol/glycols | X | X | X | X | X | X | X | X |
| 6. Ethers | X | X | X | X | X | X | X | X |
| 7. Aromatic Hydrocarbons | X | X | X | X | X | X | X | X |
| 8. Halogenated Organics | X | X | X | X | X | X | O | X |
| 9. Ketones | X | X | X | X | X | X | O | X |
| 12. Nitrates | X | X | X | X | X | X | X | X |
| 13. Mercaptans/Sulfides | X | X | X | O | O | X | X | X |
| 14. Combustible/Flammable | X | X | X | X | X | X | X | X |

X = Compatible, OK to store together
O = Incompatible, do not store together

Waste (compounds) not routinely allowed in Building 106-23:

- Mineral Acids
- Organic Acids
- Caustics
- Cyanides
- Metals

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX B

# Waste Analysis Plan 2013

Hawthorne Army Depot

SOC Environmental Services

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# SECTION A - AREAS 103 AND 108

## A.1 General Operations/Functions Performed:

The 103 and 108 areas are involved in production, renovation and/or demilitarization of explosive loaded ammunition or inert/training ammunition.

The primary concern, as far as hazardous wastes, are the chemical solvents used in processing or cleaning of ammunition, paint, waste paint, paint sludge, grit blast/sanding dust, explosive contaminated waste (i.e. rags), spent used aerosol cans, scrap explosive waste and waste water used in the processing or demilitarization of explosives. Explosive wastes are derived from the breakdown or renovation of munitions. Based on the characteristic of reactivity these need not be tested.

## A.2 Specific Wastes Generated:

**A.2.1** Spent/used solvents;

**A.2.1.1** Toluene (F005)

**A.2.1.2** Trichloroethylene (F002)

**A.2.1.3** 1,1,1 Trichloroethane (F002)

**A.2.1.4** Methyl isobutyl ketone (F003)

**A.2.1.5** Isopropanol (D001)

**A.2.1.6** Acetone (F003 or U002)

**A.2.1.7** Mixtures of above solvents (waste codes dependent upon mixture).

**A.2.2** Scrap explosives (D003)

**A.2.3** Rags or other material grossly contaminated with explosives (D003)

**A.2.4** Soil/sludge contaminated with explosives (D003)

**A.2.5** Paint/waste paint (D001, D007, D008)

**A.2.6** Paint sludge (D007, D008)

**A.2.7** Grit blast/sanding dust from paint removal operations which contain paint flakes or residue (D007, D008)

**A.2.8** Soil/sludges contaminated with toxic metals (D007, D008)

**A.2.9** Water or other liquid waste contained in holding tanks, contaminated with toxic metals (D007, D008)

**A.2.10** Wood contaminated with Pentachlorophenol (PCP) (D037)

**A.2.11** Spent/used aerosol cans (D003)


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## A.3 Parameter, Rationale, and Analytical Methods Used:

**A.3.1** All spent/used solvents which are separated and not mixed or mixtures of known composition and concentration will have no analysis performed. This waste will be declared hazardous and the appropriate hazardous waste number will be assigned.

**A.3.1.1** Rationale: No analysis is required, all necessary information to treat, store, and dispose of this waste is contained in Material Safety Data Sheets (MSDS) and Army specifications. All information necessary to determine if these wastes are restricted from land disposal is known from existing documents.

**A.3.2** Solvents which have been mixed or are unknown, either in composition or type will be analyzed to determine constituents and concentrations.

**A.3.2.1** Rationale: Unknown or mixed solvents and wastes must be identified to obtain information necessary to treat, store, and dispose of the waste. The nature of waste organic solvents/materials should be known in order to identify the proper container type required for safe storage. Concentrations and compositions must be known to determine if the waste is restricted from land disposal and appropriate treatment method.

**A.3.2.2** Analytical methods used will be one or more of the following:

**A.3.2.2.1** Method 1311 of SW-846; TCLP (Toxicity Characteristic Leaching Procedure)

**A.3.2.2.2** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**A.3.2.2.3** Method 231.0 of SW-846; Cadmium (AA, Direct Aspiration)

**A.3.2.2.4** Method 7060A of SW-846; Arsenic (AA, Furnace Technique)

**A.3.2.2.5** Method 7080A of SW-846; Barium (AA, Direct Aspiration)

**A.3.2.2.6** Method 213.0CL of SW-846; Cadmium (AA, Furnace Technique)

**A.3.2.2.7** Method 218.0 of SW-846; Chromium (AA, Direct Aspiration)

**A.3.2.2.8** Method 218.2 of SW-846; Chromium (AA, Furnace Technique)

**A.3.2.2.9** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**A.3.2.2.10** Method 239.2 of SW-846; Lead (Furnace Technique)

**A.3.2.2.11** Method 245.1CL of SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**A.3.2.2.12** Method 7471B of SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**A.3.2.2.13** Method 7740 of SW-846; Selenium (AA, Furnace Technique)


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**A.3.2.2.14** Method 7760Aof SW-846; Silver (AA, Direct Aspiration)

**A.3.2.2.15** Method 8260Bof SW-846; Gas Chromatographic Analysis for Halogenated Volatile Organics

**A.3.2.2.16** Method 8015Cof SW-846; Gas Chromatographic Analysis for Non-Halogenated Volatile Organics

**A.3.2.2.17** Method 8020Aof SW-846; Gas Chromatographic Analysis for Aromatic Volatile Organics

**A.3.2.2.18** Method 8121of SW-846; Gas Chromatographic Analysis for Chlorinated Hydrocarbons

**A.3.2.2.19** Method 8270Dof SW-846; Gas Chromatographic Mass Spectrometry Analysis of Semi-Volatile Organics (Packed Column Technique)

**A.3.2.2.20** Method 8260Bof SW-846; Gas Chromatographic Mass Spectrometry Analysis for Volatile Organics

**A.3.2.2.21** Method 8270Dof SW-846; Gas Chromatographic Mass Spectrometry Analysis of Semi-Volatile Organics (Capillary Column Technique)

**A.3.3** Rags or other material grossly contaminated with explosives will be analyzed to determine the explosives concentration (mg/kg). If analysis determines concentrations of 12% (120,000 mg/kg) or greater the contaminated material will be declared reactive and the appropriate waste code (D003) assigned.

**A.3.3.1** Rationale: Studies have demonstrated that explosives concentration of contaminated materials must reach approximately 12-15% before the material becomes reactive as defined by 40 CFR 261.23(a). Analytical procedures are much quicker and less subjective than reactivity tests therefore reducing lengthy and possibly questionable reactivity results. If concentrations of 12% or greater are determined through analytical procedures specified in 3.5.2 then the explosives will be declared reactive. If the explosive concentration is below 12% the material will be declared non-reactive and therefore not a hazardous waste and disposed of in an appropriate manner. Contaminated material with explosive concentration greater than 12% will be declared reactive hazardous waste.

**A.3.3.2** Analytical methods used one or more of the following:

**A.3.3.2.1** Method 1 of Appendix I; HPLC Analysis for Explosives

**A.3.3.2.2** Method 8330A of SW-846; HPLC Analysis for Explosives


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**A.3.4** Soil/Sludge contaminated with only explosives will be analyzed to determine the explosive concentration. If analysis determines concentrations of 12% or greater the soil/sludge will be declared a reactive hazardous waste based solely upon the analytical results.

**A.3.4.1** Rationale: Studies have demonstrated that explosive concentration of contaminated materials must reach approximately 12-15% before the material becomes reactive as defined by 40 CFR 261.23 (a). Analytical procedures are much quicker and less subjective than reactivity tests therefore reducing lengthy and possible questionable reactivity results. If concentrations of 12% are determined through analytical procedures specified in 3.6.2 then the soil/sludge will be declared reactive. If the explosive concentration of the soil/sludge is below 12% the material will be declared non-reactive and therefore not a hazardous waste and disposed of in an appropriate manner. Soil/sludge with explosive concentration greater than 12% may be used as explosive donor at the open detonation facility.

**A.3.4.2** Analytical methods used one or more of the following:

**A.3.4.2.1** Method 1 or Method 2 of Appendix I; HPLC Analysis of Soil for Explosives

**A.3.4.2.2** Method 4 of Appendix I; GC Analysis of Soils for Explosives

**A.3.4.2.3** Method 8330A of SW-846; HPLC Analysis for Explosives

**A.3.5** Soil/Sludge contaminated with explosive from an unknown source or operation will be analyzed to determine the explosive concentration. If analysis determines concentration of 12% or greater the soil/sludge will be declared a reactive hazardous waste based solely upon the analytical results. The soil/sludge will also be analyzed to determine TCLP compounds (selected compounds will be analyzed for based upon probability/likelihood of being present).

**A.3.5.1** Rationale: Studies have demonstrated that explosive concentration of contaminated materials must reach approximately 12-15% before the material becomes reactive as defined by 40 CFR 261.23. Analytical procedures are much quicker and less subjective than reactivity test therefore reducing lengthy and possible questionable reactivity results. If concentrations of 12% are determined through analytical procedures specified in 3.7.2 then the soil/sludge will be declared reactive. If the explosive concentration of the soil/sludge is below 12% the material will be declared non-reactive and therefore not a hazardous waste and disposed of in an appropriate manner. Soil/sludge with explosive concentration greater than 12% and/or determined to be reactive by test methods specified in 3.7.2 will be declared a reactive hazardous waste. Reactive soil/sludge will be considered for use as explosive donor at the open detonation facility if it contains no toxic metals TCLP is required to determine if any toxic


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metals are present at levels great enough to make the soil/sludge a toxic hazardous waste.

**A.3.5.2** Analytical methods used one or more of the following:

**A.3.5.2.1** Method 1 of Appendix I; HPLC Analysis for Explosives

**A.3.5.2.2** Method 4 of Appendix I; GC Analysis of Soils for Explosives

**A.3.5.2.3** Method 1311 of SW-846; TCLP

**A.3.5.2.4** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**A.3.5.2.5** Method 213.1 of SW-846; Cadmium (AA, Direct Aspiration)

**A.3.5.2.6** Method 7060A of SW-846; Arsenic (AA, Furnace Technique)

**A.3.5.2.7** Method 7080A of SW-846; Barium (AA, Direct Aspiration)

**A.3.5.2.8** Method 231.2CL of SW-846; Cadmium (AA, Furnace Technique)

**A.3.5.2.9** Method 218.1 of SW-846; Chromium (AA, Direct Aspiration)

**A.3.5.2.10** Method 218.2CK of SW-846; Chromium (AA, Furnace Technique)

**A.3.5.2.11** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**A.3.5.2.12** Method 239.2 of SW-846; Lead (Furnace Technique)

**A.3.5.2.13** Method 245.1CL of SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**A.3.5.2.14** Method 7471Bof SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**A.3.5.2.15** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**A.3.5.2.16** Method 7760A of SW-846; Silver (AA, Direct Aspiration)

**A.3.5.2.17** Method 8330 of SW-846; HPLC Analysis

**A.3.6** Paint/waste paint from a known source or of known composition will not be analyzed.

**A.3.6.1** Rationale: Analysis is not required if paint/waste paint is derived from a known source, operation or of known composite because a determination as to whether or not the paint is a hazardous waste can be made based upon military specifications or MSDS.


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**A.3.7** Paint/waste paint from an unknown source, operation or unknown compositions will be analyzed for TCLP and ignitability and for volatile and semi-volatile organic constituents.

**A.3.7.1** Rationale: Analysis is required because many paints contain toxic materials such as lead or chromium. Analysis is necessary to determine if metals are present at a level greater than regulated concentrations. Some paints contain flammable solvents therefore a flash point determination is necessary to determine ignitability. The analysis form volatile and semi-volatile organics require a determination of any underlying hazardous constituents that may be present.

**A.3.7.2** Analytical methods used one or more of the following:

**A.3.7.2.1** Method 1010 of SW-846; Pensky-Martins Closed-Cup Method for Ignitability

**A.3.7.2.2** Method 1311 of SW-846; TCLP

**A.3.7.2.3** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**A.3.7.2.4** Method 7060A of SW-846; Arsenic (AA, Furnace Technique)

**A.3.7.2.5** Method 7080A of SW-846; Barium (AA, Direct Aspiration)

**A.3.7.2.6** Method 218.0 of SW-846; Cadmium (AA, Direct Aspiration)

**A.3.7.2.7** Method 213.0CL of SW-846; Cadmium (AA, Furnace Technique)

**A.3.7.2.8** Method 218.1 of SW-846; Chromium (AA, Direct Aspiration)

**A.3.7.2.9** Method 218.2CL of SW-846; Chromium (AA, Furnace Technique)

**A.3.7.2.10** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**A.3.7.2.11** Method 239.2of SW-846; Lead (Furnace Technique)

**A.3.7.2.12** Method 245.1CLof SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**A.3.7.2.13** Method 7471B of SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**A.3.7.2.14** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**A.3.7.2.15** Method 7760A of SW-846; Silver (AA, Direct Aspiration)

**A.3.7.2.16** Method 8270D of SW-846; Gas Chromatographic Mass Spectrometry Analysis of Semi-Volatile Organics

**A.3.7.2.17** Method 8260B of SW-846; Gas Chromatographic Mass Spectrometry Analysis for Volatile Organics


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**A.3.7.2.18** Method 8270D of SW-846; Gas Chromatographic Analysis for Phenols

**A.3.8** All paint sludges will be analyzed for the TCLP (metals) and ignitability when an MSDS is not available

**A.3.8.1** Rationale: Analysis of paint sludges is necessary because some paints contain toxic materials. Analysis is needed to determine if the metals are present at a level greater than regulated concentrations. Some solvents may be present in the sludge so a flash point determination is required to determine ignitability and volatile and semi volatile organic constituents. The analysis for volatile and semi-volatile organics are require to determine if any underlying hazardous constituents are present.

**A.3.8.2** Analytical method used one or more of the following:

**A.3.8.2.1** Method 1010 of SW-846; Pensky-Martins Closed-Cup Method for Ignitability

**A.3.8.2.2** Method 1311 of SW-846; TCLP

**A.3.8.2.3** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**A.3.8.2.4** Method 7060A of SW-846; Arsenic (AA, Furnace Technique)

**A.3.8.2.5** Method 7080A of SW-846; Barium (AA, Direct Aspiration)

**A.3.8.2.6** Method 7130 of SW-846; Cadmium (AA, Direct Aspiration)

**A.3.8.2.7** Method 231.0CLof SW-846; Cadmium (AA, Furnace Technique)

**A.3.8.2.8** Method 218.1of SW-846; Chromium (AA, Direct Aspiration)

**A.3.8.2.9** Method 218.2CLof SW-846; Chromium (AA, Furnace Technique)

**A.3.8.2.10** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**A.3.8.2.11** Method 239.2of SW-846; Lead (Furnace Technique)

**A.3.8.2.12** Method 245.1CLof SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**A.3.8.2.13** Method 7471B of SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**A.3.8.2.14** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**A.3.8.2.15** Method 7760A of SW-846; Silver (AA, Direct Aspiration)

**A.3.8.2.16** Method 8270Dof SW-846; Gas Chromatographic Mass Spectrometry Analysis of Semi-Volatile Organics


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**A.3.8.2.17** Method 8260B of SW-846; Gas Chromatographic Mass Spectrometry Analysis for Volatile Organics

**A.3.8.2.18** Method 8270D of SW-846; Gas Chromatographic Analysis for Phenols

**A.3.9** All grit blast/sanding dust collected from paint removal operations will be analyzed for TCLP.

**A.3.9.1** Rationale: Paint removal operations process a high volume of items from many sources and locations. Some items may have been painted with paint that contained toxic metals such as lead and chromium. The TCLP must be performed on the residue/waste from the removal operation to insure metals are not present at a level greater than regulated levels.

**A.3.9.2** Analytical methods used one or more of the following:

**A.3.9.2.1** Method 1311 of SW-846; TCLP

**A.3.9.2.2** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**A.3.9.2.3** Method 7060A of SW-846; Arsenic (AA, Furnace Technique)

**A.3.9.2.4** Method 7080A of SW-846; Barium (AA, Direct Aspiration)

**A.3.9.2.5** Method 7130 of SW-846; Cadmium (AA, Direct Aspiration)

**A.3.9.2.6** Method 213.2CLof SW-846; Cadmium (AA, Furnace Technique)

**A.3.9.2.7** Method 218.1 of SW-846; Chromium (AA, Direct Aspiration)

**A.3.9.2.8** Method 218.2CL of SW-846; Chromium (AA, Furnace Technique)

**A.3.9.2.9** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**A.3.9.2.10** Method 239.2 of SW-846; Lead (Furnace Technique)

**A.3.9.2.11** Method 245.1CLof SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**A.3.9.2.12** Method 7471Bof SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**A.3.9.2.13** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**A.3.9.2.14** Method 7760A of SW-846; Silver (AA, Direct Aspiration)

**A.3.10** Spent/used/inoperable aerosol cans will not be analyzed. All information needed to properly characterize the waste can be obtained from existing product information or MSDS.


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## A.4 Sampling Plans:

**A.4.1** Unknown liquids collected in containers will be sampled with a composite liquid waste sampler (COLIWASA) , depending on the size of the container and opening, one of the following sections 4.2 and 4.3 will apply. Every container of unknown liquids will be sampled.

**A.4.2** Whole lid removal possible - a simple stir and sample strategy will be used.

**A.4.3** Single hole/bung type of opening.

**A.4.3.1** Container will be sampled vertically if contents are known to be homogeneous.

**A.4.3.2** If homogeneousness is not known, then one sample will be taken vertically as well as one sample taken at an angle extending to the furthest point to the container.

**A.4.4** At least four (4) samples will be taken from each container or a quantity sufficient for analysis. (See Appendix II, Section 2).

**A.4.5** Drums/cans of paint or waste paint from an unknown source will be sampled randomly, with a sample taken from each manufacturers batch number as available.

**A.4.6** Drums/container of paint sludge will be sampled using a drum thief or a scoop. Frequency of sampling will be dependent upon the generation rate and operational constraints.

**A.4.6.1** If the generating operation is a one-time occurrence or of short duration (less than one week) then the sampling for analysis will be performed only one time with one composite sample taken.

**A.4.6.2** If the generating operation is on-going (longer than one week), the first container generated will be sampled and analyzed and every fifth one after as they are generated. If the waste is proved to be non-hazardous, then the waste will be sampled periodically to insure continued compliance.

**A.4.7** Container of grit blast/sanding dust from paint removal operations will be sampled using a drum thief or a scoop. Frequency of sampling will be dependent upon the generation rate and operational constraints.

**A.4.7.1** If the generating operation is a one-time occurrence or of short duration (less than one week) then the sampling for analysis will be performed only one time with one composite sample taken.

**A.4.7.2** If the generating operation is on-going (longer than one week), the first container generated will be sampled and analyzed and every tenth one after as they are generated. If the waste is proved to be non-hazardous, then the waste will be sampled periodically to insure continued compliance.

**A.4.8** Because of the variation in explosive contamination levels of rags, the first container generated will be sampled and analyzed and every tenth one after as they


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are generated if the generating operation is on going. A random sample will be taken from three levels of the container, bottom, middle and top.

**A.4.9** Because of the variation in explosive contamination levels in explosive contaminated sludge, every container of explosive contaminated sludge will be sampled and analyzed for explosives. Every 25$^{th}$ container will be sampled and analyzed for TCLP metals. A simple grab sample will be taken of the content of the container in known to be homogenous. If homogeneousness is not known, then a core sample will be taken down the length of the container.

**A.4.10** Containers of explosive contaminated soils will be sampled utilizing a simple grab sample technique from the surface or while the container is being filled. The first container filled and every 25$^{th}$ container thereafter will be sampled during each containerization operation.

NOTE: A containerization operations is defined as the containerization of explosive contaminated soils generated as a result of specific event (release or contaminated area).


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# B SECTION B - NEW BOMB THERMAL TREATMENT SITE

## B.1 General Operations/functions Performed:

New Bomb Open Detonation – Thermal Treatment Site. Treatment is accomplished by open detonation (OD). Larger explosive devices are treated at this location and possibly propellants.

This section only addresses wastes generated as a result of treatment at this location. No analysis is performed on items treated at this location, all waste characteristics are known from military specifications or other appropriate documents.

## B.2 Specific Wastes Generated:

**B.2.1** Soil/small residues from detonation (D003, D005, D007, D008 and/or D030).

## B.3 Parameter, Rationale, and Analytical Methods Used:

**B.3.1** Large residue (greater than 1.5 inch)/scrap materials derived from the detonation of explosives and/or explosive items will not be analyzed.

**B.3.1.1** Rationale: Large residue and scrap metal remaining after detonation is not considered a hazardous waste. These are transferred to the Western Area Demilitarization Facility (WADF) for decontamination as required by Army Regulation. Decontamination is accomplished by flashing in a heated chamber. The scrap is then transferred to Property Disposal for sale/recycling.

**B.3.2** Soils/small residue (less than 1.5 inch) will be analyzed by the TCLP for the presence of constituents listed in Section 5.1 of this plan, and the explosive reactivity only if analysis of the material shows explosives present at levels above those set by Section 5.2 of this plan.

**B.3.2.1** Rationale: Soils/small residue must be tested according to TCLP to determine if any contaminants listed in 40 CFR 261.24 are present at levels above those allowed by the section. (Note: not all constituents listed by 40 CFR 261.24 will be tested for; only those listed in Section 5.1 of this plan or those appropriate for the item/items being treated). To determine if the soils/residue meet the definition of a hazardous waste, soils/residue will also be analyzed for explosive residue to determine if any contamination is occurring due to the open detonation operations. Soils contaminated only with explosives above the levels set by Section 5.2 will be removed and stockpiled at the New Bomb Facility for placement on the next open detonation (the top 4 – 6” closest to the donor charge). Soils contaminated with other constituents listed in 5.1 above levels set by the section will be containerized pending disposal.

**B.3.2.2** Analytical methods used will be one or more of the following:


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**B.3.2.2.1** Method 1 of Appendix I; Analysis for Explosives, HPLC (High Performance Liquid Chromatography) Method

**B.3.2.2.2** Method 9058 for Perchlorate (ion chromatography)

**B.3.2.2.3** Method 350.3 for Ammonia

**B.3.2.2.4** Method 1311 of SW-846; TCLP (Toxicity Characteristic Leaching Procedure)

**B.3.2.2.5** Method 6010 Series of SW-846 Inductively Coupled Plasma Atomic Emission Spectroscopy; to achieve required reporting limits

**B.3.2.2.6** Method 8330A of SW-846; Explosive Analysis for Nitroaromatic and Nitramine by HPLC

**B.3.2.2.7** Method 8090 of SW-846; Gas Chromatographic Analysis of Nitro Aromatic and Cyclic Ketones

**B.3.3** Potential Remedial Action:

If the results of the chemical analyzes indicate the contamination is present at ±10% of the limits specified in Section 5.1 and 5.2, then confirmatory sampling will be performed.

## B.4 Sampling Plans:

**B.4.1** Open Detonation:

**B.4.1.1** Sampling Procedures: sampling will occur, at the surrounding area from the pit area. The surrounding area is made up of 939 grids, measured at 50 ft square, as illustrated on the map. The frequency of sampling will occur semi-annually or otherwise directed by Nevada Division of Environmental Protection.

**B.4.1.1.1** Sampling of Surrounding Area: Each sampling event will consist of collecting a total of 70 samples from 33 grid locations. Grids to be sampled will be chosen randomly, by the sampler. Each soil sample per grid will be taken from the surface and analyzed for explosives and for TCLP metals. Also, two duplicate samples will be collected per sampling event.

**B.4.1.1.2** A Global Positioning System (GPS) will be used to physically locate the selected grids. Prior to the start of selecting random grids, a calibration of the GPS unit will be performed using a known fixed benchmark grid, that grid is #906 located on the southeast quadrant of the map.

**B.4.1.1.3** Sample Labeling and Record keeping: Sample labels will be placed on all containers or plastic bags at the time the sample is collected. Sample labels will be filled out with waterproof ink and will include the following information: sample identification, sampling date, sample locations, and analysis to be performed. Upon completion of sample collection activities, a


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Chain-of-Custody (COC) form will be completed by the sampling team members. This form will serve as the official record of sample collection. Chemical analytical results will be filed with the COC forms and the sample collection logs.

**B.4.1.1.4** Frequency: Sampling as outlined will occur semi-annually in the surrounding area and at a frequency directed by the Nevada Division of Environmental Protection.The area surrounding the pits will be the most likely to be affected. Semi-annual sampling will allow any contaminated areas to be identified and remediated in a timely manner.

## B.5 Maximum Allowable Contamination Levels:

**B.5.1** TCLP Constituents (40 CFR 261.24)

| Constituent | Maximum Allowable (mg/L) | Estimated Detection or Quantitation Limit (mg/L) |
|---|---|---|
| Arsenic (D004) | 5.0 | 0.001[a] |
| Barium (D005) | 100.0 | 0.002[b] |
| Cadmium (D006) | 1.0 | 0.004[b] |
| Chromium (D007) | 5.0 | 0.007[b] |
| Lead (D008) | 5.0 | 0.001[c] |
| Mercury (D009) | 0.2 | 0.0002[d] |
| Selenium (D010) | 1.0 | 0.002[e] |
| Silver (D011) | 5.0 | 0.007[b] |
| 2,4-Dinitrotoluene (D030) | 0.13 | 0.01[f] |


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**B.5.2** Explosive (total)

| Constituent | Maximum Allowable (mg/kg) | Estimated Quantization Limit (mg/kg)[g] |
|---|---|---|
| 2,4,6-trinitrotoluene | 10,000 | 0.25 |
| RDX | 10,000 | 1.0 |
| PETN | 10,000 | 4.0[h] |
| HMX | 10,000 | 2.2 |
| Dinitrotoluene | 10,000 | 0.25 |
| Nitroglycerin | 10,000 | 4.0[h] |
| Tetryl | 10,000 | 0.731[g] |
| Ammonium perchlorate | 10,000 | 3.0; 0.02[i] |

[a] SW-846 Method 7060A, Sec. 2.3
[b] SW-846 Method 6010A, Table 1
[c] SW-846 Method 239.2
[d] SW-846 Method 245.1CL
[e] SW-846 Method 7740, Sec. 2.3
[f] SW-846 Method 8270B, Table 2
[g] SW-846 Method 8330A, Table 1
[h] SW-846 Method 8330A, Table 1, unless otherwise noted
[i] SW-846 Method 350.3 for ammonia and Method 9058 for perchlorate

Laboratory which conducts EPA Method 9058 for perchlorate shall be state certified and shall provide validation data of the laboratory extraction procedure to NDEP. No analysis for ammonia is necessary to determine concentration of ammonium perchlorate. Calculation of ammonium perchlorate mass in soil will assume stoichiometric quantity of ammonium ion is available.


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## B.6 Time Line for Sampling

**B.6.1** If the results of the chemical analysis indicate that contamination is present above the specified levels above in Section 5.1 and 5.2, then confirmatory sampling will be performed in the immediate area to delineate the extent of the contamination. The contaminated soil will be removed for treatment or disposal. Confirmatory sampling will be performed after soil removal to confirm removal of the contamination.

**B.6.2** Time Lines

**B.6.2.1** Surrounding Area

| | Action | Days |
|---|---|---|
| 1. | Samples Taken | 0 |
| 2. | Analytical Results Received | 20 |
| 3. | Data Assessment | 21 |
| 4. | Confirmation Sampling Performed to determine extent of Contamination levels above regulatory threshold | 22 |
| 5. | Analytical Results Received | 43 |
| 6. | Data Assessment | 44 |
| 7. | Removal of Contaminated Soil Begins | 48 |
| 8. | Confirmation Sampling Performed | 60 |
| 9. | Analytical Results Received | 80 |
| 10. | Data Assessment | 81 |
| 11. | Removal of Contaminated Soil begins if Contamination levels above regulatory threshold | 85 |

Steps 8 through 11 will continue until the contamination levels are below regulatory threshold.


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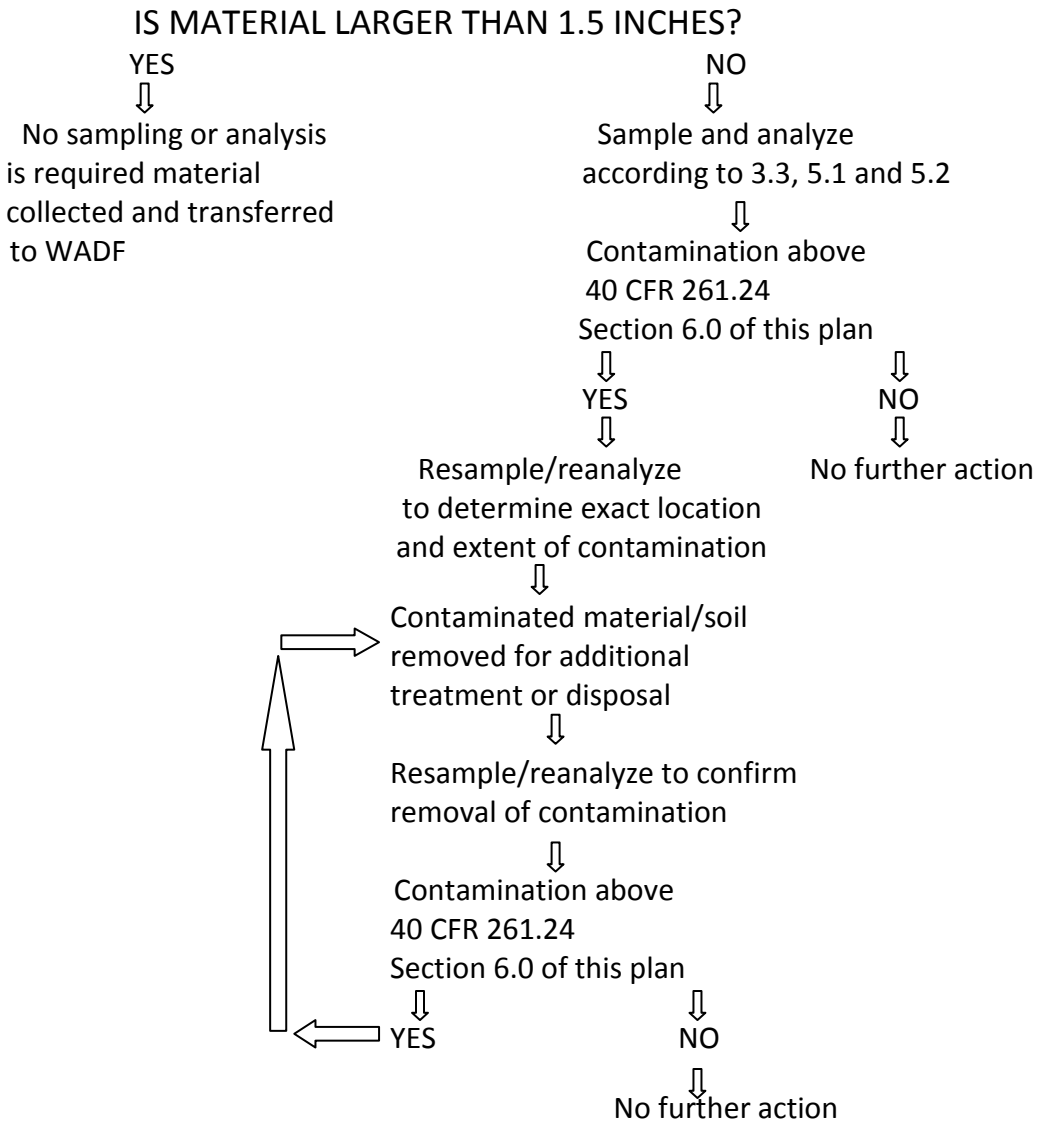
## B.7 Flow Chart for Sampling/Analysis and Disposition of Potentially Contaminated Soils





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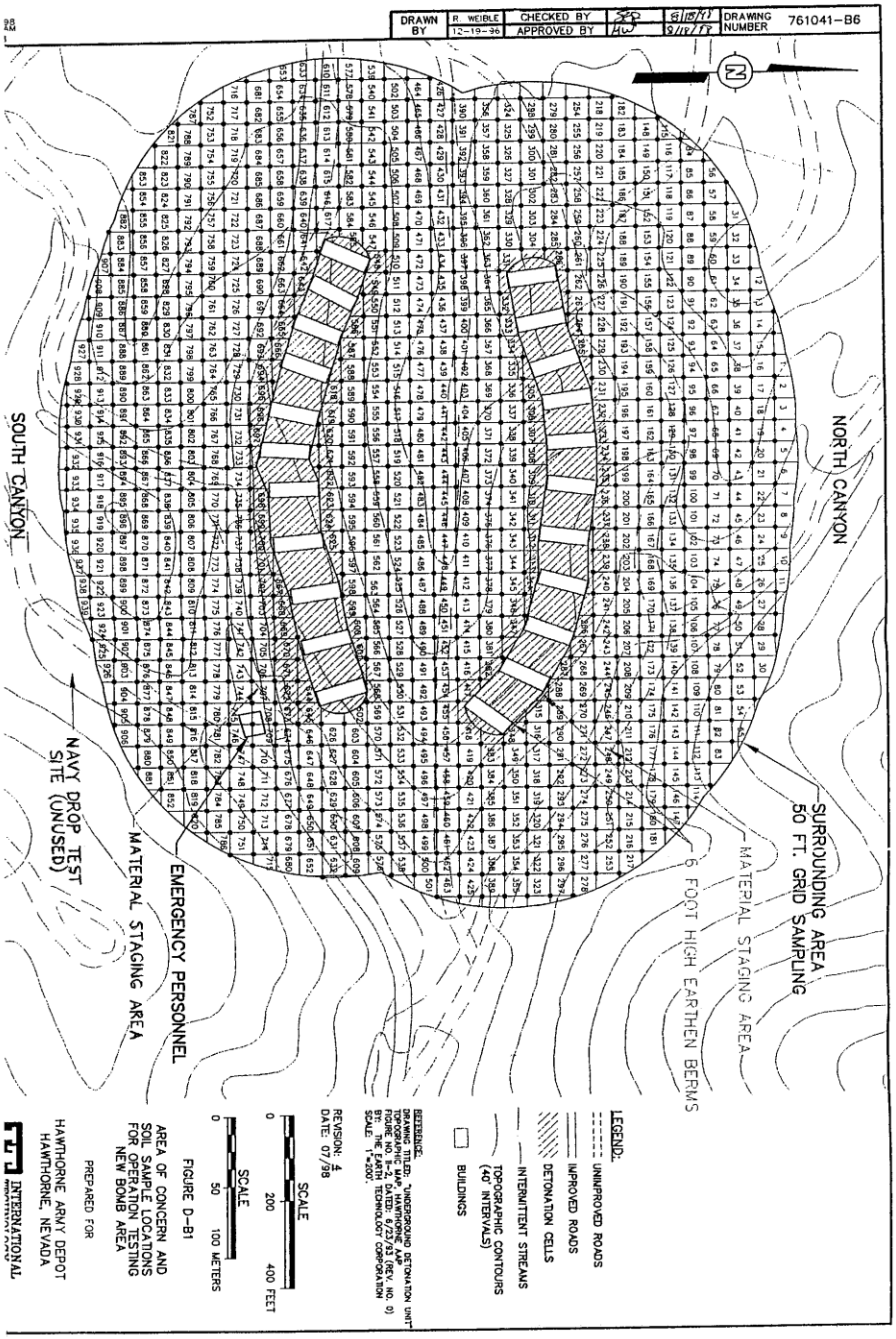




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# C SECTION C - OLD BOMB REACTIVE WASTE TREATMENT SITE

## C.1 General Operations/functions Performed:

Old Bomb is an explosive/propellant (EP) open burning thermal treatment site. Treatment is accomplished by open burning in pans.

This section only addresses wastes generated as a result of thermal treatment at this location. No analysis is required on items treated at this Old Bomb as all waste characteristics are known from military specifications or other appropriate documents.

## C.2 Specific Wastes Generated:

**C.2.1** Ash residue from burning EP material (D007, D008, D030 and/or D003)

**C.2.2** Ash/residue from burning EP-contaminated material (D007, D008 and/or D030)

## C.3 Parameter, Rationale and Analytical Methods Used:

**C.3.1** Ash derived from open burning of EP materials must be analyzed for toxicity characteristic leaching procedure (selected metals and 2,4-Dinitrotoluene).

**C.3.1.1** Rationale: Residuals of hazardous waste EP open burning must be analyzed for TCLP (toxicity characteristic leaching procedure) compounds (selected metals and 2,4-Dinitrotoluene). These compounds are found as constituents of EP.

**C.3.1.2** Analytical methods used will be one or more of the following:

**C.3.1.2.1** Method 1311 of SW-846; TCLP

**C.3.1.2.2** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**C.3.1.2.3** Method 7060A of SW-846; Arsenic (AA, Furnace Technique)

**C.3.1.2.4** Method7080A of SW-846; Barium (AA, Direct Aspiration)

**C.3.1.2.5** Method 213.0 of SW-846; Cadmium (AA, Direct Aspiration)

**C.3.1.2.6** Method 231.2 CLof SW-846; Cadmium (AA, Furnace Technique)

**C.3.1.2.7** Method 218.0 of SW-846; Chromium (AA, Direct Aspiration)

**C.3.1.2.8** Method 218.2 CL of SW-846; Chromium (AA, Furnace Technique)

**C.3.1.2.9** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**C.3.1.2.10** Method 239.2 of SW-846; Lead (Furnace Technique)

**C.3.1.2.11** Method 245.1CL of SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)


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**C.3.1.2.12** Method 7470B of SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**C.3.1.2.13** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**C.3.1.2.14** Method 7760A of SW-840; Silver (AA, Direct Aspiration)

**C.3.1.2.15** Method 8091 of SW-846; Gas Chromatographic Analysis for Nitroaromatic and Cyclic Ketones

**C.3.1.2.16** Method 8330A of SW-846; HPLC (High Performance Liquid Chromatography) for Explosives

**C.3.2** Debris derived from the burning of EP waste potentially contains insignificant quantities of EP. Examples of these materials are packing boxes, packing material, rags, and gloves. These residuals must be analyzed for TCLP and possible reactivity.

**C.3.2.1** Rationale: Residuals from the burning of EP contaminated waste must be analyzed for TCLP compounds (selected metals and 2,4-Dinitrotoluene) because these compounds are found in the constituents of PEP.

**C.3.2.2** Analytical methods used will be one or more of the following:

**C.3.2.2.1** Method 1311 of SW-846; TCLP

**C.3.2.2.2** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**C.3.2.2.3** Method213.1 of SW-846; Cadmium (AA, Direct Aspiration)

**C.3.2.2.4** Method7060A of SW-846; Arsenic (AA, Furnace Technique)

**C.3.2.2.5** Method7080A of SW-846; Barium (AA, Direct Aspiration)

**C.3.2.2.6** Method 213.2CLof SW-846; Cadmium (AA, Furnace Technique)

**C.3.2.2.7** Method 218.1 of SW-846; Chromium (AA, Direct Aspiration)

**C.3.2.2.8** Method 218.2CL of SW-846; Chromium (AA, Furnace Technique)

**C.3.2.2.9** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**C.3.2.2.10** Method 239.2of SW-846; Lead (Furnace Technique)

**C.3.2.2.11** Method 245.1CLof SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**C.3.2.2.12** Method 7471Bof SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique

**C.3.2.2.13** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**C.3.2.2.14** Method7760A of SW-846; Silver (AA, Direct Aspiration)

**C.3.2.2.15** Method8091 of SW-846; Gas Chromatographic Analysis for Nitroaromatic and Cyclic Ketones


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**C.3.2.2.16** Method 8330B of SW-846; HPLC for Explosives

**C.3.3** Potentially contaminated soil will be analyzed by the TCLP for the presence of constituents listed in Section 5.1 of this plan.

**C.3.3.1** Rationale: Soils Residue must be tested according to TCLP to determine if any contaminants listed in 40 CFR 261.24 are present at levels above those allowed by this section. (Note: Not all constituents listed by 40 CFR 261.24 will be tested for; only those listed in Section 5.1 of this plan or those appropriate for the item/items being treated).

**C.3.3.2** Analytical methods used will be one or more of the following:

**C.3.3.2.1** Method 1311 of SW-846; TCLP

**C.3.3.2.2** Method 6010 and/or 7000 Series of SW-846; To achieve required reporting limits

**C.3.3.2.3** Method 8090 of SW-846; Gas Chromatographic Analysis for Nitroaromatic and Cyclic Ketones

**C.3.3.2.4** Method 8330 of SW-846; HPLC for Explosives

**C.3.4** Analytical Turnaround Times and Potential Remedial Action.

Quick turnaround times will be utilized by the laboratory to allow the timely processing of the analytical result for the samples.

If the results of the chemical analyzes indicate the contamination is present ±10% of the limits specified in Section 5.1 then confirmatory sampling will be performed.

## C.4 Sampling Plans

**C.4.1** Potentially Contaminated Soil and Ash from Open Burning Operations.

**C.4.1.1** Sampling Procedures. The area immediately surrounding the Old Bomb open burn site will be marked by a 150-by-150 foot grid system and samples collected at random grid nodes. Sampling of these grid locations will be performed as described in Sections 4.1.1.1 and 4.1.1.2. Similar sampling, at these locations, will occur quarterly or at a frequency directed by the Nevada Division of Environmental Protection.

All open burning operations must be conducted in a containment device such as metal pan. Separate containment pans must be used for burning of EP hazardous waste and EP contaminated wastes. All ash/residuals will be swept/collected and deposited into a container after each burn. If the content of the container is known to be homogenous, a simple grab sampling strategy will be utilized. If the content of the container is not known to be homogenous,


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a composite core sample will be taken to ensure the entire depth of the container is sampled. The first container generated will be sampled as outlined above with every tenth thereafter as long as the same or similar propellants are being burned.

At least one duplicate sample will be collected per sampling event. The duplicate will be collected from the final grab or composite sample. The sampling equipment utilized to collect, and as necessary, composite the samples will consist of either a stainless steel sampling scoop and bucket which can be decontaminated between each use, or some type of disposable sampling equipment which can be disposed of after sampling activities are completed..

**C.4.1.1.1** Sampling of surrounding area: Each sampling event will consist of collection of 7 samples from 6 grid locations. Grids to be sampled will be chosen randomly by the sampler. Each soil sample per grid will be taken from the surface and analyzed for explosives and TCLP. The seventh sample will be a duplicate.

**C.4.1.1.2** Sample Labeling and Record Keeping. Sample labels will be placed on all containers at the time the sample is collected. Sample labels will be filled out with waterproof ink and will include the following information: sample identification, sampling date, sample locations, and analysis to be performed. Upon completion of sample collection activities, a Chain-of-Custody (COC) form will be completed by the sampling team members. This form will serve as the official record of sample collection. Chemical analytical results will be filed with the COC forms and the sample collection logs.

**C.4.1.2** The surrounding area will most likely to be affected by open burning operations. Quarterly sampling will allow any contaminated areas to be identified and remediated in a timely manner.


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## C.5 Maximum Allowable Contamination Levels

### C.5.1 TCLP Constituents (40 CFR 261.24)

| Constituent | Maximum Allowable (mg/L) | Estimated Detection or Quantitation Limit (mg/L) |
|---|---|---|
| Arsenic (D004) | 5.0 | 0.001[a] |
| Barium (D005) | 100.0 | 0.002[b] |
| Cadmium (D006) | 1.0 | 0.004[b] |
| Chromium (D007) | 5.0 | 0.007[b] |
| Lead (D008) | 5.0 | 0.001[c] |
| Mercury (D009) | 0.2 | 0.0002[d] |
| Selenium (D010) | 1.0 | 0.002[e] |
| Silver (D011) | 5.0 | 0.007[b] |
| 2,4-Dinitrotoluene (D030) | 0.13 | 0.01[f] |

[a] SW-846 Method 7060A

[b] SW-846 Method 6010A

[c] SW-846 Method 7421

[d] SW-846 Method 7470A

[e] SW-846 Method 7740

[f] SW-846 Method 8090

[g] SW-846 Method 8330



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## C.6 Time Line

**C.6.1** If the results of the chemical analysis indicate that contamination is present above the specified levels above in Section 5.1, then confirmatory sampling will be performed in the immediate area to delineate the extent of the contamination. The contaminated soil will be removed for treatment or disposal. Confirmatory sampling will be performed after soil removal to confirm removal of the contamination.

| | Action | Days |
|---|---|---|
| 1. | Samples Taken | 0 |
| 2. | Analytical Results Received | 20 |
| 3. | Data Assessment | 21 |
| 4. | Confirmation Sampling Performed to determine extent of Contamination levels above regulatory threshold | 22 |
| 5. | Analytical Results Received | 43 |
| 6. | Data Assessment | 44 |
| 7. | Removal of Contaminated Soil Begins | 48 |
| 8. | Confirmation Sampling Performed | 60 |
| 9. | Analytical Results Received | 80 |
| 10. | Data Assessment | 81 |
| 11. | Removal of Contaminated Soil begins if Contamination levels above regulatory threshold | 85 |

Steps 8 through 11 will continue until the contamination levels are below regulatory threshold.


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## C.7 Flow Chart for Sampling/Analysis and Disposition of Potentially Contaminated Soils

Sample and analyze
according to 3.3, 5.1 and 5.2

Contamination above
Regulatory Limits
Section 6.0 of this plan

⇩ YES → Resample/reanalyze to determine exact location and extent of contamination

⇩ NO → No further action

⇩

Contaminated material/soil removed for additional treatment or disposal

⇩

Resample/reanalyze to confirm removal of contamination

⇩

Contamination above
Regulatory Limits
Section 6.0 of this plan

⇩ YES → (return to: Contaminated material/soil removed for additional treatment or disposal)

⇩ NO → No further action


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# D SECTION D - WADF AREA

## D.1 General Operations/Functions Performed:

**D.1.1** The 117 Area, also known as the Western Area Demilitarization Facility (WADF), consists of thirteen buildings used for demilitarization of explosive loaded ammunition. Buildings of primary concerns are:

**D.1.1.1** **Building 117-1**, Service and Support, Analytical Chemistry Laboratory is located here.

**D.1.1.2** **Building 117-2**, Plasma Ordnance Demilitarization System (PODS), will be used to incinerate waste munition items.

**D.1.1.3** **Building 117-3**, Flashing Furnace, used for flashing explosive contaminated projectiles or small munition items and the RF-9, used for incineration of small caliber ammunition.

**D.1.1.4** **Building 117-4**, Bulk Energetics Demilitarization System (BEDS), used for destruction of obsolete and unusable bulk propellants.

**D.1.1.5** **Building 117-7**, Process Water Treatment Facility, used for processing explosive contaminated water for reuse.

**D.1.1.6** **Buildings 117-8 and 117-9**, Sawing Operation

**D.1.1.7** **Building 117-16,** Hot Gas Decontamination for decon of large caliber ammunition.

**D.1.1.8** **Building 117-17,** Range Scrap

**D.1.2** All buildings of the 117 Area may generate explosive contaminated wastes.

**D.1.3** All buildings of the 117 Area may generate used/spent solvents.

## D.2 Specific Waste Generated:

**D.2.1** Spent/used solvents:

**D.2.1.1** Toluene (F005)

**D.2.1.2** Trichloroethylene (F002)

**D.2.1.3** 1,1,1 Trichloroethane (F002)

**D.2.1.4** Methyl isobutyl ketone (F003)

**D.2.1.5** Isopropanol (D001)

**D.2.1.6** Acetone (F003 or U002)

**D.2.1.7** Methanol (F003 or U154)

**D.2.1.8** Xylene (F003 or U239)


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**D.2.2** Ash residue from incineration of ammunition and flashing contaminated equipment/materials (D005, D007, D008 and/or D030)

**D.2.3** Soil/sludges contaminated with explosives and/or toxic metals (D007, D008, D030 and/or D003).

**D.2.4** Water in tanks, contaminated with explosives and/or toxic metals (D007, D030 and/or D008).

**D.2.5** Rags or other material grossly contaminated with explosives (D003).

**D.2.6** Laboratory wastes (various waste codes).

**D.2.6.1** Used/spent chemicals and reagents.

**D.2.6.2** Mixed solvent wastes.

**D.2.6.3** Sample residues.

**D.2.7** Spent Carbon with Explosives (K045).

**D.2.8** Slag from PODS treatment of waste munitions such as pyrotechnic ordnance. PODS is designed to generate a slag that will pass the TCLP analysis.

**D.2.9** Particulate from PODS secondary combustion chamber and baghouse (various metals depending on ordnance type being treated).

**D.2.10** Sludge from PODS water treatment system (various metals depending on the ordnance type).

**D.2.11** Spent/used aerosol cans (D003).

**D.2.12** Particulate wastes from the BEDS baghouse consisting of carryover ash from the rotary kiln and combustion chamber, calcium salts from the reaction of acidic gases such as $SO_2$ and HCL with hydrated lime, ureacted lime, and trace amounts of solids from the evaporative cooler.

**D.2.13** Small amounts of ash from the BEDS rotary kiln (may contain various metals depending on the propellant being treated).

## D.3 Parameter Rationale and Analytical Methods Used:

**D.3.1** All spent/used solvents which are separated and not mixed or mixtures of known composition and concentration will have no analysis performed. This waste will be declared hazardous and the appropriate hazardous waste code/codes will be assigned.

**D.3.1.1** Rationale: No analysis is required, all necessary information to treat, store, and dispose of this waste is contained in Material Safety Data Sheets (MSDS) and Army specifications. All information necessary to determine if these wastes are restricted from land disposal is known from existing documents.


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**D.3.2** Solvents which have been mixed or are unknown either in composition or type will be analyzed to determine constituents and concentrations. See Section A 3.2.2 for rationale and analytical methods

**D.3.2.1** Rationale: Unknown or mixed solvents and wastes must be identified to obtain information necessary to treat, store, and dispose of the waste. The nature of waste organic solvents/materials, should be known in order to identify the proper container type required for safe storage. Concentrations and compositions must be known to determine if the waste is restricted from land disposal and appropriate treatment method.

**D.3.2.2** Analytical methods used will be one or more of the following:

**D.3.2.2.1** Method 8260B of SW-846; Gas Chromatographic Analysis for Halogenated Volatile Organics

**D.3.2.2.2** Method 8015Cof SW-846; Gas Chromatographic Analysis for Non Halogenated Volatile Organics

**D.3.2.2.3** Method 8020Aof SW-846; Gas Chromatographic Analysis for Aromatic Volatile Organics

**D.3.2.2.4** Method 8121of SW-846; Gas Chromatographic Analysis for Chlorinated Hydrocarbons

**D.3.2.2.5** Method 8260B of SW-846; Gas Chromatographic/Mass Spectrometry Analysis for Volatile Organics

**D.3.2.2.6** Method 8041of SW-846; Gas Chromatographic Analysis for Phenols

**D.3.2.2.7** Method 8270D of SW-846; Gas Chromatographic/Mass Spectrometry Analysis of Semi-Volatile Organics (Packed Column Technique)

**D.3.2.2.8** Method 8270Dof SW-846; Gas Chromatographic/Mass Spectroscopic Analysis of Semi-Volatile Organics (Capillary Column Technique)

**D.3.2.2.9** Method 7060Aof SW-846; Arsenic (AA, Furnace Technique)

**D.3.2.2.10** Method 7080Aof SW-846; Barium (AA, Direct Aspiration)

**D.3.2.2.11** Method 213.1of SW-846; Cadmium (AA, Direct Aspiration)

**D.3.2.2.12** Method213.2CL of SW-846; Cadmium (AA, Furnace Technique)

**D.3.2.2.13** Method 218.1 of SW-846; Chromium (AA, Direct Aspiration)

**D.3.2.2.14** Method 218.2CLof SW-846; Chromium (AA, Furnace Technique)

**D.3.2.2.15** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**D.3.2.2.16** Method 239.2of SW-846; Lead (Furnace Technique)


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**D.3.2.2.17** Method 245.1CLof SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**D.3.2.2.18** Method 7471Bof SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**D.3.2.2.19** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**D.3.2.2.20** Method7060A of SW-846; Silver (AA, Direct Aspiration)

**D.3.3** Ash/residue collected from the burning of small arms ammunition (Building 117-3 Rotary Furnace), the flashing of items (117-3 Flashing Furnace), and the destruction of bulk propellants (Building 117-4 BEDS), and decontamination of large munitions (117-16, Hot Gas Decontamination) will be analyzed for TCLP (toxicity characteristic leaching procedure).

**D.3.3.1** Rationale: Ash residues generated by the incineration of small arm ammunition (Building 117-3 Rotary Furnace); the flashing/heat treating of explosive contaminated items (Building 117-3 Flashing Furnace and Building 117-16, Hot Gas Decontamination); and the destruction of bulk propellants (Building 117-4 BEDS) will be analyzed for compounds that are found in the constituents of ammunition items.

**D.3.3.2** Analytical methods used will be one or more of the following:

**D.3.3.2.1** Method 1311 of SW-846; TCLP

**D.3.3.2.2** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**D.3.3.2.3** Method 7060A of SW-846; Arsenic (AA, Furnace Technique)

**D.3.3.2.4** Method 7080A of SW-846; Barium (AA, Direct Aspiration)

**D.3.3.2.5** Method 213.1 of SW-846; Cadmium (AA, Direct Aspiration)

**D.3.3.2.6** Method 213.2CL of SW-846; Cadmium (AA, Furnace Technique)

**D.3.3.2.7** Method 218.1of SW-846; Chromium (AA, Direct Aspiration)

**D.3.3.2.8** Method 218.2CL of SW-846; Chromium (AA, Furnace Technique)

**D.3.3.2.9** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**D.3.3.2.10** Method 239.2of SW-846; Lead (Furnace Technique)

**D.3.3.2.11** Method 245.1CLof SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**D.3.3.2.12** Method 7471B of SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**D.3.3.2.13** Method 7740 of SW-846; Selenium (AA, Furnace Technique)


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**D.3.3.2.14** Method 7060Aof SW-846; Silver (AA, Direct Aspiration)

**D.3.3.2.15** Method 8330Bof SW-846; HPLC Analysis for the Determination of Explosives

**D.3.3.2.16** Method 8091of SW-846; Gas Chromatographic Analysis of Nitro Aromatic and Cyclic Ketones

**D.3.4** Soil/sludge contaminated with only explosives will be analyzed to determine the explosive concentration. If analysis determines concentrations at 12% or greater the soil will be considered reactive. See Section A 3.6 for rationale and analytical methods.

**D.3.5** Soil/sludge contaminated with explosives from an unknown source or operation will be analyzed to determine the explosive concentration. If analysis determine concentrations at 12% or greater the soil/sludge will be considered reactive. The soil/sludge will also be analyzed to determine TCLP compounds (selected compound will be analyzed for based upon the probability/likelihood of being present such as D008 or D030). See Section A 3.7 for rationale and analytical methods.

**D.3.6** Rags, PPE, debris or other material grossly contaminated with explosives will be analyzed to determine the explosive concentration (mg/kg). If analysis determined concentrations of 12% (120,000 mg/kg) or greater the contaminated material is considered reactive waste.

**D.3.6.1** Rationale: Studies have demonstrated that explosive concentration of contaminated materials must reach approximately 12-15% before the material becomes reactive as defined by 40 CFR 261.23. Analytical procedures are much quicker and less subjective than reactivity tests therefore reducing lengthy and possible questionable reactivity results. If a concentration of 12% or greater is determined through analytical procedures for reactivity specified in 3.5.2 then the explosive contaminated material is considered reactive.. If the explosive concentration is below 12% the material will be declared non-reactive and therefore not a hazardous waste and disposed of in an appropriate manner.


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**D.3.7** All used/spent chemicals, reagents, solvent wastes and/or sample residues which are separate (not mixed) or of known composition will not be analyzed but handled as appropriate for the given waste/substance.

**D.3.7.1** Rationale: No analysis is required, all information necessary to treat, store and dispose of the waste is known from material safety data sheets (MSDS) Army specifications, and/or process (generation) information. All information necessary to determine if the wastes are restricted from land disposal is known from existing documents.

**D.3.8** Used/spent chemicals, reagents, solvent wastes, and/or sample residues which have been mixed or are unknown either in composition or type will be analyzed to determine constituents and concentrations.

**D.3.8.1** Rationale: Laboratory wastes which are of mixed composition or of unknown makeup will require analysis. Analysis is necessary to determine information required to treat, store, and dispose of the wastes. Compositions and concentrations are necessary to determine if the waste is restricted from land disposal.

**D.3.8.2** Analytical methods used will be one or more of the following:

**D.3.8.2.1** Method 8260B of SW-846; Gas Chromatographic Analysis for Halogenated Volatile Organics

**D.3.8.2.2** Method 8015Cof SW-846; Gas Chromatographic Analysis for Non-Halogenated Volatile Organics

**D.3.8.2.3** Method 8020Aof SW-846; Gas Chromatographic Analysis for Aromatic Volatile Organics

**D.3.8.2.4** Method 8121 of SW-846; Gas Chromatographic Analysis for Chlorinated Hydrocarbons

**D.3.8.2.5** Method 8260Bof SW-846; Gas Chromatographic/Mass Spectrometry Analysis for Volatile Organics

**D.3.8.2.6** Method 8041of SW-846; Gas Chromatographic Analysis for Phenols

**D.3.8.2.7** Method 8270Dof SW-846; Gas Chromatographic/Mass Spectrometry Analysis of Semi-Volatile Organics (Packed Column Technique)

**D.3.8.2.8** Method 8270Dof SW-846; Gas Chromatographic/mass Spectroscopic Analysis of Semi-Volatile Organics (Capillary Column Technique)

**D.3.9** The explosive contaminated spent carbon generated by the process water treatment facility will be analyzed to determine explosive concentration (mg/kg). If


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analysis determined concentrations of 12% (120,000 mg/kg) or greater the contaminated carbon will be considered reactive waste. The carbon will also be analyzed to determine selective TCLP compounds.

**D.3.9.1** Rationale: Spent carbon contaminated with explosives must be analyzed to determine the explosive concentration in the material. Studies have demonstrated that explosive concentration of contaminated material must reach approximately 12-15% before the material becomes reactive as defined by 40 CFR 261.23. Analytical procedures are much quicker and less subjective than reactivity tests therefore reducing lengthy and possibly questionable reactivity results. If a concentration of less than 12% is determined the material will be declared non-reactive and therefore not a hazardous waste and disposed as a solid waste. Many explosives and related items contain toxic metals. A TCLP analysis is required to determine if any toxic metals or compounds, primarily 2,4DNT, are present at levels great enough to make the spent carbon a hazardous waste.

**D.3.9.2** Analytical methods used will be one or more of the following:

**D.3.9.2.1** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**D.3.9.2.2** Method 7060A of SW-846; Arsenic (AA, Furnace Technique)

**D.3.9.2.3** Method 7080A of SW-846; Barium (AA, Direct Aspiration)

**D.3.9.2.4** Method 213.1of SW-846; Cadmium (AA, Direct Aspiration)

**D.3.9.2.5** Method 213.2CLof SW-846; Cadmium (AA, Furnace Technique)

**D.3.9.2.6** Method 218.1of SW-846; Chromium (AA, Direct Aspiration)

**D.3.9.2.7** Method 218.2CL of SW-846; Chromium (AA, Furnace Technique)

**D.3.9.2.8** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**D.3.9.2.9** Method 239.2 of SW-846; Lead (Furnace Technique)

**D.3.9.2.10** Method 245.1CLof SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**D.3.9.2.11** Method 7471Bof SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**D.3.9.2.12** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**D.3.9.2.13** Method7060A of SW-846; Silver (AA, Direct Aspiration)

**D.3.10** Slag from the PODS furnace will be poured into 55 gallon molds to cool into a hard, vitrified material. The slag will be subjected to TCLP analysis.

**D.3.10.1** Rationale: The noncombustible portion of the ordnance being treated mixes with soil and iron to form a solidified slag, which may or may not be


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hazardous depending on the durability of the slag matrix and the heavy metal content of the ordnance being treated. The slag will be subjected to TCLP analysis for the particular metals contained in the ordnance being treated.

**D.3.10.2** Analytical methods used will be one or more of the following:

**D.3.10.2.1** Method 1311 of SW-846; TCLP

**D.3.10.2.2** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**D.3.10.2.3** Method 7060Aof SW-846; Arsenic (AA, Furnace Technique)

**D.3.10.2.4** Method 7080Aof SW-846; Barium (AA, Direct Aspiration)

**D.3.10.2.5** Method 213.1of SW-846; Cadmium (AA, Direct Aspiration)

**D.3.10.2.6** Method 213.2CL of SW-846; Cadmium (AA, Furnace Technique)

**D.3.10.2.7** Method 218.1of SW-846; Chromium (AA, Direct Aspiration)

**D.3.10.2.8** Method 218.2CLof SW-846; Chromium (AA, Furnace Technique)

**D.3.10.2.9** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**D.3.10.2.10** Method 239.2of SW-846; Lead (Furnace Technique)

**D.3.10.2.11** Method 245.1CLof SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**D.3.10.2.12** Method 7471Bof SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**D.3.10.2.13** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**D.3.10.2.14** Method 7060A of SW-846; Silver (AA, Direct Aspiration)

**D.3.11** A small amount of particulate is collected by the PODS secondary combustion chamber (afterburner) and baghouse. This particulate should consist of noncombustible material such as heavy metals or metal compounds, as well as non hazardous minerals form the soil additive such as silicates, sulfates, and carbonates, and will be analyzed by the TCLP.

**D.3.11.1** 3.11.1 Rationale: Some ordnance treated in the PODS will contain heavy metals. A portion of these metals and metal compounds will leave the primary combustion chamber as particulate, some of which will be captured in the secondary combustion chamber or the baghouse. Therefore, the particulate from these pollution control devices will be analyzed by the TCLP.

**D.3.11.2** Analytical methods used will be one or more of the following:

**D.3.11.2.1** Method 1311 of SW-846; TCLP


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**D.3.11.2.2** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**D.3.11.2.3** Method 7060A of SW-846; Arsenic (AA, Furnace Technique)

**D.3.11.2.4** Method 7080Aof SW-846; Barium (AA, Direct Aspiration)

**D.3.11.2.5** Method 213.1 of SW-846; Cadmium (AA, Direct Aspiration)

**D.3.11.2.6** Method 213.2CL of SW-846; Cadmium (AA, Furnace Technique)

**D.3.11.2.7** Method 218.1 of SW-846; Chromium (AA, Direct Aspiration)

**D.3.11.2.8** Method 218.2CL of SW-846; Chromium (AA, Furnace Technique)

**D.3.11.2.9** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**D.3.11.2.10** Method 239.2of SW-846; Lead (Furnace Technique)

**D.3.11.2.11** Method 245.1CLof SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**D.3.11.2.12** Method 7471Bof SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**D.3.11.2.13** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**D.3.11.2.14** Method 7060Aof SW-846; Silver (AA, Direct Aspiration)

**D.3.12** The sludge from the PODS scrubber water treatment system will be analyzed for heavy metals using the TCLP.

**D.3.12.1** Rationale: Particulates captured in the water from the offgas scrubber system will be precipitate with sodium hydrosulfide and dewatered using a filter press. This sludge will contain the majority of particulates in the offgas stream including a portion of the heavy metals from the ordnance being treated.

**D.3.12.2** Analytical methods used will be one or more of the following:

**D.3.12.2.1** Method 1311 of SW-846; TCLP

**D.3.12.2.2** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**D.3.12.2.3** Method 7060Aof SW-846; Arsenic (AA, Furnace Technique)

**D.3.12.2.4** Method 7080Aof SW-846; Barium (AA, Direct Aspiration)

**D.3.12.2.5** Method 213.1of SW-846; Cadmium (AA, Direct Aspiration)

**D.3.12.2.6** Method 213.2CLof SW-846; Cadmium (AA, Furnace Technique)

**D.3.12.2.7** Method 218.1of SW-846; Chromium (AA, Direct Aspiration)

**D.3.12.2.8** Method 218.2CLof SW-846; Chromium (AA, Furnace Technique)

**D.3.12.2.9** Method 7420 of SW-846; Lead (AA, Direct Aspirations)


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**D.3.12.2.10** Method 239.2of SW-846; Lead (Furnace Technique)

**D.3.12.2.11** Method 245.1CLof SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**D.3.12.2.12** Method 7471B of SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**D.3.12.2.13** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**D.3.12.2.14** Method 7060Aof SW-846; Silver (AA, Direct Aspiration)

## D.4 Sampling Plans:

**D.4.1** The sampling plan for all mixed, spent solvents and unknown solvents is the same as outlined under Section A.

**D.4.2** Ash collected from the Rotary Furnace (Building 117-3), the Flashing Furnace (Building 117-3), Hot Gas Decontamination (Building 117-16) and ash and baghouse particulates collected from the BEDS (Building 117-4) will be sampled according to one of the following plans, depending upon ash/residue source and condition.

**D.4.2.1** If the ash/residue is homogenous and taken from a long running operation (longer than one week where the same items are being deactivated in the rotary furnace), the ash will be sampled using a scoop to sample the surface of the drum contents. The first drum and tenth drum of ash generated by the operation will be sampled. If the results indicate that the ash is hazardous, then all ash from that operation will be declared hazardous. If the ash is found to be non-hazardous, every tenth drum of ash generated by the operation thereafter or as long as the same items are being deactivated in the rotary furnace or BEDS will be sampled.

**D.4.2.2** If the ash residue is from mixed types of ammunition or of unknown homogeneity then a drum thief will be used to sample the ash/residue. A minimum of four samples will be taken or until a quantity sufficient for analysis is obtained, see Appendix II, Section B. Every drum of unknown origin or composition will be sampled.

**D.4.3** Explosive contaminated sludge will be sampled according to the following:

**D.4.3.1** Sludge from building 117-7, Process Water Treatment Facility, that is placed in containers in a single operation and is from a single process is known to be homogenous; therefore only one sample will be analyzed per containerization


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operation. The sample will either be a surface grab sample or a composite sample will be taken during the filling process.

**D.4.3.2** Because of the variation in explosives contamination levels found in explosive contaminated sludge from sources other than 117-7, every container of sludge generated will be sampled for explosives. A surface grab sample will be taken if the container is known to be homogenous. If homogeneity is not known, then a core sample will be taken down the length of the container, or a composite sample will be taken during the filling process.

**D.4.4** Containers of explosive contaminated soils will be sampled utilizing a simple grab sample technique. Sample will be taken from the surface or when the container is being filled. The first container filled will be sampled and every 25th container thereafter during each containerization operation.

**D.4.5** Because of the variation in explosive contamination levels of rags, every container of explosive contaminated rags will be sampled and analyzed.

**D.4.6** Sampling of laboratory wastes will not be required. If all contents are known from a previous completed hazardous waste analysis, then sampling will not be required. If sampling is indicated, then laboratory wastes will be sampled according to one of the following plans and every container will be analyzed.

**D.4.6.1** Containers with liquid wastes which are uniform, showing no separation of components or multi-phased will be sampled utilizing a simple grab sampling strategy.

**D.4.6.2** Containers, with liquid wastes, which show a separation of compounds or are multi phased in appearance, will be agitated until the components are mixed. A grab sample will immediately be taken before separation occurs.

**D.4.6.3** Containers, with solids (no free liquids) will be sampled utilizing a simple grab sampling strategy.

**D.4.7** When explosive contaminated spent carbon is containerized for disposal a composite sample of 10% of the number of cubic yard boxes will be taken. A simple grab sample will be taken from the surface of random boxes.

**D.4.8** Specific sampling plans will be written for processing/demilitarization of specific ammunition items in the 117 Area.

**D.4.9** Cooled, solidified slag in molds will be sampled by obtaining chips of the hardened material from the surface. The material included in each drum pour should be homogeneous as the material is thoroughly mixed in the primary chamber before being poured. The first three molds of slag from the treatment of a particular type of ordnance will be sampled. If these molds pass the TCLP, then every tenth mold thereafter will be sampled. When a different type of ordnance begins the


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treatment process, the sampling frequency will start again with the first mold. Whenever any mold fails the TCLP, each following mold will be sampled until it passes the TCLP. Then the sampling frequency will return to every tenth mold.

**D.4.10** Particulate captured in the secondary combustion chamber (SCC) will be collected and containerized in 55 gallon drums when the PODS has been shut down for maintenance or other purposes. Likewise, particulate captured in the baghouse will also be containerized in 55-gallon drums. The dust like particulate in the drums will be sampled throughout the vertical extent of the drum in order to obtain a representative sample. Every drum of particulate from both sources will be sampled and analyzed.

**D.4.11** Sludge from the scrubber water treatment system will be in the form of a filter cake from the filter press. When it becomes time to remove the filter cake from the press, a grab sample of the filter cake will be collected for analysis. The filter cake will be sampled prior to each removal from the press


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# E SECTION E - 104 & 49 AREA

## E.1 General Operations/Functions Performed:

**E.1.1** The 104 and 49 Areas are controlled by the Naval Undersea Warfare Engineering Station (NUWES), a Navy detachment and tenant activity at HWAD.

**E.1.2** NUWES is engaged in renovation and maintenance of underwater materials used by naval operations and the reclamation of metals and precious metals from batteries through the utilization of a retort system.

**E.1.3** The primary concern, as far as hazardous wastes, are the chemical solvents used in processing, or painting or cleaning of materials, paint, waste paint, grit/bead blasting residues from paint removal or cleaning operations, heavy metal contaminated wastes from the processing of batteries, and spent/used/obsolete batteries.

## E.2 Specific Wastes Generated:

**E.2.1** 2.1 Spent/used solvents:

**E.2.1.1** Toluene (F005)

**E.2.1.2** Trichloroethylene (F002)

**E.2.1.3** 1,1,1 Trichloroethane (F002)

**E.2.1.4** Isopropanol (D001)

**E.2.1.5** Acetone (F003 or U002)

**E.2.1.6** Mixtures of above solvents (waste codes dependent upon mixture)

**E.2.2** Paint/waste paint (D007, D008, D001)

**E.2.3** Grit/bead blasting residues from cleaning or paint removal operations (D007, D008)

**E.2.4** Waste adhesives/resin mixtures (D001)

**E.2.5** Solid wastes contaminated with toxic metals, primarily mercury - used as an antifouling compound.

**E.2.6** Waste acids/electrolyte from battery maintenance (D002, D008)

**E.2.7** Waste/used flint coat/asphaltic coating (D023, D024, D025, and/or D026)

**E.2.8** Wood contaminated with Pentachlorophenol (PCP), (D037)

**E.2.9** Used/Waste oils with F listed solvents


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**E.2.10** Debris/material contaminated with heavy metals including but not limited to; cadmium (D006), lead (D008) and mercury (D009)

**E.2.11** Spent/used/obsolete batteries with various waste codes (D002, D006, D007, D008, D010)

## E.3 Parameter, Rationale, and Analytical Methods Used:

**E.3.1** All spent/used solvents which are separated/not mixed or mixtures of known composition and concentration will have no analysis performed. This waste will be declared hazardous and the appropriate hazardous waste number will be assigned. See Section A 3.2 for rationale and analytical methods.

**E.3.2** Paint/waste paint from a known source or of known composition will not be analyzed.

**E.3.2.1** Analysis is not required if paint/waste paint is derived from a known source, operation or of known composition because a determination as to whether or not the paint is a hazardous waste can be made based upon military specifications or product data sheets.

**E.3.3** Paint/waste paint from an unknown source, operation or unknown composition will be analyzed for the TCLP (toxicity characteristic leaching procedure) and ignitability. See Section A 3.9 for rationale and analytical methods.

**E.3.4** All grit/bead blasting residue derived from paint removal or cleaning operations will be analyzed for TCLP.

**E.3.4.1** Rationale: Paint removal operations process a high volume of items from many sources and locations. Some items may have been painted with paint that contained toxic metals such as lead and chromium. The TCLP must be performed on the residue/waste from the removal operation to insure metals are not present at a level greater than regulated levels.

**E.3.4.2** Analytical methods used will be one or more of the following:

**E.3.4.2.1** Method 1311 of EPA SW-846; TCLP

**E.3.4.2.2** Method 1010 of EPA SW-846; Pensky-Martens Closed-Cup Method of Ignitability

**E.3.4.2.3** Method 213.1of SW-846; Cadmium (AA, Direct Aspiration)

**E.3.4.2.4** Method 7060Aof SW-846; Arsenic (AA, Furnace Technique)

**E.3.4.2.5** Method 7080Aof SW-846; Barium (AA, Direct Aspiration)

**E.3.4.2.6** Method 213.0CL of SW-846; Cadmium (AA, Furnace Technique)

**E.3.4.2.7** Method 218.1of SW-846; Chromium (AA, Direct Aspiration)

**E.3.4.2.8** Method 218.2CL of SW-846; Chromium (AA, Furnace Technique)


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**E.3.4.2.9** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**E.3.4.2.10** Method 239.2 of SW-846; Lead (Furnace Technique)

**E.3.4.2.11** Method 245.1CL of SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**E.3.4.2.12** Method 7471Bof SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**E.3.4.2.13** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**E.3.4.2.14** Method 7060A of SW-846; Silver (AA, Direct Aspiration)

**E.3.5** Waste Adhesive from known sources will not be analyzed.

**E.3.5.1** Rationale: Analysis is not required because of determination as to whether or not the waste is a hazardous waste can be made based upon military specifications; material safety data sheets (MSDS) or other product data sheets. If the waste is determined to be a hazardous, then a decision of land disposal restriction and treatment method can be made based upon the same documents.

**E.3.6** Waste/adhesives from an unknown source, operation or unknown composition will be analyzed.

**E.3.6.1** Rationale: To determine hazardous constituents and concentration, primarily volatile and semi-volatile organics and flashpoint.

**E.3.6.2** Analytical methods used will be one or more of the following:

**E.3.6.2.1** Method 1010 of EPA SW-846; Pensky-Martens Closed Cup Method of Ignitability

**E.3.6.2.2** Method 8260B of SW-846; Gas Chromatographic Analysis for Halogenated Volatile Organics

**E.3.6.2.3** Method 8015Cof SW-846; Gas Chromatographic Analysis for Non-Halogenated Volatile Organics

**E.3.6.2.4** Method 8020Aof SW-846; Gas Chromatographic Analysis for Aromatic Volatile Organics

**E.3.6.2.5** Method 8121or SW-846; Gas Chromatographic Analysis for Chlorinated Hydrocarbons

**E.3.6.2.6** Method 8270D of SW-846; Gas Chromatographic/Mass Spectrometry Analysis of Semi-Volatile Organics (Packed Column Technique)

**E.3.6.2.7** Method 8260Bof SW-846; Gas Chromatographic/Mass Spectrometry Analysis for Volatile Organics


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**E.3.6.2.8** Method 8041of SW-846; Gas chromatographic Analysis for Phenols

**E.3.6.2.9** Method 8270Dof SW-846; Gas Chromatographic/mass Spectrometry Analysis of Semi-Volatile Organics (Capillary Column Technique)

**E.3.7** No analysis will be performed on solid waste contaminated with antifouling compound

**E.3.7.1** Rationale: The composition is known from existing military specifications and product information sheets.

**E.3.8** Waste acid of known composition will not be analyzed.

**E.3.8.1** Rationale: No analysis is necessary because all information necessary to treat, store, or dispose of this waste can be determined from military specifications and product material safety data sheets. Land disposal restriction determinations can also be made from these documents.

**E.3.9** Waste acids of unknown composition or source will be analyzed to determine pH and toxic metals.

**E.3.9.1** Rationale: Analysis of acids from unknown sources must be tested for pH to determine if the waste meets the definition of corrosivity (D002). Toxic metals must be analyzed because acid dissolves metals easily and any contact with these metals will contaminate the acid.

**E.3.9.2** Analytical methods used will be one or more of the following:

**E.3.9.2.1** Method 9040 of SW-846; Determination of pH

**E.3.9.2.2** Method 1311 of EPA SW-846; TCLP

**E.3.9.2.3** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**E.3.9.2.4** Method 213.0 of SW-846; Cadmium (AA, Direct Aspiration)

**E.3.9.2.5** Method 7060Aof SW-846; Arsenic (AA, Furnace Technique)

**E.3.9.2.6** Method 7080Aof SW-846; Barium (AA, Direct Aspiration)

**E.3.9.2.7** Method 213.0CLof SW-846; Cadmium (AA, Furnace Technique)

**E.3.9.2.8** Method 218.1of SW-846; Chromium (AA, Direct Aspiration)

**E.3.9.2.9** Method 218.2CLof SW-846; Chromium (AA, Furnace Technique)

**E.3.9.2.10** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**E.3.9.2.11** Method 239.2of SW-846; Lead (Furnace Technique)


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**E.3.9.2.12** Method 245.1CL of SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**E.3.9.2.13** Method 7471B of SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**E.3.9.2.14** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**E.3.9.2.15** Method 7060Aof SW-846; Silver (AA, Direct Aspiration)

**E.3.10** Waste/used flint or asphalt coating of known composition will not be analyzed.

**E.3.10.1** No analysis is required because a hazardous waste determination can be made based upon information known from military specifications of material safety data sheets.

**E.3.11** Waste/used flint or asphaltic coatings of unknown composition must be analyzed for cresol (D023-D026).

**E.3.11.1** Rationale: Asphaltic type coating may have creosote and/or cresol present in their composition. If composition is unknown, then these listed and characteristic compounds must be analyzed for.

**E.3.11.2** Analytical methods used will be one or more of the following:

**E.3.11.2.1** Method 1311 of SW-846; TCLP

**E.3.11.2.2** Method 8100 of SW-846; Gas Chromatographic Analysis for Poly-nuclear Aromatic Hydrocarbons

**E.3.11.2.3** Method 8270Dof SW-846; Gas Chromatographic/Mass Spectrometry Analysis of Semi-Volatile Organics (Packed Column Technique)

**E.3.11.2.4** Method 8041of SW-846; Gas Chromatographic Analysis for Phenols

**E.3.12** Wood from boxes or pallets which are known to be contaminated with Pentachlorophenol (PCP), (contamination can be known from either evidence of treatment such as crystals, PCP residue visible on the surface, or a “P” stamped or burned on the wood) will be sampled and analyzed according to the TCLP to determine levels of extractable contamination.

**E.3.12.1** 3.13.1 Rationale: Wood which is known to have been treated with PCP must be extracted according to TLCP and analyzed to determine if the extractable levels of PCP is above the regulatory level of 100 mg/L.

**E.3.12.1.1** Analytical methods used will be one or more of the following:

**E.3.12.1.2** Method 1311 at SW-846; TCLP


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**E.3.12.1.3** Method 8041Dof SW-846; Gas Chromatographic Analysis for Phenols

**E.3.13** Wood which has no evidence of PCP treated will be spot tested to determine if PCP may be present. A positive spot test will necessitate a full TCLP analysis. A negative spot test will allow the wood to be declared PCP free and disposed of as scrap wood.

**E.3.13.1** Rationale: If no evidence of PCP treatment is visible on the wood box or pallet, then a spot test will provide the means to decide if a TCLP analysis is required. A negative spot test will insure PCP levels well below the 100 mg/L regulatory level. A positive spot test indicates a level of PCP which may exceed the 100 mg/L regulatory level and a TCLP analysis is necessary to determine actual extractable levels.

**E.3.13.2** Analytical methods used will be one or more of the following:

**E.3.13.2.1** Method 8 of Appendix I; Beilsten Test for Halogens (Chlorine, Fluorine, Bromine)

**E.3.13.2.2** Method 1311 of SW-846; TCLP

**E.3.13.2.3** Method 8041D of SW-846; Gas Chromatographic Analysis for Phenols

**E.3.14** Used oils will be collected in suitable containers and analyzed for total halogen content.

**E.3.14.1** Rationale: Used oils may contain halogens (chlorine) and/or organic solvents which in some cases may be present at concentrations high enough to make the oil a hazardous waste and no longer suitable for recycling. Therefore, drums of used oil must be analyzed to determine the appropriate disposal action for the oil. If a spot test (field test) determines a total halogen concentration greater than 1000 ppm an investigation will be performed to determine the source of halogen contamination. This investigation may include analysis.

**E.3.14.2** Analytical methods used will be one or more of the following:

**E.3.14.2.1** Method 9077 of SW-846; Total Chlorine in New and Used Petroleum Products (Field Test Kit Methods)

**E.3.14.2.2** Method 8260B of EPA SW-846; Gas Chromatographic Analysis for Halogenated Volatile Organics

**E.3.14.2.3** Method 8121of EPA SW-846; Gas Chromatographic Analysis for Chlorinated Hydrocarbons

**E.3.14.2.4** Method 8260Bof SW-846; Gas Chromatography/Mass Spectrometry Analysis for Volatile Organics


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**E.3.14.2.5** Method 8270D of EPA SW-846; Gas Chromatography/Mass Spectrometry Analysis for Semi-Volatile Organics (Packed Column Technique)

**E.3.14.2.6** Method 8270 of SW-846; Gas Chromatography/mass Spectrometry Analysis for Semi-Volatile Organics (Capillary Column Technique)

**E.3.15** Debris/material suspected of being contaminated with metals will be analyzed for the TCLP and analysis for selected heavy metals.

**E.3.15.1** Rationale: Analysis is required because the debris/material may contain metals above regulatory threshold levels.

**E.3.15.2** Analytical methods used will be one or more of the following:

**E.3.15.2.1** Method 1311 of EPA SW-846; TCLP

**E.3.15.2.2** Method 6010 of SW-846; Inductively Coupled Plasma Atomic Emission Spectroscopy

**E.3.15.2.3** Method 213.1of SW-846; Cadmium (AA, Direct Aspiration)

**E.3.15.2.4** Method 7060A of SW-846; Arsenic (AA, Furnace Technique)

**E.3.15.2.5** Method 7080A of SW-846; Barium (AA, Direct Aspiration)

**E.3.15.2.6** Method 213.2CL of SW-846; Cadmium (AA, Furnace Technique)

**E.3.15.2.7** Method 218.1of SW-846; Chromium (AA, Direct Aspiration)

**E.3.15.2.8** Method 218.2CLof SW-846; Chromium (AA, Furnace Technique)

**E.3.15.2.9** Method 7420 of SW-846; Lead (AA, Direct Aspirations)

**E.3.15.2.10** Method 239.2 of SW-846; Lead (Furnace Technique)

**E.3.15.2.11** Method 245.1CL of SW-846; Mercury in Liquid Waste (Manual Cold Vapor Technique)

**E.3.15.2.12** Method 7471B of SW-846; Mercury in Solid or Semi-Solid (Manual Cold-Vapor Technique)

**E.3.15.2.13** Method 7740 of SW-846; Selenium (AA, Furnace Technique)

**E.3.15.2.14** Method 7060A of SW-846; Silver (AA, Direct Aspiration)

**E.3.16** Spent/used/obsolete batteries that are derived from the demilitarization of mines/torpedoes will be managed as universal wastes. In those instances that a particular battery is deemed unique to military operations and it may contain substances that are other than corrosive, such as a lithium hydroxide battery which is reactive, it will be treated as a hazardous waste and managed accordingly.


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## E.4 Sampling Plans

**E.4.1** The sampling plans for all mixed, spent solvents, unknown solvents, paints/waste paints, grit/bead blasting procedures, rags and wood will be the same as outlined in Section A-4.

**E.4.2** Containers of waste adhesives/resins will be sampled utilizing a simple stir (if possible) and grab sample strategy. A random sample from each batch (lot number) will be taken if the product is unused.

**E.4.3** Containers of waste acids will be sampled utilizing a stir and grab sample strategy with a sample taken from the first container generated and every tenth one thereafter.

**E.4.4** Waste/used flint/asphaltic coatings will be sampled assuming homogeneity and a simple grab sample taken. A sample will be taken from the first container generated and every tenth one thereafter.

**E.4.5** Drums or smaller containers of used oil will be sampled as outlined in Section A, 4.3 - 4.4.

**E.4.6** Storage tanks of used oil will be sampled utilizing a sample grab sampling strategy. A composite sample will be made from 3-4 grab samples taken from various depth and locations in the tank.

**E.4.7** The first container of contaminated material/debris generated from a long term/ongoing process will be sampled; a single random/grab sampling strategy will be used to obtain the sample. After the initial drum is sampled then every tenth drum of material will be sampled using a composite sampling strategy when a sample will be taken from each drum and a composite of the ten samples will be analyzed.

**E.4.8** Containers generated by a short term operation (less than ten drums of containers/material generated) will be sampled using a composite sampling strategy where by a sample is taken from every drum generated and mixed into one composite sample for analysis.


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# F SECTION F - MISCELLANEOUS/INCIDENTAL AREAS

## F.1 General Operations/Functions Performed:

**F.1.1** Incidental hazardous waste generators.

**F.1.1.1** Maintenance and Utilities

**F.1.1.2** Safety, Health and Quality Assurance

## F.2 Specific Wastes Generated:

**F.2.1** Spent/used solvents

**F.2.1.1** Toluene (F005)

**F.2.1.2** Trichloroethylene (F002)

**F.2.1.3** 1,1,1 Trichloroethane (F002)

**F.2.1.4** Methyl isobutyl ketone (F003)

**F.2.1.5** Isopropanol (D001)

**F.2.1.6** Acetone (F003)

**F.2.1.7** Mixtures of above solvents (waste codes dependent upon mixture)

**F.2.2** Waste Oils with F listed solvents

**F.2.3** Wash down wastewater from battery shop (D006 and possibly D008 and D002)

**F.2.4** Silver Recovery Waste (D011)

**F.2.5** Spent/used aerosol cans (D003)

## F.3 Parameter, Rationale, and Analytical Methods Used:

**F.3.1** All spent/used solvents which are separated/not mixed or mixtures of known composition and concentration will have no analysis performed. This waste will be declared hazardous and the appropriate hazardous waste number will be assigned.

**F.3.1.1** Rationale: No analysis is required, all necessary information to treat, store, and dispose of this waste is contained in material safety data sheets (MSDS) and Army specifications. All information necessary to determine if these wastes are restricted from land disposal is known from existing documents.

**F.3.2** Solvents which have been mixed or are unknown, either in composition or type will be analyzed to determine constituents and concentrations. See Section A 3.2 for rationale and analytical methods

**F.3.3** Used oils will be collected in suitable containers (see Appendix II)..

**F.3.3.1** Rationale: Used oils may contain organic solvents which in some cases may be present at concentrations high enough to make the oil a hazardous


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waste and no longer suitable for recycling. Therefore, drums of waste oil must be analyzed to determine the appropriate disposal action for the oil. Used oil generated by the maintenance activities will be burned in space heaters approved by the NDEP-BAPC.

**F.3.3.2** Analytical methods used will be one or more of the following:

**F.3.3.2.1** Method 8260B of SW-846; Gas Chromatographic Analysis for Halogenated Volatile Organics

**F.3.3.2.2** Method 8121 of SW-846; Gas Chromatographic Analysis for Chlorinated Hydrocarbons

**F.3.3.2.3** Method 8250 of SW-846; Gas Chromatographic/Mass Spectrometry Analysis for Semi-Volatile Organics (Packed Column Technique)

**F.3.3.2.4** Method 8260 of SW-846; Gas Chromatographic/Mass Spectrometry Analysis for Volatile Organics

**F.3.3.2.5** Method 8270 of SW-846; Gas Chromatographic/Mass Spectrometry Analysis of Semi-Volatile Organics (Capillary Column Technique)

**F.3.3.2.6** Method 9077 of SW-846; Test Methods for Total Chlorine in New and Used Petroleum Products (Field Test Kit Methods)

**F.3.4** Wash down water collected from the Battery Shop will be tested for the toxic metals lead and cadmium, and a pH determination will be performed.

**F.3.4.1** Rationale; Analysis of wash down water from the Battery Shop is necessary because batteries contain lead and/or cadmium which are hazardous materials. A pH determination is necessary to determine the characteristic of corrosivity (less than or equal to 2.0 and greater than or equal to 12.5).

**F.3.4.2** Analytical methods used will be one or more of the following:

**F.3.4.2.1** Method 239.1 of EPA-600 4-79-020; Lead in Water

**F.3.4.2.2** Method 213.1 of EPA-600 4-79-20; Cadmium in Water

**F.3.4.2.3** Method 7420 of SW-846; Lead (AA, direct aspiration)

**F.3.4.2.4** Method 7030 of SW-846; Cadmium (AA, direct aspiration)

**F.3.4.2.5** Method 9040 of SW-846; Determination of pH


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## F.4 Sampling Plans:

**F.4.1** Unknown liquids collected in containers will be sampled with a composite liquid waste sample (COLIWASA), depending on the size of the container and opening, one of the following Sections 4.2 and 4.3 will apply.

**F.4.2** Whole lid removal - a simple stir and sample strategy will be used.

**F.4.3** Single hole/bung type of opening.

**F.4.3.1** Container will be sampled vertically if contents are known to be homogenous.

**F.4.3.2** If homogeneousness is not known, then one sample will be taken vertically as well as one sample taken at an angle extending to the furthest point in the container.

**F.4.4** At lease four (4) samples will be taken from each container or a quantity sufficient for analysis (see Appendix II). A sample will be taken from the first container generated and every tenth container thereafter.

**F.4.5** Used oil will may be accumulated in 55-gallon drums. These drums will be sampled utilizing a simple grab sampling strategy. The drums are assumed to be homogenous and not layered. If the contents are suspected to be layered or multi-phased, then a composite liquid water sampler (COLIWASA) will be utilized to sample the drum. Composite sample will be taken from pallets of drums of oil.

**F.4.6** Storage tanks of used oil will be sampled utilizing a sample grab sampling strategy. A composite sample will be made from 3-4 grab samples taken from various depth and locations in the tank.

**F.4.7** The wastewater from the Battery Shop is accumulated in 55-gallon drums. The contents of the drums will be mixed. Sampling will be performed on every tenth drum of liquid generated. A dipper or weighted bottle will be used to obtain a water sample.


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# G SECTION G - HAZARDOUS WASTE MUNITION ITEMS

## G.1 General Operations/functions Performed:

**G.1.1** This section discusses procedures to comply with requirements specified in 40 CFR 264.13 for munition items which have been declared a hazardous waste.

**G.1.2** Munition items may become a solid waste through one of the following means:

**G.1.2.1** Removal from storage in a magazine or other storage area for the purpose of destruction, disposal, or treatment prior to disposal.

**G.1.2.2** Munition items found leaking or deteriorated or damaged to the point that it cannot be put into serviceable condition and cannot reasonably be recycled or used for other purposes.

**G.1.2.3** Munition items may be determined/declared a hazardous waste by an authorized military official.

## G.2 Parameter and Rational:

**G.2.1** All munition items which meet one of the criteria listed in Section 1.2 will be evaluated to determine if they will be a hazardous waste by utilizing one or more of the following methods:

**G.2.1.1** Review of military specifications and drawing.

**G.2.1.2** Review/characterization utilizing the Munitions Items Disposition Action System (MIDAS).

**G.2.1.3** Review of Material Safety Data Sheets (MSDS) if available.

**G.2.2** Based upon review of available documents and an appropriate EPA waste code will be assigned to the items determined to be hazardous waste.

## G.3 Sampling Plan:

**G.3.1** Munition items will not be sampled. All information will be obtained through document research by National Stock Number (NSN), drawing number, or military specification.


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# H SECTION H - GENERAL NOTES

H.1 If the analytical scheme of a waste is outside the analytical capabilities of the HWAD's Chemistry Laboratory, a representative sample will be taken of the waste and sent by Environmental Services to an outside laboratory.

H.2 Scrap explosives which have not been mixed with other wastes may be used as donor material for open detonation operations. These explosives will not be classified as hazardous waste. Waste soil/sludge with concentration of explosives exceeding 12% may be used as donor for open detonation operations.

H.3 Frequency of Analysis – Sample every three (3) years at the permitted hazardous waste storage unit providing MSDS or generator knowledge is not available.

H.4 Wastes that are determined to be characteristic (D001-D043) and are subject to treatment standards according to the table in 40 CFR 268.40, "Treatment Standard for Hazardous Wastes" will be tested for the underlying hazardous constituents listed in 40 CFR 268.48 table of "Universal Treatment Standards". Analysis will be performed for only those constituents which can reasonably be expected to be present in the waste at the point of generation.

H.5 If an analytical method specified in this document becomes obsolete, the replacement method, as specified in SW-846, will be the method of analysis used.


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# I SECTION I - Analytical Methods

## I.1 Method 1 -High Performance Liquid Chromatographic (HPLC) Analysis of Explosives in Soils

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**Abstract**

Described is the method which permits assay of traces of six polynitro explosives in soils (down to 0.5 ppm) in a single analytical procedure. Separation of the selected explosives (HMX, RDX, Tetryl, 2,4,6-TNT, 2,6- and 2,4-DNT's) column chromatography. Sample preparation requires extraction of the compounds of interest with acetonitrile. Following the column chromatographic separations, the explosive compounds are detected by ultraviolet spectrometry. Included are coefficients of variation (Cv) of the method for each of the compounds of interest. They are based on recoveries of explosives from spiked soil controls.

The opinions or assertions contained herein are the private views of the authors and are not to be construed as reflecting the views of the Department of the Army or the Department of Defense.

**Introduction**

The objective of this study was to develop a method for quantifying the levels of explosives present in soil samples gathered from various Army ammunition dumps. The explosives of interest include HMX, RDX, Tetryl, 2,4,6-TNT, and 2,4-DNT's[1]. The levels of these compounds in samples may vary from trace amounts to upwards of 200 ppm concentrations. In as much as the soils come from different parts of the country, a variety of matrices may be expected (sands, clays, loams, ashes, etc.). In addition, the time constraint of one year was placed on processing of approximately 2000 samples and spiked soil controls. In the past, the presence of these compounds in trace amounts in air, water, and in sludges from ammunition plants, was usually determined by the use of gas chromatography (GC) and mass spectrometry (GC-MS). These methods provided more than ample detection limits (down to ppb levels by ECD) but were time consuming. Limitations on the size of injections for GC analyzes, required often tedious sample pre-concentrations or extensive dilutions when explosives appeared present in amounts out of the dynamic range of EC detectors. In the case of RDX and Tetryl, there were also limitations of GC temperature conditions and a need of complete glass system. HMX, in


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turn, had to be determined separately (on LC or MS) since it does not produce response on ECD. The GC process required also, a considerable sample clean up in order not to swamp the detector with a host of potential interferents, present to soils. To accommodate their diverse aspects, a practical HPLC method, based on word of Kayser was developed. Subsequently, this method was adapted to a routine and partially unattended operation on a newly purchased, fully automated "Waters" HPLC instrument.

## Materials

Chemicals: Most of explosive compounds in this investigation are not commercially available. The following reference chemicals were procured from Army sources: HMX, RDX, Tetryl, 2,4- and 2,6-DNT's. 2,4,6-TNT was obtained from K&K Industries. HPLC grade methanol, triple distilled water and the acetonitrile were purchased from Fisher Scientific Company.

Apparatus: The Waters Associates Model ALC 204 liquid chromatograph was used. It was equipped with a Model 710A Wisp, a Model 441 Absorbance Detector and a Radial Compression Module with a 10 micron C-18 column. The output of the detector was connected to a Model 3390 H&P integrator. Two solvent systems were used. Pump A delivered distilled water, Pump B delivered methanol.

## Method

General: The preparation of samples requires drying and homogenization of soils. The drying is effected by keeping soils in an incubator type room, at 25° C and at approximately 10 % relative humidity, for several days; the homogenization is accomplished by the removal of incidental stones and debris and by crushing and passing of soils through a 30 mesh sieve. Prior to analysis, the moisture contents of each batch of samples are determined. The sample results are then corrected accordingly.

The analysis involves extraction s (enhanced by sonification) of explosives from soil into acetonitrile. The LC separations are accomplished isocratically by the use of a 10 micron reverse phase C-18 Radial-Pac cartridge columns, with a 40/60 methanol/water mobile phase, at a flow of 2 ml/min. Quantization is made at the 254 nanometers wavelength. Calculations are based on external standards. A typical chromatogram depicting the separation of all explosives of interest is given in Figure 1. The elution time for the total assay is less than 50 minutes. Tetryl and 2,4,6-TNT are light labile, therefore amber glassware needs to be used throughout the process. Tetryl also adheres to the glass, thus its recoveries may suffer somewhat in accuracy.


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**Analytical Procedure**

1. Weigh out exactly 10 grams of soil (samples and/or controls) into a 40 ml amber vial fitted with a screw cap and teflon septum. The exact (10 grams) amount is important. This value is built into the factor to obtain printed results from the instruments computer (in ppm), thus avoiding external calculations.
2. With a volumetric pipette, introduce to each soil sample 20 ml of acetonitrile (HPLC grade 0 and screw on the closure tightly.
3. Place the vials on automatic shaker and let samples shake 20 minutes at a "moderate speed."
4. Remove the vials from the shaker and sonicate the samples for 10 minutes in an ultrasonic cleaner.
5. Follow shaking and sonication steps by centrifuging samples for 15 minutes at a low speed to obtain clear supernatant.
6. With a disposable Pasteur pipette divide a clear (totally particle free) supernatant among three 1 ml numbered wisp vials. In some cases, samples may need to be filtered. Use a disposable 0.45 micron filter (Millex-HU from Millipore Corp) attached to a glass Luer Syring.
7. Insert the vials (with the screwed on teflon discs) in the proper order onto the wisp tray, which is then positioned onto the instrument.
8. Activate the sample delivery system, the LC and integrator according to the optimized program.

**Discussion**

During the development of the method, a variety of tests were conducted such as: linearity of detector response determinations, accuracy of injections, comparison of integrations by area counts versus peak heights, stability of the standards, etc., and in the process of these tests, a multitude of standards had to be injected. The results of those injections (accumulated in the span of six weeks) were calculated for each compound in counts of microgram (cts/µg) remain unchanged at the established LC conditions within limits of accuracy of injections. Even when several new columns were used, and some shifting of the retention times occurred, the factors did not change. Subsequently, these factors were built into calculations of sample results. This greatly speeded up the process of analysis since no new daily factors needed to be obtained. The results of daily standards injections are then entered on the control charts for the purpose of analytical documentation.

Further analysis of the data accumulated in the process of establishing of the method revealed also, that the response factors (cts/µg) are reversely proportional to the flow rate. This means that, when a need arises from one flow rate to another, new values for the factors can be quickly calculated and used in lieu of additional calibrations. For example: if the HMX factor


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determined at 2 ml/min flow rate was 6,000 counts/microgram then the factor at 1.5 ml/min will be: 2ml/1.5 ml x 6,000 cts/µg = 7,998 counts/microgram.

For the purpose of the validation of this method, 23 unknown soil spikes, prepared by the CAB Quality Assurance, were analyzed. The corresponding percent recoveries from these analyses are given in Tables 1 thru 6. Based on those controls, the detection limits of 0.5 ppm and the following coefficients of variation ($C_2$) of the method in the concentration range of interest, namely 0.5-200 ppm (in soils) were obtained.

| COMPOUND | $C_v$ |
|---|---|
| HMX | 0.095 |
| RDX | 0.098 |
| Tetryl | 0.098 |
| 2,4,6-TNT | 0.100 |
| 2,6,-DNT | 0.100 |
| 2,4-DNT | 0.099 |

**Conclusion**

A rapid HPCl method for determination of six selected explosives polynitro compounds has been established. It involves an easy sample extraction from explosives bearing soils and a relatively short LC separation on a reverse phase $C_{18}$ Radial-Pak cartridge column. The method provides good accuracy and reproductibility in the range of 1-200 ppm of each explosive (in soil) and permits determination of the six compounds of interest in a single chemical analysis.

**References:**

Explosives of Military Interest, AMCP 706-177, US Army Materiel Command, January 1971

Kayser E.G., Analysis Methods for Explosive Materials, Naval Surface Center, NCWC TR 81-123 (1981).



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# Table I

## HMX Concentration

| Control # | Theoretic ppm | Observed ppm | Recovery % |
|---|---|---|---|
| 9-2 | 0.5 | 0.93 | 186.47 |
| 3-2 | 1.0 | 1.73 | 172.76 |
| 7-2 | 2.0 | 2.02 | 100.94 |
| 02051 | 1.55 | 1.93 | 124.73 |
| 6-2 | 5.0 | 5.49 | 109.83 |
| 5-2 | 10.0 | 10.07 | 100.66 |
| 4-2 | 20.0 | 18.92 | 94.58 |
| 3-1 | 50.0 | 49.83 | 99.65 |
| 2-1 | 100.0 | 97.98 | 97.98 |
| | 200.0 | 192.72 | 96.36 |
| 022311 | 50.0 | 50.25 | 100.50 |
| 022310 | 40.0 | 39.09 | 97.72 |
| 022308 | 20.0 | 20.74 | 103.70 |
| 022306 | 5.0 | 5.87 | 117.40 |
| 022301 | 10.0 | 10.47 | 104.70 |
| 02053 | 3.09 | 3.55 | 114.89 |
| 02054 | 3.86 | 4.24 | 109.73 |
| 02055 | 4.64 | 4.81 | 103.58 |
| 022304 | 40.0 | 39.60 | 99.00 |
| 022305 | 50.0 | 49.03 | 98.06 |
| 022309 | 30.0 | 29.47 | 98.23 |
| 022302 | 20.0 | 19.67 | 98.37 |
| 022303 | 30.0 | 28.00 | 93.33 |


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# Table II

## RDX Concentration

| Control # | Theoretic ppm | Observed ppm | Recovery % |
|---|---|---|---|
| 9-2 | 0.5 | 0.57 | 113.28 |
| 3-2 | 1.0 | 1.63 | 163.27 |
| 7-2 | 2.0 | 2.16 | 108.10 |
| 02051 | 1.86 | 2.09 | 112.49 |
| 6-2 | 5.0 | 4.89 | 97.82 |
| 5-2 | 10.0 | 9.73 | 97.33 |
| 4-2 | 20.0 | 18.70 | 93.40 |
| 3-1 | 50.0 | 48.93 | 97.87 |
| 2-1 | 100.0 | 96.79 | 96.79 |
| | 200.0 | 190.63 | 95.32 |
| 022311 | 50.0 | 48.80 | 97.60 |
| 022310 | 40.0 | 38.22 | 95.55 |
| 022308 | 20.0 | 20.98 | 104.90 |
| 022306 | 5.0 | 5.83 | 116.60 |
| 022301 | 10.0 | 10.34 | 103.40 |
| 02053 | 4.66 | 4.37 | 117.14 |
| 02054 | 5.59 | 4.91 | 105.46 |
| 02055 | 4.64 | 5.75 | 102.95 |
| 022304 | 40.0 | 37.44 | 93.60 |
| 022305 | 50.0 | 46.43 | 92.86 |
| 022309 | 30.0 | 28.27 | 94.23 |
| 022302 | 20.0 | 19.03 | 95.15 |
| 022303 | 30.0 | 27.20 | 90.67 |


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# Table III

## Tetryl Concentration

| Control # | Theoretic ppm | Observed ppm | Recovery % |
|---|---|---|---|
| 9-2 | 0.5 | 0.95 | 189.59 |
| 3-2 | 1.0 | 0.78 | 78.13 |
| 7-2 | 2.0 | 2.19 | 109.51 |
| 02051 | 1.78 | 1.71 | 95.99 |
| 6-2 | 5.0 | 5.01 | 100.18 |
| 5-2 | 10.0 | 10.08 | 100.78 |
| 4-2 | 20.0 | 18.29 | 91.46 |
| 3-1 | 50.0 | 48.04 | 96.09 |
| 2-1 | 100.0 | 100.55 | 100.55 |
| | 200.0 | 202.87 | 100.43 |
| 022331 | 50.0 | 54.39 | 108.78 |
| 022310 | 40.0 | 42.43 | 106.08 |
| 022308 | 20.0 | 22.53 | 112.65 |
| 022306 | 5.0 | 6.22 | 124.40 |
| 022301 | 10.0 | 11.32 | 113.20 |
| 02053 | 3.46 | 3.97 | 111.55 |
| 02054 | 4.45 | 4.79 | 107.61 |
| 02055 | 5.34 | 5.33 | 99.78 |
| 022304 | 40.0 | 38.11 | 95.27 |
| 022305 | 50.0 | 44.86 | 89.72 |
| 022309 | 30.0 | 28.45 | 78.17 |
| 022302 | 20.0 | 28.00 | 117.00 |
| 022303 | 30.0 | | |


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# Table IV

## TNT Concentration

| Control # | Theoretic ppm | Observed ppm | Recovery % |
|---|---|---|---|
| 9-2 | 0.5 | 0.57 | 113.72 |
| 3-2 | 1.0 | 0.92 | 91.90 |
| 7-2 | 2.0 | 2.04 | 101.93 |
| 02051 | 1.02 | 0.59 | 57.51 |
| 6-2 | 5.0 | 4.99 | 99.89 |
| 5-2 | 10.0 | 10.05 | 100.49 |
| 4-2 | 20.0 | 19.24 | 96.22 |
| 3-1 | 50.0 | 50.51 | 101.02 |
| 2-1 | 100.0 | 100.63 | 100.68 |
| | 200.0 | 199.52 | 99.76 |
| 022311 | 50.0 | 52.66 | 105.32 |
| 022310 | 40.0 | 41.00 | 102.50 |
| 022308 | 20.0 | 21.71 | 108.55 |
| 022306 | 5.0 | 5.96 | 119.20 |
| 022301 | 10.0 | 11.00 | 110.00 |
| 02053 | 2.04 | 1.99 | 97.59 |
| 02054 | 2.55 | 2.49 | 97.50 |
| 02055 | 3.05 | 2.91 | 95.21 |
| 022304 | 40.0 | 39.40 | 98.50 |
| 022305 | 50.0 | 48.67 | 97.34 |
| 022309 | 30.0 | 27.75 | 92.50 |
| 022302 | 20.0 | 19.70 | 98.50 |
| 022303 | 30.0 | 26.83 | 89.43 |


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# Table V

## 2,4-DNT Concentration

| Control # | Theoretic ppm | Observed ppm | Recovery % |
|---|---|---|---|
| 9-2 | 0.5 | 0.60 | 119.60 |
| 3-2 | 1.0 | 0.92 | 92.46 |
| 7-2 | 2.0 | 1.99 | 99.66 |
| 02051 | 0.578 | 0.53 | 91.72 |
| 6-2 | 5.0 | 5.00 | 100.04 |
| 5-2 | 10.0 | 10.13 | 101.33 |
| 4-2 | 20.0 | 19.80 | 98.98 |
| 3-1 | 50.0 | 51.80 | 103.59 |
| 2-1 | 100.0 | 100.60 | 102.60 |
| | 200.0 | 202.67 | 101.33 |
| 022311 | 50.0 | 53.30 | 106.60 |
| 022310 | 40.0 | 41.62 | 104.05 |
| 022308 | 20.0 | 21.95 | 109.75 |
| 022306 | 5.0 | 6.07 | 121.40 |
| 022301 | 10.0 | 11.27 | 112.70 |
| 02053 | 1.16 | 1.03 | 89.16 |
| 02054 | 1.44 | 1.36 | 94.75 |
| 02055 | 1.73 | 1.57 | 90.92 |
| 022304 | 40.0 | 38.76 | 96.00 |
| 022305 | 50.0 | 48.47 | 97.14 |
| 022309 | 30.0 | 28.63 | 95.43 |
| 022302 | 20.0 | 17.73 | 88.65 |
| 022303 | 30.0 | 27.27 | 90.90 |


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# Table VI

## 2,6-DNT Concentration

| Control # | Theoretic ppm | Observed ppm | Recovery % |
|---|---|---|---|
| 9-2 | 0.5 | 0.39 | 78.48 |
| 3-2 | 1.0 | 1.01 | 100.56 |
| 7-2 | 2.0 | 1.99 | 99.41 |
| 02051 | 0.504 | 0.27 | 53.02 |
| 6-2 | 5.0 | 5.07 | 101.38 |
| 5-2 | 10.0 | 10.19 | 101.92 |
| 4-2 | 20.0 | 19.30 | 96.52 |
| 3-1 | 50.0 | 50.73 | 101.47 |
| 2-1 | 100.0 | 100.14 | 100.14 |
| | 200.0 | 197.21 | 98.61 |
| 022311 | 50.0 | 52.16 | 104.32 |
| 022310 | 40.0 | 40.58 | 111.45 |
| 022308 | 20.0 | 21.68 | 108.20 |
| 022306 | 5.0 | 5.75 | 115.00 |
| 022301 | 10.0 | 11.06 | 110.60 |
| 02053 | 1.01 | 1.08 | 106.62 |
| 02054 | 1.26 | 1.24 | 98.42 |
| 02055 | 1.51 | 1.57 | 104.12 |
| 022304 | 40.0 | 40.87 | 102.17 |
| 022305 | 50.0 | 50.52 | 101.04 |
| 022309 | 30.0 | 30.22 | 100.73 |
| 022302 | 20.0 | 19.80 | 99.00 |
| 022303 | 30.0 | 29.60 | 98.67 |


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Samples - explosives 5 ug/ml in Acetonitrile
Sample Size - 25 ul
Mobile Phase - 40% Methanol/60%
($H_2O$ with 1% Acetic Acid)
Flow Rate - 2 ml/min
Column - Radial-Pak - C18 um
Chart Speed - 0.5 cm/min
Chart Speed - 0.5 cm/min
Uv Detector - 25 nm - 0.01 AUFS

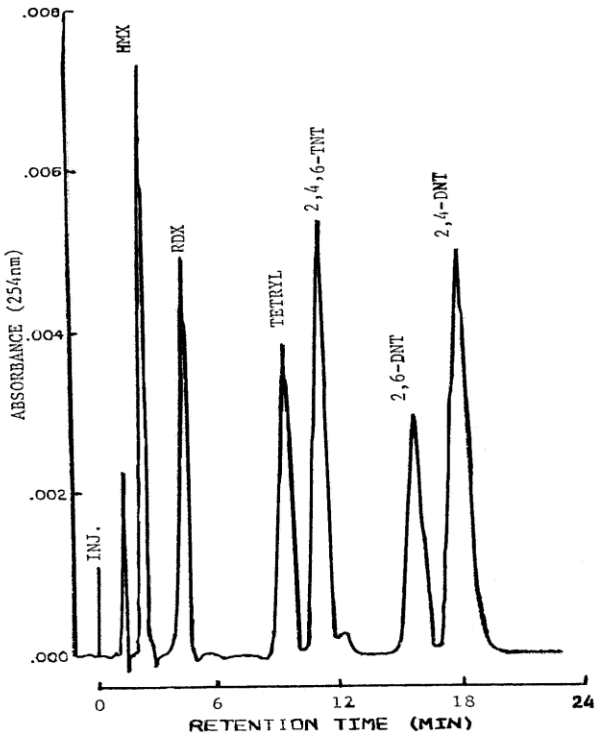


FIGURE: Chromatogram Depicting Separation of Explosives


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# I.2 Method 2 -High Performance Liquid Chromatographic (HPLC) Analysis for the Determination of TNT, RDX, HMX, and 2,4-DNT in Water

U.S. Army Environmental Hygiene Agency

Military Unique Munitions Analytical Procedure

Paper No 23, Appendix B

1. **Application:**
   This method was developed for the analysis of TNT, RDX, HMX, and 2,4-DNT in the wastewater form munitions manufacturing and processing operations, particularly for compliance monitoring activities. It is also suitable for use in ground water monitoring applications as well.
   a. **Concentration Range:**
      This method has been tested at TNT and 2,4-DNT concentrations ranging from 10 µg/L to 20 mg/L, and RDX and HMX concentrations ranging from 25 µg/L to 50 mg/L. The response in all cases was linear over the entire concentration range using either peak height or peak area measurements.

   b. **Sensitivity:**
      The response of the UV detector at 254 nm for TNT, RDX, HMX, and 2,4-DNT was estimated at 0.050, 0.031, 0.021, and 0.060 absorbance units/ppm, respectively, using the conditions described and a 100 µL sample.

   c. **Detection Limit:**
      The detection limit for each of the four substances has been determined on four separate days using the approach developed by Hubaux and Vos (1). For TNT, RDX, HMX, and 2,4-DNT the detection limits were found to be 11.2, 39.8, 37.4, and 10.4 µg/L, respectively, using a 100 µL injection volume of 50% sample, 50% methanol.

   d. **Interference:**
      No interferences have been observed in the pink and lagoon water analyzed thus far.

   e. **Analysis Rate:**
      We estimate that complete analysis of 20 samples, injected in duplicate, can be analyzed for all four components in one eight hour period, if the stock standards have been prepared in advance.


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2. **Chemistry:**
   Physical and Chemical Properties
   a. **TNT (2,4,6-trinitrotoluene)**
      Boiling point - explodes at 280$^{o}$ C (5)
      Melting point - 80$^{o}$ C (5)
      Solubility in water at 25$^{o}$ C - 100 mg/L (12)
      Octanol/water partition coefficient - 37 (11)
      Vapor pressure at 20$^{o}$ C - 1.3 x 10$^{6}$ (7)

   b. **RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)**
      Boiling point - decomposes
      Melting point - 203.5$^{o}$ C (6)
      Solubility in water at 25$^{o}$ C - 60 mg/L (4)
      Octanol/water partition coefficient at 23$^{o}$ C - 7.41 (4)
      Vapor pressure at 20$^{o}$ C - 1.0 x 10$^{9}$ torr (8)

   c. **HMX (octahydro-1,3,5,7-tetranitro-s-tetrazine)**
      Boiling point - decomposes
      Solubility in water at 25$^{o}$ C - 35 mg/L (13)
      Octanol/water partition coefficient - 2.0 (11)

   d. **2,4-DNT (2,4-dinitrotoluene)**
      Boiling point - decomposes at 300 degrees C
      Melting point - 70$^{o}$ C (5)
      Solubility in water at 22$^{o}$ C - 300 mg/L (5)
      Octanol/water partition coefficient 0 95.5 (10)
      Vapor pressure at 20$^{o}$ C - 2 x 10$^{4}$ torr (9)

3. **Apparatus:**
   a. **Instrumentation:**
      Perkin-Elmer Series 3 HPLC (or equivalent) equipped with a sample loop injector and either a fixed 254 nm UV detector or a multi wavelength UV detector (Perkin_elmer LC-65 T or equivalent) set at 254 nm.
      Strip chart recorder (0-1 mvolt full scale)
      Digital integrator (optional)

   b. **Operating Parameter:**
      Column - LC-8 (Supelco) reverse phase, 25 cm x 4.6 nm
      Column Temperature - 25$^{o}$ = 2$^{o}$ C
      Solvent System - 50% methanol, 50% water
      Flow Rate - 1.5 ml/min


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Detector - 254 nm
Recorder - 1 mvolt full scale & 0.02 in/min chart speed.

c. **Hardware/Glassware:**
Syringe - Hamilton liquid syringe - 100.0 µL
Filtration Device - Nuclepore syringe filter, 25 mm
Pipettes - glass, 10 ml
Scintillation Vials - glass, 20 ml
Plastipak Disposable Syringe, 10 ml

d. **Chemicals:**
TNT (SARM quality)
RDX (SARM quality)
HMX (SARM quality)
2,4-DNT (SARM quality)
Water (Baker HPLC grade)
Methanol (HPLC grade)
Acetonitrile (HPLC grade)

4. **Standards:**

a. **Calibration Standards**
Individual stock standards for TNT, RDX, and 2,4-DNT are prepared by accurately weighing out about 0.1 g of dried SARM material, transferring to individual 200 ml, volumetric flasks, dissolving and diluting to volume with methanol. The stock standard for HMX is prepared by dissolving 0.1 g in 100 ml of acetonitrile and diluting to volume with methanol. The stock solutions are stored in a refrigerator. A working stock standard is prepared by combining appropriate volumes of each individual stock and diluting to volume with methanol. Working standards in the range of interest, usually 20 µg/L to 10 mg/L, are prepared daily by diluting the working stock solution with 50% methanol, 50% HPLC water. Generally four standards and a blank are run to obtain the calibration curve. The highest level standard should be established at the upper end of the concentration range.

b. **Control Spike**
Separate stock solutions than those used to prepare the calibration standard are used to prepare the normal spikes. Spike samples are prepared in a similar manner to the calibration standards except using 50% sample, 50% methanol as the dilutent rather than 50% HPLC water, 50% methanol. The spike concentrations chosen for each of the substances should be in the range encountered for authentic samples.


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5. **Procedure:**
   a. **Sample Preparation**
   Samples are collected and maintained in all glass containers that have been pre-cleaned with acetone.

   The sample is shaken vigorously by hand for 30 seconds to insure that it is thoroughly mixed, a 10 ml sub-sample is withdrawn with a 10 ml glass pipette and placed in a 20 ml scintillation vial. An equal volume of methanol is added, the vial capped, shaken and allowed to stand for 15 minutes. The methanol is added for two reasons:
      i. To help desorb these substances from the surfaces of particulates and dissolve small particles of explosives that could be present.
      ii. To provide a sample compatible with HPLC mobile phase;

   otherwise, extraneous positive or negative peaks may occur in the region of HMX.

   Approximately 10 ml of this sample is then placed in a 10 ml plastipak syringe and filtered through a 0.4 um Nuclepore polycarbonate filter. The first 10 ml is discarded and a second 10 ml portion filtered and collected in a glass scintillation vial and saved for analysis.

   b. **Sample Determination**
   At the beginning of the run the HPLC is calibrated by duplicate analysis of a blank and three standards covering the range of interest. This is done by injection of 100 µL of each working standard into the sampling loop and analyzing, using the operational parameter given in the apparatus section. Individual samples are analyzed by duplicate injection using the same procedures. Analysis of the highest standard is condensed after every five samples to insure that the response of the detector remains constant over the day. This is also important to catch any changes in column or injection parameter which affect response. HMX, RDX, TNT, and 2,4-DNT eluted from the column under the specified conditions at uncorrected retention times of 2.7, 3.9, 7.2, and 8.7 minutes respectively. The peak height or peak area corresponding to each substance is obtained from either the strip chart or a digital integrator and compared to the calibration curve obtained from at least a squares foot of the peak area or peak height data versus concentration of the standards.


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**6. Calculations:**

The peak heights or peak areas corresponding to the duplicate analysis of the standards and blank are plotted versus concentration for each substance. The "best fit" straight line is obtained using least squares techniques using the original unaveraged data. These test fit lines are the calibration curves for each substance. Since the standards and samples are all analyzed using a 100 ml injection volume, the results for analysis of unknown samples can be obtained directly using these "best fit" equations.

**7. References:**

a. Hubax, A. and G. Vos, Analytical chemistry, Vol. 2, pp 849-855. (1970)
b. West, J.R., Quality Control Program Analysis of RDX, 2,4,6-TNT, 2,4-DNT in Water by Liquid Chromography. Draft Report submitted to THAMA 9/81.
c. Dalcon, R.W., Evaluation of On-Line Chromatography for Monitoring Nitrate Esters in Water (Phase I Report). Hercules Incorporated, Radford Army Ammunition Plant.
d. Banerjee, S., et al., Environ. Sci. Tehcnol., Vol. 14, pp. 1227-1229. (1980)
e. Lange's Handbook of Chemistry, 12th Edition, McGraw Hill, New York, 1979.
f. Condensed Chemical Dictionary, 9th Edition. Van Nostrand Reinhold, New York, 1979.
g. Laggett, D.C., Jour. Chromotogr., Vol. 83, pp. 88-90 (1977)
h. Coates, A.C. et al., Characteristics of Certain Military Explosives. Ballistic Research Laboratories Re. No. 1507, Nov. 1970.
i. Leggett, D.C. et al., composition of Vapors Evolved from Military TNT as influenced by temperature, solid composition, age, and source. Cold regions research and engineering laboratory SR, June 1977.
j. Hansch, C. and A. Leo, Substitute Constraints for Correlation Analysis in Chemistry and Biology. John Wiley and Sons, 1979.
k. Leggett, D.C., Upublished estimates using reverse phase HPLC correlation, Oct. 1981.
l. Merck Index. 9th ed. (1976). Merck and Co., Rahway, NJ.
m. Technical Note PXD-5-74 (1974). Mason Hangar Corp. Middletown, IA.


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# Table I

## Limits of Detection for Explosives

| Explosive | Water (HPLC) *(PPM) | GC *(PPM) | Soil & Sediment HPLC Only *(PPM) | Air GC (mg/sample) |
|---|---|---|---|---|
| HMX | 0.1 | - | 1.0 | - |
| RDX | 0.1 | - | 1.0 | 1.25 |
| Tetryl | 0.1 | 0.010 | 1.0 | - |
| 2,4,6-TNT | 0.1 | 0.001 | 1.0 | |


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# I.3 Method 3 - Analysis of TNT, DNT, and Tetryl in Water by Gas Chromatography (GC)

1. **Sampling:**
   Collect at least 100 ml of water for analysis. Samples may be stored in glass bottles with teflon lined caps, cube containers or plastic bottles (polypropylene). Samples should be acidified to pH 2-4 with sulfuric acid (3 drops of 50% $H_2SO_4$ per liter of water is usually sufficient).

2. **Sensitivity:**
   In a 100 ml water sample, 1 ppb TNT and/or DNT and 5 ppb Tetryl may be detected.

3. **Apparatus:**
   a. Volumetric fasks, 100 ml
   b. Pipette, 2 ml
   c. Rotary Shaker
   d. Parafilm$^R$ (wax sealant)
   e. Gas Chromatograph: HP5730A, or equivalent, with all glass system and Ni-63 electron capture detector.
   f. Glass column: 2 ft x 6 mm O.D. packed with BO/100 mesh. Gas Chrom Q coated with 6% OV-101 (or any other packing found suitable).
   g. Recorder
   h. Laboratory Data System or Peak Integrator

4. **Reagents:**
   a. Dry recrystallized TNT (isomer(s) of interest)
   b. Dry recrystallized DNT (isomer(s) of interest)
   c. Dry recrystallized Tetryl
   d. Toluene, reagent grade

5. **Analysis:**
   100 ml of water sample is poured into a volumetric flask and 2 ml of toluene added by pipette. The flask is stoppered, sealed with wax film, and placed on a rotary shaker. Allow the sample to mix for between 2 hr. Remove flask from shaker and allow the toluene and water layers to separate. Analyze the toluene layer versus appropriate standards in toluene by gas chromatography.

   Operating Conditions: HP5730A
   a. For analysis for 2,6-DNT; 2,4-DNT; and 2,4,6-TNT
      Carrier flow: 60 ml/min of 95 % argon, 5% methane carrier gas.


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Column Temp: 180-190$^{o}$
Injection Port temp: 200$^{o}$ C
Detector temp: 200$^{o}$ C

b. For analysis for Tetryl
Carrier flow: 60 ml/min of 95 % argon, 5% methane carrier gas.
Column Temp: 225$^{o}$ C
Injection Port temp: 250$^{o}$ C
Detector temp: 250$^{o}$ C

Note: The 2,4 and 2,6 isomers of DNT and the 2,4,6 isomers of TNT are by far the most prevalent; however, if it is desired, or necessary, to determine the others, a different column packing/G.C. conditions than listed above would have to be used.

**6. Calibration and Standards:**
Standards in the range of expected concentrations in water may be prepared in either of two ways:

a. By dissolving known weights of the explosives directly in distilled water and taking 100 ml portions through the sample extraction procedure with toluene.

b. By dissolving known weights of the explosives directly in toluene.


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# I.4 Method 4 - Gas Chromatography (GC) Procedure for Explosives in Soil (RDX, Tetryl, TNT, DNT, and NG)

1. **Sample Preparation:**
   Ten grams of air dried soil are placed in a clean glass bottle and 20 ml of acetonitrile added. The sample is agitated and then allowed to sit overnight to ensure extraction of the explosive.

2. **Sensitivity:**

| | |
|---|---|
| TNT: | 0.1 mg/kg sample |
| RDX: 2,4-DNT; 2,6-DNT; NG | 0.2 mg/kg sample |
| Tetryl: | 0.5 mg/kg sample |

3. **Apparatus:**
   a. Glass stoppered glass bottle, 50-100 ml capacity.
   b. Gas Chromatograph: HP5730A, equivalent, with an <u>all glass system</u> ni electron capture detector.
   c. Glass column: 3 ft x 6 mm O.D. packed with 80/100 mesh gas chrom Q coated with 6% OV-101 (or any other packing found suitable).
   d. Recorder.
   e. Laboratory data system or peak integrator.

4. **Reagents:**
   a. Purified explosives (TNT isomers, DNT isomers, RDX, NG, and Tetryl); Available as standard analytical reference materials from Picatinny Arsenal via USATHAMA, APG, MD.
   b. Acetonitrile, pesticide grade.

5. **Analysis:**
   The samples are analyzed along with appropriate standards by direct injection of the acetonitrile solutions into the gas chromatograph.

   <u>Operating conditions: HP5730A</u>

   a. Analysis for 2,6-DNT; 2,4-DNT; 2,4,6-TNT; and RDX:
      Column temp: 180-190$^{o}$
      Injection Port temp: 180-190$^{o}$ C
      Detector temp: 200$^{o}$ C


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b. For Analysis for Tetryl:
   Column temp: 225$^{o}$ C
   Injection Port temp: 250$^{o}$ C
   Detector temp: 250$^{o}$ C

c. For Analysis for Nitroglycerine:
   Column temp: 125$^{o}$ C
   Injection Port temp: 150$^{o}$ C
   Detector temp: 200$^{o}$ C

In all cases, carrier flow = 60 ml/min of 95% argon, 5% methane carrier gas.

Note: The 2,4 and 2,6 isomers of DNT and the 2,4,6 isomers of TNT are by far the most common isomers found of these explosives; however, if it is desired, or necessary, to determine the others, a different column packing/G.C. conditions than listed above would have to be used.

**6. Calibration and Standards:**

Standards in the range of expected concentrations in soil are prepared by dissolving known weights of explosives in acetonitrile. Generally 20.0 mg of the dry explosive is dissolved in 100 ml of acetonitrile, and 5 ml of this solution diluted to 50 ml with acetonitrile to give a 0.02 µg/µL stock standard. Subsequent dilution of aliquots of this stock with acetonitrile is done to prepare standards in the desired range of concentrations. From these standards, a standard curve can be made. The largest standard which may be injected (2 µL) and still remain within the linear range of the detector is the 0.02 µg/µL stock standard - this is equivalent to 40 mg of explosive per kilogram of soil where 20 grams of soil is extracted with 20 ml of acetonitrile. Larger concentrations of explosives must be diluted to below this level. At the lower limit of determination, a 0.05 ng/µL standard would be equivalent to 0.1 mg of explosive per kg of soil.

The standards are stable for at least a month if tightly stoppered and stored in a refrigerator.

**7. Calculations:**

A graph of peak area vs. concentration in µg/µL is made using the standards. Explosives concentration in each sample is read from this graph.

mg explosive/kg soil = µg/µL from graph X total µL extraction solvent/total grams sample used.



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# I.5 METHOD 5 - Determination of Explosives in Soil by High Pressure Liquid Chromatography

USATHAMA Method Number: LW 12

## 1. Summary

### a. Analytes:

This method is applicable to the Class 1 analysis of the following organic compounds in environmental soil samples.

Analytes
1,3-Dinitrobenzene
2,4-Dinitrotoluene
2,6-Dinitrotoluene
HMX (actahydro-1,3,5,7-tetranitro-s-tetrazocine)
Nitrobenzene
Nitroglycerin
PETN (pentaerythritol tetranitrate)
RDX (hexahrdro-1,3,5-trinitro-s-triazine)
Tetryl (N-methyl-N,2,4,6-tetranitrobenzenamine)
1,3,5-Trinitrobenzene
2,4,6-Trinitrotoluene

### b. Matrix :

This method is applicable to all relatively dry environmental soil matrices.

### c. General Methods:

This method employs extraction of one gram of an environmental soil using two milliliters (2mL) of acetonitrile. Extraction is accomplished by vortexing followed by sonication of the sample for two hours. The resulting extract is filtered and diluted 1 to 8 with water. The target analytes are separated on a high pressure liquid chromatography (HPLC) column using isocratic elution, and detected using ultraviolet absorbance (UV) at 230 nanometers (nm).

## 2. Application

a. Tested Concentration Range

The certification testing ranges in micrograms per gram (µg/g) are:


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| Analyte | Tested Range (µg/g) |
|---|---|
| 1,3-Dinitrobenzene | 0.496 - 24.8 |
| 2,4-Dinitrotoluene | 0.424 - 21.2 |
| 2,6-Dinitrotoluene | 0.524 - 26.2 |
| HMX | 0.666 - 33.3 |
| Nitrobenzene | 0.548 - 11.0 |
| Nitroglycerin | 4.00 - 200 |
| PETN | 4.00 - 80.0 |
| RDX | 0.438 - 21.9 |
| Tetryl | 0.404 - 20.2 |
| 1,3,5-Trinitrobenzene | 0.488 - 24.4 |
| 2,4,6-Trinitrotoluene | 0.456 - 22.8 |

**b. Sensitivity:**

The instrumental responses for each compound, reported in peak area units at the certified reporting limit (CDL) are:

| Analyte | Certified Reporting Limits | Area Counts |
|---|---|---|
| 1,3-Dinitrobenzene | 0.496 | 40000 |
| 2,4-Dinitrotoluene | 0.424 | 27500 |
| 2,6-Dinitrotoluene | 0.524 | 20000 |
| HMX | 0.666 | 40000 |
| Nitrobenzene | 2.410 | 50000 |
| Nitroglycerin | 4.00 | 4000 |
| PETN | 4.00 | 4000 |
| RDX | 0.587 | 35000 |
| Tetryl | 0.731 | 40000 |
| 1,3,5-Trinitrobenzene | 0.488 | 45000 |
| 2,4,6-Trinitrotoluene | 0.456 | 30000 |

**c. Reporting Limits:**

The certified reporting limits and upper certified limit for each analyte in environmental samples are:

| Analyte | Certified Reporting Limits | Upper Certified Limit (µg/g) |
|---|---|---|
| 1,3-Dinitrobenzene | 0.496 | 24.8 |
| 2,4-Dinitrotoluene | 0.424 | 21.2 |
| 2,6-Dinitrotoluene | 0.524 | 26.2 |
| HMX | 0.666 | 33.3 |
| Nitrobenzene | 2.410 | 11.0 |
| Nitroglycerin | 4.00 | 200 |
| PETN | 4.00 | 80.0 |
| RDX | 0.587 | 21.9 |
| Tetryl | 0.731 | 20.2 |
| 1,3,5-Trinitrobenzene | 0.488 | 24.4 |
| 2,4,6-Trinitrotoluene | 0.456 | 22.8 |



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**d. Interferences:**

Any materials which are extracted from soil with acetonitrile, coelute with the explosives through the HPLC column, and which absorb ultraviolet radiation at 230 nm may cause interferences. Carryover from analysis of a highly contaminated sample can result in apparent contamination of the succeeding samples analyzed. Such contamination if often manifested by the presence of unusally broad chromatographic peaks nested among narrower peaks. This interference is minimized by reanalyzing heavily contaminated samples following dilution, running blanks after heavily contaminated samples utile carry over is removed, and/or rinsing the system with a mobile phase containing a high proportion of organic modifier until the contamination is removed.

**e. Analysis Rate:**

After instrument calibration, one analyst can analyze approximately 8 samples per 8 hour day.

**f. Safety Information:**

The target commands in this method are toxic explosives and some are known carcinogens, e.g. 2,4-Dinitrotoluene. The preparation of all standard should be performed in a laboratory hood. Adequate dermal protection must be used when handling samples and standards.

Most of these compounds are either primary or secondary explosives and should be handled with care to avoid contact with electrostatic shocks or impacts. Tetryl, RDX, and PETN have intermediated sensitivity between initiating explosives and explosives used as bursting charges. However, PETN is used as an initiating agen and is extremely sensitive to initiation (more sensitive then either Tetryl or RDX). Tetryl is toxic when taken internally or by skin contact. RDX, HMX, and TNT are used as bursting charge explosives. Although TNT is less sensitive to friction and impact than many other high explosives, it can be detonated with moderate forces when confined between metal surfaces such as on the treads of bolts. TNT will form sensitive materials in the presence of alkalies.

## 3. Apparatus and Chemicals

**a. Glass and Hardware:**

i. 4 ml vials with screw top cap and teflon septa (waters wisp auto sampler vials).
ii. Vortex mixer, Scientific products Vortex-Genie, Model S3223.
iii. Ultrasonic bath, Bransson 3200.
iv. Filter assembly, Gelman Acrodisc CR 0.45 um
v. 5 ml syringe, Hamilton 10005TLL
vi. 250 µL syringe, Hamilton 7255NR
vii. 1000 µL syringe, Hamilton 1001LTN


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viii. Class A volumetric flasks 0 - 100, 15 and 50 ml
ix. Class A Volumetric pipettes 0.5, 1.0, 2.0, 5.0, and 10.0 mL.
x. Micro pipettes 50, 1000, and 200 µL.
xi. Balance, capable of weighing to 0.0001 gram

**b. Instrumentation:**

i. HPLC: Shimadzu model LC-6A high-pressure liquid
ii. Detector: Perkin-Elmer LC-75 variable wavelength ultraviolet absorbance detector (UV) set at 230 nanometers.
iii. Column: Supelcosil LC-18 octadecyldimethylsilyl, reverse-phase column, 25 centimeters (cm) length x 4.6 millimeters (mm) I.D., 5 micrometers (um) particle size (Supelco, Inc., Bellefonte, Pa).
iv. Mobile phase: 50% methanol: 50% water.
v. Flow Rate: 1.0 millitliters per minute (mL/min).
vi. Sample volume: 250 microliters (µL).

**c. Analytes:**

| Analyte | USATHAMA ABBEV. | CAS NUMBER |
|---|---|---|
| 1,3-Dinitrobenzene | 0.496 | 99-65-01 |
| 2,4-Dinitrotoluene | 0.424 | 121-14-2 |
| 2,6-Dinitrotoluene | 0.524 | 606-20-2 |
| HMX | 0.666 | 2691-41-0 |
| Nitrobenzene | 2.410 | 98-95-3 |
| Nitroglycerin | 4.00 | 53-63-0 |
| PETN | 4.00 | 75-11-5 |
| RDX | 0.587 | 121-84-4 |
| Tetryl | 0.731 | 479-45-8 |
| 1,3,5-Trinitrobenzene | 0.488 | 25377-32-6 |
| 2,4,6-Trinitrotoluene | 0.456 | 118-96-7 |

**d. Reagents and SARMS:**

i. The standards used for target compound certification and calibration is USATHAMA supplied standard analytical reference materials (SARMS). Equivalent standards may be used as long as they have been characterized according to Section 6.5.3. of the USATHAMA Quality Assurance Plan (2nd Edition, March, 1987). USATHEMA SARMS were used in this certification, and their lot numbers are listed below:


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| Analyte | SARM Lot Number |
|---|---|
| 1,3-Dinitrobenzene | 2250 |
| 2,4-Dinitrotoluene | 1147 |
| 2,6-Dinitrotoluene | 1148 |
| HMX | 1217 |
| Nitrobenzene | 2177 |
| Nitroglycerin | 1150 |
| PETN | 1151 |
| RDX | 1130 |
| Tetryl | 1149 |
| 1,3,5-Trinitrobenzene | 1153 |
| 2,4,6-Trinitrotoluene | 1129 |

ii. Methanol (HPLC grade - American Burdick & Jackson, McGaw Park, Illinois).
iii. Water (HPLC grade - American Burdick & Jackson, McGaw Park, Illinois).
iv. Acetonitrile (HPLC grade - American Burdick & Jackson, McGaw Park, Illinois).

**4. Calibration**

**a. Initial Calibration:**

**i. Preparation of Standards**

Precertification Calibration: Separate primary stock standards (SPSS) for each target analyte are prepared according to the dilution scheme presented in table 4-1. The SPSS solutions should be prepared fresh every two months. Tetryl needs to be made fresh every two weeks. Each separate stock solution is made to volume with acetonitrile. Two SARMS (nitroglycerin and PETN) are provided by USATHAMA as solution containing a total of 200 milligrams. The entire contents of he vial were used to prepare the respective primary stock standards. Aliquots of the separate primary stock standards (SPSS) are used to prepare the combined stock standard (CSS) by dilution to final volume of 50 mL using acetonitrile as described in Table 4-2. The CSS solutions should be prepared fresh week. All primary stocks and combined stocks should be stored in a freezer. For precertification calibration, duplicate composite calibration standards (CSS-1 through CSS-7) are prepared from the combined stock standard (CSS) as given in Tables 4-3 and 4-4. HPLC-grade water is used for dilution to final volumes for the composite calibration standards. Standards are prepared fresh daily.
Initial Calibration. Standards CSS-1, CSS-3, CSS-5, CSS-6, CSS-7, and a blank described in Tables 4-3 and 4-4 are prepared. These solutions are prepared fresh for every run.

**ii. Instruments Calibration**

To calibrate the instrument, 250 µL of each standard in Tables 4-3 and 4-4 is injected into the instrument in the same manner as a sample extract. Each duplicate composite


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calibration standard is analyzed during precertification calibration, and single dilutions of the composite standards are analyzed during initial calibration.

**iii. Independent Reference Standard**

An independent stock will be prepared to serve as a reference standard for explosives in soil. The independent reference standard must be analyzed along with the initial and precertification calibration standards,, and the results must be with +/- 25% of the expected value, for the calibration standards to be considered valid. If the analysis of the independent reference standard fails, the source of the problem must be identified and corrected. The results of the second analysis of the independent reference standard must be within the acceptable limits before the analysis of samples may proceed. Since a new initial calibration is performed daily, a reference, if available, is required at least weekly.

**iv. Analysis of Calibration Data**

After analyzing the standards (i.e., one blank and ten standards), the data are tabulated and graphed. For precertification calibration, the duplicate calibration data are analyzed using the lack of fit (LOF) and zero intercept (ZI) tests (USATHAMA QA Plan, 2nd Edition, march, 1987)

**b. Daily Calibration:**

i. The daily calibration standards are CSS-, CSS-3, CSS-5, CSS-6, CSS-7, and a blank as presented in Tables 4-3 and 4-4. These standards must be prepared fresh daily. The daily calibration curve used by ESE for this method is actually the same as an initial calibration curve as defined by the USATHAMA QA Plan, March 1987.

ii. Instrument Calibration:

At the beginning of each analytical run, inject 250 µL of each standard presented in Sec. IV.B.1, above. At the end of the analytical run, one standard CSS-1 will be analyzed.

iii. Analysis of Calibration Data:

The response for the target compounds does not have to be less than 25% different from the response obtained during the previous initial calibration, because each run is an initial calibration. Since reference solutions are not readily available, responses could be monitored to evaluate trends changes in stocks. It is advised that stocks for standards and spike solutions be staggered to ensure that degradation of the solutions is dissimilar. The response of the target compounds in the end run standard must be less than 25 % different from response factors obtained from the standard analyzed at the beginning of the day. If the response



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is greater than 25 % different, the standard will be reanalyzed. If reanalysis still fails the 25 % criterion, a new initial calibration must be performed and all analyses since the last acceptable calibration be repeated. After seven calibrations have been completed, the end of run response must agree to within two times the standard deviation of the mean response rather that a percentage. Failure of the tighter criteria will not be an automatic requirement for re-analyses if documentation exists to ensure that data quality of the samples is not affected by instrument drift (i.e. increase in sensitivity and all samples less than the CRL). In addition, drifts outside criteria and within a 25 % should be evaluated in the light of expected method performance.

**5. Certification Testing**

**a. Sampling Procedure:**

Samples will be collected using adequate dermal and inhalation protection and must follow Sections 5.6 and 5.7 of USATHAMA Quality Assurance Plan (March 1987)

**b. Containers:**

Amber colored glass jars with Teflon-lined lids are required.

**c. Holding Time Limits:**

Verification of the calibration standards is based on the analyses of daily QC spikes and analysis of independent reference standards (if available). Since stable reference solutions are not readily available, staggered preparation of stock solutions for control spikes and standards need to be implemented ensure acceptable solution verification. An unextracted control spike solution could be analyzed weekly as a check to avoid extraction and storage effects. The response of this check must be within 25% of the true value or +/- 2 standard deviations for recent performance (last 7 runs). If criteria cannot be met for the target compounds, new stock solutions must be prepared.

**6. Procedure**

**a. Sample Preparation:**

A portion of the sample is spread out on a sheet of aluminum foil and allowed to air dry overnight under a hood. The dried soil needs to be submitted for moisture determination.

**b. Sample Extraction:**

One dram of dried soil is weighed into a 4 ml vial and with a pipet 2.0 ml of acetonitrile is added. The sample is vortexed for 30 seconds and then placed in a sonicator for 2 hours. Following settling, a portion of the extract is removed with a dispo pipet and placed into a 5 mL syringe equipped with a 0.45 um acrodisc filter.


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The extract is filtered and collected into a 1 mL sample vial. The extract is stored in the dark at 4 degrees C until analysis. Prior to analysis, 100 µL of the extract is mixed with 700 µL of water directly in the auto sampler vial.

**c. Chemical Reactions:**

This method does not involve any chemical reactions.

**d. Instrumental Analysis:**

Instrumental analysis involves injection of 250 µL of the diluted extract onto the analytical column described in Section III.B. The instrumental conditions are specified in Section III.b.3, and the integrated output of the UV detector is used in the calculations of Section VIII.

**7. Calculations**

A linear regression equation is calculated from calibration data by using the response versus the concentration for each compound. The concentration of a target compound in the soil extract is calculated by substituting the response into the calibration curve equation. The following formula is then used to calculate the concentration (µg/g) of each compound in the soil.

$$C = EC \times EV \times (DV + EAV/EAV)/SE$$

Where: EC is the extract concentration from the standard curve in µg/mL

EV is the extraction volume (2 mL)

DV is the dilution volume (700 µL).

EAV is the extract aliquot volume (100 µL), and SW is the soil sample weight in gm (1 gm).

**8. Daily Quality Control**

**a. Control Samples:**

Daily quality control samples consist of a standard matrix method blank (USATHAMA Standard soil), duplicate spikes at the upper concentration of the certified range, and a single spike at approximately twice the certified reporting limit. These quality control samples should be carried throughout the entire method at the same time samples are run. Separate stock solutions for the daily control spike samples are prepared in the same manner as for the calibration stock solutions (see Section IV.A.1 and Tables 4-1). The spiking combined stock solution made up as described in Table 4-7 and is used as spiking solution A, (see Table 4-8).



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**b. Daily Spiking Scheme**

Daily spiking should be performed into USATHAMA standard soil using spiking solution AQ (Table 4-7). The spiking scheme presented in Table 4.8 should be used. Control analytes for this method are RDX, NB, TNB, 2,4-DNT, NG and PETN.

**c. Control Charts:**

Control charts are prepared for all of the control analytes being analyzed for using the percent recovery data from both the duplicate high level spikes and the low level spikes calculated according to the following equation:

$$\% \text{ Recovery} = \frac{\text{Found Conc.}}{\text{Spiked Concentration}} \times 100\ \%$$

The found response is corrected for method blank response prior to calculation of the found concentration. Method blank correction may be in terms of instrument response of in terms of the concentration in the blank.

Preparation of control charts requires the following data:

i. Average percent recovery (X) of the two high concentration spike QC samples in each lot.
ii. Difference (R) between the two high concentration spiked QC samples in each lot.
iii. Three-point moving average difference (R) control chart for the low level spike in each lot and
iv. Three-point moving average difference (R) control chart for the high concentration spike.

For values that fall outside the control limits and data points that are deemed as outliers, the data will be evaluated and corrective action will be taken.

## 9. References

U.S. Army Toxic and Hazardous Materials Agency, 1987, USATHAMA QA Program (December 1985, 2nd Ed., March 1987)

## 10. Data

a. Off The Shelf Analytical Reference Materials Characterization
Only SARMS were used in this certification.


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b. Initial/Precertification Calibration – See Attachment #1
   Response of each target analyte is tabulated at each calibration target concentration. The results from the lack of fit (LOF) and zero intercept (ZI) tests are presented.

c. Daily Calibration During Certification
   Calibration responses and required percentage on the end-run standard.

d. Standard Certification Samples

e. Chromatogram


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**Table 4-1. Preparation of Separate Primary Stock Standards (SPSS)**

| ANALYTE | 13DNB | 24DNT | 26DNT | HMX | NB | NG | PETN | RDX | TETRYL | 135TNB | 246TNT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mg SARM added | 12.4 | 10.6 | 13.1 | 41.6 | 13.7 | 200 | 200 | 109.5 | 10.1 | 12.2 | 11.4 |
| Final Volume (ml) | 10.0 | 10.0 | 10.0 | 25 | 10.0 | 50.0 | 50.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Conc. SPSS (µg/mL) | 1,240 | 1,060 | 1,310 | 1,664 | 1,370 | 4,000 | 4,000 | 1,095 | 1,010 | 1,220 | 1,140 |

Note: Each SARM diluted to the volume indicated with acetonitrile.

Source: ESE, 1988

**Table 4-2. Preparation of Composite Stock Standards (CSS)**

| **ANALYTE** | **13DNB** | **24DNT** | **26DNT** | **HMX** | **NB** | **NG** | **PETN** | **RDX** | **TETRYL** | **135TNB** | **246TNT** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mL SPSS added | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 2.5 | 2.5 | 1.0 | 1.0 | 1.0 | 1.0 |
| Final Volume (ml) | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Conc. SPSS (µg/mL) | 24.8 | 21.2 | 26.2 | 33.82 | 27.4 | 200.0 | 200.0 | 21.9 | 20.2 | 24.4 | 22.9 |

Note: Acetonitrile used for dilution to the 50 mL final volume for the Composite Stock Standard (CSS) Source: ESE, 1988


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**Table 4-3. Preparation of Calibration Standards 1 through 4 (CSS-1 through CSS-4)**

| ANALYTE | 13DNB | 24DNT | 26DNT | HMX | NB | NG | PETN | RDX | TETRYL | 135TNB | 246TNT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Conc. in CSS-1 (µg/mL) | 2.480 | 2.120 | 2.620 | 3.330 | 2.740 | 20 | 20 | 2.19 | 2.01 | 2.44 | 2.28 |
| Conc. in CSS-2 (µg/mL) | 0.992 | 0.848 | 1.048 | 1.330 | 1.096 | 8.00 | 8.00 | 0.876 | 0.808 | 0.976 | 0.912 |
| Conc. in CSS-3 (µg/mL) | 0.496 | 0.424 | 0.524 | 0.666 | 0.548 | 4.000 | 4.000 | 0.438 | 0.404 | 0.488 | 0.456 |
| Conc. in CSS-4 (µg/mL) | 0.248 | 0.212 | 0.262 | 0.333 | 0.274 | 2.000 | 2.000 | 0.219 | 0.202 | 0.244 | 0.228 |

Note: CSS-1 prepared by diluting 5.0 mL of CSS to 50 mL with HPLC-grade water.

CSS-2 prepared by diluting 2.0 mL of CSS to 50 mL with HPLC-grade water.

CSS-3 prepared by diluting 1.0 mL of CSS to 50 mL with HPLC-grade water.

CSS-4 prepared by diluting 0.5 mL of CSS to 50 mL with HPLC-grade water.

Source: ESE, 1988



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**Table 4-4 Preparation of Calibration Standards 1 through 4 (CSS-5 through CSS-7)**

| ANALYTE | 13DNB | 24DNT | 26DNT | HMX | NB | NG | PETN | RDX | TETRYL | 135TNB | 246TNT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Conc. in CSS-5 (µg/mL) | 0.9920 | 0.0848 | 0.1048 | 0.1330 | 0.1096 | 0.8000 | 0.8000 | 0.0876 | 0.0876 | 0.0976 | 0.0912 |
| Conc. in CSS-6 (µg/mL) | 0.0496 | 0.0424 | 0.0520 | 0.0666 | 0.0548 | 0.4000 | 0.4000 | 0.0438 | 0.0404 | 0.0488 | 0.0456 |
| Conc. in CSS-7 (µg/mL) | 0.0248 | 0.0212 | 0.0262 | 0.0333 | 0.0274 | 0.2000 | 0.2000 | 0.0129 | 0.2020 | 0.0244 | 0.0228 |

Note: CSS-5 prepared by diluting 2.0 mL of CSS to 50 mL with HPLC-grade water.

CSS-6 prepared by diluting 0.1 mL of CSS to 50 mL with HPLC-grade water.

CSS-7 prepared by diluting 0.5 mL of CSS to 50 mL with HPLC-grade water.

Source: ESE, 1988



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**Table 4-5 Spiking Solutions for Soil Validation Concentration mg/mL:**

| SPIKING SOLUTION | HMX | RDX | TNB | DNB | TETRYL | NB | NG | TNT | 26DNT | 24DNT | PETN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 33.30 | 21.90 | 24.40 | 24.80 | 20.20 | 27.40 | 200.00 | 22.80 | 26.20 | 21.20 | 200.00 |
| B | 6.66 | 4.38 | 4.88 | 4.96 | 4.04 | 5.48 | 40.00 | 4.56 | 5.24 | 4.24 | 40.00 |

**Table 4-6 Spiking Scheme for Soil Validation (µg/g).**

| Level | Spike Vol. | Spike Sol. | Weight Soil | HMX | RDX | TNB | DNB | TETRYL | NB | NG | TNT | 26DNT | 24DNT | PETN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/2 x | .05 mL | B | 1 g | 0.333 | 0.219 | 0.244 | 0.248 | 0.202 | 0.274 | 2.000 | 0.228 | 0.262 | 0.212 | 2.000 |
| 1 x | .10 mL | B | 1 g | 0.666 | 0.438 | 0.488 | 0.496 | 0.404 | 0.548 | 4.000 | 0.456 | 0.524 | 0.424 | 4.000 |
| 2 x | .20 mL | B | 1 g | .1.33 | 0.876 | 0.976 | 0.992 | 0.808 | 1.100 | 8.000 | 0.912 | 1.050 | 0.848 | 8.000 |
| 5 x | .50 mL | B | 1 g | 3.33 | 2.19 | 2.44 | 2.48 | 2.02 | 2.74 | 20.00 | 2.28 | 2.62 | 2.12 | 20.00 |
| 20 x | .20 mL | A | 1 g | 6.66 | 4.38 | 4.88 | 4.96 | 4.04 | 5.48 | 40.00 | 4.56 | 5.24 | 4.24 | 40.00 |
| 40 x | .40 mL | A | 1 g | 13.30 | 8.76 | 9.76 | 9.92 | 8.08 | 11.00 | 80.00 | 9.12 | 10.50 | 8.48 | 80.80 |
| 100 x | 1.0 mL | A | 1 g | 33.30 | 21.90 | 24.40 | 24.80 | 20.20 | 27.40 | 200.00 | 22.80 | 26.20 | 21.20 | 200.00 |


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**Table 4-7 Preparation of Combined Stock Standards (SCSS)**

| ANALYTE | 13DNB | 24DNT | 26DNT | HMX | NB | NG | PETN | RDX | TETRYL | 135TNB | 246TNT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mL SPSS added | 1.0 | 1.0 | 1.0 | 1.0 | 2.0 | 2.5 | 2.5 | 1.0 | 1.0 | 1.0 | 1.0 |
| Final Volume (ml) | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Conc. of SPSS (µg/mL) | 24.80 | 21.20 | 26.20 | 33.28 | 27.40 | 200.00 | 200.00 | 21.90 | 20.20 | 24.40 | 22.90 |

Note: Acetonitrile used for dilution to the 50 mL final volume for the Spike composite Stock Standard (SCSS)

Source: ESE, 1988

**Table 4-8 Daily Spiking Scheme**

| ml of Spiking Solution A used | gm of USATHAMA Std. Soil | HMX | RDX | TNB | DNB | TETRYL | NB | NG | TNT | 26DNT | 24DNT | PETN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blank 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Low Level 0.05 | 1 | 1.64 | 1.10 | 1.22 | 1.24 | 1.01 | 2.74 | 10.00 | 1.14 | 1.31 | 1.06 | 10.00 |
| High Level 0.4 | 1 | 13.30 | 8.76 | 9.76 | 9.92 | 8.08 | 22.00 | 80.00 | 9.12 | 10.50 | 8.48 | 80.00 |


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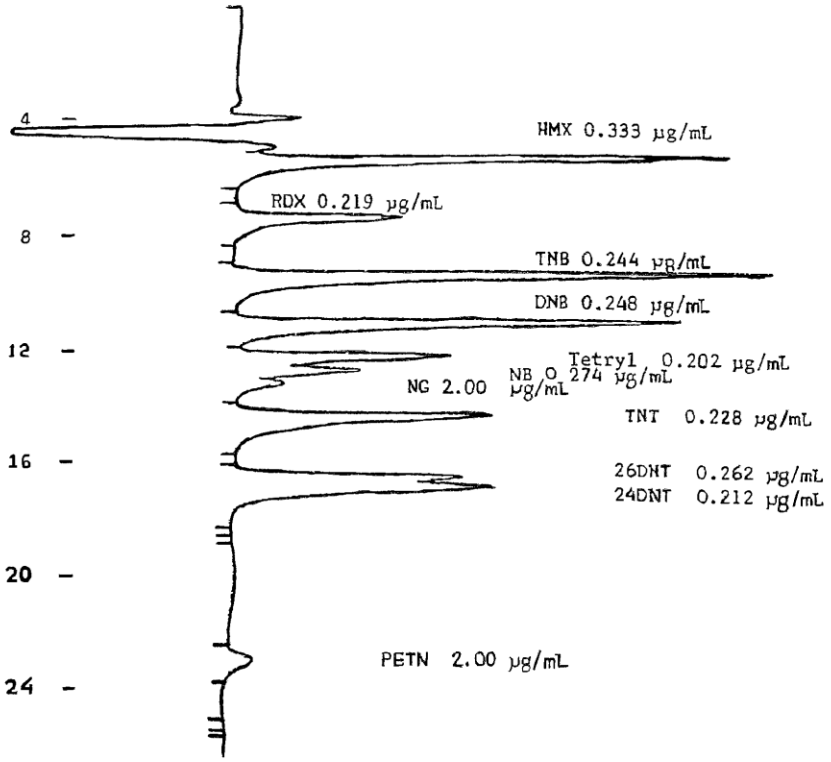
CHROMATOGRAM OF EXPLOSIVES IN SOIL



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# I.6 METHOD 6 - Beilstein Test for the Presence of Halogens

**APPLICATION**:

Remove a small sliver of the skid or box or carefully scrape some shavings from a clean surface of the skid or box. Catch the shavings on a clean piece of paper. Take a piece of fine mesh copper or a bronze screen about 3" by 2" and heat in the laboratory burner flame until no green color is imparted to the flame. Carefully place either the small sliver of the shaving in the center of the screen and fold pressing firmly to clamp the test material. Insert in the flame. If the pentachlorophenol is present, a green flame will be noticed: its duration varies according to the concentration of the preservative present. Continue heating until the flame is again colorless and repeat.


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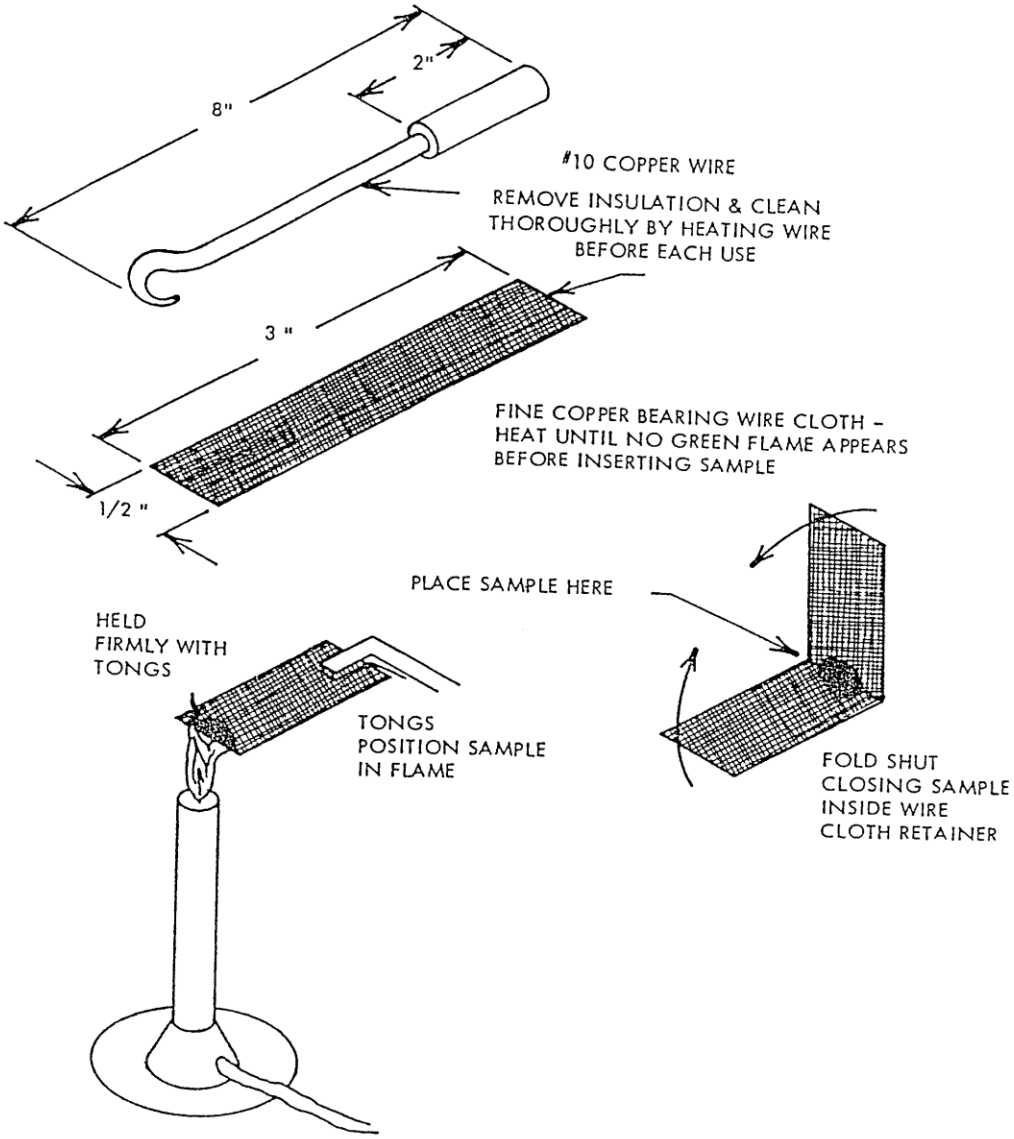
METHODS OF USING THE BEILSTEIN TEST





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# J SECTION J - SUMMARY

## J.1 Summary of Waste Streams

**103 and 108 Areas**

Waste paint – D007, D008, D001

Paint sludges – D007, D008, D001

Waste paint related materials – F005, D001

Waste solvents – D001

Grit blasting residues – D007, D008

Solid waste contaminated with explosives – D003

Water contaminated with explosives – D030

Solids/sludges contaminated with RCRA metals – D007, D008

Wood/residue contaminated with Pentachlorophenol – D037

Spent/used aerosol cans – D003

**Old Bomb Area**

Ash/residue from burning PEP material – D007, D008, D030, D003

Ash/residue from burning PEP contaminated material – D007, D008, D030, D003

Soil contaminated from burning operations – D007, D008, D030, D003

Spent/used aerosol cans – D003

**New Bomb Area**

Residues from detonation – D007, D008, D030

Residues from burning items – D007, D008, D030

Soil contaminated from detonation operations – D007, D008, D030

Spent/used aerosol cans – D003

**117 Area (WADF)**

Waste paints – D007, D008, D001

Waste paint related materials – F005, D001

Waste solvents – D001


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Baghouse – Demil ash – D005, D007, D008, D030

Solid waste contaminated with explosives – D003, K044

Solid/sludge's contaminated with RCRA metals – D007, D008

Wood/residue contaminated with Pentachlorophenol – D037

Laboratory waste – various EPA waste codes

Slag from PODS – D004 through D008

Particulate from PODS secondary combustion chamber and baghouse – D004 through D008

Sludge from PODS water treatment system – D004 through D008

Spent/used aerosol cans – D003

**104 NUWES Area**

Water contaminated with RCRA metals – D006, D007

Waste acids – D002, D008

Waste paints – D007, D008

Waste solvents – D001

Waste paint related materials – D001, D007, and D008

Waste adhesives – D001

Waste resin mixtures – D001

Grit blasting residues – D007, D008

Solid wastes including used/spent/obsolete batteries contaminated with RCRA metals – D006, D007, D009, D010, and D012

Waste oils – F-listed solvents

Spent/used aerosol cans – D003

**Miscellaneous Areas**

Waste paints – D001, D007, and D008

Waste paints related material – D001, D007, D008

Waste solvents – D001

Waste oil – F-listed solvents

Battery washwater – D006, D008, D002

Spent/used aerosol cans – D003


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## J.2 Sample Collection Summary

| Waste | Container | Minimum Amount |
|---|---|---|
| Waste/Paint/Sludges | Glass | 1 Liter |
| Organic solvents | Glass | 1 Liter |
| Solids for TCLP | Glass or Polyethylene/Plastic Bag | 200 Grams |
| Aqueous Liquids | Glass or Polyethylene/Plastic Bag | 1 Liter |
| Battery Acid/Corrosive liquids | Glass | 1 Liter |
| Solids for explosives | Glass | 100 Grams |
| Liquids for explosives | Glass | 1 Liter |
| Wood | Glass, Polyethylene/Plastic Bag | 200 Grams |
| Rags | Plastic Bag | 1 Kilogram |
| Carbon for explosives | Glass | 100 Grams |
| Sludges for explosives | Glass | 100 Grams |
| Used oils | Glass or Plastic | 250 ml |

Sample, labeling and record keeping – Sample labels will be placed on all containers at the time the sample is collected. Sample labels will be filled out with waterproof ink and will include the following information: Sample identification, sampling date, sample locations and analysis to be performed. Upon completion of sample collection activities a chain of custody (COC) form will be completed by the sampling team member. This form will serve as the official record of sample collection. A sample collection log for each sample will also be completed. Chemical analytical results will be filed with the COC forms.

## J.3 General Land Disposal Information

**A. Waste Solvents – D001**

Ignitable liquids subcategory >=10% TOC non-wastewater only

Treatment Standard - No Concentration based standard
CMBST - High temperature organic destruction technologies
POLYM – Polymerization of monomers into the formulation
RORGS – Recovery of organics


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**B. Waste Corrosives – D002**

Non-wastewaters

Treatment Standard - No Concentration based standard

DEACT – Deactivation to remove the hazardous characteristic

**C. Waste Explosives – D003**

Explosives subcategory for non-wastewaters

Treatment Standard – No concentrations based standard

DEACT – Deactivation to remove the hazardous characteristic

**D. Barium Contaminated Wastes – D005**

Based on TCLP for non-wastewaters

Concentration based treatment standard = 21.0 mg/L and meet Universal Treatment Standard for Underlying Hazardous Constituents

**E. Cadmium Contaminated Wastes – D006**

Based on TCLP for non-wastewaters

Concentration based treatment standard = 0.11 mg/L and meet Universal Treatment Standard for Underlying Hazardous Constituents

**F. Chromium Contaminated Wastes – D007**

Based on TCLP for non-wastewaters

Concentration based treatment standard = 0.6 mg/L and meet Universal Treatment Standard for Underlying Hazardous Constituents

**G. Lead Contaminated Waste – D008**

Based on TCLP for non-wastewaters

Concentration based treatment standard = 0.75 mg/L and meet Universal Treatment Standard for Underlying Hazardous Constituents

**H. Solvents – F Listed**

Non-wastewaters

Concentration based treatment standard

a. Acetone – F003 - 160 mg/kg
b. Toluene – F003 - 10 mg/kg
c. Trichloroethylene – F001, F002 - 6.0 mg/kg
d. 1,1,1-Trichoroethane – F001, F002 - 6.0 mg/kg
e. Methyl isobutyl ketone – F003 - 33 mg/kg
f. Xylene – F003 - 30 mg/kg



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**I. Solvents – Wastes**

Wastewater

Concentration based treatment standard

a. Acetone – F003 – 0.28 mg/L
b. Toluene – F003 – 0.08 mg/L
c. Trichloroethylene – F001, F002 – 0.054 mg/L
d. 1,1,1-Trichoroethane – F001, F002 – 0.054 mg/L
e. Methyl isobutyl ketone – F003 – 0.14 mg/L
f. Xylene – F003 – 0.32 mg/L

**J. Explosive Treatment Waste – K044, K047, K045 and possibly D003**

Non-wastewaters

Treatment Standard

DEACT – deactivation to remove the hazardous characteristic

D003 - Reactive Treatment Standard – DEACT and meet Universal Treatment Standard for Underlying Hazardous Constituents

**K. Wood with Pentachlorophenol (PCP) – D037**

Based on TCLP for non-wastewaters

Treatment Standard concentration based = 7.4 mg/kg and meet Universal Treatment Standard for Underlying Hazardous Constituents

**L. 2,4-Dinitrotoluene Contaminated Waste – D030**

Based on TCLP for non-wastewaters

Treatment Standard concentration based = 140 mg/kg and meet Universal Treatment Standard for Underlying Hazardous Constituents



Check the permit to verify this is the correct revision before use. All downloaded/copied docs are considered uncontrolled.

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX C

Main Base
Revision 003
06/21/12

# HAZARDOUS MATERIALS/WASTES CONTINGENCY PLAN

## Hawthorne Army Depot Main Base

SOC Environmental Services

# PREFACE

The HWAD Hazardous Materials/Waste Contingency Plan has been written as required by both Army and US Environmental Protection Agency regulations. This Plan meets the requirements of the Resource Conservation and Recovery Act (40 CFR Parts 261 through 270) for a Hazardous Waste Contingency Plan. This plan establishes procedures for the prevention of and the response to fires, explosions, and discharges involving hazardous materials, hazardous wastes. It also defines the responsibilities of HWAD employees in controlling these emergencies should they occur. It is the responsibility of each Director/Manager/Special Staff Officer to familiarize themselves and their subordinates with this plan and its implementation.

KIRK BAUSMAN
Deputy to the Commander
Hawthorne Army Depot

And

GORGE R. GRAM
General Manager
SOC NEVADA LLC

# CERTIFICATION

I hereby certify, under penalty of law, that this Hazardous Waste Hazardous Materials Contingency Plan was prepared under my direction or supervision in accordance with the requirements of the Resource Conservation and Recovery Act (40 CFR 261 through 270) for the establishment of procedures for the prevention of and the response to fires, explosions, and discharges involving hazardous material, hazardous wastes. It describes the responsibilities of employees involved in such responses and that I am the responsible person to assure the implementation of the provisions of this plan at Hawthorne Army Depot (HWAD).

KIRK BAUSMAN
Deputy to the Commander
Hawthorne Army Depot

20120625
Date

GEORGE GRAM
General Manager
SOC NEVADA LLC

6/25/12
Date

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# 1 GENERAL INFORMATION

## 1.1 Introduction

Hawthorne Army Depot (HWAD) supports the major military services (Army, Air Force, Marines, and Navy) with facilities to receive, store, and issue ammunition and explosive ordnance items. HWAD also has responsibility to renovate, recover, or dispose of unserviceable ammunition and explosives (demilitarization). During these operations HWAD generates a number of wastes containing hazardous materials, many or all of which are subject to spillage during generation, handling, storage, treatment, and disposal. HWAD also uses large quantities of POL (petroleum, oil and lubricant) products as fuels and lubricants as well as other types of hazardous materials such as solvents and pesticides in support of the Depot mission. This plan describes the emergency organization and anticipated response to spills, fires, explosions, or other emergencies involving these materials. This plan has been prepared in accordance with the regulations described in 40 CFR Subpart D of Part 264. It is a stand-alone document and intended to be used by plant personnel in conjunction with the HWAD Disaster Control, HWAD Emergency Response Plan, HWAD Spill Prevention Control and Countermeasures Plan (SPCCP), and other applicable plans for all emergencies involving hazardous materials, hazardous wastes, and POL products.

## 1.2 HWAD Mission

HWAD is a Government Owned, Contractor Operated (GOCO) by SOC Nevada, LLC (SOC) military industrial installation under the jurisdiction of headquarters, U. S. Army Joint Munitions Command (JMC), and is assigned the responsibility for the receipt, issue, storage, maintenance, and demilitarization of munitions, and components both explosive loaded and inert. HWAD normally employs one active duty person as Commanding Officer and 550 primary contractor personnel.

The HWAD's primary mission is to provide ammunition to the war fighter when and where needed. Incidental to HWAD's primary mission includes the capability to: receive, assemble, load and pack, issue, store, renovate, inspect, test, demilitarize, and R-3 (Recover, Recycle, Reclaim) and component reutilize conventional ammunition; thermally treat reactive conventional munitions, propellants and explosives; conduct special research and development (R&D) of high explosive casting, extruding and pressing, and support services to designated research and development activities; provide storage of National Stockpile and Industrial Reserve material for mercury, act as principal storage facility for war reserve ammunition and maintain designated ammunition in a state of readiness for mobilization including assembling or otherwise providing base unit materials; and conduct testing of high explosive warheads, mechanical and electronic fuses, cartridge cases, primers, rocket motors, and other ballistic devices.

## 1.3 Facility Description

The Depot is located in the central western edge of Nevada. It nearly surrounds the town of Hawthorne and is at the southeastern end of Walker Lake. The installation encloses an area of approximately 147,236 acres. HWAD operates and/or maintains 2605 buildings with 2302 utilized for storage, 17 maintenance buildings, 61 process or production buildings, 16 office buildings, 263 other miscellaneous use or vacant unused buildings, and 96 family housing units. HWAD operates and maintains 575 miles of roads and approximately 500 vehicles. HWAD utilizes its own watershed with three reservoirs, three wells, as well as, operates and maintains its own potable water disinfection system, culinary water system, and sewage water system and treatment plants. HWAD operates extensive property, equipment, and facilities, maintenance organizations. HWAD's mission facilities and personnel are supported by personnel specialized in the areas of Safety, Environmental, Finance, Procurement, Information Services, Security, Office Systems, Clinic, and other specialties. More importantly, for the purposes of this plan, HWAD operates and maintains its own full time (365 days per year at 24 hours per day) Fire and Emergency Services (FES) with approximately twenty-three FES personnel who are also Emergency Response Team (ERT) personnel. The primary and designated alternate Emergency Response Coordinators (ERC) are the FES Chief, FES Assistant Chiefs, Captains, and Inspector, one of whom is on duty at all times. A list of trained, designated ERC and ERT personnel is revised and reissued minimally every six months or whenever a change occurs for designated ERCs (whichever is more frequent). All HWAD's specialized personnel and/or resources are available to the ERC through the General Manager during an emergency or upon the implementation of this plan. HWAD is essentially self-sufficient in such matters. Two major highways trisect the Depot for access into the town of Hawthorne. U. S. Highway 95 for East and North access and State Highway 359 for South and Western access.

An Army owned Railroad enters the Depot along the northeastern boundary and provides rail service to the facility. The storage areas at the Depot are located on generally flat ground, sloping gently southeast to northwest into Walker Lake. The Mount Grant Watershed, located on the western portion of the Depot, generates several creeks that if not captured for the Depots water supply would drain into Walker Lake.

## 1.4 Description of Hazardous Waste Facilities

Environmental excursions involving hazardous wastes may occur from generation sites, processing and treatment facilities, storage and disposal sites, and transportation routes. Additional detail on the products and waste streams associated with each facility are provided in Table 1 and 2.

## 1.5 Hazardous Materials Facilities

Most facilities at HWAD contain hazardous materials of one type or another. Therefore, no attempt will be made here to describe the contents of each facility. It is incumbent on the supervisors of each facility where hazardous materials are used to insure that all personnel at that facility are aware of the hazards of the materials they are working with and the procedures to be followed in the event of an emergency. . The FES, has in its files, a list of every building that contains or uses hazardous material.

## 1.6 Definitions and Acronyms

Please see Appendix I.

# TABLE 1 -Primary Hazardous Waste Generation Sites

| Location | Map Ref.* | Function | Material Handled | Waste Streams | Normal Waste Stream Capacity/Flow |
|---|---|---|---|---|---|
| Old Bomb Disposal Area | I | Open Burning | Propellants Smokeless powder | Ash/Soil with metals and/or explosives | 200 lbs/day |
| Dock 3 | M | Munitions renovation, 90 day storage site | Munition items | Paints, solvents, aerosol cans, solvent contaminated rags | 1,000 lbs/wk |
| 11, 26, 63, 64, Industrial Area & 102-52 | K | Equipment and facilities maintenance | Equipment Facilities | POL, solvents, paints, battery electrolyte | -- |
| 49-9 | H | Material renovation/ breakdown 90 day storage site | Mine materials | Mercury debris, cadmium, paints, thinners, aerosol cans, hazardous waste liquids | 10,000 gal/yr |
| 103-5 and 103-16 | | Material renovation/ breakdown, | Munition items | Reactive or explosive contaminated wastes | 23,000 lbs/day |
| 104-5 | D | Material renovation/ breakdown, battery retort | Mine material and batteries | Battery electrolyte, paints, thinners, adhesives, mercury, cadmium, aerosol cans, hazardous waste liquids | 10,000 gal/yr |
| 108-20 | E | Material renovation/ breakdown, 90 day storage site | Munition items | Reactive or explosive contaminated wastes | 23,000 lbs/day |
| 117-2 WADF | A | Thermal treatment of pyrotechnics, smokes, etc. | Munition Items | Sludge from air pollution abatement system. | 10,000 lbs/yr |
| 117-3 WADF RF-9 & FF-13 | A | Detonating items furnace, tray flashing furnace, 90 day storage site | Small fired ammunition | Scrap metal, bag-house dust | 1200 lbs/day |
| 117-5 WADF | A | Explosive refining material, Reclamation, 90 day storage site | Munition items | Explosive contaminated water, rags, & PPE | 8,000 gal/day |
| 117-6 WADF | A | Steam-out, washout, 90 day storage site | Munition items | Explosive contaminated water, rags, & PPE | 5,000 gal/day |
| 117-7 WADF | A | Process water treatment facility, 90 day storage site | Process wastewater | Spent carbon | 30,000 lbs/yr |
| 117-9 WADF | A | Material breakdown, 90 day storage site | Munition items | Reactive or explosive contaminated wastes | 30,000 lbs/yr |

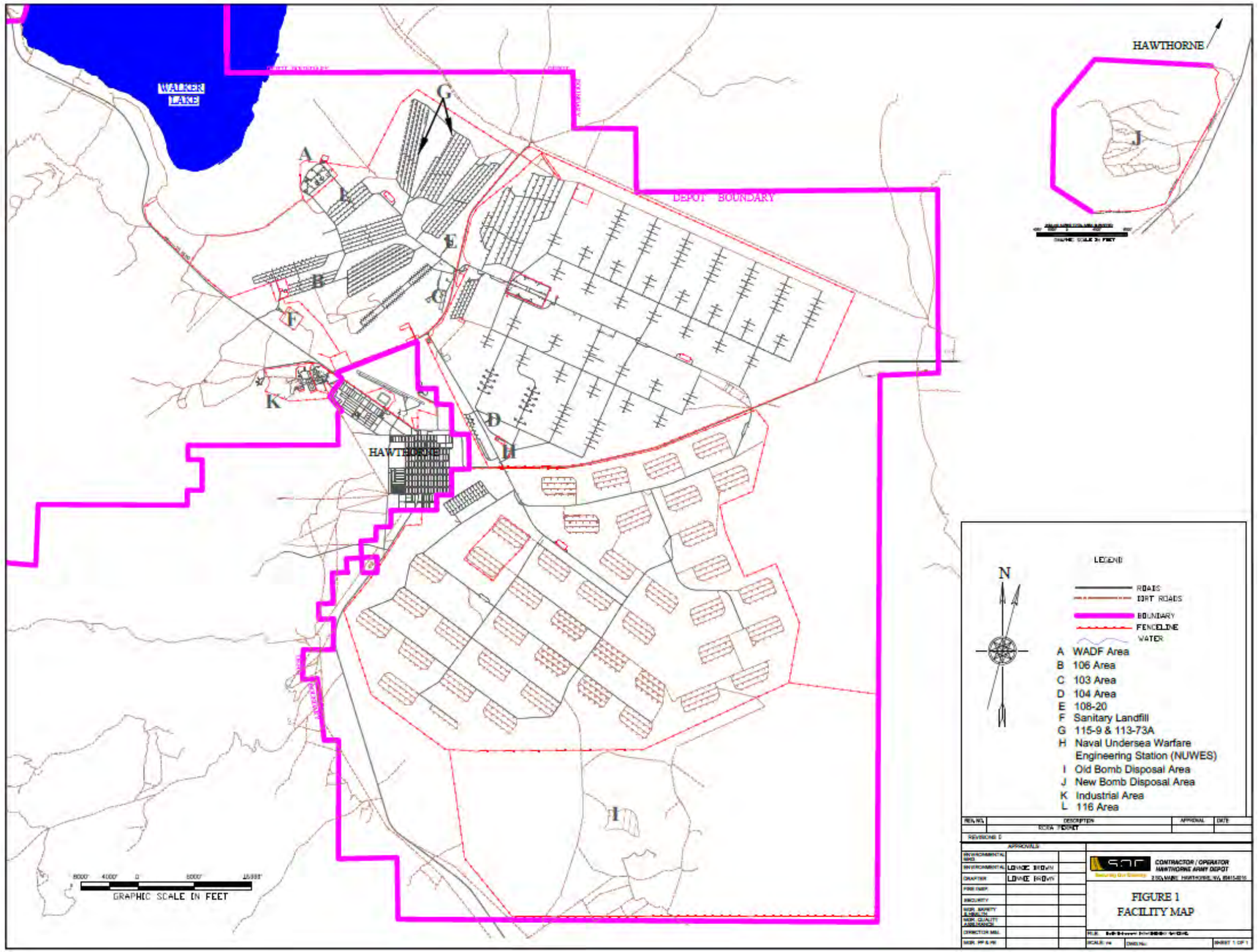
*Map reference is found in the legend on the Facility Map, Figure 1.

# TABLE 2 - Primary Hazardous Waste Storage Sites

| Location | Map Ref.* | Function | Waste Stream Materials Handled | Normal Waste Stream Capacity |
|---|---|---|---|---|
| 106-22 | B | Container storage | Incinerator and open burn ash, Corrosives, Pesticides, Oxidizers | 1,620 drums |
| 106-23 | B | Container storage | Waste organics, PCB's | 1,344 drums |
| Triple Arch<br>116-37<br>116-38<br>116-39<br>116-41<br>116-42<br>116-43<br>116-44<br>116-45 | L | Storage | Waste munitions | 96 Pallets,<br>4,000 lbs/pallet,<br>125,000 lbs (NEW) Net<br>Explosive Weight,<br>384 55-gal drums/arch |
| 113-73A | G | Container storage | Reactive or explosive contaminated wastes | 384 drums |
| 115-9 | G | Container storage | Reactive or explosive contaminated wastes | 624 drums |

*Map reference is found in the legend on the Facility Map, Figure 1.

**FIGURE 1**
**Facility Map**



# 2 EMERGENCY RESPONSE ORGANIZATION: 264.52(d), 264.55

The HWAD Emergency Response Organization described in this section will be staffed by facility personnel and activated by the Emergency Response Coordinator (ERC) in the event of a hazardous materials incident. The purpose of the organization is to provide qualified personnel to conduct an accurate assessment of the threat posed by an incident, alert the appropriate authorities, and implement response actions to minimize the effects of the incident. The response actions to be taken are described in Section 4.

The overall direction of the Emergency Response Organization and response procedures will be provided by the ERC. In the event of a hazardous materials or waste incident, the ERC will establish an Emergency Operations Center (EOC) at a safe distance from the incident and conduct the response from there. The emergency response procedures will be carried out by the Emergency Response Team (ERT), in accordance with the Emergency Response Plan (ERP), and other applicable documents. [Note that this plan (Installation Contingency Plan (ISCP)) has been incorporated into the ERP as permitted by 29 CFR 1910.120(p)(8) and this plan may incorporate other existing documents in its implementation.] The responsibilities of the ERC, ERT, and advisory personnel at HWAD are described below. HWAD operates and maintains its own full time (365 days per year, 24 hours per day) Fire and Emergency Service (FES) with approximately twenty-three FES personnel (except for clerical staff), all of whom are members of the ERT. There are not fewer than seven FES ERT members on duty 365 days per year, 24 hours per day (in accordance with 40 CFR 264.55) including the designated primary and/or alternate ERC (refer to Appendix J).

The FES ERT members are augmented with non-FES ERT members. All ERT members are trained and certified in accordance with the requirements of 29 CFR 1910.120 for “Hazardous Waste Operations and Emergency Response”.

All HWAD specialized staff are available to the ERC upon request as internal resources through the General Manager. The specialized staff may consist of but is not limited to specialists from the various Directorates consisting of Area Supervisors, Safety Specialists, Health Specialists, Security Specialists, Environmental Specialists, Equipment and Property Management Specialists, Facilities Management Specialists, Procurement Specialists, and Financial Management Specialists. Examples of their duties are described in items 2d through 2k of this plan.

In addition to the internal specialized personnel, there are vast equipment type resources available internally (40 CFR 264.52(e)) to the ERC upon request (see Table

6). These equipment type resources are in addition to the dedicated emergency response equipment (which contains, but is not limited to those items listed in Appendix B) and personnel of the ERT and FES. In accordance with 264.52(d) the designated primary and alternate ERCs names; position and order of designation; and home and office locations phone numbers are contained in Appendix J.

SOC maintains an internal resource organizational chart listing HWAD's advisory personnel, positions, and office phone numbers. This chart is immediately available to the ERC and provides immediate availability to and coordination with internal resources for assistance through the General Manger.

External resources are available to the ERC, upon request, through the SOC General Manager. These external resources are listed in Table 4. The Depot Commander will provide additional external resources as appropriate, such as the Federal Bureau of Investigations (FBI).

This plan and the information contained in it, including: Organization Charts; Figure 2, Emergency Response Organization; Appendix J, Emergency Response Coordinators; and Table 4, Government and Outside Services Notification are available at GOC, FES, ERC, and the Shack at Old Bomb, as well as various other locations throughout HWAD.

## 2.1 Emergency Response Coordinator

The ERC is the HWAD representative having overall responsibility for implementing the Contingency Plan and associated response activities. The primary designate for this position is the SOC Fire Chief, while the designated alternates are the on duty Fire Assistant Chiefs, Captains, and Inspector (listed in Table 2), one of whom is on duty at all times. The ERC will coordinate the response activities with the SOC General Manager. The ERC will assess the severity of the hazard presented by the incident and determine the required response. The ERC alternate will have the authority in coordination with the SOC General Manager to commit all HWAD resources necessary to adequately implement response actions. In the event of a hazardous waste incident, major fire, or threat of an off-site excursion of a hazardous waste, the ERC will direct the ERT and coordinate with other HWAD specialized personnel and/or resources available internally at HWAD through the SOC General Manager. External resources are available to the ERC, upon request, from local, state and federal agencies as specified but not limited to those on Table 4.

The ERC will ensure that specified indoctrination and training programs are carried out in coordination with the Training Section of the Human Resources Office in accordance with the Master Training Plan.

Additional duties/responsibilities for the ERC are summarized as follows:

- Maintain contact with the General Manager and, with the General Manager's approval, request assistance from non-HWAD emergency services and coordinate their actions.
- Notify SOC Safety Specialist and Environmental Personnel, who will in turn notify the appropriate Army (Administrative Contracting Officer- ACO) Representatives and the appropriate non-HWAD agencies.
- Mobilize the Installation Response Team and direct their actions at the spill scene.
- With assistance from other installation departments, assess possible hazards, both direct and indirect, to human health and the environment and evacuate all danger areas.
- Identify the character, source, quantity, and area extent of any released materials and determine the proper course of action.
- Monitor for leaks, pressure build-up, ruptures, etc., in facility equipment if operations are stopped in response to an emergency.
- Take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, reoccur, or spread at the facility.
- Maintain a list of personnel, equipment, and supplies available for implementation of the Contingency Plan.
- In the absence of an actual emergency requiring implementation of this plan, conduct, at minimum, an annual exercise to test the effectiveness of the plan and the ability of all tasked organizations to meet their tasking.
- Establish and coordinate training exercise with the FES; Safety and Health; and Security Offices that simulate an incident requiring implementation of the Contingency Plan.

## FIGURE 2 - Emergency Response Organization

```
-----------------------------Emergency Response Coordinator---------------------
        |                                (ERC)                                |
Internal Available                        |                          External Available
Resources                                 |                          Resources
Emergency Response Team                   |                            Table 4
(ERT)
```

## 2.2 Fire and Emergency Services (FES)

The HWAD FES will respond to all fires, explosions and to all confirmed spills where the real or potential threat of fire and explosion exists. All non-clerical members of the FES are members of the ERT.

## 2.3 Emergency Response Team (ERT)

The ERT consists of a minimum of seven members of the FES, who are on duty 24 hours per day 365 day per year, which includes the primary and/or the designated alternate ERC. The ERC primary and alternate include the FES Chief, Assistant Chiefs, Captains, or Inspectors (respectively) on duty.

There are additional FES and ERT members, off duty, who can be requested to respond in an emergency. There are also additional non-FES and ERT members who are employed in non-fire fighting capacities at HWAD during regular working hours that can be requested to respond in an emergency.

All ERT members not on duty are reasonably on call or available to respond to the facility within a short period of time upon notification of an emergency and request to respond. ERC and ERT members' notification information is available in Appendix J.

As an ongoing activity, the FES provides training to the designated ERT members in coordination with the ERC and the Training Section of the Human Resources Office in accordance with the Master Training Plan. The FES ERT will rescue injured personnel and render first aid.

**INTERNAL AVAILABLE RESOURCES (2d through 2k)**

## 2.4 Area Supervisors

The Area Supervisors conduct daily inspections for leaks and spills and provide recommendations to the Director of Program Management Support Group to correct any potential spill sources. They are responsible for transients and/or visitors to his or her area of responsibility. In most situations, the Area Supervisor is the first person to observe or be notified of a spill, in which case, he or she will immediately call x7911 or 911 from any base operated phone to alert the Guard Operations Center (GOC) (who will notify the FES) and the Area Supervisor will confirm the spill if they were notified by someone else. The Area Supervisor will also begin evacuating any personnel in imminent danger.

In addition to the above responsibilities, the Area Supervisor will:

- Assist the ERC or ERT in spill response actions if requested.
- Record all information regarding the spill incident, including cause, material spilled, quantity, response actions taken, initial impacts, etc. for submittal to the ERC (Forms generated by Firehouse Software can be used. An example of that form is in Appendix A).
- Assist the ERC, upon request, in obtaining additional equipment, personnel, and supplies as necessary.

## 2.5 Safety Officer

The Safety Officer, upon request of the ERC, will respond in an advisory capacity. The Safety Officer will point out potential hazards or safety precautions that should be taken during an incident. The Safety Officer will also record safety information regarding the incident, make recommendations to improve the plan, and provide the details to the ERC.

## 2.6 Health Officer

The Health Officer (SOC Clinic) will, upon request of the ERC, respond to an incident in an advisory capacity. The Health Officer will point out any health hazards and make recommendations on the proper procedures to be followed. The Health Officer will assist the FES in rendering first aid, helping the injured, and record all medical information regarding the incident, including injuries, health hazards, degree of chemical exposure to personnel, etc., as well as, provide such information to the ERC.

## 2.7 Security

The Security Division, upon request of the ERC, will insure that proper security measures have been taken to limit access to hazardous materials, hazardous waste storage areas, pumping stations, and/or control facilities where unauthorized access

could result in releases of these materials. In the event of discharges, fires, or other emergencies involving these materials, the Security Representative will secure the area and assist the ERC in evacuating personnel to safety. In the event of an incident, the Security Representative may request sufficient personnel from the Guard Force to secure the area. Off-plant incidents will be performed as required by the Mutual Aid Agreement with the Mineral County Sheriff's Office. The Security Office will investigate all possible security violations and/or criminal activity associated with these emergencies.

## 2.8 Environmental Services

The Environmental Personnel, upon request of the ERC, will receive reports from the ERC, ERT members, security, and area supervisors. He or she will, in turn, prepare necessary reports for the ERC and submit required reports of hazardous waste incidents to the Army Administrative Contracting Officer (ACO) as well as notify appropriate authorities, with coordination of the ACO staff, followed with a written report within 15 days of the incident. In addition, Environmental Personnel will:

- Maintain a record of all hazardous waste or material incidents at the Depot.
- Respond, at the request of the ERC, to all confirmed spills and provide technical advice.
- Report to the LEPC all reportable spills.
- Review and update this plan annually and insure review by appropriate personnel once yearly.
- Conduct periodic surveys or inspections to verify compliance with all applicable portions of 40 CFR, and all applicable portions of the Nevada Administrative Code.
- Provide for treating, storing, or disposing of recovered waste and contaminated material after an emergency.

## 2.9 Directors

The Directors will:

- Ensure that the budget includes resources for personnel, materials, equipment, and training programs required for oil and hazardous substances spill prevention, containment, and cleanup.
- Ensure that appropriate personnel are trained in the operation and maintenance of equipment to prevent the discharges of oil and hazardous substances.
- Ensure personnel that will respond to hazardous waste or material spills are properly trained.
- Ensure that facility lighting is sufficient, where necessary, to discover spills occurring during hours of darkness. Also, ensure that lighting is adequate to help

prevent accidental spills where hazardous waste or material related operations take place during hours of darkness.

- Assist the ERC, upon request, with the resources of: Maintenance and Utility Operations; and Contract Administration and Purchasing.

## 2.10 Contract Administration and Purchasing

Contract Administration and Purchasing will ensure contracts or agreements with subcontractors, haulers, or similar personnel, for movement of such commodities as fuel, waste oil, etc., on or off the facility, will stipulate the subcontractor, hauler, or similar person will be responsible for cleanup of facility spills caused by his or her negligence. Once he or she leaves the physical confines of the facility the SOC General Manager at HWAD no longer has responsibility for the subcontractor actions. The SOC Contract Administration and Purchasing, shall add provisions in the contract for reimbursement for cleanup costs to SOC, provided the contractor or handler refuses, or is unable to respond in a timely manner, and SOC is required to accomplish the cleanup.

## 2.11 Equipment Maintenance

Equipment Maintenance, under the direction of the Manager, Maintenance Utilities Operations, is responsible for monitoring and inspection of all boiler fuel storage tanks and liquefied petroleum gas tanks.

# 3 CRITERIA FOR IMPLEMENTATION OF HAZARDOUS MATERIALS/WASTE CONTENGENCY PLAN

The provisions of this plan must be carried out immediately whenever there is: a fire; explosion; release of hazardous materials; release of hazardous waste; or release of hazardous waste constituents that could threaten human health or the environment. Typical types of incidents include:

- Fire and/or explosion involving hazardous materials or waste products, or occurring near a hazardous waste management site.
- A large and/or unconfined spill or release of a hazardous material.
- Tank flooding, leaking, or dike failure.

The Contingency Plan will be reviewed and immediately amended, with the appropriate modification (40 CFR 270.42) if necessary, whenever:

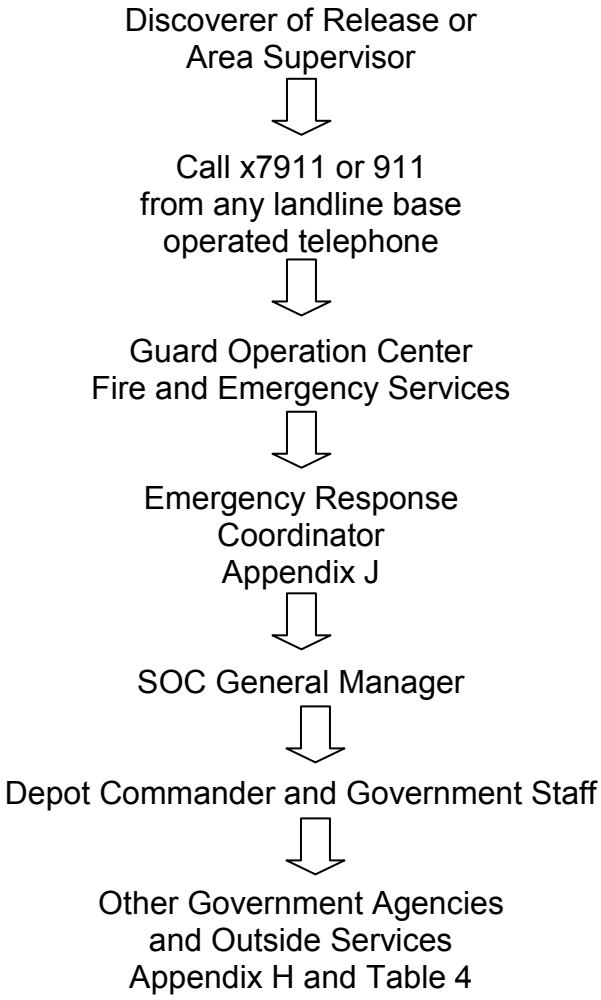
- The facility permit is revised;
- The plan fails in an emergency;
- The facility changes its design, construction, operation, maintenance, or other circumstances in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous constituents, or changes the response necessary in an emergency.
- The list of Emergency Response Coordinators changes; or
- The list of emergency equipment changes.

# 4 EMERGENCY RESPONSE PROCEDURES

## 4.1 Notification 264.56(a)

Figure 3 presents the notification sequence for most emergency responses during duty and off-duty hours. Should an emergency situation develop at the facility, the first person to observe the situation will notify the GOC (who will notify FES) by call extension x7911 or 911 from any base operated phone. A call to x7911 or 911 is answered by GOC and dispatched to the FES. The FES communications recorder is activated and records all x7911 or 911 calls, made from base operated phones, and records radio emergency communications and the times of those communications. The GOC and FES will notify the ERC, who is responsible for other internal notifications. To notify facility personnel, the observing party will activate the internal facility alarm or communication system, where applicable.

FIGURE 3 - HWAD Emergency Notification Procedures



## TABLE 4 - Government Agency and Outside Services Notification

| **Government Agency** | **Phone Number** |
|---|---|
| National Response Center | (800) 424-8802 (24 hr) |
| EPA Region IX – Regional On Scene Coordinator (415)-227-9500 | ~~(800) 300-2193~~ |
| Nevada Division of Environmental Protection (NDEP) | (775) 687-4670 |
| NDEP Duty Officer<br>Out of State | (888) 331-6337<br>(775) 687-9485 |
| Nevada Division of Emergency Management | (775) 687-0300 8-5 Mon-Fri<br>(775) 683-0400 After Hours |
| Local Agency<br>Mineral County Office of Emergency Management | (775) 945-2497 |
| Mineral County Sheriff Office | (775) 945-2434 or from a base operated phone dial 9911 |
| Hawthorne Fire and Emergency Services | (775) 945-2497 or from a base operated phone dial 9911 |
| Local Emergency Planning Committee (LEPC) | (775) 945-2497 |
| Mount Grant General Hospital | (775) 945-2461 |

**Outside Service**
Chemical Transportation Emergency Center (CHEMTREC) (800) 424-9300

After making the initial assessment of the emergency, the ERC will inform the SOC General Manager of the situation. The SOC General Manager will notify the Depot Commander, and notify local agencies and/or local services with designated response roles if their assistance is required. The government staff will notify appropriate personnel as needed under the direction of the Depot Commander. Table 4 lists the government agencies and outside service telephone numbers that SOC will notify as required. The sequence for notification during duty and non-duty hours are as follows: during duty hours the GOC will notify in order the personnel listed in Appendix J; the GOC and FES maintain a copy of the internal Organization Chart, Table 4, and a copy of this plan.

## 4.2 Identification of Released Hazardous Materials 264.56(b)

The ERC, in consultation with the Area Supervisor and Environmental Personnel, will identify the type, source, and quantity of any release of hazardous material or hazardous waste. The identification of released hazardous wastes or materials potentially involved in an incident will be based on the knowledge of the facility involved and the knowledge of the materials being stored, handled, or processed. In some cases, test equipment from the Safety Office, Environmental Office, or Chemistry Laboratory may be used to aid in identification of hazardous materials or hazardous waste.

## 4.3 Hazard Assessment 264.56(c), 264.56(d)

Based on the initial evaluation of the hazardous material or waste composition and the emergency conditions, the ERC will determine the potential hazard to human health, safety and environment, will also determine appropriate actions to minimize and abate the hazard, as well as assess the need for evacuation and notification of authorities. Material Safety Data Sheets (MSDS) and US Army specification data can be used in assessing the hazards posed by a given spill or release

## 4.4 Control Procedures 264.52(a)

Potential hazardous materials or waste incidents at the HWAD facility can be classed as: fires or explosions; spills or releases due to operational irregularities; and spills due to natural events, such as severe storms, earthquakes, or floods. The initial response to any emergency will be to protect human health and safety and then the environment. Identification, containment, treatment, and disposal assessment will be the secondary response. The following paragraphs describe the emergency response procedures.

### 4.4.1 Fires and/or Explosions

There are two types of explosion and/or fires that could occur at the HWAD facility those, which are <u>planned</u> and those, which are <u>unplanned</u>.

- The <u>planned</u> explosions and/or fires include **permitted** open burning, open detonation, range activity (generally associated with munitions treatment or demilitarization), retort operations, and scheduled horticultural (fence line) burns.
- Unplanned explosions and/or fires may include those associated with the functioning of reactive components in munitions, reactive components in batteries, or during transportation or handling of the components or explosives; and unscheduled explosions and/or fires which could include those associated with more common causes such as; electrical failures, fuel line leaks, and ignition of combustible materials.

HWAD FES will respond to fires or explosions occurring on the facility grounds. Assistance from the Mineral County FES will be requested to supplement on site capabilities if required in accordance to the Mutual Aid Agreement (appendices). All fire response personnel will be provided with the appropriate protective clothing and safety equipment. Care will be taken to contain and recover any run-off of waste and water; foams; or chemicals applied to the fire. If possible, the area should be diked and/or any run-off drains blocked prior to using liquids to put out the fire. Once extinguished, the materials involved in the fire and surrounding area will be examined, decontaminated, recovered, and placed in containers for proper disposal if necessary.

Fires or explosions within some of HWAD's buildings handling flammable or explosive materials will be controlled and may be extinguished by built-in fire-protection systems, including sprinklers and deluge systems. The built-in systems will be activated automatically by heat sensors, but can be activated manually. Fire extinguishers and/or hydrants are located in strategic locations inside or outside some buildings for use by on-site personnel.

In the event of a fire, the ERC's major efforts will be placed on preventing the fire from spreading to nearby areas. The following actions (not necessarily listed in order of importance or action sequence) will be taken in indoor areas affected by a fire or explosion:

- Hazardous work in all areas will be terminated immediately.
- Fire doors in buildings will be closed.
- All feed lines to the furnaces and additional equipment will be shut down, as necessary and practical.
- All electrical circuits will be deactivated.
- The area will be cleared of all personnel not actively involved in fighting the fire.
- All injured persons will be removed and medical treatment will be administered by qualified personnel.

If the ERC decides that the chances of an impending explosion are high, the entire area within a 4,000 ft radius of the source will be evacuated. A greater radius will be evacuated if recommended by the Safety Representative. Specifics are outlined under general evacuation procedures contained in the Standard Operating Procedures for each facility. All personnel have been trained in evacuation procedures.

Until evacuation is signaled, personnel who are not in an affected area will stay in their respective work areas. Subcontract personnel and visitors will be cleared from the area and instructed to report to a designated evacuation point.

The ERC will be responsible for all firefighting efforts. Supervisors of unaffected areas will stay with their personnel and be ready to evacuate and account for persons under their supervision.

A verbal “all clear” signal will be given when the fire has been extinguished and the safety of personnel is no longer endangered. The ERC will determine when the emergency has passed and the “all clear” signal is given. All emergency equipment used in the emergency response must be cleaned and ready for use prior to resumption of plant operation in the affected areas. Once the “all clear” is given, steps will be taken to remove hazardous materials or wastes to a safe storage location unless investigators require that they be left in place.

### 4.4.2 Spills or Releases

All hazardous material or waste releases will be contained as close to the source as possible. For small spills, absorbent materials such as sand, sawdust, commercial absorbents, etc., will be placed directly on the material to prevent further spread and aid recovery. If the material is hazardous, it should be neutralized and/or desensitized prior to attempting recovery and provisions should be made to contain and recover the neutralizing or desensitizing solution. Berms of earthen or absorbent materials can be used to contain larger spills and should be constructed downstream of the leading edge. They are especially effective in containing continuing spills such as impoundment or pipeline leaks. Drains or drainage in the spill area should also be surrounded by berms to exclude the spilled materials or wastes and any materials applied to it. Any contaminated absorbents or earthen materials should be cleaned up and placed in drums for proper storage or disposal. No contaminant or contaminated materials will be left at the spill site. The ERC will determine the procedures for the timely removal of these materials.

Spills within a hazardous waste storage building will be contained by the building itself. The floor and walls are constructed of concrete, and sealed with an epoxy sealer, as are the small curbs separating incompatible materials. Although there is no slope to the floor and no drains installed, any spills that would occur as a result of leaking drums are not expected to be very large. These buildings are inspected weekly and any spilled material or waste will be cleaned up immediately upon discovery.

Spills within the Battery Retort Furnace building (104-5) will be contained by the building itself. The floor and walls are constructed of concrete, and sealed with an epoxy sealer. Secondary containment is provided to separate incompatible materials. Although there is no slope to the floor and no drains installed, any spills that would occur as a result of leaking drums are not expected to be very large. The building is inspected daily and any spilled material or waste will be cleaned up immediately upon discovery.

If any spill is large and/or continuing, an initial isolation area of at least 100 ft in all directions will be used. Small spills or leaks from a drum, tank, or pipe will require evacuation of at least 50 ft in all directions to allow cleanup and repair, to prevent exposure. When any spill occurs, only those persons involved in overseeing or performing emergency operations will be allowed within the designated hazard area. If possible, the area will be roped or otherwise blocked off.

If the spill results in the formation of a toxic vapor cloud, (by reaction with surrounding materials or by outbreak of fire) further evacuation may be required. A downwind area at least 500 ft wide and 1,000 ft long should be evacuated. A larger area may need to be evacuated, depending on the materials involved and the ambient weather conditions.

Specific responses to various types of hazardous materials or wastes are discussed in the following paragraphs. In all cases, disposal of hazardous materials or wastes and any contaminated materials must be coordinated with the HWAD Environmental Office. In most cases, spilled hazardous materials will be disposed of as hazardous wastes.

### 4.4.3 Explosive Items/Materials

Whenever any potentially explosive items or materials are released or scattered, immediately secure the area and notify the GOC by calling x7911 or 911 from any base operated phone. The GOC will notify FES as outlined in Figure 3. Every precaution must be taken to guard against explosion due to impact, friction, spark, shock, or heat. The ERC, Safety Officer, Range Clearance and Environmental personnel will determine the appropriate procedures to clean up the explosive waste. If the accident occurs outside of HWAD property, the proper local authorities will be notified. The local authorities will be asked to help secure the area in accordance with the Mutual Aid Agreement (see appendices).

### 4.4.4 Other Hazardous Materials

Any solvents, degreasers, wood preservatives, or other items listed on EPA's Hazardous Waste Listing used by HWAD that are spilled should be contained immediately by calling x7911 or 911 from any base operated phone. GOC will notify the FES as outlined in Figure 3. Absorbent materials such as sand, sawdust, or clay should be used on liquids. The contaminated material should be placed in drums and disposed of properly. For proper disposal, contact the Environmental Office.

In general, ERC personnel will direct the following:

- Making sure all unnecessary persons are removed from the hazard area.
- Wear proper protective clothing and use proper equipment.

- If a flammable waste is involved, remove all ignition sources, and use spark and explosion-proof equipment in containment and cleanup.
- If possible, try to stop the leak. Special materials will be kept on hand for temporary repairs.
- Remove all surrounding materials that could be especially reactive with materials in the waste.
- Determine the major components in the waste at the time of the spill.

### 4.4.5 Natural Disasters

In the event of an earthquake, the resulting emergency response is likely fall into one of the categories discussed above and the Emergency Operations Plan will be implemented. If no releases are observed following a significant earthquake, all processes involving hazardous wastes should be stopped to allow a close examination of the equipment for any signs of damage.

Should severe storms or flooding occur, waste producing or processing operations should be halted and all hazardous material or waste containers secured within their respective buildings. The container storage facilities, Buildings 106-22, 106-23, 115-9, and 113-73 are elevated 4'1" above grade, with additional curb height at the entry doors; this is well above the 100 year flood level. Building 104-5 is elevated 3’6” above grade; this is also, well above the 100 year flood level. Similar precautions have been taken for other facilities that handle hazardous materials or wastes such as the tanks, furnaces, and incinerators. Floodwaters will be directed away from the tanks by the dikes surrounding them.

In the event of a dam failure or wild land fire, the Emergency Operations Plan will be implemented. Flood waters or fire will be directed away from storage buildings and waste producing or processing operations, so long as there is not an unreasonable risk to human life.

## 4.5 Prevention of Recurrence or Spread of Fires, Explosions, or Releases 264.56(c)

The fire protection systems discussed previously, along with response actions (such as shutting fire doors and stopping process and operations) are the primary means of preventing releases of hazardous materials or wastes due to the recurrence or spread of fires and explosions. Other actions include collecting and containing the released waste and recovering or isolating containers. In addition, if the facility stops operations in response to an emergency, the ERC will monitor valves, pipes, and other equipment for leaks, pressure build-up, gas generation, or ruptures.

Regulated underground storage tanks holding hazardous materials or wastes will have release detection or prevention systems and will be operated and maintained as

required by 40 CFR Parts 264 or 280 and State regulations. Above ground storage tanks holding hazardous materials or wastes will have release detection/prevention systems and will be operated and maintained in accordance with 29 CFR Part 1910.106 and/or 40 CFR, Parts 264/265, as applicable.

### 4.6 Storage and Treatment of Released Material 264.56

Immediately after an emergency, the ERC will make arrangements for treatment, storage, or disposal of recovered waste, contaminated soil, surface water, or any other contaminated material. In general, the recovered wastes and contaminated materials will be placed in drums and stored with other hazardous wastes at a container storage facility or will be demilitarized through incineration.

### 4.7 Incompatible Materials 264.56(h)(1)

The ERC will be responsible for assuring that no incompatible materials or wastes will be treated, stored, or located in an area where a hazardous material or waste incident has occurred until cleanup procedures are completed.

### 4.8 Post-Emergency Equipment Maintenance 264.56(h)(2)

After an emergency event, all emergency equipment that was used will be cleaned so that it is fit for reuse, or it will be replaced. The equipment and protective clothing will be washed or discarded in proper containers and replaced with new equipment or clothing. Before operations are resumed, an inspection of all safety equipment will be conducted by the ERC, Safety Officer, and Environmental Personnel (as required) to ensure that they are fit for future use. When the inspection is completed, the Government Staff, the EPA Regional Administrator, the State, the local authorities, and the Hawthorne Senior Command will be notified that the response operations were satisfactorily completed; all waste materials were stored or disposed of in an appropriate manner; and the status of the emergency equipment. Once notification has been completed normal operations will resume.

### 4.9 Container Spills and Leakage 264.52, 264.171

The procedures for responding to container spills or leakage under this plan will be to evacuate the area within a 50 ft radius and contain and clean up the spill with small berms and/or absorbent materials. Damaged containers will be thoroughly cleaned and disposed of or place in over pack containers. Other response procedures are discussed in Section 4d.

### 4.10 Tank Spills and Leakage 264.194(c)

Actual or suspected leakage from underground storage tanks and associated piping holding hazardous materials or wastes will be handled in accordance with 40 CFR 280 Subparts E and F. Surface spills from underground storage tanks and any spill or leak

from above ground storage tanks and their associated piping holding hazardous materials or wastes will be analyzed for total petroleum hydrocarbons, volatile organic compound and semi-volatile organic compound, and if appropriate, metals, and polychlorinated biphenyls (PCB). Any soil with greater than 100 ppm total petroleum hydrocarbon contamination will be containerized and removed for disposal.

In the event of a leak, spill, or any condition that deems the BRF tank system is deemed unfit for use, the tank system will be removed from service immediately, and the owner or operator will follow the directions of 40 CFR 264.196 as follows:

- Cessation of use; prevent flow or addition of wastes
- Removal of waste from tank system or secondary containment system
- Containment of visible releases to the environment
- Notifications, reports
- Provision of secondary containment, repair, or closure
- Certification of major repairs

## 4.11 **Baghouse/Incinerator Spills and Leakage 264.56**

The response to spills or leaks at the HWAD incinerator facilities under this plan will be to curtail operations in the area of the spill until the spilled material is removed and the cause of the spill has been rectified. Spills of explosive materials will be cleaned up using non-sparking brooms, dustpans, and receptacles. Using standard safety precautions, these materials can be reloaded for incineration. Spills of baghouse dust or incinerator ash will be shoveled up and placed in drums for transport to the hazardous waste storage buildings. Floors, other surface areas, and equipment affected by the spill or leak will be decontaminated as necessary, which include using steam or water with mops and rags. All cleanup materials will be drummed and stored or disposed of as hazardous waste when warranted. The ERC, Safety Officer, and Environmental Personnel (as required) will inspect the area prior to continuance of normal operations.

## 4.12 Notification 264.56 (i)

Once the ERC ensures that in the affected area(s) no waste that may be incompatible with the released material is treated, stored, or disposed of, until cleanup procedures are completed and all emergency equipment listed in this plan is cleaned and fit for its intended use before operations are resumed. Then the ERC will notify Environmental Office who will notify the State and local authorities that the facility is in compliance.

## 4.13 Reporting 264.56 (i)

Within 15 days after the incident the Environmental Personnel must submit a written report on the incident to the Nevada Division of Environmental Protection. The report must include:

- Name, address, and telephone number of the owner or operator;
- Name, address, and telephone number of the facility;
- Date, time, and type of incident (e.g., fire, explosion);
- Name and quantity of material(s) involved;
- The extent of injuries, if any;
- An assessment of actual or potential hazards to human health or the environment, where this is applicable; and
- Estimated quantity and disposition of recovered material that resulted from the incident.

# 5 EMERGENCY EQUIPMENT: 264.52(e)

The Hawthorne Army Depot was designed to incorporate emergency equipment that will maximize safety during emergency conditions. Records of equipment inspections are kept in an operating log. Response and key facility personnel are thoroughly trained in the use of the equipment and participate in routine drills to ensure continued familiarity with the emergency equipment and procedures.

## 5.1 Location of Emergency Equipment

For the location and emergency equipment please see Appendix B, Table 5, and Table 6. The emergency equipment is not limited to, but does include those items listed in Appendix B, Tables 5 and 6. All locations at HWAD have FES available with the minimum equipment listed in Appendix B. The emergency equipment listed in Appendix B is staged on the FES Hazardous Material Trailer, which is dispatched out of Building 94.

The majority of the emergency spill response heavy equipment at HWAD is staged at or dispatched out of Building 150. Equipment such as trucks, bulldozers, hand tools, etc., may be in other locations at the time of an emergency but can be recalled if needed. Safety equipment such as respirators and safety clothing are staged at Building 7 as well as the two firehouses (Buildings 8 and 94). The bulk of the mobile emergency communications equipment is staged at the GOC. Permanently installed communications equipment is found at various locations within the Depot. Emergency telephones are located along roads within the magazine areas and in all buildings where people work except the magazines and storage sheds. Call boxes are located at numerous locations throughout the facility. The mobile fire equipment is maintained at the firehouses (Buildings 8 and 94), along with some safety equipment and protective

clothing. Portable fire extinguishers are located in all buildings where people work and built-in extinguishing systems are installed in select buildings. Fire retardant work clothing is provided to incinerator operators and at explosive operations.

## 5.2 Fire Protection Equipment

Fire protection equipment for HWAD was mentioned briefly above and in Section 4d. In general, the equipment includes built-in sprinkler and deluge systems, portable fire extinguishers, hydrants, and mobile firefighting equipment. Hydrants are located near all buildings on the Depot. Mobile fire protection and control equipment is also available from the Mineral County FES in accordance with the Mutual Aid Agreement. Sprinkler systems have been installed in some buildings that may produce or accumulate hazardous materials or wastes. Table 5 identifies the fire protection equipment at the Hazardous Waste Storage Facilities.

Water is supplied to the sprinkler deluge systems through the conventional water supply, although seven elevated storage tanks with capacities ranging from 30,000 to 100,000 gallons each are provided to supply water to the system in the event of a power failure. In addition, under extreme emergencies, water can be supplied directly from storage reservoirs in the nearby mountains. Three reservoirs have capacities of 40 million gallons each.

Mobile fire protection equipment is maintained at the two facility firehouses. The firehouses are Fire Station 1 (Building 8) and Fire Station 2 (Building 94).

Fire protection and alarm systems are located throughout HWAD. Automatic fire detectors are provided in buildings with permanently installed fire protections systems, in addition to manually activated alarms and sprinklers. Closed circuit televisions used to control hazardous operations on the Depot are also used to detect fires. In addition, call boxes are located at loading docks, in buildings, and between magazines and storage sheds that can be used to report fires and other emergencies by any person discovering such an event by calling x7911 or 911 from any base operated phone.

## 5.3 Internally Available Spill Equipment for Hazardous Material/Waste

The hazardous material or hazardous waste spill internally available equipment stored at HWAD consists primarily of earth moving and heavy construction type equipment and assorted hand tools. The earth moving equipment is very effective for spills resulting from tank failures or breaching, while hand tools are used primarily for small spills. The type, number, and location of the HWAD's spill response internally available equipment is given in Table 6. As mentioned previously, the majority of equipment is maintained at and dispatched from Building 150, but some equipment may be in use at other locations at any given time. In the event of a spill, this equipment can be recalled as necessary.

## 5.4 Communications Equipment

In addition to the equipment discussed above, each person or group of persons will be equipped with a two-way, hand-held radio, or cellular telephone to maintain contact with the operations center and request assistance if required. The communications system at HWAD consists of two-way communications between security personnel, selected employees, and a central communications (Guard Operations Center). Two base radio stations are located at the GOC, with an alternate station at the Electronics Shop (Bldg 95). Remote transmitters are located in the Guard Center (Bldg 37), Electronics Shop (Bldg 95), and ACO (Bldg 5). Communications during power failures will be maintained by field telephones and radios with independent battery supplies. A list of communications equipment for primary net control is given in Table 7.

## 5.5 Automated Decision Aid System for Hazardous Incidents (ADASHI)

The ERC has many information and technical resources at his or her disposal, one of which is ADASHI, (Automated Decision Aid System for Hazardous Incidents). The FES has one laptop in the Command Vehicle at Fire Station #1 and one laptop in Engine-2 located at Fire Station #2.

When the FES is called for all hazardous material or waste incidents, ADASHI is then utilized for on-scene information retrieval. All production buildings and hazardous operation buildings on HWAD are programmed into the computers and updated by FES personnel at least annually.

Some of the capabilities of ADASHI are as follows:

- Facility Information: Has pre-planned buildings that contain hazardous material, which can be pulled up quickly for a response to a hazardous material incident at HWAD and in Mineral County.
- Street-level hazard visualization.
- NIMS Event Management using ICS Smart Form technology.
- Cameo and ALOHA integration.
- Customizable EOC style action and checklists with real time entry.
- Automatically switch between real-time internet and portable MET Station weather.
- Intelligent WMD/ Hazmat agent discovery.
- Comprehensive responder library, including ERG 2004, EPA, NIOSH, CHRIS,NTP and more.
- PPE recommendations, respiratory breakthrough times, and MSDSs.
- Pre –calculated worst-case scenarios and pre-plans.

TABLE 5 **Fire Protection and Spill Response Equipment at Hazardous Waste Storage Areas and Buildings**

| Building | Equipment | Capabilities | Location |
|---|---|---|---|
| Old Bomb<br>HW Treatment | Shovels<br>See Appendix B | Clean Spills<br>Clean Spills | Office Area @ Old Bomb<br>Staged at Bldg 8, 94, 150 |
| 106-22<br>HW Storage | Phone<br>ABC Extinguishers<br>Eye/Shower Wash Station<br>Brooms<br>Shovels<br>Absorbent<br>Spill Kit<br>Over packs<br>Mop<br>See Appendix B<br>See Table 6 | Send & Receive Calls<br>Fire Suppressant<br>Rinse Personnel<br>Clean Spills<br>Clean Spills<br>Absorb Spills<br>Contain & Absorb Spills<br>Contain Leaking Drums<br>Clean Spills<br>Clean Spills<br>See Table 6 | Outside Bldg<br>Inside Bldg<br>Inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged Inside Bldg<br>Staged at Bldg 8, 94, 150<br>See Table 6 |
| 106-23<br>HW Storage | Phone<br>ABC Extinguishers<br>Eye/Shower Wash Station<br>Brooms<br>Shovels<br>Absorbent<br>Over packs<br>Mop<br>See Appendix B<br>See Table 6 | Send & Receive Calls<br>Fire Suppressant<br>Rinse Personnel<br>Clean Spills<br>Clean Spills<br>Absorb Spills<br>Contain Leaking Drums<br>Clean Spills<br>Clean Spills<br>See Table 6 | Outside Bldg<br>Inside Bldg<br>Inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged at Bldg 8, 94, 150<br>See Table 6 |
| 113-73A<br>HW Storage | Broom<br>ABC Extinguishers<br>See Appendix B<br>See Table 6 | Clean Spills<br>Fire Suppressant<br>Clean Spills<br>See Table 6 | Staged inside Bldg<br>Inside Bldg<br>Staged at Bldg 8, 94, 150<br>See Table 6 |
| 115-9<br>HW Storage | Brooms<br>ABC Extinguishers<br>Absorbent<br>Over packs<br>Mop<br>Shovels<br>Eye/Shower Wash Station<br>See Appendix B<br>See Table 6 | Clean Spills<br>Fire Suppressant<br>Absorb Spills<br>Contain Leaking Drums<br>Clean Spills<br>Clean Spills<br>Rinse Personnel<br>Clean Spills<br>See Table 6 | Staged inside Bldg<br>Inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Outside Bldg<br>Staged at Bldg 8, 94, 150<br>See Table 6 |
| 116-37<br>HW Storage | Please see Section 4d<br>See Appendix B<br>See Table 6 | Fires and/or Explosions<br>Clean Spills<br>See Table 6 | Staged at Bldg 8, 94, 150<br>See Table 6 |

| Building | Equipment | Capabilities | Location |
|---|---|---|---|
| 116-38<br>HW Storage | Please see Section 4d<br>See Appendix B<br>See Table 6 | Fires and/or Explosions<br>Clean Spills<br>See Table 6 | Staged at Bldg 8, 94, 150<br>See Table 6 |
| 116-39<br>HW Storage | Please see Section 4d<br>See Appendix B<br>See Table 6 | Fires and/or Explosions<br>Clean Spills<br>See Table 6 | Staged at Bldg 8, 94, 150<br>See Table 6 |
| 116-41<br>HW Storage | Please see Section 4d<br>See Appendix B<br>See Table 6 | Fires and/or Explosions<br>Clean Spills<br>See Table 6 | Staged at Bldg 8, 94, 150<br>See Table 6 |
| 116-42<br>HW Storage | Please see Section 4d<br>See Appendix B<br>See Table 6 | Fires and/or Explosions<br>Clean Spills<br>See Table 6 | Staged at Bldg 8, 94, 150<br>See Table 6 |
| 116-43<br>HW Storage | Please see Section 4d<br>See Appendix B<br>See Table 6 | Fires and/or Explosions<br>Clean Spills<br>See Table 6 | Staged at Bldg 8, 94, 150<br>See Table 6 |
| 116-44<br>HW Storage | Please see Section 4d<br>See Appendix B<br>See Table 6 | Fires and/or Explosions<br>Clean Spills<br>See Table 6 | Staged at Bldg 8, 94, 150<br>See Table 6 |
| 116-45<br>HW Storage | Please see Section 4d<br>See Appendix B<br>See Table 6 | Fires and/or Explosions<br>Clean Spills<br>See Table 6 | Staged at Bldg 8, 94, 150<br>See Table 6 |
| 108-20 | See Appendix B<br>Sprinkler System<br>Deluge System<br>Alarm System<br>Rake<br>Hose<br>Broom<br>Flat Shovel<br>Bladed Shovel<br>Dust Pan<br>Sweeping Compound<br>Absorbents<br>See Table 6 | Clean Spills<br>Fire Suppressant<br>Fire Suppressant<br>Fire Notification<br>Clean Spills<br>Clean Spills<br>Clean Spills<br>Clean Spills<br>Clean Spills<br>Clean Spills<br>Absorb Spills<br>Absorb Spills<br>See Table 6 | Staged at Bldg 8, 94, 150<br>Outside Bldg<br>Outside Bldg<br>Outside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>See Table 6 |

| Building | Equipment | Capabilities | Location |
|---|---|---|---|
| 49-9 | See Appendix B<br>Alarm System<br>Absorbent socks<br>Chemical spill clothing<br>15” crescent wrench<br>Bail of rags<br>HM disposal bags<br>Absorbent sponges<br>Absorbent<br>Plastic shovel<br>Tape<br>Broom<br>See Table 6 | Clean Spills<br>Fire Notification<br>Absorb Spills<br>Protect from Spills<br>Close Drums<br>Absorb Spills<br>Containerize Spills<br>Absorb Spills<br>Absorb Spills<br>Clean Spills<br>Assist in Cleaning Spills<br>Clean Spills<br>See Table 6 | Staged at Bldg 8, 94, 150<br>Outside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>See Table 6 |
| Dock 3 | See Appendix B<br>Alarm System<br>Absorbent socks<br>Chemical spill clothing<br>15” crescent wrench<br>Bail of rags<br>HM disposal bags<br>Absorbent sponges<br>Absorbent<br>Plastic shovel<br>Tape<br>Broom<br>See Table 6 | Clean Spills<br>Fire Notification<br>Absorb Spills<br>Protect from Spills<br>Close Drums<br>Absorb Spills<br>Containerize Spills<br>Absorb Spills<br>Absorb Spills<br>Clean Spills<br>Assist in Cleaning Spills<br>Clean Spills<br>See Table 6 | Staged at Bldg 8, 94, 150<br>Outside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>Staged inside Bldg<br>See Table 6 |

# TABLE 6 - Hazardous Material Spill Response Equipment, Internally

| Equipment Type | Qty | Capacity | Location |
|---|---|---|---|
| Bobcat Backhoe | 1 | 3/8 Cu Yd | Staged at Bldg 150 |
| Backhoe | 1 | 3/8 Cu Yd | Staged at Bldg 150 |
| Excavator | 1 | ¾ Cu Yd | Staged at Bldg 150 |
| Gradeall | 1 | ¼ - 1 Cu Yd | Staged at Bldg 150 |
| Sweeper | 1 | 1 ½ Cu Yd | Staged at Bldg 150 |
| Crane | 1 | 7.5 Ton | Staged at Bldg 150 |
| Crane | 1 | 12.5 Ton (magnet) | Staged at Bldg 150 |
| Crane | 2 | 40 Ton | Staged at Bldg 150 |
| Crane | 1 | 60 Ton | Staged at Bldg 150 |
| Bulldozer | 3 | D-7 | Staged at Bldg 150 |
| Blade | 6 | 130 G | Staged at Bldg 150 |
| Dump Truck | 1 | 5 yard | Staged at Bldg 150 |
| Dump Truck | 2 | 10 Yard | Staged at Bldg 150 |
| Ditch Witch w/Backhoe | 1 | 1/4 Cu Yd | Staged at Bldg 150 |
| Brooms | 2 | 6 Foot | Staged at Bldg 150 |
| Water Tender | 1 | 1200 Gallon | Staged at Bldg 150 |
| Water Truck | 1 | 3500 Gallon | Staged at Bldg 150 |
| Front End Loader | 4 | 2.5 Cu Yd | Staged at Bldg 150 |
| Front End Loader | 5 | 5 Cu Yd | Staged at Bldg 150 |
| Low Bed Trailer | 1 | 60 Ton | Staged at Bldg 150 |
| Tractor | 1 | F 9000 | Staged at Bldg 150 |
| Roller (Steel) | 1 | 2 Ton | Staged at Bldg 150 |
| Roller (Rubber Tire) | 1 | 5 Ton | Staged at Bldg 150 |
| Scraper | 1 | 21 Cu Yd | Staged at Bldg 150 |
| Dumpster Truck | 2 | 5 Ton | Staged at Bldg 150 |
| Hand Tools (shovels, pickups, etc.) | --- | As available to clean spills | Staged at Bldg 150 |
| Absorbent Materials (sand, vermiculite) | --- | As available to clean spills | All Bldgs where HM/HW is stored & FES |
| Steam lines & Hoses for Decontamination | --- | N/A | Stored & Fire Dept. All Process Bldgs & Treatment Facilities |
| Available spill response & emergency equipment | --- | See Appendix B to clean spills | Staged at Bldg 8, 94, 150 |

# TABLE 7 - Communications Equipment Primary Control Net

**Hawthorne Army Depot Frequencies**

| Department | | RPTR Tone | Transmit | Receive |
|---|---|---|---|---|
| A1 | Security | - | 104.0375 MHZ | 148.6625 MHZ |
| A2 | Rail Road | - | 141.5125 MHZ | 141.5125 MHZ |
| A3 | Fire Dept. | - | 140.8875 MHZ | 149.2875 MHZ |
| A4 | IOL Operations | - | 141.325 MHZ | 149.2125 MHZ |
| A5 | Operations & Logistics | - | 140.9375 MHZ | 148.3125 MHZ |
| A6 | Facilities Management | - | 139.9875 MHZ | 150.2875 MHZ |
| A7 | Range Control | - | 142.0375 MHZ | 150.2 MHZ |
| A8 | ACO Info Management | - | 139.9125 MHZ | 139.9125 MHZ |
| A9 | VITRO US Navy (104 Group) | - | 138.375 MHZ | 138.375 MHZ |
| A10 | USMC US Marines (Old Bomb) | | 138.750 MHZ | 138.750 MHZ |

**Non-Depot Frequencies**

| Department | | RPTR Tone | Transmit | Receive |
|---|---|---|---|---|
| MCEOC | Mineral EOC #1 | - | 155.715 MHZ | 155.715 MHZ |
| MCEOC | Mineral EOC #2 | - | 155.145 MHZ | 155.145 MHZ |
| MCFD | Hawthorne Fire Dept. (Local) | - | 154.415 MHZ | 154.415 MHZ |
| MCFD | Hawthorne Fire Dept. (Kincaid) | 203.5 | 153.770 MHZ | 154.415 MHZ |
| YFD | Lyon County Fire Dept. | - | 155.925 MHZ | 155.100 MHZ |
| MCSAR | MC Search & Rescue | | 155.160 MHZ | 155.160 MHZ |
| MCSO | Mineral County Sheriff's Office (Local) | | 155.115 MHZ | 155.115 MHZ |
| MCSO | MC Sheriff's Office (Cory) | 156.7 | 155.955 MHZ | 155.115 MHZ |
| MCSO | MC Sheriff's Office (Pilot) | 114.8 | 155.955 MHZ | 155.115 MHZ |
| MCSO | MC Sheriff's Office (Kincaid) | 107.2 | 155.955 MHZ | 155.115 MHZ |
| MCSO | MC Sheriff's Office (Schurz) | 127.3 | 155.955 MHZ | 155.115 MHZ |
| MCRD | Mineral County Road Department | - | 156.240 MHZ | 156.240 MHZ |
| HAWUTL | Hawthorne Utilities | | 153.710 MHZ | 153.710 MHZ |

# 6 SPILL PREVENTION MEASURES

## 6.1 Pesticides

Pesticides are stored in Building 24. Building 24 contains fertilizers and all liquid poisons, baits and powders. This building has self contained spill areas. The doorways in each of these buildings have spill lips and the fenced cement pad next to Building 24 has a spill lip around its circumference. Vermiculite absorbent material is kept on the pest controller truck, as well as in the building, and only authorized personnel have access to this building.

## 6.2 Used Oil

Used oil from engine crankcases, gearboxes, transmissions, and hydraulic systems generated by HWAD vehicle and equipment maintenance operations is collected in drums and stored in a double walled tank located outside Building 64. Oil that does not meet criteria established by the EPA will be disposed of as a hazardous wasted under the provisions of the Resource Conservation and Recovery Act (RCRA). Used oil that meets criteria established by the EPA will be turned in for sale to an oil recycling company. A used oil burner has been installed in Bldg 64 which meets the requirements of 40 CFR 279.23. Only used oil generated at HWAD is burned in the burner. Excess oil that is not consumed will be turned over to a used oil recycler.

## 6.3 Petroleum, Oil, and Lubricants (POL) Products

POL (petroleum, oil, and lubricant) products and POL spills are regulated under the Spill Prevention Control and Countermeasure Plan (SPCCP).

POL products include gasoline, DF-2 (diesel fuel no. 2) oil for use as heating fuel, motor fuel, and generation of process steam, hydraulic and lubricating oils.

Gasoline: Gasoline for plant use is received by tank truck, placed in underground tanks, and dispensed with standard filling station pumps. The HWAD FES are readily available whenever the underground storage tanks are being filled to immediately control any spills or fires that may occur. The tanks contents are checked with an appropriate measuring device and deliveries are not scheduled until the tanks are sufficiently empty to hold a full transport load and retain the EPA mandated 5% void as a safety margin against overflow. Any unexplained change in tank contents, such as a drop in gasoline level in excess of that pumped during day operations or an increase or decrease in the water level at the bottom of the tank will be grounds for suspecting a leak. All leaking tanks will be reported immediately so that all required regulatory

agencies can be notified, and corrective/remedial actions will begin immediately in accordance with 40 CFR Part 280 as well as guidance received from the regulatory agencies.

Diesel Fuel Oil: DF-2 is received in the same manner as gasoline. DF-2 is stored in underground and above ground storage tanks and may be dispensed through standard pumps for railroad and heavy equipment motor fuel or it is used on the premises as fuel for boilers. All DF-2 fired boiler and stationary combustion equipment tanks are gauged and/or fuel use is metered. The HWAD FES is readily available for DF-2 transfer operations and an employee of the facility receiving the oil, who is cognizant of this plan, is also available during all such operations. The criteria for checking tank contents and reporting discrepancies or suspected leaks are the same as those for gasoline.

Hydraulic and Lubricating Oils: These materials are received in a variety of containers including tubes, plastic bottles, cans, drums and intermediate bulk containers of up to 350 gallons. All containers are stored in a manner that will contain a spill.

Liquefied Petroleum Gas: LPG is used as a residential heating fuel and as fuel for various outlying buildings such as climate-controlled magazines. Residential fuel is stored in a 33,000 gallon above ground storage tank located adjacent to the golf course. Other plant facilities that require propane have small (20 to 1,150 gallon) tanks near those facilities. All propane deliveries are via truck and the amount of fuel in each tank is carefully controlled to insure that the tank is not overfilled for the ambient temperatures likely to be encountered during the period before the next expected filling. LPG does not pose a soil or water contamination problem. However, leaking LPG poses a severe fire hazard. Water will be used on all spills to reduce the risk to the surrounding area and speed up the evaporation and dispersal of the LPG. Discharges of LPG will be reported in accordance with the applicable portions of the Superfund Amendment and Reauthorization Act of 1986 (SARA).

## 6.4 Polychlorinated Biphenyls (PCBs)

This class of compounds is found most frequently at HWAD in electrical equipment such as transformers, capacitors, electrical oil switches, and motor controllers. It was used in antifouling compound applied to mine anchors, cables and torpedoes. It is also occasionally found in old hydraulic oil. All PCBs at HWAD are in existing equipment; no new equipment containing PCBs is being procured. PCBs or PCB containing equipment at HWAD is being replaced on an attrition basis. Containers/transformers contaminated with PCBs are inspected for leaks on a weekly basis. Waste PCBs and failed or leaking PCB containing equipment that are turned in as waste are kept in steel trays in Building 106-23. All facilities and equipment containing PCBs are marked with PCB warning decals in accordance with Toxic Substance Control Act (TSCA). Spilled

or leaked PCBs, which have not escaped to the soil or water, will be cleaned up by the responsible personnel. PCBs that have contaminated the environment will be reported immediately so that all applicable regulatory agencies can be notified.

## 6.5 Other Hazardous Materials

HWAD uses a variety of hazardous materials to support its mission, including paints, acids, caustics, solvents, explosives, and radionuclides. These materials are used in accordance with instructions contained in Standing Operating Procedures (SOP) involving munitions related operations and these procedures also include instructions for handling the hazardous wastes produced by Depot operations using these materials.

## 6.6 Hazardous Wastes

Hazardous wastes produced by operations at HWAD are handled in accordance with the provisions of RCRA Subtitle C. All containerized hazardous waste is segregated from other incompatible materials or wastes, and further protection in the form of concrete berms and sealed floors in the storage facilities to facilitate the containment of spills or leaks. Most of the storage facilities do not have landline telephone access and therefore rely upon radio or cellular phone contact.

# 7 COORDINATION AGREEMENTS: 264.52(c), 264.37

HWAD provides its own 24 hour FES which has primacy over the installation (264.37(a)(2)), therefore, coordinated arrangements for services from Mineral County police, fire department, emergency personnel, state response teams, emergency response contractors, and equipment suppliers are not required.(264.52(c), 264.37(a), and 264.37(a)(3)).

HWAD's 24 hour FES are familiar with: the layout of the facility; properties of hazardous materials or wastes handled at the installation and the associated hazards; places where facility personnel would normally be working; entrances to and roads inside the facility; and possible evacuation routes as required by the National Fire Protection Code (NFPA) and the Uniform Fire Code (UFC), (264.37(a)(1)).

The Mount Grant General Hospital, Mineral County Fire and Emergency Services, Local Emergency Planning Community, and the Mineral County Sheriff's Department have been made aware of the properties of hazardous materials and waste handled and the type of injuries or illnesses which could result from fires, explosions, or releases at the installation (264.37(a)(4)). The Mount Grant General Hospital, Mineral County Fire and Emergency Services, Local Emergency Planning Community, and the Mineral County Sheriff's Department also retain a copy of this plan.

Appendix D is a mutual aid agreement between the HWAD and the Mineral County FES. The Mineral County FES will only respond if requested.

Appendix E is an agreement for the use of the railroad to for emergency support, training and for advance notice of train movement and unusual hazards between HWAD and the Walker River Paiute Tribe.

Appendix F is a mutual aid agreement between the HWAD and the Mineral County Sheriff's Office in the form of a Memorandum of Understanding.

Appendix G is a mutual aid agreement between the HWAD and Mount Grant General Hospital in the form of a Memorandum of Understanding.

# 8 OPERATING CONTRACTOR'S ACKNOWLEDGMENT

The undersigned, representing SOC Nevada, LLC, does hereby acknowledge that he has reviewed the attached agreements:

- Mutual Aid Protection with Mineral County Office of Emergency Management
- Emergency Support, Training and for Advance Notice of Train Movement and Unusual Hazards with the Walker River Paiute Tribe
- Coordination and Cooperation of Law Enforcement Actions with the Mineral County Sheriff's Office
- Emergency medical Care with Mount Grant General Hospital

and concurs with the basic requirements as specified in these agreements.

_____ _____

GORGE R GRAM
General Manager
SOC Nevada, LLC
Hawthorne Army Depot

DATE

# 9 EVACUATION PLAN: 264.52(f)

In the event of a hazardous material or waste incident that requires the evacuation of a building or area, the fire or evacuation alarm will be sounded to alert personnel to evacuate the premises. HAWD has a Mass Notification System for Quick Wide area warnings. The signal for a general evacuation of all HWAD is 3 one minute long blasts. Other signals that may be used are sirens and voice messages. This system can be heard anywhere on HWAD. Vehicle sirens, flashing lights and loudspeakers will be used in designated areas to provide additional warnings or instructions. The design of building fire alarm systems varies depending on the nature of the operation. All systems meet National Fire Protection Association standards. The fire alarm systems provide an audible warning signal that notifies personnel to evacuate. Once the alarm is activated, all personnel will leave by the nearest unobstructed exit away from the hazard. If the hazard is capable of explosion, personnel will be instructed to go to the nearest bunker, ditch, or dirt mound to protect against shrapnel. If the material or waste is poisonous or flammable, personnel will be instructed to move upwind to a safe area. The facility Directors are obligated to maintain current evacuation plans at visible locations for each area or building that may deal with a hazardous material or waste. The Area Supervisors are responsible for training assigned personnel on evacuation procedures. They are also responsible for training assigned personnel when a new job starts and when new employees start a job. The emergency evacuation plans for hazardous waste storage buildings and Old Bomb are shown in Appendix C.

# 10 REQUIRED REPORTS 264.52(i)

Any emergency event that requires notification to appropriate agencies will be reported by Environmental Personnel to the Government Staff, the LEPC, and provide telephonic notification to Nevada Division of Environmental Protection (NDEP). This notification will be followed up with a report, in writing to the Region IX Administrator of the Environmental Protection Agency (EPA) and/or the NDEP within 15 days. The following information will be provided:

- Name, address, and phone number of owner/operator.
- Name, address, and phone number of facility.
- Date, time, and type of incident (e.g., fire, spill, etc.)
- Type and quantity of material involved.
- Extent of injuries, if any.
- Assessment of actual or potential hazards to human health or the environment, if applicable.
- Estimated quantity and disposition of material recovered from the incident.

The time, date, and details of emergency incidents requiring implementation of this plan will be entered in the facilities operating record. Other reports for hazardous material or waste accidents or incidents are required by the U.S. Army and are discussed in this Plan. The HWAD Commander will be responsible for making these reports available to the appropriate Army personnel.

# 11 LOCATION AND DISTRIBUTION OF CONTINGENCY PLAN - 40 CFR 270.14(b) (17) and 264.53

Copies of HWAD's Hazardous Material/Waste Contingency Plan or Installation Contingency Plan (ISCP) are maintained in the Environmental Office, FES, Old Bomb, New Bomb, and ACO. An electronic copy is available on the HWAD Intranet as a part of the ISO 14000 documentation. In addition, copies are distributed to the local authorities including the Mineral County FES, the Local Emergency Planning Committee, Mount Grant General Hospital, and the Mineral County Sheriff's Department.

| Serial # | Location |
|---|---|
| 001 | NDEP |
| 002 | Environmental Services |
| 003 | ACO |
| 004 | Mineral County Sheriff's Office |
| 005 | Mt. Grant General Hospital |
| 006 | Mineral County Fire Dept/Emergency Management |
| 007 | Local Emergency Planning Committee (LEPC) |
| 008 | Fire Protection |
| 009 | New Bomb |
| 010 | Old Bomb |

# APPENDIX A

Example Firehouse Software Report.

**K1 Person/Entity Involved**
Local Option

Business name (if applicable) | Area Code - Phone Number

☐ Check This Box if same address as incident location. Then skip the three duplicate address lines.

Mr.,Ms., Mrs. | First Name | MI | Last Name | Suffix

Number | Prefix | Street or Highway | Street Type | Suffix

Post Office Box | Apt./Suite/Room | City

State | Zip Code

☐ **More people involved? Check this box and attach Supplemental Forms (NFIRS-1S) as necessary**

**K2 Owner**
Local Option

☐ Same as person involved? Then check this box and skip The rest of this section.

Business name (if Applicable) | Area Code - Phone Number

☐ Check this box if same address as incident location. Then skip the three duplicate address lines.

Mr.,Ms., Mrs. | First Name | MI | Last Name | Suffix

Number | Prefix | Street or Highway | Street Type | Suffix

Post Office Box | Apt./Suite/Room | City

State | Zip Code

**L Remarks**
Local Option

responded to oil leak from sky track at 103-16 less than a quart.

---

On 02/01/2012 at 14:30:00 dispatched To 103-16 /Hawthorne, NV 89415. The location is a Munitions Operations. The incident was determined to be a(n) Chemical spill or leak.

14:35:00 arrived on scene.
The following actions were performed on scene:
Hazardous materials leak control & containment

Units responding were:
Unit ENG2 responded.

15:00:00 all units back in service.

**L Authorization**

| Officer in charge ID | Signature | Position or rank | Assignment | Month | Day | Year |
|---|---|---|---|---|---|---|
| 5087 | Scott, Chuck | CP | | 02 | 01 | 2012 |

Check Box if same as Officer in charge. ☒

| Member making report ID | Signature | Position or rank | Assignment | Month | Day | Year |
|---|---|---|---|---|---|---|
| 5087 | Scott, Chuck | CP | | 02 | 01 | 2012 |

| FDID * | State * | MM | DD | YYYY | Station | Incident Number * | Exposure * | |
|---|---|---|---|---|---|---|---|---|
| AF006 | NV | 2 | 1 | 2012 | 01 | 12-1200027 | 000 | Complete Narrative |

**Narrative:**
responded to oil leak from sky track at 103-16 less than a quart.
---
On 02/01/2012 at 14:30:00 dispatched To 103-16 /Hawthorne, NV 89415. The location is a Munitions Operations. The incident was determined to be a(n) Chemical spill or leak.

14:35:00 arrived on scene.
The following actions were performed on scene:
Hazardous materials leak control & containment

Units responding were:
Unit ENG2 responded.

15:00:00 all units back in service.

| AF006 | NV | 2 | 1 | 2012 | 01 | 12-1200027 | 000 | Responding Units/Personnel |
|---|---|---|---|---|---|---|---|---|
| FDID | State | Incident Date | | | Station | Incident Number | Exposure | |

| Unit | Notify Time | Enroute Time | Arrival Time | Cleared Time |
|---|---|---|---|---|
| ENG2 Engine 2, 1986 Pierce 1000GPM | 14:30:00 | 14:30:00 | 14:35:00 | 15:00:00 |

| Staff ID\Staff Name | | Activity | Rank | Position | Role |
|---|---|---|---|---|---|
| 3989 | Young, Charles R | On Duty | Firefighter | Driver Opera | Haz Mat Tech |
| 5087 | Scott, Chuck | On Duty | Captain | Fire Captain | Incident Com |

Unit Narrative

No apparatus/vehicular complications were encountered during this incident.

# APPENDIX B

# BRUSH TRUCK 1 INVENTORY

**Cab:**
1- Mobile Radio
1- Binder w. Inventory & maps
1- Bottle Jack (under p/s seat)

**Drivers Side:**

**Front:**
1- Winch cord w/ remote
1- 2 ½" Siamese
1- 1" Forestry nozzle
1- Red Wild Land Nozzles
1- Spanner wrenches
3- 1 ¾" to 1" Reducers
1- FDJ Wild land nozzle
1- Wheel Chock
1- 1 ¾" Gated Wye
3- 2 ½" to 1 ¾" Reducer
1- 2 ½" Double Female
2- 2 ½" Double Male
1- 3" to 2 ½" Double Female
1- 2 ½" to 3" Double Male

**Middle:**
2- Pencil lines
6- Rolls of 1 ½" Wild land hose

**Rear:**
1- Foam Pack
1- 5 gal. foam
1 - Fire Extinguisher
1– Back Pack Pump

**Above Comps.:**
100' of 1 ¾" and 200' of wild land hose & nozzle

**Passenger Side:**

**Front:**
15- Pink UXO Marker Flags
1- Water Jug

**Middle:**
2- Sections of structure 1 ¾"
1- Pulaskie
1- Pick

**Rear:**
2- 5 gal. jugs of foam (AFFF)
2- 40:1 Gas can
1- Quart Bar Oil
1- Pair Chaps

**Above Comps.**
1- Hose pack
1- Chainsaw
1- Wheel Chock
1 – Shovel
1 – McCloud

# BRUSH 2 INVENTORY

**Cab:**

1- Inventory Binder w/
Maps, Inventory, Copies of Run Reports & Trip Ticket
1- Mobile Radio
1- Wheel Chock

**Drivers Side:**

**Front:** 1- Jack
1- Wheel Chock

**Middle:** 1- Case of Water
4- 100' of 1" Wild land hose
2- Spanner Wrenches
1- 2 ½" Elbow
1- 1 ¾" Double Female
2- 2 ½" Double Female
1- 1 ¾" Double Male
1- 2 ½" Double Male
2- 1 ¾" to ¾" Reducer
2- 2 ½" to 1 ¾" Reducer
2- 1" Red nozzle
2- Piss Pack
1- Progressive Hose Pack

**Rear:** 5- Sections Cotton Wild land hose w/ 3 Section 1 ½"
2- Sections 1 ¾"
1- 5 gal. Jug of Class A foam

**Passenger Side:**

**Front:** 1- Progressive Hose Pack

**Middle:** 1- Chiansaw
1- Utility Rope
2- Shovel
3- Pairs Chaps
1- Pulaskie
2- McClouds
1- Boys Axe
1- Med Bag

**Rear:** 1- Set of Sqwrench
1- 40:1 Fuel can w/ Bar Oil

**Between Hose Reels:**

2- 1 ¾" Sections Structure Hose
1- 2 ½" Structure Hose

# COMMAND 1 TRUCK - INVENTORY

**Cab**

1- Mobile Radio
1- MX6
1- ERG
1- Key Box
1- Flashlight
1- Lap Top
1- Spot Light

**Outside Rear**

**Drivers side Top**:
1- Emergency Blanket
1- Fuzzes
1- Pink UXO Flags

**Bottom:**
1- Flashlight w/ Charger
Various Maps of the base

**Pull Out:**

**Top:** 1- Portable Printer

**Top Left Drawer**

1- Trailer Hitch w/ sleeve
Flagging Tape

**Center Drawers:**

1- CMC Field Guide
1- Fire Ground Tactical Command Booklet
1- "CHRIS" Chemical Response Information System Manual
1- Firefighter's Handbook of Hazardous Materials
1- NIOSH Pocket Book to Chemical Hazards
1- Field Handbook to Rail Car / Tank Car Identification
1- J.J.Keller Pocket Guide to Hazardous Materials
1- Hazardous Classification of United States Military Explosives and Munitions
1- DOT Federal Motor Carrier Safety Regulations Pocket Book
1- Emergency Chemical Management Essentials Pocket Book
1- Emergency Care for Hazardous Material Exposure
1- JANES Chem-Bio Handbook
1- DZHC Emergency Response Book
1- DZHC Operation Manual
1- NFPA's Fire Protection Guide to Hazardous Materials

**Bottom Drawer:** Maps

**Bottom Right Drawer:**

1- Polaroid Heat Gun
1- Binoculars
1- Dry Erase Markers w/ Eraser
1- Note Pad
2- Maps

**Right Side Top:**

1- Battery Charger w/ 2 Batteries
1- Bag of Highway Vests
1- IC Bag
1- Triage Kit
1- Jump Kit

**Bottom:**

1- Spotting Scope
1- Command Board
1- Caution Tape
1- Magazine & Bunker Storage Compatibility and Explosive List
1- Guide Lines and Form Book
1- SOC Emergency Response Plan
1- Pre Determined Command Post Sites
1- SOC Spill Prevention Control and Counter Measure Plan
1- SOC Fire Info Binder

## ENGINE 1 INVENTORY

**Cab**

1- Inventory Binder w/ Maps & Trip Ticket
1- Mobile Radio
2- Flashlights
4- SCBA Packs
1- Medical Jump Kit w/O2
1- ERG 2008
1- Portable Suction
2- Duct Tape
1-Black Wheel Chock

**D/S Front Comp.**

1- Rubber Mallet
2- Spanner Wrenches
2- 3" Double Female
2- 3" Double Male
1- 3" To 1 ¾" Reducer
2- 1 ¾" Double Female
2- 1 ¾" Double Male
1- Storz to 3"
4- LDH Wrenches
1- 25' LDH
1- 15' LDH
2- Section of 3"
1- Section of 1 ¾"
1- LDH Hose roller

**Under Front Comp.**

2- Wheel Chocks

**D/S Middle Comp.**

1- TNT Tool
1- Pry Bar
1- Halligan Tool
1- Bolt Cutter
1- Sledge Hammer
50' Section Rope
1- Tool bag
**2-** Firemans Axes
1- Hydrant Wrench
1- Bundle UXO Flags

**D/S Rear Comp.**

2- Hallway Runner
1- Salvage Cover
4- Spare SCBA Bottles
1- Hydraulic Hose Clamp
1- Bucket of Oil Dry
1- 20 lb. ABC Extinguisher

**Rear**

6- Collapsible Cones
1- Inflatable Prism Light
1- Foam Pack
2- Sections of 1 ¾" Hose
1- Hydrant bag w/ 1- Gate Valve, 1- Hydrant Wrench,
2 -Spanner Wrenches, 1- Gate Valve & 1- 3" Female to Male

**P/S Front Comp.**

1- Generator
1- Gas Can **Regular**
1- Gas Can **MIX** 40:1
2- Bar Oil

**P/S Rear**

1- Chainsaw
1- Chainsaw Scrench / Carb Screwdriver
1- K12 Saw
1- Spare K12 blade
1- PPV Fan

**Above P/S Comp's.**

1- Pike Pole
1- Attic Ladder
1- 12' Roof Ladder
1- 24' Extension Ladder

**Cross Lays**

Front- 200' Yellow 1 ¾"
Rear- 200' White 1 ¾"

**Hose Bed**

Right- 300' of 3"
Left- 500' of 5"

# ENGINE 2 INVENTORY

**Cab:**

1- Mobile Radio
1- Keys (Various)
1- Binder w/ Maps & Inv.
1- ERG
1- GPS, Laptop, MX6, Flashlight
1- RIT Pack
1- Portable Suction
1- Bag of rope
1- Extinguisher
3- SCBA's
1- Wheel Chocks

**D/S Bottom Front:**

1- Rubber Mallet
2- LDH Spanner Wrenches
1- Spanner Wrench
1- Hose Roller
1- Section of 5" Supply
1- Section of 3"
2- Sections of 1 ¾"

**D/S Top Front:**

1- Short Shovel
1- Sledge Hammer
2- Fire Axe
1- Halligan Bar
1- Bolt Cutter
1- Crash Axe
1- Utility Rope
1- TNT
1- K-Tool
1- 2 ½" to 1 ¾" Gated Wye
3- 2 ½" to 1 ¾" Reducers
3- 2 ½" Double Females
1- 2 ½" Double Male
1- 2 ½" Elbow
2- 1 ¾" Double Females
1- 1 ¾" Double Male

**D/S Bottom Rear:**

1- PPV Fan
1- Extension Cord Reel

**D/S Top Rear:**

4- Spare SCBA Bottles
3- Air Bags
1- Tool bag

| | | |
|---|---|---|
| **P/S Front:** | 2- | Gas cans (1 mixed 40:1) (1 regular) |
| | 1- | Foam High Expansion Nozzle |
| | 1- | Quart Bar & Chain Oil |
| | 1- | Scrench for Stihl Chainsaw |
| | 1- | Lock Out Tag Out Kit |
| | 1- | Bucket of Oil Absorbent & Trash Bags |
| **P/S Rear:** | | Various Cribbing |
| | 4- | Step Chocks |
| | 2- | Salvage Tarps |
| | 1- | Seatbelt Cutter |
| | 2- | Glass Masters |
| **Above P/S Comps.:** | | |
| | 1- | Section of Hard Suction w/ Strainer |
| | 1- | 35’ Extension Ladder |
| | 1- | 10’ Roof Ladder |
| | 1- | Attic Ladder |
| | 1- | Pike Pole |
| **Rear Top:** | 1- | Chainsaw |
| | 1- | Combi Tool |
| **Rear Bottom:** | 1- | Hydraulic Power Unit |
| | 2- | Hydraulic Hoses |
| | 1- | Sawzall |
| | 1- | Hydrant Bag |
| | 4- | Pieces of Plywood for Airbags |
| | 1- | Box w/ Control & Hoses for Airbags |

# HAZ MAT TRUCK 1 - INVENTORY

**CAB:**

1- Binder w/ Maps, Inventory, Trip Ticket
1- Mobile Radio
1- Jump Kit (in rear seat)
1- Box of ear plugs
1- Bag w/ Dave's Turnouts

**REAR:**

1- Extinguisher
1- Flashlight
1- Tool box w/
    1- Crescent Wrenches
    2- Phillips Screwdriver
    2- Flat Head Screwdriver
    1- Channel Locks
    1- Sharpie Marker
1- Gray Tote w/ yellow pads & 5 pink mini booms
    10 white pads & 5 gray/ blue booms
1- Bag of Garbage bags
2- Mercury kit
1- Round nose shovels
2- Flat nose shovels
1- Broom
1- Plastic grain shovel
2- 5gal. Buckets
2- 25' Garden hose
1- First Responder Plug and patch kit in bag.

# Haz Mat Trailer Inventory

**Tongue of trailer:**

1- Generator

**Front Compartments:**

- Water Heater hoses,
- Extension Cord,
- Visqueen,
- Drain Cover

**Below Front Compartments:**

- 1 EZ up Canopy
- 4 Grates for the Shower
- 1- 3 gal. Water Jug
- 1- 20lb. Extinguisher
- 2 Wheel chocks
- 17 Orange cones

**Grey Drawers**-

Drawer # 1
- 1pr. Binoculars
- 1 Rolls duct tape
- 1 Air gauge
- Trailer Inventory

Drawer # 2
- 4 Rolls Flagging tape
- 1 Seat belt cutter
- 1 Blaze orange flag

Drawer # 3
- 2 boxes of rubber gloves
- 4 Safety Blaze orange vests
- 3 Black Permanent markers

Drawer # 4
- 2 Extra clipboards

Drawer # 5
- 1 pkg. Wide pH strips
- 2 Tubes Chemical Classifier Strips
- 1 Can of Bumper gas
- 1 Pair of scissors
- 1 Insta Check Ph Paper kit

Drawer # 6
- 1 Human scale
- 1 Binder w/ extra forms

Drawer # 7
- 7 Instant Canopy Pouches
- 1 pkg. of 9 Canopies
- 1 pkg. tent stakes

Drawer # 8
- 3 Ground straps w/ clips
- 3 Static straps
- 1 3ft. chain
- 1 5ft. chain

**Left Side Shelves-**

**Top Shelf-**
3 - Level "A" suits,
Rags,
Utility Pump,
Yellow Tyvek,
Safety Glasses,
Misc. Gloves,
4 - Tubes of Pig Putty,
3 - Blue Privacy Tyvek,
1 - Towel,
1 - Roll 1 ¾" Pipe Hose,
1 - Water Manifold

**2nd Shelf-**
7 - CBRNE Suits,
Wood Plugs,
2 - Orange Tubs,
2 - Tarps,
1 - Incident Identifying Kit

**3rd Shelf-**
17 - CBRNE Suits

**4th Shelf-**
Chairs,
Air Chisel,
Rubber Gloves

**Floor Under Shelves-**
"A" Kit,
Shower,
Shower Enclosure,
2 Buckets of Oil-Dry,
1 gal. Bleach,
1 bucket of HgX

**Rear Behind Shelves-**
4 - Decon Tubs,
3 - Spare SCBA Btls.

**Right Side:**

**In Front of Shelf-**
Water Heater w/ Propane Bottle

**Top Shelf-**
Soda Ash,
2- Face shields,
2- Air hoses,
5 pr. Boots,
1 bx. Pink Pads,
1 bx. Pipe Bandages,
Weather Station

**2nd Shelf-**
Ratchet Straps,
Air Bags, Regulator,
Controllers,
Blue & Gray Pigs

**3rd Shelf-** Fox Tails,
Dustpans,
2 SCBA's (4500 psi.)
Pink& Gray Pigs

**4th Shelf-** Haz-Mat bags,
Decon Solutions

**Floor Under Shelves-** 2 Buckets of Oil Dry,
Canopy Walls,
Garden Hoses,
Red Plug Kit,
Red Pipe Patch kit

**Rear Right in Cage-**

- 2 Beryllium Flat Nose Shovels
- 1 Pitch fork
- 1 Grain Shovel
- 1 Rake
- 1 Straw Broom
- 3 Round Nose Shovel
- 1 Pick
- 1 Sledge Hammer
- 1 High Flow Rotary Pump
- 3 Drum test tubes

**Decon set up in Trash cans:**

- 6 Pails
- 2 Blue long handle scrubbers
- 2 Yellow scrubbers
- 2 Triangle scrubbers
- 1 White scrubber
- 6 Water wands
- 3 32 gal. Trash cans
- 4 Garden hoses
- 2 Kiddie pools

## INSPECTOR 1 INVENTORY

**CAB:**

1- Binder w/Maps, Inventory, Trip Ticket, Sharpie
1- Mobile Radio
1- Jump Kit (in rear seat)
1- Bag w/ Tim's Turnouts

**REAR:**

1- Extinguisher
1- Flashlight
1- *Tim's Tool box:*
  *1- Crescent Wrench*
  *2- Phillips Screwdriver*
  *2- Flat Head Screwdriver*
  *1- Channel Locks*
  *1- Sharpie Marker*
1- Gray Tote w/ 10 yellow pig pads & 5 pink pig mini booms
  10 white pig pads & 5 gray/ blue pig mini booms
1- Garbage bag of Garbage bags
1- CSI Kit
3- Flat nose shovels
2- Push Broom
1- Plastic grain shovel
1- Bag of Pig Dry
1- Dust Pan/ Fox Tail
1- Box mixed Pig Pads

# MED 1 - INVENTORY

**Cab**

1- Binder w/ Inventory & Maps
1- Binder w/ EMS Protocols
1- Box Latex Gloves
1- Flashlight
1- ERG

**Pt. Comp:**
**O2 Comp;**

2- Adult BVM
1- Child BVM mask
2- Combi Tubes
ET Tubes #'s 1ea. 2.5 – 8.0 w/ 2 Adult & 2 Pediatric Stylets

**Airway Comp:**

1- CO2 Detector
3- Nebulizers
1- NPA Kit
1- OPA Kit
1- Suction Tubing
4- Suction Tubing w/ Air flow control
5- Adult NRB
3- Ped. NRB
1- Adult Nasal Cannula

**Counter:**

2- Adult NRB
1- Bulb Syringe
1- Suction Tubing
1- Yankuer Tip w/ Tubing
1- Bite Stick
1- IV Bag Warmer w/ 2- Bags of NS
1- AED
1- IV Kit in tote w/

| | | | |
|---|---|---|---|
| 3- | 4x4's | IV Catheters: | 2- 24ga. |
| 1- | Starter Kit | | 2- 22ga. |
| 2- | 3 mL Syringes | | 2- 20ga. |
| 2- | 1 mL Syringe | | 2- 18ga. |
| 1- | Trauma Sheers | | 2- 16ga. |
| 1- | Roll Tape | | 2- 14ga. |

**Under CPR Seat:**

1- Blanket
2- Pillow Cases

**Dressings:**

1- Arm Splint
2- Wrist Splints
1- Triangle Bandage
4- Roller Gauze
4- Occlusive Dressings
10- 5x9's
4- 10x30 Trauma Dressings
4- Abdomen Pads
2- Burn Blankets
3- 2" Kling
2- Boxes 4x4's

**Bedding:**

1- Blanket
1- Pillow
1- Sheet

**OB/Sterile:**

3- 1000 mL Irrigation Fluid
2- 250 mL Sterile Water
3- Hot Packs
4- Cold Packs
1- OB Kit

**IV Supplies:**

2- Bags of NS
1- Box of Tape
1- Tube Glucose
1- D50
1- Nalaxone
2- Buretrols
1- Bag of Lubricating Jelly
2- Emesis Basins
4- Dust Masks
1- IO Needle
2- IV Starter Kits
5- Macro Drip Sets

**Under Counter:**

2- Emesis Basins
1- Sheet

**Under Bench Seat:**

1- CPR Board
1- Ped. Back Board
1- Ped. Sager
1- Infant Swaddler
2- Spare Portable O2 Bottles

**Intubation Bag:**

ET Tubes #'s 1ea. 2.5 – 8.0 w/ 2 Adult & 3 Pediatric Stylets
1- McGill Forceps
1- 10 mL Syringe
1- 5 mL Syringe
1- Adult CO2 Detector
1- Ped. CO2 Detector

**Drug Bag:**

1- D50
6- Albuterol
3- Diphenhydramine/Benadryl
1- Naloxone
2- Thiamine
1- Nitro Spray
2- Epi Pens

**IV Bag:**

1- Sharps Container
1- IO Needle
1- Macro Drip Set
3- Starter Kits
1- Mini Drip Set
3- Tubing Extensions
3- 1 mL Syringe
1- Bag of NS

IV Catheters:
2- 24ga.
2- 22ga.
2- 20ga.
2- 18ga.
2- 16ga.
2- 14ga.

**Jump Bag:**

Assortment of Gauze
1- Thermometer
1- Ring Cutter
1- Activated Charcoal
1- Chewable Aspirin
1- Pocket Mask
2- Tubes of Glucose
1- Bulb Syringe
2- Hot Packs
2- Cold Packs
1- Manual Suction Kit
2- Finger Splints
1- Sam Splints
1- Trauma Dressing
1- Blood Pressure Cuff Set
1- Stethoscope
1- Trauma Sheers
2- Adult NRB
5- Adult Nasal Cannulas
3- Ped. NRB
1- Portable O2 Bottle
1- Adult BVM
1- Ped. BVM
1- Pulse Ox
7- Occlusive Dressings
1- Burn Sheet

**Front Comp's:**

- 1- Head Block
- 1- Pedi Bag
- 1- Air Splint Kit
- 1- Broselow Bag
- 1- Case Drinking Water
- 1- MASG Pants
- 1- Triage Kit
- 2- Ped. C-collar
- 1- Vacuum Splint
- 1- Crash Bag
  - 4- Adult C-collars
  - 1- Ped. C-collar
  - 2- Head Block
  - 3- Spider Straps
  - 2- Rolls of Duct Tape

**Above the Door:**

- 3- Boxes of Latex Gloves

**Outside:**

**D/S Front:**

- 1- Stair Chair
- 1- Broom
- 1- O2 Bottle

**D/S Middle:**

- 1- Full Body Splint
- 6- Flares
- 1- Set Tire Chains
- 1- Flashlight

**D/S Rear:**

- 1- SCBA
- 1- Extinguisher

**P/S Rear:**

- 1- KED
- 1- Breakaway
- 1- Sager
- 2- Back Boards
- 1- Ped. Board

# MED. 2 INVENTORY

**Cab**
- 1- Binder w/ Inventory & Maps
- 1- Binder w/ EMS Protocols
- 1- Box Latex Gloves
- 1- Spot light
- 1- ERG

**Comp. A**
- 1- BVM Adult
- 1- OPA Kit
- 1- NPA Kit
- 1- 6' Suction Tubing
- 2- Pocket Mask
- 2- Pediatric NRB
- 1- Pediatric Nasal Cannulas
- 1- O2 Tubing
- 4- Adult NRB
- 4- Adult Nasal Cannulas
- 3- Nebulizers
- 2- Yankuer Tips

**Counter**
- 1- Pen Light
- 1- Stethoscope
- 1- Broselow Tape
- 1- Thermometer
- 1- AED
- 1- Portable Suction
- 1- IV Warmer
- 1- Bulb Syringe

**Under Seat**
- Bio Bags

**Comp. B**
- 1- Container Vionex Wipes
- 1- Box of Surgical Masks
- 1- Emisis Basin
- 4- Cold Pack
- 5- Hot Packs
- 1- Bag of Disposable Suction Bags
- 1- ET Tubes 1 ea. # 2.5-8.5
- 1- CO2 Detector
- 1- Buretrol
- 2- Blood Borne Pathogen Kits
- 1- Btl. Fluid Solidifier
- 4- Safety Glasses
- 2- IV Mini Drip sets
- 1- Box Surgical Masks

**Comp. C**

2- Burn Pads
2- Burn Sheets
4- Trauma Dressings
3- 3x8's
3- Bottles of Drinking Water
1- Box of First Aid Burn Cream
1- Arm Sling
3- Triangle Bandage
1- Bottle of Rubbing Alcohol
2- Rolls of Self Adhesive Wrap
3- Rolls of Tape
3- Roll of Flexible Adhesive Bandage
2- Ace Bandage
2- 6x5 Bandage
1- Blood Stopper
3- 250mL Btl. Sterile Water
1- Box Hygi net

**Under Bench Seat:**

8- Splints
1- Pillow
1- Sheet
1- Blanket
10- Disposable Blankets

**Open Comp's:**

1- Air Splint Kit
1- Sam Splint
2- Long Finger Splints
1- Pedi Mate
1- Triage Kit
1- Broselow Bag
1- Pedi Bag

**Gurney**

1- Jump Bag including Intermediate items
1- Pillow
1- Oxygen Bag

**Outside**

**Comp. # 1**

1- Ked
2- Traction Splint
1- Sager Splint
1- Oxygen Bottle

**Comp. # 2**

1- Extinguisher

**Comp. # 3**

2- Spanner Wrenches
1- Case Water

**Comp. # 4**

2- Long Board
1- Break Away

**Comp. # 5**

1- Tool Box
3- Flares
1- Bottle Jack
1- Set Tire Chains

## MERCURY RESPONSE TRAILER INVENTORY

**Front:**
1- 50# bucket of Sulfur T
"B" Kit
MSDS book w/ Inventory
Barrel Hoist
1 Brush
1 gal Mercon Vap
Propane tank for heater
Pneumatic pump

**Shelves:**

**Top:**
Misc. Gloves
Face shields
small Hg spill kit
Chairs
Flashlight mounted on the wall
Power strip

**2nd :**
1 ea. L, XL, XXL. Box of Tyvek
Ear plugs
2 Level "A" suits
Extension cord

**3rd :**
Sample Scoops
Misc. Gloves
Hg Mask Filters
Cryo Gloves
1- Level "A" suit

**4th :**
Pipes w/ valves
Ratchet Straps
Disposable Shoe Covers

**Floor :**
Boots,
Outside Carpet,
Pig pads,
ICS Clipboards,
Suction Hoses for pneumatic pump,
Hg Vacuum

**Right Side Floor:**
Hg Over pack Drum,
33 gal. Hg Spill Kit,
Propane Heater,
Yellow Salvage Drum.

# RESCUE TRAILER - INVENTORY

**Left Side Rear**

1- SABA Manifold
2- SCBA Cylinders
4- 50' Breathing Air Hose

**Left Side Hanging**

1- 8mm Blue Accessory Cord
10- Purple Prusik
10- Green Prusik
8- Green Bound Looped Prusik
7- Red Bound Looped Prusik
1- Red Rescue Cache
5- 10' Purple Webbing
8- 15' Yellow Webbing
5- 20' Orange Webbing

**Rescue Cache:**

1- RPM Rack,
3- Figure 8's,
1- Yellow Anchor Strap,
2- Yellow Webbing,
2- Orange Webbing,
3- Green Webbing,
2- Green Bound Prusik,
3- Red Bound Prusik,
5- Blue Pulleys,
5- Gold Steel Carabineers (CMC Rescue),
5- Gold/Silver Steel Carabineers (Hiatt England)

**Drawer # 1**

8- Silver/Aluminum Carabineers
7- Red Aluminum Carabineers
1- Dry Erase Eraser
1- Dry Erase Markers (Black)
4- Brass Hose Couplings
1- Hose Cleaner
5- Pair of Gloves, (2 XL's, 2 LG's, 1 Med)

**Door # 1**

2- SABA Masks
2- SABA Harnesses
2- SABA Escape Bottles
4- CMC Radio Harnesses

**Drawer #2**

1- RPM Rack:
    1- Rack,
    1- Pulley,
    1- Mariner,
    1- Rigging Plate
    4- Silver Steel Carabineers.
2- Load Release Strap w/ Carabineers,
1- Pick-Off Strap

**Door #2**

#1 Bag of Rope 150' (Red w/ White Stripe)
#2 Bag of Rope 150' (Blue w/ White Stripe)
#3 Bag of Rope 150' (Black)
#5 Bag or Rope 100' (Bright Orange)
#7 Bag of Rope 100' (Red)

**Drawer #3**

2- Blue Pulleys
2- Gold Double Pulleys
2- Red Double Pulleys
1- Large Silver Pulley

**Door #3**

#4 Bag of Rope 300' (Red)
#9 Bag of Rope 300' (Orange & Blue)
#10 Bag of Rope 300' (Red w/ White Stripe)
#11 Bag of Rope 300' (Blue w/ White Stripe)

**Drawer #4**

1- Book w/ Inventory, CSR Forms & Rope Log
2- Working Extensions
2- Brown CMC Rescue bags w/ multi colored cord

**Door #4**

Various Edge Protections
1- Edge Roller
Yellow #3 Bag of Rope 200' / CMC Rescue CSR Pulley Kit (RED)

**Front Wall**

4- Seat Harnesses (1- XL, 1- XXL, 2 LG)
2- Black/Blue Full Body Harness w/ Spreader Bar
3- Orange Full Body Harness
2- Chest Harnesses
6- Red PETZL Helmets 3 w/ Lights, 3w/o Lights
1- White PETZL Helmet
1- Half SKED

**Front Floor**

1- Vent Fan w/Hose (RAMFAN)
1- Manhole Saddle
1- Sledge Hammer w/ 12 Anchor Pickets
1- Tripod Winch
1- Full Body Harness (WADF **ONLY**)

**Right Side Wall**

1- Stokes Litter w/ Lifting Bridal, 4-Red Prusik's, 3-Red Webbing,
1-Green Rope, 1-Red & 1-Silver Aluminum Carabineers.
1- SKED Litter
1- Miller Half Back
1- Rescue Harness w/ Chest Strap, Pick-Off Strap w/ 1- Silver/Gold Carabineer
1- Bag of Software: Atriers, Runners, Wristlets.
1- CSR Tripod on the floor

# TENDER 1 INVENTORY

**Cab**

1- DZHC Mobile Radio
1- Flashlight w/ charger
1- Roll Toilet Paper (under pass. Seat)

**Above D/S Comps.**

1- Wheel Chock
1- 50' of 3" Hose
1- McCloud
2- 10' by 3" Hard Suction
1- 5 gal. Water Jug

**D/S Front Top Comp.**

1- Bolt Cutter
1- Quart Canteen w/ pouch
1- Wild Land Belt
2- Hard Hats
2- 1 Gallon Canteens

**D/S Front Bottom Comp.**

1- Hale Floatable Pump

**D/S Rear Top Comp.**

1- 25' 1 ¾" Hose
1- 50' 3" Hose
1- Roll 1" Wild land Hose
2- 25' 1" Wild land hose

**D/S Rear Bottom Comp.**

1- Hydrant Wrench
1- 1 ½" to 1" Reducer
1- 4" Double Female
1- 3" Double Male
1- 1 ¾" (nh) to ½" (np) Reducer
1- 4" Steamer/LDH Hook up
1- 2 ½" Female to 1 ½" Male Reducer
1- 2 ½" Female to 1 ½" Male Swivel Reducer
1- 3" to 2 ½" Reducer
1- 3" to 2 ½" Double Female Reducer
1- 2 ½" Double Female
1- 2 ½" Elbow
1- 2 ½" Male Cam lock
2- Spanner Wrenches

**D/S Rear Bottom Comp. (con't)**

2- Pin Lug Spanner Wrenches
2- 4" to 2 ½" Double Females
3- 3" Hard Suction Strainers

**Cross Lays**

1- 200' 1 ¾" Hose
1- 500' 1" Forestry Line w/ Appliances

**Tailboard**

1- Hose Reel w/ Red Line & Nozzle
2- 5 gal. Buckets of Foam

**P/S Above Comp.**

1- Chainsaw
1- 2 gal. **mixed** Gas 40:1
1- Pair of Chaps
1- Tool Pouch
1- 50' ¼" Lanyard
2- Chainsaw Wrenches
5- Spare Chains

**P/S Front Top Comp.**

1- 50' of 3" Double Jacketed Hose
1- Brush Hook
1- Pulaski
1- Hatchet
2- Shovels

**P/S Front Bottom Comp.**

2- 5 gal. Jugs of Fire Gel
1- Hose Reel w/ 200' 1 ½" Forestry Line

**P/S Rear Top Comp.**

2- 50' Hose (np)
1- Tool Box w/ Various Tools

**P/S Rear Bottom Comp.**

1- Foam Pak
2- 5 gal. Class "A" Foam

# TRUCK 1 - INVENTORY

**Cab**

1- MX 6
1- Flashlights
1- Thermal Imager
1- Portable suction
1- EMS jump kit
4- Air Packs
1- Ammo Can w/ 20' Chains

**Pump Panel**

1- Hydrant Wrench
2- Standard Spanners
2- LDH Wrenches

**D/S Comp. #1**

1- 2 ½ Double Male
2- 2 ½ Double Female
2- 1 ½ Double Female
2- 2 ½ to 1 ½ Reducer
1- Storz to 2 ½ Adapter
1- Storz to 4" Adapter
1- 4 ½ to 4" Reducer
1- 2 ½ Gated Valve
1- 250 GPM Nozzles
2- Flashlights and Chargers
1- Rubber Mallet
1- Hose Reel Hand Crank
1- LDH Roller
1- 25' LDH
1- 50' LDH
1- 50' 2 ½" Hose
2- 50' 1 ¾ " Hose

**D/S Comp. #2**

1- Ladder Safety Harness
4- Ladder Belts
2- Ladder Tie Off Straps
2- Fire Axes
1- Tool Bag w/ Assorted tools
1- Halligan Tool
1- Sledge Hammer
1- Bolt Cutter
1- TNT Tool

**D/S Comp. #3**

1- Cimbi Tool ( power unit, cutter tool)
2- Glass Master's
2- Seatbelt Cutters
4- Step Chocks
1- Dewalt Sawzall
1- Yellow Tarp
1- Set of Cribbing
1- Air bag Kit

**Rear**

1- Hydrant Bag Ariel Intake
2- Standard Spanner Wrenches
2- LDH Wrenches
1- Pike Pole
1- Attic Ladder
1- Storz to 2 ½" Adapter on LDH

**P/S Comp. #1**

1- PPV Fan
1- Chain Saw w/ Extra Chain
1- Chain Saw Tool Kit
1- K-12 Saw w/ Extra Blade
1- Funnel for Chain Saw

**P/S Comp. #2**

1- 10lb. Dry Chem. Extinguisher
1- Stored Pressure Water Extinguisher
2- PPE / Privacy Kits
9- Traffic Cones
1- Ammo Can w/ Extinguisher Stuff

**P/S Comp. #3**

3- Air bags
4- Pieces of Ply wood for air bags

**P/S Comp. #4**

1- Generator
1- 2 ½ Gal. Gasoline Can
1- 2 ½ Gal. **Mixed** Gasoline Can

**Ladder Rack**

1- 35' Extension Ladder
1- 14' Roof Ladder

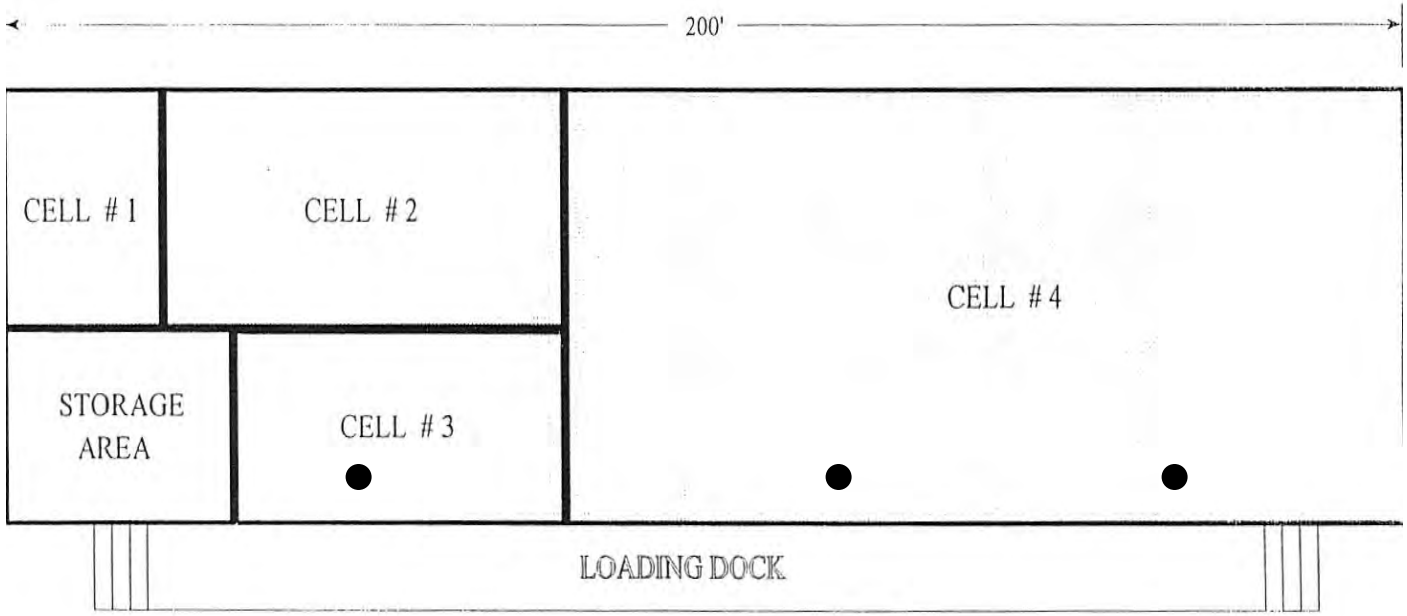
**Cross Lays** 200' 1 ¾" Hose w/ TFT Nozzles

**Hose Bed**

600' of 5" LDH
500' of 3" Hose
1- 5 Gal. Bucket of Oil Dry
1- Plastic Flat nose shovel

# APPENDIX C

# FLOOR PLAN BLDG. 106-22



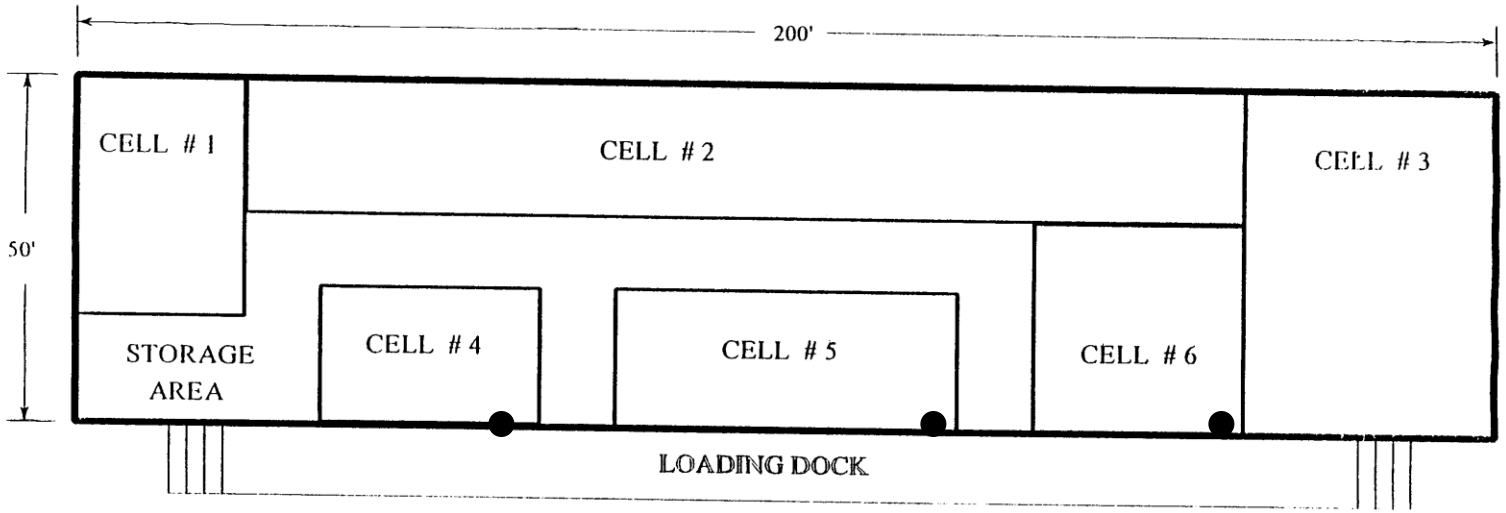

| Position | Dimension | Max # Drums |
|---|---|---|
| CELL # 1 | 24' x 27' | 136 |
| CELL # 2 | 54' x 27' | 288 |
| CELL # 3 | 43' x 21' | 216 |
| CELL # 4 | 119' x 48' | 980 |

Cells are divided by two inch high concrete berms.

● Fire Extinguishers and Exits

FIGURE 20

# FLOOR PLAN BLDG. 106-23

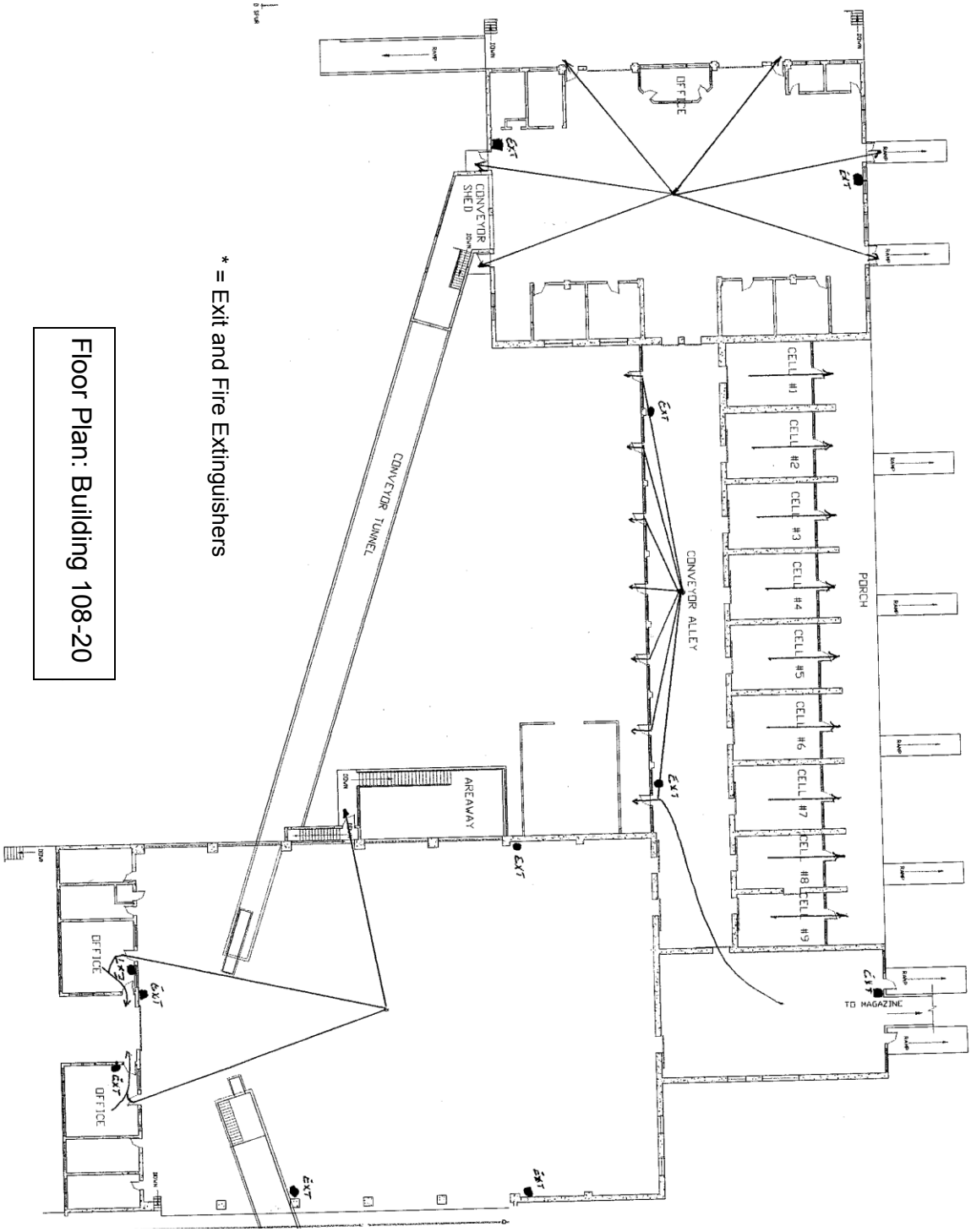



| Position | Dimension | Max # Drums |
|---|---|---|
| CELL # 1 | 25' x 34' | 160 |
| CELL # 2 | 148' x 18'6" | 560 |
| CELL # 3 | 33'6" x 48' | 168 |
| CELL # 4 | 19' x 30'6" | 96 |
| CELL # 5 | 19' x 50'6" | 176 |
| CELL # 6 | 31' x 30'6" | 184 |
| | TOTAL | 1,344 |

Cells are divided or bordered by two inch high concrete berms.

● Fire Extinguishers and Exits

All measurements approximate.



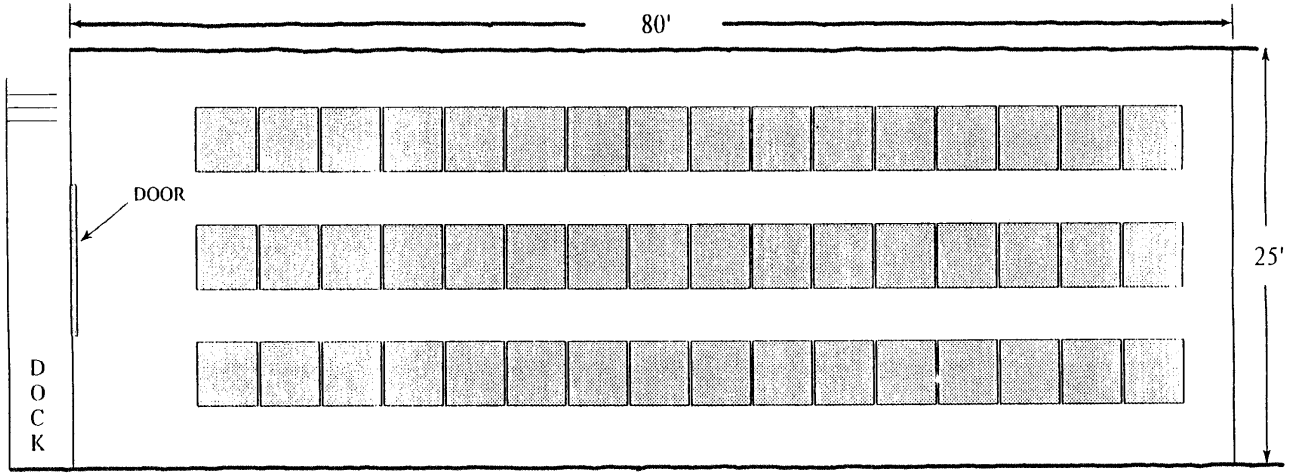

* = Exit and Fire Extinguishers

Floor Plan: Building 108-20

FIGURE 23

# FLOOR PLAN OF A TYPICAL BAY IN A TRIPLE-ARCH MAGAZINE IN THE 116 GROUP

## Which includes all the 116 Bldgs and 113-73A



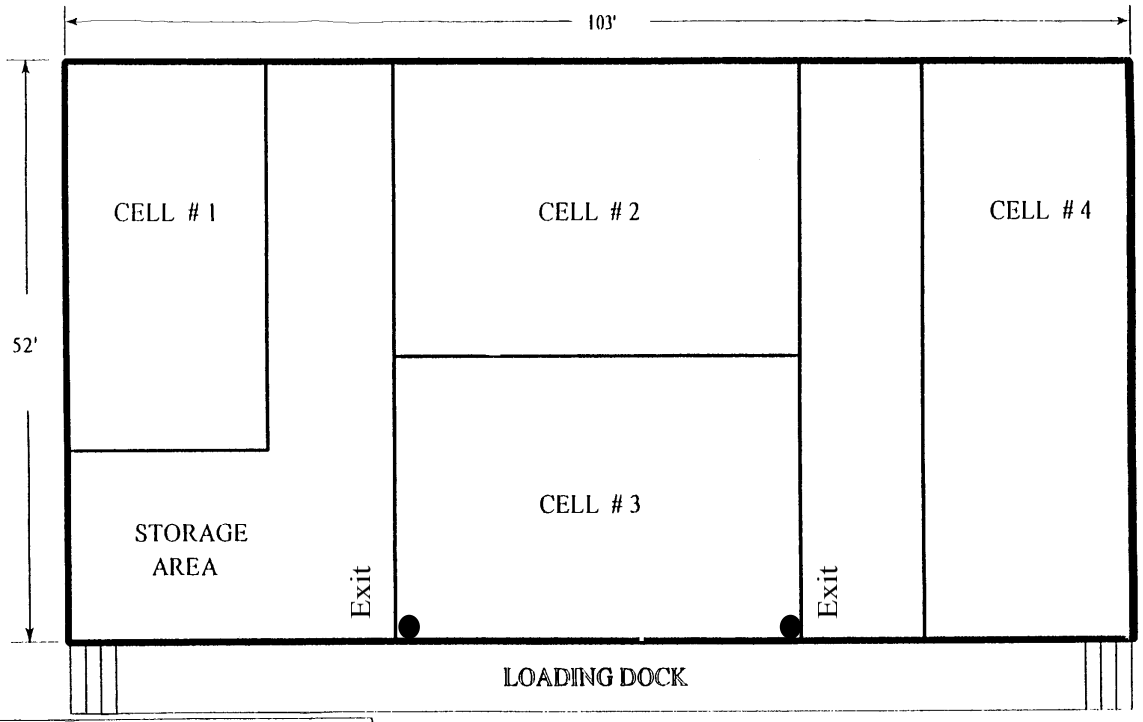

| Position | Dimension | Max # of Pallets |
|---|---|---|
| CELL A | 25' x 80' | 96 |

Three rows of pallets (4' x 4') with a minimum of 3' on all sides.

All measurements approximate.

FIGURE 21

# FLOOR PLAN BLDG. 115-9

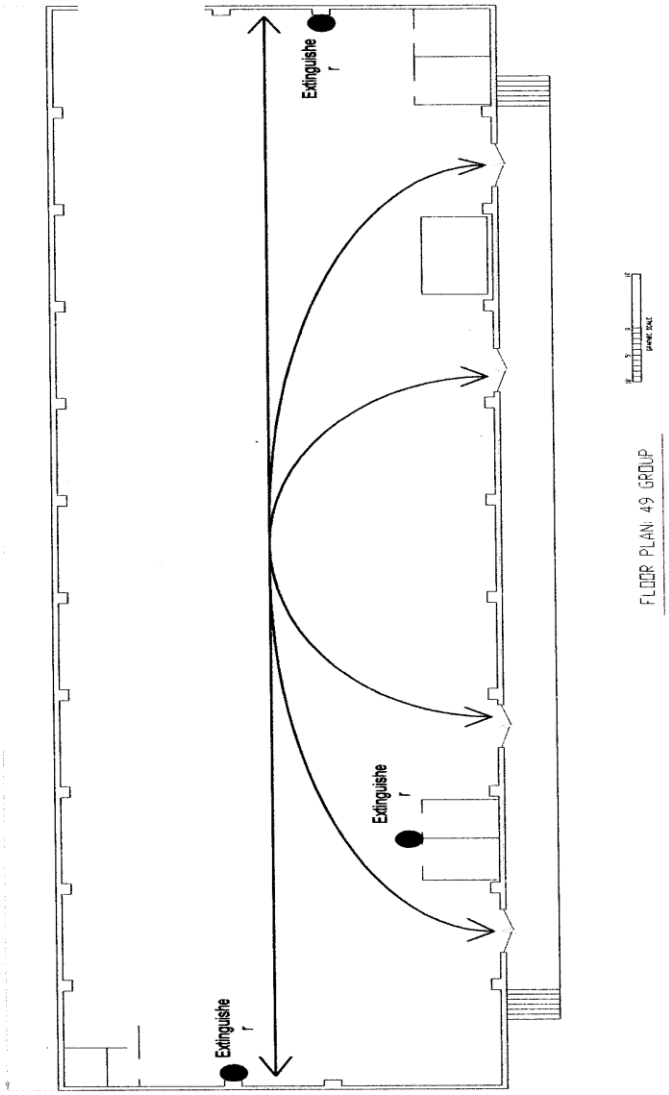



| Position | Dimension | Max # Drums |
|---|---|---|
| CELL # 1 | 18' x 33'6" | 96 |
| CELL # 2 | 25' x 39' | 192 |
| CELL # 3 | 25' x 39' | 192 |
| CELL # 4 | 19' x 50' | 144 |
| | TOTAL | 624 |

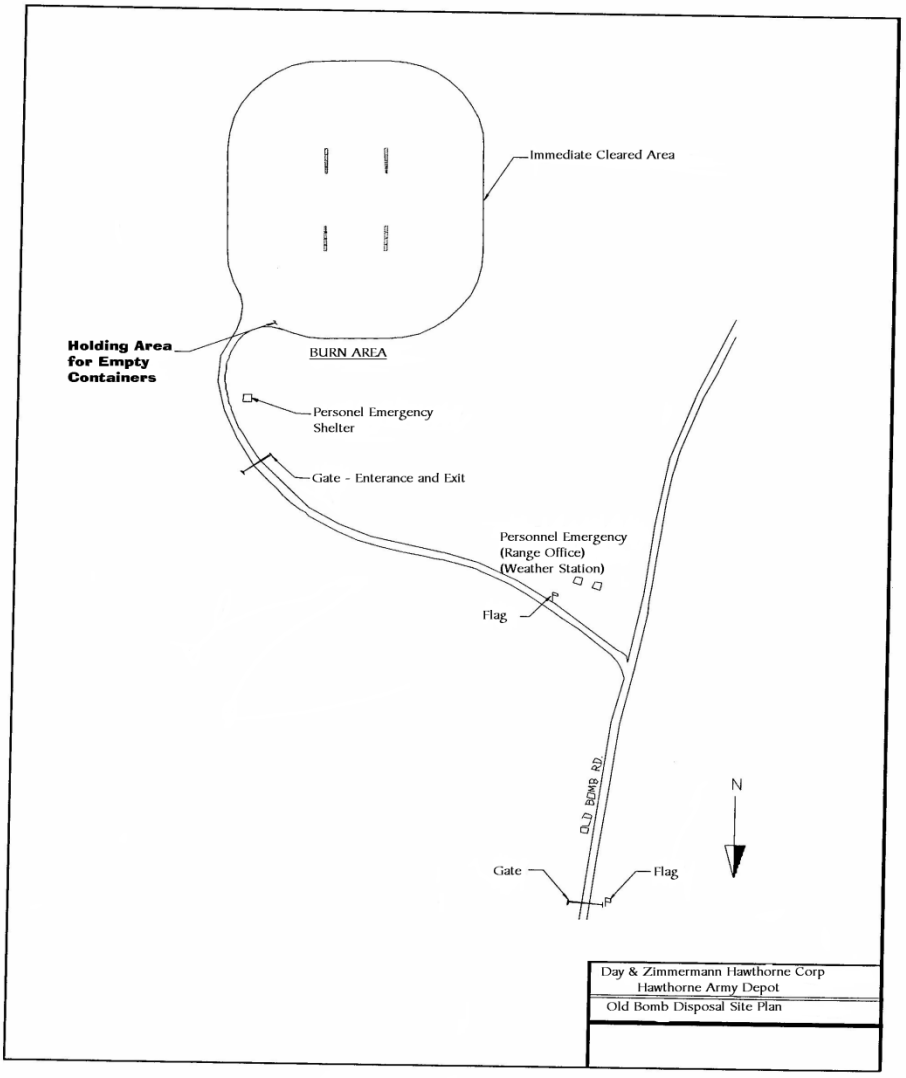
**Cells are divided by two inch high concrete berms.**

● Fire Extingisher

All measurements approximate.


Extinguishe
r
Extinguishe
r
Extinguishe
r
FLOOR PLAN: 49 GROUP

## SITE LAYOUT


Immediate Cleared Area
Holding Area for Empty Containers
BURN AREA
Personel Emergency Shelter
Gate - Enterance and Exit
Personnel Emergency
(Range Office)
(Weather Station)
Flag
OLD BOMB RD.
N
Gate
Flag
Day & Zimmermann Hawthorne Corp
Hawthorne Army Depot
Old Bomb Disposal Site Plan

# APPENDIX D

# Memorandum of Agreement
# Between
# Hawthorne Army Depot and
# Mineral County Office of Emergency Management

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**SUBJECT: AGREEMENT FOR MUTUAL AID**

This Agreement entered into this 1st day of January 2010, between the Commander of the Hawthorne Army Depot (HWAD), acting according to the authority of Section 1856, Title 42, United States Code and the Mineral County Office of Emergency Management, acting pursuant to NRS 277.180, to secure for each the benefits of mutual aid in the protection of life and property; firefighting; emergency medical services; hazardous materials incidents; rescues; technical rescue incidents; vehicle and machinery extrication; wildland fires; mass casualties accordingly, it is agreed that:

1. Upon request by a representative of Hawthorne Army Depot (HWAD) or designee, or by a representative of the Operating Contractor Fire & Emergency Services (FES), or by a representative of the Mineral County Office of Emergency Management (MCEOM) or designee, or by Mineral County Fire Department (MCFD), HWAD Fire & Emergency Services personnel and equipment will be dispatched 40 miles in each direction of HWAD property for which the MCFD normally provides emergency services as designated by the representative of the MCFD.

2. Upon request by a representative of the MCFD, equipment and personnel of the MCFD will be dispatched to any point within the area for which the HWAD FES normally provides emergency services as designated by the representative of HWAD FES.

3. The participating agencies will provide fire suppression equipment and mutual aid assistance within their own protection guidelines, safety limitations, and availability of resources, without unnecessary depletion of resources.

(a) Rapid Intervention Teams (RIT) consists of trained firefighters equipped to perform RIT tasks.

(b) These standards require that a minimum of two firefighters be prepared outside in full protective equipment, while other crew members are working in a hazardous atmosphere.

(c) Two members of the initial attack crew who are assigned for rapid deployment to rescue lost or trapped members.

NOTE: Mutual Aid firefighters will not be used to fight fires in the buildings or structures that contain explosives, radiological, or toxic chemicals.

# Memorandum of Agreement
# Between
# Hawthorne Army Depot and
# Mineral County Office of Emergency Management

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4. Any dispatch of equipment and personnel pursuant to this agreement is subject to the following conditions.

(a) Any request for aid under this agreement will include a statement of the amount and type of equipment and personnel requested, and will specify the location to which the equipment and personnel are to be dispatched. A representative of the responding organization will determine the amount and type of equipment and number of personnel to be furnished.

(b) The responding organization will report to the officer in charge of the requesting organization at the location to which the equipment is dispatched and will be subject to the orders of that official.

(c) The responding organization will be released by the requesting organization when the services of the responding organization are no longer required, or when the responding organization is needed within the area where it normally provides fire protection.

(d) If a incident occurs involving aircraft owned or operated by the United States or military aircraft of any foreign nation within the area for which MCFD normally provides emergency services, the Fire Chief or designee of the HWAD FES will assume command on arrival of the scene.

5. Each party waives all claims against every other party for compensation of any loss, damage, injury, or death occurring as a consequence of the performance of this agreement except those claims authorized under section 2201, Title 15, United States Code.

6. Section 2201, Title 15, United States Code governs compensations to municipalities for direct costs and losses sustained while fighting fires on federal property.

7. All equipment used by HWAD FES in the execution of this agreement will, at the time of action hereunder, be owned by either the government or Operating Contractor of the Hawthorne Army Depot; and all personnel acting in behalf of the Operating Contractor under this agreement will, at the time of such, be an employee of the Operating Contractor.

# Memorandum of Agreement
# Between
# Hawthorne Army Depot and
# Mineral County Office of Emergency Management

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8. All equipment used by the MCFD in the execution of this agreement will, at the time of action hereunder, be owned by Mineral County; and all personnel acting for the MCFD under this agreement will, at the time of such, be an employee or volunteer member of the MCFD.

9. This agreement shall be in effect for two (2) years from the date of signature. This agreement may be terminated by either party with sixty (60) days written notice.

Kimberly L. Gilbert-Mason — 1-21-2010
Kimberly L. Gilbert-Mason
Lieutenant Colonel, U.S. Army
Commanding
Date

1-19-2010
Clifford Cichowlaz
General Manager
Day & Zimmermann Hawthorne Corporation
Date

1/21/10
Ken Ramsey,
Director, Depot Protection
Day & Zimmermann Hawthorne Corporation
Date

1/13/2010
Jerrie Tipton
Chairman, Board of Mineral County
Commissioner
Date

Jan 13, 2010
Craig Nixon
Fire Chief, Mineral County
Fire Department
Date

# Memorandum of Agreement
# Between
# Hawthorne Army Depot and
# Mineral County Office of Emergency Management

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Rob Mathias — 1/4/2010

Rob Mathias — Date
Fire Chief, Day & Zimmermann Hawthorne Corporation
Fire & Emergency Services

Cherrie George — January 13, 2010

Cherrie George — Date
Mineral County Clerk Treasurer

# APPENDIX E

# Memorandum of Agreement
# Between
# Hawthorne Army Depot
# and
# Walker River Paiute Tribe

SUBJECT: AGREEMENT FOR EMERGENCY SUPPORT, TRAINING, AND FOR ADVANCE NOTICE OF TRAIN MOVEMENT AND UNUSUAL HAZARDS

This Agreement, entered into this 16th day of May 2006, between the Commander, Hawthorne Army Depot (HWAD) as agent of the secretary of the Army under authority of Section 1856a, Title 42, United States Code and the Chairperson of the Walker River Paiute Tribal Council representing the Walker River Paiute Tribe (Tribe), is to secure an agreement for the protection of life and property from damage resulting from any accidents occurring during the transportation of ammunition and explosives and other materials and equipment via railroad/highway through the Walker River Paiute Reservation. This agreement is entered into in compliance with paragraphs 5c and 12c of the Right-of-Way Agreement Between Indian Plaintiffs and Army, which agreement was approved by all parties and by the federal district court for the district of Nevada in the consolidated cases United States v. Southern Pacific Transportation Co., and Walker River Paiute Tribe et al v. Southern Pacific Transportation Co., Civ. No.s R2707-**BRT** and R2708-**BRT**. Accordingly, it is agreed that:

a. Upon request of the Walker River Paiute Tribe's designated representative, the Commander of HWAD or **his/her** designated representative will dispatch equipment and personnel from HWAD to the site of the accident, upon the Walker River Paiute Reservation, to render assistance in the resolution of a Railroad/Highway accident occurring during shipments to or from HWAD.

b. Hawthorne Army Depot's designated contact for emergency response to rail accidents and highway accidents involving explosives is the HWAD Guard Operations Center (945-7555) or Emergency Response (945-7911). Both are manned 24 hours per day. The reporting Tribal official will provide the name and the phone number of their point of contact to the Guard Operations Center.

c. The dispatch of personnel and equipment pursuant to this Agreement is subject to the following conditions:

   (1) Any request for assistance under this Agreement will include a statement of the location and any observable condition that has resulted from the accident; what evacuation measures have been executed by emergency volunteers or law enforcement officers; and any applicable restrictions in route to the accident site.

(2) Hawthorne Army Depot designated personnel will report to the Walker River Paiute representative an appraisal of the situation.

(3) Upon arrival at the site of any accident, HWAD designated personnel will take charge of the situation until such time as the emergency has ceased to exist.

(4) Personnel from the Walker River Paiute Tribe may be requested and permitted but not required to render direct assistance in the actual resolution of the accident. Tribe assistance from trained emergency volunteers and other emergency responders will consist primarily in the initial identification of the hazard and evacuation of personnel from the area but could involve other activities completed by emergency responders who are trained to handle the particular emergency.

d. Hawthorne Army Depot's government transportation officer will provide if possible a 72 hour advance notice but at a minimum a 24 hour advance notice to the Tribe's designated representative or representatives of shipments by rail to and from HWAD. The notice will include the number of railcars expected and the hazard class of the material being transported. Shipments that involve unusual transportation requirements, i.e., extremely heavy shipments of battleship gun barrels or hazards that will necessitate either special security or safety will be coordinated with designated Tribal officials prior to movement through the Reservation. This advance notice could be via a telephone call, email, fax or any combination of these modes of notice or other means of notice determined by the Tribe and agreed by HWAD.

e. To facilitate communications between the parties concerning the implementation of this agreement, HWAD and the Walker River Paiute Tribe agree that each party shall designate a liaison or liaisons who will be responsible for contact and coordination between the parties concerning matters covered by this Agreement and related inquiries that may arise from time to time. Such liaison shall be designated in writing by the Tribal Chairperson and the HWAD Commander. Such designation of liaison may subsequently be changed from time to time in writing. The Chairperson of the Tribe and the Commander of the HWAD shall represent the parties in signing any such letters designating liaisons.

f. The U.S. Army will offer, through its operating contractor at HWAD at no cost to the Walker River Paiute Tribe, the opportunity to participate in training sessions held for emergency response employees at HWAD.

Hazmat training, per the Army rail right-of-way agreement, will be provided to the Tribal emergency response employees. This training will be conducted at Schurz.

Mercury transportation emergency response training will also be provided to Tribal emergency response personnel at Schurz prior to transport of mercury by truck to HWAD. This training will be a one time event, unless the mercury is removed from HWAD and then, the training will be provided again.

They will be trained in recognition of hazards and actions required in emergency situations resulting from railroad/highway transportation of Army hazardous material (ammunition and explosives). Other training opportunities, to be conducted at HWAD, will be made available to Tribal personnel.

HWAD understands that they are required per the Army Right-of-Way Agreement to conduct training for Tribal emergency responders on topics related to potential hazards and endangerment to the Tribal community associated with the transportation of hazardous materials to and from HWAD. These trainings can include identification and recognition trainings since dealing with transportation accidents could involve a higher level of response from the Tribal emergency responders.

All requests for emergency service training should be coordinated with the operating contractor's Fire Chief at (775) 945-7487.

g. This agreement shall become effective upon the date signed and shall remain in effect for five years or may be amended by mutual written consent of the parties hereto.

FOR WALKER RIVER PAIUTE TRIBE:

Genia Williams
Tribal Chairperson

May 16, 2006
Date

FOR SECRETARY OF THE ARMY:

Johnny M. Summers
Lieutenant Colonel, U.S. Army
Commanding

May 25, 2006
Date

# APPENDIX F

# M.O.U BETWEEN THE US ARMY, DAY & ZIMMERMANN HAWTHORNE CORPORATION AND THE MINERAL COUNTY SHERIFF'S OFFICE

## 1. PURPOSE

A. It is the intent of this document to define the coordination and cooperation between the Mineral County Sheriff's Office (MCSO), the Mineral County District Attorneys Office (MCDA), the Commander of Hawthorne Army Depot (HWAD), and Day & Zimmermann Hawthorne Corporation (DZHC), Operating Contractor of HWAD.

## 2. REFERENCES

A. Department of the Army Contract #DAAA09-99-D-0022.

B. Army Regulation 525-13, 10 September 1998, Antiterrorism Force Protection

## 3. SITUATION

A. Applicable county, state, and Federal laws, rules and regulations prescribe functions, authority and jurisdictions, which control the preservation of order effort on HWAD. Simply stated, the Commander of HWAD has ultimate responsibility for the safety and security of all persons and property on the Depot. DZHC has the contractual obligation to provide preservation of order services, and the MCSO has the authority and responsibility for providing law enforcement services for the entire county, which includes concurrent jurisdiction at HWAD. The Mineral County District Attorney bears the obligation to investigate/prosecute any person involved in criminal activity in Mineral County, Nevada.

B. This agreement does not alter such matters. The preservation of order on HWAD is of mutual concern to all parties; however, the investigation of criminal incidents on HWAD may involve matters relating to the functioning of command or operation of the Depot that are non-criminal in nature. In such instances, it is essential that certain administrative procedures be initiated or be continued as separate actions while investigation of the criminal incident continues. Similarly, reporting requirements for criminal and non-criminal incidents by the Commander, HWAD are governed by the Army regulations that may be of no concern to DZHC, MCSO, or the District Attorney. Thus, it is recognized that dividing lines are not always clear, and generally there are legitimate areas of overlap of interest.

C. This memorandum recognizes the above situation, and makes provisions for working effectively with it. It is not intended to restrict the parties involved, but to enhance interrelationships through cooperation and coordination. The following are the objectives of this memorandum:

1. To provide a basis for cooperation and coordination between the MCSO, HWAD, DZHC, and between the various personnel assigned the task of preserving an acceptable level of order on HWAD.

2. To preclude uncoordinated or unnecessary duplicate investigation of the same incident by two or more agencies.

3. To preclude compromise of investigative effort being made by one of the parties.

4. As a baseline for cooperation and coordination, there will be a free flow of information, on a close hold, **"OFFICIAL USE ONLY"** basis between the parties on the nature and content of enforcement or investigative activity, except where law restricts transfer of information.

5. It is mutually recognized that the Commander, HWAD has unique reporting requirements and responsibilities, which include the notification and referral of criminal incidents to other Federal agencies, such as the Federal Bureau of Investigation, US Army Criminal Investigation Division, the US Army Intelligence Service and the Defense Investigative Service. The Commander, HWAD will be advised, through appropriate HWAD channels, of all crimes occurring on the Depot.

## 4. SCOPE

A. This agreement encompasses all currently recognizable interfaces between parties involved, and it is intended that any unforeseen problems that might arise will be resolved through negotiation between the parties, using this document as basic guidelines. Prior planning may be required for certain types of routine or emergency situations. Such planning documents, to include special orders, standing operating procedures, or other instructional material will be sectioned to this agreement.

## 5. AGREEMENTS, SUPPORT, AND RESOURCES REQUIREMENTS

A. Coordination and liaison will be accomplished by the following, or by alternate(s) in the event of the absence of designated individual(s):

1. The Mineral County Sheriff

2. The Mineral County District Attorney

3. The ACO Security Officer, HWAD

4. The DZHC Physical & Industrial Security Manager

B. The MCSO will provide 24 hour routine and standard law enforcement services for the areas of HWAD that are generally located to the west of U.S. 95, including the areas commonly known as, Conelly, Public Quarters, Thorne Road and unimproved real estate.

C. MCSO will not be responsible for checking security of the fences, gates, shops and administrative buildings within the Industrial Area.

D. The MCSO will respond to calls for assistance from DZHC in other areas of the Depot.

E. The MCSO will respond to HWAD for assistance for critical incidents that may be beyond DZHC Security's abilities. SRT duties cannot be provided by MCSO, but the MCSO will agree that sufficient resources will be used to set up a perimeter and initially contain a critical incident. MCSO further agrees to quickly receive additional manpower support from adjacent counties agencies as well as the Nevada Highway Patrol if a situation exceeds their capabilities.

F. The Mineral County Animal Control will provide animal control services for the housing areas, and will respond to requests for assistance in other areas of HWAD. (The Commander of HWAD and the DZHC General Manger can and will enforce tenant agreements relating to household pets; however, equipment and personnel to handle stray or dangerous animals are not available at HWAD).

G. The MCSO has the right and duty to serve various warrants and summons on HWAD. The Government staff and DZHC will cooperate to the fullest by making employees available at convenient locations for serving such documents. In the event the MCSO has reason to believe that the person to be served may flee or be dangerous, DZHC will be notified and will make arrangements for service at the work site. Access to fenced housing areas for the purpose of serving such documents at individual homes will not be impeded.

H. The MCSO will be notified of fatal vehicle accidents occurring inside the fenced areas of the Depot.

I. The MCSO will advise DZHC of any accidents or traffic citations involving the operation of government owned or DZHC owned vehicles assigned to HWAD.

J. Nothing in this agreement will interfere with the right of individuals living or working on HWAD to call on the MCSO for personal reasons, nor shall it impede the MCSO from handling such calls as routine law enforcement matters.

K. Upon request of the MCSO, DZHC may provide assistance in controlling traffic at accident scenes along state and county roads, when such roads are in close proximity to HWAD.

6. **TERM OF AGREEMENT**

A. This agreement will be reviewed one (1) year from the date of approval. This agreement may be terminated by any party, without cause, by giving the other party thirty-day (30) written notice.

7. **INDEMNIFICATION AND HOLD HARMLESS**

A. The parties hereto agree to indemnify and hold harmless the other parties to this MOU for any acts performed by its officers and employees that occur while acting under the scope of this agreement. By entering into this agreement, the parties do not waive sovereign immunity and intend to assert all defenses as set forth in statute.

Acknowledgment:

LTC Johnny M. Summers
**Commander**
Hawthorne Army Depot

CLIFFORD P. CICHOWLAZ
**General Manager**
Day & Zimmermann Hawthorne Corporation

FRED TRDLA
**Sheriff**
Mineral County

CHERI EMM-SMITH
**District Attorney**
Mineral County

KEVIN WADLOW
**Chairman**
Board of Mineral County Commissioners

**The Mineral County Board of Commissioners approved this agreement in open meeting on _____ 2004.**

# APPENDIX G

# Memorandum of Agreement between Hawthorne Army Depot And Mount Grant General Hospital

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SUBJECT: AGREEMENT FOR MUTUAL AID

This agreement, entered into this 8 day of June, 2004, between the Secretary of the Army, acting according to the authority of Section 1856, Title 42, United States Code, and Mount Grant General Hospital, is to secure for each the benefits of mutual aid to voluntarily coordinate services with each of the signatories in a good faith effort to minimize risk to patient care and hospital operations in the event of a natural disaster(s) and weapons of mass destruction that include but are not limited to mass casualties from terrorism. It is agreed that:

1. SCOPE AND APPLICABILITY

a. Both agencies agree that in the event of natural disaster(s), weapons of mass destruction (WMD) and/or mass casualty incidents (MCI), affecting hospital services as a result of the above incidents which impacts the operational capabilities of any other agency, the affected agency may request assistance from the other agency as set forth herein.

b. In the event of a disaster, an affected agency should first contact the Safety Officer, Mt. Grant General Hospital. If the incident is broader than the agreed agencies determine that they can handle by working together, then they will contact the Mineral County Office of Emergency Management (MCOEM) who then will coordinate with the State of Nevada Emergency Operations Center (NEOC).

c. All agencies will use the guidelines established herein to coordinate the care and services necessary to deal with the incident. Agencies shall agree to take all appropriate actions during an incident without regard to race, color, creed, national origin, age, sex, religion, or handicap, to assist other Agencies as necessary. No Agency shall be required to provide treatment, care, medical supplies, equipment, services or personnel over and above that which is necessary to meet its own needs, existing or anticipated, or beyond its own resources.

d. In the event of a disaster, each of the Agencies agree to provide assistance as set forth herein, at their sole cost and expense for a period to be determined by the affected Agency's EOC based upon the needs of affected Agencies.

# Memorandum of Agreement between Hawthorne Army Depot And Mount Grant General Hospital

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e. In the event that the affected Agency is unable to continue patient care for some or all of its patients, the Agency will agree to act as receiving facilities for these patients. The EOC of affected Agencies will coordinate the transfer of patients and will assign them to the other Agencies' facilities.

f. Each Agency agrees to follow the guidelines set forth herein to the extent possible. There shall be no cause of action or basis of liability for breach of this Agreement.

g. This Agreement is not intended to replace each facilities emergency operations plan or to adversely effect existing transfer agreements between facilities, but is intended to support those plans and agreement.

2. GUIDELINES

It is agreed that:

a. Accept as many casualties as possible.
b. Accept as many transfers as possible.
c. Provide emergency treatment/care within the capabilities of the facility.
d. Provide emergency physician and medical support services.
e. Provide diagnostic services as available.
f. Provide transportation as available and requested.
g. Notify the Agencies when vacancies no longer exist.
h. Provide medical record for patient transferred/received (copy acceptable if time permits.)
i. Provide other medical services that may be necessary and requested.

3. EMERGENCY MEDICAL SUPPLIES AND EQUIPMENT

a. Provide emergency medical supplies and equipment within resource capabilities.

4. COST OF SERVICES, EQUIPMENT AND PERSONNEL

a. An Agency receiving services, equipment and personnel, will reimburse the cost of it to the Agency providing services, equipment and personnel.

# Memorandum of Agreement between Hawthorne Army Depot And Mount Grant General Hospital

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## 5. COMMUNICATION SERVICES

In the event the Agencies' normal lines of communication are disrupted, each Agency will:

a. Monitor Emergency Room Radios for emergency information transmitted.
b. Notify local fire, police and other municipal services.
c. Provide emergency communication equipment, if available, to the effected agency.
d. Request support from Agencies Emergency Operations Center.

## 6. ADMINISTRATIVE SERVICES

Agencies will provide the following administrative services for them selves and will assist by:

a. Maintaining a current listing of all casualties or transfers made.
b. Maintaining a current listing of all discharges, their assigned areas and location.
c. Maintaining a current listing of all deaths.
d. Maintaining a record of all treatment administered, including medical supplies, or charges made.
e. Contact family members of patient/personnel and inform them of the disposition of each.
f. Other information or record keeping, as may be requested or deemed necessary

## 7. EMERGENCY MEDICAL INFORMATION

Agencies experiencing a disaster and seeking assistance will:

a. Notify Agencies of the incident, and those casualties, if any, and/or transfers are being made, or will be made.
b. Provide all medical information and/or records as necessary or requested.
c. Coordinate emergency transportation as necessary or requested.
d. Maintain a current listing of all patients and/or personnel and the disposition of each.
e. Assign medical personnel as requested.
f. Notify the attending physicians of the disaster and the disposition of their patients.

# Memorandum of Agreement between Hawthorne Army Depot And Mount Grant General Hospital

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g. Notify each agency when the disaster is over.
h. Provide or coordinate other services/duties that may be necessary or requested.

# Memorandum of Agreement between Hawthorne Army Depot And Mount Grant General Hospital

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for _____ 1 June 04
DAVID W. DORNBLASER — Date
Lieutenant Colonel, U.S. Army
Commanding

_____ 1 June 04
CLIFFORD CICHOWLAZ, General Manager — Date
Day & Zimmermann

_____ 6/1/04
KEN RAMSEY, Director — Date
Depot Protection, Day & Zimmermann

_____ 6/8/04
RICHARD MUNGER — Date
Director, Mount Grant General Hospital

_____ 6-8-04
LARRY MARSHALL — Date
Fire Chief, Day & Zimmermann
Fire & Emergency Services

# APPENDIX H

## Hazardous Materials

## Emergency Notification Procedures

The telephone numbers listed below should be called in sequence. Give your name, location, telephone number, and identify your call as a hazardous materials emergency.

Nevada Division of Emergency Management - ask for the city officer

| | |
|---|---|
| Business Hours | (775) 687-0300 |
| Evenings and Weekends (NHP Dispatch) | (775) 683-0400 |

If prompt response is not available from the Division of Emergency Management, call the numbers listed below as needed.

| | |
|---|---|
| CHEM TREC | 1-800-424-9300 |
| National Response Center (Spills involving waterways) | 1-800-424-8802 |
| Explosive Ordnance Disposal Team | |
| Herlong, CA | 1-560-827-4400 or |
| | 1-530-827-4408 |
| Presidio (San Francisco, CA) | 1-415-561-4203/4312 |

# APPENDIX I

## 11.1 **1f Definitions and Acronyms**

**Discharge:** The spilling, draining, pumping, pouring, exhausting, venting, emitting, emptying, leaking, or dumping of hazardous materials, hazardous waste, or POL products as defined elsewhere in this plan. For the purpose of this plan, the terms “discharge” and “release” are synonymous. These terms do not include the discharge/release of any material which is authorized by a permit issued by a Federal or State regulatory agency under the Federal Water Pollution Control Act, the Clean Air Act, or the Resource Conservation and Recovery Act, or which is contained within a structure.

**Reportable Discharge:** Any discharge of hazardous materials, hazardous waste, or POL products to the environment will be reported to the Guard Operations Center/FES by calling x7911 or 911 from any base operated phone. The ERC, in consultation with the Depot’s Environmental Office, will determine if the quantity discharged is in excess of those allowed by and reportable according to 40 CFR Parts 117, 302, 355 Appendix A, 370.20, 28, the Nevada Administrative Code (NAC) Sections 445.430 through 445.945 and 445.070 through 445.241, or permit conditions governing the discharge of the substance in question.

**Facility:** For the purpose of this plan, this term includes any structure or land area where POL products are stored, dispensed, or burned; where hazardous waste is treated, stored, disposed of, or generated; or where hazardous materials are stored or used.

**Hazardous Material:** Any material meeting Department of Transportation, Environmental Protection Agency, the Nuclear Regulatory Commission, or Occupational Safety and Health Administration criteria for posing a hazard to people or the environment. Examples of such materials include flammable, corrosives, explosives, radioactive materials, asbestos, pesticides, oxidizers, polychlorinated biphenyls, chlorinated organic solvents, and toxic dusts containing metals such as lead, cadmium, or barium.

**Hazardous Waste:** For the purpose of this plan, any material which can no longer be used for its intended function, which cannot be recycled or sold as scrap, and whose disposal is regulated by either the Resource Conservation and Recovery Act or the Toxic Substance Control Act.

**Petroleum/Oil/Lubricant (POL) products:** For the purpose of this plan, all materials distilled, refined, or otherwise produced from petroleum and used for heating, lubrication, or as a motor fuel. Such materials at HWAD include gasoline, No 2 diesel fuel oil (DF-2), lubricating oil, and liquefied petroleum gas (LPG).

**Emergency Response Team (ERT):** Those agencies and individuals designated to respond to emergencies covered by this plan and to conduct rescue, fire fighting, damage control, and cleanup operations as directed by the ERC.

**Emergency:** For the purpose of this plan, any fire, explosion, discharge, or other event which has or could put human health and safety or the environment at risk.

**Emergency Response Coordinator (ERC):** The HWAD representative having overall responsibility for implementing this plan and its associated response activities. The primary designate for this position is the Fire Chief, or his alternates as indicated in Appendix J and described in Section 2a, b, and c.

**Acronyms:**
ACO – Administrative Contracting Office (government staff)
BRF – Battery Retort Facility
CAMEO – Computer Aided Management of Emergency Operations
CHEMTREC – Chemical Transportation Emergency Center
DF2 – Diesel Fuel Number 2
EPA – Environmental Protection Agency
ERC – Emergency Response Coordinator
ERP – Emergency Response Plan
ERT – Emergency Response Team
FBI – Federal Bureau of Investigations
FES – Fire and Emergency Services
GOC – Guard Operation Center
HOC – Halogenated Organic Compounds
HWAD – Hawthorne Army Depot
ISCP – Installation Contingency Plan
LEPC – Local Emergency Planning Committee
LPG – Liquid Petroleum Gas
MSDS – Material Safety Data Sheet
NAC – Nevada Administrative Code
NDEP – Nevada Division of Environmental Protection
NEW – Net Explosive Weight
NHP – Nevada Highway Patrol
NRS – Nevada Revised Statutes
PCB – Polychlorinated Biphenyl
POL – Petroleum, Oil, Lubricant
RCRA – Resource Conservation Recovery Act
SARA – Superfund Amendment Reauthorization Act
SOC – SOC Nevada, LLC
SOP – Standard Operating Procedure
SPCCP – Spill Prevention Control and Countermeasures Plan
TSCA – Toxic Substances Control Act

# APPENDIX J

SECURING OUR COUNTRY

## SOC Fire Department Emergency Response Coordinators

| Badge | Call | Rank | Name | Address | Phone |
|---|---|---|---|---|---|
| **CHIEF** | | | | | |
| 829 | 301 | Chief | Robert Mathias | 115 Harrison, Hawthorne | 945-3930/316-0714 |
| **INSPECTION DEPT.** | | | | | |
| 2409 | 302 | FI | Tim Rutherford | 165 Fir, Hawthorne | 945-3833/316-0724 |
| 729 | 312 | FI | | | |
| **A PLATOON** | | | | | |
| 527 | 303A | A/C | Rick Schumann | 705 Fir St., Hawthorne | 945-5443/316-0727<br>316-0117 |
| 3184 | 304A | Capt | Robert Weissman | 425 Connelly, Hawthorne | 945-1940/316-0666/<br>312-0320 |
| **B PLATOON** | | | | | |
| 635 | 303B | A/C | Doug Homestead | 425 Silver Star Ct, Yerington | 463-2958/316-0702<br>530-2958 |
| 3612 | 304B | Capt | Trustin Crittenden | 109 W. 3rd St., Hawthorne | 316-0822 / 316-2712 |
| **C PLATOON** | | | | | |
| 2084 | 303C | A/C | Ken Little | 411 Baker, Hawthorne | 945-3980/316-0709/<br>316-0606 |
| 3304 | 304C | Capt. | Chuck Scott | 8285 Scenic Ave, Stagecoach | 775-691-6388/<br>316-0703 |

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX D

# WASTE MINIMIZATION PLAN

FOR

# Hawthorne Army Depot
(HWAD)

SOC Environmental Services
2013

## INTRODUCTION

Hawthorne Army Depot (HWAD) Main Base is classified as a "large quantity generator" of hazardous waste by the Nevada Department of Environmental Protection and the U.S. Environmental Protection Agency. These agencies enforce the Resource Conservation and Recovery Act (RCRA) of 1984, which requires a "large quantity generator" to certify that it has a program in place to reduce the volume and toxicity of waste generated to the degree it has determined to be economically practicable. Waste Minimization is necessary in order to minimize present and future threats to human health and the environment. HWAD has an Environmental Policy statement in place to help achieve our goal in reducing waste.

While the Waste Minimization is written to meet the RCRA regulatory requirements, the Pollution Prevention (P2) is written to meet the requirements of AR 200-1. These two plans are very similar but very different; therefore the P2 requirements are listed in a separate document.

P2 is implemented at the HWAD, when technically feasible and cost effective, to achieve and maintain compliance with environmental laws and regulations. This includes reducing pollutants at the source; modifying manufacturing, packaging & shipping processes, maintenance or other industrial practices; modifying product designs; developing and modifying acquisition systems; recycling/reuse (to include implementing water and energy conservation measures), especially in closed loop processes; preventing disposal & transfer of pollution between media; meeting affirmative procurement requirements & promoting the acquisition & use of environmental preferable products & services; and promoting use of nontoxic substances. HWAD uses P2 to complement, and where practicable, replace traditional pollution control approaches as well as incorporates P2 planning throughout the mission, operations or product life cycle at the HWAD.

## WHAT IS WASTE MINIMIZATION?

Waste minimization is a waste management approach that focuses on reducing the amount and toxicity of hazardous waste that is generated. In addition to hazardous waste regulated under RCRA, the EPA encourages waste minimization techniques that focus on preventing waste from ever being created, (source reduction) and recycling. Waste minimization does not include waste treatment, that is, any process designed to change the physical, chemical, or biological composition of waste streams. It is important that every employee of HWAD be aware of the environmental and financial impacts related to the disposal of hazardous wastes and material and to help minimize the volumes that are generated. Areas on the Depot that generate hazardous waste and materials include chemical laboratory, maintenance/garage shops, production jobs, machine shops, subcontractors, and tenants. There are three general methods of waste minimization: **source reduction**, **recycling**, and **treatment**.

## SOURCE REDUCTION

Source reduction reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants. Source reduction includes equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

Here are some examples of HWAD efforts and ideas to help control waste generation at the source.

- Improve housekeeping and awareness by personnel regarding the proper management and use of toxic and hazardous materials. This can greatly reduce the amount of accidental spills, releases and waste generation.
- Redesign and modify production processes to possibly limit or prevent pollution or waste generation from occurring.
- Date all chemical containers when received so that the older chemicals will be used first, and most importantly label product containers to prevent accumulation of unknown products.
- When feasible, substitute non-hazardous or less hazardous materials to reduce the toxicity of the resulting waste stream. Generally, the lower degree of hazard requires lower level of control and may result in less stringent regulation.
- Purchase only what is needed, in the smallest quantities needed. Maintain inventories at a minimum, and redistribute any excess products to other divisions who may utilize to help to reduce, avoid or eliminate the generation of hazardous waste.

## RECYCLING

Another method of waste minimization is recycling. Recycling is when a waste material is used for another purpose, treated and reused in the same process or reclaimed for another process. Recycling is such a broad term that encompasses the reuse of materials in original or changed forms rather that discarding them as wastes. HWAD has common examples of recycling include:

- Some materials are commercially recycled by off-site industrial contractors including: used oil, batteries, and solvents.
- Derived dunnage from off loading commercial conveyances is sent to Property Reutilization Office (PRO) for resale.
- Metal Casing and other inert components may be separated from the energetic production job and sent to PRO.
- HWAD conducts routine open detonation shrapnel collection operations as a recycling measure which is also sent to PRO.

## TREATMENT

The last technique for waste minimization is treatment of waste. Treatment should be investigated for any waste that is unavoidably generated and that cannot be recycled in its current form. Treatment is any method, technique, or process that changes the physical, chemical, or biological character of a waste. Treatment renders the waste less hazardous and, therefore, recyclable or safer to transport, store, and dispose. Note that treatment does not prevent the creation of pollutants. Treatment involves changing the nature of the waste or reducing or eliminating the pollutants in a waste. Example of treatment:

- Rotary Furnace 9 (RF-9) – is used for the treatment of waste small arms ammunition (up to and including 20MM) as well as other small items such as fuses and primers. Use of the furnace is limited by its treatment capability and treatment limits imposed by the RCRA permit.
- Open burn pans are used to dispose of propellants and explosives that are no longer safe to store due to instability. Use of the burn pans are limited by the treatment limits imposed by the RCRA permit.
- Open detonation is used to dispose of munitions that cannot safely be processed in any other process at HWAD. Open detonation is limited by the treatment limits imposed by the RCRA permit.

At HWAD, treatment is used only for those items that cannot be safely recycled, using the least polluting method allowed under the limitations of the RCRA and Air Permits and the treatment capability of the existing processes.

## WASTE MINIMIZATION CONCLUSION

Waste prevention and minimization has positive environmental, human health and safety, and economic impacts. Waste minimization is important because it helps to protect the environment and its makes good business sense. Waste minimization saves money through avoided disposal costs, creates safer working conditions for employees, and the bottom line: protects human health and the environment. For waste minimization to be effective, all generators of hazardous waste need to have an active role. Waste minimization is a feasible and obtainable goal if carefully planned and implemented.

Therefore, waste minimization is an important goal at Hawthorne Army Depot. Implementing a "less is better" concept provides better protection of human health and safety by reducing exposures, generating less demand for disposal on the environment. Less waste also lowers disposal cost. It is our mission to eliminate waste generation at the source wherever possible without compromising product quality. The bottom line: HWAD will utilize ISO14001 to help minimize and reduce waste. Senior management support is critical for the Plan's success at HWAD.

# WASTE MINIMIZATION CERTIFICATION

February 2013

This Hawthorne Army Depot Facility has in-place a program to reduce the volume and toxicity of all hazardous wastes which are generated by the facility operations to the degree, determined by the Permittee, to be economically practicable; and that the method of treatment, storage, or disposal is the only practicable method or combination of methods currently available to the facility that minimizes the present and future threat to human health and the environment.

_____

George R. Gram II,
General Manager, SOC Nevada, LLC

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX E

# DRAFT PROTOCOL

# CUMULATIVE HUMAN HEALTH & ECOLOGICAL RISK ASSESSMENT PODS, RF-9 and OBA

**Contract # 06PD02**

*Prepared for*

**Day and Zimmerman Hawthorne Corp**
Hawthorne, Nevada

*Prepared by*

**TRC**
Windsor, Connecticut

May, 2006 (Revised August 2007)

# DRAFT PROTOCOL

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*Prepared for*
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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ADD | average daily dose |
| AEGL | acute exposure guideline level |
| AHQ | acute hazard quotient |
| AIEC | acute inhalation exposure criteria |
| APCE | air pollution control equipment |
| APCS | air pollution control system |
| AWFCO | automatic waste feed cut-off |
| | |
| BCF | bioconcentration factor |
| BIF | boilers and industrial furnace |
| BLM | Bureau of Land Management |
| BPIP | Building Profile Input Program |
| BW | body weight |
| | |
| Cal/EPA | California Environmental Protection Agency |
| CB | chlorobenzene |
| CEMS | continuous emission monitoring system |
| CHPPM | Center for Health Promotion and Preventive Medicine |
| $Cl_2$ | chlorine |
| CO | carbon monoxide |
| $CO_2$ | carbon dioxide |
| COPC | constituent of potential concern |
| CP | chlorophenol |
| CPTP | comprehensive performance testing plan |
| Cr | Chromium |
| DRE | destruction/removal efficiency |
| dscf | dry standard cubic feet |
| DZHC | Day and Zimmerman Hawthorne Corporation |
| | |
| EDL | estimated detection limit |
| EEL | estimated exposure level |
| EHQ | environmental hazard quotient |
| ERA | ecological risk assessment |
| ERAP | ecological risk assessment protocol |
| ERPG | emergency planning guidelines |
| | |
| F | fluoride |
| | |
| GOCO | government-owned, contractor-operated |
| | |
| HCE | high collection efficiency |
| HCl | hydrogen chloride |
| HEAST | Health Effects Assessment Summary Tables |
| HEPA | High Efficiency Particulate Air (Filters) |
| HF | hydrogen fluoride |
| HHERA | human health and ecological risk assessment |

## ABBREVIATIONS AND ACRONYMS
(Continued)

| | |
|---|---|
| HHERAP | human health and ecological risk assessment protocol |
| HHRA | human health risk assessment |
| HHRAP | human health risk assessment protocol |
| HI | hazard index |
| HQ | hazard quotient |
| HWAAP | Hawthorne Army Ammunition Plant |
| HWAD | Hawthorne Army Depot |
| | |
| IEUBK | Integrated Exposure Uptake Biokinetic |
| IRIS | Integrated Risk Information System |
| ISC | industrial source complex |
| ISCST | industrial source complex short-term |
| | |
| km | kilometer |
| kW | kilowatts |
| | |
| LADD | lifetime average daily dose |
| LOAEL | Lowest Observable Adverse Effect Level |
| | |
| MDL | method detection level |
| MDRK | munitions detonation rotary kiln |
| MEI | maximally exposed individual |
| $\mu g/m^3$ | microgram per cubic meter |
| $mg/m^3$ | microgram per cubic meter |
| mg/kg | milligram per kilogram |
| mg/kg/d | milligram per kilogram per day |
| MLE | most likely exposed individual |
| MPRM | Meteorological Processor for Regulatory Models |
| msl | mean sea level |
| MW | megawatts |
| | |
| NASA | National Aeronautic and Space Administration |
| NDEP | Nevada Division of Environmental Protection |
| NDOW | Nevada Division of Wildlife |
| NED | National Elevation Dataset |
| NLCD | National Land Cover Dataset |
| NNHP | Nevada Natural Heritage Program |
| NOAA | National Oceanic and Atmospheric Administration |
| NOAEL | no observable adverse effect level |
| $NO_x$ | nitrogen oxide |
| NRCS | Natural Resource Conservation Service |
| NWS | National Weather Service |

## ABBREVIATIONS AND ACRONYMS
(Continued)

| | |
|---|---|
| $O_2$ | oxygen |
| OB | open burning |
| OBA | Old Bomb Area |
| OBODM | Open Burn/Open Detonation Dispersion Model |
| | |
| PACT-6 | Plasma Arc Centrifugal Treatment |
| PAH | polycyclic aromatic hydrocarbon |
| PAS | pollution abatement system |
| PCB | polychlorinated biphenyls |
| PCDD/PCDF | polychlorinated dibenzo(p)dioxins/ polychlorinated dibenzo(p)furans |
| pg | picogram |
| PIC | product of incomplete combustion |
| PODS | Plasma Arc Ordnance Demilitarization System |
| POHC | principle organic hazardous constituent |
| PPC | primary processing chamber |
| ppm | parts per million |
| ppmv | parts per million on a volume basis |
| PPRTVs | Provisional Peer-Reviewed Toxicity Values |
| PSD | Particle Size Determination |
| psig | per square inch gauge |
| | |
| RAIS | Risk Assessment Information System |
| RCRA | Resource Conservation and Recovery Act |
| RDL | reliable detection level |
| REL | reference exposure level |
| RF-9 | Ammunition Particular Equipment 2210 Deactivation Furnace |
| RfC | reference concentration |
| RfD | reference dose |
| RME | reasonably maximum exposed |
| RSA | Range Site Association |
| | |
| SCC | secondary combustion chamber |
| scfm | standard cubic feet per minute |
| SCR | selective catalytic removal |
| SEM | Scanning Electron Microscopy |
| SLERAP | screening level ecological risk assessment protocol |
| STEM | Sampling Train for Energetic Materials |
| SVOC | semivolatile organics |
| | |
| TCDD | tetrachlorodibenzo(p)dioxin |
| TEEL | temporary emergency exposure limit |
| TEF | toxicity equivalency factor |
| TEL | threshold effect level |
| TEQ | toxic equivalent |

## ABBREVIATIONS AND ACRONYMS
(Continued)

| | |
|---|---|
| THC | total hydrocarbon |
| TIC | tentatively identified compounds |
| TOC | total organic carbon |
| TOE | total organic emissions |
| TRV | toxicity reference value |
| | |
| UF | uncertainty factor |
| USEPA | U.S. Environmental Protection Agency |
| USGS | U.S. Geological Survey |
| | |
| VOC | volatile organic compound |
| | |
| WADF | Western Area Demilitarization Facility |
| WFMS | Waste Feed Monitoring System |

## 1.0 INTRODUCTION

Day and Zimmermann Hawthorne Corporation (DZHC) has requested the development of a cumulative human health and ecological risk assessment protocol (HHERAP) and a multiple pathway human health and ecological risk assessment (HHERA) for the Hawthorne Army Depot (HWAD) Ammunition Particular Equipment 2210 Deactivation Furnace (RF-9), Plasma Ordnance Demilitarization System (PODS) and Old Bomb Area (OBA), each document suitable for submission to USEPA Region IX and the Nevada Department of Environmental Protection (NDEP). Currently there is an approved health risk assessment protocol for PODS and OBA (US Army, CHPPM, 2004). The PODS, RF-9, and OBA are located on the HWAD in Mineral County, Nevada.

This protocol outlines the risk assessment methodology that will be used to evaluate potential human health and ecological risks associated with emissions from HWAD's PODS and RF-9 utilizing the emission rates from the CPT/Risk Burns. Potential risks associated with emissions from the OBA will be evaluated utilizing emission rates from the RCRA Part B Permit application for Hazardous Waste Storage and Open Burning, Hawthorne Army Depot (IT Corporation 1996). The purpose of this risk assessment is to demonstrate whether cumulative emissions from these three sources are below a level of concern. The approach described will provide theoretical estimates of individual risk based on realistic, yet conservative exposure scenarios. The risk assessment (following the CPT/Risk Burn) will include an evaluation of potential risks associated with direct and indirect exposures to emissions from the incinerators. For the purposes of this document, direct exposures are defined as those associated with the inhalation of constituents released via stack emissions. Exposures to constituents in surface soils, surface water, and food following constituent deposition on to soils, plants, and surface water bodies are considered indirect exposures.

This HHERAP will outline all methodologies and procedures used to conduct the Human Health and Ecological Risk Assessments for RF-9, PODS and OBA as described in USEPA's most recent guidance documents: *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (HHRAP) (USEPA, 2005a) and the *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (SLERAP) (USEPA, 1999). The 2005 HHRAP updates and replaces the 1998 Peer Review Draft document (USEPA, 1998a). Appendices A through C provide the equations and parameters used in this risk assessment.

This Protocol is divided into several sections that correspond to the primary components of the risk assessment effort. These sections describe:

- Selection of constituents of potential concern (Section 2.0),
- Emissions dispersion and deposition modeling (Section 3.0),
- Human Health Risk Assessment (Section 4.0)
- Ecological Risk Assessment (Section 5.0)

Note: HWAD reserves the right to modify or refine the methodologies described in this protocol should relevant new information or guidance become available.

## 2.0 FACILITY CHARACTERIZATION

The facility characterization component of the risk assessment is comprised of a compilation of basic facility information; identification of emission sources; estimation of emission rates; identification of chemicals of potential concern (COPCs) and estimation of COPC concentrations for non-detects. The facility specific information in the subsequent sections was obtained from the approved HHRAP for the PODS and OBA (CHPPM 2004) and the Comprehensive Performance Test Plan (CPTP) for RF-9 (TSD 2004).

### 2.1 Facility Information

#### 2.1.1 Facility Location and Geography

The HWAD is located on 144,441 acres of Federal land south of Walker Lake in Mineral County, Nevada. The HWAD is situated approximately 135 miles southeast of Reno. It lies in a basin bordered by the Wassuk Mountains to the west, the Gillis Range to the east, Walker Lake to the north, and the Excelsior Mountains to the south. The installation almost surrounds the town of Hawthorne (CHPPM 2000). Figure 2-1 presents a map showing the location of the facility and the surrounding study area.

The HWAD occupies a portion of the Great Basin section of the Basin and Range Physiographic Province. Geologists characterize the basin and range as a series of discontinuous, roughly parallel fault block mountain ranges separated by intermontane valleys, plains, and bolsons. The intermontane plains vary in width from a few hundred feet to several miles, and their lengths may reach several tens of miles. Many of the plains contain lakes or playas (dry lakebeds) in the low areas (CHPPM 2000).

The installation fills a bolson that opens to the northwest. The valley floor of the bolson consists of a broad alluvial apron. The floor slopes from an elevation of 4,400 feet mean sea level (msl) at the foot of the Garfield Hills in the southeast, to less than 4,000 feet msl in the northwest at the edge of Walker Lake. Flanking the alluvial apron are alluvial fans with slopes up to six percent. The alluvial fans are a result of sheet and channel erosion from the surrounding mountains after intense and local thunderstorms. The highest point on the installation is in the Wassuk Mountains at 11,239 feet msl. The point of lowest elevation is Walker Lake at 3,956 feet msl (CHPPM 2000).

### 2.1.2 Facility Description

Presently, the HWAD contains over 3,400 buildings and structures consisting of offices, production buildings, ammunition storage magazines, and warehouses. These buildings and structures can be divided into four principal areas (CHPPM 2000):

- The Administration Area, located in the west-central portion of the depot, which houses the installation headquarters and family housing.
- The South Magazine Area, situated south of U.S. Highway 95, and southeast of the town of Hawthorne, which primarily contains ammunition storage and magazines.
- The Central Magazine Area, situated east of U.S. Highway 95 and northeast of the town of Hawthorne, which is comprised of ammunition storage magazines and old ammunition production facilities.
- The North Magazine Area situated east of U.S. Highway 95, and north of the town of Hawthorne, which is comprised of ammunition storage magazines and the Western Area Demilitarization Facility (WADF).

The WADF, situated just south of Walker Lake, was constructed between 1976 and 1982 to serve as a conventional ammunition demilitarization facility. Various types of ammunition items are deactivated in the 160-acre complex consisting of nine production buildings and six support buildings. The WADF is also the location of the RF-9 rotary kiln furnace and PODS.

### 2.1.3 History and Mission

The HWAD was established in 1930 as a U.S. Naval Ammunition Depot to store, service, and issue ammunition. It was transferred to the U.S. Army in October 1977 and renamed the Hawthorne Army Ammunition Plant (HWAAP). Employment at the depot was at its highest at 5,625 employees in 1945. The installation became a government-owned, contractor-operated (GOCO) facility in 1980 and currently, supports approximately 500 workers consisting of government, contractor, subcontractor, and tenant staff (LVRJ 2002).

Under the Base Realignment and Closure Commission of 1988, the Hawthorne Army Depot acquired the missions of three other installations: The conventional ammunition mission from the Umatilla Army Depot, Oregon; and the ammunition mission stocks, equipment and personnel from the Navajo Army Depot Activity, Arizona, and Fort Wingate Army Depot Activity, New Mexico. The relocation of these missions was completed in 1994. In the same

year, the depot was re-designated from the HWAAP to the HWAD. The current missions of HWAD are to (IOC 1997):

- Receive, issue, store, renovate, test, demilitarize, and provide depot storage for conventional ammunition;
- Operate the calibration laboratory and ballistics test facility;
- Maintain the capability to receive and ship containerized cargo; and,
- Perform special missions and assignments when the need arises.

## 2.2 Emission Sources

### 2.2.1 Plasma Arc Ordnance Demilitarization System

#### 2.2.1.1 Description of the Plasma Arc Ordnance Demilitarization System

The PODS is located at the HWAD WADF in Building 117-2. The PODS was designed and constructed by MSE Technology Applications, Inc. who owns and operates the 6-foot Plasma Arc Centrifugal Treatment (PACT-6) system in Butte, Montana. The PACT-6 unit is similar in theory but slightly different in design to the PODS unit. The PODS system is designed to destroy (deactivate) a wide variety of obsolete or unserviceable munitions using plasma technology. The munitions are considered hazardous waste either for their explosive components, metal content, and/or the principle organic hazardous constituent (POHC) content (CHPPM 2004).

#### 2.2.1.2 Description of the Process

The PODS furnace consists of a sealed primary processing chamber (PPC) in which plasma torches supply thermal energy to melt inorganic materials and combust organic materials through thermal oxidation. From the treatment process, a glassy slag is poured from the PPC and off-gas is treated through air pollution control equipment (APCE). Off-gas scrubber water is treated to form a water treatment sludge and treated water. The PODS consists of the following equipment (CHPPM 2004):

- bulk and discrete item conveyor feeders
- transferred/non-transferred plasma torch
- PPC
- slag collection chamber
- secondary combustion chamber (SCC)

- APCE
- stack gas analysis system
- exhaust stack

The following is a brief description of each portion of the PODS as listed.

***Feed System***

The bulk and discrete item conveyor feeders consist of belt conveyors with individual pockets to hold items such as ordnance, metal pieces, or loose material. Each belt conveyor empties into a Y-shaped chute (Y-chute) that has two valves providing isolation from the primary chamber. The feed is loaded into the conveyor flights and fed to the primary chamber (CHPPM 2004).

***Plasma Arc Torches***

The transferred/non-transferred arc torch can be positioned in the primary chamber by electric positioning mechanisms. The positioning system allows the operator to keep the molten pool uniform for better combustion. Helium is used as the torch gas for ignition. Immediately following ignition, the torch gas is switched to air. The torch is supported by a plasma gas supply system, closed-loop cooling water supply system, and a power supply.

When operated in transferred arc mode the torch contains an electrode that is the positive termination point for the electrode arc. The molten pool in contact with the crucible is the cathode. The torch assembly has three water-cooled circuits: the outer housing or ram, the nozzle, and the electrode cooling passage. With air as the torch plasma gas, the transferred arc torch is capable of a heat output of 1.0 megawatt (MW).

When operated in non-transferred arc mode both the anode and cathode are internal to the torch. Air will also be used as the plasma gas (CHPPM 2004).

***Primary Processing Chamber***

Primary processing takes place in a water-cooled, refractory-lined chamber. The primary processing chamber (PPC) consists of the lid (or dome), a spool piece, and the crucible. The PPC has a holding capacity of approximately 1,000 pounds.

The lid encloses the upper portion of the PPC and supports the torches, off-gas piping, and feed system Y-chute. It also forms the first few feet of the combustion zone. The lid is water cooled and refractory lined. The lid can be removed from the remainder of the PPC.

The refractory-lined and water-cooled spool piece encloses the vertical portion of the PPC. There are several penetrations in the side of the spool piece for instrumentation and camera view ports. The spool piece can be accessed by removing the hearth through the slag chamber or removing the spool piece from the lid.

The bottom portion of the PPC is the crucible. The crucible is water-cooled but does not have the refractory lining of the spool piece and lid. This is where the actual processing takes place and the melt is contained. It is equipped with a water-cooled copper tap hole for pouring of the slag. The crucible can be removed through the slag chamber for maintenance.

The PPC gas temperature and pressure are measured during operation near the top of the chamber. Oxygen ($O_2$) is delivered to the headspace of the PPC using injectors to ensure stable operating conditions. A pressure relief valve is installed on the PPC as a safety measure to relieve pressure if it exceeds 14.5-pounds per square inch gauge (psig). The PPC is designed for approximately a 10-second residence time depending on the waste being treated. The molten pool will be approximately between 2,000° and 3,000°F, and the headspace of the PPC will be less then 2200°F.

The non-transferred torch mode is used initially to melt the residual material in the hearth. Once a molten pool has been formed, the transferred torch mode is started to deepen and mix the slag pool. Waste feed is initiated once the pool is ready. Either torch can be used to treat the material being fed. A spray nozzle is available to inject water into the PPC to remove some of the thermal energy allowing the operator to increase the waste feed rate (CHPPM 2004).

***Slag Collection Chamber***

Once the crucible has filled, the waste feed is stopped. The processed material is thoroughly heated with the transferred torch to ensure complete oxidation. The crucible is lanced with the Oxy-lance burning bar and the molten glass produced during treatment is discharged into the collection chamber and collected in 55-gallon drums. Approximately one 55-gallon drum of material will be filled per hour of processing (CHPPM 2004).

***Secondary Combustion Chamber***

The SCC is situated between the PPC and the off-gas scrubbing system. The SCC is connected to the top of the PPC lid through a refractory-lined pipe. It is 5 feet wide and is 22 feet long. The SCC interior is refractory-lined, and the internal dimensions give a volume sufficient to maintain a minimum residence time of two seconds with maximum off-gas inlet flow rate. Gas temperature is measured at the inlet, midpoint, and outlet of the SCC. The $O_2$ and diesel fuel are supplied to the SCC burner. The SCC will maintain a temperature of approximately 1,800° F to ensure complete combustion of any residual organic material (CHPPM 2004).

***Air Pollution Control Equipment***

The APCE is connected in series to the base of the SCC. The APCE consists of an off-gas quench vessel, a packed-bed absorber, a high-energy scrubber, a superheater, a baghouse, a reheater, and a selective catalytic removal (SCR) reactor for oxides of nitrogen ($NO_x$) removal. Two positive displacement blowers located downstream from the baghouse maintain system vacuum. These blowers are followed by the reheater and $NO_x$ reactor (CHPPM 2004).

***Off-Gas Quench Vessel***

The quench vessel is constructed of stainless steel and is designed to cool the exhaust gases from the SCC. Two stages of cooling are combined in the quench vessel as the exhaust gases from the SCC enter the top of the quench vessel. The first nozzle sprays a cone-shaped mist of water downward into the exhaust gas from the SCC. This diverts the exhaust gas to move down along the walls of the quench vessel to the weir located at approximately midway through the vessel. The gas moves across the weir as a second set of nozzles spray water into the base of the U-shaped weir, circling the vessel, forcing the water up into the gas stream. The gas stream then exits the quench vessel through the center of the weir. Both the quench water and exhaust gas then enter the base of the packed bed absorber (CHPPM 2004).

***Packed-Bed Absorber/Condenser***

The packed-bed absorber/condenser column, in combination with the quench vessel, is designed to absorb particulate, remove acid gases, condense moisture, and remove heat from the exhaust gas. The absorber/condenser column is packed with one inch Hy-Pak metal packing.

The one-inch packing was chosen to ensure the best efficiency. The absorber/condenser column is constructed of stainless steel. An emergency exhaust vent is located prior to the packed bed for venting the gas directly to the atmosphere.

The exhaust gas moves up through the packed bed while water is filtered through the bed from the top. The absorber water, condenser water, particulate, and acids are removed at the bottom of the absorber/condenser column as the exhaust gas exits through the top of the column into the gas scrubber (CHPPM 2004).

***Gas Scrubber***

The Hydro-Sonic Air scrubber is a compressed-air-driven scrubber that has the ability to scrub fine particulate, noxious gases, and condensable hydrocarbon gases. A high-speed, free-air jet shatters a stream of water into small droplets that attach to fine particulates. This mixture is driven down into the separator, where the particulate and other condensable gases are removed from the gas stream. The cleaned gas is then vented to the first reheater. The scrubber is designed to reduce particulate concentration to no greater than 0.01 grains per dry standard cubic foot (dscf) with an inlet particulate load concentration of five grains per dscf. Using these values, the removal efficiency of particulate matter is 99.8% for the hydro-sonic scrubber alone (CHPPM 2004).

***Baghouse and Reheater***

The exhaust gases from the scrubber are passed through a reheater to increase the temperature of the exhaust gas to protect the baghouse (e.g., condensation on the filter bags). The Mikro-Pulsaire baghouse is a continuous self-cleaning dust filter capable of removing dust particles as small as sub-micron size from gaseous streams. The filter bags are constructed of polyester with a high collection efficiency (HCE) treatment. The HCE treatment consists of coating the bags with a silicon solution, thus effectively reducing the porosity of the fabric and increasing removal efficiency. A cyclic timer is used to actuate a series of solenoid valves to open, creating a momentary rush of high-pressure air. This causes an instantaneous pressure increase on the clean side of the bags which forces air through the filter bags. The dust released from the bags falls to the bottom of the baghouse and is removed through a hopper. The filter bags being used in the PODS baghouse are designed to reduce particulate concentration to no more than 0.003 grains per dscf with a design inlet particulate load concentration that can exceed

100 grains per dscf. Using a conservative inlet concentration of five grains per dscf, the removal efficiency of particulate matter is 99.94% for the baghouse alone (CHPPM 2004).

### *$NO_x$ Abatement System*

The high-temperature, long-residence-time, concentration of $O_2$, and amount of excess air in the primary chamber cause the $NO_x$ concentrations in the exhaust gas to be between 5,000 and 12,000 parts-per-million on a volume basis (ppmv). The PODS will have a $NO_x$ catalyst reduction unit to reduce the level of $NO_x$ in the exhaust gases. The reducing agent for the process is anhydrous ammonia. The $NO_x$ reactor injects the reducing agent into the gas stream upstream of the catalysts. The reducing agent and gas are mixed by flow guiding devices to ensure homogeneity. In the presence of the extruded catalysts, the $NO_x$ reacts with the ammonia to form molecular nitrogen and water. The amount of reducing agent injected into the gas is dependent on the $NO_x$ concentrations before and after the catalysts are measured by gas analyzers. The cleaned gases are then discharged to the exhaust stack.

Prior to the $NO_x$ reactor, an electric reheater heats the exhaust gas from the induced draft fan to approximately 700° F. The temperature must be maintained above 500° F to ensure an efficient reduction reaction. Thermocouples in the exhaust regulate the reheater operation (CHPPM 2004).

### *Exhaust Stack*

The exhaust stack is located at the north corner of Building 117-2. The stack is double-walled steel with a 12-inch inside diameter extending 51'-8" above the ground. Sampling ports will be placed every eight feet for sampling of the exhaust gases during the CPT/Risk Burn. A continuous emission monitoring port is located on the four inch piping from the $NO_x$ reactor. Exhaust gases from the $NO_x$ reactor will enter the stack at approximately 700° F. The exit temperature at the stack top will drop to approximately 629° F due to heat loss through the stack walls. The exit velocity of the gas will be approximately 4.65 meters per second (MSE Technology Applications, Inc. 1998).

***Continuous Emission Monitoring System***

A continuous emission monitoring system (CEMS) will be used to analyze the gas for carbon monoxide (CO), $O_2$, carbon dioxide ($CO_2$), and $NO_x$ before it exits the exhaust stack (CHPPM 2004).

2.2.2 APE 2210 Deactivation Furnace (RF-9)

2.2.2.1 Description of the APE 2210 Deactivation Furnace (RF-9)

The RF-9 incinerator is located in the WADF at Building 117-3 in the northwest portion of the installation. The RF-9 facility was constructed in the late 1970's and operated until 1989. The building consists of an off-loading dock, temporary storage area, control room, utility deck, and a waste feed conveyor system. The main components of the DZHC RF-9 rotary kiln incinerator system consist of feed handling systems, feed conveying systems, a munitions detonation rotary kiln, a combustion chamber, air pollution control equipment, metals and ash handling systems and plant support systems (USACE 1996).

2.2.2.2 Description of the Process

The demilitarization process involves three main steps: transport and handling of munitions from the existing munitions storage areas to the deactivation furnace, or the transport and handling of munitions components from breakdown operations to Building 117-3; incineration of munitions or components; and management of the waste materials that remain after incineration. Waste from the RF-9 incinerator will consist of atmospheric emissions and solid wastes. The RF-9 consists of the following equipment (USACE 1996):

- feed system
- rotary kiln
- discharge conveyor
- primary combustion chamber
- evaporative cooler
- baghouse
- induced draft fan
- exhaust stack
- CO, $O_2$, $NO_x$ and opacity continuous monitors

The following is a brief description of each portion of the RF-9 system taken from the RCRA Part B Application for Hawthorne Army Depot, Nevada, November 1996 (USACE 1996).

***Feed System***

The feed system consists of a Waste Feed Monitoring System (WFMS), a primary feed conveyor, and a secondary conveyor.

The WFMS controls the furnace feed rate and consists of the precision scale, support frame and air cylinder ram feed assembly. The WFMS is located over the primary waste feed conveyor 20 feet from the furnace feed chute. The scale is located in the Waste Feed Monitor that prohibits overloading of the furnace. The feed rate is based on the munitions being incinerated, therefore the munitions type must be entered into the computer before the waste can be fed into the incinerator. The computer reads the munition weight and air cylinder pushes the munitions on to the feed conveyor. The trap door remains closed until the conveyor belt flight moves into position. The air cylinder will not push if the weight exceeds the maximum weight limit or the feed door is open.

The primary feed conveyor transports the munitions to the secondary feed conveyor. The primary conveyor in the corridor area is covered with shroud to prevent loading of munitions after the WFMS. The secondary feed conveyor transports the munitions into the feed chute at the low temperature inlet of the incinerator. The secondary conveyor is implemented for safety precautions. If an emergency arises, the primary conveyor is shut down, however, the secondary remains operating. This allows munitions near the high temperature end of the kiln to continue to move through the furnace and deters possible explosions outside of the furnace (USACE 1996).

***Rotary Kiln***

The deactivation rotary kiln is designed to destroy by incineration small ammunition or explosives end items and bulk explosives or propelling materials. The rotary kiln includes feed and discharge assemblies, internal spiral flights, lifters, and a recycle scrap conveyor system. The internal spiral flights, which are located in each of the retort sections, with the exception of the center section, advance the waste through the furnace as it rotates. The center section is slightly larger than the other sections and is equipped with lifters. The lifters are filled with

spent munitions casings as further protection for the retort steel shell from the munitions detonations. The retort unit is 25 feet in length and is constructed of high strength steel. The retort is made up of four 5-foot diameter sections and one five-and-one-half foot diameter section that are bolted together. The retort is equipped with a Hauck NMC-230-A proportioning burner installed in the breaching at the residue discharge of the retort unit. This is a distillate oil fired burner.

Materials to be thermally treated are fed into the cool end of the retort and are propelled towards the flame at the burner end via the spiral flights. As the items being treated approach the flame, they burn or detonate depending on their characteristics. The RF-9 incinerator does not run at capacity at all times, nor is it in continuous operation. High order detonations are contained within the retort walls, which are two-and-one-half inches thick at the ends and three-and-one-quarter inches thick in the center, where most high-order detonations occur. Scrap metal and residue pass from the retort onto the discharge conveyor or are diverted to the recycle scrap container. Metal may be re-circulated to the rotary kiln to provide an inert carrier stream to augment the flow characteristics of the fresh feed streams. All recyclable metals are sent to a recycling center. Gases, ashes and other residues escaping from the retort are routed through the Air Pollution Control System (APCS). The APCS is comprised of a PCC, quencher, HEPA filter, bag-house, induced draft fan, stack and associated ducting, and CEM equipment (USACE 1996).

***Discharge Conveyor***

Metal components of end-item munitions are discharged from the furnace onto the discharge conveyor. The discharge conveyor transports metal waste to a scrap collection point (USACE 1996).

***Primary Combustion Chamber***

The PCC is designed to elevate the temperature of the exhaust gases exiting from the kiln. The elevated temperature and the additional residence time improve the complete combustion of the explosives. The PCC is internally insulated with a combination of modular and ceramic fiber products. The PCC has a capability of heating 4,000 standard cubic feet per minute (scfm) of air T 250-900º F up to 1200-1800º F in a minimum residence time of one second (USACE 1996).

***Evaporative Cooler***

In addition to the pollution control function that the afterburner provides, this plant will utilize a two-stage APCS. The first stage of the system is the evaporative cooler. The exhaust gases from the afterburner are routed to the evaporative cooler where they are rapidly quenched from up to 1800 deg F to approximately 350-400 deg F with injected water. The temperature of the exhaust gas from the evaporative cooler is maintained by controlling the flow of quench water fed to the evaporative cooler.

Just downstream of the evaporative cooler, a reagent will be continuously fed into the gas stream to react with HCl gas to form chloride salts. A sufficient stoichiometric ratio will be used to ensure an excess of reagent and thereby attain a high percentage of capture of HCl gas (TSD 2004).

***Baghouse***

The second stage of the APCS is the baghouse. The baghouse will be designed so that all of the high-efficiency bags operate in parallel. Reagent will be carried over to the baghouse in the exhaust gases leaving the evaporative cooler. The particulate matter will collect on the fabric filter bags to obtain a highly efficient removal of solids, including fly ash, reaction products and reagent. Although the primary function of the baghouse is to remove particulates, an additional scrubbing action takes place there. Un-reacted reagent which collects on the bags reacts with un-reacted HCl in the effluent gases from the evaporative cooler. The baghouse shall have a pulse-jet cleaning system operating on compressed air to clean the bags. The dust, composed of the reaction products, fly ash and unreacted reagent, shall be collected in the bottom section of the baghouses. Valves transfer the collected dust via sealed piping to the collection containers for offsite disposal at a permitted hazardous waste landfill. The baghouse shall be sized to accommodate the full flow of quenched flue gas. The baghouse exhaust pipe shall include a Bag Leak Detector capable of sensing <0.001 grains of particulates per cubic foot of flue gas. This Bag Leak Detector shall include a pre-wired 4-20 mA output signal that DZHC will use in their controls system to warn operators of a leak in a fabric filter bag (TSD 2004). In addition to the bag house, all exhaust gases are routed through pre-filters and High Efficiency Particulate Filters (HEPA).

***Induced Draft Fan***

The Induced Draft Fan will provide the system draft control, using a variable frequency drive to modulate fan suction based on a pressure signal at the kiln exhaust gas manifold piping. The induced draft fan discharges all gases to an adjacent 20 inch ID stack, which contains a gas sampling system to provide continuous analysis for both CO, $O_2$, $NO_x$ and opacity (USACE 1996).

***Exhaust Stack***

The A36 carbon steel, circular exhaust stack is 45 feet high and 20 inches in diameter. The distance between the stack and the draft fan is 5 feet. The top of the stack inlet is located at an elevation of 5 feet above ground level (USACE 1996).

***CO, $O_2$, $NO_x$ and Opacity Continuous Monitors***

The gas monitoring equipment uses a non-dispersive infrared photometer as the principle of measurement. The monitoring has the capability to monitor all required gases simultaneously and provides a record of the acquired data on a strip chart recorder. The carbon monoxide continuous monitor is capable of measuring at a low range of 0-200 ppm with a maximum value 200 ppm, and at a high range 0-3000 ppm with a minimum upper value of 3000. The gas monitoring equipment housing 4 feet wide by 6.5 feet high by 2.5 feet deep and is purged with climatic air (USACE 1996).

### 2.2.3 Old Bomb Area

#### 2.2.3.1 Description of Old Bomb Area

OBA is located in the southern part of the HWAD in the Southern Magazine Area. The OBA encompasses approximately 300 acres; however the open burning (OB) operation only takes place on 6.5 acres of the 300 acres. Since the 1980s, OB has been performed by an on-site contractor, under the guidance of government personnel assigned to quality assurance surveillance. Propellants and explosives are typically treated by OB operations.

#### 2.2.3.2 Description of Open Burning Process

Unserviceable propellants and explosives on the installation are transferred to OBA for treatment by OB. OB process is conducted following the Standard Operating Procedure No.

HW-0000-H-006, revised October 29, 1992 and other U.S. Army guidance documents, such as the Technical Manual 9-1300-277, General Instructions for Demilitarization of Conventional Munitions.

The OB operation consists of burn pans, burn pad stand, and the burn pan cover. OB operations are conducted in burn pans that are 16 feet in length, 6 feet in width, and 1 foot in depth. The burn pans are made from ¼-inch thick carbon steel plate. The burn pan cover and handles are made from aluminum and the stands are made of steel. The burning capacity for each burn pan is 1,000 pounds/pan. There are a total of four burn pads available for OB operations, each pad consisting of five burn pans; therefore the maximum amount of propellants/explosive that can be burned per day equates to 20,000 pounds. The burn pads are spaced at least 150 feet apart.

## 2.3 Emission Rates

### 2.3.1 PODS and RF-9

The PODS is designed to destroy (deactivate) a wide variety of obsolete or unserviceable munitions using plasma technology. The RF-9 has been redesigned to destroy small ammunition or explosives, end items and bulk explosives or propelling materials by incineration.

Emission rates for the PODS and RF-9 will be obtained from data collected during a combined Comprehensive Performance Test (CPT)/Risk Burn. Sampling and analysis will be conducted for metals, acid gases, dioxin and furans, polychlorinated biphenyls (PCBs), volatile and semi-volatile organics (including total organic emissions) and particle size distribution (PSD). Sampling efforts will be performed in accordance with all USEPA trial/risk burn requirements for combustion sources. CPT/Risk Burn testing is scheduled for the year 2006.

The PODS is designed to ensure the complete destruction of organic material by maintaining temperatures of the molten pool between 2,000° F and 3,000° F, with a residence time of approximately 10 seconds in the PPC, and a SCC with a temperature of 1,800° F and 2-second residence time. The system is also designed to quench the off-gases from the furnace to reduce the potential for dioxin and furans formations.

The RF-9 is designed to ensure complete destruction (>99.99%) of organic compounds within the combustion chamber and is designed to provide complete combustion of the organic materials in the feed. The kiln is designed to volatilize the organic materials from the munitions and provide partial combustion prior to the combustion chamber. The combustion chamber is

horizontally mounted, heats the exhaust gases from the MDRK up to 1800$^{o}$ F, provides greater than 1 second of residence time, and achieves highly turbulent flow to ensure good mixing and therefore effective destruction of waste gasses.

The following sections address the sampling and analyses to be conducted during the CPT/Risk Burn for PODS and RF-9. Table 2-1 provides a list of those constituents of potential concern (COPCs) to be considered in the risk assessment.

#### 2.3.1.1 Metals Emission Rates

USEPA risk assessment and risk burn guidance (USEPA 2005a, 2001) recommends evaluating the 10 BIF metals (antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, silver, and thallium which may pose human health risks via the inhalation exposure pathway. These guidance documents also identify eight additional metals as constituents of potential concern for evaluation of human and ecological risks. These eight additional metals are aluminum, copper, cobalt, manganese, nickel, selenium, vanadium, and zinc. These eighteen metals will be target analytes for the CPT/Risk Burn. All but mercury will be analyzed using USEPA Method 29/SW-6020, mercury will be analyzed using SW-7470. All metals are assumed to be in particulate form except for mercury which is assumed to be present in vapor form. All metals including mercury will be in particulate form after being cooled in the quench tower and scrubber. Mercury will move back into vapor form when reheated prior to the baghouse.

Metal emission rates are dependent upon the quantity of metal in the feed items and the removal efficiency of the APCE. The system removal efficiencies (SREs) for all eighteen metals will be based on three metals representing the three volatility groups (high, medium, and low). For the PODS, chromium oxide (low volatility), lead acetate trihydrate (medium volatility) and mercury oxide (high volatility) will be spiked and the resultant SREs will be applied to each metal in that respective group. For the RF-9 incinerator, chromium oxide (low volatility) will be spiked, lead is in the test munition item (medium volatility) and high volatility is based on maximum theoretical emission concentration (MTEC) limit. Mercury is not anticipated in the waste feed stream for the RF-9 incinerator, per the MIDAS database. The metal feed rates will be scaled up based on the SRE and the MACT emission limits. For metals not regulated by MACT, a theoretical feed rate will be chosen and the emission rate calculated using the SRE for the representative metal. Table 2-2 presents the metals and their respective volatility groups.

***Mercury***

Mercury can exist in either organic or inorganic forms in the environment. Mercury emissions from the PODS and RF-9 incinerator stacks are expected to be in an inorganic form. It is possible, however, that the mercury could converted to its more toxic organic form in the environment.

***Chromium***

Chromium is capable of existing in several different oxidation states in the environment ranging from divalent chromium ($Cr^{+2}$) to hexavalent chromium ($Cr^{+6}$), of which only trivalent chromium ($Cr^{+3}$) and $Cr^{+6}$ are of biological significance. The $Cr^{+6}$ species is highly unstable in the environment and is carcinogenic. Since only total chromium will be available from CPT/Risk Burn data, to ensure conservatism, all chromium emissions will be assumed to be in the $Cr^{+6}$ form. Speciated data of chromium will be used if the data is made available.

2.3.1.2 Acid Gas Emission Rates

Chlorine ($Cl_2$) is present in the proposed feed items to be treated by PODS and RF-9. During incineration and in the presence of water, $Cl_2$ readily forms the acid gas, hydrogen chloride (HCl). The PODS is equipped with a condenser/absorber and hydrosonic scrubber designed to remove particulate and acid gases. Acid gasses and particulates will be removed from the exhaust stream of the RF-9 by the addition of reactive agents in the evaporative cooler and by continuous reaction of these reagents in the baghouse. EPA Method 26A (SW-9057) will be used to analyze chlorine and HCl from the PODS and RF-9 exhaust stacks (Tetra Tech 2004, TSD 2004).

2.3.1.3 PCDDs/PCDFs Emission Rates

The PODS and RF-9 pollution abatement systems (PAS) are designed to reduce formation of polychlorinated dibenzo(p)dioxins/polychlorinated dibenzo(p) furans (PCDDs/PCDFs). However, there is the potential for PCDDs/PCDFs to be created as a by-product of combustion and can pose a significant health risk from direct and indirect exposure. The emission rates for PCDDs/PCDFs will be detected using EPA SW-846 Methods 0023A and 8290 (Tetra Tech 2004; TSD, 2004).

#### 2.3.1.4 PCB Emission Rates

There is no waste containing PCBs in the PODS or RF-9 waste feeds. EPA Methods 0010, 3542 and 1668A will be employed to sample for PCBs (Tetra Tech 2004; TSD, 2004). The CPT/Risk Burn tests will include total homologues (i.e., chlorobiphenyl, dichlorobiphenyls, trichlorobiphenyls, etc.) as well as speciated individual coplanar (i.e., congeners having four or more chlorine atoms with few substitutions in the ortho position). The emission rates for co-planar PCBs will be determined.

The HHERA will evaluate the risks from both total PCBs and the coplanar PCBs. This approach will be conservative since the total PCB emission estimates include the coplanar PCBs.

#### 2.3.1.5 Principle Organic Hazardous Constituents (POHCs)

The PODS and RF-9 are designed to treat ordnance items. The PODS and RF-9 are required to achieve a DRE of 99.99% for all POHCs in the waste feed according to 40 CFR 266.104. The two POHCs that will be used to determine the DRE for PODS are hexachloroethane and naphthalene. Naphthalene will be analyzed to determine the DRE for RF-9 in the RF-9 emissions. EPA Method 0010/SW-8270 will be used to sample for POHCs (Tetra Tech 2004) in PODS emissions. Energetics are not included in the POHC sampling plan but will be evaluated in the risk assessment. The DRE for naphthalene, which is in the lowest thermal stability class (i.e., hardest to destroy), will be used to determine the amount of energetics removed before exiting the stack. A theoretical feed rate of energetics will be based upon potential future anticipated munitions that could be processed. Emission rates of energetics will then be determined by applying the naphthalene DRE to the theoretical energetic feed rate. The energetics to be considered are found in Table 2-1.

#### 2.3.1.6. Volatile Organic PIC and TIC Emission Rates

Volatile products of incomplete combustion (PICs) encompass volatile organic species emitted from the stack regardless of their origin. The sample analysis will also identify volatile TICs (tentatively identified compounds). USEPA guidance (2005a) generally recommends characterizing TICs when the peak intensity is 10 percent or more of the full chromatographic scale. Sampling/analysis will employ EPA Methods 0030/5041A/8260B (SW846) for volatile organic compounds (Tetra Tech 2004; TSD, 2004).

2.3.1.7. Semi-Volatile Organics Speciated PICs and TICs Emission Rates

Semi-volatile PICs and TICs sampling will use EPA Method 0010 – modified method 5 sampling train (Tetra Tech 2004, TSD 2004). Analysis will be conducted using EPA 3542/8270. USEPA guidance (2005a) generally recommends characterizing TICs when the peak intensity is 10 percent or more of the full chromatographic scale.

2.3.1.8. Criteria Pollutants Emission Rates

Continuous emission monitoring (40 CFR 60, Appendix A) (Tetra Tech 2004; TSD 2004) will be performed. PODs continuous emission monitoring will identify CO, $CO_2$, $O_2$, $NO_x$, and $SO_2$, while RF-9 continuous monitoring will identify CO, $O_2$, and $NO_X$.

2.3.1.9 Particulate Size Determination

Particulate size determination (PSD) will be measured using a modified Method 5 sampling train with a polycarbonate filter with PSD analysis by Scanning Electron Microscopy (SEM).

2.3.1.10 Total Organic Emission Rates

Total organic emissions (TOE) will be conducted using sampling Methods 0010 (TCO/GRAV, detected by 3542/8015) and 0040 (for total volatile organics in the condensate by purge and trap GC, plus field GC for total volatile organics in the gas phase). This evaluation will be used to develop the TOE factor as further described in Section 2.3.5.

2.3.2 OBA

The OBA is the only operational RCRA-permitted facility at HWAD. Currently, there are no OBA-specific emissions data available, therefore, emissions characterization for COPCs will be determined using several sources of information to include data from munitions testing. Open burning emission factors will be obtained from the RCRA Part B Permit application for Hazardous Waste Storage and Open Burning, Hawthorne Army Depot (IT Corporation 1996). These OB emission factors were derived from various U.S. Army studies considering a wide range of ordnance, munitions, and propellants that are demilitarized at other facilities. The stockpile at HWAD is a subset of these materials.

The U.S. Army studies evaluated emission factors from the POLU-11 combustion emissions model in conjunction with the "Air Pathway Screening Assessments for RCRA Subpart X Permitting" document (USAEC 1995). This document provides emissions data from Bang Box tests performed at Dugway Proving Ground. The Bang Box facility is an air supported, rubber-coated, flexible hemisphere. A burn pan is located at the center of the facility under a baffled over-blast protection structure. The hemisphere is supported by a positive air pressure blower. Bang Box studies have produced an emission factor database that can be used as input to dispersion models. Emission factors have been developed from Bang Box data for: energetics, semivolatiles, volatile organics, criteria pollutants, inorganic gases, and metals.

Emission factors were developed for both short- and long-term exposure periods. In each case, the emission factor developed for acute exposure (exposures of 24-hours or less) represents the worst-case (highest) emission factor found from all available test data. An average emission factor from all the test data will be used for each substance to represent chronic exposures (exposures greater than 24 hours). The Bang Box data proved to be more accurate than the POLU-11 model data and subsequently became the primary data source for OB emissions in the RCRA Part B permit application. Emission rates for the metals were derived on the basis of a mass balance assumption from the weight composition of each item. The total weight of a metal compound was assigned to the respective metal element.

### 2.3.3 Upset Emissions

The USEPA guidance indicates that the issue of upset emissions needs to be addressed within the HHERA. HWAD will evaluate the potential for upset emissions by following the guidelines provided in USEPA's 2005 HHRAP. Default factors provided in the HHRAP will be used to evaluate upset emissions and will be discussed in the Uncertainty Analysis of the HHERA. The HHRAP recommends multiplying stack emission rates by the default process upset emission factors of 2.8 for organics and 1.45 for metals to represent stack emission rates during process upsets. These factors assume that emissions during upsets are 10 fold higher than emissions measured during the CPT/Risk Burn. The factor is then adjusted to account for an assumed period of time over a year that the unit operates under upset conditions. For organics it is assumed that the unit operates under upset conditions 20% of the time and for metals 5% of the time.

Through both design and operational requirements, the RF-9 and PODS must operate to reduce the potential for increased emissions due to startup/shutdown, upsets, and malfunctions. For example, for RF-9 and PODS, waste feed cannot be initiated until all operating parameters (i.e., afterburner temperature) are within the ranges specified in the permit. During shutdown procedures, waste feed is terminated and the incinerator system, along with pollution control devices, will remain operating until all residual compounds are incinerated. Therefore, based on required operating controls and requirements, it is anticipated that the scale-up factor resulting from this evaluation will be lower than the default factor provided in USEPA's 2005 HHRAP. A discussion of the uncertainty associated with the use of the default factors will be provided in the Uncertainty Analysis of the HHERA.

There are no emission control processes in place for operations at the OBA. Open burning is governed by type, quantity of propellant or explosive, and rigid meteorological parameters. Due to these very strict permit conditions, operational upsets for the OBA where an increase in emissions would occur are considered highly unlikely.

The USEPA's 2005 HHRAP includes guidance to estimate process upset emissions, but does not address emergency release scenarios or catastrophic process upsets attributed to equipment failures. The failure of the combustion system or APCS (e.g., explosion, fire, and power failure) is considered a non-routine event resulting in accidental releases. These events are not addressed by the 2005 HHRAP guidance and will not be evaluated for this assessment.

#### 2.3.4 Fugitive Emissions

The USEPA guidance (USEPA 2005a) indicates that the issue of fugitive emissions needs to be addressed within the risk assessment.

HWAD maintains the RF-9 and PODS under negative pressure that should preclude any fugitive emissions from occurring. The destruction of munitions in the PODS results in slag or a glassy material and is not a source of fugitive emissions. The exhaust gas stream from this unit is treated through the APCS and exhausts through the stacks. The APCS is connected in series to the base of the SCC. The APCE consists of an off-gas quench vessel, a packed-bed absorber, a high-energy scrubber, a superheater, a baghouse, a reheater and a selective catalytic removal (SCR) reactor for $NO_x$. Two positive displacement blowers located downstream from the baghouse maintain system vacuum. These blowers are followed by the reheater and the $NO_x$ reactor (CHPPM, 2004).

The incineration of munitions in RF-9 produces gases, ashes and other residues that are routed through the APCS. The APCS is comprised of a PCC, quencher, bag-house, HEPA filter, induced draft fan, stack and associated ducting, and CEM equipment (USACE 1996). The dust, composed of the reaction products, fly ash and unreacted reagent, is collected in the bottom section of the baghouses. Valves transfer the collected dust via sealed piping to the collection containers for offsite disposal at a permitted hazardous waste landfill. The baghouse is sized to accommodate the full flow of quenched flue gas. The baghouse exhaust pipe includes a Bag Leak Detector capable of sensing <0.001 grains of particulates per cubic foot of flue gas. This Bag Leak Detector includes a pre-wired 4-20 mA output signal that DZHC uses in their controls system to warn operators of a leak in a fabric filter bag. These systems collectively should preclude any fugitive emissions from occurring.

In addition, MACT requires that there be no fugitive emissions (40 CFR 63.1206 (C)(5)(i)) from the facility. In regards to the OBA, there is no ancillary process equipment associated with OB operations. At the end of the burn, there is very little ash left in the pans and what is left is placed into a 55-gallon drum, and therefore fugitive emissions are not relevant.

### 2.3.5 Estimates of Total Organic Emission Rate

In order to account for unidentified compounds, total organic emissions (TOE) testing will also be conducted during the CPT/Risk Burns for RF-9 and PODS and the data will be used to calculate a TOE factor. The TOE factor is a means of conducting mass-balance for organics and to evaluate the risks from the unknown fraction of organics. The TOE factor evaluation will be incorporated into the uncertainty section of the risk assessment. The TOE factor is defined by the guidance as the ratio of the Total Organic Emissions mass to the mass of identified organic compounds. The mass of identified organic compounds will include all detected (including VOC and SVOC TICs) and non-detected organic compounds evaluated in the risk assessment.

$$TO_{TOTAL} = TO_{VOC} + TO_{SVOC} + TO_{GRAV}$$

Where:

$TO_{TOTAL}$ = stack concentration of TO, including identified and unidentified compounds ($mg/m^3$)

$TO_{VOC}$ = stack concentration of volatile TO, including identified and unidentified compounds ($mg/m^3$)

$TO_{SVOC}$ = stack concentration of semi-volatile TO, including identified and unidentified compounds ($mg/m^3$)

$TO_{GRAV}$ = stack concentration of gravimetric TO, including identified and unidentified compounds ($mg/m^3$)

The TOE data is used with the identified data to compute a TOE factor.

$$F_{TOE} = \frac{TO_{TOTAL}}{\sum_i C_i}$$

Where:

$F_{TOE}$ = TOE factor (unitless)
$TO_{TOTAL}$ = total organic emission ($mg/m^3$)
$C_i$ = stack concentration of the ith identified COPC ($mg/m^3$)

Per USEPA's Screening Guidance (USEPA, 1994a):

> "Unidentified organic compounds will be assumed to be similar in toxicity and chemical properties to those of the identified organic compound..."
>
> "Under this assumption, the total risks from the organic compounds would be equal to the risks from the identified organic compounds multiplied by the ratio of the mass of total organic compounds to the mass of the identified organic compounds. This is accomplished computationally by increasing the emission rate of each of the identified organic compounds by the ratio of the concentration of total organic compounds to the concentration of all the identified organic compounds combined."

## 2.4 Selection of Constituents of Potential Concern

Constituents of potential concern to human and ecological health will be selected based on the following:

1. A list of all compounds specified in the analytical methods performed in the CPT/Risk Burn evaluation will be prepared (See Table 2-1).

2. The list will denote whether each compound was detected or not detected. A detection in any one of the sample components (e.g., front half rinse, XAD resin, condensate, Tenax tube) in any run will constitute a detection for that specific compound. Concentrations of compounds detected in blanks will be compared to concentrations detected in samples collected during the CPT/Risk Burn. Common

laboratory contaminants (acetone, 2-butanone (MEK), methylene chloride, toluene and the phthalate esters) will be considered detected in site samples if the concentration in a site sample exceeds 10 times the concentration detected in the blank samples. If a compound that is not considered common laboratory contaminant is detected in a blank sample, it will be considered detected if the concentration in a site sample exceeds five times the concentration detected in the blank sample.

3. Detected compounds will be selected as COPCs. Those COPCs to be considered for inclusion in the indirect pathway risk assessment will be evaluated for their ability to bioaccumulate or bioconcentrate (i.e., have log Kow values equal to or greater than 4.0 or, for inorganics, have a whole body bioconcentration factor (BCF) equal to or greater than 100), in the environment and food chain.

4. Compounds that are not detected will be selected as COPCs if they:

   - Are potentially present in the waste stream,
   - Are likely to be emitted as PICs,
   - Are likely to be emitted because they are likely reformation products,
   - Are potentially toxic to humans,
   - Have a tendency to bioaccumulate or bioconcentrate in the environment and foodchain, or
   - Are within the TICs for which toxicity data or surrogate toxicity data is available.

Table 2-1 contains the analyte list of constituents to be considered in this process.

### 2.4.1 Characterization of Unidentified Compounds

USEPA guidance (2005a) generally recommends characterizing TICs when the peak intensity is 10 percent or more of the full chromatographic scale. From a health risk perspective, these are the compounds of greatest concern and will be the focus of the multiple pathway risk assessment. For those TICs without toxicological data, the TIC will be evaluated qualitatively using surrogate toxicity data from similar compounds.

### 2.4.2 Use of Non-Detects in the Risk Assessment

Three test runs will be conducted per test condition. For those compounds that were analyzed for, but not detected in the test run, the emission rates will be modeled in one of two ways. For those non-detects analyzed with non-isotope dilution methods, the reliable detection level (RDL) as described in the HHRAP (USEPA 2005a) will be used to quantify the non-detect. The actual method detection limit (MDL) for every non-detect compound will be used in the calculation of the RDL (laboratory reported MDL multiplied by 2.623). For those non-detects analyzed with isotope dilution methods, the estimated detection limit (EDL), as defined by SW-846 Method 8290 and EPA Method 1668A, will be used to quantify the non-detect. Should all

three test runs for a constituent be non-detect, the constituent will be evaluated in the risk assessment if it meets the criteria described in Section 2.4, #4. Those non-detected constituents that meet the above criteria will be retained and evaluated at their appropriate detection limits provided in the CPT/Risk Burn reports. Should a constituent not meet the criteria of a COPC, it will not be carried through the risk assessment.

### 2.4.3 Use of Qualifiers in the Risk Assessment

Data validation qualifiers will also assessed during the data evaluation process. The Quality Assurance Project Plan (QAPP) provides assessment procedures and criteria for accuracy, precision and completeness for the source samples collected during the CPT and risk burn. Each parameter has specific accuracy and precision criteria that are evaluated by the laboratory. Should QC sample results not meet the accuracy and precision criteria, the laboratory (in most all cases except volatiles by EPA 8260) has the ability to repeat sample analysis until the criteria is met. It is very rare that an entire data set would be deemed unusable. In cases where an entire data set is deemed unusable, that data will be evaluated based on its impact on the risk assessment. If the absence or use of this data has a significant impact on the Risk Assessment, re-sampling for that parameter may be required.

Unless the data is qualified with an "R" and is considered rejected data, all qualified data is considered usable for the risk assessment. In general, the use of qualifiers as outlined in USEPA's RAGS PART A (1989) will be followed. Data that is qualified with a "U" or "UJ" will be considered a non-detect and will be assigned a value equal to the full value of the appropriate detection limit as described above. Data that is qualified with a "J" or any other qualifier that indicates that the sample detection is an estimated value will be treated as a detected concentration in the risk assessment.

## 3.0 AIR DISPERSION AND DEPOSITION MODELING

Data collected during the CPT/Risk Burns, onsite meteorological observations and other facility data will be used as input to air quality dispersion models to predict one-hour and annual average concentrations as well as annual average deposition rates for pollutants emitted by RF-9, PODS and the OBA. The modeling approach follows EPA's human health (USEPA 2005a) and ecological (USEPA 1999) risk assessment protocols.

### 3.1 Description of Models Selected

Two air quality dispersion models will be used in concert to predict the dispersion and deposition of emissions from RF-9, PODS and the OBA. The American Meteorological Society's (AMS) and U.S. Environmental Protection Agency's AMS/EPA Regulatory Model (AERMOD) (USEPA 2004a) will be applied to RF-9 and PODS. The Department of the Army's Open Burn/Open Detonation Dispersion Model (OBODM) (Bjorklund, JR, et al., 1998) will be applied to the OBA. The selection of AERMOD is consistent with HHRAP and has been requested by EPA Region 9. The selection of OBODM is consistent with the previously approved risk assessment protocol for the New Bomb Area (Tetra Tech 2005). The latest versions of both AERMOD (Version 07026) and OBODM will be used. The models, together with their documentation, are available on EPA's Support Center for Regulatory Atmospheric Modeling website. If any deviations from the dispersion modeling protocol are required, they will be noted and discussed in the final risk assessment reports.

The application of EPA's Industrial Source Complex Model (ISCST3) is detailed in the HHRAP for assessing the impacts of emissions from waste combustor facilities, however since the HHRAP was issued in 2005, EPA has adopted AERMOD as its preferred regulatory model and has stopped supporting ISCST3. In the "Guideline on Air Quality Models" (USEPA 2005b) EPA describes AERMOD:

> "AERMOD is a steady-state plume dispersion model for assessment of pollutant concentrations from a variety of sources. AERMOD simulates transport and dispersion from multiple point, area, or volume sources based on an up-to-date characterization of the atmospheric boundary layer. Sources may be located in rural or urban areas, and receptors may be located in simple or complex terrain. AERMOD accounts for building wake effects (i.e., plume downwash) based on the PRIME building downwash algorithms. The model employs hourly sequential preprocessed meteorological data to estimate concentrations for averaging times from one hour to one year (also multiple years). AERMOD is designed to operate in concert with two pre-processor codes: AERMET processes meteorological data for input to AERMOD, and AERMAP processes terrain elevation data and generates receptor information for input to AERMOD."

AERMOD is listed in the HHRAP as an alternative model, has gained broad regulatory acceptance and is applicable to both the emission source types and the terrain of the Hawthorne Army Depot. Thus this protocol substitutes AERMOD for ISCST3, but follows the overall modeling methods of the HHRAP with modifications needed to accommodate AERMOD.

OBODM was developed specifically to address the air quality impacts of open air burning and detonation of munitions and propellants. Unique empirical factors in OBODM are based on munitions disposal data collected at Dugway Proving Grounds. OBODM employs both a Gaussian puff algorithm to simulate detonation emissions and an integrated puff/continuous plume algorithm to simulate open burning emissions. The model includes cloud and plume rise as well as dispersion based on planetary boundary layer scaling. OBODM predicts both concentrations and particle deposition attributable to gravitational settling.

## 3.2 AERMOD Modeling

### 3.2.1 Preprocessing Programs

AERMOD requires three USEPA preprocessors, the Building Profile Input Program for PRIME (BPIPPRIME), the meteorological processor (AERMET, Version 06341) and the terrain processor (AERMAP, Version 06341), all available on USEPA's regulatory air modeling website (http://www.epa.gov/scram001/). BPIPPRIME is used to establish the building geometry near the emission source to incorporate building-induced aerodynamic downwash and cavity zone effects. AERMET combines concurrent surface and upper air meteorological data to produce a model compatible meteorological input files. AERMAP transforms digital terrain information and receptor grid specifications into receptor files compatible with AERMOD.

BPIPPRIME will be run for building tiers within five building heights or maximum projected building widths (5L) of each source modeled with AERMOD. Building dimension data will be taken from plot plans and architectural drawings of the facility. Figure 3-1 shows the layout of the Western Area Demilitarization Facility (WADF), which includes the PODS and RF-9. Stack-specific BPIPPRIME output will be included in the AERMOD model input as appropriate.

AERMET will be used to prepare AERMOD compatible meteorological data input files. The meteorological data input file uses hourly on-site surface observations collected at the WADF (see Figure 3-1) in 2005, the latest full year of onsite data, supplemented with concurrent

National Weather Service (NWS) surface and upper air observations from Reno airport. Further discussion of the meteorological data processing is presented in the Meteorological Data section.

AERMAP will be used with U.S. Geological Survey (USGS) Digital Elevation Model data (DEM) to prepare modeling receptor arrays for the modeling domain. The receptor arrays are discussed further in the Surrounding Terrain Information section.

### 3.2.2 Partitioning Emissions

Following the HHRAP recommendations, AERMOD will be run for each emission source:

- "vapor phase" runs to predict concentration, dry deposition and wet deposition for gaseous compounds with AERMOD's gas deposition algorithm,
- a "divalent mercury vapor phase" run to predict concentration, dry deposition and wet deposition for vapor phase divalent mercury with a compound specific deposition recommended by Wesely, et.al., 2002 ,
- a "particle phase" run to predict concentration, dry deposition, wet deposition and total deposition for particles, and
- a "particle-bound phase" run to predict concentration, dry deposition, wet deposition and total deposition for compounds that condense on or coat the surface of particles emitted from the sources.

Predicted concentrations and deposition rates from all three emission sources will be combined.

#### 3.2.2.1 Vapor Phase Modeling

Highly volatile compounds emitted by RF-9 and PODS will be modeled using AERMOD to predict hourly (acute exposure) concentrations and annual average (chronic exposure) concentrations and deposition rates. Following the HHRAP, organics, chlorine, dioxins, furans, hydrochloric acid and divalent mercury will be modeled as vapor phase components. Gaseous deposition for these compounds will be modeled as recommended in the Addendum User's Guide for the AMS/EPA Regulatory Model – AERMOD (USEPA 2006a) following the deposition parameterization of Wesely et al. (2002).

For gaseous deposition AERMOD requires the user define seasonal categories, land use categories, pollutant specific diffusivity in air ($cm^2/s$), diffusivity in water ($cm^2/s$), cuticular resistance (s/cm) and Henry's Law constant (Pa $m^3$/mol). Each of these is discussed below:

Following the Addendum, each month of the 2005 modeling year was assigned a season:

1. January – Category 4: defined as "winter with snow on the ground" (based on the National Climate Data Center (NCDC) snowcover website (http://www.ncdc.noaa.gov/oa/climate/research/2005/jan/snow.html) showing more than one-half the month with snow on the ground).
2. February – Category 3: defined as "late autumn after frost and harvest, or winter with no snow."
3. March – Category 3
4. April – Category 3
5. May – Category 5: defined as "transitional spring with partial green coverage or short annuals" (based on being the first month after the last killing frost/occurrence of 28° Fahrenheit).
6. June – Category 1: defined as "midsummer with lush vegetation."
7. July – Category 1
8. August - Category 1
9. September – Category 1
10. October – Category 2: defined as "autumn with unharvested crops" (based on transition to Category 3).
11. November – Category 3: (based on first occurrence of sub-freezing temperatures).
12. December – Category 3

The above seasonal data will be input to modeling keyword GDSEASON.

Land use categories were defined about the WADF in 36 wind direction sectors out to a distance of 3 kilometers from the station. The predominant land use in each sector, is based on the U.S. Geological Survey's "National Land Cover Dataset 2001" (NLCD; USGS 2001). Table 3-1 presents the land-use category assigned to each downwind sector which is used with the modeling keyword GDLANDUSE.

Pollutant specific diffusivity in air, diffusivity in water, and Henry's Law constant are based on tabulated values as contained in USEPA, 2005c, The Hazardous Waste Companion Database to USEPA's HHRAP.

Cuticular resistance is based on table values contained in Wesely et al. (2002), where available. Otherwise, the cuticular resistance is calculated based on the method presented in Wesely et al. (2002). The Le Bas molar volumes for compounds not listed in the tables are based on the molecular structure of the specific compounds.

For divalent mercury, the dry deposition parameters suggested by Wesley et al. are used:

- Henry's Law coefficient = $6 \times 10^{-6}$ Pa $m^3$ $mol^{-1}$
- Reactivity factor = 1
- Diffusivity in air = $0.06 \times 10^{-4}$ $m^2$ $s^{-1}$
- Cuticular resistance = $10^7$ s $m^{-1}$

Because the dry deposition factors are pollutant specific, each vapor phase pollutant with distinct deposition parameters must be modeled using separate AERMOD modeling runs with actual emission rates (i.e., unit emission rates, 1 g/s, cannot be used to model deposition for vapor phase emissions).

#### 3.2.2.2 Particle and Particle-Bound Phase Modeling

Particle size distribution (PSD) data will be available from the CPT/Risk Burns to be conducted for PODS and RF-9. With the level of particulate control that is anticipated for RF-9 and PODS, obtaining a representative PSD sample using EPA Method 201A (in-stack impactor) is not practical. Instead, PSD will be measured using a modified Method 5 sampling train with a polycarbonate filter with PSD analysis by scanning electron microscopy (SEM).

If more than 10 percent of the particle mass has a size diameter greater than 10 µm, AERMOD "Method 1" for particle deposition will be used with PARTDIAM and MASSFRAX based on the SEM particle sizing. PARTDENS will be set to a value of 1.0 for all size ranges. If less than 10 percent of the particle mass has a diameter greater than 10 µm or the distribution cannot be reliably determined, AERMOD "Method 2" for particle deposition will be used, per the recommendation of the AERMOD addendum. Precipitation data for the deposition algorithm will be based on the hourly onsite precipitation observations. Precipitation occurring at temperatures below freezing will be assumed to be frozen. Precipitation occurring at temperatures above freezing will be assumed to be liquid.

Particle phase and particle bound phase emissions will be modeled at unit emission rates (1.0 g/s) for each source and post-processed using the pollutant specific emission rate to determine the predicted concentration for each pollutant.

### 3.2.3 Site-Specific Information Needed for Air Modeling

#### 3.2.3.1 Surrounding Terrain Information

Terrain elevation data will be taken from the U.S. Geological Survey's (USGS) Digital Elevation Model (http://rmmcweb.cr.usgs.gov/elevation/dpi_dem.html). DEMs contain elevation data for the contiguous states with 30 meter resolution.

The terrain elevation data will be used to determine receptor node elevations and will be processed for AERMOD through the AERMAP preprocessor to produce x,y,z receptor coordinates and an AERMOD compatible receptor input file. Two Cartesian receptor arrays will be run, as shown in Figure 3-2. The first Cartesian receptor node array will be centered on the

centroid of PODS and RF-9. The second receptor array will be centered on the OBA. Each array will contain a 100-meter spaced Cartesian receptor array developed to a distance of 3 km from the PODS/RF-9 centroid or OBA with 500 m spaced Cartesian receptor array from 3 km to 10 km from the centroid or OBA. Additional receptor nodes for distances out to 50 km may be added for evaluation of water bodies, drinking water reservoirs and their watersheds, specific human receptors, ecosystems and special ecological habitats. The position of the Cartesian array centered on the OBA will be adjusted so that its receptor nodes coincide with the receptor nodes in the overlapping PODS/RF-9 receptor array.

#### 3.2.3.2 Surrounding Land Use Information

The USGS National Land Cover Dataset (NLCD; USGS 2001) will be used to characterize land use surrounding the site. Land use within 3 km of the WADF will be used to classify the area as urban or rural and to determine the albedo, Bowen ratio and surface roughness following USEPA's guidance. Land use to distances of 50 km, as shown in Figure 3-3, will be used to aid in the identification of sensitive receptors and locations of interest for the human health and ecological risk assessments.

### 3.2.4 Meteorological Data

AERMOD requires both surface and upper air meteorological data processed through the AERMET preprocessor. Hawthorne Army Depot collected hourly surface meteorological data at the WADF near the RF-9 and PODS units. The hourly meteorological data are available from January 1, 2005 through August 8, 2006. The 2005 full year of WADF meteorological data will be used for AERMOD modeling. Table 3-2 shows the data recovery for this period. All four quarters of the 2005 onsite data meet EPA's data capture requirements for regulatory modeling applications (USEPA 2000) for precipitation, temperature, sigma theta, wind direction, and wind speed. Upon review, the pressure readings were deemed invalid. Instead, altimeter readings from Reno, NV surface observations will be used. The Reno surface data also provide cloud cover observations. Reno upper air data will also be used to provide temperature profile information required by AERMET and AERMOD. The data recovery for the Reno observations is also presented in Table 3-2. AERMET input and output data will be reviewed and compared to ensure that the final, processed meteorological data accurately reflect the observations. In addition, AERMET provides numerous automated data quality checks that will be reviewed to identify meteorological data problems.

AERMET employs three micro-meteorological input parameters (noontime surface albedo, Bowen ratio, roughness length) to characterize the influence of the earth's surface on the mixed layer. The terrain surrounding the meteorological site was divided into twelve 30 degree sectors to a distance of 3 km and the micro-meteorological parameters were estimated separately for each sector in each month using the values presented in the User's Guide for the AERMOD Meteorological Preprocessor (AERMET) (USEPA 2004b). Land-use in each sector was quantified using USGS' NLCD (see Figure 3-4). The acreage of each land-use type in each sector was used to provide weighted averages of the surface characteristics for the sector, and was used to calculate the appropriate micro-meteorological parameter value assigned for each sector in each month. Following EPA recommendations, average albedo and Bowen ratio values are applied to all sectors and sector-specific roughness lengths are used. The micrometeorological parameters for each month are presented in Table 3-3.

### 3.2.5 Model Inputs

All AERMOD runs will be made with the MODELOPT keywords including TOXICS, CONC, DDEP, WDEP and DEPOS to include simulation of both atmospheric dispersion and deposition processes. For the vapor phase runs the gaseous deposition parameters described above will be implemented for each vapor phase pollutant.

Table 3-4 presents the nominal stack parameter information for both PODS and RF-9. Note that stack variables for modeling (exit velocity and stack exhaust temperature) will be based on the results of the CPT/Risk Burn stack tests. The emission rate for each particle and particle bound model run will be 1.0 g/s. Particle densities will be set to 1.0 g/cm$^3$. For the vapor phase runs, the actual emission rates will be used. To account for process upsets following the HHRAP, the emission rates determined from the trial burns for all organic compounds will be multiplied by 2.8 and the emission rates for all metals will be multiplied by 1.45.

AERMOD will be run to predict appropriate annual deposition rates and long term concentrations for chronic exposures. Hourly concentrations will be predicted to investigate acute exposures.

### 3.2.6 Fugitive Emissions

As discussed in Section 2.3.4, munitions and explosives fed to RF-9, PODS and the burn pans at OBA are either solids or encapsulated and little to no fugitives are emitted as a result of handling the feed stock. HWAD maintains the RF-9 and PODS under negative pressure that

should preclude any fugitive emissions from occurring. The destruction of munitions in the PODS results in slag or a glassy material and is not a source of fugitive emissions. The exhaust gas stream from this unit is treated through a series of air pollution control devices and exhausted through the stacks. The incineration of munitions in RF-9 produces gases, ashes and other residues that are routed through the APCS. The dust, composed of the reaction products, fly ash and unreacted reagent, is collected in the bottom section of the baghouses. Valves transfer the collected dust via sealed piping to the collection containers for offsite disposal at a permitted hazardous waste landfill. Pulse-jet systems are used to clean the bags in the RF-9 and PODS baghouses. The collected dust is transferred via sealed piping to collection containers for disposal, and is not a significant source of fugitive emissions.

The propellants are delivered to Old Bomb in metal cans, each containing approximately 110 pounds of propellant. The cans are placed next to the burn pans and then manually opened and dumped into the pans. At the end of the burn, there is very little ash left in the pans and what is left is placed into a 55-gallon drum.

Because there are no significant fugitive emissions associated with the combustors or with OBA, only the stack emissions from PODS and RF-9 and the detonation emissions from OBA will be modeled.

#### 3.2.7 Model Outputs

Following the recommendation of the HHRAP, the RF-9, PODS and OBA will be modeled separately to predict long-term average concentrations for the vapor and particle phases, annual wet and dry deposition rates for the vapor and particle phases, and hourly concentrations for the vapor, particle and particle bound phases. In addition to model output summary text, output "plot files" will be generated for concentrations and deposition rates.

### 3.3 OBODM Modeling

The OBA contains four burn pads, each with five, 16 feet long by 6 feet wide by 1 foot deep burn pans, capable of holding 1000 pounds of unserviceable propellants, munitions and donor explosives per pan. The materials to be treated at the OBA are detonated using donor explosives. The detonation is a short event (microseconds), at high temperatures (2,500 to 5,600$^{o}$ C), followed by afterburning which lasts on the order of seconds. The detonation and burn occur without control of combustion air or any containment other than the open burn pan. Operations at the OBA take place only during daylight hours.

The OBA operations cause the emissions of heated clouds of effluent that buoyantly rise in the atmosphere and disperse downwind. AERMOD was not designed to model explosions and open burns. While AERMOD will model plume rise from stack sources and will model dispersion from volume sources, it will not model the rise of buoyant clouds resulting from explosions and open burning and the subsequent dispersion of these clouds. The Open Burn Open Detonation Model (OBODM) does model these scenarios and was developed to simulate the destruction of propellants and munitions using burn pans. Therefore, OBODM was selected for the OBA modeling.

### 3.3.1 Preprocessing Programs

OBODM requires a sequential hourly file of input meteorological data covering up to one year. OBODM will be run using EPA's Meteorological Processor for Regulatory Modeling (MPRM), available on the EPA's air modeling website. MPRM will be used to process 2005 WADF onsite meteorological data together with surface and upper air observations from Reno.

### 3.3.2 Partitioning Emissions

#### 3.3.2.1 Vapor Phase Modeling

OBODM will be run in the concentration mode to predict the concentrations of vapor phase pollutants. OBODM does not model vapor deposition and thus assumes that all vapor mass emitted contributes to inhalation exposure.

#### 3.3.2.2 Particle and Particle-Bound Phase Modeling

OBODM will be run with both concentration mode and gravitational deposition mode implemented to model particle and particle bound phases. A particle size distribution is available from NASA testing of rocket propellants with a mass mean diameter of 12.3 µm and a geometric standard deviation of 2 µm. The NASA particle size distribution will be used in OBODM for the OBA. To maximize near-field, worst-case deposition, a particle density of 11.3 $g/cm^3$ (density of lead) will be assumed. This particle distribution will be used to predict both particle and particle-bound phase gravitational settling and deposition.

### 3.3.3 Site-Specific Information Needed for Air Modeling

#### 3.3.3.1 Surrounding Terrain Information

Terrain elevation data will be taken from the U.S. Geological Survey's (USGS) Digital Elevation Model (http://rmmcweb.cr.usgs.gov/elevation/dpi_dem.html). DEMs contain elevation data for the contiguous states with 30 meter resolution.

The terrain elevation data will be used to determine receptor node elevations. Two Cartesian receptor arrays will be run (see Figure 3-2). The first Cartesian receptor node array will be centered on the centroid of PODS and RF-9. The second receptor array will be centered on the OBA. Each array will be a 100 meter spaced Cartesian receptor array developed to a distance of 3 km from the centroid or OBA with a 500 m spaced Cartesian receptor array from 3 km to 10 km from the centroid or OBA. Additional receptor nodes for distances out to 50 km may be added for evaluation of water bodies, drinking water reservoirs and their watersheds, specific human receptors, ecosystems and special ecological habitats. The position of the Cartesian array centered on the OBA will be adjusted so that its receptor nodes coincide with the receptor nodes in the overlapping PODS/RF-9 receptor array.

Because OBODM is limited to a single receptor array center and spacing, as well as 100 user specified receptors per run, OBODM will be run at least four times (two grid centers by two grid spacings) for each modeling scenario (vapor and particles) to predict concentrations and deposition.

### 3.3.4 Meteorological Data

OBODM can run up to one year of hourly MPRM processed meteorological data when run in the detailed processing mode (providing hourly concentration output). The MPRM data will be used as input to OBODM. Each modeling scenario (2) and receptor grid (4) will be run for a total of eight model runs.

Because operations at the OBA occur only during daylight hours, the daylight hours only processing option will be selected, requiring the input of longitude, latitude and time zone to properly select the meteorological hours to run. Average relative humidity will be input at 50 percent (the climatological average for Reno) to ensure the model assumes the region is arid and uses appropriate vertical temperature gradients. Default wind speed shear will be implemented and wind direction shear will be set to zero. The station pressure will be input as 780 millibars (used to determine air density for gravitational settling calculations). Following USEPA

preference, calm winds will be treated as missing wind speed values and no dispersion calculations will be made for hours with missing meteorological variables.

### 3.3.5 Model Inputs

OBODM will be run in the "detailed mode" to predict one hour and annual concentrations and gravitational deposition. Detailed mode provides hourly output of concentrations at each receptor node, should it become necessary to combine source contributions from the OBA with contributions from the RF-9 and PODS. The daily and annual amounts of material treated, as well as the amounts of donor explosives, will be used to derive the number of pounds of material detonated in the burn pans each day. The "fraction of exhaust cloud" variable will be adjusted so that the source emission rate will be 1 g/s. The heat content of the materials will be assumed to be 925 calories per gram, a relatively low heat content which conservatively leads to lower predicted plume rise and higher predicted plume impacts. The emissions will be modeled as instantaneous volume releases. It will be assumed that all burn pans are detonated between 9 and 10 AM daily, resulting in the maximum possible predicted hourly concentrations. A more realistic operating scenario may be modeled if the simultaneous detonation scenario proves too conservative.

### 3.3.6 Model Outputs

OBODM will be run with unit emission rates in "detail mode" which causes the model to create an output file of hourly concentrations and annual depositions for every receptor node. In addition, print files will be generated that summarizes the maximum predicted concentrations and deposition rates for each averaging period (hourly and annual). These files will be available to determine both maximum concentrations/deposition rates overall, plus identify the concentration/deposition rates at specific receptors.

## 3.4 Using Combined Model Output

The output of AERMOD and OBODM will be available to determine the predicted concentrations and deposition rates for each source (RF-9, PODS and the OBA). Because the hourly prediction files will be available and each model has used the same receptor node array, the model output files can be post-processed to determine the contribution of each source to the total predicted concentrations and deposition rates at each receptor location.

## 4.0 HUMAN HEALTH RISK ASSESSMENT

The following human health risk assessment (HHRA) methodology is based on current risk assessment guidelines and experience in conducting risk assessments for combustion units. Table 4-1 lists many of the current risk assessment guidance documents.

### 4.1 Exposure Assessment

Constituents emitted from PODS, RF-9 and OBA are dispersed into ambient air and may eventually deposit onto soils, plants, and surface water. Individuals within the study area may inhale airborne materials, inadvertently ingest soil, and consume drinking water, produce, livestock, dairy products or fish from the area.

The exposure assessment characterizes the potentially exposed population and estimates the magnitude of exposure for individuals in the area surrounding the HWAD facility. To do this, the exposed population and exposure pathways are identified, the concentrations of constituents in various environmental media are modeled, and potential constituent specific intakes by individuals are estimated. The methodology uses theoretically possible exposures, not actual exposures, and may significantly overstate what any individual is likely to experience. Where possible, existing and site-specific information will be used throughout the risk assessment process.

The potentially exposed populations and exposure pathways will be identified based on an evaluation of the land use characteristics of Hawthorne, Nevada, and the study area surrounding the HWAD facility. The evaluated areas will be based on the defined area of facility impact, which is determined from the dispersion and deposition modeling effort. The most recent HHRAP (USEPA 2005a) states that "…the most significant deposition occurs within a 10 km radius", and that "most recommended exposure scenarios appropriate for the assessment will likely be located within this area". However, the HHRAP states that it may be necessary to characterize the exposure setting beyond the 10 km radius should recommended exposure scenarios or special populations are not found within the 10 km area. A 50 km radius is the recognized limit of AERMOD air dispersion modeling and is used as the outer boundary for characterizing additional exposure settings. Figure 4-1 shows the 50 km and 10 km study area boundaries.

A discussion of the potential exposure pathways is provided below. Information on the activity and potential exposure patterns of local individuals, including potential locations of

residences, drinking water sources, beef cattle and dairy farms, and fishing of the nearby water bodies, is presented. This information will be used to reflect site-specific characteristics of the study area and ultimately assist in the identification of exposed populations and exposure pathways.

### 4.1.1 Demographics and Land Use

The nearest area of civilian population to HWAD is the city of Hawthorne that is bordered on three sides by HWAD. Hawthorne covers a land area of approximately 1.5 square miles. Hawthorne is the largest community in Mineral County with a 2000 Census population of 3,311 or roughly 65% of the population of Mineral County (USCB 2001). One of the major employers of Mineral County is Day & Zimmerman Hawthorne Corporation (DZHC) that runs the HWAD. Currently, DZHC employs approximately 500 people. The next largest employers are El Capitan Lodge and Casino, and the Mineral County School District (NCED 2002).

The majority of the land within a 100-kilometer (km) (62 miles) radius of HWAD is open rangeland of the Toiyabe National Forest located to the south and west of the HWAD. Agricultural activities occur primarily in Lyon County. Major crops of this area of Nevada include onions, garlic, potatoes and alfalfa, although only hay is produced in Mineral County. Most farms raise beef or dairy cows in Mineral County (USDA 1997).

### 4.1.2 Potential Receptors and Exposure Pathways

#### 4.1.2.1 Chronic Exposures

The HHRA will evaluate receptors at current and future off-site locations using the highest air and depositional concentrations at each location (see Section 3.0) with the caveat that future locations are limited to those that are reasonably expected to support a particular receptor population (for example, a future farm is unlikely to be located in an area of steep rugged terrain). Specifically, indirect exposure pathways (those other than direct inhalation) will be evaluated at current and future locations using air and depositional concentrations, and direct inhalation exposures will be evaluated at current and future locations using air concentrations. It should be noted that actual air and depositional concentrations will be used for specific receptor locations (e.g. Hawthorne, NV for the resident receptor). For the future receptor, the maximally exposed individual (MEI) will be evaluated. That is, the maximum air and depositional concentration will be used as long as the location(s) of those concentrations support the specific

activity. It is not uncommon for the maximum concentrations to occur in different locations. For the purpose of this assessment they will be co-located. Off-site locations are defined as locations beyond the restricted area of the HWAD but within 50 km of the HWAD. It is assumed that HWAD's mission as it is currently defined (see Section 2.0) will continue into the foreseeable future. The off-site land use around HWAD (primarily open rangeland) is also assumed to remain as it is currently defined.

The HWAD risk assessment will include evaluation of four exposure scenarios including:

***Current/Future Residential (adult and child)***

Residential exposures are expected to occur through incidental ingestion of soil, ingestion of drinking water and home-grown produce, and via inhalation. In addition, infant exposure through the ingestion of breast-milk will also be evaluated. Black Beauty and Rose Creek Reservoirs will be evaluated for the drinking water pathway for this receptor. See section 4.1.2.2 below for a discussion of the rationale for the selection of these waterbodies.

Based on 2000 Census results and review of topographic maps, the nearest area of civilian population to HWAD is the city of Hawthorne that is bordered on three sides by HWAD. Therefore, for the purposes of the HHRA, residential receptors will be evaluated at both the location of Hawthorne, Nevada and at the location of the highest modeled air and depositional concentrations (the MEI) as long as these two locations do not overlap. If an overlap occurs, the single common location will be evaluated. In addition, the MEI locations that exhibit significant topographical change, or exhibit a significant amount of rock outcropping (and hence incompatible with a residence) or are located on HWAD or Federal (Bureau of Land Management (BLM), Toiyabe National Forest) property will be excluded as well.

***Current/Future Fisher (adult and child)***

Fisher exposures are expected to occur through incidental ingestion of soil, ingestion of drinking water and home-grown produce, ingestion of locally caught fish, and via inhalation. In addition, infant exposure through the ingestion of breast-milk will also be evaluated. The incidental ingestion of soil, ingestion of drinking water and homegrown produce, and the inhalation portion of the risk to the fisher is the same as that of the residential receptors. Black Beauty and Rose Creek Reservoirs will be evaluated for the drinking water pathway for this receptor. The HHRA will include evaluation of fisher receptors based on exposures to fish

caught at Walker Lake. See Section 4.1.2.2 below for a discussion of the rationale for the selection of these waterbodies.

***Current/Future Farmer (adult and child)***

Farmer exposures are expected to occur through incidental ingestion of soil, ingestion of drinking water and home-grown produce, ingestion of home-grown beef, dairy, chickens, eggs, pork and via inhalation. In addition, infant exposure through the ingestion of breast-milk will also be evaluated. Black Beauty and Rose Creek Reservoirs will be evaluated for the drinking water pathway for this receptor. See Section 4.1.2.2 below for a discussion of the rationale for the selection of these waterbodies.

Most of the off-site land within 20 km of the PODS, RF-9 and OBA is incompatible with farming. Specifically, much of this land is either federally owned (such as the Toyiabe National Forest), rocky, very inaccessible, affected by significant topographical changes, or characterized by some combination of these qualities. In general, the land is very rugged and isolated. The current/future farmer receptor locations will therefore be selected as the location of highest modeled air and depositional concentrations (the MEI) in an area that is currently farmed or could reasonably be farmed in the future. Within 10 to 20 km south of the OBA, along Highway 359, the area called Whiskey Flat appears to be potentially compatible with farming; that is, the features discussed above are absent. The Sweetwater Ranch is located in Whiskey Flat. In addition, during a site visit, TRC personnel noted the presence of grazing cattle just north of Walker Lake (approximately 24 km from PODS/RF-9). For the purposes of the HHRA, a current farmer receptor will be evaluated at either the location of Sweetwater Ranch or north of Walker Lake, depending on which has the highest modeled air and depositional concentrations, and the future farmer location will be evaluated at the location of the highest modeled air and depositional concentrations (the MEI) as long as these two locations do not overlap and the locations are not incompatible with farming (i.e., locations that are heavily forested, exhibit significant topographical change, or exhibit a significant amount of rock outcropping, etc). If an overlap occurs, the single common location will be evaluated.

4.1.2.2. Water Bodies and Associated Watersheds

Surface water bodies and their associated watersheds are important for the characterization of the exposure setting and evaluating some human exposures because they can

be important sources of COPC exposures from the ingestion of fish (for the fisher scenario) or drinking water (for all scenarios). The HHRAP recommends identification of the surface water bodies and associated watersheds within the exposure setting (50-km radius) that support fishing or are a source of drinking water.

In the previously approved protocol for PODS and OBA, a radius of 10-km was chosen to identify those surface water bodies and associated watersheds that may be impacted by HWAD emissions (CHPPM 2004).

Current or potential future drinking water sources from surface water bodies around the HWAD area were located by using topographic maps and contacting personnel from HWAD and the State of Nevada (CHPPM 2004). Water bodies identified for potential evaluation by CHPPM include Black Beauty Reservoir, Cat Creek Reservoir, and Rose Creek Reservoir. However, as noted in CHPPM's ecological risk assessment protocol (CHPPM 2004), Cat Dam Reservoir dries up during the summer months (Millsap 2003). Therefore, Black Beauty and Rose Creek Reservoirs will be evaluated for the drinking water pathway in this HHRA. Figure 2-1 depicts locations of these two reservoirs.

Current or potential future water bodies supporting fishing were located by using topographic maps and contacting personnel from HWAD and the State of Nevada (CHPPM 2004). Water bodies identified by CHPPM for potential evaluation included Walker Lake, East Walker River, Rose Creek Reservoir. Walker River, Rose Creek, Corey Creek, and Cottonwood Creek were also identified as current or potential fishing water bodies, however Rose Creek, Corey Creek and Underwood Creek are not large enough to support fish (TRC 2006b). Rose Creek Reservoir is concrete lined and is drained and cleaned every 5 years. Rose Creek is located on HWAD property and is not under the jurisdiction of NDOW. HWAD personnel have indicated that there are no future plans to restock Rose Creek Reservoir (TRC personal communication, 2006) and therefore this waterbody was eliminated from the evaluation. According to the Nevada Department of Wildlife (NDOW), Walker Lake and the East Walker River are among the top western Nevada fishable waters (NDOW 2004). However, preliminary evaluations by CHPPM determined that estimated substance concentrations at Walker Lake would be higher than Walker River. This conclusion was derived based on two reasons: (1) Walker Lake lies closer to the facility, and (2) the volumetric flow rate of Walker Lake was assumed to be zero meaning that washout of COPCs from the lake is minimal. This conservative assumption was used to address concerns that the volume of Walker Lake has been decreasing

over time (USGS 1995). It was thus decided that evaluating Walker Lake alone would be sufficient to address potential concerns with regard to the ingestion of fish caught from Walker River (CHPPM 2000) as well as East Walker River.

Walker Lake (depicted in Figure 2-1) obtains most of its source water from the Walker River and is a terminal sink for all surface water and ground-water flow in the Walker River Basin (USGS 1995). Records show that the level of Walker Lake has been decreasing over the years. The USGS (1995) estimated an average volume loss of 93.7 $m^3$/year between 1939-1993. This had led to an increase in the concentration of dissolved solids thus increasing the salinity of the lake. Despite this, the lake still sustains a fishable population.

#### 4.1.2.3. Acute Exposure

Acute exposures will be evaluated to account for short-term effects of exposure to maximum 1-hour concentrations of COPCs in emissions from the facility through direct inhalation of vapors and particles.

### 4.1.3 Exposure Concentration and Dose

The estimation of exposure concentration and dose received by receptors will follow procedures outlined in USEPA's HHRAP (USEPA 2005a). The approach that will be taken to quantify exposure via each pathway is provided in Appendix A (media calculations) and Appendix B (exposure and risk calculations).

#### 4.1.3.1 Media Calculations

Concentration calculations vary depending on the medium or food type evaluated. The constituent concentration in air is simply the ground level concentration estimated by the ISCST3 model. The concentration in soil, water, plant, or animal tissue will be derived using the modeled wet and dry weight deposition rates for each potential constituent and the equations described in Appendices A and B.

General input parameters for the equations shown in Appendix A and B are in accordance with USEPA's HHRAP (2005a) and are provided in Table 4-2. Constituent specific fate and transport parameters will be obtained from USEPA's HHRAP (2005a) companion access database (USEPA 2005c). For those constituents not addressed in the 2005 HHRAP, chemical/physical properties will be obtained from data sources cited in the 2005 HHRAP. Some of these sources include:

1. Superfund Chemical Data Matrix (USEPA 2004c)
2. CHEMFATE Database (SRC 2003a)
3. PHYSPROP Database (SRC 2003b)
4. CRC Handbook of Chemistry and Physics (Lide 2003)
5. The Merck Index (O'Neil 2001)
6. Calculated using procedures outlined by Handbook of Property Estimation Methods (Lyman, et al. 1990)
7. WATER9 (USEPA 2004d)
8. Soil Screening Guidance: Technical Background Document and User's Guide (USEPA 1996 a,b)

In addition, for those constituents that are specific to ordnance and munitions, the Army Risk Assessment Modeling System (ARAMS) will be consulted. The ARAMS was discussed in detail in Appendix G of CHPPM's 2004 HHRAP. A discussion of the relevant databases within ARAMS is discussed below:

Army Risk Assessment Modeling System (ARAMS) is accessible at http://www.wes.army.mil/el/arams/arams.html.

The two ARAMS sub-databases, outlined in the following subsections, have been selected for use in this document.

Range Database
Both chemical/physical properties and biotransfer factors can be found in the Range Database at http://www.wes.army.mil/el/arams/arams.html. Range Database (Technical Report ERDC/EL TR-02-27 and MS Access 2000 database) - The Range Database is a database of physicochemical and toxicological benchmark data for military unique substances that can be found on the ARAMS Databases website.

Biota-Sediment Accumulation Factors Database
Biota-Sediment Accumulation Factors (BSAF) (Clarke and McFarland 1991) – The BSAF database is a source for biota-sediment accumulation factors and lipid data for fish and aquatic invertebrates on the ARAMS Databases website at http://www.wes.army.mil/el/arams/arams.html

4.1.3.2. Calculation of Daily Intakes

Appendix B provides the specific equations used to calculate daily intakes from the exposure media. Daily intake of constituents from the various media (soil, plant or animal tissue) from oral exposures will be calculated using the following standard equation:

$$I_m = C_m \times IR_m \times FR_m$$

Where:

$I_m$ = daily intake of constituent in media (soil, plant, animal tissue, or water), mg/d, mg/L
$C_m$ = constituent concentration in media, mg/kg
$IR_m$ = intake rate, kg/d
$FR_m$ = fraction of contaminated media, unitless

It should be noted that the intake rates do not represent the entire dietary intake of the individual, but only that portion of the diet produced at home. For example, the beef consumption rate represents only the amount of beef consumed each day which was raised on the farm property.

The HHRAP (USEPA 2005a) assumes that only the portion of an individual's daily intake which is home-grown (i.e., the farm for the farming scenarios, the home garden for the residential and fisher scenarios) is impacted by facility emissions. Therefore since the consumption rates are specific to home produced foods, the fraction of home-produced foods that are considered to be contaminated is 100 percent.

The input values for assessing the oral exposures (e.g., intake rate) will be consistent with current guidance for characterizing RME (reasonable maximum exposure) conditions and are presented in Table 4-2. For all exposure scenarios and pathways, the RME exposure assumptions incorporated into the HHRA are intended to be conservative (i.e., health protective) and likely overestimate the potential exposures and risks.

## 4.2 Dose-Response Assessment

### 4.2.1 Chronic Exposures

A hierarchical approach will be used to select chronic toxicity criteria for the constituents detected during the CPT/Risk Burn. The hierarchy is consistent with current USEPA guidance (USEPA 2003a, 2005a). This approach ensures that the most up-to-date information is used for this risk assessment. The chronic toxicity criteria for each COPC evaluated in the risk assessment will be summarized in tabular form. These toxicity criteria characterize the relationship between the level of exposure and the magnitude of toxic effect (i.e., dose-response), and include cancer slope factors for evaluating the increased risk of cancer and non-cancer reference doses for evaluating the potential for non-carcinogenic (e.g., systemic) effects.

Listed in order, these data sources are as follows:

1. Tier 1- EPA's Integrated Risk Information System (IRIS) Database (USEPA 2007).

2. Tier 2- EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) – The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) develops PPRTVs on a chemical specific basis when requested by USEPA's Superfund program. PPRTVs will be obtained from the Risk Assessment Information System (RAIS 2007), which is updated monthly.

3. Tier 3- Other Toxicity Values – Tier 3 includes additional USEPA and non-USEPA sources of toxicity information. Priority will be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed. Tier 3 values include toxicity values obtained from CalEPA, Agency for Toxic Substances and Disease Registry's (ATSDR's) Minimum Risk Levels (MRLs) and toxicity values obtained from HEAST (USEPA 1997a).

4. Consultation with USEPA Region IX – Should toxicity criteria not be available from the above sources, USEPA Region IX will be consulted for the development of toxicity criteria.

#### 4.2.1.1 Toxicity Information For Carcinogenic Effects

Potential cancer risks from indirect pathways will be evaluated using oral cancer slope factors expressed in terms of risk per unit exposure dose (i.e., risk per mg/kg/d or $(mg/kg/d)^{-1}$), while potential cancer risks from direct pathways will be evaluated using inhalation unit risk factors expressed in terms of risk per unit concentration (i.e., risk per $\mu g/m^3$ or $(\mu g/m^3)^{-1}$). Constituents for which inhalation toxicity values are available will be carried through the direct pathway risk assessment.

The constituent-specific toxicity criteria for carcinogens (in units of $(mg/kg\text{-}d)^{-1}$ or $(ug/m^3)^{-1}$) are generally estimated through the use of mathematical extrapolation models (e.g., the linearized multistage model). These models estimate the largest possible linear slope, within a 95% confidence interval, at low extrapolated doses. Thus, the slope/unit risk factor is characterized as a 95% upper-bound estimate, such that the true risk is not likely to exceed the upper-bound estimate and may be lower. In addition to identifying cancer slope and unit risk factors, the USEPA classifies constituents with regard to their relative carcinogenicity. The classification scheme is as follows (USEPA 1997a):

| Classification | Basis |
|---|---|
| Group A: Human Carcinogen | Sufficient evidence of carcinogenicity in humans. |
| Group B1: Probable Human Carcinogen | Limited evidence in humans. |

| | |
|---|---|
| Group B2: Probable Human Carcinogen | Sufficient evidence in animals with inadequate or lack of evidence in humans. |
| Group C: Possible Human Carcinogen | Limited evidence in animals with inadequate or lack of evidence in humans. |
| Group D: Not Classifiable | Inadequate or lack of evidence. |
| Group E: Not Carcinogenic | No evidence in adequate studies. |

4.2.1.2 Toxicity Information For Non-Carcinogenic Effects

Non-carcinogenic effects from oral exposures from indirect pathways will be evaluated using reference doses (RfDs) expressed in units of mg/kg/d, while non-carcinogenic effects from inhalation exposures from direct pathways will be evaluated using reference concentrations (RfCs) expressed in units of $mg/m^3$. Constituents for which inhalation toxicity values are available will be carried through the direct pathway risk assessment. For those constituents without toxicity values, if appropriate, route-to-route extrapolation will be used to cross-assign toxicity values from the oral route of exposure to the inhalation route. The following equation will be used to convert an oral RfD to an inhalation RfC:

$$RfC = RfD\, x \frac{InhalationRate(20m^3)}{BW\,(70kg)}$$

RfDs and RfCs are estimates of daily exposure to the population (including sensitive subpopulations) that are likely to be without appreciable risk of deleterious effects for the defined exposure period, subchronic or chronic. In general, the RfD or RfC is calculated by dividing the no adverse effect level (NOAEL) or lowest observed adverse effect level (LOAEL) derived from animal or human studies by an uncertainty and/or modifying factor.

RfD/RfCs incorporate uncertainty factors that serve as a conservative downward adjustment of the numerical value and reflect scientific judgment regarding the data used to estimate the RfD/RfC. For example, a factor of 10 is used to account for variations in human sensitivity (i.e., to protect sensitive subpopulations) when the data stems from human studies involving average, healthy subjects. An additional factor of 10 may also be used for extrapolation from chronic animal studies to humans, extrapolation from a LOAEL to a NOAEL, and extrapolation from subchronic to chronic studies. Finally, based on the level of certainty of

the study and database, an additional modifying factor (between zero and ten) may be used. The USEPA assigns RfDs a confidence level: low, medium, or high, which reflects USEPA's confidence in the study data set used in developing the specific toxicity criteria.

#### 4.2.2 Acute Exposures

USEPA (2005a) recommends considering short-term or acute effects from the direct inhalation of vapor phase and particle phase COPCs. Short-term emissions don't typically have a significant impact through indirect exposure pathways. Acute inhalation exposure criteria (AIEC) for the COPCs evaluated in the HHRA will be summarized in tabular form. The criteria to be used, in the order of preference specified in the HHRAP, include:

1. Cal/EPA Acute RELs (Cal/EPA 2000))
2. Acute Exposure Guidelines (AEGL-1) (USEPA 2006b)
3. Level 1 Emergency Planning Guidelines (ERPG-1) (AIHA 2005)
4. Temporary Emergency Exposure Limits (TEEL-1) (DOE 2006)

#### 4.2.3 Special Considerations

##### 4.2.3.1 Lead

IRIS doesn't currently list an RfD or an RfC for lead because a threshold level for exposure to lead has not been established. Although USEPA has characterized lead as a probable human carcinogen, it has not developed a quantitative estimate of cancer risk. In lieu of calculating a hazard quotient for lead, an evaluation will be conducted for children at receptor locations using the IEUBK model. Modeled media concentrations (drinking water, air, soil and foodstuffs) will be incorporated into the IEUBK model for a more accurate representation of a child's resultant BLL. The Adult Lead Model (ALM) will be implemented for the three adult model receptors (resident, fisher and farmer) using the PRG spreadsheets provided by USEPA (2003b).

##### 4.2.3.2 Dioxins and Furans

In order to calculate exposure media concentrations of PCDDs/PCDFs, USEPA's HHRAP (2005a) recommends using the congener-specific PCDD/PCDF emission rates from the stack to estimate congener-specific concentrations in the media. After estimating congener-specific exposure media concentrations, it is recommended that the toxicity equivalent factors (TEFs) provided in USEPA's HHRAP (2005a) be used to estimate a "toxic equivalent" (TEQ) exposure media concentration. The TEQ exposure media concentration is calculated by multiplying the appropriate TEF times the congener specific media concentration, and then

summing the TEQ concentrations of the individual congeners to get an overall TEQ media concentration. To estimate carcinogenic risk, this TEQ media concentration is then used to calculate the lifetime average daily dose (LADD) for the TEQ concentration. The cancer risk is then assessed by applying the cancer slope factor for 2,3,7,8-TCDD in combination with the TEQ-based LADD. Since there are no non-cancer toxicity criteria to evaluate non-cancer risks to PCDDs/PCDFs, the TEQ media concentration is used to calculate an average daily dose (ADD) for the TEQ concentration which is then compared to national average background exposure levels, using 1 picogram (pg) TEQ/kg/day for adults and 60 pg TEQ/kg/day for nursing infants.

#### 4.2.3.3 Polychlorinated Biphenyls

USEPA's HHRAP (2005a) recommends the evaluation of both the coplanar PCBs as well as the Aroclor congeners. PCBs have been identified as having 209 different congeners. Research has shown that "moderately chlorinated PCB congeners can have dioxin-like effects" (USEPA 1992c, 1994d; ATSDR 2000). The moderately chlorinated PCB congeners, which have "four or more chlorine atoms with few substitutions in the ortho positions" (positions designated as 2, 2', 6, or 6' on the molecular ring), are sometimes referred to as the coplanar PCBs. They are referred to as coplanar PCBs because the molecules rings can rotate into the same plane if not blocked from rotation by ortho-substituted chlorine atoms. This coplanar shape is very similar to that of a PCDF molecule and is thus thought to produce similar toxic effects to the PCDDs/PCDFs (USEPA 2005a). Thirteen coplanar PCBs are identified in the EPA HHRAP. For the coplanar PCBs, the TEFs presented in USEPA's HHRAP (2005a) will be used in a similar manner as described above for the PCDDs/PCDFs. After estimating congener-specific exposure media concentrations, the TEFs will be used to estimate a TEQ exposure media concentration. The TEQ exposure media concentration is calculated by multiplying the appropriate TEF times the congener specific media concentration, and then summing the TEQ concentrations of the individual congeners to get an overall TEQ media concentration. To estimate carcinogenic risk, this TEQ media concentration is then used to calculate the lifetime average daily dose (LADD) for the TEQ concentration. The cancer risk is then assessed by applying the cancer slope factor for 2,3,7,8-TCDD in combination with the TEQ-based LADD. Since there are no non-cancer toxicity criteria to evaluate non-cancer risks to coplanar PCBs, the TEQ media concentration is used to calculate an average daily dose (ADD) for the TEQ

concentration which is then compared to national average background exposure levels, using 1 picogram (pg) TEQ/kg/day for adults and 60 pg TEQ/kg/day for nursing infants.

To assess carcinogenic risk from the remaining PCBs (i.e., noncoplanar PCBs), an oral cancer slope factor of 2 $(mg/kg\text{-}day)^{-1}$) and an inhalation unit risk factor of 5.7E-04 $(ug/m^3)^{-1}$ will be applied to each PCB concentration. To assess non-carcinogenic risk from the remaining PCBs, the RfD for Aroclor 1254 (2E-05 mg/kg/day) will be applied to each PCB concentration as per USEPA, 2005a.

## 4.3 Risk Characterization

Human health risks will be evaluated quantitatively based on potential effects from the COPCs. A quantitative HHRA for carcinogens involves calculations of the lifetime incremental probabilities of cancer that take into account exposure concentrations and the carcinogenic potencies of the chemicals. Health effects associated with exposures to non-carcinogenic chemicals will be evaluated by comparing estimated exposure concentrations with appropriate RfD/RfC values. The established potential for a human health risk is a function of the exposure duration and frequency for each exposure scenario. Exposure duration and frequency are based on USEPA guidance (USEPA 2005a).

### 4.3.1 Characterization of Carcinogenic Risk

The results of the quantitative carcinogenic risk analysis are presented as the lifetime probability of additional cancer risk. The excess lifetime cancer risk will be estimated as the product of the estimated lifetime dose (mg/kg-d) times the identified oral cancer slope factor $((mg/kg\text{-}d)^{-1})$ for oral exposures. For inhalation exposures, the excess lifetime cancer risk will be estimated as the product of the estimated exposure concentration $(\mu g/m^3)$ times the identified inhalation unit risk factor $((\mu g/m^3)^{-1})$. In numerical terms, these risk estimates are presented in scientific notation in the risk assessment report. Thus, a lifetime risk of 1E-04 means a lifetime incremental risk of one in ten thousand; a lifetime risk of 1E-06 means an incremental lifetime risk of one in one million.

Cancer risks for each pathway will be obtained by summing across constituents. A total cancer risk for each receptor will be obtained by summing across receptor-specific pathways. Per the Screening Guidance (USEPA 1994a), the calculated cancer risks will be evaluated in relation to a cancer target of 1E-05.

### 4.3.2 Characterization of Non-Carcinogenic Effects

The results of the quantitative non-carcinogenic risk analysis are presented as a ratio for non-carcinogenic risk. For estimating risks to human health from exposure to non-carcinogens, the hazard quotient (HQ) is used. The HQ is calculated as the non-cancer exposure dose (mg/kg-d) or concentration (mg/m$^3$) divided by the RfD (mg/kg-d) or RfC (mg/m$^3$), respectively.

Non-cancer risks for each pathway will be obtained by summing across constituents. A total non-cancer hazard index (HI) for each receptor will be obtained by summing across receptor-specific pathways. Per the Screening Guidance (USEPA 1994a), the calculated non-cancer HQs and total non-cancer hazard indices (HIs) will be evaluated in relation to a non-cancer target of 0.25 (2.5E-01). For those HIs exceeding the hazard level, the HIs for the major health effects and target organs or systems will be calculated separately.

### 4.3.3 Characterization of Acute Effects

For acute exposures, the acute hazard quotient (AHQ) will be calculated as the calculated acute air concentration (mg/m$^3$) divided by the AIEC (mg/m$^3$). The acute air concentration is the maximum 1-hour ambient air concentration. The calculated AHQs and total acute hazard indices (AHIs) will be evaluated in relation to a acute target of 0.25 (2.5E-01).

## 4.4 Uncertainty Assessment

The risk assessment will include a discussion of the various method-related and site-specific uncertainties associated with the calculated risk estimates. An attempt will be made to identify and evaluate the relative importance of the sources of uncertainty. This analysis will focus on evaluating the effects of different exposure model inputs on the estimated RME cancer risks and non-cancer HIs. For pathways associated with RME cancer risks or target organ HIs greater than the criterion levels, an additional analysis based on most likely exposure (MLE) parameters will be performed. Current USEPA guidance (e.g., USEPA 1997b) and best professional judgment will be used to identify the MLE parameter values.

This protocol has a level of conservatism built in to provide a health protective assessment. A discussion of the areas of conservatism (i.e., use of carcinogenic form of chromium, co-location of the maximum depositional and airborne concentrations for the resident receptor) will be provided in the Uncertainty Analysis.

## 5.0 ECOLOGICAL RISK ASSESSMENT

The purpose of the ecological risk assessment (ERA) is to evaluate potential risks to ecological receptors posed by emissions from the combustion units. The approach will provide estimates of reasonable potential risks to ecological receptors using measurement receptors representing food web-specific guilds and communities and available exposure and ecological effects information for each habitat type within the assessment area. The ERA methodology generally follows USEPA's Screening Level Ecological Risk Assessment Protocol (SLERAP) for Hazardous Waste Combustion Facilities (USEPA 1999) using available site-specific data in place of USEPA's conservative default assumptions where appropriate.

Applicable information and data presented in from the ERA protocol presented in the USEPA-approved *Resource Conservation and Recovery Act Part B Health Risk Assessment No. 39-DA-02Y1-04 Plasma Arc Ordinance Demilitarization System and Old Bomb Area, Hawthorne Army Depot, Hawthorne, Nevada* (CHPPM 2004) is presented in this work plan. The CHPPM 2004 protocol uses information presented in the installation-wide integrated natural resource management plan for HWAD (Tetra Tech 1998).

The ERA work plan consists of the following components (USEPA 1999):

- Facility characterization;
- Air dispersion/deposition modeling;
- Problem Formulation; and
- Risk characterization.

Facility characterization is discussed in Section 1.0, and the air dispersion and deposition modeling protocol is discussed in Section 2.0.

### 5.1 Problem Formulation

This section establishes the exposure setting used as the basis for exposure analysis and risk characterization. This section includes:

- Characterization of the exposure setting for identification of potentially exposed habitats in the assessment area,
- Development of food webs representative of the habitat types to be evaluated,
- Selection of assessment endpoints relevant to food web structure and function, and
- Identification of measurement receptors.

### 5.1.1 Exposure Setting Characterization

The following description of the environmental setting, taken from the CHPPM 2004 protocol, focuses on the assessment area shown on Figure 2-1.

The HWAD is located on 144,441 acres of Federal land south of Walker Lake in Mineral County, Nevada. The depot is situated approximately 135 miles southeast of Reno and lies in a basin bordered by the Wassuk Mountains to the west, the Gillis Range to the east, Walker Lake to the north, and the Excelsior Mountains to the south. Walker Lake is a large brackish body of water formed by an internal drainage basin that is fed primarily by the Walker River at its northern end. The highest point on the installation is in the Wassuk Mountains at 11,239 feet msl, and the point of lowest elevation is Walker Lake at 3,956 feet msl. Mount Grant, which is about 7,200 feet higher than the valley floor near Walker Lake, is just 5 aerial miles away. Three reservoirs along the eastern side of the Wassuk Range (Rose Creek, Cat Dam, and Black Beauty Reservoirs) capture surface water runoff from the Mount Grant area and divert it for municipal use at the HWAD (IT Corporation 1996).

Based on vegetation, the Wassuk Mountain Range is classified as belonging to the Reno section of the Great Basin. Thirteen distinct plant communities comprise the range including pinyon pine woodland, montane sagebrush scrub, subalpine pine forest, aspen forest, and alpine scrub communities are some of the predominant types. Although none of these communities are unique, they are in excellent condition in terms of plant vigor and relative lack of exotic species. Though no threatened or endangered species are known to occur in this area, five plant species considered rare by the Nevada National Heritage Program (NNHP) are either known to occur or could potentially occur in the vicinity of Mount Grant (IT Corporation 1996).

The vegetation of the arid valley floor and surrounding hills consists primarily of mixed desert shrubs and grasses. The lower elevations of the valley floor are within the Shadscale Zone, which is dominated by a variety of shrub species, including shadscale (*Atriplex confertifolia*), little greasewood (*Sarcobatus vermiculatus var. baileyi*), spiny hopsage (*Grayia spinosa*), rabbitbrush (*Chrysothamnus viscidiflorus*) and four-wing saltbrush (*Atriplex tridentate*). At higher elevations of the valley, there is a gradual transition toward the Lower Sagebrush Zone, indicated by an increasing presence of big sagebrush (*Artemisia tridentate*) and other shrubs such as desert bitterbrush (*Purshia glandulosa*), and horsebrush (*Tetradymia glabrata*) (IT Corporation 1996).

Mount Grant is quite diverse and has a healthy ecosystem. It is a multiple-use zone since it provides habitat for desert wildlife, supplies water to HWAD, is a recreation area for a variety of activities (i.e., golfing, fishing, picnicking, hunting, sightseeing), and contains mines and cultural artifacts (Tetra Tech EM, Inc. 1998). The Mount Grant surface water resource at HWAD consists of seven creeks and numerous springs on the mountain. The quality of the surface water in the Mount Grant watershed is excellent. There is a diverse benthic invertebrate community in Mount Grant waterways because cattle that can degrade the stream banks are restricted from using the streams (Tetra Tech EM, Inc. 1998). The man-made reservoirs along the eastern slope of Mount Grant have created isolated pockets of aquatic habitat that may be significant for populations of several species including the federally threatened Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) and the state-protected American white pelican (*Pelecanus erythrorhynchos*) and Snowy plover (*Charadrius alexandrinus nivosus*).

Walker Lake is a highly alkaline, mineralized lake. There are limited fish and invertebrate communities in Walker Lake because of the arid climate, which produces highly alkaline lake conditions. Most of the tributaries to Walker Lake contain only intermittent surface water therefore, the invertebrate community becomes dormant, and survives in an egg or larval stage during dry periods. Of the tributaries which discharge to Walker Lake, only Cottonwood Creek maintains constant flow, however, the flow is often shallow. Aquatic species that are present include important sport fishing species and prey species, especially the Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) whose survival in Walker Lake depends on artificial stocking efforts (Tetra Tech EM, Inc. 1998). In addition, Walker Lake is an important site for common loons (*Gavia immer*), thousands of which use the lake as a staging area during migration (IT Corporation 1996).

There are 185 bird species that have been identified at Mount Grant and/or Walker Lake. Surveys have identified 70 mammals, potentially 10 amphibians, and 45 reptile species inhabiting depot land holdings. The Nevada Division of Wildlife (NDOW) is considering introducing pronghorn antelope and several game bird species to Mount Grant to establish hunting populations and increase biodiversity (Tetra Tech EM, Inc.1998). The state and federally listed endangered American peregrine falcon (*Falco peregrinus anatum*) has been recorded (historically) in the Wassuk Range near Walker Lake; however, there are no current records of peregrine falcon nesting in that area. During the periods of spring and fall migration, the Walker Lake area may potentially provide foraging habitat for peregrine falcons. However,

the current absence of nearby nesting sites would limit exposure to site-related emissions. In addition, the principal prey (birds) of peregrine falcons would also have limited exposure as they migrate between breeding and wintering areas. A detailed list of rare species provided by the NNHP for Mineral County, Nevada (NNHP 2004) is presented in Appendix E. The NNHP has been contacted for information on State or federally listed species known to inhabit the HWAD assessment area and an interim deliverable will be provided to the Agency for review. The area also has biological significance due to the fact that it represents an isolated high elevation "island" containing such species as the Whitetail jackrabbit (*Lepus townsendi*), Sage grouse (*Centrocercus urophasianus*), and Blue grouse (*Dendragapus abscurus*) (IT Corporation 1996).

Toiyabe National Forest, which is located within the 50-km radius at HWAD, is considered a sensitive habitat (Tetra Tech EM, Inc.1998). Toiyabe National Forest is the largest national forest within the National Forest System, outside of Alaska, having a net acreage of approximately 3,855,960 acres. The Forest is located mostly in Nevada with a portion also in California and is home to many reptiles, birds (including the golden and bald eagles), small mammals, and larger mammals (USDA 1999).

#### 5.1.1.1 Habitat Types

The Natural Resource Conservation Service (NRCS) mapped habitat types found on HWAD into range site associates (RSAs) and woodlands on the basis of the vegetation, soil, water and topographic associations (CH2MHill 2004). The boundaries of the RSAs are shown on Figure 5-1, and Table 5-1 describes each RSA. The RSAs were grouped into four major habitat types for the purpose of selecting habitats for evaluation in the ERA. The four major categories are: woodland, scrub/grassland, freshwater wetland and freshwater/brackish aquatic habitats. These habitat types are shown on Figure 5-2. In addition, the land use map shown on Figure 5-3 focusing on the area surrounding the OBA identifies similar habitats.

The woodland habitats encompass subalpine and alpine open woodlands at the highest elevations on Mount Grant along with pinyon woodlands mixed with sagebrush dominating the middle elevations on Mount Grant. Riparian forests of cottonwood, willows and aspen are found along perennial drainages (CH2MHill 2004).

The scrub/grassland habitat is dominated by sagebrush, desert needlegrass and sedges and co-mingled with the forest habitats. Scrub/grassland habitat is also found along stream floodplains, with creeping wildrye, western wheatgrass, rushes and sedges dominating the

herbaceous layer. Montane meadows include small patches of herbaceous communities at drainage headwater and along lower gradient stream sections (CH2MHill 2004).

The freshwater aquatic habitat includes Walker Lake, man-made reservoirs, and associated drainages.

Small patch wetlands associated with Walker Lake provide important habitat for amphibians, birds, butterflies and small mammals. Although wetlands are present within the assessment area, the ecological receptors (i.e., communities and guilds) that will be evaluated for the woodland, scrub/grassland and aquatic habitats will incorporate those species that would be evaluated within the wetland habitat. Furthermore, wetlands are located within close proximity to the woodland and aquatic habitats. Therefore, the evaluation of the woodland, scrub/grassland and aquatic habitats will be protective of wetland habitats within the assessment area, and wetlands will not be evaluated separately in the ERA.

#### 5.1.1.2 Selection of Exposure Scenario Locations

***Terrestrial Habitats***

The selection of exposure scenario location(s) to be assessed in the ERA for each terrestrial habitat type will be based on the results of the air dispersion modeling, as recommended by USEPA guidance (1999). For each terrestrial habitat type, the modeled air parameter data for the receptor nodes within or on the boundary of that area will be evaluated to identify those receptor nodes with the highest yearly average concentration for each modeled air parameter. The determination of the highest yearly average concentration will be based on an evaluation of the three emission sources combined. In accordance with USEPA guidance, the receptor node or nodes selected as exposure scenario locations for each habitat type will meet one or more of the following criteria:

- Highest modeled unitized vapor phase air concentration
- Highest modeled unitized vapor phase wet deposition rate
- Highest modeled unitized particle phase air concentration
- Highest modeled unitized particle phase wet deposition rate
- Highest modeled unitized particle phase dry deposition rate
- Highest modeled unitize particle-bound phase air concentration
- Highest modeled unitized particle-bound phase wet deposition rate
- Highest modeled unitized particle-bound phase dry deposition rate

More than one receptor grid node may be selected if modeling results indicate maximum air concentrations or deposition rates are located at different receptor nodes within the same habitat. However, only modeled air parameters corresponding to a single receptor grid node will be used as input to the media equations (USEPA 1999). Also, due to the separation distance between RF-9/PODS and OBA and the potential for OBA to emit COPCs that will not be emitted from RF-9/PODS, woodland, scrub/grassland and aquatic habitats will be selected in the vicinity of OBA separately from habitats in the vicinity of RF-9/PODs. Receptor grid nodes for each habitat in the vicinity of OBA will be selected in accordance with the methodology presented above for RF-9/PODs. This approach is more realistic because it takes into consideration that the OBA is at a significant distance from the RF-9 and PODS emission sources.

A perennial water body and associated watershed in close proximity of each habitat-specific exposure scenario location will be identified to represent a drinking water source for applicable receptors (USEPA 1999). If a definable, perennial water body is not located within or in close proximity to the terrestrial habitat being evaluated (as is the case for the OBA area), the ERA will assume that a small water body exists at the same receptor grid node(s) selected for the specific habitat.

***Aquatic Habitats***

Four water bodies, Walker Lake, Black Beauty Reservoir, Cat Dam Reservoir, and Rose Creek Reservoir, are within the 50-km radius for evaluation. However, only two of these water bodies, Walker Lake and Cat Dam Reservoir will be evaluated. A complete exposure pathway does not exist for ecological receptors at Black Beauty Reservoir since it is surrounded by a fence that prevents large mammals from using the reservoir and wiring that deters waterfowl. Black Beauty Reservoir is also drained and cleaned on a regular basis (i.e., every 3-5 years); therefore, it does not contain fish or significant vegetation (Millsap 2003). Rose Creek Reservoir is concrete lined and is drained every 3 years. Currently there are no fish in Rose Creek Reservoir and it is currently not stocked. Also, due to the concrete substrate, benthic invertebrates are not likely to be present in the reservoir to any significant extent. Walker Lake provides more suitable aquatic habitat for ecological receptors and is located at a similar distance from the combustion units. Therefore, evaluating Walker Lake will address any potential concerns associated with Rose Creek Reservoir. Cat Dam Reservoir has a natural sediment

substrate, but dries up during the summer months (Millsap 2003). Therefore, potential receptors for Cat Dam are limited to those species that forage primarily on aquatic invertebrates or algae/aquatic vegetation. Cat Dam Reservoir may be evaluated as an aquatic habitat, depending on the results of the air modeling. If the results of the air modeling indicate that maximum annual unitized values are higher at Cat Dam Reservoir than at Walker Lake, both aquatic habitats will be evaluated quantitatively in the ERA. Otherwise, only Walker Lake will be evaluated as it represents the most suitable aquatic habitat.

Walker River and Cottonwood Creek, which are streams within the 50-km radius that flow into Walker Lake, were also not evaluated. Preliminary evaluation conducted by CHPPM determined that estimated substance concentrations at Walker Lake would be higher than either Walker River or Cottonwood Creek. This conclusion was derived based on two reasons: (1) Walker Lake lies closer to RF-9/PODS, and (2) the volumetric flow rate out of Walker Lake was assumed to be zero meaning that washout of COPCs from the lake is minimal. This conservative assumption was used to address concerns that the volume of Walker Lake has been decreasing over time (USGS 1995). It was thus decided that evaluating Walker Lake alone would be sufficient to address potential concerns with regard to ecological receptors from either Walker River or Cottonwood Creek (CHPPM 2000).

For Walker Lake, the receptor grid nodes within the lake boundary that lie within the 10-km radius associated with RF-9/PODS will be averaged. The watershed for this section of the lake will be determined, and the receptor nodes that lie within that specific watershed will be averaged. This ensures that portions of Walker Lake that are not impacted by facility emissions are not evaluated and focuses the ERA on areas potentially impacted, consistent with USEPA guidance (1999). For Cat Dam Creek Reservoir and its associated watershed, the air parameter values for all receptor grid nodes that lie within the reservoir boundary will be averaged, and the receptor grid nodes located within its watershed will be averaged (USEPA 1999).

### 5.1.2 Assessment Endpoints

Assessment endpoints represent expressions of an ecological attribute that is to be protected (USEPA 1999). The selected assessment endpoints represent both community level endpoints (e.g., soil, surface water, sediment), population level endpoints (e.g., survival, growth and reproduction of particular guilds such as carnivorous birds), and in the case of State and Federally listed species, individual level endpoints (e.g., survival, growth and reproduction of

individuals). Descriptions of assessment endpoints (i.e., critical ecological attributes to be protected) for each community and class-specific guild for each trophic level for the food webs to be evaluated in the ERA are presented in Table 5-2.

5.1.2.1 Selecting Measurement Receptors

In order to evaluate the potential effects of air emissions from the facility on ecological receptors, receptors representative of the assessment endpoints were selected for each community and class-specific guild. Individual species were selected for class-specific guilds based on the following criteria (USEPA 1999):

- Ecological relevance,
- Exposure potential,
- Degree of sensitivity to COPCs,
- Social or economic importance, and
- Availability of natural history information such as body weight and food, water, soil, and sediment ingestion rates.

The Nevada Natural History Program has been contacted for information on State or federally-listed species identified within the HWAD assessment area. Once this information obtained, those State or federally-listed species identified within the HWAD assessment area, along with measurement receptors and life history data for the specific species will be provided as an interim deliverable for agency review and approval prior to conducting the ERA.

***Measurement Receptors for Communities***

For soil communities, soil invertebrates and terrestrial plant communities are the measurement receptors. For sediment communities, benthic invertebrate communities are the measurement receptors. For surface water communities, water invertebrates, phytoplankton, zooplankton and fish communities are the measurement receptors.

***Measurement Receptors for Feeding Guilds***

The following indicator species were selected as representative of species associated with the feeding guilds identified for each habitat type within the HWAD assessment area. In all cases, species selected as measurement receptors are known to inhabit the HWAD area. Detailed life history and exposure parameter data for each indicator species is provided in Appendix F. Life history and exposure parameter data for the snowy plover, chukar partridge, Merriam's

shrew, least chipmunk, belted kingfisher, badger, red-tailed hawk, and mink were obtained from the CHPPM protocol (CHPPM 2004).

For the Scrub/Grassland food web, the following measurement receptors were selected:

- Least chipmunk (*Eutamias minimus*) – Herbivorous Mammal
- Chukar partridge (*Alectoris chukar*) – Herbivorous Bird
- Merriam's shrew (*Sorex merriami*) – Insectivorous Mammal
- American robin (*Turdus migratorius*) – Omnivorous Bird
- Badger (*Taxidea taxus*) – Carnivorous Mammal
- Red-tailed hawk (*Buteo jamaicensis*) – Carnivorous Bird
- Western toad (*Bufo boreas*) – Insectivorous Amphibian
- Side-blotched lizard (*Uta stansburiana*) – Insectivorous Reptile

For the woodland food web, the following measurement receptors were selected:

- Least chipmunk (*Eutamias minimus*) – Herbivorous Mammal
- Mourning dove (*Zenaida macroura*) – Herbivorous Bird
- Deer mouse (*Peromyscus maniculatus*) – Omnivorous Mammal
- American Robin (*Turdus migratorius*) – Omnivorous Bird
- Long-tailed weasel (*Mustela frenata*) – Carnivorous Mammal
- Red-tailed hawk (*Buteo jamaicensis*)– Carnivorous Bird
- Western toad (*Bufo boreas*) – Insectivorous Amphibian
- Side-blotched lizard (*Uta stansburiana*) – Insectivorous Reptile

For the Aquatic food webs, the following measurement receptors were selected:

- Muskrat (*Ondrata zibethicus*)– Herbivorous mammal
- Canada goose (*Branta canadensis*) – Herbivorous bird
- Little brown bat (*Myotis lucifugus*)– Insectivorous mammal
- Snowy plover (*Charadrius alexandrinus*) – Insectivorous bird
- Raccoon (*Procyon lotor*) – Omnivorous mammal
- Mallard (*Anas platyrhynchos*) – Omnivorous bird
- Mink (*Mustela vison*) – Piscivorous mammal for Walker Lake only
- Belted kingfisher (*Ceryle alcyon)* – Piscivorous bird for Walker Lake only
- Bullfrog (*Rana catesbeiana*) – Omnivorous Amphibian

### 5.1.3 Food Webs for Each Habitat Type

Habitat-specific food webs were developed for the three habitat types that will be evaluated in the ERA: woodland, scrub/grassland and freshwater aquatic habitats. Two aquatic food webs are presented – Walker Lake and Cat Dam Reservoir. As discussed in Section 5.1.2.1, Cat Dam Reservoir may be evaluated quantitatively; however, since it dries up in during summer months, fish do not inhabit the reservoir. Therefore, the food web for Cat Dam

Reservoir differs from the food web presented for Walker Lake. The food webs are provided on Figures 5-4 to 5-7. Species representative of each feeding guild are presented with the selected measurement receptor identified in italics. Detailed life history and exposure parameter data for each measurement species is provided in Appendix F.

## 5.2 Exposure Assessment

Constituents emitted from the emission sources are dispersed into ambient air and may eventually deposit onto soils, plants, and surface water. The constituents that will be analyzed for due to their potential presence in the emissions from RF-9, PODS or OBA are provided in Table 2-1. Once the comprehensive performance test/risk burns are complete, COPCs will be selected based on the results of the stack tests, focusing on chemicals likely to be emitted; are potentially toxic to ecological receptors; and/or bioconcentrate in ecological receptors and bioaccumulate in food chains (USEPA 1999).

Ecological receptors within the assessment area may come in contact with a COPC through complete exposure pathways. Exposure pathways that will be evaluated in the ERA include direct uptake pathways from media for lower trophic level receptors evaluated at the community level and ingestion of a COPC-contaminated organism (plant or animal food item) and/or media for higher trophic level receptors evaluated as class-specific guilds (USEPA 1999). Due to limited data, inhalation and dermal exposure pathways for upper trophic level organisms and ingestion via grooming and preening, and foliar uptake of dissolved COPCs by aquatic plants will not be evaluated in the ERA (USEPA 1999). The equations that will be used to calculate COPC concentrations in environmental media are provided in Appendix A.

### 5.2.1 Exposure to Community Measurement Receptors

For community measurement receptors, the exposure assessment will consist of determining COPC concentrations for each media of concern. For water communities, dissolved phase COPC concentrations will be determined.

### 5.2.2 Exposure to Class-Specific Guild Measurement Receptors

For class-specific guild measurement receptors, exposure will be assessed by quantifying the COPC daily dose ingested of contaminated food items and media within the specific habitat

supporting the food web being evaluated. The daily dose ingested will be calculated using the following equation:

$$DD = \sum IR_F \times C_i \times P_i \times F_i + \sum IR_M \times C_M \times P_M$$

Where:

| | | |
|---|---|---|
| DD | = | Daily dose of COPC ingested (mg COPC/kg BW-day) |
| $IR_F$ | = | Measurement receptor plant or animal food item ingestion rate (kg/kg BW-day) |
| Ci | = | COPC concentration in ith plant or animal food item (mg COPC/kg) |
| Pi | = | Proportion of ith food item that is contaminated (unitless) |
| Fi | = | Fraction of diet consisting of plant or animal food item i (unitless) |
| $IR_M$ | = | Measurement receptor media ingestion rate (kg/kg BW-day [soil or bed sediment] or L/kg BW-day [water]) |
| $C_M$ | = | COPC concentration in media (mg/kg [soil or bed sediment] or mg/L [water]) |
| $P_M$ | = | Proportion of ingested media that is contaminated (unitless) |

For measurement receptors ingesting more than one plant or animal food item, exposures will be determined based on the diet proportions presented in Appendix F for each measurement receptor. The equations for calculating COPC concentrations in water, sediment, soil and plants) are presented in Appendix A. The equations for calculating COPC concentrations in prey species are presented in Appendix C.

## 5.3 Toxicity Assessment

Toxicity of a COPC will be assessed by identifying toxicity reference values (TRVs) specific to a COPC and the measurement receptor being evaluated. A TRV represents a COPC concentration or dose that causes no observed adverse effects to an ecologically relevant endpoint for a receptor exposed for a chronic (long-term) duration (USEPA 1999). The TRVs were selected based on the EPA-recommended hierarchy (1999), where federal and/or state standards, criteria, guidance or benchmarks are preferred; followed by toxicity values published in scientific literature; toxicity values calculate for sediment using the equilibrium partitioning approach; and toxicity values from surrogate compounds. Where multiple references are available, references were chosen which have been used in other ecological risk assessments approved by EPA.

TRVs for sediments will be determined using the following sources, listed in order of preference:

- Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems (Macdonald, et al 2000)
- Freshwater sediment TRVs (USEPA 1999);
- National Oceanic and Atmospheric Administration (NOAA) Sediment Screening Concentrations, Threshold Effects Level (TELs; Buchman 1999) ;
- Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota (Jones, et al 1997) ;
- Calculated sediment toxicity values using the equilibrium partitioning approach; and
- Toxicity data from surrogate compounds selected based on chemical structure and toxicity mechanisms of action.

TRVs for surface water will be determined using the following sources, listed in order of preference:

- National Ambient Water Quality Criteria (USEPA 2002);
- Freshwater TRVs (USEPA 1999);
- NOAA Surface Water Chronic Values (Buchman 1999);
- Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter, et al 1996); and
- Studies published in scientific literature that characterizes appropriate adverse effects to ecological endpoints such as growth, reproduction, or mortality.

TRVs for soil invertebrates will be determined using the following sources, listed in order of preference:

- Ecological Soil Screening Levels (USEPA 2005d); and
- Soil Invertebrate TRVs (USEPA 1999)

TRVs for terrestrial plants will be determined using the following sources, listed in order of preference:

- Ecological Soil Screening Levels (USEPA 2005d);
- Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants (Efroymson, et al 1997); and
- Studies published in scientific literature that characterizes appropriate adverse effects to ecological endpoints such as growth, reproduction, or mortality.

TRVs for wildlife will be determined using the following sources, listed in order of preference:

- TRVs for Wildlife Measurement Receptors (USEPA 1999);
- Toxicological Benchmarks for Wildlife (Sample, et al, 1996);
- Ecological Soil Screening Levels (USEPA 2005d); and

- Studies published in scientific literature that characterizes appropriate adverse effects to ecological endpoints such as growth, reproduction, or mortality.

The basis for determining TRVs using toxicity values published in scientific literature will be documented in the ERA.

TRVs will be selected based on the following criteria, listed in order of preference:

- Chronic no observable adverse effect level (NOAEL);
- Subchronic NOAEL;
- Chronic lowest observable adverse effect level (LOAEL);
- Subchronic LOAEL;
- Acute median lethality point estimate; and
- Single dose toxicity value.

The following criteria will be used in evaluating whether a study represents a chronic, subchronic or acute toxicological value:

<u>Fish, Mammals and Birds</u>

| | |
|---|---|
| Chronic: | test lasts greater than 90 days |
| Subchronic: | test lasts from 14 to 90 days |
| Acute: | test lasts less than 14 days |

<u>Other Receptors</u>

| | |
|---|---|
| Chronic: | test lasts for 7 or more days |
| Subchronic: | test lasts from 3 to 6 days |
| Acute: | test lasts less than 3 days |

If more than one study meets the criteria for study endpoints and exposure duration, the study with the least uncertainty associated with determining the endpoint value will be used in developing the TRV. For fish chronic TRVs, the results of a 28-day early life stage toxicity test will be substituted for a chronic test of greater than 90 day duration if no such test results are available.

Uncertainty factors (UFs) are used to reduce the potential for risk estimates to underestimate risk. Toxicity values will be multiplied by the EPA-recommended UF to derive a NOAEL-based TRV as follows (EPA 1999):

| | |
|---|---|
| 0.1 | Convert a chronic LOAEL to a chronic NOAEL |
| 0.1 | Convert a subchronic NOAEL to a chronic NOAEL |
| 0.01 | Convert an acute lethal value to convert it to a chronic NOAEL |

## 5.4 Risk Characterization

The Risk Characterization portion of the ERA is comprised of the risk estimation and risk description. Risks to ecological receptors will be estimated quantitatively using the quotient method to calculate an ecological hazard quotient (EHQ). The magnitude and nature of the potential risks for each community and guild and uncertainties and limitations associated with the risk estimation will be discussed in the in the risk description section.

### 5.4.1 Risk Estimation

An EHQ is a quotient of the COPC estimated exposure level (EEL) divided by the COPC and measurement receptor specific TRV as follows:

$$EHQ = \frac{EEL}{TRV}$$

Where:

| | | |
|---|---|---|
| EHQ | = | Ecological screening quotient (unitless) |
| EEL | = | COPC estimated exposure level (mass COPC/mass media [communities] or mass daily dose COPC ingested/mass body weight-day [class-specific guilds]) |
| TRV | = | COPC toxicity reference value (mass COPC/mass media [communities] or mass daily dose COPC ingested/mass body weight-day [class-specific guilds]) |

An EHQ will be calculated for each measurement receptor, COPC and exposure scenario location evaluated in the ERA. Sediment and soil related daily doses and exposure levels will be determined on a dry weight basis. Food and water related daily doses and exposure levels will be determined on a wet weight basis. For measurement receptors ingesting more than one food item, an EHQ will be calculated based on an equal diet dose and on an exclusive diet dose.

The risks associated with exposure to multiple COPCs at a specific location will be evaluated by summing each of the COPC-specific EHQ values as follows:

$$EHQ_{ReceptorTotal} = \sum EHQ_{COPCSpecific}$$

Where:

| | | |
|---|---|---|
| $EHQ_{ReceptorTotal}$ | = | Total ecological hazard quotient for receptor (unitless) |
| $EHQ_{COPC\ Specific}$ | = | COPC specific ecological hazard quotient (unitless) |

### 5.4.2 Risk Description

The magnitude and nature of potential risks will be described for each community and guild in each food web and exposure scenario location with a COPC-specific or total EHQ value at or above risk target levels. The target EHQ value is 0.25. The risk description will include the contributing COPCs, emission sources, exposure pathways and significant uncertainties for each measurement receptor. Associated potential risks to the selected assessment endpoints will be addressed. Assumptions made to address data gaps and uncertainties associated with available scientific information will be presented in this section.

### 5.4.3 Uncertainty

The risk characterization section will include a discussion of the various method-related and site-specific uncertainties associated with the calculated risk estimates. The uncertainty section will evaluate the relative importance of the sources of uncertainty. Key assumptions, the rationale for each assumption, their relative effect on the risk estimates and the magnitude of the effect will be discussed for each section of the SLERA: the site characterization (e.g., COPC selection and assumptions used in developing media and prey species tissue concentrations); exposure assessment (e.g., exposure assumptions and the extent to which the values selected under or over-estimate risks); and toxicity assessment (e.g., the uncertainties associated with the available TRVs and the lack of TRVs for COPCs and receptors). The extent to which protective assumptions were used and the impact on the uncertainty associated with the SLERA will be discussed.

The potential risks associated with the unknown fraction of organics will be evaluated using the TOE factor and presented in this section. This evaluation will include quantitatively estimating the increased risks associated with unidentified organic compounds.

## 6.0 REFERENCES


American Industrial Hygiene Association (AIHA). 2005. Emergency Response Planning Guidelines and Workplace Environmental Exposure Level Guides Handbook. Fairfax, Virginia.

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Polychlorinated Biphenyls (PCBs). November.

Bjorklund, JR, et al. 1998. Open Burn/Open Detonation Dispersion Model (OBODM) User's Guide, DPG-TR-96-008b, April.

Buchman, M.F. 1999. NOAA Screening Quick Reference Tables. NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pp. September.

CalEPA. 2000. California Environmental Protection Agency. Office of Environmental Health Hazard Assessment. All Acute Reference Exposure Levels Developed by OEHHA as of May 2000. [Online]. Available at: http://www.oehha.ca.gov/air/acute_rels/allAcRELs.html

CH2MHill. 2004. Integrated Natural Resources Management Plan. CH2MHill. Sacramento. July.

CHPPM. 2004. Resource Conservation and Recovery Act Part B Health Risk Assessment No. 39-DA-02Y1-04 Plasma Arc Ordinance Demilitarization System and Old Bomb Area, Hawthorne Army Depot, Hawthorne, Nevada. US Army Center for Health Promotion and Preventative Medicine. Aberdeen Proving Ground. August.

Clarke, Joan U., and McFarland, Victor A. 1991. "Assessing Bioaccumulation in Aquatic Organisms Exposed to Contaminated Sediments." Miscellaneous Paper D-91-2, Waterways Experiment Station, Vicksburg, MS 39180.

Efroymson, R.A., Will, M.E., Sutter, G.W., and Wooten, A.C. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 128 pp. ES/ER/TM-85/R3.

Industrial Operations Command (IOC). 1997. Hawthorne Army Depot - Active.: http://www.ioc.army.mil/rm/iocfact/hwad.htm. *As cited in CHPPM, 2004.*

IT Corporation. 1996. RCRA Part B Permit Application for the Hazardous Waste Storage and Open Burning, Volume I, Hawthorne Army Depot, Hawthorne, Nevada, November.

Jones, D.D., Suter II, G.W., Hull, R.N. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision. Lockheed Martin Energy Systems. ES/ER/TM-95/R4. November.

Lide, D.R. 2003. CRC Handbook of Chemistry and Physics, 83rd Edition. CRC Press. Boca Raton, Florida

LVRJ. 2002. Las Vegas Review Journal World Wide Web.

http://www.reviewjournal.com/lvrj_home/2002/May-13-Mon-2002/news/18717483.html. *As cited in CHPPM, 2004.*

Lyman, W.J., W.F. Reehl, and D.H. Rosenblatt. 1990. Handbook of Chemical Property Estimation Methods. American Chemical Society. Washington. D.C.

MacDonald, D.D., Ingersoll, C.G., and Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Archives of Environmental Contamination and Toxicology 39: 20-31.

Millsap, H. 2003. (HWAD environmental personnel). Personal communication via e-mail (June) with USACHPPM staff (Lia Gaizick). *As cited in CHPPM, 2004.*

MSE Technology Applications, Inc. 1998. PODS Permit Flow Diagram, 425-pound feed M-676 ordnance without attemperation water, DWG No. E18-00AM-001 Revision P1 Sheet 1.

Nevada Commission on Economic Development (NCED). 2002. NCED Research. World Wide Web. Accessed September 10, 2003. http://www.expand2nevada.com/regions/counties/pdfs/Mineral.pdf. *As cited in CHPPM 2004.*

Nevada Department of Wildlife (NDOW). 2004. Hunting Seasons and Regulations. Accessed on October 28, 2004. On-Line Address: http://www.ndow.org/hunt/seasons/. *As cited in Tetra Tech, 2005.*

NHP. 2004. Mineral County Rare Species List. State of Nevada Department of Conservation and Natural Resources. http://heritage.nv.gov/lists/cominera.htm. March 18.

O'Neil, M. and A. Smith. 2001. The Merck Index: An Encyclopedia of Chemicals, Drugs, and Biologicals. 13th Edition. Merck and Company, Inc. Rahway, New Jersey.

Risk Assessment Information System (RAIS) Database. 2007. U.S. Department of Energy (DOE), Office of Environmental Management, Oak Ridge Operations (ORO) Office. http://risk.lsd.ornl.gov/index.shtml.

Sample, B.E., Opresko, D.M., Suter, G.W. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory, Oak Ridge, TN. 227 pp, ES/ER/TM-86/R3.

Sample, B.E., Aplin, M.s., Efroymson, R.A., Sutter II, G.W., and Welsh, C.J.E. 1997. Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants. Oak Ridge National Laboratory, Oak Ridge. ORNL/TM-13391. October.

Syracuse Research Corporation (SRC). 2003a. CHEMFATE Database. SRC. Syracuse, NY.

Syracuse Research Corporation (SRC). 2003b. PHYSPROP Database. SRC. Syracuse, NY.

Suter II, G.W., Tsao, C.L. 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision. Risk Assessment Program, Health Sciences Research Division, Lockheed Martin Energy Systems, Inc. Oak Ridge. ES/ER/TM-96/R2.

SWReGAP. 2006. Southwest Regional Gap Analysis Project, Animal Habitat Models. http://fws-nmcfwru.nmsu.edu/swregap/habitatreview/.

Tetra Tech. 2004. Comprehensive Performance Test Plan Plasma Arc Ordnance Demilitarization System, Prepared for Hawthorne Army Depot, Hawthorne, Nevada.

Tetra Tech. 2005. Human Health and Ecological Risk Assessment Protocol for New Bomb Area. Hawthorne Army Depot, Hawthorne, Nevada. November.

TSD Management Associates (TSD). 2004. Comprehensive Performance Test for RF-9. October.

TRC Environmental Corporation (TRC). 2006a. Personal Communication with Jeffery Methany, DZHC, February 20.

TRC Environmental Corporation (TRC). 2006b. Personal Communication with Jeffery Methany, DZHC, April 17.

U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM). 2000. Screening Health Risk Assessment for the Plasma Arc Ordnance Demilitarization System Project no. 39-EJ-6403-99, Hawthorne Army Depot, Hawthorne, February.

U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM). 2004. Protocol. Resource Conservation and Recovery Act Part B. Health Risk Assessment. No. 39-DA-02Y1-04. Plasma Arc Ordnance Demilitarization System and Old Bomb Area. Hawthorne Army Depot, Hawthorne, Nevada. August.

U.S. Army Corp of Engineers (USACE). 1996. U.S. Army Corps of Engineers. RCRA Part B Application for the Hawthorne Army Depot, Hawthorne, Nevada, November 1996.

U. S. Army Environmental Center (USAEC). 1995. Air Pathway Screening Assessments for RCRA Subpart X Permitting, prepared by Halibuton NUS Corporation. May.

U.S. Census Bureau (USCB). 2001. U.S. Census Bureau. 2001. World Wide Web. http://quickfacts.census.gov/qfd/states/32/32021.html. "Mineral County Profile." Accessed July 1. *As cited in CHPPM, 2004.*

U.S. Department of Agriculture (USDA). 1997. National Agricultural Statistics Service. 1997 Census of Agriculture. Mineral County. http://www.nass.usda.gov/census/census97/highlights/nv/nvc011.txt. Accessed September 10, 2003. *As cited in CHPPM, 2004.*

USDA Forest Service 1999. Toiyabe National Forest homepage. http://www.fs.fed.us/htnf/toiyabe.htm. Accessed 25 August 2003.

U.S. Department of Energy (DOE). 2006. Revision of 21 AEGLs, ERPGs and TEELs for Chemicals Of Concern. http://www.eh.doe.gov/chem_safety//teel.html.

U.S. Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A). Interim Final. EPA/540/1-89/002. December.

U.S. Environmental Protection Agency (USEPA). 1990. Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions. Interim Final. EPA/600/6-90/003. January.

U.S. Environmental Protection Agency (USEPA). 1992a. Estimating Exposure to Dioxin-like Compounds. EPA/600/6-88/005B.

U.S. Environmental Protection Agency (USEPA). 1992b. Guidelines for Exposure Assessment. FR57[104]:22888-22936.

U.S. Environmental Protection Agency (USEPA). 1992c. Health Reassessment to Dioxin-Like Compounds. Draft Report. OHEA. Washington, D.C. EPA/600/6-88/005B. August.

U.S. Environmental Protection Agency (USEPA). 1993a. Addendum to the Methodology for Assessing Risks Associated with Indirect Exposure to Combustor Emissions. Draft. EPA/600/AP-93/003.

U.S. Environmental Protection Agency (USEPA). 1993b. Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife. EPA/600/R-93/055.

U.S. Environmental Protection Agency (USEPA). 1994a. Implementation Guidance for Conducting Indirect Exposure Analysis at RCRA Combustion Units. Revised Draft. April 22.

U.S. Environmental Protection Agency (USEPA). 1994b. Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes. Errata. Revised Draft. October 4.

U.S. Environmental Protection Agency (USEPA). 1994c. Memorandum: Further Issues for Indirect Exposure Assessment Modeling. OHEA and ECAO, September.

U.S. Environmental Protection Agency (USEPA). 1994d. Health Assessment Document for 2,3,7,8-TCDD and Related Compounds. Volume III. Review Draft. ORD. Washington, D.C. EPA/600/BP-92/001c.

U.S. Environmental Protection Agency (USEPA). 1994e. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. OERR. Washington, D.C. EPA/540/R-93/081. February.

U.S. Environmental Protection Agency (USEPA). 1994f. "Memorandum Regarding Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities." OSWER Directive 9355.4-12. From Elliot P. Laws, Assistant Administrator. To Regional Administrators Regions I-IX. July 14.

U.S. Environmental Protection Agency (USEPA). 1995. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models, EPA-454/B-95-003a, September.

U.S. Environmental Protection Agency (USEPA). 1996a. Soil Screening Guidance: User's Guide. United States Environmental Protection Agency. Office of Solid Waste and Emergency Response. Washington, D.C. Publication 9355. 4-23.

U.S. Environmental Protection Agency (USEPA). 1996b. Soil Screening Guidance: Technical Background Document. United States Environmental Protection Agency. Office of Solid Waste and Emergency Response. Washington, D.C. EPA/540/R-95/128.

U.S. Environmental Protection Agency (USEPA). 1997a. Health Effects Assessment Summary Tables (HEAST). Annual Update. FY-1997Update. EPA/540/R-97/036.July.

U.S. Environmental Protection Agency (USEPA). 1997b. Exposure Factors Handbook. Volumes I – III. Update. EPA/600/P-95/002Fa. August.

U.S. Environmental Protection Agency (USEPA). 1998a. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Peer Review Draft. EPA530-D-98-001A. July.

U.S. Environmental Protection Agency (USEPA). 1998b. Region 6 Risk Management Addendum – Draft Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. EPA-R6-98-002. July

U.S. Environmental Protection Agency (USEPA). 1999. Screening-Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Peer Review Draft. OSWER. EPA530-D-99-001C. August.

U.S. Environmental Protection Agency (USEPA). 2000. Meteorological Monitoring Guidance for Regulatory Modeling Applications, EPA-454/R-99-005, OAQPS, Research Triangle Park, NC).

U.S. Environmental Protection Agency (USEPA). 2001. Risk Burn Guidance for Hazardous Waste Combustion Facilites. OSWER. EPA530-R-01-001. July.

U.S. Environmental Protection Agency (USEPA). 2002. National Ambient Water Quality Criteria: 2002. US Environmental Protection Agency, Office of Water. EPA-822-R-02-047. November.

U.S. Environmental Protection Agency (USEPA). 2003a. Human Health Toxicity Values in Superfund Risk Assessments. OSWER Directive 9285.7-53. December 5.

U.S. Environmental Protection Agency (USEPA). 2003b. Adult Lead Model Spreadsheet (Calculation of PRGs, Appendix B of Adult Lead Model Guidance. EPA-540-R-03-001, OSWER Dir #9285.7-54.

U.S. Environmental Protection Agency (USEPA). 2004a. User's Guide for the AMS/EPA Regulatory Model-AERMOD, EPA-454/B-03-001, September.

U.S. Environmental Protection Agency (USEPA). 2004b. User's Guide for the AERMOD Meteorological Preprocessor (AERMET), EPA-454/B-03-002, November.

U.S. Environmental Protection Agency (USEPA). 2004c. Superfund Chemical Data Matrix Methodology. January.

U.S. Environmental Protection Agency (USEPA). 2004d. WATER9 – Air Emissions Models Wastewater Treatment, Version 2.0 OAQPS. Research Triangle Park, North Carolina. July 1.

U.S. Environmental Protection Agency (USEPA). 2005a. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Final. EPA 530-R-05-006. September.

U.S. Environmental Protection Agency (USEPA). 2005b, Federal Register, Vol. 70, No. 216, November 9.

U.S. Environmental Protection Agency (USEPA). 2005c. The Hazardous Waste Companion Database. Downloadable at: http://www.epa.gov/epaoswer/hazwaste/combust/risk.htm.

U.S. Environmental Protection Agency (USEPA). 2005d. Ecological Soil Screening Levels. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response. http://www.epa.gov/ecotox/ecossl/. March.

U.S. Environmental Protection Agency (USEPA). 2006a, Addendum User's Guide for the AMS/EPA Regulatory Model – AERMOD, EPA-454/B-03-001)

U.S. Environmental Protection Agency (USEPA). 2006b. Acute Exposure Guideline Levels http://www.epa.gov/oppt/aegl/chemlist.htm.

U.S. Environmental Protection Agency (USEPA). 2007. Integrated Risk Information System (IRIS) Database. http://www.epa.gov/iris/.

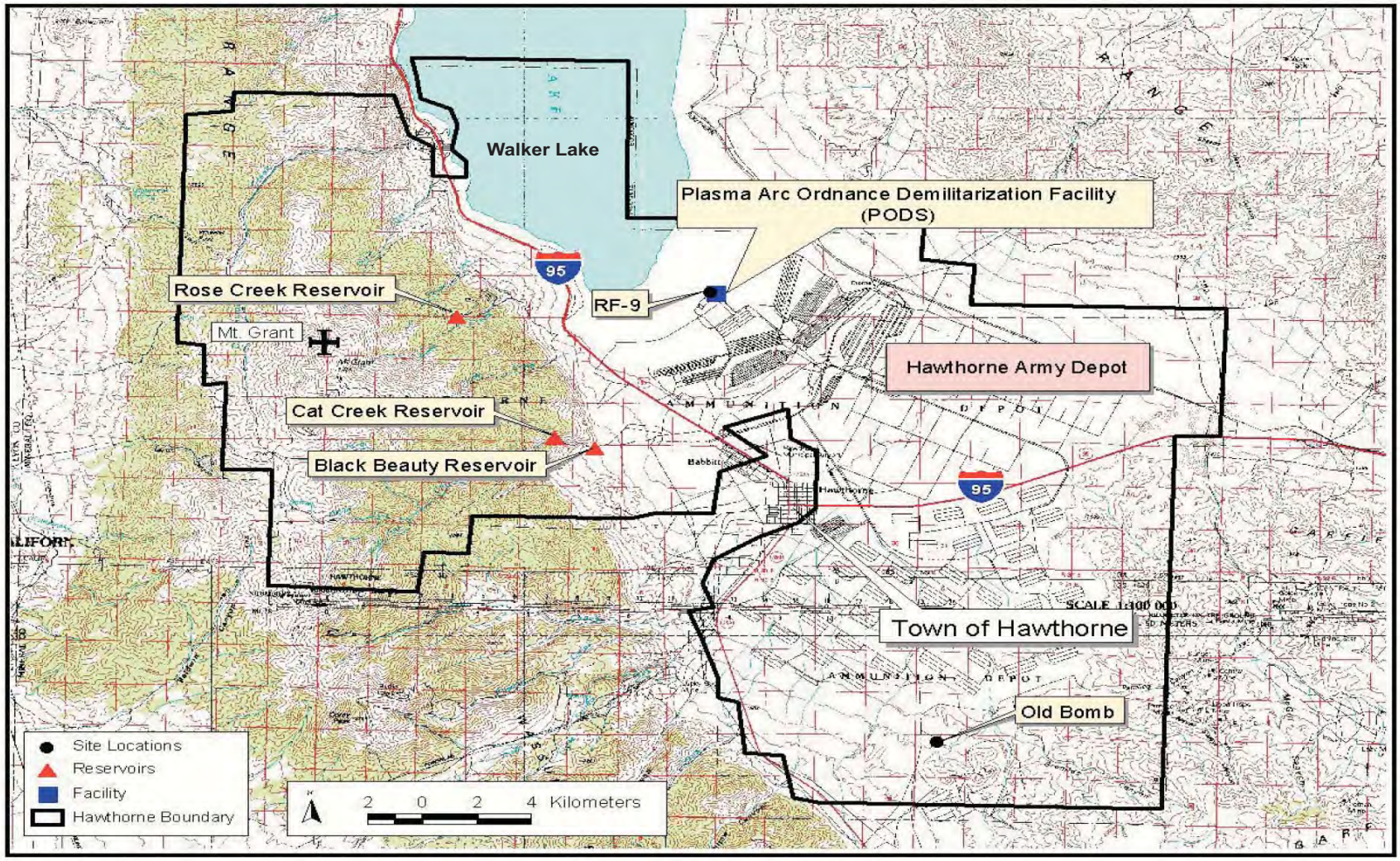
United States Geological Survey (USGS). 1992. National Elevation Dataset. http://seamless.usgs.gov.

United States Geological Survey (USGS). 1995. Water Budget and Salinity of Walker Lake, Western Nevada. Fact Sheet FS-115-95.

United States Geological Survey (USGS). 2001. National Land Cover Dataset. http://seamless.usgs.gov.

Wesley, ML, PV Doskey, and JD Shannon. 2002. Deposition Parameterization for the Industrial Source Complex (ISC3) Model, ANL/ER/TR-01/003, Argonne National Laboratory, Argonne, IL, June.

# FIGURES

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**HAWTHORNE ARMY DEPOT**
HAWTHORNE, NEVADA

**Figure 2-1**

**Hawthorne Army Depot and Study Area (taken from CHPPM, 2004)**

**Date:** 03/31/06 | **Project No.** 02563-0000-00004

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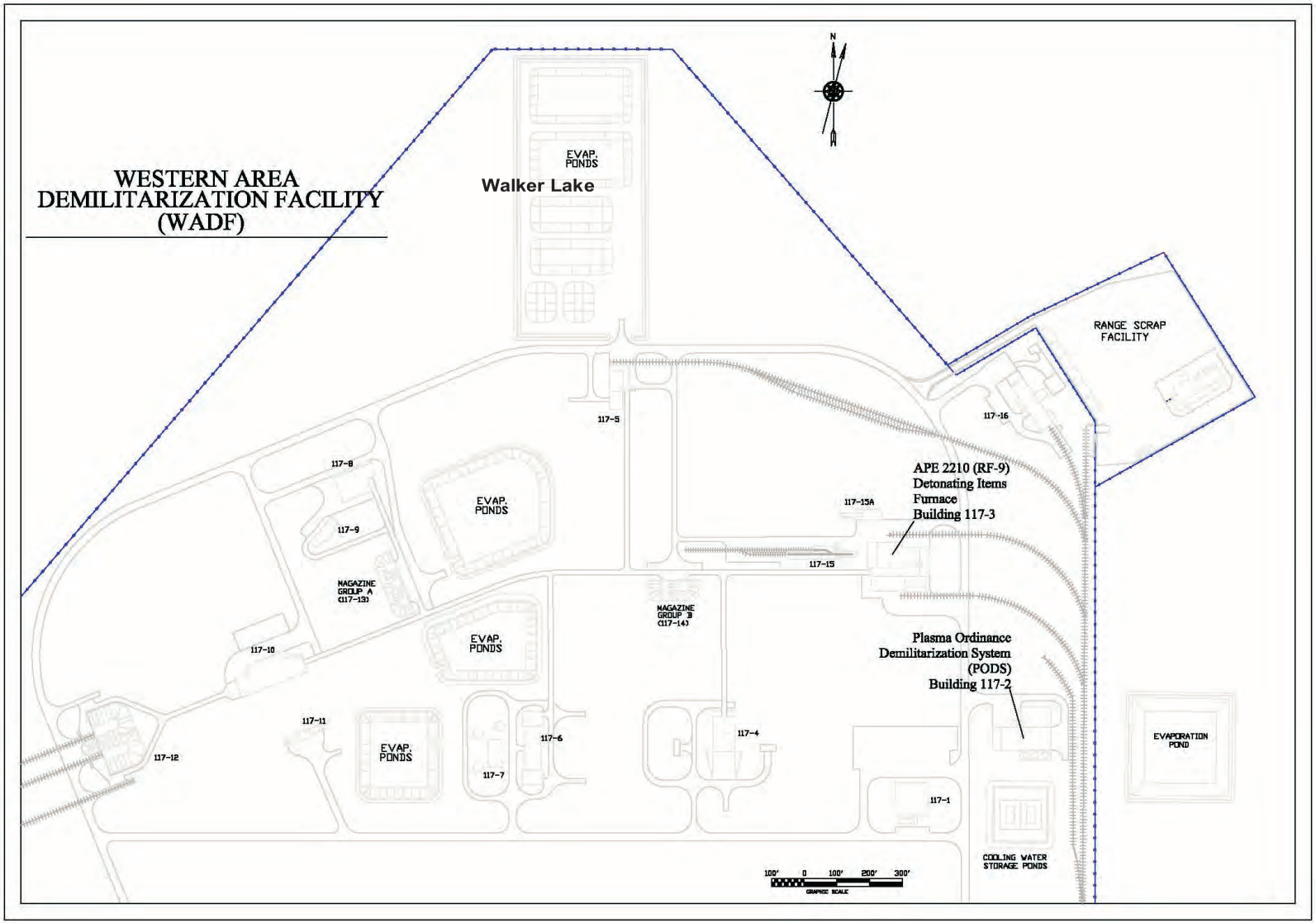


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**HAWTHORNE ARMY DEPOT**
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**Figure 3-1**

**Western Area Demiliterization Facility Layout**

**Date:** 03/31/06 | **Project No.** 02563-0000-00004

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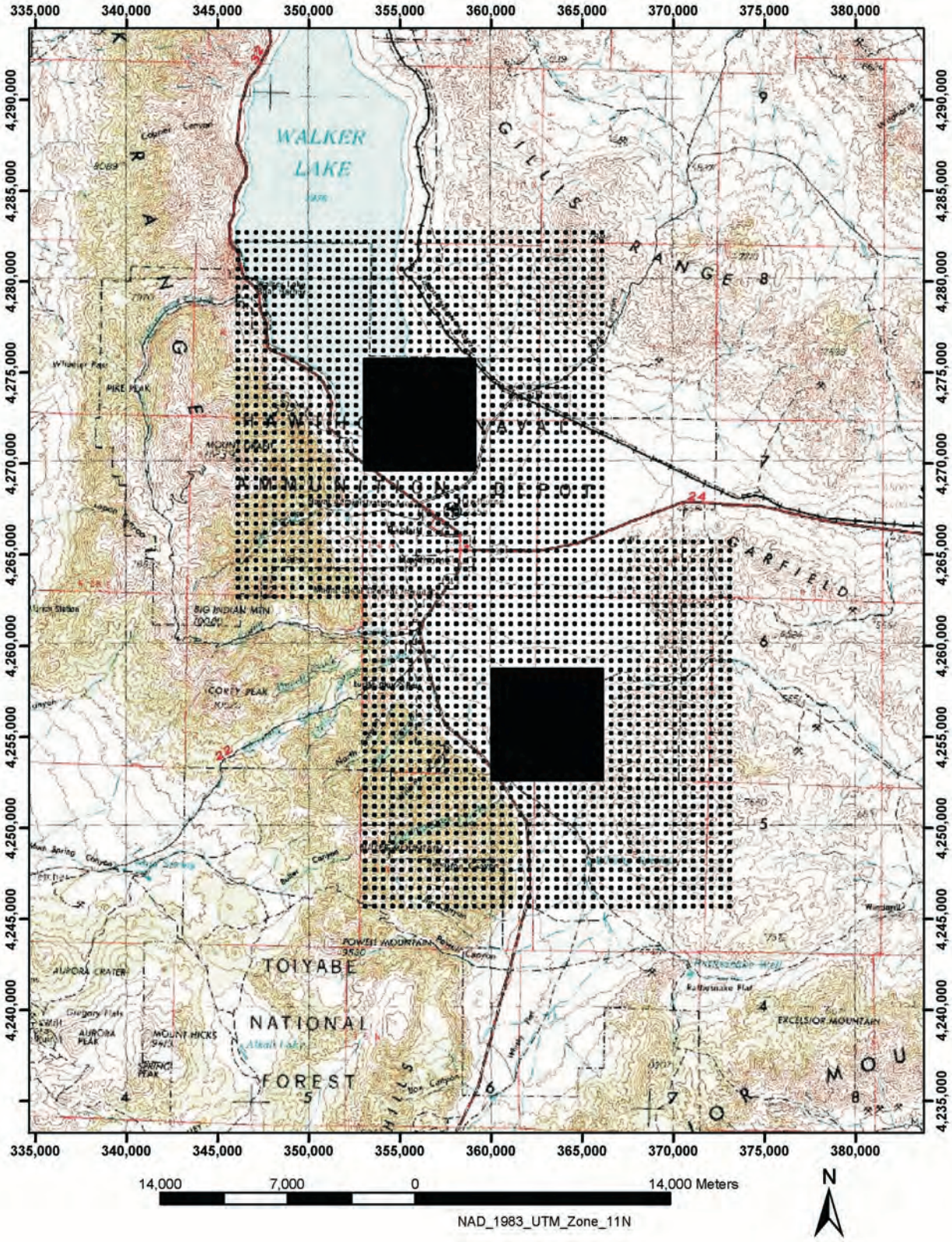


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**HAWTHORNE ARMY DEPOT**
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**Figure 3-2**

**Pods, RF-9 and OBA Cartesian Receptor Arrays**

**Date:** 03/31/06 | **Project No.** 02563-0000-00004

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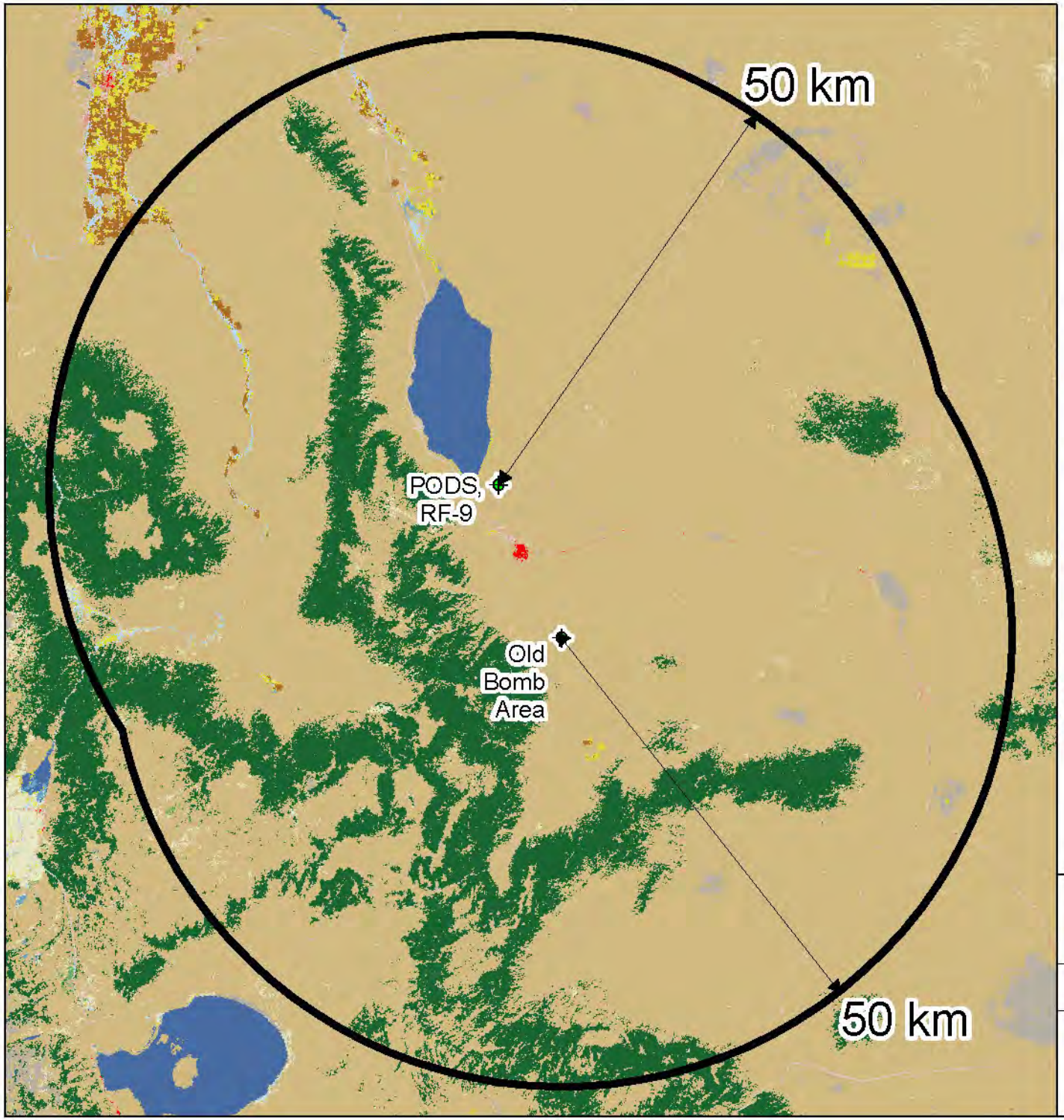


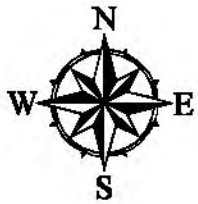


**Legend**

**Land Cover**

- Open Water
- Perennial Ice/Snow
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Scrub/Shrub
- Grassland/Herbaceous
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands

0 12,500 25,000 Meters

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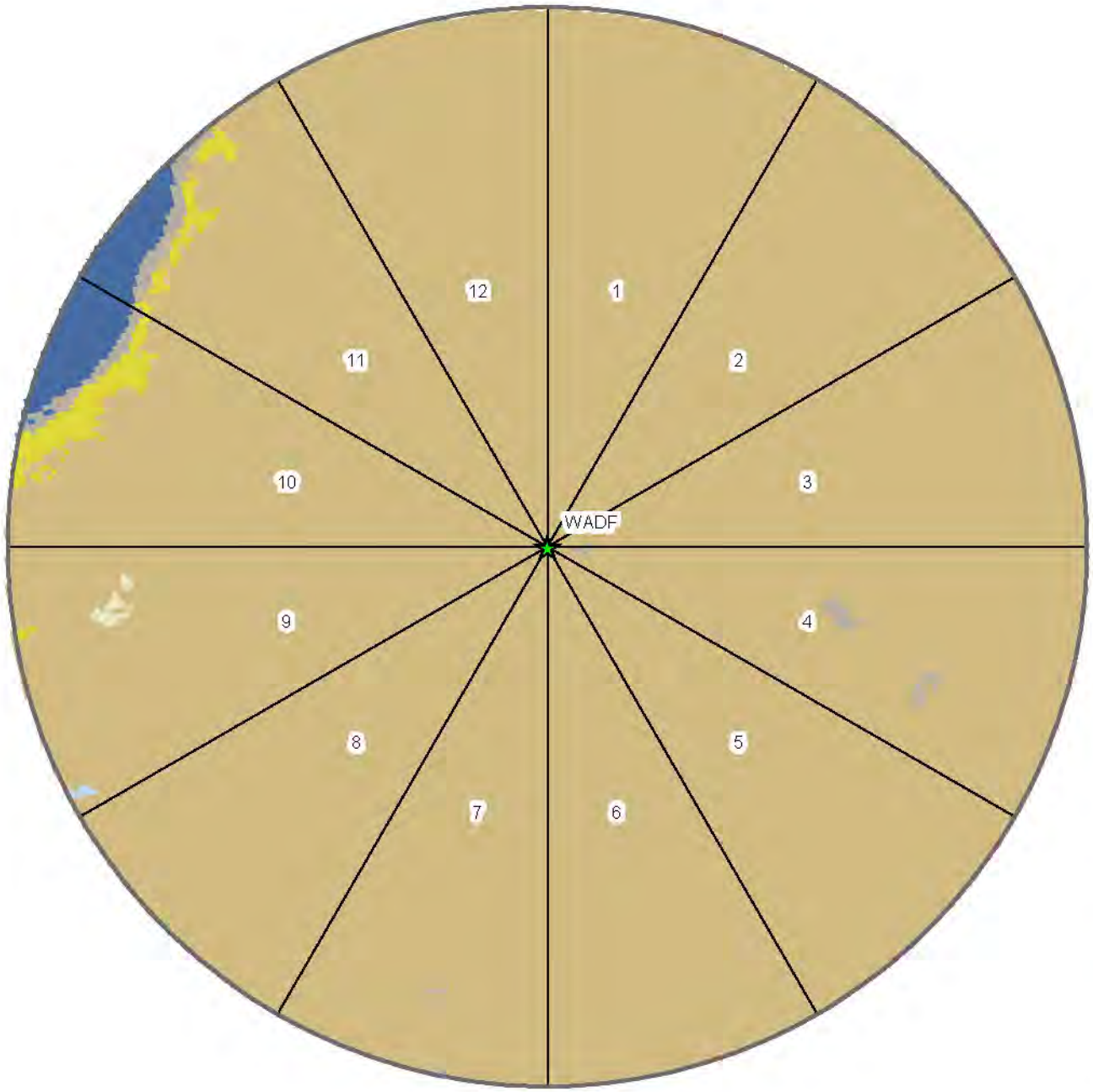
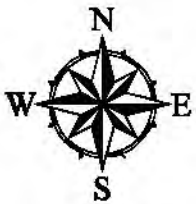
**Figure 3-3: Land Cover Out to 50 km**




**Legend**

**Land Cover**

- Open Water
- Barren Land
- Scrub/Shrub
- Grassland/Herbaceous
- Pasture/Hay
- Woody Wetlands
- Emergent Herbaceous Wetlands

0 750 1,500 Meters

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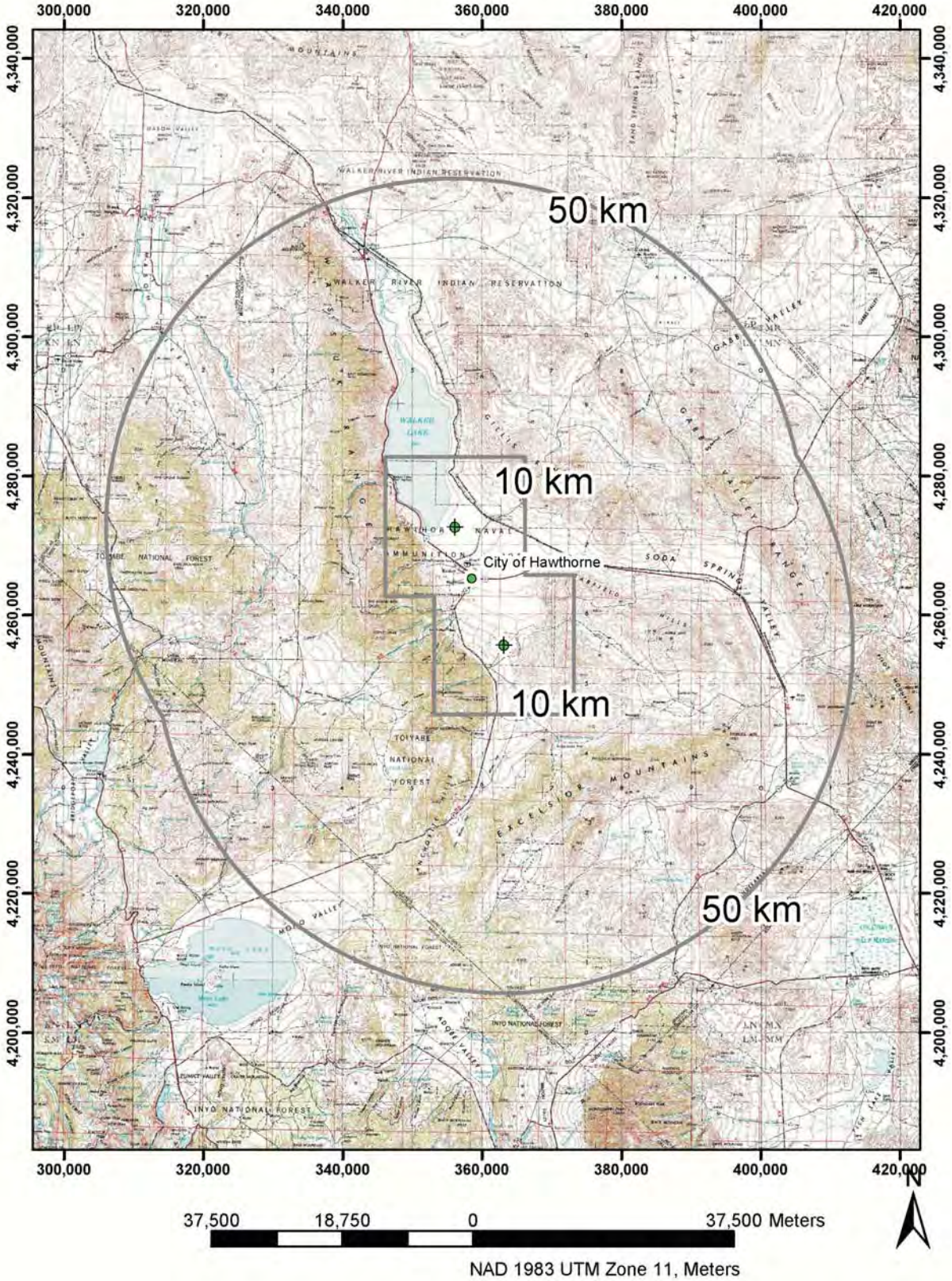
Hawthorne Army Depot

**Figure 3-4: Land Cover in a 3-km Radius Circle Around the Western Area Demilitarization Facility (WADF)**

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**HAWTHORNE ARMY DEPOT**
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**Figure 4-1**

**50 km and 10 km Study Area Boundries**

**Date:** 03/31/06 | **Project No.** 02563-0000-00004

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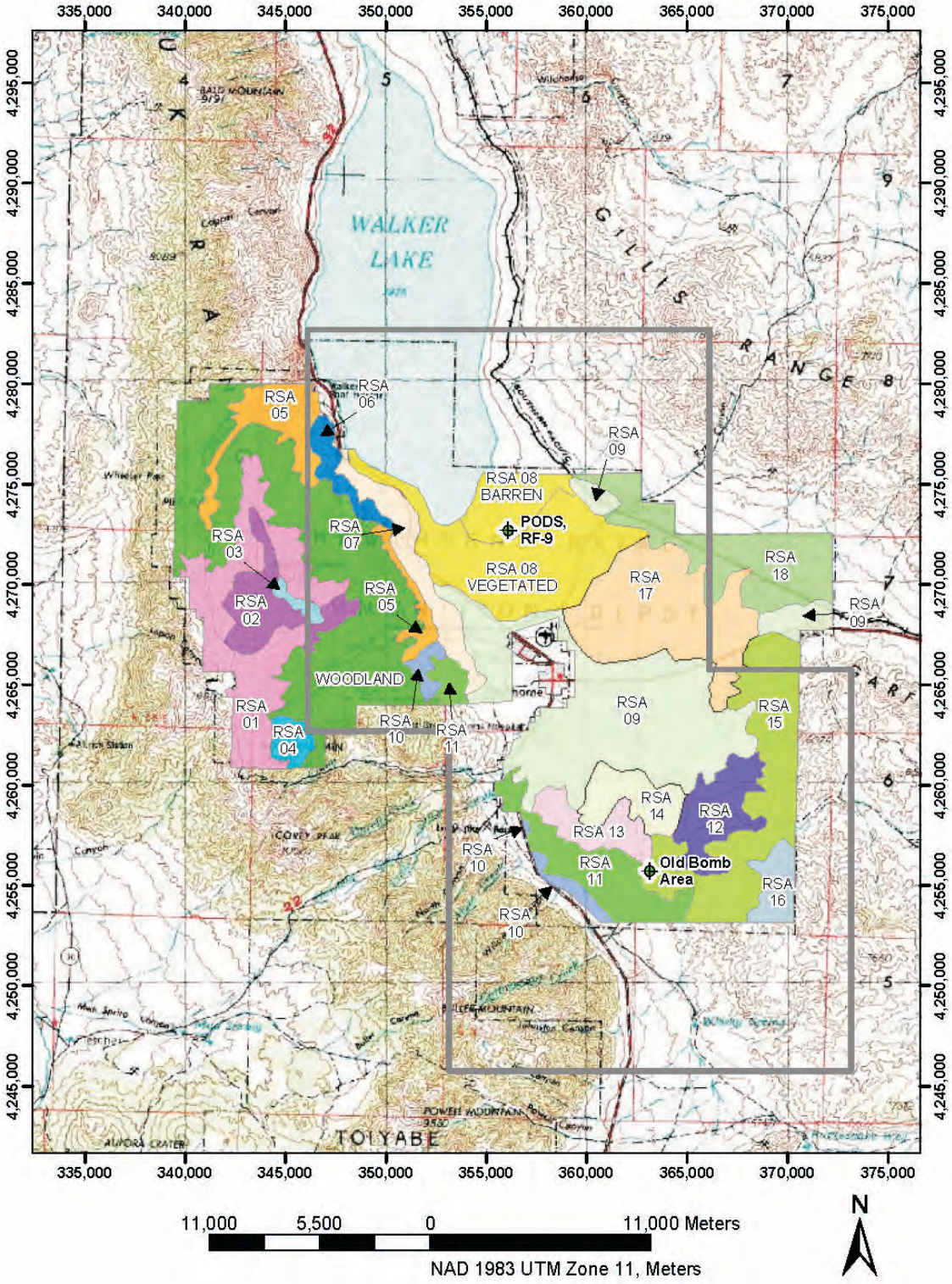


NOTE: RSA information taken from CH2MHill 2004

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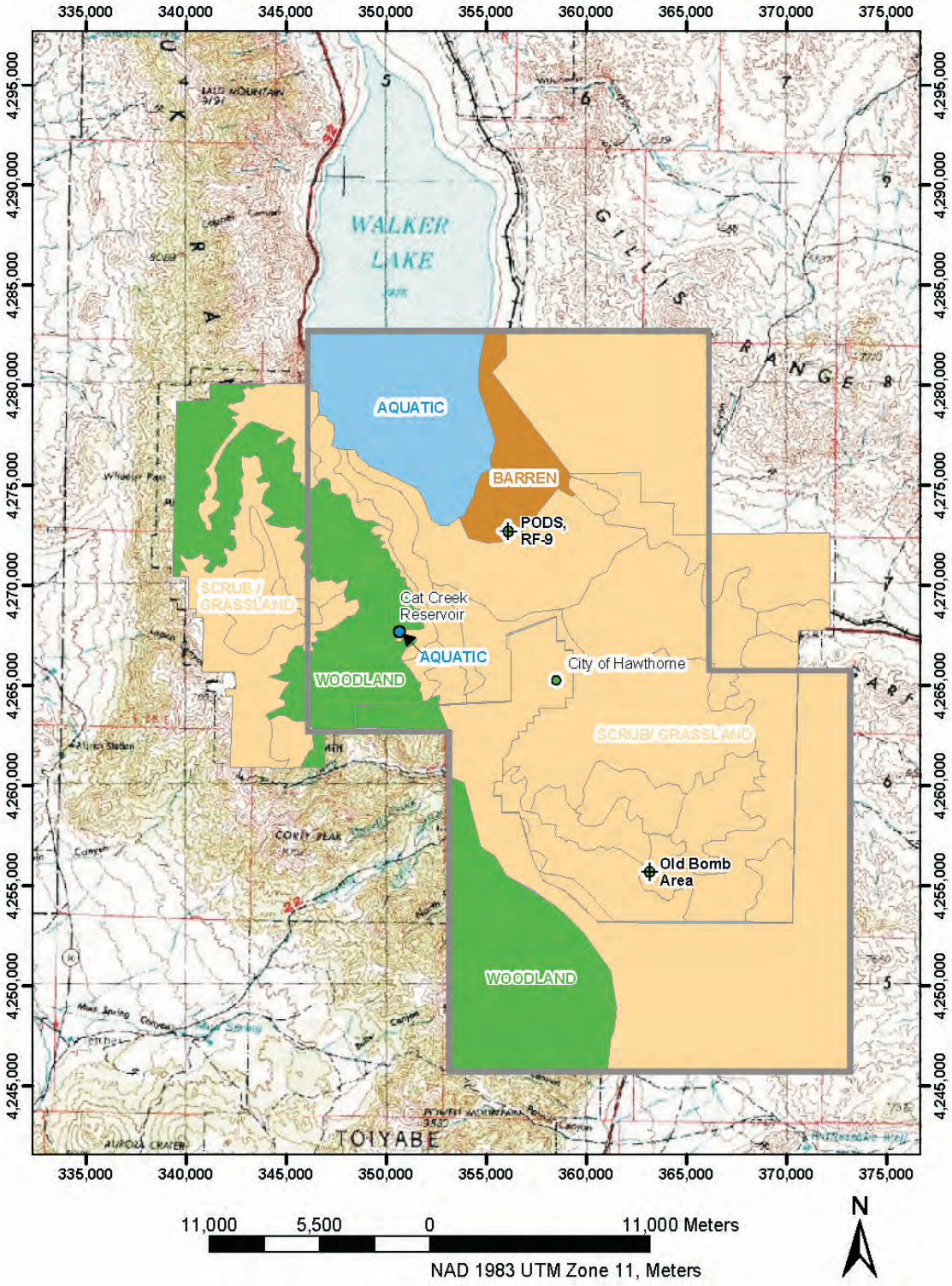
**HAWTHORNE ARMY DEPOT**
HAWTHORNE, NEVADA

**Figure 5-1**

**Habitat Types**

**Date:** 03/31/06 | **Project No.** 02563

shared/publications/jean/fh7/H&S/02563 map.fh10

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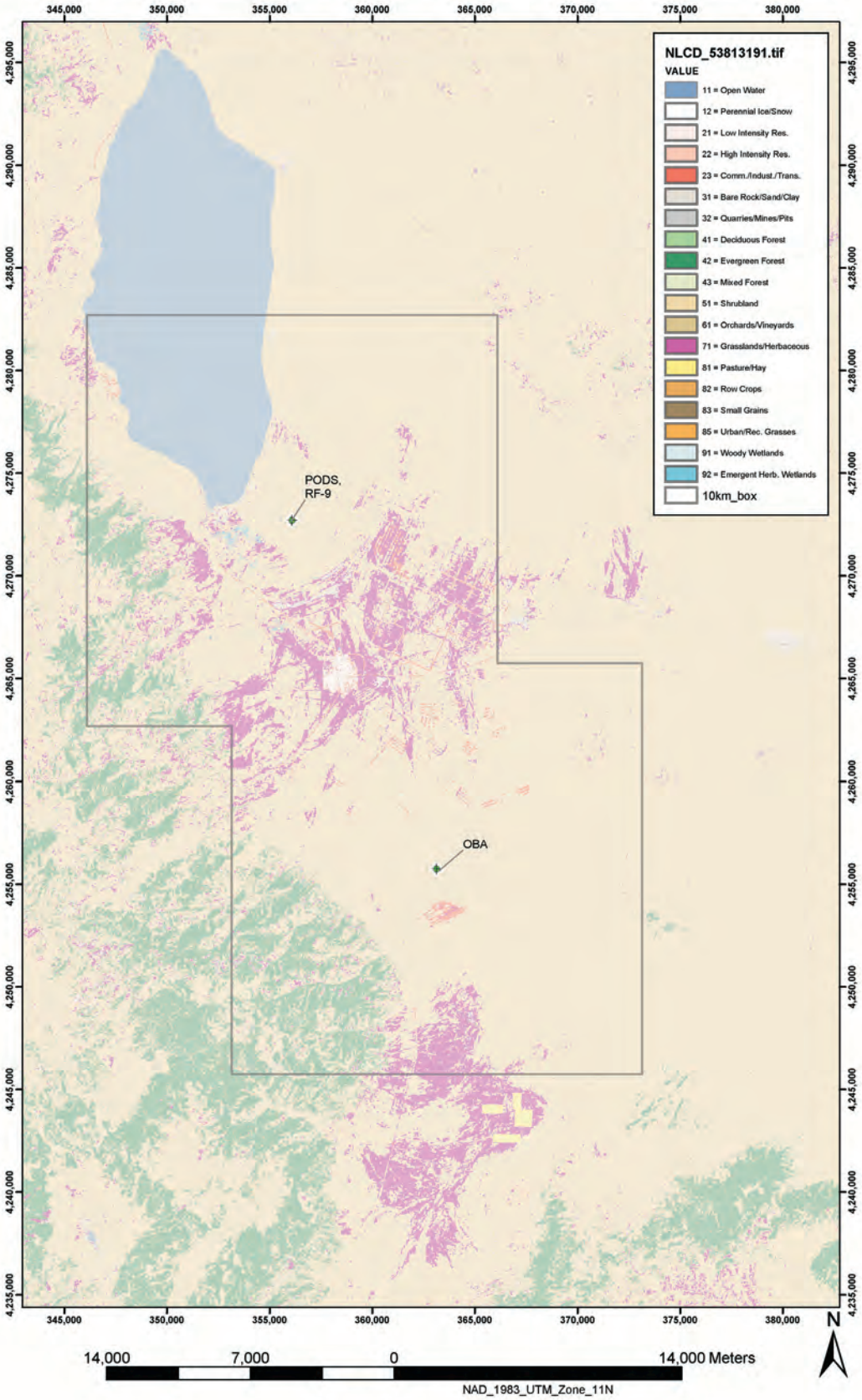
**HAWTHORNE ARMY DEPOT**
HAWTHORNE, NEVADA

**Figure 5-2**

**Habitat Types for Assessment Area**

**Date:** 03/31/06 | **Project No.** 02563

shared/publications/jean/fh7/H&S/02563 map.fh10




NOTE: Land use information taken from USGS 1992b

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**HAWTHORNE ARMY DEPOT**
HAWTHORNE, NEVADA

**Figure 5-3**

**Land Use Map**

**Date:** 03/31/06 | **Project No.** 02563

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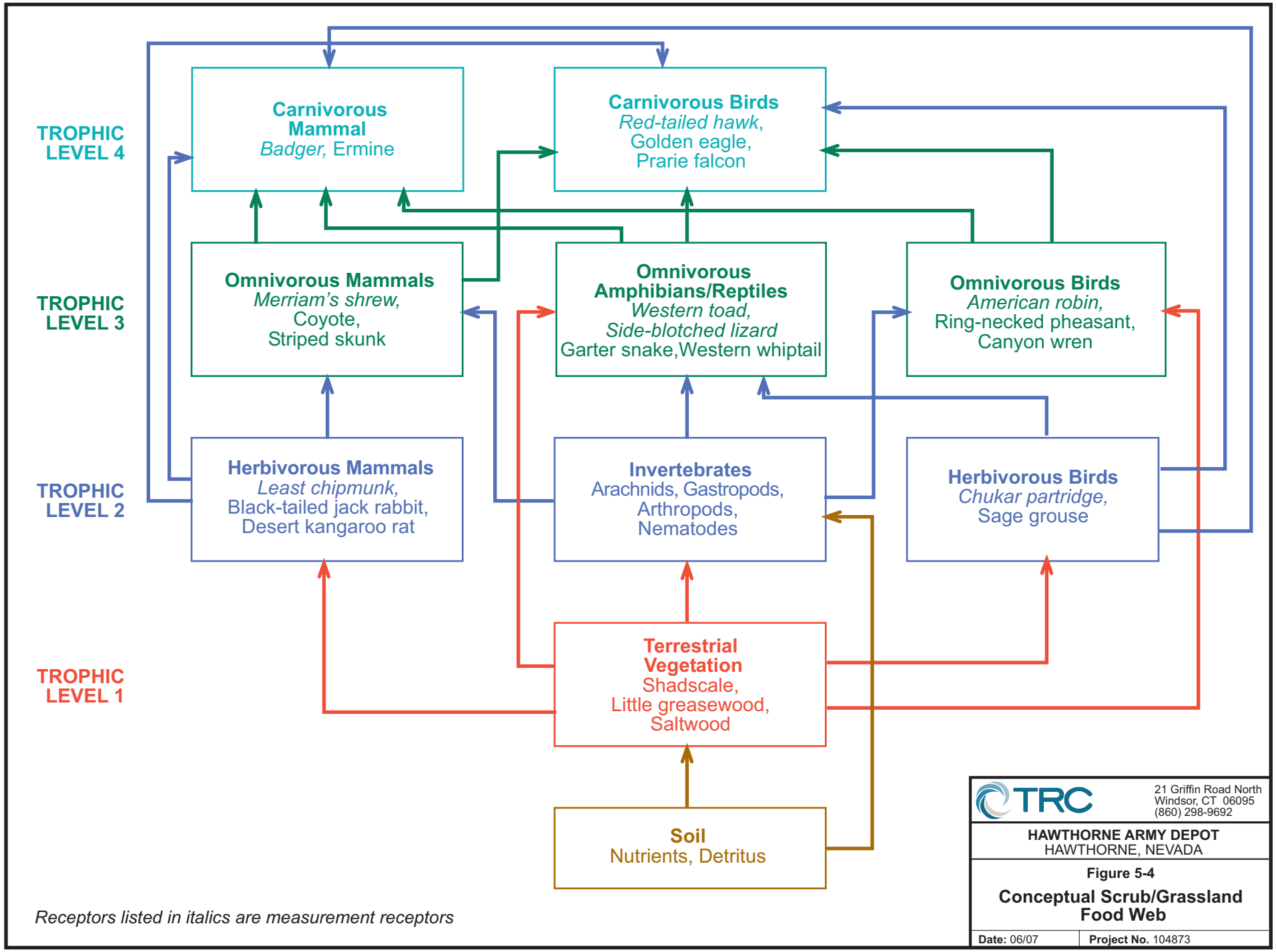
TROPHIC LEVEL 4
TROPHIC LEVEL 3
TROPHIC LEVEL 2
TROPHIC LEVEL 1
Carnivorous Mammal
Badger, Ermine
Carnivorous Birds
Red-tailed hawk,
Golden eagle,
Prarie falcon
Omnivorous Mammals
Merriam's shrew,
Coyote,
Striped skunk
Omnivorous Amphibians/Reptiles
Western toad,
Side-blotched lizard
Garter snake,Western whiptail
Omnivorous Birds
American robin,
Ring-necked pheasant,
Canyon wren
Herbivorous Mammals
Least chipmunk,
Black-tailed jack rabbit,
Desert kangaroo rat
Invertebrates
Arachnids, Gastropods,
Arthropods,
Nematodes
Herbivorous Birds
Chukar partridge,
Sage grouse
Terrestrial Vegetation
Shadscale,
Little greasewood,
Saltwood
Soil
Nutrients, Detritus
Receptors listed in italics are measurement receptors
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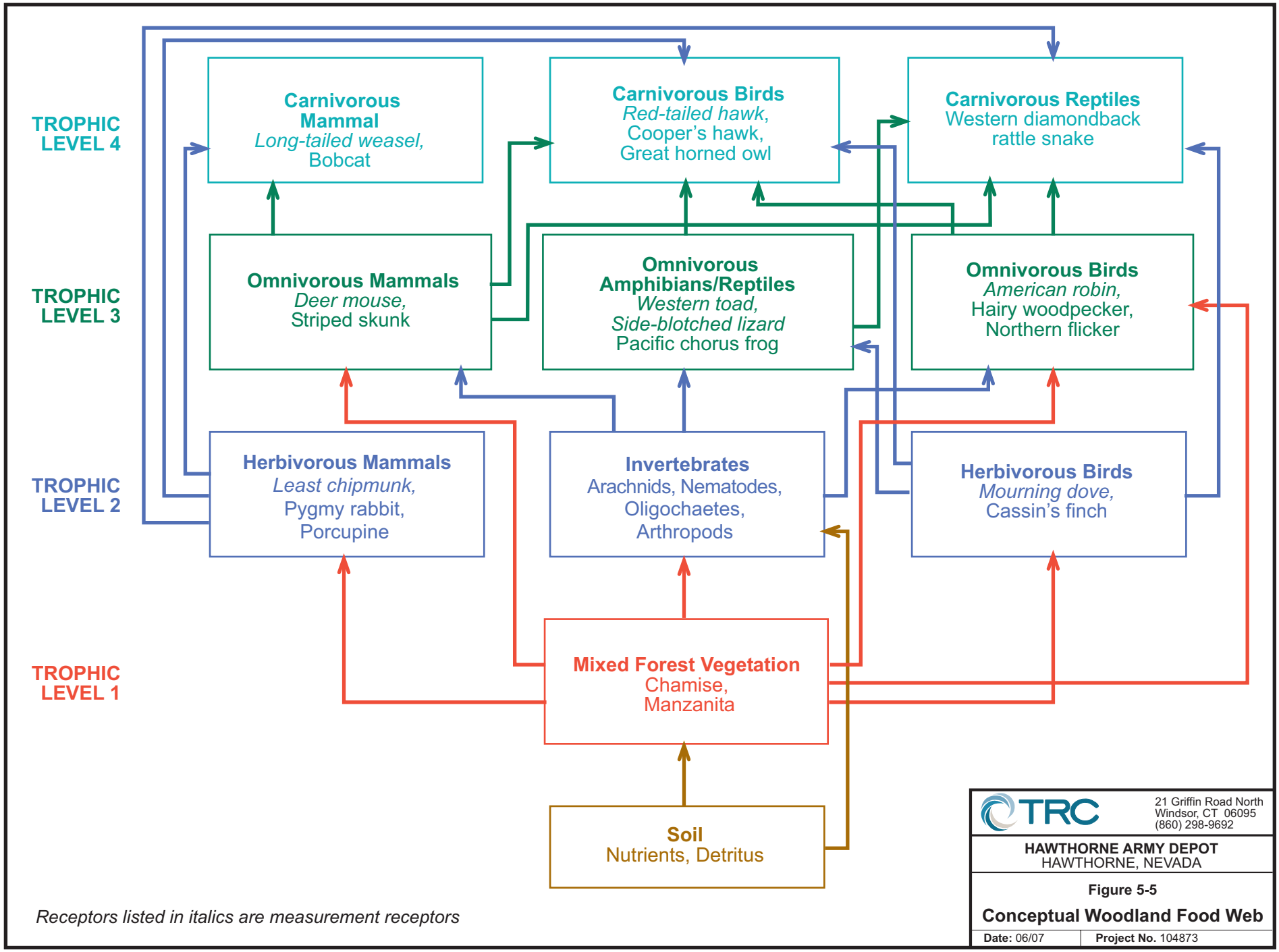
HAWTHORNE ARMY DEPOT
HAWTHORNE, NEVADA
Figure 5-4
Conceptual Scrub/Grassland Food Web
Date: 06/07
Project No. 104873


TROPHIC LEVEL 4
TROPHIC LEVEL 3
TROPHIC LEVEL 2
TROPHIC LEVEL 1
Carnivorous Mammal
Long-tailed weasel,
Bobcat
Carnivorous Birds
Red-tailed hawk,
Cooper's hawk,
Great horned owl
Carnivorous Reptiles
Western diamondback
rattle snake
Omnivorous Mammals
Deer mouse,
Striped skunk
Omnivorous Amphibians/Reptiles
Western toad,
Side-blotched lizard
Pacific chorus frog
Omnivorous Birds
American robin,
Hairy woodpecker,
Northern flicker
Herbivorous Mammals
Least chipmunk,
Pygmy rabbit,
Porcupine
Invertebrates
Arachnids, Nematodes,
Oligochaetes,
Arthropods
Herbivorous Birds
Mourning dove,
Cassin's finch
Mixed Forest Vegetation
Chamise,
Manzanita
Soil
Nutrients, Detritus
Receptors listed in italics are measurement receptors
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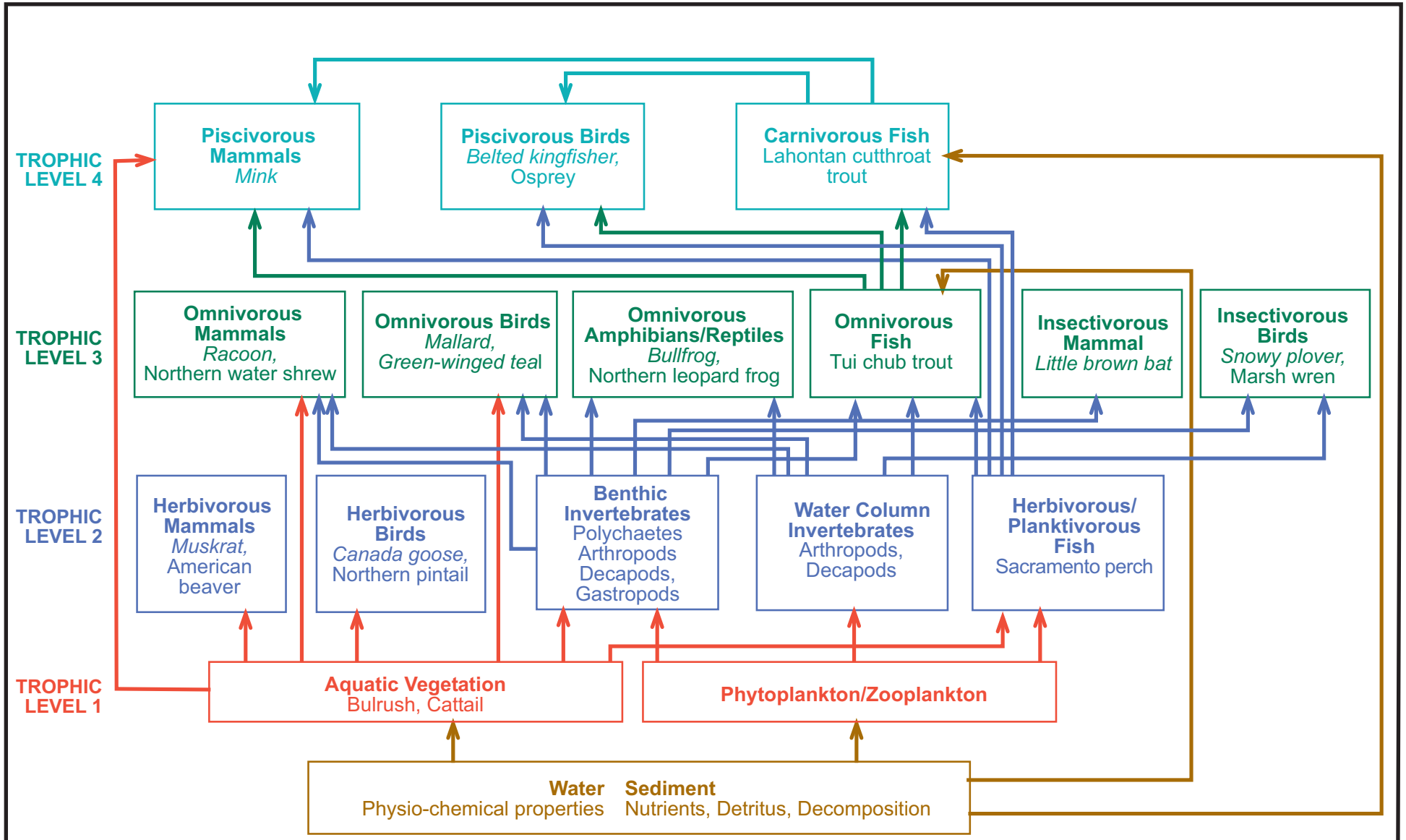
HAWTHORNE ARMY DEPOT
HAWTHORNE, NEVADA
Figure 5-5
Conceptual Woodland Food Web
Date: 06/07
Project No. 104873




*Receptors listed in italics are measurement receptors*

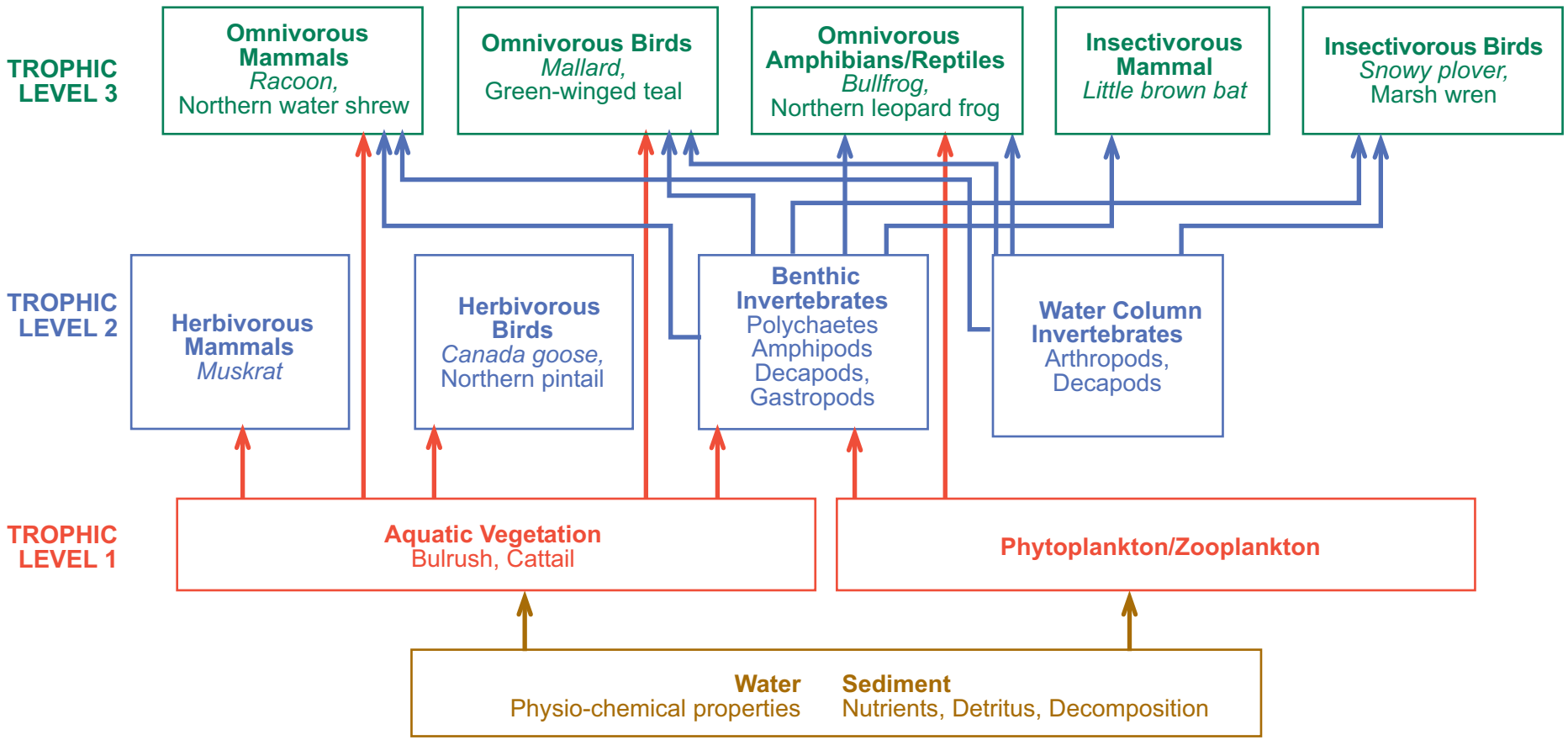
TRC
21 Griffin Road North
Windsor, CT 06095
(860) 298-9692

**HAWTHORNE ARMY DEPOT**
HAWTHORNE, NEVADA

**Figure 5-6**

**Conceptual Aquatic Food Web**
**Walker Lake**

**Date:** 06/07 | **Project No.** 104873




*Receptors listed in italics are measurement receptors*

TRC
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Windsor, CT 06095
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**HAWTHORNE ARMY DEPOT**
HAWTHORNE, NEVADA

**Figure 5-7**

**Conceptual Aquatic Food Web**
**Cat Dam Reservoir**

**Date:** 06/07 **Project No.** 104873

# TABLES

**TABLE 2-1a**
**CONSTITUENTS TO BE ANALYZED FOR IN THE CPT/RISK BURN FOR PODS AND RF-9**

| METALS | PCBs | VOC PICS (cont'd) |
|---|---|---|
| Aluminum | 3,3',4,4'-tetrachlorobiphenyl | Benzene |
| Antimony | 3,4,4',5-tetrachlorobiphenyl | *Bromobenzene* |
| Arsenic | 2,3,3',4,4'-pentachlorobiphenyl | *Bromochloromethane* |
| Barium | 2,3,4,4',5-pentachlorobiphenyl | Bromodichloromethane |
| Beryllium | 2,3',4,4',5-pentachlorobiphenyl | Bromoform |
| Cadmium | 2',3,4,4',5-pentachlorobiphenyl | Bromomethane |
| Chromium | 3,3',4,4',5-pentachlorobiphenyl | *n-Butylbenzene* |
| Cobalt | 2,3,3',4,4',5-hexachlorobiphenyl | *sec-Butylbenzene* |
| Copper | 2,3,3',4,4',5'-hexachlorobiphenyl | *tert-Butylbenzene* |
| Lead | 2,3',4,4',5,5'-hexachlorobiphenyl | Carbon disulfide |
| Manganese | 3,3',4,4',5,5'-hexachlorobiphenyl | Carbon tetrachloride |
| Mercury | 2,2',3,3',4,4',5-heptachlorobiphenyl | Chlorobenzene |
| Nickel | 2,2',3,4,4',5,5'-heptachlorobiphenyl | Chlorodibromomethane |
| Selenium | 2,3,3',4,4',5,5'-heptachlorobiphenyl | Chloroethane |
| Silver | | Chloroform |
| Thallium | VOC PICs | Chloromethane |
| Vanadium | 1,1-Dichloroethane | Dibromomethane |
| Zinc | 1,1-Dichloroethene | Dichlorodifluoromethane |
| | *1,1-Dichloropropene* | Ethylbenzene |
| ACID GASSES | 1,1,1-Trichloroethane | **Ethylene dibromide** |
| Chlorine | 1,1,1,2-Tetrachloroethane | *Hexachlorobutadiene* |
| Hydrogen Chloride | 1,1,2-Trichloroethane | Iodomethane |
| | 1,1,2,2-Tetrachloroethane | *Isopropylbenzene* |
| PCDD/PCDF | *1,2-Dibromo-3-chloropropane* | *p-Isopropyltoluene* |
| 2,3,7,8-TCDD | *1,2-Dibromoethane* | Methylene chloride |
| 1,2,3,7,8-PeCDD | 1,2-Dichlorobenzene | *n-Propylbenzene* |
| 1,2,3,4,7,8-HxCDD | 1,2-Dichloroethane | *Styrene* |
| 1,2,3,6,7,8-HxCDD | 1,2-Dichloroethene, cis- | Tetrachloroethene |
| 1,2,3,7,8,9-HxCDD | 1,2-Dichloroethene, trans- | Toluene |
| 1,2,3,4,6,7,8-HpCDD | 1,2-Dichloropropane | Trichloroethene |
| Octa CDD | *1,2,3-Trichlorobenzene* | Trichlorofluoromethane |
| 2,3,7,8-TCDF | 1,2,3-Trichloropropane | **Vinyl acetate** |
| 1,2,3,7,8-PeCDF | *1,2,4-Trichlorobenzene* | Vinyl bromide |
| 2,3,4,7,8-PeCDF | *1,2,4-Trimethylbenzene* | Vinyl chloride |
| 1,2,3,4,7,8-HxCDF | 1,3-Dichlorobenzene | o-Xylene |
| 1,2,3,6,7,8-HxCDF | *1,3-Dichloropropane* | m,p-Xylene |
| 1,2,3,7,8,9-HxCDF | 1,3-Dichloropropene, cis- | |
| 2,3,4,6,7,8-HxCDF | 1,3-Dichloropropene, trans- | SVOC PICs[1] |
| 1,2,3,4,6,7,8-HpCDF | *1,3,5-Trimethylbenzene* | 1-Chloronaphthalene |
| 1,2,3,4,7,8,9-HpCDF | 1,4-Dichlorobenzene | *1-Naphthylamine* |
| Octa CDF | 2-Butanone | 1,2-Dichlorobenzene |
| | *2-Chlorotoluene* | *1,2-Diphenylhydrazine* |
| | 2-Hexanone (MBK) | 1,2,4-Trichlorobenzene |
| | *2,2-Dichloropropane* | *1,2,4,5-Tetrachlorobenzene* |
| | *4-Chlorotoluene* | 1,3-Dichlorobenzene |
| | 4-Methyl-2-pentanone (MIBK) | 1,4-Dichlorobenzene |
| | Acetone | |
| | *Acrylonitrile* | |

**TABLE 2-1a (CONTINUED)**
**CONSTITUENTS TO BE ANALYZED FOR IN THE CPT/RISK BURN FOR PODS AND RF-9**

| SVOC PICs[1] (cont'd) | SVOC PICs[1] (cont'd) | SVOC PICs[1] (cont'd) |
|---|---|---|
| 2-Chloronaphthalene | Benzoic acid | Pentachlorophenol |
| 2-Chlorophenol | Benzo(ghi)perylene | *Phenacetin* |
| 2-Methylnaphthalene | Benzo(a)pyrene | Phenanthrene |
| 2-Methylphenol | Benzyl alcohol | Phenol |
| *2-Naphthylamine* | **Biphenyl** | Pyrene |
| 2-Nitroaniline | bis(2-Chloroethoxy)methane | *Pyridine* |
| 2-Nitrophenol | bis(2-Chloroethyl) ether | |
| *2-Picoline* | bis(2-Chloroisopropyl) ether | ENERGETICS[4] |
| *2,3,4,6-Tetrachlorophenol* | bis(2-Ethylhexyl) phthalate | RDX |
| 2,4-Dichlorophenol | Butyl benzyl phthalate | HMX (Cyclotetramethylene |
| *2,4-Dimethylphenol* | Carbazole | Tetranitramine) |
| *2,4-Dinitrophenol* | Chrysene | TNT (Trinitrotoluene) |
| 2,4-Dinitrotoluene | Dibenz(a,h)anthracene | Nitroglycerin |
| 2,4,5-Trichlorophenol | Dibenzofuran | Tetryl |
| 2,4,6-Trichlorophenol | Di-n-butyl phthalate | 1,3-Dinitrobenzene |
| *2,6-Dichlorophenol* | Diethyl phthalate | 1,3,5-Trinitrobenzene |
| 2,6-Dinitrotoluene | *p-Dimethylaminoazobenzene* | 2-amino-4,6-Dinitrotoluene |
| *3-Methylcholanthrene* | Dimethyl phthalate | 2-Nitrotoluene |
| 3-Nitroaniline | Di-n-octyl phthalate | 3-Nitrotoluene |
| 3,3'-Dichlorobenzidine | *Diphenylamine* | 4-amino-2,6-Dinitrotoluene |
| 3/4-Methylphenol | *Ethyl methanesulfonate* | 4-Nitrotoluene |
| *4-Aminobiphenyl* | Fluoranthene | |
| 4-Bromophenyl phenyl ether | Fluorene | CRITERIA POLLUTANTS |
| 4-Chloroaniline | Hexachlorobenzene | $CO_2$ |
| *4-Chloro-3-methylphenol* | Hexachlorobutadiene | CO |
| 4-Chlorophenyl phenyl ether | Hexachlorocyclopentadiene | $NO_X$ |
| 4-Nitroaniline | Hexachloroethane[2] | $SO_2$ |
| *4-Nitrophenol* | Indeno(1,2,3-cd)pyrene | |
| 4,6-Dinitro-2-methylphenol | Isophorone | |
| *7,12-Dimethylbenz(a)anthracene* | *Methyl methanesulfonate* | |
| Acenaphthene | Naphthalene[2,3] | |
| Acenaphthylene | Nitrobenzene | |
| *Acetophenone* | *N-Nitrosodi-n-butylamine* | |
| Aniline | N-Nitrosodimethylamine | |
| Anthracene | N-Nitrosodiphenylamine | |
| Benz(a)anthracene | N-Nitrosodi-n-propylamine | |
| Benzidine | *N-Nitrosopiperidine* | |
| Benzo(b)fluoranthene | *Pentachlorobenzene* | |
| Benzo(k)fluoranthene | *Pentachloronitrobenzene* | |

[1]Polycyclic Aromatic Hydrocarbons (PAHs) may be present in the exhaust due to use of diesel fuel in the combustion chamber
[2]POHC DRE for PODS
[3]POHC DRE for RF-9
[4]Will not be analyzed for during CPT/Risk Burn, but will be addressed in Risk Assessment
Italicized compound – PODS only
Bolded compound – RF-9 only

**TABLE 2-1b**
**CONSTITUENTS TO BE CONSIDERED IN THE RISK ASSESSMENT FOR OBA**

| | |
|---|---|
| **METALS** | **VOCs/SVOCs (cont'd)** |
| Aluminum | N-Nitrosodiphenylamine |
| Antimony | o-Nitrophenol |
| Barium | Phenol |
| Copper | Phenyl diisodecylphosphite |
| Lead | Pyrene |
| Magnesium | TNB (1,3,5-Trinitrobenzene) |
| Potassium | TNMHC |
| Sodium | Triacitin |
| Tin | |
| | **CRITERIA POLLUTANTS** |
| **VOCs/SVOCs** | CO |
| 1,6-Dinitropyrene | $NO_X$ |
| 1-Nitropyrene | $SO_2$ |
| 2,2-Methylene bis (4-methyl-6-t-butyl phenol) | PM-10 |
| 2-Naphthylamine | |
| 2-Nitronaphthalene | **ACID GASSES** |
| 5-ethyl-1,3-diglycidyl-5-methylhydentoin diepoxide | Salicylic Acid |
| Ammonia | Hydrogen Cyanide |
| Benzene | Resorcinol |
| Benzo(a)pyrene | **ENERGETICS** |
| Benzo(c)acridine | DNT (2,4 and 2,6-Dinitrotoluene) |
| Dibenz(a,h)anthracene | HMX (Cyclotetramethylene Tetranitramine |
| Dibenzofurans | NG (Nitroguanidine) |
| Diethylenetriamine | RDX (Cyclo-1,3,5-trimethylene-2,4,6-trinitramine |
| Di-n-propyladipate | TNG (Trinitroglycerol/Nitroglycerine) |
| DioctylIsebacate | TNT (Trinitrotoluene) |
| Diphenylamine | |
| Isophorone di-isocyanate | |
| Naphthalene | |

**TABLE 2-2**
**VOLATILITY CLASSIFICATION OF METALS**

| Metal | Low Volatility | Medium Volatility | High Volatility |
|---|---|---|---|
| Aluminum | | X[2] | |
| Antimony | | X[2] | |
| Arsenic | X[1] | | |
| Barium | | X[2] | |
| Beryllium | X[1] | | |
| Cadmium | | X[1] | |
| Chromium | X[1] | | |
| Copper | | X[2] | |
| Cobalt | | X[2] | |
| Lead | | X[1] | |
| Mercury | | | X[1] |
| Manganese | X[2] | | |
| Nickel | | X[2] | |
| Selenium | | X[2] | |
| Silver | X[2] | | |
| Thallium | | X[2] | |
| Vanadium | | X[2] | |
| Zinc | | X[2] | |

[1]MACT Classification
[2]USEPA, 2001 (Risk Burn Guidance)

**TABLE 3-1**
**AERMET GAS DRY DEPOSITION LAND USE CATEGORIES**
**ASSIGNED TO EACH SECTOR**

| Sectors 1-12 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

| Sectors 13-24 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

| Sectors 25-36 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |

* AERMET Gas Dry Deposition Land Use Categories:
[1] Urban land, no vegetation
[2] Agricultural land
[3] Rangeland
[4] Forest
[5] Suburban areas, grassy
[6] Suburban areas, forested
[7] Bodies of water
[8] Barren land, mostly desert
[9] Non-forested wetlands

**TABLE 3-2**
**DATA CAPTURE RATES FOR**
**WADF AND RENO METEOROLOGICAL STATIONS FOR 2005**

| Data Set | Location | Variable | Quarter | | | | Annual |
|---|---|---|---|---|---|---|---|
| | | | Jan-Feb-Mar | Apr-May-Jun | Jul-Aug-Sep | Oct-Nov-Dec | |
| Onsite | WADF (Hawthorne, NV) | Precipitation | 99.95% | 100.00% | 100.00% | 99.91% | 99.97% |
| | | Temperature | 99.95% | 100.00% | 100.00% | 99.91% | 99.97% |
| | | Sigma Theta | 99.58% | 100.00% | 100.00% | 99.91% | 99.87% |
| | | Wind Direction | 99.58% | 100.00% | 100.00% | 99.91% | 99.87% |
| | | Wind Speed | 99.58% | 100.00% | 100.00% | 99.91% | 99.87% |
| Surface | Reno, NV | Cloud Cover | 98.43% | 97.25% | 98.19% | 98.23% | 98.03% |
| | | Pressure | 99.86% | 99.86% | 100.00% | 99.91% | 99.91% |
| Upper Air | Reno, NV | Morning Sounding | 99.91% | 99.95% | 100.00% | 100.00% | 99.97% |

**TABLE 3-3**
**SURFACE MICROMETEOROLOGICAL PARAMETERS**

| Month | Season | Albedo | Bowen Ratio | Roughness Length (meters) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (Averaged Over All Sectors) | | (Sector Specific Values) | | | | | | | | | | | |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Jan | Winter | 0.448 | 5.889 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.150 | 0.148 | 0.123 | 0.135 | 0.150 |
| Feb | Autumn | 0.277 | 5.863 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.296 | 0.247 | 0.270 | 0.300 |
| Mar | Autumn | 0.277 | 5.863 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.296 | 0.247 | 0.270 | 0.300 |
| Apr | Autumn | 0.277 | 5.863 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.296 | 0.247 | 0.270 | 0.300 |
| May | Spring | 0.296 | 2.931 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.297 | 0.250 | 0.271 | 0.300 |
| Jun | Summer | 0.276 | 3.911 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.297 | 0.254 | 0.273 | 0.300 |
| Jul | Summer | 0.276 | 3.911 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.297 | 0.254 | 0.273 | 0.300 |
| Aug | Summer | 0.276 | 3.911 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.297 | 0.254 | 0.273 | 0.300 |
| Sep | Summer | 0.276 | 3.911 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.297 | 0.254 | 0.273 | 0.300 |
| Oct | Autumn | 0.277 | 5.863 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.296 | 0.247 | 0.270 | 0.300 |
| Nov | Autumn | 0.277 | 5.863 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.296 | 0.247 | 0.270 | 0.300 |
| Dec | Autumn | 0.277 | 5.863 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.300 | 0.296 | 0.247 | 0.270 | 0.300 |

**TABLE 3-4**
**STACK PARAMETER DATA**

| Source ID | Source Description | Stack Parameter Data | | | | | | | | Stack Location | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Height | | Temperature* | | Exit Velocity* | | Diameter | | UTM Easting (m) | UTM Northing (m) | Base Elevation | |
| | | (m) | (ft) | (K) | (F) | (m/s) | (ft/s) | (m) | (ft) | NAD83-11 | NAD83-11 | (m) | (ft) |
| PODS | Plasma Arc Ordnance Demilitarization System | 15.8 | 51.7 | 605 | 629 | 4.65 | 15.3 | 0.305 | 1.00 | 356,185 | 4,273,223 | 1,227 | 4,025 |
| RF9 | Ammunition Particular Equipment 2210 Deactivation Furnace | 13.7 | 45.0 | 478 | 400 | * | * | 0.509 | 1.67 | 355,985 | 4,273,269 | 1,227 | 4,025 |

* Final values to be based on the results of the CPT/Risk Burn stack tests.

**TABLE 4-1**
**RISK ASSESSMENT GUIDANCE DOCUMENTS**

| |
|---|
| U.S. Environmental Protection Agency (EPA). 1989. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A). Interim Final. EPA/540/1-89/002. December. |
| U.S. Environmental Protection Agency (EPA). 1990. Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions. Interim Final. EPA/600/6-90/003. January. |
| U.S. Environmental Protection Agency (EPA). 1992a. Estimating Exposure to Dioxin-like Compounds. EPA/600/6-88/005B. |
| U.S. Environmental Protection Agency (EPA). 1992b. Guidelines For Exposure Assessment. FR 57[104]: 22888-22936. |
| U.S. Environmental Protection Agency (EPA). 1993a. Addendum to the Methodology for Assessing Risks Associated with Indirect Exposure to Combustor Emissions. Draft. EPA/600/AP-93/003. |
| U.S. Environmental Protection Agency (EPA). 1993b. Interim Report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin Risks to Aquatic Life and Associated Wildlife. EPA/600/R-93/055. |
| U.S. Environmental Protection Agency (USEPA). 1994a. Implementation Guidance for Conducting Indirect Exposure Analysis at RCRA Combustion Units. Revised Draft. April 22. |
| U.S. Environmental Protection Agency (USEPA). 1994b. Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes. Errata. Revised Draft. October 4. |
| U.S. Environmental Protection Agency (USEPA). 1994c. Memorandum: Further Issues for Indirect Exposure Assessment Modeling. OHEA and ECAO, September. |
| U.S. Environmental Protection Agency (USEPA). 1998. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Peer Review Draft. EPA530-D-98-001A. July. |
| U.S. Environmental Protection Agency (USEPA). 2003. Framework for Conducting Cumulative Risk Assessments. Final. EPA/630/P-02/001F. May. |
| U.S. Environmental Protection Agency (USEPA). 2005a. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Final. EPA530-R-05-006. September. |

TABLE 4-2
INPUT PARAMETERS
Hawthorne Army Depot, Hawthorne, NV

| CATEGORY/PARAMETER | VALUE | REFERENCES |
|---|---|---|
| SOIL CONCENTRATION | | |
| Time period over which average concentration occurs, tD (yr): | 30 | default, USEPA 2005a |
| Time period at beginning of combustion, T1 (yr): | 0 | default, USEPA 2005a |
| Length of Exposure Duration, T2 (yr): | 6, 30 or 40 | default, USEPA 2005a |
| Soil bulk density (g/cm3): | 1.5 | default, USEPA 2005a |
| Soil mixing depth, untilled (cm): | 2 | default, USEPA 2005a |
| Soil mixing depth, tilled (cm): | 20 | default, USEPA 2005a |
| Fraction of COPC air concentration in vapor phase (--): | 0 or 1 | default, USEPA 2005a |
| COPC loss constant due to erosion (yr-1): | 0 | default, USEPA 2005a |
| Average annual surface runoff from pervious areas, RO (cm/yr): | 2.54 | USGS 1995 |
| Soil moisture content, theta sw, (cm3/cm3): | 0.2 | default, USEPA 2005a |
| Average annual precipitation (cm/yr): | 31.5 | site-specific |
| Average annual irrigation (cm/yr): | 116.84 | NRCS 1995 |
| Average annual evapotranspiration (cm/yr): | 125 | USGS 1995 |
| Ideal Gas Constant (atm-m3/mole-K): | 8.2E-05 | default, USEPA 2005a |
| Ambient air temperature, Kelvin (K): | 2.98E+02 | default, USEPA 2005a |
| Solids particle density (g/cm3): | 2.7E+00 | default, USEPA 2005a |
| PLANT UPTAKE | | |
| Interception factor for above ground vegetation, Rp (--): | 0.39 | default, USEPA 2005a |
| Fraction of COPC wet deposition that adheres to plant surfaces, Fw (--): | See below: | |
| anions: | 0.2 | default, USEPA 2005a |
| cations and most organics: | 0.6 | default, USEPA 2005a |
| Plant surface loss coefficient, kp (yr-1): | 18 | default, USEPA 2005a |
| Length of growing season for above ground vegetation, Tp (yr): | 0.16 | default, USEPA 2005a |
| Vegetation yield for above ground vegetation, Yp (kg DW/m2): | 2.24 | default, USEPA 2005a |
| Air density (g/m3): | 1200 | default, USEPA 2005a |
| Empirical correction factor for above ground produce $Vg_{ag}$(--): | See below: | |
| log Kow >4: | 0.01 | default, USEPA 2005a |
| log Kow <4: | 1 | default, USEPA 2005a |
| Empirical correction factor for below ground produce $Vg_{ag}$(--): | See below: | |
| log Kow >4: | 0.01 | default, USEPA 2005a |
| log Kow <4: | 1 | default, USEPA 2005a |
| WATERBODY CONCENTRATION - WALKER LAKE | | |
| Watershed Soil Constituent Concentration | | |
| Time period over which average concentration occurs, tD (yr): | 30 | default, USEPA 2005a |
| Time period at beginning of combustion, T1 (yr): | 0 | default, USEPA 2005a |
| Length of Exposure Duration, T2 (yr): | 6, 30 or 40 | default, USEPA 2005a |
| Soil bulk density (g/cm3): | 1.5 | default, USEPA 2005a |
| Soil mixing depth, untilled (cm): | 2 | default, USEPA 2005a |
| Soil mixing depth, tilled (cm): | 20 | default, USEPA 2005a |
| Fraction of COPC air concentration in vapor phase (--): | 0 or 1 | default, USEPA 2005a |
| COPC loss constant due to erosion (yr-1): | 0 | default, USEPA 2005a |
| Average annual surface runoff from pervious areas, RO (cm/yr): | 2.54 | USGS 1995 |
| Soil moisture content, theta sw, (cm3/cm3): | 0.2 | default, USEPA 2005a |
| Average annual precipitation (cm/yr): | 31.5 | site-specific |
| Average annual irrigation (cm/yr): | 116.84 | NRCS 1995 |
| Average annual evapotranspiration (cm/yr): | 125 | USGS 1995 |
| Ideal Gas Constant (atm-m3/mole-K): | 8.2E-05 | default, USEPA 2005a |
| Ambient air temperature, Kelvin (K): | 2.98E+02 | default, USEPA 2005a |
| Solids particle density (g/cm3): | 2.7E+00 | default, USEPA 2005a |

TABLE 4-2
INPUT PARAMETERS
Hawthorne Army Depot, Hawthorne, NV

| CATEGORY/PARAMETER | VALUE | REFERENCES |
|---|---|---|
| Total Waterbody Load | | |
| Waterbody area (m2): | 1.3E+08 | site specific, CHPPM, 2003 |
| Impervious watershed area receiving fallout (m2): | 5.31E+07 | site specific |
| Average annual surface runoff (cm/yr): | 2.54 | USGS 1995 |
| Total watershed area receiving fallout (m2): | 1.05E+10 | site specific, CHPPM, 2003 |
| Soil bulk density (g/cm3) | 1.5 | default, USEPA 2005a |
| Soil moisture content, theta sw, (cm3/cm3): | 0.2 | default, USEPA 2005a |
| Constituent enrichment ratio (--): | See below | |
| Inorganics: | 1 | default, USEPA 2005a |
| Organics: | 3 | default, USEPA 2005a |
| Water body temperature (K): | 298 | default, USEPA 2005a (or site-specific if available) |
| Universal gas constant (atm-m3/mol-K): | 8.21E-05 | default, USEPA 2005a |
| USLE rainfall (or erosivity) factor, RF (yr-1): | 1.00E+01 | NRCS 1995 |
| USLE erodability factor, K (ton/acre) | 3.90E-01 | default, USEPA 1994a (or site-specific if available) |
| USLE length-slope factor, LE (unitless): | 1.50E+00 | default, USEPA 1994a (or site-specific if available) |
| USLE cover management factor, C (unitless): | 1.00E-01 | default, USEPA 1994a (or site-specific if available) |
| USLE supporting practice factor, PF (unitless): | 1.00E+00 | default, USEPA 1994a (or site-specific if available) |
| Empirical intercept coefficient (a): | 6.00E-01 | default, USEPA 2005a, based on site specific information |
| Empirical slope coefficient (b): | 1.25E-01 | default, USEPA 2005a |
| Water Concentration | | |
| Average volumetric flow rate (m3/yr): | 1.5E+08 | site specific, CHPPM 2003a |
| Depth of water column (m): | 24.39 | site specific, CHPPM 2003a |
| Depth of benthic layer (m): | 0.03 | default, USEPA 2005a |
| Total suspended solids (mg/L): | 10 | default, NC DEHNR 1997 (or site-specific if available) |
| Bed sediment porosity (Lwater/L): | 0.6 | default, USEPA 2005a |
| Bed sediment concentration (g/cm3): | 1 | default, USEPA 2005a |
| Temperature correction factor (unitless): | 1.026E+00 | default, USEPA 2005a |
| Drag Coefficient (unitless): | 1.1E-03 | default, USEPA 2005a |
| Average annual wind speed (m/s): | 3.9E+00 | default, USEPA 2005a (or site-specific if available) |
| Density of air (g/cm3): | 1.2E-03 | default, USEPA 2005a |
| Density of water (g/cm3): | 1.0E+00 | default, USEPA 2005a |
| von Karman's Constant (unitless): | 4.0E-01 | default, USEPA 2005a |
| Dimensionless viscous sublayer thickness (unitless): | 4.0E+00 | default, USEPA 2005a |
| Viscosity of water corresponding to water temperature (g/cm-s): | 1.7E-02 | default, USEPA 2005a |
| Viscosity of air (g/cm-s) | 1.8E-04 | default, USEPA 2005a |
| Fish Concentration | | |
| Fish lipid content: | 0.07 | default, USEPA 2005a |
| Fraction organic carbon in bottom sediment: | 0.04 | default, USEPA 2005a |
| WATERBODY CONCENTRATION - BLACK BEAUTY RESERVOIR | | |
| Watershed Soil Constituent Concentration | | |
| Time period over which average concentration occurs, tD (yr): | 30 | default, USEPA 2005a |
| Time period at beginning of combustion, T1 (yr): | 0 | default, USEPA 2005a |
| Length of Exposure Duration, T2 (yr): | 6, 30 or 40 | default, USEPA 2005a |
| Soil bulk density (g/cm3): | 1.5 | default, USEPA 2005a |
| Soil mixing depth, untilled (cm): | 2 | default, USEPA 2005a |
| Soil mixing depth, tilled (cm): | 20 | default, USEPA 2005a |
| Fraction of COPC air concentration in vapor phase (--): | 0 or 1 | default, USEPA 2005a |
| COPC loss constant due to erosion (yr-1): | 0 | default, USEPA 2005a |
| Average annual surface runoff from pervious areas, RO (cm/yr): | 2.54 | USGS 1995 |
| Soil moisture content, theta sw, (cm3/cm3): | 0.2 | default, USEPA 2005a |
| Average annual precipitation (cm/yr): | 31.5 | site-specific |
| Average annual irrigation (cm/yr): | 116.84 | NRCS 1995 |
| Average annual evapotranspiration (cm/yr): | 125 | USGS 1995 |
| Ideal Gas Constant (atm-m3/mole-K): | 8.2E-05 | default, USEPA 2005a |
| Ambient air temperature, Kelvin (K): | 2.98E+02 | default, USEPA 2005a |
| Solids particle density (g/cm3): | 2.7E+00 | default, USEPA 2005a |

TABLE 4-2
INPUT PARAMETERS
Hawthorne Army Depot, Hawthorne, NV

| CATEGORY/PARAMETER | VALUE | REFERENCES |
|---|---|---|
| Total Waterbody Load | | |
| Waterbody area (m2): | 2.2E+04 | site specific, CHPPM, 2003b |
| Impervious watershed area receiving fallout (m2): | 0.00E+00 | site specific |
| Average annual surface runoff (cm/yr): | 2.54 | USGS 1995 |
| Total watershed area receiving fallout (m2): | 4.10E+05 | site specific |
| Soil bulk density (g/cm3) | 1.5 | default, USEPA 2005a |
| Soil moisture content, theta sw, (cm3/cm3): | 0.2 | default, USEPA 2005a |
| Constituent enrichment ratio (--): | See below | |
| Inorganics: | 1 | default, USEPA 2005a |
| Organics: | 3 | default, USEPA 2005a |
| Water body temperature (K): | 298 | default, USEPA 2005a (or site-specific if available) |
| Universal gas constant (atm-m3/mol-K): | 8.21E-05 | default, USEPA 2005a |
| USLE rainfall (or erosivity) factor, RF (yr-1): | 1.00E+01 | NRCS 1995 |
| USLE erodability factor, K (ton/acre) | 3.90E-01 | default, USEPA 1994a (or site-specific if available) |
| USLE length-slope factor, LE (unitless): | 1.50E+00 | default, USEPA 1994a (or site-specific if available) |
| USLE cover management factor, C (unitless): | 1.00E-01 | default, USEPA 1994a (or site-specific if available) |
| USLE supporting practice factor, PF (unitless): | 1.00E+00 | default, USEPA 1994a (or site-specific if available) |
| Empirical intercept coefficient (a): | 2.10E+00 | default, USEPA 2005a, based on site specific information |
| Empirical slope coefficient (b): | 1.25E-01 | default, USEPA 2005a |
| Water Concentration | | |
| Average volumetric flow rate (m3/yr): | 7.7E+05 | site specific, CHPPM 2003b |
| Depth of water column (m): | 10.21 | calculated, USEPA 2005a |
| Depth of benthic layer (m): | 0.03 | default, USEPA 2005a |
| Total suspended solids (mg/L): | 10 | default, NC DEHNR 1997 (or site-specific if available) |
| Bed sediment porosity (Lwater/L): | 0.6 | default, USEPA 2005a |
| Bed sediment concentration (g/cm3): | 1 | default, USEPA 2005a |
| Temperature correction factor (unitless): | 1.026E+00 | default, USEPA 2005a |
| Drag Coefficient (unitless): | 1.1E-03 | default, USEPA 2005a |
| Average annual wind speed (m/s): | 3.9E+00 | default, USEPA 2005a (or site-specific if available) |
| Density of air (g/cm3): | 1.2E-03 | default, USEPA 2005a |
| Density of water (g/cm3): | 1.0E+00 | default, USEPA 2005a |
| von Karman's Constant (unitless): | 4.0E-01 | default, USEPA 2005a |
| Dimensionless viscous sublayer thickness (unitless): | 4.0E+00 | default, USEPA 2005a |
| Viscosity of water corresponding to water temperature (g/cm-s): | 1.7E-02 | default, USEPA 2005a |
| Viscosity of air (g/cm-s) | 1.8E-04 | default, USEPA 2005a |
| WATERBODY CONCENTRATION - ROSE CREEK RESERVOIR | | |
| Watershed Soil Constituent Concentration | | |
| Time period over which average concentration occurs, tD (yr): | 30 | default, USEPA 2005a |
| Time period at beginning of combustion, T1 (yr): | 0 | default, USEPA 2005a |
| Length of Exposure Duration, T2 (yr): | 6, 30 or 40 | default, USEPA 2005a |
| Soil bulk density (g/cm3): | 1.5 | default, USEPA 2005a |
| Soil mixing depth, untilled (cm): | 2 | default, USEPA 2005a |
| Soil mixing depth, tilled (cm): | 20 | default, USEPA 2005a |
| Fraction of COPC air concentration in vapor phase (--): | 0 or 1 | default, USEPA 2005a |
| COPC loss constant due to erosion (yr-1): | 0 | default, USEPA 2005a |
| Average annual surface runoff from pervious areas, RO (cm/yr): | 2.54 | USGS 1995 |
| Soil moisture content, theta sw, (cm3/cm3): | 0.2 | default, USEPA 2005a |
| Average annual precipitation (cm/yr): | 31.5 | site-specific |
| Average annual irrigation (cm/yr): | 116.84 | NRCS 1995 |
| Average annual evapotranspiration (cm/yr): | 125 | USGS 1995 |
| Ideal Gas Constant (atm-m3/mole-K): | 8.2E-05 | default, USEPA 2005a |
| Ambient air temperature, Kelvin (K): | 2.98E+02 | default, USEPA 2005a |
| Solids particle density (g/cm3): | 2.7E+00 | default, USEPA 2005a |

TABLE 4-2
INPUT PARAMETERS
Hawthorne Army Depot, Hawthorne, NV

| CATEGORY/PARAMETER | VALUE | REFERENCES |
|---|---|---|
| Total Waterbody Load | | |
| Waterbody area (m2): | 3.6E+04 | site specific, CHPPM 2003b |
| Impervious watershed area receiving fallout (m2): | 5.31E+07 | site specific |
| Average annual surface runoff (cm/yr): | 2.54 | USGS 1995 |
| Total watershed area receiving fallout (m2): | 3.88E+05 | site specific, CHPPM 2003b |
| Soil bulk density (g/cm3) | 1.5 | default, USEPA 2005a |
| Soil moisture content, theta sw, (cm3/cm3): | 0.2 | default, USEPA 2005a |
| Constituent enrichment ratio (--): | See below | |
| Inorganics: | 1 | default, USEPA 2005a |
| Organics: | 3 | default, USEPA 2005a |
| Water body temperature (K): | 298 | default, USEPA 2005a (or site-specific if available) |
| Universal gas constant (atm-m3/mol-K): | 8.21E-05 | default, USEPA 2005a |
| USLE rainfall (or erosivity) factor, RF (yr-1): | 1.00E+01 | NRCS 1995 |
| USLE erodability factor, K (ton/acre) | 3.90E-01 | default, USEPA 1994a (or site-specific if available) |
| USLE length-slope factor, LE (unitless): | 1.50E+00 | default, USEPA 1994a (or site-specific if available) |
| USLE cover management factor, C (unitless): | 1.00E-01 | default, USEPA 1994a (or site-specific if available) |
| USLE supporting practice factor, PF (unitless): | 1.00E+00 | default, USEPA 1994a (or site-specific if available) |
| Empirical intercept coefficient (a): | 2.10E+00 | default, USEPA 2005a, based on site specific information |
| Empirical slope coefficient (b): | 1.25E-01 | default, USEPA 2005a |
| Water Concentration | | |
| Average volumetric flow rate (m3/yr): | 2.0E+07 | calculated, USEPA 2005a |
| Depth of water column (m): | 3.63 | calculated, USEPA 2005a |
| Depth of benthic layer (m): | 0.03 | default, USEPA 2005a |
| Total suspended solids (mg/L): | 10 | default, NC DEHNR 1997 (or site-specific if available) |
| Bed sediment porosity (Lwater/L): | 0.6 | default, USEPA 2005a |
| Bed sediment concentration (g/cm3): | 1 | default, USEPA 2005a |
| Temperature correction factor (unitless): | 1.026E+00 | default, USEPA 2005a |
| Drag Coefficient (unitless): | 1.1E-03 | default, USEPA 2005a |
| Average annual wind speed (m/s): | 3.9E+00 | default, USEPA 2005a (or site-specific if available) |
| Density of air (g/cm3): | 1.2E-03 | default, USEPA 2005a |
| Density of water (g/cm3): | 1.0E+00 | default, USEPA 2005a |
| von Karman's Constant (unitless): | 4.0E-01 | default, USEPA 2005a |
| Dimensionless viscous sublayer thickness (unitless): | 4.0E+00 | default, USEPA 2005a |
| Viscosity of water corresponding to water temperature (g/cm-s): | 1.7E-02 | default, USEPA 2005a |
| Viscosity of air (g/cm-s) | 1.8E-04 | default, USEPA 2005a |
| LIVESTOCK CONCENTRATIONS | | |
| FORAGE UPTAKE | | |
| Interception factor for above ground vegetation, Rp (--): | 0.5 | default, USEPA 2005a |
| Plant surface loss coefficient, kp (yr-1): | 18 | default, USEPA 2005a |
| Length of growing season for above ground vegetation, Tp (yr): | 0.12 | default, USEPA 2005a |
| Vegetation yield for above ground vegetation, Yp (kg DW/m2): | 0.24 | default, USEPA 2005a |
| Air density (g/m3): | 1200 | default, USEPA 2005a |
| Above ground vegetable correction factor, $Vg_g$ (--): | 1 | default, USEPA 2005a |
| SILAGE UPTAKE | | |
| Interception factor for above ground vegetation, Rp (--): | 0.46 | default, USEPA 2005a |
| Plant surface loss coefficient, kp (yr-1): | 18 | default, USEPA 2005a |
| Length of growing season for above ground vegetation, Tp (yr): | 0.16 | default, USEPA 2005a |
| Vegetation yield for above ground vegetation, Yp (kg DW/m2): | 0.8 | default, USEPA 2005a |
| Air density (g/m3): | 1200 | default, USEPA 2005a |
| Above ground vegetable correction factor, $Vg_g$ (--): | 0.5 | default, USEPA 2005a |

TABLE 4-2
INPUT PARAMETERS
Hawthorne Army Depot, Hawthorne, NV

| CATEGORY/PARAMETER | VALUE | REFERENCES |
|---|---|---|
| BEEF AND MILK UPTAKE | | |
| Quantity of soil eaten each day (kg soil/d): | See below | |
| Beef cattle: | 0.5 | default, USEPA 2005a |
| Dairy cattle: | 0.4 | default, USEPA 2005a |
| Quantity of forage eaten each day (kg plant DW/d): | See below | |
| Beef cattle: | 8.8 | default, USEPA 2005a |
| Dairy cattle: | 13.2 | default, USEPA 2005a |
| Quantity of silage eaten each day (kg plant DW/d): | See below | |
| Beef cattle: | 2.5 | default, USEPA 2005a |
| Dairy cattle: | 4.1 | default, USEPA 2005a |
| Quantity of grain eaten each day (kg plant DW/d): | See below | |
| Beef cattle: | 0.47 | default, USEPA 2005a |
| Dairy cattle: | 3 | default, USEPA 2005a |
| Fraction of vegetation grown on contaminated soil: | 1 | default, USEPA 2005a |
| Soil bioavailability factor (--): | 1 | default, USEPA 2005a |
| Metabolism factor (--): | 0.1 or 1 | default, USEPA 2005a |
| PORK UPTAKE | | |
| Quantity of soil eaten each day (kg soil/d): | 0.37 | default, USEPA 2005a |
| Quantity of silage eaten each day (kg plant DW/d): | 1.4 | default, USEPA 2005a |
| Quantity of grain eaten each day (kg plant DW/d): | 3.3 | default, USEPA 2005a |
| Fraction of vegetation grown on contaminated soil: | 1 | default, USEPA 2005a |
| Soil bioavailability factor (--): | 1 | default, USEPA 2005a |
| Metabolism factor (--): | 0.1 or 1 | default, USEPA 2005a |
| CHICKEN UPTAKE | | |
| Quantity of soil eaten each day (kg soil/d): | 0.022 | default, USEPA 2005a |
| Quantity of grain eaten each day (kg plant DW/d): | 0.2 | default, USEPA 2005a |
| Fraction of grain grown on contaminated soil: | 1 | default, USEPA 2005a |
| Soil bioavailability factor (--): | 1 | default, USEPA 2005a |
| HUMAN INTAKE | | |
| Residential Scenario | | |
| Soil consumption rate (kg/d): | See below | |
| adult: | 0.0001 | default, USEPA, 1999a |
| child: | 0.0002 | default, USEPA, 1999a |
| Fraction of consumed soil that is contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of above ground vegetables (kg/kgBW-d): | See below | |
| adult: | 0.00032 | default, USEPA 2005a |
| child: | 0.00077 | default, USEPA 2005a |
| Consumption rate of protected above ground vegetables (kg/kgBW-d): | See below | |
| adult: | 0.00061 | default, USEPA 2005a |
| child: | 0.00015 | default, USEPA 2005a |
| Fraction of above ground vegetables that are contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of below ground vegetables (kg/kgBW-d): | See below | |
| adult: | 0.00014 | default, USEPA 2005a |
| child: | 0.00023 | default, USEPA 2005a |
| Fraction of below ground vegetables that are contaminated: | 1.00 | default, USEPA 2005a |
| Consumption rate of drinking water(L/d): | See below | |
| adult: | 1.40 | default, USEPA 2005a |
| child: | 0.67 | default, USEPA 2005a |
| Fraction of drinking water that is contaminated: | 1.00 | default, USEPA 2005a |
| Subsistence Fisher Scenario | | |
| Soil consumption rate (kg/d): | See below | |
| adult: | 0.0001 | default, USEPA, 1999, errata |
| child: | 0.0002 | default, USEPA, 1999, errata |
| Fraction of consumed soil that is contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of above ground vegetables (kg/kgBW-d): | See below | |
| adult: | 0.00032 | default, USEPA 2005a |
| child: | 0.00077 | default, USEPA 2005a |
| Consumption rate of protected above ground vegetables (kg/kgBW-d): | See below | |
| adult: | 0.00061 | default, USEPA 2005a |
| child: | 0.00015 | default, USEPA 2005a |
| Fraction of above ground vegetables that are contaminated: | 1 | default, USEPA 2005a |

TABLE 4-2
INPUT PARAMETERS
Hawthorne Army Depot, Hawthorne, NV

| CATEGORY/PARAMETER | VALUE | REFERENCES |
|---|---|---|
| Consumption rate of below ground vegetables (kg/kgBW-d): | See below | |
| adult: | 0.00014 | default, USEPA 2005a |
| child: | 0.00023 | default, USEPA 2005a |
| Fraction of below ground vegetables that are contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of fish (kg/kgBW-d): | See below | |
| Adult: | 0.00125 | default, USEPA 2005a |
| Child: | 0.000888 | default, USEPA 2005a |
| Fraction of ingested fish that is contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of drinking water(L/d): | See below | |
| adult: | 1.40 | default, USEPA 2005a |
| child: | 0.67 | default, USEPA 2005a |
| Fraction of drinking water that is contaminated: | 1.00 | default, USEPA 2005a |
| | | |
| Subsistence Farmer Scenario | | |
| Soil consumption rate (kg/d): | See below | |
| adult: | 0.0001 | default, USEPA, 1999, errata |
| child: | 0.0002 | default, USEPA, 1999, errata |
| Fraction of consumed soil that is contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of above ground vegetables (kg/kgBW-d): | See below | |
| adult: | 0.00047 | default, USEPA 2005a |
| child: | 0.00113 | default, USEPA 2005a |
| Consumption rate of protected above ground vegetables (kg/kgBW-d): | See below | |
| adult: | 0.00064 | default, USEPA 2005a |
| child: | 0.00157 | default, USEPA 2005a |
| Fraction of above ground vegetables that are contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of below ground vegetables (kg/kgBW-d): | See below | |
| adult: | 0.00017 | default, USEPA 2005a |
| child: | 0.00028 | default, USEPA 2005a |
| Fraction of below ground vegetables that are contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of beef (kg/kgBW-d): | See below | |
| adult: | 0.00122 | default, USEPA 2005a |
| child: | 0.00075 | default, USEPA 2005a |
| Fraction of beef that is contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of milk (kg/kgBW-d): | See below | |
| adult: | 0.01367 | default, USEPA 2005a |
| child: | 0.02268 | default, USEPA 2005a |
| Fraction of milk that is contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of pork (kg/kgBW-d): | See below | |
| adult: | 0.00055 | default, USEPA 2005a |
| child: | 0.00042 | default, USEPA 2005a |
| Fraction of pork that is contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of chicken (kg/kgBW-d): | See below | |
| adult: | 0.00066 | default, USEPA 2005a |
| child: | 0.00045 | default, USEPA 2005a |
| Fraction of chicken that is contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of eggs (kg/kgBW-d): | See below | |
| adult: | 0.00075 | default, USEPA 2005a |
| child: | 0.00054 | default, USEPA 2005a |
| Fraction of eggs that is contaminated: | 1 | default, USEPA 2005a |
| Consumption rate of drinking water(L/d): | See below | |
| adult: | 1.40 | default, USEPA 2005a |
| child: | 0.67 | default, USEPA 2005a |
| Fraction of drinking water that is contaminated: | 1.00 | default, USEPA 2005a |
| | | |
| Breast milk Ingestion (All Scenarios) | | |
| Fraction of ingested dioxin that is stored in fat (--): | 0.9 | default, USEPA 2005a |
| Half-life of dioxin in adults (days): | 2555 | default, USEPA 2005a |
| Fraction of mother's breast milk that is fat (--): | 0.04 | default, USEPA 2005a |
| Fraction of ingested dioxin that is absorbed (--): | 0.9 | default, USEPA 2005a |
| Proportion of Maternal weight that is fat: | 0.3 | default, USEPA 2005a |
| Infant consumption rate of breastmilk (kg/d): | 0.688 | default, USEPA 2005a |

TABLE 4-2
INPUT PARAMETERS
Hawthorne Army Depot, Hawthorne, NV

| CATEGORY/PARAMETER | VALUE | REFERENCES |
|---|---|---|
| EXPOSURE PARAMETERS | | |
| Averaging time (yr): | See below | default, USEPA 2005a |
| Carcinogens: | 70 | default, USEPA 2005a |
| Non-carcinogens: | ED | default, USEPA 2005a |
| Exposure Duration (yr): | See below | default, USEPA 2005a |
| Adult Resident: | 30 | default, USEPA 2005a |
| Child Resident: | 6 | default, USEPA 2005a |
| Infant Resident: | 1 | default, USEPA 2005a |
| Adult Subsistence Fisher: | 30 | default, USEPA 2005a |
| Child Subsistence Fisher: | 6 | default, USEPA 2005a |
| Infant Subsistence Fisher: | 1 | default, USEPA 2005a |
| Adult Subsistence Farmer: | 40 | default, USEPA 2005a |
| Child Subsistence Farmer: | 6 | default, USEPA 2005a |
| Infant Subsistence Farmer: | 1 | default, USEPA 2005a |
| Exposure Frequency (d/yr): | See below | |
| Residential Scenario: | 350 | default, USEPA 2005a |
| Recreational Fisher Scenario: | 350 | default, USEPA 2005a |
| Subsistence Farmer Scenario: | 350 | default, USEPA 2005a |
| Breastmilk Scenario: | 350 | default, USEPA 2005a |
| Body weight (kg): | See below | |
| Adult: | 70 | default, USEPA 2005a |
| Child : | 15 | default, USEPA 2005a |
| Infant: | 9.4 | default, USEPA 2005a |
| Exposure Time (hr/d): | 24 | default, USEPA 2005a |
| Inhalation Rate (m3/hr): | See below | |
| Adult: | 0.83 | default, USEPA 2005a |

**TABLE 5-1**
**HABITAT TYPES**

| Range Site Association | Description |
|---|---|
| 1 | Big sagebrush communities dominate this association; other species include Baltic rush, wild iris, and Kentucky bluegrass. |
| 2 | Low sagebrush communities dominate this association, with big sagebrush dominating only pocket depressions. |
| 3 | No dominant plants have been specified for these alpine ridge and mountain ridge communities. Very few plants grow in this association, because this habitat has a very short growing season, limited soil formation, and a cold climate. |
| 4 | Mountain mahogany communities dominate this association. |
| 5 | Wyoming big sagebrush, Thurber's needlegrass, and desert needlegrass dominate this association. |
| 6 | Spiny mendora, shadescale, lndian ricegrass, desert needlegrass, and galleta dominate this association, which occurs alongside pinyon juniper woodlands. |
| 7 | No dominant plants have been specified for this association. |
| 8 | Because this association consists of recently exposed beaches, no soil has yet formed. Areas with little or no vegetation are considered barren. Vegetative areas consist of communities dominated by wetland and salt-tolerant species, such as cottonwood trees, saltgrass, and desert needlegrass. |
| 9 | Bailey greasewood, Indian ricegrass, and Cooper's wolfberry communities dominate this association. |
| 10 | Wyoming big sagebrush and desert needlegrass dominate this association. |
| 11 | Spiny mendora communities and Wyoming sagebrush communities form complexes that dominate this association. |
| 12 | No dominant species are identified for this association, although it consists of one range site. |
| 13 | A shrub community generally dominates this association. |
| 14 | Indian grass and Bailey greasewood dominate this association. |
| 15 | This association was too isolated for field evaluation. Its range condition assignments are composed of neighboring areas. |
| 16 | This association was too isolated for field evaluation. |
| 17 | Cooper's wolfberry communities dominate this association. |
| 18 | No dominant species are identified for this association, although it consists of one range site. |

Taken from (CH2MHill, 2004)

## TABLE 5-2
## ASSESSMENT ENDPOINTS FOR GUILDS, COMMUNITIES AND STATE OR FEDERALLY LISTED SPECIES

| Ecological Receptors | Representative Receptors | Critical Ecological Attributes |
|---|---|---|
| **Aquatic Receptors** | | |
| Aquatic Plants | Bulrush, Cattail | Primary producers convert light energy into biomass, and are the first link in aquatic food chains supporting higher trophic level aquatic consumers and wildlife. |
| Water Invertebrates | Arthropods, decapods | Important food source for higher trophic level consumers. |
| Herbivorous/Planktivorous Fish | Mountain Sucker, Gizzard Shad, Sacramento Perch | Important prey species for higher trophic level predators and provide a critical link for energy transfer from primary producers to higher trophic level consumers; regulation of algae and plankton biomass. |
| Omnivorous Fish | Tui Chub | Important prey item for higher trophic level predators; regulate population levels in lower trophic level fish and invertebrates; important recreational species. |
| Carnivorous Fish | Lahontan Cutthroat Trout | Regulate lower trophic populations through predation; important prey species for top level carnivores. |
| **Sediment Receptors** | | |
| Benthic Invertebrates | Polychaetes, Arthropods, Decapods | Important food source for higher trophic level predators; provide important role as decomposer/detritivores in nutrient cycling. |
| **Soil Receptors** | | |
| Terrestrial Plants | Sagebrush, Wild Iris, Thurber's Needlegrass, Chamise, Manzanita | Primary producers provide a critical food source and are the first link in the terrestrial food chain for higher trophic level consumers; provide habitat for wildlife |
| Soil Invertebrates | Arachnids, Gastropods, Arthropods | Important food source for higher tropic level species; play a critical role in nutrient cycling and aid in soil aeration and infiltration. |
| **Upper Trophic Level Avian and Mammalian Wildlife** | | |
| Herbivorous Mammals | Deer Mouse, Least chipmunk, Muskrat | Important prey item for higher trophic level predators; provide important link for energy transfer between primary producers and higher trophic level consumers; important in seed dispersal and pollination for many plant species. |
| Herbivorous Birds | Mourning Dove, Sage Grouse, Chukar Partridge, Canada Goose | Important prey item for higher trophic level predators; important in seed dispersal for plants in both terrestrial and aquatic ecosystems. |
| Omnivorous Mammals | Striped Skunk, Merriam's Shrew, Red Fox, Little Brown Bat, Raccoon | Important prey item for higher trophic level predators and influence lower trophic level populations through predation; important in seed dispersal for many types of terrestrial plants |
| Omnivorous Birds | American Robin, Mallard, Green-Winged Teal | Important prey item for higher trophic level predators; important in seed dispersal and pollination and aquatic egg dispersal. |
| Omnivorous Amphibians/Reptiles | Western Toad, Side-blotched Lizard, Bullfrog | Provide important food source for predators. |
| Insectivorous Mammals | Little Brown Bat | Influence lower trophic level populations through predation. |
| Insectivorous Bird | Snowy Plover, Marsh Wren | Influence lower trophic level populations through predation. |
| Carnivorous Mammals | Long-tailed Weasel, Ermine | Influence lower trophic level populations through predation. |
| Carnivorous Birds | Red-Tailed Hawk, Golden Eagle | Influence lower trophic level populations through predation. |
| Piscivorous Mammal | Mink | Influence lower trophic level populations through predation. |
| Piscivorous Bird | Belted Kingfisher, Osprey | Influence lower trophic level populations through predation. |

# APPENDIX A

# ENVIRONMENTAL CONCENTRATIONS

## A.1 Calculation of Constituent Concentrations in Soil

Constituent levels in soil are estimated as a function of wet and dry deposition of particles and vapors onto soil; the time period over which the deposition occurs and the loss of constituents via processes such as leaching, erosion runoff, degradation and volatilization. The average concentration of constituents in soil is estimated as follows:

### A.1.1 Carcinogenic Constituents:

For carcinogenic constituents, the HHRAP recommends either of two algorithms depending on whether the exposure period is less than, or equal to, the time period of incinerator operation.

For ED $\leq$ tD:

$$Sc = \frac{Ds}{ks\ x\ (tD - T_1)}\ x\ [(tD + \frac{\exp^{(-ks\,x\,tD)}}{ks} - (T_1 + \frac{\exp^{(-ks\,x\,T_1)}}{ks})]$$

For tD < ED:

$$Sc = \frac{(\frac{Ds\ x\ tD - C_s tD}{ks}) + (\frac{C_s tD}{ks})\ x\ (1 - \exp^{[-ks\ x\ (T_2 - tD)]})}{(T_2 - T_1)}$$

### A.1.2 Non-carcinogenic Constituents:

$$C_s tD = \frac{Ds\ x\ [1 - \exp^{(-ks\ x\ tD)}]}{ks}$$

Where:

| | | |
|---|---|---|
| Sc | = | average soil concentration over exposure duration (mg/kg) |
| $C_s$tD | = | soil concentration at time tD (mg/kg) |
| Ds | = | deposition term (mg constituent/kg soil-yr) |
| tD | = | time period over which deposition occurs (yr) |
| $T_1$ | = | time period at beginning of combustion (yr) |
| $T_2$ | = | exposure duration or ED (yr) |
| ks | = | soil loss constant ($yr^{-1}$) |

And:

$$Ds = [\frac{100\ x\ Q}{Zs\ x\ BD}]\ x\ [(Fv\ x\ (Dydv + Dywv) + (Dydp + Dywp)\ x\ (1 - Fv)]$$

For mercury modeling, the HHRAP recommends:

$$Ds = [\frac{100\ x\ Q\ x\ 0.48}{Zs\ x\ BD}]\ x\ [(Fv\ x\ (Dydv + Dywv) + (Dydp + Dywp)\ x\ (1 - Fv)]$$

For Ds ($HgCl_2$) = Ds x 0.98
For Ds (MeHg) = Ds x 0.02

Where:

| | | |
|---|---|---|
| Ds | = | deposition term (mg/kg soil-yr) |
| Q | = | constituent specific emission rate (g/s) |
| Zs | = | soil mixing zone depth (cm) |
| BD | = | soil bulk density (g/cm$^3$) |
| FV | = | fraction of constituent air concentration in vapor phase (unitless) |
| Dydv | = | unitized yearly average dry deposition from vapor phase (s/m$^2$-yr) |
| Dywv | = | unitized yearly average wet deposition from vapor phase (s/m$^2$-yr) |
| Dydp | = | unitized yearly average dry deposition from particle or particle bound phase (s/m$^2$-yr) |
| Dywp | = | unitized yearly average wet deposition from particle or particle bound phase (s/m$^2$-yr) |

And:

$$ks = ksl + ksg + ksr + ksv + kse$$

Where:

| | | |
|---|---|---|
| $k_s$ | = | soil loss constant (yr$^{-1}$) |
| ksl | = | loss constant due to leaching (yr$^{-1}$) |
| ksg | = | loss constant due to degradation (yr$^{-1}$) |
| ksr | = | loss constant due to runoff (yr$^{-1}$) |
| ksv | = | loss constant due to volatilization (yr$^{-1}$) |
| kse | = | loss constant due to soil erosion (yr$^{-1}$) |

And:

$$ksl = \frac{P + I + RO + E_V}{\theta_{SW}\ x\ Z_S\ x\ [1.0 + (BD\ x\ Kd_S / \theta_{SW})]}$$

$$ksr = \frac{RO}{\left[\theta_{SW} \, x \, Z_S\right] x \left[1.0 + \left(BD \, x \, Kd_S\right)/\theta_{SW}\right]}$$

ksg = chemical-specific

$$ksv = \left[\frac{UC \, x \, H}{Z_S \, x \, Kd_S \, x \, R \, x \, T_a \, x \, BD}\right] x \left(\frac{D_a}{Z_S}\right) x \left[1 - \left(\frac{BD}{\rho_{soil}}\right) - \theta_{SW}\right]$$

kse = default (0)

Where:

| | | |
|---|---|---|
| P | = | average annual precipitation (cm/yr) |
| I | = | average annual irrigation (cm/yr) |
| RO | = | average annual surface runoff from pervious areas (cm/yr) |
| EV | = | average annual evapotranspiration (cm/yr) |
| Zs | = | soil mixing zone depth (cm) |
| $\theta_{sw}$ | = | soil volumetric water content (ml/cm$^3$) |
| $Kd_s$ | = | soil-water partition coefficient (cm$^3$/g) |
| BD | = | soil bulk density (g/cm$^3$) |
| UC | = | units conversion (s/yr), 3.1536E+07 |
| H | = | Henry's Law constant (atm-m$^3$/mole) |
| R | = | ideal gas constant (atm-m$^3$/mole-K) |
| Ta | = | ambient temperature in Kelvin (K) |
| Da | = | diffusion coefficient of constituent in air (cm$^2$/s) |
| ρsoil | = | solids particle density (g/cm$^3$) |

Default soil properties such as bulk density, etc., are taken from the companion database to the final HHRAP Guidance (USEPA, 2005c).

## A.2 Calculation of Concentrations in Vegetation

Constituent concentrations in plants are calculated based on one or more of the following: potential root uptake of constituents from soil, potential direct deposition of particulates onto plant surfaces, and potential air-to-plant transfer of constituents. These calculations are based on the equations outlined below, input values from the final HHRAP guidance and various constituent-specific factors:

### A.2.1 Concentration in Aboveground Vegetation

$$CAGV = PD + PV + PRa$$

Where:

| | | |
|---|---|---|
| CAGV | = | total concentration of constituent in above ground vegetables (mg/kg), |
| PD | = | concentration of constituent due to direct deposition (mg/kg) |
| PV | = | concentration of constituent due to air-to-plant transfer (mg/kg) |
| PRa | = | concentration of constituent in aboveground produce due to root uptake (mg/kg) |

A.2.1.1 Direct Deposition

Potential concentrations in plant tissue due to the direct deposition on plant surfaces are calculated using the following equation:

$$PD = \frac{UC\ x\ Q\ x\ (1 - Fv)\ x\ [Dydp + (Fw\ x\ Dywp)]\ x\ Rpi\ x\ (1 - \exp^{(-kp\ x Tp)})}{Y_p\ x\ k_p}$$

For mercury modeling:

$$PD = \frac{UC\ x\ Q\ x\ 0.48\ x\ (1 - Fv_{Hg^{2+}})\ x\ [Dydp + (Fw\ x\ Dywp)]\ x\ Rpi\ x\ (1 - \exp^{(-kp\ x Tp)})}{Y_p\ x\ k_p}$$

And:

Pd ($HgCl_2$) = 0.78Pd
Pd (MeHg) = 0.22Pd

Where:

| | | |
|---|---|---|
| PD | = | concentration of constituent due to direct deposition (mg/kg) |
| Q | = | constituent specific emission rate (g/s) |
| UC | = | units conversion factor (mg/g), 1000 |
| Fv | = | fraction of constituent air concentration in vapor phase (unitless) |
| Dydp | = | unitized yearly average dry deposition from particle phase ($s/m^2$-yr) |
| Dywp | = | unitized yearly average wet deposition from particle phase ($s/m^2$-yr) |
| Fw | = | fraction of wet deposition that adheres to plant surfaces (unitless) |
| $Rp_i$ | = | interception fraction of the edible portion of plant tissue (unitless) |
| $k_p$ | = | rate constant for constituent degradation ($yr^{-1}$) |
| $T_p$ | = | length of growing season (yr) |
| $Y_p$ | = | yield or standing crop dry weight (DW) biomass of the edible portion of the plant group (kg $DW/m^2$) |

A.2.1.2 Air-to-plant Transfer

Air-to-plant transfers of constituents to aboveground vegetation are estimated by:

$$PV = (Q\ x\ F_v\ x\ \frac{Cyv\ x\ Bv_{ag}\ x\ VG_{ag}}{\rho_a})$$

For mercury modeling:

$$PV = (Q \ x \ Fv_{Hg^{2+}} \ x \ 0.48 \ x \ \frac{Cyv \ x \ Bv_{ag} \ x \ VG_{ag}}{\rho_a})$$

And:

Pv ($HgCl_2$) = 0.78Pv
Pv (MeHg) = 0.22Pv

Where:

| | | |
|---|---|---|
| PV | = | concentration of constituent due to air-to-plant transfer (mg/kg) |
| Q | = | constituent specific emission rate (g/s) |
| Fv | = | fraction of air concentration in vapor phase, chemical-specific (unitless) |
| Cyv | = | unitized yearly air concentration from vapor phase (µg-s/g-$m^3$) |
| $B_v$ | = | air-to-plant biotransfer factor, (mg constituent/kg DW plant tissue)/(mg constituent/kg air) |
| $Vg_{ag}$ | = | aboveground vegetable correction factor (unitless) |
| $\rho_a$ | = | density of air (g/$m^3$) |

A.2.1.3 Root Uptake

Potential concentrations in plant tissue due to root uptake in exposed and protected aboveground produce are estimated by:

$$PRa = Sc \ x \ Br$$

For mercury modeling:

$$PRa_{(Hg^{2+})} = Sc_{(Hg^{2+})} \ x \ Br$$

$$PRa_{(MeHg)} = Sc_{(MeHg)} \ x \ Br$$

Where:

| | | |
|---|---|---|
| PRa | = | concentration of constituent in aboveground produce due to root uptake (mg/kg) ($Hg^{2+}$ = divalent mercury; MeHg = methyl mercury) |
| Sc | = | average soil concentration over exposure duration (mg/kg) ($Hg^{2+}$ = divalent mercury; MeHg = methyl mercury) |
| Br | = | plant-soil bioconcentration factor for aboveground produce (unitless) |

A.2.2 Concentration in Belowground Vegetation

Potential concentrations in belowground vegetation are estimated by:

$$PRb = \frac{Sc \ x \ RCF \ \ x \ VG_{rv}}{Kd_s}$$

Where:

| | | |
|---|---|---|
| PRb | = | concentration of constituent in belowground vegetables (mg/kg) |
| Sc | = | average soil concentration over exposure duration (mg/kg) |
| $VG_{rv}$ | = | belowground vegetable correction factor (unitless) |
| $Kd_s$ | = | Soil-water partition coefficient ($cm^3/g$) |

For root uptake of vegetables evaluated in the HHRA, emissions potentially deposited on soils are assumed to be mixed into the soil to a tilling depth of 20 cm (USEPA 2005a). For root uptake of plants evaluated in the ERA, emissions potentially deposited on soils are assumed to be mixed into the soil to a tilling depth of 2 cm (USEPA 2005a). Information on growing periods and yields is obtained from USEPA 2005a.

## A.3 Calculation of Constituent Concentration in Water

Facility emissions may potentially deposit directly on surface water bodies. Thus, it is theoretically possible for receptors to be exposed to facility emissions via the ingestion of surface water as drinking water or via the ingestion of fish from that surface water body. Constituent concentrations in drinking water reflect dissolved water column concentrations. Estimation of the dissolved phase concentration for each constituent is conducted in accordance with the HHRAP guidance (USEPA 2005a) and involves calculation of the total water body concentration for each constituent (Cwtot). This concentration is partitioned into a total water column concentration (Cwctot) and bed sediment concentration (Csb). The dissolved phase concentration is then calculated from the total water column concentration. The calculations are illustrated below.

### A.3.1 Constituent Load to the Waterbody

The first step is to calculate the load of each constituent to the waterbody. The U.S. EPA's HHRAP guidance (USEPA 2005a), suggests five pathways cause constituent loading of the waterbody: 1) direct deposition; 2) runoff from impervious surfaces within the watershed; 3) runoff from pervious surfaces within the watershed; 4) soil erosion from the watershed; and 5) vapor phase constituent diffusion to the waterbody.

$$L_T = L_{Dep} + L_{RI} + L_R + L_E + L_{Dif}$$

Where:

| | | |
|---|---|---|
| $L_T$ | = | total constituent load to the waterbody (g/yr) |
| $L_{Dep}$ | = | deposition of particle bound constituent to the waterbody (g/yr) |
| $L_{RI}$ | = | runoff load from impervious surfaces (g/yr) |
| $L_R$ | = | runoff load from pervious surfaces (g/yr) |
| $L_E$ | = | soil erosion load (g/yr) |
| $L_{Dif}$ | = | vapor phase constituent diffusion (dry deposition) to water body (g/yr) |

And:

$$L_{Dep} = Q\ x\ [Fv\ x\ Dytwv + (1.0 - Fv)\ x\ Dytwp]\ x\ WA_w$$

$$L_{Dif} = Kv\ x\ Q\ x\ Fv\ x\ Cywv + WA_w\ x\ UC1/(H / R\ x\ T_{wk})$$

$$L_{RI} = Q\ x\ [Fv\ x\ Dytwv + (1.0 - Fv)\ x\ Dytwp]\ x\ WA_i$$

$$L_R = RO\ x\ (WA_L - WA_i)\ x\ \frac{Cs\ x\ BD}{\theta_{sw} + Kd_s\ x\ BD}\ x\ UC2$$

$$L_E = Xe\ x\ (WA_L - WA_i)\ x\ SD\ x\ ER\ x\ \frac{Sc\ x\ Kds\ x\ BD}{\theta_{sw} + Kds\ x\ BD}\ x\ UC3$$

For Mercury

$$L_{Dep\ Initial} = Q\ x\ 0.48\ x\ [Fv_{Hg^{2+}}\ x\ Dytwv + (1.0 - Fv_{Hg^{2+}})\ x\ Dytwp]\ x\ WA_w$$

$$L_{RI\ Initial} = Q\ x\ 0.48\ x\ [Fv_{Hg^{2+}}\ x\ Dytwv + (1.0 - Fv_{Hg^{2+}})\ x\ Dytwp]\ x\ WA_i$$

$$L_{Dif\ Initial} = Kv\ x\ Q\ x\ 0.48\ x\ Fv_{Hg^{2+}}\ x\ Cywv + WA_w\ x\ UC1/(H / R\ x\ T_{wk})$$

And:

$$K_v = [K_L^{-1} + [K_G\ x\ \frac{H}{R\ x\ T_{wk}}]^{-1}]^{-1}\ x\ \theta^{Twk-293}$$

For Flowing Streams or Rivers:

$$K_L = \sqrt{\frac{UC4\ \ x\ D_w\ x\ u}{d_z}}\ x\ UC5$$

For Quiescent Lakes or Ponds:

$$K_L = (C_d^{0.5}\ x\ W)\ x\ (\frac{\rho_a}{\rho_w})^{0.5}\ x\ \frac{k^{0.33}}{\lambda z}\ x\ (\frac{\mu_w}{\rho_w\ x\ Dw})^{-0.67}\ x\ UC5$$

For Flowing Streams or Rivers:

$$K_G = 36500\ m/yr$$

For Quiescent Lakes or Ponds:

$$K_G = (C_d^{0.5}\ x\ W)\ x\ \frac{k^{0.33}}{\lambda z}\ x\ (\frac{\mu a}{\rho_a\ x\ D_a})^{-0.67}\ x\ UC5$$

Universal Soil Loss Equation:

$$Xe = RF \ x \ K \ x \ LS \ x \ C \ x \ PF \ x \frac{UC6}{UC7}$$

Sediment Delivery Ratio:

$$SD = a \ x \left( A_L \right)^b$$

Where:

| | | |
|---|---|---|
| Q | = | constituent specific emission rate (g/s) |
| Fv | = | fraction of air concentration in vapor phase (unitless) |
| Dywwv | = | unitized yearly average wet deposition from vapor phase for watershed ($s/m^2$-yr) |
| Dytwp | = | unitized yearly average total (wet and dry) deposition from particle phase for watershed ($s/m^2$-yr) |
| $WA_w$ | = | total water body area ($m^2$) |
| $WA_i$ | = | impervious watershed area receiving pollutant deposition ($m^2$) |
| UC1 | = | units conversion factor (g/ug), 1E-06 |
| $WA_L$ | = | total watershed area receiving pollutant deposition ($m^2$) |
| RO | = | average annual surface runoff (cm/yr) |
| Sc | = | average soil concentration over exposure duration (mg/kg) |
| BD | = | soil bulk density ($g/cm^3$) |
| $\theta_{sw}$ | = | soil volumetric water content ($cm^3/cm^3$) |
| $Kd_s$ | = | soil-water partition coefficient ($cm^3$/g or ml/g) |
| $X_e$ | = | unit soil loss (from Universal Soil Loss Equation), ($kg/m^2$-yr) |
| SD | = | sediment delivery ratio (unitless) |
| ER | = | constituent enrichment ratio (unitless) |
| $K_v$ | = | overall transfer rate coefficient (m/yr) |
| UC2 | = | units conversion factor (kg-$cm^2$/mg-$m^2$), 0.01 |
| UC3 | = | units conversion factor (g/mg), 0.001 |
| $K_L$ | = | liquid phase transfer coefficient (m/yr) |
| $K_G$ | = | gas phase transfer coefficient (m/yr) |
| H | = | Henry's law constant (atm-$m^3$/mol) |
| R | = | universal gas constant (atm-$m^3$/mol-K) |
| $T_{wk}$ | = | water body temperature (K) |
| $\theta$ | = | temperature correction factor |
| $D_w$ | = | diffusivity of constituent in water ($cm^2/s$) |
| u | = | current velocity (m/s) |
| dz | = | total water body depth (m) |
| UC4 | = | units conversion factor ($m^2/cm^2$), 1E-4 |
| UC5 | = | units conversion factor (s/yr), 3.1536E+7 |
| Cd | = | drag coefficient (unitless) |
| W | = | average annual wind speed (m/s) |
| $\rho_a$ | = | density of air ($g/cm^3$) |
| $\rho_w$ | = | density of water ($g/cm^3$) |
| k | = | von Karman's constant (unitless) |

| | | |
|---|---|---|
| $\lambda_z$ | = | dimensionless viscous sublayer thickness (unitless) |
| $\mu_w$ | = | viscosity of water corresponding to water temperature (g/cm-s) |
| $\mu_a$ | = | viscosity of air (g/cm-s) |
| $D_a$ | = | diffusivity of constituent in air ($cm^2/s$) |
| RF | = | USLE rainfall (or erosivity) factor ($yr^{-1}$) |
| K | = | USLE erodibility factor ($yr^{-1}$) |
| LS | = | USLE length-slope factor ($yr^{-1}$) |
| C | = | USLE cover management factor ($yr^{-1}$) |
| PF | = | USLE supporting practice factor (unitless) |
| UC6 | = | Units conversion factor (kg/ton), 907.18 |
| UC7 | = | Units conversion factor ($m^2$/acre), 4047 |
| a | = | Empirical intercept coefficient (unitless) |
| $A_L$ | = | Total watershed area receiving deposition ($m^2$) |
| b | = | Empirical slope coefficient (unitless), 0.125 |

A.3.2 Total Waterbody Concentration

The second step involves calculating the total waterbody concentration (in the water column and sediments) from the waterbody load and partitioning the total concentration into a water column concentration and a bed sediment concentration.

$$C_{wtot} = \frac{L_T}{[Vf_x \ x \ f_{wc} \ x \ k_{wt} \ x \ WA_w \ x \ (d_{wc} + d_{bs})]}$$

And:

$$f_{wc} = \frac{(1 + Kd_{sw} \ x \ TSS \ x \ UC1) \ x \ \frac{d_{wc}}{dz}}{(1 + KD_{sw} \ x \ TSS \ x \ UC1) \ x \ \frac{d_{wc}}{dz} + (\theta_{bs} + Kd_{bs} \ x \ C_{bs}) \ x \ \frac{d_{bs}}{dz}}$$

$$k_{wt} = f_{wc} \ x \ k_v + f_{bs} \ x \ k_b$$

$$f_{bs} = 1 - f_{wc}$$

$$k_v = \frac{K_v}{dz \ x \ (1 + Kd_{sw} \ x \ TSS \ x \ UC1)}$$

$$k_b = \left(\frac{Xe \ x \ WA_L \ x \ SD \ x \ UC2 - Vf_x \ x \ TSS}{WA_w \ x \ TSS}\right) \ x \ \left(\frac{TSS \ x \ UC1}{C_{bs} \ x \ d_{bs}}\right)$$

Where:

| | | |
|---|---|---|
| $C_{wtot}$ | = | total waterbody concentration ($g/m^3$) |
| $L_T$ | = | total constituent load to the waterbody (g/yr) |
| $f_{wc}$ | = | fraction of total water body concentration that occurs in the water column (unitless) |
| $k_{wt}$ | = | total first order dissipation rate constant ($yr^{-1}$) |
| $Vf_x$ | = | average volumetric flow rate through the water body ($m^3/yr$) |
| $d_{wc}$ | = | depth of water column (m) |
| $WA_w$ | = | total water body area ($m^2$) |
| $Kd_{sw}$ | = | suspended sediment/surface water partition coefficient (l/kg) |
| TSS | = | total suspended solids (mg/l) |
| UC1 | = | units conversion 1 (kg/mg), 1E-06 |
| dz | = | total water body depth (m) |
| $C_{bs}$ | = | bed sediment concentration ($g/cm^3$) |
| $\theta_{bs}$ | = | bed sediment porosity ($l_{water}/l$) |
| $Kd_{bs}$ | = | bed sediment/sediment pore water partition coefficient (l/kg) |
| $d_{bs}$ | = | depth of upper benthic sediment layer (m) |
| $k_v$ | = | water column volatilization rate constant ($yr^{-1}$) |
| $f_{bs}$ | = | fraction of total water body constituent concentration in benthic sediment (unitless) |
| $k_b$ | = | benthic burial rate constant ($yr^{-1}$) |
| Kv | = | overall constituent transfer rate coefficient (m/yr) |
| Xe | = | unit soil loss ($kg/m^2$-yr) |
| $WA_L$ | = | total watershed area receiving deposition ($m^2$) |
| SD | = | watershed sediment delivery ratio (unitless) |
| UC2 | = | units conversion 2 (g/kg), 1000 |

### A.3.3 Water Column Concentration

The water column portion of the total waterbody concentration for each constituent, $C_{wc}$, can be calculated as follows:

$$C_{wc} = f_{wc} \; x \; C_{wtot} \; x \; \frac{d_{wc} + d_{bs}}{d_{wc}}$$

Where:

| | | |
|---|---|---|
| $C_{wc}$ | = | total constituent concentration in water column (mg/l) |
| $C_{wtot}$ | = | total waterbody concentration (mg/l) |
| $f_{wc}$ | = | fraction of total water body concentration that occurs in the water column (unitless) |
| $d_{wc}$ | = | depth of water column (m) |
| $d_{bs}$ | = | depth of upper benthic sediment layer (m) |

### A.3.3.1 Dissolved Phase Water Column Concentration

The dissolved phase portion of the water column concentration for each constituent, $C_{dw}$, can be calculated as follows:

$$C_{dw} = \frac{C_{wc}}{1 + Kd_{sw}\ x\ TSS\ x\ UC}$$

For mercury modeling,

$$C_{dwMercury} = \frac{C_{wcHg2^+}}{1 + Kd_{swHg2^+}\ x\ TSS\ x\ UC}$$

And for apportioning total mercury into divalent mercury ($Hg2^+$) and methyl mercury (MeHg):

$$C_{dwHg2^+} = 0.85\, x\, C_{dwmercury}$$

$$C_{dwMeHg} = 0.15\, x\, C_{dwmercury}$$

Where:

| | | |
|---|---|---|
| $C_{dw}$ | = | dissolved phase water concentration (mg/l) |
| $C_{wc}$ | = | total constituent concentration in water column (mg/l) |
| $Kd_{sw}$ | = | suspended sediment/surface water partition coefficient (l/kg) |
| TSS | = | total suspended solids (mg/l) |
| UC | = | units conversion (kg/mg), 1E-06 |

### A.3.3.2 Constituent Concentration Sorbed to Bed Sediment

The portion of the total water body concentration sorbed to bed sediment for each constituent, $C_{sb}$, can be calculated as follows:

$$C_{sb} = f_{bs}\ x\ C_{wtot}\ x\ \frac{Kd_{bs}}{\theta_{bs} + Kd_{bs}\ x\ C_{bs}}\ x\ \frac{d_{wc} + d_{bs}}{d_{bs}}$$

Where:

| | | |
|---|---|---|
| $C_{sb}$ | = | concentration sorbed to bed sediments (mg/kg) |
| $C_{wtot}$ | = | total waterbody concentration (mg/l) |
| $f_{bs}$ | = | fraction of total water body concentration that occurs in the bed sediment (unitless) |
| $d_{wc}$ | = | depth of water column (m) |
| $d_{bs}$ | = | depth of upper benthic sediment layer (m) |
| $\theta_{bs}$ | = | bed sediment porosity ($l_{water}$/l) |
| $Kd_{bs}$ | = | bed sediment/sediment pore water partition coefficient (l/kg) |
| $C_{bs}$ | = | bed sediment concentration (g/cm$^3$) |

### A.3.4 Fish Concentration

Estimated constituent concentrations in fish are calculated from the dissolved water concentration or the bed sediment concentration using a constituent-specific bioconcentration factor, bioaccumulation factor, or a sediment bioaccumulation factor as appropriate.

$$C_{fishdw} = C_{dw} \ x \ BCF$$

$$C_{fishdw} = C_{dw} \ x \ BAF$$

For Mercury:

$$C_{fishdwHg2^{+}} = C_{dwHg2^{+}} \ x \ BAF_{Hg2^{+}}$$

$$C_{fishdwMeHg} = C_{dwMeHg} \ x \ BAF_{MeHg}$$

$$C_{fishsb} = \frac{C_{sb} \ x \ f_{lipid} \ x \ BSAF}{OC_{sed}}$$

Where:

| | | |
|---|---|---|
| $C_{fishdw}$ | = | fish concentration from dissolved water concentration (mg/kg) |
| $C_{fishsb}$ | = | fish concentration from bed sediment (mg/kg) |
| $C_{dw}$ | = | dissolved water concentration (mg/l) |
| $C_{sb}$ | = | concentration of constituent sorbed to bed sediment (mg/kg) |
| BCF | = | bioconcentration factor (l/kg), used for organics with log Kow less than 4.0 |
| BAF | = | bioaccumulation factor (l/kg), used for organics with log Kow greater than 4.0 |
| BSAF | = | biota- to-sediment accumulation factor (unitless), used for PCDDs, PCDFs and PCBs |
| $f_{lipid}$ | = | fish lipid content (fraction) |
| $OC_{sed}$ | = | fraction organic carbon in bottom sediment (unitless) |

# APPENDIX B

# HUMAN HEALTH RISK ASSESSMENT EXPOSURE INTAKE/DOSE EQUATIONS

## B.1 Inhalation of Airborne Constituents

Air concentrations are calculated for the evaluation of long-term or chronic exposure and for acute exposure and are based on the fraction of the constituent in vapor, particle (inorganics) or particle bound (organics) phases. The ambient air concentration for chronic exposure is calculated using receptor specific unitized yearly air parameter values. Air concentrations for acute exposure are calculated using receptor specific unitized hourly air parameter values.

### B.1.1 Chronic Exposure:

$$C_{chronic} = Q\ x\ [Fv\ x\ Cyv + (1.0 - Fv)\ x\ Cyp]$$

For Mercury:

$$For\ Hg^{0} : C_{chronic} = 0.002Q\ x\ [Fv_{Hg^0}\ x\ Cyv + (1.0 - Fv_{Hg^0})\ x\ Cyp]$$
$$For\ Hg^{2+} : C_{chronic} = 0.48Q\ x\ [Fv_{Hg^{2+}}\ x\ Cyv + (1.0 - Fv_{Hg^{2+}})\ x\ Cyp]$$

Where:

| | | |
|---|---|---|
| $C_{chronic}$ | = | Chronic air concentration ($\mu g/m^3$) |
| Q | = | constituent specific emission rate (g/s) |
| Fv | = | fraction of constituent air concentration in vapor phase (unitless) |
| Cyv | = | unitized yearly air concentration from vapor phase ($\mu g\text{-}s/g\text{-}m^3$) |
| Cyp | = | unitized yearly air concentration from particle or particle bound phase ($\mu g\text{-}s/g\text{-}m^3$) |

### B.1.2 Acute Exposure:

$$C_{acute} = Q\ x\ [Fv\ x\ Chv + (1.0 - Fv)\ x\ Chp]$$

For Mercury:

$$For\ Hg^{0} : C_{acute} = 0.002Q\ x\ [Fv_{Hg^0}\ x\ Chv + (1.0 - Fv_{Hg^0})\ x\ Chp]$$
$$For\ Hg^{2+} : C_{acute} = 0.48Q\ x\ [Fv_{Hg^{2+}}\ x\ Chv + (1.0 - Fv_{Hg^{2+}})\ x\ Chp]$$

Where:

| | | |
|---|---|---|
| $C_{acute}$ | = | Acute air concentration ($\mu g/m^3$) |
| Q | = | constituent specific emission rate (g/s) |
| Fv | = | fraction of constituent air concentration in vapor phase (unitless) |
| Chv | = | unitized hourly air concentration from vapor phase ($\mu g\text{-}s/g\text{-}m^3$) |
| Chp | = | unitized hourly air concentration from particle or particle bound phase ($\mu g\text{-}s/g\text{-}m^3$) |

B.1.3 Daily Intake of Constituents by Inhalation

Daily intake of facility emissions by inhalation is estimated based on annual ambient impact and exposure time:

$$EC = \frac{Ca \ x \ EF \ x \ ED}{AT \ x \ UC1}$$

Where:

| | | |
|---|---|---|
| EC | = | Exposure Concentration ($\mu g/m^3$) |
| Ca | = | total air concentration ($\mu g/m^3$) |
| EF | = | exposure frequency (d/yr) |
| ED | = | exposure duration (yr) |
| AT | = | averaging time (yr) |
| UC1 | = | units conversion (d/yr), 365 |

Cancer Risks and Hazard Quotients for Individual Chemicals by Inhalation

Cancer Risk:

$$CRi = EC \ x \ URFi$$

Where:

| | | |
|---|---|---|
| $CR_i$ | = | individual excess lifetime cancer risk, inhalation (unitless) |
| EC | = | Exposure concentration ($\mu g/m^3$) |
| $URF_i$ | = | inhalation unit risk factor ($(\mu g/m^3)^{-1}$) |

Hazard Quotient:

$$HQ_i = \frac{EC \ x \ UC}{RfC_i}$$

Where:

| | | |
|---|---|---|
| $HQ_i$ | = | Hazard Quotient, inhalation (unitless) |
| EC | = | Exposure concentration ($\mu g/m^3$) |
| $RfC_i$ | = | Reference concentration ($\mu g/m^3$) |
| UC | = | Units conversion ($mg/\mu g$), 0.001 |

Acute Exposure:

$$AHQ_{inh} = \frac{C_{acute} \ x \ UC}{AIEC}$$

Where:

| | | |
|---|---|---|
| $AHQ_{inh}$ | = | acute hazard quotient (unitless) |
| $C_{acute}$ | = | acute air concentration ($\mu g/m^3$) |
| AIEC | = | acute inhalation exposure criteria ($mg/m^3$) |
| UC | = | units conversion factor (mg/µg), 0.001 |

## B.2 Residential Scenario

The residential scenario assumes that the resident inadvertently ingests soil, consumes produce grown in the residential area, ingests drinking water from a local reservoir and inhales the constituents in air at the residential impact point. Exposure doses for the inadvertent ingestion of soil, produce consumption and ingestion of drinking water are calculated both for the adult resident and child resident. An exposure pathway for infants via the ingestion of breastmilk is also included. All equations for the calculation of media concentrations (soil, plants, drinking water) can be found in Appendix A.

### B.2.1 Incidental Ingestion of Soil

Soil Intake

Daily constituent intake from surface soil is calculated based on the estimated concentrations in untilled soil (i.e., in the top 2 cm of soil (USEPA, 2005a)), the rate of soil ingestion, and the fraction of contaminated soil that is ingested:

$$I_{soil} = \frac{Sc \ x \ CR_{soil} \ x \ F_{soil}}{BW}$$

Where:

| | | |
|---|---|---|
| $I_{soil}$ | = | daily intake of constituent from soil (mg/kg-d) |
| Sc | = | concentration of constituent in soil (untilled) (mg/kg) |
| $CR_{soil}$ | = | soil consumption rate (kg/d) |
| $F_{soil}$ | = | fraction of consumed soil that is impacted (unitless) |
| BW | = | body weight (kg) |

### B.2.2 Ingestion of Produce

Produce Intake

Daily constituent intake from produce is calculated based on the amount of produce ingested per day, the estimated concentration of constituents in the produce, and the percentage of produce ingested that is homegrown as shown in the following equation:

$$I_{vg} = [(CAGV \ x \ CR_{ag}) + (PRa \ x \ Cr_{pp}) + (PRb \ x \ CR_{bg})] \ x \ F_{ag}$$

Where:

| | | |
|---|---|---|
| $I_{vg}$ | = | daily intake of constituent from vegetables (mg/kg-d) |
| CAGV | = | concentration of constituents in aboveground vegetables (mg/kg) |
| $CR_{ag}$ | = | consumption rate of aboveground vegetables (kg/kg-d) |
| PRa | = | concentration of constituents in aboveground vegetables due to root uptake (mg/kg) |
| $CR_{pp}$ | = | consumption rate of protected aboveground vegetables (kg/kg-d) |
| PRbg | = | concentration of constituents in belowground vegetables due to root uptake (mg/kg) |
| $CR_{bg}$ | = | consumption rate of belowground vegetables (kg/kg-d) |
| $F_{ag}$ | = | fraction of vegetables that are contaminated (unitless) |

Consumption rates of the two plant groups (aboveground (exposed and protected) and belowground) and fractions contaminated are based on information presented in the final HHRAP guidance document (USEPA 2005a).

### B.2.3 Ingestion of Drinking Water

Drinking Water Intake

Daily constituent intake from drinking water is estimated based on the calculated dissolved phase constituent concentrations in surface water, the rate of drinking water ingestion, and the fraction of drinking water obtained from the impacted surface water body that is ingested:

$$I_{dw} = \frac{C_{dw} \ x \ CR_{dw} \ x \ F_{dw}}{BW}$$

Where:

| | | |
|---|---|---|
| $I_{dw}$ | = | daily intake of constituent from drinking water (mg/kg-d) |
| $C_{dw}$ | = | dissolved phase water concentration (mg/l) |
| $CR_{dw}$ | = | drinking water consumption rate (l/d) |
| $F_{dw}$ | = | fraction of daily intake of drinking water from impacted surface water body (unitless) |
| BW | = | body weight (kg) |

B.2.4 Total Daily Intake for Indirect Pathways: Residential Scenario

The total daily constituent intake is estimated as:

$$I_{tot} = I_{soil} + I_{vg} + I_{dw}$$

Where:

| | | |
|---|---|---|
| $I_{tot}$ | = | total daily intake of constituent (mg/kg-d) |
| $I_{soil}$ | = | daily intake of constituent from soil (mg/kg-d) |
| $I_{vg}$ | = | daily intake of constituent from vegetables (mg/kg-d) |
| $I_{dw}$ | = | daily intake of constituent from drinking water (mg/kg-d) |

B.2.5 Cancer Risks and Hazard Quotients for Individual Chemicals in the Residential Scenario

Cancer Risk:

$$CRo = \frac{I_{tot} \ x \ EF \ x \ ED \ x \ CSFo}{AT \ x \ UC}$$

Where:

| | | |
|---|---|---|
| $CR_O$ | = | individual excess lifetime cancer risk, oral (unitless) |
| $I_{tot}$ | = | total daily intake of constituent (mg/kg-d) |
| EF | = | exposure frequency (d/yr) |
| ED | = | exposure duration (yr) |
| $CSF_O$ | = | cancer slope factor, oral $(mg/kg\text{-}d)^{-1}$ |
| AT | = | time over which the dose is averaged (yr) |
| UC | = | units conversion (d/yr), 365 |

Hazard Quotient:

$$HQo = \frac{I_{tot} \ x \ ED \ x \ EF}{AT \ x \ RfDo \ x \ UC}$$

Where:

| | | |
|---|---|---|
| $HQ_O$ | = | hazard quotient, oral |
| $I_{tot}$ | = | total daily intake of constituent (mg/kg-d) |
| EF | = | exposure frequency (d/yr) |
| ED | = | exposure duration (yr) |
| $RfD_O$ | = | reference dose (oral, mg/kg-d) |
| AT | = | time over which the dose is averaged (ED) |
| UC | = | units conversion (d/yr), 365 |

B.3 Fisher Scenario

The fishing scenario assumes that the fisher resides in the residential area, thus inhalation, inadvertent ingestion of soil, consumption of produce and ingestion of drinking water are the same as for the resident. Consumption of fish from a local waterbody caught recreationally is also included. Daily constituent intake via the incidental ingestion of soil,

consumption of homegrown produce and consumption of drinking water is calculated as described in Section B.2.

B.3.1 Ingestion of Fish

The daily constituent intake from fish is estimated based on the calculated constituent concentration in fish tissue, the fish consumption rate, and the fraction of ingested fish that is obtained from the impacted waterbody:

$$If_{ish} = C_{fish} \ x \ CR_{fish} \ x \ F_{fish}$$

Where:

| | | |
|---|---|---|
| $I_{fish}$ | = | daily intake of constituent from fish (mg/kg-d) |
| $C_{fish}$ | = | fish concentration (mg/kg) |
| $CR_{fish}$ | = | consumption rate of fish (kg/kg-d) |
| $F_{fish}$ | = | fraction of fish contaminated (unitless) |

B.3.2 Total Daily Intake for Indirect Pathway: Fisher Scenario

The total daily constituent intake is estimated as:

$$I_{tot} = I_{soil} + I_{vg} + I_{dw} + I_{fish}$$

Where:

| | | |
|---|---|---|
| $I_{tot}$ | = | total daily intake of constituent (mg/kg-d) |
| $I_{soil}$ | = | daily intake of constituent from soil (mg/kg-d) |
| $I_{vg}$ | = | daily intake of constituent from vegetables (mg/kg-d) |
| $I_{dw}$ | = | daily intake of constituent from drinking water (mg/kg-d) |
| $I_{fish}$ | = | daily intake of constituent from fish (mg/kg-d) |

B.3.3 Cancer Risks and Hazard Quotients for Individual Chemicals in the Fisher Scenario

Cancer Risk:

$$CRo = \frac{I_{tot} \ x \ EF \ x \ ED \ x \ CSFo}{AT \ x \ UC}$$

Where:

| | | |
|---|---|---|
| $CR_O$ | = | individual excess lifetime cancer risk, oral (unitless) |
| $I_{tot}$ | = | total daily intake of constituent (mg/kg-d) |
| EF | = | exposure frequency (d/yr) |
| ED | = | exposure duration (yr) |
| $CSF_O$ | = | cancer slope factor, oral $(mg/kg\text{-}d)^{-1}$ |
| AT | = | time over which the dose is averaged (yr) |
| UC | = | units conversion (d/yr), 365 |

Hazard Quotient:

$$HQo = \frac{I_{tot} \ x \ ED \ x \ EF}{AT \ x \ RfDo \ x \ UC}$$

Where:

| | | |
|---|---|---|
| $HQ_O$ | = | hazard quotient, oral (unitless) |
| $I_{tot}$ | = | total daily intake of constituent (mg/kg-d) |
| EF | = | exposure frequency (d/yr) |
| ED | = | exposure duration (yr) |
| AT | = | time over which the dose is averaged (ED) |
| UC | = | units conversion (d/yr), 365 |
| $RfD_O$ | = | reference dose, oral (mg/kg-d) |

## B.4 Farmer Scenario

The farming scenario assumes that a farmer inadvertently ingests soil, consumes produce, beef, dairy, pork, chicken and eggs specific to the farm and inhales constituents in air at the farm impact point. Daily constituent intake via incidental soil ingestion, consumption of homegrown produce and drinking water are calculated as described in Section B.2.

### B.4.1 Ingestion of Animal Tissue

Constituent concentrations in animal tissue (beef, dairy, pork, chicken, eggs) are estimated based on the calculated concentrations in the type of plant eaten (forage, silage, grain) and soils ingested by cattle, swine and chickens and constituent-specific biotransfer factors as shown in the following equations:

$$A_{beef} = (\sum (F_i \ x \ Qp_i \ x \ P_i) + (Qs \ x \ Sc \ x \ BS)) \ x \ Ba_{beef} \ x \ MF$$

$$A_{milk} = (\sum (F_i \ x \ Qp_i \ x \ P_i) + (Qs \ x \ Sc \ x \ BS)) \ x \ Ba_{milk} \ x \ MF$$

$$A_{pork} = (\sum (F_i \ x \ Qp_i \ x \ P_i) + (Qs \ x \ Sc \ x \ BS)) \ x \ Ba_{pork} \ x \ MF$$

$$A_{chicken} = (\sum (F_i \ x \ Qp_i \ x \ P_i) + (Qs \ x \ Sc \ x \ BS)) \ x \ Ba_{chicken} \ x \ MF$$

$$A_{egg} = (\sum (F_i \ x \ Qp_i \ x \ P_i) + (Qs \ x \ Sc \ x \ BS)) \ x \ Ba_{egg} \ x \ MF$$

Where:

| | | |
|---|---|---|
| $A_{beef}$ | = | concentration of constituent in beef tissue (mg/kg) |
| $A_{milk}$ | = | concentration of constituent in milk (mg/kg) |
| $A_{pork}$ | = | concentration of constituent in pork (mg/kg) |
| $A_{chicken}$ | = | concentration of constituent in chicken (mg/kg) |
| $A_{egg}$ | = | concentration of constituent in eggs (mg/kg) |

$P_i$ = concentration of constituent in plant type i consumed by the animal (mg/kg DW)
$Qp_i$ = quantity of plant type i consumed by the animal each day (kg DW/d)
$F_i$ = fraction of consumed plant type i grown on contaminated soil (unitless)
Sc = soil concentration (mg/kg)
Qs = quantity of soil eaten each day (kg soil/d)
Bs = soil bioavailability factor (unitless)
$Ba_{beef}$ = beef biotransfer factor (d/kg-fresh weight (FW))
$Ba_{milk}$ = milk biotransfer factor (d/kg-wet weight (WW))
$Ba_{pork}$ = pork biotransfer factor (d/kg-FW)
$Ba_{chicken}$ = chicken biotransfer factor (d/kg-FW)
$Ba_{egg}$ = egg biotransfer factor (d/kg-FW)
MF = metabolism factor (unitless)

Estimated concentrations in forage and silage are calculated using algorithms for estimating concentrations in exposed aboveground vegetation. Concentrations in grain are estimated using algorithms for estimating levels in protected aboveground vegetation. The algorithms are discussed in Appendix A, Section A.2. Algorithm inputs for estimating concentrations in forage, silage and grain are taken from the HHRAP Guidance (USEPA 2005a) as are feed and soil consumption rates, and constituent-specific beef, milk, pork, chicken and egg biotransfer factors (USEPA, 2005b).

Constituent Intake from Beef

The daily constituent intake from beef tissue is estimated based on the calculated constituent concentration in beef tissue, the beef consumption rate, and the fraction of consumed beef that is impacted:

$$I_{beef} = A_{beef} \ x \ CR_{beef} \ x \ F_{beef}$$

Where:

$I_{beef}$ = daily intake of constituent from beef (mg/kg-d)
$A_{beef}$ = beef concentration (mg/kg)
$CR_{beef}$ = consumption rate of beef (kg/kg-d)
$F_{beef}$ = fraction of beef consumed that is impacted (unitless)

Beef ingestion rates are based on default values presented in the HHRAP Guidance (USEPA 2005a).

Constituent Intake from Milk

Daily constituent intake form milk is estimated based on the calculated constituent concentration in milk, the milk consumption rate, and the fraction of ingested milk that is impacted:

$$I_{milk} = A_{milk} \times CR_{milk} \times F_{milk}$$

Where:

| | | |
|---|---|---|
| $I_{milk}$ | = | daily intake of constituent from milk (mg/kg-d) |
| $A_{milk}$ | = | milk concentration (mg/kg) |
| $CR_{milk}$ | = | consumption rate of milk (kg/kg-d) |
| $F_{milk}$ | = | fraction of milk consumed that is impacted (unitless) |

Milk ingestion rates are based on default values presented in the HHRAP Guidance (USEPA 2005a).

Constituent Intake from Pork

Daily constituent intake from pork is estimated based on the calculated constituent concentration in pork, the pork consumption rate, and the fraction of ingested pork that is impacted:

$$I_{pork} = A_{pork} \times CR_{pork} \times F_{pork}$$

Where:

| | | |
|---|---|---|
| $I_{pork}$ | = | daily intake of constituent from pork (mg/kg-d) |
| $A_{pork}$ | = | pork concentration (mg/kg) |
| $CR_{pork}$ | = | consumption rate of pork (kg/kg-d) |
| $F_{pork}$ | = | fraction of pork consumed that is impacted (unitless) |

Pork ingestion rates are based on default values presented in the HHRAP Guidance (USEPA 2005a).

Constituent Intake from Chicken

Daily constituent intake from chicken is estimated based on the calculated constituent concentration in chicken, the chicken consumption rate, and the fraction of ingested chicken that is impacted:

$$I_{chicken} = A_{chicken} \times CR_{chicken} \times F_{chicken}$$

Where:

| | | |
|---|---|---|
| $I_{chicken}$ | = | daily intake of constituent from chicken (mg/kg-d) |
| $A_{chicken}$ | = | chicken concentration (mg/kg) |

$CR_{chicken}$ = consumption rate of chicken (kg/kg-d)
$F_{chicken}$ = fraction of chicken consumed that is impacted (unitless)

Chicken ingestion rates are based on default values presented in the HHRAP Guidance (USEPA 2005a).

Constituent Intake from Eggs

Daily constituent intake from eggs is estimated based on the calculated constituent concentration in eggs, the egg consumption rate, and the fraction of ingested eggs that are impacted:

$$I_{egg} = A_{egg} \ x \ CR_{egg} \ x \ F_{egg}$$

Where:

$I_{egg}$ = daily intake of constituent from eggs (mg/kg-d)
$A_{egg}$ = egg concentration (mg/kg)
$CR_{egg}$ = consumption rate of eggs (kg/kg-d)
$F_{egg}$ = fraction of eggs consumed that is impacted (unitless)

Egg ingestion rates are based on default values presented in the HHRAP Guidance (USEPA 2005a).

B.4.2 Total Daily Intake from Indirect Pathways: Farming Scenario

The total daily constituent intake is estimated as:

$$I_{tot} = I_{soil} + I_{vg} + I_{dw} + I_{beef} + I_{milk} + I_{pork} + I_{chicken} + I_{egg}$$

Where:

$I_{tot}$ = total daily intake of constituent (mg/kg-d)
$I_{soil}$ = daily intake of constituent from soil (mg/kg-d)
$I_{vg}$ = daily intake of constituent from vegetables (mg/kg-d)
$I_{dw}$ = daily intake of constituent from drinking water (mg/kg-d)
$I_{beef}$ = daily intake of constituent from beef (mg/kg-d)
$I_{milk}$ = daily intake of constituent from milk (mg/kg-d)
$I_{pork}$ = daily intake of constituent from pork (mg/kg-d)
$I_{chicken}$ = daily intake of constituent from chicken (mg/kg-d)
$I_{egg}$ = daily intake of constituent from eggs (mg/kg-d)

B.4.3 Cancer Risks and Hazard Quotients for Individual Chemicals in the Farmer Scenario

Cancer Risk:

$$CRo = \frac{I_{tot} \ x \ EF \ x \ ED \ x \ CSFo}{AT \ x \ UC}$$

Where:

| | | |
|---|---|---|
| $CR_O$ | = | individual excess lifetime cancer risk, oral (unitless) |
| $I_{tot}$ | = | total daily intake of constituent (mg/kg-d) |
| EF | = | exposure frequency (d/yr) |
| ED | = | exposure duration (yr) |
| $CSF_O$ | = | oral cancer slope factor, $(mg/kg\text{-}d)^{-1}$ |
| AT | = | time over which the dose is averaged (yr) |
| UC | = | units conversion (d/yr), 365 |

Hazard Quotient:

$$HQo = \frac{Itot\ x\ EF\ x\ ED}{AT\ x\ RfDo\ x\ UC}$$

Where:

| | | |
|---|---|---|
| $HQ_O$ | = | hazard quotient, oral (unitless) |
| $I_{tot}$ | = | total daily intake of constituent (mg/kg-d) |
| EF | = | exposure frequency (d/yr) |
| ED | = | exposure duration (yr) |
| $RfD_O$ | = | reference dose, oral (mg/kg-d) |
| AT | = | time over which the dose is averaged (ED) |
| UC | = | units conversion (d/yr), 365 |

## B.5 Infant Exposure via Breastmilk Ingestion

Per the HHRAP Guidance (USEPA, 2005a), the risk assessment includes an estimate of the exposure of breast-fed infants to potential dioxin/furans and dioxin-like PCB emissions for each of the three scenarios. Dioxin/furans and dioxin-like PCBs are the only constituents evaluated in this pathway because of their lipophilic nature and because they have been reported to be found in human breastmilk. Maternal exposures from each of the scenarios are used to determine infant exposure via breast-feeding. The concentrations of dioxins/furans as a 2,3,7,8-TCDD toxicity equivalent (TEQ) is compared with an infant target intake level of 60 picograms per kilogram per day (pg/kg-d).

Maternal Milk Concentration

The concentration in maternal milk is calculated as follows:

$$C_{milkfat} = \frac{(M\ x\ UC\ x\ h\ x\ f1)}{(0.693\ x\ f2)}$$

$$ADI = \frac{Ca \ x \ IR \ x \ ET \ x \ EF \ x \ ED \ x \ UC1}{BW \ x \ AT \ x \ UC2}$$

Where:

| | | |
|---|---|---|
| $C_{milkfat}$ | = | concentration of dioxin in milkfat of breast milk (pg/kg) |
| M | = | total maternal exposure by all routes (including inhalation, ADI) (mg/kg-d) |
| UC | = | units conversion (pg/mg), 1E+9 |
| f1 | = | fraction of ingested dioxin that is stored in fat (unitless) |
| h | = | half-life of constituent in mother's body (d) |
| f2 | = | proportion of maternal weight that is fat (unitless) |
| ADI | = | average daily intake of constituent by inhalation (mg/kg-d) |
| Ca | = | total air concentration (□ g/m$^3$) |
| IR | = | inhalation rate (m$^3$/hr) |
| ET | = | exposure time (hr/d) |
| EF | = | exposure frequency (d/yr) |
| ED | = | exposure duration (yr) |
| UC1 | = | units conversion (mg/□g), 0.001 |
| BW | = | body weight (kg) |
| AT | = | averaging time (yr) |
| UC2 | = | units conversion (d/yr), 365 |

Ingestion of Breastmilk

The infant's average daily dose is calculated as follows:

$$ADD_{infant} = \frac{C_{milkfat} \ x \ f3 \ x \ f4 \ x \ IR_{milk} \ x \ ED}{BW \ x \ AT}$$

Where:

| | | |
|---|---|---|
| $ADD_{infant}$ | = | average daily dose for infant (pg/kg-d) |
| $C_{milkfat}$ | = | concentration of dioxin in milkfat of breast milk (pg/kg) |
| $IR_{milk}$ | = | infant breast milk ingestion rate (kg/d) |
| f3 | = | fraction of breast milk that is fat (unitless) |
| f4 | = | fraction constituent absorbed (unitless) |
| ED | = | exposure duration (yr) |
| BW | = | body weight of infant (kg) |
| AT | = | averaging time (yr) |

# APPENDIX C

# ECOLOGICAL RISK ASSESSMENT EXPOSURE INTAKE/DOSE EQUATIONS

## C.0 COPC Concentration in Mammals and Birds

The equations that will be used to estimate COPC concentrations in food items of mammalian and avian measurement receptors are presented in the following sections, organized by the guild to which the prey or food item belongs.

## C.1 COPC Concentration in Herbivorous Mammals and Birds

The COPC concentration in herbivorous mammals and birds will be calculated by summing the contribution due to ingestion of contaminated plant food items and media as follows:

$$C_H = \sum \left( C_{Pi} \times BCF_{Pi\text{-}H} \times P_{Pi} \times F_{Pi} \right) + \left( C_{s/sed} \times BCF_{S/BS\text{-}H} \times P_{S/BS} \right) + \left( C_{wctot} \times BCF_{W-H} \times P_W \right)$$

where

| | | |
|---|---|---|
| $C_H$ | = | COPC concentration in herbivore (mg/kg) |
| $C_{Pi}$ | = | COPC concentration in *i*th plant food item (mg/kg) |
| $BCF_{Pi\text{-}H}$ | = | Bioconcentration factor for plant-to-herbivore for *i*th plant food item (unitless) |
| $P_{Pi}$ | = | Proportion of *i*th plant food item in diet that is contaminated (unitless) |
| $F_{Pi}$ | = | Fraction of diet consisting of *i*th plant food item (unitless) |
| $C_{s/sed}$ | = | COPC concentration in soil or bed sediment (mg/kg) |
| $BCF_{S/BS\text{-}H}$ | = | Bioconcentration factor for soil-to-plant or bed sediment-to-plant (unitless) |
| $P_{S/BS}$ | = | Proportion of soil or bed sediment in diet that is contaminated (unitless) |
| $C_{wctot}$ | = | Total COPC concentration in water column (mg/L) |
| $BCF_{W\text{-}HM}$ | = | Bioconcentration factor for water-to-herbivore (L/kg) |
| $P_w$ | = | Proportion of water in diet that is contaminated (unitless) |

## C.2 COPC Concentration in Omnivorous Mammals and Birds

The COPC concentration in omnivorous mammals and birds will be calculated by summing the contribution due to ingestion of contaminated animal and plant food items and media as follows:

$$C_{OM} = \sum \left( C_{Ai} \times \frac{FCM_{TL3}}{FCM_{TLn=Ai}} \times P_{Ai} \times F_{Ai} \right) + \sum \left( C_{Pi} \times BCF_{Pi\text{-}OM} \times P_{Pi} \times F_{Pi} \right) + \left( C_{s/sed} \times BCF_{S/BS\text{-}OM} \times P_{S/BS} \right) + \left( C_{wctot} \times BCF_{W-OM} \times P_W \right)$$

Where

| | | |
|---|---|---|
| $C_{OM}$ | = | COPC concentration in omnivore (mg/kg) |
| $C_{Ai}$ | = | COPC concentration in *i*th animal food item (mg/kg) |
| $FCM_{TL3}$ | = | Food chain multiplier for trophic level 3 (unitless) |
| $FCM_{TLn\text{-}Ai}$ | = | Food chain multiplier for trophic level of *i*th animal food item (unitless) |

| | | |
|---|---|---|
| $P_{Ai}$ | = | Proportion of *i*th animal food item in diet that is contaminated (unitless) |
| $F_{Ai}$ | = | Fraction of diet consisting of *i*th animal food item (unitless) |
| $BCF_{Pi\text{-}OM}$ | = | Bioconcentration factor for plant-to-omnivore for *i*th plant food item (unitless) |
| $C_{Pi}$ | = | COPC concentration in *i*th plant food item (mg/kg) |
| $P_{Pi}$ | = | Proportion of *i*th plant food item that is contaminated (unitless) |
| $F_{Pi}$ | = | Fraction diet consisting of *i*th plant food item (unitless) |
| $C_{s/sed}$ | = | COPC concentration in soil or bed sediment (mg/kg) |
| $BCF_{S/BS\text{-}OM}$ | = | Bioconcentration factor for soil- or bed sediment-to-omnivore (unitless) |
| $P_{S/BS}$ | = | Proportion of soil or bed sediment in diet that is contaminated (mg/kg) |
| $C_{wctot}$ | = | Total COPC concentration in water column (mg/L) |
| $BCF_{W\text{-}OM}$ | = | Bioconcentration factor for water-to-omnivore (L/kg) |
| $P_w$ | = | Proportion of water in diet that is contaminated (unitless) |

## C.3 COPC Concentration in Carnivorous Mammals and Birds

The COPC concentration in carnivorous mammals and birds will be calculated by summing the contribution due to ingestion of contaminated animal food items and media as follows:

$$C_C = \sum\left(C_{Ai} \times \frac{FCM_{TL4}}{FCM_{TLn=Ai}} \times P_{Ai} \times F_{Ai}\right) + C_{s/sed} \times BCF_{S/BS\text{-}C} \times P_{S/BS} + C_{wctot} \times BCF_{W-C} \times P_W$$

where

| | | |
|---|---|---|
| $C_C$ | = | COPC concentration in carnivore (mg/kg) |
| $C_{Ai}$ | = | COPC concentration in *i*th animal food item (mg/kg) |
| $FCM_{TL4}$ | = | Food chain multiplier for trophic level 4 (unitless) |
| $FCM_{TLn\text{-}Ai}$ | = | Food chain multiplier for trophic level of *i*th animal food item (unitless) |
| $P_{Ai}$ | = | Proportion of *i*th animal food item in diet that is contaminated (unitless) |
| $F_{Ai}$ | = | Fraction of diet consisting of *i*th animal food item (unitless) |
| $C_{s/sed}$ | = | COPC concentration in soil or bed sediment (mg/kg) |
| $BCF_{S/BS\text{-}C}$ | = | Bioconcentration factor for soil- or bed sediment-to-carnivore (unitless) |
| $P_{S/BS}$ | = | Proportion of soil or bed sediment in diet that is contaminated (mg/kg) |
| $C_{wctot}$ | = | Total COPC concentration in water column (mg/L) |
| $BCF_{W\text{-}C}$ | = | Bioconcentration factor for water-to-carnivore (L/kg) |
| $P_w$ | = | Proportion of water in diet that is contaminated (unitless) |

# APPENDIX D

# METEOROLOGICAL DATA PROCESSING DESCRIPTION FROM CHPPM, 2004

D.1. **Background**.

Meteorological data processed for the air quality analysis was a composite of on-site surface data from Western Area Demilitarization Facility (WADF) within the Main Base of HWAD, National Weather Service (NWS) surface data, and NWS upper air data. The three data sets were processed using the Meteorological Processor for Regulatory Models (MPRM) to create an ASCII format sequential hourly meteorological data file. Meteorological information from a location close to the study area is preferred. A complete onsite meteorological data set, however, was unavailable for the HWAD study area. Therefore, surface data files from Tonopah, upper air data files from Reno, and precipitation data files from Wabuska were used for 1997 through 1998.

Tonopah is approximately 80 miles southeast of Hawthorne, and is the closest source for a complete surface data set. Reno was used for the upper air data set, while Wabuska, located approximately 55 miles northwest of Hawthorne was the closest source for precipitation data.

a. **Upper Air Data**. A complete upper air data set was not available at the WADF. Upper air data was obtained from the Reno International Airport (Station ID 3198, 119.7W 39.5N).

b. **NWS Surface Data**. The NWS surface data was obtained from the Tonopah Airport (Station ID 72485 -117.10W 38.07N). This data was necessary because the on-site data did not include the type of precipitation and relative humidity that is required for the wet deposition algorithm in Industrial Source Complex Short-Term (ISCST3) Dispersion Model used for this assessment. The cloud cover data, which the MPRM requires to calculate the surface friction coefficient, was also not available from the on-site station. The stability class was actually determined by using the on-site sigma-theta data. This method is designated by the SASITE in the WADF324.inp file. This method is a turbulence-based method that uses the standard deviation of the wind direction in combination with the scalar mean wind speed.

c. **On-Site Surface Data**. Weather News Networks, Inc., (WNN) has been performing 3rd-party audits/calibrations of the HWAD meteorological stations for Day and Zimmerman Hawthorne Corporation (DZHC). As it was never part of their contract for DZHC to store electronic data from these stations, only sporadic records of meteorological data used in their calibration procedures exist. Most of the data was essentially unusable and audits/calibrations were performed when requested by DZHC. This information was provided to USACHPPM and they used it for the initial 1997 PODS air dispersion modeling for the risk assessment. Through additional efforts, DZHC was able to obtain about 3 years of WADF meteorological data (1996 through 1999). Partial and incomplete data sets were available for calendar years (CY) 1996 and 1999; therefore only CY 1997 and 1998 were processed. Calendar year 1997 and 1998 has a total of 9 hours with missing data. The missing data was filled using the USEPA's On-site Meteorological Program Guidance for Regulatory Modeling Applications (USEPA 1987). The on-site meteorological monitoring station (longitude 118.652W, latitude 38.352N) is located near the PODS and RF-9 Incinerator. The WADF station recorded wind speed, wind direction, temperature, precipitation, barometric pressure, and calculated sigma theta and the on-site SODAR unit measured atmospheric mixing height. This station does not have a station number and was arbitrarily given the number 12345 for use in the MPRM. The data formats are as follows:

<u>Hourly Data</u>
Col 1 Table ID
Col 2 Year
Col 3 Day (Julian)

Col 4 Time (LST)
Col 5 Temp (F)
Col 6 Wind Speed (mph)
Col 7 Wind Dir (degrees N)
Col 8 Sigma Theta (deg)
Col 9 Max gust (mph)
Col 10 Precipitation (Hour total, in inches)
Col 11 Barometric Pressure (in Hg)

Daily Averages
Col 1 Table ID
Col 2 Year
Col 3 Day (Julian)
Col 4 Time (2400)
Col 5 Max temp (F)
Col 6 Time of max temp (LST)
Col 7 Min temp (F)
Col 8 Time of min temp (LST)
Col 9 Average temp (F)
Col 10 Average wind speed (mph)
Col 11 Average wind direction (degrees N)
Col 12 Max wind gust (mph)
Col 13 Time of max gust (LST)
Col 14 Dir of max gust (degrees N)
Col 15 Total precipitation (inches)
Col 16 Average Barometric Pressure (in Hg)
Col 17 Min Battery Voltage (volts)

D.2. **MPRM Processing**.

Table 1 provides a summary of the files used in the three steps of the MPRM. The EPA's example was followed for the naming of all input and output files. The first step in processing the meteorological data was for the MPRM to extract and quality check the three data sets. The second step was for the upper air data and the two surface data sets to be merged. The third and final step is to actually process the meteorological data to produce an output file that the ISC model can use in conducting the air dispersion modeling.

a. **Stage 1 Processing**.

i. **Upper Air Data**. A complete set of upper air (mixing height) data (January 1997-December 1998) was purchased from TRINITY Consultants; the meteorologist at TRINITY filled any missing data prior to providing the data to USACHPPM. The input file follows the examples in the MPRM User's guide very closely for the upper air extraction and quality check. The time period of interest was entered in the UA EXT line to match the available on-site surface data. In order to adjust the upper air data (supplied in Greenwich Mean Time, GMT) to local standard time, an eight (8) was added to the upper air location line of the input file since Nevada is in the Pacific Time Zone. This adjustment is necessary for the merging of the upper air data with the surface data in Stage 2 processing. Review of the upper air extraction/quality check report revealed that the run terminated normally and that there were no warnings or errors. The data quality checked within the MPRM's upper and lower bounds.

ii. **National Weather Service Surface Data.** The NWS surface data was required for precipitation type, relative humidity, and cloud cover information. This data was not collected at the on-site meteorological station and is required for the wet deposition algorithm in the ISC3 dispersion model and for MPRM to calculate the surface friction coefficient. This data was purchased from TRINITY Consultants, and was supplied in CD144 format (surface data) and TD3240 format (precipitation data). The surface data was obtained from the Reno Airport (Station ID 72485) and the precipitation data from Wabuska County (Station ID 268822). Again the EPA's example in the MPRM User's guide was followed closely. The specified time period from 1 January 1997 through 31 December 1998 was added to the input file, and since the surface data was supplied in local standard time, a zero (0) was added to the end of the SF LOC input line. Review of the report file revealed a normal job termination with greater than 98 percent of the data within the upper and lower bounds of the processor.

iii. **On-site Surface Data.** The on-site surface data was obtained from Shaw Environmental and Infrastructure, Inc. All missing data was filled following the USEPA's format for missing values and the input file was adjusted to allow the processor to recognize the data as missing. Minor adjustments were made to the raw data such as changing Julian days to calendar days and the raw data had to be broken into two lines to accommodate the MPRM's limit of no more than 40 values per record. The on-site input file includes Fortran formatting code for reading the raw data. Several of the lower and upper bounds had to be redefined to allow the data to be accepted by MPRM. Table 2 lists the new lower and upper bound values. Review of the report file reveals that the job terminated normally and greater than 99 percent of the data was within the specified bounds. There were no error messages.

b. **Stage 2 Processing.** In Stage 2, the upper air data, NWS surface data, and on-site surface data are combined. The output from Stage 2 is stored in an unformatted (binary) data file. The user only specifies file names and the start and stop dates for this stage of the processing. The report file indicated that the job terminated normally and that NWS mixing height data, NWS surface data, and on-site surface data were successfully merged for the period 1 January 1997 to 31 December 1998. There were no error messages.

c. **Stage 3 Processing.** In Stage 3 processing, the merged data was used to construct a meteorological data file for use with a user-selected model. In the input file, information pertaining to the location, identification, and surface characteristics of the on-site station was provided. Table 3 lists the values that were used in processing the meteorological data. The MP MET line provided the name of the merge file to process as well as the eight (8) that accounts for the mixing height data being in GMT. The appropriateness of this adjustment was confirmed with Mr. Desmond Bailey of the EPA. The MP MMP line specified the output file name and the dispersion model to be used. The ISCGASW was specified because it is required for the wet and dry deposition of emissions for the RCRA Health Risk Assessment. The on-site wind speed and direction were specified at 10 meters in the MP VBL Wind On-site line. The MP VBL TEMP line was used to specify the temperature measurement height at 10 m. The report file indicated that the job terminated normally, that the input files were successfully opened and read, and that there were no errors. A warning message was given for the net radiation during evening hours and early morning hours when the sun had set or had not risen. Review of the output file indicated that the data had been processed successfully.

**Table D–1: MPRM File Descriptions**

**MPRM FILE DESCRIPTION**

Stage I: Extraction and Quality Assurance

Upper Air Extraction Files

| | |
|---|---|
| 3198-98.mix | Upper air data file from Reno Airport NWS station<br>SCRAM Mixing Height Format, See page F-3 of MPRM User's Guide |
| WADF121.inp | Upper air input file |
| WADF121.err | Upper air extraction error report |
| WADF121.rpt | Upper air extraction report |
| IQWADF.121 | QA input file |
| OQWADF.121 | QA output file |

Surface Data Extraction Files

| | |
|---|---|
| 72485-98.dat | Surface data from Tonopah Airport<br>CD-144 Format Page F-4 of MPRM User's Guide |
| 8822-98.ppp | Precipitation data from Wabuska County |
| WADF122.inp | Surface data input file |
| WADF122.err | Surface data extraction error report |
| WADF122.rpt | Surface data extraction report |
| IQWADF.122 | QA input file |
| OQWADF.122 | QA output file |

On-Site Data Extraction Files

| | |
|---|---|
| WADF-OS.met | On-site met. data file<br>See WADF123.inp for format description. |
| WADF123.inp | On-site data input file |
| WADF123.err | On-site data extraction error report |
| WADF123.rpt | On-site data extraction report |
| OQWADF.123 | QA output file |

Stage II: Merge Upper Air, NWS Surface Data, and On-site Data

| | |
|---|---|
| WADF223.inp | Merge data input file |
| WADF223.err | Merge data error report |
| WADF223.rpt | Merge data report |
| MWADF.223 | Merge output file |

Stage III: Processing Data

| | |
|---|---|
| WADF324.inp | Processing data input file |
| WADF324.err | Processed data error report |
| WADF324.rpt | Processed data report |
| WADF324.out | Processed data output file |

**Table D–2. Redefined Bound Limits**

| | |
|---|---|
| **Lower Bound** | |
| Station Pressure | 8000 |
| **Upper Bound** | |
| Standard Deviation - horizontal wind | 100 |
| Temperature | 45 |

**Table D–3. Surface Characteristics for the On-Site Station.**

| | Winter | Spring | Summer | Autumn |
|---|---|---|---|---|
| Monin-Obukhov Length | 2.0 | 2.0 | 2.0 | 2.0 |
| Anemometer Height | 10 | 10 | 10 | 10 |
| Absorbed Net Radiation | 0.15 | 0.15 | 0.15 | 0.15 |
| Anthropogenic Heat Flux | 0 | 0 | 0 | 0 |
| Surface Roughness (measurement site) | 0.15 | 0.30 | 0.30 | 0.30 |
| Surface Roughness (application site) | 0.15 | 0.30 | 0.30 | 0.30 |
| Noon-time Albedo | 0.45 | 0.30 | 0.28 | 0.28 |
| Bowen Ratio | 10.0 | 5.0 | 6.0 | 10.0 |
| Leaf Area Index | 0.2 | 0.2 | 0.2 | 0.2 |
| Condition | Dry | | | |

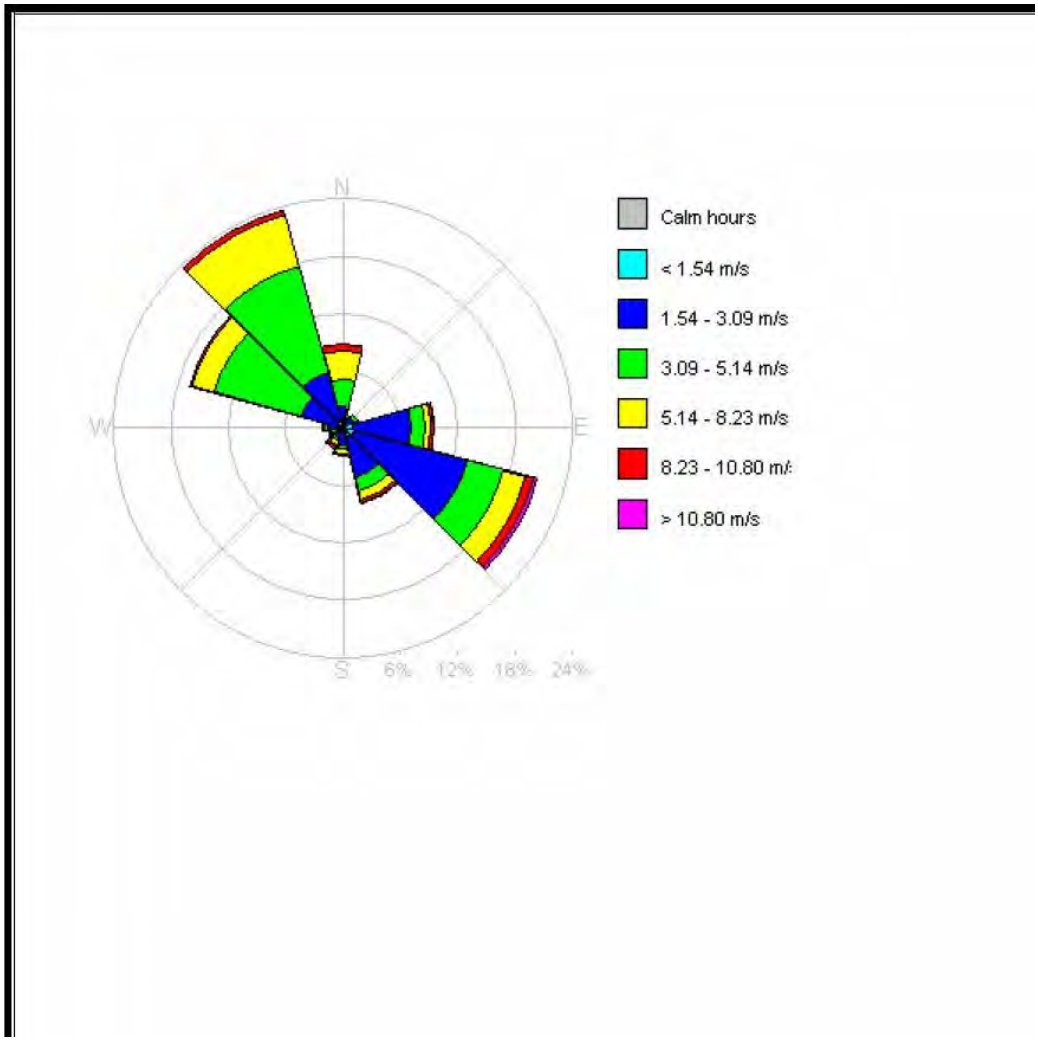


**Figure D-1**. Windrose for the WADF area for CY 1997 through 1998.

# APPENDIX E

# RARE SPECIES IN MINERAL COUNTY, NEVADA

## MINERAL COUNTY RARE SPECIES LIST

### Plants - Pteridophytes (fern allies)

Botrychium crenulatum (dainty moonwort)

### Plants - Flowering Dicots

Arabis bodiensis (Bodie Hills rockcress)
Astragalus cimae var. cimae (Cima milkvetch)
Astragalus johannis-howellii (Long Valley milkvetch)
Astragalus lentiginosus var. sesquimetralis (Sodaville milkvetch)
Astragalus oophorus var. lavinii (Lavin eggvetch)
Astragalus pseudiodanthus (Tonopah milkvetch)
Cusickiella quadricostata (Bodie Hills draba)
Cymopterus cinerarius (gray wavewing)
Eriogonum ampullaceum (Mono buckwheat)
Eriogonum beatleyae (Beatley buckwheat)
Helianthus deserticola (dune sunflower)
Opuntia pulchella (sand cholla)
Oryctes nevadensis (oryctes)
Penstemon arenarius (Nevada dune beardtongue)
Penstemon rubicund us (Wassuk beardtongue)
Phacelia monoensis (Mono County phacelia)
Polyctenium williamsiae (Williams combleaf)
Sclerocactus polyancistrus (hermit cactus)
Senecio pattersonensis (Mono ragwort)
Streptanthus oliganthus (Masonic Mountain jewelflower)

### Mollusks

Pyrgulopsis wongi (Wongs pyrg)

### Insects

Euphilotes enoptes primavera (early blue)
Icaricia icarioides albihalos (White Mountains icarioides blue)

## Fishes

Crenichthys baileyi grandis (Hiko White River springfish)
Crenichthys nevadae (Railroad Valley springfish)
Oncorhynchus clarki henshawi (Lahontan cutthroat trout)

## Mammals

Corynorhinus townsendii (Townsend's big-eared bat)
Euderma maculatum (spotted bat)
Microdipodops megacephalus nasutus (Fletcher dark kangaroo mouse)
Myotis californicus (California myotis)
Myotis ciliolabrum (western small-footed myotis)
Myotis lucifugus (little brown myotis)
Myotis thysanodes (fringed myotis)

## Birds

Athene cunicularia hypugaea (Western Burrowing Owl)
Buteo regalis (Ferruginous Hawk)
Buteo swainsoni (Swainson's Hawk)
Centrocercus urophasianus (Sage Grouse)
Charadrius alexandrinus nivosus (Western Snowy Plover)
Chlidonias niger (Black Tern)
Falco peregrinus (Peregrine Falcon)
Gavia immer (Common Loon)
Haliaeetus leucocephalus (Bald Eagle (contiguous US pop))
Otus flammeolus (Flammulated Owl)
Plegadis chihi (White-faced Ibis)

## MINERAL COUNTY WATCH-LIST TAXA

### Plants - Flowering Dicots

Arabis dispar (pinyon rockcress)
Arabis shockleyi (Shockley rockcress)
Astragalus callithrix (Callaway milkvetch)
Astragalus lentiginosus var. scorpionis (scorpion milkvetch)
Ericameria watsonii (Watson goldenbush)
Eriogonum rubricaule (Lahontan Basin buckwheat)
Mentzelia candelariae (Candelaria blazingstar)
Oxytheca watsonii (Watson spinecup)
Perideridia lemmonii (tuni)
Phacelia glaberrima (Reese River phacelia)
Plagiobothrys salsus (salt marsh allocarya)

### Plants - Flowering Monocots

Calochortus leichtlinii (Leichtlin mariposa lily)

### Amphibians

Bufo boreas halophilus (California toad)
Rana pipiens (northern leopard frog)

### Reptiles

Charina bottae (rubber boa)

### Mammals

Antrozous pallidus (pallid bat)
Lasionycteris noctivagans (silver-haired bat)
Lasiurus cinereus (hoary bat)
Microdipodops pallidus (pale kangaroo mouse)
Myotis evotis (long-eared myotis)
Myotis volans (long-legged myotis)
Myotis yumanensis (Yuma myotis)
Ochotona princeps (American pika)
Pipistrellus hesperus (western pipistrelle)
Tadarida brasiliensis (Brazilian free-tailed bat)

**Birds**

Agelaius tricolor (Tricolored Blackbird)
Aquila chrysaetos (Golden Eagle)
Asio otus (Long-eared Owl)
Baeolophus griseus (Juniper Titmouse)
Dendroica petechia (Yellow Warbler)
Falco mexicanus (Prairie Falcon)
Geothlypis trichas (Common Yellowthroat)
Gymnorhinus cyanocephalus (Pinyon Jay)
Histrionicus histrionicus (Harlequin Duck)
Lanius ludovicianus (Loggerhead Shrike)
Melanerpes lewis (Lewis' Woodpecker)
Numenius americanus (Long-billed Curlew)
Oporornis tolmiei (Macgillivray's Warbler)
Pelecanus erythrorhynchos (American White Pelican)
Pooecetes gramineus (Vesper Sparrow)
Sphyrapicus nuchalis (Red-naped Sapsucker)
Vermivora celata (Orange-crowned Warbler)
Wilsonia pusilla (Wilson's Warbler)

Source: NNHP 2004. Mineral County Rare Species Lists. State of Nevada Department of Conservation and Natural Resources Nevada Natural Heritage Program. http://heritage.nv.gov/lists/counties.htm. March 18 and archives.

# APPENDIX F

# MEASUREMENT RECEPTOR SPECIES PROFILES

## American Robin

The American robin, *Turdus migratorius*, inhabits mixed conifer forests in Nevada and also inhabits a variety of habitats, including on the canyon slopes adjacent to riparian areas in central Nevada consisting primarily of single-leaf pinyon, Utah juniper and curl-leaf mountain mahogany. The American robin forages primarily on worms, insects and fruit (USEPA 1993). This avian was chosen as a receptor for the shrub/grassland and forest food webs to represent the omnivorous bird guild because it is known to inhabit the HWAD area and may provide an important niche as a food source for higher order terrestrial predators.

### Biological Characteristics

Body weight (BW): 67 g
This BW represents the average of the BW data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Normalized ingestion rate (NIR): 0.444 g/g-day ww
This NIR is calculated value provided in USEPA 1999.

Normalized water ingestion rate (NIRw): 0.21 g/g-day
This NIRw is a calculated value using the allometric equation provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) and the BW presented above.

Normalized soil ingestion rate (NIRs): 0.0143 g/g-day
This NIRs is based on data presented in Beyer et al, 1994 as reported in USEPA 1999.

Exposure frequency (EF): 365 d

Exposure duration (ED): 13 y
This value was obtained from the United States Geological Survey's Patuxent Database (USGS 2006).

Assimilation efficiency of consumed food (AE): 63%
This value represents the average assimilation efficiency (AE) of fruits and insects. The *Wildlife Exposure Factors Handbook* (USEPA, 1993) reports that the American robin's AE for fruit is 55% and for insects is 70%. Based on the relative proportion of fruits (44.8%) and insects (55.2%), the resulting average AE is 63%.

Home range: 0.5 ha
This value represents the average foraging home range data presented in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

### Ecological Characteristics

The following dietary proportions have been selected for use in the model:

Proportion of diet that is invertebrates: 55.2%

This proportion is based on research presented in the *Wildlife Exposure Factors Handbook* on American robins in the western United States.

Proportion of diet that is fruit: 44.8%
This proportion is based on research presented in the *Wildlife Exposure Factors Handbook* on American robins in the western United States.

References

Beyer, N., Conner, E. and Gerould, S. 1994 Estimates of Soil Ingestion by Wildlife. Journal of Wildlife Management. Volume 58. Pages 375-382.

USGS 2006. Patuxent Wildlife Research Center. http://www.mbr-pwrc.usgs.gov/id/framlst/infocenter.html

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

USEPA 1999. Screening Level Ecological Risk Assessment Protocol. USEPA Region 6 and OSW. Volumes 1-3. EPA530-D-99-001A. August.

## Badger

The badger, *Taxidea taxus*, is a unique carnivorous mammal belonging to the skunk family. This heavy-bodied, short-legged, yellowish-grey mammal has a median white stripe from nose over the top of its head, white cheeks, and a black spot in front of each ear. This animal favors open grasslands and deserts as its habitat and is mostly nocturnal. It has extremely long front claws which are used to dig out small rodents (its main food item) and to dig out its dens (Burt and Grossenheider 1980). This mammal was chosen as a receptor for terrestrial sites to represent the carnivore feeding guild because it is known to inhabit HWAD and fills the highest trophic level for mammals in terrestrial scenarios.

### Biological Characteristics

Body weight (BW): 6.95 kg
We will use the body weight given by IT Corporation (1996) of 6.95 kg.

Normalized ingestion rate (NIR): 0.153 kg/kg-d ww
The NIR of the badger was able to be calculated from equation 3-7 in the *Wildlife Exposure Factors Handbook* (USEPA 1993) and the moisture content for prey species reported in USEPA 1999.

Normalized ingestion rate of water (NIRw)
A specific source of water cannot be pinpointed and all water gained is assumed to be through ingested food and metabolism. Therefore, $NIR_w$ for the badger is not evaluated for this project.

Exposure frequency (EF): 365 d/yr
The badger does not migrate; therefore, the exposure frequency for badgers is 365 days/year.

Exposure duration (ED): 12 yrs
As stated in the *Peterson Field Guide* (Burt and Grossenheider, 1980) for mammals, badgers in captivity have been found to live up to 12 years.

Assimilation efficiency of consumed food (AE): 84%
The *Wildlife Exposure Factors Handbook* (USEPA 1993) gives an assimilation efficiency of 84% for mammals whose prey consists of small birds and mammals. This best fits the profile of badgers so far as diet and classification.

Home range: 200 ha.
Typically males have a larger home range (of 240 hectares) than females (160 hectares) (Shefferly 1999). For the evaluation, the average of the two home ranges of 200 hectares will be used.

### Ecological Characteristics

Badgers consume small mammals, consisting mainly of small rodents (Burt and Grossenheider 1980).

Proportion of diet that is trophic level three small mammals: 77.6 %
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

Proportion of diet that is trophic level two small mammals: 19.4 %
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

Proportion of diet that is soil: 3%
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

References

Burt, WH, and RP Grossenheider. 1980. A Field Guild to the Mammals North America north of Mexico, 3rd Edition. Peterson Field Guides.
IT Corporation. 1996. RF-9 Incinerator Ecological Risk Assessment, Hawthorne Army Depot. Prepared for Hazardous Waste Remedial Actions Program. November. In: Volume III of the RCRA Part B Application for the APE 2210 Deactivation Furnace Upgrade (RF-9). Hawthorne Army Depot. November 1996.

Shefferly, N. 1999. "Taxidea taxus" (On-line), Animal Diversity Web. Accessed July 15, 2004 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Taxidea_taxus.html.

USEPA (United States Environmental Protection Agency) 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

Taken from CHPPM 2004.

## Belted Kingfisher

The belted kingfisher, *Ceryle alcyon*, is a solitary, fish-eating bird that inhabits aquatic environments throughout North America. Belted Kingfishers prefer clear, shallow water to enhance their hunting strategy of diving and capturing their prey. They dig nests in burrows on the shore banks away from large amounts of brush and vegetation. This avian was chosen as a receptor for the aquatic food web to represent the piscivorous feeding guild and is considered protective of other piscivorous avian species, such as the state-protected American White Pelican (*Pelecanus erythrorhynchos)*, which is known to inhabit Walker Lake. The belted kingfisher will not be evaluated for Cat Dam Reservoir as the reservoir does not support fish species, and is, therefore, not suitable habitat for a piscivorous bird.

**Biological Characteristic**s

Body weight (BW): 0.147 kg
The *Wildlife Exposure Factors Handbook* (USEPA 1993) reports that the mean body weight for adult belted kingfishers ranges from 0.136 to 0.158 kg. A value of 0.147 kg has been selected as the midpoint of these values.

Normalized ingestion rate (NIR): 0.50 kg/kg-d ww
According to the *Wildlife Exposure Factors Handbook* (USEPA 1993), the food ingestion rate for belted kingfishers is 0.50 g/g-d. This value is a result of a study in Michigan for adult belted kingfishers of both sexes.

Normalized ingestion rate of water (NIRw): 0.11 L/kg-d
The estimated water ingestion rate by the *Wildlife Exposure Factors Handbook* (USEPA 1993) for adult belted kingfishers of both sexes is 0.11 g/g-d or 0.11 L/kg-d.

Exposure frequency (EF)
As stated in the *Wildlife Exposure Factors Handbook* (USEPA 1993), belted kingfishers that spend the breeding season in the coldest parts of North America migrate into the continental United States for the winter season to avoid the ice that eliminates their hunting grounds. Belted kingfishers that reside in the U.S. do not need to migrate; therefore, they remain resident year round. The exposure frequency is 365 days/yr.

Exposure duration (ED)
No longevity values have been found for belted kingfishers.

Assimilation efficiency of consumed food (AE)
The *Wildlife Exposure Factors Handbook* (USEPA 1993) reports an assimilation efficiency value of 79% for eagles and seabirds that consume fish. This diet best corresponds to that of the belted kingfisher.

Home Range
The territories reported in the *Wildlife Exposure Factors Handbook* (USEPA 1993) for belted kingfishers range depending on the season. Breeding pairs in early summer cover 1.03 to 2.19 km of shoreline and non-breeding pairs in late summer cover 0.39 to 1.03 km of shoreline.

**Ecological Characteristics**

Belted kingfishers dive into the water to catch their prey, capturing the fish that reside at or near the surface. They consume a variety of different organisms, depending on which ones are most abundant. The types of fish they consume are trout and forage fish such as minnows. In addition to fish, belted kingfishers consume crayfish, crabs, and insects regularly. At times of food shortage, they will also prey upon amphibians, birds, and small mammals. This information was obtained from the *Wildlife Exposure Factors Handbook* (USEPA 1993) and is based on data from for riparian streams in Nova Scotia.

Proportion of diet that is omnivorous/game fish: 69%
This number was taken from data reported in the *Wildlife Exposure Factors Handbook* (USEPA 1993) for riparian streams in Nova Scotia during the summer season. The value for omnivorous/game fish given for belted kingfishers comes from the sum for salmon fry (11%), one year old salmon (42%), two year old salmon (1%) and trout (15%) to yield a total of 69%.

Proportion of diet that is forage fish: 30%
This number was taken from data reported in the *Wildlife Exposure Factors Handbook* (USEPA 1993) for riparian streams in Nova Scotia during the summer season. The value for forage fish given for belted kingfishers comes from the value for sticklebacks of 30%.

Proportion of diet that is soil/sediment: 0%
There was no designated value for the soil/sediment ingestion by belted kingfishers or any other similar avian species in eating habits and dietary composition (USEPA 1993). Additionally, CH2MHILL (2001) indicates that because kingfishers primarily feed on fish near the surface of the water, sediment ingestion is expected to be negligible.

References
CH2MHILL. 2001. Development of Terrestrial Exposure and Bioaccumulation Information for the Army Risk Assessment Modeling System (ARAMS). Prepared for US Army Center for Health Promotion and Preventive Medicine, Health Effects Research Program. March 2001.

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

Taken from CHPPM 2004.

## Canada Goose

The Canada goose, *Branta canadensis*, inhabits reservoirs, ponds, gravel pits, marshes, rivers, croplands and urban areas (SWReGAP 2006). Canada geese prefer to nest on dry ground, with nesting sites are close to open water with visibility in all directions. The Canada goose usually returns to the same nesting site from year to year. Canada geese feed primarily on roots, tubers, and leaves of various food plants which are usually locally abundant (Reeves, S.L. 2006). This avian was chosen as a receptor for the aquatic food webs to represent the herbivorous avian guild because it is known to inhabit the HWAD area (SWReGAP, 2006).

**Biological Characteristic**s

Body weight (BW): 3237 g
This BW represents the average of the adult male and female BW data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Normalized ingestion rate (NIR): 0.32 g/g-day ww
This NIR represents the calculated value using the allometric equation presented in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) for all birds and the average BW presented above. An average moisture content of ingested plant matter of 88% was assumed (USEPA 1999).

Normalized water ingestion rate (NIRw): 0.04 g/g-day
This NIRw represents the calculated value using the allometric equation presented in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) for all mammals and the average BW presented above.

Normalized soil/sediment ingestion rate (NIRs): 0.003 g/g-day
This NIRs is based on the estimated percent soil in diet provided in the *Wildlife Exposure Factors Handbook* (USEPA 1993).

Exposure frequency (EF): 183
The Canada goose is known to summer in the HWAD area (SWReGAP 2006) so a value of 183 days was selected.

Exposure duration (ED): 24 y
This value represents the maximum lifespan reported for non-captive Canada geese (UMMZ 2006).

Assimilation efficiency of consumed food (AE): 56%
This value represents the AE reported for geese and grouse provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Home range: varies
Home range is assumed to be the size of the aquatic habitat selected.

**Ecological Characteristics**

The following dietary proportions have been selected for use in the model:

Proportion of diet that is aquatic plants: 100%
This proportion is based on the average of the dietary composition data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) for an aquatic habitat.

References

Reeves, Sonja L. 2006. Chlorogalum pomeridianum. In: Fire Effects Information System, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). http://www.fs.fed.us/database/feis. March 30.

UMMZ 2006. Animal Diversity Web. University of Michigan Museum of Zoology. http://animaldiversity.ummz.umich.edu/site/accounts/information/Ondatra_zibethicus.html.

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

USEPA 1999. Screening Level Ecological Risk Assessment Protocol. USEPA Region 6 and OSW. Volumes 1-3. EPA530-D-99-001A. August.

## Chukar Partridge

The chukar partridge, *Alectoris chukar*, an introduced species from Eurasia inhabits areas east of the Sierra Nevada and Cascade ranges (Ahlborn 2003). They inhabit dry sagebrush grasslands and deserts, in brushy river bottoms and arid mountain or canyon areas (Terres 1996). The chukar feeds primarily on grasses and seeds of weedy forbs (Ware and Tirhi 2004). While chukars are a non-native species, they hold an important role as a recreational species for hunting. This avian was chosen as a receptor for terrestrial sties to represent the seed-eating herbivore feeding guild because it is an abundant avian known to inhabit HWAD and may provide an important niche as a food source for higher order terrestrial predators.

**Biological Characteristics**

Body weight (BW): 0.578 kg
We will use the body weight given by IT Corporation (1996) of 0.578 kg.

Normalized ingestion rate (NIR): 0.08 kg/kg-d ww
The closest surrogate for the chukar partridge, based on dietary composition, that is found in the *Wildlife Exposure Factors Handbook* (USEPA 1993) is the Northern bobwhite quail. Therefore, the NIR of the Northern bobwhite quail as reported by the *Wildlife Exposure Factors Handbook* (USEPA 1993) will be used in this report for the chukar partridge. The *Wildlife Exposure Factors Handbook* (USEPA 1993) reports that the food ingestion rate for adults of both sexes ranges from 0.067 to 0.093 g/g-d. The midpoint value of 0.08 g/g-d will be used.

Normalized ingestion rate of water (NIRw)
A specific source of water cannot be pinpointed and all water gained is assumed to be through ingested food and metabolism. Therefore, $NIR_w$ will not be evaluated as a component of the oral dose for this project.

Exposure frequency (EF): 365 d
The information that is given in the *Field Guide to the Birds of North America, Fourth Edition* (National Geographic 2002) states that chukar partridges do not migrate, therefore the exposure frequency is 365 days/year.

Exposure duration (ED)
A data gap exists for the exposure duration of the chukar partridge since specific data for the chukar partridge are unavailable at this time.

Assimilation efficiency of consumed food (AE)
The value given in the "General Assimilation Efficiency Values" table in the *Wildlife Exposure Factors Handbook* (USEPA 1993) for birds that consume fruit pulp, skin, and seeds, is 51%. Since fruit and seeds compose the majority of the chukar partridge's diet, this value was selected. The other options for birds did not fit close enough to be included. The value of 51% refers to a diet closest to that of the chukar partridge.

Home range: 260 ha.

Chukar partridge coveys move daily over 260 hectares, which will be used as its home range for this evaluation (Ahlborn 2003).

**Ecological Characteristics**

The following dietary proportions have been selected for use in the model:

Proportion of diet that is above-ground plant parts: 81 %
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

Proportion of diet that is terrestrial invertebrates: 10 %
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

Proportion of diet that is soil: 9%
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

References

Ahlborn, G. 2003. California Department of Fish and Game, California Interagency Wildlife Task Group, Chukar home range notes. <http://www.dfg.ca.gov/whdab/html/B132.html>. Accessed 2004 Jul 15.

IT Corporation. 1996. RF-9 Incinerator Ecological Risk Assessment, Hawthorne Army Depot. Prepared for Hazardous Waste Remedial Actions Program. November. In: Volume III of the RCRA Part B Application for the APE 2210 Deactivation Furnace Upgrade (RF-9). Hawthorne Army Depot. November 1996.

National Geographic. (2002) *Field Guide to the Birds of North America, Fourth Edition*. National Geographic, Washington, D.C.

Terres, JK. 1996. *The Audubon Society Encyclopedia of North American Birds*. Alfred A. Knopf, Inc., New Jersey.

USEPA (United States Environmental Protection Agency) 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

Ware, DA and M Tirhi. 2004. Washington Department of Fish and Wildlife, Management Recommendations for Washington's Priority Species, Volume IV: Birds, Chukar, *Alectoris chukar*. <http://wdfw.wa.gov/hab/phs/vol4/chukar.htm>. Accessed 2004 Jul 13.

Taken from CHPPM 2004.

## Deer Mouse

The deer mouse, Peromyscus Maniculatus, is a small omnivorous mammal that primarily consumes grains but also consumes arthropods, green vegetation, roots, fruits and fungi when available. They inhabit habitats ranging from grass-sage communities to deciduous and ponderosa pine forests. This mammal was chosen as a receptor for the scrub/grassland food web to represent the herbivore feeding guild because it is an abundant mammal known to inhabit the HWAD and may provide an important niche as a food source for higher order terrestrial predators.

### Biological Characteristics

Body Weight (BW): 19.4 g
Deer mice have body weights ranging from 14.8 to 22 grams (g), as reported in the *Wildlife Exposure Factors Handbook* (USEPA 1993). The average of the values reported, 19.4 g was selected for use in the ERA.

Normalized ingestion rate (NIR): 1.4 g/g-day ww
This value was calculated using the allometric equation provided in USEPA 1999 and the BW presented above. A moisture content for ingested plant matter of 88% is assumed (USEPA 1999).

Normalized soil ingestion rate (NIRs): 0.0034 g/g-day
This value was calculated by multiplying the percent soil in diet (2%) by the food ingestion rate, on a dry-weight basis.

Exposure frequency (EF): 365 days/year
Deer mice do not migrate; therefore, the exposure frequency for the deer mouse is 365 days/year.

Exposure duration (ED): 3 years

Assimilation efficiency of consumed food (AE): 88%
The *Wildlife Exposure Factors Handbook* (USEPA 1993) reports an assimilation efficiency for deer mice of 88%.

Home range: Assumed to reside within selected forest habitat

### Ecological Characteristics

Deer mice consume a variety of vegetation, seeds, green vegetation and fungi in addition to invertebrates.

Proportion of diet that is plants: 61.5%
This proportion of the diet that is plant matter is the average of the data presented in the Wildlife *Exposure Factors Handbook* (USEPA 1993).

Proportion of diet that is invertebrates: 38.5%

This proportion of the diet that is plant matter is the average of the data presented in the Wildlife *Exposure Factors Handbook* (USEPA 1993).

Proportion of diet that is soil: 2%
This proportion is based on the data for the white-footed mouse presented in the *Wildlife Exposure Factors Handbook* (USEPA 1993).

References

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

USEPA 1999. Screening Level Ecological Risk Assessment Protocol. USEPA Region 6 and OSW. Volumes 1-3. EPA530-D-99-001A. August.

## Least Chipmunk

The least chipmunk, *Eutamias minimus*, is a small herbivorous mammal that consumes vegetation, seeds, nuts and fruits. They inhabit habitats ranging from sagebrush deserts to hardwood or coniferous forests. This mammal was chosen as a receptor for terrestrial sites to represent the herbivore feeding guild because it is an abundant mammal known to inhabit HWAD and may provide an important niche as a food source for higher order terrestrial predators.

**Biological Characteristics**

Body weight (BW): 0.031 kg
Least chipmunks are the smallest members of the chipmunk family, with a head and body length of 3 2/3 – 4 ½ inches and weights ranging from 28 – 57 grams (Burt and Grossenheider 1980). The BW given by IT Corporation (1996) of 0.031 kg will be used.

Normalized ingestion rate (NIR): 0.56 kg/kg-d ww
As the closest surrogate for the least chipmunk, data from the *Wildlife Exposure Factors Handbook* (USEPA 1993) for short-tailed shrew will be used instead. The NIR given in the *Wildlife Exposure Factors Handbook* (USEPA 1993) for adults of both sexes of short-tailed shrews came from the study by Morrison et al. (1957) and ranged from 0.49 g/g-day to 0.62 g/gday. The midpoint between the minimum and maximum ingestion rates of 0.56 g/g-day will be used for the evaluation of the least chipmunk.

Normalized ingestion rate of water (NIRw)
Chipmunks do not require a water source other than food, so a normalized ingestion rate of water is not reported (Harris 2003). Additionally, a specific source of water cannot be pinpointed so $NIR_w$ will not be evaluated as a component of the oral dose.

Exposure frequency (EF): 365 d/yr
The least chipmunks do not migrate; therefore, the exposure frequency for least chipmunks is 365 days/year.

Exposure duration (ED): 3 yrs
As stated in the *Peterson Field Guide* (Burt and Grossenheider 1980) for mammals, least chipmunks in the wild have been found to live up to three years of age.

Assimilation efficiency of consumed food (AE): 90%
The *Wildlife Exposure Factors Handbook* (USEPA 1993) reports an assimilation efficiency for short-tailed shrews as 90%. This number will be used for the least chipmunk as well.

Home range: 2.6 ha.
The mean home range of least chipmunks of both sexes, adults and juveniles, is roughly 2.6 hectares as reported in the eastern chipmunk entry of the *Peterson Field Guide* (Burt and Grossenheider 1980) for mammals.

**Ecological Characteristics**

Least chipmunks consume a variety of vegetation, seeds, fruits and nuts as well as insects and invertebrates (Burt and Grossenheider 1980).

Proportion of diet that is plants: 98%
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

Proportion of diet that is soil: 2%
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

References

Burt, WH, and RP Grossenheider. 1980. A Field Guild to the Mammals North America north of Mexico, 3rd Edition. Peterson Field Guides.

IT Corporation. 1996. RF-9 Incinerator Ecological Risk Assessment, Hawthorne Army Depot. Prepared for Hazardous Waste Remedial Actions Program. November. In: Volume III of the RCRA Part B Application for the APE 2210 Deactivation Furnace Upgrade (RF-9). Hawthorne Army Depot. November 1996.

Harris, J. 2003. California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch, Least Chipmunk life history notes. <http://www.dfg.ca.gov/whdab/html/M054.html>. Accessed 2004 Jul 12.

USEPA (United States Environmental Protection Agency) 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R- 3/187a.

Taken from CHPPM 2004.

## Little Brown Bat

The little brown bat, *Myotis lucifugus,* occurs in river canyons above permanent streams lined with cottonwood, willow, and mesic shrubs; deciduous forests of aspen, cottonwood, and mesic shrubs, often by high-gradient streams; coniferous forests of juniper, fir, spruce, and pine, often with cliffs and caves in the vicinity; and in caves and underground mines It frequents water sources to drink and forage. It prefers to forage over water but will also forage over clearings and in trees. This mammal was chosen as a receptor for the aquatic food web to represent the insectivorous mammal guild because it is known to inhabit the HWAD area and is a representative species for other state-protected bat species, such as the small-footed bat, long-eared bat and fringed bat.

**Biological Characteristics**

Body weight (BW): 8 g
This BW represents the average of the BW data provided in the *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants* (Sample et al, 1997)

Normalized ingestion rate (NIR): 1.12 g/g-day ww
This NIR represents the average of the NIR data provided in the *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants* (Sample et al, 1997)

Normalized water ingestion rate (NIRw): 0.16 g/g-day
This NIRw is the estimated value presented in the *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants* (Sample et al, 1997)

Normalized soil ingestion rate (NIRs): NA
Assumed to be negligible, as the little brown bat is an aerial insectivore (Sample et al, 1997)

Exposure frequency (EF): 275 d
Little brown bats hibernate during the winter months, assumed to be 4 months.

Exposure duration (ED): 2.15 y
This value represents an average life span for a female, which is longer than the typical life span reported for males (1.5 years) obtained from *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants* (Sample et al, 1997)

Assimilation efficiency of consumed food (AE): 100%
Assimilation efficiency data is not available; therefore, a value of 100% is assumed.

Home range: 660 ha
This value was obtained from the *Southwest Regional Gap Analysis Project* (SWReGAP, 2006) website.

**Ecological Characteristics**

The following dietary proportions have been selected for use in the model:

Proportion of diet that is invertebrates: 100%
This proportion is based on data provided in *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants* (Sample et al, 1997).

Proportion of diet that is soil: 0%
This proportion is based on data provided in *Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants* (Sample et al, 1997).

References

Sample, B.E., Aplin, M.s., Efroymson, R.A., Sutter II, G.W., and Welsh, C.J.E. 1997. Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants. Oak Ridge National Laboratory, Oak Ridge. ORNL/TM-13391. October.

SWReGAP 2006. Southwest Regional Gap Analysis Project, Animal Habitat Models. http://fws-nmcfwru.nmsu.edu/swregap/habitatreview/

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

## Long-Tailed Weasel

The long-tailed weasel, *Mustela Frenata*, is a small carnivorous mammal that primarily consumes rodents and other small mammals. While they are highly opportunistic foragers, primary prey of weasels consist of voles and deer mice, both of which are present within the assessment area. Less common prey include grasshopper mice, harvest mice, woodrats, cotton rats, muskrats, meadow jumping mice and chipmunks. They inhabit habitats ranging from grass-sage communities to deciduous and ponderosa pine forests. This mammal was chosen as a receptor for the forest food web to represent the carnivore mammal feeding guild because it is known to inhabit the HWAD and may provide an important niche as a regulator of small mammal populations and is also a food source for higher trophic level predators, such as the red-tailed hawk.

**Biological Characteristics**

Body Weight (BW): 227 g
This value was obtained from data on male and female long-tailed weasels in Nevada (Sample et al, 1997).

Normalized ingestion rate (NIR): 0.333 g/g-day ww
The NIR is provided in USEPA 1999.

Normalized water ingestion rate (NIRw): 0.127 g/g-day
The NIR is provided in USEPA guidance (1999) and was derived using the allometric equations given in the *Wildlife Exposure Factors Handbook* (USEPA 1993).

Normalized soil ingestion rate (NIRs): 0.003 g/g-day
The NIR is provided in USEPA guidance (1999) and was derived using the allometric equations given in the *Wildlife Exposure Factors Handbook* (USEPA 1993).

Exposure frequency (EF): 365 d
Long-tailed weasels do not migrate; therefore, the exposure frequency for the long-tailed weasel is 365 days/year.

Exposure duration (ED): 3 years
The lifespan for short-tailed weasels in the wild is reported to be 4 to 6 years. This is consistent with observations made of adult long-tailed weasels within the same area in Colorado for 3 years (Sample et al, 1997). Therefore, a value of 3 years will be used.

Assimilation efficiency of consumed food (AE): 91%
The AE is the highest AE value reported in the *Wildlife Exposure Factors Handbook* (USEPA 1993).

Home range: highly variable
The home range for long-tailed weasels and weasels in general is highly variable and dependent on food availability (Sample et al, 1997). Therefore, it will be assumed that the home range is within the habitat being evaluated.

**Ecological Characteristics**

Long-tailed weasels primarily consume a variety of small mammals, although it may consume reptiles and birds, as it is an opportunistic hunter.

Proportion of diet that is small mammals: 100%
This proportion is assumed based on research for long-tailed weasels in California (Sample et al 1997).

References
USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

Sample, B.E., Alpin, M.S. Efroymson, R.A. Suter II, G.W. and Welsh, C.J.E. Methods and Tools for Estimation of the Exposure of Terrestrial Wildlife to Contaminants. Oak Ridge National Laboratory. Oak Ridge. ORNL/TM-13391. October.

## Mallard

The Mallard, *Anas Platyrhynchos*, inhabits wetlands, rivers and reservoirs, and nests in dense grassy vegetation that provide concealment from predators. The mallard feeds mostly on aquatic plants, seeds and aquatic invertebrates, depending on the Season. Nests are usually located within a few kilometers of water (USEPA, 1993). This avian was chosen as a receptor for the aquatic food webs to represent the omnivorous bird guild because it is known to inhabit the HWAD area (BRRC, 2006) and may provide an important niche as a food source for higher order terrestrial predators.

### Biological Characteristics

Body weight (BW): 1162 g
This BW represents the average of the BW data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Normalized ingestion rate (NIR): 0.25 g/g-day
This NIR represents the calculated value using the allometric equation presented in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) for non-passerine avian species and the average BW presented above. A moisture content of 78% for ingested food items is assumed (USEPA 1999).

Normalized water ingestion rate (NIRw): 0.056 g/g-day
This NIRs represents the value provided in USEPA guidance (USEPA, 1999).

Normalized soil ingestion rate (NIRs): 0.003 g/g-day
This NIRs represents the value provided in *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Exposure frequency (EF): 365
The mallard is a resident avian species (BRRC, 2006) so a value of 365 days was selected.

Exposure duration (ED): 29 y
This value represents a maximum recorded life span (Clapp et al, 1982).

Assimilation efficiency of consumed food (AE): 23%
The AE is the value reported for ducks in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

### Ecological Characteristics

The following dietary proportions have been selected for use in the model:

Proportion of diet that invertebrates: 74%
This proportion is based on data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) for breeding females.

Proportion of diet that is seeds: 25%
This proportion is based on data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) for breeding females.

Proportion of diet that is plants: 4%
This proportion is based on data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) for breeding females.

References

Clapp, R.B., M.K. Klimkiewicz, and J.H. Kennard, 1982. Longevity records of North American birds: Gaviidae through Alcidae. Journal of Field Ornithology 53: 81-124, 125-208.

BRRC 2006. Biological Resources Research Center, University of Nevada. Reno. http://www.brrc.unr.edu/ March.

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

USEPA 1999. Screening Level Ecological Risk Assessment Protocol. USEPA Region 6 and OSW. Volumes 1-3. EPA530-D-99-001A. August.

## Merriam's Shrew

Merriam's shrew, *Sorex merriami*, is a small insectivorous mammal that has a high metabolism and, thus, consumes large amounts of insects and invertebrates. They inhabit arid areas abundant with sagebrush or bunchgrass in the western United States. The *Wildlife Exposure Factors Handbook* (USEPA 1993) provides a detailed evaluation of exposure factors for the short-tailed shrew and recommends that the short-tailed shrew can be used to develop surrogate exposure factors for Merriam's shrew because they are similar species and are within the same feeding niche. Therefore, we use the data from the short-tailed shrew for Merriam's shrew. This mammal was chosen as a receptor for terrestrial sites to represent the insectivore feeding guild because it is an abundant mammal known to inhabit HWAD and may provide an important niche as a food source for higher order terrestrial predators.

### Biological Characteristics

Body weight (BW): 0.0054 kg
We will use the body weight as noted by IT Corporation (1996) of 0.0054 kg.

Normalized ingestion rate (NIR): 0.56 kg/kg-d ww
As the closest surrogate for Merriam's shrew, data from the *Wildlife Exposure Factors Handbook* (USEPA 1993) for short-tailed shrew will be used instead. The NIR given in the *Wildlife Exposure Factors Handbook* (USEPA 1993) for adults of both sexes of short-tailed shrews came from the study by Morrison et al. (1957) and ranged from 0.49 g/g-day to 0.62 g/g-day. The midpoint between the minimum and maximum ingestion rates of 0.56 g/g-day will be used for the evaluation of Merriam's shrews.

Normalized ingestion rate of water (NIRw)
A specific source of water cannot be pinpointed and all water gained is assumed to be through ingested food and metabolism. Therefore, $NIR_w$ for the Merriam's shrew is not evaluated for this project.

Exposure frequency (EF): 365 d/yr
The Merriam's shrew does not migrate; therefore, the exposure frequency for Merriam's shrew is 365 days/year, as taken from information given in the *Wildlife Exposure Factors Handbook* (USEPA 1993).

Exposure duration (ED): 20 months
As stated in the *Wildlife Exposure Factors Handbook* (USEPA 1993), shrews in New York fields have been found to live up to 20 months.

Assimilation efficiency of consumed food (AE): 90%
The *Wildlife Exposure Factors Handbook* (USEPA 1993) reports an assimilation efficiency for short-tailed shrews as 90%. This number will be used for the Merriam's shrew as well.

Home range: 0.39 ha
The mean home range of short-tailed shrews of both sexes, adults and juveniles, is 0.39 ha, as reported in the *Wildlife Exposure Factors Handbook* (USEPA 1993) and will be used as a surrogate for the Merriam's shrew home range.

**Ecological Characteristics**

Merriam's shrews consume insects and invertebrates such as earthworms, snails, and beetles. This information was obtained in the *Wildlife Exposure Factors Handbook* (USEPA 1993).

Proportion of diet that is terrestrial invertebrates: 87 %
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996). Merriam's shrews eat a variety of invertebrates. This includes earthworms, slugs, and snails, which compose much of the invertebrate portion of the diet. Also included are lepidopteran larvae, chilopods, and beetles.

Proportion of diet that is soil: 13%
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

References

IT Corporation. 1996. RF-9 Incinerator Ecological Risk Assessment, Hawthorne Army Depot. Prepared for Hazardous Waste Remedial Actions Program. November. In: Volume III of the RCRA Part B Application for the APE 2210 Deactivation Furnace Upgrade (RF-9). Hawthorne Army Depot. November 1996.

Morrison PR, Pierce M, Ryser FA. 1957. Food consumption and body weight in the masked and short-tailed shrews (genus *Blarina*) in Kansas, Iowa, and Missouri. Ann. Carnegie Mus. 51: 157-180.

USEPA (United States Environmental Protection Agency) 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

Taken from CHPPM 2004.

## Mink

The mink, *Mustela vison*, is a carnivorous mammal common to most parts of the United States, Canada, and Mexico, with the exception of severely cold or dry regions. Mink inhabit aquatic environments that contain the brush and debris required for dens. They are nocturnal and consume both aquatic and terrestrial organisms. Mink are known to be sensitive to a buildup of PCBs and other related chemicals in their subcutaneous fat. They are rather solitary animals and are active year-round (USEPA 1993). This mammal was chosen as a receptor for the Walker Lake aquatic food web to represent the piscivorous feeding guild because it is an abundant mammal known to inhabit Walker Lake and Rose Creek Reservoir on HWAD. The mink will not be evaluated for Cat Dam Reservoir as the reservoir does not support fish species and is, therefore, not suitable habitat for a piscivorous mammal.

### Biological Characteristics

Body weight (BW): 1.14 kg
According to the *Wildlife Exposure Factors Handbook* (USEPA 1993), the body weight of mink fluctuates, being higher in the fall than in the summer. Males, ranging from 1.04 to 1.23 kg, weigh significantly more than females, weighing only from 0.550 to 0.586 kg. Therefore, based on professional judgment (i.e., considering that larger body weights would provided a more conservative estimate of exposure), the midpoint of range of male body weights (1.14 kg) was chosen.

Normalized ingestion rate (NIR): 0.22 kg/kg-d ww
The *Wildlife Exposure Factors Handbook* (USEPA 1993) reports that the food ingestion rate for adult male minks is 0.22 g/g-d. This is a year-round average.

Normalized ingestion rate of water (NIRw): 0.105 L/kg-d
The water ingestion rate, as included in the *Wildlife Exposure Factors Handbook* (USEPA 1993), spans between 0.099 L/kg-d (males) and 0.11 L/kg-d (females). The midpoint of 0.105 L/kg-d was chosen.

Exposure frequency (EF): 365 d/yr
Mink are active year-round residents; therefore, the exposure frequency is 365 days/year, as reported by the *Wildlife Exposure Factors Handbook* (USEPA 1993).

Exposure duration (ED): 7 yrs
According to the *Wildlife Exposure Factors Handbook* (USEPA 1993), the mean longevity for female minks is 7 years. A maximum life span of 11 years was reported for farm-raised mink.

Assimilation efficiency of consumed food (AE): 91%
The table in the *Wildlife Exposure Factors Handbook* (USEPA 1993) reports an assimilation efficiency value of 91% for mammals that consume fish. This value most closely represents the diet of mink because the majority of the mink's diet is fish.

Home range: 2.63 km
Male adult mink have much larger home ranges than females. The mean given in the *Wildlife Exposure Factors Handbook* (USEPA 1993) for males is 2.63 km, and for females is 1.85 km.

**Ecological Characteristics**

Mink consume a variety of different foods, which can differ between populations according to the surrounding habitat and the conditions affecting it. They feed on the most abundant prey, and a large part of the mink's diet is fish, which mostly includes trout, but consists of other types of fish as well. In addition to fish, mink consume crustaceans, amphibians, birds, small mammals, and some vegetation. They are nocturnal hunters that feed in marshy areas of brush and vegetation along the shoreline. This information was obtained from the *Wildlife Exposure Factors Handbook* (USEPA 1993).

Proportion of diet that is omnivorous/ game fish (trout): 54%
In the *Wildlife Exposure Factors Handbook* (USEPA 1993), values for the dietary composition of mink are given for two different populations in Michigan: mink that inhabit the river and mink that inhabit the stream. The percentage of trout that composes the diet of the mink ranges between 52% (stream) and 56% (river). The indicated value is the midpoint of this range.

Proportion of diet that is forage fish: 19%
In the *Wildlife Exposure Factors Handbook* (USEPA 1993), values for the dietary composition of mink are given for two different populations in Michigan: mink that inhabit the river and mink that inhabit the stream. The percentage of non-trout fish and unidentified fish that compose the diet of the mink ranges between 9% (stream) and 29% (river). The indicated value is the midpoint of this range.

Proportion of diet that is vegetation: 9%
In the *Wildlife Exposure Factors Handbook* (USEPA 1993), values for the dietary composition of mink are given for two different populations in Michigan: mink that inhabit the river and mink that inhabit the stream. The percentage of vegetation that composes the diet of the mink ranges between 1% (river) and 17% (stream). The indicated value is the midpoint of this range.

Proportion of diet that is benthic invertebrates (crustaceans): 7.5%
In the *Wildlife Exposure Factors Handbook* (USEPA 1993), values for the dietary composition of mink are given for two different populations in Michigan: mink that inhabit the river and mink that inhabit the stream. The percentage of crustaceans that composes the diet of the mink ranges between 4% (river) and 11% (stream). The indicated value is the midpoint of this range.

Proportion of diet that is soil: 2.5%
In the *Wildlife Exposure Factors Handbook* (USEPA 1993), no value was given for soil ingestion by mink. The value used is the remainder of the 100% total in the diet composition of mink. Note that the sum of the proportions of the diet may not equal 100%. USEPA (1999) recommends that generally interactions that contribute less than five percent of the total diet should not be considered for development of a food web because the assumption is made that the food web can be simplified without underestimating exposure.

References

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

Taken from CHPPM 2004.

## Mourning Dove

The mourning dove, *Zenaida macroura*, inhabits open woodlands and the edges between forest and prairies. The mourning dove forages primarily on seeds. This avian was chosen as a receptor for the forest food webs to represent the herbivorous bird guild because it is known to inhabit the HWAD area and may provide an important niche as a food source for higher order terrestrial predators.

### Biological Characteristics

Body weight (BW): 150 g
This BW was obtained from USEPA 1999.

Normalized ingestion rate (NIR): 0.94 g/g-day ww
This NIR represents the calculated value using the allometric equation presented in the *Wildlife Exposure Factors Handbook* (USEPA 1993) and the average BW presented above. A moisture content of 88% is assumed for ingested plant matter (USEPA 1999).

Normalized water ingestion rate (NIRw): 0.019 g/g-day
This NIRw represents the calculated value using the allometric equation presented in the *Wildlife Exposure Factors Handbook* (USEPA 1993) and the average BW presented above.

Normalized soil ingestion rate (NIRs): 0.007 g/g-day
This NIRs represents the value provided in USEPA guidance (USEPA, 1999).

Exposure frequency (EF): 365 d
The mourning dove resides in the Hawthorne area year-round (SWReGAP, 2006).

Exposure duration (ED): 1.5 y
This value was obtained from the United States Geological Survey's Patuxent Database (USGS 2006).

Assimilation efficiency of consumed food (AE): 100%
Assimilation efficiency data is not available; therefore, a value of 100% is assumed.

Home range: 1000 ha
This value represents the average foraging home range data presented in the *Wildlife Exposure Factors Handbook* (USEPA 1993).

### Ecological Characteristics

The following dietary proportions have been selected for use in the model:

Proportion of diet that is seeds and grains: 99%
This proportion is based on data provided in the Southwest Regional GAP database (SWReGAP, 2006).

References

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

SWReGAP 2006. Southwest Regional Gap Analysis Project. http://fws-nmcfwru.nmsu.edu/swregap/habitatreview/

USEPA 1999. Screening Level Ecological Risk Assessment Protocol. USEPA Region 6 and OSW. Volumes 1-3. EPA530-D-99-001A. August.

USGS 2006. Patuxent Bird Identification Infocenter. US Geological Survey, Patuxent Research Center. http://www.mbr-pwrc.usgs.gov/id/framlst/infocenter.html

## Muskrat

The muskrat, *Ondatra zibethicus*, inhabits riparian habitats along permanent supplies (SWReGAP 2006). Muskrats feed primarily on aquatic plants, including marsh grasses and sedges (USEPA, 1993). This mammal was chosen as a receptor for the aquatic food webs to represent the herbivorous mammal guild because it is known to inhabit the HWAD area (SWReGAP, 2006).

### Biological Characteristics

Body weight (BW): 1174 g
This BW represents the average of the adult male and female BW data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Normalized ingestion rate (NIR): 0.24 g/g-day ww
This NIR represents the calculated value using the allometric equation presented in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) for all mammals and the average BW presented above. A moisture content of 88% is assumed for ingested plant matter (USEPA 1999).

Normalized water ingestion rate (NIRw): 0.049 g/g-day
This NIRw represents the calculated value using the allometric equation presented in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) for all mammals and the average BW presented above.

Normalized sediment ingestion rate (NIRs): 0.00064 g/g-day
This NIRs is based on the sediment ingestion rate data provided in Beyer et al 1994, as reported in USEPA 1999.

Exposure frequency (EF): 365
The mallard is a resident avian species (BRRC, 2006) so a value of 365 days was selected.

Exposure duration (ED): 3 y
This value represents a typical value for muskrats living in the wild (UMMZ 2006).

Assimilation efficiency of consumed food (AE): 91%
This value represents the highest AE reported for mammals provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Home range: 0.3 ha
This value was obtained from the SWReGAP Wildlife Habitat Relationship Report (SWReGAP 2006).

### Ecological Characteristics

The following dietary proportions have been selected for use in the model:

Proportion of diet that is aquatic plants: 100%
This proportion is based on the average of the dietary composition data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

References

Beyer, N., Conner, E. and Gerould, S. 1994 Estimates of Soil Ingestion by Wildlife. Journal of Wildlife Management. Volume 58. Pages 375-382.

BRRC 2006. Biological Resources Research Center, University of Nevada. Reno. http://www.brrc.unr.edu/ March.

UMMZ 2006. Animal Diversity Web. University of Michigan Museum of Zoology. http://animaldiversity.ummz.umich.edu/site/accounts/information/Ondatra_zibethicus.html.

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

USEPA 1999. Screening Level Ecological Risk Assessment Protocol. USEPA Region 6 and OSW. Volumes 1-3. EPA530-D-99-001A. August.

## Raccoon

The raccoon, *Procyon lotor*, inhabits aquatic habitats, including floodplain forests, freshwater and saltwater marshes. The raccoon is an opportunistic feeder, but feed primarily on fleshy fruits, nuts, grains, insects, frogs, eggs and virtually any animal and vegetable matter (USEPA, 1993). This mammal was chosen as a receptor for the aquatic food webs to represent the omnivorous mammal guild because it is known to inhabit Nevada (SWReGAP, 2006). It is selected as a surrogate species for other omnivorous mammals that provide an important niche as a food source for higher order terrestrial predators.

### Biological Characteristics

Body weight (BW): 4930 g
This BW represents the average of the adult male and female BW data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Normalized ingestion rate (NIR): 0.24 g/g-day ww
This NIR represents the calculated value using the allometric equation presented in the *Wildlife Exposure Factors Handbook* (USEPA, 1993) for all mammals and the average BW presented above. A moisture content of 78% is assumed for ingested food items (USEPA 1999).

Normalized water ingestion rate (NIRw): 0.084 g/g-day
This NIRs represents the value provided in USEPA guidance (USEPA, 1999).

Normalized soil ingestion rate (NIRs): 0.0049 g/g-day
This NIRs was calculated by multiplying the NIR by the percentage of soil ingested on a daily basis for raccoons, 9.3% reported in Beyer et al, 1994.

Exposure frequency (EF): 365
The raccoon is a resident mammalian species so a value of 365 days was selected.

Exposure duration (ED): 5 y
This value represents the life span raccoons are not expected to exceed in the wild (Reeves, S.L. 2006).

Assimilation efficiency of consumed food (AE): 91%
This value represents the highest AE reported for mammals provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

### Ecological Characteristics

The following dietary proportions have been selected for use in the model:

Proportion of diet that is aquatic macroinvertebrates: 53%
This proportion is based on the average of the dietary composition data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Proportion of diet that is insects: 8%
This proportion is based on the average of the dietary composition data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Proportion of diet that is reptiles/amphibians: 3.5%
This proportion is based on the average of the dietary composition data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Proportion of diet that is seeds, grains, fruits: 39%
This proportion is based on the average of the dietary composition data provided in the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Proportion of diet that is soil: 9.4%
This value is presented in the *Wildlife Exposure Factors Handbook* (USEPA 1993).

References

Beyer, N., Conner, E. and Gerould, S. 1994 Estimates of Soil Ingestion by Wildlife. Journal of Wildlife Management. Volume 58. Pages 375-382.

BRRC 2006. Biological Resources Research Center, University of Nevada. Reno. http://www.brrc.unr.edu/ March.

Clapp, R.B., M.K. Klimkiewicz, and J.H. Kennard, 1982. Longevity records of North American birds: Gaviidae through Alcidae. Journal of Field Ornithology 53: 81-124, 125-208.

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

USEPA 1999. Screening Level Ecological Risk Assessment Protocol. USEPA Region 6 and OSW. Volumes 1-3. EPA530-D-99-001A. August.

Reeves, Sonja L. 2006. Chlorogalum pomeridianum. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis [2006, March 30].

## Red-Tailed Hawk

The red-tailed hawk (*Buteo jamaicensis*) was chosen to represent top-level carnivores that inhabit the HWAD habitat. Red-tailed hawks are commonly found in a wide variety of habitats of Nevada, including deserts and plains with scattered trees and open mountain forests. This avian was chosen as a receptor for terrestrial sites to represent the carnivore feeding guild because it is an avian known to inhabit HWAD. It is important in this evaluation because it fills the highest trophic level for avians in terrestrial scenarios.

**Biological Characteristics**

Body weight (BW): 1.126 kg
We will use the body weight given by IT Corporation (1996) of 1.126 kg.

Normalized ingestion rate (NIR): 0.175 kg/kg-d ww
The NIR of the red-tailed hawk was able to be calculated from equation 3-5 in the *Wildlife Exposure Factors Handbook* (USEPA 1993).

$$NIR = (0.0582(BW)_{0.651})/BW$$

where:
NIR = Normalized ingestion rate (kg/kg-day)
BW = Body weight (kg)
The resulting NIR is 0.056 kg DW/kg-day based on using the above body weight. This value was converted to a food ingestion rate based on an assumed moisture content of prey species of 68% (USEPA 1999).

Normalized ingestion rate of water (NIRw)
The specific source of water for ingestion cannot be pinpointed and all water gained is assumed to be through ingested food and metabolism. Therefore, NIRw for the red-tailed hawk is nonapplicable for this project.

Exposure frequency (EF): 365 d/yr
According to USEPA (1993), the red-tailed hawk is territorial year-round, including winter, in the southern portion of its North American rangelands. In addition, it has been found that these territories very little from year to year; therefore, the species is assumed to not migrate from the region. The selected value for EF is 365 days/year.

Exposure duration (ED): 24 yrs
The *Wildlife Exposure Factors Handbook* (USEPA 1993) reports that this species can live up to a maximum of 18 years; however, other sources have reported red-tailed hawks living as long as 26-29 years (Klimkiewicz, 2000; Terres, 1996). For this evaluation the average age of 24 years will be used.

Assimilation efficiency of consumed food (AE): 78%
The value for assimilation efficiency given in the *Wildlife Exposure Factors Handbook* (USEPA 1993) for birds of prey feeding birds and small mammals is 78%. The exposure model assumes an AE of 78%.

Home range: 110 ha
The home range of the red-tailed hawk varies with the season and food availability. The values given in the *Wildlife Exposure Factors Handbook* (USEPA 1993) for adult hawks of both sexes ranged from a low of 60 - 160 ha in the spring to a high of 957 – 2,465 ha in the fall. For this evaluation the average of the lower home range of 110 ha will be used.

**Ecological Characteristics**

The diet of the red-tailed hawk consists primarily of ground-dwelling vertebrate, especially rodents and other small mammals; however in wintering area, red-tailed hawks will prey on medium to fairly large birds (quail, meadowlark) chiefly caught on ground (Virginia Fish and Wildlife Information Service). These hawks are daytime predators in open or semi-open areas, usually hunting from the air or exposed perches. Where forests are more abundant, red-tailed hawks nest close to the tops of trees in low-density forests; however, where there are less trees, nesting is done on ledges, rock pinnacles, or man-made structures.

The following dietary proportions have been selected for use in the model:

Proportion of diet that is terrestrial omnivores: 65%
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

Proportion of diet that is terrestrial herbivores: 25%
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

Proportion of diet that is birds: 9%
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

Proportion of the diet that is soil (Ps): 2%
This proportion is based upon data presented in Table 2.2 *Data Used to Model Exposure in the Indicator Species at the Mount Grant Exposure Point* taken from the IT Corporation Report (1996).

References

CH2MHILL. 2001. Development of Terrestrial Exposure and Bioaccumulation Information for the Army Risk Assessment Modeling System (ARAMS). Prepared for US Army Center for Health Promotion and Preventive Medicine, Health Effects Research Program. March 2001.

IT Corporation. 1996. RF-9 Incinerator Ecological Risk Assessment, Hawthorne Army Depot. Prepared for Hazardous Waste Remedial Actions Program. November. In: Volume III of the RCRA Part B Application for the APE 2210 Deactivation Furnace Upgrade (RF-9). Hawthorne Army Depot. November 1996.

Klimkiewicz, M. K. 2000. Longevity Records of North American Birds. Version 2000.1.

Patuxent Wildlife Research Center. Bird Banding Laboratory. Laurel MD. Found at http://www.pwrc.nbs.gov/bbl/homepage/longvrec.htm. *As cited in CHPPM 2004.*

Terres, John K.: The Audubon Encyclopedia of North American Birds. ISBN 0-517-03288-0, 1996.

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

USEPA 1999. Screening Level Ecological Risk Assessment Protocol. USEPA Region 6 and OSW. Volumes 1-3. EPA530-D-99-001A. August.

Virginia Fish and Wildlife Information Service, an extension of the Virginia Department of Game & Inland Fisheries, found at http://www.dgif.state.va.us. *As cited in CHPPM 2004.*

Taken from CHPPM 2004.

## Snow Plover

The snowy plover, *Charadrius alexandrinus*, is a small avian that feeds on crustaceans, marine worms, beetles, flies and other various terrestrial and aquatic invertebrates (Tague 2000). They inhabit sandy marine and estuarine shores and salt ponds or alkaline lakes in the interior of North America (Terres 1996). Snowy plovers require sandy or gravelly soil for nesting and frequently nest under driftwood or rocks (Rigney 2003). This avian was chosen as a receptor for aquatic sites to represent the insectivorous feeding guild for the aquatic food web because it is an abundant avian known to inhabit Walker Lake and Cat Dam Reservoir on HWAD and it is a State-protected species.

### Biological Characteristics

Body weight (BW): 0.04 kg
We will use the body weight given by Sibley (2000) of 0.04 kg.

Normalized ingestion rate (NIR): 0.81 kg/kg-d dw
The NIR of the snowy plover was calculated from equation 3-3 in the *Wildlife Exposure Factors Handbook* (USEPA 1993). A moisture content of 78% for ingested food items is assumed (USEPA 1999).

Normalized ingestion rate of water (NIRw): 0.171 L/kg body weight/day
The water ingestion rate was calculated using the allometric equation from the *Wildlife Exposure Factors Handbook* (USEPA 1993) to determine a NIRw for snowy plovers.

Exposure frequency (EF): 165 d/yr
Based upon information in the *National Geographic Field Guide to the Birds of North America* (National Geographic 2002), snowy plover will tend to winter in the southern United States during Fall and Winter. The selected value for EF is estimated to be 165 days/year.

Exposure duration (ED):A data gap exists for the exposure duration of the snowy plover since specific data for the snowy plover are unavailable at this time.

Assimilation efficiency of consumed food (AE): 77%
The exposure model assumes that snowy plover assimilate approximately 77% of their food. This value is given in the *Wildlife Exposure Factors Handbook* (USEPA 1993) for birds eating aquatic insects.

Home range: 706.5 ha.
For breeding adults the home range was calculated to be 706.5 hectares (Rigney 2003).

### Ecological Characteristics

The following dietary proportions have been selected for use in the model:

Proportion of diet that is aquatic invertebrates: 81%

The snowy plover's diet consists of invertebrates split between aquatic and terrestrial. However since receptors are not being associated with a particular water body we will assume its diet consists entirely of aquatic invertebrates.

Proportion of diet that is sediment: 19%
The *Development of Terrestrial Exposure and Bioaccumulation Information for the Army Risk Assessment Modeling System* (ARAMS) (CH2MHILL 2001) notes soil ingestion of the spotted sandpiper's diet between 7.3 and 30 percent. The average value, 19 percent, will be used.

Snowy plover are mostly found in western United States. Data on the spotted sandpipers were chosen because they may be the closest surrogate species for the snowy plover.

References

CH2MHILL. 2001. Development of Terrestrial Exposure and Bioaccumulation Information for the Army Risk Assessment Modeling System (ARAMS). Prepared for US Army Center for Health Promotion and Preventive Medicine, Health Effects Research Program. March 2001.

National Geographic. (2002) Field Guide to the Birds of North America, Fourth Edition. National Geographic, Washington, D.C.

Rigney, M. 2003. California Department of Fish and Game, California Interagency Wildlife Task Group, Snowy Plover home range notes. <http://www.dfg.ca.gov/whdab/html/B154.html>. Accessed 2004 Jul 15. *As cited in CHPPM 2004.*

Tague, K. 2000. "Charadrius alexandrinus"(On-line), Animal Diversity Web. Accessed July 13, 2004 at http://animaldiversity.ummz.umich.edu/site/accounts/information/Charadrius_alexandrinus.htm. *As cited in CHPPM 2004.*

Terres, JK. 1996. The Audubon Society Encyclopedia of North American Birds. Alfred A. Knopf, Inc., New Jersey.

Sibley, DA. (2000) National Audubon Society: The Sibley Guide to Birds. Chantideer Press, Inc., New York.

USEPA 1993. Wildlife Exposure Factors Handbook. Office of Health and Environmental Assessment. EPA/600/R-93/187a.

USEPA 1999. Screening Level Ecological Risk Assessment Protocol. USEPA Region 6 and OSW. Volumes 1-3. EPA530-D-99-001A. August.

Taken from CHPPM 2004.

# APPENDIX A
# STACK SAMPLING REPORT

## A.1 Narrative

Weston Solutions, Inc. performed the stack emissions sampling during the CPT. This appendix contains detailed test data and test results and supporting field data sheets and calibration records. Stack emission test results were summarized in the CPT Report. Section 7 and Appendix D provides detailed information regarding QA/QC results. Chain of Custody records for individual samples are included with the associated laboratory reports in Appendix I.

## A.2 Summary of sampling and stack gas conditions

Tables 5-1 through 5-5 in Section 5 present the detailed test data and test results for the HWC MACT emissions. Tables 9-1 through 9-10 in Section 9 present the detailed test data and test results for the risk assessment emissions. Additional detailed test data input sheets and raw test data are provided in this Appendix:

| | |
|---|---|
| Table A-1 | M0023A |
| Table A-2 | M29 (MACT Emissions) |
| Table A-3 | M5/26A (MACT Emissions) |
| Table A-4 | M0010 (POHC) |
| Table A-5 | M3A, 10, 25A |
| Table A-6 | M0030 |
| Table A-7 | M0010 (SVOC) |
| Table A-8 | M0010 (PAHs) |
| Table A-9 | M0010 (TCO/GRAV) |
| Table A-10 | M0040 |
| Table A-11 | M5 (PSD) |
| Table A-12 | M0023A (PCBs) |
| Table A-13 | M29 (Risk Assessment Emissions) |
| Table A-14 | M5/26A (Risk Assessment Emissions) |
| Table A-15 | M3A, 6C, 7E, 10, 25A |

**A.3** Calculation of sample point locations, in accordance with Method 1 and performance of cyclonic flow checks

See A.7 of this Appendix.

**A.4** Example calculation of average velocity/volumetric flow rate, in accordance with Method 2

Appendix F has example calculations for EPA Method 2.

**A.5** Example calculation of dry molecular weight, in accordance with Method 3

Appendix F has example calculations for EPA Method 3.

**A.6** Example calculation of moisture content, in accordance with Method 4

Appendix F has example calculations for EPA Method 4.

**A.7** Field Data Sheets.

All field data sheets are provided herein.

**A.8** Independent CEMS information.

WESTON CEM information is provided herein.

**A.9** Analyses performed by stack sampling company

Other than the WESTON CEM data generated onsite, no analyses were performed by WESTON.

**A.10** Stack sampling equipment calibration data

Stack sampling equipment calibration data is included here.

**A.11** Certification of Lab Accreditation Status

There is no formal accreditation for the stack sampling company. Accreditations or Certifications for the laboratories are provided at the front of Appendix I.

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX E

**Note*: Field Data and Test Result Sheets were removed from this web copy in order to reduce the file size. Please contact NDEP if you are interested in the data sheets.

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX F

SOC NEVADA LLC
HAWTHORNE ARMY DEPOT
STANDING OPERATING PROCEDURE

UNCONTROLLED DOCUMENT
MAR 14 2012

ITEM: AEDA

OPERATION: Logistics Services

DODAC: Various

EST. DAILY PROD. RATE: N/A

PACKAGED: 1.1

ORGANIZATION SYMBOL: HW-PP&PE

FIRE SYMBOL: 1

SOP: HW-0000-L-002

DATE: 01/11/2011

UNPACKED: 1.1

REVISION

DATE:

FIRE SYMBOL: 1

CHANGE 1

DATE: 04/26/11

CHEMICAL HAZARD SYMBOL: N/A

AUTHORITY: W52P1J-11-D-0002

Document For Reference Only

PREPARED BY: 2/15/11
Terri Trujillo, ext. 7998 — Date

REVIEWED BY: 2-16-11
Ben Roberts, ext. 7562 — Date

SUBMITTED BY: 2/16/11
Teresa McNally, ext. 7447 — Date

## CONCURRENCES – OPERATING CONTRACTOR:

| | | | |
|---|---|---|---|
| Manager, PP&PE | 2/17/11 | Manager, ES | 2-28-2011 |
| Manager, QA | 2/17/11 | Deputy Director, Logistics | 2/24/11 |
| Manager, Safety | 2/28/11 | Director, Base Operations | 2/28/11 |
| Industrial Hygienist | 2/28/11 | Director, M&L Services | 2/24/11 |
| Approval, General Manager | 2/28/11 | | |

## CONCURRENCES – ADMINISTRATIVE CONTRACTING OFFICERS STAFF

| | | | |
|---|---|---|---|
| Chief, Ammunition Surveillance | 14 April | S & OH Specialist | 4/25/11 |
| Environmentalist | 4/18/11 | Approval, Authorized Representative | 26 APR 11 |

WILLIAM C. JOHNSON, JR.
LTC, LG
Commanding

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WILLIAM E. JOHNSON JR.
LTC, LG
Commanding

# SUPERVISOR'S STATEMENT

SOP_____ REVISION_____CHANGE_____ DATE_____

1. The Supervisor will sign this statement:

   a. When first assigned as supervisor of the operation.

   b. When an approved change is made to the SOP.

   c. On the 10th day following the start of the operation.

   d. At least once per quarter during continuing operations.

   e. After absence from the job in excess of 15 consecutive workdays.

2. I have personally reviewed each of the operational steps of this SOP and have no question in my mind that the operation can be performed safely, efficiently, and in compliance with environmental restrictions noted in this SOP. I have verified to my satisfaction that operators have been trained and are capable of performing their part of the operation in a safe and efficient manner and have instructed them to follow this SOP without deviation.

**SUPERVISOR'S PRINTED NAME:** _____

| SUPERVISOR'S NAME / SIGNATURE | DATE |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

DZHC 46-E

# OPERATOR'S STATEMENT

SOP_____ REVISION_____CHANGE_____ DATE_____

1. The Operator will sign this statement:

   a. When first assigned to the operation.

   b. When an approved change is made to the SOP.

   c. On the 10th day following the start of the operation.

   d. At least once per quarter during continuing operations.

   e. After absence from the job in excess of 15 consecutive workdays.

2. I have read, or have had read to me, and understand the general and specific safety and environmental requirements, the personnel and explosive limits, and the work description and inspection requirements necessary to accomplish my operation. I have been trained in my part of the operation and I agree to abide by these instructions, without deviation, throughout my assignment to the operation.

| NAME / SIGNATURE | DATE | OPERATION NUMBER |
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HWAD 45-E

## ACRONYMS/DEFINITIONS

**AD&C** – Ammunition Distribution & Control
**AEDA** – Ammunition, Explosives and Dangerous Articles
**AMC** – Army Military Command
**ATR** – Ammunition Transfer Record
**BATF** – Bureau of Ammunition, Tobacco, Firearms, and Explosives
**CFR** – Code of Federal Regulations
**D&SP** – Demil & Special Projects
**DAC** – Defense Ammunition Center
**DODAAC** – Department of Defense Activity Address Code
**DODAC** – Department of Defense Ammunition Code (8 digit)
**DODIC** – Department of Defense Identification Code (4 digit)
**DOT** – Department of Transportation
**DU** – Depleted Uranium
**GOC** – Guard Operations Center
**HEPA** – High Efficiency Particulate Air
**HWAD** – Hawthorne Army Depot
**IAW** – In Accordance With
**IDS** – Intrusion Detection System
**INTERPLANT** – Between different bases
**INTRAPLANT** – Within the base
**ISPM** – International Standard for Phytosanitary Measures
**JHCS** – Joint Hazard Classification System
**JMBL** – Joint Munitions Barcode Labeler
**LCL** – Less than a carload
**LTL** – Less than a truckload
**MAG** – Magazine
**MHE** – Material Handling Equipment
**MIL** – Military
**MILVAN** – Military Conveyance
**MPH** – miles per hour
**MRO** – Material Release Order
**NSN** – National Stock Number
**(O)** – Operator's function
**POD** – Point of Destination
**POE** – Port of Embarkation
**POP** – Performance Oriented Packing
**PP&PE** – Production Planning and Process Engineering
**PRO** – Property Reutilization Office
**QA** – Quality Assurance
**QASAS** – Quality Assurance Specialist Ammunition Surveillance
**(QC)** – Operator's Quality Control Check
**R3** – Resource, Recovery, & Recycling
**RDD** – Required Delivery Date
**RR** – Railroad
**RSO** – Radiation Safety Officer
**RTCH** – Rough Terrain Container Handler
**(S)** – Operator Safety Check
**SILC** – Stock Item Locator Code
**SOC** – SOC Nevada LLC (Contractor Operator)
**SOP** – Standing Operating Procedure
**STD** – Standard
**SWA** – Southwest Asia
**TCN** – Transportation Control Number
**TLD** – Thermoluminescence Dosimeter
**UN** – United Nations
**VR** – Variable Reach
**WADF** – Western Area Demilitarization Facility
**WPM** – Wood Packaging Material
**WR** – Work Requirements

## INDEX OF OPERATIONS


| OPER | BLDG/ SITE | TOTAL EXPL. IN SITE | DESCRIPTION | PAGE |
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| 1 | Magazine Areas | See Table 1 | Housekeeping in Storage Facilities | 27 |
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| 3 | Magazine Areas | See Table 1 | Prepare to Load/Unload Commercial Conveyances | 29 |
| 4 | Magazine Areas | See Table 1 | Unload Commercial Conveyances | 32 |
| 5 | Magazine Areas | See Table 1 | Prepare Material for Intraplant Moves or Interplant Shipments | 36 |
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**REMARKS:**

The purpose of this procedure is to assure that receipt, storage, preparation for shipment, transfer and issue of explosive and inert materials is handled in a safe and consistent manner. The types of explosive and explosive limits that are applicable to magazines have been established in other documents; therefore, explosive limits for magazines are not included in this SOP. (Refer to the Master Storage Plan or applicable planograph for Specific Site Explosive Limits.) MILVAN containers are to be inspected for contents upon receipt at the classification yard or receipt site (e.g., truck lot, offload site, staging area, etc). When Category I or II material is within a MILVAN container, Security Office will be notified of the container number and the location where the container will be stored until downloading can be affected. The normal temporary storage of MILVAN containers is at one of the MILVAN Staging Areas or MILVAN Pads. MILVAN containers with Category I or II material will be stowed door-end to door-end and/or will have the door-end of a single unit against the end of another MILVAN container to prevent possible pilferage of contents. When two MILVAN containers are stowed door to door and one is removed for downloading, the remaining one will be so positioned as to preclude forced entry. Security will notify the physical security division of the MILVAN container's location and number, and will instruct that a security guard maintain constant surveillance of all containers. This surveillance will be maintained during all SOC LLC non-working hours, including weekends and/or holidays.

When transporting Category I and II material to New Bomb, a security escort is required from the storage magazine to the receiving area at New Bomb.

For the purpose of this SOP, Sea/Land MILVAN containers are considered the same as trucks.

Storage of elemental Mercury is not included this SOP, but is covered in SOP HW 0000-M-010.

QA personnel are responsible for documenting and initiating corrective action for all deviations from this SOP.

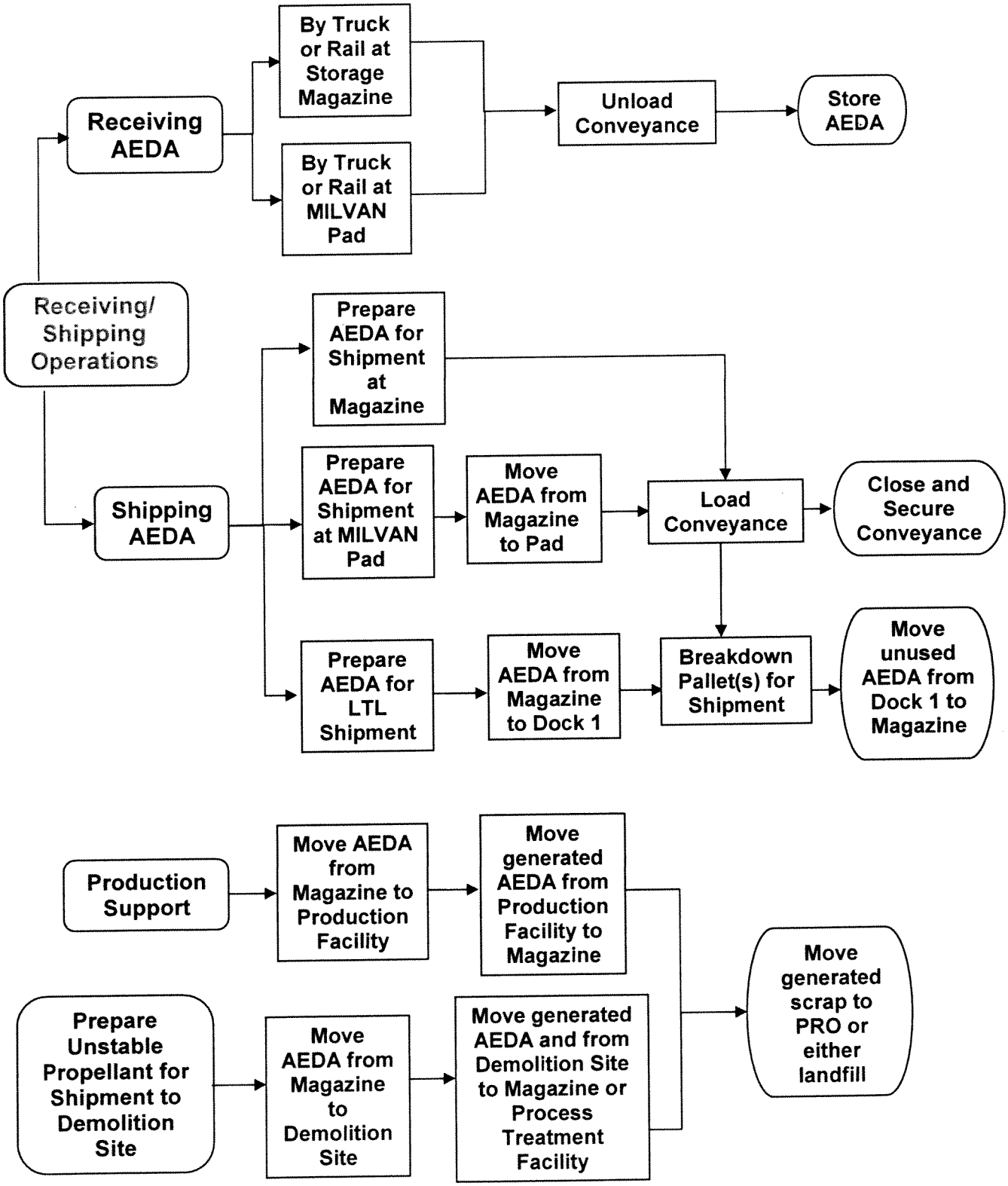
This SOP supersedes SOP DZHC-0000-L-002.

**REFERENCES:**

| | | |
|---|---|---|
| 49 CFR | DOD 5100.76-M | MIL-STD-882D |
| AR-190-11 | Drawing 12982865 | TM 43-0001-28 |
| BOE 6000 | DA PAM 385-64 | Drawing 1948-4116-20 PA 1002 |
| SB 742-1 | AMC R-385-100 | SOC.OHS.SP.0002 |
| DOD 4160.21-M | DOD 4145.26-M-1 | DOD 4160.21-M-1 |
| AMC-R 700-107 | SOP HW-0000-A-001 | |

**CHANGE 1:** Adds changes to SOP per Safety personnel per SOP review.
- **Page 3:** Adds to Acronyms.
- **Page 5:** Adds Change 1 to SOP; adds to References.
- **Page 7:** Adds Note 4 to Table 1.
- **Page 8:** Adds Note 4 to Table 2.
- **Page 9:** Bolds wording in Basic MHE Safety Instruction 1.
- **Page 10:** Adds wording to Basic MHE Safety Instruction 24.
- **Page 11:** Changes ext. # in Basic MHE Safety Instructions 24e and 24f.
- **Page 12:** Bolds wording and changes Step # in Basic MHE Safety Instruction 37.
- **Page 13:** Changes wording in Basic Truck Safety Instruction 3b.
- **Page 14:** Adds wording to Basic Truck Safety Instruction 8; changes wording in #8e, 8f, and 9.
- **Page 20:** Changes Step numbering and phone numbers in Item Specific Guidelines 4a-4c.
- **Page 22:** Adds Item Specific Guidelines #9 pertaining to Hazardous Waste Buildings (LOI 10-008).
- **Page 29:** Deletes last sentence in Step 2 of Operation 3.
- **Page 42:** Adds wording in Step 1b of Operation 6.

## PROCESS FLOW



## TABLE 1
## EXPLOSIVE/PERSONNEL LIMITS

| BUILDING / HAZARD CLASS | 1.1 | 1.2 (04) 1.2 (08) | 1.2 (12) 1.2 (18) | 1.3 | 1.4 | OPER[3] | TRANS[3] |
|---|---|---|---|---|---|---|---|
| Dock 1[1] | 60,000 | Unlimited | 500,000 | 1,000,000 | Unlimited | 14 | 6 |
| Docks 2, 4 & 6 | 500,000 | Unlimited | 500,000 | 1,000,000 | Unlimited | 14 | 6 |
| Dock 3 | 125,000 | Unlimited | 500,000 | 1,000,000 | Unlimited | 14 | 6 |
| Dock 5 | 185,000 | Unlimited | 500,000 | 1,000,000 | Unlimited | 14 | 6 |
| Pad 1 | 300,000 | Unlimited | 500,000 | 1,000,000 | Unlimited | 30 | 10 |
| Pads 2 & 3 | 500,000 | Unlimited | 500,000 | 1,000,000 | Unlimited | 30 | 10 |
| 102-21 | Inert Only ---------- | | | | | | |
| 117-12[2] | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 10 | 6 |
| 117-13[3], 117-14[3] Ready Service Magazines | 9,000 | 9,000 | 9,000 | 9,000 | 9,000 | 10 | 6 |
| Holding Areas 1 and 2 (in 110 Group) | 50,000 | 150,000 | 150,000 | 1,000,000 | Unlimited | N/A | N/A |
| Holding Areas 3 and 4 (in South Mag) | 500,000 | 500,000 | 500,000 | 1,000,000 | Unlimited | N/A | N/A |
| Production Buildings | Limits as noted in the SOP for the building's operation | | | | | | |
| Truck Lot/RR Classification Yard[4] | No limit under 24 hours as long as used for receiving, dispatching, and classifying | | | | | | |
| Extended Classification Yard[4] | No limit under 24 hours as long as used for receiving, dispatching, and classifying | | | | | | |

[1] 1.1 (21), 1.1 (18), 1.1 (14), and 1.2 (18) ammunition is not to be handled at Dock 1.

[2] Personnel limits are dependent upon the operations being performed. Personnel limits will be consistent with safe and efficient operations. Care will be taken to limit exposure to a minimum number of personnel, for a minimum time, to a minimum amount of hazardous material while performing operations. Personnel limits for routine operations are Operators - 12 and Transients - 4.

[3] 117-13 (Group A - 3 storage doors) – 9000 lbs. per door.
117-14 (Group B - 2 storage doors) – 9000 lbs. per door.

[4] Due to quantity distance restrictions, explosive loaded trucks and railcars are not authorized for storage at the classification yards in excess of 24 hours.

For the explosive limits of magazines and storage buildings, refer to a current planograph or the Master Storage Plan.

## TABLE 2
## SURGE EXPLOSIVE/PERSONNEL LIMITS

The following explosive limits are approved for use during Surge or Mobilization Activities ONLY.

| BUILDING / HAZARD CLASS | 1.1 | 1.2 (04) 1.2 (08) | 1.2 (12) 1.2 (18) | 1.3 | 1.4 | OPER[3] | TRANS[3] |
|---|---|---|---|---|---|---|---|
| Dock 1[1] | 60,000 | Unlimited | 500,000 | 1,000,000 | Unlimited | 14 | 6 |
| Docks 2, 4 & 6 | 1,000,000 | Unlimited | 1,000,000 | 1,000,000 | Unlimited | 14 | 6 |
| Dock 3 | 125,000 | Unlimited | 500,000 | 1,000,000 | Unlimited | 14 | 6 |
| Dock 5 | 185,000 | Unlimited | 500,000 | 1,000,000 | Unlimited | 14 | 6 |
| Pad 1 | 300,000 | Unlimited | 500,000 | 1,000,000 | Unlimited | 30 | 10 |
| Pads 2 & 3 | 1,000,000 | Unlimited | 1,000,000 | 1,000,000 | Unlimited | 30 | 10 |
| 102-21 | Inert Only ---------- | | | | | | |
| 117-12[2] | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 10 | 6 |
| 117-13[3], 117-14[3] Ready Service Magazines | 9,000 | 9,000 | 9,000 | 9,000 | 9,000 | 10 | 6 |
| Holding Areas 1 and 2 (in 110 Group) | 50,000 | 150,000 | 150,000 | 1,000,000 | Unlimited | N/A | N/A |
| Holding Areas 3 and 4 (in South Mag) | 500,000 | 500,000 | 500,000 | 1,000,000 | Unlimited | N/A | N/A |
| Production Buildings | Limits as noted in the SOP for the building's operation | | | | | | |
| Truck Lot/RR Classification Yard[4] | No limit under 24 hours as long as used for receiving, dispatching, and classifying | | | | | | |
| Extended Classification Yard[4] | No limit under 24 hours as long as used for receiving, dispatching, and classifying | | | | | | |

[1] 1.1 (21), 1.1 (18), 1.1 (14), and 1.2 (18) ammunition is not to be handled at Dock 1.

[2] Personnel limits are dependent upon the operations being performed. Personnel limits will be consistent with safe and efficient operations. Care will be taken to limit exposure to a minimum number of personnel, for a minimum time, to a minimum amount of hazardous material while performing operations. Personnel limits for routine operations are Operators - 12 and Transients - 4.

[3] 117-13 (Group A - 3 storage doors) – 9000 lbs. per door.
117-14 (Group B - 2 storage doors) – 9000 lbs. per door.

[4] Due to quantity distance restrictions, explosive loaded trucks and railcars are not authorized for storage at the classification yards in excess of 24 hours.

For the explosive limits of magazines and storage buildings, refer to a current planograph or the Master Storage Plan.

## BASIC MHE SAFETY INSTRUCTIONS

1. Trip Tickets (AMC-Form 2205) will be present and completed **prior to use** and after operations of any MHE.

2. MHE will be thoroughly checked for safety hazards prior to operation. Any hazards present will be reported to the supervisor immediately. Do not operate defective equipment.

3. MHE operating in explosive buildings will be equipped with a serviceable fire extinguisher, having a minimum rating of 2A/10BC. Crews performing operations in magazines will have two fire extinguishers with at least a 2A/10BC rating available at all times. One of the two extinguishers may be the one mounted on the forklift and the other may be from the crew's vehicle.

4. The operator will wear a seat belt while operating all equipment, when available.

5. Overhead guards are required for forklifts of all types. The Depot Commander may grant exceptions in writing for work areas in which the height of the forklift or overhead guard would be lower than the operator's head. Operators of forklifts that are not equipped with overhead guards will wear hard hats.

6. No riders/passengers will be allowed on/in any equipment while in operation. The only exception to this is instructors, who may ride on the container handler during training only, as they are not considered riders or passengers.

7. Stunt driving or horseplay will not be permitted.

8. Loading: Only stable or safely arranged loads will be handled. Caution will be exercised when handling off-center loads that cannot be centered.

9. Safe Load: Overloading of equipment is strictly prohibited. The equipment will safely lift and carry no more than its rated capacity.

10. Determination of Safe Loading: Equipment will tip forward if the load exceeds the lift capacity of the piece of equipment. The manufacturer has established the load rating (expressed in pounds of load on the piece of equipment). Refer to Figure 1.

Figure 1

11. The driver will be required to slow down and sound the horn at any open doorway, at cross aisles, and/or at any location where vision is obstructed.

12. Grades will be ascended or descended slowly.

13. Under all travel conditions, the equipment will be operated at a speed that will permit it to be brought to a stop in a safe manner.

14. The driver will be required to slow down for wet and/or slippery floors.

15. Sharp and rapid turns will not be made with any piece of equipment.

16. Each operator will remove the key from equipment when leaving and securing it.

17. Jerky starts and sudden stops that could result in losing a load are not permitted.

18. High speeds while loaded are not permitted.

19. The operator's vision while operating equipment is limited to the rear. It is his/her responsibility to check very carefully before backing MHE and to keep a clear view of the path of travel for the forklift. If available, or the conditions dictate it necessary, a spotter will be used.

20. When operations require a plate to span an open space, the plate will be properly secured for safe operation. Dock plates or bridge plates will be properly secured before they are driven over. Dock plates or bridge plates will be driven over carefully and slowly and their rated capacity will never be exceeded.

21. A safe distance will be maintained from the edge of platforms while on any elevated dock.

22. When forklifts are not in operation, they will be parked with the tines resting on the floor, the parking brakes applied, and the key removed. Refer to Figure 2. Boom lift trucks will be parked with the boom hoisted as high as possible to eliminate the danger of personal injury caused by hitting the boom, and the parking brakes will be applied.

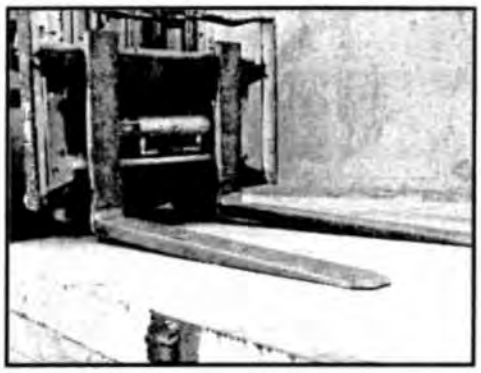


Figure 2

23. Diesel powered equipment will not be stored in buildings or on explosive loading docks when explosives or ammunition are present. Diesel powered equipment will be parked a minimum of 100 feet from any location containing ammunition or explosives.

24. Refueling of diesel or gas operated equipment will be performed at least 20 feet from inert warehouses, inert buildings, or inert loading docks, and 90 feet from an explosives location or building. In areas where earth covered magazines are 185 feet apart; refueling will be accomplished at a point midway between magazines. **Ammunition and/or any type of explosives (AA&E) will not be on fork tines or in close proximity to equipment. If AA&E is stored outside of production building or on pad, the equipment will be moved a safe distance away to be refueled, i.e., 90 feet or more.**

    a. Do not fill the fuel tank of equipment with the engine running or near an open flame. Be sure to use the correct fuel. Ground the fuel funnel or nozzle against the filler neck to prevent sparks.

    b. When adding fuel to operating equipment, stop the engine and turn the key to the off position. The operator must be off of the equipment and have a fire extinguisher available. Fill tank in designated areas away from sparks or open flame. Make sure the area has good ventilation.

    c. During refueling, doors and windows through which vapors may enter the building will be closed.

d. During refueling, an electrically continuous path to ground will be maintained between the tank being filled and the tank being emptied. The entire system will be grounded before the refueling operation is begun. Motors of both the piece of equipment and the refueling truck (unless refueling truck motor drives the pump) will be stopped during the refueling operations.

e. In the event of a fuel spill during refueling, notify the Fire Department at ext. 7911 or 945-7911.

f. In the event of a fuel spill during refueling, the motors of the refueling truck and piece of equipment will not be started until the equipment is first moved at least 50 feet from where the spillage occurred, or until after the spill has been cleaned up. Any fuel spill will be reported to GOC at ext 7911 or 945-7911.

25. Material on forklift tines will be only high enough to clear the floor/ground when transporting pallet loads.

26. Only one pallet or container of explosive material will be moved on the tines of a forklift at one time, unless the pallets or containers are strapped together vertically, or have vertical interlocks, such as CBUs, 2000 lb. Bombs, etc. Boxed ammunition stacked two pallets high in a container may be moved using a variable reach forklift. In that case, with forklift stationary at the door of the container, the variable reach boom may be used to slowly bring a two-high stack of pallets to the container doorway, where the pallets will be moved one at a time. Refer to Figure 3.

Figure 3

a. Two or three skids may be moved horizontally on the tines of a forklift provided the tines extend full-length under the outermost skid being handled. Refer to Figure 4.

b. Skids need not be strapped together but rounds must be strapped/secured to individual skids.

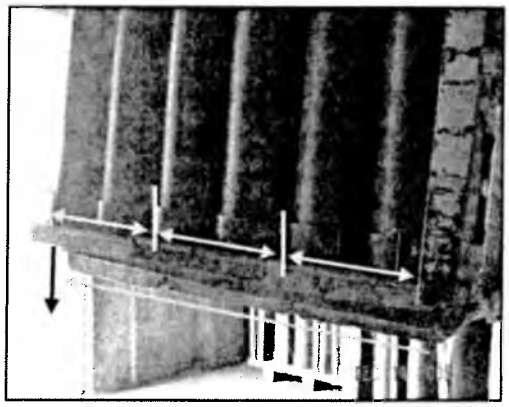


Figure 4

27. Anytime a unit load is handled with a forklift, the tines or extensions must extend beyond the center of gravity of the unit load. Forklift tine extensions must be used to meet all lift requirements for large containers, such as end lifting of CBUs or linear charges.

28. Heavy loads lifted to unnecessary heights cause instability of the MHE. Transport loads as close to the ground as practical. When operating with a load lifted high, the handler will be operated at low speeds and with extreme care.

29. RTCH diesel powered container handlers have weight handling limitations of 25 tons. Overloading can cause the rupture of high-pressure hydraulic lines, spraying of hydraulic fluid, dropping of the load, or injury to personnel, as well as damage to equipment and material.

30. When loading the container handler, it will be driven forward at slow speed to assure that lift mechanism can be maneuvered to mate with the container lifting holes and not cause damage to pallets or material in the container.

31. The handler will be brought to a complete stop before transmission gear changes, from forward to reverse or from reverse to forward, are made.

32. When parking the handler, the lifting mechanism will be lowered to its lowest position and tilted to the rear and the brake will be set. The lifting mechanism will be left raised to clear passing vehicles if the handler must be parked where passing vehicles could hit the spreader bar. Refer to Figure 5.

Figure 5

33. When a powered industrial truck is left unattended, load engaging means will be fully lowered, controls will be neutralized, power will be shut off, and brakes set. Wheels will be chocked if the truck is parked on an incline.

34. When operating the container handler, assure the lifting mechanism is fully unlocked from a container before disengaging from the container by checking the control panel in the cab.

35. The Super Stacker container handler is not to be used in rough terrain. It must **ONLY** be operated on smooth flat surfaces.

36. The Super Stacker has a rated weight capacity of 45 tons. Overloading the Super Stacker can cause the high pressure hydraulic lines to rupture, which will result in the failure of the mast to sustain the load, cause injury to personnel and generate spilled hydraulic fluid.

37. **The Super Stacker will not be operated in conditions where the wind speed reaches more than 25 mph.**

    a. Winds in excess of 25 mph may cause twisting of the mast under loaded conditions, creating the potential for serious injury to personnel as well as damage to the equipment.

    b. An air speed indicator is located on the Super Stacker. Refer to Figure 6 for the location of the air speed indicator.

Figure 6

## BASIC TRUCK SAFETY INSTRUCTIONS

1. Cargo-type trucks and truck-tractor drawn semi-trailers are the preferred type of equipment for transporting explosives and ammunition. For intraplant movement, open body vehicles (other than flatbed) must have sides and tailgate or rear doors that are strong and securely fastened, so that explosives or ammunition are safely retained. Vehicles (including flatbed type), partly or completely loaded, will have the load blocked, braced, chocked, tied down, or otherwise secured to prevent shifting during transit.

2. All conveyance load limits will be observed at all times.

3. Conveyances used to transport ammunition and explosives intraplant will be inspected by qualified personnel a minimum of once every thirty (30) calendar days, using the criteria listed on the DD Form 626, Motor Vehicle Inspection (Transporting Hazardous Materials).

   a. Conveyances transporting hazardous cargo over a public transportation route (interplant) will be inspected prior to receiving their cargo, and the loaded conveyance will be inspected, after loading has been accomplished, by certified inspectors using the DD Form 626. The DD Form 626 must be on board the conveyance prior to departing HWAD.

   b. When closure of a public highway (i.e., US Route 359 between HWAD and New Bomb) is achieved and control of a public roadway is maintained by SOC personnel, only a 30 day inspection record is required for vehicles assigned to transport explosive items.

4. All trucks weighing less than 14,000 pounds that carry any DOT class of explosives (intraplant) will be equipped with two portable fire extinguishers with a combined class rating of 4A/20BC. All trucks weighing over 14,000 pounds that carry any DOT class of explosives (on station) will be equipped with two portable fire extinguishers with a combined class rating of 4A/70BC. Trucks that do not carry any DOT class of explosives do not require a fire extinguisher, unless they are going to any of the outlying areas (i.e., New Bomb, etc.) wherein the previous requirements pertain. One of the two extinguishers must be $CO_2$ or dry chemical if chemical munitions are being transported.

5. A spotter, when available, will be used when backing or positioning vehicles. When a spotter is not available, it is the driver's responsibility to assure the area behind the vehicle is clear before backing.

6. Nothing, other than destined cargo, will be carried or transported in the bed of a commercial truck loaded with explosives.

7. No explosives will be loaded into or unloaded from a commercial truck while the motor is running. This excludes the following:

   a. The accessory is an integral part of the vehicle.

   b. The exhaust gases from the motor are emitted at least six feet from the point at which the operations are conducted and are directed away from this point.

c. The exhaust pipe is equipped with a spark arrester.

d. Material being loaded/unloaded that might evolve flammable vapors is closed into tightly fitting containers.

e. Engine power is required to maintain the proper height of air ride trailers.

8. Equipment refueling will be performed at least 20 feet from inert warehouses, inert buildings, or inert loading docks, and 90 feet from an explosives location or building. In areas where earth covered magazines are 185 feet apart, refueling will be accomplished at a point midway between magazines. **Ammunition and/or any type of explosives (AA&E) will not be on truck or in close proximity to equipment. If AA&E is stored outside of production building or on pad, the equipment will be moved a safe distance away to be refueled, i.e., 90 feet or more.**

   a. Do not fill the fuel tank of equipment with the engine running or near an open flame. Be sure to use the correct fuel. Ground the fuel funnel or nozzle against the filler neck to prevent sparks.

   b. When adding fuel to a truck, stop the engine and turn the key to the off position. The operator must be off the equipment and have a fire extinguisher available. Fill tank in designated areas away from sparks or open flame. Make sure the area has good ventilation.

   c. During refueling, doors and windows through which vapors may enter the building will be closed.

   d. During refueling, an electrically continuous path to ground will be maintained between the tank being filled and the tank being emptied. The entire system will be grounded before the refueling operation is begun. Motors of both the piece of equipment and the refueling truck (unless refueling truck motor drives the pump) will be stopped during the refueling operations.

   e. In the event of a fuel spill during refueling, notify the Fire Department at ext. 7911 or 945-7911.

   f. In the event of a fuel spill during refueling, the motors of the refueling truck and piece of equipment will not be started until the equipment is first moved at least 50 feet from where the spillage occurred, or until after the spill has been cleaned up. Any fuel spill will be reported to the Fire Department at ext. 7911 or 945-7911.

9. Extreme caution in the driving and operation of an explosive laden SOC motor vehicle will be exercised when hazardous conditions may possibly exist. Potentially hazardous conditions include cattle, horses, wildlife, snow, ice, sleet, fog, mist, rain, dust, smoke, etc. Speed will be reduced when such conditions exist. If conditions become sufficiently dangerous, the operation of the motor vehicle will be discontinued and will not be resumed until the motor vehicle can be safely operated.

10. Explosive laden trucks destined for New Bomb will not exceed 55 MPH under any conditions, regardless of the posted speed limit.

11. At no time will an explosive laden vehicle bound for New Bomb enter the public highway without both front and rear escorts.

a. Explosive laden trucks/convoys will be lead by a security escort vehicle and followed by a QA escort vehicle. The New Bomb supervisor may serve as either the lead or trailing escort as long as a security guard is present.

b. The front security escort vehicle will be followed at a safe distance by the explosive laden vehicles. Personnel in the security escort vehicle will serve as a lookout for potential hazards and warn the explosive laden vehicle operator by radio of any hazard present.

c. QA personnel will serve as observers to vehicle safety issues (i.e., flat tires, smoking brakes, etc.) in addition to the potentially hazardous conditions previously mentioned and will notify the explosive laden vehicle operator by radio of any hazard present.

## SAFETY REQUIREMENTS FOR LOGISTICS OPERATIONS

1. Adhere with all safety and security requirements listed in the General Safety and Security Requirements SOP (HW-0000-A-001) pertaining to the performance of this procedure.

2. Pneumatic nail guns will not be used within 50 feet of ammunition or explosives unless equipped with a safety shot trigger mechanism.

3. Smoking, eating, or drinking in magazines or storage buildings is prohibited. Operators will wash hands before eating, smoking, or using toilet facilities after having worked in magazines or storage buildings.

4. All material will be stored in a manner to assure a stable stow (i.e., square and vertical with each pallet resting squarely and solidly on the pallet beneath it). This requirement may be met in several ways, one of which would be to move the material/pallet unit to a serviceable pallet, strap in place and then place in storage. Breakdown of material for shipment will assure remaining quantity is palletized or placed on dunnage prior to return to storage

5. All Ammunition that is either Category I or II will be banded to pallets at the time of storage. In addition, any activity that breaks down a pallet for use, such as New Bomb, Surveillance, shipments, etc., will responsible for banding the remaining assets to the existing pallets on which they were originally stored. If material comes in loose and is destined to storage, it will be palletized prior to storage.

6. Unserviceable pallets or skids, which do not meet stability requirements, will be repaired prior to storage, shipping, or during re-warehousing.

7. Care will be taken to prevent jamming or exerting undue pressure on explosive containers that could result in compression and possible detonation.

8. Only approved explosion proof flashlights will be permitted inside any magazine. Radio and cellular telephone transmissions are prohibited within magazines containing explosives.

9. All personnel will be instructed in proper fire fighting procedures, safety regulations, and special instructions pertaining to the procedure in progress.

10. Prior to entering a magazine where chemical agents/munitions are stored and/or prior to preparation of same for shipment or movement, all personnel will understand the provisions of the personal dangers involved in handling and processing chemical agents or munitions. Refer to SOP HW-0000-A-001 for pertinent information.

11. No individual is permitted to work alone (i.e., moving ammunition) while in magazines, shipment docks, etc., where assistance from another person cannot be given immediately, in case of an accident. Activities such as transporting (to include container handlers, SkyTraks, and trucks used outside magazines), counting, checking, sweeping, etc., may be performed alone. This does not preclude one person from observing at a safe distance or using two people to meet security standards.

12. All material will be placed in magazine stows with the identification facing the aisle, showing the complete identification and quantity.

13. Explosive limitations listing the amount and classification of explosives permitted for a facility will not be exceeded for any reason. Refer to Table 1 and/or a building planograph.

14. Operations incidental to storage are permitted in magazines containing ammunition and explosives. The following operations are also permitted when incidental to shipping: palletization; removal and replacement of shipping strapping on bombs; removal and replacement of grommets on separate loading projectiles; replacement of damaged or loose strapping on boxes of ammunition and explosives; and application of labels, bar codes and placards. If there is not adequate space to perform these operations in the magazine, they should be performed immediately outside the magazine.

15. Stenciling or re-stenciling of containers is permitted in magazines, using stencil ink and brush only. No open containers of flammable liquids or spray paint used for stenciling will be permitted in magazines. Where essential (as with the use of flammable adhesive for MAP labels), flammable liquids may be used immediately outside of magazines. In such cases, quantities of flammable liquids in open containers will be kept to the absolute minimum required to perform the operation.

16. Hazard Class 1.3 or 1.4 material containers or boxes may be opened outside magazines for the purpose of visual examination. The inspection site will be located as far as practical from magazines containing Hazard Class 1.3 or 1.4 materials. The magazine doors will be closed while the boxes or containers are open. Normal maintenance of small arms ammunition may be performed in magazines containing small arms ammunition only.

17. Except as stated above, containers of explosives and ammunition will not be opened or repaired in any magazines containing the same. If special facilities are not available for this type of operation, the work may be done in the open, at least 90 feet from a magazine containing ammunition and explosives, but in no case at a distance less than that prescribed in the intraline distance table.

18. Storage drawings will be obtained utilizing the DAC Home Page for the latest drawings through CAPULDI. This may be done in QA Division or by the Storage Planner.

19. Material being received on-station should be placed with the parent lot by location and condition code. Material received, but not inspected to determine true condition, will be assigned a condition code by QASAS. An effort should be made to segregate, inspect, and assign a true condition code prior to storage.

20. The loading and unloading of top heavy or awkwardly packaged munitions will include the following steps:

    a. Metal braces will be inserted into the "Stake Pockets" or holes of the flat bed trailer. This should be done on the opposite side of the loading operations.

    b. A spotter will be present at the operation. The spotter's job will be to assist the equipment operator in assuring the packaged material is properly lifted.

c. Material that is loaded into or from the magazines will be lifted from the side of the dock, either adjacent to or opposite from the railroad tracks.

21. During loading, unloading, or preparation of ammunition and explosives for shipment, at least two doors must be open, where possible, and all personnel must have unobstructed access to the nearest exit. Exits will not be obstructed at any time.

22. All outgoing conveyances are sealed with a temporary seal by the storage crew after loading. QA personnel install the permanent seal after the conveyance is inspected and the shipping papers are placed with the load at the truck lot. Temporary seal cards will be turned in to the originator.

23. Boxcars or commercial trucks that have safety hazards present (primarily weak floors) will be sent back for re-examination to determine the fitness for hauling materials, both inert and explosive.

24. If any discrepancy or damage is discovered during the unloading of incoming shipments, the storage crew will prepare a HWAAP Form 691 which will be forwarded to the Traffic Division. QASAS will be notified in the event of damage to ammunition, explosives, or containers, in order to properly identify the need for segregation and Condition Coding.

25. MILVAN container stuffing/unstuffing Pads may be used for containerization operations in support of storage areas or production lines. The following safety requirements and restrictions are applicable to these facilities:

    a. Only the minimum quantity of explosives consistent with safe and efficient operations will be permitted to accumulate at these facilities.

    b. These facilities may be used for the temporary storage of loaded containers pending receipt of shipping orders or commercial trailers or railcars. If temporary storage of loaded containers in excess of 300,000 pounds NEW at Pad 1 or 500,000 pounds NEW at Pads 2 or 3 is required, containers must be moved to a separate holding area.

    c. Temporary storage of empty containers at these facilities is permitted if the empty containers are kept in a clearly defined area that is separated from the loaded containers.

26. When stuffing MILVAN containers at magazines, the containers will be located at magazines for the minimum time required for efficient loading and unloading.

27. Gasoline driven air compressors or generators used to support explosive operations will be located at least 50 feet from explosives. Generators required at MILVAN stuffing operations will be located no less than 25 feet from the open side of a MILVAN. Wiring from the generator to the magazine must be hard service cord approved for extra hard usage in damp places.

    a. The ground area between the generating unit and the explosives facility will be clear of debris or other combustible materials and at least two 10 BC fire extinguishers will be readily available.

    b. The flexible cord should be located in such a position as to prevent trucks or personnel from running over or otherwise damaging the cables.

    c. Refueling will be accomplished at least 100 feet from the magazine or ammunition. A suitable extinguisher will be kept ready for use during all refueling operations.

28. When loading or unloading railroad boxcars to or from a storage building in the 110 Group, a grounding strap will be attached to a ground clamp receptacle which has been welded to the steel dock bumper at the center of the building and to a bare (non painted) surface of the boxcar. This will assure the boxcar is grounded to the building ground and lightning protection system.

29. Prior to loading a railcar, place a blue "DO NOT COUPLE" sign on each approach end of the railcar. Also assure the railcar is properly chocked prior to use.

## ITEM SPECIFIC GUIDELINES

1. **M732 Fuzes:**

   a. The requirements for marking, storing, and unitizing M732 fuzes (1390-N464) in wirebound boxes are as follows:

      (1.) Wirebound boxes must be marked with the word UP and an arrow indicating the bottom of the box is facing upward.

      (2.) Wirebound boxes containing M732 fuzes must be unitized so the bottoms of the boxes are oriented upward on the pallet.

      (3.) The same precautions must be taken during movement so the fuze is both stored and moved base up.

2. **CHEMICAL MUNITIONS:** Guidelines to be followed for chemical munitions can be found in SOP HW-0000-A-001.

3. **NASA MUNITIONS:** Personnel performing storage operations in NASA magazines (in the 116 Area) will follow the Handling Manual (TM 743-200) and the NASA Handling Manual.

4. **RADIOACTIVE MUNITIONS (Depleted Uranium (DU)):**

   a. Notify the RSO (ext. 7587) or alternate (ext. 7041) when radioactive material is received, prepared for shipment, or planned for movement from one onsite location to another. This is to permit a baseline survey of any magazine before radioactive material is placed therein. It also permits a survey of any magazine no longer used to store radioactive material and assures the proper signage is emplaced.

   b. In the event of an accident/incident occurring or an unusual condition being observed when working with radioactive material, all work will cease immediately, and the RSO (ext. 7587) or alternate (ext. 7041) will be notified. The RSO or alternate will then determine the course of action to be taken.

   c. Film or TLD badges are not required for entry into magazines containing radioactive DU during normal operations; however, any damage to the pack/container must be reported to the RSO at ext. 7587. DU items include the following:

| DODIC | MODEL | DODIC | MODEL | DODIC | MODEL |
|---|---|---|---|---|---|
| A675 | MK149, 20mm | B102 | PGU-14, 30mm | C523 | M774, 105mm |
| A676 | MK149, 20mm | B103 | PGU-14, 30mm | C524 | M833, 105mm |
| A979 | PGU-20, 25mm | B117 | PGU-14, 30mm | C543 | M900, 105mm |
| A983 | PGU-20, 25mm | B128 | PGU-14, 30mm | C783 | M827, 120mm |
| A986 | M919, 25mm | C380 | M829A1, 20mm | C786 | M829, 120mm |
| | | | | C792 | M829A2, 120mm |

5. **SOUTHWEST ASIA RETURNS:** Retrograde munitions from Southwest Asia (SWA), when segregated, must have the letter "Y" affixed to the Lot Number. The "Y" designator will not be affixed to Lot Numbers of material until directed by the QASAS Inspector. QASAS Inspector will determine the exact location of the "Y" in the Lot Number. The letter "Y" will be the same color and size as Lot Number applied by stamp or stencil brush and template.

6. **PROPULSIVE STATE MUNITIONS:** All propulsive ammunition stored within a magazine must be stored with the nose end pointed in one direction other than the door, or as specified in the applicable drawing.

7. **TOOL LOCKOUT/TAG OUT PROCEDURE:** The following lockout/tag out procedure applies to all power tools used at Building 102-21, MILVAN Pads 1, 2, and 3 and Docks 1, 2, 3, 4, 5, and 6. This requirement is for the lockout of energy isolating devices whenever maintenance or servicing is done on machines or equipment.

   a. SEQUENCE OF LOCKOUT:

      (1.) Notify all affected employees that servicing or maintenance is required and the machine or equipment must be shut down and locked out to perform the servicing or maintenance.

      (2.) The employee performing the servicing or maintenance of the machine or equipment will understand the hazards of the energy the machine or equipment utilizes and will know the methods to control the energy.

      (3.) If the machine or equipment is operating, it should be shut down by normal stopping procedure (depressing stop button, open switch, etc.).

      (4.) Deactivate the energy isolating device(s) so that the machine or equipment is isolated from the energy source(s).

      (5.) Lockout the energy isolating device(s) with assigned individual locks or other devices that will assure energy sources cannot be reactivated by other personnel.

      (6.) Assure that the equipment is disconnected from the energy source. Verify the isolation of the equipment by actuating normal operating controls to make certain equipment will not operate.

      (7.) Once isolation of the energy source to the machine has been checked and verified, the machine or equipment is considered adequately locked out.

   b. TO RESTORE EQUIPMENT TO SERVICE, THE FOLLOWING STEPS WILL BE TAKEN:

      (1.) Check the machine or equipment and the immediate area to assure that nonessential items have been removed and that the machine or equipment is operationally intact.

      (2.) Verify controls are in neutral. Remove the lockout device and re-energize the machine or equipment as required.

      (3.) Notify affected employees that the servicing or maintenance is complete and the equipment is ready for use.

8. **LOADING AND UNLOADING AIRCRAFT:**

   a. Prior to loading or unloading ammunition, explosives, and other hazardous materials, the aircraft will be electrically grounded so that the resistance to ground does not exceed 10,000 ohms.

b. When loading or unloading aircraft containing ammunition or explosives, placards and fire symbols will be displayed as required.

c. Loading and unloading will be done in accordance with quantity-distance requirements.

d. All ignition switches must be in the off position.

e. Front and rear wheel chocks will be in place.

f. Military aircraft will be loaded in accordance with written and verbal direction of the aircraft loading crew.

g. Nonmilitary airfields used for loading and unloading explosives will be provided with aircraft firefighters' service equal to Army standards.

h. Firefighters will be used during periods of Army flight activities, including loading and unloading of explosives. In addition, protection will be furnished through use of portable fire extinguishers by operating agency personnel trained as auxiliary firefighters.

i. As a minimum, four portable fire extinguishers should be available for firefighting purposes during all loading and unloading of explosives. The following are recommended extinguishers:

(1.) Two pressurized water type extinguishers, using Aqueous Film-Forming Foam (AFFF) liquid concentrate, 6 percent, and

(2.) Two Potassium Bicarbonate Base Dry Chemical Extinguishers, 30 lb. capacity.

9. **MOVEMENT OF HAZARDOUS WASTE MATERIAL:** Employees are restricted from placing material into or from removing material out of a Hazardous Waste building without the presence of an Environmental Services employee.

a. Employees will notify Environmental Services personnel of any movement of material into or out of any Hazardous Waste building, with the following information to be included:

(1.) Location of Movement
(2.) Estimated Time of Arrival

b. Employees will not begin loading or offloading any material until Environmental Services personnel are present at building to log information (contact information listed below).

(1.) Jeff Moody – x7579, cell 316-1972

(2.) Foster Kenton – x7356, cell 945-0438

(3.) Tad Williams – x7359, cell 945-0447

c. Listed below are the current assigned Hazardous Waste Locations.

| | | | | | |
|---|---|---|---|---|---|
| 106-22 | 113-73A | 116-37 | 116-39 | 116-42 | 116-44 |
| 106-23 | 115-9 | 116-38 | 116-41 | 116-43 | 116-45 |

The following table contains a list of the equipment used in operations. The quantity needed is dependent upon the procedure.

| EQUIPMENT AND GAGES | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Forklift, diesel, clean burning, 4,000-6,000 lb capacity | Commercial | As required |
| Forklift, electric, EE/EX, 4,000-6,000 lb capacity | Commercial | As required |
| Forklift, electric, w/boom, 6,000 lb capacity | Commercial | As required |
| Forklift, industrial, up to 10,000 lb capacity | Commercial | As required |
| Forklift, variable reach, 6,000 lb capacity (SKY TRAC) | Commercial | As required |
| Handler, cargo container, 50,000 lb capacity | Commercial | As required |
| Super Stacker, capacity | Commercial | As required |
| Swing Master, 4,000 lb capacity | Commercial | As required |
| Truck, run-through | Commercial | As required |
| Transporter, electric, EE/EX, 10,000 lb capacity | Commercial | As required |

The following table contains a list of tools and supplies used in operations. The quantities required will be dependant upon the procedure.

| TOOLS AND SUPPLIES | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Adhesive, f/labels, 1 gal. | 8040-00-855-6968 | As required |
| Apron, carpenter's | Commercial | As required |
| Apron, rubber | Commercial | As required |
| Bar, pry, non-sparking, various sizes | Commercial | As required |
| Bar, pry, wrecking | Commercial | As required |
| Barrel, 55 gal, f/water, f/WP ammunition | Commercial | As required |
| Battery, f/saw 5-¼", 6-¼" | Commercial | As required |
| Broom, push | Commercial | As required |
| Brush, adhesive | H-B-292 | As required |
| Brush, bristle, dusting | H-B-190 | As required |
| Brush, paint, various sizes and applications | H-B-420 | As required |
| Brush, stencil, fountain type | H-B-621 | As required |
| Cart, 2-wheel, hand (dolly) | Commercial | As required |
| Chains, tie down, with binders | Commercial | As required |
| Chocks, wheel, wooden | Commercial | As required |
| Closer, Salle | 5120-00-319-5434 | As required |
| Compound, coating, bituminous | MIL-C-450C | As required |
| Compressor, air | Commercial | As required |
| Container, for obliterating paint | Commercial | As required |

| TOOLS AND SUPPLIES | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Container, for contaminated rags | Commercial | As required |
| Containers, for lead seals | Commercial | As required |
| Container, for trash, 10 gal. | A-A-1069 | As required |
| Container, safety approved | Commercial | As required |
| Conveyor, 8-feet | Commercial | As required |
| Coveralls, flame retardant | Commercial | As required |
| Cutter, cable, various sizes | Commercial | As required |
| Cutters, steel strapping | Commercial | As required |
| Dispenser, tape, 1" | Commercial | As required |
| Dumpster, hopper | Commercial | As required |
| Dustpan, rubber | Commercial | As required |
| Emery cloth, abrasive | A-A-1049 | As required |
| Envelopes, shipping | A-A-1658 | As required |
| Extension cord 50' & 100' | Commercial | As required |
| Filter, respirator, dust/mist type | Commercial | As required |
| Filter, respirator, HEPA | Commercial | As required |
| Flashlight, explosive-proof | 6230-00-299-3035 | As required |
| Gaskets | Commercial | As required |
| Gate, wooden, f/flatcar | Local Fabrication | As required |
| Generator, gas operated | Commercial | As required |
| Glasses, safety, with side shields | Commercial | As required |
| Gloves, leather/leather palm | Commercial | As required |
| Gloves, rubber | Commercial | As required |
| Gun, staple | Commercial | As required |
| Hammer, claw, non-sparking, various sizes | GGG-H-86 | As required |
| Hammer, claw, steel, various sizes | GGG-G-86 | As required |
| Hat, hard, construction worker's | ANSI Z89-1 | As required |
| Hearing protection | Commercial | As required |
| Hose, pneumatic, various lengths | Commercial | As required |
| Ink, stencil, Type II or IV, various colors | A-A-208 | As required |
| Jack, pallet, hydraulic/mechanical | Commercial | As required |
| Knife, utility | 5110-00-223-7782 | As required |
| Lumber, assorted dimensions | Commercial | As required |
| Machine, stencil cutting, various sizes | Commercial | As required |
| Marker, felt tip | Commercial | As required |
| Mask, dust | Commercial | As required |

| TOOLS AND SUPPLIES | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Mat, conductive rubber | Commercial | As required |
| Material, packing | 8135-00-855-6968 | As required |
| Nail Gun, pneumatic various sizes | Commercial | As required |
| Nails, various sizes | Commercial | As required |
| Paint, enamel, black | TT-E-516/MIL-E-52891 | As required |
| Paint, enamel, Olive Drab | TT-E-516/MIL-E-52891 | As required |
| Paint, obliterating, sand color | Commercial | As required |
| Paint, orange | Commercial | As required |
| Paint, water emulsion type | MIL-P-52108A (MR) | As required |
| Palletainer, lined/unlined | Commercial | As required |
| Pallets or fabricated spacers | Commercial | As required |
| Paper, stencil | Commercial | As required |
| Placard | Commercial | As required |
| Plate, container | Local Fabrication | As required |
| Plate, dock, aluminum, various sizes | Local Fabrication | As required |
| Platen, inking, plastic | Local Fabrication | As required |
| Pliers, common, various sizes | Commercial | As required |
| Pliers, diagonal/side cutting | GGG-P-468 | As required |
| Pliers, lineman | Commercial | As required |
| Pliers, vise grips, 12" | Commercial | As required |
| Pliers, wire, cutting | Commercial | As required |
| Plywood, various thickness, 4" x 8" | Commercial | As required |
| Pots, glue, with brush, 1 gal | Local Fabrication | As required |
| Press, drill | Commercial | As required |
| Press, hand, wire seal | GGG-S-735 | As required |
| Primer, coating, f/enamel | TT-P-664 | As required |
| Rake, garden | 3750-00-171-7182 | As required |
| Ramps, wooden or aluminum | Commercial | As required |
| Respirator, with filter, half face type | Commercial | As required |
| Roller, inking, (Brayer) | Commercial | As required |
| Sandpaper | Commercial | As required |
| Scales, weighing, 500, 5000 and 6000 lbs. | Commercial | As required |
| Scissors, various sizes | Commercial | As required |
| Screwdriver, flat/hex head type | Commercial | As required |
| Sealer, heat | Doughboy or equivalent | As required |

| TOOLS AND SUPPLIES | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Sealer, strapping, various sizes | Commercial | As required |
| Seals, anti-pilferage | Commercial | As required |
| Seals, ribbon, numbered, tin | Commercial | As required |
| Seals, strapping steel, various sizes | ASTM-D-3953 | As required |
| Shield, face | L-F-36 | As required |
| Shoes, safety, steel-toed | Commercial | As required |
| Sign, "DO NOT COUPLE", blue | Commercial | As required |
| Stapler, heavy duty, 1 ½" | Commercial | As required |
| Stapler, pneumatic, various sizes | Commercial | As required |
| Staples, 1-¼" | Commercial | As required |
| Staples, wire, 1-½" | Commercial | As required |
| Steel, strapping, various sizes | ASTM -D-3953 | As required |
| Stencilboard | A-A-1733 | As required |
| Straps, boxcar grounding | Local Fabrication | As required |
| Straps, tie down, with binders | Commercial | As required |
| Stretcher, steel strapping, various sizes | MIL-S-17743 | As required |
| Table, metal, w/side rails, 4' x 8' | Commercial | As required |
| Tag, reject | Commercial | As required |
| Tape, cloth, ordnance | PPP-T-60D | As required |
| Tape, measuring, steel | Commercial | As required |
| Tape, pressure sensitive, 1-½" | MIL-T-43036 | As required |
| Tape, waterproof, 1" and 2" | A-A-1689 | As required |
| Ties, plastic tag | Commercial | As required |
| Thinner, enamel | TT-E-306 | As required |
| Thinner, naphtha, aliphatic | TT-N-97 | As required |
| Twists, heavy gauge wire | Local Fabrication | As required |
| Vacuum, w/attachments | Commercial | As required |
| Worktable | Commercial | As required |
| Wrench, adjustable, open end | A-A-2344 | As required |
| Wrench, cribbing, boxcar | Commercial | As required |

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 1**

**MAGAZINE AREAS**

**SOP:** HW-0000-L-002

**REVISION**

**CHANGE**

**OPERATION:** Housekeeping in Storage Facilities

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Housekeeping of Storage Facilities.

   a. (O) The interior of magazines and warehouses will be neat and orderly at all times.

   b. (O) Material will be stored IAW applicable storage drawings.

   c. (O) Aisles will be maintained for stows, as specified in the applicable drawing.

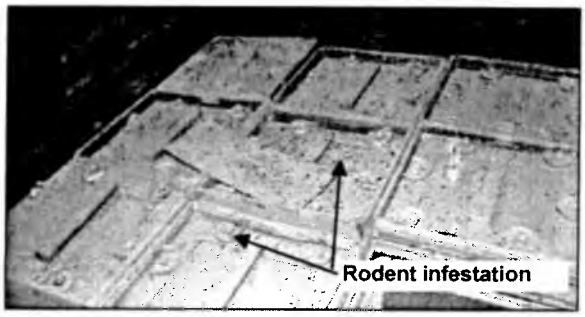


Figure 1-1

   d. (O)(S) When operations inside a magazine are completed, all debris, broken pallets, tools, and all other materials will be removed from the magazines and properly secured or disposed.

   e. (O)(QC)(S) Inspect magazine for loose grounding straps, rodent infestation, and safety hazards. Report any discrepancies. Refer to Figure 1-1.

   f. (O)(S) Magazine floors are to be swept clean prior to locking up after each operation. Refer to SOP HW-0000-A-001 for appropriate procedures for cleaning of rodent infestation.

   g. (O) Examine exterior for trash, loose material, etc., prior to departing.

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 2**

**MAGAZINE AREAS**

**SOP:** HW-0000-L-002

**REVISION**

**CHANGE**

**OPERATION:** Creating 2D Barcode Labels

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Create 2D Barcode Labels using the JMBL Program.

**Mandatory information required on a DOD label: Stock Number (NSN or Part Number), Lot Number, Quantity, Unit of Issue, Serial Numbers (if any), Label Type, and DODIC (if known)**

a. (O) Create the 2D barcode labels using the JMBL program.

(1.) Open the JMBL program by double clicking the icon on the desktop of the computer.

(2.) The JMBL program is used to make 4 inch box labels. Click on the Settings button to make a selection. Also, check to ensure that the correct media is loaded in the barcode machine (4 inch box labels).

**NOTE: If labels are being made from another location (not the building normally set up for the job), PLEASE set the labels back to original settings (i.e., put back to 4 inch, etc.) before logging off.**

(3.) Type in the Mandatory fields for a DOD label: NSN/Part No, Lot Number, Qty, Unit of Issue, Serial Numbers, Label Type and DODIC (if known).

(4.) At the bottom of the screen, input how many pallets (or boxes, containers, etc.) will need labels. This will depend on what was selected for label type.

(5.) If adding more than one label, click "Add item to Label" and continue to add more items. If only adding one NSN, click the "Print Immediately" button to print.

(6.) If adding multiple NSN's: Once all information has been added, select the "Print Labels" button.

(7.) When through for the day, close the program and shutdown the computer.

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 3**

**MAGAZINE AREAS**

**SOP:** HW-0000-L-002

**REVISION**

**CHANGE 1**

**OPERATION:** Prepare to Load/Unload Commercial Conveyances

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

**Conveyances may be loaded/unloaded at a variety of locations to include magazines, MILVAN Pads, and Docks. If loading/unloading occurs at a Pad or Dock, it will be moved to storage IAW Operation 7.**

1. As required, prepare magazine.

   a. (O)(QC)(S) Unlock magazine doors and secure in open position with door hooks.

      (1.) If door hooks are not present or are unserviceable, notify the Trouble Desk. Assure that at least two doors are open where possible and that all personnel have unobstructed access to the nearest exit.

      (2.) No exit will be obstructed at any time.

   b. (O)(QC) Assure an electric forklift has been delivered and is in place. If not, call for forklift and determine if it will be delivered in a timely manner, while proceeding through Step 2.

   c. (O)(S) Sweep the floor, as required, for safe forklift operation.

   d. (O)(QC)(S) Observe good housekeeping policies, as noted in Operation 1.

   e. (O)(S) Inspect the interior of the magazine for available storage space. Note the condition of the stored material, particularly the vertical positioning of palletized material. Shift material to prevent any danger of toppling before starting operations.

2. Position and secure the run-through truck at magazines without docks for truck unloading, as required. A "run-through" truck is a flat bed semi-trailer truck with the tailgates removed. It carries an electric forklift, which is chained down when not in use.

a. (O)(QC)(S) The foreman will determine the appropriate equipment to be used to unload conveyances.

b. (O) Position run-through in front of magazine doorway.

c. (O) Shut off engine and place in lowest gear. Apply tractor and trailer brakes. Chock tractor wheels as in Figure 3-1.

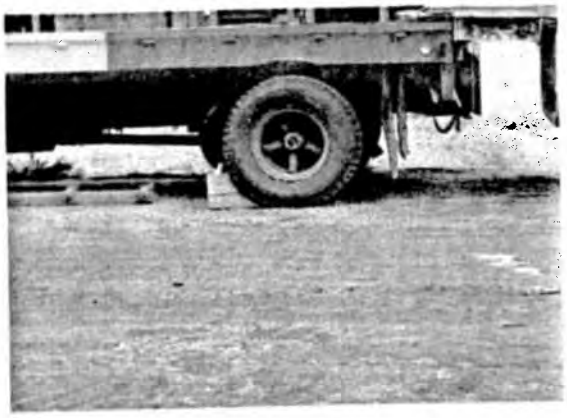


Figure 3-1

d. (O) Place ramps appropriately for commercial trucks to back onto safely.

e. (O) Compare the number on the seal with the number on the seal card; annotate the seal card and return the seal card to the driver for delivery to the Truck Lot.

f. (O) Open doors and assure they are secured in the open position.

Figure 3-2

g. (O) Back commercial truck onto ramps while placing the dock plate. The trailer tires must be on the top of the ramps, not on the incline. Also, the trailer must be square to the run-thru to ensure proper placement of the dock plate.

h. (O) Shut off engine and apply tractor and trailer brakes (unless engine is required for air-ride suspension).

i. (O) Place chock in front of the drive wheels (Figure 3-2) and in front of trailer wheels (Figure 3-3).

Figure 3-3

j. (O) Download material, removing dunnage as required.

3. Prepare Railroad Boxcar/Flatcar for Unloading.

a. (O)(QC)(S) The railroad crew will spot the boxcar/flatcar in front of the magazine or warehouse doors for unloading of cargo by the storage crew.

b. (O)(QC) Operators will assure QA has inspected railcar and that railcar is ready for unloading by contacting the inspector at the Truck Lot at ext. 7829.

c. (O)(QC)(S) Place a blue "DO NOT COUPLE" sign on each approach end of the railcar. Assure the railcar is properly chocked. Refer to Figure 3-4.

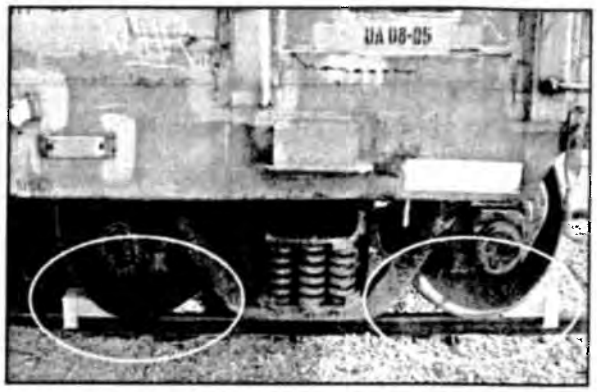



Figure 3-4
Proper chocking of railcar

4. Prepare MILVAN Containers for Unloading.

a. (O)(QC)(S) MILVAN containers will be received on flatcar or trailer.

(1.) If on a trailer, chock truck drive wheels, both front and back.

(2.) If on a railcar, perform Steps 3a through 3c.

(3.) Check for pre-existing defects before downloading conveyance. Upon identification of such defects, notify Supervisor, who will implement appropriate steps as necessary.

b. (O)(QC)(S) If the MILVAN container is to be downloaded while still on the conveyance:

(1.) Place a dock plate between the dock and the flatcar or truck as applicable. The plate should rest firmly on the dock and the conveyance bed. Assure the dock plate cannot slide out of position.

(2.) Place a container plate on the conveyance, open the container and fit the plate to the container.

c. (O)(QC)(S) If the MILVAN container is to be downloaded after removal from the conveyance:

(1.) Using a material handler, remove the MILVAN container from the conveyance carefully to avoid damaging the conveyance.

(2.) At the staging area, lower the MILVAN container into position on a flat hardstand or onto appropriate dunnage. Move container handler away to a position clear of the staging area and park it until needed.

(3.) MILVAN container should be placed so that it is not touched by standing water.

d. (O) Open door to container.

5. All Conveyances.

a. (O)(QC)(S) Place dock plate to bridge the gap between the dock and the conveyance or the run-through truck and the truck. Secure the dock plate to assure it cannot slide out of position during loading operations.

b. (O)(QC) Applicable outloading/storage drawings will be present for this operation.

c. (O)(QC)(S) Remove any bulkheads or bracing that held the load in place during shipment. Assure that load is stable and has not shifted in transit.

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 4**

**MAGAZINE AREAS**

**SOP:** HW-0000-L-002

**REVISION**

**CHANGE**

**OPERATION:** Unload Commercial Conveyances

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

**Conveyances may be loaded/unloaded at a variety of locations to include magazines, MILVAN Pads and Docks. If loading/unloading occurs at a Pad or Dock, it will be moved to storage IAW Operation 8.**

1. Assure there is adequate storage space to store material.

2. Identify Material. This may be performed as material is being removed from conveyances.

   a. (O)(QC) Compare the NSN, lot number, and quantity noted on the shipping documents with the material received.

   b. (O)(QC) Upon receipt of material, immediately verify that the seals are intact and inspect for any signs of damage or tampering. If there are any such signs, there must be an immediate inventory to verify quantities and to determine the extent of any damage or tampering on all shipments.

      (1.) An inventory report of damage/tampered-with shipments, outlining date of receipt, item, quantity, and extent of damage, shall be provided to the ACO Security Officer by the end of the day on which the affected shipment was received. If the seals are intact, quantity verification must take place by the end of the next working day.

   c. (O)(QC) Fill in the appropriate data (i.e., the actual quantity received, the building and grid(s) where the material is stowed, etc.) on the receipt document(s).

   d. (O)(QC) If the description of the material being stowed differs from the description on the receipt documents, note on the receipt document(s). If there is a discrepancy or damage discovered during the unloading of incoming shipments, the crew will request QASAS inspection.

e. (O)(QC)(S) Replace all broken pallets or boxes that will interfere with the stability of a stow or pallet when placing in storage.

f. (O)(QC)(S) Correct packaging defects before storage when it prevents safe storage. This includes, but is not limited to, broken or damaged pallets, damaged wood boxes, banding, correction of incidental marking and labeling defects, and application of pallet placards for all assets.

3. Unload Conveyances

a. (O)(QC)(S) Unload Commercial Trucks.

(1.) Transfer material from commercial truck and place in magazine or on the bed of the run-through truck. Tilt forklift tines back when lifting material to prevent inadvertent dropping of material.

(2.) As required, move the pallet of material from the run-through truck bed and place in the magazine with the magazine forklift. Tilt forklift tines back when lifting material to prevent inadvertent dropping of material.

(3.) Remove bracing/cribbing in the commercial truck, as necessary, during unloading operation.

**NOTE: A "run-through" truck is a flat bed semi-trailer truck with the tailgates removed. It carries an electric forklift, which is chained down when not in use.**

b. (O)(QC)(S) Unload Railcars.

(1.) Pending repair to the magazine grounding systems, an interim procedure will be used during railcar loading/unloading of propellant.

(a.) A temporary ground strap will be used between the railcar and the building ground during offloading of propellant.

(b.) The railcar will be positioned at an appropriate distance (at least six feet) from the existing mast type terminal.

(c.) Location will be evacuated if a lightning storm approaches.

(2.) Remove side gates for access (for flatcars with gates).

(3.) Inspect the load for any visible damage that may have occurred during transit.

(4.) Transport material from railcar into the magazine and place in stow(s). Bulky items will be removed using the appropriate equipment. Re-warehouse any material that was moved in order to store incoming material. Assure proper gridding is maintained.

(5.) Care will be taken to assure forklift tines do not protrude through the pockets in the pallets to the extent that they could cause damage to the material already in the stow, or to the walls of the boxcar. Forklift tines will not be used to push AEDA containers. Push only on the most substantial portion of the pallet, when needed.

(6.) Remove bracing/cribbing from the railcar, as needed.

c. (O)(QC)(S) Download MILVAN Containers.

(1.) Using appropriate tools, remove bracing, as applicable, to afford access to material in the container.

(2.) Using a forklift, remove a container/pallet and place in magazine stow or in an inspection/segregation temporary storage area if at one of the MILVAN Pads.

(3.) Drive the forklift over the gate/ramp into the MILVAN container and pick up the load of material. Back out of the MILVAN container and place the material in magazine or in an inspection/segregation temporary storage area if at one of the MILVAN Pads.

(4.) Some MILVAN containers are equipped with structural restraint bars that may/will be removed to gain access to the material. Remove the sections divider(s) as necessary by hand to access material. Once MILVAN container is downloaded, return restraint bars into container, locking the restraint bars into the slotted horizontal rails.

d. (O)(QC)(S) All Conveyances.

(1.) Remove the explosive placards from the conveyance once the conveyance has been downloaded of ammunition.

(2.) Remove all remaining bracing/cribbing from conveyances and set aside to a suitable container or crew's truck bed for transfer to either PRO or one of the landfills.

(3.) Sweep out conveyance.

(4.) As required, replace restraints.

(5.) Remove dock plate from between commercial truck and run-through truck, or from between conveyance and dock, and set aside for reuse.

(6.) As required, remove wheel chocks securing the two trailers together.

(7.) Operator will direct driver as he/she moves truck off ramps or away from the dock.

(8.) Close and secure conveyance doors.

(9.) As required, provide driver with receipts and copies of transportation documents. Then, direct/escort the truck driver to truck inspection lot IAW current Security requirements.

4. Prepare and Move Run-Through Truck from Magazine Doors at Magazines without Docks.

a. (O) Secure electric forklift.

b. (O) Remove commercial truck ramps; place and secure on the run-through.

c. (O) Remove wheel chocks.

d. (O) Move truck from in front of magazine doors.

5. Segregation of Ammunition:

a. (O)(QC) Material should be placed with its parent lot by location and condition code. Material that is received, but not inspected for true condition, will be assigned a condition code by QASAS. An effort should be made to segregate, inspect, and assign a true condition code prior to storage.

b. (O)(QC)(S) Prior to placing material in storage, it must be identified and segregated by NSN, DODIC, Lot Number, Condition Code, Nomenclature, quantity, and compatibility as directed by Storage Planning Personnel. Explosive materials that are not compatible will not be stored in the same magazine.

c. (O)(QC) Upon receipt of off-station material, it may be necessary to offload conveyance at a temporary storage site and receipt the material to the temporary site.

d. (O) After segregation and/or posting, movement of material to a permanent storage site will be accomplished by ATR (Form DA-4508) or by scanner.

e. (O)(QC) ISPM 15 compliant packaging will be separated by a minimum of five feet in storage.

6. Secure Magazine Forklift.

a. (O) Move forklift to a point in the magazine or on the dock furthest from explosive stows as possible.

b. (O) Lower tines all the way to the floor. Turn switches OFF, if present. Remove key from forklift.

c. (S) Battery cables will not be disconnected in explosive storage locations.

7. Secure Magazine.

a. (O) Complete documentation, update log book in Storage Planner office, then deliver to AD&C.

b. (O)(QC)(S) Observe good housekeeping policies as noted in Operation 1, then close doors to magazine.

**SPECIAL REQUIREMENT:**

**1. BOXCARS THAT ARE FULLY LOADED WITH EXPLOSIVES OFTEN PRESENT A PROBLEM SINCE THERE IS EXTREMELY LIMITED ROOM INSIDE THE BOXCAR FOR THE MANEUVERING OF FORKLIFTS. CARE WILL BE TAKEN TO ASSURE PALLETS AND PALLETIZED MATERIAL IS NOT DAMAGED WHEN SHIFTING THE PALLETS TO GET THEM ON THE TINES OF THE FORKLIFT. IT IS OFTEN MORE ADVANTAGEOUS TO USE ALTERNATE EQUIPMENT INSTEAD OF A FORKLIFT TO REMOVE THE FIRST FEW PALLETS FROM THE BOXCAR TO PROVIDE MANEUVERING ROOM INSIDE THE BOXCAR FOR FORKLIFT OPERATIONS.**

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 5**

**MAGAZINE AREAS**

**SOP: HW-0000-L-002**

**REVISION**

**CHANGE**

**OPERATION:** Prepare Material for Intraplant Moves or Interplant Shipments

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Identify Material.

   a. (O) For On-Station Movement:

      (1.) Select and prepare material IAW the ATR or DD Form 1348-1.

      (2.) Compare material by NSN, DODIC, lot number, owner, condition code, quantity, and grid location with the related documents.

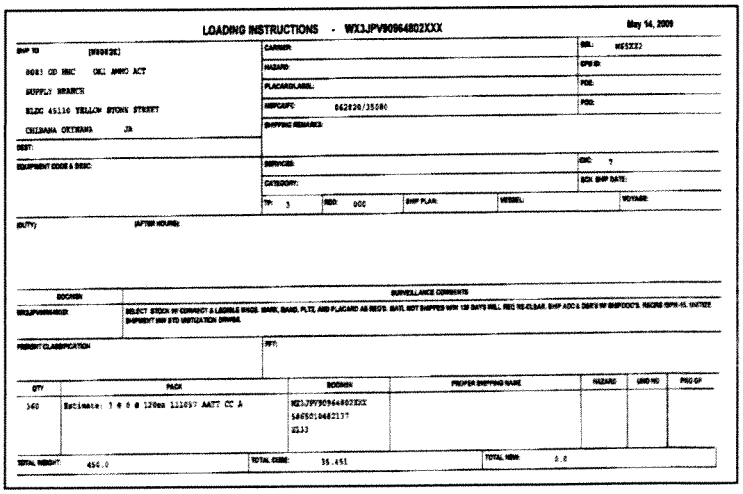
      (3.) Process PCP crystal contaminated boxes and pallets IAW SOP HW-0000-A-001.

   b. (O) For Off-Station Shipment:

      (1.) All material, whether explosive or inert, will be processed prior to shipment.

      (2.) Compare material by NSN, DODIC, ammunition lot number, owner, condition code, quantity, and grid location with the related documents.

      (3.) Prepare item to be processed IAW the Load Instructions and related documents. Refer to Figure 5-1.


LOADING INSTRUCTIONS - WX3JPV90964802XXX

May 14, 2009

| QTY | PACK | DODIC | PROPER SHIPPING NAME | HAZARD | UNO NO | PKG GP |
|---|---|---|---|---|---|---|
| 360 | Estimate: 1 @ 0 @ 120mm 111697 AATT CC A | WX3JPV90964802XXX 5A65210482137 2133 | | | | |

TOTAL WEIGHT: 454.0 TOTAL CUBE: 35.451 TOTAL NEW: 0.0

Figure 5-1

      (4.) Process PCP crystal contaminated boxes and pallets IAW SOP HW-0000-A-001.

2. Select Forklift.

   a. (O)(S) Use an electrical forklift with the proper weight lifting capacity for indoor storage, or one of the diesel forklifts with the proper weight lifting capacity for outdoor storage.

   b. (O) Remove material from stows and place it on the floor/ground for inspection and preparation for shipment. Re-warehouse any material that was moved in order to gain access to loaded material. Assure proper gridding is maintained.

3. Inspect Materials.

   a. (O)(QC)(S) For On-Station Movement:

      (1.) Material will be inspected to assure it is a stable load and is safe to move. Palletized loads will be banded with banding steel that is adequately associated with the weight.

      (2.) NSN, Lot Number, and quantity will be legible and complete.

   b. (O)(QC)(S) For Off-Station Shipment:

      (1.) Material will be inspected for serviceability of the pallets, boxes or containers, the squareness of boxes or containers on pallets, and the tightness of strapping that secures the material to the pallets.

      (2.) Light boxes/containers will be painted orange (as required) and marked IAW Drawing 12982865 (latest revision).

      (3.) Apply 2D bar code IAW Operation 2 for Logistics Operations.

      (4.) Boxes and containers that are broken, battered, rotten, heavily rusted, or corroded will not be shipped unless special instructions indicate the customer will accept such condition.

4. Prepare to Load/Unload Conveyances.

   a. (O) On-Station Movement:

      (1.) Material that is packaged in cardboard boxes requires a chain board to keep material secure to conveyance and to reduce damage to material.

      (2.) Material that is top heavy will not be hauled until it is made stable.

      (3.) Material that is over five feet long requires two tie downs.

      (4.) After making material safe for movement, place scrap strapping steel into lined palletainers. As necessary, fold scrap strapping steel into lengths that allow for placement into palletainers.

      (5.) Complete DD Form 1348-1A and transport the palletainer to PRO scrap disposal area when the job is completed.

b. (O) Off-Station Shipment:

(1.) Remove material from unserviceable pallets; place on serviceable pallets and strap IAW appropriate palletization/unitization drawing(s).

(2.) Replace damaged containers with serviceable containers of material from other stock in stows, if available. Repackaging operations will be IAW applicable safety requirements. Substitutions must be made from the same Ammunition Lot and Condition Code.

(3.) When time allows, remove material from damaged containers and repackage in serviceable containers, if available. Remove damaged containers that have been emptied to the trash receptacle or to PRO, as applicable. If damaged material remains, notify QASAS for disposition instructions.

(4.) Strapping will conform to service requirements.

(5.) Apply 2D bar code IAW Operation 2.

(6.) When the material has been processed, it may be placed in temporary storage in the magazine aisles to provide working space for more pallets to be processed.

(7.) When tightening and re-tightening strapping steel, the strapping will be tightened enough to secure the material firmly to the pallet; but tightening will not be so tight that it crushes the corners of wooden boxes or warps and distorts metal containers.

(8.) Boxes for palletizing will be stacked straight, prior to strapping. All pallets will be squared.

(9.) Place scrap-strapping steel in lined palletainer, after being folded into lengths to fit inside. Complete DD Form 1348-1A and transport the palletainer to PRO scrap disposal area when the job is completed.

5. MULTIPLE LOT PALLETS:

a. Prior to strapping/securing a multiple-lot pallet, personnel must have the lot numbers and quantities for each lot verified by QA, only if lot numbers are not visible.

b. GRANDFATHER CLAUSE - Material packaged prior to January 1, 1990, will have the DD Form 1348-1A stamped with the following statement – "GOVERNMENT OWNED GOODS PACKAGED PRIOR TO 1 JAN 90".

c. Generally, multiple lot pallets are not acceptable for storage or shipment of military munitions. However certain exceptions apply, such as Navy gun ammo, belted or linked items.

(1.) Items listed on multiple MROs that have the same destination address, NSN, Condition Code, Owner and Project Code, and are different Lot Numbers, may be palletized together to make a full unit load.

(a.) Select one MRO as the "Parent Document" and each additional MRO must bear the statement "Packed with TCN: XXXXXX-XXXX-XXXX-XXX".

(b.) List each TCN on the "Parent Document" and a breakdown of the entire quantity for all of the MROs consolidated. At no time will multiple Lot Numbers be packed within the same box, unless the item is in a linked configuration.

(c.) Place two placards listing each lot number and their respective quantities on the pallet once consolidation is accomplished.

(d.) All other requirements apply with respect to marking, labeling, packaging, unitization, and reporting of discrepancies.

(e.) Only one multiple lot pallet per NSN will be shipped for a full truckload of material.

(f.) Shown in Figure 5-2 is an example of how to complete multiple TCN/Lot Number shipment documentation:

(2.) Truck/Railcar/Container Loaded items may include one or more multiple lot pallets if partially full pallets can be combined to square off a unit load. All marking, labeling, and identification requirements must be met as listed in step 5c(1)(c) above.

6. For off-station shipments, assure correct United Nations (UN) Performance Oriented Packing (POP) markings and UN Proper Shipping Name and serial number are applied.

   a. (O) When an exterior (shipping) container is replaced, the POP markings will be the same as the Load Instructions, as required per MIL-STD.

   b. (O) POP markings are required to be placed on the outer shipping containers of all ammunition/explosive items and explosive components, with the exception of separate loading projectiles, palletized bombs, and items in bulk packaging weighing over 880 lbs. or containing more than 450 liters of liquid.

   c. (O) POP markings will be exposed on at least two places on the unit load.

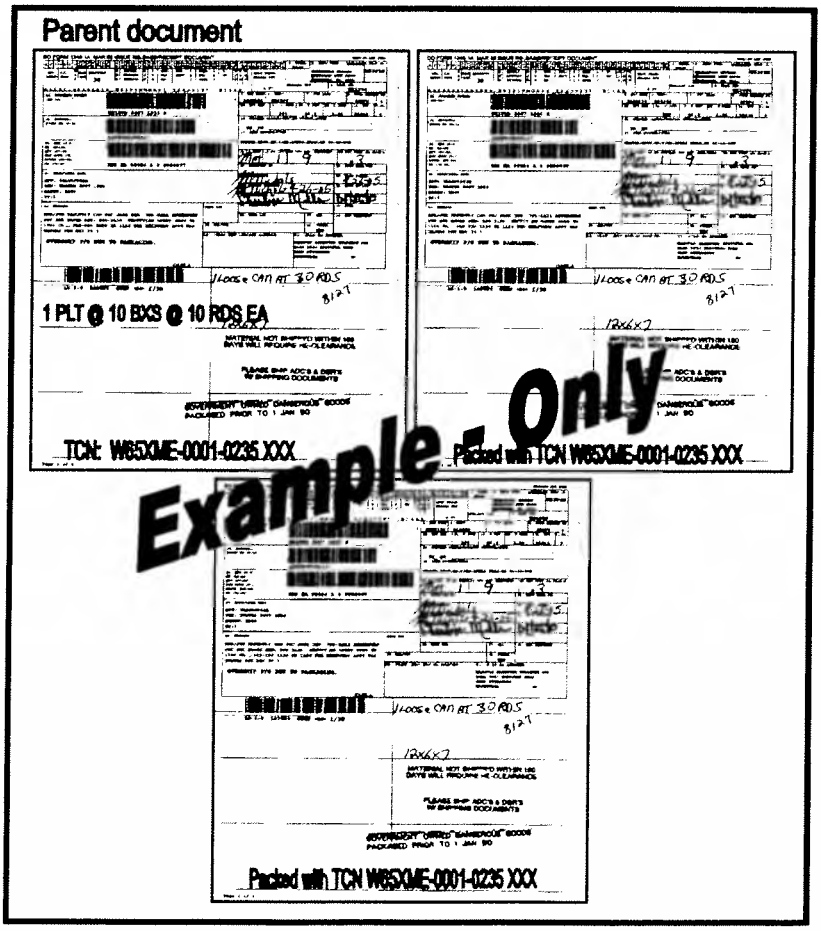



Figure 5-2

   d. (O) Apply correct UN Proper Shipping Name and UN ID Number.

   e. (O) For those items that are already in a shipment state, wooden placards may be used for applying POP markings in lieu of repalletization.

f. (O) As required, apply competent authorization number.

g. (O)(QC) As required for all shipments, all wood pallets must be checked for nematodes and stamped twice verifying that the wood is nematode free. All wooden boxes must also be checked and have any visible box ends stamped stating that they are nematode free. OCONUS shipments require all boxes and pallets to be ISPM 15 certified.

7. Inspection Guidance for Shipments of Wood Packaging Material (WPM).

a. Pest free certification is applicable to CONUS shipments, shipments to ISPM-15 non-signatory countries, and retrograde.

b. (O)(QC) Pest free certification inspections are as follows:

(1.) If the pack date is less than five years (or cannot be determined), ensure:

(a.) The WPM is bark free.

(b.) The WPM contains no boreholes larger than 3mm (about the height of a stack of two pennies or the size of a ⅛" drill bit).

(c.) The moisture content is less than 20%.

(d.) There is no evidence of other insect infestation.

(2.) If the pack date is five years or older, ensure:

(a.) The WPM is bark free.

(b.) The WPM contains no boreholes larger than 3mm (about the height of a stack of two pennies or the size of a ⅛" drill bit).

(c.) There is no evidence of other insect infestation.

a. (O)(QC) Pest free certification markings are to be visible and readable via use of a brand or permanent ink. Depalletization for marking of each container is not necessary. Only authorized, certified personnel will apply WPM markings. Markings are to be placed as follows:

(1.) Box markings shall be placed on both ends of the outer packaging, between the end cleats or end battens (refer to Figure 5-3).

Figure 5-3

(2.) Pallet markings shall be applied to two opposite corner end posts on same side as the preservative markings.

(3.) Dunnage markings shall be applied to two opposite sides.

**NOTE: ONLY WPM THAT IS VISIBLE AND ACCESSIBLE IS TO BE MARKED. IF SHIPMENT IS ALREADY UNITIZED/PALLETIZED, THERE IS NO NEED TO STAMP THE BOXES THAT ARE NOT VISIBLE/ACCESSIBLE. IF SHIPMENT IS NOT UNITIZED/PALLETIZED, STAMP EACH BOX BEFORE IT IS UNITIZED/PALLETIZED.**

8. Stow Material Processed for Off-Station Shipment.

   a. (O) Material to be shipped may be processed for shipment, identified by TCN number, and re-stowed in magazine to await the shipping date. Magazine Data Card and Planograph update will be accomplished for all stock movements within a site.

   b. (S) Care will be exercised when removing and returning material to stows.

**SPECIAL REQUIREMENTS:**

1. **DO NOT PROCESS BROKEN AND BATTERED BOXES OF EXPLOSIVE MATERIAL INSIDE A MAGAZINE. TRANSPORT TO A FACILITY (DOCKS, PRODUCTION BUILDINGS, SHEDS, ETC.) FOR RE-BOXING, THEN RETURN TO STORAGE MAGAZINE.**

2. **NORMAL MAINTENANCE OF SMALL ARMS AMMUNITION, UNPACKING, AND REPACKING MAY BE PERFORMED IN MAGAZINES CONTAINING SMALL ARMS AMMUNITION ONLY, PROVIDED THERE IS SUFFICIENT ROOM IN THE MAGAZINE AND OTHER SAFETY REQUIREMENTS PRESCRIBED HEREIN ARE OBSERVED.**

3. **CONVEYANCES WILL BE PLACARDED AS SOON AS THE FIRST EXPLOSIVE ITEM IS LOADED INTO THE CONVEYANCE; EMPTY CONVEYANCES WILL HAVE EXPLOSIVE PLACARDS REMOVED.**

4. **INSPECTION OF MULTI-LOT PALLETS WILL BE PERFORMED BY QA PRIOR TO PALLETIZATION. THE INSPECTION WILL BE FOR VERIFICATION OF STOCK NUMBERS, LOT NUMBERS, QUANTITIES, AND/OR ANY OTHER PERTINENT INFORMATION CALLED FOR ON THE SHIPPING DOCUMENT. ONCE PALLETIZED, THE QA INSPECTOR WILL SIGN THE DOCUMENTS. MULTI-LOT PLACARDS WILL BE ATTACHED THAT ACCURATELY SHOW THE QUANTITY OF EACH LOT IAW DRAWING 12982865 (LATEST REVISION). THIS IS NOT REQUIRED, HOWEVER, IF ALL LOT NUMBERS ARE VISIBLE.**

5. **IN THE EVENT OF A SHIPMENT DESTINED FOR OVERSEAS, ALL WOODEN MATERIALS (INCLUDING DUNNAGE) WILL BE HEAT TREATED ACCORDING TO ISPM 15 CERTIFICATION. THE REQUIREMENTS FOR THE INSPECTION WILL BE VERIFIED BY QA PRIOR TO RELEASING THE SHIPMENT. THE REQUIREMENT IS TWO STAMPS ON EACH WOODEN PALLET. IF WOODEN BOXES ARE SHIPPED, ALL BOXES ON OUTSIDE OF PALLET WILL BE STAMPED (REPALLETIZATION WILL NOT BE REQUIRED TO STAMP BOXES). ALL DUNNAGE UTILIZED FOR BLOCKING AND BRACING MUST ALSO BE HEAT TREATED AND STAMPED WITH ISPM 15 STAMP.**

UNCONTROLLED
DOCUMENT

MAR 1 4 2012

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 6**

**ALL AREAS**

**SOP:** HW-0000-L-002

**REVISION**

**CHANGE 1**

**OPERATION:** Load Commercial Conveyances

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

**Conveyances may be loaded/unloaded at a variety of locations to include magazines, MILVAN Pads and Docks. If loading/unloading occurs at a Pad or Dock, it will be moved to storage IAW Operation 7.**

1. Prepare Magazine.

   a. (O)(QC)(S) Unlock magazine doors and secure in open position. Assure that at least two doors are open where possible and all personnel have unobstructed access to the nearest exit. No exit will be obstructed at any time.

   b. (O)(QC) Assure an electric forklift has been delivered and is in place. If not, call for forklift (at ext. 7600) and determine if it will be delivered in a timely manner, while proceeding through Step 2. Fill out trip ticket.

   c. (O)(S) Sweep the floor, as required, for safe forklift operation.

2. Identify and Inspect Material to Be Loaded on Conveyance.

   a. (O) Locate material described on shipping documents.

   b. (O)(QC) Inspect for the following:

      (1.) Pallets are serviceable.

      (2.) Containers are serviceable.

      (3.) Strapping is secure.

      (4.) Containers have correct markings.

c. (O)(QC) Assure material has been previously prepared for shipment IAW Operation 5.

d. (O)(QC) Have the QA personnel inspect and sign documents prior to loading.

3. See Operation 3 for Run-Through Set Up.

4. Load Conveyances. Refer to Figure 6-1.

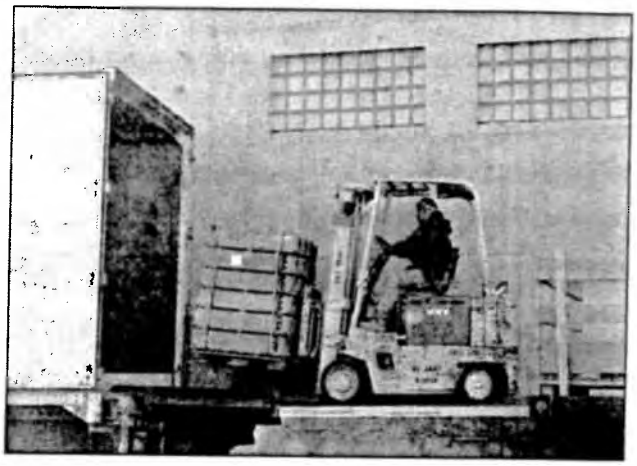


Figure 6-1

a. (O)(QC)(S) Commercial Trucks.

(1.) Transfer material from magazine and load into commercial truck IAW applicable truck loading drawings.

(2.) Using an approved forklift, remove required material from storage and place on conveyance. Re-warehouse any material that was moved in order to gain access to loaded material. Assure proper gridding is maintained.

(3.) As required, move pallets of material from stow in magazine to the bed of run-through truck or position pallets in commercial truck with forklift.

(4.) If required, move pallet of material from run-through truck bed and position in commercial truck with run-through truck forklift.

b. (O)(QC)(S) Railcars.

(1.) Remove side gates for access (applicable for flatcars with gates).

(2.) Transfer material from magazine and load into railcar IAW railcar loading drawings.

(3.) Transport material across dock plate with the forklift in reverse, if practical.

(4.) For propellant: Pending repair to the magazine grounding systems, an interim procedure will be used during railcar loading/unloading:

(a.) A temporary ground strap will be used between the railcar and the building ground during offloading.

(b.) The railcar will be positioned at an appropriate distance (at least six feet) from the existing lighting mast type terminal.

c. (O)(QC)(S) MILVAN Containers.

(1.) Transfer pallet of material into MILVAN container IAW applicable drawings and position.

(2.) Some MILVAN containers are equipped with restraint bars that may/will have to be replaced to properly load material/projectiles. Replace restraint bars as necessary.

(3.) Transfer unit load of material/projectiles and drive the forklift over the gate/ramp into the MILVAN container and place into position in the farthest stow.

d. (O)(QC)(S) All Conveyances.

(1.) Pallet loads are to be blocked and braced as loaded into the conveyance during the loading process IAW the applicable AMC and/or WR drawings. Refer to Figure 6-2.

Figure 6-2

(2.) Assure all tools, excess blocking and bracing materials, trash, etc., are removed prior to closing the doors.

(3.) Once conveyances are loaded, remove the dock plate.

(4.) Close and secure conveyances IAW Operation 4.

(5.) Complete documentation for delivery to Traffic Division. Fill out Magazine Data Card and annotate planograph to show accurate space release.

5. Secure Forklift at Magazine.

a. (O) Move forklift to a point in the magazine, or on the dock, furthest from explosive storage, as necessary.

b. (O) Lower tines all the way to the floor. Turn switches OFF, if present. Remove key from forklift. Fill out trip ticket.

**Note: Battery cables will not be disconnected in explosive storage locations.**

6. Secure Magazine.

a. (O)(QC)(S) Observe good housekeeping policies as noted in Operation 1, then close doors to magazine.

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 7**

**ALL AREAS**

**SOP:** HW-0000-L-002

**REVISION**

**CHANGE**

**OPERATION:** Close and Secure Conveyances for Shipment

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Secure Truck Doors.

   a. (O)(QC) Remove chocks and direct driver as he/she moves truck off the ramps and away from run-through truck or away from the dock. The commercial truck is only moved far enough to provide room to close trailer doors.

**NOTE: A "Run-Through" truck is a flat bed semi-trailer truck with the tailgates removed. It carries an electric forklift, which is chained down when not in use.**

   b. (O)(QC) Seal and/or lock the loaded trailer consistent with the provisions of DOD 5100.76-M, AR 190-11 and information contained in shipping documentation.

   c. (O)(QC) Close trailer door(s) and apply temporary seal(s) and/or lock(s).

   d. (O)(QC) Complete seal card and return it to the driver for transport to the Truck Lot.

   e. (O)(QC) After applying door seals, or in the company of a security escort if seals are not applied, direct the driver to drive to the truck inspection lot for weighing and preparation of shipping documents. Trucks with CIIC CAT I or II material will be escorted to truck inspection lot by SOC security.

2. Secure Railcars.

   a. (O)(QC) Full/partially loaded railcars will be secured at all times when not attended by storage personnel. The doors will be secured IAW the following as referenced in AR 190-11:

      (1.) Category I and II:

         (a.) Call SOC Security.

(b.) Option 1: US Navy padlocks (or heavy gauge wire twists), numbered ribbon seal (tins), and upper rail locks.

(c.) Option 2: Numbered cable seals and upper rail locks.

(2.) Category III and IV:

(a.) Option 1: US Navy padlocks (or heavy gauge wire twists) and numbered ribbon (tin) seals.

(b.) Option 2: Numbered cable seals. Upper rail locks are not required.

(3.) Confidential/Classified:

(a.) Option 1: US Navy padlocks (or heavy gauge wire twists) and numbered ribbon (tin) seals.

(b.) Option 2: Numbered cable seals. Upper rail locks are not required.

(4.) Category 7 and U:

(a.) Ribbon (tin) seals required.

(5.) Identification of the category of material is based on the JHCS. Inert material is subject to the above requirements.

(6.) Remove the blue "DO NOT COUPLE" signs.

b. (O)(QC) Completed cars will have paperwork filled out and turned into Traffic Division. On-station seal requirements will be dictated by the material security code. Seal card will be filled out by the originator.

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 8**

**MAGAZINE AREAS**

**SOP:** HW-0000-L-002

**REVISION**

**CHANGE**

**OPERATION:** Consolidation Moves for Shipments

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Prepare Magazine.

   a. (O)(QC)(S) Unlock magazine doors and secure in open position. Assure that at least two doors are open where possible and all personnel have unobstructed access to the nearest exit. No exit will be obstructed at any time.

   b. (O)(QC) Assure an electric forklift has been delivered and is in place. If not, call for forklift (at ext. 7600) and determine if it will be delivered in a timely manner, while proceeding through Step 2.

   c. (O)(S) Sweep the floor, as required, for safe forklift operation.

2. Identify Material to Be Loaded.

   a. (O) This material may consist of a single box, a single item, or several pallets of material. Sign the shipping documents for delivery to the appropriate office.

   b. (O)(S) When shipping documents call for a specific number of explosive items that require opening a box or carton to remove the items, or when a document is not able to overship/undership due to unit pack quantity, the container will not be opened in the magazine. It will be taken to Dock 1, where the required number of items will be removed and the remainder returned to storage.

      (1.) Remaining material will be put back into the same grid location that it was removed.

      (2.) If material is not put back into the same grid location, storage personnel will annotate a building Planograph to show the exact magazine grid locations where material is re-warehoused. This Planograph will be sent to the Inventory Branch.

      (3.) Box/carton will be painted and/or marked IAW Operation 9 to denote less than a full box/carton.

(4.) When such boxes/cartons are returned to storage, they will be secured to a pallet with steel strapping IAW steps in Operation 9.

(5.) Only one light box/carton, stenciled IAW Drawing 12982865 (latest revision), is permitted per lot and Condition Code in each storage magazine.

c. (O)(QC) Determine the identification criteria on shipping documents; consisting of NSN, DODIC, ALN, Condition Code, quantity, Nomenclature, and Owner, will make this identity.

3. Load Material.

a. (O) Move stowed material to give access to the items to be loaded, if required.

b. (O) Material, when moved, will be stored IAW applicable storage drawings.

c. (O) Remove required material from storage and place on truck. Re-warehouse material that was moved to gain access to loaded material in proper stows.

d. (O)(S) When a forklift is backed off a "Special" truck, care must be taken not to strike the magazine doorframe; the brakes will be used to prevent fast backward movement down the ramp onto the warehouse dock.

e. (O)(S) Pallets will not be transported on any base truck more than one high, unless the pallets are strapped together or have interlocking devices.

f. (O)(S) Load must be secured with tie down straps.

g. (O) After material has been placed on the truck and secured, it will be transferred to the new building or dock for processing.

h. (O)(QC) Fill out Magazine Data Card. Annotate planograph to reflect space release.

4. Secure Magazine Forklift.

a. (O) Move forklift to a point in the magazine, or on the dock, furthest from explosive storage, as necessary.

b. (O) Lower tines all the way to the floor. Turn switches OFF, if present. Remove key from forklift. Fill out trip ticket.

**Note: Battery cables will not be disconnected in explosive storage locations.**

5. Secure Magazine.

a. (O) Complete documentation, including planograph for delivery to consolidation site.

b. (QC)(S) Observe good housekeeping policies as noted in Operation 1, then close doors to magazine.

SPECIAL REQUIREMENTS:

1. ALL EXPLOSIVE ITEMS WILL BE TRANSPORTED TO PROCESSING BUILDINGS ABOARD THE DEPOT ON APPROVED AMMUNITION TRUCKS.

2. INERT MATERIAL MAY BE TRANSPORTED IN THE SAME TRUCK WITH EXPLOSIVES.

3. IT IS THE DRIVER'S RESPONSIBILITY TO DISPLAY PROPER FIRE SYMBOLS ON THE TRUCK WHEN IT IS LOADED WITH EXPLOSIVES. WHEN EXPLOSIVES ARE UNLOADED, THE FIRE SYMBOLS WILL BE COVERED OR REMOVED FROM THE TRUCK.

4. THE TRUCKS NORMALLY USED TO TRANSPORT LESS THAN TRUCK LOAD LOTS FROM WAREHOUSES TO PROCESSING BUILDINGS CARRY AN ELECTRIC FORKLIFT ON THE SEMI-TRAILER THAT IS USED TO LOAD MATERIAL ONTO THE TRUCK. THIS FORKLIFT, WHEN IT IS ON THE TRUCK, WILL BE SECURED BY LOWERING THE TINES SO THEY REST OVER AN IRON BEAM WELDED TO THE TRUCK BED TO PREVENT THE FORKLIFT FROM MOVING, IN THE EVENT THE RESTRAINING CHAINS SHOULD BREAK. THE EMERGENCY BRAKE IS ALSO SET AS AN ADDITIONAL SAFETY MEASURE. SECURING CHAINS WILL BE SECURED BEHIND THE FORKLIFT AS A SAFETY DEVICE.

5. ALL DEPOT SEMI-TRAILER TRUCKS WILL BE EQUIPPED WITH RUNNERS NAILED TO THE TRUCK BED IN SUCH A POSITION THAT THEY WILL PREVENT THE LATERAL MOVEMENT OF MATERIAL. THE VEHICLES, WHETHER PARTLY OR COMPLETELY LOADED, WILL HAVE THE MATERIAL BLOCKED, BRACED, CHOCKED, TIED DOWN, OR OTHERWISE SECURED TO PREVENT SHIFTING DURING TRANSIT. THE TRUCK DRIVER WILL REFUSE TO PERMIT ANY TRUCK TO BE MOVED IF ITS LOAD IS NOT PROPERLY SECURED.

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 9**

**DOCK 1**

**SOP:** HW-0000-L-002

**REVISION**

**CHANGE**

**OPERATION:** Process LTL/LCL Shipments

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

**LTL/LCL lots of explosives are normally transported from the magazines or warehouses, IAW Operation 8, to Dock 1 or other buildings for processing and off station shipments.**

1. Depalletize and Unpack.

   a. (O) Using steel strapping cutter and diagonal pliers, cut and remove wire seals/strapping, as required, and set aside in an appropriate container.

   b. (O)(QC) Inspect each row of boxes and empty pallets for presence of PCP crystals. Process PCP crystal contaminated wood IAW SOP HW-0000-A-001.

   c. (O) Remove container of material from pallet and place on worktable or on floor adjacent to worktable, as applicable.

   d. (O) Open or remove cover from container, as required, to identify contents; set aside cover to workplace. If cover is nailed, pry cover from box, remove nails, and set aside nails to scrap. If cover is secured to container with screws, remove screws and set aside to a container for reuse.

   e. (O) DO NOT open hermetically sealed containers. If container is damaged, send to Surveillance (101-71) for inspection. If quantity ordered is less than unit pack, under/over ship (see Item Manager).

   f. (O)(QC) Visually inspect and assure the items as assembled/packed are consistent with assigned NSN, lot(s), condition code, quantity, and owner.

   g. (O) Segregate material by lots, as applicable.

   h. (O) Maintain lot integrity.

2. Inspect Packing Containers and Material.

3. Repackage Items.

   a. (O) Material packed in barrier material will be resealed in the same material it was received in. Transfer material to Surveillance Workshop for the remainder of Step 3.

      (1.) New bags must be prepared if the original bag cannot be resealed. The original material, or its equivalent, will be used when replacing barrier bags. Barrier bags, which are resealed or replaced, must be capable of being resealed at least twice by recipient.

      (2.) Electric heat-sealing machines (e.g., Doughboy Electric Sealers) will be separated from all similar or dissimilar operations, to limit the effect of an incident originating at sealing operation to the immediate vicinity. Such sealing equipment will be limited to one machine per operating bay or cell.

      (3.) In order to properly seal the 3M barrier material, use a standard heat sealing iron set at 250°-375° F., and a maximum dwell time of 2.0 seconds, but not less than 0.2 seconds.

      (4.) Repackage items using existing filler, spacers, and liners.

      (5.) Replace missing, incomplete, and/or incorrect identification on packing containers (handwritten identification is not acceptable).

      (6.) When necessary to replace damaged container, replacement containers will meet specification of item's standard pack.

      (7.) Repack inner packing containers in outer packing containers, as required.

4. Paint/Mark Light Box.

   a. (O) Light boxes less than three cubic feet in size - use paintbrush or spray can to apply orange paint to top and side surfaces. With a precut stencil, fountain brush, and black ink, mark "LIGHT BOX" in ½" characters on the top and front of the box above nomenclature marking. Refer to Figure 9-1.

   b. (O) Light boxes three cubic feet or more - using precut stencil, paint brush, and orange paint, mark "LIGHT BOX" on the top and front of box above nomenclature marking in ½" characters. The box need not be painted orange. Refer to Figure 9-2.

Figure 9-1
Less than three cubic feet

**NOTE: ONLY ONE LIGHT BOX/CARTON, STENCILED IAW DRAWING 12982865 (LATEST VERSION), IS PERMITTED PER LOT AND CONDITION CODE IN EACH STORAGE MAGAZINE.**

   c. (O) Using precut stencil with fountain brush, apply corrected stencil with same size characters and same location as shown on appropriate drawings, to correct the quantity.

5. Secure Cover on Containers.

   a. (O) Secure cover to wooden boxes with ⅝" steel straps as follows:

      (1.) Boxes less than 18" - one strap.

      (2.) Boxes 18" to 36" - two straps.

      (3.) Boxes over 36" in length - three straps.

   b. (O) Secure cover on metal containers with latch hasps, safety retaining pins, and wire, as applicable.

   c. (O) Attach antipilferage seal to containers, as required; crimp with hand press.

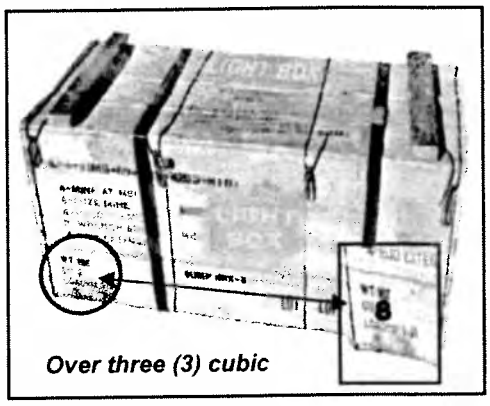



Figure 9-2

6. Prepare Boxes For Shipment.

   a. (O) Determine the weight of material for shipment IAW the MRO documentation.

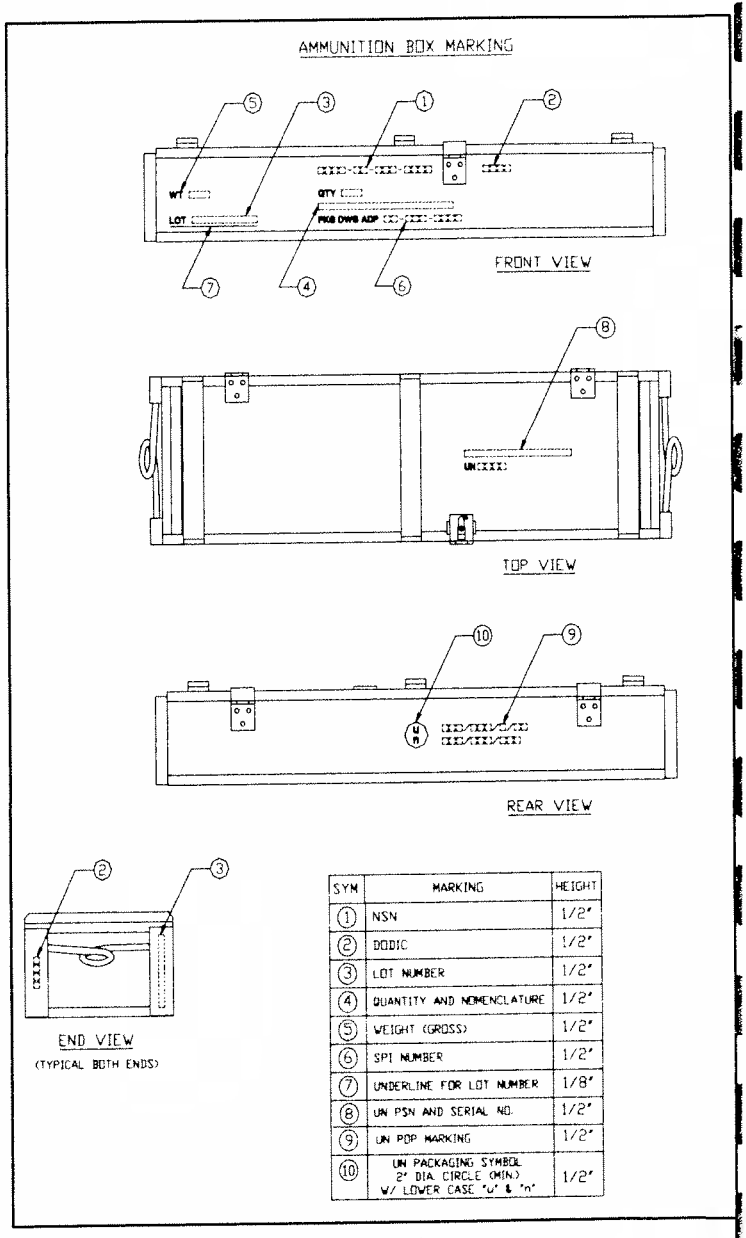
   b. (O) Obliterate incorrect and/or illegible box markings.

   c. (O) Use precut stencil with fountain brush or stamp to replace, correct, or apply necessary markings and/or other data as specified in the applicable Army/Navy Specifications and Drawings, Drawing 12982865 (latest revision), and information supplied by MRO documentation.

   d. (O) Use precut stencil with fountain brush to apply required UN POP marking.

   e. (O)(QC) Under no circumstances will markings on the outer packs be less than that required by Drawing 12982865 (latest revision) when shipped to any Service.

   f. (O) Refer to Figure 9-3 for placement of markings.




| SYM | MARKING | HEIGHT |
|---|---|---|
| 1 | NSN | 1/2" |
| 2 | DODIC | 1/2" |
| 3 | LOT NUMBER | 1/2" |
| 4 | QUANTITY AND NOMENCLATURE | 1/2" |
| 5 | WEIGHT (GROSS) | 1/2" |
| 6 | SPI NUMBER | 1/2" |
| 7 | UNDERLINE FOR LOT NUMBER | 1/8" |
| 8 | UN PSN AND SERIAL NO. | 1/2" |
| 9 | UN POP MARKING | 1/2" |
| 10 | UN PACKAGING SYMBOL 2" DIA. CIRCLE (MIN.) W/ LOWER CASE "u" & "n" | 1/2" |

Figure 9-3

7. Unitize Boxes and Containers for Shipment.

   a. (O) Manually place and stack containers on pallet or skid. Strap and seal IAW AMC outloading drawings, Army packaging drawings, Military Standards or WRs, and/or information supplied by MRO documentation.

b. (O) Use precut stencil with fountain brush to mark placards. Attach placards to unitized load, one each to adjacent sides.

8. Apply Bar Code Labels IAW Operation 2.

9. Label.

a. (O) Affix shipment labels to all stocks shipped to foreign countries. Unit/pallet load will be labeled as prescribed by Title 49 CFR, Parts 172.400 and 172.407.

b. (O) Military Shipment Label (DD Form 1387 or 1387-1) will be attached to all air or overseas shipment, carload/truckload shipment to CONUS, and shipments to U.S. Army Forces in the Panama Canal Zone, IAW Drawing 12982865 (latest revision).

(1.) The following is an illustration of the stencil marking on a box of munitions, in lieu of Military shipment labels (DD Form 1387):

First Line: TCN
Second Line: RDD, EXPEDITED, Handling "999" Code, Project Code (when specified), and transportation priority
Third Line: DODAAC and clear test address of consignor
Fourth Line: Port Identifier Code and clear name text name of POE
Fifth Line: Port Identifier Code and clear name text of POD
Sixth & Seventh Lines: DODAAC and clear text address of consignee
Eighth Line: Piece number, total pieces, weight, and cube of shipment

c. (O) Affix Special Handling Data/Certification (DD Form 1387-2) to all hazardous material for air shipment IAW Paragraph 13-3 of TM 38-250. Refer to Figure 9-4.

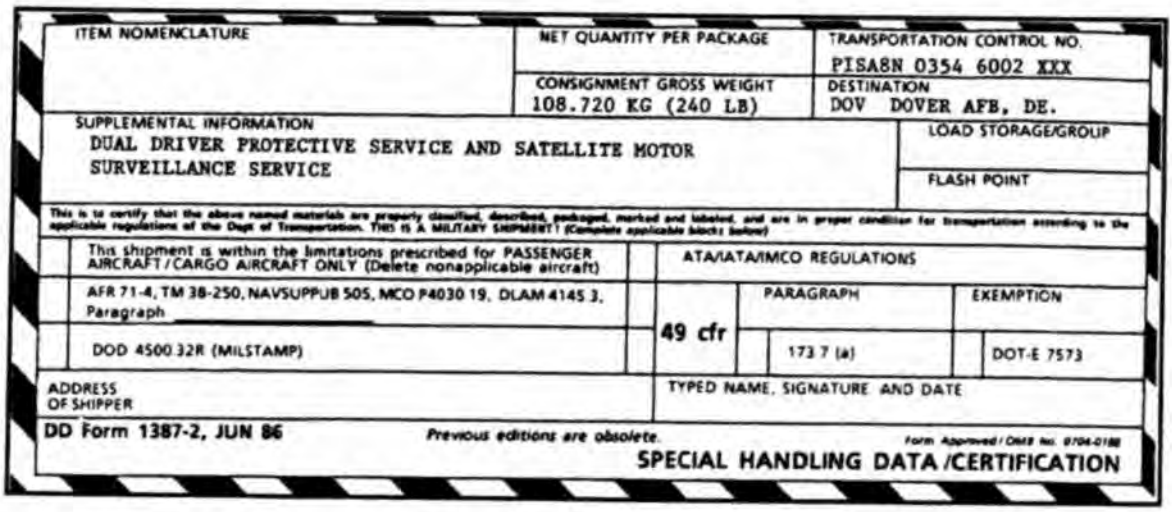

ITEM NOMENCLATURE
NET QUANTITY PER PACKAGE
TRANSPORTATION CONTROL NO. PISA8N 0354 6002 XXX
CONSIGNMENT GROSS WEIGHT 108.720 KG (240 LB)
DESTINATION DOV DOVER AFB, DE.
SUPPLEMENTAL INFORMATION
DUAL DRIVER PROTECTIVE SERVICE AND SATELLITE MOTOR SURVEILLANCE SERVICE
LOAD STORAGE/GROUP
FLASH POINT
This is to certify that the above named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Dept of Transportation. THIS IS A MILITARY SHIPMENT! (Complete applicable blocks below)
This shipment is within the limitations prescribed for PASSENGER AIRCRAFT/CARGO AIRCRAFT ONLY (Delete nonapplicable aircraft)
ATA/IATA/IMCO REGULATIONS
AFR 71-4, TM 38-250, NAVSUPPUB 505, MCO P4030 19, DLAM 4145 3, Paragraph
PARAGRAPH
EXEMPTION
49 cfr
DOD 4500 32R (MILSTAMP)
173 7 (a)
DOT-E 7573
ADDRESS OF SHIPPER
TYPED NAME, SIGNATURE AND DATE
DD Form 1387-2, JUN 86
Previous editions are obsolete.
Form Approved/OMB No. 0704-0188
SPECIAL HANDLING DATA/CERTIFICATION

Figure 9-4

(1.) When using DD Form 1387-2 for Unclassified Shipments, prepare and complete form as follows:

(a.) Consignment Gross Weight: The total consignment gross weight of explosives or hazardous material on each pallet shipped under the same TCN.

(b.) Transportation Control Number: TCN of this package.

(c.) Destination: address of consignee.

(d.) Supplemental Information: enter the special handling information for explosives (i.e., Class A poison, radioactive material, etc.). Specify neutralizing material for corrosive liquids and/or type of protective service required.

(2.) When using DD Form 1387-2 for Classified Shipments, prepare IAW pages 5-8 and 5-9 of DOD Regulation 4500.32R Volume 1.

d. (O) Fill out Item Release/Receipt Documents (DD Form 1348-1, DD Form 1348, and Standard Form 1103) for shipment, as applicable. Place the appropriate copies into shipping envelope and attach to pallet for shipment.

10. Transfer Containerized Ammunition/Material.

a. (O) Set aside containerized ammunition/material for transfer to Operation 3.

b. (O) Using forklift, transport serviceable pallets to palletizing station (Operation 3), unserviceable pallets to conveyance for transport to PRO, and PCP crystal contaminated pallets to the designated storage site.

c. (O) Using forklift, transport serviceable pallets to palletizing station (Operation 3), unserviceable pallets to conveyance for transport to PRO, and PCP crystal contaminated pallets to the designated storage site.

11. Use forklift to transport prepared ammunition to conveyance or temporary storage pending shipment.

**SPECIAL REQUIREMENTS:**

1. **ITEMS FOR OUTGOING SHIPMENT WILL NOT BE ACCUMULATED PRIOR TO RECEIPT OF ORDERS COVERING EACH SPECIFIC SHIPMENT.**

2. **PROPER STORAGE COMPATIBILITY WILL BE MAINTAINED AT ALL TIMES.**

3. **CATEGORY I MATERIAL, WHICH IS NOT SHIPPED ON THE SAME DAY AS PREPARED AT DOCK 1, WILL BE RETURNED TO MAGAZINE FROM WHICH IT CAME, AND AS NEAR AS PRACTICAL TO SAME GRID LOCATION WITHIN THE MAGAZINE, PRIOR TO END OF SAME WORK DAY.**

4. **WHEN ANY MATERIAL IS STORED OVERNIGHT IN A LOCATION OTHER THAN A PROPERLY SECURED MAGAZINE, INFORMATION CONCERNING RISK CATEGORY, LOCATION, CONVEYANCE (IF ANY), AND MATERIAL MUST BE REPORTED TO THE D&SP ADMINISTRATIVE ASSISTANT BEFORE 3:00 PM (1500) DAILY, WHO WILL COMPILE A REPORT FOR PICK-UP BY SECURITY PERSONNEL. LATE CHANGES WILL BE PROVIDED TO GOC DIRECTLY.**

5. EACH UNIT/PALLET LOAD CONTAINING EMPTY AND/OR LIGHT BOXES WILL HAVE A WEATHERPROOF PLACARD IDENTIFYING THE NUMBER OF EMPTY AND/OR LIGHT BOXES AND THE QUANTITY PER LIGHT BOX, IAW DRAWING 1948-4116-20 PA 1002.

6. PALLETS WITH MORE THAN ONE LOT WILL HAVE A PLAIN TAG, 4" X 6", WITH A MINIMUM 1/4" HEIGHT LETTERING IDENTIFYING EACH LOT AND PLACED AS NEAR TO THE ADDRESS MARKING/LABELING AS POSSIBLE.

7. INSPECTION OF MULTI-LOT PALLETS WILL BE PERFORMED BY QA PRIOR TO PALLETIZATION. THE INSPECTION WILL BE FOR VERIFICATION OF STOCK NUMBERS, LOT NUMBERS, QUANTITIES, AND/OR ANY OTHER PERTINENT INFORMATION CALLED FOR ON THE SHIPPING DOCUMENT. ONCE PALLETIZED, THE QA INSPECTOR WILL SIGN THE DOCUMENTS.

8. HERMETICALLY SEALED METAL CONTAINERS SHOULD BE OPENED ONLY WHEN THE CONTAINER IS DAMAGED OR CORRODED TO THE EXTENT THAT THE SERVICEABILITY OF THE CONTENTS IS SUSPECT. A REQUIREMENT FOR LESS THAN A FULL HERMETICALLY SEALED CONTAINER SHOULD BE REFERRED TO QASAS AND TRAFFIC DIVISION MANAGER FOR DISPOSITION (I.E., DECREASE/INCREASE AMOUNT REQUIRED FOR SHIPMENT TO PREVENT HAVING TO OPEN CONTAINER TO MEET SHIPPING REQUIREMENT). IF REQUIERD TO BE OPENED, CONTAINERS WILL BE TRANSPORTED TO SURVEILLANCE WORKSHOP.

9. AMMUNITION FOUND IN DETERIORATED CONTAINERS SHOULD BE REFUSED FOR SHIPMENT. NOTIFY QASAS FOR SPECIAL INSPECTION TO DETERMINE IF RECLASSIFICATION OF LOT IS NECESSARY. ITEMS REQUIRING WAX SEALING (I.E., SURVEILLANCE SAMPLES) SHOULD BE SENT TO 101-71 (SURVEILLANCE WORKSHOP) FOR FINAL REVIEW OF CONTENTS AND SEALING.

10. THE IDENTIFICATION MARKINGS FOR LIGHT BOXES WILL BE AS FOLLOWS:

    a. A LIGHT BOX/CONTAINER, LESS THAN THREE CUBIC FEET IN SIZE, WILL BE IDENTIFIED BY PAINTING THE ENTIRE BOX ORANGE, EXCEPT FOR THE BOTTOM, AND MARKING THE WORDS "LIGHT BOX" WITH A CONTRASTING COLOR ON TOP AND AT LEAST ONE SIDE OF BOX. WHEN THE BOTTOM SURFACE OF A LIGHT BOX IS VISIBLE WITHIN A UNIT LOAD, IT MUST ALSO BE PAINTED ORANGE AND MARKED WITH THE WORDS "LIGHT BOX".

    b. A LIGHT BOX/CONTAINER, THREE CUBIC FEET OR LARGER, OR ANY SIZE CONTAINER BEING PREPARED FOR SHIPMENT TO A RETAIL ACTIVITY, WILL BE IDENTIFIED BY MARKING THE WORDS "LIGHT BOX" IN ORANGE ON TOP, SIDES AND ENDS OF BOX IN THE LARGEST PRACTICAL LETTERS. WHEN THE BOTTOM SURFACE OF A LIGHT BOX IS VISIBLE WITHIN A UNIT LOAD, IT MUST ALSO BE MARKED IN ORANGE WITH THE WORDS "LIGHT BOX".

    c. EMPTY BOXES IN UNIT LOADS OF AMMUNITION WILL BE IDENTIFIED BY PAINTING THE ENTIRE BOX ORANGE, EXCEPT THE BOTTOM OF THE BOX, AND MARKING THE WORD "EMPTY" USING A CONTRASTING COLOR ON THE TOP, ON BOTH ENDS, AND ON AT LEAST ONE SIDE OF THE BOX. WHEN THE BOTTOM IS VISIBLE IN THE UNIT LOAD, IT MUST ALSO BE PAINTED ORANGE AND MARKED WITH THE WORD "EMPTY".

11. IF REPACKAGING OR RE-PALLETIZING IS REQUIRED, PCP TREATED MATERIAL IS TO BE AVOIDED FOR ALL OVERSEAS SHIPMENTS, IF FEASIBLE. NON-PCP TREATED MATERIAL SHOULD BE USED, UNLESS NO SUBSTITUTE IS AVAILABLE AND CLEARANCE FOR ITS USE IS PROVIDED BY QASAS.

12. CONTAINERS WILL NOT BE TUMBLED, DRAGGED, THROWN, DROPPED, ROLLED, WALKED ON OR STRUCK AGAINST EACH OTHER.

13. ANY REPACKAGING INVOLVING THE INTERIOR OF INNER PACKS SHOULD BE PLANNED BY PP&PE AS A SPECIAL OR MRO UPGRADE TASK WITH APPROPRIATE QA/QASAS INVOLVEMENT.

14. BOXES WILL BE CONSTRUCTED AS REQUIRED, IAW DRAWINGS, LATEST REVISION TO CFR 49 PART 179, AND/OR BOE 6000.

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 10**

**MAGAZINE AREAS**

**SOP:** HW-0000-L-002

**REVISION**

**CHANGE**

**OPERATION:** Prepare Unstable Propellant/Ammunition for Transfer to Disposal Grounds

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

**This procedure covers all unstable propellants, whether in bulk form (propellant charges) or in cartridge cases (semi-fixed and fixed munitions). Propellant is unstable when it has lost its stabilizer and has the potential to auto-ignite at any time.**

1. Prior to gaining access to magazines containing unstable propellant/munitions, the following procedures apply:

   a. (S) The Fire Department (ext. 7107) and Safety Office (ext. 7842) will be notified and requested to perform an air sampling of the magazine.

      (1.) Sampling tests are performed inside the magazine using a gas detection instrument.

      (2.) Negative sampling test results at a magazine are in effect at that site as long as the magazine is opened on consecutive days (within 24 hours). This means that additional testing must be performed once a magazine has not been opened past a 24-hour timeframe.

      (3.) Ether concentrations between 1.9% and 48% by volume of atmosphere present a known explosive flammability hazard.

   b. (S) Only personnel performing the test will be allowed in the magazine until the magazine has been determined to be safe.

   c. (O)(S) Only when the magazine has been tested and determined to be safe will other personnel be allowed to enter the magazine.

   d. (O)(S) If the concentration of explosive vapors is over the acceptable level, as determined by the person performing the tests, the magazine will be allowed to vent or air out naturally. Samples will be taken intermittently until concentrations are within an acceptable range.

e. (O)(S) On subsequent operating days after testing, the magazine will be opened for a minimum of 15 to 30 minutes to allow for natural venting, prior to starting any other operations. If more than 24 hours has elapsed from the last air sampling or magazine use, a new air sample will be obtained.

f. (O)(S) If magazine is free of hazardous vapors, inspect involved containers for evidence of imminent spontaneous fire/detonation. Imminent spontaneous combustion may be determined by excess bulging of the container, container temperature above ambient air temperature, smoke, and high or strong ether vapor concentration near the container lid. Secure the magazine if any of these conditions are encountered. The supervisor will immediately notify the Fire Department and Safety Office.

g. (O)(QC)(S) Verify and/or clear the magazine floor of any obstructions or debris that would interfere with safe operations.

h. (O)(S) Any time a magazine contains unstable propellant/munitions, the Fire Department will wet down the stow and floor area (via a mist or fog) in order to reduce the possibility of static electricity build-up and discharges. Fire Department will be on standby at a safe distance from the magazine.

2. Identify And Inspect Explosive Materiel.

a. (O)(S) No more than the minimum number of personnel needed to perform the identification, inspection, repalletization (if required), and transfer to the conveyance will be in the magazine while unstable propellant is being moved.

b. (O)(QC) Compare materiel to the shipping documents, sequence sheets, and planograph. Identify material by DODIC, NSN, Ammunition Lot Number, Owner activity code (B5A, B14, MHQ, etc.) or other information that positively identifies the material.

c. (O)(QC)(S) Inspect the stability of the stow to assure containers are securely strapped and the strapping is not excessively weakened by rust. Assure containers are not deteriorated to the point of being unsafe to handle.

d. (O)(S) Repalletize and/or re-strap as necessary.

3. Load Conveyance.

a. (O)(QC) Using an approved forklift, remove required material from storage and place on conveyance. Re-warehouse any material that was moved in order to gain access to loaded material. Assure proper gridding is maintained.

b. (O)(S) No more than ONE pallet of unstable propellant or munitions will be removed from the magazine at one time. When TWO pallet loads are strapped together, they will be considered as one pallet (unit) and may be removed from magazine as one pallet (unit).

4. Transfer:

a. (O) Unstable propellant and/or munitions to Disposal Grounds. The Fire Department will have a mobile firefighting vehicle follow at a safe distance and maintain visual contact with the loaded conveyance to the South Magazine Area.

SPECIAL REQUIREMENTS:

1. ALL OPERATORS WORKING WITH UNOPENED CONTAINERS OF UNSTABLE PROPELLANT WILL WEAR HAIR COVERING (POWDER CAPS), FIRE RETARDANT COVERALLS AND SAFETY EYE WEAR AT ALL TIMES. COVERALLS WILL BE PROPERLY WORN WITH ALL BUTTONS BUTTONED OR WITH ALL VELCRO TABS CLOSED.

2. CONTAINERS OF PROPELLANT WILL BE GROUNDED AT ALL TIMES WHEN POSSIBLE.

3. MAGAZINE DOORWAYS WILL BE KEPT CLEAR AT ALL TIMES DURING OUTLOADING OPERATIONS.

4. FORKLIFT OPERATORS WILL KEEP THEMSELVES AND THE FORKLIFT BETWEEN THE PALLET OF PROPELLANT AND DOORWAYS AT ALL TIMES WHENEVER POSSIBLE.

5. THE SUPERVISOR WILL DETERMINE THE PERSONNEL REQUIREMENTS, ONLY THE MINIMUM NUMBER OF PERSONNEL WILL BE EXPOSED TO THE UNSTABLE PROPELLANT OR MUNITIONS, AS NECESSARY, TO CARRY OUT THE OPERATION.

6. ONLY FORKLIFTS APPROVED FOR WORKING IN EXPLOSIVE ATMOSPHERES WILL BE USED IN THE MAGAZINE CONTAINING UNSTABLE PROPELLANT OR MUNITIONS.

7. IF ANY UNUSUAL CIRCUMSTANCES ARISE, THE OPERATION WILL CEASE WITHOUT FURTHER MOVEMENT OR HANDLING AND THE SUPERVISOR NOTIFIED.

8. MOBILE FIRE FIGHTING EQUIPMENT AND FIREFIGHTERS WILL STAND BY AT THE MAGAZINE DURING THE OUTLOADING OPERATION AND ACCOMPANY THE LOADED CONVEYANCE FROM THE MAGAZINE TO THE SOUTH MAGAZINE AREA.

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 11**

**ALL AREAS**

**SOP:** HW-0000-L-002

**REVISION**

**CHANGE**

**OPERATION:** Handling Material Regulated by the BATF

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

**MATERIAL REGULATED BY THE BATF IS ANY AEDA OWNED BY SOC LLC (11Z ACCOUNT). THIS INCLUDES, BUT IS NOT LIMITED TO, EXPLOSIVES GENERATED FROM PRODUCTION OPERATIONS AND THE EXPLOSIVE CHAIN PURCHASED FOR USE IN ANY DETONATION OR BURNING OPERATIONS ON SITE.**

1. Receipt of BATF Regulated Material (SOC LLC Owned) from Off Station.

**ASSURE ALL PAPERWORK ASSOCIATED WITH SOC LLC OWNED MATERIAL HAS "BATF" STAMPED ON IT TO ASSURE COMPLIANCE WITH BATF REGULATIONS. THIS INCLUDES THE FOLLOWING DOCUMENTS AS A MINIMUM: RECEIPT DOCUMENTS, ATRS, AND MAGAZINE DATA CARDS.**

   a. (O)(QC) Notify Production Planner at ext. 7262 to aid in verification of material records.

   b. (O) Material received from another company will be delivered to Dock 1.

   c. (O)(QC) At Dock 1, every container of AEDA will be opened IAW Operation 9 and the contents will be counted. If any discrepancies are found, notify Security at ext. 7601 and QA at ext. 7043 to investigate and substantiate findings.

   d. (O)(QC) Repack all material for transfer to storage IAW Operation 9.

   e. (O) Transfer material to storage.

2. Transfer of AEDA Generated (SOC LLC owned) at WADF (i.e., 117-5, 117-6, etc.).

   a. (O)(QC) Explosives generated at WADF will be compared with the transfer documents prior to movement. Notify the supervisor of the generation building (117-5, 117-6NT, etc.) of any discrepancies found.

b. (O) Process the material IAW Operation 5 to ship to storage location.

c. (O)(QC) Explosives will be stored in a temporary stow until a Certificate of Compliance is generated.

d. (O)(QC) Once the Certificate of Compliance is provided by QA, material will be segregated into separate locations by condition code to assure serviceable material is segregated from unserviceable material.

**Lotted material with moisture content below two percent may be sold and as such is serviceable. Lotted material that is downgraded due to moisture content above two percent is still serviceable material with a potential resale value. Lot Unknown material is unserviceable for resale purposes, but still useable for open detonation operations.**

3. Shipment of SOC LLC Owned Explosives to Another Company.

   a. (O)(QC) Explosive shipments will be performed IAW Operations 5 through 7 with the following exception:

      (1.) A Certificate of Compliance from QA will be provided with the usual shipping documents. This will assure the crew selects the serviceable material for shipment. QA personnel will verify material selection prior to material being loaded onto a commercial truck for shipment.

4. Shipment of SOC LLC Owned Material to Range Operations (Old Bomb, New Bomb, or other Ranges).

   a. (O)(QC) All explosive train material will be counted prior to removing any material from the containers. The magazine data card will indicate all movements.

   b. (O)(QC) Upon return of any unused material, all of the material will be recounted and listed on the Magazine Data Card.

   c. (O)(QC) All shipments will be performed IAW Operations 3, 4, and 6.

**SPECIAL REQUIREMENTS:**

1. **ASSURE ALL PAPERWORK ASSOCIATED WITH SOC LLC OWNED MATERIAL HAS "BATF" STAMPED ON IT TO ASSURE COMPLIANCE WITH BATF REGULATIONS. THIS INCLUDES THE FOLLOWING DOCUMENTS AS A MINIMUM: RECEIPT DOCUMENTS, ATRS, AND MAGAZINE DATA CARDS.**

2. **ALL REQUIREMENTS FOR LOADING, UNLOADING, TRANSPORTING, AND LABELING WILL BE FOLLOWED WITH ADDITIONAL REQUIREMENTS LISTED IN THE ABOVE PROCEDURE WHEN DEALING WITH SOC LLC OWNED MATERIAL.**

**STANDING OPERATING PROCEDURE:**
AEDA; Logistics Services

**OPERATION 12**

**MAGAZINE AREAS**

**SOP:** HW-0000-L-002

**REVISION**

**CHANGE**

**OPERATION:** Storage of Large Missile Motors

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

**The owning service personnel using their vehicles, equipment, and procedures will deliver missile motors to a magazine dock. This operation only includes moving the motors, on wooden chocks, into or from a magazine.**

1. Prepare the magazine IAW appropriate Steps of Operation 2 or 5, unless otherwise dictated by LOI or other technical guidelines.

2. Prepare Truck for Loading/Unloading (assumes a flatbed trailer).

   a. (O)(S) Position the truck in a manner that affords safe and adequate maneuvering room for the load or unload.

   b. (O)(QC)(S) After positioning the truck, assure that the driver of the commercial truck sets the air brakes on both the tractor and trailer, turns off the tractor engine, and chocks the wheels of the truck and trailer.

   c. (O)(QC)(S) If the conveyance is an outgoing shipment, assure that the driver places explosive placards on the trailer.

3. Move Material into/out of Storage.

   a. (O) Applicable storage drawings will be present and followed during unloading.

   b. (O)(QC) Assure all material listed on shipping documents is physically present. Sign the shipping documents for delivery to Traffic Division.

   c. (O)(S) For missile motors, position forklift and/or transporter so that the tines are under the end of the motor wooden chocks. Using a combination of the forklift and transporter, move the missile motors into or out of the magazine.

d. (O)(QC) Assure the Magazine Data Card is filled out. Annotate on the planograph to show space released or space occupied.

4. Secure the empty commercial truck IAW appropriate steps of Operation 4.

5. Secure magazine forklift or transporter IAW appropriate steps of Operation 4.

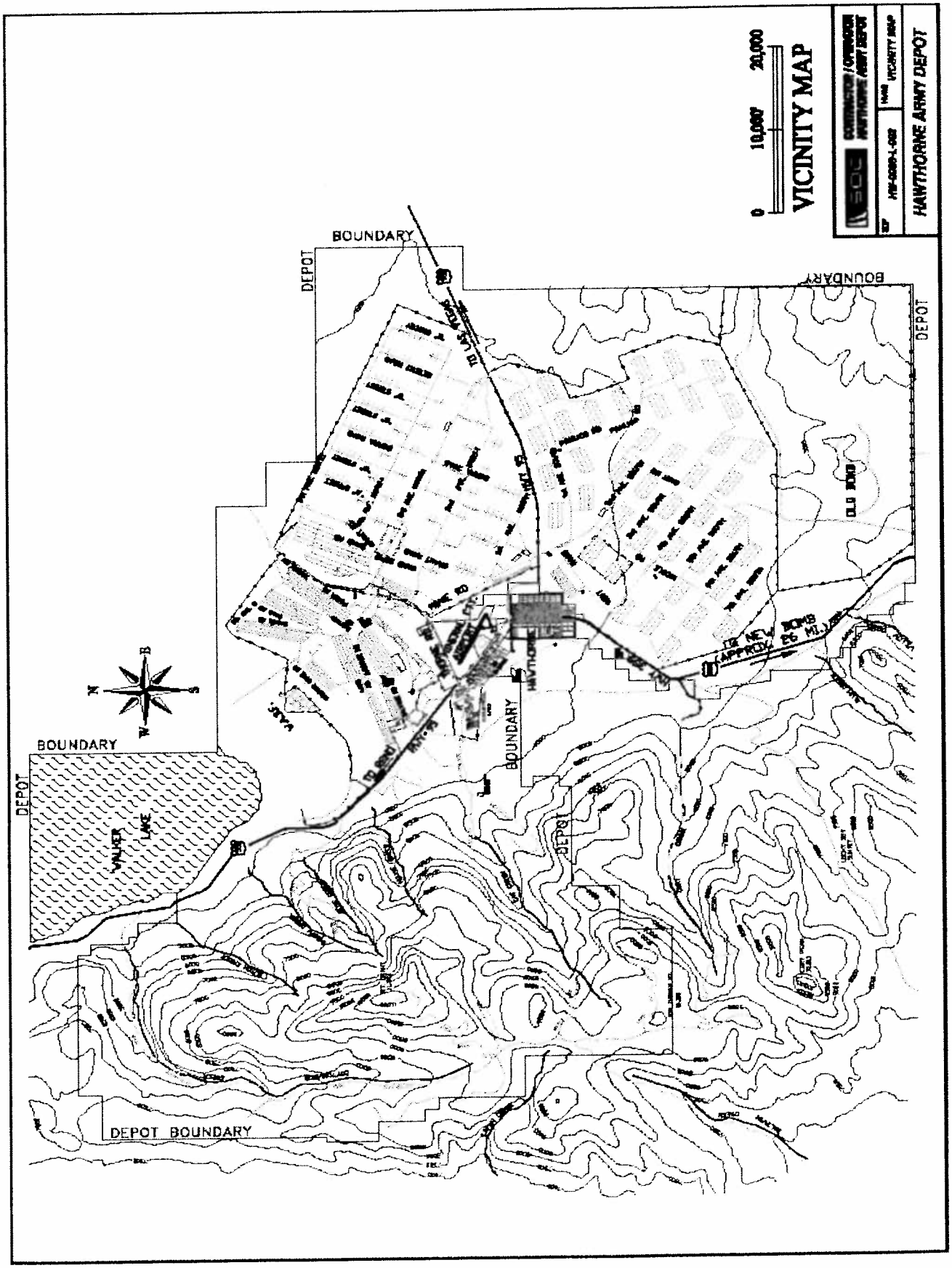
6. Secure magazine IAW appropriate steps of Operation 4.

**SPECIAL REQUIREMENTS:**

1. **SUDDEN STOPS MAY CAUSE LOADS TO SLIDE OFF THE TINES; STARTS AND STOPS MUST BE SMOOTH AND WITHOUT JERKS.**

2. **ALL PROPULSIVE MOTORS STORED WITHIN A MAGAZINE MUST BE STORED POINTED IN ONE DIRECTION OTHER THAN TOWARD THE DOOR, OR AS SPECIFIED IN THE APPLICABLE DRAWING.**

## SITE MAP OF HWAD



# *SOC NEVADA LLC*

**HAWTHORNE ARMY DEPOT**
HAZARD ANALYSIS & RISK ASSESSMENT

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**SUPPLY DEPOT OPERATIONS**
*(Operational Process/System)*

**HW-0000-L-002**
*(Standing Operating Procedure)*

**December 13, 2010**
*(Replaces HA/RA, Same Subject, Dtd 2/8/10)*
*(Date)*

**VARIOUS LOCATIONS**
*(Location)*

Prepared by: _____ Date: December 13, 2010
Andrea Marshall, Safety Specialist
Safety & Health Division

Prepared by: _____ Date: December 13, 2010
Wayne Larson, Manager
Safety & Health Division

# *SOC NEVADA LLC*
# HAZARD ANALYSIS

**OPERATIONAL PROCESS/SYSTEM:** Receipt, Storage & Issue (RS&I): Supply Depot Operations
**STANDING OPERATING PROCEDURE:** HW-0000-L-002
**LOCATION:** VARIOUS LOCATIONS

December 13, 2010

| PROCESS DESCRIPTION | RISK ASSESSMENT | RECOMMENDATIONS | REFERENCES |
|---|---|---|---|
| This procedure is established to ensure that all operations involving the receipt, storage, preparation for shipment, intra-plant transfer of inert and explosive material and off plant shipment by truck and rail conveyance of explosives is performed and accomplished in a safe and consistent manner.<br>This procedure also covers the loading, unloading, and handling of MILVAN's on railcars and trailer chassis. Additionally covered is the operation of the Rough Terrain Container Handler (RTCH) and other associated handling equipment.<br>Guidelines are also covered for the handling and transfer of unstable propellant from storage magazines to New Bomb for Disposal. | The Hazard Analysis was performed after considering the adequacy of safety considerations covered in the applicable SOP. A Hazard Severity of "1" (Catastrophic) and an Accident Probability of D (Remote) is assessed to this operation with a RAC of "3". When recommendations and controls are implemented a Hazard Severity of "1" (Catastrophic) and an Accident Probability of "E" (Improbable) is assessed with a RAC of "5" assigned this operation. | 1. Operator training and SOP compliance is emphasized.<br>2. Training and compliance with proper material handling procedures is emphasized.<br>3. Only trained operators under adequate supervision should perform sawing operations and associated procedures.<br>4. The use of personal protective equipment requirements should be strictly adhered to. | 1. MIL-STD 882D; System Safety Program Requirements<br>2. DoD 4145.26-M; Contractors Safety Manual for Ammunition & Explosives<br>3. SOC.OHS.SP.0002; SOC Safety Program<br>4. 29 CFR 1910; Occupational Safety & Health Standards for General Industry |

## *SOC NEVADA LLC*
## HAZARD ANALYSIS

**OPERATIONAL PROCESS/SYSTEM:** Receipt, Storage & Issue (RS&I): Supply Depot Operations
**STANDING OPERATING PROCEDURE:** HW-0000-L-002
**LOCATION:** VARIOUS LOCATIONS

December 13, 2010

| OPERATIONS OR FUNCTIONS | TOOLS AND EQUIPMENT | FAILURE MODE/CAUSE | FAILURE EFFECT | HAZARDS BEFORE CONTROLS | RAC BEFORE CONTROLS | RECOMMENDATIONS AND/OR CONTROLS | HAZARDS AFTER CONTROLS | RAC AFTER CONTROLS |
|---|---|---|---|---|---|---|---|---|
| 1. Housekeeping in Storage Facilities | Forklift, broom, sweeping compound PPE & bleach | Operators sweeping floors fail to use the required respiratory protection or bleach solution | Serious health hazard due to contaminants in the dust, i.e., crystallized pentachlorophenol (PCP) or hanta virus infestation | II D | 4 | All operators will be fit tested for a proper respirator and required to wear them in dusty and/or contaminated locations. Sweeping compound should be used and a bleach solution when required. | II E | 5 |
| 3. Prepare to Load/Unload commercial Conveyances | Run-through trailer, forklift, dock plate, wheel chocks & PPE | Commercial truck not chocked or adequately snugged up to run through trailer. | Trailers could separate causing damage to equipment and material. Possible injury to personnel | II D | 4 | Operator training in trailer preparation for loading explosive and inert material. | II E | 5 |
| 4. Unload commercial conveyances | Forklifts, dock plates, wheel chocks & PPE | Commercial truck not inspected before unloading. Weak flooring or sides. Possible shifting of materials. | Damage to equipment and material possible injury to personnel. | II D | 4 | Operator training in proper conveyance inspection procedures before unloading. | II E | 5 |
| 5. a. Prepare material for Intra-plant moves or Intra-plant shipments | Tie down straps, chains & load binders, hand tools & PPE | Load not properly secured or side gates not properly interlocked | Load could break loose and cause potential danger to operator(s) and damage to equipment | II D | 4 | Operator training in proper tie down procedures and equipment serviceability inspections. | II E | 5 |
| 5. b. Intra-plant securing of loads in a boxcar | Hand tools, power tools & PPE | Boxcar not properly blocked and braced causing the load to shift or fall | Damage to equipment and material. Possible injury to personnel | II D | 4 | Employee training in securing loads of material in boxcars. Use of PPE shall be enforced | II E | 5 |
| 5. c. Intra-plant securing of Loads on various types of vehicles | Tie down straps, chains & load binders, hand tools and PPE | Load not properly secured or defective tie down equipment used | Load could break loose and fall from transport vehicle | II D | 4 | Operator training in proper tie down procedures and equipment serviceability inspections. | II E | 5 |
| 6. Load Commercial Conveyances | Forklift, dock plate, wheel chocks & PPE | Commercial truck not chocked or adequately snugged up to dock plate. | Trailer could separate from dock plate or dock plate could shift causing damage to equipment and material. Possible injury to personnel | II D | 4 | Operator training in trailer preparation for loading explosive and inert material. | II E | 5 |

# *SOC NEVADA LLC*
# HAZARD ANALYSIS

**OPERATIONAL PROCESS/SYSTEM:** Receipt, Storage & Issue (RS&I): Supply Depot Operations
**STANDING OPERATING PROCEDURE:** HW-0000-L-002
**LOCATION:** VARIOUS LOCATIONS

December 13, 2010

| OPERATIONS OR FUNCTIONS | TOOLS AND EQUIPMENT | FAILURE MODE/CAUSE | FAILURE EFFECT | HAZARDS BEFORE CONTROLS | RAC BEFORE CONTROLS | RECOMMENDATIONS AND/OR CONTROLS | HAZARDS AFTER CONTROLS | RAC AFTER CONTROLS |
|---|---|---|---|---|---|---|---|---|
| 7. Close and Secure Conveyances for shipment | Forklifts, dock plates, wheel chocks & PPE | Operator fails to wear the required PPE when handling material or doors. Heavy doors hard to close. | Operator handles sharp or rough objects injuring hands. Operator strains arms/shoulders/back trying to close conveyance. | III C | 4 | Operator instruction in proper use of PPE. Training on handling doors. | IV D | 5 |
| 9. Inspect mark & package LTL & LCL material | Hand tools, stencil ink, paint & PPE | Operator fails to wear the required PPE when handling material | Operator could get cut with steel | III C | 4 | Operator instruction in proper use of PPE | IV D | 5 |
| 10. a. Prepare unstable propellant for transfer to Disposal Grounds | Explosive vapors, gas detection equipment & PPE | Personnel are overcome by ether after opening magazine doors | Possible asphyxiation hazard causing death or serious injury to personnel | II D | 4 | Proper use of detection equipment. Personnel not allowed until vapor concentrations fall to acceptable levels | IV E | 4 |
| 10. b. Load unstable propellant. Load munitions for transfer to disposal grounds | Explosive vapors, gas detection equipment & PPE | Propellant container or palletized munitions are penetrated by forklift tine or item(s) fall from forklift or from stack. More than one pallet moved at a time (not strapped to another). | Possible explosion or fire causing death or serious injury to operators. Major damage to equipment and material | I D | 3 | Operators selected should be highly proficient in forklift operations. If needed, a spotter should be used. | IV E | 5 |
| 11. Load or unload large missile motors at explosive magazines | Forklift dock plate, chocks & PPE | Missile container is penetrated by forklift tines or falls from lift or stack | Possible explosion or fire. Major damage to equipment and material. Serous injury or death of personnel | I D | 3 | Operator compliance and strict adherence to special handling requirements. Personnel training in missile movements. | III E | 5 |
| | | | | | | | | |

Document For Reference Only

UNCONTROLLED DOCUMENT
MAR 14 2012

**SOC NEVADA LLC**
**HAZARD ANALYSIS**

**OPERATIONAL PROCESS/SYSTEM:** Receipt, Storage & Issue (RS&I): Supply Depot Operations
**STANDING OPERATING PROCEDURE:** HW-0000-L-002
**LOCATION:** VARIOUS LOCATIONS

December 13, 2010

| OPERATIONS OR FUNCTIONS | TOOLS AND EQUIPMENT | FAILURE MODE/CAUSE | FAILURE EFFECT | HAZARDS BEFORE CONTROLS | RAC BEFORE CONTROLS | RECOMMENDATIONS AND/OR CONTROLS | HAZARDS AFTER CONTROLS | RAC AFTER CONTROLS |
|---|---|---|---|---|---|---|---|---|
| The following is for the Blocker and Bracer operations that are a primary support function of shipping and receiving. | | | | | | | | |
| Blocker & Bracer Operations | Hand tools, air powered nail guns & PPE | Improper use of nail gun or nail gun used in an unauthorized location | Serious injury or death to personnel. Major equipment damage and material loss | I D | 3 | Strict compliance to safety requirements and extensive training in the proper use of air powered nail guns. Strict enforcement of locations where nail guns are authorized for use | IV E | 5 |
| Blocker & Bracer Operations | Hand tools, power saws & PPE | Improper use of power saw or operation of saw without proper guards | Serious injury or death to personnel. Major equipment damage and material loss | II D | 4 | Operator training in the proper use and machine guarding requirements & procedures. The use of safety glasses and hearing protection shall be strictly enforced. | IV E | 5 |
| Blocker & Bracer Operations | Hand tools, air compressor & PPE | Gasoline powered air compressor catches fire. | Serious potential for a fire involving explosives. Death or serious injury to personnel Major damage to equipment and facilities | I D | 3 | Compliance and operator care when inspecting air compressors. Strict compliance with the requirement to locate compressors at least 50 feet from all explosives. Suitable fire extinguisher availability. | IV E | 5 |

| HAZARD PROBABILITY CODES | | | | | HAZARD SEVERITY CODES | | | |
|---|---|---|---|---|---|---|---|---|
| FREQUENT | PROBABLE | OCCASIONAL | REMOTE | IMPROBABLE | CATASTROPHIC | CRITICAL | MARGINAL | NEGLIGIBLE |
| A | B | C | D | E | I | II | III | IV |

| RISK ASSESSMENT CODE | | | |
|---|---|---|---|
| UNACCEPTABLE | UNDESIRABLE | ACCEPTABLE WITH REVIEW | ACCEPTABLE WITHOUT REVIEW |
| 1 OR 2 | 3 | 4 | 5 |

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX G

SOC NEVADA LLC
HAWTHORNE ARMY DEPOT
STANDING OPERATING PROCEDURE

UNCONTROLLED DOCUMENT
MAR 1 4 2012

ITEM: Propellant

OPERATION: Demilitarization by Open Burning

DODAC: Various

EST. DAILY PROD. RATE: 20,000 Pounds

PACKAGED: 1.3

ORGANIZATION SYMBOL: HWAD-PP&PE

FIRE SYMBOL: 3

SOP: HW-[illegible]-006 DATE 02/10/11

UNPACKED: 1.3

REVISION DATE

FIRE SYMBOL: 3

CHANGE # DATE

Document For Reference Only

CHEMICAL HAZARD SYMBOL: N/A AUTHORITY: W52P1J-11-D-0002

PREPARED BY: Terri Trujillo 4/27/11
Terri Trujillo, ext. 7998 — Date

REVIEWED BY: BW 4-27-11
Process Engineering — Date

SUBMITTED BY: Suzanne Lahre 4/27/11
Suzanne Lahre, ext. 7262 — Date

CONCURRENCES – OPERATING CONTRACTOR:

Manager, PP&PE — Date 4/27/11

Manager, ES — Date 4/28/11

Manager, QA — Date 4-27-11

Manager, APOD — Date 4-27-11

Manager, Safety — Date 4/28/11

UXO Tech III — Date 5/3/11

Industrial Hygienist — Date 4/28/11

Director, Base Operations — Date 4/28/11

Approval, General Manager — Date 6/8/11

Director, M&L Services — Date 4-27-11

CONCURRENCES – ADMINISTRATIVE CONTRACTING OFFICERS STAFF

Chief, Ammunition Surveillance — Date 22 June 11

S & OH Specialist — Date Not required SR

Environmentalist — Date Not required SR

Approval, Depot Commander/ Assigned Representative — Date Not required SR

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HAZARD ANALYSIS AND RISK ASSESSMENT....I-1

# SUPERVISOR'S STATEMENT

SOP_____ REVISION_____CHANGE_____ DATE_____

1. The Supervisor will sign this statement:

   a. When first assigned as supervisor of the operation.

   b. When an approved change is made to the SOP.

   c. On the 10th day following the start of the operation.

   d. At least once per quarter during continuing operations.

   e. After absence from the job in excess of 15 consecutive workdays.

2. I have personally reviewed each of the operational steps of this SOP and have no question in my mind that the operation can be performed safely, efficiently, and in compliance with environmental restrictions noted in this SOP. I have verified to my satisfaction that operators have been trained and are capable of performing their part of the operation in a safe and efficient manner and have instructed them to follow this SOP without deviation.

**SUPERVISOR'S PRINTED NAME:** _____

| SUPERVISOR'S NAME / SIGNATURE | DATE |
|---|---|
| | |
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DZHC 46-E

# OPERATOR'S STATEMENT

SOP_____ REVISION_____CHANGE_____ DATE_____

1. The Operator will sign this statement:

   a. When first assigned to the operation.

   b. When an approved change is made to the SOP.

   c. On the 10th day following the start of the operation.

   d. At least once per quarter during continuing operations.

   e. After absence from the job in excess of 15 consecutive workdays.

2. I have read, or have had read to me, and understand the general and specific safety and environmental requirements, the personnel and explosive limits, and the work description and inspection requirements necessary to accomplish my operation. I have been thoroughly trained in, and am familiar with, my part of the operation and I agree to abide by these instructions throughout my assignment to the operation.

| NAME / SIGNATURE | DATE | OPERATION NUMBER |
|---|---|---|
| | | |
| | | |
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| | | |

DZHC 45-E

## ACRONYMS

**ACO** – Administrating Contract Officer
**DELETE**
**CFR** – Code of Federal Regulations
**CPR** – Cardio Pulmonary Resuscitation
**DD** – Defense Department
**DOD** – Department of Defense
**DODAC** – Department of Defense Ammunition Code (8 digit)
**DOT** – Department of Transportation
**DZHC** – Day & Zimmermann Hawthorne Corporation
**EPA** – Environmental Protection Agency
**FM** – Field Manual
**M&L** – Munitions & Logistics
**E.G.** – Example
**EPA** – Environmental Protection Agency
**EXT.** – Extension
**GOC** – Guard Operations Center
**HEPA** – High Efficiency Particulate Air
**HWAD** – Hawthorne Army Depot
**IAW** – In Accordance With
**I.E.** – That Is
**LBS** – Pounds
**MCPO** – Marine Corps Project Office
**MHE** – Material Handling Equipment
**MK** – Mark
**MPH** – Miles Per Hour
**NEW** – Net Explosive Weight
**NSN** – National Stock Number
**(O)** – Operator's function
**PCP** – Pentachlorophenol
**PRO** – Property Reutilization Office
**PP&PE** – Production Planning and Process Engineering
**PPE** – Personal Protective Equipment
**QA** – Quality Assurance
**QASAS** – Quality Assurance Specialist Ammunition Surveillance
**(QC)** – Quality Check for operators
**QTY** – Quantity
**(S)** – Safety inspection point for operators
**SOP** – Standing Operating Procedure
**TM** – Technical Manual

INDEX OF OPERATIONS


| OPER | SITE | TOTAL EXPLOSIVES IN AREA | DESCRIPTION | PAGE |
|---|---|---|---|---|
| 1 | Old Bomb | N/A | Open Burning Grounds | 16 |
| 2 | Old Bomb | See Table 1 | Prepare Burning Grounds and Check Equipment | 19 |
| 3 | Old Bomb | See Table 1 | Receive, Inspect, and Unload | 22 |
| 4 | Old Bomb | See Table 1 | Inspect and Unpalletize | 26 |
| 5 | Old Bomb | See Table 1 | Prepare for Burning | 29 |
| 6 | Old Bomb | See Table 1 | Set Up Initiation System | 33 |
| 7 | Old Bomb | See Table 1 | Initiate Burn Pans | 36 |
| 8 | Old Bomb | See Table 1 | Misfires | 38 |
| 9 | Old Bomb | See Table 1 | Inspect Burn Area | 40 |
| 10 | Old Bomb | See Table 1 | Partial Burns | 42 |
| 11 | Old Bomb | See Table 1 | Dispose of Packing Materials | 44 |
| 12 | Old Bomb | See Table 1 | Clean Burning Grounds Area | 47 |
| 13 | Old Bomb | N/A | Close Burning Grounds | 49 |


**REMARKS:**
The purpose of this procedure is to cover the demilitarization of bulk propellant, propellant charges, and component charges. The procedure consists of the following: general burning ground operations, safety, and meteorological requirements, opening burning grounds, setup of burn pans, and demilitarization by burning, misfires, inspection, and cleanup of the area.

Coordination between the Old Bomb Supervisor or a designated representative with demil certification, the MCPO, and SOC LLC Range Operations will be performed to assure that no personnel are placed at risk during concurrent operations at Old Bomb.

QA Personnel are responsible for documenting and initiating corrective action for all deviations from this SOP.

The receipt and outloading operations of this SOP will be IAW HW-0000-L-002.

REFERENCES:

29 CFR 1910 Subparagraph 151
FM–5-250
TM 9-1300-277
DOD 4160-21-M-1
DA PAM 385-64
AMC-R 700-107
DOD 4145.26-M-1
AMC R 385-100
DOD 4160-21-M
MIL-STD-882D
SB 742-1
TM 43-0001-28

**CHANGE 1** – Adds changes to SOP per Supervisory UXO Tech III review

**Page i:** Adds Supervisory UXO Tech III signature line to SOP.
**Page ii:** Adds Weather Data Statistics – Open Burning AMC Form 2886-R-E to Table of Contents.
**Page 2:** Adds updated Operator's Statement to SOP.
**Page 3:** Deleted from Acronyms list.
**Page 4:** Changes Operation Descriptions in Index of Operations to match Operations 4 and 7.
**Page 5:** Adds Change 1 to SOP.
**Page 8:** Changes Range Control Operations to Chief Ammunition Surveillance in Step 6a.
**Page 14:** Adds to and makes correction to Tools and Supplies List.
**Page 17:** Adds wording to Step 2c2; changes wording of Step 2e (Operation 1).
**Page 18:** Adds Step 3d to Operation 1.
**Page 27:** Changes wording in Step 3c of Operation 4.
**Page 30:** Changes wording in Step 3e3 of Operation 5.
**Page 31:** Changes wording in Step 7 of Operation 5.
**Page 32:** Changes wording in SR#10 of Operation 5.
**Page 33:** Adds wording to Step 3d of Operation 6.
**Page 36:** Changes wording in Step 1e of Operation 7.
**Page 42:** Changes wording in Step 2b of Operation 10.
**Page 47:** Adds wording to Step 1e of Operation 12.
**Page A-1:** Adds Weather Data Statistics – Open Burning AMC Form 2886-R-E to SOP.

TABLE 1
EXPLOSIVE/PERSONNEL LIMITS
OLD BOMB

| BURN AREA | | | |
|---|---|---|---|
| EXPLOSIVE ITEMS | QUANTITY | NEW | EXPLOSIVE LBS. |
| Fuse Lighter | 12 each | 0.0001 | 0.0012 |
| Safety Fuse | 100 feet | 0.0037 | 0.3700 |
| Bulk Propellant, Propellant Charges, and/or Increments | 5 pans @ 995# each[1] | 4,975# per pad[1] | 19,900[1] |
| TOTAL | | | 19,900.3712[2] |
| PERSONNEL LIMITS: OPERATORS: 8 | | | TRANSIENTS: 4 |

[1]Quantities based on average burn amounts per pan at five pans per pad (total of four pads at Old Bomb).

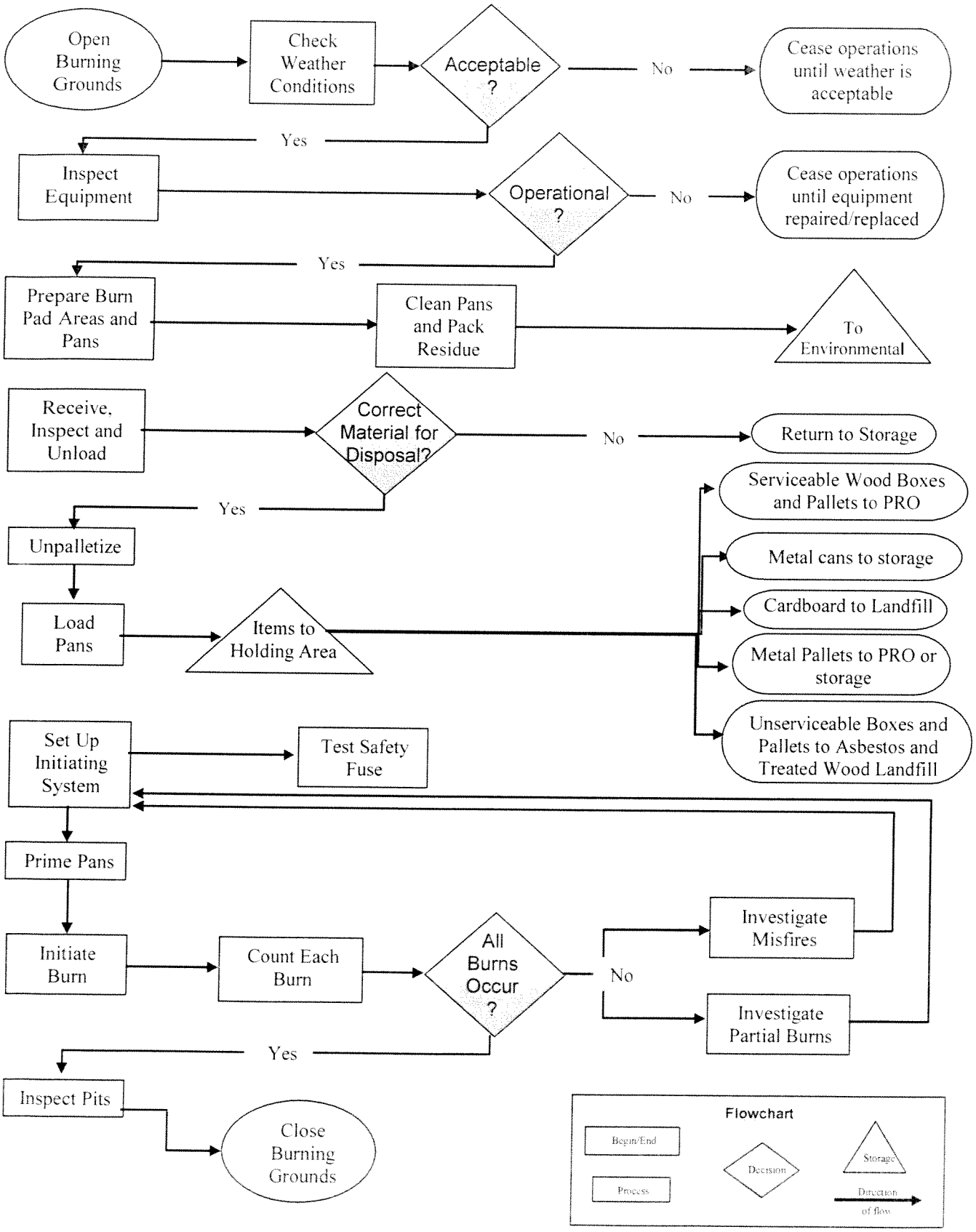
[2]NOTE: As long as 20,000 pound NEW is not exceeded, any combination of the items listed in the above Table may be used.

## SECURITY REQUIREMENT FOR OLD BOMB

1. Safety fuses and fuse lighters may be stored at Old Bomb during each week of operations. A preset amount of fuses and lighters will be taken to the site at the start of the week and stored in a locked container. At the end of each week, all remaining fuses and lighters not expended will be returned to storage.

2. The Supervisor, or a designated representative with demil certification, will notify Security at ext. 7555 at the start and conclusion of operations.

# PROCESS FLOW FOR OLD BOMB OPERATIONS



## SAFETY REQUIREMENTS FOR OLD BOMB

1. Comply with all safety and security requirements listed in SOP HW-0000-A-001 pertaining to the performance of this procedure.

2. Any propellant determined too dangerous to handle or store, as indicated by one of the following conditions, will be reported immediately to Supervisory personnel: excess bulging of the container, temperature of the container is above the ambient temperature, smoking, or high/strong ether vapor concentration near the container lid. Operations will be suspended and, if warranted, personnel may be evacuated pending further instruction.

3. Do not unstrap or unpalletize any material appearing to be in any unusual or abnormal condition. All personnel will be instructed to report these conditions to the Old Bomb Supervisor, or a designated representative with demil certification.

4. No individual will work in an explosive handling operation without another operator in close visual proximity.

5. Smoking, spark or flame producing devices:

   a. Smoking is permitted only in the designated smoking area. Smoking is not permitted in vehicles at any time.

   b. Matches, lighters and similar devices will not be transported through the burning ground areas. Personnel are specifically ordered not to carry matches or other spark producing devices. 'Strike anywhere-type' kitchen matches are prohibited at all times in all locations.

   c. The Old Bomb Supervisor, or a designated representative with demil certification, will obtain written authorization from the SOC LLC Fire Chief for the use of safety matches in the burning ground area. The safety matches will be kept in a metal container too large to fit into the pockets, i.e., a M2A1 can painted red and marked "Safety Matches".

6. In case any casualty, mishap, or accident should occur during disposal operations, the operations will be immediately suspended and reported to the following personnel and operations will not be resumed until authorized by a higher authority:

   a. Fire Department, ext. 7911.

   b. Chief Ammunition Surveillance, ext. 7830, 7400, or cell 316-0008.

   c. Head, Marine Corps Project Office (MCPO), ext. 7871 or cell 760-822-8774.

   d. Director of Munitions and Logistics (M&L), ext. 7244 and/or 945-0301.

   e. Safety, ext.7842 and/or cell 945-0362.

7. Emergency response equipment:

   a. A first aid kit will be issued. The first aid kit will be readily available in the work area at all times when work is being performed.

b. A vehicle will be available to transport casualties that may occur during demilitarization/ disposal.

c. A minimum of two personnel who have had Red Cross First Aid (or equivalent) training and have current certification will be on-site at all times during burning operations.

d. Radio communications between the burn pad area and the Old Bomb office will be available during all burning operations.

8. Only non-sparking tools will be used while working with or in the vicinity of exposed propellant.

9. The Old Bomb Supervisor, or a designated representative with demil certification, is responsible for the assignment of qualified personnel to each work element. To assure that responsibility is fulfilled, the Old Bomb Supervisor, or a designated representative with demil certification, will brief each Munitions Handler in:

   a. The overall disposal/burning operation process.

   b. The specific work element(s) assigned to the individuals.

10. Burning operations will be carried out only by experienced and trained personnel who have been carefully instructed and are completely familiar with procedures outlined in this SOP and with other applicable safety publications and instructions.

11. The Old Bomb Supervisor in charge, or a designated representative with demil certification, will be responsible for the enforcement of all safety regulations and for the safety of all personnel and operations in the Old Bomb Disposal area. If there is any question about procedures or safety, operations will be deferred until a competent authority has been consulted and the proper approval/authority is obtained. The Old Bomb Supervisor, or a designated representative with demil certification, is responsible for ensuring that a minimum number of personnel are exposed to hazardous operations consistent with safety and operational requirements.

12. Burning material will be undertaken only in those areas or locations which have been specifically approved and permitted by the State agency for that purpose. The maximum limits will not be exceeded.

13. Fire fighting equipment will be readily available for use in the burning area at all times while work is in progress. Fire fighting equipment will consist of round nosed, long handled shovels, Mattock with axe bit, and garden type rakes. The fire fighting equipment will be stored in the storage shelter at Old Bomb Disposal area office and transported back and forth from the burning area in crew trucks.

14. Prior to delivery of any propellant, prop charges, or increments to the burn area, the area and burn pans will be carefully inspected for the presence of hazards (i.e.; residual heat, propellant, explosives, dangerous objects or prohibited foreign material) which may be present. If found, contain or completely remove. Burning will not be repeated in previously used burn pans until they have cooled a minimum of two hours and have had all ash/residue removed. The Old Bomb Supervisor, or a designated representative with demil certification, will assure burn pans have cooled sufficiently.

15. The burn pans will be cleaned of all loose material after each burn. All residue will be removed from the site at the end of each week or at the end of the job. Burn residue will be containerized into DOT approved, sealable containers. Containers will be sealed with a ring and bolted with a lock nut, except during actual filling. The container will be labeled with a Hazardous Waste label to identify contents. The Environmental Office will be notified to perform a test of the residue and will determine final disposition.

16. No propellant, propellant charges or increments will be stored at the burning sites. Propellant, propellant charges or increments will not be stored overnight at Old Bomb unless GOC is notified so that a check can be made at least once every four hours.

17. Prior to starting demilitarization operations, the burning grounds will be searched for unauthorized personnel. Old Bomb personnel will guard/watch the entrance gate to prevent entry of unauthorized personnel into the area prior to and throughout the operation. Red flags will be displayed and will not be taken down until the burning operations are completed and the pads have been determined secure. **The MCPO or other military training units may be performing concurrent operations during demilitarization of propellant, propellant charges or increments. The Old Bomb Supervisor (or in his absence a designated representative with demil certification) will coordinate with the MCPO Head (or MCPO Range Leader in his absence) and Range Operations to assure access control and coordination is achieved.**

18. The Fire Department will maintain gate keys for fire fighting and emergency medical assistance; the MCPO and SOC LLC Range Operations will maintain gate keys for range operations; and the Old Bomb Supervisor, or a designated representative with demil certification, will maintain gate keys. GOC forces maintain a second lock. Care will be taken when the gates are locked to assure both locks are capable of opening the gate in case of an emergency at Old Bomb.

19. Material handling equipment will not be fueled within 200 feet of burning operations.

20. When the fire hazard is high (as determined by the Old Bomb Supervisor, or a designated representative with demil certification/Fire Department) because of unusually dry weed growth, operations will not be undertaken unless properly manned mobile fire fighting equipment is standing by in a safe location.

21. During burning operations, personnel will not be stationed near material awaiting disposal.

22. All burning operations will be conducted between 9:00 am and ½ hour before sunset local time, Monday through Friday. Any exception to this time scheduling for burning will be coordinated with ACO staff.

23. Compliance with permit requirements of the State of Nevada Division of EPA is mandatory.

24. The handling or disposition of ammunition, explosives, or other hazardous materials, which are not specifically identifiable, will not be undertaken without authorization from the Safety Office and written approval from the General Manager or his designated representative.

25. The burning of propellant, propellant charges or increments will not be initiated unless:

    a. Ample visible warning is given, i.e., the red flag (DANGER) is displayed.

b. Operable communications are available.

c. The Old Bomb Supervisor, or a designated representative with demil certification, has ascertained that the burn pan area is clear and all personnel are accounted for and safely sheltered.

d. All equipment is at a safe distance from the hazard area.

e. The Old Bomb Supervisor, or a designated representative with demil certification, has coordinated with the MCPO Range Supervisor and SOC LLC Range Operations to assure the safety of all range and Old Bomb personnel.

26. Personnel will remain at the shelter a minimum of 15 minutes after the burning has been completed. The site will not be secured at the end of the workday until 15 minutes after final burn and all fires have been extinguished.

27. All personnel employed at the disposal areas will be given refresher instructions regarding coordination with MCPO and SOC LLC Range Operations, operational and safety procedures during regular safety meetings, and any additional instructions deemed necessary by the Old Bomb Supervisor, or a designated representative with demil certification.

28. Improvised methods of burning are strictly prohibited.

29. Containers of propellant, propellant charges or increments to be destroyed will be spotted and opened at least ten feet from each other and from material previously laid out for destruction to prevent rapid transmission of fire in the event of premature ignition. Containers of propellant, propellant charges or increments will not be opened until the vehicle(s) have been withdrawn a minimum of 35 feet.

30. Propellant, propellant charges or increments destined for burning will be in original closed packages or in containers of fire-retardant materials that will not contribute to the existing hazard by readily producing sparks when contacting rocks, steel, or another container. Bags or containers made from easily ignited material will not be used. Containers will have closures that will prevent spilling or leakage of contents when handled or if overturned. Closures will be of a type that will not pinch or rub explosives during closing and opening. The closures and surfaces of container openings will be thoroughly cleaned of explosive contamination to minimize the hazard during closing or opening.

31. Containers of propellant, propellant charges or increments will be grounded. Wood and fiberboard boxes are not electrical conductors and do not require grounding.

32. Operators will be grounded, with approved wrist stats, to the metal pan any time they are handling exposed smokeless powder and/or placing the ignition system in the burn pan. Wrist stats will be attached to bare skin, not over gloves or over clothing.

33. Burn pans, when not in use, will be stored with lids in place.

34. Direct skin contact with the solid residue or inhalation of the smoke may cause a health hazard. During the actual burning of propellant, propellant charges or increments within the 1.5-mile (2.3-Kilometer) radius of the pits at Old Bomb, all personnel will be required to wear a half-face mask type respirators with HEPA filters. Refer to the Site Plan.

35. Smoking, eating, or drinking in areas where propellant, propellant charges or increments are being burned is prohibited.

36. Operators cleaning burn pans or handling residue from burnt propellant, propellant charges or increments will wear gloves, coveralls and respirators, and will wash hands before eating, smoking, or using toilet facilities.

37. Dry grass, leaves, and other extraneous combustible material will be removed within a radius of 200 feet around the burn pads (within the bermed area). The area immediately around the burn pans will be free of large rocks and cracks in the ground, which could trap propellant grains.

38. The earthen berm surrounding the burn area will be maintained to assure water run-off does not occur.

39. The following table contains a list of the fire fighting equipment used in operations. The quantity needed is dependent upon the procedure.

| FIRE FIGHTING EQUIPMENT | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Beater, fire | Local Fabrication | 2 each |
| Extinguisher, fire, Class 5 BC and 10 BC | Commercial | As required |
| Extinguisher, fire, water, 5 gallon pump | Commercial | 2 each |
| Kit, First Aid | Commercial | As required |

40. The following table contains a list of the equipment, gages used in operations. The quantity needed is dependent upon the procedure.

| EQUIPMENT AND GAGES | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Forklift, rough terrain, 6,000 lb. capacity | Commercial | As required |
| Fuse, safety | Commercial | As required |
| Lighter, fuse | Commercial | As required |
| Pan, burn | Commercial | As required |
| Radio, portable | Commercial | As required |
| Radio, vehicular | Commercial | As required |
| Strap, ground | Commercial | As required |
| Tester, wriststat | Commercial | 1 each |
| Timing Device (stop watch or watch with second hand) | Commercial | As required |

41. The following table contains a list of tools and supplies used in operations. The quantities required will be dependant upon the procedure. It is not necessary to list those tools that are commonly used in most operations, e.g., strapping, cutters, hammers, screwdrivers, unless they must be spark-proof. Before introducing common tools and/or supplies onto the line, notify PP&PE to authorize use. Form DZHC-41-E will be used to authorize use of common tools and supplies pending subsequent change or revision to the SOP.

| TOOLS AND SUPPLIES | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Bags, plastic | Commercial | As required |
| Brush, natural fiber, foxtail | Commercial | As required |
| Cart, hand | Commercial | As required |
| Checklist, Old Bomb Burning Grounds | DZHC-293-E | As required |
| Checklist, Meteorological Weather Station Inspection | DZHC-104-E | As required |
| Container, DOT approved f/hazardous waste | Commercial | As required |
| Container, metal, for safety matches | M2A1 | As required |
| Container, sealable, f/PCP crystals | Commercial | As required |
| Container, sealable, f/lead seals | Commercial | As required |
| Covering, head, flame resistant | Commercial | As required |
| Crimper, blasting cap, M2 | MIL-C-43438 | As required |
| Crimper, steel strapping, (5/8", ¾", 1-¼") | MIL-S-43180 | As required |
| Cutters, steel strapping | GGG-C-835 | As required |
| Dumpster, hopper or trailer type | Commercial | As required |
| Dustpan, rubber | Commercial | As required |
| Filter, respirator, HEPA | Commercial | As required |
| Fire hazard symbol | Commercial | As required |
| Fixture, lifting | Local Fabrication | 1 each |
| Flag, red, danger, 3' x 5' | Commercial | As required |
| Gloves, cotton, powder | Commercial | As required |
| Gloves, Kevlar | Commercial | As required |
| Gloves, Leather/Leather Palm | Commercial | As required |
| Gloves, rubber | Commercial | As required |
| Goggles, dust proof | GGG-G-515 | As required |
| Hammer, non-sparking | GGG-H-86 | As required |
| Hearing Protection | Commercial | As required |
| Ink, stencil, Type II or IV | A-A-208 | As required |
| Knife, non-sparking | Commercial | As required |
| Label, Hazardous Waste | Commercial | As required |
| Log, Old Bomb Contemporaneous | DZHC-100-E | As required |

| TOOLS AND SUPPLIES | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Logbook | Commercial | As required |
| Machine, stencil cutting, ¼", ½" | GG-S-747 | As required |
| Marker, felt tip, assorted colors | Commercial | As required |
| Mat, conductive rubber | Commercial | As required |
| Mattocks, with axe bit | Commercial | 1 each |
| Pad, stamp, rubber, identification | Commercial | As required |
| Pallet, curbed | Commercial | As required |
| Palletainer, lined | Commercial | As required |
| Pen, ballpoint, black/blue | Commercial | As required |
| Pliers, diagonal, non-sparking | Commercial | As required |
| Pliers, lineman, non-sparking | GGG-P-471 | As required |
| Powder, smokeless | Small grain | As required |
| Press, hand, anti-pilferage seal | GGG-S-735 | As required |
| Pry bar, non-sparking, 18" | GGG-B-101 | As required |
| Rake, garden type | Commercial | As required |
| Rake, rubber, beryllium, wood, aluminum | Commercial | As required |
| Respirator, with cartridge and HEPA filter, half-face mask | Commercial | As required |
| Scissors | Commercial | As required |
| Scraper, wood | Local Fabrication | As required |
| Seals, antipilferage | Commercial | As required |
| Seals, steel strapping, (5/8", ¾", 1-¼") | ASTM D 3953 | As required |
| Shield, face | L-F-36 | As required |
| Shovel, round nose, long handle | Commercial | As required |
| Steel, strapping, (5/8", ¾", 1-¼") | ASTM D 3953 | As required |
| Stretcher, steel strapping, (5/8", ¾", 1-¼") | MIL-S-17743 | As required |
| Tape, electrical | Commercial | As required |
| Tape Measure, 12 foot minimum | Commercial | As required |
| Tape, pressure sensitive | Commercial | As required |
| Truck, hand | Commercial | As required |
| Undergarments, cotton | Commercial | As required |
| Weather Data Statistics – Open Burning | AMC-Form 2886-R-E | As required |
| Wrist stats | Commercial | As required |

## FIRST AID INSTRUCTIONS
## HEAT EXHAUSTION

***SYMPTOMS:***

Profuse sweating without evaporation (cooling) effect.
Skin usually cold or clammy.
Face becomes ashen or gray.
May feel weak, dizzy or faint.
May experience nausea and/or headache.
Pulse may be rapid.

***TREATMENT:***

Remove patient from heat source.
Loosen tight clothing.
Remove excess layers of clothing.
Lay the patient down.
Urge patient to drink at least one liter of water.

HEAT EXHAUSTION NOT TREATED CAN LEAD TO HEATSTROKE. HEAT STROKE UNTREATED CAN AND WILL LEAD TO DEATH.

Heat stroke, though the least likely of the heat related illnesses, is the most serious.

## HEAT STROKE

***SYMPTOMS:***

No sweat.
Hot dry flush skin.
Rapid rising temperature.
Pulse strong and rapid.
Becomes unresponsive.
Pulse becomes weaker as patient progresses into deeper unresponsiveness.
Some moisture may collect on portions of the body but sweat glands have ceased to function.

***TREATMENT:***

Cool entire body by any means available.
Move to shade.
Remove clothing.
Apply wet towels, clothing, or rags.
Act with speed and vigor - the faster proper treatment is started and executed - the quicker the patient is likely to respond and recover with no ill effects.

## PREVENTION OF HEAT EXHAUSTION/STROKE:

**REMEMBER!**
**Cool the entire body by any means available.**
**Drink plenty of fluids.**
**Do not overwork the sweat producing mechanism.**
**Wear loose clothing.**
**Rest frequently**

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 1**

**OLD BOMB**

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE**

**OPERATION:** Open Burning Grounds

**EXPLOSIVE/PERSONNEL LIMITS:** N/A

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Pre-Clearance.

   a. (O)(S) Twenty-four (24) hours prior to or the last working day of the week before the first day of operation Production Planning personnel will notify the following personnel by electronic mail or telephone call:

      (1.) Safety at ext. 7842 and/or cell 945-0362.
      (2.) QASAS Office at ext. 7400.
      (3.) Fire Department at ext. 7107.
      (4.) Range Control Operations, ext. 7482, 7488, 7495, or 7493.
      (5.) Head, MCPO at ext. 7871 or cell 760-822-8774.

   b. (O)(QC) The Old Bomb Supervisor, or a designated representative with demil certification, will assure communications are available with the following:

      (1.) Fire Department, ext. 7107 (ext. 7911 in an Emergency), or "Station One" on Channel 3 via portable or vehicular radio.
      (2.) GOC, ext. 7555, or "Net Control" on Channel 1 via portable or vehicular radio.
      (3.) SOC LLC Range Operations at "Range Operations" on either Channel 1 or 7 via portable or vehicular radio.
      (4.) MCPO Range Supervisor at "Range Control" on Channel 1 via portable or vehicular radio.

2. The Old Bomb Supervisor, or a designated representative with demil certification, will assure the following requirements are met prior to opening the burning grounds for operations:

   a. (O)(QC)(S) Weather information is obtained through the Department of Defense Weather Station or the National Weather Station and if any of the data listed meets the meteorological requirements shown in Step 2c, continue to Step 2b. If not, operations will not be performed. Data can be downloaded from the following site: http://www.wunderground.com/.

b. (O)(QC) Meteorological Weather Station is turned on and operating properly.

c. (O)(QC) Meteorological requirements have been met.

(1.) Operations may be conducted during the following conditions:

(a.) Probability of an electrical storm is 50% or less or when such a storm is not approaching within eight to ten miles of operations.

(b.) Probability of a thunderstorm is 50% or less, no thunderstorm is occurring in the direct vicinity or is approaching within eight to ten miles of operations.

(c.) Probability of precipitation is 50% or less and no precipitation is occurring during operations.

(d.) Visibility is more than one mile (i.e., fog, blowing snow, sand or dust storms).

(e.) The cloud cover is at 80% or less at a ceiling of 2000 feet or more.

(f.) Surface wind speed is more than three miles per hour and not more than 15 miles per hour IAW DOD 4145.26-M, Chapter C15.5.3. (This supersedes SOC LLC's air permit that lists the wind speed of between 3 and 20 mph.)

(2.) At the discretion of the Old Bomb Supervisor, or a designated representative with demil certification, the operating procedures up to, but NOT including, the SETUP INITIATION SYSTEM (Operation 6) may be performed when no electrical/thunder storms are present.

(3.) Meteorological data will be recorded during the period from five minutes preceding the initial burn to one hour subsequent to the final burn on a minute-by-minute basis.

(4.) The timed average for all on site quantitative measurements of wind speed or direction must be for a minimum of five minutes.

(5.) If there is a communication problem between the meteorological station and the printer that will not allow for meteorological readings to be read, the Environmental Office will send a representative to Old Bomb to download the data for review until the communication problem can be resolved. The Environmental Office representative will notify the Supervisor, or a designated representative with demil certification, when the above requirements have been met and the ignition of the burn may occur. The Environmental Office representative will download the data as soon as feasible to assure there is a permanent record.

d. (O) The Meteorological Weather Station Inspection Checklist (Form DZHC 104-E) has been completed.

e. (O) The weather data on the Weather Data Statistics – Open Burning Form (Form AMC Form 2886-R-E) has been completed.

f. (O)(S) Coordination with the Head of MCPO and/or MCPO Range Supervisor and SOC LLC Range Operations has been performed during concurrent operations.

g. (O)(S) Hazards and safety precautions have been evaluated and personnel briefed.

h. (O)(S) Burning grounds danger area is clear of all unauthorized personnel.

i. (O) The current approved State of Nevada Division of Environmental Protection Permit is posted in the Old Bomb Disposal Area Office and the site is in compliance.

j. (O) The current Hazardous Material/Waste Contingency Plan is available in the Old Bomb Disposal Area Office.

k. (O) The First Responder Personnel are present and must be familiar with and trained in Proper Response Procedures.

3. The Old Bomb Supervisor, or a designated representative with demil certification, will turn in the following forms upon daily completion to PP&PE, along with a copy of the print-out from the meteorological weather station:

   a. Old Bomb Burning Grounds Checklist, Form DZHC-293-E.

   b. Meteorological Weather Station Inspection Checklist, Form DZHC 104-E.

   c. Old Bomb Contemporaneous Log, Form DZHC-100-E.

   d. Weather Data Statistics – Open Burning (Form AMC Form 2886-R-E).

**SPECIAL REQUIREMENTS:**

1. **ONLY THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, IS AUTHORIZED TO GIVE CLEARANCE FOR OPENING THE BURNING GROUNDS AND THE BURNING OF PROPELLANT, PROPELLANT CHARGES OR INCREMENTS.**

2. **BURNING IS PERMITTED FROM 09:00 A.M. UNTIL ONE-HALF HOUR BEFORE SUNSET ONLY.**

3. **THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, WILL ASSURE THAT THE OLD BOMB LOG AND WEATHER DATA FORMS ARE PROPERLY FILLED OUT FOR EACH DAY'S OPERATIONS.**

4. **NO OPERATION WILL BE LEFT UNATTENDED DURING THE ACTIVE PORTION OF THE OPERATION (I.E., DURING THE ACTUAL PRIMING AND BURNING).**

5. **ALL PERSONNEL ARRIVING AT OLD BOMB WILL REPORT TO THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, AND SIGN IN THE LOGBOOK.**

6. **ALL PERSONNEL LEAVING THE OLD BOMB DISPOSAL AREA WILL SIGN OUT IN THE LOGBOOK.**

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 2**

**OLD BOMB**

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE**

**OPERATION: Prepare Burning Grounds and Check Equipment**

**EXPLOSIVE/PERSONNEL LIMITS: N/A**

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Preparation of Burning Grounds.

   a. (O) Unlock gate.

   b. (O)(S) Place red danger flag (3 ft. x 5 ft.), or appropriate warning signs, at the Old Bomb Office (Building 399 or Trailer).

   c. (O)(S) Display correct fire hazard symbol at gate for the material received.

   d. (O)(QC) Assure burning ground area is clear of unauthorized personnel.

   e. (O)(QC) The Old Bomb Supervisor, or a designated representative with demil certification, will coordinate Old Bomb operations with MCPO Range Supervisor and SOC LLC Range Operations.

2. Inspect Equipment.

   a. (O)(S) Assure a serviceable operating portable or vehicular radio is available at the burn pad area at all times when explosive operations are being performed.

   b. (O)(QC)(S) Inspect fire fighting equipment and first aid kit containing a minimum of: Band aids, gauze, roll bandage, breathing barrier for CPR, gloves (exam/medical), antiseptic wipes, and eyewash.

3. Preparation of Burn Pad Areas and Pans.

   a. (O)(S) If a burn pan has been previously used, it must be allowed to cool for a minimum of two hours and all ash/residue will be removed prior to reuse. The Old Bomb Supervisor, or a designated representative with demil certification, will assure burn pans have cooled sufficiently.

**Burn pans are elevated to allow air circulation and inspection of underside of pans.**

b. (O)(S) Dry grass, leaves, and other extraneous combustible material will be removed, within a radius of 200 feet around the burn pads (within the bermed area). The area immediately around the burn pans will be free of large rocks and cracks in the ground, which could trap propellant grains.

c. (O)(QC) Visually inspect to assure burn pans are electrically bonded and connected to a common earth ground.

d. (O) If a cover is on a burn pan, remove the cover from the pan and set it aside for reuse. The burn pan cover should be placed a minimum of ten feet from the burn pad.

e. (O) If present, residue from previous burns will be removed from the pans by using a wooden scraper, foxtail brush, and dustpan. The burn residue will be containerized into DOT approved, sealable containers. Containers will be sealed with a ring and bolted with a lock nut, except during actual filling, and labeled to identify contents. The Environmental Office will be notified to perform a test of the residue and determine final disposition.

f. (O) Recovered propellant or explosives will be placed into the burn pan.

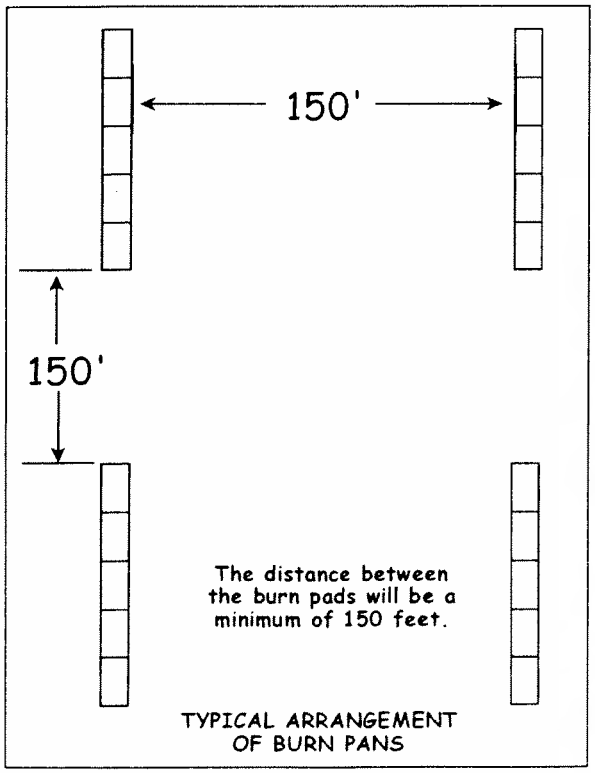



Figure 2-1

g. (O)(S) The burn pads will be separated by at least 150 linear feet. Refer to Figure 2-1. A typical layout may be seen in Figure 2-2.

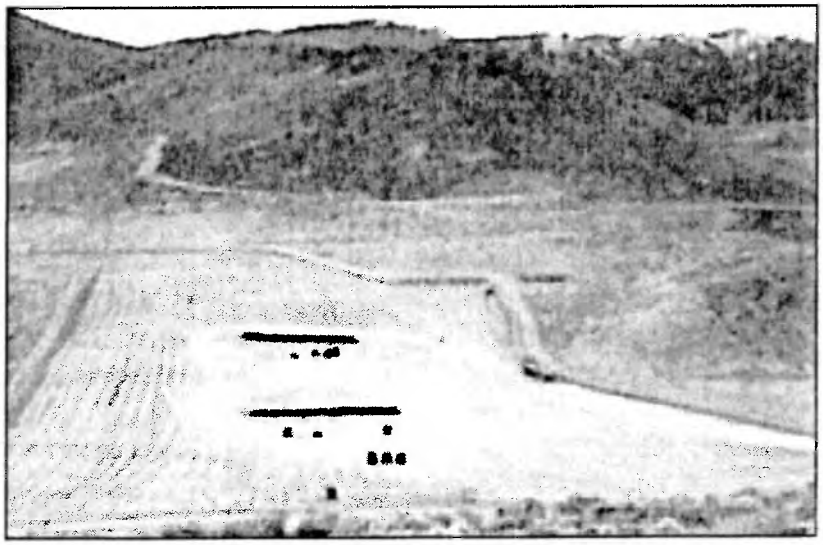


Figure 2-2

SPECIAL REQUIREMENTS:

1. PERSONNEL WILL WEAR RESPIRATORS (HALF-FACE TYPE WITH HEPA FILTER FOR TOXIC PARTICULATES) WHEN REQUIRED TO OPEN CONTAINER(S) WITH PROPELLANT ASH RESIDUE (TO CHECK LEVELS OR ADD TO THE CONTENTS) OR TO PERFORM CLEAN UP WORK INVOLVING THE SAME.

2. WHEN WORKING AROUND EXPOSED PROPELLANT, THE FOLLOWING PPE WILL BE WORN: FLAME RETARDANT COVERALLS, LEATHER, LEATHER PALM OR KEVLAR GLOVES WORN OVER POWDER GLOVES, COTTON UNDERGARMENTS, SAFETY GLASSES WITH SIDE SHIELDS, STEEL-TOED SAFETY SHOES, AND FLAME RETARDANT HEAD COVERING. COLD WEATHER GEAR WILL BE PROVIDED AS NEEDED. NO STREET CLOTHING WILL BE WORN. ASSURE ALL CLOTHING FITS SNUGLY AROUND THE WRISTS TO PREVENT EXPLOSIVE DUST/POWDER FROM COMING INTO CONTACT WITH THE SKIN WHEN POURING PROPELLANT.

3. A BURN PAD CONSISTS OF A SERIES OF BURN PANS CONNECTED TOGETHER TO A COMMON EARTH BOND. THE BURN PADS WILL BE SEPARATED A MINIMUM OF 150 LINEAR FEET FROM EACH OTHER.

4. THE SOLID RESIDUE PRODUCED BY THE OPEN AIR BURNING OF M1 AND M6 PROPELLANT MAY BE HAZARDOUS TO PERSONNEL HEALTH. THEREFORE, PERSONNEL INVOLVED WITH THE CLEANUP OPERATIONS WILL WEAR THE PPE DESCRIBED IN SPECIAL REQUIREMENT 2, WITH RESPIRATOR HAVING A FILTER FOR PARTICULATES. PERSONNEL WILL WASH THEIR HANDS THOROUGHLY BEFORE EATING, DRINKING, SMOKING, OR USING TOILET FACILITIES. EATING AND SMOKING ARE PROHIBITED IN THE OPEN BURNING AREA.

5. DAILY, ASSURE THE OLD BOMB FLAGS AND BARRICADES ARE IN PLACE.

6. PRIOR TO PREPARING PANS, THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, WILL INSPECT THE AREA FOR PRESENCE OF DANGEROUS OBJECTS OR PROHIBITED MATERIAL. ASSURE THE AREA IS NOT DANGEROUSLY WARM AND IS FREE FROM BURNING OR SMOLDERING RESIDUE. THE BURNING AREA WILL NOT BE USED UNTIL SAFE CONDITIONS ARE PRESENT.

7. DAILY, ASSURE PORTABLE OR VEHICULAR RADIO IS OPERATIONAL.

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 3**

**OLD BOMB**

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE**

**OPERATION:** Receive, Inspect and Unload

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Receive material from storage.

2. Inspect.

   a. (O)(QC) Upon arrival of propellant or explosives, the truck driver will sign in logbook and indicate the time of arrival. Trucks with propellant will not park within 200 feet of the Old Bomb Office.

   b. (O)(QC) Propellant destined for Old Bomb will be labeled as a Hazardous Waste with the applicable DOT markings.

   c. (O) Enter the quantity and identification of the items in the Old Bomb Contemporaneous Log.

   d. (O)(QC)(S) The Old Bomb Supervisor, or a designated representative with demil certification, or Munitions Destroyer will inspect the pan(s) to be used and the items received to determine if any special hazards exist.

   e. (O)(QC) Compare items received with transfer documents to assure items listed are scheduled for burning and the quantity is accurate. Any quantity discrepancy will be processed IAW SOP HW-0000-A-001 General Safety and Security Requirements.

   f. (O) Items not identified for burning will be returned to storage.

   g. (O) The Old Bomb Supervisor, or a designated representative with demil certification, will sign and date the shipping documents to show the material was received at the burning area.

3. Unload Conveyance.

   a. (O) The Old Bomb Supervisor, or a designated representative with demil certification, will direct the approved explosive loaded trucks to the burn pad area(s) for unloading.

   b. (O)(S) When a truck has been positioned for unloading, the engine will be shut off, the wheels chocked, and the brakes set to prevent vehicle movement.

   c. (O)(QC) Using a rough terrain diesel forklift (6,000 lb capacity), unload the required quantity of explosive/propellant items and position them as directed. The material will be spotted at least ten feet from the burn pan to be used, and at least ten feet from other material. Refer to Figure 3-1.

   d. (O)(S) Continually inspect the propellant containers for signs of deterioration to the point of being unsafe to handle or that imminent spontaneous fire/detonation could occur. One or more of the following conditions may aid in determining imminent spontaneous combustion:

      (1.) Excess bulging of the container.

      (2.) Temperature of the container is above the ambient temperature.

      (3.) Smoking.

      (4.) High or strong ether vapor concentration near the container lid.

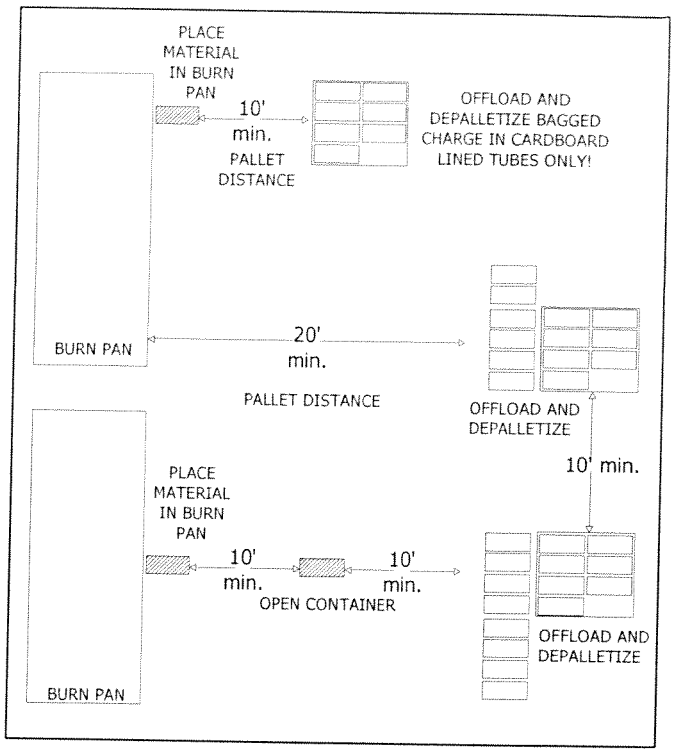



Figure 3-1
Typical Layouts

   e. (O)(S) Notify the Old Bomb Supervisor, or a designated representative with demil certification, if any hazards listed in Step d are observed. The Old Bomb Supervisor, or a designated representative with demil certification, will notify:

      (1.) Safety (ext. 7842 and/or cell 945-0362)

      (2.) Fire Department through GOC (ext. 7911).

4. The truck will be repositioned to the Holding Area as soon as practical after unloading. Refer to the Site Plan for this location. Reloading of empty containers will be performed, as required, and the truck driver will log out of the area and depart prior to ignition of the burn. **Containers of propellant will NOT be opened until the trucks have been withdrawn a minimum of 35 feet.**

UNCONTROLLED DOCUMENT

MAR 14 2012

5. Transfer:

   a. (O) Containers of propellant, propellant charges or increments to Operation 4.

   b. (O) Safety fuse, fuse lighters, and if applicable, smokeless powder to Operation 6.

SPECIAL REQUIREMENTS:

1. WHEN PALLETS ARE STACKED TWO-DEEP, AN OPERATOR WILL GUIDE THE FORKLIFT OPERATOR TO THE TRUCK FROM WHICH THE EXPLOSIVES AND PROPELLANT, PROPELLANT CHARGES OR INCREMENTS ARE TO BE REMOVED. AN OPERATOR WILL THEN GUIDE THE FORKLIFT OPERATOR TO ASSURE THE FORK TINES ENTER THE TRACK OF THE PALLET BEING REMOVED AND DO NOT COME IN CONTACT WITH THE CONTAINERS OR PULL THE CONTAINERS FROM THE TRUCK.

2. IF ANY UNUSUAL CIRCUMSTANCE ARISES, THE OPERATIONS WILL DISCONTINUE WITHOUT FURTHER MOVEMENT OR HANDLING. THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, AND SAFETY MANAGER (EXT. 7842 AND/OR CELL 945-0362) WILL BE NOTIFIED.

3. DIESEL POWERED ROUGH TERRAIN FORKLIFT OPERATORS WILL WEAR APPROVED HEARING PROTECTION.

4. PERSONNEL WILL STAY CLEAR OF ALL MATERIAL HANDLING EQUIPMENT BEING OPERATED.

5. MATERIAL HANDLING EQUIPMENT WILL NOT BE REFUELED WITHIN 200 FEET OF BURNING OPERATIONS.

6. PRIOR TO DELIVERY OF ANY EXPLOSIVE MATERIAL TO A BURN PAD AREA, THE AREA WILL BE CAREFULLY INSPECTED FOR THE PRESENCE OF DANGEROUS OBJECTS OR PROHIBITED FOREIGN MATERIAL.

7. SAFETY WILL BE STRESSED AT ALL TIMES. MANY CIRCUMSTANCES MAY BE ENCOUNTERED WITH THE SAME TYPE OF MATERIAL DUE TO AGE AND STORAGE CONDITIONS.

8. THE PROPELLANT, PROPELLANT CHARGES OR INCREMENTS SCHEDULED FOR BURNING IS CONSIDERED HAZARDOUS BECAUSE OF LOSS OF STABILIZER. IT MAY SELF-IGNITE AND SELF-DESTRUCT. EXERCISE DUE CAUTION WHILE WORKING WITH AND AROUND THIS UNSTABLE PROPELLANT.

9. AT NO TIME WILL THE CONTAINER BE SLID, DROPPED, ROLLED OR TREATED IN SUCH A MANNER THAT WOULD CREATE SHOCK OR STATIC ELECTRICITY.

10. MOTOR VEHICLE ENGINES WILL BE SHUT OFF AND BRAKES, SET PRIOR TO UNLOADING. WHEELS WILL BE CHOCKED TO PREVENT FORWARD OR REARWARD MOVEMENT. CHOCKS WILL BE PLACED AT FRONT AND REAR OF WHEEL.

11. THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, WILL BE NOTIFIED OF ANY ABNORMAL CIRCUMSTANCES AND WILL USE HIS/HER JUDGEMENT TO ASSURE THE SAFEST POSSIBLE PROCEDURES ARE USED WHEN HANDLING PROPELLANTS.

12. BURN PANS WILL BE ALLOWED TO COOL FOR A MINIMUM OF TWO HOURS AND WILL HAVE ALL ASH/RESIDUE REMOVED PRIOR TO BEING REUSED. THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, WILL ASSURE BURN PANS HAVE COOLED SUFFICIENTLY PRIOR TO USE.

13. EMPTY CONTAINERS WILL BE MOVED A SUFFICIENT DISTANCE AWAY TO PREVENT CHARRING OR DAMAGE DURING BURNING OF THE EXPLOSIVES. EMPTY CONTAINERS MAY BE PICKED UP BY TRUCK ON THE RETURN TRIP AFTER DELIVERY OF THE NEXT QUANTITY TO BE BURNED. PICK UP POINT MUST BE A MINIMUM OF 100 FEET FROM THE EXPOSED EXPLOSIVES.

14. DIESEL POWERED ROUGH TERRAIN FORKLIFTS HAVE A MAXIMUM LOAD HANDLING CAPACITY OF 6,000 LBS. THIS WEIGHT HANDLING CAPACITY WILL NOT BE EXCEEDED UNDER ANY CONDITIONS.

15. ALL OPERATORS WORKING WITH OR AROUND UNOPENED OR OPEN CONTAINERS OF UNSTABLE PROPELLANT OR OTHERWISE EXPOSED TO UNSTABLE PROPELLANT WILL WEAR FLAME RETARDANT HEAD COVERING, FIRE RETARDANT COVERALLS, COTTON UNDER GARMENTS, KEVLAR GLOVES WORN OVER COTTON POWDER GLOVES, AND SAFETY EYE WEAR AT ALL TIMES. POWDER GLOVES WILL BE CHANGED AT LEAST DAILY. COVERALLS WILL BE PROPERLY WORN WITH ALL BUTTONS PROPERLY FASTENED OR WITH ALL VELCRO TABS CLOSED; AS REQUIRED, USE ALTERNATE METHODS TO ASSURE PPE IS WORN PROPERLY.

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 4**

**OLD BOMB**

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE**

**OPERATION:** Inspect and Unpalletize

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Receive containers of propellant, propellant charges or increments from Operation 3.

2. Inspect for PCP Crystals.

   a. (O) Inspect surfaces of wooden boxes and/or pallets for presence of PCP crystals.

   b. (O) Process PCP crystal contaminated boxes and/or pallets in accordance with SOP HW-0000-A-001.

3. Unpalletize.

   a. (O) Cut and remove strapping, as required. Set aside strapping to a suitable container.

   b. (O)(S) Continuous inspection for special hazards should be performed, (i.e., loose or exposed powder or explosives). If any hazards, not covered in briefings occur, they will be reported to the Old Bomb Supervisor, or a designated representative with demil certification.

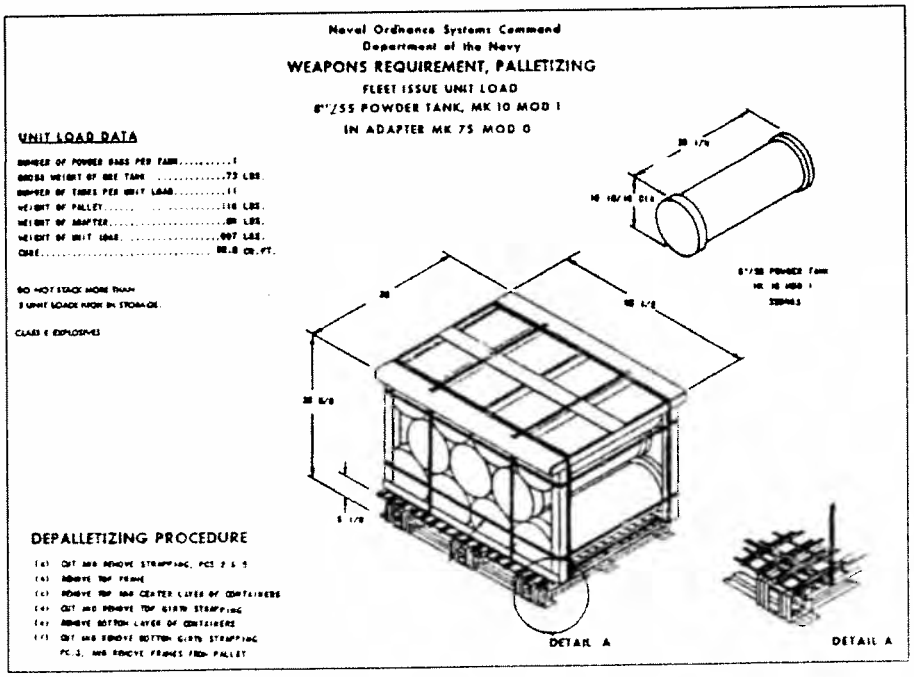



Figure 4-1

c. (O) Remove the container from the pallet manually (two operators required when container weight exceeds 50 pounds) or using a lifting fixture.

d. (O) For bagged charges in the canister type container, refer to the depalletizing procedures in Figures 4-1 and 4-2.

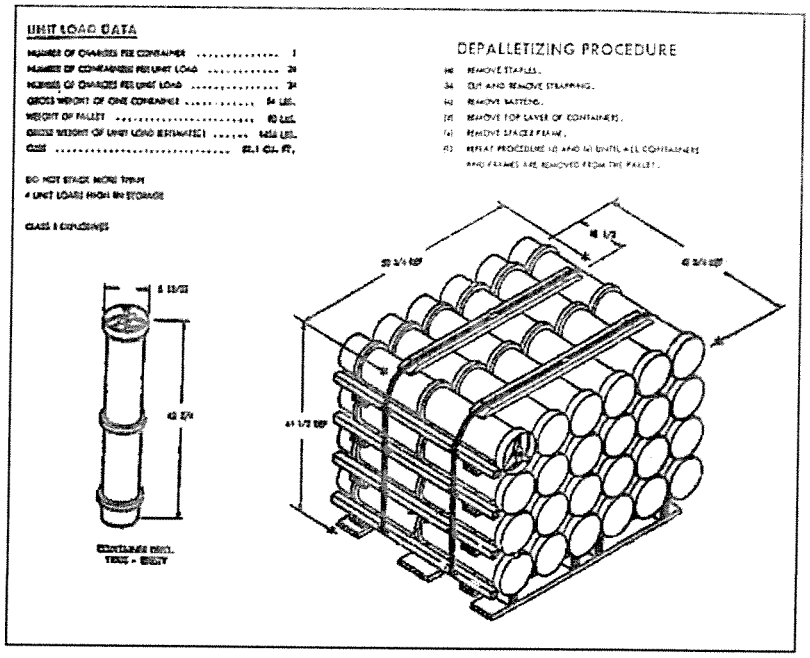



Figure 4-2

4. Unpack.

a. (O) Unpack as directed.

b. (O)(S) Remove and place lead seals into a sealable container, non-lead seals into a suitable container and strapping into a suitable container. Refer to SOP HW-0000-A-001 for processing of seals.

c. (O)(S) The Old Bomb Supervisor, or a designated representative with demil certification, will determine the amount of unpacking required based on any special hazards involved.

d. (O) Remove packing from container and place in a suitable storage container, as required.

5. Place emptied boxes, pallets and other materials on truck via forklift or hand and transfer to material holding area for inspection. These materials may be removed to a location far enough away from the Burn Pan to preclude scorching while burning and relocated after the burn.

6. Transfer:

a. (O) Containers of propellant, propellant charges or increments to Operation 5.

b. (O) Lead Seals to PRO.

c. (O) Non lead seals to the landfill.

## SPECIAL REQUIREMENTS:

1. **SAFETY WILL BE STRESSED AT ALL TIMES. MANY CIRCUMSTANCES MAY BE ENCOUNTERED WITH THE SAME TYPE OF MATERIAL DUE TO AGE AND STORAGE CONDITIONS.**

2. AT NO TIME WILL THE CONTAINERS BE SLID, DROPPED, ROLLED OR TREATED IN SUCH A MANNER THAT WOULD CREATE SHOCK OR STATIC ELECTRICITY.

3. TO PREVENT RAPID TRANSMISSION OF FIRE IN THE EVENT OF A PREMATURE IGNITION, CONTAINERS OF PROPELLANTS, PROPELLANT CHARGES OR INCREMENTS WILL BE SPOTTED AND OPENED AT LEAST TEN FEET FROM EACH OTHER AND FROM OTHER MATERIAL PREVIOUSLY UNPACKED AND PLACED IN A BURN PAN. REFER TO FIGURE 4-3.

4. VEHICLES (FORKLIFTS, ETC.) WILL BE REPOSITIONED TO THE HOLDING AREA AS SOON AS PRACTICAL AFTER UNLOADING, BUT PRIOR TO EXPOSING EXPLOSIVES/ PROPELLANT. REFER TO THE SITE PLAN FOR THIS LOCATION. RELOADING OF EMPTY CONTAINERS WILL BE PERFORMED, AS REQUIRED, AND THE TRUCK DRIVER WILL LOG OUT OF THE AREA AND DEPART PRIOR TO IGNITION OF BURN. CONTAINERS OF PROPELLANT WILL NOT BE OPENED UNTIL THE TRUCKS AND FORKLIFTS HAVE BEEN WITHDRAWN A MINIMUM OF 35 FEET.

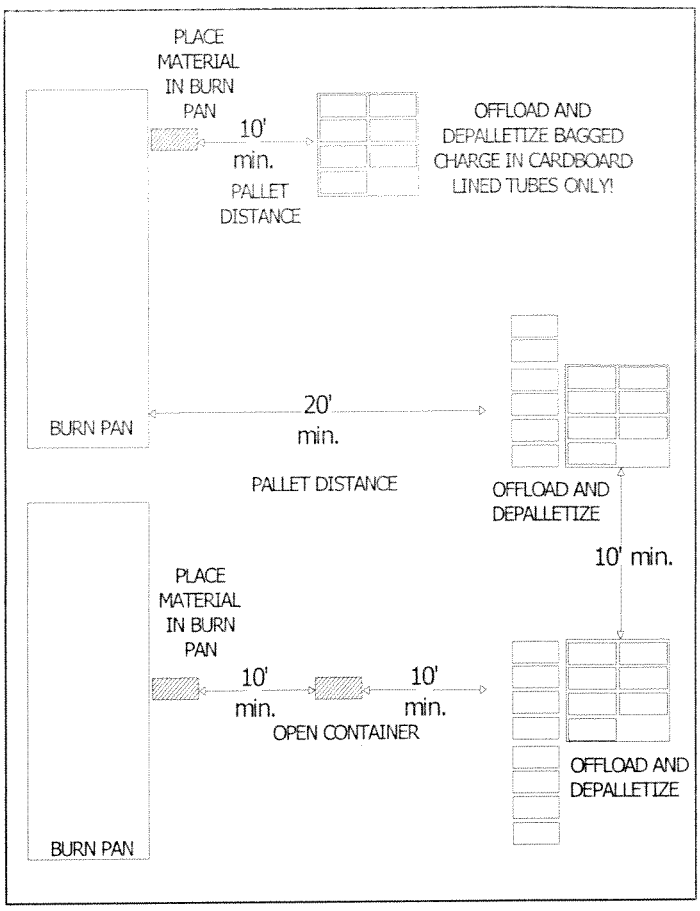



Figure 4-3
Typical Layouts

5. ALL OPERATORS WORKING WITH OR AROUND UNOPENED OR OPEN CONTAINERS OF PROPELLANT, PROPELLANT CHARGES OR INCREMENTS OR OTHERWISE EXPOSED TO UNSTABLE PROPELLANT WILL WEAR FLAME RETARDANT HEAD COVERING, FIRE RETARDANT COVERALLS, COTTON UNDER GARMENTS, LEATHER, LEATHER PALM, OR KEVLAR GLOVES WORN OVER COTTON POWDER GLOVES, AND SAFETY EYE WEAR AT ALL TIMES. POWDER GLOVES WILL BE CHANGED AT LEAST DAILY. COVERALLS WILL BE PROPERLY WORN WITH ALL OF THE BUTTONS PROPERLY FASTENED OR WITH ALL VELCRO TABS CLOSED; AS REQUIRED, USE ALTERNATE METHODS TO ASSURE PPE IS WORN PROPERLY.

6. ALL OPERATORS WORKING WITH BANDING STEEL WILL WEAR SAFETY GLASSES WITH SIDE SHIELDS, FACE SHIELDS AND LEATHER PALM GLOVES.

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 5**

**OLD BOMB**

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE**

**OPERATION:** Prepare for Burning

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Receive containers of propellant, propellant charges or increments from Operations 4 and 11.

2. Clear and Secure Burning Grounds.

   a. (O)(QC)(S) The Old Bomb Supervisor, or a designated representative with demil certification, will assure that unauthorized and non-essential personnel are cleared from the burning grounds.

**The Old Bomb Supervisor, or a designated representative with demil certification, will maintain the gate key. The gate (Number 130) will remain open from the time the crew arrives through the completion of operations for the day. Emergency personnel will not enter the burning grounds without permission from the Old Bomb Supervisor, or a designated representative with demil certification.**

3. Place Bulk Propellant in Burn Pan. Refer to Figure 5-1.

**The Old Bomb Supervisor, or a designated representative with demil certification, will determine the amount of propellant to be unpacked, based on the special hazards involved.**

   a. (O)(S) Coordinate operations with MCPO Range Supervisor and SOC LLC Range Operations.

   b. (O)(S) Attach a ground between container and the burn pan whenever possible. Both operators will attach their wrist stats to the ground strap adjacent to the container, assuring wrist stat is on bare skin.

c. (O) Open the container and pour propellant into the burn pan. Material will be laid in a bed in the burn pan not more than three inches deep.

d. (O) A beryllium, rubber, aluminum, or wood rake may be used to spread material.

e. (O) When using the MK7 packing box, the following procedure will be followed:

(1.) The packing boxes may be transported from the pallet to the burn pan via hand truck.

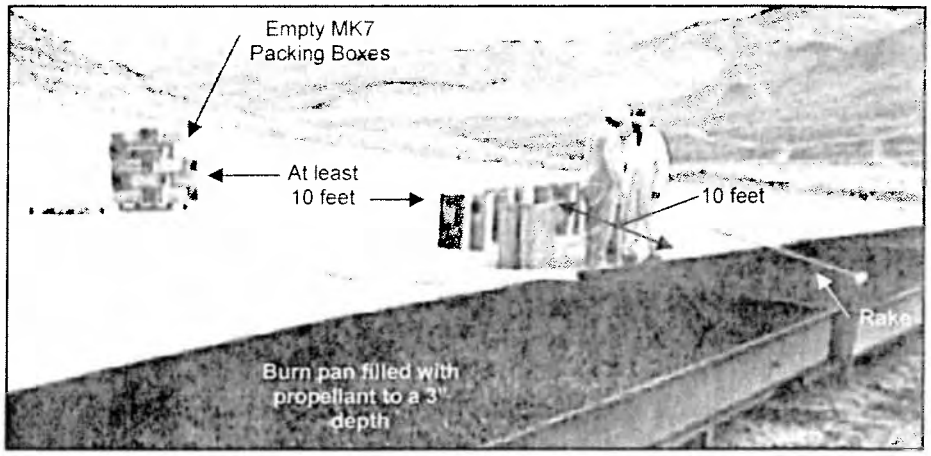



Figure 5-1

(2.) Tilt the MK7 packing box against the edge of the burn pan and dump propellant by lifting the opposite corner of the can. One operator may perform this step.

(3.) Once the weight is reduced to within working limits (50 lbs.) for one operator, lift the MK7 packing box and pour the remaining propellant into the burn pan.

4. Place Bag Charges in Burn Pan.

a. (O)(S) Attach a ground strap between the container and the burn pan. Operator(s) will attach their wrist stats to the ground strap adjacent to the container.

b. (O)(S) Remove the lid from the container and place it in a suitable container. This will take place at a distance of at least ten feet from pallet, and other material previously unpacked. Refer to Figure 5-2.

c. (O)(QC)(S) If the items being unpacked are bagged charges in cardboard lined tubes, the pallet of charges may be placed a minimum of ten feet from the burn pan, have a ground attached and, while opening only one tank at a time, have the charge removed and placed into the burn pan. Assure the operator is grounded prior to performing this operation. Refer to Figure 5-2.

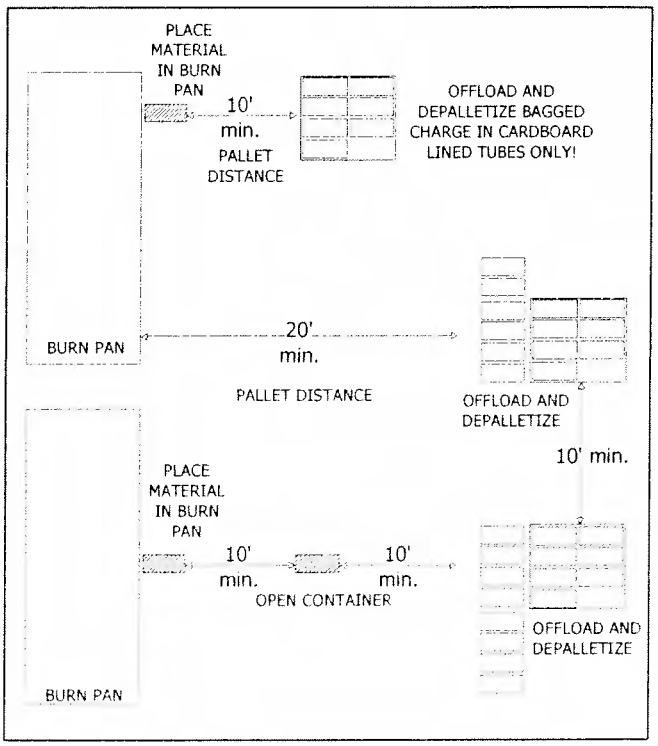



Figure 5-2
Typical Layouts

d. (O)(S) One operator will place the container, open end down, into the burn pan and tilt the container to an upright position, lifting the container from the charge.

e. (O)(S) When the container is clear, place the charge on its side in the burn pan. Remove any cardboard that may have come loose while removing the charge.

f. (O) Split the bag and level the powder in the burn pan, leaving the bags on the bottom of the burn pan. Material will be layered in a bed in the burn pan no more than three inches deep.

g. (O)(S) Operator(s) will take care not to step on hazardous material when loading the burn pans. Propellant spilled/dropped on the ground will be picked up immediately and placed in burn pan.

5. Place Propellant Increments in Burn Pan.

a. (O)(S) Operators will be adequately grounded while handling increments.

b. (O)(S) The lid removal will take place at a distance of at least ten feet from pallet and from other material previously unpacked.

c. (O) Remove the propellant container from the box. The operator will open the propellant container and place the increments in the burn pan. The increments will be laid in a bed in the burn pan not more than three inches deep.

6. Move Empty Propellant Containers.

a. (O)(S) Check containers to assure they are empty.

(1.) Containers that will not be taken to storage for reuse at any production or demil facility will have the lids removed and be left open, with the lids and containers unitized separately.

(2.) Empty powder cans that will be taken to storage for reuse at any production or demil facility will be inspected and have the lids replaced. Empty powder cans do not need to be stamped inside and outside.

b. (O) After all propellant has been placed in burn pan, a rough terrain forklift will be used to move containers and dunnage to material handling area. These materials may be moved to a location far enough away from the burn pan to preclude scorching while burning, and then relocated after the burn.

7. Complete the weather portion of Weather Data Statistics - Open Burn Form.

**SPECIAL REQUIREMENTS:**

**1. VOLATILE FLAMMABLE LIQUID WILL NOT BE USED TO START OR FACILITATE BURNING.**

2. ALL OPERATORS WORKING WITH OR AROUND UNOPENED OR OPEN CONTAINERS OF PROPELLANT, OR OTHERWISE EXPOSED TO UNSTABLE PROPELLANT, WILL WEAR FLAME RETARDANT HEAD COVERING, FIRE RETARDANT COVERALLS, COTTON UNDER GARMENTS, LEATHER, LEATHER PALM, OR KEVLAR GLOVES WORN OVER COTTON POWDER GLOVES, AND SAFETY EYE WEAR AT ALL TIMES. POWDER GLOVES WILL BE CHANGED AT LEAST DAILY. COVERALLS WILL BE PROPERLY WORN WITH ALL OF THE BUTTONS PROPERLY FASTENED OR WITH ALL VELCRO TABS CLOSED; AS REQUIRED, USE ALTERNATE METHODS TO ASSURE PPE IS WORN PROPERLY.

3. AT NO TIME WILL MATERIAL BE SLID, DROPPED, ROLLED OR TREATED IN SUCH A MANNER THAT WOULD CREATE SHOCK OR STATIC ELECTRICITY.

4. TO PREVENT RAPID TRANSMISSION OF FIRE IN THE EVENT OF A PREMATURE IGNITION, CONTAINERS OF PROPELLANTS WILL BE SPOTTED AND OPENED AT LEAST 10 FEET FROM EACH OTHER AND FROM OTHER MATERIAL PREVIOUSLY UNPACKED AND PLACED IN BURN PAN. REFER TO FIGURE 5-2.

5. ASSURE GROUND STRAP IS CONNECTED FROM BURN PAN TO POWDER CONTAINER DURING POURING OF POWDER INTO BURN PAN OR WHEN PLACING BAG CHARGES INTO THE BURN PAN. WRIST STATS MUST BE SECURELY ATTACHED TO THE GROUND STRAP IN BOTH INSTANCES.

6. HIGH ETHER CONCENTRATIONS MAY BE PRESENT IN POWDER CANS. IF ETHER VAPORS ARE DETECTED, EXTRA CAUTION WILL BE EXERCISED. AVOID ANY ACTION THAT MAY PRODUCE SPARKS AND ASSURE GROUNDING CONNECTIONS ARE SECURE.

7. PANS MUST BE CLEANED OF ALL LOOSE MATERIAL PRIOR TO EACH USE. BURNING WILL NOT BE REPEATED ON PREVIOUSLY USED PANS UNTIL THEY HAVE COOLED A MINIMUM OF TWO HOURS AND ALL ASH/RESIDUE HAS BEEN REMOVED FROM PANS. PRIOR TO START OF BURNING OPERATIONS, THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, WILL INSPECT THE BURNING AREA AND PANS TO ASSURE THE SAFETY OF PERSONNEL DURING SUBSEQUENT BURNING OPERATIONS. NOTE THAT BURNING IS LIMITED TO 20,000 POUNDS NEW PER DAY.

8. ALL EQUIPMENT WILL BE MOVED TO A MINIMUM OF 35 FEET FROM THE MATERIAL BEFORE OPENING CONTAINERS AND/OR PLACING MATERIAL IN THE BURN PANS.

9. SAFETY WILL BE STRESSED AT ALL TIMES. MANY CIRCUMSTANCES MAY BE ENCOUNTERED WITH THE SAME TYPE OF MATERIAL DUE TO AGE AND STORAGE CONDITIONS.

10. WHEN MOVING A CONTAINER WEIGHING MORE THAN 50 POUNDS, TWO OPERATORS OR A HAND TRUCK WILL BE USED TO HANDLE CONTAINER. A SINGLE OPERATOR MAY TILT A CONTAINER ON THE BURN PAN LIP UNTIL AN ADEQUATE AMOUNT OF PROPELLANT FLOWS INTO THE PAN, THEREBY DECREASING THE WEIGHT TO AN ACCEPTABLE LEVEL FOR ONE OPERATOR TO POUR OUT THE REMAINING PROPELLANT.

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 6**

**OLD BOMB**

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE 1**

**OPERATION:** Set Up Initiation System

**EXPLOSIVE LIMITS:** See Table 1
**PERSONNEL LIMITS:** **OPERATORS – 2 TRANSIENTS - 0**

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Receive safety fuse, fuse lighters, and if applicable, smokeless powder from Operation 3.

2. One hour before burning, notify the Production Planner of approximate time of burning.

3. Clear Burning Grounds.

   a. (O)(QC) Assure the red flags are properly displayed and the entrance gate is guarded/watched so no unauthorized personnel will enter.

   b. (O)(S) The Old Bomb Supervisor, or a designated representative with demil certification, will coordinate operations with MCPO Range Supervisor and SOC LLC Range Operations.

   c. (O)(QC)(S) The Old Bomb Supervisor, or a designated representative with demil certification, will assure that unauthorized and non-essential personnel are cleared from the burning grounds.

      (1.) All personnel will return to the personnel shelter.

      (2.) The Old Bomb Supervisor, or a designated representative with demil certification, will conduct a roll call, accounting for all personnel, utilizing the sign in/sign out logbook.

      (3.) Upon completion of the roll call (accounting for all personnel), the Old Bomb Supervisor, or a designated representative with demil certification, will assign Munitions Destroyers (two qualified operators) to their designated locations.

   d. (O) The Old Bomb Supervisor, or a designated representative with demil certification, will complete the forms listed in Operation 1, (i.e., Disposal Area Checklist, Meteorological Weather Station Inspection Checklist, and Old Bomb Contemporaneous Log, Weather Data Statistics – Open Burn).

4. Test Safety Fuse.

   a. (S) At the beginning of the day's operations and whenever a new coil of safety fuse is used, the safety fuse's burning time will be tested IAW the Manufacturer's recommendations.

   b. (S) Test burning of the fuse will be performed downwind at a minimum distance of 50 feet from any hazardous materials.

   c. (O)(QC) Using a non-sparking knife or cap crimper, cut six inches from the free end of the fuse. Assure the fuse is cut squarely. A slanted cut is more likely to cause a failure to ignite the fuse. Place the trimmed fuse in the burn pan for burning.

   d. (O) Insert the fuse in the open end of the fuse lighter tube, pushing it in slowly and carefully, until it stops.

   e. (O) Remove the safety clip.

   f. (O)(S) Hold the lighter tightly in one hand and, with the other hand, give a firm pull on the white safety cap.

5. Prepare Safety Fuse.

   a. (O) Cut the required length of safety fuse for dual priming IAW Step 4c.

   b. (O)(S) The safety fuse will be cut to provide sufficient time between ignitions for an accurate count of the burns to be made.

   c. (S) The safety fuse will be cut long enough for personnel to retire to a safe distance. Under no circumstances will the fuse length be less than that required for a seven minute burn time.

   d. (O) Cut the required amount of fuse (two for each burn) as established by Step 4.

   e. (O) When required, place small grain smokeless powder donor charge into a plastic bag or use 81MM mortar increments or 105mm propellant bag (refer to Figures 6-1 and 6-2). Slit the end of the safety fuse, approximately three inches or notch with five notches (refer to Figure 6-3). Attach bag to safety fuse. Add additional smokeless powder donor material, as required. The split end (sufficient length to assure ignition) of the safety fuse may be inserted into the smokeless powder donor charge (refer to Figure 6-4).

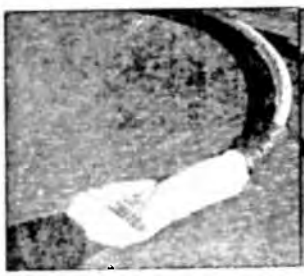


Figure 6-1

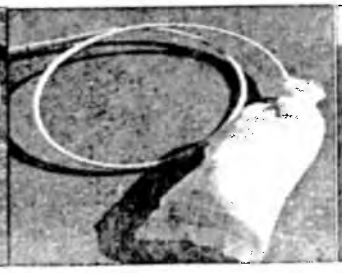


Figure 6-2

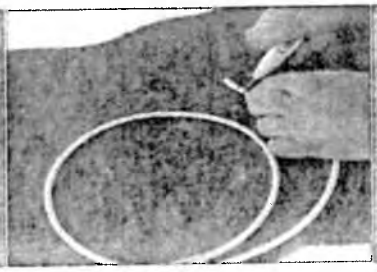


Figure 6-3

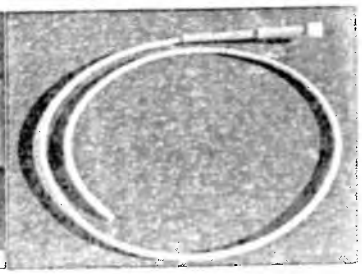


Figure 6-4

6. Prime Burn Pans.

   a. (O)(S) The operator will be grounded to the metal pan with a wrist stat during placement of the ignition systems.

   b. (O) Carry the ignition systems to the burn pan. Position two ignition systems in each pan. The ignition train must be placed in the pan upwind. The Old Bomb Supervisor, or a designated representative with demil certification, will supervise the preparation.

SPECIAL REQUIREMENTS:

1. ONLY TWO PERSONNEL WILL PREPARE THE INITIATION SYSTEM.

2. THE PREPARATION OF INITIATING DEVICES WILL NOT BE PERFORMED IN ADVANCE OF REQUIREMENTS. PREPARED DEVICES, IF NOT USED, WILL BE EXPENDED. THEY WILL NOT BE RETURNED TO THE STORAGE LOCATIONS.

3. A TEST BURN OF THE SAFETY FUSE WILL BE PERFORMED ON EACH NEW ROLL OR EACH DAY PRIOR TO USE.

4. TEST BURNING OF THE SAFETY FUSE WILL BE PERFORMED, DOWNWIND, AT A MINIMUM DISTANCE OF 50 FEET FROM THE OTHER EXPLOSIVES.

5. USE CUTTING JAW OF THE CAP CRIMPER (M2) OR A NON-SPARKING KNIFE TO CUT THE SAFETY FUSE. CUT THE SAFETY FUSE SQUARELY ACROSS THE END TO HAVE THE FUSE LIGHTER INSTALLED.

6. WHEN THE PANS ARE READY FOR PRIMING, THE IGNITION SYSTEM WILL BE TRANSPORTED TO THE BURN PAN AREA.

   A. THE IGNITION SYSTEM MUST BE IN A CLOSED CONTAINER WHEN BEING TRANSPORTED BY VEHICLES.

   B. VEHICLES CARRYING EXPLOSIVES WILL BE INSPECTED, USING A DD FORM 626, MOTOR VEHICLE INSPECTION FORM.

7. THE SAFETY FUSE WILL BE UNCOILED AND LAID OUT IN A STRAIGHT LINE. A HEAVY OBJECT, E.G., STONE, WILL BE PLACED SO THAT THE FUSE WILL NOT CURL UP AND CAUSE PREMATURE IGNITION.

8. ALL OPERATORS WORKING WITH OR AROUND UNOPENED OR OPEN CONTAINERS OF PROPELLANT, PROPELLANT CHARGES, OR INCREMENTS OR OTHERWISE EXPOSED TO UNSTABLE PROPELLANT WILL WEAR FLAME RETARDANT HEAD COVERING, FIRE RETARDANT COVERALLS, COTTON UNDER GARMENTS, LEATHER, LEATHER PALM, OR KEVLAR GLOVES WORN OVER COTTON POWDER GLOVES, AND SAFETY EYE WEAR AT ALL TIMES. POWDER GLOVES WILL BE CHANGED AT LEAST DAILY. COVERALLS WILL BE PROPERLY WORN WITH ALL OF THE BUTTONS PROPERLY FASTENED OR WITH ALL VELCRO TABS CLOSED; AS REQUIRED, USE ALTERNATE METHODS TO ASSURE PPE IS WORN PROPERLY.

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 7**

**OLD BOMB**

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE 1**

**OPERATION:** Initiate Burn Pans

**EXPLOSIVE LIMITS:** See Table 1
**PERSONNEL LIMITS:** **OPERATORS – 2 TRANSIENTS – 1 (QASAS)**

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Initiate the Burn.

   a. (O) The Old Bomb Supervisor, or a designated representative with demil certification, and/or a designated Munitions Destroyer will initiate the system after being assured that all other requirements are met (i.e., meteorological, coordination with MCPO and SOC LLC Range Operations has occurred, and personnel are removed to a safe distance and protected by cover as in the personnel shelter).

   b. (O) Park the escape vehicle 75 feet from the burn pans. Assure vehicle is facing the direction of the escape route.

   c. (O) Walk to the pan furthest from the truck to begin initiating the burns IAW Step 1d.

   d. (O) To fire the lighter assembly, remove the safety clip. In one hand, tightly hold the lighter in the center. Give a firm pull on the white safety cap. A leather/leather palm glove will be worn on the hand holding the lighter to avoid a potential flash from the lighter. Safety glasses with side shields will also be worn when handling the lighter.

   e. (O) Repeat Step 1d until all charges have been initiated. Once the last charge is set, proceed to the personnel shelter.

   f. (O) Two personnel will be assigned to count the burn starts. They will be a minimum distance of 650 feet from the burn site.

SPECIAL REQUIREMENTS:

1. INITIATION OF BURN PANS WILL START AT THE PAN MOST DISTANT FROM THE PERSONNEL SHELTER (OLD BOMB OFFICE) AFTER THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, HAS CHECKED THAT ALL BURN PANS HAVE BEEN PRIMED AND THE BURNING GROUND IS CLEAR.

2. NOTIFY PERSONNEL AT OLD BOMB OFFICE OF ANY UNUSUAL SITUATION ENCOUNTERED DURING THE INITIATING PROCESS VIA A HAND HELD RADIO.

3. TO FIRE THE LIGHTER ASSEMBLY, REMOVE THE SAFETY CLIP. TIGHTLY HOLD THE LIGHTER IN THE CENTER, IN ONE HAND. GIVE A FIRM PULL ON THE WHITE SAFETY CAP. A LEATHER/LEATHER PALM GLOVE WILL BE WORN ON THE HAND HOLDING THE LIGHTER TO AVOID A POTENTIAL FLASH FROM THE LIGHTER. SAFETY GLASSES WITH SIDE SHIELDS WILL ALSO BE WORN WHEN HANDLING THE LIGHTER.

4. IF THE FIRST FUSE LIGHTER FAILS, GO TO THE SECOND AND IGNITE. IF THE SECOND FUSE LIGHTER FAILS, REPLACE WITH SPARE FUSE LIGHTER AND IGNITE. IF THE SPARE FUSE LIGHTER FAILS TO IGNITE, DO NOT REPLACE. GO TO THE NEXT BURN PAN.

5. TWO PERSONNEL WILL BE TASKED TO COUNT THE NUMBER OF BURNS FROM A DISTANCE BEYOND 650 FEET OF THE BURN PANS. REFER TO THE SITE PLAN FOR VIEWING AREAS.

6. VOLATILE FLAMMABLE LIQUID WILL NOT BE USED TO START OR FACILITATE BURNING.

7. ALL OPERATORS WORKING WITH OR AROUND UNOPENED OR OPEN CONTAINERS OF PROPELLANT OR OTHERWISE EXPOSED TO UNSTABLE PROPELLANT WILL WEAR FLAME RETARDANT HEAD COVERING, FIRE RETARDANT COVERALLS, COTTON UNDER GARMENTS, LEATHER, LEATHER PALM, OR KEVLAR GLOVES WORN OVER COTTON POWDER GLOVES, AND SAFETY EYE WEAR AT ALL TIMES. POWDER GLOVES WILL BE CHANGED AT LEAST DAILY. COVERALLS WILL BE PROPERLY WORN WITH ALL OF THE BUTTONS PROPERLY FASTENED OR WITH ALL VELCRO TABS CLOSED; AS REQUIRED, USE ALTERNATE METHODS TO ASSURE PPE IS WORN PROPERLY.

8. ASSURE THE ESCAPE VEHICLE IS FACING THE DIRECTION OF THE ESCAPE ROUTE PRIOR TO THE INITIATION OF THE BURNS. IF THE ESCAPE VEHICLE SHOULD STALL AND CANNOT BE RESTARTED, THE SENIOR MUNITIONS DESTROYER WILL USE HIS DISCRETION TO DETERMINE WHETHER TO REMAIN IN THE STALLED VEHICLE.

**STANDING OPERATING PROCEDURE:** Propellant; Demilitarization by Open Burning

**OPERATION 8**

OLD BOMB

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE**

**OPERATION:** Misfires

**EXPLOSIVE LIMITS:** See Table 1

**PERSONNEL LIMITS:** **OPERATORS – 2 TRANSIENTS - 0**

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Waiting Period.

   a. (O)(S) After it has been determined by the two personnel tasked to count the burns that a misfire has occurred, the Old Bomb Supervisor, or a designated representative with demil certification, will be notified.

   b. (O)(S) Wait a minimum of one hour after the expected burn completion before investigating the misfire. The Old Bomb Supervisor, or a designated representative with demil certification, may extend the waiting interval, as required.

2. Investigation.

   a. (S) Only the Old Bomb Supervisor, or a designated representative with demil certification, and one Munitions Destroyer will investigate. All other personnel will remain in the personnel shelter. The Munitions Destroyer will only approach close enough to the misfire to keep the Old Bomb Supervisor, or a designated representative with demil certification, or a designated representative under observation while the Old Bomb Supervisor, or a designated representative with demil certification, or a designated representative checks the misfire.

   b. (O) Upon reaching the misfired burn; visually check the fuse lighter. If the fuse lighter failed to function, remove the safety fuse and cut off ¼ to ½ inch of the safety fuse. This will provide a fresh safety fuse end to attach a new fuse lighter. Attach a new fuse lighter and perform steps IAW Operation 7.

   c. (O) If the fuse lighter has functioned and failed to initiate the safety fuse, attach a new dual firing system, as stated in Operation 6 and perform IAW Operation 7.

d. (O) If the fuse lighter has functioned and initiated the safety fuse, inspect the burn pan area for evidence of a partial burn. If this is the case, refer to Operation 10.

SPECIAL REQUIREMENTS:

1. IF A PARTIAL BURN IS SUSPECTED, THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, MAY EXTEND THE WAITING TIME. EXTRA CAUTION SHOULD BE EXERCISED WHEN APPROACHING THE BURN PAN.

2. THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, AND ONE MUNITIONS DESTROYER WILL INVESTIGATE MISFIRE. ALL OTHER PERSONNEL WILL REMAIN IN THE PERSONNEL SHELTER. THE MUNITIONS DESTROYER WILL ONLY APPROACH CLOSE ENOUGH TO THE MISFIRE TO KEEP THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, UNDER OBSERVATION WHILE THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, CHECKS THE MISFIRE/PARTIAL BURN.

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 9**

OLD BOMB

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE**

**OPERATION:** Inspect Burn Area

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Investigation and Inspection.

   a. (O) Personnel will remain in the safety shelter until all scheduled burns have occurred and authorized or directed by the Old Bomb Supervisor, or a designated representative with demil certification. This will be determined by two personnel tasked to count the number of burns.

   b. (O)(S) If a partial burn is suspected, perform steps IAW Operation 10.

   c. (O)(S) After all burns have been counted and the area has been swept, the Old Bomb Supervisor, or a designated representative with demil certification, and one Munitions Destroyer will inspect each pan for any hazards (i.e., smoldering embers or explosives).

   d. (O) When the Old Bomb Supervisor, or a designated representative with demil certification, is satisfied that there are no undue hazards, all personnel may be called up to inspect the area around the burn pans for propellant kicked out during the burn. If propellant is found, personnel will wait one hour and the propellant will be burned the same day if possible. If it is not possible to burn the same day, propellant will be burned the following burn day.

2. Using a forklift, replace burn pan covers, as required.

**SPECIAL REQUIREMENTS:**

1. **IF A FIRE IS OBSERVED, CONTACT EXT. 7911 TO ASSURE FIRE DEPARTMENT HAS BRUSH TRUCK REMAIN ON STANDBY TO ASSIST IF NECESSARY.**

2. **EXTINGUISH ALL FIRES THAT HAVE STARTED. ASSURE THEY ARE COMPLETELY OUT. FIRES IN THE OUTER AREA WILL BE EXTINGUISHED FIRST.**

3. A FIRE WATCH WILL BE MAINTAINED UNTIL ALL FIRES HAVE BEEN EXTINGUISHED AND/OR COMPLETELY BURNED OUT.

4. ALL OPERATORS WORKING WITH OR AROUND UNOPENED OR OPENED CONTAINERS OF UNSTABLE PROPELLANT OR OTHERWISE EXPOSED UNSTABLE PROPELLANT WILL WEAR FLAME RETARDANT HEAD COVERING, FIRE RETARDANT COVERALLS, COTTON UNDER GARMENTS, LEATHER, LEATHER PALM, OR KEVLAR GLOVES WORN OVER COTTON POWDER GLOVES, AND SAFETY EYE WEAR AT ALL TIMES. POWDER GLOVES WILL BE CHANGED AT LEAST DAILY. COVERALLS WILL BE PROPERLY WORN WITH ALL OF THE BUTTONS PROPERLY FASTENED OR WITH ALL VELCRO TABS CLOSED; AS REQUIRED, USE ALTERNATE METHODS TO ASSURE PPE IS WORN PROPERLY.

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 10**

**OLD BOMB**

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE 1**

**OPERATION:** Partial Burns

**EXPLOSIVE LIMITS:** See Table 1
**PERSONNEL LIMITS:** **OPERATORS – 2 TRANSIENTS – 0**

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Waiting Period.

   a. (O)(S) After it has been determined by the two personnel tasked to count the burns that a partial burn has occurred, the Old Bomb Supervisor, or a designated representative with demil certification, will be notified.

   b. (O)(S) Wait a minimum of one hour after the expected burn completion before investigating the partial burn. The Old Bomb Supervisor, or a designated representative with demil certification, may extend the waiting interval, as required.

2. Investigation.

   a. (S) Only the Old Bomb Supervisor, or a designated representative with demil certification, and one Munitions Destroyer will investigate. All other personnel will remain in the personnel shelter. The Munitions Destroyer will only approach close enough to the partial burn to keep the Old Bomb Supervisor, or a designated representative with demil certification, under observation while that person checks the partial burn.

   b. (O) The Old Bomb Supervisor, or a designated representative with demil certification, will inspect and determine when the operation is safe enough to re-prime and re-initiate the propellant IAW Operations 6 and 7.

SPECIAL REQUIREMENTS:

1. IF A PARTIAL BURN IS SUSPECTED, CONTACT EMS TO BE ON STAND-BY AT OLD BOMB BEFORE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, APPROACHES BURN PAN FOR INSPECTION.

2. IF A PARTIAL BURN IS SUSPECTED, THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, MAY EXTEND THE WAITING TIME. EXTRA CAUTION SHOULD BE EXERCISED WHEN APPROACHING THE BURN PAN.

3. THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, AND ONE MUNITIONS DESTROYER WILL INVESTIGATE PARTIAL BURN. ALL OTHER PERSONNEL WILL REMAIN IN THE PERSONNEL SHELTER. THE MUNITIONS DESTROYER WILL ONLY APPROACH CLOSE ENOUGH TO THE MISFIRE TO KEEP THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, UNDER OBSERVATION WHILE THAT PERSON CHECKS THE MISFIRE/PARTIAL BURN.

4. BRUSH FIRES IN THE OUTER AREAS WILL BE EXTINGUISHED FIRST. THE OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, WILL DETERMINE IF FIRES ARE SAFE TO FIGHT.

5. A FIRE WATCH WILL BE MAINTAINED UNTIL ALL FIRES ARE COMPLETELY OUT.

6. THE FIRE DEPARTMENT (EXT. 7107), SECURITY OFFICE (EXT. 7601 CELL 945-0415), THE HEAD OF MCPO (EXT. 7871 CELL 760-822-8774), AND SOC LLC RANGE OPERATIONS (EXT. 7482, 7488 OR 7495) WILL BE NOTIFIED OF EXTENDED OR OVERNIGHT DELAYS.

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 11**

**OLD BOMB**

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE**

**OPERATION:** Dispose of Packing Materials

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Inspect Containers.

   a. (O) Open all containers.

      (1.) Containers with removable lids will have the lids removed and unitized separately. Where applicable, inner packs will be removed from outer packs and unitized separately.

      (2.) Empty powder cans that will be taken to storage for reuse at any production or demil facility will be inspected and have the lids replaced.

   b. (O)(S) Inspect the wood boxes and pallets for presence of PCP IAW SOP HW-0000-A-001. Separate PCP treated wood from non-PCP treated wood and set aside PCP treated wood for transfer to the landfill after processing IAW SOP HW-0000-A-001.

2. Certify/Inspect Empty Containers.

   a. (O)(QC) Inspect containers 100 percent for any propellant. If found, set aside for processing in Operation 5.

   b. (O)(QC)(S) Containers will be certified as free of items of a dangerous nature IAW SOP HW-0000-A-001, prior to transfer to PRO or inert storage. Empty powder cans that will be taken to storage for reuse at any production or demil facility will be inspected, but do not need to be stamped inside and outside.

   c. (O)(QC)(S) Containers with explosive residue will be segregated and unitized separately from those that are free of items of a dangerous nature.

3. Unitize certified/inspected material IAW SOP HW-0000-A-001 and apply steel strapping to the unitized load.

4. Prepare placard and affix to palletized load. EXAMPLE:

   NSN
   (QTY) TANKS/CONTAINER MK___ Mod ___
   EMPTY

5. Containerize Ash Residue.

   a. (O) Place ash residue in sealable container.

   b. (O) Mark container of ash with ½" high letters, using black stencil ink. EXAMPLE:

      ASH, PROPELLANT
      DERIVED FROM
      BURNING OPERATIONS

   c. (O) Notify SOC LLC Environmental Services when container is full and ready for transfer.

6. Palletize Ash Residue, as Required.

   a. (O) Secure ash barrel to pallet with ¾" steel strapping.

   b. (O) Set aside palletized containers for removal from area.

7. Transfer items.

   a. (O) Serviceable pallets, boxes, containers, and/or lids to storage or as directed by Production Planner.

   b. (O) Unserviceable non-PCP treated boxes and/or pallets to PRO or landfill.

   c. (O) Unserviceable PCP treated boxes and/or pallets to the treated wood landfill.

   d. (O) Lead wire seals to PRO.

   e. (O) Non lead seals to landfill.

   f. (O) Containers with residue to hazardous waste storage for processing by Environmental Services.

SPECIAL REQUIREMENTS:

1. AN ATR WILL BE USED FOR REPORTING THE TRANSFER OF ITEMS FROM DEMIL OPERATIONS TO STORAGE AND A 1348-1A WILL BE USE FOR THE TRANSFER OF MATERIALS TO PRO AND THE LANDFILL.

2. WHEN EMPLOYEES ARE REQUIRED TO OPEN A CONTAINER TO CHECK ITS CONTENTS OR CONTAINERIZE ASH RESIDUE, A HALF-FACE RESPIRATOR WITH A HEPA FILTER WILL BE WORN. IN ADDITION, OPERATORS WILL WEAR FLAME RETARDANT HEAD COVERING, FIRE RETARDANT COVERALLS, COTTON UNDER GARMENTS, LEATHER, LEATHER PALM, OR KEVLAR GLOVES WORN OVER COTTON POWDER GLOVES, AND SAFETY EYE WEAR.

3. SERVICEABLE PACKING MATERIAL WILL BE PACKAGED IAW SOP HW-0000-A-001.

4. MK7 PACKING BOXES WILL BE PLACED ON THE PALLETS WITH THE OPEN ENDS FACING OUTWARD IN TWO OPPOSITE DIRECTIONS AND HAVE STRAPPING STEEL APPLIED TO THE PALLETIZED LOAD.

5. PCP TREATED WOOD PRODUCTS WILL BE PROCESSED IAW SOP HW-0000-A-001.

6. WASTE CONTAINERS MUST BE GOOD QUALITY DRUMS WITH TIGHT SEALS ON COVER.

7. ALL CONTAINERS, LIDS AND PACKING MATERIAL DESTINED FOR INERT STORAGE, LANDFILL, OR PRO REQUIRE A 100% VISUAL INSPECTION TO ASSURE THE ABSENCE OF DANGEROUS MATERIAL.

8. ALL OPERATORS WORKING WITH BANDING STEEL WILL WEAR SAFETY GLASSES WITH SIDE SHIELDS, FACE SHIELDS AND LEATHER PALM/KEVLAR GLOVES.

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 12**

**OLD BOMB**

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE 1**

**OPERATION:** Clean Burning Grounds Area

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Perform Daily:

   a. (O)(QC) Check all burning ground areas around burn pans for propellant and/or hazardous material. Retrieved material will be placed in suitable explosive waste container. Set aside for next scheduled burn.

   b. (O) Make appropriate entries in Old Bomb Contemporaneous Log.

   c. (O) As required, return unused ignition systems to storage.

   d. (O) Perform housekeeping in and around vicinity of Old Bomb buildings (i.e., break room and personnel shelters).

   e. (O) Groom road network, pans and area around pans, as necessary. Ash/debris/soil retrieved from around the pans will be placed in separate containers and marked as such for Environmental testing.

   f. (O) Place covers on the burn pans, as required.

2. Perform Weekly.

   a. (O) Remove all dry grass, leaves and other extraneous combustible materials around the burn pans for a 200-foot radius (within the bermed area).

**SPECIAL REQUIREMENTS:**

1. **OLD BOMB SUPERVISOR, OR A DESIGNATED REPRESENTATIVE WITH DEMIL CERTIFICATION, MUST SUPERVISE THIS CLEAN-UP OPERATION. PERSONNEL WILL BE BRIEFED ON THE HAZARDS AND APPROPRIATE PROCEDURES.**

2. ALL SHIPPING CONTAINERS FROM DEMILITARIZATION OPERATIONS DESTINED FOR INERT STORAGE, THE LANDFILL OR PRO WILL BE 100% VISUALLY INSPECTED TO ASSURE THE ABSENCE OF DANGEROUS MATERIAL.

3. WHEN OPERATORS ARE REQUIRED TO PERFORM CLEAN-UP WORK INVOLVING PROPELLANT ASH RESIDUE, THEY WILL WEAR A HALF-FACE TYPE RESPIRATOR WITH A HEPA FILTER. IN ADDITION, OPERATORS WILL WEAR FLAME RETARDANT HEAD COVERING, FIRE RETARDANT COVERALLS, COTTON UNDER GARMENTS, KEVLAR GLOVES WORN OVER COTTON POWDER GLOVES, AND SAFETY EYE WEAR.

**STANDING OPERATING PROCEDURE:**
Propellant; Demilitarization by Open Burning

**OPERATION 13**

**OLD BOMB**

**SOP:** HW-0000-H-006

**REVISION**

**CHANGE**

**OPERATION: Close Burning Grounds**

**EXPLOSIVE/PERSONNEL LIMITS: N/A**

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Daily Close of Burning Grounds:

   a. (O)(QC) Assure cleanup operation has been performed.

   b. (O) Remove flags and secure after coordinating with the MCPO Range Supervisor and SOC LLC Range Operations.

   c. (O)(QC) Assure all explosive materials are removed from the burning grounds.

   d. (O)(QC) Assure fire hazard symbol is removed.

   e. (O)(QC) Assure all inert material is properly stored.

   f. (O)(QC) Assure all building/shelters are secured.

   g. (O) Transfer all vehicles to locations as specified by Old Bomb Supervisor, or a designated representative with demil certification.

   h. (O) Close and lock gate at entrance.

2. Closing Under Unusual Conditions:

   a. (O) The Old Bomb Supervisor, or a designated representative with demil certification, or a designated Munitions Destroyer is to notify the following personnel:

      (1.) Manager, Safety, ext. 7842 and/or cell 945-0362

      (2.) Director, M&L, ext. 7244 and/or cell 945-0301

      (3.) Manager, PP&PE Division, ext. 7463 and/or cell 316-0667

(4.) Fire Department through GOC, ext. 7555 or 7444

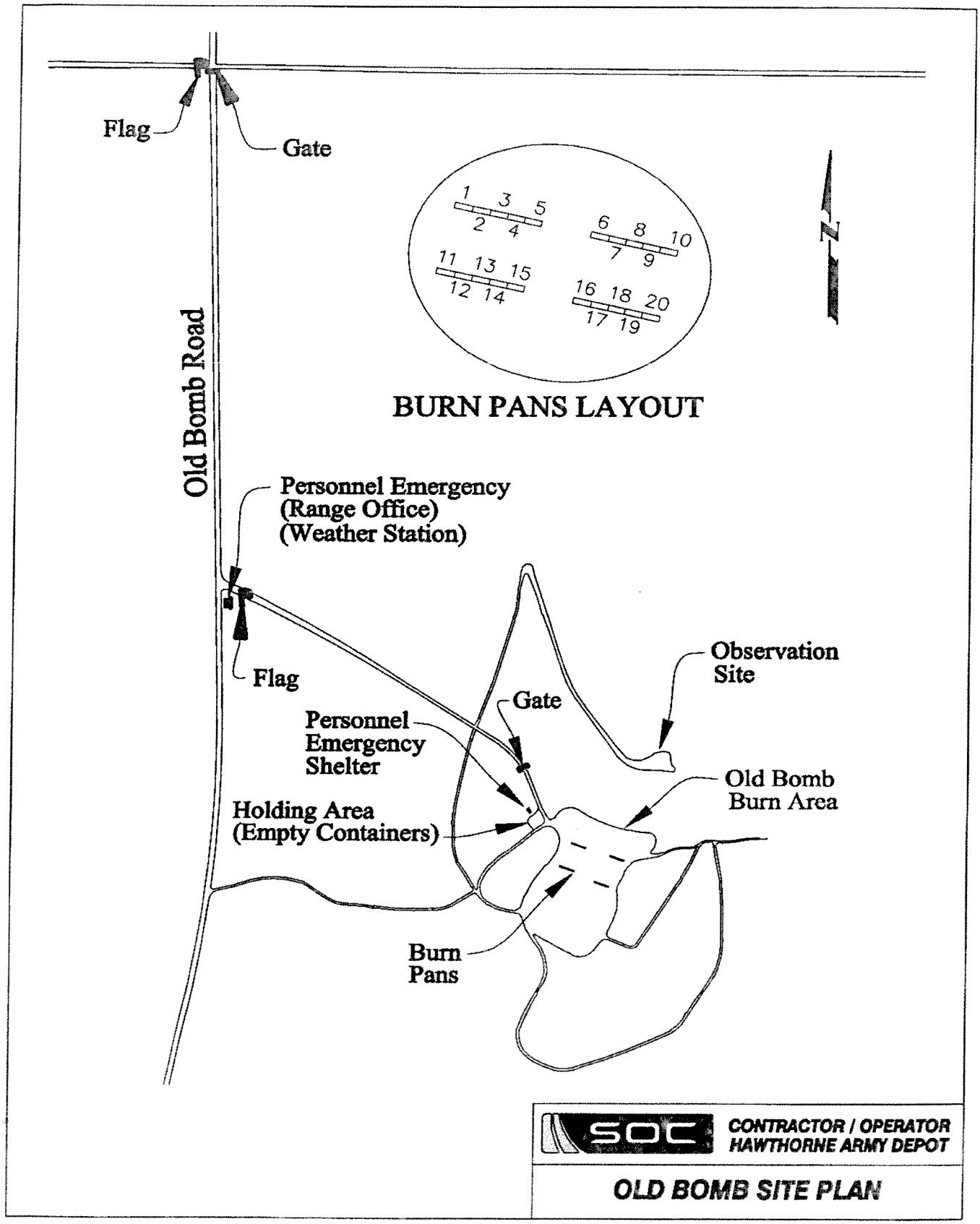
(5.) Chief, Security, ext. 7601 and/or cell 945-0415

3. Closing Burning Grounds at the End of a Job.

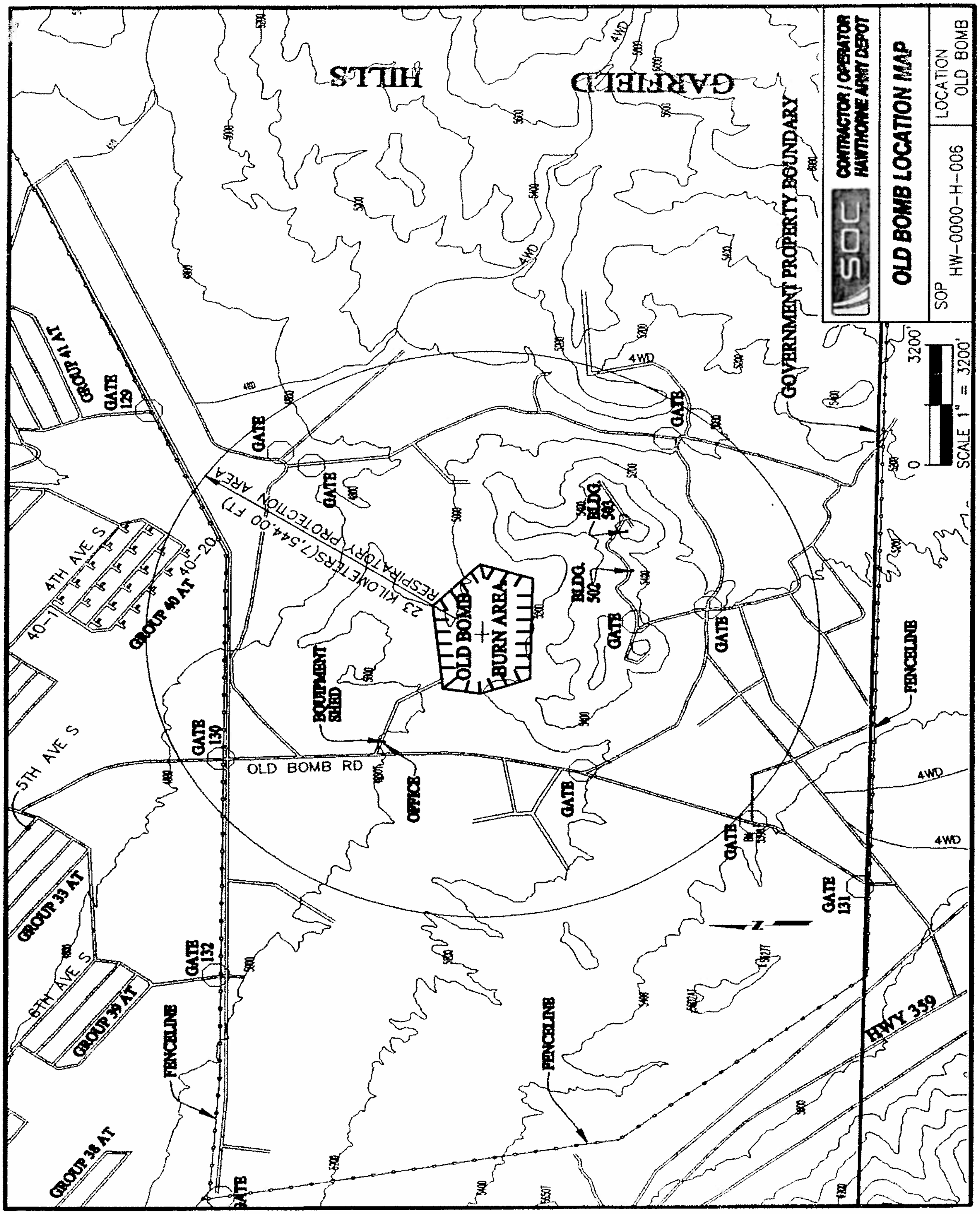
   a. (O)(S) Perform Steps 1 and 2.

   b. (O) Transfer vehicles and materials to point of issue.

SITE LAYOUT


Flag
Gate
1 3 5
2 4
6 8 10
7 9
11 13 15
12 14
16 18 20
17 19
N
BURN PANS LAYOUT
Old Bomb Road
Personnel Emergency
(Range Office)
(Weather Station)
Flag
Gate
Observation
Site
Personnel
Emergency
Shelter
Old Bomb
Burn Area
Holding Area
(Empty Containers)
Burn
Pans
SOC
CONTRACTOR / OPERATOR
HAWTHORNE ARMY DEPOT
OLD BOMB SITE PLAN

SITE PLAN


GARFIELD HILLS
GOVERNMENT PROPERTY BOUNDARY
CONTRACTOR / OPERATOR HAWTHORNE ARMY DEPOT
SOC
OLD BOMB LOCATION MAP
SOP HW-0000-H-006
LOCATION OLD BOMB
SCALE 1" = 3200'
0
3200'
23 KILOMETERS(7,544.00 FT) RESPIRATORY PROTECTION AREA
OLD BOMB BURN AREA
BLDG. 502
BLDG. 503
EQUIPMENT SHED
OFFICE
OLD BOMB RD
GATE
GATE 129
GATE 130
GATE 131
GATE 132
GROUP 41 AT
GROUP 40 AT
GROUP 39 AT
GROUP 38 AT
GROUP 33 AT
4TH AVE S
5TH AVE S
6TH AVE S
40-1
40-20
FENCELINE
4WD
HWY 359

# APPENDIX A
# WEATHER DATA STATISTICS – OPEN BURNING
# AMC FORM 2886-R-E

## WEATHER DATA STATISTICS - OPEN BURNING

(AMC-R 755-8)

REPORTING MONTH/YEAR:

INSTALLATION:

BURNING GROUND LOCATION:

| GENERAL | | | | | | WIND | | | MATERIAL DESTROYED | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DAY/TIME | 1/2 M TEMP | 4 M TEMP | TEMP DIFFERENCE | CONDLAPSE INVERSION | % RELATIVE HUMIDITY | SPEED MPH | DIRECTION | SKY CONDITION | QUANTITY | DA FORM 4508 NO. | TYPE |
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AMC FORM 2886-R-E

# *SOC NEVADA LLC*

**HAWTHORNE ARMY DEPOT**
HAZARD ANALYSIS & RISK ASSESSMENT

---

**PROPELLANT DEMILITARIZATION BY OPEN BURNING**
*(Operational Process/System)*

**HW-0000-H-006**
*(Standing Operating Procedure)*

**December 8, 2010**
*(Replaces HA/RA, Same Subject, Dtd 3/2/10)*
*(Date)*

**OLD BOMB FACILITY**
*(Location)*

Prepared by: Andrea Marshall
**ANDREA MARSHALL**, Safety Specialist
Safety & Health Division

December 8, 2010
Date

Reviewed by: Wayne Larson
**WAYNE LARSON**, Manager
Safety & Health Division

December 8, 2010
Date

# SOC NEVADA LLC
# HAZARD ANALYSIS

**OPERATIONAL PROCESS/SYSTEM:** Propellant Demilitarization by Open Burning
**STANDING OPERATING PROCEDURE:** HW-0000-H-006
**LOCATION:** Old Bomb Facility

December 8, 2010

| PROCESS DESCRIPTION | RISK ASSESSMENT | RECOMMENDATIONS | REFERENCES |
|---|---|---|---|
| This process covers the demilitarization of bulk propellants including bagged propellant charges by burning in open burn pans. This procedure begins with receiving, verifying documentation and downloading propellant. The propellant is then placed in open burn pans and an ignition device is placed in the propellant. The propellant is then ignited. Any residual ash is containerized and handled as hazardous waste.<br><br>The process also covers range safety and meteorological requirements, range opening and burn pan set up procedures and procedures to be followed in the event of misfires. This process covers range cleanup, container and material disposition procedures. | The Hazard analysis was performed after considering the adequacy of safety considerations covered in the SOP and long experience in performing operations of a similar nature. An initial Severity of "I" (Catastrophic) and an Accident Probability of "D" (Remote) is assessed to this operation with a RAC of "3". After recommended controls have been implemented, a Hazard Severity of "I" (Catastrophic) and an Accident Probability of "E" (Improbable) is assessed with a RAC of "5" assigned to this operation. | 1. Operator training and SOP compliance is emphasized.<br><br>2. Training and compliance with proper material handling procedures is emphasized.<br><br>3. Burning operations shall be performed only by trained operators under adequate supervision.<br><br>4. All personnel will adhere to PPE use requirements. | 1. MIL-STD 882D; System Safety Program Requirements<br><br>2. DoD 4145.26-M; Contractors Safety Manual for Ammunition & Explosives<br><br>3. SOC.OHS.SP.0002; SOC Safety Program<br><br>4. 29 CFR 1910; Occupational Safety & Health Standards for General Industry |

# SOC NEVADA LLC
# HAZARD ANALYSIS

**OPERATIONAL PROCESS/SYSTEM:** Propellant Demilitarization by Open Burning
**STANDING OPERATING PROCEDURE:** HW-0000-H-006
**LOCATION:** Old Bomb Facility

December 8, 2010

| OPERATIONS OR FUNCTIONS | TOOLS AND EQUIPMENT | FAILURE MODE/CAUSE | FAILURE EFFECT | HAZARDS BEFORE CONTROLS | RAC BEFORE CONTROLS | RECOMMENDATIONS AND/OR CONTROLS | HAZARDS AFTER CONTROLS | RAC AFTER CONTROLS |
|---|---|---|---|---|---|---|---|---|
| 1. Open Range (Burning Grounds) | Portable Radio | Range Supervisor fails to notify all applicable agencies. | Agencies having a need to be notified may not be aware of range operations in progress. | III C | 4 | Utilization of a pre-clearance check sheet to assure notification of all applicable agencies. | III D | 5 |
| 2. Preparation of Range and Check Equipment | Hand tools and Personal Protective Equipment (PPE), and burn pans | Burn pans not properly bonded and grounded. | Possible static electrical discharge during pouring powder could cause a flash fire resulting in death or serious injury to operators. | I D | 3 | Operator instruction and training in inspecting burn pans for proper bonding and grounding. | IV E | 5 |
| 3. Receive, Inspect and Unload | Forklift, Transport vehicles and Tie- down Equipment | Forklift operator hits powder can with tines penetrating the container. | Possible fire causing serious injury or death to operators and major damage to equipment and facility. | I D | 3 | Provide forklift operator training and qualifications to specify safety requirements for handling unstable powder. | III E | 5 |
| 4. Un-palletize | Rough Terrain Forklift, Hand tools and PPE | Unauthorized Material Handling Equipment (MHE) allowed to operate too near exposed propellant. | Sparks from MHE exhaust could ignite propellant causing death or serious injury to operating personnel and major damage to equipment. | I D | 3 | Strict enforcement of material handling equipment utilization and control of areas where MHE may no be operated. | III E | 5 |
| 5. Prepare material for Burning | Propellant Burn Pans and PPE, and hand truck | Burn pans not properly bonded and electrically grounded as required | Static electrical discharge could ignite exposed propellant causing death or serious injury to operators | I D | 3 | Provide personnel and operator training in visually inspecting grounding straps on burn pans prior to and during load operations. Ground system should be tested periodically to assure serviceability. | III E | 5 |

# SOC NEVADA LLC
# HAZARD ANALYSIS

**OPERATIONAL PROCESS/SYSTEM:** Propellant Demilitarization by Open Burning
**STANDING OPERATING PROCEDURE:** HW-0000-H-006
**LOCATION:** Old Bomb Facility

December 8, 2010

| OPERATIONS OR FUNCTIONS | TOOLS AND EQUIPMENT | FAILURE MODE/CAUSE | FAILURE EFFECT | HAZARDS BEFORE CONTROLS | RAC BEFORE CONTROLS | RECOMMENDATIONS AND/OR CONTROLS | HAZARDS AFTER CONTROLS | RAC AFTER CONTROLS |
|---|---|---|---|---|---|---|---|---|
| 6. Set up Initiation System | Safety Fuze, Igniter and PPE | While preparing safety fuze, the operator accidentally breaks out fuze covering. | Upon initiation of safety fuze, fire could develop at the break in the fuze causing premature ignition of propellant. Death or serious injury to operating personnel could result. | I D | 3 | Provide operator training in initiation system preparation. Fully qualified Munitions Destroyers or equivalent shall only accomplish operations of this nature. | III E | 5 |
| 7. Initiate Burns | Burn Pans, Propellant and PPE | While initiating the fuze igniter, operator twists ankle going from pan to pan. | Injured employee would be unable to proceed and would require assistance. | III D | 4 | Operator instructed in emergency procedures to be followed in the event of an unforeseen accident or incident. This is to be a two-person operation. | IV E | 5 |
| 8. Misfire Procedure | Demolition Material, Equipment and PPE | Operators fail to wait 60 minutes before investigating a misfire. | Possible death or serious injury due to delayed ignition of propellant could occur. | I D | 3 | Personnel training and instruction in time requirements and handling procedures for misfires. | III E | 5 |
| 9. Inspection of Burn Area | Hand tools and PPE | All powder in burn pans not consumed in fire. | Possible flash fire when propellant is disturbed causing injury to operating personnel. | II D | 3 | Operator training and strict supervision when approaching burn pans with unburned powder present. | III E | 5 |
| 10. Partial Burns | Demolition Material, Equipment and PPE | Undetected sparks or hot spots in burn pans. | Possible ignition of propellant causing death or serious injury to operating personnel | I D | 3 | Operator training in special procedures to be followed in the event of a partial burn | III E | 5 |
| 11. Disposition of packaging materials | Forklift, Hand Tools and PPE | Containers or boxes containing propellant or other reactive material not detected during inspection. | Reactive material could be offered for sale or buried in a landfill unknowingly. | II D | 4 | Operator instructed in proper procedures to be followed when inspecting packaging material and boxes for residual powder or other reactive material. | IV E | 5 |
| 12. Range Clean -up | Hand Tools and PPE | While picking up explosive waste, smoldering material is inadvertently placed into an explosive waste container | Possible flash fire of residual material in waste container causing injury to operating personnel. | II D | 3 | Provide all operators training in range clean-up procedures and special handling requirements when retrieving hazardous material. | III E | 5 |

UNCONTROLLED DOCUMENT
MAR 14 2012

# SOC NEVADA LLC
# HAZARD ANALYSIS

**OPERATIONAL PROCESS/SYSTEM:** Propellant Demilitarization by Open Burning
**STANDING OPERATING PROCEDURE:** HW-0000-H-006
**LOCATION:** Old Bomb Facility

December 8, 2010

| OPERATIONS OR FUNCTIONS | TOOLS AND EQUIPMENT | FAILURE MODE/CAUSE | FAILURE EFFECT | HAZARDS BEFORE CONTROLS | RAC BEFORE CONTROLS | RECOMMENDATIONS AND/OR CONTROLS | HAZARDS AFTER CONTROLS | RAC AFTER CONTROLS |
|---|---|---|---|---|---|---|---|---|
| 13. Closing Burning Grounds | Communications Equipment | Explosive material not properly secured or stored. | Hazardous (Explosive) material could be removed from disposal site by unauthorized personnel | II D | 4 | Operator instructed in securing explosive material | III E | 5 |

| HAZARD PROBABILITY CODES | | | | | HAZARD SEVERITY CODES | | | |
|---|---|---|---|---|---|---|---|---|
| FREQUENT | PROBABLE | OCCASIONAL | REMOTE | IMPROBABLE | CATASTROPHIC | CRITICAL | MARGINAL | NEGLIGIBLE |
| A | B | C | D | E | I | II | III | IV |

| RISK ASSESSMENT CODE | | | |
|---|---|---|---|
| UNACCEPTABLE | UNDESIRABLE | ACCEPTABLE WITH REVIEW | ACCEPTABLE WITHOUT REVIEW |
| 1 OR 2 | 3 | 4 | 5 |

Document For Reference Only

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX H

SOC NEVADA LLC
HAWTHORNE ARMY DEPOT
STANDING OPERATING PROCEDURE

COPY# Environmen

DEPT: _____

ITEM: Various Munition Items

DODAC: Various

PACKAGED: 1.2

FIRE SYMBOL: 1

UNPACKED: 1.1

FIRE SYMBOL: 1

CHEMICAL HAZARD SYMBOL: N/A

UNCONTROLLED DOCUMENT

OPERATION: Detonation In RF9 Furnace

EST. DAILY PROD. RATE: Varied

ORGANIZATION SYMBOL: HWAD-PP&PE

SOP HW-0000-K-006 DATE 02/10/2011

REVISION DATE

CHANGE 1 DATE FEB 14 2012

AUTHORITY: W52P1J-11-D-0002

PREPARED BY: _____ 2/9/12
Teresa Trujillo, ext 7998 Date

REVIEWED BY: _____ 2/13/12
Process Engineering Date

SUBMITTED BY: _____ 2/13/12
Jeff Matheny, ext 7558 Date

Document Reference Only

CONCURRENCES – OPERATING CONTRACTOR:

Manager, PP&PE _____ 2/13/12 Date

Manager, Env Serv _____ 2/13/12 Date

Manager, QA _____ 2/13/12 Date

Manager, DSP _____ 2-13-12 Date

Manager, Safety _____ 2/13/12 Date

Director, ISSS _____ 2/13/12 Date

Industrial Hygienist _____ 2/13/12 Date

Director, M&L Services _____ 2-13-12 Date

Approval, General Manager _____ 2.14.12 Date

CONCURRENCES – ADMINISTRATIVE CONTRACTING OFFICERS STAFF

_____ 15 FEB 12
Chief, Ammunition Surveillance Date

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OPERATOR'S STATEMENT....2
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SAFETY REQUIREMENTS FOR 117-3....8
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SITE PLAN....65
APPENDIX A: DAILY MAINTENANCE CHECK SHEET....A-1
ATTACHMENT 1: HAZARD ANALYSIS AND RISK ASSESSMENT....I-1

Received on 3/7/13

# HAWTHORNE ARMY DEPOT
# STANDING OPERATING PROCEDURE

ITEM: Various Munition Items

OPERATION: Detonation in RF9 Furnace

DODAC: Various

EST. DAILY PROD. RATE: Varied

PACKAGED: 1.2

ORGANIZATION SYMBOL: HWAD-PP&PE

FIRE SYMBOL: 1

SOP HW-0000-K-006 DATE 02/10/2011

UNPACKED: 1.1

REVISION DATE

FIRE SYMBOL: 1

CHANGE 2 DATE

CHEMICAL HAZARD SYMBOL: N/A

AUTHORITY: W52P1J-11-D-0002

PREPARED BY: _____
Teresa Trujillo, ext 7998 Date

REVIEWED BY: _____
Process Engineering Date

SUBMITTED BY: _____
Jeff Matheny, ext 7558 Date

## CONCURRENCES

_____
Manager, PP&PE Date

_____
Director, ISSS Date

_____
Manager, QA Date

_____
Manager, ES Date

_____
Manager, Safety Date

_____
Approval, General Manager Date

_____
Manager, APOD Date

(see attached)
_____
Government Endorsement

_____
Director, M&L Services Date

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OPERATOR'S STATEMENT....2

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APPENDIX B: WEEKLY MAINTENANCE INSPECTION CHECK LIST....B-1

ATTACHMENT 1: HAZARD ANALYSIS AND RISK ASSESSMENT....I-1

# SUPERVISOR'S STATEMENT

SOP_____ REVISION_____CHANGE_____ DATE_____

1. The Supervisor will sign this statement:

   a. When first assigned as supervisor of the operation.

   b. When an approved change is made to the SOP.

   c. On the 10th day following the start of the operation.

   d. At least once per quarter during continuing operations.

   e. After absence from the job in excess of 15 consecutive workdays.

2. I have personally reviewed each of the operational steps of this SOP and have no question in my mind that the operation can be performed safely, efficiently, and in compliance with environmental restrictions noted in this SOP. I have verified to my satisfaction that operators have been trained and are capable of performing their part of the operation in a safe and efficient manner and have instructed them to follow this SOP without deviation.

**SUPERVISOR'S PRINTED NAME:** _____

| SUPERVISOR'S NAME / SIGNATURE | DATE |
|---|---|
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HWAD 46-E

# OPERATOR'S STATEMENT

SOP_____ REVISION_____CHANGE_____ DATE_____

1. The Operator will sign this statement:

   a. When first assigned to the operation.

   b. When an approved change is made to the SOP.

   c. On the 10th day following the start of the operation.

   d. At least once per quarter during continuing operations.

   e. After absence from the job in excess of 15 consecutive workdays.

2. I have read, or have had read to me, and understand the general and specific safety and environmental requirements, the personnel and explosive limits, and the work description and inspection requirements necessary to accomplish my operation. I have been thoroughly trained in, and am familiar with, my part of the operation and I agree to abide by these instructions throughout my assignment to the operation.

| NAME / SIGNATURE | DATE | OPERATION NUMBER |
|---|---|---|
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DZHC 45-E

## ACRONYMS/ABBREVIATIONS

° – Degrees
**APOD** – Ammunitions Process Operations Division
**AWFCO** – Automatic Waste Feed Cutoff
**BLDG** – Building
**CEMS** – Continuous Emission Monitoring System
**DOD** – Department of Defense
**DODAC** – Department of Defense Ammunition Code (8 digit)
**DOT** – Department of Transportation
**e.g.** – Example
**EE** – Spark Resistant
**ES** – Environmental Services
**etc** – And So On
**EX** – Explosion Proof
**EXPL** – Explosive
**EXT** – Extension
**FT** – Feet
**HW** – Hawthorne (Installation Code)
**HEPA** – High Efficiency Particulate Air
**HWCO** – Hazardous Waste Combustor Operator
**IAW** – In Accordance With
**ID Fan** – Induced Draft Fan
**LB** – Pounds
**M&L** – Munitions and Logistics
**MDRK** – Munitions Detonation Rotary Kiln
**NO** – Nitric Oxide
**NOX** – Nitrogen Oxides
**NSN** – National Stock Number
**(O)** – Operator Function
**O2** – Oxygen
**OPER** – Operation
**PAS** – Pollution Abatement System
**PCC** – Primary Combustion Chamber
**PCP** – Pentachlorophenol
**PPE** – Personal Protective Equipment
**PPM** – Parts Per Million
**PPMVD** – Parts per million volumetric dry
**PP&PE** – Production Planning and Process Engineering
**PRO** – Property Reutilization Office
**QA** – Quality Assurance
**QATIP** – Quality Assurance Test & Inspection Plan
**(QC)** – Operator Quality Check
**RPM** – Revolutions per Minute
**(S)** – Operator Safety Check
**SEC** – Second
**SOP** – Standing Operating Procedure
**WG** – Water Gauge

## INDEX OF OPERATIONS


| OPER | BLDG SITE | BAY | TOTAL EXPL. IN BAY | DESCRIPTION | PAGE |
|---|---|---|---|---|---|
| 1 | 117-3 | Control Room | N/A | Pre-operational Check-out and Start-up | 14 |
| 2 | 117-3 | 2 | Table 1 | Receive, Identify, and Unload | 40 |
| 3 | 117-3 | 1 or 2 | Table 1 | Unpack Boxes/Containers | 42 |
| 4 | 117-3 | 1 and Control Room | Table 1 | Load Munitions onto Conveyor and Monitor Process | 44 |
| 5 | 117-3 | Outside Building and 1 | N/A | Process Scrap | 55 |
| 6 | 117-3 | Control Room | N/A | Shutdown Procedure | 57 |
| 7 | 117-3 | Inside & Outside Building | N/A | Area Clean-up | 61 |
| 8 | 117-3 | Control Room | N/A | Emergency Restart | 63 |


**REMARKS:** This procedure is designed to demilitarize various types of munition items. The demilitarization process is accomplished by detonating items in the Rotary Furnace (RF9) by exposing them to high heat. The procedure consists of verification and initiation of facility equipment prior to commencement of operation, receiving items, unpacking, in-process monitoring, and disposition of residue materials.

Safety and security requirements for this SOP will be followed IAW SOP HW-0000-A-001 and the Safety Requirements for 117-3. The safety requirements will be retained with all SOPs and treated in a like manner.

QA Personnel are responsible for documenting and initiating corrective action for all deviations from this SOP, IAW SOC.QATIP.180.

The receipt and outloading operations of this SOP will be IAW HW-0000-L-002.

**REFERENCES:**

| | | |
|---|---|---|
| DOD 4145.26-M-1 | DA PAM 385-64 | DOD 4160.21-M |
| MIL-STD-882D | TM 9-1300-277 | DOD 4160.21-M-1 |
| AMC R-385-100 | SB 742-1 | |

**CHANGE 1** updates Special Requirements in Operation 8; changes wording of Safety Requirement 19.

**Page i:** Updates Concurrence page.
**Page 4:** Deletes wording in first sentence of **Remarks**.
**Page 5:** Adds Change 1 to SOP.
**Page 9:** Changes wording in Safety Requirement 19.
**Page 54:** Adds wording to SR#1 of Operation 4.
**Page 63:** Changes wording in Special Requirements 1 and 2.

TABLE 1
EXPLOSIVE/PERSONNEL LIMITS
117-3

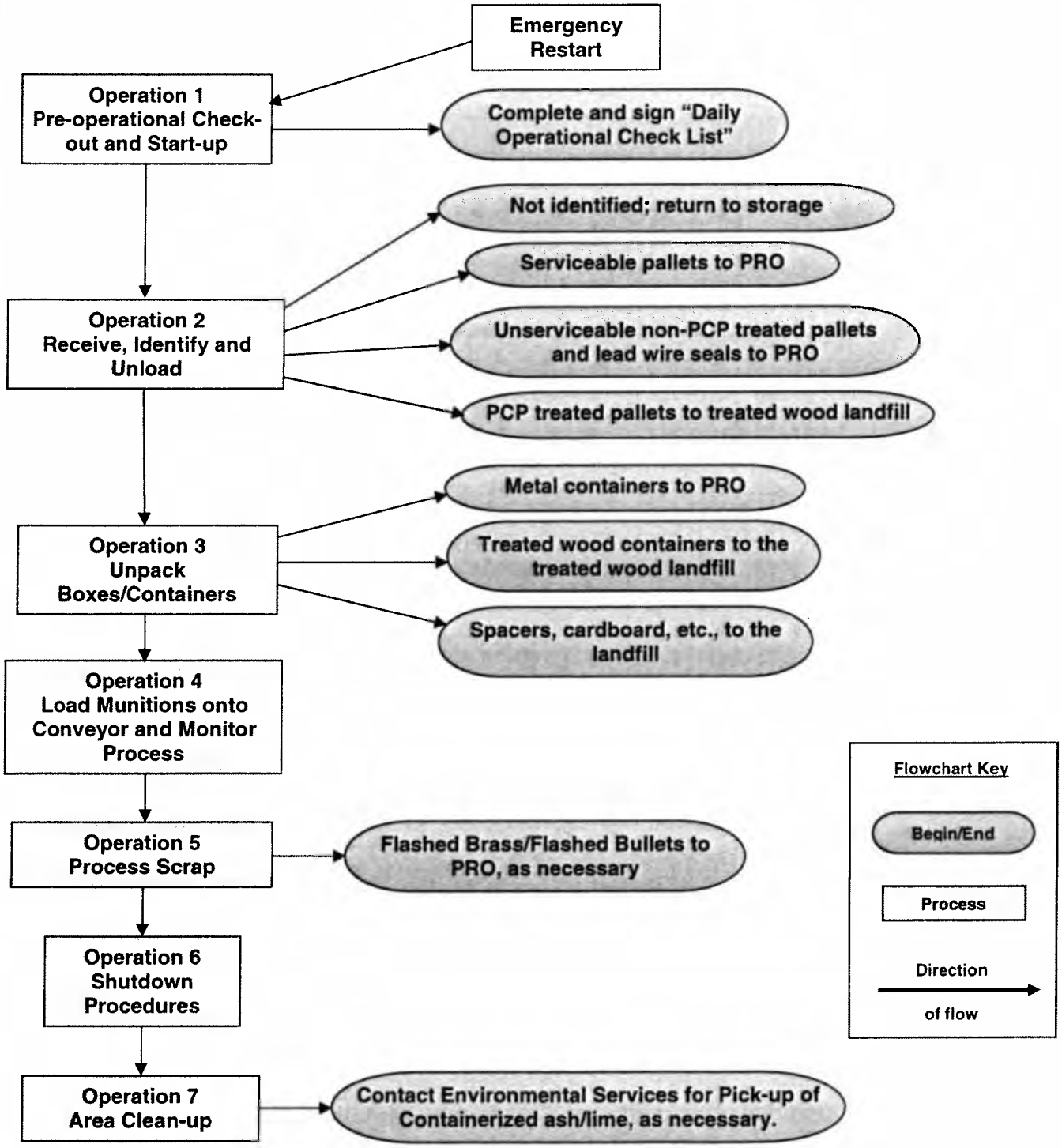
| BAY 1 | | |
|---|---|---|
| EXPLOSIVE LIMITS: | QUANTITY | TOTAL EXPLOSIVE LBS.: |
| Various Munition Items | | 899 |
| TOTAL | | 899 |
| PERSONNEL LIMITS: OPERATORS: 7 | | TRANSIENTS: 12 |

| BAY 2 | | |
|---|---|---|
| EXPLOSIVE LIMITS: | QUANTITY | TOTAL EXPLOSIVE LBS.: |
| Various Munition Items | | 1,335 |
| TOTAL | | 1,335 |
| PERSONNEL LIMITS: OPERATORS: 7 | | TRANSIENTS: 12 |

| CELL 1 | | |
|---|---|---|
| EXPLOSIVE LIMITS: | QUANTITY | TOTAL EXPLOSIVE LBS.: |
| Various Munition Items | | 266 |
| TOTAL | | 266 |
| PERSONNEL LIMITS: OPERATORS: 3 | | TRANSIENTS: 3 |

Cell 1 is used as a storage area (4 carts at 385 rounds). Due to the variety of items that can be run through the furnace, the weight of explosives cannot be precise.

## PROCESS FLOW FOR 117-3



## SAFETY REQUIREMENTS FOR 117-3

1. Comply with all safety and security requirements listed in the General Safety and Security Requirements (SOP HW-0000-A-001) pertaining to the performance of this procedure.

2. The area in and around the furnace is a restricted area and will be posted with signs bearing the following information:

**RESTRICTED AREA**
**DO NOT ENTER WITHOUT**
**PERMISSION OF**
**BUILDING SUPERVISOR**

3. During the performance of cleaning in and around the baghouse and/or furnace area, including the Lime Injection system, personnel are required to wear additional PPE consisting of disposable coveralls with head covering, face shield or vented goggles, respirator (½ or full face/class 1) and gloves. During the performance of Lime Injection system tasks, a dust mask may be used in place of the respirator.

4. **AVOID PRODUCING DUST:** The ash debris generated during demil process will be tested for lead and, if positive, shall be handled and disposed of as identified in Operation 7 (Area Cleanup) and in accordance with applicable governing regulations.

5. When processing 20MM cartridges, do not handle more than two cartridges per hand.

6. When processing 20MM cartridges, do not place more than 385 cartridges on the table at one time.

7. There is a variety of munitions items that can be run through the furnace. Each item will have its own inherent safety processes that will be addressed, as necessary, in a Letter of Instruction.

8. 50 caliber cartridges identified as 1305-00-028-6962-A525 and 1305-00-555-7061-A525 will be packed ten cartridges per fiberboard carton and four cartons at ten each will be emptied into the waste feed conveyor for processing through the furnace (40 cartridges per cycle).

9. 20MM cartridges identified as 1305-00-028-4556-A776, or any ammunition item packed in hermetically sealed containers, will apply the following during the unpacking process:

   a. Operator must wear Kevlar gloves and protective sleeves covering the forearm, prior to the removal of lid from the inner container. The containers and lids have sharp edges and personnel must handle them with caution.

   b. 20MM cartridges – open only seven hermetically sealed cans at a time (7 cans x 55 = 385). Each cart holds 55 cups with seven rounds each (55 cups x 7 rounds = 385).

      (1.) When removing the fiberboard sleeve from the 20MM cartridge, do not put the sleeve in dumpster; place the sleeve in bucket(s) until all 385 cartridges have been placed in the 105MM lids.

c. Once the cartridges have been accounted for, then and only then will the buckets of fiberboard sleeves be dumped into the dumpster.

d. If there are any missing 20MM cartridges, do not empty the buckets; inspect the fiberboard sleeves until the missing round is located.

e. If unable to locate the round, cease opening containers and notify the building Supervisor who will be responsible for notifying the Manager of APOD.

10. No food or drinks are allowed on control panel desk. Also, the mouse is to be used to make screen selections, even though the control panel is a touch screen.

11. RF-9 Training Coordinator is responsible for the training of all personnel in the operation of the furnace, conveyors, etc., until each operator has passed the required classes and has acquired an acceptable degree of proficiency. The training will consist of classroom training and "hands on" type training, where the operators actually operate the equipment. Control room operators must be trained and certified as Hazardous Waste Combustor Operators (HWCO); one (HWCO) must be at the controls at all times.

12. The Operators will have passwords that will allow access to the computers.

13. At the time of delivery, the Building Supervisor will inspect each dump trailer or railcar exterior and interior for flammable material. Conveyances may require repositioning during operations to establish even loads.

14. Constant operator monitoring of the furnace operation is required by law.

15. Approved furnace temperatures will be strictly observed for furnace operations.

16. Hearing protection is required in Bay 1 while loading munition items onto feed conveyor and also when loading empty metal cans into hopper.

17. While cleaning in or around the furnace, if a cartridge is found that is questionable as to its safety (only a partial detonation), call David Strange, ext 7276 or 316-0725.

18. Mechanics may communicate with the Control Room of 117-3 by way of a cell phone and the land line while performing repair work at the back side of 117-3.

The following table contains a list of the equipment and gages used in operations. The quantity needed is dependent upon the procedure.

| EQUIPMENT AND GAGES | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Forklift, electric, EE/EX, 4,000-6,000 lb capacity | Commercial | As required |
| Ladder, f/inside of trailer | Commercial | As required |
| Meter, Conductive Test | APE 1953 or equiv. | As required |
| Regulator, air | Commercial | As required |
| Table, lift | Commercial | 1 each |

The following table contains a list of tools and supplies used in operations. The quantities required will be dependent upon the procedure. It is not necessary to list those tools that are commonly used in most operations, e.g., strapping, cutters, hammers, screwdrivers, etc., (unless they must be spark-proof). Before introducing common tools and/or supplies onto the line, notify PP&PE to authorize use. Form DZHC-41-E will be used to authorize use of common tools and supplies pending subsequent change or revision to the SOP.

| TOOLS AND SUPPLIES | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Air, compressed | Commercial | As required |
| Barrels, 55 gallon, with lid for baghouse | Commercial | As required |
| Barricades, road | Commercial | As required |
| Broom, floor | Commercial | As required |
| Brush, bristle, foxtail | Commercial | As required |
| Bucket, empty | Commercial | As required |
| Can opener, duck bill | Commercial | As required |
| Cart | Commercial | As required |
| Chisel, non-sparking | Commercial | As required |
| Container, DOT approved for hazardous waste | Commercial | As required |
| Container, sealable, for lead seals | Commercial | As required |
| Container, sealable, for PCP crystals | Commercial | As required |
| Coveralls, Tyvek | Commercial | As required |
| Crimper, steel strapping (⅝", ¾", 1-¼") | MIL-S-43180 | As required |
| Crowbar | Commercial | As required |
| Cutters, steel strapping | GGG-C-835 | As required |
| Diagonal cutters | Commercial | As required |
| Drill, pneumatic | Commercial | As required |
| Dumpster, hopper or trailer type | Commercial | As required |
| Dustpan, rubber | ZZ-D-800 | As required |
| Fire hazard symbol | Commercial | As required |
| Flashlight | Commercial | As required |
| Fuel, diesel | Commercial | As required |
| Gas, 15 PCT Oxygen Balance: Nitrogen PN 02000284DAL | Scott Gases | As required |
| Gas, calibration, 151 PPM Carbon Monoxide Balance: Nitrogen PN 020000860DAL | Scott Gases | As required |
| Gas, calibration, 2270 PPM Carbon Monoxide Balance: Nitrogen PN 020000860DAL | Scott Gases | As required |
| Gas, calibration, 3610 PPM Nitric Oxide, Balance: Nitrogen Oxygen Free PN 020002470DAL | Scott Gases | As required |
| Gas, ultra high pure nitrogen 99.999% | J. W. Welding | As required |

| TOOLS AND SUPPLIES | NSN/SPECIFICATION | QUANTITY |
|---|---|---|
| Gloves, Kevlar | Commercial | As required |
| Gloves, leather/leather palmed | Commercial | As required |
| Goggles | Commercial | As required |
| Hammer, claw | Commercial | As required |
| Hearing Protection | Commercial | As required |
| Ink, stencil, Type II or IV | A-A-208 | As required |
| Lime, hydrated | Commercial | As required |
| Pallet, curbed | Commercial | As required |
| Palletainer, lined | Commercial | As required |
| Propane | Commercial | As required |
| Rags, cotton, wiping | Commercial | As required |
| Respirator | Commercial | As required |
| Scissors | Commercial | As required |
| Screwdriver | Commercial | As required |
| Screwdriver, non-sparking | Commercial | As required |
| Seals, steel strapping (⅝", ¾", 1-¼") | ASTM D 3953 | As required |
| Shield, face | L-F-36 | As required |
| Sleeve, protective (cut resistant) | Commercial | As required |
| Steel, strapping (⅝", ¾", 1-¼") | ASTM D 3953 | As required |
| Stretcher, steel strapping (⅝", ¾", 1-¼") | MIL-S-17743 | As required |
| Table, metal, w/wooden side rails | Commercial | As required |
| Vacuum, HEPA w/attachments f/lead contaminated debris | UL 586 | As required |
| Wrench, speed | Commercial | As required |

## ALARMS

### 1. General Notes Regarding Alarms:

a. All alarms will have an individual timer. The alarm condition must be TRUE for the preset amount of time before indicating an alarm, and the alarm condition must be FALSE for a preset amount of time before the alarms turns off. This minimizes false and nuisance alarms.

b. All alarms based on analog input will contain the alarm set point value and an alarm reset value. The alarm reset value will be slightly lower than the alarm set point value. This minimizes the nuisance of repetitive alarms if the analog input is close to the alarm set point value.

2. **Alarm Levels:**

   a. Critical Alarm – An alarm that is triggered by an event that puts personnel safety or equipment integrity in danger.

   b. System Alarm – An alarm that is triggered by an event that affects other components in the system, but does not indicate current personnel or equipment danger.

   c. Indication Alarm – An alarm that is triggered by an event that needs to be known by the operator, but has no immediate impact on any other system components.

   d. In some cases, indication alarms can progress to be system alarms and system alarms can progress to be critical alarms, if they are not addressed expeditiously.

3. **Table of Alarms** – The following is a table of the alarms, their respective levels, and automatic systems responses:

| *DESCRIPTION* | *LEVEL* | *AUTOMATIC RESPONSE* |
|---|---|---|
| *Evaporative cooler air pressure low* | *Critical* | *Bypass baghouse, stop process feed to incinerator, shut down I.D. fan* |
| *Evaporative cooler water pressure low* | *System* | *Start back-up water pump* |
| *Evaporative cooler water pressure low-low* | *Critical* | *Bypass baghouse, stop process feed to incinerator, shut down I.D. fan* |
| *Lime level low* | *Ind.* | *None* |
| *Baghouse differential pressure high-high* | *Ind.* | *None* |
| *Baghouse high hopper level* | *Ind.* | *None* |
| *Baghouse inlet temperature high* | *Ind.* | *None* |
| *Baghouse inlet temperature high-high* | *Critical* | *Bypass baghouse, stop process feed to incinerator, shut down I.D. fan* |
| *Baghouse module valve failure* | *System* | *May prevent bypass valve from closing (must be a path for the flue gas.)* |
| *Instrument air pressure low* | *System* | *Stop baghouse cleaning* |
| *Water pump run failure* | *System* | *Switch to stand-by pump* |
| *Reagent blower run failure* | *System* | *Will not allow reagent feed* |
| *Rotary airlock run failure* | *Ind.* | *None* |
| *Hopper heat failure* | *Ind.* | *None* |
| *Feeder downspout level high* | *System* | *Stop reagent feed* |
| *Loss of ID Fan* | *Critical* | *AWFCO, shut down PCC, shut down MDRK, baghouse bypass open.* |

| DESCRIPTION | LEVEL | AUTOMATIC RESPONSE |
|---|---|---|
| *Munitions Destruction Rotary Kiln (MDRK) burner failure.* | *System* | *AWFCO – Automatic Waste Feed Cutoff.* |
| *Primary Combustion Chamber (PCC) burner failure.* | *System* | *AWFCO* |
| *Minimum combustion zone temperature, 1650°F, 1 hour rolling average.* | *System* | *AWFCO* |
| *Maximum combustion gas velocity , 42 ft/sec, 1 hour rolling average.* | *System* | *AWFCO* |
| *Maximum hazardous waste feed rate, 240 lb/hour, 1 hour rolling average.* | *System* | *AWFCO* |
| *Maximum temperature at baghouse inlet, 400°F, 1 hour rolling average.* | *System* | *AWFCO* |
| *Maximum stack gas CO, 100 ppmvd @ 7% oxygen.* | *System* | *AWFCO* |
| *Maximum combustion chamber pressure, > -.1" wg,* | *System* | *AWFCO* |
| *Maximum and minimum baghouse differential pressure, 7" and 2.5" wg, respectively.* | *System* | *AWFCO* |
| *Minimum stack oxygen content, 4% oxygen.* | *System* | *AWFCO* |
| *Reagent feeder not running* | *System* | *AWFCO* |

**STANDING OPERATING PROCEDURE:**
Various Munition Items, Detonate in RF9 Furnace

**OPERATION 1**

**Control Room**

**SOP**: HW-0000-K-006

**REVISION**

**CHANGE**

**OPERATION:** Pre-operational Check-out and Start-up

**EXPLOSIVE/PERSONNEL LIMITS:** N/A

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

## PREREQUISITES

The following checklist (example-only) identifies the verification and other prerequisite activities necessary to ensure sufficient consumables are available and that RF-9 is configured to support processing operations:

# START-UP PROCEDURE COMPLETION CHECK LIST

(To be filled out by the Operator during each start-up)

| (2) PREREQUISITES | | Operator's Initials |
|---|---|---|
| 1. | Verify that Building 117-3 compressed air system is on line and available. | |
| 2. | Verify that the Western Area Demil Facility (WADF) Industrial Cold Water System is lined up and available to support Building 117-3. | |
| 3. | Verify that 117-3 diesel storage tank contains sufficient quantity for planned operation. | |
| 4. | Verify that the RF-9 lime injection system contains sufficient quantity to support planned operations. | |
| 5. | Verify the 117-3 propane storage tanks contain sufficient quantity for the planned run. | |
| 6. | Verify that the ash collection barrel has sufficient space available for the planned operations. | |
| 7. | Verify that CEMS calibration gases are on hand in sufficient quantities to support planned operations. Verify expiration date on each gas, making sure it hasn't expired. | |
| 8. | Review the lockout/tag out log and resolve any discrepancies. | |
| 9. | Review plant maintenance status log and ensure all required/essential maintenance and repair work has been completed. | |
| **(3) PRESTART-UP CHECKLIST** | | |
| 1. | Verify that a valve lineup has been completed, if required. | |
| 2. | Verify that an electrical lineup has been completed, if required. | |
| 3. | Energize CEMS analyzers. | |
| 4. | Verify that the control and data recording computers are running. | |
| 5. | Log onto the main control computer as operator. | |

| | | |
|---|---|---|
| **(4)** | **SUPPORT SYSTEM START-UP PROCEDURE** | |
| 1. | **Note:** Unless stated otherwise, all start, stop, adjustment and monitoring of process equipment is to be performed from the main control computer in the Central Control Room (CCR). | |
| **(4.1)** | **UNINTERRUPTIBLE POWER SUPPLY** | |
| 1. | At the UPS local panel, verify the UPS Input Power indicator is illuminated and the UPS Output Availability indicator is illuminated. | |
| **(4.2)** | **CONTROL AND DATA RECORDING COMPUTERS** | |
| 1. | Start the controlling computer. | |
| 2. | Verify the controlling computer boots up and displays the main control screen. | |
| 3. | Verify the data-recording computer is operating. | |
| 4. | Verify/Reset the ESS function at main control console. **Note:** ESS button must reset before the ESS function can be reset. | |
| 5. | Verify batch/ parameter is set. (recipe loaded) | |
| 6. | Verify system is "ON" and equipment control is in "AUTO" | |
| **(4.3)** | **INSTRUMENT AND PLANT AIR SUPPLY** | |
| 1. | Verify on the pollution abatement screen, "Instrument air OK" | |
| 2. | Verify that the instrument air dryer is "energized" | |
| 3. | Verify on the pollution abatement screen, "Plant air OK" | |
| 4. | Open or verify open, the valves in accordance with attachment D | |
| **(4.4)** | **INDUSTRIAL COLD WATER** | |
| 1. | Open or verify open, the valves in accordance with attachment D. | |
| **(4.5)** | **CEMS START-UP** | |
| 1. | Energize CEMS analyzers. (allow for sufficient equipment warm up) | |
| 2. | Energize "stack sample line" heating system. Breaker #??, panel ?? | |
| 3. | Perform CEMS calibration In accordance with SOP. (start-up sequence, step #4) | |
| **(4.6)** | **INDUCED DRAFT FAN START-UP** | |
| 1. | Start "induced draft fan" in accordance with SOP. (start-up sequence, step #5) | |
| **(4.7)** | **PAS SYSTEM START-UP** | |
| 1. | Start "bag house hopper heater" IAW SOP. (PAS Panel) | |
| 2. | Start "bag house cleaning cycle" IAW SOP. (PAS Panel) | |
| 3. | Start "rotary airlock" IAW SOP. (PAS Panel) | |
| 4. | Start "Evap. cooler water pumps" IAW SOP. (PAS Panel) | |
| **(4.8)** | **PCC START-UP** | |
| 1. | Start "fuel pump" IAW SOP. (HMI Fuel system Screen) | |
| 2. | Start "PCC Combustion Blower" IAW SOP. (HMI, Start-up Sequence PG 2) | |
| 3. | Start "PCC Burner" IAW SOP . (HMI, Start-up Sequence PG 2) | |
| **(4.9)** | **PCC START-UP** | |
| 1. | Start "MDRK Combustion Blower" IAW SOP. (HMI, Start-up Sequence PG 2) | |
| 2. | Start "MDRK Burner" IAW SOP. (HMI, Start-up Sequence PG 2) | |
| **(4.10)** | **MDRK ROTATION START-UP** | |
| 1. | Start "MDRK Rotation". IAW SOP. (HMI, Start-up Sequence PG 2). | |
| 2. | Note: Conveyors RF-24, RF-23, RF-22, and RF-19 will start after the MDRK has reach rotation speed set point. | |

| | | |
|---|---|---|
| **(4.11) MAGNETIC SEPARATOR START-UP** | | |
| 1. | Start "Magnetic Separator". IAW SOP. (HMI, Start-up Sequence PG 2). | |
| 2. | Note: Conveyors RF-15, and RF-21, will start after the Magnetic separator has started. | |
| **(4.12) BAGHOUSE ISOLATION VALVES** | | |
| 1. | Execute "bag house" online IAW SOP. (HMI, Start-up Sequence PG 3). | |
| 2. | Start "reagent blower" IAW SOP. (HMI, Start-up Sequence PG 3). | |
| 3. | Start "reagent blower" IAW SOP . (HMI, Start-up Sequence PG 3). | |
| **(5.1) START FEED SYSTEM** | | |
| 1. | Verify the Pre-Start-up Checklist has been completed. IAW SOP/ Test Plan, STEP 21 | |
| 2. | Start "Secondary Feed Conveyor" IAW SOP. (HMI, Start-up Sequence PG 3). | |
| 3. | Start "Primary Feed Conveyor" IAW SOP. (HMI, Start-up Sequence PG 3). | |
| 4. | Start " Waste Feed System" IAW SOP. (HMI, Start-up Sequence PG 3). | |
| **(5.2) START-UP COMPLETE** | | |
| 1. | Acknowledge "Start-up Complete" (HMI, Start-up Sequence PG 3). | |

**Operator's Signature** _____ **Date** _____

This is to be filed under START-UP CHECK LIST in the filing cabinet at 117-3.

## START UP SEQUENCE

1. Control and Data Recording Computers / CEMS System.

   a. (HWCO) Turn on CEMS analyzers. Allow two hours before any calibration takes place.

   b. (HWCO) Verify that the control and data recording computers are running.

   c. (HWCO) Using the mouse, click on SECURITY (found on right screen of Main Control Panel, lower right-hand side) and the screen as seen in Figure 1-3 will appear.

   d. (HWCO) Click on LOG ON (Figures 1-3 and 1-4). Log on as operator or administrator and type password; click OK.

   e. (HWCO) Click on STARTUP (found on right side of right screen of Main Control Panel, as shown in Figure 1-2); this pulls up STARTUP SEQUENCE PAGE 1 (Figure 1-5).

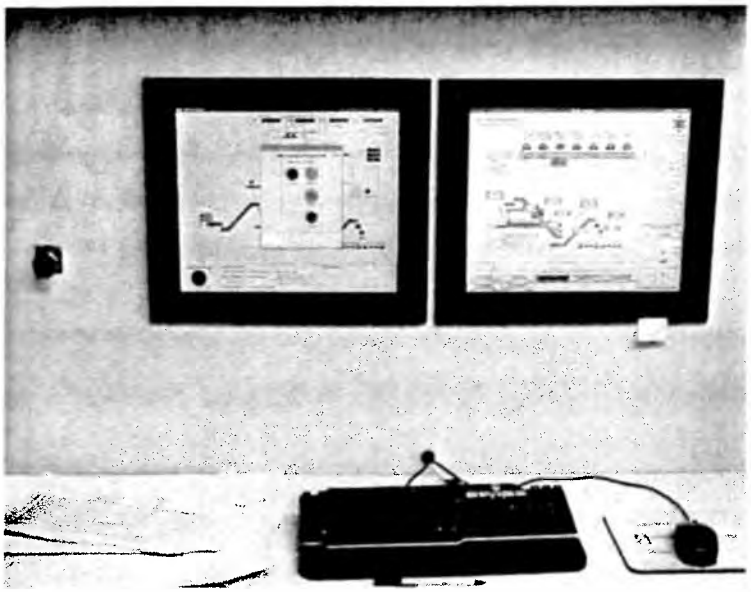


Figure 1-1 (Main Control Panel – Left and Right Screens)

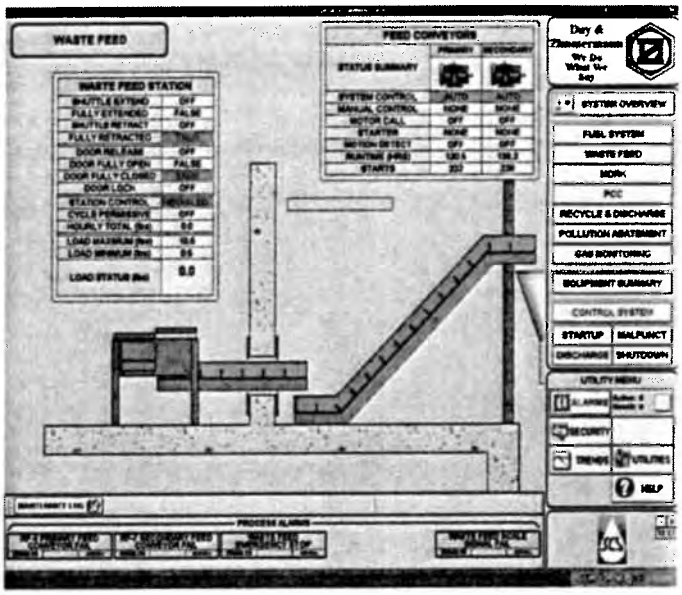



Figure 1-2 (Right Screen - Main Control Panel)

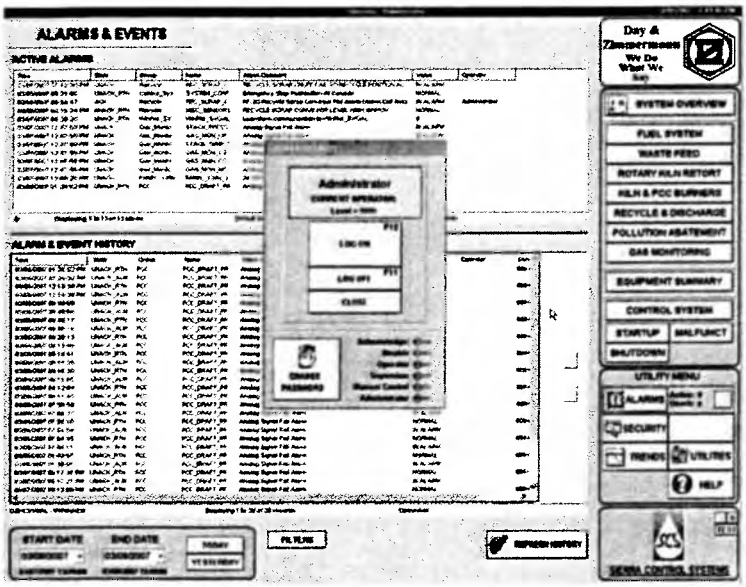



Figure 1-3 (Logon and Security Screen)

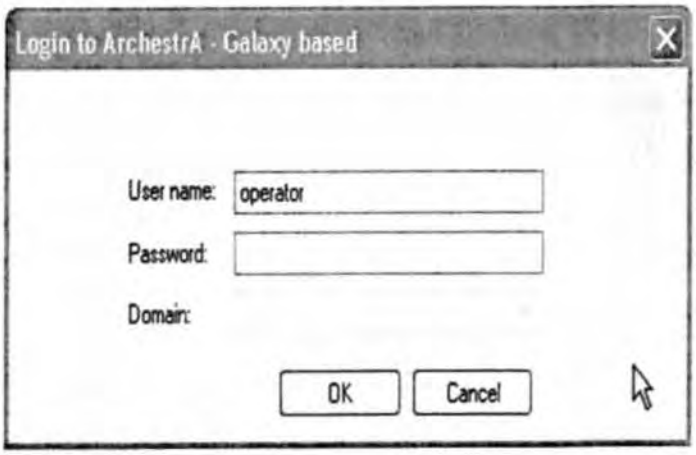



Figure 1-4

2. System Master Control (Main Panel).

   a. (HWCO) STARTUP SEQUENCE Page 1, lower right hand corner (System Master Control), verifies that the system is on and the equipment control is in auto (Figure 1-5).

3. Batch / Parameter Setup - Main Panel (Refer to Figure 1-5).

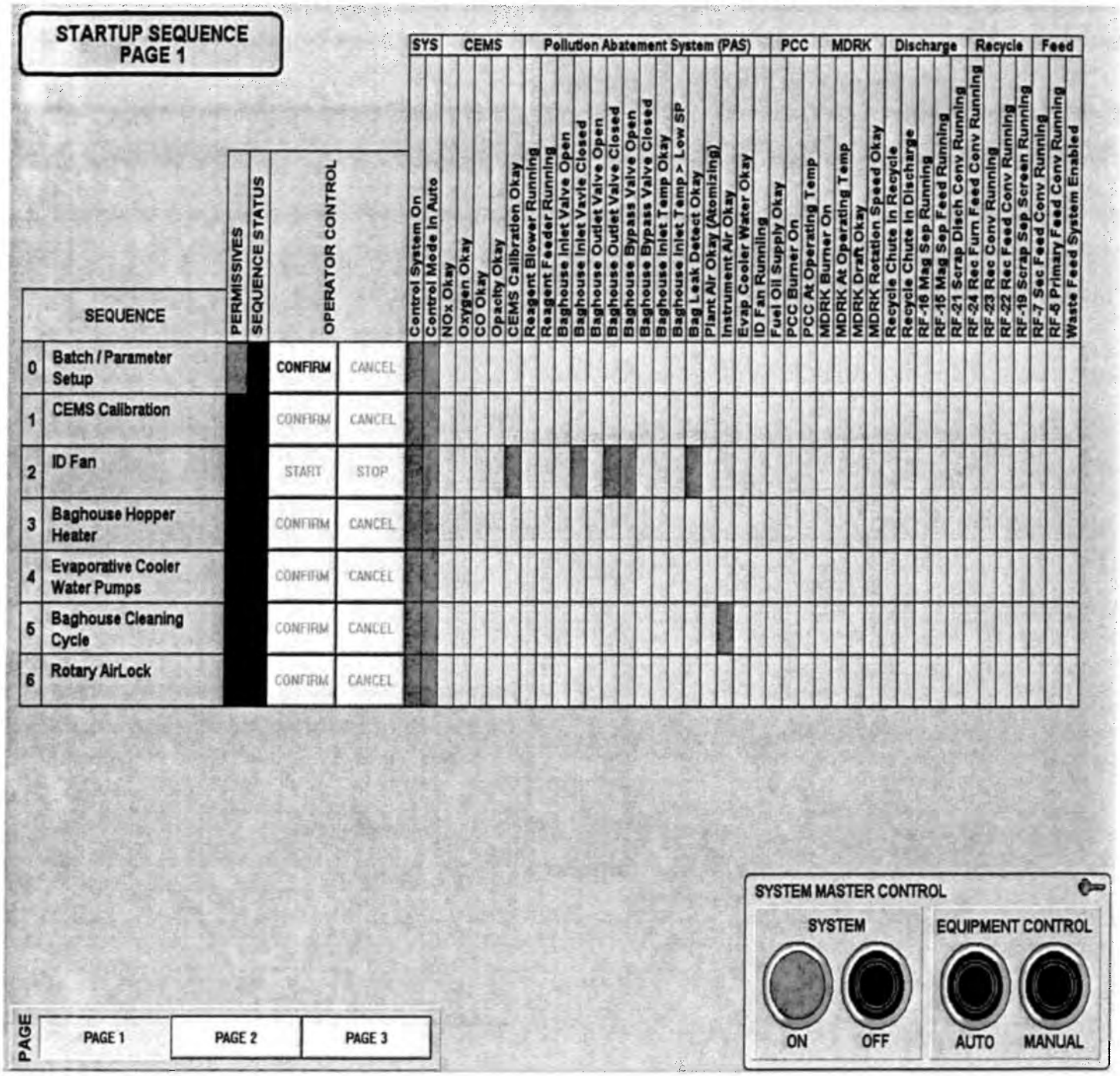



Figure 1-5 (Startup Sequence Page 1)

a. (HWCO) Under the SEQUENCE column on STARTUP SEQUENCE Page 1, click on BATCH/PARAMETER SETUP. The following MUNITIONS RECIPE screen will appear on the right (Figure 1-6):

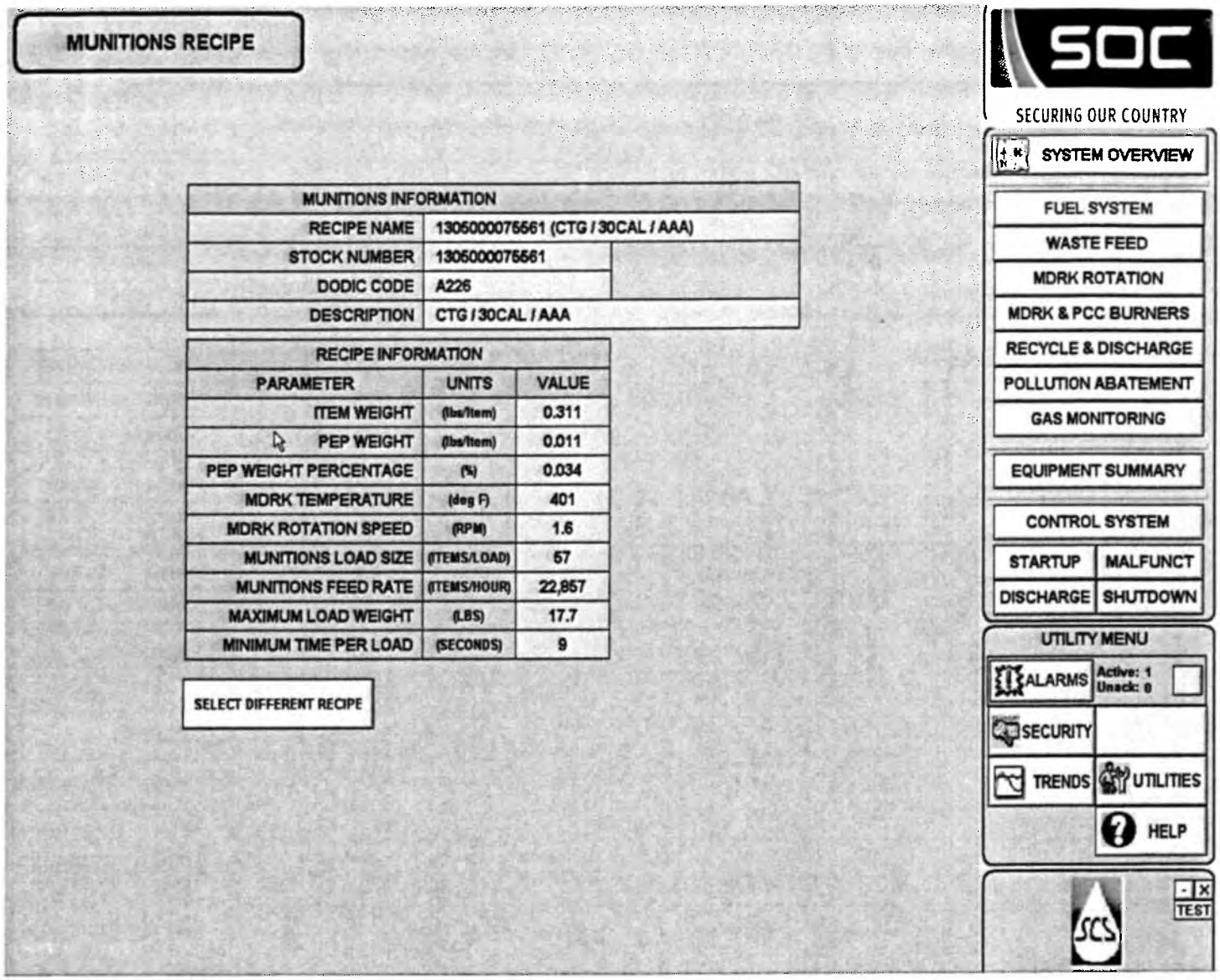



Figure 1-6 (Munitions Recipe Screen)

b. (HWCO) Select the correct recipe.

c. (HWCO) Once the correct recipe has been selected, click on CONFIRM on STARTUP SEQUENCE Page 1 (see Figure 1-5).

4. CEMS Calibration (Main Panel).

   a. (HWCO) Under the SEQUENCE column, click on CEMS CALIBRATION (Figure 1-5). The following Gas Monitoring Screen will appear on the right screen (2).(see Figure 1-7):

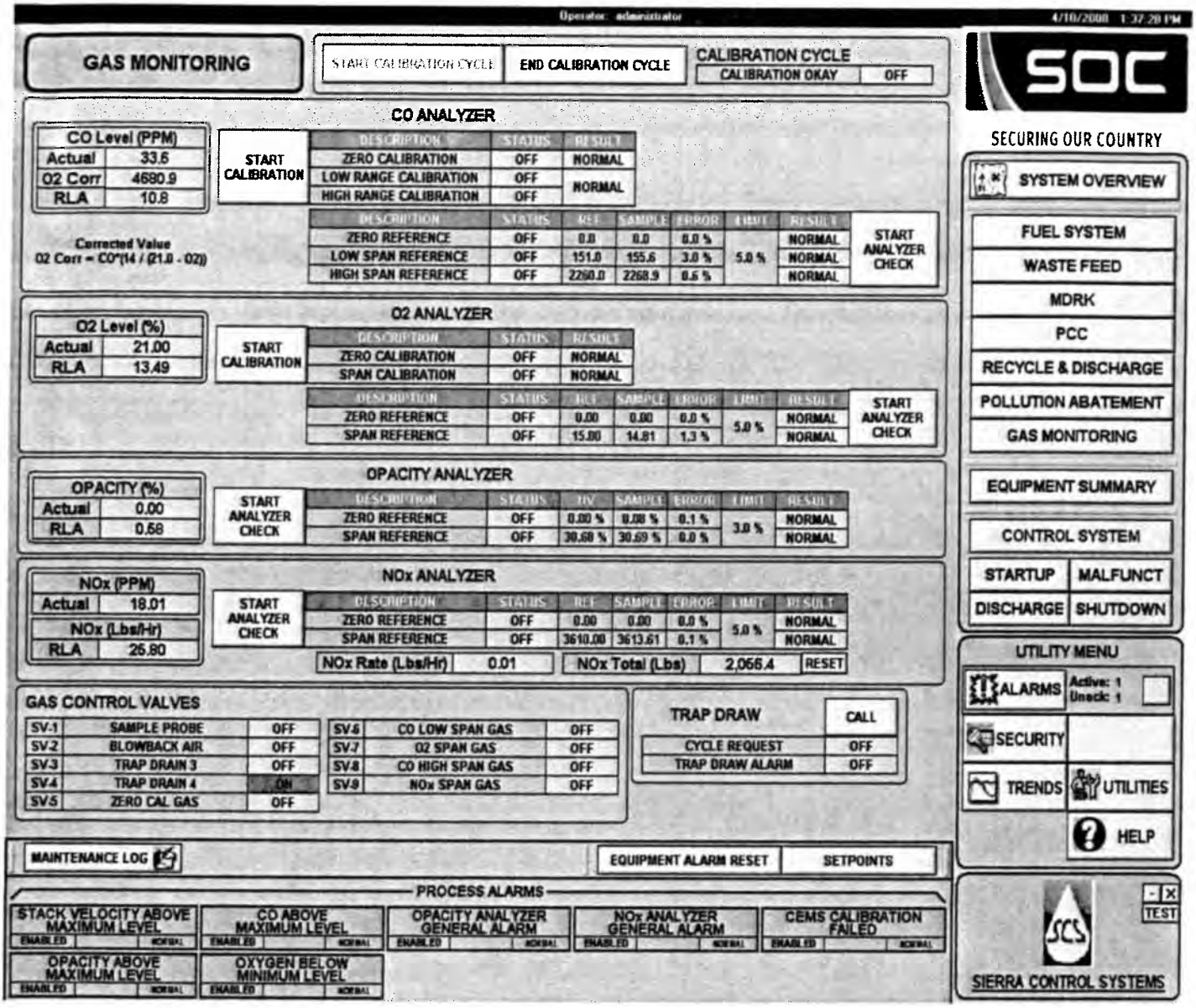



Figure 1-7
(Gas Monitoring Screen)

   b. (HWCO) Click on START CALIBRATION CYCLE. Assure that all the valves are opened on the calibrations gases before any calibrations start. Check expiration date on each gas cylinder to assure the date has not expired. Check each gage on each gas cylinder to assure there is adequate gas for the test. When the gases are flowing, the regulator should be set at 18 psi (see Figure 1-8).

Figure 1-8 (Gages)

c. (HWCO) $O_2$ Analyzer – click on START CALIBRATION (Figure 1-9). A timer will start and will not let operator proceed to the next analyzer until it times out (approximately 13-½ minutes or 800 seconds).

d. (HWCO) At the CEMS cabinet (Figure 1-9, Beckman $O_2$ analyzer), zero gas will automatically be sent to the analyzer. Allow the zero gas to flow for three minutes and then adjust the zero knob until the needle on the analyzer is exactly on zero.

e. (HWCO) At the CEMS cabinet (Figure 1-10, Servomex $O_2$ analyzer), zero gas will automatically be sent to the analyzer. Allow the zero gas to flow for three minutes and then calibrate it to zero as shown in Figure 1-10 below.

(1.) Press Menu and the screen as seen in Figure 1-11 will appear.

(2.) Press Enter (CALIBRATE). Operator will then be asked to enter a password (0000), as seen in Figure 1-12; press Enter and the screen as seen in Figure 1-13 will appear.

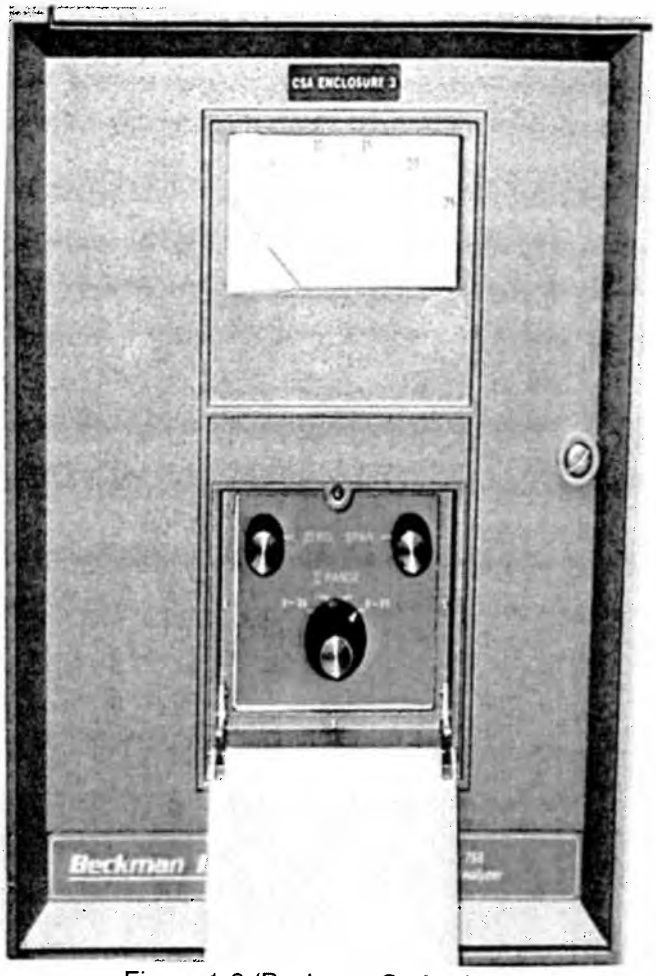


Figure 1-9 (Beckman $O_2$ Analyzer)

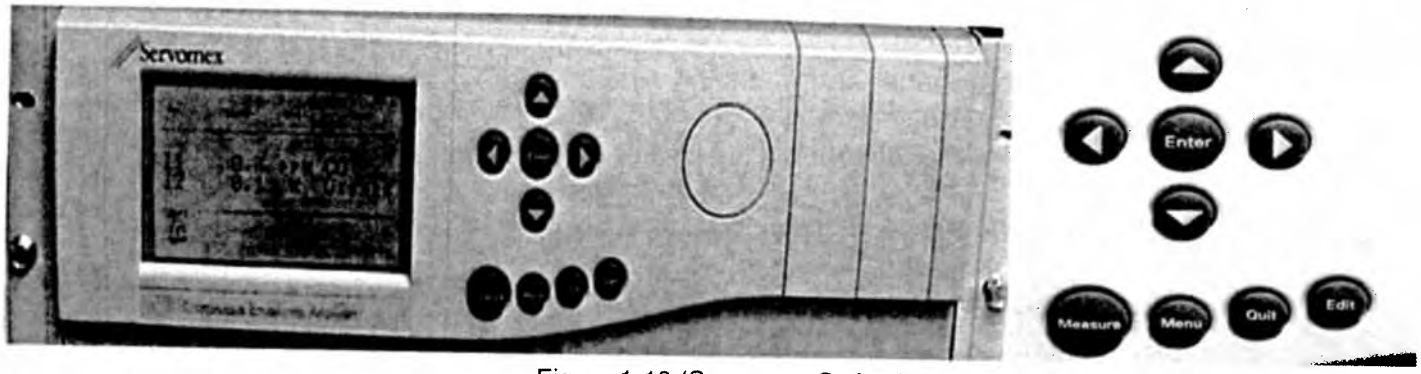


Figure 1-10 (Servomex $O_2$ Analyzer)

Figure 1-11

Figure 1-12

Figure 1-13

(3.) Press ENTER (MANUAL CAL) and the screen as seen in Figure 1-14 will appear.

(4.) Press on the ↑ key to get to the Oxygen screen (see Figure 1-15); press ENTER and the screen as seen in Figure 1-16 will appear.

Figure 1-14

Figure 1-15

Figure 1-16

(5.) Assure that LOW CAL is hi-lighted; press ENTER. The screen as seen in Figure 1-17 will appear. Press ENTER again and the value will set to zero. The screen as seen in Figure 1-18 may appear.

(6.) Assure that Y (YES) is hi-lighted; press ENTER. Press MEASURE and computer will return back to the main screen (see Figure 1-19).

Figure 1-17

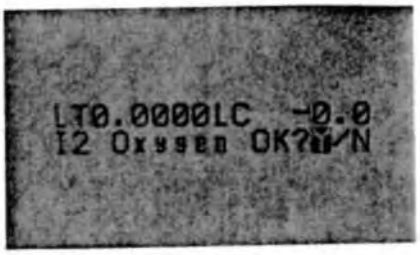



Figure 1-18

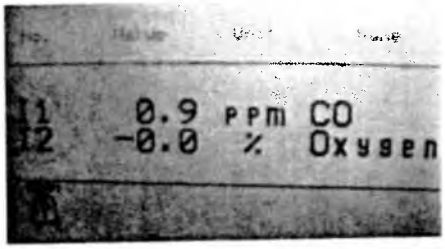



Figure 1-19

f. (HWCO) The analyzers will then automatically switch to span gas (15%). Allow the span gas to flow for three minutes and then adjust the span knob (see Figure 1-9) until the needle on the Beckman O2 analyzer is exactly on 15.

g. (HWCO) Calibrate Servomex Analyzer as follows:

(1.) Press Menu and the screen as seen in Figure 1-11 will appear.

(2.) Press Enter (CALIBRATE). Operator will then be asked to enter a password (0000), as seen in Figure 1-12; press Enter and the screen as seen in Figure 1-13 will appear.

(3.) Press Enter (MANUAL CAL); the screen as seen in Figure 1-14 will appear.

(4.) Press on the ↑ key to get the Oxygen screen (see Figure 1-15); press Enter and the screen as seen in Figure 1-16 will appear.

(5.) Press on the → key to hi-light HIGH CAL (figure 1-20); press Enter, and screen as seen in Figure 1-21 will appear. Press ENTER again, and the value will set at 15%.

Figure 1-20

Figure 1-21

(6.) Press Measure and computer will return back to the main screen (Figure 1-19).

h. (HWCO) CO Analyzer – click on START ANALYZER CHECK (main computer – Figure 1-7). A timer will start and will not let operator proceed to the next analyzer until it times out (approximately 14 minutes or 850 seconds).

i. (HWCO) At the CEMS cabinet (Servomex CO analyzer), zero gas will automatically be sent to the analyzer. Allow the zero gas to flow for about three minutes and then set the CO to zero. This is done by performing the following steps:

(1.) Press Menu and screen as seen in Figure 1-11 will appear.

(2.) Press Enter (CALIBRATE), operator will then be asked to enter a password (0000), as seen in Figure 1-12. Press Enter and the screen as seen in Figure 1-13 will appear.

(3.) Press Enter (MANUAL CAL); and screen as seen in Figure 1-14 will appear.

(4.) Assure the screen reads CO; press Enter.

(5.) Assure that LOW CAL is hi-lighted (see Figure 1-16) and press Enter. Press Enter again and the computer will set the value to zero. If a screen such as Figure 1-18 (CO instead of OXYGEN) appears, assure that Y (YES) is hi-lighted then press Enter.

(6.) Press Measure and computer will return back to the main screen (Figure 1-19).

j. (HWCO) The analyzer will then automatically switch (210 seconds) to span gas (151ppm). Allow the span gas to flow for approximately 3-½ minutes and then set the span according to the following:

(1.) Press Menu and the screen as seen in Figure 1-11 will appear.

(2.) Press Enter (CALIBRATE); operator will be asked to enter a password (0000) and press Enter. The screen as seen in Figure 1-13 will appear.

(3.) Press Enter (MANUAL CAL); the screen as seen in Figure 1-14 will appear.

(4.) Press Enter and the screen as seen in Figure 1-16 will appear.

(5.) Press on the → key to hi-light HIGH CAL (see Figure 1-20); press Enter and screen as seen in Figure 1-22 will appear. Press Enter again, and the value will set at 151 ppm.

Figure 1-22

k. (HWCO) Press Measure and computer will return back to the main screen (Figure 1-19). The analyzer will automatically switch (240 seconds) to 1,650 ppm gas. Allow this gas to flow for 360 seconds, or 6 minutes (no adjustments are required).

l. (HWCO) OPACITY Analyzer – click on START CALIBRATION (see Figure 1-7). Calibration of this machine is done automatically. A timer will start and will not let operator proceed to the next analyzer until it times out (approximately 30 seconds).

m. (HWCO) $NO_x$ Analyzer – click on START ANALYZER CHECK (see Figure 1-7). A timer will start and will not let operator proceed to the next analyzer until it times out (approximately 13-½ minutes, or 800 seconds).

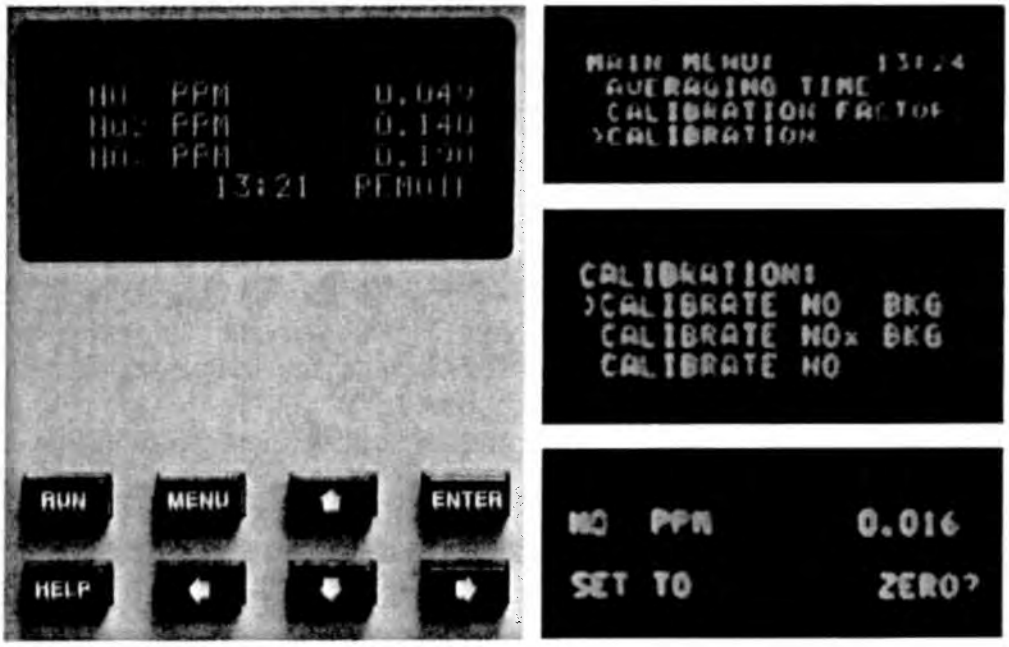



Figure 1-23 (NOx Analyzer)

n. (HWCO) At the CEMS Cabinet ($NO_x$ analyzer – Figure 1-23), zero gas will automatically be sent to the analyzer. Allow the gas to flow for about five minutes and then set the NO and $NO_x$ to zero. This is done by the performing following steps:

(1.) Setting analyzer to zero.

(a.) The analyzer must be in LOCAL MODE to calibrate. Press ENTER button; this will toggle between LOCAL and REMOTE MODE. Place in LOCAL MODE.

(b.) Press MENU.

(c.) Using ↑ ↓ select CALIBRATION and press ENTER.

(d.) Using ↑ ↓ select CALIBRATE NO BKG and press ENTER.

(e.) Need to set this NO value to zero – press ENTER.

(f.) Press MENU; computer will return back to CALIBRATION screen.

(g.) Using ↑ ↓ select CALIBRATE NOx BKG and press ENTER.

(h.) Need to set this NOx value to zero – press ENTER.

(i.) Press MENU; computer will return back to CALIBRATION screen.

(2.) Setting analyzer to span gas. At the six minute mark, the analyzer will automatically switch from zero gas to span gas. Allow the span gas to flow for four to five minutes and then set the span using the following steps:

(a.) Using ↑ ↓ select CALIBRATE NO and press ENTER.

(b.) Need to set this NO value to the span gas value (3,610 ppm) – press ENTER.

(c.) Press MENU; computer will return back to CALIBRATION screen.

(d.) Using ↑ ↓ select CALIBRATE NOx and press ENTER.

(e.) Need to set this NOx value to the span gas value (3,610 ppm) – press ENTER.

(f.) Press RUN; computer will return back to regular screen.

(g.) Press ENTER button; this will toggle from LOCAL back to REMOTE mode.

o. (HWCO) If an analyzer will not calibrate, notify a qualified person to calibrate the analyzer.

**NOTE: ON THE FIRST DAY OF STARTUP, THE ANALYZERS ARE TO BE CALIBRATED AS LISTED ABOVE. ON THE FOLLOWING DAYS, A CALIBRATION CHECK MUST BE DONE AND RECORDED/FILED FOR EACH DAY (THIS SHOULD BE COMPLETED AT APPROXIMATELY THE SAME TIME EACH DAY). AT THE END OF THE FINAL SHIFT FOR THE WEEK, THIS MUST BE DONE ALSO. CALIBRATION CHECKS WILL BE COMPLETED BY PERFORMING THE FOLLOWING:**

p. (HWCO) CEMS ANALYZER CHECK (Main Panel)

(1.) Click on GAS MONITORING. The screen as seen in Figure 1-24 will appear on the right screen.

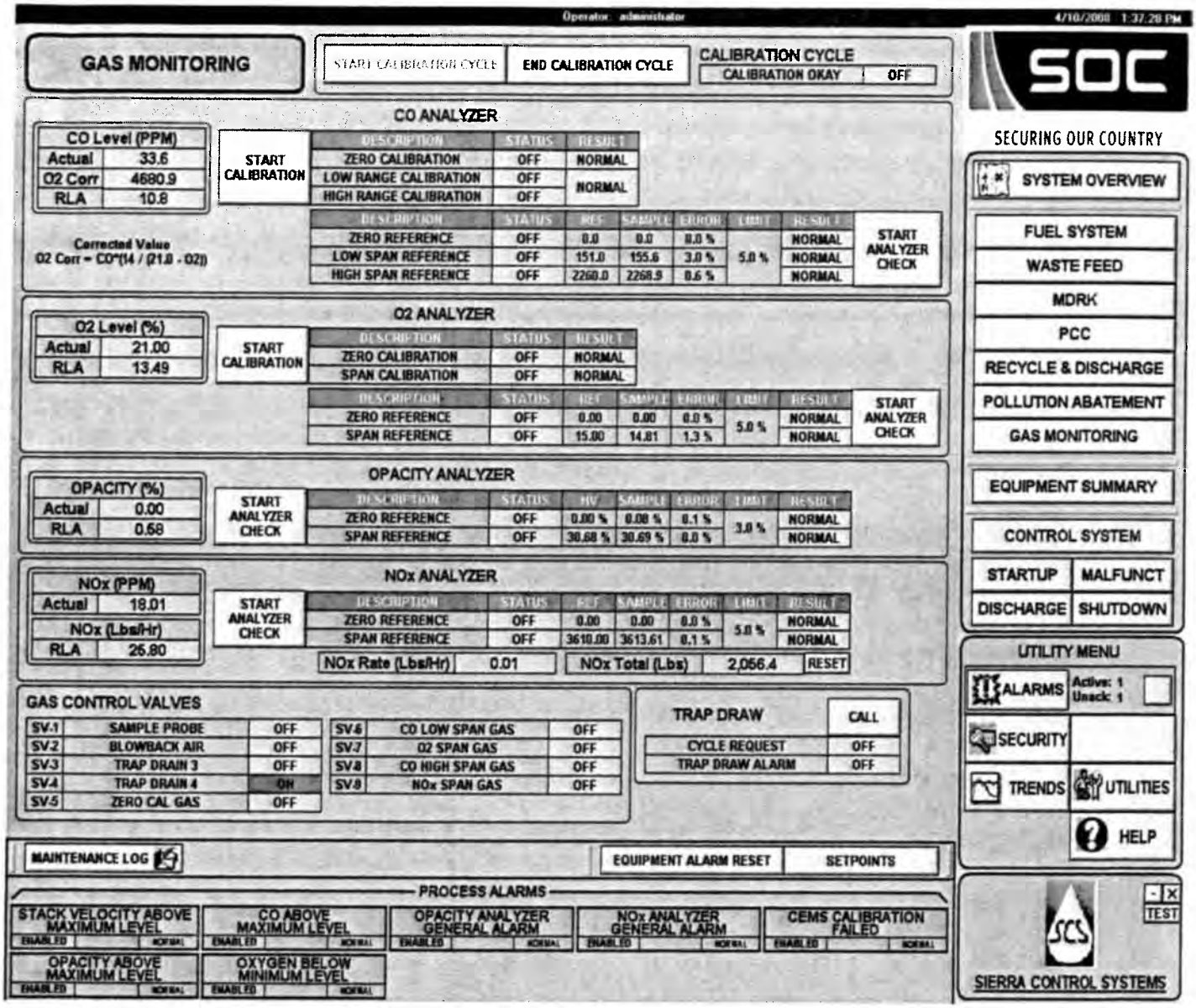



Figure 1-24
(Gas Monitoring Screen)

(2.) Click on START CALIBRATION CYCLE. Assure that all the valves are opened on the calibrations gases before any calibrations start. Check expiration date on each gas cylinder making sure it hasn't expired. Check each gage on each gas cylinders making sure there is adequate gas for the test. When the gases are flowing, the regulator should be set at 18 psi.

(3.) $O_2$ Analyzer – click on START ANALYZER CHECK. A timer will start and will not let operator proceed to the next analyzer until it times out (approximately 7 minutes or 400 seconds).

(4.) CO Analyzer – click on START ANALYZER CHECK. A timer will start and will not let operator proceed to the next analyzer until it times out (approximately 14 minutes or 850 seconds).

(5.) $NO_x$ Analyzer – click on START ANALYZER CHECK. A timer will start and will not let operator proceed to the next analyzer until it times out (approximately 12 minutes or 740 seconds).

(6.) Once all of the ANALYZER CHECKS have been completed, take a snapshot of the GAS MONITORING page using SNAGIT. Assure that the time and date are visible in the picture. File the picture in the filing cabinet under DAILY CALIBRATION CHECK.

Figure 1-25

(7.) If the analyzers are out of calibration by more than 0.5%, calibrate them as shown above (Figure 1-25). If the analyzers are out of calibration by more than 5%, notify one of the following to calibrate the analyzer:

(a.) Jeff Matheny, ext 7558 or cell 316-0668
or
(b.) Greg West, ext 7563 or cell 316-0738

(8.) Click on END CALIBRATION CYCLE. Close valves on all calibration gases.

5. Start ID (Induced Draft) Fan on STARTUP SEQUENCE Page 1 (refer to Figure 1-5, Main Panel).

**NOTE: The system start-up is manual from the main control panel or from the Pollution Abatement System (PAS) Panel. The operator starts or enables each piece of equipment individually, except for some conveyors that start automatically.**

a. (HWCO) Check Permissives –

CEMS Calibration OK
Baghouse Inlet Valve CLOSED
Baghouse Outlet Valve CLOSED
Baghouse By-Pass Valve OPENED
Bag Leak Detector OK

b. (HWCO) Under the SEQUENCE column, click on ID FAN (Figure 1-5); the following (as seen in Figure 1-26) will appear on screen 2:

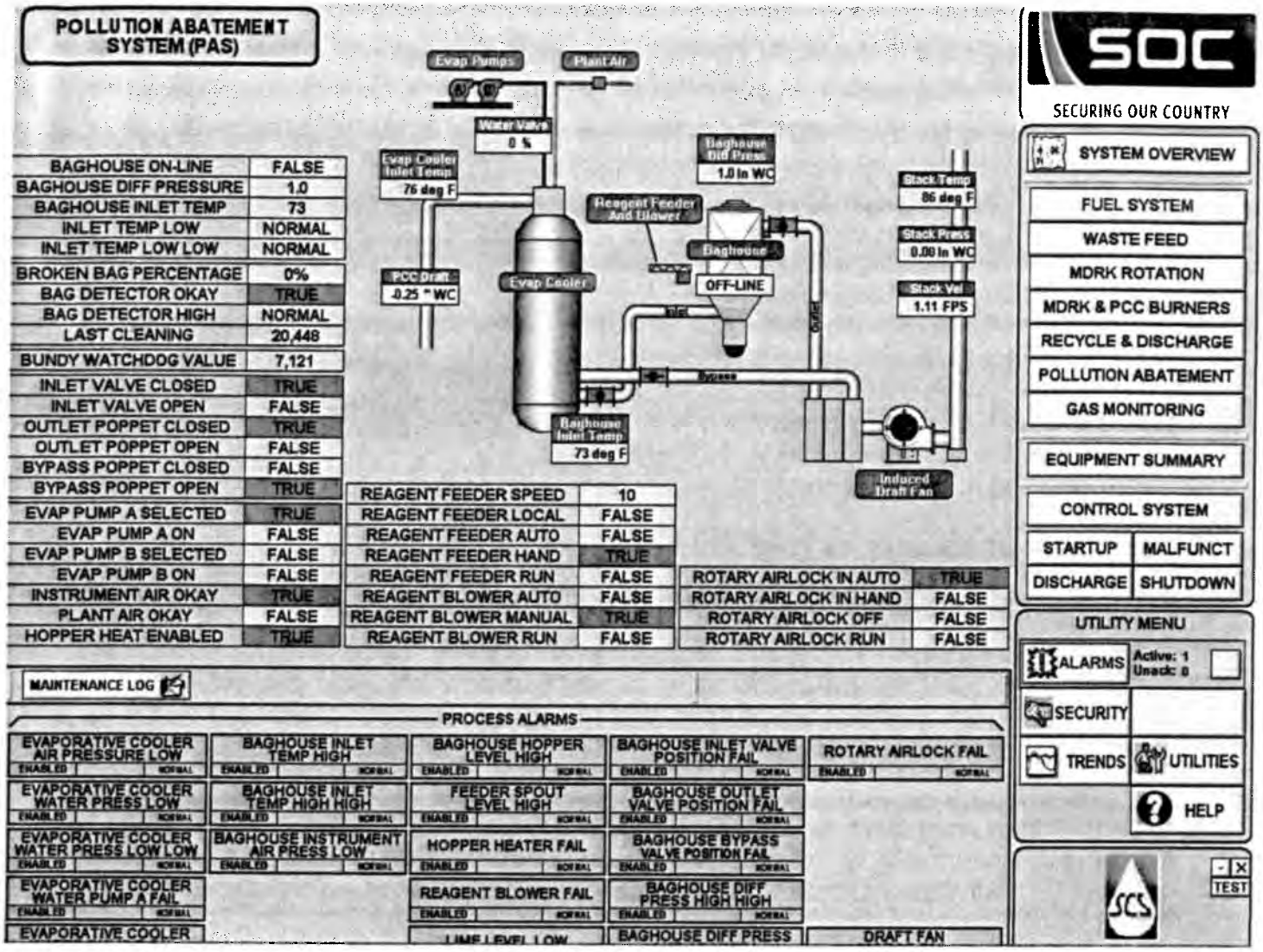



Figure 1-26 (PAS)

c. (HWCO) Set ID Fan at 16HZ – click on START.

d. (HWCO) At the Pollution Abatement System (PAS) Panel (Figure 1-27), pull up the Baghouse Screen by pressing the baghouse button.

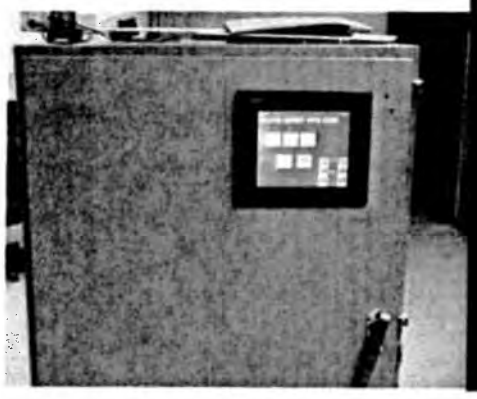


Figure 1-27 (PAS Panel)

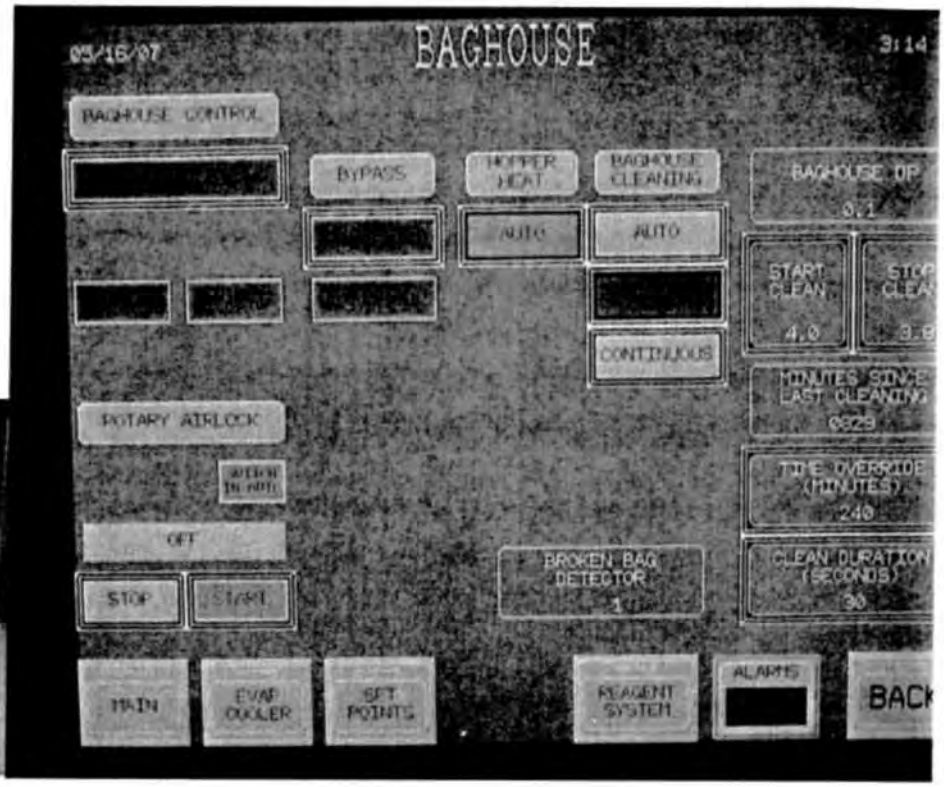



Figure 1-28 (BAGHOUSE screen)

e. (HWCO) BAGHOUSE screen (Figure 1-28) – assure that the baghouse hopper heat is in AUTO, press AUTO under baghouse cleaning cycle, and press START rotary airlock.

f. (HWCO) Press on Evaporative cooler (Figure 1-29) screen and press START water pump.

6. At the main control panel (Figure 1-5), click on CONFIRM for the following:

   Baghouse Hopper Heater.
   Evaporative Cooler Water Pumps.
   Baghouse Cleaning Cycle.
   Rotary Airlock.

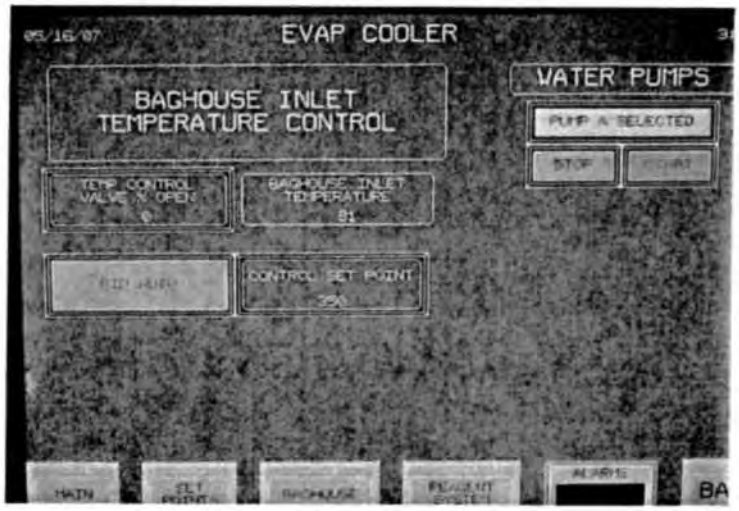



Figure 1-29 (Evaporative Cooler Screen)

7. On the STARTUP SEQUENCE PAGE 1 (Figure 1-5), click on PAGE 2 and the following screen will appear (Figure 1-30):

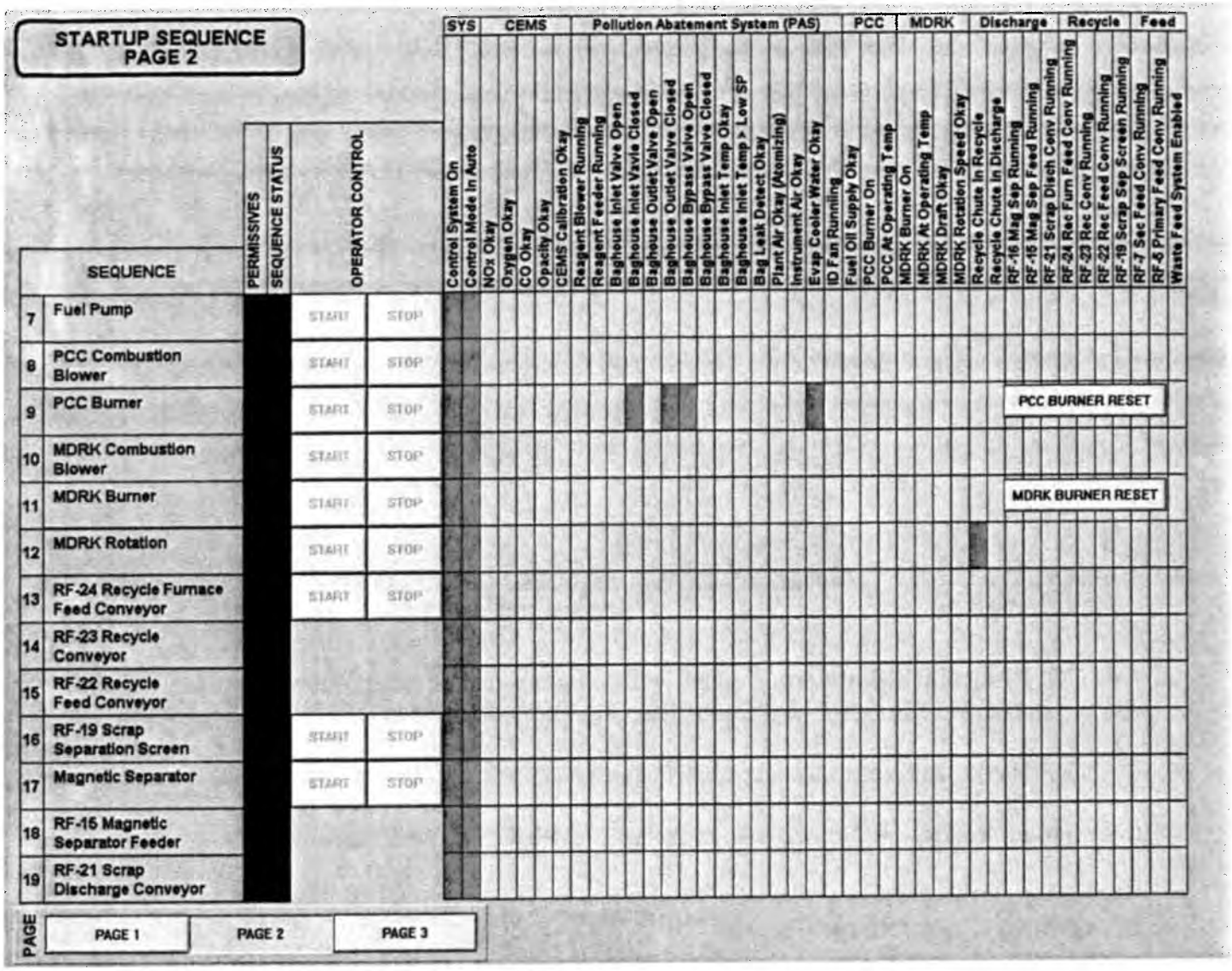



Figure 1-30 (Startup Sequence, Page 2)

8. Start Fuel Pump

   a. (HWCO) Under the SEQUENCE column, click on FUEL PUMP. The following FUEL SYSTEM screen will appear on the right screen (Figure 1-31) of the Main Control Panel.

   b. (HWCO) Fuel Pump – Click on START to initiate Pump A (Figure 1-30). Watch screen 2 until PRESSURE (AT MDRK) comes on (Figure 1-31). Start Pump B at the MCC panel in the Mechanical Room. Record the number of gallons of fuel in log book.

   c. (HWCO) PCC Combustion Blower (Figure 1-30) – Click on START.

9. Start PCC Burner (Figure 1-30).

   a. (HWCO) Check Permissives –

      NOx OK
      OXYGEN OK
      CO OK
      Opacity OK
      Baghouse Inlet Valve CLOSED
      Baghouse Outlet Valve CLOSED
      Baghouse By-Pass Valve OPENED
      Plant Air Supply OK
      Evaporative Cooling Water OK
      ID Fan RUNNING
      Fuel Oil Supply OK
      MDRK Draft OK

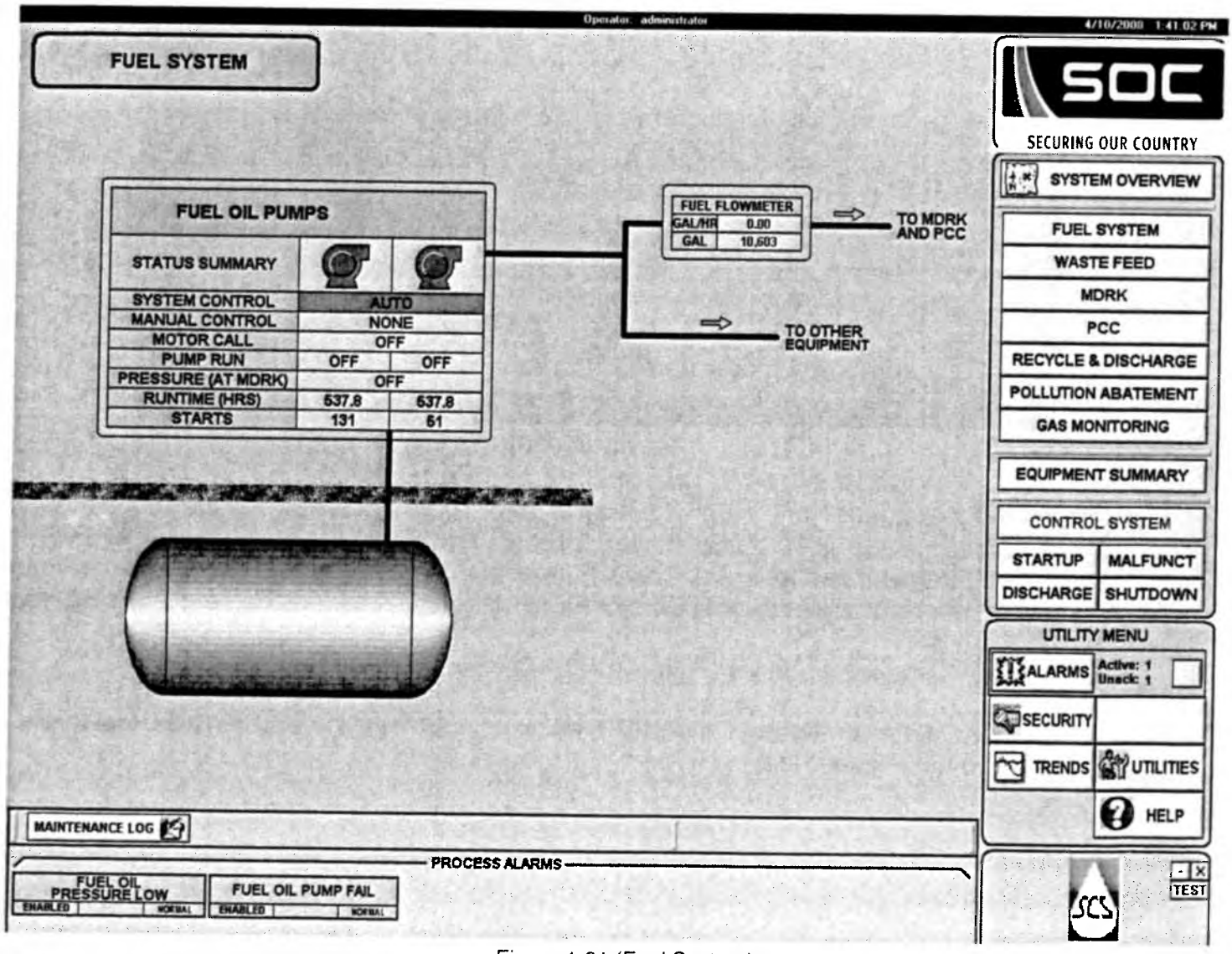



Figure 1-31 (Fuel System)

b. (HWCO) Under the SEQUENCE column (Figure 1-30), click on PCC Burner. The following screen will appear on the right screen of the Main Control Panel (Figure 1-32):

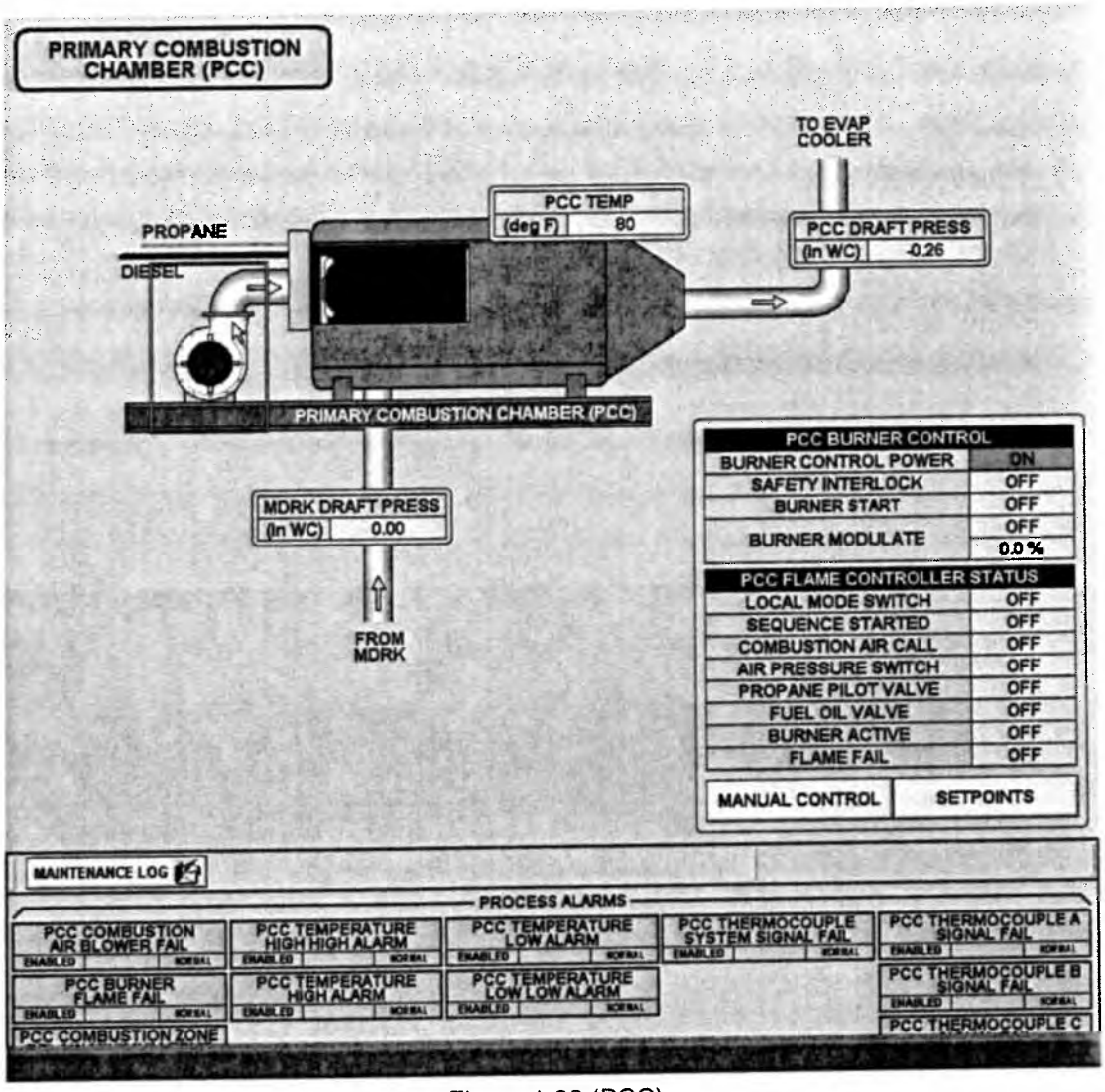



Figure 1-32 (PCC)

c. (HWCO) PCC Burner (Figure 1-30) – Click on START. It takes several minutes to go through the start up sequence. If PCC doesn't start, click on PCC BURNER RESET (on STARTUP SEQUENCE Page 2) and try again. Check Burner status by having PCC Burner page (Figure 1-32) up on the right screen of Main Control Panel. Log start time and fuel reading in log book.

10. (HWCO) MDRK Combustion Blower (Figure 1-30) – Click on START.

11. Start Munitions Detonation Rotary Kiln (MDRK), located on STARTUP SEQUENCE Page 2 on Main Control Panel (Figure 1-30):

a. (HWCO) Check Permissives –
   - NOx OK
   - OXYGEN OK
   - CO OK
   - Opacity OK
   - ID Fan RUNNING
   - Fuel Oil Supply OK
   - PCC Burner ON
   - PCC at Operating Temperature (1,650 °F)
   - MDRK Draft OK

b. (HWCO) Under the SEQUENCE column located on STARTUP SEQUENCE Page 2 on Main Control Panel, click on MDRK Burner (Figure 1-30); the following screen will appear (Figure 1-33):

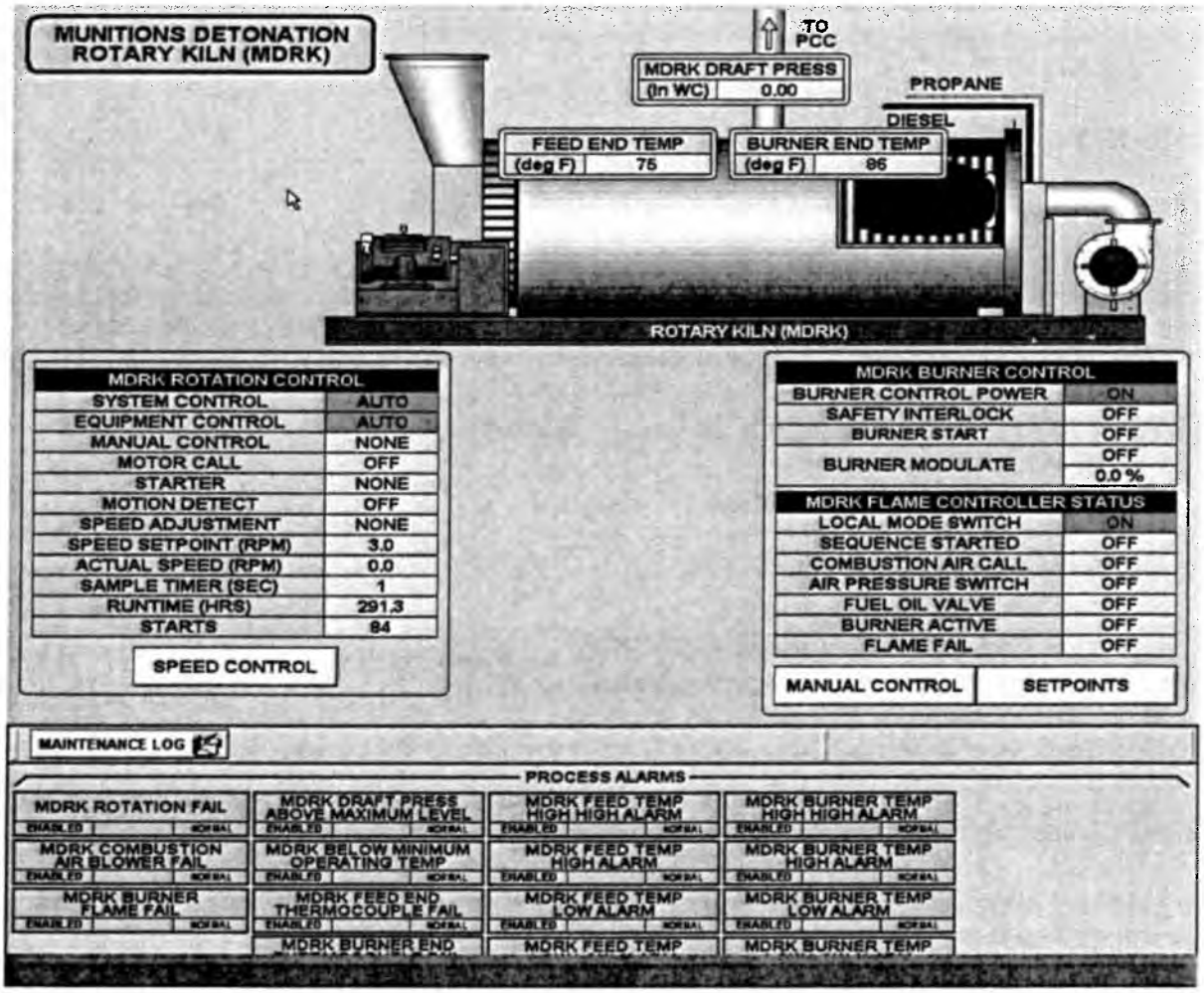



Figure 1-33 (MDRK)

c. (HWCO) MDRK Burner (Figure 1-30) – Click on START. It takes several minutes to go through the start up sequence. If MDRK does not start, click on MDRK BURNER RESET (STARTUP SEQUENCE Page 2) and try again. Check Burner status by having MDRK Burner page up on the right screen of Main Control Panel.

12. Start MDRK Rotation located on STARTUP SEQUENCE Page 2 on Main Control Panel (Figure 1-30):

    a. (HWCO) Check Permissives – Discharge chute RECYCLE.

    b. (HWCO) MDRK Rotation – Click on START.

13. Start RF-24 Recycle Furnace Feed Conveyor (Figure 1-30).

    a. (HWCO) Check Permissives – MDRK Rotation Speed OK.

    b. (HWCO) RF-24 Recycle Furnace Feed Conveyor – Click on START.

        (1.) RF-23 Recycle conveyor starts automatically (if MDRK is rotating and RF-24 is running).

        (2.) RF-22 Recycle conveyor starts automatically (if MDRK is rotating and RF-24 and RF-23 are running).

14. Start RF-19 Scrap Separation Screen (Figure 1-30).

    a. (HWCO) Check Permissives –
        MDRK rotation speed OK
        RF-24 Recycle Conveyor RUNNING
        RF-23 Recycle Conveyor RUNNING
        RF-22 Recycle Conveyor RUNNING

    b. (HWCO) RF-19 Scrap Separation Screen – Click on START.

15. Start Magnetic Separator (Figure 1-30).

    a. (HWCO) Check Permissives –
        MDRK Rotation Speed OK
        RF-24 Recycle Conveyor RUNNING
        RF-23 Recycle Conveyor RUNNING
        RF-22 Recycle Conveyor RUNNING
        RF-19 Scrap Separation Screen RUNNING

    b. (HWCO) Magnetic Separator – Click on START.

        (1.) RF-15 Magnetic separator feeder conveyor starts automatically (if MDRK rotation speed is OK, and RF-16 Magnetic separator, RF-24, RF-23, RF-22, and RF-19 are RUNNING).

            (a.) RF-21 Scrap discharge conveyor starts automatically (if MDRK rotation speed is OK, and RF-15, RF-16, RF-24, RF-23, RF-22, and RF-19 are RUNNING).

            (b.) Click on PAGE 3, located at bottom of STARTUP SEQUENCE Page 2 (Figure 1-30). The following screen will appear (Figure 1-34):

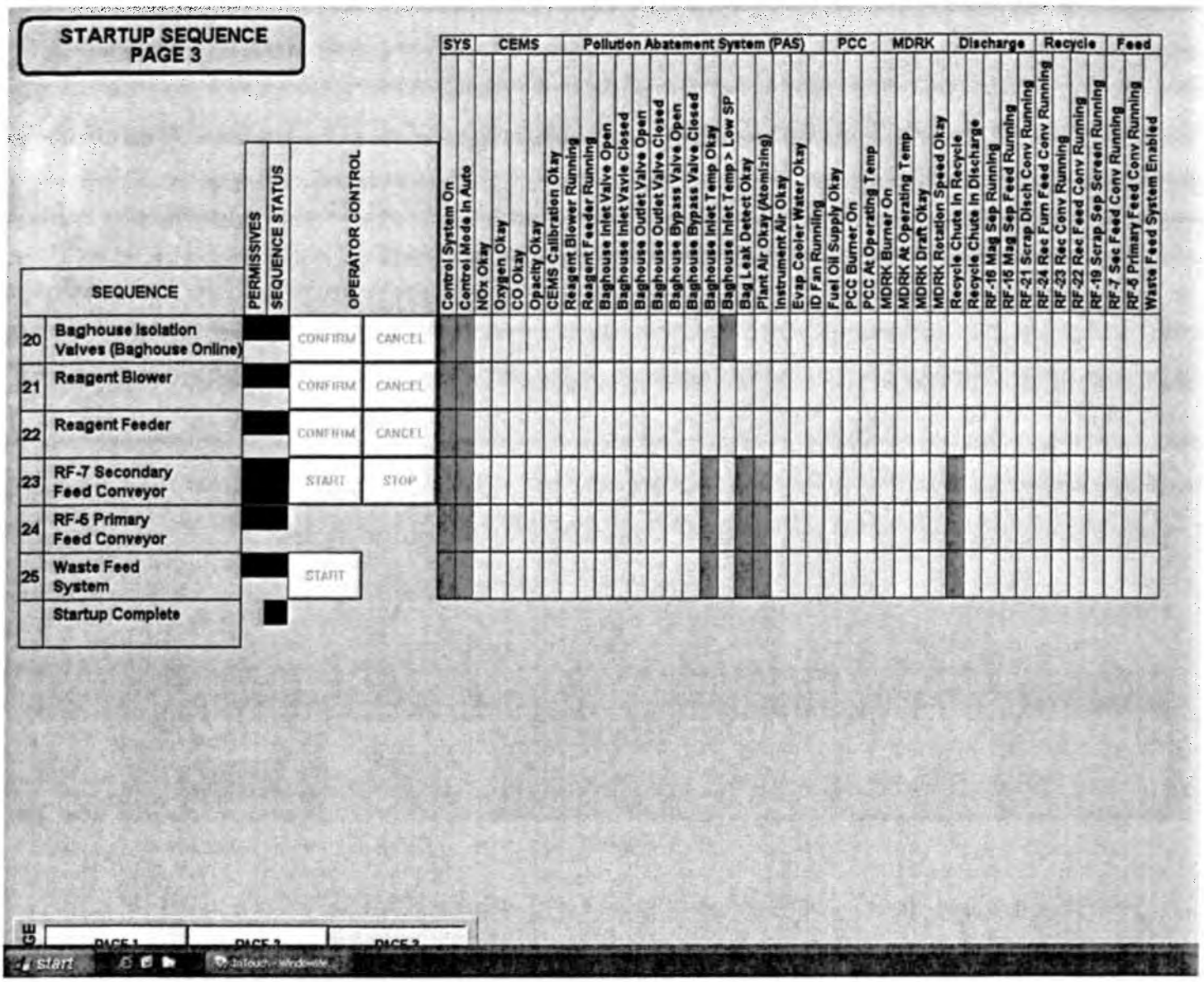



Figure 1-34 (Startup Sequence Page 3)

16. Baghouse Isolation Valves – Bringing Baghouse on line (PAS Panel).

    a. (HWCO) Check Permissives – Baghouse inlet temperature is above LOW SET POINT.

    b. (HWCO) Baghouse Isolation Valve – Baghouse Online (PAS Panel) – Under BAGHOUSE CONTROL, press the red button OFF LINE (Figure 1-35). This will open both the inlet and outlet valves and will show up on the screen in green as INLET OPEN and OUTLET OPEN. OFF LINE will change from red to green and read ON LINE.

    c. (HWCO) Under the BYPASS (Figure 1-35), press the red button OPEN. This will close the bypass valve and will show up on the screen in green as BYPASS CLOSED. OPEN will change from red to green and read CLOSED. Confirm baghouse is online (Figure 1-34) on Main Panel (STARTUP SEQUENCE).

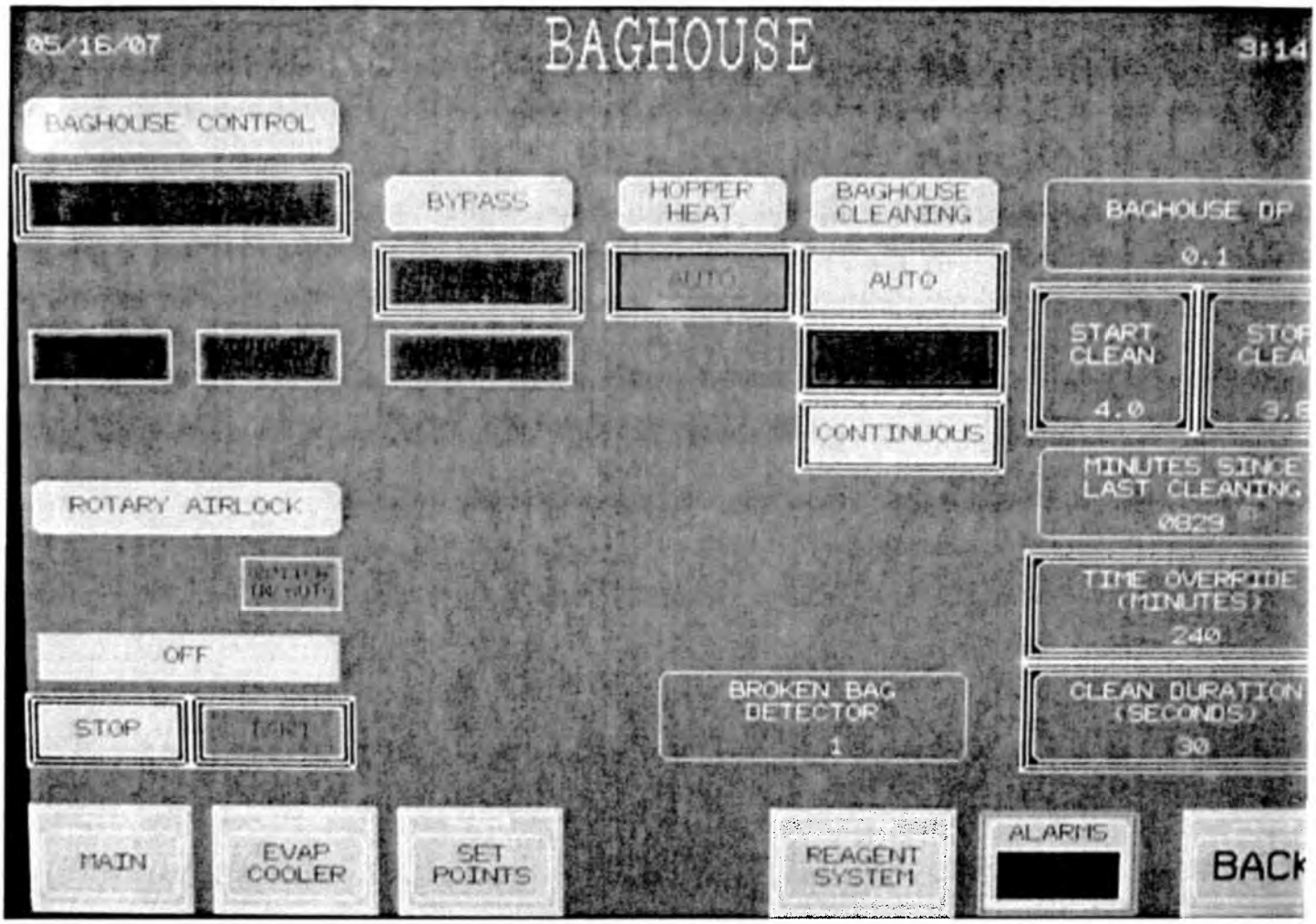



Figure 1-35

17. (HWCO) Reagent Blower – PAS Panel (Figure 1-36) – Press START.

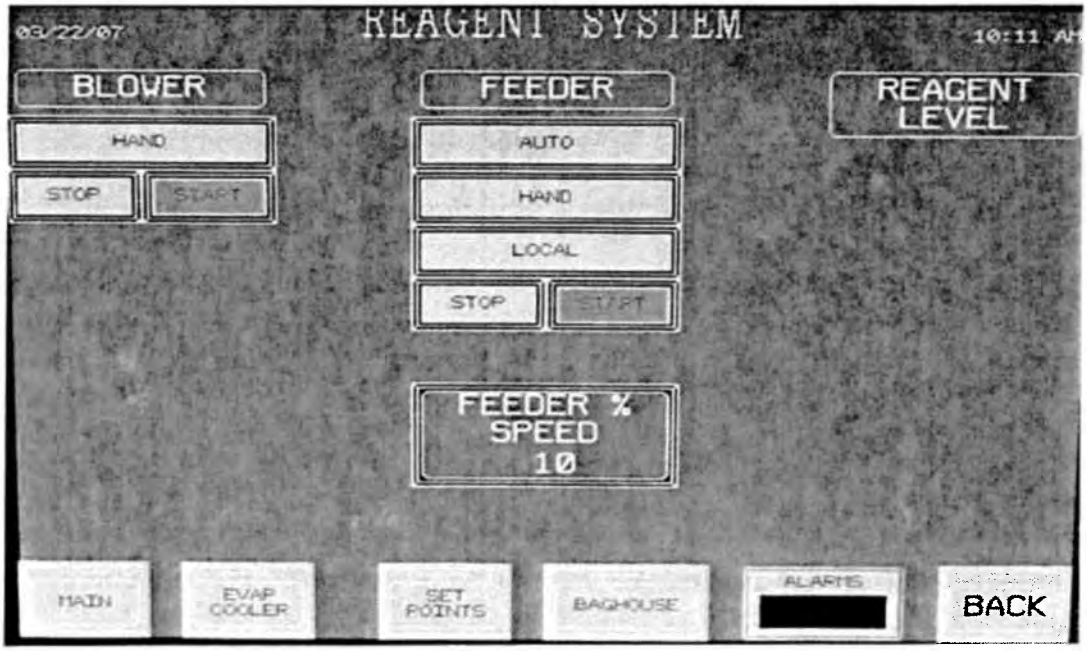



Figure 1-36

18. (HWCO) Start Reagent Feeder (PAS Panel) (Figure 1-36). Before reagent feeder can be started, the stack temperature should be at least 220°F, there should be no moisture in baghouse, and broken bag detector is less than 3. (HWCO) Press START.

19. Start RF-7 Secondary Conveyor – MAIN Panel (Figure 1-34).

    a. (HWCO) Check Permissives –
    NOx OK
    OXYGEN OK
    CO OK
    Opacity OK
    Reagent Blower RUNNING
    Reagent Feeder RUNNING
    Baghouse Inlet Valve OPEN
    Baghouse Outlet Valve OPEN
    Baghouse Bypass Valve CLOSED
    Baghouse Inlet Temperature OK
    Bag Leak Detection OK
    Plant Air Supply OK
    Evaporative Cooler Water OK
    PCC at Operating Temperature OK
    MDRK at Operating Temperature OK
    Discharge Chute RECYCLE
    RF-24 Recycle Conveyor RUNNING
    RF-23 Recycle Conveyor RUNNING
    RF-22 Recycle Conveyor RUNNING
    RF-19 Scrap Separation Screen RUNNING

    b. (HWCO) RF-7 Secondary Conveyor (Figure 1-34) – Click on START.

    c. (HWCO) RF-5 Primary Forward Conveyor will automatically start if the following permissives are met (refer to Figure 1-34):
    NOx OK
    OXYGEN OK
    CO OK
    Opacity OK
    Reagent Blower RUNNING
    Reagent Feeder RUNNING
    Baghouse Inlet Valve OPEN
    Baghouse Outlet Valve OPEN
    Baghouse Bypass Valve CLOSED
    Baghouse Inlet Temperature OK
    Bag Leak Detection OK
    Plant Air Supply OK
    Evaporative Cooler Water OK
    PCC at Operating Temperature OK
    MDRK at Operating Temperature OK
    MDRK Draft OK

NOx OK
Discharge Chute RECYCLE
RF-24 Recycle Conveyor RUNNING
RF-23 Recycle Conveyor RUNNING
RF-22 Recycle Conveyor RUNNING
RF-19 Scrap Separation Screen RUNNING
RF-7 Secondary Conveyor RUNNING

20. Start Waste Feed System – Main Panel (Figure 1-34).

    a. (HWCO) Check Permissives –
    NOx OK
    OXYGEN OK
    CO OK
    Opacity OK
    Reagent Blower RUNNING
    Reagent Feeder RUNNING
    Baghouse Inlet Valve OPEN
    Baghouse Outlet Valve OPEN
    Baghouse Bypass Valve CLOSED
    Baghouse Inlet Temperature OK
    MDRK Draft OK
    Discharge Chute RECYCLE
    RF-24 Recycle Conveyor RUNNING
    RF-23 Recycle Conveyor RUNNING
    RF-22 Recycle Conveyor RUNNING
    RF-19 Scrap Separation screen RUNNING
    RF-7 Secondary Conveyor RUNNING
    RF-5 Primary Forward Conveyor RUNNING

    b. (HWCO) Waste Feed System (Figure 1-34) – Click on START; this completes the startup sequence.

21. Complete and sign "Daily Operational Check List" (refer to Figure 1-37).

**SPECIAL REQUIREMENT:**

1. **THE DAILY OPERATIONAL CHECK LIST WILL BE COMPLETED AFTER MAINTENANCE PERSONNEL HAVE PERFORMED NORMAL START-UP IN ACCORDANCE WITH MAINTENANCE CHECK SHEET.**

## DAILY OPERATIONAL CHECK LIST
## (EXAMPLE ONLY)

**BUILDING NO:** 117-3 **SOP NO:** HW-0000-K-006

**DATE:** _____ **TIME:** _____

1. Fire Protection:

   a. Fire extinguishers properly sealed and tagged. _____

2. Road Barricades:

   a. Ensure road barricades are in position blocking roads leading to the back of 117-3. _____

3. Personnel exits are not obstructed. _____

4. Verify that all telephones in building are operational. _____

**Remarks:** _____

_____

_____

_____

_____

_____

_____

_____

**SIGNATURE:** _____

Figure 1-37

**STANDING OPERATING PROCEDURE:**
Various Munition Items, Detonate in RF9 Furnace

**OPERATION 2**

**Bay 1 or 2**

**SOP**: HW-0000-K-006

**REVISION**

**CHANGE**

**OPERATION:** Receive, Identify, and Unload

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Receive and Identify Munition Items.

   a. (O) Receive items via conveyance.

   b. (O)(QC) Compare items to transfer documentation. Items not identified will be returned to storage.

2. Unload Items and Inspect Pack.

   a. (O) Using a forklift, unload conveyance and place material in incoming storage area, as required.

   b. (O)(QC) Inspect pallets and boxes for presence of PCP crystals. Process PCP contaminated material IAW SOP HW-0000-A-001.

3. Unpalletize boxes.

   a. (O) Bring one pallet of munition items to the work line by means of a forklift. As required, place pallet on lift table.

   b. (O) Cut and remove steel banding and set aside to a cardboard lined palletainer for transfer to PRO.

   c. (O)(QC) Remove boxes and place on work surface. Check each layer of boxes for the presence of PCP crystals. Process PCP contaminated material IAW SOP HW-0000-A-001.

   d. (O) Using diagonal cutters, cut and remove lead wire seal from the box and set it aside to an approved container and process IAW SOP HW-0000-A-001.

4. Transfer:

   a. (O) Serviceable pallets to PRO.

   b. (O) Non-repairable non-PCP contaminated pallets and lead wire seals to PRO.

   c. (O) PCP contaminated pallets to the treated wood landfill.

Document For Reference Only

**STANDING OPERATING PROCEDURE:**
Various Munition Items, Detonate in RF9 Furnace

**OPERATION 3**

**Bay 1 or 2**

**SOP:** HW-0000-K-006

**REVISION**

**CHANGE**

**OPERATION:** Unpack Boxes/Containers

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Unpack Boxes/Containers. See Special Requirements 5 through 9 for 117-3 (refer to Table of Contents for page number).

   a. (O) Cut and/or remove steel straps, seals, wing nuts, clips, and other cover retaining devices from box/container; set aside to an appropriate container.

   b. (O) Remove cover and fillers from outer pack, as required, allowing access to contents in the container; set aside cover and fillers to an appropriate container.

   c. (O) Ammunition packed in hermetically sealed containers – pierce the inner pack (at least 1" in from all outer edges of container) using the corner of non-sparking screwdriver or non-sparking chisel to remove inner air, as required.

**NOTE: DO NOT PIERCE IN CORNER OF CANS.**

   d. (O) Remove inner pack from container and set aside to work station, as required.

   e. (O) Remove item from inner container, as required; set aside inner container to an appropriate container for transfer to PRO and all cardboard to trash.

   f. (O) Empty munition items onto the work table, as required.

   g. (O) Place munition items into 105MM lids, as required. The quantity per lid will depend on the recipe for the munition being run. Refer to Figure 3-1.

Figure 3-1

2. Transfer:

**Verify that all explosive material has been removed from inner and outer containers**

a. (O) Munition items from preparation station to Operation 4, using a forklift or hand cart, as applicable.

b. (O) Metal containers to PRO.

c. (O) Treated wood containers to the treated wood landfill.

d. (O) Spacers, cardboard, etc., to the landfill.

**SPECIAL REQUIREMENT:**

1. **THE 105MM CUPS (LIDS) THAT ARE IN THE CARTS WILL BE INSPECTED FOR CLEANLINESS TO ASSURE THAT PRIMERS WILL NOT COME IN CONTACT WITH ANY DEBRIS THAT MAY BE PRESENT. THE 105MM CUPS (LIDS) SHOULD BE INSPECTED AT THE BEGINNING OF JOB START, AT THE BEGINNING OF EACH WORK WEEK, AND AS NECESSARY, BASED ON SUPERVISOR'S DISCRETION.**

UNCONTROLLED DOCUMENT

**STANDING OPERATING PROCEDURE:**
Various Munition Items, Detonate in RF9 Furnace

**OPERATION 4**

**Bay 1 and Control Room**

**SOP:** HW-0000-K-006

**REVISION**

**CHANGE**

**OPERATION:** Load Munitions onto Conveyor and Monitor Process

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Receive munition items from Operation 3.

2. Once the Waste Feed System has been started, munitions can be fed onto the conveyor.

   a. (O) Feed munitions onto the conveyor at the predetermined rate (recipe for item).

   b. (O)(S) Periodically, using air pressure supported by a separate regulator and air line, clean the Waste Feed Station of debris from the normal feeding operations. Assure air pressure is at or below 30 psi.

**WHEN PERFORMING THIS STEP, OPERATOR WILL WEAR PROPER PPE, WHICH WILL INCLUDE SAFETY GLASSES AND FACE SHIELD. DO NOT USE THE AIR HOSE TO CLEAN PERSONNEL.**

3. Monitor process.

   a. (HWCO)(S) Constant operator monitoring of furnace operation is necessary due to the possibility of restriction/jam of material flow in feed chute, retort, or discharge conveyer (watch video cameras), and because it is required by law (operation of a hazardous waste incinerator).

   b. (HWCO)(S) Pull up the various screens and monitor pressures, temperatures, velocities, air quality, etc., to assure processes are operating correctly.

   c. (HWCO)(QC) Operator will monitor furnace operations and emission controls as items are processed through furnace. If any hazardous conditions are observed, operator will make the necessary adjustments to return to normal conditions; if needed, activate EMERGENCY STOP button and notify Building Supervisor. For restart, refer to Operation 8.

d. (HWCO)(ENV) Immediately following the occurrence of a malfunction, the (HWCO) must fill out a MALFUNCTION COMPLIANCE FORM, along with a MALFUNCTION EVALUATION FORM, to document pertinent information related to the malfunction. These forms need to be completed before the end of shift, with a fax copy sent to Environmental Services (fax 7782) and the original form filed in the filing cabinet at 117-3. Any AWFCO or excess emissions must be reported to Bureau of Air Pollution Control within 24 hours of the excess emissions. Contact Environmental Services as soon as possible after excess emissions.

(1.) Greg West, ext 7563 or cell 316-0738.
or
(2.) Jeff Matheny, ext 7558 or cell 316-0668.

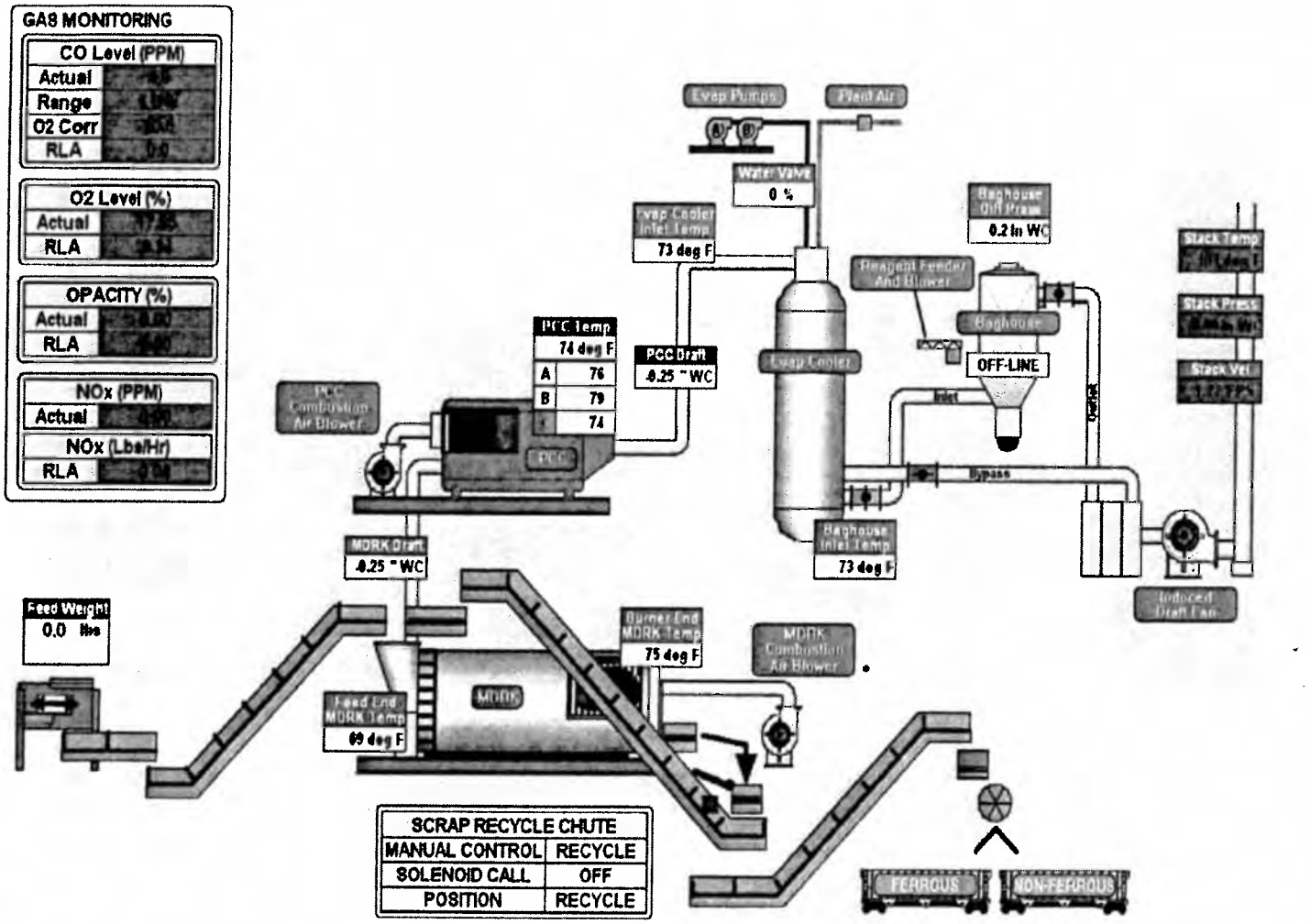



Figure 4-1 (Overview Screen)

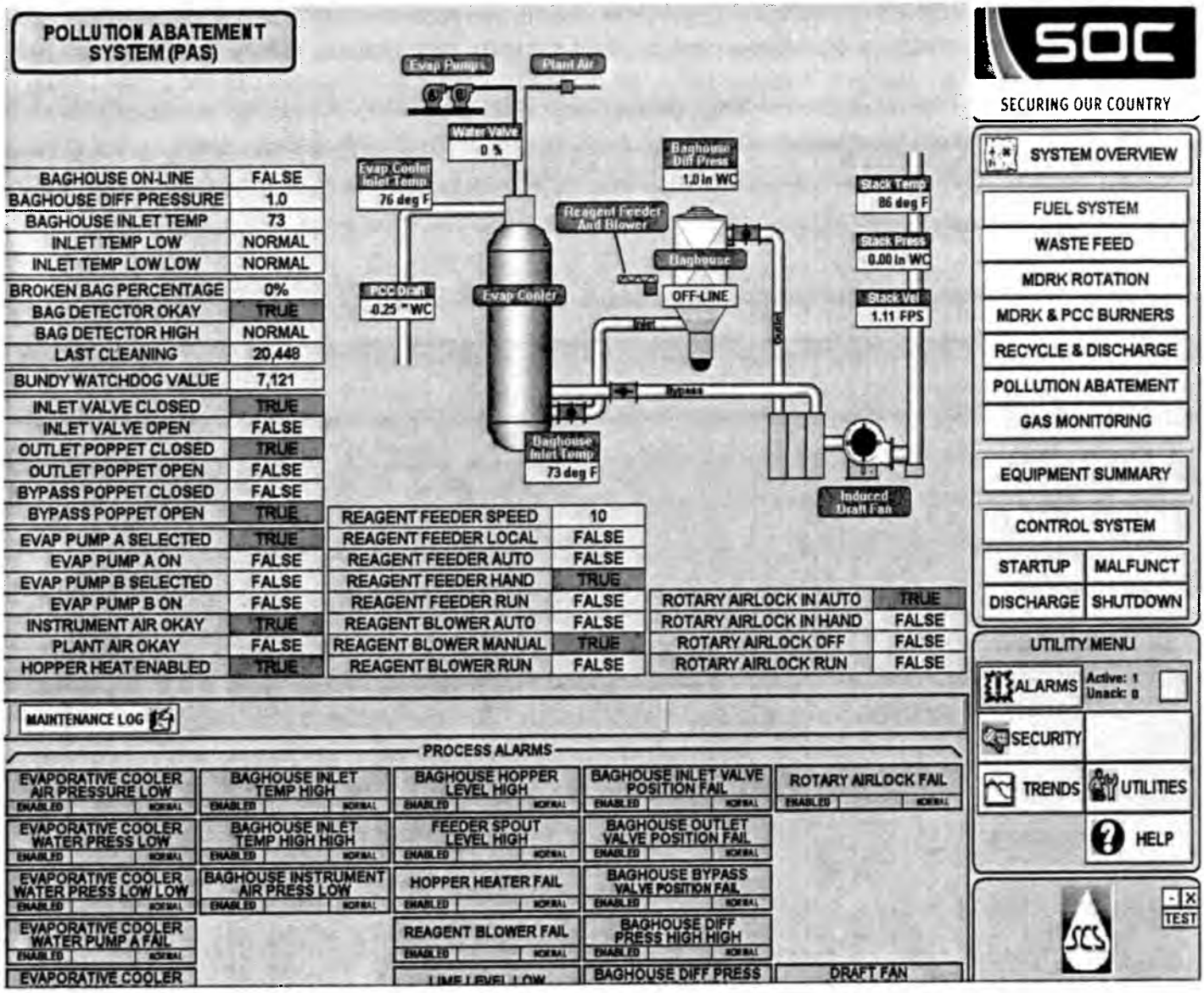



Figure 4-2

e. (HWCO) While monitoring furnace operations, it may become necessary to either increase or decrease ID Fan to control the MDRK draft. This is done by performing the following steps:

(1.) Place the mouse over the Induced Draft Fan on either the SYSTEM OVERVIEW (Figure 4-1) or POLLUTION ABATEMENT (Figure 4-2) screen and CLICK; the DRAFT FAN screen will appear (Figure 4-3).

(2.) Locate the pointer over the MAN SPEED SETPOINT (16 Hz) using the mouse and CLICK. Type in the desired value and enter; this will change the speed of the ID Fan.

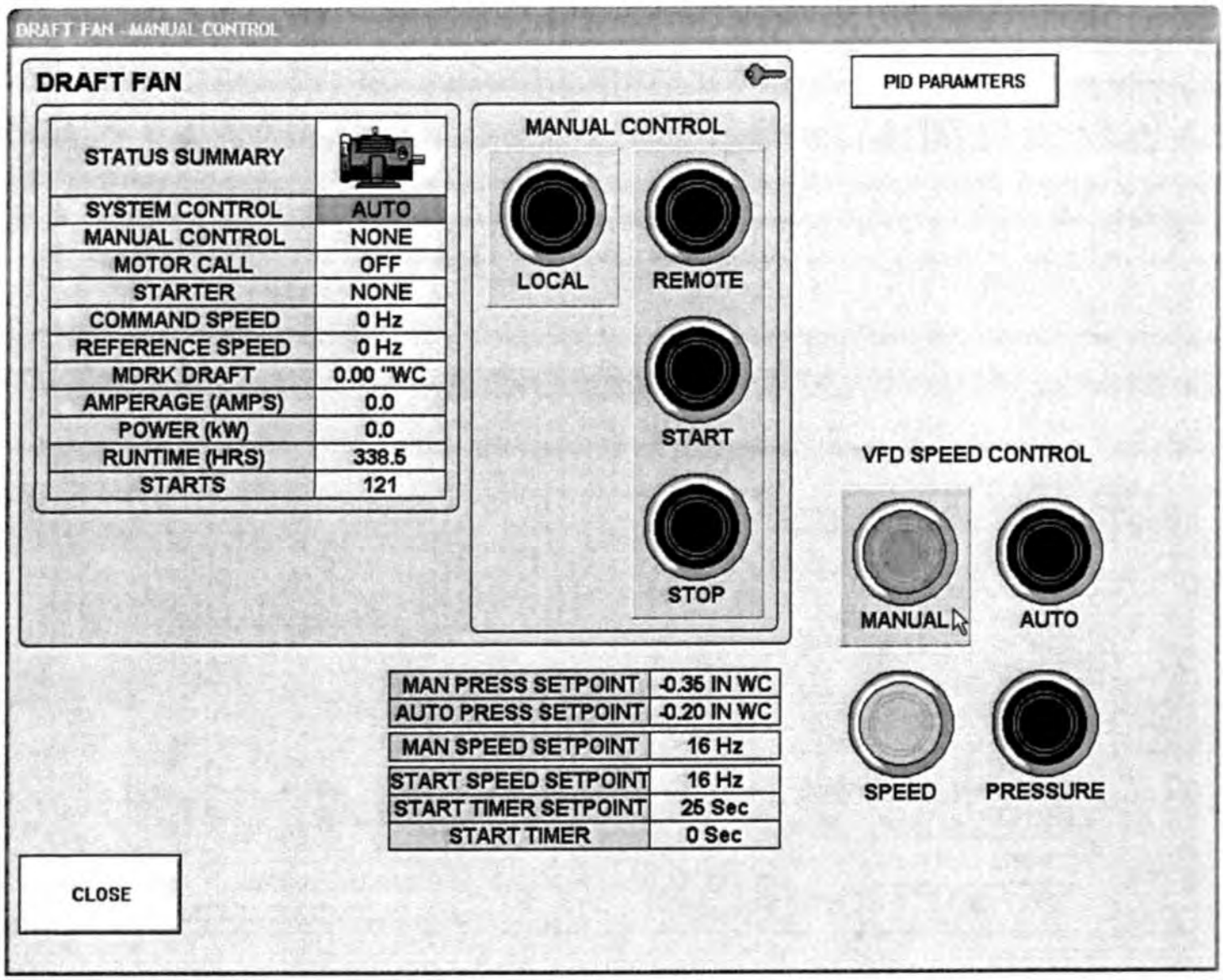



Figure 4-3

f. (HWCO) While monitoring furnace operations, it may become necessary to either increase or decrease MDRK rotation. This is done by performing the following steps:

(1.) From the MDRK Screen in the MDRK Rotation Control box (Figure 4-4), place the mouse over the SPEED CONTROL and CLICK; the MDRK ROTATION CONTROL screen (Figure 4-5) will appear.

(2.) Using the mouse, locate the pointer over the AUTO SETPOINT (RPM) value (3.0) and CLICK. Type in the desired value and hit enter - this will change of the speed of the MDRK rotation. It is recommended to increase/decrease speed in increments of 0.2 RPM at a time.

g. (HWCO) If any alarm (audible and/or visual) is activated, operator will depress the appropriate silence button and address cause of alarm.

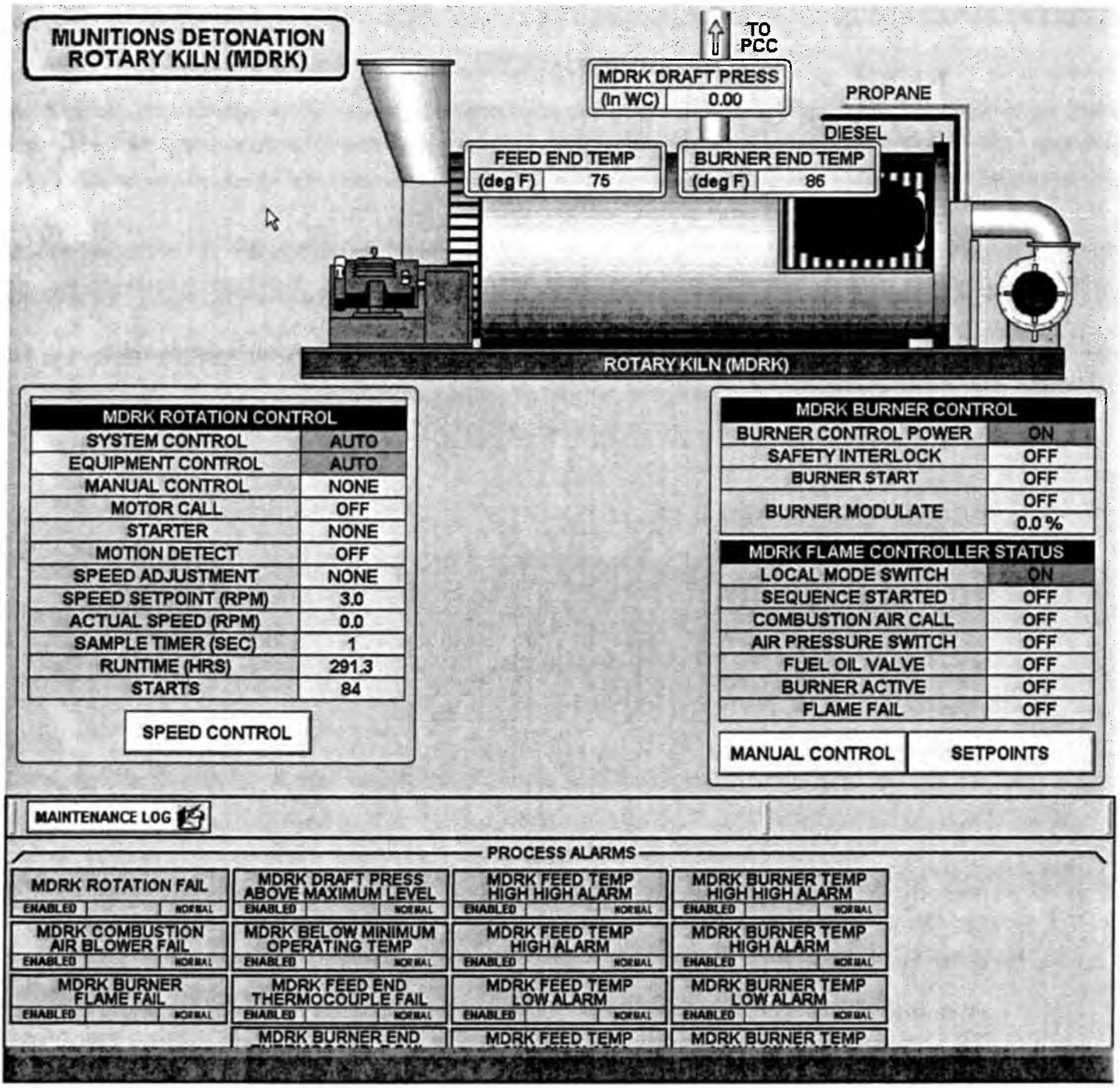
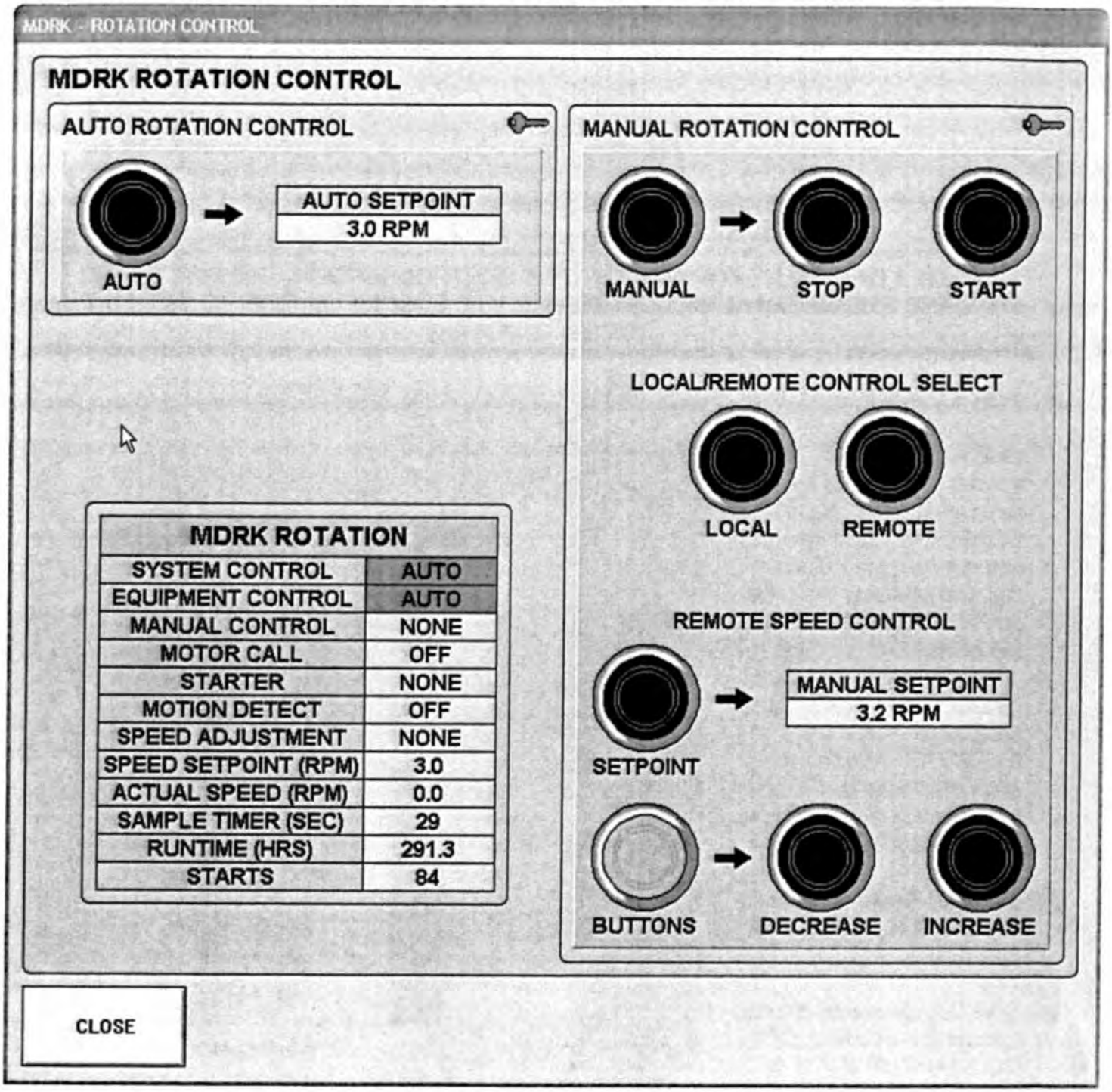

MUNITIONS DETONATION ROTARY KILN (MDRK)
TO PCC
MDRK DRAFT PRESS
(In WC) 0.00
PROPANE
DIESEL
FEED END TEMP
(deg F) 75
BURNER END TEMP
(deg F) 86
ROTARY KILN (MDRK)
MDRK ROTATION CONTROL
SYSTEM CONTROL AUTO
EQUIPMENT CONTROL AUTO
MANUAL CONTROL NONE
MOTOR CALL OFF
STARTER NONE
MOTION DETECT OFF
SPEED ADJUSTMENT NONE
SPEED SETPOINT (RPM) 3.0
ACTUAL SPEED (RPM) 0.0
SAMPLE TIMER (SEC) 1
RUNTIME (HRS) 291.3
STARTS 84
SPEED CONTROL
MDRK BURNER CONTROL
BURNER CONTROL POWER ON
SAFETY INTERLOCK OFF
BURNER START OFF
BURNER MODULATE OFF
0.0 %
MDRK FLAME CONTROLLER STATUS
LOCAL MODE SWITCH ON
SEQUENCE STARTED OFF
COMBUSTION AIR CALL OFF
AIR PRESSURE SWITCH OFF
FUEL OIL VALVE OFF
BURNER ACTIVE OFF
FLAME FAIL OFF
MANUAL CONTROL
SETPOINTS
MAINTENANCE LOG
PROCESS ALARMS
MDRK ROTATION FAIL
MDRK DRAFT PRESS ABOVE MAXIMUM LEVEL
MDRK FEED TEMP HIGH HIGH ALARM
MDRK BURNER TEMP HIGH HIGH ALARM
MDRK COMBUSTION AIR BLOWER FAIL
MDRK BELOW MINIMUM OPERATING TEMP
MDRK FEED TEMP HIGH ALARM
MDRK BURNER TEMP HIGH ALARM
MDRK BURNER FLAME FAIL
MDRK FEED END THERMOCOUPLE FAIL
MDRK FEED TEMP LOW ALARM
MDRK BURNER TEMP LOW ALARM
ENABLED
NORMAL

Figure 4-4




| MDRK ROTATION | |
|---|---|
| SYSTEM CONTROL | AUTO |
| EQUIPMENT CONTROL | AUTO |
| MANUAL CONTROL | NONE |
| MOTOR CALL | OFF |
| STARTER | NONE |
| MOTION DETECT | OFF |
| SPEED ADJUSTMENT | NONE |
| SPEED SETPOINT (RPM) | 3.0 |
| ACTUAL SPEED (RPM) | 0.0 |
| SAMPLE TIMER (SEC) | 29 |
| RUNTIME (HRS) | 291.3 |
| STARTS | 84 |

Figure 4-5

4. Operation Mode – When it is time to discharge the MDRK, click on DISCHARGE (screen 2) and the DISCHARGE SEQUENCE screen will appear (Figure 4-6):

   a. (HWCO) Begin DISCHARGE SEQUENCE – click on BEGIN.

   b. (HWCO) Waste Feed System – click on STOP.

   c. (HWCO) RF-5 and RF-7 Feed Conveyors – click on STOP.

**WHEN A DIFFERENT AMMUNITION ITEM IS INTRODUCED TO THE DEMIL LINE, PROCESS ENGINEERING WILL DETERMINE THE AMOUNT OF TIME TO SET ON THE TIMER. (STEP 4.d)**

   d. (HWCO) Last Pop (Detonations Complete) – click on CONFIRM. The operator listens for the last detonations and hits CONFIRM. If another detonation goes off after this, the operator will click on RESET, and the timer will reset.

   e. (HWCO) Recycle Chute to Discharge – click on EXECUTE. After a set amount of time has expired, the operator will be allowed to go on to the next step.

   f. (HWCO) Recycle Chute to Recycle – click on EXECUTE.

   g. (HWCO) Complete Startup Sequence – click on GO TO STARTUP PAGE 3 (Figure 4-6). This automatically pulls up page 3 of the startup sequence and takes the operator to step 23.

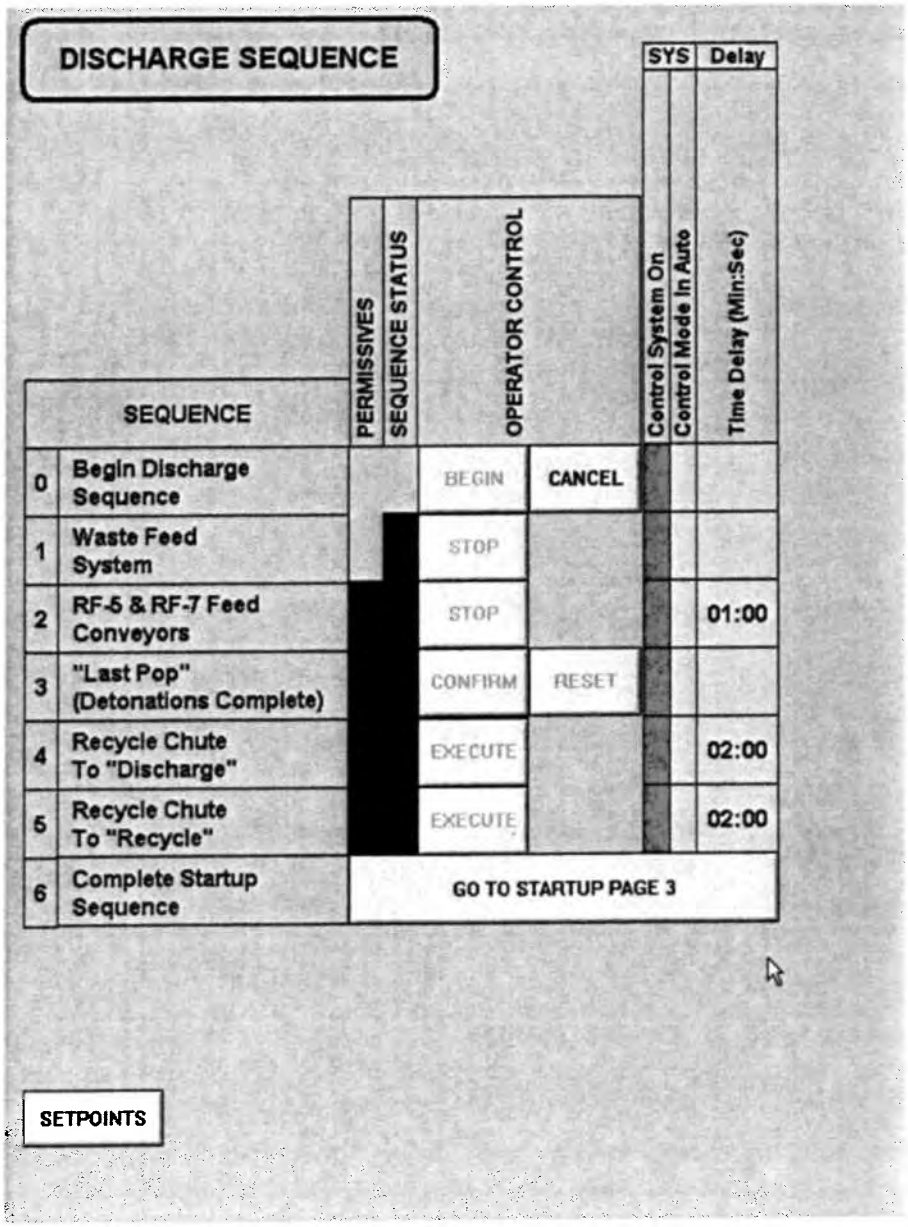



Figure 4-6

h. (HWCO) RF-7 Secondary Feed Conveyor (Figure 4-7) – click on START.

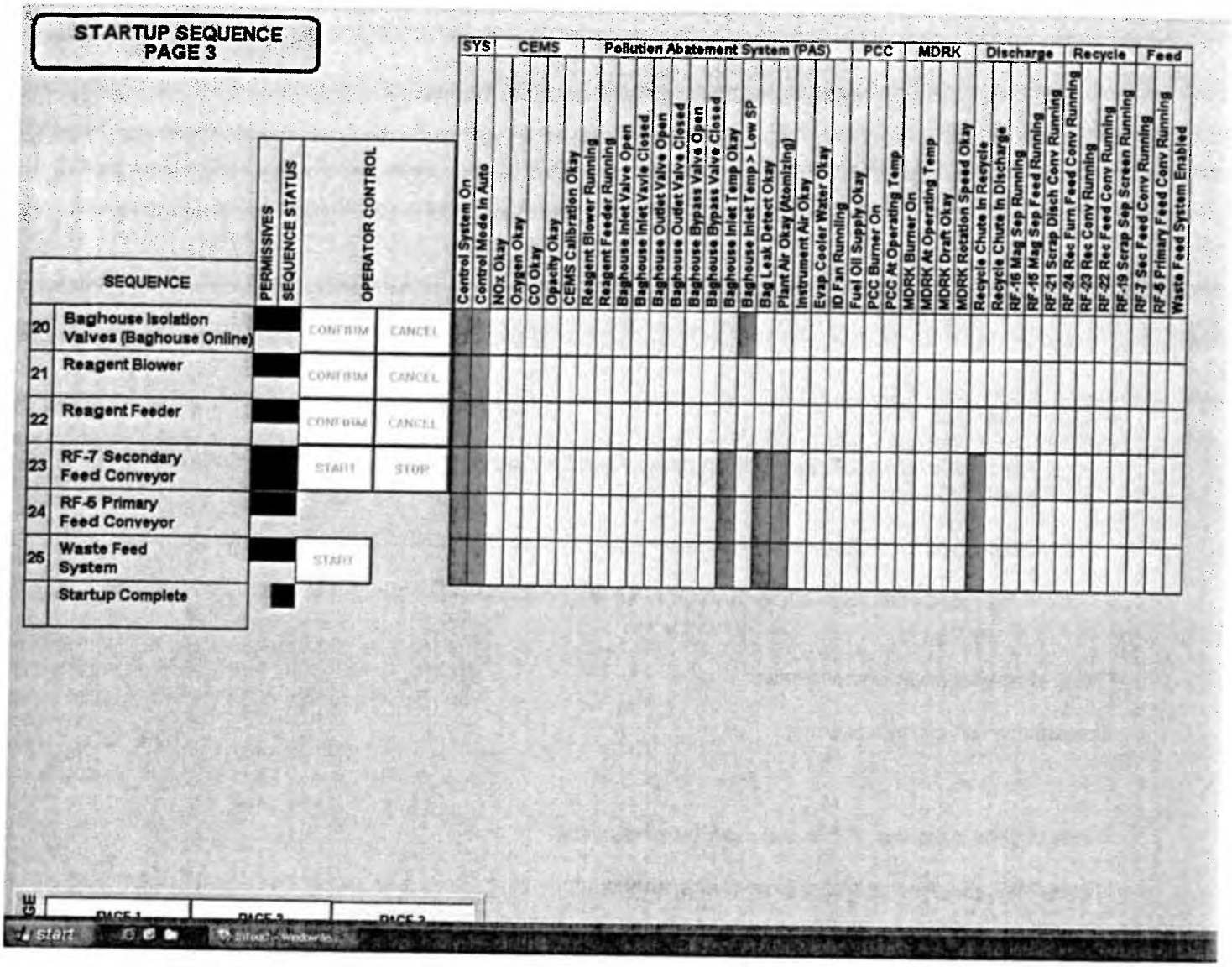



Figure 4-7

i. (HWCO) Waste Feed System – click on START. Start feeding munitions; when it is necessary to discharge, go back to step 4a.

5. Procedure for restrictions/jams.

**The system will automatically go into recycle mode.**

a. (O) Clear jam after required cool down period.

b. (HWCO) Perform start-up in accordance with Operation 8.

(EXAMPLE ONLY)

**RF-9 DEMILITARIZATION SYSTEM**
**MALFUNCTION COMPLIANCE FORM**

Date: Operational shift:

Assigned control room operators:

Malfunction (1, 2, or 3)

1. Automatic Waste Feed Cut-off, Stop Feed, or Belt Timing Error in which the MDRK and PCC continue to operate
2. Stop Feed or Automatic Shutdown in which the MDRK or PCC continue to operate
3. Emergency Shutdown Sequence in which both the MDRK and the PCC are secured

Time of malfunction occurrence:

Description of initiating event:

Time MDRK secured, if not secured automatically:

Time PCC secured, if not secured automatically:

Was established malfunction response followed subsequent to malfunction occurrence? Yes/No

Attach printout of control computer alarm history covering the time period 5 minutes before and after occurrence of the malfunction.

**Notes:**

(EXAMPLE ONLY)

**RF-9 DEMILITARIZATION SYSTEM MALFUNCTION EVALUATION FORM**

Date:

Date of occurrence:

Description of occurrence:

Were operating parameter limits exceeded? Yes/No (If Yes, describe below)

Were emission limits exceeded? Yes/No (If Yes, describe below)

Does occurrence meet definition of malfunction? Yes/No

Was Start-up, Shutdown, and Malfunction Plan Response Plan followed? Yes/No

Cause of occurrence?

---

Does Start-up, Shutdown, and Malfunction Plan require modification to adequately address this occurrence? Yes/No

Actions taken to minimize future frequency and severity of this occurrence:

Approving management signature:

Attach copy of applicable malfunction compliance form.

**Notes**: Revision Number: 1 C-4 Revision Date: September 2004

SPECIAL REQUIREMENTS:

1. IF DOUBT EXISTS CONCERNING JAM LOCATION, BUILDING SUPERVISOR AND MAINTENANCE MECHANIC SHALL MAKE THE DETERMINATION AND WILL DESIGNATE PERSONNEL TO REMOVE JAM. THE SUPERVISOR AND MAINTENANCE MECHANIC WILL DETERMINE IF AN OVERNIGHT COOL DOWN PERIOD IS REQUIRED.

2. NO POUNDING OR PRYING SHALL BE DONE ON THE COMPONENT; COMPONENT SHALL BE REMOVED CAREFULLY.

3. ANY ITEMS FOUND CONTAINING EXPLOSIVES WILL BE REPROCESSED THROUGH THE FURNACE.

**STANDING OPERATING PROCEDURE:**
Various Munition Items, Detonate in RF9 Furnace

**OPERATION 5**

**Outside Building and Bay 1**

**SOP:** HW-0000-K-006

**REVISION**

**CHANGE**

**OPERATION:** Process Scrap

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Process Scrap.

   a. (O) After the overnight cooling period and before restart of the furnace, remove any scrap from area in front of furnace feed chute (outside building). Open the door to the feed chute and carefully remove scrap. Any scrap in front of furnace feed will be returned for reprocessing.

   b. (O)(QC)(S) Visually inspect scrap items. Return any items containing explosives, or questionable items, to building for reprocessing.

   c. (O)(QC)(S) Inspect scrap fragments for complete burn-off each morning after an overnight cooling period of at least eight hours.

      (1.) QA shall inspect each trailer load for non-expended explosive items.

      (2.) Inspection does not entail a 100% inspection of each load; only visual inspection of the surface or near surface of each load is required.

      (3.) If an explosive loaded item is found during inspection of trailer load, notify the APOD Manager, Ext. 7300 or 316-0707.

      (4.) In the event that explosive loaded items are found during inspection of trailer load, the suspect scrap that was processed on the previous work shift shall be inspected 100% for items containing explosives. Scrap will be placed on the inspection pad. Items containing explosives will be brought back into the building and recycled.

   d. (O)(QC) Verify that scrap from explosive loaded items has been inspected IAW the General Safety and Security Requirements in SOP HW-0000-A-001.

2. Transfer:

   a. (O) Trailers containing inspected flashed brass/flashed bullets to PRO, as necessary.

**SPECIAL REQUIREMENT:**

1. **CONTAINERS FOR SCRAP METAL MUST BE CHANGED ANY TIME A DIFFERENT TYPE OF SCRAP IS GENERATED IN THE DEACTIVATION FURNACE. THIS WILL ELIMINATE MIXING AND CONTAMINATION OF ONE METAL WITH ANOTHER.**

**STANDING OPERATING PROCEDURE:**
Various Munition Items, Detonate in RF9 Furnace

**OPERATION 6**

**Control Room, Outside Building and Mechanical Room**

**SOP**: HW-0000-K-006

**REVISION**

**CHANGE**

**OPERATION:** Shutdown Procedures

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

**NOTE: Operator is required to fill out 'Shutdown Procedure Completion Checklist' (Figure 6-2) whenever a shutdown of operations is performed. This checklist will be filed in the filing cabinet at 117-3.**

1. Shutdown Waste Feed System (MAIN Panel) - click on SHUTDOWN on Screen 2 of main panel and the screen as seen in Figure 6-1 will appear.

   a. (HWCO) Waste Feed System – click on STOP.

2. (HWCO) RF-5 Primary and RF-7 Secondary Conveyors will automatically shutdown (five minute timeout).

3. (HWCO) Recycle Chute to recycle – click on EXECUTE.

4. (HWCO) Recycle Chute to discharge – click on EXECUTE.

5. (HWCO) Recycle Chute to recycle – click on EXECUTE.

6. (HWCO) RF-21, RF-15, RF-16 Conveyor System – click on STOP.

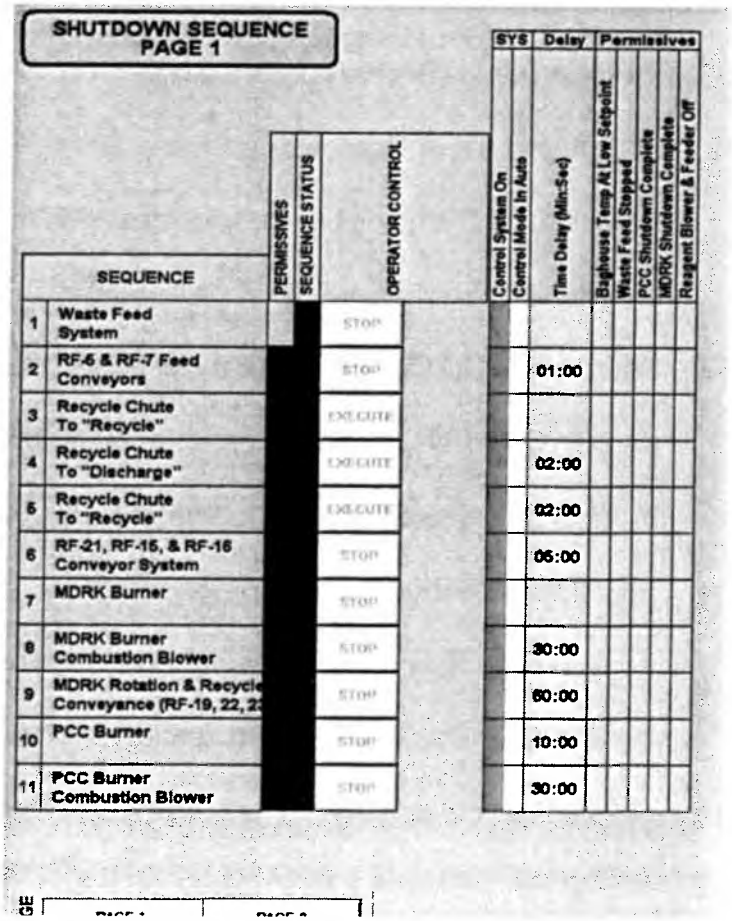



Figure 6-1

7. (HWCO) MDRK Burner – click on STOP.

8. (HWCO) PCC Burner – click on STOP (ten minute timeout from MDRK burner shutdown). Fuel Pump A will shutdown automatically; shut off Pump B at the MCC panel in the Mechanical Room.

9. Shutdown Reagent Feeder and Blower (PAS Panel).

   a. (HWCO) Shutdown (STOP) REAGENT FEEDER; once stopped, click on CONFIRM on main panel (Shutdown Sequence).

   b. (HWCO) Shutdown (STOP) REAGENT BLOWER; once stopped, click on CONFIRM on main panel (Shutdown Sequence).

10. Baghouse Valves to Off-Line (PAS Panel).

    a. (HWCO) Switch baghouse bypass valve to OPEN.

    b. (HWCO) Switch baghouse isolation valve to CLOSED.

    c. (HWCO) Click on CONFIRM Baghouse Valves to Off-Line on main panel (Shutdown Sequence).

11. Shutdown Evaporative Cooler Pump (PAS Panel).

    a. (HWCO) Shutdown (STOP) evaporative cooler pump; once stopped, confirm it is stopped on main panel (Shutdown Sequence).

12. Shutdown MDRK Combustion Blower (MAIN Panel).

    a. (HWCO) Thirty minute timeout from MDRK burner shutdown.

    b. (HWCO) Shutdown MDRK combustion blower – click on STOP.

13. Shutdown PCC Combustion Blower (MAIN Panel).

    a. (HWCO) Thirty minute timeout from shutdown of PCC burner.

    b. (HWCO) Shutdown PCC combustion blower – click on STOP.

14. Shutdown MDRK Rotation (MAIN Panel).

    a. (HWCO) Sixty minute timeout from recycle/discharge gate to RECYCLE (Step 4).

    b. (HWCO) Shutdown MDRK rotation – click on STOP.

15. RF-24 Recycle conveyor shuts down automatically.

16. RF-23 Recycle conveyor shuts down automatically.

17. RF-22 Recycle conveyor shuts down automatically.

18. RF-19 Scrap separation screen shuts down automatically.

19. Shutdown ID Fan (MAIN Panel).

    a. (HWCO) Shutdown ID fan – click on STOP.

20. Shutdown Rotary Airlock (PAS Panel).

    a. (HWCO) Shutdown (STOP) Rotary Airlock; once stopped, confirm it is stopped on main panel (Shutdown Sequence).

21. Shutdown Baghouse Cleaning Cycle (PAS Panel).

    a. (HWCO) Shutdown (STOP) baghouse cleaning cycle; once stopped, confirm it is stopped on main panel (Shutdown Sequence).

22. Baghouse Hopper Heaters (PAS Panel).

    a. (HWCO) Leave baghouse hopper heaters in auto unless there is a long term shutdown; confirm it is stopped on main panel (Shutdown Sequence).

23. Shutdown CEMS System (CEMS Panel).

    a. (HWCO) Shutdown CEMS system by turning off breakers in the rear of the CEMS Panel; once shutoff, confirm CEMS shutdown on main panel (Shutdown Sequence).

24. (HWCO) Shutdown CCTV and intercom system.

25. Shutdown is complete.

**SPECIAL REQUIREMENTS:**

1. **PRIOR TO EXTENDED FURNACE SHUTDOWN, THE FURNACE AREA, CONVEYORS, AND WORK AREA MUST BE FREE OF ANY EXPLOSIVE ITEMS.**

2. **WHEN EXPLOSIVE ITEMS ARE FOUND, THEY WILL BE COLLECTED, MOVED TO A SAFE AREA, AND CYCLED THROUGH THE FURNACE AT THE NEXT START-UP.**

# SHUTDOWN PROCEDURE COMPLETION CHECKLIST

(To be filled out by the Operator during each start-up)

| | | Operator's Initials |
|---|---|---|
| 1. | Shutdown "Waste Feed System" IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 1). | |
| 2. | Execute "Recycle Chute" to recycle IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 1). | |
| 3. | Execute "Recycle Chute" to discharge after preset time IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 1). | |
| 4. | Execute "Recycle Chute" to recycle after preset time IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 1). | |
| 5. | Shutdown conveyors RF-21, RF-15 and RF-16, IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 1). | |
| 6. | Shutdown "MDRK Burner" IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 1). | |
| 7. | Shutdown "MDRK Burner" after preset time IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 1). | |
| 8. | Shutdown "Reagent Blower" and "Feeder" IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 2). | |
| 9. | Execute "Bag house isolation valve" to offline, IAW SOP/ Test Plan. (HMI, Shutdown Sequence PG 2). | |
| 10. | Shutdown "Evaporative Cooler Water Pumps" IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 2). | |
| 11. | Shutdown "MDRK Combustion Blower" after preset time, IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 2). | |
| 12. | Shutdown "PCC Combustion Blower" after preset time, IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 2). | |
| 13. | Shutdown "MDRK Rotation" after preset time, IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 2). | |
| 14. | Shutdown "ID Fan" after preset time, IAW SOP/ Test Plan (HMI, Shutdown Sequence PG 2). | |
| 15. | Shutdown "Rotary Airlock" IAW SOP/ Test Plan (PAS Panel). | |
| 16. | Shutdown "Bag house Cleaning Cycle" IAW SOP/ Test Plan (PAS Panel). | |
| 17. | Shutdown "Bag house Hopper Heaters" IAW SOP/ Test Plan (PAS Panel). | |
| 18. | Shutdown "CEMS system" IAW SOP/ Test Plan (CEMS Panel.) | |
| | Note: CEMS shutdown for extended periods only. | |
| | Note: Shut down sequence has pre-set timers in the sequence for cool down periods. | |

**Operator's Signature** _____ **Date** _____

This is to be filed under SHUTDOWN CHECK LIST in the filing cabinet at 117-3.

Figure 6-2

**STANDING OPERATING PROCEDURE:**
Various Munition Items, Detonate in RF9 Furnace

**OPERATION 7**

**All Areas**

**SOP:** HW-0000-K-006

**REVISION**

**CHANGE**

**OPERATION:** Area Clean-up

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

**WHEN PERFORMING THIS STEP, OPERATOR WILL WEAR PROPER PPE WHICH INCLUDES SAFETY GLASSES AND THE APPROPRIATE RESPIRATOR. DO NOT USE THE AIR HOSE TO CLEAN PERSONNEL.**

1. Perform daily clean-up of area, before furnace start-up.

   a. (O)(S) Explosive loaded items, if found, shall be set aside for reprocessing.

   b. (O)(S) Inspect the conveyor and floor area of Cells 1 and 2 to be sure they are free of explosive items.

   c. (O) Clean Bays 1 and 2.

      (1.) Inspect tables and floor areas to ensure they are free of explosive items.

      (2.) Sweep area clean.

   d. (O) Clean furnace area.

      (1.) Sweep area and segregate metal items that have fallen from conveyors to proper containers.

      (2.) Using the UL 586 HEPA vacuum, remove heavy deposits of ash debris.

      (3.) Sweep and containerize remaining visible contaminated debris from the floor and surrounding equipment using ample amounts of sweeping compound. Containerize all contaminated disposable coveralls and cleaning equipment in appropriate drums.

e. (O) Clean Baghouse area.

(1.) Check barrel under Baghouse hopper for replacement, as required.

(2.) Using the UL 586 HEPA vacuum, remove heavy deposits of ash debris.

(3.) Sweep and containerize remaining visible contaminated debris from the floor and surrounding equipment using ample amounts of sweeping compound. Containerize all contaminated disposable coveralls and cleaning equipment in appropriate drums.

(4.) Maintenance and cleaning of the UL 586 HEPA vacuum shall be performed so as not to contaminate the job site.

2. Process barrels containing ash residue, IAW the following:

a. (O) Replace full barrel with an empty barrel.

b. (O) Place lid over full barrel and secure; process IAW SOP HW-0000-A-001.

3. Process containers containing lime residue.

a. (O) Building Foreman will contact Environmental Services, as necessary, to arrange for pick-up of containers of lime residue, IAW SOP HW-0000-A-001 procedures pertaining to handling hazardous waste containers. The building mechanic, however, is responsible for performing actual procedures involving lime.

**STANDING OPERATING PROCEDURE:**
Various Munition Items, Detonate in RF9 Furnace

**OPERATION 8**

**Control Room**

**SOP:** HW-0000-K-006

**REVISION**

**CHANGE 1**

**OPERATION:** Emergency Restart

**EXPLOSIVE/PERSONNEL LIMITS:** See Table 1

| STEP | DESCRIPTION | SPECIFIC INSTRUCTION (SAFETY, OPERATIONAL, QUALITY CHECKS) |
|---|---|---|

1. Restart (RF-9).

   a. (HWCO) Confirm stoppage condition has been corrected and EMERGENCY STOP button has been reset.

      (1) To restart any of the process equipment due to a power outage or after an emergency shutdown, the Building Supervisor and maintenance personnel (when required) will determine cause for stoppage, and, when corrected, will reset EMERGENCY STOP button on appropriate panel before restart.

   b. (HWCO) Go to Startup (Operation 1) and begin Startup Sequence.

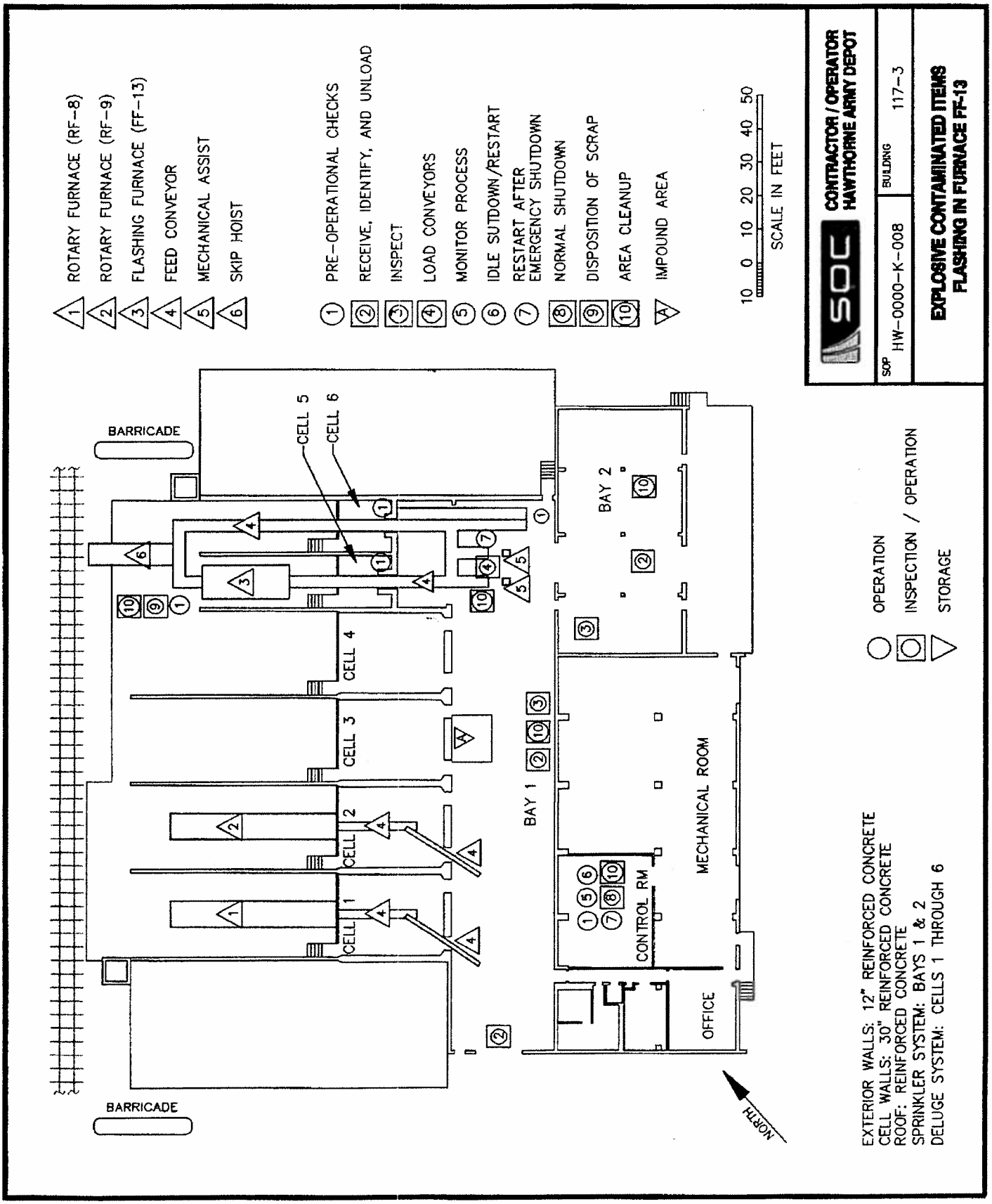
   c. (HWCO) Proceed with operations.

**SPECIAL REQUIREMENTS:**

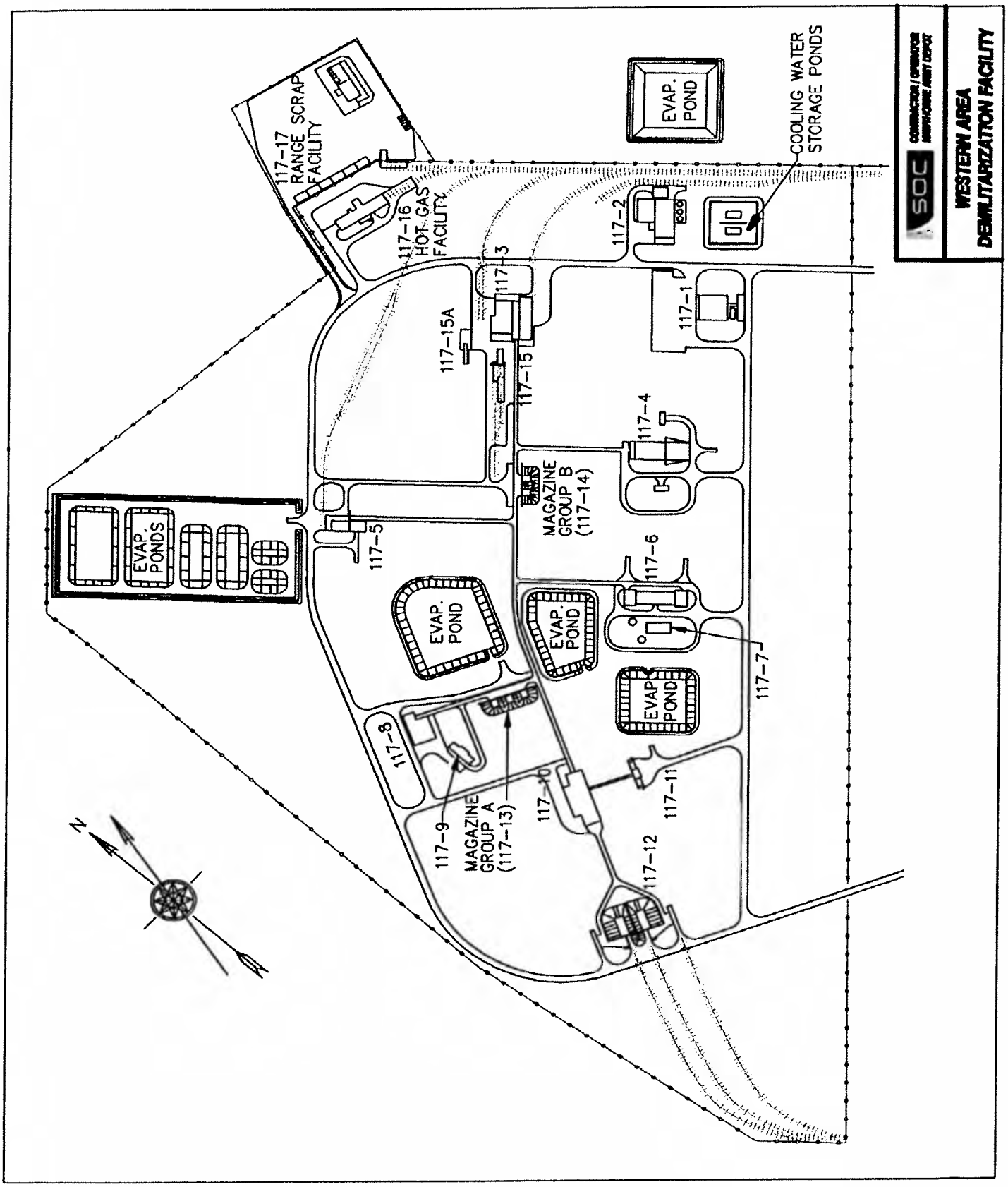
1. **AN OVERNIGHT COOL DOWN PERIOD IS REQUIRED IF, DURING AN EMERGENCY SHUTDOWN OR AN UPSET CONDITION, IT IS SUSPECTED THAT LIVE MUNITIONS HAVE BEEN DISCHARGED.**

2. **AFTER REQUIRED COOL DOWN PERIOD, SCRAP IN AND AROUND FURNACE WILL BE REPROCESSED THROUGH FURNACE. SCRAP CONTAINERS WILL BE SCREENED FOR LIVE MUNITIONS AND REPROCESSED, IF NECESSARY.**

## LINE LAYOUT


1 ROTARY FURNACE (RF-8)
2 ROTARY FURNACE (RF-9)
3 FLASHING FURNACE (FF-13)
4 FEED CONVEYOR
5 MECHANICAL ASSIST
6 SKIP HOIST
1 PRE-OPERATIONAL CHECKS
2 RECEIVE, IDENTIFY, AND UNLOAD
3 INSPECT
4 LOAD CONVEYORS
5 MONITOR PROCESS
6 IDLE SUTDOWN/RESTART
7 RESTART AFTER EMERGENCY SHUTDOWN
8 NORMAL SHUTDOWN
9 DISPOSITION OF SCRAP
10 AREA CLEANUP
A IMPOUND AREA
10 0 10 20 30 40 50
SCALE IN FEET
SOC
CONTRACTOR / OPERATOR
HAWTHORNE ARMY DEPOT
SOP HW-0000-K-008
BUILDING 117-3
EXPLOSIVE CONTAMINATED ITEMS
FLASHING IN FURNACE FF-13
BARRICADE
CELL 5
CELL 6
CELL 4
CELL 3
CELL 2
CELL 1
BAY 2
BAY 1
CONTROL RM
MECHANICAL ROOM
OFFICE
NORTH
OPERATION
INSPECTION / OPERATION
STORAGE
EXTERIOR WALLS: 12" REINFORCED CONCRETE
CELL WALLS: 30" REINFORCED CONCRETE
ROOF: REINFORCED CONCRETE
SPRINKLER SYSTEM: BAYS 1 & 2
DELUGE SYSTEM: CELLS 1 THROUGH 6

## SITE PLAN


117-17
RANGE SCRAP
FACILITY
117-16
HOT GAS
FACILITY
EVAP.
POND
COOLING WATER
STORAGE PONDS
117-2
117-3
117-1
117-15A
117-15
117-4
MAGAZINE
GROUP B
(117-14)
EVAP.
PONDS
117-5
117-6
EVAP.
POND
EVAP.
POND
EVAP.
POND
117-7
117-8
117-9
MAGAZINE
GROUP A
(117-13)
117-10
117-11
117-12
N
WESTERN AREA
DEMILITARIZATION FACILITY

# APPENDIX A
# DAILY MAINTENANCE CHECK SHEET
# BUILDING 117-3 RF9 FURNACE
# (EXAMPLE ONLY)

| TASK DESCRIPTION | WEEK OF _____ | | | | |
|---|---|---|---|---|---|
| | M | T | W | TH | F |
| FUEL | | | | | |
| 1. Check: | | | | | |
| a. Diesel Fuel Tank Pressure Gauge at Pumps (50 to 60 PSI) | | | | | |
| b. Propane Level | | | | | |
| LIME | | | | | |
| a. Check Bag Level | | | | | |
| b. Insure Lime Hose is Clear | | | | | |
| c. Inspect, Lubricate, and Clean as Required | | | | | |
| BAGHOUSE | | | | | |
| a. Check Rotary Air Lock | | | | | |
| b. Check Dump Hose for Leaks | | | | | |
| c. Check Drum at Beginning of Shift | | | | | |
| CEMS | | | | | |
| a. Check Gas Bottle Levels | | | | | |
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# SOC LLC HAWTHORNE DIVISION

## HAWTHORNE ARMY DEPOT
HAZARD ANALYSIS & RISK ASSESSMENT

## PROCESSING MUNITIONS IN FLASHING FURNACE RF9
*(Operational Process/System)*

**DZHC-0000-K-006**
*(Standing Operating Procedure)*

**November 17, 2011**
*(Replaces HA/RA, Same Subject, Dated November 1, 2010)*
*(Date)*

**117-3**
*(Location)*

Prepared by: Andrea Marshall
**ANDREA MARSHALL**, Safety Specialist
Safety & Health Division

November 17, 2011
DATE

Reviewed by: Wayne Larson
**WAYNE LARSON**, Manager
Safety & Health Division

November 17, 2011
DATE

Check with Safety for current version of this document prior to use.

# RISK ASSESSMENT

**OPERATIONAL PROCESS/SYSTEM:** Process Munitions in RF9 Furnace
**STANDING OPERATING PROCEDURE:** HW-0000-K-006
**LOCATION:** 117-3

November 17, 2011

| PROCESS DESCRIPTION | RISK ASSESSMENT | RECOMMENDATIONS | REFERENCES |
|---|---|---|---|
| This process covers the demilitarization of various types of munitions items that do not contain plastic or resin treated fabric ogives. The demil process is accomplished by detonating items in the rotary furnace (RF9) by exposing them to high heat. The procedure consists of verification and initiation of facility equipment, receipt, removal, unpacking, processing, monitoring and disposition of derived materials. | The Hazard Analysis was performed after considering the adequacy of safety considerations covered in the applicable SOP. A Hazard Severity of I (Catastrophic) and an Accident Probability of D (Remote) is assessed to this operation with a RAC of 3. When recommendations and controls are implemented a Hazard Severity of "IV" (NEGLIGIBLE) and an Accident Probability of E (Improbable) is assessed with a RAC of 5 assigned this operation. | 1. Operator training and SOP compliance is emphasized.<br>2. Training and compliance with proper material handling procedures is emphasized.<br>3. Demilitarization operations and associated procedures should be performed only by trained operators under adequate supervision.<br>4. The use of personal protective equipment requirements should be strictly adhered to. | 1. **MIL-STD 882D**; System Safety Program Requirements<br>2. **DOD 4145.26-M**; Contractors Safety Manual for Ammunition & Explosives<br>3. **SOC.OHS.SP.0002**; SOC Safety Program<br>4. **29 CFR 1910**; Occupational Safety & Health Standards for General Industry |

# RISK ASSESSMENT

**OPERATIONAL PROCESS/SYSTEM:** Process Munitions in RF9 Furnace
**STANDING OPERATING PROCEDURE:** HW-0000-K-006
**LOCATION:** 117-3

November 17, 2011

| TOOLS AND EQUIPMENT | OPERATIONS OR FUNCTIONS | FAILURE MODE/CAUSE | FAILURE EFFECT | HAZARDS BEFORE CONTROLS | RAC BEFORE CONTROLS | RECOMMENDATIONS AND/OR CONTROLS | HAZARDS AFTER CONTROLS | RAC AFTER CONTROLS |
|---|---|---|---|---|---|---|---|---|
| (1) Maintenance Check Sheet. | Pre-operational Check and Setup. | Facility equipment not readied for operational use or damaged. | Equipment failure or malfunction causing injury to operators. | III C | 4 | Supervisor shall assure maintenance check sheets have been completed and equipment is safe and fully operational. | IV E | 5 |
| (2) Forklift and PPE | Receive and Unload boxed ammo from pallet | Material packaged poorly, dropping, or dumping containers/materials. | Heavy containers. Personnel injury due to sharp/jagged edges on metal containers. | II D | 4 | Operator care and training in material handling operations. Proper PPE should be worn when handling this material. | IV E | 5 |
| (3) Duck Bill ammo can opener, Pneumatic tools, hand tools, PPE | Open metal ammo cans and remove rounds to send to Load Station | Employee uses tools incorrectly or uses wrong tools. Extremely sharp edges cuts employee. | Cuts or serious injury to personnel. Damage to assets, or premature functioning of bullets. | II D | 3 | Engineering controls, SOP, Training of employees. Provide proper tools and PPE | III D | 5 |
| (4) Forklift/Pallet/ PPE | Transfer Material to Load Station. | Material not marked or verified for demil. Contaminates introduced to system. | Possible detonation. Serious injury to operators and extensive damage to equipment and facilities. | I D | 3 | Operator training. Visual check and inspection against documentation. Visual aids or information for approved materials. | IV E | 5 |
| (5) Waste feed monitor/Weigh station, load tray, Conveyor and PPE. | Feed material onto weigh station, process onto conveyor. | Feed conveyors malfunction due to improperly loaded. Bullet jams on conveyor. | Possible detonation. Serious injury to operators. Damage to equipment. Loss of production and equipment downtime. | II D | 4 | Operator training and periodic maintenance performed on conveyors as required. | IV E | 5 |
| (6) a. Operator Control Console | Monitor Process. | Material becomes jammed or stuck in furnace conveyor. | Damage to equipment. Loss of production due to equipment downtime. | II D | 4 | Continuous monitoring at control panel and load station. Preventive maintenance performed on recurring basis. | IV E | 5 |

# RISK ASSESSMENT

**OPERATIONAL PROCESS/SYSTEM:** Process Munitions in RF9 Furnace
**STANDING OPERATING PROCEDURE:** HW-0000-K-006
**LOCATION:** 117-3

November 17, 2011

| TOOLS AND EQUIPMENT | OPERATIONS OR FUNCTIONS | FAILURE MODE/CAUSE | FAILURE EFFECT | HAZARDS BEFORE CONTROLS | RAC BEFORE CONTROLS | RECOMMENDATIONS AND/OR CONTROLS | HAZARDS AFTER CONTROLS | RAC AFTER CONTROLS |
|---|---|---|---|---|---|---|---|---|
| (6) b. Control Console Panel PFF-1 | Idle Shutdown/ Restart Procedures. | Emergency shut down procedures fail to stop conveyor or furnace ignition. | Damage to equipment and possible personnel injury and overheating of the furnace. | II D | 4 | Operator training in emergency shut-down procedures. | IV E | 5 |
| (6) c. Control Console, Conveyor and Furnace | Restart After Emergency Shutdown. | HMI Equipment fails to function properly. | Damage to equipment due to improper sequence of operation. | II D | 4 | Operator training in restart procedures. | IV E | 5 |
| (7) Certification Forms for processed material in railcar or hopper. Proper PPE | Disposition of Scrap Metal. | Thorough inspection and certification of scrap ***not*** accomplished. Un-functioned ammunition in/on scrap material. | Energetic scrap released for sale to general public. | I D | 3 | Provide training to inspector/certifying official in inspection, certification and documentation of processed scrap metal. | IV E | 5 |
| (8) Control Console | Normal Shutdown. | System malfunction or lights inoperative. | Damage to equipment causing loss of production time. | III C | 4 | Operator training in shut-down procedures. | IV D | 5 |
| (9) Conveyor and Furnace, proper PPE | Area Cleanup. | Live ordnance on conveyor or around furnace. | Possible detonation causing injury to operating personnel and damage to equipment. | I D | 3 | Operator training in recognizing and identifying unexploded ordnance and safe cleanup procedures. | IV E | 5 |
| (10) Forklift, PPE | Exchange ash barrel at bag house | Employee tips barrel over, potential strain of muscles if improperly handled. Release of ash into environment (air-born), entry into water system. | Employee possibly injured. Exposure to lead dust.. Ash is allowed into environment. Contamination of air, ground and water systems. | II D | 3 | Training and following engineering controls. Proper equipment used to handle barrels. | IV E | 4 |

# RISK ASSESSMENT

**OPERATIONAL PROCESS/SYSTEM:** Process Munitions in RF9 Furnace
**STANDING OPERATING PROCEDURE:** HW-0000-K-006
**LOCATION:** 117-3

November 17, 2011

| TOOLS AND EQUIPMENT | OPERATIONS OR FUNCTIONS | FAILURE MODE/CAUSE | FAILURE EFFECT | HAZARDS BEFORE CONTROLS | RAC BEFORE CONTROLS | RECOMMENDATIONS AND/OR CONTROLS | HAZARDS AFTER CONTROLS | RAC AFTER CONTROLS |
|---|---|---|---|---|---|---|---|---|
| (11) Control Console Panel PFF-1 | Idle Shutdown/Restart Procedures. | Emergency shut down procedures fail to stop conveyor or furnace ignition. | Damage to equipment and possible personnel injury and overheating of the furnace. | II D | 4 | Operator training in emergency shut-down procedures. | IV E | 5 |

| HAZARD PROBABILITY CODES | | | | | HAZARD SEVERITY CODES | | | |
|---|---|---|---|---|---|---|---|---|
| FREQUENT | PROBABLE | OCCASIONAL | REMOTE | IMPROBABLE | CATASTROPHIC | CRITICAL | MARGINAL | NEGLIGIBLE |
| A | B | C | D | E | I | II | III | IV |

| RISK ASSESSMENT CODE | | | |
|---|---|---|---|
| UNACCEPTABLE | UNDESIRABLE | ACCEPTABLE WITH REVIEW | ACCEPTABLE WITHOUT REVIEW |
| 1 OR 2 | 3 | 4 | 5 |

Check with Safety for current version of this document prior to use.

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX I

# APPENDIX I

# STARTUP, SHUTDOWN, AND MALFUNCTION PLAN

## START-UP, SHUTDOWN, AND MALFUNCTION PLAN FOR THE ROTORY FURNACE DEMILITARIZATION SYSTEM (RF-9)

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| APC | air pollution control |
| ASD | automatic shutdown |
| AWFCO | automatic waste feed cutoff |
| CEMS | continuous emissions monitoring system |
| CFR | Code of Federal Regulations |
| CO | carbon monoxide |
| dP | differential pressure |
| ESS | emergency shutdown sequence |
| HAP | hazardous air pollutant |
| ICW | industrial cold water |
| MDRK | munitions detonation rotary kiln |
| NOx | oxides of nitrogen |
| O&M | operation and maintenance |
| OPL | operating parameter limit |
| PCC | primary combustion chamber |
| RF-9 | rotary furnace system |
| VFD | variable frequency drive |

# 1. INTRODUCTION

The purpose of this plan is to provide written procedures for minimizing emissions of hazardous air pollutants (HAPs) during start-ups, shutdowns, and malfunctions of the Rotary Furnace System (RF-9) located at the Hawthorne Army Depot in Hawthorne, Nevada. The RF-9 facility is located in Building 117-3 on a portion of the main base known as the Western Area Demilitarization Facility. These procedures show how pollution prevention systems are operated and how corrective actions are implemented in accordance with best-accepted practices.

## 1.1 SCOPE

This start-up, shutdown, and malfunction plan provides standardized start-up, shutdown, and malfunction response procedures for the RF-9, associated pollution control equipment, and ancillary systems. The procedures contained in this plan are intended to standardize operator actions and responses during periods of start-up, shutdown, and malfunction to promote operational safety and to minimize the potential for excess emission of HAPS.

## 1.2 GOALS

The goals of this start-up, shutdown, and malfunction plan are to: 1) ensure the RF-9, including associated air pollution control (APC) equipment, is operated in a manner consistent with good APC; 2) ensure malfunctions are identified and corrected as soon as practicable after their occurrence so excess emissions of HAPs are minimized; and 3) reduce the reporting burden associated with periods of start-up, shutdown, and malfunction, including corrective action taken to restore a malfunctioning process and APC equipment to its normal or usual manner of operation.

# 2. REQUIREMENTS

This plan will become effective on the date of RF-9 operation as determined by the state of Nevada Air Quality Operating Permit. The RF-9 start-up, shutdown, and malfunction plan was developed to comply with 40 Code of Federal Regulations (CFR) 1206(c)(2), Start-up, Shutdown, and Malfunction Plan. Specific CFR requirements are referenced and summarized in Table 2-1.

# 3. PROCEDURES

## 3.1 START-UP PROCEDURE

The RF-9 start-up procedure, presented in Appendix A, provides detailed sequences and instructions for starting the RF-9 system. The start-up procedure is addressed in the following sections:

- **Prerequisites and Valve/Electrical Lineup:** The Prerequisite and Valve/Electrical Lineup section provides instructions for preparing and configuring the plant and process equipment for system startup. Prerequisites include review of maintenance and plant lockout/tag-out logs, area walk-around inspections, and other preparatory actions to ensure general readiness. The valve lineup list, presented in Appendix D, provides the operator with the required position of each valve associated with process and facility equipment to ensure safe and effective operation. The electrical lineup list, presented in Appendix E, provides the operator with the required position of all electrical switchgear, motor control centers, and electrical power panels. The purpose of the electrical lineup is to ensure all equipment has electrical power and electrical power control is properly configured.

***Table 2-1. Requirements for developing start-up, shutdown, and malfunction procedures.***

| **Location in Start-up, Shutdown, and Malfunction Plan** | **40 CFR Requirement** | **Description** |
|---|---|---|
| Throughout the document | 63.1206(c)(2)<br>63.6(e)(3) | The owner/operator must develop a start-up, shutdown, and malfunction plan that describes procedures for operating the source, as well as associated APC and monitoring equipment, during periods of start-up, shutdown, and malfunction. |
| Sections 3.1, 3.2, and 3.3 and Appendix A, Appendix B, and Appendix C | 63.6(e)(3)(ii) and (iii) | The owner must operate the source and associated APC and monitoring equipment in accordance with the plan during all periods of start-up, shutdown, and malfunction. Conformance with the plan, in the form of a checklist or other effective form of record keeping, must be documented. |
| Section 3.5 | 63.1206(c)(2)(iii) | Identify a projected oxygen correction factor to use during periods of start-up and shutdown, based on normal operations. |
| Section 3.6 | 63.6(e)(3)(viii) | The owner may periodically revise the start-up, shutdown, and malfunction plan to reflect changes in equipment or procedures without prior approval. In the event a malfunction is encountered that is not addressed, or is inadequately addressed, by the plan, the owner must revise the plan within 45 days of the malfunction. |
| Section 4 | 63.6(e)(3)(iii)<br>63.10(b)<br>63.1206(c)(2)(iv) | The source will maintain sufficient records to document all periods of start-up, shutdown, and malfunction and demonstrate compliance with plan procedures and correction actions. Records will be maintained for a period of 5 years. The most recent 2 years of data will be maintained on site. The previous 3 years of data may be maintained off site. |
| Section 4 | 63.6(e)(3)(v) | A current start-up, shutdown, and malfunction plan will be maintained on site. Previous versions of the plan will also be maintained on site for 5 years. |
| Section 5 | 63.6(e)(3)(iii)<br>63.10(d)(5)(i) | A semiannual start-up, shutdown, and malfunction report will be prepared and submitted to the designated administrator summarizing activities performed in compliance with this plan. |
| Section 5 | 63.10(e)(3)<br>63.1206(c)(2)(v) | In the event that 10 malfunctions are encountered in a 60-day period, an investigation into the cause of the malfunctions and approaches to minimize future occurrences shall be completed within 45 days of the tenth malfunction. A summary of the investigation shall be included in the semiannual Start-up, Shutdown, and Malfunction Report. |
| Section 5 | 63.6(e)(3)(iv)<br>63.10(d)(5)(ii) | In the event that start-up, shutdown, or malfunction responses are not performed in compliance with this plan, the administrator must be notified within 2 working days via telephone or facsimile. A formal letter summarizing the noncompliant event, whether excess emissions were experienced as a result, and actions taken will be forwarded to the designated administrator within 7 working days. |

**Facility Systems Start-up:** The Facility Systems Start-up section provides detailed instructions for start-up of the control computer, instrument air system and industrial cold water,.

**Offgas Equipment Start-up:** The Offgas Equipment Start-up section provides instructions for startup of the induce draft fan, fabric filter bag house, reagent feed system and evaporative cooler.

**PCC and MDRK Warm-up:** The primary combustion chamber (PCC) and munitions detonation rotary kiln (MDRK) warm-up section provides instructions for warming up the PCC and MDRK in accordance with the manufacture's recommendations. Temperature ramp-up rates will be specified.

**Safety Interlock Functional Check:** The Safety Interlock Functional Check section verifies critical safety interlock and permissive functions. Simple field actions, such as closing valves or opening circuit breakers, will be used to simulate various plant system failures to verify proper interlock and permissive operation. No system components, such as instrumentation and piping, will be

disassembled, adjusted, or reconfigured to support these checks. The interlock checks will be limited to those verifications that can be accomplished within these limitations.

The RF-9 start-up procedure takes the RF-9 from a cold, secured condition and configures it to process waste ordnance. Compliance with the RF-9 start-up procedures will be documented in a RF-9 start-up procedure compliance form, presented in Appendix C. Specific information regarding RF-9 start-up is recorded on the compliance form, which is used to document compliance with the start-up procedure.

The RF-9 start-up procedure, in its entirety, will be followed for each start-up from a cold, secured condition. A compliance form will be filled out for each start-up event. The completed form will be filed according to the requirements of Section 5 of this plan.

Partial system start-ups, resulting from recovery, including malfunction conditions, unplanned maintenance, and shortage of consumables or waste materials, will be performed at the direction of a certified primary control room operator or shift supervisor. The operator will use the RF-9 start-up procedures as guidance for reconfiguring the RF-9 systems and reestablish operating conditions that were invalidated by the unplanned condition. Partial system start-ups will be documented in the control room operator's logbook. General requirements for maintaining the control room operator's logbook are presented in Section 3.4 of this plan.

## 3.2 SHUTDOWN PROCEDURE

The RF-9 shutdown procedure, which is presented in Appendix B, provides detailed sequences and instructions by which qualified operators are to shut down and secure the RF-9 system.

The RF-9 shutdown procedure takes the RF-9 from feed processing to a cold, secured condition. The shutdown procedures will be followed for all shutdown events. The shutdown procedures include the following components:

**Secure Feed Operations and Discharge Scrap: [According to Operations and Maintenance (O&M) Plan]:** Procedures for securing the feed operation and discharging scrap are covered in the O&M plan. To ensure proper implementation, operations referenced in the shutdown procedure should be followed.
**Secure MDRK and PCC:** The MDRK and PCC section provides instructions for turning off the MDRK and PCC.
**System Cooldown:** The System Cooldown section provides instructions for cooldown of the MDRK and PCC and shutdown order of the RF-9 systems.

The RF-9 shutdown procedure takes the RF-9 system from operational status and configures it to a secured condition. Compliance with RF-9 shutdown procedures will be documented in a RF-9 shutdown procedure compliance form, which is presented in Appendix C. Specific information regarding RF-9 shutdown is recorded on the compliance form, which is used to document compliance with the shutdown procedure. A compliance form will be filled out for each shutdown event. The completed form will be filed according to the requirements of Section 5 of this plan.

## 3.3 MALFUNCTION PROCEDURES AND RESPONSES

### 3.3.1 Malfunction Definition

Malfunctions are defined as sudden and infrequent failures of APC equipment, process equipment, or

instrumentation to operate in its normal or usual manner that are not reasonably preventable through good operating practice, proper training, and/or proper maintenance. Failures that result from poor or improper maintenance or careless operation are not malfunctions.

Examples of failures that are classified as malfunctions include loss of electrical power, failure of instruments, and premature pump/motor failure. Examples of failures that are not classified as malfunctions include improper valve/electrical lineup or pump/motor failure due to lack of maintenance.

This plan is concerned with malfunctions and failures that occur whenever a RF-9 emission source is in operation. RF-9 emission sources are the MDRK, the PCC, and the waste feeder. Operational failures that may occur when no RF-9 emission sources are in operation are not covered by this plan.

## 3.3.2 Malfunctions and Failures

### 3.3.2.1 Measures to Minimize Frequency and Severity of Malfunctions

The primary measures taken to minimize the frequency of malfunctions are extensive operator training, use of established standard operating procedures, and implementation of a comprehensive maintenance program. These measures are defined in detail in the RF-9 operator training program, the start-up and shutdown procedures contained in this plan, and the operating instructions and maintenance schedule contained in the RF-9 O&M manual.

Both the frequency and severity of malfunctions are further reduced by RF-9 control programming. The RF-9 is instrumented and integrated with a comprehensive computer control system that not only provides relevant information to the operator in a timely manner, but also implements an extensive layer hierarchy of protective interlocks and controlled shutdowns that are intended to protect personnel/equipment and minimize the potential for excess emissions.

The RF-9 control system provides the following layered, automated control actions:

- permissive interlocks;
- annunciated alarms and warnings;
- stop-feed sequence;
- automatic waste feed cutoff (AWFCO) sequence;
- automatic shutdown (ASD); and
- emergency shutdown sequence (ESS).

Permissive interlocks were implemented to prevent equipment from being started or operated in improper sequences.

Annunciated alarms and warnings alert the operator to process conditions that are approaching action levels. The annunciated alarms and warnings provide the operator time to respond to stabilize process conditions before a more serious condition is reached.
The stop-feed sequence monitors selected equipment status and process conditions and will automatically stop waste feed if abnormal conditions are sensed. The stop-feed parameters were selected to prevent process conditions from reaching levels that require initiation of an AWFCO.

The AWFCO function monitors key process parameters as required by 40 CFR 63.1209 and will automatically secure waste processing if any parameter exceeds its established limit. The annunciated alarms were integrated with the AWFCO such that the operator will receive an alarm or warning prior to initiation of an AWFCO.

The ASD is designed primarily to protect personnel and process equipment. The ASD function will initiate a stop-feed sequence and remove all thermal sources from the MDRK.

The ESS function is the final layer of the RF-9 protective control system. The control computer will automatically initiate an ESS that consists of an ASD and secures the PCC, removing all thermal sources. If initiated manually, all computer control is bypassed and the entire RF-9 facility is taken to its fail-safe condition, allowing immediate personnel evacuation.

### 3.3.2.2 Actions Required Subsequent to a Malfunction

The RF-9 integrated control system was designed to respond to all malfunctions envisioned to have the potential to result in excess emissions or significant hazard to personnel or equipment. The response of the control computer can be summarized in three general classifications.

**Class 1, AWFCO, Stop Feed, or Belt Timing Error in Which the MDRK and PCC Continue Operation:** In this scenario, the control system detects exceedance of an established operating parameter limit (OPL), a potential exceedance condition (stop feed), or a feeder system problem. The feed system is secured, but the MDRK, PCC, and all pollution control equipment continue to operate. The cause of Class 1 malfunctions and their potential root causes are listed in Table 3-1.

In response to a Class 1 computer response, the operator shall take the following actions:

Using the control screen alarm status displays, identify/verify the source of the malfunction.
Acknowledge the alarm and silence the audible alarms, as appropriate.
Verify/secure the feed system.
Monitor continuous emissions monitoring system (CEMS) data for carbon monoxide (CO), oxides of nitrogen ($NO_x$), and Opacity.

- If monitored values are below emission alarm limits and are stable or decreasing, allow the MDRK and PCC to continue to operate for at least 15 min to ensure complete waste treatment. The maximum residence time for organic waste constituent is approximately 3 min.
- If monitored values are above alarm limits or CEMS data is not available, allow the MDRK and PCC to operate for a minimum of 5 min, but do not to exceed 10 min, to complete waste treatment. The maximum residence time for organic waste constituent is approximately 3 min.

The system is in best-practice condition; proceed with shutdown of process equipment and support systems. Initiate malfunction troubleshooting and repair using the RF-9 O&M manuals as a reference.

As soon as practical, fill out a malfunction compliance form (Appendix C) and initiate malfunction evaluation and documentation, as detailed in Section 3.3.2.3 of this plan.

**Class 2, Stop Feed or ASD in Which the MDRK or PCC Continue to Operate:** In this scenario, the control system detects a potential exceedance condition (stop feed) or other potentially unsafe condition. The feed system and endangered equipment are secured, but either the MDRK or the PCC and unaffected pollution control equipment continue to operate. The cause of Class 2 malfunctions and their potential root causes are listed in Table 3-1.

In response to a Class 2 computer response, the operator shall take the following actions:

Using the control screen alarm status displays, identify/verify the source of the malfunction.
Acknowledge the alarm and silence the audible alarms, as appropriate.
Verify/secure the feed system.

Monitor CEMS data for CO, $NO_x$, and Opacity.

- If monitored values are below emission alarm limits and are stable or decreasing, allow MDRK/ PCC to continue to operate for at least 15 min to ensure complete waste treatment. The maximum residence time for organic waste constituent is approximately 3 min.
- If monitored values are above alarm limits or CEMS data is not available, allow the MDRK/PCC to operate for a minimum of 5 min, but do not to exceed 10 min, to promote waste treatment. The maximum residence time for organic waste constituent is approximately 3 min.

The system is in best-practice condition; proceed with shutdown of process equipment and support systems. Initiate malfunction troubleshooting and repair using the RF-9 O&M manuals as a reference.

As soon as practical, fill out a malfunction compliance form (Appendix C) and initiate malfunction evaluation and documentation, as detailed in Section 3.3.2.3 of this plan.

**Class 3, ESS in Which Both the MDRK and the PCC Are Secured:** In this scenario, the control system detects a potentially unsafe condition that requires immediate response. This scenario also includes ESS responses that are manually initiated by the operator. The feed system and all process equipment, including both the MDRK and the PCC, are secured. Only the main blowers continue to operate. The cause of Class 3 malfunctions and their potential root causes are listed in Table 3-1.

The following operator actions shall be taken in response to a Class 3 computer response to the extent that operator safety is not jeopardized:

Using the control screen alarm status displays, identify/verify the source of the malfunction.
Acknowledge the alarm and silence the audible alarms, as appropriate.
Verify/secure the feed system.
Verify that the MDRK and the PCC are secured.

The system is in best-practice condition; proceed with shutdown of process equipment and support systems. Initiate malfunction troubleshooting and repair using the RF-9 O&M manuals as a reference.

As soon as practical, fill out a malfunction compliance form (Appendix C) and initiate malfunction evaluation and documentation, as detailed in Section 3.3.4 of this plan.

***Table 3-1. Malfunction descriptions and potential root causes.***

| Malfunction Class | Malfunction Description | Malfunction Cause | Potential Root Cause | Notes |
|---|---|---|---|---|
| 1 | AWFCO | High MDRK pressure | PT 1201 fail | |
| 1 | AWFCO | | ID fan fail | |
| 1 | AWFCO | | VFD fail | |
| 1 | AWFCO | Low PCC outlet temperature | TE 701 fail | |
| | | | PCC burner controller fail | |
| 1 | AWFCO | Maximum Stack Gas Velocity | MDRK pressure control loop fail | |
| | | | Stack velocity equipment fail | |
| | | | Stack velocity probe fail | |
| 1 | AWFCO | Maximum Hazardous Waste Feed Rate | Feed rate control system fail | |
| | | | Weigh cell fail | |
| 1 | AWFCO | Maximum Bag House Inlet Temperature | Evaporative cooler spray water pumps fail, M-1511, M-1512 | |
| | | | Evaporative cooler spray nozzle failure | |
| | | | Plant air supply fail, PA-1800-UX | |
| | | | Air shut off valve fail, FV-1812 | |
| | | | Spray water control valve fail, FV-1516 | |
| | | | Instrument air supply fail, IA-1801-UX | |
| 1 | AWFCO | Maximum Stack Gas CO concentration exceeded | PCC failure | |
| 1 | AWFCO | Maximum Bag House Differential Pressure | Filter bag blinding/ plugging | |
| | | | Bag house cleaning cycle not functioning | |
| | | | Instrument air fail | |
| | | | Differential pressure transmitter fail, DPIT-1001 | |
| 1 | AWFCO | Minimum Bag House Differential Pressure | Leaking filter bag | |
| | | | Bag house cleaning cycle, over cleaning | |
| | | | Lime injection system malfunction | |
| | | | Differential pressure transmitter fail, DPIT-1001 | |
| 1 | AWFCO | Minimum O2 level | | |
| 1 | AWFCO | Stack Opacity High | MDRK flame fail | |
| | | | PCC flame fail | |
| 1 | AWFCO | Low lime level | Lime bridges in feed hopper | |
| | | | Lime supply empty | |
| | | | Low level detector fail, LSL-923 | |
| 1 | AWFCO | Reagent blower fail | Motor fail | |

| | | | | |
|---|---|---|---|---|
| | | | Circuit overload | |
| **Malfunction Class** | **Malfunction Description** | **Malfunction Cause** | **Potential Root Cause** | **Notes** |
| 1 | AWFCO | Reagent down spout level "high" | Down spout blocked | |
| | | | Eductor blocked | |
| | | | Lime feed line blocked | |
| | | | Injection tube blocked | |
| | | | High level detector fail, LSH-924 | |
| 1 | AWFCO | "ID" fan failure | VFD fail | |
| | | | Motor fail | |
| | | | Circuit overload | |
| 1 | AWFCO | PCC burner fail | UV detector fail, BE-701 | |
| | | | Fuel pump fail | |
| | | | Fuel shut-off valve fail | |
| | | | Burner controller fail | |
| | | | Burner actuator fail | |
| 1 | AWFCO | PCC Minimum combustion zone temp. | Temp control loop fail | |
| | | | Burner controller fail | |
| | | | Thermal couple fail, TE-701 | |
| 1 | AWFCO | MDRK burner fail | UV detector fail, BE-601 | |
| | | | Fuel pump fail | |
| | | | Fuel shut-off valve fail | |
| | | | Burner controller fail | |
| | | | Burner actuator fail | |
| 2 | Stop feed | Minimum MDRK operating temp | Temp control loop fail | |
| | | | Burner controller fail | |
| | | | Thermal couple fail, TE-601 | |
| 2 | Stop feed | MDRK thermal couple fail | Temp control loop fail | |
| 2 | Stop feed | MDRK rotation fail | Rotation variable speed drive fail | |
| | | | Motor fail | |
| | | | Drive chain fail | |
| | | | Circuit overload | |
| 2 | Stop feed | Recycle furnace feed conveyor fail | Motor fail | |
| | | | Circuit overload | |
| 2 | Stop feed | Recycle conveyor fail | Jammed with scrap | |
| | | | Clutch fail | |
| | | | Motor fail | |
| | | | Circuit overload | |
| | | | Conveyor rollers fail | |
| 2 | Stop feed | Recycle feed conveyor fail | Motor fail | |
| | | | Circuit overload | |
| 2 | Stop feed | Scrap separation screen fail | Motor fail | |
| | | | Circuit overload | |
| 2 | Stop feed | Waste feed system "load over weight limit" | Scale overloaded with items | |
| | | | Weigh cell fail | |
| 2 | Stop feed | Secondary feed conveyor fail | Jammed with scrap | |

| | | | | |
|---|---|---|---|---|
| | | | Clutch fail | |
| | | | Motor fail | |
| | | | Circuit overload | |
| 2 | Stop feed | Primary feed conveyor fail | Jammed with scrap | |
| | | | Clutch fail | |
| | | | Motor fail | |
| | | | Circuit overload | |
| **Malfunction Class** | **Malfunction Description** | **Malfunction Cause** | **Potential Root Cause** | **Notes** |
| | | | Conveyor rollers fail | |
| 3 | ESS | Evap cooler air pressure low | Plant air supply fail | |
| 3 | ESS | Evap cooler water pressure low, low | Plant water supply fail | |
| | | | Evap cooling water pumps fail | |
| | | | Ruptured water supply line to spray lances | |
| 3 | ESS | Baghouse inlet temp High,High | Evap cooler fail | |
| | | | Spray lance nozzle fail | |
| | | | Evap cooling water pumps fail | |
| | | | Water control valve fail, FV-1516 | |
| | | | Temp control loop fail | |
| 3 | ESS | ID fan fail | VFD fail | |
| | | | Motor fail | |
| | | | Circuit overload | |

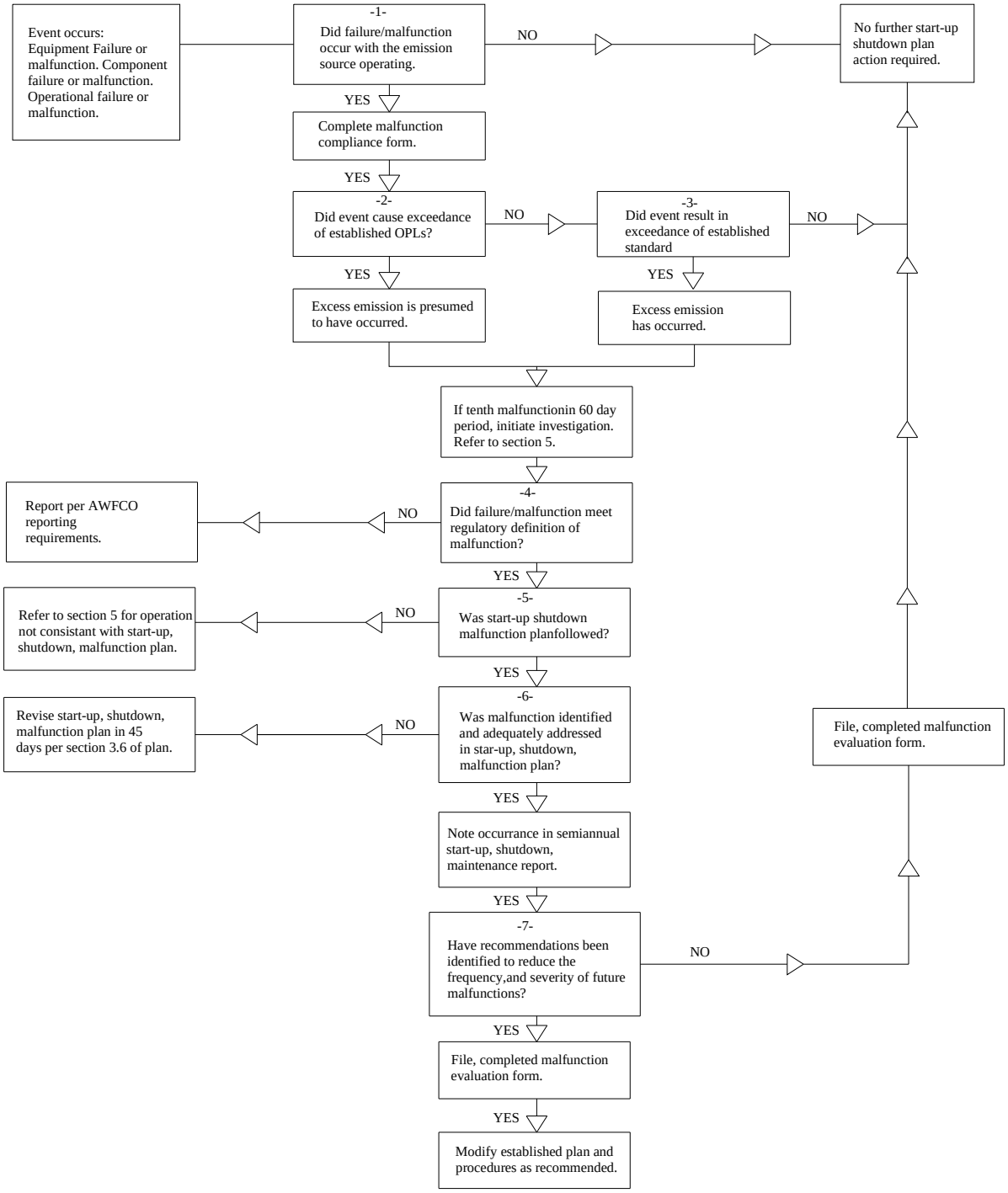
### 3.3.2.3 Malfunction Evaluation and Documentation

As it is not possible to anticipate all malfunctions or failures that may occur over the life of the RF-9 facility, a method for evaluating each malfunction or failure was established. This evaluation method serves several purposes: 1) it provides a mechanism for classifying unanticipated failures as malfunctions; 2) it provides a mechanism for continual review and improvement of the malfunction response actions required by this plan; and 3) it provides a mechanism for identifying measures to reduce the frequency and severity of malfunctions.

Immediately following the occurrence of a malfunction, the operator must fill out a malfunction compliance form (Appendix C) to document pertinent information related to the malfunction. The malfunction compliance form must be filed in the operating record at the end of the shift, as specified in Section 4 of this plan.

As soon as possible, but prior to initiating further waste processing, a malfunction evaluation form (Appendix C) must be filled out. The form is intended to document implementation of the malfunction review process summarized in Figure 3-1.

*Figure 3-1. Malfunction Evaluation Flowchart*



### 3.4 USE OF CONTROL ROOM OPERATOR LOGBOOK

The control room operator will be responsible for maintaining the operator's logbook. The operator's logbook will contain pertinent information regarding the operating sequence and configuration of process and plant equipment. The purpose of the operator's log is: 1) to provide a communication mechanism between operating shifts; and 2) to provide a detailed operating record. The operator's log will contain the following information:

- date;
- shift of operation;
- name of on-duty control room operators;
- description of significant operating events, such as start-up, shutdown, malfunctions, feed start, or feed stop;
- description of significant configuration or equipment changes, such as inoperative standby pump or empty calibration gas bottles; and
- each entry will include the current time as indicated by the main control computer.

The operator's log will be maintained in a bound notebook. The operator's logbook will be retained as part of the operating record, as specified in Section 5 of this plan.

### 3.5 USE OF OXYGEN CORRECTION FACTOR

The oxygen content of the stack emissions will vary considerably from 7% during start-up and shutdown. An oxygen correction factor of 7% will be used during preliminary testing and will be applied during all phases of operation. Based on operational experience, alternate corrections factors may be applied during start-up and shutdown.

### 3.6 PLAN REVISION

The start-up, shutdown, and malfunction plan may be revised, as required, without prior approval. All revisions to the plan will be controlled as specified in Section 4.

In the event malfunctions are encountered that are not covered by this plan, the plan shall be revised within 45 days.

## 4. RECORDS RETENTION REQUIREMENTS

Completed procedure compliance forms will be filed in the RF-9 operating record at the end of each shift. Completed forms must be retained for 5 years with the most recent 2 years of records maintained on site. The operator logbooks, when completed, will be filed in the RF-9 operating record. Logbooks must be retained for 5 years with the most recent 2 years of records maintained on site. A current version of the RF-9 start-up, shutdown, and malfunction plan will be maintained in the RF-9 control room. Previous versions of the RF-9 start-up, shutdown, and malfunction plan will be maintained as part of the RF-9 operating record for 5 years.

## 5. REPORTING RETENTION REQUIREMENTS

A semiannual start-up, shutdown, and malfunction report, summarizing activities performed in compliance with this plan, will be prepared and submitted to the designated administrator. The report will include the number, duration, and a brief description of each start-up, shutdown, and malfunction event.
In the event that 10 malfunctions are experienced in a 60-day period, an investigation into the cause of the malfunctions and an evaluation of approaches to minimize future occurrences shall be completed within 45 days

of the tenth malfunction. A record summarizing the investigation and evaluation shall be included in the semiannual Start-up, Shutdown, and Malfunction Report.

If start-up, shutdown, or malfunction responses are not performed in compliance with this plan, the administrator will be notified within 2 working days of the response via telephone or facsimile. A formal letter summarizing the noncompliant event, whether excess emissions were experienced as a result, and actions taken will be forwarded to the designated administrator within 7 working days after the response.

## 6. REVISION TRACKING

| Revision Number | Description | Date |
|---|---|---|
| 0 | Initial issue. | Jan 2007 |
| 1 | Changed from IAW SOP/Test plan to just IAW SOP | Oct 2010 |
| 2 | Included AWFCO testing in standard startup procedure | June 2012 |

**ATTACHMENT A**

Standard Start-up Procedure

# 1. INTRODUCTION

This standard operating procedure (SOP) is part of the start-up, shutdown, and malfunction plan. The SOP, in its entirety, will be followed for each start-up from a cold, secured condition. Partial system start-ups resulting from recovery (including malfunction conditions, unplanned maintenance, and shortage of consumables or waste materials) will be performed at the direction of a certified primary control room operator or shift supervisor. The operator will use the RF-9 start-up procedures as guidance for reconfiguring the RF-9 systems and reestablish operating conditions that were invalidated by the unplanned condition. Partial system start-ups will be documented in the control room operator's logbook.

## 1.1 REFERENCES

### Drawings

General arrangement drawing.
Piping and Instrumentation Diagram. S410.104
DZHC, RF-9 PLC upgrade DWGs. 05-363, 1 thru 48
Bundy Electrical DWGs. S410.401 thru S410.407

### Manuals

RF-9 operations and maintenance (O&M) manual
RF-9 continuous emissions monitoring system (CEMS) plan

### Miscellaneous

Valve lineup list
Electrical lineup list

# 2. PREREQUISITES

This list identifies the verifications and other prerequisite activities necessary to ensure sufficient consumables are available and that the RF-9 is configured to support processing operations.

| | | |
|---|---|---|
| 1. | Verify that Building 117-3 compressed air system is on line and available. | |
| 2. | Verify that the Western Area Demil Facility (WADF) Industrial Cold Water System is lined up and available to support Building 117-3. | |
| 3. | Verify that 117-3 diesel storage tank contains sufficient quantity for planned operation. | |

| | | |
|---|---|---|
| 4. | Verify that the RF-9 lime injection system contains sufficient quantity to support planned operations. | |
| 5. | Verify the 117-3 propane storage tanks contain sufficient quantity for the planned run. | |
| 6. | Verify that the ash collection barrel has sufficient space available for the planned operations. | |
| 7. | Verify that CEMS calibration gases are on hand in sufficient quantities to support planned operations. Verify expiration date on each gas, making sure it hasn't expired. | |
| 8. | Review the lockout/tag out log and resolve any discrepancies. | |
| 9. | Review plant maintenance status log and ensure all required/essential maintenance and repair work has been completed. | |

## 3. PRESTART-UP CHECKLIST

| | | |
|---|---|---|
| 1. | Verify that a valve lineup has been completed, if required. | |
| 2. | Verify that an electrical lineup has been completed, if required. | |
| 3. | Energize CEMS analyzers. | |
| 4. | Verify that the control and data recording computers are running. | |
| 5. | Log onto the main control computer as operator. | |

## 4. SUPPORT SYSTEM START-UP PROCEDURE

| | | |
|---|---|---|
| | **Note:** Unless stated otherwise, all start, stop, adjustment and monitoring of process equipment is to be performed from the main control computer in the Central Control Room (CCR). | |
| | | |
| **4.1** | **UNINTERRUPTIBLE POWER SUPPLY** | |
| 1. | At the UPS local panel, verify the UPS Input Power indicator is illuminated and the UPS Output Availability indicator is illuminated. | |
| | | |
| **4.2** | **CONTROL AND DATA RECORDING COMPUTERS** | |
| 1. | Start the controlling computer. | |
| 2. | Verify the controlling computer boots up and displays the main control screen. | |
| 3. | Verify the data-recording computer is operating. | |
| 4. | Verify/Reset the ESS function at main control console. **Note:** ESS button must reset before the ESS function can be reset. | |
| 5. | Verify batch/ parameter is set. (recipe loaded) | |
| 6. | Verify system is "ON" and equipment control is in "AUTO" | |
| **4.3** | **INSTRUMENT AND PLANT AIR SUPPLY** | |
| 1. | Verify on the pollution abatement screen, "Instrument air OK" | |
| 2. | Verify that the instrument air dryer is "energized" | |
| 3. | Verify on the pollution abatement screen, "Plant air OK" | |
| 4. | Open or verify open, the valves in accordance with attachment D | |
| | | |

| | | |
|---|---|---|
| **4.4** | **INDUSTRIAL COLD WATER** | |
| 1. | Open or verify open, the valves in accordance with attachment D. | |
| | | |
| **4.5** | **CEMS START-UP** | |
| 1. | Energize CEMS analyzers. (allow for sufficient equipment warm up) | |
| 2. | Energize "stack sample line" heating system. Breaker #??, panel ??. | |
| 3. | Perform CEMS calibration In accordance with SOP. (start-up sequence, step #4) | |
| **4.6** | **INDUCED DRAFT FAN START-UP** | |
| 1. | Start "induced draft fan" in accordance with SOP. (start-up sequence, step #5) | |
| | | |
| **4.7** | **PAS SYSTEM START-UP** | |
| 1. | Start "bag house hopper heater" IAW SOP. (PAS Panel) | |
| 2. | Start "bag house cleaning cycle" IAW SOP. (PAS Panel) | |
| 3. | Start "rotary airlock" IAW SOP. (PAS Panel) | |
| 4. | Start "Evap. cooler water pumps" IAW SOP. (PAS Panel) | |
| | | |
| **4.8** | **PCC START-UP** | |
| 1. | Start "fuel pump" IAW SOP. (HMI Fuel system Screen) | |
| 2. | Start "PCC Combustion Blower" IAW SOP. (HMI, Start-up Sequence PG 2) | |
| 3. | Start "PCC Burner" IAW SOP . (HMI, Start-up Sequence PG 2) | |
| | | |
| **4.9** | **PCC START-UP** | |
| 1. | Start "MDRK Combustion Blower" IAW SOP. (HMI, Start-up Sequence PG 2) | |
| 2. | Start "MDRK Burner" IAW SOP. (HMI, Start-up Sequence PG 2) | |
| **4.10** | **MDRK ROTATION START-UP** | |
| 1. | Start "MDRK Rotation". IAW SOP. (HMI, Start-up Sequence PG 2). | |
| 2. | Note: Conveyors RF-24, RF-23, RF-22, and RF-19 will start after the MDRK has reach rotation speed set point. | |
| | | |
| **4.11** | **MAGNETIC SEPARATOR START-UP** | |
| 1. | Start "Magnetic Separator". IAW SOP. (HMI, Start-up Sequence PG 2). | |
| 2. | Note: Conveyors RF-15, and RF-21, will start after the Magnetic separator has started. | |
| **4.12** | **BAGHOUSE ISOLATION VALVES** | |
| 1. | Execute "bag house" online IAW SOP. (HMI, Start-up Sequence PG 3). | |
| 2. | Start "reagent blower" IAW SOP. (HMI, Start-up Sequence PG 3). | |
| 3. | Start "reagent blower" IAW SOP. (HMI, Start-up Sequence PG 3). | |
| | | |

## 5. RF-9 WASTE PROCESSING START-UP

This section starts RF-9 waste processing equipment. All support equipment has been started.

| | | |
|---|---|---|
| **5.1** | **START FEED SYSTEM** | |
| 1. | Verify the Pre-Start-up Checklist has been completed. IAW SOP, STEP 21 | |
| 2. | Start "Secondary Feed Conveyor" IAW SOP. (HMI, Start-up Sequence PG 3). | |
| 3. | Start "Primary Feed Conveyor" IAW SOP. (HMI, Start-up Sequence PG 3). | |
| 4. | Start "Waste Feed System" IAW SOP. (HMI, Start-up Sequence PG 3). | |

| | | |
|---|---|---|
| | | |
| **5.2** | **START-UP COMPLETE** | |
| 1. | Acknowledge “Start-up Complete” (HMI, Start-up Sequence PG 3). | |
| | | |
| **5.3** | **AWFCO Testing** | |
| 1. | Perform “AWFCO Test” IAW SOP (HMI, Utilities, AWFCO Testing). | |
| | | |

**ATTACHMENT B**

Standard Shutdown Procedure

# 1. INTRODUCTION

This standard operating procedure (SOP) is part of the start-up, shutdown, and malfunction plan. The SOP, in its entirety, will be followed for each start-up from a cold, secured condition. Partial system start-ups resulting from recovery (including malfunction conditions, unplanned maintenance, and shortage of consumables or waste materials) will be performed at the direction of a certified primary control room operator or shift supervisor. The operator will use the RF-9 start-up procedures as guidance for reconfiguring the RF-9 systems and reestablish operating conditions that were invalidated by the unplanned condition. Partial system start-ups will be documented in the control room operator's logbook.

## 1.1 REFERENCES

### Drawings

General arrangement drawing.
Piping and Instrumentation Diagram. S410.104
DZHC, RF-9 PLC upgrade DWGs. 05-363, 1 thru 48
Bundy Electrical DWGs. S410.401 thru S410.407

### Manuals

RF-9 operations and maintenance (O&M) manual
RF-9 continuous emissions monitoring system (CEMS) plan

### Miscellaneous

Valve lineup list
Electrical lineup list

# 2. NORMAL SHUTDOWN

| | | |
|---|---|---|
| 1. | Shutdown “Waste Feed System”. IAW SOP. (HMI, Shutdown Sequence PG 1). | |
| 2. | Execute “Recycle Chute” to recycle. IAW SOP (HMI, Shutdown Sequence PG 1). | |
| 3. | Execute “Recycle Chute” to discharge after preset time. IAW SOP. (HMI, Shutdown Sequence PG 1). | |
| 4. | Execute “Recycle Chute” to recycle after preset time. IAW SOP. (HMI, Shutdown Sequence PG 1). | |
| 5. | Shutdown conveyors RF-21, RF-15 and RF-16. IAW SOP. (HMI, Shutdown Sequence PG 1). | |
| 6. | Shutdown “MDRK Burner” IAW SOP. (HMI, Shutdown Sequence PG 1). | |
| 7. | Shutdown “MDRK Burner” after preset time IAW SOP. (HMI, Shutdown Sequence PG 1). | |
| 8. | Shutdown “Reagent Blower” and “Feeder” IAW SOP. (HMI, Shutdown Sequence PG 2). | |
| 9. | Execute “Bag house isolation valve” to offline, IAW SOP. (HMI, Shutdown Sequence PG 2). | |
| 10. | Shutdown “Evaporative Cooler Water Pumps” IAW SOP. (HMI, Shutdown Sequence PG 2). | |
| 11. | Shutdown “MDRK Combustion Blower” after preset time, IAW SOP. (HMI, Shutdown Sequence PG 2). | |
| 12. | Shutdown “PCC Combustion Blower” after preset time, IAW SOP. (HMI, Shutdown Sequence PG 2). | |
| 13. | Shutdown “MDRK Rotation” after preset time, IAW SOP. (HMI, Shutdown Sequence PG 2). | |
| 14. | Shutdown “ID Fan” after preset time, IAW SOP. (HMI, Shutdown Sequence PG 2). | |
| 15. | Shutdown “Rotary Airlock” IAW SOP (PAS Panel) | |
| 16. | Shutdown “Bag house Cleaning Cycle” IAW SOP (PAS Panel) | |
| 17. | Shutdown “Bag house Hopper Heaters” IAW SOP (PAS Panel) | |
| 18. | Shutdown “CEMS system” IAW SOP. (CEMS Panel) | |
| | Note: CEMS shutdown for extended periods only. | |
| | Note: Shut down sequence has pre-set timers in the sequence for cool down periods. | |

**ATTACHMENT C**

Compliance Forms

# RF-9 DEMILITARIZATION SYSTEM START-UP COMPLIANCE FORM

Date: Operational shift:

Assigned control room operators:

Time start-up initiated (PCC ignited):

Time start-up completed (initiate normal waste feed):

## START-UP PROCEDURE COMPLETION CHECKLIST

**Description Initials**

Section 2: Prerequisites Completed Section 3: Prestart-up Verifications Completed Section 4: Support System

Start-up Completed Section 5: PCC and MDRK Warm-up Completed Section

**Notes:**

# RF-9 DEMILITARIZATION SYSTEM
# SHUTDOWN COMPLIANCE FORM

Date: Operational shift:

Assigned control room operators:

Time shutdown initiated (feeders secured):

Time shutdown completed (PCC secured):

## SHUTDOWN PROCEDURE COMPLETION CHECKLIST

**Description Initials** Section 2: Normal Shutdown Completed Section 3: System Cooldown Completed

**Notes:**

# RF-9 DEMILITARIZATION SYSTEM
# MALFUNCTION COMPLIANCE FORM

Date: Operational shift:

Assigned control room operators:

Malfunction (1, 2, or 3)

1 Automatic Waste Feed Cutoff, Stop Feed, or Belt Timing Error in Which the MDRK and PCC Continue Operation
2 Stop Feed or Automatic Shutdown in Which the MDRK or PCC Continue to Operate
3 Emergency Shutdown Sequence in Which Both the MDRK and the PCC Are Secured

Time of malfunction occurrence:

Description of initiating event:

Time MDRK secured, if not secured automatically:

Time PCC secured, if not secured automatically:

Was established malfunction response
followed subsequent to malfunction
occurrence (Yes/No)

Attach printout of control computer alarm history covering the time period 5 min before and after occurrence of the malfunction.

**Notes:**

# RF-9 DEMILITARIZATION SYSTEM MALFUNCTION EVALUATION FORM

Date:

Date of occurrence:

Description of occurrence:

Were operating parameter limits exceeded? Yes/No (If yes, describe below)

Were emission limits exceeded? Yes/No (If yes, describe below)

Does occurrence meet definition of malfunction? Yes/No

Was start-up, shutdown, and malfunction plan response plan followed? Yes/No

Cause of occurrence:

---

Does start-up, shutdown, and malfunction plan require modification to adequately address this occurrence? Yes/No

Actions taken to minimize future frequency and severity of this occurrence:

Approving management signature:

Attach copy of applicable malfunction compliance form.

**Notes:** Revision Number: 1 C-4 Revision Date: September 2004

## ATTACHMENT D

Valve Lineup List

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| ECWS-001 | ICW | ICWS to pump skid | Cell #3 | N,E CORNER | S410.104 | Open |
| ECWS-002 | ICW | ICWS to pump "A" pump skid (isolation valve) | Evap cooler pump skid. | Outside cell #3 | S410.104 | Open |
| ECWS-003 | ICW | ICWS to pump "B" pump skid (isolation valve) | Evap cooler pump skid. | Outside cell #3 | S410.104 | Open |
| ECWS-004 | ICW | ICWS to pump "B" pump skid (isolation valve) | Evap cooler pump skid. | Outside cell #3 | S410.104 | Open |
| ECWS-005 | ICW | ICWS to pump "A" pump skid (isolation valve) | Evap cooler pump skid. | Outside cell #3 | S410.104 | Open |
| ECWS-006 | ICW | Water control valve (by-pass) | Evap cooler pump skid. | Outside cell #3 | S410.104 | Open |
| ECWS-007 | ICW | Water control valve (by-pass) | Evap cooler pump skid. | Outside cell #3 | S410.104 | Open |
| FV-1517 | ICW | Water control valve (by-pass) | Evap cooler pump skid. | Outside cell #3 | S410.104 | Closed |
| ECWS-008 | ICW | ICWS to spray nozzles from pump skid. | Evap cooler catwalk. | Evap cooler | S410.104 | Open |
| ECWS-009 | ICW | ICWS at spray nozzle "A" | Evap cooler catwalk | Evap cooler | S410.104 | Open |
| ECWS-010 | ICW | ICWS at spray nozzle "B" | Evap cooler catwalk | Evap cooler | S410.104 | Open |
| ECWS-011 | ICW | ICWS at spray nozzle "C" | Evap cooler catwalk | Evap cooler | S410.104 | Open |
| ECAS-001 | Plant Air Supply | Plant Air Supply to Evap cooler spray nozzles. | On top of roof . | ECAS control manifold. | S410.104 | Open |
| ECAS-002 | Plant Air Supply | Air Supply to nozzles | Evap cooler catwalk | Evap cooler | S410.104 | Open |
| ECAS-003 | Plant Air Supply | Air Supply to nozzle "A" | Evap cooler catwalk | Evap cooler | S410.104 | Open |
| ECAS-004 | Plant Air Supply | Air Supply to nozzle "B" | Evap cooler catwalk | Evap cooler | S410.104 | Open |
| ECAS-005 | Plant Air Supply | Air Supply to nozzle "C" | Evap cooler catwalk | Evap cooler | S410.104 | Open |
| IAS-001 | Inst. Air | Inst. Air supply valve. | Cell #3 outside | SE corner by pump skid | S410.104 | Open |
| IAS-002 | Inst. Air | Inst. Air supply valve. | Pump Skid | Outside, cell #3 | S410.104 | Open |
| IAS-003 | Inst. Air | IAS valve to water shut off valve FV-1513. | Pump Skid | Outside, cell #3 | S410.104 | Open |
| IAS-004 | Inst. Air | IAS valve to water control valve FV-1516. | Pump Skid | Outside, cell #3 | S410.104 | Open |
| IAS-005 | Inst. Air | IAS valve to baghouse vibrator V-1005. | East wall Cell #3, outside. | Outside, cell #3 | S410.104 | Open |

| | | | | | | |
|---|---|---|---|---|---|---|
| IAS-006 | Inst. Air | IAS valve ducting valves | Cell #3 outside | Outside, cell #3 | S410.104 | Open |
| IAS-007 | Inst. Air | IAS valve to outlet poppet control valve, SV-904 | Top, baghouse | Outside, cell #3 | S410.104 | Open |
| IAS-008 | Inst. Air | IAS valve baghouse cleaning system. | Top, baghouse | Outside, cell #3 | S410.104 | Open |
| IAS-009 | Inst. Air | IAS valve to bypass poppet control valve, SV-950 | Ducting, bottom of evap cooler. | Outside, cell #3 | S410.104 | Open |
| IAS-010 | Inst. Air | IAS valve to inlet butterfly control valve, SV-902 | Ducting, bottom of evap cooler. | Outside, cell #3 | S410.104 | Open |
| IAS-011 | Inst. Air | IAS valve to lime injection sys. control valve, SV-926 | Lime injection system. | Outside, cell #3 | S410.104 | Open |
| IAS-012 | Inst. Air | IAS valve to lime injection sys. control valve, SV-926 | Lime injection system. | Outside, cell #3 | S410.104 | Open |

# ATTACHMENT E

Electrical Lineup List

| Location | Row/Slot | Description | Normal Position | System Operating Test Procedure Position |
|---|---|---|---|---|
| MCC | | Draft Fan | Closed/On | |
| MCC | | PCC Combustion Blower | Closed/On | |
| MCC | | MDRK Combustion Blower | Closed/On | |
| MCC | | Evaporative Cooler Pump “A” | Closed/On | |
| MCC | | Evaporative Cooler Pump “B” | Closed/On | |
| MCC | | Bag House Hopper Heater | Closed/On | |
| MCC | | Rotary Airlock | Closed/On | |
| MCC | | Reagent Blower | Closed/On | |
| MCC | | Magnetic Separator RF-15 | Closed/On | |
| MCC | | Magnetic Separator RF-16 | Closed/On | |
| MCC | | Recycle Scrap Conveyor RF-22 | Closed/On | |
| MCC | | Recycle Scrap Conveyor RF-23 | Closed/On | |
| MCC | | Recycle Scrap Furnace Feed Conveyor RF-24 | Closed/On | |
| MCC | | Scrap Separation Screen RF-19 | Closed/On | |
| MCC | | Load Conveyor RF-5 | Closed/On | |
| MCC | | Furnace Feed Conveyor | Closed/On | |
| MCC | | MDRK Rotation | Closed/On | |
| MCC | | Scrap Cooling Conveyor | Closed/On | |
| Panel LD-3 | | Breaker # 9 Sub Panel Feed | Closed/On | |
| Panel LD-3 | | Breaker # 10 Sub Panel Feed | Closed/On | |
| Panel LD-3 | | Breaker # 16 Fuel Leak Sensor | Closed/On | |
| Sub Panel RF-9 | | Breaker # 1 Pwr Strip RT Control Console | Closed/On | |
| Sub Panel RF-9 | | Breaker # 2 UPS Control Room | Closed/On | |
| Sub Panel RF-9 | | Breaker # 3 CEMS Panel | Closed/On | |
| Sub Panel RF-9 | | Breaker # 4 Bundy Panel (PAS) | Closed/On | |
| Sub Panel RF-9 | | Breaker # 5 199 Panel / MCC Coils | Closed/On | |
| Sub Panel RF-9 | | Breaker # 6 Fan Optical Scan (Opacity) | Closed/On | |
| Sub Panel RF-9 | | Breaker # 7 Fan Optical Scan (Opacity) | Closed/On | |
| Sub Panel RF-9 | | Breaker # 8 Recep. Air Dryer | Closed/On | |
| Sub Panel RF-9 | | Breaker # 9 Pwr. Strip LT Control Console | Closed/On | |
| Sub Panel RF-9 | | Breaker # 10 Grace Port Panel 199/299/699 | Closed/On | |
| Sub Panel RF-9 | | Breaker # 11 Heat Trace Evap Cooler Water Supply | Closed/On | |
| Sub Panel RF-9 | | Breaker # 13 Pwr. Strip Panel 699 | Closed/On | |

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX J

# START-UP, SHUTDOWN, AND MALFUNCTION PLAN FOR THE PLASMA ORDNANCE DEMILITARIZATION SYSTEM

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| APC | air pollution control |
| ASD | automatic shutdown |
| AWFCO | automatic waste feed cutoff |
| CEMS | continuous emissions monitoring system |
| CFR | Code of Federal Regulations |
| CO | carbon monoxide |
| dc | direct current |
| DI | deionized |
| dP | differential pressure |
| EPA | U.S. Environmental Protection Agency |
| ESS | emergency shutdown sequence |
| HAP | hazardous air pollutant |
| $NO_x$ | oxides of nitrogen |
| NT | nontransferred |
| O&M | operations and maintenance |
| OPL | operating parameter limit |
| PODS | Plasma Ordnance Demilitarization System |
| PPC | primary processing chamber |
| SCC | secondary combustion chamber |
| SCR | selective catalytic reactor |
| $SO_2$ | sulfur dioxide |
| T | transferred |

# UNITS

| | |
|---|---|
| min | minute |
| % | percent |
| V | volt |

# 1. INTRODUCTION

The purpose of this plan is to provide written procedures for minimizing emissions of hazardous air pollutants (HAPs) during start-ups, shutdowns, and malfunctions of the Plasma Ordnance Demilitarization System (PODS) located at the Hawthorne Army Depot in Hawthorne, Nevada. The PODS facility is located in Building 117-2 on a portion of the main base known as the Western Area Demilitarization Facility. These procedures show how pollution prevention systems are operated and how corrective actions are implemented in accordance with best-accepted practices.

## 1.1 SCOPE

This start-up, shutdown, and malfunction plan provides standardized start-up, shutdown, and malfunction response procedures for the PODS, associated pollution control equipment, and ancillary systems. The procedures contained in this plan are intended to standardize operator actions and responses during periods of start-up, shutdown, and malfunction to promote operational safety and to minimize the potential for excess emission of HAPS.

## 1.2 GOALS

The goals of this start-up, shutdown, and malfunction plan are to: 1) ensure the PODS, including associated air pollution control (APC) equipment, is operated in a manner consistent with good APC; 2) ensure malfunctions are identified and corrected as soon as practicable after their occurrence so excess emissions of HAPs are minimized; and 3) reduce the reporting burden associated with periods of start-up, shutdown, and malfunction, including corrective action taken to restore a malfunctioning process and APC equipment to its normal or usual manner of operation.

# 2. REQUIREMENTS

This plan will become effective on the date of PODS operation as determined by the state of Nevada Air Quality Operating Permit. The PODS start-up, shutdown, and malfunction plan was developed to comply with 40 Code of Federal Regulations (CFR) 1206(c)(2), Start-up, Shutdown, and Malfunction Plan. Specific CFR requirements are referenced and summarized in Table 2-1.

# 3. PROCEDURES

## 3.1 START-UP PROCEDURE

The PODS start-up procedure, presented in Appendix A, provides detailed sequences and instructions for starting the PODS. The start-up procedure is addressed in the following sections:

- **Prerequisites and Valve/Electrical Lineup:** The Prerequisite and Valve/Electrical Lineup section provides instructions for preparing and configuring the plant and process equipment for system start-up. Prerequisites include review of maintenance and plant lockout/tag-out logs, area walk-around inspections, and other preparatory actions to ensure general readiness. The valve lineup list, presented in Appendix D, provides the operator with the required position of each valve associated with process and facility equipment to ensure safe and effective operation. The electrical lineup list, presented in Appendix E, provides the operator with the required position of all electrical switchgear, motor control centers, and electrical power panels. The purpose of the electrical lineup is to ensure all equipment has electrical power and electrical power control is properly configured.

*Table 2-1. Requirements for developing start-up, shutdown, and malfunction procedures.*

| Location in Start-up, Shutdown, and Malfunction Plan | 40 CFR Requirement | Description |
|---|---|---|
| Throughout the document | 63.1206(c)(2)<br>63.6(e)(3) | The owner/operator must develop a start-up, shutdown, and malfunction plan that describes procedures for operating the source, as well as associated APC and monitoring equipment, during periods of start-up, shutdown, and malfunction. |
| Sections 3.1, 3.2, and 3.3 and Appendix A, Appendix B, and Appendix C | 63.6(e)(3)(ii) and (iii) | The owner must operate the source and associated APC and monitoring equipment in accordance with the plan during all periods of start-up, shutdown, and malfunction. Conformance with the plan, in the form of a checklist or other effective form of record keeping, must be documented. |
| Section 3.5 | 63.1206(c)(2)(iii) | Identify a projected oxygen correction factor to use during periods of start-up and shutdown, based on normal operations. |
| Section 3.6 | 63.6(e)(3)(viii) | The owner may periodically revise the start-up, shutdown, and malfunction plan to reflect changes in equipment or procedures without prior approval. In the event a malfunction is encountered that is not addressed, or is inadequately addressed, by the plan, the owner must revise the plan within 45 days of the malfunction. |
| Section 4 | 63.6(e)(3)(iii)<br>63.10(b)<br>63.1206(c)(2)(iv) | The source will maintain sufficient records to document all periods of start-up, shutdown, and malfunction and demonstrate compliance with plan procedures and correction actions. Records will be maintained for a period of 5 years. The most recent 2 years of data will be maintained on site. The previous 3 years of data may be maintained off site. |
| Section 4 | 63.6(e)(3)(v) | A current start-up, shutdown, and malfunction plan will be maintained on site. Previous versions of the plan will also be maintained on site for 5 years. |
| Section 5 | 63.6(e)(3)(iii)<br>63.10(d)(5)(i) | A semiannual start-up, shutdown, and malfunction report will be prepared and submitted to the U.S. Environmental Protection Agency (EPA) administrator summarizing activities performed in compliance with this plan. |
| Section 5 | 63.6(e)(3)(iv)<br>63.10(d)(5)(ii) | In the event that start-up, shutdown, or malfunction responses are not performed in compliance with this plan, the administrator must be notified within 2 working days via telephone of facsimile. A formal letter summarizing the noncompliant event, whether excess emissions were experienced as a result, and actions taken will be forwarded to the EPA administrator within 7 working days. |

- **Facility Systems Start-up:** The Facility Systems Start-up section provides detailed instructions for start-up of the control computer, instrument air system, industrial cold water, water treatment system plant cooling water, and deionized cooling water systems.

- **Offgas Equipment Start-up:** The Offgas Equipment Start-up section provides instructions for start-up of the main blowers, scrubber solution pumps, quencher, absorber, and high-energy scrubber flows, chiller, reheater, superheater, and secondary combustion chamber (SCC).

- **SCC Warm-up:** The SCC Warm-up section provides instructions for warming up the SCC in accordance with the manufacture's recommendations regarding refractory life. Temperature ramp-up rates and soak times will be specified.

- **Safety Interlock Functional Check:** The Safety Interlock Functional Check section verifies critical safety interlock and permissive functions. Simple field actions, such as closing valves or opening circuit breakers, will be used to simulate various plant system failures to verify proper interlock and permissive operation. No system components, such as instrumentation and piping, will be disassembled, adjusted, or reconfigured to support these checks. The interlock checks will be limited to those verifications that can be accomplished within these limitations.

- **Plasma Torch Start-up and Primary Processing Chamber (PPC) Warm-up:** The Plasma Torch Start-up and PPC Warm-up section provides directions for starting the plasma torch and subsequent warm-up of the primary vessel in preparation for feeding hazardous waste materials.

The PODS start-up procedure takes the PODS from a cold, secured condition and configures it to process waste ordnance. Compliance with the PODS start-up procedures will be documented in a PODS start-up procedure compliance form, presented in Appendix C. Specific information regarding PODS start-up is recorded on the compliance form, which is used to document compliance with the start-up procedure.

The PODS start-up procedure, in its entirety, will be followed for each start-up from a cold, secured condition. A compliance form will be filled out for each start-up event. The completed form will be filed according to the requirements of Section 5 of this plan.

Partial system start-ups, resulting from recovery, including malfunction conditions, unplanned maintenance, and shortage of consumables or waste materials, will be performed at the direction of a certified primary control room operator or shift supervisor. The operator will use the PODS start-up procedures as guidance for reconfiguring the PODS systems and reestablish operating conditions that were invalidated by the unplanned condition. Partial system start-ups will be documented in the control room operator's logbook. General requirements for maintaining the control room operator's logbook are presented in Section 3.4 of this plan.

## 3.2 SHUTDOWN PROCEDURE

The PODS shutdown procedure, which is presented in Appendix B, provides detailed sequences and instructions by which qualified operators are to shut down and secure the PODS.

The PODS shutdown procedure takes the PODS from feed processing to a cold, secured condition. The shutdown procedures will be followed for all shutdown events. The shutdown procedures include the following components:

- **Secure Feed Operations and Slag Tap, If Required [According to Operations and Maintenance (O&M) Plan]:** Procedures for securing the feeders and slag tapping are covered in the O&M plan. To ensure proper implementation, operations referenced in the shutdown procedure should be followed.

- **Secure Plasma Torch and Direct Current (dc) Power Supplies:** The plasma torch section provides instructions for turning off the plasma arc torches and securing the dc power supplies.

- **System Cooldown:** The System Cooldown section provides instructions for cooldown of the PPC and SCC and shutdown order of the PODS systems.

The PODS shutdown procedure takes the PODS from operational status and configures it to a secured condition. Compliance with PODS shutdown procedures will be documented in a PODS shutdown procedure compliance form, which is presented in Appendix C. Specific information regarding PODS shutdown is recorded on the compliance form, which is used to document compliance with the shutdown procedure. A compliance form will be filled out for each shutdown event. The completed form will be filed according to the requirements of Section 5 of this plan.

## 3.3 MALFUNCTION PROCEDURES AND RESPONSES

### 3.3.1 Malfunction Definition

Malfunctions are defined as sudden and infrequent failures of APC equipment, process equipment, or instrumentation to operate in its normal or usual manner that are not reasonably preventable through good operating practice, proper training, and/or proper maintenance. Failures that result from poor or improper maintenance or careless operation are not malfunctions.

Examples of failures that are classified as malfunctions include loss of electrical power, failure of instruments, and premature pump/motor failure. Examples of failures that are not classified as malfunctions include improper valve/electrical lineup or pump/motor failure due to lack of maintenance.

This plan is concerned with malfunctions and failures that occur whenever a PODS emission source is in operation. PODS emission sources are the plasma torches, the SCC, and the waste feeder. Operational failures that may occur when no PODS emission sources are in operation are not covered by this plan.

### 3.3.2 Malfunctions and Failures

#### 3.3.2.1 Measures to Minimize Frequency and Severity of Malfunctions

The primary measures taken to minimize the frequency of malfunctions are extensive operator training, use of established standard operating procedures, and implementation of a comprehensive maintenance program. These measures are defined in detail in the PODS operator training program, the start-up and shutdown procedures contained in this plan, and the operating instructions and maintenance schedule contained in the PODS O&M manual.

Both the frequency and severity of malfunctions are further reduced by PODS control programming. The PODS is heavily instrumented and integrated with a comprehensive computer control system that not only provides relevant information to the operator in a timely manner, but also implements an extensive layer hierarchy of protective interlocks and controlled shutdowns that are intended to protect personnel/equipment and minimize the potential for excess emissions.

The PODS control system provides the following layered, automated control actions:

- permissive interlocks;
- annunciated alarms and warnings;
- stop-feed sequence;
- automatic waste feed cutoff (AWFCO) sequence;
- automatic shutdown (ASD); and
- emergency shutdown sequence (ESS).

Permissive interlocks were implemented to prevent equipment from being started or operated in improper sequences.

Annunciated alarms and warnings alert the operator to process conditions that are approaching action levels. The annunciated alarms and warnings provide the operator time to respond to stabilize process conditions before a more serious condition is reached.

The stop-feed sequence monitors selected equipment status and process conditions and will automatically stop waste feed if abnormal conditions are sensed. The stop-feed parameters were selected to prevent process conditions from reaching levels that require initiation of an AWFCO.

The AWFCO function monitors key process parameters as required by 40 CFR 63.1209 and will automatically secure waste processing if any parameter exceeds its established limit. The annunciated alarms were integrated with the AWFCO such that the operator will receive an alarm or warning prior to initiation of an AWFCO.

The ASD is designed primarily to protect personnel and process equipment. The ASD function will initiate a stop-feed sequence and remove all thermal sources from the PPC.

The ESS function is the final layer of the PODS protective control system. The control computer will automatically initiate an ESS that consists of an ASD and secures the SCC, removing all thermal sources. The ESS will also initiate emergency cooling water, if required. If initiated manually, all computer control is bypassed and the entire PODS facility is taken to its fail-safe condition, allowing immediate personnel evacuation.

### 3.3.2.2 Actions Required Subsequent to a Malfunction

The PODS integrated control system was designed to respond to all malfunctions envisioned to have the potential to result in excess emissions or significant hazard to personnel or equipment. The response of the control computer can be summarized in three general classifications.

**Class 1, AWFCO, Stop Feed, or Belt Timing Error in Which the Plasma Torch and SCC Continue Operation:** In this scenario, the control system detects exceedance of an established operating parameter limit (OPL), a potential exceedance condition (stop feed), or a feeder system problem. The feed system is secured, but the torch, SCC, and all pollution control equipment continue to operate. The cause of Class 1 malfunctions and their potential root causes are listed in Table 3-1.

***Table 3-1. Malfunction descriptions and potential root causes.***

| Malfunction Class | Malfunction Description | Malfunction Cause | Potential Root Cause | Notes |
|---|---|---|---|---|
| 1 | AWFCO | High primary chamber pressure | PIT 1516 fail | Will also generate ESS |
| | | Low SCC outlet temperature | TSLL 5300 fail | |
| | | Low quench water flow | FSL 5314 fail | Will also generate ESS |
| | | | Quench pump fail | Will also generate ESS |
| | | Low absorber solution flow | FAL 4222 fail | Will also generate ESS |
| | | | Solution filter differential pressure (dP) high | |
| | | | Scrubber pump fail | Will also generate ESS |
| | | Low absorber solution pressure | PAL 5372 fail | |
| | | | Solution filter dP high | |
| | | | Scrubber pump fail | |
| | | Low absorber solution pH | AIT 5320/5312 fail | |
| | | | Metering pump fail | |
| | | Low absorber column dP | PDIT 5313 fail | |
| | | Low scrubber sump level | LS 5324 fail | |
| | | | LV 5324 fail | |

| Malfunction Class | Malfunction Description | Malfunction Cause | Potential Root Cause | Notes |
|---|---|---|---|---|
| | | Low high-energy scrubber flow | FALL 5363 fail | |
| | | | Quench pump fail | |
| | | High baghouse inlet temperature | TE 5412 fail | |
| | | Low baghouse dP | PDIT 5432 fail | |
| | | High baghouse dP | PDIT 5432 fail | |
| | | High stack mass flow | MFIT 5530 fail | |
| | | Low $NO_x$ selective catalytic reactor (SCR) inlet temperature | TE 5630 fail | |
| | | | TIC 5612 fail (reheater controller) | |
| | | High $NO_x$ SCR outlet temperature | TT 5650 fail | |
| | | High CO discharge | AIT 5820 fail | |
| | | High sulfur/$SO_2$ discharge | AIT 5880 fail | |
| | | High stack gas opacity | AIT 5870 fail | |
| | | High $NO_x$ discharge | AIT 5810 fail | |
| 1 | Stop feed | High absorber outlet temperature | TE 5332 fail (absorber outlet temperature) | Will also generate ESS |
| | | Low quench storage tank level | LIT 7417 fail (quench tank level) | |
| | | | HV 7405 fail (quench tank fill valve) | |
| | | Low stack gas oxygen percent | HV 4119 fail (main oxygen isolation) | |
| | | | HV 4113 fail (oxygen lance isolation) | |
| | | | FT 4120 fail (oxygen lance flow control) | |
| | | CEMS system trouble | Trouble condition detected | |
| | | Baghouse leak detector | LD 5732 fail (leak detector) | |
| 1 | Feeder error | Feeder permissive | High air-lock temperature | |
| | | | TE 2070 fail (air-lock temperature) | |
| | | | HV 2120/2150 fail (air-lock valve) | |
| | | | SS 2024/2026 fail (speed switch) | |
| | | | Operator-activated feeder emergency stop | |
| 2 | ASD | Chiller fault | Internal chiller fault detected | |
| | | | Chilled water pump fail | |
| | | Low furnace cooling flow | FSL 3008 fail (main flow) | |
| | | | Furnace pump fail | |
| | | | LE 3050 fail (sump level) | |
| | | | HV 3050 fail (makeup control valve) | |
| | | Low plant cooling flow | FSL 3006 fail (main flow) | |
| | | | Plant pump fail | |
| | | | LE 3050 fail (sump level) | |
| | | | HV 3050 fail (makeup control valve) | |
| 2 | Stop feed | Loss of SCC flame | BE 5022 flame detect fail | |
| | | | Loss of facility compressor | |
| | | | PSL 5108 fail (purge air pressure) | |
| | | | PSL 5203 fail (fuel pressure) | |
| | | | Fuel pump fail | |
| | | | PSL 5286 fail (oxygen pressure) | |
| | | | Facility isolation HV 4119 fail | |
| | | Loss of torch arc | Furnace emergency valve FZH 30387 position fail | |
| | | | Deionized (DI) skid emergency valve FZH 4012 position fail | |

| Malfunction Class | Malfunction Description | Malfunction Cause | Potential Root Cause | Notes |
|---|---|---|---|---|
| | | | Absorber emergency valve ZSH 5383 position fail | |
| | | | FIT 4049 fail (main DI flow) | |
| | | | DI pump fail | |
| | | | LIT 4050 fail (DI level) | |
| | | | PSE 4130 fail (PPC pressure relief) | |
| | | | PPC temperature element fail (2) | |
| | | | HV 0789 fail (attemperation water isolation) | |
| | | | FT 784 fail (attemperation water flow) | |
| | | | PPC lower cooling flow fail (4) | |
| | | | PPC upper cooling flow fail (4) | |
| | | | PPC port cooling flow fail (5) | |
| | | | Y-chute cooling flow fail (1) | |
| | | | Crucible/chamber cooling flow fail (12) | |
| | | | Torch motion control fail | |
| | | | FT 1940 fail (torch gas) | |
| | | | Transferred (T) torch low volt/amp | |
| | | | T torch power supply internal fault | |
| | | | T torch power supply fan fail | |
| | | | T torch power supply FSL 1236 fail | |
| | | | Nontransferred (NT) torch low volt/amp | |
| | | | NT torch power supply internal fault | |
| | | | NT torch power supply fan fail | |
| | | | NT torch power supply FSL 1736 fail | |
| | | | T torch cooling flow fail (4) | |
| | | | NT torch cooling flow fail (4) | |
| | | | Loss of main 4,160-V disconnect | |
| 3 | ESS | High-high PPC pressure | PIT 1516 fail | |
| | | High-high absorber outlet temperature | TAHH 5332 fail | |
| | | High-high absorber sump level | LA 5324 fail | |
| | | Low-low quench water flow | FIT 5314 fail | |
| | | | Quench pump fail | |
| | | Low-low absorber solution flow | FIT 4222 fail | |
| | | | Scrubber pump fail | |
| | | Loss of blowers | Both blowers status off | |

In response to a Class 1 computer response, the operator shall take the following actions:

- Using the control screen alarm status displays, identify/verify the source of the malfunction. Acknowledge the alarm and silence the audible alarms, as appropriate.
- Verify/secure the feed system.
- Monitor continuous emissions monitoring system (CEMS) data for carbon monoxide (CO), oxides of nitrogen ($NO_x$), and sulfur dioxide ($SO_2$).

- If monitored values are below emission alarm limits and are stable or decreasing, allow the plasma torch and SCC to continue to operate for at least 15 min to ensure complete waste treatment. The maximum residence time for organic waste constituent is approximately 3 min.
- If monitored values are above alarm limits or CEMS data is not available, allow the torch and SCC to operate for a minimum of 5 min, but do not to exceed 10 min, to complete waste treatment. The maximum residence time for organic waste constituent is approximately 3 min. Secure the torch and SCC, ignoring the SCC cooldown recommendations.

- The system is in best-practice condition; proceed with shutdown of process equipment and support systems. Initiate malfunction troubleshooting and repair using the PODS O&M manuals as a reference.

- As soon as practical, fill out a malfunction compliance form (Appendix C) and initiate malfunction evaluation and documentation, as detailed in Section 3.3.2.3 of this plan.

**Class 2, Stop Feed or ASD in Which the Plasma Torch or SCC Continue to Operate:** In this scenario, the control system detects a potential exceedance condition (stop feed) or other potentially unsafe condition. The feed system and endangered equipment are secured, but either the torch or the SCC and unaffected pollution control equipment continue to operate. The cause of Class 2 malfunctions and their potential root causes are listed in Table 3-1.

In response to a Class 2 computer response, the operator shall take the following actions:

- Using the control screen alarm status displays, identify/verify the source of the malfunction. Acknowledge the alarm and silence the audible alarms, as appropriate.

- Verify/secure the feed system.

- Monitor CEMS data for CO, $NO_x$, and $SO_2$.

  - If monitored values are below emission alarm limits and are stable or decreasing, allow plasma torch/SCC to continue to operate for at least 15 min to ensure complete waste treatment. The maximum residence time for organic waste constituent is approximately 3 min.
  - If monitored values are above alarm limits or CEMS data is not available, allow the torch/SCC to operate for a minimum of 5 min, but do not to exceed 10 min, to promote waste treatment. The maximum residence time for organic waste constituent is approximately 3 min. Secure the torch/SCC, ignoring the SCC cooldown recommendations.

- The system is in best-practice condition; proceed with shutdown of process equipment and support systems. Initiate malfunction troubleshooting and repair using the PODS O&M manuals as a reference.

- As soon as practical, fill out a malfunction compliance form (Appendix C) and initiate malfunction evaluation and documentation, as detailed in Section 3.3.2.3 of this plan.

**Class 3, ESS in Which Both the Plasma Torch and the SCC Are Secured:** In this scenario, the control system detects a potentially unsafe condition that requires immediate response. This scenario also includes ESS responses that are manually initiated by the operator. The feed system and all process equipment, including both the torch and the SCC, are secured. Only the main blowers continue to operate. In the event that the ESS was manually initiated, emergency cooling water is also applied to the

torch, the furnace, and the pollution control equipment. The cause of Class 3 malfunctions and their potential root causes are listed in Table 3-1.

The following operator actions shall be taken in response to a Class 3 computer response to the extent that operator safety is not jeopardized:

- Using the control screen alarm status displays, identify/verify the source of the malfunction. Acknowledge the alarm and silence the audible alarms, as appropriate.
- Verify/secure the feed system.
- Verify that the torch and the SCC are secured.
- Verify that the PPC attemperation water and oxygen are secured.
- The system is in best-practice condition; proceed with shutdown of process equipment and support systems. Initiate malfunction troubleshooting and repair using the PODS O&M manuals as a reference.
- As soon as practical, fill out a malfunction compliance form (Appendix C) and initiate malfunction evaluation and documentation, as detailed in Section 3.3.4 of this plan.

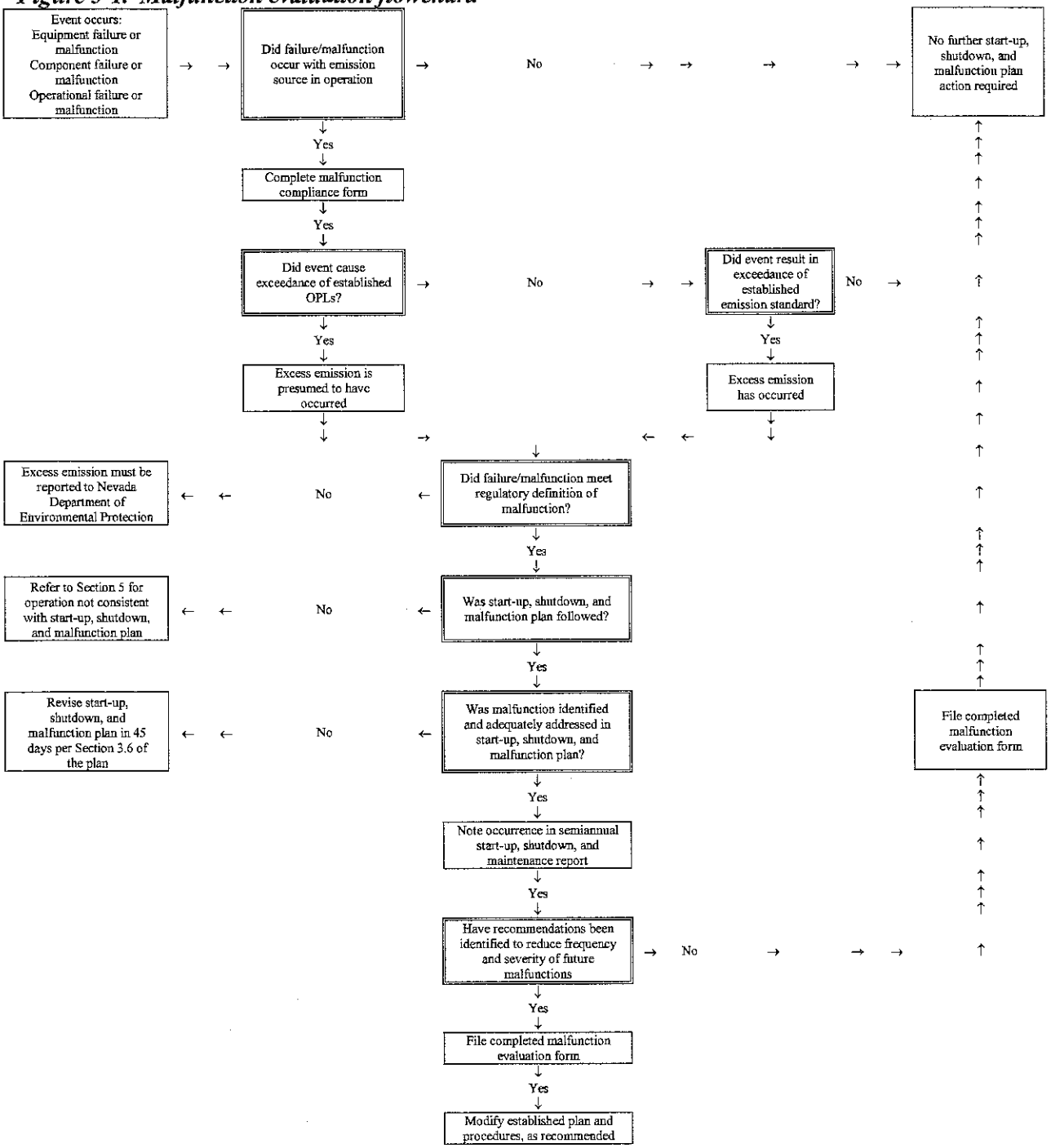
#### 3.3.2.3 Malfunction Evaluation and Documentation

As it is not possible to anticipate all malfunctions or failures that may occur over the life of the PODS facility, a method for evaluating each malfunction or failure was established. This evaluation method serves several purposes: 1) it provides a mechanism for classifying unanticipated failures as malfunctions; 2) it provides a mechanism for continual review and improvement of the malfunction response actions required by this plan; and 3) it provides a mechanism for identifying measures to reduce the frequency and severity of malfunctions.

Immediately following the occurrence of a malfunction, the operator must fill out a malfunction compliance form (Appendix C) to document pertinent information related to the malfunction. The malfunction compliance form must be filed in the operating record at the end of the shift, as specified in Section 4 of this plan.

As soon as possible, but prior to initiating further waste processing, a malfunction evaluation form (Appendix C) must be filled out. The form is intended to document implementation of the malfunction review process summarized in Figure 3-1.

## *Figure 3-1. Malfunction evaluation flowchart.*



## 3.4 USE OF CONTROL ROOM OPERATOR LOGBOOK

The control room operator will be responsible for maintaining the operator's logbook. The operator's logbook will contain pertinent information regarding the operating sequence and configuration of process and plant equipment. The purpose of the operator's log is: 1) to provide a communication mechanism between operating shifts; and 2) to provide a detailed operating record. The operator's log will contain the following information:

- date;
- shift of operation;
- name of on-duty control room operators;
- description of significant operating events, such as start-up, shutdown, malfunctions, feed start, or feed stop;
- description of significant configuration or equipment changes, such as inoperative standby pump or empty calibration gas bottles; and
- each entry will include the current time as indicated by the main control computer.

The operator's log will be maintained in a bound notebook. The operator's logbook will be retained as part of the operating record, as specified in Section 5 of this plan.

## 3.5 USE OF OXYGEN CORRECTION FACTOR

The oxygen content of the stack emissions will vary considerably from 7% during start-up and shutdown. An oxygen correction factor of 7% will be used during preliminary testing and will be applied during all phases of operation. Based on operational experience, alternate corrections factors may be applied during start-up and shutdown.

## 3.6 PLAN REVISION

The start-up, shutdown, and malfunction plan may be revised, as required, without prior approval. All revisions to the plan will be controlled as specified in Section 4.

In the event malfunctions are encountered that are not covered by this plan, the plan shall be revised within 45 days.

# 4. RECORDS RETENTION REQUIREMENTS

Completed procedure compliance forms will be filed in the PODS operating record at the end of each shift. Completed forms must be retained for 5 years with the most recent 2 years of records maintained on site. The operator logbooks, when completed, will be filed in the PODS operating record. Logbooks must be retained for 5 years with the most recent 2 years of records maintained on site. A current version of the PODS start-up, shutdown, and malfunction plan will be maintained in the PODS control room. Previous versions of the PODS start-up, shutdown, and malfunction plan will be maintained as part of the PODS operating record for 5 years.

# 5. REPORTING RETENTION REQUIREMENTS

A semiannual start-up, shutdown, and malfunction report, summarizing activities performed in compliance with this plan, will be prepared and submitted to the EPA administrator. The report will include the number, duration, and a brief description of each start-up, shutdown, and malfunction event.

If start-up, shutdown, or malfunction responses are not performed in compliance with this plan, the administrator will be notified within 2 working days of the response via telephone of facsimile. A formal letter summarizing the noncompliant event, whether excess emissions were experienced as a result, and actions taken will be forwarded to the EPA administrator within 7 working days after the response.

# APPENDIX A

Standard Start-up Procedure

# 1. INTRODUCTION

This standard operating procedure (SOP) is part of the start-up, shutdown, and malfunction plan. The SOP, in its entirety, will be followed for each start-up from a cold, secured condition. Partial system start-ups resulting from recovery (including malfunction conditions, unplanned maintenance, and shortage of consumables or waste materials) will be performed at the direction of a certified primary control room operator or shift supervisor. The operator will use the Plasma Ordnance Demilitarization System (PODS) start-up procedures as guidance for reconfiguring the PODS systems and reestablish operating conditions that were invalidated by the unplanned condition. Partial system start-ups will be documented in the control room operator's logbook.

## 1.1 REFERENCES

### Drawings

- General arrangement drawing, Piping Plan, E18-00GA-001, Sheets 2 through 4
- General arrangement drawing, Instrumentation Plan, E18-00GA-001, Sheets 8 through 10
- Piping and Instrumentation Diagrams, E18-00PI-001 through -017
- Day and Zimmerman Hawthorne Corporation (DZHC) PODS Electrical One-Line Diagram, EE-2
- Motor Control Center (MCC)-2 Single-Line Electrical Diagram, E18-00EE-011
- MCC-1 Single-Line Electrical Diagram, E18-00EE-012
- Main, Central Control Room (CCR), and Panel Uninterruptible Power Supply (UPS) Panel Schedule, E18-00EE-014

### Manuals

- PODS operations and maintenance (O&M) manual, Volumes 1 through 6
- PODS O&M plan
- PODS continuous emissions monitoring system (CEMS) plan

### Miscellaneous

- Valve lineup list
- Electrical lineup list

# 2. PREREQUISITES

This list identifies the verifications and other prerequisite activities necessary to ensure sufficient consumables are available and that the PODS is configured to support processing operations.

| | | |
|---|---|---|
| 1. | Verify that Building 117-2 compressed air system is on line and available. | |
| 2. | Verify that the Western Area Demil Facility (WADF) Industrial Cold Water System is lined up and available to support Building 117-2. | |
| 3. | Verify that WADF diesel storage tank contains sufficient quantity for planned operation and that vacuum pump OBH-266 is operating. | |
| 4. | Verify that the PODS oxygen storage tank contains sufficient quantity to support planned operations. | |
| 5. | Verify the PODS ammonia storage tanks contain sufficient quantity for the planned run. | |
| 6. | Verify that the PODS sodium hydroxide storage tank contains sufficient quantity to support planned operations. | |

| | | |
|---|---|---|
| 7. | Verify that the scrubber water treatment system is available. Verify a sufficient quantity of chemical additives are available to support planned operations. | |
| 8. | Verify that a sufficient quantity of slag collection barrels are available for the planned operations. | |
| 9. | Verify that CEMS calibration gases are on hand in sufficient quantities to support planned operations. | |
| 10. | Verify that the installed helium gas bottle has a minimum of 500 psi pressure and that sufficient full bottles are available to support planned operations. | |
| 11. | Verify sufficient feedstock components (soil and iron) are available for the planned operations. | |
| 12. | Verify sufficient oxy-lance burning bars are available for planned operations. | |
| 13. | Review the lockout/tag out log and resolve any discrepancies. | |
| 14. | Review plant maintenance status log and ensure all required/essential maintenance and repair work has been completed. | |
| 15. | Verify both the transferred and nontransferred power supply doors are all closed and locked. | |

# 3. PRESTART-UP CHECKLIST

| | | |
|---|---|---|
| 1. | Verify that a valve lineup has been completed, if required. | |
| 2. | Verify that an electrical lineup has been completed, if required. | |
| 3. | Energize chiller compressor heaters by turning chiller "On/Off" switch to the "On" position.<br><br>Record Time Heaters turned on in the control room log book.<br><br>**Note:** Chiller crankcase heaters must have operated for at least 12 hours before start-up if the chiller has been off for a week or more. If the chiller has been off for less than a week, the crankcase heaters must be on 2 hours before chiller start-up. | |
| 4. | Verify that oil reservoirs and sight glasses on the following equipment are at least half full:<br><br>– plant cooling water circulation pumps (2);<br>– furnace cooling water circulation pumps (2);<br>– chilled water circulation (1);<br>– DI cooling water circulation pumps (2);<br>– scrubber water circulation pumps (2); and<br>– quench water supply pump (1). | |
| 5. | Check all fluid tanks/reservoirs and ensure proper level:<br><br>– plant cooling water sump (> 25 inches);<br>– scrubber sump (36 inches);<br>– sodium hydroxide run tank (> low level switch);<br>– DI head tank (> 37 inches);<br>– chilled water expansion tank (> 12 psig); and<br>– quench water storage tank (> 50 inches). | |
| 6. | Verify the number of operating hours currently on the torch electrode and nozzle are consistent with planned operations. Install a new electrode and nozzle as required. | |

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| 7. | Perform a torch megger test if torch parts have been replaced since the last torch operation or if the torch has not operated for more that one week.<br><br>**Megger test procedure:**<br><br>**Note:** The 4160 AC power on the motor controller and the 480V power supply control power must be lockout/tag out before the megger test can be performed. Disconnect the DC + and – leads in the power supply.<br><br>a. Connect the megger leads across the + and – DC leads going out to the transferred torch.<br>b. Never megger the torch with the DC torch leads connected to the power supply.<br>c. Megger at 1000 volts DC with the igniter contactor open and hold for one minute before recording results on the pretest check sheet.<br>d. Perform the same test with the igniter contactor closed, and record the results.<br><br>Once the megger checks are complete, return the power leads to their locations, bolted up to the buss bars. | |
| 8. | Verify that empty slag barrels are in both slag carriages and that the leading barrel is located in the pour position. | |

# 4. SUPPORT SYSTEM START-UP PROCEDURE

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| | **Note:** Unless stated otherwise, all start, stop, adjustment and monitoring of process equipment is to be performed from the main control computer in the Central Control Room (CCR). | |
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| **4.1** | **UNINTERRUPTIBLE POWER SUPPLY** | |
| 1. | At the UPS local panel, start the UPS and configure for operation in the UPS mode. | |
| 2. | At the UPS local panel, verify the UPS Input Power indicator is illuminated and the UPS Output Availability indicator is illuminated. | |
| | | |
| **4.2** | **CONTROL AND DATA RECORDING COMPUTERS** | |
| 1. | Start the controlling computer. | |
| 2. | Verify the controlling computer boots up and displays the main control screen. | |
| 3. | Start the data-recording computer. | |
| 4. | Verify the data-recording computer boots up and displays the main data screen. | |
| 5. | Verify/Reset the ESS function at main control console.<br><br>**Note:** All four ESS buttons must reset before the ESS function can be reset. | |
| | | |
| **4.3** | **INSTRUMENT AND HIGH PRESSURE AIR** | |
| 1. | At the air dryer local control panel, power up the IAS air dryer controller. | |
| 2. | Verify that both air dryer inlet filter-housing indicators are in the "green" range. | |
| 3. | At the air dryer control panel, verify that low pressure is not indicated. | |
| 4. | Open, or verify open, the following valves:<br><br>– IAS-10025 (Air Lock Valves and Weight Cell Isolation). | |
| 5. | Close, or verify close, the following valves:<br><br>– HPA-15036 (High-Pressure Air Receiver Outlet Isolation). | |
| 6. | Turn on, or verify on, the high-pressure compressor at the local control panel. | |
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| **4.4** | **INDUSTRIAL COLD WATER** | |
| 1. | Verify that the following valves status in the "closed" or "normal" position:<br><br>– HV 4020 (DI emergency cooling drain);<br>– HV 4762 (DI emergency cooling control);<br>– HV 5380 (quencher/absorber emergency cooling control);<br>– HV 5322A (quencher/absorber emergency vent);<br>– HV 5322B (quencher/absorber emergency drain);<br>– ICW 3055 (PCW emergency cooling control);<br>– HV 3064 (PCW emergency cooling); and<br>– HV 3062 (PCW emergency cooling return). | |
| 2. | Open, or verify open, the following valves:<br><br>– ICW 30010 (facility ICW supply isolation); and<br>– ICW 30011 (facility ICW supply isolation). | |
| 3. | Open, or verify open, the following valves:<br><br>– ICW 30080 (DI emergency cooling isolation);<br>– ICW 30023 (quencher/absorber emergency cooling isolation); and<br>– ICW 30387 (furnace emergency cooling isolation). | |
| | | |
| **4.5** | **SCRUBBER WATER TREATMENT SYSTEM** | |
| 1. | Open, or verify open, the following valves:<br><br>– ICW 30212 (scrubber water treatment system isolation); and<br>– IAS 15258 (scrubber water treatment system isolation). | |
| 2. | At the scrubber water treatment system local panel:<br><br>– Verify control power is present;<br>– Verify both clarifier rakes are turned to the enable position; and<br>– Verify that the equalization pump is turned to the on position. | |
| | | |
| **4.6** | **PLANT COOLING WATER** | |
| 1. | Open, verify open, the following valves:<br><br>– IAS 30384 (PCW soft water makeup isolation). | |
| 2. | Verify the plant cooling water sump level is greater than TBD-inches. Fill as required. | |
| 3. | **Note:** The control computer automatically selects pump A/B based upon run history. The operator does not have control of pump selection from the main control computer.<br><br>Start the plant cooling water pump. Verify pump run indication. | |
| 4. | Monitor the cooling water storage tank level on LI 3050 to ensure it stays above 10 inches. | |
| 5. | Verify that all cooling circuit flow switches for the upper reactor, lower reactor and hearth status in the "low-low flow" condition. All flow circuit graphic should display in red.<br><br>**Note:** Any flow switch that displays a flow status (green flow circuit graphic) is potentially stuck in the open position. Repair all improperly functioning flow switches prior to proceeding. | |
| 6. | **Note:** The control computer automatically selects pump A/B based upon run history. The operator does not have control of pump selection from the main control computer.<br><br>Start the furnace cooling water pump. Verify pump run indication. | |
| 7. | Monitor the cooling water storage tank level on LI 3050 to ensure it stays above 10-inches. | |
| 8. | Verify that all cooling circuit flow switches for the upper reactor, lower reactor and hearth do not status is in either the "low flow" or "low-low flow" condition. All flow circuit graphic should display in green. | |
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| **4.7** | **COOLING WATER TREATMENT SYSTEM** | |
| 1. | At the cooling water treatment system local control panel, start the cooling water treatment system. | |
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| **4.8** | **CHILLED WATER SYSTEM** | |
| 1. | Start the chilled water pump. Verify chilled water pump run indication. | |
| 2. | **Note:** Chiller crankcase heaters must have operated for at least 12 hours before start-up if the chiller has been off for a week or more. If the chiller has been off for less than a week, the crankcase heaters must be on 2 hours before chiller start-up.<br><br>Verify that the chiller crankcase heaters have been operated for 2-12 hours as indicated above. | |
| 3. | At the chiller local control panel, start the chiller. Verify chiller operation status. | |
| | | |
| **4.9** | **DI WATER SYSTEM** | |
| 1. | Verify the DI head tank level is greater than 37-inches. | |
| 2. | Verify that all cooling circuit flow switches for the transferred arc torch anode, nozzle, ram and ball in the "low-low flow" condition. All flow circuit graphic should display in red.<br><br>**Note:** Any flow switch that displays a flow status (green flow circuit graphic) is potentially stuck in the open position. Repair all improperly functioning flow switches prior to proceeding. | |
| 3. | Verify that all cooling circuit flow switches for the nontransferred arc torch anode, cathode/nozzle, ram and ball in the "low-low flow" condition. All flow circuit graphic should display in red (at the torch control screen).<br><br>**Note:** Any flow switch that displays a flow status (green flow circuit graphic) is potentially stuck in the open position. Repair all improperly functioning flow switches prior to proceeding. | |
| 4. | **Note:** The control computer automatically selects pump A/B based upon run history. The operator does not have control of pump selection from the main control computer.<br><br>Start the DI cooling water pump. Verify DI pump run indication. | |
| 5. | Monitor the DI water reservoir level on LI 4050 to ensure it stays above 37-inches. | |
| 6. | Verify that all cooling circuit flow switches for the transferred arc torch anode, nozzle, ram and ball do not status in the "low-flow" or "low-low flow" condition. All flow circuit graphic should display in green (at the torch control screen). | |
| 7. | Verify that all cooling circuit flow switches for the nontransferred arc torch anode, cathode/nozzle, ram and ball do not status in the "low-flow" or "low-low flow" condition. All flow circuit graphic should display in green (at the torch control screen). | |
| | | |
| **4.10** | **MAIN BLOWERS** | |
| 1. | Set the primary chamber pressure set point to -5 inches of water vacuum. | |
| 2. | Set the stack gas blower speed setpoint to 50%. | |
| 3. | Close the slag chamber purge control valve. | |
| 4. | Establish Y-chute/Chamber Purge. | |
| 5. | Open the following IAS valves to establish torch gas flow into the primary chamber:<br><br>– IAS 10020 (torch gas isolation);<br>– IAS 10019 (torch purge isolation);<br>– IAS 10206 (Y chute/chamber purge);<br>– IAS 10073 (camera purge isolation); and<br>– IAS 10087 (slag chamber purge). | |
| 6. | **Note:** The control computer automatically selects blower A/B based upon run history. The operator does not have control of pump selection from the main control computer.<br><br>Start the main blower. Verify blower run status.<br><br>**Note:** The isolation valves for the operating stack gas blower should status open and the isolation valves for the non-running blower should status closed. | |
| 7. | Adjust blower speed as required so that PPC pressure can be maintained. | |
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| **4.11** | **BAGHOUSE/SUPERHEATER** | |
| 1. | Open, or verify open, the following valves:<br><br>– IAS 15062 (baghouse pulse isolation). | |
| 2. | At the baghouse local control panel, enable the baghouse automated cleaning cycle by placing the on/off switch to the on position. | |
| 3. | At the heater local control panel, set the zone 1 and zone 2 on/off switches to the on position. | |
| 4. | Verify or set the superheater setpoint to 140 °F and start the superheater. | |
| | | |
| **4.12** | **$NO_X$ SKID/REHEATER** | |
| 1. | Verify or set the reheater setpoint to 550 °F and start the reheater. | |
| 2. | **Note:** Do not start the $NO_x$ skid until the exit gas inlet temperature (TI 5630) is above 536 °F.<br><br>Start up the $NO_x$ skid as follows:<br><br>a. Open AMM-15077 and AMM-15079 ($NH_3$ Tank Isolation valves).<br>b. Set $NO_x$ controller set point to 2,000 ppm. | |
| | | |
| **4.13** | **ABSORBER SYSTEM** | |
| 1. | Verify that the scrub water equalization and treated waste storage tanks do not indicate high-level alarms.<br><br>– equalization tank level high (LAH 7504); and<br>– treated water storage tank level high (LAH 7130).<br><br>**Note:** Starting the scrub water circulation pumps with an equalization tank high-level alarm may cause the equalization tank to overflow. | |
| 2. | Close, or verify closed, the following valves:<br><br>– SLS-TBD (Quencher/Scrub Water Cross Connect Isolation). | |
| 3. | Verify the scrubber liquor sump level is approximately 36 inches. | |
| 4. | **Note:** The control computer automatically selects pump A/B based upon run history. The operator does not have control of pump selection from the main control computer.<br><br>Start the scrubber water pump. Verify pump run indication | |
| 5. | Open, or verify open, the following valves:<br><br>– CAU-1561 (Caustic Day Tank Inlet Isolation). | |
| 6. | Enable the caustic transfer pump and caustic metering pump. | |
| 7. | Set, or verify, pH control set point of 7.0. | |
| | | |
| **4.14** | **SCC UNIT START-UP** | |
| 1. | Verify that the CEMS is operational, calibrated and ready to support PODS operations. | |
| 2. | Start, or verify, data recording. | |
| 3. | Initiate high-pressure air to the high-energy scrubber by opening the following valves:<br><br>– HPA-15036 (High-pressure receiver isolation). | |
| 4. | Start the Quench water pump. Verify pump run status. | |
| 5. | Start the diesel fuel supply pump. Verify pump run status. | |
| 6. | Open facility oxygen supply isolation valve. | |

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| 7. | Start the PODS SCC unit:<br><br>a. Open the oxygen block valve (OXY-10353);<br>b. Open diesel block valve (DFL-15119);<br>c. Open air block valves (IAS-10243 and IAS-10357);<br>d. Verify the SCC temperature controller (HC 5300) is set to less than 400 °; and<br>e. Start the main burner.<br><br>**Note:** SCC purge cycle will be initiated. At completion of purge cycle, the "limits satisfied" indication will be established and the burner will be ignited. The burner "flame proved" signal will be established in 30 seconds.<br><br>f. Verify heat up of SCC.<br>g. Adjust the SCC temperature setpoint using HC 5300 to control the heat up rate to 150 °F per hour or less. | |
| 8. | Monitor % oxygen in the stack gas as indicated by the CEMS O2 analyzer. Initiate PPC oxygen injection as required to maintain > 5 % oxygen. | |

# 5. PODS TORCH AND WASTE PROCESSING START-UP

This section starts PODS waste processing equipment. All support equipment has been started.

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| | These steps must be completed prior to starting either torch. | |
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| **5.1** | **PREREQUISITES** | |
| 1. | Verify the Pre-Start-up Checklist has been completed per section 3. | |
| 2. | Verify support systems have been started per section 4. | |
| 3. | Verify the SCC temperature is 1,100 °F or above. | |
| | | |
| **5.2** | **POWER SUPPLY** | |
| 1. | Verify both the transferred and nontransferred power supply doors are all closed. | |
| 2. | Verify/Line up 480-VAC control power to both power supplies and verify that the local/remote switch is in remote. | |
| 3. | Verify/Reset the power supply ESS located on each power supplies. | |
| 4. | Verify that the system ready light and operational status light for both torches are indicating "ready" status on the torch control screen. | |
| | | |
| **5.3** | **SAFETY INTERLOCK FUNCTION CHECKS** | |
| | | |
| 1. | Miscellaneous Safety Interlock Functional Checks – System Ready. | |
| 2. | Safety Interlock Functional Checks – Operational Ready. | |
| | **Note:** Cooling water flow interlocks shall be functionally checked per the instructions of this section prior to torch ignition. Interlocks on both torches shall be checked unless specific torch is not to be operated, in which case interlock checks on that torch can be skipped. | |
| 3. | Verify that the Torch Permissive Ready light for both torches are indicating "ready" status on the torch control screen. | |
| 4. | Slowly throttle back the cooling flow to the 1,333-kW torch anode (FISLL 1130) until the second low flow alarm is displayed on the alarm screen. Record actual flow at each alarm point.<br><br>Low flow _____, should be 10 +/- 1.5 gpm.<br>Low, Low flow _____, should be 8.2 +/- 1.5 gpm.<br><br>Verify the 1,333-kW torch (Torch Permissive) status indicates not ready. | |
| 5. | Return cooling flow to the 1,333-kW torch anode to normal flow. Record final flow.<br><br>1,333-kW torch anode flow _____, should be (25-35) gpm.<br><br>Verify 1,333-kW torch (Torch Permissive) status indicates ready. | |

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| 6. | Slowly throttle back the cooling flow to the 1,333-kW torch nozzle (FISLL-1135) until the second low flow alarm is displayed on the alarm screen. Record actual flow at each alarm point.<br><br>Low flow _____, should be 20 +/- 1.5 gpm.<br>Low, Low flow _____, should be 16.4 +/- 1.5 gpm.<br><br>Verify the 1,333-kW torch (Torch Permissive) status indicates not ready. | |
| 7. | Return cooling flow to the 1,333-kW torch nozzle to normal flow. Record final flow.<br><br>1,333-kW torch nozzle flow _____, should be (40-45) gpm.<br><br>Verify 1,333-kW torch (Torch Permissive) status indicates ready. | |
| 8. | Slowly throttle back the cooling flow to the 675-kW torch anode (FISLL-1640) until the second low flow alarm is displayed on the alarm screen. Record actual flow at each alarm point.<br><br>Low flow _____, should be 10 +/- 1.5 gpm.<br>Low, Low flow _____, should be 8.2 +/- 1.5 gpm.<br><br>Verify the 675-kW torch (Torch Permissive) status indicates not ready. | |
| 9. | Return cooling flow to the 675-kW torch anode to normal flow. Record final flow.<br><br>675-kW torch anode flow _____, should be (25-35) gpm.<br><br>Verify 675-kW torch (Torch Permissive) status indicates ready. | |
| 10. | Slowly throttle back the cooling flow to the 675-kW torch cathode/nozzle (FISLL-1635) until the second low flow alarm is displayed on the alarm screen. Record actual flow at each alarm point.<br><br>Low flow _____, should be 20 +/- 1.5 gpm.<br>Low, Low flow _____, should be 16.4 +/- 1.5 gpm.<br><br>Verify the 675-kW torch (Torch Permissive) status indicates not ready. | |
| 11. | Return cooling flow to the 675-kW torch cathode to normal flow. Record final flow.<br><br>675-kW torch cathode/nozzle flow _____, should be (40-45) gpm.<br><br>Verify 675-kW torch (Torch Permissive) status indicates ready. | |
| 12. | Safety Interlock Functional Check – Torch Start Sequence Ready. | |
| 13. | Establish motion on the 1,333-kW torch.<br><br>**Note:** The 675 kW torch must be in the park position to established motion on the 1333 kW torch. | |
| 14. | Energize 1,333-kW torch power supply 4160-VAC input by activating AC on control, on the torch control screen display. Verify AC Breaker ON is indicating on the torch control screen. | |
| 15. | Verify the 1,333-kW power supply torch start sequence indicates ready. | |
| 16. | Slowly throttle torch gas flow to the 1,333-kW torch until the torch gas pressure alarm is displayed on the alarm screen. Record the actual pressure at alarm point.<br><br>Pressure low _____, should be 5 +/- 1 psig.<br><br>Verify 1,333-kW torch start sequence indicates not ready and AC interrupter has tripped. | |
| 17. | Return 1,333-kW torch gas pressure to normal condition. Record final pressure.<br><br>1,333-kW torch gas pressure _____, should be 85 gpm. | |
| 18. | Energize 1,333-kW torch power supply 4160 VAC input by activating AC on control, on the torch control screen display. Verify AC Breaker ON is indicating on the torch control screen.<br><br>Verify 1,333-kW torch operational status indicates ready. | |

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| 19. | Establish motion on the 675-kW torch.<br><br>**Note:** The 675 kW torch must be in the park position to established motion on the 1333 kW torch. | |
| 20. | Energize 675-kW torch power supply 4160 VAC input by activating AC on control, on the torch control screen display. Verify AC Breaker ON is indicating on the torch control screen.<br><br>**Note:** The 1,333-kW power supply AC Breaker may be secured or opened depending upon operational plans. | |
| 21. | Verify the 675-kW power supply torch start sequence indicates ready. | |
| 22. | Slowly throttle torch gas flow to the 675-kW torch until the torch gas pressure alarm is displayed on the alarm screen. Record the actual pressure at alarm point.<br><br>Pressure low _____, should be 5 +/- 1 psig.<br><br>Verify 675-kW torch start sequence indicates not ready. | |
| 23. | Return 675-kW torch gas pressure to normal condition. Record final pressure.<br><br>675-kW torch gas pressure _____, should be 85 gpm. | |
| 24. | Energize 675W torch power supply 4160 VAC input by activating AC on control, on the torch control screen display. Verify AC Breaker ON is indicating on the torch control screen.<br><br>Verify 675W torch operational status indicates ready. | |
| | | |
| **5.4** | **PLASMA TORCH OPERATION** | |
| 1. | Place the slag chamber purge and exhaust into automatic mode on the slag conveyor screen. | |
| | **Note:** Either, but not both, torches may be started after the SCC is above 1100 °F to assist in the SCC warm up and to warm up the PCC for processing waste ordnance. | |
| 2. | Energize the desired torch power supply 4160 VAC input by activating AC on control, on the torch control screen display. Verify AC Breaker ON is indicating on the torch control screen. | |
| | **Nontransferred Arc Torch** | |
| 1. | Set the non-transfer torch speed, torch radius, and the torch Z position using the on screen display. | |
| 2. | Verify the 675-kW power supply torch start sequence indicates ready. | |
| 3. | Select the start sequence button.<br><br>**Note:** The torch Start Sequence button initiates a sequence for igniting the torch. The sequence and values might require adjustment. The sequence and values used for starting the torch are:<br><br>a. Switch from shield gas to start gas;<br>b. Pause for 10 seconds;<br>c. Close start contactor for 2 seconds; and<br>d. Switch from start gas to shield gas. | |
| 4. | Repeat the torch start sequence until an arc is established. | |
| | **Transferred Arc Torch** | |
| 1. | Set the transfer torch speed, torch radius, and the torch Z position using the on screen display to the shift engineer's requirements. | |
| 2. | Verify the 1,333-kW power supply torch start sequence indicates ready. | |
| 3. | Select the torch start sequence button. Repeat the torch start sequence until an arc is established. | |
| | **Note:** The transferred torch is operating in a nontransferred mode until the start contactor is opened. The torch Z position will determine the ability of the torch to transfer to tbe work material when the start contactor is opened. Furthermore, the conductivity of the work piece and torch travel speed will affect torch transfer. | |
| | | |
| **5.5** | **PCC Warm-up** | |
| 1. | Review the control computer displays to ensure that no AWFCO or stop feed alarms are indicated. | |
| 2. | Verify the soil feeder and slide valve cameras function properly (CE-2580 and CE 2582) and provide clear images on the monitor. | |

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| 3. | Operate the transferred or nontransferred torches as required to establish a molten slag pool. Once the PPC has reached 1,000 oF and a minimum molten pool of 2-foot diameter (1 foot torch radius) has been reached, soil/iron may be processed as needed to maintain molten pool conductivity and provide sufficient molten material. Reference Operations and Maintenance Plan for procedures covering feeder operation. | |
| | **Note:** The following conditions must be established prior to initiating ordnance processing:<br><br>– minimum PPC temperature of 1,000 °F;<br>– minimum SCC temperature of 1,800 °F; and<br>– minimum molten pool diameter of 2 feet (12 foot torch motion radius).<br><br>Ordnance processing shall be started at no more than 1/2 the predicted maximum feed rate. Feed rate shall be slowly increased to maximum feed rate over a minimum of 30 minutes.<br><br>Reference operations and maintenance plan for procedures covering feeder operation. | |

# APPENDIX B

Standard Shutdown Procedure

# 1. INTRODUCTION

This standard operating procedure (SOP) is part of the start-up, shutdown, and malfunction plan. The SOP, in its entirety, will be followed for each shutdown of the Plasma Ordnance Demilitarization System (PODS) from an operating condition to a cold, secured condition. Partial system shutdowns to support unplanned maintenance, shortage of consumables or waste materials, etc., will be performed at the direction of a certified primary control room operator or shift supervisor. The operator will use the PODS shutdown procedures as guidance for configuring the PODS systems for partial shutdown. Partial system shutdowns will be documented in the control room operator's logbook.

## 1.1 REFERENCES

### Drawings

- General arrangement drawing, Piping Plan, E18-00GA-001, Sheets 2 through 4
- General arrangement drawing, Instrumentation Plan, E18-00GA-001, Sheets 8 through 10
- Piping and Instrument Diagrams, E18-00PI-001 through -017
- Day and Zimmerman Hawthorne Corporation (DZHC) PODS Electrical One-Line Diagram, EE-2
- Motor Control Center (MCC)-2 Single-Line Electrical Diagram, E18-00EE-011
- MCC-1 Single-Line Electrical Diagram, E18-00EE-012
- Main, Central Control Room (CCR), and Panel Uninterruptible (UPS) Panel Schedule, E18-00EE-014

### Manuals

- PODS operations and maintenance (O&M) manual, Volumes 1 through 6
- PODS O&M plan
- PODS continuous emissions monitoring system (CEMS) plan

### Miscellaneous

- Valve lineup list
- Electrical lineup list

# 2. NORMAL SHUTDOWN

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| 1. | Stop ordnance and soil feeders. Reference procedures outlined in O&M plan. | |
| 2. | Verify weight cell and gate valves have cycled to clear ordnance from weigh cell and slide valves with camera CE 2082. | |
| 3. | Continue thermal treatment with plasma torch to fully treat waste material for a minimum of 20 min. Work entire surface of molten pool. | |
| 4. | Perform slag pour, if required, per procedures outlined in O&M plan. | |
| 5. | Secure PPC oxygen supply. | |
| 6. | Secure operating torch(s) by entering current setpoint of zero on torch control screen. Retract torches to parked position. | |
| 7. | Select AC OFF from torch control screen to secure power supply. Both power supplies should be secured at this time. | |
| 8. | Terminate data recording. | |

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| 9. | Secure SCC. Close following isolation valves:<br><br>– DFL 15119 (SCC main supply isolation);<br>– OXY 10353 (SCC main supply isolation); and<br>– IAS 10243 (SCC burner atomizing air isolation). | |
| 10. | Secure diesel fuel pump. | |
| 11. | Close Isolation Valve DFL 15118 once diesel pump is off. | |
| 12. | Monitor PPC pressure and blower speed. Adjust blower speed to maintain slight vacuum (-5 inches of water) in primary chamber. | |
| 13. | Secure $NO_x$ skid by closing AMM 15077 and AMM 15079 ($NH_3$ tank isolation valves). | |
| 14. | Allow PPC and SCC to cool in current configuration until PPC temperature is 1,200 °F. Monitor PPC pressure and blower speed. Adjust as required. | |
| | | |
| **2.1** | **PODS COOLDOWN TO COMPLETE SHUTDOWN** | |
| 1. | When PPC reaches 1,200 °F, cross connect quench water supply to ICW by opening following valves:<br><br>– SLS TBD (quencher/scrub water cross connect isolation). | |
| 2. | Secure quench water supply pump. | |
| 3. | Secure HPA compressor and HPA isolation valve:<br><br>– IAS 15038 (HPA compressor outlet isolation). | |
| 4. | Secure caustic transfer pump and caustic metering pump. | |
| 5. | Close following valves:<br><br>– CAU 1561 (caustic day tank inlet isolation). | |
| 6. | Allow PPC and SCC to cool in current configuration until PPC and SCC temperature is 300 °F. Monitor PPC pressure and blower speed. Adjust as required. | |
| 7. | Secure chiller. | |
| 8. | Secure absorber pumps. | |
| 9. | Secure reheater and superheater. | |
| 10. | Secure blowers. | |
| 11. | Close following valves:<br><br>– IAS 10206 (Y chute/chamber purge);<br>– IAS 10019 (torch purge isolation);<br>– IAS 10020 (torch gas isolation);<br>– IAS 10073 (camera purge isolation);<br>– IAS 10087 (slag chamber purge isolation);<br>– IAS 10357 (SCC purge isolation); and<br>– IAS 15062 (baghouse pulse isolation). | |
| 12. | Continue cooldown in current configuration until PPC and SCC temperature is 100 °F. | |
| 13. | Close following ICW emergency cooling isolation valves:<br><br>– ICW 30387 (furnace emergency cooling isolation);<br>– ICW 30023 (quencher/absorber emergency cooling isolation); and<br>– ICW 30080 (DI emergency cooling isolation). | |
| 14. | Secure DI pumps. | |
| 15. | Secure PCW treatment system. | |
| 16. | Close following valves:<br><br>– ICW 10384 (PCW soft water makeup isolation). | |
| 17. | Secure PCW pumps. | |
| 18. | At scrubber water treatment system local control panel, take all pump switches to off position. | |
| 19. | Close following valves:<br><br>– IAS 15258 (scrubber water treatment system isolation); and<br>– ICW 30212 (scrubber water treatment system isolation). | |

# APPENDIX C

Compliance Forms

# PLASMA ORDNANCE DEMILITARIZATION SYSTEM
# START-UP COMPLIANCE FORM

Date: _____ Operational shift: _____

Assigned control room operators: _____

Time start-up initiated (secondary combustion chamber ignited): _____

Time start-up completed (initiate normal waste feed): _____

## START-UP PROCEDURE COMPLETION CHECKLIST

| Description | Initials |
|---|---|
| Section 2: Prerequisites Completed | _____ |
| Section 3: Prestart-up Verifications Completed | _____ |
| Section 4: Support System Start-up Completed | _____ |
| Section 5: Torch Start-up and Primary Processing Chamber Warm-up Completed | _____ |
| Section 6: Waste Feed Start-up Completed | _____ |

**Notes:**

# PLASMA ORDNANCE DEMILITARIZATION SYSTEM
# SHUTDOWN COMPLIANCE FORM

Date: _____ Operational shift: _____

Assigned control room operators: _____

Time shutdown initiated (feeders secured): _____

Time shutdown completed (secondary combustion chamber secured): _____

## START-UP PROCEDURE COMPLETION CHECKLIST

| Description | Initials |
|---|---|
| Section 2: Normal Shutdown Completed | _____ |
| Section 3: System Cooldown Completed | _____ |

**Notes:**

# PLASMA ORDNANCE DEMILITARIZATION SYSTEM
# MALFUNCTION COMPLIANCE FORM

Date: _____ Operational shift: _____

Assigned control room operators: _____

Malfunction (1, 2, or 3) _____

1. Automatic Waste Feed Cutoff, Stop Feed, or Belt Timing Error in Which the Plasma Torch and Secondary Combustion Chamber Continue Operation
2. Stop Feed or Automatic Shutdown in Which the Plasma Torch or Secondary Combustion Chamber Continue to Operate
3. Emergency Shutdown Sequence in Which Both the Plasma Torch and the Secondary Combustion Chamber Are Secured

Time of malfunction occurrence: _____

Description of initiating event: _____

Time torch secured, if not secured automatically: _____

Time torch secondary combustion chamber secured, if not secured automatically: _____

Was established malfunction response followed subsequent to malfunction occurrence (Yes/No) _____

Attach printout of control computer alarm history covering the time period 5 min before and after occurrence of the malfunction.

**Notes:**

# PLASMA ORDNANCE DEMILITARIZATION SYSTEM
# MALFUNCTION EVALUATION FORM

Date: _____

Date of occurrence: _____

Description of occurrence:

_____

_____

_____

Were operating parameter limits exceeded? Yes/No (If yes, describe below)

_____

_____

_____

Were emission limits exceeded? Yes/No (If yes, describe below)

_____

_____

_____

Does occurrence meet definition of malfunction? Yes/No

Was start-up, shutdown, and malfunction plan response plan followed? Yes/No

Cause of occurrence:

_____

_____

_____

Does start-up, shutdown, and malfunction plan require modification to adequately address this occurrence? Yes/No

Actions taken to minimize future frequency and severity of this occurrence:

_____

_____

_____

_____

Approving management signature: _____

Attach copy of applicable malfunction compliance form.

**Notes:**

# APPENDIX D

Valve Lineup List

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| AMM-15060 | AMM | Ammonia Injection Isolation | $NO_x$ Reactor Panel | O-NE | E18-00PI-014 | Open |
| AMM-15068 | AMM | Ammonia Supply #1 Isolation | Ammonia Supply Manifold | O-NE | E18-00PI-014 | Open |
| AMM-15069 | AMM | Ammonia Supply #2 Isolation | Ammonia Supply Manifold | O-NE | E18-00PI-014 | Closed |
| AMM-15077 | AMM | Ammonia Tank #1 Isolation | Ammonia Tank #1 | O-NE | E18-00PI-014 | Per SOI |
| AMM-15079 | AMM | Ammonia Tank #2 Isolation | Ammonia Tank #2 | O-NE | E18-00PI-014 | Per SOI |
| AMM-15079 | AMM | Ammonia Control Bypass Select | $NO_x$ Reactor Panel | O-NE | E18-00PI-014 | Closed |
| AMM-15388 | AMM | Ammonia Control Bypass Select | $NO_x$ Reactor Panel | O-NE | E18-00PI-014 | Control |
| AMM-15389 | AMM | Ammonia Control Bypass Select | $NO_x$ Reactor Panel | O-NE | E18-00PI-014 | Control |
| CAU-1557 | CAU | Caustic Supply Isolation | Absorber Supply Manifold | B-NW | E18-00PI-013 | Per SOI |
| CAU-1558 | CAU | Caustic Metering Pump Inlet Isolation | 500-Gal Day Tank | B-NW | E18-00PI-013 | Per SOI |
| CAU-1559 | CAU | Metering Pressure Relief Bypass | 500-Gal Day Tank | B-NW | E18-00PI-013 | Open |
| CAU-1560 | CAU | Caustic Transfer Pump Bleed | Caustic Transfer Pump | O-NW | E18-00PI-013 | Closed |
| CAU-1561 | CAU | Caustic Day Tank Inlet Isolation | 500-Gal Day Tank | B-NW | E18-00PI-013 | Per SOI |
| CAU-1562 | CAU | Caustic Transfer Pump Outlet Isolation | Caustic Transfer Pump | O-NW | E18-00PI-013 | Per SOI |
| CAU-1563 | CAU | Caustic Transfer Pump Inlet Isolation | Caustic Transfer Pump | O-NW | E18-00PI-013 | Per SOI |
| CAU-1564 | CAU | Caustic Storage Tank Outlet Isolation | 5,500-Gal Storage Tank | O-NW | E18-00PI-013 | Per SOI |
| CAU-1565 | CAU | Caustic Storage Tank Fill Isolation | 5,500-Gal Storage Tank | O-NW | E18-00PI-013 | Closed |
| CAU-1566 | CAU | Caustic Storage Tank Drain Isolation | 5,500-Gal Storage Tank | O-NW | E18-00PI-013 | Closed |
| CWS-30360 | CWS | Chilled Water System Vent | Ceiling B-SE | B-SE | E18-00PI-010 | Closed |
| CWS-30361 | CWS | Chilled Water/Makeup Isolation | Ceiling B-SE | B-SE | E18-00PI-010 | Closed |
| CWS-30364 | CWS | CWS Expansion Tank Isolation | CWS Expansion Tank | B-SW | E18-00PI-010 | Open |
| CWS-30365 | CWS | Chiller Outlet Isolation | Chiller | B-SW | E18-00PI-010 | Open |
| CWS-30366 | CWS | Chilled Water Precooler Inlet Isolation | DI Precooler | B-SW | E18-00PI-010 | Open |
| CWS-30367 | CWS | Scrub Water HX Inlet Isolation | Scrub Water HX | B-NE | E18-00PI-010 | Open |
| CWS-30368 | CWS | Chilled Water Precooler Outlet Isolation | DI Precooler | B-SW | E18-00PI-010 | Open |
| CWS-30369 | CWS | Scrub Water HX Outlet Isolation | Scrub Water HX | B-NE | E18-00PI-010 | Open |
| CWS-30370 | CWS | Chiller Inlet Isolation | Chiller | B-SW | E18-00PI-010 | Open |
| CWS-30371 | CWS | Chilled Water Pump Inlet Isolation | Chilled Water Pump | B-SW | E18-00PI-010 | Open |

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| DFL- | DFL | Diesel Pump Outlet Isolation | Basement Northwest Corner | B-NW | E18-00PI-012 | Open |
| DFL-15118 | DFL | Diesel Pump Inlet Isolation | Basement Northwest Corner | B-NW | E18-00PI-012 | Open |
| DFL-15119 | DFL | SCC Burner Supply Main Isolation | Fuel Train | M-NE | E18-00PI-012 | Per SOI |
| DFL-15120 | DFL | SCC Burner Supply Isolation | Fuel Train | M-NE | E18-00PI-012 | Open |
| DFL-15361 | DFL | SCC Pilot Supply Main Isolation | Fuel Train | M-NE | E18-00PI-012 | Per SOI |
| DFL-15362 | DFL | SCC Pilot Supply Isolation | Fuel Train | M-NE | E18-00PI-012 | Open |
| DFL-15363 | DFL | SCC Fuel Line Purge | Fuel Train | M-NE | E18-00PI-012 | Closed |
| DIW-40076 | DIW | DI Reservoir Inlet Isolation | DI Reservoir | B-SE | E18-00PI-009 | Open |
| DIW-45074 | DIW | DI Precooler Inlet Isolation | X-4506 | B-SE | E18-00PI-010 | Open |
| DIW-45075 | DIW | DI Precooler Outlet Isolation | X-4506 | B-SE | E18-00PI-010 | Open |
| DIW-45077 | DIW | DI Manual Emergency Drain | DI Reservoir | B-SE | E18-00PI-009 | Closed |
| DIW-45115 | DIW | Chilled Water Supply Manifold Isolation | Primary Chamber | B-NW | E18-00PI-008 | Open |
| DIW-45116 | DIW | Chilled Water Return Manifold Isolation | Primary Chamber | B-NW | E18-00PI-008 | Open |
| DIW-45116 | DIW | DI Supply Manifold Vent | Primary Chamber | B-NW | E18-00PI-009 | Closed |
| DIW-45124 | DIW | DI Pump A Inlet Isolation | P-4502-A | B-SE | E18-00PI-009 | Open |
| DIW-45125 | DIW | DI Pump B Inlet Isolation | P-4502-B | B-SE | E18-00PI-009 | Open |
| DIW-45126 | DIW | DI Pump A Outlet Isolation | P-4502-A | B-SE | E18-00PI-009 | Open |
| DIW-45127 | DIW | DI Pump B Outlet Isolation | P-4502-B | B-SE | E18-00PI-009 | Open |
| DIW-45128 | DIW | Ion Exchange B Inlet Isolation | DI Skid | B-SE | E18-00PI-009 | Closed |
| DIW-45129 | DIW | Ion Exchange A Inlet Isolation | DI Skid | B-SE | E18-00PI-009 | Open |
| DIW-45131 | DIW | DI Make up Isolation | DI Skid | B-SE | E18-00PI-009 | Open |
| DIW-45133 | DIW | DI Water Reservoir Drain | T-4505 | B-SE | E18-00PI-009 | Closed |
| DIW-45177 | DIW | T-Torch Nozzle Supply Isolation | Primary Chamber | B-NW | E18-00PI-007 | Open |
| DIW-45178 | DIW | T-Torch Ram Supply Isolation | Primary Chamber | B-NW | E18-00PI-009 | Open |
| DIW-45179 | DIW | T-Torch Ball Supply Isolation | Primary Chamber | B-NW | E18-00PI-009 | Open |
| DIW-45180 | DIW | T-Torch Nozzle Return Isolation | Primary Chamber | B-NW | E18-00PI-007 | Open |
| DIW-45181 | DIW | T-Torch Ram Return Isolation | Primary Chamber | B-NW | E18-00PI-007 | Open |
| DIW-45182 | DIW | T-Torch Ball Return Isolation | Primary Chamber | B-NW | E18-00PI-007 | Open |

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| DIW-45183 | DIW | NT-Torch Nozzle Supply Isolation | Primary Chamber | B-NW | E18-00PI-008 | Open |
| DIW-45184 | DIW | NT-Torch Ram Supply Isolation | Primary Chamber | B-NW | E18-00PI-009 | Open |
| DIW-45185 | DIW | NT-Torch Ball Supply Isolation | Primary Chamber | B-NW | E18-00PI-009 | Open |
| DIW-45186 | DIW | NT-Torch Nozzle Return Isolation | Primary Chamber | B-NW | E18-00PI-008 | Open |
| DIW-45187 | DIW | NT-Torch Ram Return Isolation | Primary Chamber | B-NW | E18-00PI-008 | Open |
| DIW-45188 | DIW | NT-Torch Ball Return Isolation | Primary Chamber | B-NW | E18-00PI-008 | Open |
| DIW-45200 | DIW | T-Torch Anode Supply Isolation | Primary Chamber | B-NW | E18-00PI-007 | Open |
| DIW-45201 | DIW | T-Torch Anode Return Isolation | Primary Chamber | B-NW | E18-00PI-007 | Open |
| DIW-45206 | DIW | NT-Torch Anode Return Isolation | Primary Chamber | B-NW | E18-00PI-008 | Open |
| DIW-45207 | DIW | NT-Torch Anode Supply Isolation | Primary Chamber | B-NW | E18-00PI-008 | Open |
| DIW-45265 | DIW | DI Supply Manifold Drain | Primary Chamber | B-NW | E18-00PI-009 | Closed |
| DIW-45267 | DIW | DI Bulk Supply Isolation | DI Strainer Discharge | B-SE | E18-00PI-009 | Open |
| DIW-45279 | DIW | Chilled Water Supply Manifold Vent | Primary Chamber | B-NW | E18-00PI-008 | Closed |
| DIW-45280 | DIW | Chilled Water Supply Manifold Drain | Primary Chamber | B-NW | E18-00PI-008 | Closed |
| DIW-45281 | DIW | Chilled Water Return Manifold Vent | Primary Chamber | B-NW | E18-00PI-008 | Closed |
| DIW-45281 | DIW | DI Return Manifold Vent | Primary Chamber | B-NW | E18-00PI-008 | Closed |
| DIW-45282 | DIW | Chilled Water Return Manifold Drain | Primary Chamber | B-NW | E18-00PI-008 | Closed |
| DIW-45282 | DIW | DI Return Manifold Drain | Primary Chamber | B-NW | E18-00PI-008 | Closed |
| HPA-15036 | HPA | HP Compressor Outlet Isolation | HPA Compressor | B-NE | E18-00PI-013 | Per SOI |
| HPA-15192 | HPA | HP Compressor Receiver Drain | HPA Compressor | B-NE | E18-00PI-013 | Closed |
| IAS-10017 | IAS | Torch Purge Adjust | Torch Control Cabinet | M-SW | E18-00PI-002 | N/A |
| IAS-10019 | IAS | Torch Purge Isolation | Torch Control Cabinet | M-SW | E18-00PI-002 | Per SOI |
| IAS-10020 | IAS | Torch Gas Isolation | Torch Control Cabinet | M-SW | E18-00PI-002 | Per SOI |
| IAS-10025 | IAS | Feed System Isolation | 1st Floor Under Stairs | M-SW | E18-00PI-002 | Per SOI |
| IAS-10026 | IAS | Soil Weigh Cell Isolation | Soil Feeder | MEZ | E18-00PI-004 | Open |
| IAS-10027 | IAS | Soil Valve Cylinder Isolation | Soil Feed Chute | MEZ | E18-00PI-004 | Open |
| IAS-10028 | IAS | Soil Valve Cylinder Isolation | Soil Feed Chute | MEZ | E18-00PI-004 | Open |
| IAS-10029 | IAS | Y Chute Purge Isolation | Y-Chute | MEZ | E18-00PI-004 | Open |

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| IAS-10030 | IAS | Ordnance Valve Cylinder Isolation | Ordnance Feed Chute | MEZ | E18-00PI-004 | Open |
| IAS-10031 | IAS | Ordnance Valve Cylinder Isolation | Ordnance Feed Chute | MEZ | E18-00PI-004 | Open |
| IAS-10032 | IAS | Ordnance Weigh Cell Isolation | Ordnance Weigh Cell | MEZ | E18-00PI-004 | Open |
| IAS-10037 | IAS | Air Dryer Inlet Isolation | Air Supply Manifold | B-NW | E18-00PI-002 | Open |
| IAS-10073 | IAS | Main Camera Purge Isolation | Primary Chamber | | E18-00PI-005 | Per SOI |
| IAS-10077 | IAS | Chamber Camera Purge Isolation | Primary Chamber | | E18-00PI-005 | Open |
| IAS-10078 | IAS | Chamber Camera Purge Isolation | Primary Chamber | | E18-00PI-005 | Open |
| IAS-10079 | IAS | Chamber Camera Purge Isolation | Primary Chamber | | E18-00PI-005 | Open |
| IAS-10080 | IAS | Chamber Camera Purge Isolation | Primary Chamber | | E18-00PI-005 | Open |
| IAS-10087 | IAS | Slag Chamber Purge Isolation | Primary Chamber | B-NE | E18-00PI-006 | Per SOI |
| IAS-10088 | IAS | Slag Camera Purge Isolation | Primary Chamber | B-NE | E18-00PI-006 | Open |
| IAS-10205 | IAS | Dome Camera Purge Isolation | Primary Chamber | | E18-00PI-003 | Open |
| IAS-10234 | IAS | Slag Chamber Purge Supply Adjust | Primary Chamber | B-NE | E18-00PI-006 | N/A |
| IAS-10237 | IAS | Slag Chamber/Camera Purge Isolation | Primary Chamber | B-NE | E18-00PI-002 | Open |
| IAS-10243 | IAS | SCC Burner Atomizing Air Main Isolation | Fuel Train | M-NE | E18-00PI-012 | Per SOI |
| IAS-10244 | IAS | SCC Burner Atomizing Air Isolation | Fuel Train | M-NE | E18-00PI-012 | Open |
| IAS-10357 | IAS | SCC Purge Main Isolation | Fuel Train | M-NE | E18-00PI-012 | Per SOI |
| IAS-10358 | IAS | SCC Purge Isolation | Fuel Train | M-NE | E18-00PI-012 | Open |
| IAS-15029 | IAS | Prefilter By-pass | Air Supply Manifold | B-NW | E18-00PI-002 | Closed |
| IAS-15030 | IAS | Postfilter Inlet Isolation | Air Supply Manifold | B-NW | E18-00PI-002 | Open |
| IAS-15033 | IAS | Air Dryer By-pass | Air Supply Manifold | B-NW | E18-00PI-002 | Closed |
| IAS-15039 | IAS | Postfilter Outlet Isolation | Air Supply Manifold | B-NW | E18-00PI-002 | Open |
| IAS-15052 | IAS | Prefilter A By-pass | Air Supply Manifold | B-NW | E18-00PI-002 | Closed |
| IAS-15057 | IAS | Prefilter B By-pass | Air Supply Manifold | B-NW | E18-00PI-002 | Closed |
| IAS-15058 | IAS | High-Pressure Compressor Inlet Isolation | HPA Compressor | B-NE | E18-00PI-013 | Open |
| IAS-15062 | IAS | Baghouse Pulse Isolation | Baghouse | O-NE | E18-00PI-014 | Per SOI |
| IAS-15067 | IAS | Prefilter A Inlet Isolation | Air Supply Manifold | B-NW | E18-00PI-002 | Open |
| IAS-15073 | IAS | Prefilter B Outlet Isolation | Air Supply Manifold | B-NW | E18-00PI-002 | Open |

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| IAS-15075 | IAS | Prefilter B Inlet Isolation | Air Supply Manifold | B-NW | E18-00PI-002 | Open |
| IAS-15076 | IAS | Prefilter A Outlet Isolation | Air Supply Manifold | B-NW | E18-00PI-002 | Open |
| IAS-15077 | IAS | Postfilter By-pass | Air Supply Manifold | B-NW | E18-00PI-002 | Closed |
| IAS-15084 | IAS | CEMS Air Isolation | CEMS | M-NE | E18-00PI-002 | Per SOI |
| IAS-15255 | IAS | Scrubber WTS Isolation | Scrubber WTS Panel | M-NE | E18-00PI-002 | Per SOI |
| IAS-25009 | IAS | Scrub WTS Filter Press Isolation | Water Treatment System | WTS | E18-00PI-015 | Open |
| IAS-25305 | IAS | Scrub WTS Slurry Pump Isolation | Water Treatment System | WTS | E18-00PI-015 | Open |
| IAS-25306 | IAS | Scrub WTS Slurry Pump Isolation | Water Treatment System | WTS | E18-00PI-015 | Open |
| IAS-25326 | IAS | Scrub WTS Lime Meter Pump Isolation | Water Treatment System | WTS | E18-00PI-015 | Open |
| IAS-25328 | IAS | Scrub WTS Recycle Pump A Isolation | Water Treatment System | WTS | E18-00PI-015 | Open |
| IAS-25329 | IAS | Scrub WTS Recycle Pump B Isolation | Water Treatment System | WTS | E18-00PI-015 | Open |
| IAS-25339 | IAS | Scrub WTS Filter Press Air Isolation | Water Treatment System | WTS | E18-00PI-015 | Open |
| IAS-25356 | IAS | Scrub WTS Sand Filter Isolation | Water Treatment System | WTS | E18-00PI-016 | Open |
| ICW-25285 | ICW | Sand Filter Fill Isolation | Water Treatment System | WTS | E18-00PI-016 | Open |
| ICW-25323 | ICW | Coagulant Tank Fill Isolation | Water Treatment System | WTS | E18-00PI-015 | Open |
| ICW-25327 | ICW | Sodium Metasulfate Tank Fill Isolation | Water Treatment System | WTS | E18-00PI-015 | Open |
| ICW-25336 | ICW | Lime Delivery Dilution Isolation | Water Treatment System | WTS | E18-00PI-015 | Open |
| ICW-25337 | ICW | Lime Mix Tank Fill Isolation | Water Treatment System | WTS | E18-00PI-015 | Open |
| ICW-25342 | ICW | Polymer Mix Tank Fill Isolation | Water Treatment System | WTS | E18-00PI-016 | Open |
| ICW-30010 | ICW | Building 117-2 Main ICW Isolation | ICW Supply Manifold | B-NE | E18-00PI-009 | Per SOI |
| ICW-30011 | ICW | Building 117-2 Main ICW Isolation | ICW Supply Manifold | B-NE | E18-00PI-009 | Per SOI |
| ICW-30022 | ICW | Scrubber ICW By-pass | Quench/Absorber | B-NW | E18-00PI-013 | Closed |
| ICW-30023 | ICW | Scrubber Emergency Cooling Isolation | Quench/Absorber | B-NW | E18-00PI-013 | Per SOI |
| ICW-30026 | ICW | ICW/Absorber X-Connect | Quench/Absorber | B-NW | E18-00PI-013 | Open |
| ICW-30027 | ICW | Quencher/Scrubber X-Connect Isolation | Quench/Absorber | | E18-00PI-013 | Closed |
| ICW-30078 | ICW | DI Emergency Cooling By-pass | DI Skid | | E18-00PI-009 | Closed |
| ICW-30080 | ICW | DI Emergency Cooling Isolation | DI Skid | B-SW | E18-00PI-009 | Per SOI |
| ICW-30149 | ICW | Scrub Water Filter Isolation | Scrub Water Filter | | E18-00PI-009 | Open |

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| ICW-30212 | ICW | Scrub Water Treatment Isolation | Quench/Absorber | M-NE | E18-00PI-009 | Per SOI |
| ICW-30213 | ICW | Absorber pH Meter Isolation | Quench/Absorber | B-NW | E18-00PI-009 | Open |
| ICW-30283 | ICW | Scrub Water Filter Wash Isolation | Scrubber Filter | B-NW | E18-00PI-010 | Closed |
| ICW-30383 | ICW | PCW Soft Water Make up Isolation | Cooling Water Storage Tank | B-NW | E18-00PI-017 | Closed |
| ICW-30384 | ICW | PCW Soft Water Make up Isolation | Cooling Water Storage Tank | B-NW | E18-00PI-017 | Open |
| ICW-30385 | ICW | PCW Make Up Isolation | Cooling Water Storage Tank | B-NW | E18-00PI-017 | Closed |
| ICW-30386 | ICW | PCW Soft Water X-Connect Isolation | Cooling Water Storage Tank | B-NW | E18-00PI-017 | Open |
| ICW-30387 | ICW | Furnace Emergency Cooling Isolation | Furnace Pump Skid | B-NW | E18-00PI-017 | Per SOI |
| ICW-45131 | ICW | DI Make Up Isolation | DI Skid | | E18-00PI-009 | Open |
| OXY-10047 | OXY | Primary Chamber Supply Isolation | Primary Chamber | B-NE | E18-00PI-005 | Open |
| OXY-10050 | OXY | Facility Supply Isolation | B-SE Staircase | B-SE | E18-00PI-005 | Open |
| OXY-10353 | OXY | SCC Burner Supply Main Isolation | Fuel Train | M-NE | E18-00PI-012 | Per SOI |
| OXY-10354 | OXY | SCC Burner Supply Isolation | Fuel Train | M-NE | E18-00PI-012 | Open |
| OXY-10359 | OXY | SCC Pilot Supply Main Isolation | Fuel Train | M-NE | E18-00PI-012 | Per SOI |
| OXY-10360 | OXY | SCC Pilot Supply Isolation | Fuel Train | M-NE | E18-00PI-012 | Open |
| OXY-10373 | OXY | Oxy-Lance Supply Isolation | Primary Chamber | B-NE | E18-00PI-006 | Per SOI |
| PCW-10235 | PCW | Y-Chute Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-10236 | PCW | Y-Chute Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30058 | PCW | PCW Blow Down Isolation | Water Treatment | B-NW | E18-00PI-017 | Open |
| PCW-30059 | PCW | PCW Storage Tank Drain Isolation | Cooling Water Storage Tank | B-NW | E18-00PI-017 | Closed |
| PCW-30094 | PCW | Lower Reactor Supply Manifold Isolation | Primary Chamber | B-SW | E18-00PI-005 | Open |
| PCW-30095 | PCW | Lower Reactor Return Manifold Isolation | Primary Chamber | B-SW | E18-00PI-005 | Open |
| PCW-30098 | PCW | Upper Reactor Supply Manifold Isolation | Primary Chamber | B-SW | E18-00PI-003 | Open |
| PCW-30099 | PCW | Upper Reactor Return Manifold Isolation | Primary Chamber | B-SW | E18-00PI-003 | Open |
| PCW-30100 | PCW | Cooling Tower A Inlet Isolation | Cooling Tower "A" | O-NW | E18-00PI-017 | Open |
| PCW-30101 | PCW | Cooling Tower B Inlet Isolation | Cooling Tower "B" | O-NW | E18-00PI-017 | Open |
| PCW-30103 | PCW | Furnace Load Return Isolation | PCW Furnace Pump Skid | B-NW | E18-00PI-017 | Open |
| PCW-30106 | PCW | Cooling Tower A Outlet Isolation | Cooling Tower "A" | O-NW | E18-00PI-017 | Open |

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| PCW-30109 | PCW | Cooling Tower B Outlet Isolation | Cooling Tower "B" | O-NW | E18-00PI-017 | Open |
| PCW-30135 | PCW | Lower Reactor Supply #1 Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30136 | PCW | Lower Reactor Supply #2 Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30137 | PCW | Lower Reactor Supply #3 Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30138 | PCW | Lower Reactor Supply #4 Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30139 | PCW | Lower Camera #1 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30140 | PCW | Lower Camera #2 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30141 | PCW | Lower Reactor Return #1 Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30142 | PCW | Lower Reactor Return #2 Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30143 | PCW | Lower Reactor Return #3 Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30144 | PCW | Lower Reactor Return #4 Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30145 | PCW | Lower Camera #1 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30146 | PCW | Lower Camera #2 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30147 | PCW | Slag Chamber Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30150 | PCW | Upper Reactor Supply #1 Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30151 | PCW | Upper Reactor Supply #3 Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30152 | PCW | Upper Reactor Supply #2 Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30153 | PCW | Upper Reactor Supply #4 Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30155 | PCW | Upper Reactor Return #1 Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30156 | PCW | Upper Reactor Return #2 Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30157 | PCW | Upper Reactor Return #3 Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30158 | PCW | Upper Reactor Return #4 Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30160 | PCW | Lance Loop #1 Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30161 | PCW | Feed/Off Gas Port Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30162 | PCW | T Torch Port Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30163 | PCW | Upper Camera Port Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30165 | PCW | NT Torch Port Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30166 | PCW | Lance Loop #2 Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| PCW-30167 | PCW | Lance Loop #1 Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30168 | PCW | Lance Loop #2 Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30169 | PCW | T Torch Port Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30170 | PCW | Upper Camera Port Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30172 | PCW | NT Torch Port Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30173 | PCW | Feed/Off Gas Port Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30194 | PCW | Chiller Inlet Isolation | Plant System Chiller | B-SW | E18-00PI-010 | Open |
| PCW-30195 | PCW | Chiller Outlet Isolation | Plant System Chiller | B-SW | E18-00PI-010 | Open |
| PCW-30198 | PCW | Hearth Bottom #1 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30199 | PCW | Hearth Bottom #1 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30202 | PCW | Slag Chamber Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30217 | PCW | Hearth Bottom #2 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30218 | PCW | Hearth Bottom #2 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30219 | PCW | Hearth Side #1 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30220 | PCW | Hearth Side #1 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30221 | PCW | Hearth Side #2 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30222 | PCW | Hearth Side #2 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30223 | PCW | DC P/S Supply Isolation | DC Power Supply #2 | M-SW | E18-00PI-010 | Open |
| PCW-30224 | PCW | DC P/S Return Isolation | DC Power Supply #2 | M-SW | E18-00PI-008 | Open |
| PCW-30225 | PCW | DC P/S Supply Isolation | DC Power Supply #1 | M-Se | E18-00PI-010 | Open |
| PCW-30226 | PCW | DC P/S Return Isolation | DC Power Supply #1 | M-SE | E18-00PI-007 | Open |
| PCW-30245 | PCW | Off Gas Riser Port Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30246 | PCW | Off Gas Riser Port Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30250 | PCW | Relief Port Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30251 | PCW | Relief Port Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-30253 | PCW | Upper Reactor Supply Manifold Drain | Primary Chamber | B-SW | E18-00PI-003 | Closed |
| PCW-30254 | PCW | Lower Reactor Supply Manifold Drain | Primary Chamber | B-SW | E18-00PI-005 | Closed |
| PCW-30255 | PCW | Upper Reactor Return Manifold Drain | Primary Chamber | B-SW | E18-00PI-003 | Closed |

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| PCW-30258 | PCW | Heat Exchanger Inlet Isolation | DI Heat Exchanger | B-SW | E18-00PI-010 | Open |
| PCW-30259 | PCW | Crucible Return Manifold #1 Drain | Slag Chamber | B-SW | E18-00PI-005 | Closed |
| PCW-30259 | PCW | Heat Exchanger Outlet Isolation | DI Heat Exchanger | B-SW | E18-00PI-010 | Open |
| PCW-30260 | PCW | Crucible Return Manifold #2 Drain | Slag Chamber | B-SW | E18-00PI-005 | Closed |
| PCW-30288 | PCW | Tap Hole Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30299 | PCW | Tap Hole Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30309 | PCW | Hearth Side #3 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30310 | PCW | Hearth Side #3 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30311 | PCW | Hearth Side #4 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30312 | PCW | Hearth Side #4 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30313 | PCW | Hearth Side #5 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30314 | PCW | Hearth Side #5 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30315 | PCW | Plant Load Return Isolation | Towers | B-NW | E18-00PI-017 | Open |
| PCW-30315 | PCW | Hearth Side #6 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30316 | PCW | Hearth Side #6 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30317 | PCW | Lower Camera #4 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30318 | PCW | Lower Camera #4 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30319 | PCW | Lower Camera #3 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30320 | PCW | Lower Camera #3 Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30321 | PCW | Transition Supply Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30322 | PCW | Transition #1 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30325 | PCW | Transition #2 Return Isolation | Primary Chamber | | E18-00PI-005 | Open |
| PCW-30356 | PCW | Tap Hole Cooling Control By-pass | Primary Chamber | | E18-00PI-005 | Closed |
| PCW-30373 | PCW | PCW Furnace Pump A Inlet Isolation | PCW Furnace Pump A | B-NW | E18-00PI-017 | Open |
| PCW-30374 | PCW | PCW Furnace Pump A Outlet Isolation | PCW Furnace Pump A | B-NW | E18-00PI-017 | Open |
| PCW-30375 | PCW | PCW Furnace Pump B Inlet Isolation | PCW Furnace Pump B | B-NW | E18-00PI-017 | Open |
| PCW-30376 | PCW | PCW Furnace Pump B Outlet Isolation | PCW Furnace Pump B | B-NW | E18-00PI-017 | Open |
| PCW-30377 | PCW | PCW Plant Pump B Inlet Isolation | PCW Low Pressure Pump B | B-NW | E18-00PI-017 | Open |

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| PCW-30378 | PCW | PCW Plant Pump B Outlet Isolation | PCW Low Pressure Pump B | B-NW | E18-00PI-017 | Open |
| PCW-30379 | PCW | PCW Plant Pump A Inlet Isolation | PCW Low Pressure Pump A | B-NW | E18-00PI-017 | Open |
| PCW-30380 | PCW | PCW Plant Pump A Outlet Isolation | PCW Low Pressure Pump A | B-NW | E18-00PI-017 | Open |
| PCW-30388 | PCW | PCW Treatment Sys Outlet Isolation | Water Treatment | B-NW | E18-00PI-017 | Open |
| PCW-30389 | PCW | PCW Treatment Sys Inlet Isolation | Water Treatment | B-NW | E18-00PI-017 | Open |
| PCW-40010 | PCW | O2 Lance #1 Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-40011 | PCW | O2 Lance #1 Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-40012 | PCW | O2 Lance #2 Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-40013 | PCW | O2 Lance #2 Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-40014 | PCW | Water Lance #1 Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-40015 | PCW | Water Lance #1 Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-40016 | PCW | Water Lance #2 Supply Isolation | Primary Chamber | | E18-00PI-003 | Open |
| PCW-40017 | PCW | Water Lance #2 Return Isolation | Primary Chamber | | E18-00PI-003 | Open |
| SLS-15027 | SLS | Quencher Wash Supply Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-15028 | SLS | Absorber Solution Supply Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-15029 | SLS | Absorber Solution Supply Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-15030 | SLS | Absorber Solution Supply Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-15031 | SLS | Absorber Solution Supply Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-15032 | SLS | Absorber Solution Supply Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-15033 | SLS | Absorber Solution Supply Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-15037 | SLS | Scrubber Water Pump A Inlet Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-15038 | SLS | Scrubber Water Pump B Inlet Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-15039 | SLS | Scrub Water Pump A Outlet Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-15040 | SLS | Scrub Water Pump B Outlet Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-15050 | SLS | Quench/Scrub Water X-Connect Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Per SOI |
| SLS-15063 | SLS | Scrub Water Filter Inlet Isolation | Scrub Water Filter | B-NE | E18-00PI-010 | Open |
| SLS-15065 | SLS | Scrub Water Filter Outlet Isolation | Scrub Water Filter | B-NE | E18-00PI-010 | Open |
| SLS-15066 | SLS | Scrub Water Filter Backwash Isolation | Scrub Water Filter | B-NE | E18-00PI-010 | Open |

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| SLS-15067 | SLS | Scrub Water Filter By-pass | Scrub Water Filter | B-NE | E18-00PI-010 | Closed |
| SLS-15068 | SLS | Absorber Sump Drain | Quench/Absorber | B-NE | E18-00PI-013 | Closed |
| SLS-15122 | SLS | Scrub Water HX Inlet Isolation | Scrub Water HX | B-NE | E18-00PI-010 | Open |
| SLS-15123 | SLS | Scrub Water HX Outlet Isolation | Scrub Water HX | B-NE | E18-00PI-010 | Open |
| SLS-25001 | SLS | WTS Recycle Pump A Inlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25002 | SLS | WTS Recycle Pump B Inlet Isolation | Water Treatment System | WT | E18-00PI-015 | Closed |
| SLS-25003 | SLS | WTS Recycle Pump A Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25004 | SLS | WTS Recycle Pump B Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25005 | SLS | WTS Slurry Pump Inlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25006 | SLS | WTS Slurry Pump Inlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25007 | SLS | WTS Slurry Pump Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25008 | SLS | WTS Slurry Pump Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25009 | SLS | Treated Water Storage Tank Inlet | Water Treatment System | WT | E18-00PI-016 | Open |
| SLS-25010 | SLS | Treated Water Surge Tank Inlet | Water Treatment System | WT | E18-00PI-016 | Open |
| SLS-25011 | SLS | Treated Water Storage Tank Outlet | Water Treatment System | WT | E18-00PI-016 | Open |
| SLS-25012 | SLS | Treated Water Surge Tank Outlet | Water Treatment System | WT | E18-00PI-016 | Open |
| SLS-25013 | SLS | Treated Water Pump Outlet Isolation | Water Treatment System | WT | E18-00PI-016 | Open |
| SLS-25021 | SLS | Sodium Metabisulfite Pump Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25023 | SLS | Quencher Supply Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-25024 | SLS | High-Energy Scrubber Supply Isolation | HE Scrubber | B-NE | E18-00PI-013 | Open |
| SLS-25046 | SLS | Quench Water Manifold Supply Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-25048 | SLS | pH Slipstream Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-25049 | SLS | pH Meter Wash Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Closed |
| SLS-25050 | SLS | pH Meter Wash Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Closed |
| SLS-25052 | SLS | pH Meter Inlet Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-25053 | SLS | pH Meter Inlet Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Closed |
| SLS-25055 | SLS | pH Meter Outlet Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Open |
| SLS-25056 | SLS | pH Meter Outlet Isolation | Quench/Absorber | B-NE | E18-00PI-013 | Closed |

| Valve Number | System | Description | Location | Building Area | Drawing Number | Normal Operating Position |
|---|---|---|---|---|---|---|
| SLS-25057 | SLS | Quench Water Storage Tank Isolation | Quench Water Tank | B-NE | E18-00PI-016 | Open |
| SLS-25197 | SLS | Lime Pump Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25232 | SLS | Filter Press Inlet | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25233 | SLS | Filter Press Inlet | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25298 | SLS | Polymer Pump Outlet Isolation | Water Treatment System | WT | E18-00PI-016 | Open |
| SLS-25301 | SLS | Absorber Water Manifold Drain | Quench/Absorber | B-NE | E18-00PI-013 | Closed |
| SLS-25330 | SLS | Sulfuric Acid Pump Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25331 | SLS | Polymer Mixer Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25332 | SLS | Sulfuric Acid Pump Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25333 | SLS | Coagulant Pump Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25334 | SLS | Coagulant Pump Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25335 | SLS | Caustic Soda Pump Outlet Isolation | Water Treatment System | WT | E18-00PI-015 | Open |
| SLS-25345 | SLS | Quench Water Pump Inlet Isolation | Quench Water Pump | B-NE | E18-00PI-016 | Open |
| SLS-25346 | SLS | Quench Water Pump Outlet Isolation | Quench Water Pump | B-NE | E18-00PI-016 | Open |
| SLS-30300 | SLS | Absorber Water Manifold Vent | Quench/Absorber | B-NE | E18-00PI-013 | Closed |

# APPENDIX E

Electrical Lineup List

| Location | Row/Slot | Description | Normal Position | System Operating Test Procedure Position |
|---|---|---|---|---|
| Motor Control Center (MCC)-1 | | Deionized (DI) Pump A | Closed/On | |
| MCC-1 | | DI Pump B | Closed/On | |
| MCC-1 | | Air Booster Compressor | Closed/On | |
| MCC-1 | | Chiller Compressor | Closed/On | |
| MCC-1 | | Chilled Water Pump | Closed/On | |
| MCC-1 | | Power Supply Fan #1 | Closed/On | |
| MCC-1 | | Power Supply Fan #2 | Closed/On | |
| MCC-1 | | Ordnance Conveyor | Closed/On | |
| MCC-1 | | Soil Conveyor | Closed/On | |
| MCC-1 | | Slag Conveyor | Closed/On | |
| MCC-1 | | Mezzanine Crane | Closed/On | |
| MCC-1 | | Storage Pond Pump | Closed/On | |
| MCC-1 | | Transformer XF2 | Closed/On | |
| MCC-1 | | Screw Conveyor | Closed/On | |
| MCC-1 | | Transformer XF3 | Closed/On | |
| MCC-1 | | Torch Crane | Closed/On | |
| | | | | |
| MCC-2 | | Slag Crane | Closed/On | |
| MCC-2 | | Quench Water Pump | Closed/On | |
| MCC-2 | | Treated Water Pump | Closed/On | |
| MCC-2 | | Sodium Hydroxide Pump | Closed/On | |
| MCC-2 | | Scrubber Pump A | Closed/On | |
| MCC-2 | | Scrubber Pump B | Closed/On | |
| MCC-2 | | Heater Skid | Closed/On | |
| MCC-2 | | Water Treatment System Hoffland | Closed/On | |
| MCC-2 | | Furnace Cooling Water Pump A | Closed/On | |
| MCC-2 | | Furnace Cooling Water Pump B | Closed/On | |
| MCC-2 | | Low-Pressure Cooling Water Pump A | Closed/On | |
| MCC-2 | | Low-Pressure Cooling Water Pump B | Closed/On | |
| MCC-2 | | Cooling Tower Fans #1 and #2 | Closed/On | |
| MCC-2 | | Cooling Tower Fans #3 and #4 | Closed/On | |
| MCC-2 | | Cooling Tower Fans #5 and #6 | Closed/On | |
| MCC-2 | | Variable-Frequency Drive Bus | Closed/On | |
| MCC-2 | | Water Treatment Cooling Tower | Closed/On | |

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HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX K

# Appendix K

## Chemical and Physical Analysis Results for Containerized Waste

DOCUMENT NUMBER
REQUISITIONER DATE

N41867231700005

# HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP2055

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15
Hawthorne Nevada
5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Corrosion Resistant Coating MIL-C-81706
2. USEPA/or/STATE WASTE CODE(S): D001, D002, D007
3. PROCESS GENERATING WASTE: overage material
4. PROJECTED ANNUAL VOLUME/UNITS: — / —
5. MODE OF COLLECTION: drum
6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO
7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

**1. MATERIAL CHARACTERIZATION**
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Brown-Black-yellow
DENSITY: 1.0 BTU/LB
TOTAL SOLIDS: 0 ASH CONTENT
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER
TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER
☒ IGNITABLE (D001) FLASH POINT (F) oxidizer
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)
☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE
☒ CORROSIVE (D002) pH 2.0
☐ CORRODES STEEL
☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

COPPER N/A
NICKEL
ZINC
CHROMIUM-HEX
(OTHER)
PHENOLICS N/A
TOTAL HALOGENS
VOLATILE ORGANICS
PCBs

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| water | 98% | |
| chromium oxide | 1% | |
| Dissolved Silicofluoride | <1% | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☐ YES ☐ NO
PROPER SHIPPING NAME: Corrosive liquid, oxidizing N.O.S.
HAZARD CLASS: 8 UN. or N.A. NO. 3093
ADDITIONAL DESCRIPTION
METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:
CERCLA REPORTABLE QUANTITY (RQ)
EMERGENCY RESPONSE GUIDE PAGE
DOT PUBLICATION 5800.4 PAGE NO. 45 EDITION (YR) 90
SPECIAL HANDLING INFORMATION

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION
☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]
DATE: 11/12/92

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☐ LEAD | D008 | |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☑ CHROMIUM | D007 | >5.0 mg/L | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

N41862307

# HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP 2046

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15
Hawthorne Nevada
5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7582

B. 1. NAME OF WASTE: Glass Beads with metals

2. USEPA/or/STATE WASTE CODE(S): D006, D008

3. PROCESS GENERATING WASTE: Bead Blasting

4. PROJECTED ANNUAL VOLUME/UNITS: 8 / drum

5. MODE OF COLLECTION: drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

**1. MATERIAL CHARACTERIZATION**
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Dirty white
DENSITY: 2.46 - 2.49 BTU/LB: —
TOTAL SOLIDS: 100% ASH CONTENT: _____
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☒ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

COPPER: N/A
NICKEL: _____
ZINC: _____
CHROMIUM-HEX: _____
(OTHER) _____

PHENOLICS: N/A
TOTAL HALOGENS: _____
VOLATILE ORGANICS: _____
PCBs: _____

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Glassbeads | > 99.0% | |
| Cadmium | ~~[illegible]~~ < 1% | |
| Lead | < 1% | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous Waste Solid N.O.S. (Glassbeads w/metals)

HAZARD CLASS: 9 U.N. or (N.A.) NO. 3077

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 96

SPECIAL HANDLING INFORMATION _____

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: T. Erickson

DATE: 10/29/92

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 6.35 |
| ☒ CADMIUM | D006 | 74.1 | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

REPRODUCED AT GOVERNMENT EXPENSE

Rein Hazardous Waste

3966
322TFN D (39)
07 MAR 1990

WQEC
CHEMICAL ANALYSIS REPORT NO. 277-90
Naval Undersea Warfare Engineering Station
Keyport, Washington

From: 30
To: 20

Subj: Analysis of Contaminants
Program: ADCAP/MK 48

Requested By: Code 211 (K. Ronan)
Analyst: Teresita Nartea

Job Order No: 0387-099-322

BACKGROUND: On 26 February 1990, Code 211 requested that Code 322 analyze one sample of glass beads for Otto Fuel II and total heavy metal content. The material is used in the abrasive cleaning of the CVA spline valves from the MK 48 and ADCAP torpedoes at Hawthorne, Nevada. The spline valve is manufactured from molybdenum alloy and is cleaned with the glass bead material to remove carbon by-products from the combustion process and may have been exposed to Otto Fuel II during operations. The analysis is needed to determine proper handling and disposal procedures for the material.

ANALYSIS: The results are as follows:

Color = Translucent dirty white
Physical State = Solid
Specific Gravity = 2.46 - 2.49
Otto Fuel II = < 0.01 ppm

| TOTAL METALS | CONCENTRATION, MG/L |
|---|---|
| Arsenic | <0.05 |
| Barium | 2.87 |
| Cadmium | 74.1 |
| Chromium | 3.90 |
| Lead | 8.35 |
| Mercury | <0.05 |
| Selenium | 0.51 |
| Silver | <0.10 |

D. H. DANIELSON

Copy to:
211 (K. Ronan)

2/2

HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWM12054

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15
Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Paint Remover

2. USEPA/or/STATE WASTE CODE(S): D001 F002

3 PROCESS GENERATING WASTE: out dated material

4. PROJECTED ANNUAL VOLUME/UNITS: — / —

5. MODE OF COLLECTION: drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

**1. MATERIAL CHARACTERIZATION**
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: yellow
DENSITY: 1.02 BTU/LB:
TOTAL SOLIDS: <1% ASH CONTENT:
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F)
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☒ CORROSIVE (D002)
pH <2.0
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Methylene Chloride | <40% | |
| Ammonium Hydroxide | <10% | |
| Dodecyl Benzene Sulfonic Acid | <5% | |
| water | <45 | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Corrosive Liquid N.O.S. (Paint Remover)

HAZARD CLASS: 8 U.N. or N.A. NO.: 1760

ADDITIONAL DESCRIPTION:
METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:
CERCLA REPORTABLE QUANTITY (RQ):
EMERGENCY RESPONSE GUIDE PAGE
DOT PUBLICATION 5800.4 PAGE NO. 60 EDITION (YR) 90
SPECIAL HANDLING INFORMATION:

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION
☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 11/12/97

DRMS Form 1930

EFFECTIVE 26 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | _____ | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | _____ |
| ☐ BARIUM | D005 | _____ | ☐ HEXACHLOROETHANE | D034 | _____ |
| ☐ BENZENE | D018 | _____ | ☐ LEAD | D008 | _____ |
| ☐ CADMIUM | D006 | _____ | ☐ LINDANE | D013 | _____ |
| ☐ CARBON TETRACHLORIDE | D019 | _____ | ☐ MERCURY | D009 | _____ |
| ☐ CHLORDANE | D020 | _____ | ☐ METHOXYCHLOR | D014 | _____ |
| ☐ CHLOROBENZENE | D021 | _____ | ☐ METHYL ETHYL KETONE | D035 | _____ |
| ☐ CHLOROFORM | D022 | _____ | ☐ NITROBENZENE | D036 | _____ |
| ☐ CHROMIUM | D007 | _____ | ☐ PENTACHLOROPHENOL | D037 | _____ |
| ☐ O CRESOL | D023 | _____ | ☐ PYRIDINE | D038 | _____ |
| ☐ M-CRESOL | D024 | _____ | ☐ SELENIUM | D010 | _____ |
| ☐ P-CRESOL | D025 | _____ | ☐ SILVER | D011 | _____ |
| ☐ CRESOL | D026 | _____ | ☐ TETRACHLOROETHYLENE | D039 | _____ |
| ☐ 2,4-D | D016 | _____ | ☐ TOXOPHENE | D015 | _____ |
| ☐ 1,4-DICHLOROBENZENE | D027 | _____ | ☐ TRICHLOROETHYLENE | D040 | _____ |
| ☐ 1,2-DICHLOROETHANE | D028 | _____ | ☐ 2,4,5-TRICHLOROPHENOL | D041 | _____ |
| ☐ 1,1-DICHLOROETHYLENE | D029 | _____ | ☐ 2,4,6-TRICHLOROPHENOL | D042 | _____ |
| ☐ 2,4-DINITROTOLUENE | D030 | _____ | ☐ 2,4,5-TP (SILVEX) | D017 | _____ |
| ☐ ENDRIN | D012 | _____ | ☐ VINYL CHLORIDE | D043 | _____ |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | _____ | | | |
| ☐ HEXACHLOROBENZENE | D032 | _____ | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP2001

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

8. 1. NAME OF WASTE: Dirt, Debris, Ash

2. USEPA/or/STATE WASTE CODE(S): D008

3. PROCESS GENERATING WASTE: Furnace clean-up

4. PROJECTED ANNUAL VOLUME/UNITS: 5 DR / YR

5. MODE OF COLLECTION: drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR
DENSITY BTU/LB
TOTAL SOLIDS 100% ASH CONTENT
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☒ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F)
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

COPPER N/A
NICKEL
ZINC
CHROMIUM-HEX
(OTHER)

PHENOLICS N/A
TOTAL HALOGENS
VOLATILE ORGANICS
PCBs

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Dirt | | 40-50% |
| Debris | | 10-20 |
| Ash | | 30-50% |
| - Lead | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME Hazardous Waste Solid N.O.S (Ash/Debris with Lead)

HAZARD CLASS 9 U.N. or N.A. NO. 3077

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 6/10/92

DRMS Form 1930

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 6.25 |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | 0022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,45-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP2002

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: metal pieces / slag

2. USEPA/or/STATE WASTE CODE(S): D005, D008

3. PROCESS GENERATING WASTE: Deactivation furnace cleaning

4. PROJECTED ANNUAL VOLUME/UNITS: 4 Drum / YR 5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

**1. MATERIAL CHARACTERIZATION** *(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Brown-Black-Grey
DENSITY: _____ BTU/LB: _____
TOTAL SOLIDS: 100% ASH CONTENT: _____
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☒ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| metal pieces | | 40 - 60% |
| slag | | 30 - 40% |
| Exploded cartridge cases/heads | | 5 - 15% |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous waste solid N.O.S (metal with Barium, Lead)

HAZARD CLASS: 9 U.N. or N.A. NO. 3077

ADDITIONAL DESCRIPTION: _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 6/13/92

DRMS Form 1930

TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg. |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☒ BARIUM | D005 | 115.0 | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 2900.0 |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

## FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

# HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION** — WASTE PROFILE NO. HWAP2004

1. GENERATOR NAME: Hawthorne Army Ammunition Plant
2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada — 5. ZIP CODE: 89415
3. GENERATOR USEPA ID: NV1210090006
4. GENERATOR STATE ID: N/A
6. TECHNICAL CONTACT: Tom Erickson — 7. TITLE: Environmental Sp'lst — PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Water with Ash / Bags
2. USEPA/or/STATE WASTE CODE(S): D005, D006, D008, D030
3. PROCESS GENERATING WASTE: Deactivation Furnace
4. PROJECTED ANNUAL VOLUME/UNITS: 5 drum / yr — 5. MODE OF COLLECTION: Drum
6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO
7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

**1. MATERIAL CHARACTERIZATION** *(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Brown-Black
DENSITY: — BTU/LB:
TOTAL SOLIDS: 50-60% — ASH CONTENT:
LAYERING: ☒ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☒ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER
TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER
☐ IGNITABLE (D001) — FLASH POINT (F): ☐ HIGH TOC (> 10%) ☐ LOW TOC (< 10%)
☐ CORROSIVE (D002) — pH: ☐ CORRODES STEEL
☐ REACTIVE (D003) — ☐ WATER REACTIVE ☐ CYANIDE REACTIVE ☐ SULFIDE REACTIVE
☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Water | | 30-50% |
| Ash / Bags | | 50-60% |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO
PROPER SHIPPING NAME: Hazardous Waste Liquid N.O.S. (Water with Ash / Bags)
HAZARD CLASS: 9 — U.N. or (N.A.) NO.: 3082
ADDITIONAL DESCRIPTION:
METHOD OF SHIPMENT: ☐ BULK ☒ DRUM ☐ OTHER:
CERCLA REPORTABLE QUANTITY (RQ):
EMERGENCY RESPONSE GUIDE PAGE
DOT PUBLICATION 5800.4 — PAGE NO. 31 — EDITION (YR) 9
SPECIAL HANDLING INFORMATION:

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION:
☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature] — DATE: 4/13/92

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☒ BARIUM | D005 | 150 - 250 | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 2.75 - 32.5 |
| ☒ CADMIUM | D006 | 1.85 - 37.5 | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☒ 2,4-DINITROTOLUENE | D030 | 61.3 - 150.0 | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP2005

**1. GENERATOR NAME**
Hawthorne Army Ammunition Plant

**2. FACILITY ADDRESS**
P.O. Box 15
Hawthorne, Nevada

**5. ZIP CODE** 89415

**3. GENERATOR USEPA ID**
NV1210090006

**4. GENERATOR STATE ID**
N/A

**6. TECHNICAL CONTACT**
Tom Erickson

**7. TITLE**
Environmental Sp'lst

**PHONE**
(702) 945-7587

**8. 1. NAME OF WASTE** Ash From Propellant Burn
2. USEPA/or/STATE WASTE CODE(S) D008
3. PROCESS GENERATING WASTE Propellant Burn
4. PROJECTED ANNUAL VOLUME/UNITS 8 dr / yr 5. MODE OF COLLECTION Drum
6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO
7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

**1. MATERIAL CHARACTERIZATION**
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR Black
DENSITY BTU/LB
TOTAL SOLIDS 100% ASH CONTENT
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☒ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER
TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER
☐ IGNITABLE (D001)
FLASH POINT (F)
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)
☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE
☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL
☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Ash - | | 100% |
| Lead | 600 mg/L | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO
PROPER SHIPPING NAME Hazardous waste Solid N.O.S (Ash)
HAZARD CLASS 9 U.N. or N.A. NO. 3077
ADDITIONAL DESCRIPTION
METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:
CERCLA REPORTABLE QUANTITY (RQ)
EMERGENCY RESPONSE GUIDE PAGE
DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90
SPECIAL HANDLING INFORMATION

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION
☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE Thomas J. Erickson
DATE 6/13/92

DRMS Form 1930

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 600 u |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP 2007

GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Fire debris

2. USEPA/or/STATE WASTE CODE(S): D008

3 PROCESS GENERATING WASTE: Fire clean-up

4. PROJECTED ANNUAL VOLUME/UNITS: — / —

5. MODE OF COLLECTION: drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO

HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO

DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Gray - Black

DENSITY: _____ BTU/LB: _____

TOTAL SOLIDS: 100% ASH CONTENT: _____

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☒ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Ash | | 30-40% |
| metal | | 40-60% |
| Floor sweep | pic | 10-20% |
| | | |
| | | |
| | | |

TOTAL _____ 100%

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous waste Solid N.O.S. (Debris with lead)

HAZARD CLASS: 9 U.N. or N.A. NO. 3077

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 92

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*.

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 6/13/92

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 47.5 |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,45-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

# HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP2008

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Battery electrolyte and water

2. USEPA/or/STATE WASTE CODE(S): D002, D006

3. PROCESS GENERATING WASTE: Battery maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 50 gal / yr

5. MODE OF COLLECTION: 5 gal jug

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO

HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO

DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

**1. MATERIAL CHARACTERIZATION**
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: clear

DENSITY: _____ BTU/LB: _____

TOTAL SOLIDS: 0 ASH CONTENT: _____

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☒ CORROSIVE (D002)
pH 13.1
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Potassium Hydroxide | | 90-100% |
| Lithium Hydroxide | | 3-10% |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Corrosive Liquid N.O.S. (Potassium Hydroxide)

HAZARD CLASS: 8 (U.N.) or N.A. NO. 1760

ADDITIONAL DESCRIPTION: _____

METHOD OF SHIPMENT ☐ BULK ☐ DRUM ☒ OTHER: 5 gal jug

CERCLA REPORTABLE QUANTITY (RQ): _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 60 EDITION (YR) 90

SPECIAL HANDLING INFORMATION: _____

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)* MSDS

I, Thomas S. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas S. Erickson

DATE: 6/13/92

DRMS Form 1930

# HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP 2009

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Ammonium hydroxide

2. USEPA/or/STATE WASTE CODE(S): D002

3 PROCESS GENERATING WASTE: Blue print machine

4. PROJECTED ANNUAL VOLUME/UNITS: 15 gal / yr

5. MODE OF COLLECTION: 2.5 gal jug

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☑ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☑ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDAROS? ☐ YES ☑ NO REFERENCE STANDARDS

## PART II

**1. MATERIAL CHARACTERIZATION**
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: clear

DENSITY: BTU/LB:

TOTAL SOLIDS: ASH CONTENT:

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☑ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☐ SOLID ☑ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☑ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F)
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☑ CORROSIVE (D002)
pH 12.6 - 13.0
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Ammonium hydroxide | 25.5% | |
| water | 74.5% | |
| Inhibitor | Trace | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☑ YES ☐ NO

PROPER SHIPPING NAME: Spent Ammonia Solution

HAZARD CLASS: 8

U.N. or N.A. NO. 2679

ADDITIONAL DESCRIPTION:

METHOD OF SHIPMENT ☐ BULK ☐ DRUM ☑ OTHER: Jug

CERCLA REPORTABLE QUANTITY (RQ):

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 60 EDITION (YR) 90

SPECIAL HANDLING INFORMATION:

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION:
☑ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☑ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)* MSDS

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 4/13/92

DRMS Form 1930

W65WSN 2165001

# WASTE MATERIAL PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP2014

1. GENERATOR NAME: HAWTHORNE ARMY AMMUNITION PLANT

2. FACILITY ADDRESS: U.S. ROUTE 95 NORTH, P.O. BOX 15, HAWTHORNE, NV

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: TOM ERICKSON

7. TITLE: Environmental Specialist

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Battery wash water

2. USEPA/or/STATE I.D. NO.(S): Non RCRA

3. PROCESS GENERATING WASTE: Battery maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 5000 gal/yr

5. MODE OF COLLECTION: drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F0226, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO

## PART II

**1. MATERIAL CHARACTERIZATION**

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ OTHER

ODOR: ☒ NONE ☐ HIGH ☐ STRONG

DESCRIPTION

COLOR: Hazy - tan

DENSITY: 1.0 BTU/LB

FLASH POINT (F): — ASH CONTENT

TOTAL SOLIDS: 71% pH: 2.5

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☒ SINGLE PHASE

**2. CHEMICAL COMPOSITION**

HEAVY METALS ☒ TOTAL (ppm) ☐ EXTRACTION (mg/L)

| | | | | | |
|---|---|---|---|---|---|
| ARSENIC | N/A | MERCURY | N/A | ZINC | N/A |
| BARIUM | N/A | SELENIUM | | CHROMIUM-HEX | |
| CADMIUM | 0.4 | SILVER | | (OTHER) | |
| CHROMIUM | N/A | COPPER | | | |
| LEAD | 1.0 | NICKEL | | | |
| (OTHER) | — | (OTHER) | | | |

OTHER COMPONENTS (PPM)

| | | | |
|---|---|---|---|
| CYANIDES | N/A | VOLATILE ORGANICS | N/A |
| SULFIDES | | TOTAL HALOGENS | |
| PCBS | | PHENOLICS | |
| (OTHER) | | | |

**3. HAZARDOUS CHARACTERISTICS**

☐ REACTIVE ☐ PYROPHORIC ☐ SHOCK SENSITIVE
☐ EXPLOSIVE ☐ WATER REACTIVE ☐ RADIOACTIVE
☐ ETIOLOGICAL ☒ NONE OF THE ABOVE
☐ TOXICITY CHARACTERISTIC (SEE REVERSE FOR LISTING)
☒ OTHER Corrosive (DOT)

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| WATER | | 98-100% |
| Sulfuric Acid | | 1-2% |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Corrosive Liquid N.O.S (water w/ sulfuric Acid)

HAZARD CLASS: 8 U.N. or N.A. NO. 1760

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 60 EDITION (YR) 90

SPECIAL HANDLING INFORMATION

**6. GENERATOR CERTIFICATION**

I, Thomas J. Erickson, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS COMPLETE AND ACCURATE. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE: [signature] DATE: 4/13/92

HQ DRMS Form 0120 (Test) May 90

## PART III

### TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | _____ | ☐ HEXACHLOROBUTAOIENE | D033 | _____ |
| ☐ BARIUM | D005 | _____ | ☐ HEXACHLOROETHANE | D034 | _____ |
| ☐ BENZENE | D018 | _____ | ☐ LEAD | D008 | _____ |
| ☐ CADMIUM | D018 | _____ | ☐ LINDANE | D013 | _____ |
| ☐ CARBON TETRACHLORIDE | D019 | _____ | ☐ MERCURY | D009 | _____ |
| ☐ CHLORDANE | D020 | _____ | ☐ METHOXYCHLOR | D014 | _____ |
| ☐ CHLOROBENZENE | D021 | _____ | ☐ METHYL ETHYL KETONE | D035 | _____ |
| ☐ CHLOROFORM | D022 | _____ | ☐ NITROBENZENE | D036 | _____ |
| ☐ CHROMIUM | D077 | _____ | ☐ PENTRACHLOROPHENOL | D037 | _____ |
| ☐ O-CRESOL | D023 | _____ | ☐ PYRIDINE | D038 | _____ |
| ☐ M-CRESOL | D024 | _____ | ☐ SELENIUM | D010 | _____ |
| ☐ CRESOL | D026 | _____ | ☐ SILVER | O011 | _____ |
| ☐ 2,4-D | D016 | _____ | ☐ TETRACHLOROETHYLENE | D039 | _____ |
| ☐ 1,4-DICHLOROBENZENE | D027 | _____ | ☐ TOXOPHENE | D015 | _____ |
| ☐ 1,2-DICHLOROETHENE | D028 | _____ | ☐ TRICHLOROETHYLENE | D040 | _____ |
| ☐ 1,1-DICHLOROETHYLENE | D029 | _____ | ☐ 2,4,5-TRICHLOROPHENOL | D041 | _____ |
| ☐ 2,4-DINITROTOLUENE | D030 | _____ | ☐ 2,4,6-TRICHLOROPHENOL | D042 | _____ |
| ☐ ENDRIN | D012 | _____ | ☐ 2,45-TP (SILVEX) | D017 | _____ |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | _____ | ☐ VINYL CHLORIDE | D043 | _____ |
| ☐ HEXACHLOROBENZENE | D032 | _____ | | | |

## FOR DRMO USE ONLY

### DRMO VERIFICATION

1 DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

EP TOXICITY _____

TCLP _____

# HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP 3017

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15
Hawthorne Nevada
5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Deltic Pesticide

2. USEPA/or/STATE WASTE CODE(S): Dool

3. PROCESS GENERATING WASTE: Shelf-life

4. PROJECTED ANNUAL VOLUME/UNITS: 0 / —

5. MODE OF COLLECTION: drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

**1. MATERIAL CHARACTERIZATION**
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: clear-brown
DENSITY: 0.97 g/ml BTU/LB _____
TOTAL SOLIDS: 0 ASH CONTENT _____
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☒ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☒ IGNITABLE (D001)
FLASH POINT (F): 104°F
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

***NOTE:** EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Dioxathion | | 29.4% |
| Aromatic Naphtha | | 65.0% |
| Cyclohexane | | 0.6% |
| Inert | | 5.0% |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Organophosphorus pesticide liquid, toxic, flammable n.o.s. (Deltic)

HAZARD CLASS: 6.1 U.N. or N.A. NO. 3017

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE
DOT PUBLICATION 5800.4 PAGE NO. 28 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION
☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)* MSDS

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 6/23/92

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/ |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | _____ | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | _____ |
| ☐ BARIUM | D005 | _____ | ☐ HEXACHLOROETHANE | D034 | _____ |
| ☐ BENZENE | D018 | _____ | ☐ LEAD | D008 | _____ |
| ☐ CADMIUM | D006 | _____ | ☐ LINDANE | D013 | _____ |
| ☐ CARBON TETRACHLORIDE | D019 | _____ | ☐ MERCURY | D009 | _____ |
| ☐ CHLORDANE | D020 | _____ | ☐ METHOXYCHLOR | D014 | _____ |
| ☐ CHLOROBENZENE | D021 | _____ | ☐ METHYL ETHYL KETONE | D035 | _____ |
| ☐ CHLOROFORM | D022 | _____ | ☐ NITROBENZENE | D036 | _____ |
| ☐ CHROMIUM | D007 | _____ | ☐ PENTACHLOROPHENOL | D037 | _____ |
| ☐ O CRESOL | D023 | _____ | ☐ PYRIDINE | D038 | _____ |
| ☐ M-CRESOL | D024 | _____ | ☐ SELENIUM | D010 | _____ |
| ☐ P-CRESOL | D025 | _____ | ☐ SILVER | D011 | _____ |
| ☐ CRESOL | D026 | _____ | ☐ TETRACHLOROETHYLENE | D039 | _____ |
| ☐ 2,4-D | D016 | _____ | ☐ TOXOPHENE | D015 | _____ |
| ☐ 1,4-DICHLOROBENZENE | D027 | _____ | ☐ TRICHLOROETHYLENE | D040 | _____ |
| ☐ 1,2-DICHLOROETHANE | D028 | _____ | ☐ 2,4,5-TRICHLOROPHENOL | D041 | _____ |
| ☐ 1,1-DICHLOROETHYLENE | D029 | _____ | ☐ 2,4,6-TRICHLOROPHENOL | D042 | _____ |
| ☐ 2,4-DINITROTOLUENE | D030 | _____ | ☐ 2,45-TP (SILVEX) | D017 | _____ |
| ☐ ENDRIN | D012 | _____ | ☐ VINYL CHLORIDE | D043 | _____ |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | _____ | | | |
| ☐ HEXACHLOROBENZENE | D032 | _____ | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

W63W9N21 / 62001

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP 2019

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Insecticide - Bidrin

2. USEPA/or/STATE WASTE CODE(S): Dec1

3. PROCESS GENERATING WASTE: over aged product

4. PROJECTED ANNUAL VOLUME/UNITS: — / —

5. MODE OF COLLECTION: drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Brown

DENSITY: 1.19 BTU/LB: _____

TOTAL SOLIDS: Ø ASH CONTENT: —

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☒ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☒ IGNITABLE (D001)
FLASH POINT (F) 101-110°
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Dicrotophos | | 82% |
| Inert | | 18% |
| isopropyl/Alcohol | | 25% |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Organophosphorous pesticide, liquid, toxic, flammable n

HAZARD CLASS: 6.1 (U.N. or N.A. NO.) 3017

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 28 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)* MSDS

I, Thomas J Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 6/24/92

DRMS Form 1930

# HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAR2011

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Alumiprep 33

2. USEPA/or/STATE WASTE CODE(S): D002

3. PROCESS GENERATING WASTE: munitions maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 30 gal / yr

5. MODE OF COLLECTION: 15 gal jug

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F028, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO

HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO

DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

**1. MATERIAL CHARACTERIZATION**
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: clear

DENSITY: 1.13 - 1.15 BTU/LB: _____

TOTAL SOLIDS: _____ ASH CONTENT: _____

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☒ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☒ CORROSIVE (D002)
pH < 2.0
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| phosphoric Acid | | 20-30 % |
| Butyl Cellosolve | | 10-15 % |
| potas. Fluoride | | 1-3 % |
| water | | remainder |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Corrosive Liquid N.O.S. (phosphoric Acid)

HAZARD CLASS: 8 U.N. or N.A. NO. 1760

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☐ DRUM ☒ OTHER: 15 gal

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 60 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)* MSDS

I, Thomas S. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 6/13/92

DRMS Form 1930

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | _____ | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | _____ |
| ☐ BARIUM | D005 | _____ | ☐ HEXACHLOROETHANE | D034 | _____ |
| ☐ BENZENE | D018 | _____ | ☐ LEAD | D008 | _____ |
| ☐ CADMIUM | D006 | _____ | ☐ LINDANE | D013 | _____ |
| ☐ CARBON TETRACHLORIDE | D019 | _____ | ☐ MERCURY | D009 | _____ |
| ☐ CHLORDANE | D020 | _____ | ☐ METHOXYCHLOR | D014 | _____ |
| ☐ CHLOROBENZENE | D021 | _____ | ☐ METHYL ETHYL KETONE | D035 | _____ |
| ☐ CHLOROFORM | D022 | _____ | ☐ NITROBENZENE | D036 | _____ |
| ☐ CHROMIUM | D007 | _____ | ☐ PENTACHLOROPHENOL | D037 | _____ |
| ☐ O-CRESOL | D023 | _____ | ☐ PYRIDINE | D038 | _____ |
| ☐ M-CRESOL | D024 | _____ | ☐ SELENIUM | D010 | _____ |
| ☐ P-CRESOL | D025 | _____ | ☐ SILVER | D011 | _____ |
| ☐ CRESOL | D026 | _____ | ☐ TETRACHLOROETHYLENE | D039 | _____ |
| ☐ 2,4-D | D016 | _____ | ☐ TOXOPHENE | D015 | _____ |
| ☐ 1,4 DICHLOROBENZENE | D027 | _____ | ☐ TRICHLOROETHYLENE | D040 | _____ |
| ☐ 1,2-DICHLOROETHANE | D028 | _____ | ☐ 2,4,5-TRICHLOROPHENOL | D041 | _____ |
| ☐ 1,1-DICHLOROETHYLENE | D029 | _____ | ☐ 2,4,6-TRICHLOROPHENOL | D042 | _____ |
| ☐ 2,4-DINITROTOLUENE | D030 | _____ | ☐ 2,45-TP (SILVEX) | D017 | _____ |
| ☐ ENDRIN | D012 | _____ | ☐ VINYL CHLORIDE | D043 | _____ |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | _____ | | | |
| ☐ HEXACHLOROBENZENE | D032 | _____ | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

NA1867216002

# HAZARDOUS WASTE PROFILE SHEET

## PART I

GENERAL INFORMATION

WASTE PROFILE NO. HWAP2012

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

8. 1. NAME OF WASTE: Battery electrolyte

2. USEPA/or/STATE WASTE CODE(S): D002, D008

3. PROCESS GENERATING WASTE: Battery maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 110 gal / yr

5. MODE OF COLLECTION: Drum / jugs

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☑ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☑ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☑ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: clear
DENSITY _____ BTU/LB _____
TOTAL SOLIDS _____ ASH CONTENT _____
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☑ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☑ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☑ CORROSIVE (D002)
pH 1.3
☐ CORRODES STEEL

☑ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Lead Fluoroborate | 558-615 gm/L | |
| Free Fluoroboric Acid | 40-60 gm/L | |
| Free Boric Acid | 26-70 gm/L | |
| Bone Glue | 0.5-0.6 gm/L | |
| Dist. water | Remainder | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☑ YES ☐ NO

PROPER SHIPPING NAME: Waste Corrosive Liquid N.O.S. (Battery Electrolyte)

HAZARD CLASS: 8 (U.N. or) N.A. NO. 1760

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☑ DRUM ☑ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 60 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION
☑ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☑ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 9/13/92

DRMS Form 1930

CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 556-615 gm/L |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D026 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,45-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III
## FOR DRMO USE ONLY
### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

STOCK NUMBER | NIIN | ADD | UNIT OF ISSUE | QUANTITY | DOCUMENT NUMBER (SERV, REQUISITIONER, DATE, SERIAL) | SUFFIX | SUPPLEMENTARY ADDRESS | SIGNAL | FUND | DISTRIBUTION | PROJECT | PRIORITY | REQ'D DEL DATE | ADVICE | RI | UNIT PRICE (DOLLARS, CTS)

7999 100 Debris | D2 | 9 | H41869 2166 0003 | 21 | N/A | 01

SHIP TO | MARK FOR | PROJECT | TOTAL PRICE (DOLLARS, CTS)

USE LOCATION | TYPE OF CARGO | UNIT PACK | UNIT WEIGHT | UNIT CUBE | U F C | NMFC | FREIGHT RATE | DOCUMENT DATE | MAT. COND | QUANTITY | 6E7

TITUTE DATA (ITEM ORIGINALLY REQUESTED) | FREIGHT CLASSIFICATION NOMENCLATURE

UN 2100 - 0.17 x 687 = 116.79

U Filter Bags with Cadmium & Chromium | D006 | CDA | D007

ITEM NOMENCLATURE

Table HWAP 2013

X HAZARDOUS waste Solid N.O.S

ELECTED BY AND DATE | TYPE OF CONTAINER(S) | TOTAL WEIGHT | RECEIVED BY AND DATE | INSPECTED BY AND DATE

Bags - 90-100%
Residue 5-10%
Cadmium 2.15 mg/L
Chromium 11.0 mg/L

35 gal Drm | 687

ACKED BY AND DATE | NO. OF CONTAINERS | TOTAL CUBE | WAREHOUSED BY AND DATE | WAREHOUSE LOCATION

9

S | HAW 22

Generated by blasting booth maintenance

Accum. start 66 3/5/92

ESTINATION ADDRESS | DATE SHIPPED

SPORTATION CHARGEABLE TO | 14 B/LADING, AWB, OR RECEIVER'S SIGNATURE (AND DATE) | 15 RECEIVER'S DOCUMENT NUMBER

5

RM 1348-1 | 1 MAR 74 | EDITION OF 1 JAN 64 MAY BE USED UNTIL EXHAUSTED | DOD SINGLE LINE ITEM RELEASE/RECEIPT DOCUMENT

## 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☒ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

TOTAL _____ 100%

## 3. CHEMICAL COMPOSITION (ppm or mg/L)

COPPER N/A
NICKEL
ZINC
CHROMIUM-HEX
(OTHER)

PHENOLICS N/A
TOTAL HALOGENS
VOLATILE ORGANICS
PCBs

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

## 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME HAZARDOUS WASTE Solid N.O.S (Bags with Cadmium & Chromium)

HAZARD CLASS 9 U.N. or (N.A.) NO. 3077

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION

## 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE | DATE

Thomas J. Erickson | 6/13/92

DRMS Form 1930

EFFECTIVE 26 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☐ LEAD | D008 | |
| ☒ CADMIUM | D006 | 2.15 | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☒ CHROMIUM | D007 | 11.0 | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

## FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

NA1998216000005

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP 2016

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Turco Transpo

2. USEPA/or/STATE WASTE CODE(S): D001, F002, F004

3 PROCESS GENERATING WASTE: Shelf-life Expired

4. PROJECTED ANNUAL VOLUME/UNITS: — / —

5. MODE OF COLLECTION: drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Amber

DENSITY: 1.165 BTU/LB: —

TOTAL SOLIDS: 0 ASH CONTENT: _____

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☒ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

COPPER: N/A PHENOLICS: N/A
NICKEL: N/A TOTAL HALOGENS: _____
ZINC: N/A VOLATILE ORGANICS: _____
CHROMIUM-HEX: N/A PCBs: _____
(OTHER) _____

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Methylene Chloride | | 55 % |
| Cresylic Acid | | 15 % |
| Kerosine | | 5 % |
| Sodium Chromate | | 1 % |
| Sodium Fluoride | | 1 |
| Other Nonhazardous | | 23 % |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous Waste Liquid N.O.S. - (Turco - transpo)

HAZARD CLASS: 9 (U.N. or) N.A. NO. 3082

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 92

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)* MSDS

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 4/13/92

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☐ LEAD | D008 | |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☒ CHROMIUM | D007 | 25.0 | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

N4186909000002

# HAZARDOUS WASTE PROFILE SHEET

## PART I

GENERAL INFORMATION

WASTE PROFILE NO. HWAP3029

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: PAINT BLAST WASTE

2. USEPA/or/STATE WASTE CODE(S): D007, D008

3. PROCESS GENERATING WASTE: PAINT REMOVAL

4. PROJECTED ANNUAL VOLUME/UNITS: 2000 / LB

5. MODE OF COLLECTION: DR

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO

HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO

DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: White

DENSITY: BTU/LB:

TOTAL SOLIDS: 70%

ASH CONTENT:

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☒ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F)
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| WATER | 15-30 % | |
| PAINT SOLIDS | 50-70% | |
| Sodium Bicarbonate | 5-10% | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: HAZARDOUS WASTE LIQUID N.O.S

HAZARD CLASS: 9

U.N. or N.A. NO.: 3082

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 3/31/93

DRMS Form 1930

TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 5-10.0 |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☒ CHROMIUM | D007 | 5-30.0 | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

## FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

# HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP3009

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Laboratory waste TCLP Extract

2. USEPA/or/STATE WASTE CODE(S): D006, D008

3. PROCESS GENERATING WASTE: Laboratory operations

4. PROJECTED ANNUAL VOLUME/UNITS: 10 / Gallons 5. MODE OF COLLECTION: 5 gal ☒ container

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

**1. MATERIAL CHARACTERIZATION** *(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Tan
DENSITY: 1.0 BTU/LB:
TOTAL SOLIDS: 1-2% ASH CONTENT:
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☒ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Water | 95-100% | |
| Acetic Acid | < 1% | |
| Cadmium | 1.5-10 mg/L | |
| Lead | 5.0-200.0 mg/L | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous waste liquid N.O.S. (TCLP Extract with Cadmium & Lead)

HAZARD CLASS: 9 U.N. or (N.A.) NO.: 3082

ADDITIONAL DESCRIPTION:

METHOD OF SHIPMENT ☐ BULK ☐ DRUM ☒ OTHER: 5 gal

CERCLA REPORTABLE QUANTITY (RQ):

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION:

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION:
☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature] DATE: 3/11/93

DRMS Form 1930

TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☑ LEAD | D008 | 50-200.0 |
| ☑ CADMIUM | D006 | 1.5-10.0 | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D026 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

## A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP 3080

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15
Hawthorne Nevada
5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-758

B. 1. NAME OF WASTE: Laboratory Sampling Baghouse Ash w/metals
2. USEPA/or/STATE WASTE CODE(S): D005, D008
3. PROCESS GENERATING WASTE: Laboratory operation
4. PROJECTED ANNUAL VOLUME/UNITS: 1000 / LB
5. MODE OF COLLECTION: DR
6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☑ NO
7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☑ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☑ NO REFERENCE STANDARDS

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Grey - Black
DENSITY: BTU/LB:
TOTAL SOLIDS: 100% ASH CONTENT:
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☑ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F)
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☑ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Baghouse Ash | 75-80% | |
| Plastic Rags | 25-50% | |
| Barium | 5.0-6,000 mg/L | |
| Lead | 5.0-10,000 mg/L | |
| Cadmium | 1.0-8,000 mg/L | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☑ YES ☐ NO

PROPER SHIPPING NAME: Hazardous Waste Solid N.O.S. (Ash w/metals)

HAZARD CLASS: 9 U.N. or (N.A.) NO. 3077

ADDITIONAL DESCRIPTION:

METHOD OF SHIPMENT: ☐ BULK ☑ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ):

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 7

SPECIAL HANDLING INFORMATION:

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION
☑ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas Erickson (Print or Type Name), HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/11/99

DRMS Form 1930

| CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|
| ☐ ARSENIC | D004 | |
| ☑ BARIUM | D005 | 5.0 - 6,000 |
| ☐ BENZENE | D018 | |
| ☑ CADMIUM | D006 | 1.0 - 8,000 |
| ☐ CARBON TETRACHLORIDE | D019 | |
| ☐ CHLORDANE | D020 | |
| ☐ CHLOROBENZENE | D021 | |
| ☐ CHLOROFORM | D022 | |
| ☐ CHROMIUM | D007 | |
| ☐ O CRESOL | D023 | |
| ☐ M-CRESOL | D024 | |
| ☐ P-CRESOL | D025 | |
| ☐ CRESOL | D026 | |
| ☐ 2,4-D | D016 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | |
| ☐ 1,2-DICHLOROETHANE | D028 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | |
| ☐ 2,4-DINITROTOLUENE | D030 | |
| ☐ ENDRIN | D012 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | |
| ☐ HEXACHLOROBENZENE | D032 | |

| CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|
| ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ HEXACHLOROETHANE | D034 | |
| ☑ LEAD | D008 | 5.0 - 10 |
| ☐ LINDANE | D013 | |
| ☐ MERCURY | D009 | |
| ☐ METHOXYCHLOR | D014 | |
| ☐ METHYL ETHYL KETONE | D035 | |
| ☐ NITROBENZENE | D036 | |
| ☐ PENTACHLOROPHENOL | D037 | |
| ☐ PYRIDINE | D038 | |
| ☐ SELENIUM | D010 | |
| ☐ SILVER | D011 | |
| ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ TOXOPHENE | D015 | |
| ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ VINYL CHLORIDE | D043 | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

W6SWSN30710003

# WASTE MATERIAL PROFILE SHEET

## PART I

AL INFORMATION

WASTE PROFILE NO. HWAP 3011

1. GENERATOR NAME: HAWTHORNE ARMY AMMUNITION PLANT

2. FACILITY ADDRESS: U.S. ROUTE 95 NORTH
P.O. BOX 15
HAWTHORNE, NV
5. ZIP CODE 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: TOM ERICKSON

7. TITLE: Environmental Specialist

PHONE: (702) 945-5787

B. 1. NAME OF WASTE: Photo Fixer Solution

2. USEPA/or/STATE I.D. NO.(S): Non-RCRA

3. PROCESS GENERATING WASTE: Photo processing

4. PROJECTED ANNUAL VOLUME/UNITS: 300 lb / lb

5. MODE OF COLLECTION: 5 gal poly

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F0226, F027, OR F028)? ☐ YES ☑ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☑ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☑ NO

## PART II

### 1. MATERIAL CHARACTERIZATION

PHYSICAL STATE: ☐ SOLID ☑ LIQUID ☐ SEMI-SOLID ☐ OTHER

ODOR: ☐ NONE ☐ HIGH ☐ STRONG

DESCRIPTION: Acetic Acid

COLOR: tan-hazy

DENSITY: 1.0 BTU/LB

FLASH POINT (F): 7200 ASH CONTENT

TOTAL SOLIDS: 51% pH: 4.6

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. CHEMICAL COMPOSITION

HEAVY METALS ☑ TOTAL (ppm) ☐ EXTRACTION (mg/L)

| | | | | | |
|---|---|---|---|---|---|
| ARSENIC | N/A | MERCURY | N/A | ZINC | N/A |
| BARIUM | | SELENIUM | | CHROMIUM-HEX | |
| CADMIUM | | SILVER | 2.9 | (OTHER) | |
| CHROMIUM | | COPPER | | | |
| LEAD | | NICKEL | | | |
| (OTHER) | | (OTHER) | | | |

OTHER COMPONENTS (PPM)

| | | | |
|---|---|---|---|
| CYANIDES | | VOLATILE ORGANICS | |
| SULFIDES | | TOTAL HALOGENS | |
| PCBS | | PHENOLICS | |
| (OTHER) | | | |

### 3. HAZARDOUS CHARACTERISTICS

☐ REACTIVE ☐ PYROPHORIC ☐ SHOCK SENSITIVE
☐ EXPLOSIVE ☐ WATER REACTIVE ☐ RADIOACTIVE
☐ ETIOLOGICAL ☐ NONE OF THE ABOVE
☐ TOXICITY CHARACTERISTIC, SEE REVERSE FOR LISTING

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Ammonium Thiosulfate | | 15-20% |
| Sodium Acetate | | 0.5-1.5% |
| Acetic Acid | | 0.5-1.5% |
| Aluminum Sulfate | | 1-3% |
| Sulfuric Acid | | 3-4.5% |
| Water | | 68-78% |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☑ YES ☐ NO

PROPER SHIPPING NAME: Waste Environmentally Hazardous Substance, liquid N.O.S

HAZARD CLASS: 9 UN or N.A. NO. 3082

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☐ DRUM ☑ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION

### 6. GENERATOR CERTIFICATION

I, Thomas Erickson, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS COMPLETE AND ACCURATE. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

## PART III

### TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLOROBUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☐ LEAD | D008 | |
| ☐ CADMIUM | D018 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D077 | | ☐ PENTRACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ CRESOL | D026 | | ☑ SILVER | D011 | 2.7 |
| ☐ 2,4-D | D016 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,2-DICHLOROETHENE | D028 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ ENDRIN | O012 | | ☐ 2,45-TP (SILVEX) | D017 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

### FOR DRMO USE ONLY

#### DRMO VERIFICATION

1 DATE VERIFIED _____

2 RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

EP TOXICITY _____

TCLP _____

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAR3012

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

FACILITY ADDRESS: P.O. Box 15
Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Chloroform

2. USEPA/or/STATE WASTE CODE(S): U044, D022

3. PROCESS GENERATING WASTE: ovoo Agx product

4. PROJECTED ANNUAL VOLUME/UNITS: — / —  5. MODE OF COLLECTION: —

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS: _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Clear
DENSITY: 1.47  BTU/LB: _____
TOTAL SOLIDS: <1%  ASH CONTENT: _____
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

IGNITABLE (D001)
FLASH POINT (F): _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH: _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | n/a | PHENOLICS | n/a |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Chloroform | 90-100% | |
| | | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Chloroform

HAZARD CLASS: 6.1  U.N. or N.A. NO.: 1888

ADDITIONAL DESCRIPTION: _____

METHOD OF SHIPMENT: ☐ BULK ☐ DRUM ☒ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ): _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4  PAGE NO. 55  EDITION (YR) 90

SPECIAL HANDLING INFORMATION: _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION:
☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)* MSDS

I, Thomas Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/12/93

MS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☐ LEAD | D008 | |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☑ CHLOROFORM | D022 | 290 % | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4 D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4 DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

W65W3N30710003

# HAZARDOUS WASTE PROFILE SHEET

## PART I

GENERAL INFORMATION

WASTE PROFILE NO. HWAP3013

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020004

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

8. 1. NAME OF WASTE: Sodium Cyanide

2. USEPA/or/STATE WASTE CODE(S): D003, P106

3. PROCESS GENERATING WASTE: overage product

4. PROJECTED ANNUAL VOLUME/UNITS: — / —

5. MODE OF COLLECTION: —

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☑ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☑ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☑ NO REFERENCE STANDARDS: —

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: white
DENSITY: 1.6 BTU/LB:
TOTAL SOLIDS: 100% ASH CONTENT:
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☑ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F):
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☑ REACTIVE (D003)
☐ WATER REACTIVE
☑ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH:
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Sodium Cyanide | 90-100% | |
| | | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☑ YES ☐ NO

PROPER SHIPPING NAME: Waste Sodium Cyanide

HAZARD CLASS: 6.1 U.N. or N.A. NO.: 1689

ADDITIONAL DESCRIPTION:

METHOD OF SHIPMENT: ☐ BULK ☐ DRUM ☑ OTHER:

CERCLA REPORTABLE QUANTITY (RQ):

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 55 EDITION (YR) 20

SPECIAL HANDLING INFORMATION:

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*.

☑ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/12/93

DRMS Form 1930

WESWGN 30710006

# WASTE MATERIAL PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAQ 30 19

1. GENERATOR NAME: HAWTHORNE ARMY AMMUNITION PLANT

2. FACILITY ADDRESS: U.S. ROUTE 95 NORTH
P.O. BOX 15
HAWTHORNE, NV

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: TOM ERICKSON

7. TITLE: Environmental Specialist

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Empty container - Residue Cyclohexylamine

2. USEPA/or/STATE I.D. NO.(S): Non-RCRA

3. PROCESS GENERATING WASTE: water treatment

4. PROJECTED ANNUAL VOLUME/UNITS: — / —

5. MODE OF COLLECTION:

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F0226, F027, OR F028)? ☐ YES ☑ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☐ YES ☑ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☑ NO

## PART II

### 1. MATERIAL CHARACTERIZATION

PHYSICAL STATE: ☐ SOLID ☑ LIQUID ☐ SEMI-SOLID ☐ OTHER

ODOR: ☐ NONE ☐ HIGH ☑ STRONG

DESCRIPTION: unpleasant

COLOR: clear

DENSITY: 0.872 BTU/LB

FLASH POINT (F): 90° ASH CONTENT

TOTAL SOLIDS: <1% pH

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. CHEMICAL COMPOSITION

HEAVY METALS ☐ TOTAL (ppm) ☐ EXTRACTION (mg/L)

| | | | | | |
|---|---|---|---|---|---|
| ARSENIC | N/A | MERCURY | N/A | ZINC | N/A |
| BARIUM | | SELENIUM | | CHROMIUM-HEX | |
| CADMIUM | | SILVER | | (OTHER) | |
| CHROMIUM | | COPPER | | | |
| LEAD | | NICKEL | | | |
| (OTHER) | | (OTHER) | | | |

OTHER COMPONENTS (PPM)

| | | | |
|---|---|---|---|
| CYANIDES | N/A | VOLATILE ORGANICS | N/A |
| SULFIDES | | TOTAL HALOGENS | |
| PCBS | | PHENOLICS | |
| (OTHER) | | | |

### 3. HAZARDOUS CHARACTERISTICS

☐ REACTIVE ☐ PYROPHORIC ☐ SHOCK SENSITIVE
☐ EXPLOSIVE ☐ WATER REACTIVE ☐ RADIOACTIVE
☐ ETIOLOGICAL ☐ NONE OF THE ABOVE
☐ TOXICITY CHARACTERISTIC (SEE REVERSE FOR LISTING)
☐ OTHER

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| cyclohexylamine | 0-1.0 % | |
| drum w/ Residue | 99-100% | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☐ YES ☑ NO

PROPER SHIPPING NAME: Empty Container previously held Cyclohexyl Amine

HAZARD CLASS U.N. or N.A. NO.

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☑ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. EDITION (YR)

SPECIAL HANDLING INFORMATION

### 6. GENERATOR CERTIFICATION

I, Thomas J. Erickson, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS COMPLETE AND ACCURATE. ALL KNOWN OR SUSPECTED HAZARDS HAV BEEN DISCLOSED.

SIGNATURE: Thomas J. Erickson

DATE: 3/12/93

HQ DRMS Form 0120 (Test)

W65W9M3013 0001

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP3001

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15
Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7582

B. 1. NAME OF WASTE: Waste oil with metals

2. USEPA/or/STATE WASTE CODE(S): D004, D006

3. PROCESS GENERATING WASTE: Vehicle maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 5000 / LB

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Black
DENSITY: _____ BTU/LB: _____
TOTAL SOLIDS: < 5% ASH CONTENT: _____
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Hydraulic / waste oil | > 99% | |
| Arsenic | < 1% | |
| Cadmium | < 1% | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous waste liquid N.O.S. (waste oil)

HAZARD CLASS: 9 U.N. or N.A. NO. 3082

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 3/5/93

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☒ ARSENIC | D004 | 6.5 | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☐ LEAD | D008 | |
| ☒ CADMIUM | D006 | 1.25 | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,45-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP 3002

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7582

B. 1. NAME OF WASTE: Waste oil with metals - Cadmium & Lead

2. USEPA/or/STATE WASTE CODE(S): D006, D008

3. PROCESS GENERATING WASTE: Vehicle maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 5000 / LB

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO

HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO

DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Black

DENSITY: BTU/LB:

TOTAL SOLIDS: >95% ASH CONTENT:

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F)
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Waste oil | >99% | |
| Cadmium | <1% | |
| Lead | <1% | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous waste liquid N.O.S. (oil with metals)

HAZARD CLASS: 9 U.N. or (N.A.) NO. 3082

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/9/93

DMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 13.0 |
| ☒ CADMIUM | D006 | 1.7 | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

WESTON 30 760001

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP3003

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15
Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Waste oil with Lead

2. USEPA/or/STATE WASTE CODE(S): D008

3 PROCESS GENERATING WASTE: Vehicle maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 15,000 / LB

5. MODE OF COLLECTION: DR

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Black

DENSITY: BTU/LB:

TOTAL SOLIDS: <.95% ASH CONTENT:

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F)
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Waste oil | >99% | |
| Lead | 5.0 - 26.0 mg/L | |
| | | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous Waste Liquid N.O.S. (Waste oil w/ Lead)

HAZARD CLASS: 9 U.N. or (N.A.) NO. 3082

ADDITIONAL DESCRIPTION:

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ):

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION:

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 3/10/93

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 5.0 - 16.0 |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP 3004

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15
Hawthorne Nevada
6. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

5. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

8. 1. NAME OF WASTE: Waste oil with metals (Arsenic)
2. USEPA/or/STATE WASTE CODE(S): D004
3. PROCESS GENERATING WASTE: Vehicle maintenance
4. PROJECTED ANNUAL VOLUME/UNITS: 5000 / LB
5. MODE OF COLLECTION: DR
6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO
7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Black
DENSITY: BTU/LB
TOTAL SOLIDS: < 1%
ASH CONTENT:
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F)
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

COPPER: N/A
NICKEL:
ZINC:
CHROMIUM-HEX:
(OTHER):
PHENOLICS: N/A
TOTAL HALOGENS:
VOLATILE ORGANICS:
PCBs:

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Waste oil | > 99% | |
| Arsenic | 5-8 mg/L | |
| | | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous waste liquid N.O.S. (waste oil w/ arsenic)

HAZARD CLASS: 9
U.N. or N.A. NO.: 3082
ADDITIONAL DESCRIPTION:
METHOD OF SHIPMENT: ☐ BULK ☒ DRUM ☐ OTHER:
CERCLA REPORTABLE QUANTITY (RQ):
EMERGENCY RESPONSE GUIDE PAGE
DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90
SPECIAL HANDLING INFORMATION:

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION
☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson (Print or Type Name), HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 3/10/93

DRMS Form 1930

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☒ ARSENIC | D004 | 5.0 – 8.0 mg/L | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☐ LEAD | D008 | |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,45-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

W6SW9N3076 003

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAD3005

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7381

B. 1. NAME OF WASTE: Gas/water with mercury

2. USEPA/or/STATE WASTE CODE(S): D009

3. PROCESS GENERATING WASTE: UST Removal

4. PROJECTED ANNUAL VOLUME/UNITS: — / —

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Tan
DENSITY: _____ BTU/LB: _____
TOTAL SOLIDS: <1% ASH CONTENT: _____
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORROOES STEEL

☒ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Gasoline | 50-75% | |
| water | 50-75% | |
| mercury | 0.31 mg/L | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous waste liquid n.o.s. (water/gas w/mercury)

HAZARD CLASS: 9 U.N. or N.A. NO. 3082

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION
☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/10/93

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☐ LEAD | D008 | |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | 0.31 mg/L |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

W65WH3076 0004

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP3006

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: oil/water with metals (Arsenic, Lead)

2. USEPA/or/STATE WASTE CODE(S): D004 - D008

3. PROCESS GENERATING WASTE: Vehicle maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 1000 / LB

5. MODE OF COLLECTION: DR

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Black - cloudy

DENSITY: _____ BTU/LB: _____

TOTAL SOLIDS: <1% ASH CONTENT: _____

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| O.L | 50-75% | |
| water | 25-50% | |
| Arsenic | 8.0 mg/L | |
| Lead | 7.0 mg/L | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous waste liquid n.o.s (oil/water w/metals)

HAZARD CLASS: 9 U.N. or N.A. NO. 3082

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/4/93

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☑ ARSENIC | D004 | 5.0-10.0 | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☑ LEAD | D008 | 5.0-10.0 m |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLORDETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

W65WRA3072600005

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP3007

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Transmission fluid with metals (cadmium)

2. USEPA/or/STATE WASTE CODE(S): D006

3 PROCESS GENERATING WASTE: Equipment maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 1000 / LB

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F028, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Black - Brown

DENSITY: _____ BTU/LB: _____

TOTAL SOLIDS: <1% ASH CONTENT: _____

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Transmission Fluid | >99% | |
| Cadmium | 1.0 - 5.0 mg/L | |
| | | |
| | | |
| | | |
| | | |
| | | |

TOTAL _____ 100%

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous waste liquid n.o.s. (waste oil with cadmium)

HAZARD CLASS: 9 U.N. or N.A. NO.: 3082

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson (Print or Type Name), HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 3/10/93

DRMS Form 1930

NV6570190000

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP 300A

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15
Hawthorne Nevada
5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Waste oil / water with metals

2. USEPA/or/STATE WASTE CODE(S): D007, D008

3 PROCESS GENERATING WASTE: vehicle maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 10000 / lb

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Black
DENSITY: _____ BTU/LB: _____
TOTAL SOLIDS: <1% ASH CONTENT: _____
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE ORMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| waste oil | 80-100% | |
| water | 20-40% | |
| chromium | 5-22.0 mg/L | |
| lead | 5-10 mg/L | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous waste liquid N.O.S. (oil / water with metals)

HAZARD CLASS: 9 U.N. or N.A. NO. 3082

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED OVER. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 3/10/93

NAVS FORM 1332

W65WGN30P50001

# HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP30/15

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15
Hawthorne Nevada
5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Rust Remover w/ Phosphoric Acid

2. USEPA/or/STATE WASTE CODE(S): D002

3. PROCESS GENERATING WASTE: Ammunition maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: — / —

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☑ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☑ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☑ NO REFERENCE STANDARDS _____

## PART II

**1. MATERIAL CHARACTERIZATION**
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: clear-hazy
DENSITY: 1.0 BTU/LB: _____
TOTAL SOLIDS: <1% ASH CONTENT: _____
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☑ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☐ SOLID ☑ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☑ CORROSIVE (D002)
pH <2.0
☐ CORRODES STEEL

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION** [illegible]

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| water | 80-100% | |
| Phosphoric Acid | <20% | |
| | | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☑ YES ☐ NO

[illegible]

HAZARD CLASS: 8 U.N. or N.A. NO. 1760
ADDITIONAL DESCRIPTION _____
METHOD OF SHIPMENT ☐ BULK ☑ DRUM ☐ OTHER: _____
CERCLA REPORTABLE QUANTITY (RQ) _____
EMERGENCY RESPONSE GUIDE PAGE
DOT PUBLICATION 5800.4 PAGE NO. 60 EDITION (YR) 90
SPECIAL HANDLING INFORMATION _____

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION
☑ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☑ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/26/93

DRMS Form 1030

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | _____ | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | _____ |
| ☐ BARIUM | D005 | _____ | ☐ HEXACHLOROETHANE | D034 | _____ |
| ☐ BENZENE | D018 | _____ | ☐ LEAD | D008 | _____ |
| ☐ CADMIUM | D006 | _____ | ☐ LINDANE | D013 | _____ |
| ☐ CARBON TETRACHLORIDE | D019 | _____ | ☐ MERCURY | D009 | _____ |
| ☐ CHLORDANE | D020 | _____ | ☐ METHOXYCHLOR | D014 | _____ |
| ☐ CHLOROBENZENE | D021 | _____ | ☐ METHYL ETHYL KETONE | D035 | _____ |
| ☐ CHLOROFORM | D022 | _____ | ☐ NITROBENZENE | D036 | _____ |
| ☐ CHROMIUM | D007 | _____ | ☐ PENTACHLOROPHENOL | D037 | _____ |
| ☐ O CRESOL | D023 | _____ | ☐ PYRIDINE | D038 | _____ |
| ☐ M-CRESOL | D024 | _____ | ☐ SELENIUM | D010 | _____ |
| ☐ P-CRESOL | D025 | _____ | ☐ SILVER | D011 | _____ |
| ☐ CRESOL | D026 | _____ | ☐ TETRACHLOROETHYLENE | D039 | _____ |
| ☐ 2,4-D | D016 | _____ | ☐ TOXOPHENE | D015 | _____ |
| ☐ 1,4-DICHLOROBENZENE | D027 | _____ | ☐ TRICHLORDETHYLENE | D040 | _____ |
| ☐ 1,2-DICHLOROETHANE | D028 | _____ | ☐ 2,4,5-TRICHLOROPHENOL | D041 | _____ |
| ☐ 1,1-DICHLOROETHYLENE | D029 | _____ | ☐ 2,4,6-TRICHLOROPHENOL | D042 | _____ |
| ☐ 2,4-DINITROTOLUENE | D030 | _____ | ☐ 2,4,5-TP (SILVEX) | D017 | _____ |
| ☐ ENDRIN | D012 | _____ | ☐ VINYL CHLORIDE | D043 | _____ |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | _____ | | | |
| ☐ HEXACHLOROBENZENE | D032 | _____ | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

W68WZN30850002

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP3016

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Corrosion Preventative Comp.

2. USEPA/or/STATE WASTE CODE(S): D001

3 PROCESS GENERATING WASTE: Ammunition maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 1500 / LB

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Brown-Black
DENSITY: 0.87 BTU/LB
TOTAL SOLIDS: <1% ASH CONTENT
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☒ IGNITABLE (D001)
FLASH POINT (F) 100°
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Petroleum Distillates | 40-55% | |
| | | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Flammable Liquid N.O.S

HAZARD CLASS: 3 (U.N. or N.A. NO.) 1993

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 27 EDITION (YR) 90

SPECIAL HANDLING INFORMATION

6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION
☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUPPOSED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/24/93

DRMS Form 1930

## [illegible]TY CHARACTERISTIC LIST

[illegible] 29 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| [illegible] | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (m |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☐ LEAD | D008 | |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

W65W7N3088 0001

# HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP3017

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Waste oil & Gasoline

2. USEPA/or/STATE WASTE CODE(S): D001, D018

3 PROCESS GENERATING WASTE: Vehicle Maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 5000 / LB

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

**1. MATERIAL CHARACTERIZATION**
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Black
DENSITY: _____ BTU/LB: _____
TOTAL SOLIDS: <1% ASH CONTENT: _____
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☒ IGNITABLE (D001)
FLASH POINT (F) 200°
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| WASTE OIL | 30-50% | |
| GASOLINE | 30-50% | |
| DIESEL | 10-20% | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Flammable Liquid N.O.S (OIL/GAS)

HAZARD CLASS: 3 U.N. or N.A. NO. 1993

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 27 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION
☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/29/93

DRMS Form 1930

EFFECTIVE 26 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (m |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☐ LEAD | D008 | |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III
## FOR DRMO USE ONLY
### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

# HAZARDOUS WASTE PROFILE SHEET

## PART I

GENERAL INFORMATION

WASTE PROFILE NO. HWAP 3018

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-757

B. 1. NAME OF WASTE: Laboratory waste

2. USEPA/or/STATE WASTE CODE(S): D001 F003

3. PROCESS GENERATING WASTE: Laboratory Analysis

4. PROJECTED ANNUAL VOLUME/UNITS: 1000 / LB

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☑ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☑ YES ☐ NO

HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO

DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☑ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Clear-Black

DENSITY: <1.0 BTU/LB: _____

TOTAL SOLIDS: <1.0% ASH CONTENT: _____

LAYERING: ☑ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☑ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☑ IGNITABLE (D001)
FLASH POINT (F) <60°C
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Water | | 10-20% |
| Xylene | | 30-50% |
| Acetone | | 30-50% |
| Waste oil | | 5-10% |
| | | |
| | | |

TOTAL _____ 100%

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☑ YES ☐ NO

PROPER SHIPPING NAME: Waste Flammable Liquid N.O.S. (Acetone, Xylene)

HAZARD CLASS: 3 U.N. or N.A. NO. 1993

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☑ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 27 EDITION (YR) 9

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☑ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)* _____

I, Thomas Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE _____ DATE _____

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP 3019

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210020006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: with

2. USEPA/or/STATE WASTE CODE(S): D001

3 PROCESS GENERATING WASTE: Vehicle Refueling

4. PROJECTED ANNUAL VOLUME/UNITS: — / —

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☑ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☑ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☑ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Tan-
DENSITY: _____ BTU/LB: _____
TOTAL SOLIDS: <0.5% ASH CONTENT: _____
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☑ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☑ NON-WASTEWATER

☑ IGNITABLE (D001)
FLASH POINT (F) <60°
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Gasoline | 60-75% | |
| Diesel Fuel | 25-40% | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☑ YES ☐ NO

PROPER SHIPPING NAME: Waste Flammable Liquid N.O.S (Gas, Diesel)

HAZARD CLASS: 3 (U.N.) or N.A. NO. 1993

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☑ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 27 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☑ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 3/29/93

DRMS Form 1930

## PART III

### TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | _____ | ☐ HEXACHLOROBUTADIENE | D033 | _____ |
| ☐ BARIUM | D005 | _____ | ☐ HEXACHLOROETHANE | D034 | _____ |
| ☐ BENZENE | D018 | _____ | ☐ LEAD | D008 | _____ |
| ☐ CADMIUM | D018 | _____ | ☐ LINDANE | D013 | _____ |
| ☐ CARBON TETRACHLORIDE | D019 | _____ | ☐ MERCURY | D009 | _____ |
| ☐ CHLORDANE | D020 | _____ | ☐ METHOXYCHLOR | D014 | _____ |
| ☐ CHLOROBENZENE | D021 | _____ | ☐ METHYL ETHYL KETONE | D035 | _____ |
| ☐ CHLOROFORM | D022 | _____ | ☐ NITROBENZENE | D036 | _____ |
| ☐ CHROMIUM | D077 | _____ | ☐ PENTRACHLOROPHENOL | D037 | _____ |
| ☐ O-CRESOL | D023 | _____ | ☐ PYRIDINE | D038 | _____ |
| ☐ M-CRESOL | D024 | _____ | ☐ SELENIUM | D010 | _____ |
| ☐ CRESOL | D026 | _____ | ☐ SILVER | D011 | _____ |
| ☐ 2,4-O | O016 | _____ | ☐ TETRACHLOROETHYLENE | D039 | _____ |
| ☐ 1,4-DICHLOROBENZENE | D027 | _____ | ☐ TOXOPHENE | D015 | _____ |
| ☐ 1,2-DICHLOROETHENE | D028 | _____ | ☐ TRICHLOROETHYLENE | D040 | _____ |
| ☐ 1,1-DICHLOROETHYLENE | D029 | _____ | ☐ 2,4,5-TRICHLOROPHENOL | D041 | _____ |
| ☐ 2,4-DINITROTOLUENE | D030 | _____ | ☐ 2,4,6-TRICHLOROPHENOL | D042 | _____ |
| ☐ ENDRIN | O012 | _____ | ☐ 2,45-TP (SILVEX) | D017 | _____ |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | _____ | ☐ VINYL CHLORIDE | D043 | _____ |
| ☐ HEXACHLOROBENZENE | D032 | _____ | | | |

## FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

EP TOXICITY _____

_____

TCLP _____

_____

WESTON 3 Boxes

# HAZARDOUS WASTE PROFILE SHEET

## PART I

INFORMATION

WASTE PROFILE NO. HWAP3021

.RATOR NAME: chorne Army Ammunition Plant

ACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Aluminum powder

2. USEPA/or/STATE WASTE CODE(S): D003

3 PROCESS GENERATING WASTE: over age

4. PROJECTED ANNUAL VOLUME/UNITS: — / —  5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☑ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☑ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☑ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Gray

DENSITY _____ BTU/LB _____

TOTAL SOLIDS _____ ASH CONTENT _____

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☑ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☑ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☑ REACTIVE (D003)
☑ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

***NOTE:** EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Aluminum pow | 7.95 % | |
| | | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☑ YES ☐ NO

PROPER SHIPPING NAME: Aluminum Powder, uncoated

HAZARD CLASS: 4.3  (U.N. or N.A. NO.) 1396

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☑ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4  PAGE NO. 40  EDITION (YR) 90

SPECIAL HANDLING INFORMATION: Dangerous when wet

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☑ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

Thomas J. Erickson, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED OVER TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

*(Print or Type Name)*

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/29/93

N4186930880006

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAF3022

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Cleaning Compound

2. USEPA/or/STATE WASTE CODE(S): D001

3. PROCESS GENERATING WASTE: Office use

4. PROJECTED ANNUAL VOLUME/UNITS: — / —

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Pink-clear

DENSITY: 0.95 BTU/LB: _____

TOTAL SOLIDS: <1% ASH CONTENT: _____

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☒ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☒ IGNITABLE (D001)
FLASH POINT (F) 136°
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | n/a | PHENOLICS | n/a |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| N,N-Dimethyl Formamide | 96-97% | |
| | | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste N,N-Dimethyl Formamide

HAZARD CLASS: 3 (U.N. or N.A.) NO. 2265

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 26 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED OVER TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/29/93

DRMS Form 1938

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | _____ | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | _____ |
| ☐ BARIUM | D005 | _____ | ☐ HEXACHLOROETHANE | D034 | _____ |
| ☐ BENZENE | D018 | _____ | ☐ LEAD | D008 | _____ |
| ☐ CADMIUM | D006 | _____ | ☐ LINDANE | D013 | _____ |
| ☐ CARBON TETRACHLORIDE | D019 | _____ | ☐ MERCURY | D009 | _____ |
| ☐ CHLORDANE | D020 | _____ | ☐ METHOXYCHLOR | D014 | _____ |
| ☐ CHLOROBENZENE | D021 | _____ | ☐ METHYL ETHYL KETONE | D035 | _____ |
| ☐ CHLOROFORM | D022 | _____ | ☐ NITROBENZENE | D036 | _____ |
| ☐ CHROMIUM | D007 | _____ | ☐ PENTACHLOROPHENOL | D037 | _____ |
| ☐ O CRESOL | D023 | _____ | ☐ PYRIDINE | D038 | _____ |
| ☐ M-CRESOL | D024 | _____ | ☐ SELENIUM | D010 | _____ |
| ☐ P CRESOL | D025 | _____ | ☐ SILVER | D011 | _____ |
| ☐ CRESOL | D026 | _____ | ☐ TETRACHLOROETHYLENE | D039 | _____ |
| ☐ 2,4-D | D016 | _____ | ☐ TOXOPHENE | D015 | _____ |
| ☐ 1,4 DICHLOROBENZENE | D027 | _____ | ☐ TRICHLOROETHYLENE | D040 | _____ |
| ☐ 1,2-DICHLOROETHANE | D028 | _____ | ☐ 2,4,5-TRICHLOROPHENOL | D041 | _____ |
| ☐ 1,1-DICHLOROETHYLENE | D029 | _____ | ☐ 2,4,6-TRICHLOROPHENOL | D042 | _____ |
| ☐ 2,4-DINITROTOLUENE | D030 | _____ | ☐ 2,4,5-TP (SILVEX) | D017 | _____ |
| ☐ ENDRIN | D012 | _____ | ☐ VINYL CHLORIDE | D043 | _____ |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | _____ | | | |
| ☐ HEXACHLOROBENZENE | D032 | _____ | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

3. _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

4. REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

5. _____

NA1867320220007

# HAZARDOUS WASTE PROFILE SHEET

## PART I

.L INFORMATION

WASTE PROFILE NO. HWAP3023

NERATOR NAME

wthorne Army Ammunition Plant

FACILITY ADDRESS

P.O. Box 15

Hawthorne, Nevada

5. ZIP CODE 89415

3. GENERATOR USEPA ID NV1210090006

4. GENERATOR STATE ID N/A

6. TECHNICAL CONTACT Tom Erickson

7. TITLE Environmental Sp'lst

PHONE (702) 945-7587

B. 1. NAME OF WASTE DEGREASER

2. USEPA/or/STATE WASTE CODE(S) F001

3 PROCESS GENERATING WASTE OVERAGE

4. PROJECTED ANNUAL VOLUME/UNITS 1000 / LB 5. MODE OF COLLECTION Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☑ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☑ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☑ NO REFERENCE STANDARDS

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR clear

DENSITY 1.3 BTU/LB

TOTAL SOLIDS <1% ASH CONTENT

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☑ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☑ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☑ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F)
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

COPPER N/A PHENOLICS N/A
NICKEL TOTAL HALOGENS
ZINC VOLATILE ORGANICS
CHROMIUM-HEX PCBs
(OTHER)

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| 1,1,1 Trichloroethane | 95% | |
| | | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☑ YES ☐ NO

PROPER SHIPPING NAME 1,1,1-Trichloroethane

HAZARD CLASS 6.1 U.N. or N.A. NO. 2831

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☑ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 74 EDITION (YR) 92

SPECIAL HANDLING INFORMATION

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☑ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas Frederick, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.
*(Print or Type Name)*

SIGNATURE OF GENERATOR'S REPRESENTATIVE

DATE 3/29/93

DRMS Form 1930

W65W3N30880008

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAp3025

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Acetone

2. USEPA/or/STATE WASTE CODE(S): D001, U002

3. PROCESS GENERATING WASTE: overage

4. PROJECTED ANNUAL VOLUME/UNITS: 1000 / LB

5. MODE OF COLLECTION: Cal

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO

HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO

DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: clear

DENSITY: 0.79 BTU/LB:

TOTAL SOLIDS: 0% ASH CONTENT:

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☒ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☒ IGNITABLE (D001) FLASH POINT (F): 4°
- ☐ HIGH TOC (> 10%)
- ☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
- ☐ WATER REACTIVE
- ☐ CYANIDE REACTIVE
- ☐ SULFIDE REACTIVE

☐ CORROSIVE (D002) pH:
- ☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Acetone | 100 % | |
| | | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Acetone

HAZARD CLASS: 3 U.N. or N.A. NO.: 1090

ADDITIONAL DESCRIPTION:

METHOD OF SHIPMENT: ☐ BULK ☐ DRUM ☒ OTHER: Cal

CERCLA REPORTABLE QUANTITY (RQ):

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 26 EDITION (YR) 90

SPECIAL HANDLING INFORMATION:

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE:

DATE: 3/29/93

# ...OUS WASTE PROFILE SHEET

## PART I

**GENERATOR INFORMATION**

WASTE PROFILE NO. HWAD 3024

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Paint, Thinner, Alcohol

2. USEPA/or/STATE WASTE CODE(S): D001, D008

3. PROCESS GENERATING WASTE: Ammunition Maintenance

4. PROJECTED ANNUAL VOLUME/UNITS: 3000 / LB 5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Green

DENSITY: _____ BTU/LB: _____

TOTAL SOLIDS: 5% ASH CONTENT: _____

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☒ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☒ IGNITABLE (D001)
FLASH POINT (F) < 50°
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Paint | 40-50 % | |
| Thinner | 40-50 % | |
| Alcohol | 5-10 % | |
| Paint sludge | 1-5 % | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Paint Related Material

HAZARD CLASS: 3 (U.N. or N.A. NO.) 1263

ADDITIONAL DESCRIPTION: _____

METHOD OF SHIPMENT: ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ): _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 26 EDITION (YR) 90

SPECIAL HANDLING INFORMATION: _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas Erickson

DATE: 3/29/93

DRMS Form 1930

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 5 - 50 mg |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

## FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

W6549430890001

# HAZARDOUS WASTE PROFILE SHEET

## PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. HWAP3026

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Stencil Inks

2. USEPA/or/STATE WASTE CODE(S): D001, D008

3. PROCESS GENERATING WASTE: OVERHAUL

4. PROJECTED ANNUAL VOLUME/UNITS: 1000 / LB

5. MODE OF COLLECTION: DR

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☑ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☑ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☑ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☑ NO REFERENCE STANDARDS

## PART II

1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Various
DENSITY: 1.02 - 1.4 BTU/LB
TOTAL SOLIDS: 1-5% ASH CONTENT
LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☑ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☑ NON-WASTEWATER

☑ IGNITABLE (D001)
FLASH POINT (F): 126
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☑ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

3. CHEMICAL COMPOSITION (ppm or mg/L)

COPPER: N/A
NICKEL
ZINC
CHROMIUM-HEX
(OTHER)
PHENOLICS: N/A
TOTAL HALOGENS
VOLATILE ORGANICS
PCBs

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| D: Acetone Alcohol | 40-70% | |
| D: propylene Glycol | 0-5% | |
| D: ethylene Glycol | 0-5% | |
| D: ethylene glycol Ethyl Ether | 0-15% | |
| | | |
| | | |
| TOTAL | 100% | |

5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☑ YES ☐ NO

PROPER SHIPPING NAME

HAZARD CLASS: 3 U.N. or N.A. NO.: 1210

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☑ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 26 EDITION (YR) 90

SPECIAL HANDLING INFORMATION

6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION
☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☑ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson (Print or Type Name), HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: Thomas J. Erickson

DATE: 3/30/93

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (m |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☑ LEAD | D008 | 0-20 |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,45-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

W6SW9N308900002

# HAZARDOUS WASTE PROFILE SHEET

## PART I

GENERAL INFORMATION

WASTE PROFILE NO. HWAP 3027

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Paint Solids and Rags

2. USEPA/or/STATE WASTE CODE(S): D007, D008

3. PROCESS GENERATING WASTE: Painting operations

4. PROJECTED ANNUAL VOLUME/UNITS: 1020 / LB

5. MODE OF COLLECTION: DR

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Various

DENSITY: _____ BTU/LB: _____

TOTAL SOLIDS: 100% ASH CONTENT: _____

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☒ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☐ IGNITABLE (D001)
FLASH POINT (F) _____
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Paint Solids | 30-50% | |
| Rags w/paint | 15-30% | |
| Cans | 10-20% | |
| Lead | 0-2% | |
| Chromium | 0-2% | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous waste S.L.P. N.O.S.

HAZARD CLASS: 9 U.N. or (N.A.) NO. 3077

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 96

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/30/93

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☑ LEAD | D008 | 5.0 - 50.0 |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☑ CHROMIUM | D007 | 1.0 - 20.0 | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | O030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

W65n.

# HAZARDOUS WASTE PROFILE SHEET

## PART I

GENERAL INFORMATION

WASTE PROFILE NO. HWAP3028

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

8. 1. NAME OF WASTE: Various Adhesives

2. USEPA/or/STATE WASTE CODE(S): D001

3. PROCESS GENERATING WASTE: Overage

4. PROJECTED ANNUAL VOLUME/UNITS: 1000 / lb

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS _____

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Clear-tan

DENSITY _____ BTU/LB _____

TOTAL SOLIDS _____ ASH CONTENT _____

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☒ IGNITABLE (D001)
FLASH POINT (F) <100°
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH _____
☐ CORRODES STEEL

☐ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| MEK | 25-30 % | |
| Alcohol | 25-30 | |
| Toluene | 20-30 | |
| Polyamide Resin | 20-30 | |
| N-Butyl Acetate | 5-10 | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Flammable Liquid N.O.S.

HAZARD CLASS: 3

U.N. or N.A. NO.: 1993

ADDITIONAL DESCRIPTION _____

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER: _____

CERCLA REPORTABLE QUANTITY (RQ) _____

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 27 EDITION (YR) 90

SPECIAL HANDLING INFORMATION _____

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson (Print or Type Name), HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/3/93

DRMS Form 1930

W65W9N30900005

# HAZARDOUS WASTE PROFILE SHEET

## PART I

GENERAL INFORMATION

WASTE PROFILE NO. HWAP3030

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne, Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environmental Sp'lst

PHONE: (702) 945-7587

B. 1. NAME OF WASTE: Paint

2. USEPA/or/STATE WASTE CODE(S): D001, D008

3. PROCESS GENERATING WASTE: over paint

4. PROJECTED ANNUAL VOLUME/UNITS: 5000 / yr

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Green

DENSITY: BTU/LB:

TOTAL SOLIDS: <0.5% ASH CONTENT:

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☐ NON-WASTEWATER

☒ IGNITABLE (D001)
FLASH POINT (F) <50°
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

| | | | |
|---|---|---|---|
| COPPER | N/A | PHENOLICS | N/A |
| NICKEL | | TOTAL HALOGENS | |
| ZINC | | VOLATILE ORGANICS | |
| CHROMIUM-HEX | | PCBs | |
| (OTHER) | | | |

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| UMED Naphtha | 15-30 % | |
| Iso butyl Alcohol | 5-10 % | |
| Iso butyl Acetate | 5-10 % | |
| Naptha | 0-10% | |
| Toluene | 0-10% | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Paint

HAZARD CLASS: 3 (U.N.) or N.A. NO.: 1263

ADDITIONAL DESCRIPTION:

METHOD OF SHIPMENT: ☐ BULK ☒ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ):

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 27 EDITION (YR) 86

SPECIAL HANDLING INFORMATION:

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION:

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☒ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: [signature]

DATE: 3/3/93

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☑ LEAD | D008 | 7.5.0 |
| ☐ CADMIUM | D006 | | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O-CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,4,5-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

H41269 3020004

# HAZARDOUS WASTE PROFILE SHEET

## PART I

AL INFORMATION

WASTE PROFILE NO. HWAP3031

GENERATOR NAME

Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS
P.O. Box 15
Hawthorne, Nevada
5. ZIP CODE 89415

3. GENERATOR USEPA ID NV1210090006

4. GENERATOR STATE ID N/A

6. TECHNICAL CONTACT Tom Erickson

7. TITLE Environmental Sp'lst

PHONE (702) 945-7587

B. 1. NAME OF WASTE Paint Solids / Solvent

2. USEPA/or/STATE WASTE CODE(S) D001, D006, D007, D008, D009

3. PROCESS GENERATING WASTE Painting operation

4. PROJECTED ANNUAL VOLUME/UNITS 500 / LB 5. MODE OF COLLECTION Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

### 1. MATERIAL CHARACTERIZATION
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR Green-brown
DENSITY BTU/LB
TOTAL SOLIDS 80% ASH CONTENT
LAYERING: ☒ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

### 2. RCRA CHARACTERISTICS

PHYSICAL STATE: ☒ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☒ IGNITABLE (D001)
FLASH POINT (F) 86°
☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ REACTIVE (D003)
☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC *(SEE REVERSE FOR LISTING)*

### 3. CHEMICAL COMPOSITION (ppm or mg/L)

COPPER n/a
NICKEL
ZINC
CHROMIUM-HEX
(OTHER)

PHENOLICS n/a
TOTAL HALOGENS
VOLATILE ORGANICS
PCBs

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

### 4. MATERIAL COMPOSITION

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Paint Solids | 60-80% | |
| Thinner | 10-20% | |
| Alcohol | 10-20% | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

### 5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME Waste Paint Related Material

HAZARD CLASS 3 U.N. or N.A. NO. 1263

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 27 EDITION (YR) 90

SPECIAL HANDLING INFORMATION

### 6. GENERATOR CERTIFICATION

BASIS FOR INFORMATION

☐ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*

☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE [signature]

DATE 3/9/88

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☑ LEAD | D008 | 5.0-25.0 |
| ☑ CADMIUM | D006 | 1.0-3.0 | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☑ MERCURY | D009 | 0-0.25 |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☑ CHROMIUM | D007 | 5-40.0 | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4 DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,45-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

VERIFIED _____

☐ ATTACHED

_____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY _____ CYANIDES _____ SULFIDES _____

N41868230700001

# HAZARDOUS WASTE PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP 2046

1. GENERATOR NAME: Hawthorne Army Ammunition Plant

2. FACILITY ADDRESS: P.O. Box 15, Hawthorne Nevada

5. ZIP CODE: 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: Tom Erickson

7. TITLE: Environ Specialist

PHONE: (702) 945-7581

B. 1. NAME OF WASTE: Glass Beads with metals

2. USEPA/or/STATE WASTE CODE(S): D006, D008

3. PROCESS GENERATING WASTE: Bead Blasting

4. PROJECTED ANNUAL VOLUME/UNITS: 3 / drums

5. MODE OF COLLECTION: drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO REFERENCE STANDARDS

## PART II

**1. MATERIAL CHARACTERIZATION**
*(OPTIONAL-NOT REQUIRED DATA)*

COLOR: Dirty white

DENSITY: 2.42 - 2.49 BTU/LB: —

TOTAL SOLIDS: 100% ASH CONTENT:

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

**2. RCRA CHARACTERISTICS**

PHYSICAL STATE: ☒ SOLID ☐ LIQUID ☐ SEMI-SOLID ☐ GAS ☐ OTHER

TREATMENT GROUP: ☐ WASTEWATER ☒ NON-WASTEWATER

☐ HIGH TOC (> 10%)
☐ LOW TOC (< 10%)

☐ WATER REACTIVE
☐ CYANIDE REACTIVE
☐ SULFIDE REACTIVE

☐ CORROSIVE (D002)
pH
☐ CORRODES STEEL

☒ TOXICITY CHARACTERISTIC
*(SEE REVERSE FOR LISTING)*

**3. CHEMICAL COMPOSITION (ppm or mg/L)**

COPPER: N/A
NICKEL:
ZINC:
CHROMIUM-HEX:
(OTHER):

PHENOLICS: N/A
TOTAL HALOGENS:
VOLATILE ORGANICS:
PCBs:

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Glass beads | > 99.0% | |
| Cadmium | < 1% | |
| Lead | < 1% | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Hazardous Waste Solid N.O.S. (Glass beads w/metals)

HAZARD CLASS: 9 U.N. or (N.A.) NO. 3077

ADDITIONAL DESCRIPTION:

METHOD OF SHIPMENT: ☐ BULK ☒ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ):

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 90

SPECIAL HANDLING INFORMATION

**6. GENERATOR CERTIFICATION**

BASIS FOR INFORMATION
☒ CHEMICAL ANALYSIS *(ATTACH TEST RESULTS)*
☐ USER KNOWLEDGE *(ATTACH SUPPORTING DOCUMENTS - Explain how and why these documents comply with RCRA requirements)*

I, Thomas J. Erickson *(Print or Type Name)*, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS TO THE BEST OF MY KNOWLEDGE AN ACCURATE REPRESENTATION OF THE WASTE TURNED IN TO THE DRMO. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE: T. Erickson

DATE: [illegible]

DRMS Form 1930

## TOXICITY CHARACTERISTIC LIST

EFFECTIVE 25 SEP 90 - LARGE QUANTITY GENERATORS
29 MAR 91 - SMALL QUANTITY GENERATORS

| CONTAMINANT | EPA HW No. | (mg/L) | CONTAMINANT | EPA HW No. | (mg/L) |
|---|---|---|---|---|---|
| ☐ ARSENIC | D004 | | ☐ HEXACHLORO-1,3,-BUTADIENE | D033 | |
| ☐ BARIUM | D005 | | ☐ HEXACHLOROETHANE | D034 | |
| ☐ BENZENE | D018 | | ☒ LEAD | D008 | 8.35 |
| ☒ CADMIUM | D006 | 74.1 | ☐ LINDANE | D013 | |
| ☐ CARBON TETRACHLORIDE | D019 | | ☐ MERCURY | D009 | |
| ☐ CHLORDANE | D020 | | ☐ METHOXYCHLOR | D014 | |
| ☐ CHLOROBENZENE | D021 | | ☐ METHYL ETHYL KETONE | D035 | |
| ☐ CHLOROFORM | D022 | | ☐ NITROBENZENE | D036 | |
| ☐ CHROMIUM | D007 | | ☐ PENTACHLOROPHENOL | D037 | |
| ☐ O CRESOL | D023 | | ☐ PYRIDINE | D038 | |
| ☐ M-CRESOL | D024 | | ☐ SELENIUM | D010 | |
| ☐ P-CRESOL | D025 | | ☐ SILVER | D011 | |
| ☐ CRESOL | D026 | | ☐ TETRACHLOROETHYLENE | D039 | |
| ☐ 2,4-D | D016 | | ☐ TOXOPHENE | D015 | |
| ☐ 1,4-DICHLOROBENZENE | D027 | | ☐ TRICHLOROETHYLENE | D040 | |
| ☐ 1,2-DICHLOROETHANE | D028 | | ☐ 2,4,5-TRICHLOROPHENOL | D041 | |
| ☐ 1,1-DICHLOROETHYLENE | D029 | | ☐ 2,4,6-TRICHLOROPHENOL | D042 | |
| ☐ 2,4-DINITROTOLUENE | D030 | | ☐ 2,45-TP (SILVEX) | D017 | |
| ☐ ENDRIN | D012 | | ☐ VINYL CHLORIDE | D043 | |
| ☐ HEPTACHLOR (AND ITS HYDROXIDE) | D031 | | | | |
| ☐ HEXACHLOROBENZENE | D032 | | | | |

## PART III

### FOR DRMO USE ONLY

### DRMO VERIFICATION

1. DATE VERIFIED _____

2. RESULTS ☐ *ATTACHED*

pH _____ FLASH POINT _____ SPECIFIC GRAVITY _____ HALIDES (TOX) _____

REACTIVITY: WATER REACTIVITY _____ CYANIDES _____ SULFIDES _____

TCLP _____

NA1869307832 91

# WASTE MATERIAL PROFILE SHEET

## PART I

**A. GENERAL INFORMATION**

WASTE PROFILE NO. HWAP 3032.

1. GENERATOR NAME: HAWTHORNE ARMY AMMUNITION PLANT

2. FACILITY ADDRESS: U.S. ROUTE 95 NORTH
P.O. BOX 15
HAWTHORNE, NV
5. ZIP CODE 89415

3. GENERATOR USEPA ID: NV1210090006

4. GENERATOR STATE ID: N/A

6. TECHNICAL CONTACT: TOM ERICKSON

7. TITLE: Environmental Specialist

PHONE: (702) 945-7287

B. 1. NAME OF WASTE: Light machine oil

2. USEPA/or/STATE I.D. NO.(S): Non-RCRA

3. PROCESS GENERATING WASTE: Minor material Breakdown

4. PROJECTED ANNUAL VOLUME/UNITS: — / —

5. MODE OF COLLECTION: Drum

6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F0226, F027, OR F028)? ☐ YES ☒ NO

7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? ☒ YES ☐ NO
HAS AN EXEMPTION BEEN GRANTED? ☐ YES ☒ NO
DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? ☐ YES ☒ NO

## PART II

**1. MATERIAL CHARACTERIZATION**

PHYSICAL STATE: ☐ SOLID ☒ LIQUID ☐ SEMI-SOLID ☐ OTHER

ODOR: ☐ NONE ☐ HIGH ☐ STRONG

DESCRIPTION

COLOR: clear

DENSITY: 0.97

FLASH POINT (F): 260°F

BTU/LB

ASH CONTENT

TOTAL SOLIDS: <1%

pH

LAYERING: ☐ MULTILAYERED ☐ BILAYERED ☐ SINGLE PHASE

**2. CHEMICAL COMPOSITION**

HEAVY METALS ☐ TOTAL (ppm) ☐ EXTRACTION (mg/L)

| | | | | | |
|---|---|---|---|---|---|
| ARSENIC | N/A | MERCURY | N/A | ZINC | N/A |
| BARIUM | | SELENIUM | | CHROMIUM-HEX | |
| CADMIUM | | SILVER | | (OTHER) | |
| CHROMIUM | | COPPER | | | |
| LEAD | | NICKEL | | | |
| (OTHER) | | (OTHER) | | | |

OTHER COMPONENTS (PPM)

| | | | |
|---|---|---|---|
| CYANIDES | N/A | VOLATILE ORGANICS | N/A |
| SULFIDES | | TOTAL HALOGENS | |
| PCBS | | PHENOLICS | |
| (OTHER) | | | |

**3. HAZARDOUS CHARACTERISTICS**

☐ REACTIVE ☐ PYROPHORIC ☐ SHOCK SENSITIVE
☐ EXPLOSIVE ☐ WATER REACTIVE ☐ RADIOACTIVE
☐ ETIOLOGICAL ☐ NONE OF THE ABOVE
☐ TOXICITY CHARACTERISTIC (SEE REVERSE FOR LISTING)
☐ OTHER

*NOTE: EXPLOSIVES, SHOCK SENSITIVE, PYROPHORIC, RADIOACTIVE, AND ETIOLOGICAL WASTE NORMALLY ARE NOT ACCEPTED BY THE DRMO.*

**4. MATERIAL COMPOSITION**

| COMPONENT | CONCENTRATION | RANGE |
|---|---|---|
| Light machine oil | 100% | |
| | | |
| | | |
| | | |
| | | |
| | | |
| TOTAL | 100% | |

**5. SHIPPING INFORMATION**

DOT HAZARDOUS MATERIAL? ☒ YES ☐ NO

PROPER SHIPPING NAME: Waste Environmentally Hazardous Substance, liquid N.O.S.

HAZARD CLASS: 9

U.N. or N.A. NO. 3082

ADDITIONAL DESCRIPTION

METHOD OF SHIPMENT ☐ BULK ☒ DRUM ☐ OTHER:

CERCLA REPORTABLE QUANTITY (RQ)

EMERGENCY RESPONSE GUIDE PAGE

DOT PUBLICATION 5800.4 PAGE NO. 31 EDITION (YR) 80

SPECIAL HANDLING INFORMATION

**6. GENERATOR CERTIFICATION**

I, Thomas J. Erickson, HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS COMPLETE AND ACCURATE. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE: [signature]

DATE: 1/-/92

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX L

# Appendix L

## Chemical and Physical Analysis Results for Ash

# HAZARDOUS WASTE DETERMINATION

| REQUESTED BY | DIRECTORATE/DIVISION | TELEPHONE NO. |
|---|---|---|
| Tom Erickson | Environmental | 7587 |
| TE | PROJECT/ITEM | SAMPLE NO./LAB REPORT NO. |
| July 29, 1992 | Ash - TCLP Metals | 2209006 |

| QUANTITY SUBMITTED | SAMPLE TAKEN BY/DATE TAKEN |
|---|---|
| Approx. 200g/sample | T. Erickson 7-29-92 |

SAMPLE INFORMATION (APPERARENCE, SOURCE):

Sample is ash from propellant burn at Old Bomb. Sample is currently at 106-22. Test sample for the presence and concentration of TCLP Metals.

RESULTS

| CHARACTERISTIC | RESULTS OF TESTS | SAMPLE RESULT | DETECTION LIMIT | MAXIMUM ALLOWABLE CONCENTRATION |
|---|---|---|---|---|
| NITABILITY: | N/A | | | |
| CORROSIVITY: | N/A | | | |
| REACTIVITY: GAP TEST INTERNAL IGNITION | N/A | | | |
| EXTRACTION PROCEDURE TOXICITY: | | | | |
| ARSENIC | Negative | 0.0275mg/L | 0.001mg/L | 5.0mg/L |
| BARIUM | Negative | Not Detected | 0.1mg/L | 100.0mg/L |
| CADMIUM | Negative | 0.15mg/L | 0.005mg/L | 1.0mg/L |
| CHROMIUM | Negative | Not Detected | 0.05mg/L | 5.0mg/L |
| LEAD | Positive | 57.0mg/L | 0.1mg/L | 5.0mg/L |
| MERCURY | Negative | Not Detected | 0.0002mg/L | 0.2mg/L |
| SELENIUM | Negative | Not Detected | 0.002mg/L | 1.0mg/L |
| SILVER | Negative | Not Detected | 0.01mg/L | 5.0mg/L |

| DATE | ANALYST |
|---|---|
| August 14, 1992 | Carolyn Krizenesky |

REQUEST FOR AND RESULTS OF TESTS

| AMPLE RECEIVED FROM (NAME) | DIRECTORATE/DIVISION | TELEPHONE NO. |
|---|---|---|
| Tom Erickson | Environmental | 7587 |
| ATE | PROJECT/ITEM | SAMPLE NO./LAB REPORT NO |
| July 29, 1992 | DNT - Ash | 2209006 |

| UANTITY SUBMITTED | MILITARY SPECIFICATIONS/DRAWING NO. |
|---|---|
| Approx. 200g/sample | N/A |

EMARKS/SPECIAL INSTRUCTIONS:

Sample is Ash from propellant burn at Old Bomb. Test sample for the presence and concentration of 2,4 DNT.

RESULTS

| ESTS PERFORMED | RESULTS OF TESTS | SAMPLE RESULT | REQUIREMENT |
|---|---|---|---|
| HPLC Analysis for the | presence and concentrat | ion of 2,4 DNT | |
| 2209006 | 2,4 DNT: Not Detected | ( Less than 0.05mg/kg ) | |

| DATE | ANALYST |
|---|---|
| August 18, 1992 | Carolyn Krizenesky Carolyn Krizenesky |

HWAAP 797

HAZARDOUS WASTE DETERMINATION
TOXICITY CHARACTERISTICS LEACHING PROCEDURE

| REQUESTED BY | DIRECTORATE/DIVISION | TELEPHONE NUMBER |
|---|---|---|
| Tom Erickson | Safety Office | 7587 |
| DATE | PROJECT/ITEM | SAMPLE NUMBER |
| July 18, 1992 | Ash/Residue - TCLP Metals | 9199001 |

| QUANTITY SUBMITTED | SAMPLED BY/DATE SAMPLED |
|---|---|
| Approx. 500g | Tom Erickson/07-18-89 |

SAMPLE INFORMATION (APPEARANCE, SOURCE):

Analyze sample of ash/residue for the TCLP metals. Sample was taken from trays at Old Bomb following the burning of 8"/55 smokeless powder.

RESULTS

| CHARACTERISTIC | RESULTS OF TESTS | SAMPLE RESULT | DETECTION LIMIT | MAX. ALLOWABLE CONCENTRATION |
|---|---|---|---|---|
| IGNITABILITY | Negative | Would Not Ignite | | |
| CORROSIVITY | N/A | | | |
| REACTIVITY: GAP TEST INTERNAL IGNITION | N/A | | | |
| (TCLP) | | | | |
| ARSENIC | Negative | 0.006mg/L | 0.001mg/L | 5.000mg/L |
| BARIUM | Negative | 2.8mg/L | 0.1mg/L | 100.0mg/L |
| CADMIUM | Negative | 0.400mg/L | 0.005mg/L | 1.000mg/L |
| CHROMIUM | Negative | Not Detected | 0.05mg/L | 5.00mg/L |
| LEAD | Negative | 1.5mg/L | 0.1mg/L | 5.0mg/L |
| MERCURY | Negative | 0.001mg/L | 0.0002mg/L | 0.2000mg/L |
| SELENIUM | Negative | Not Detected | 0.002mg/L | 1.000mg/L |
| SILVER | Negative | 0.10mg/L | 0.01mg/L | 5.00mg/L |
| PENTACHLOROPHENOL (PCP) | | | 0.0074mg/L | 100.000mg/L |

| DATE | ANALYST |
|---|---|
| July 28, 1989 | Jacqueline Mantravadi |

DZB-63-E

# HAZARDOUS WASTE DETERMINATION
## TOXICITY CHARACTERISTICS LEACHING PROCEDURE

| REQUESTED BY | DIRECTORATE/DIVISION | TELEPHONE NUMBER |
|---|---|---|
| Tom Erickson | Environmental | 7587 |
| **DATE** | **PROJECT/ITEM** | **SAMPLE NUMBER** |
| May 19, 1992 | TCLP Metals, DNT | 2140005 |

| QUANTITY SUBMITTED | SAMPLED BY/DATE SAMPLED |
|---|---|
| Approx. 200g/sample | Erickson 5-19-92 |

**SAMPLE INFORMATION (APPEARANCE, SOURCE):**

Sample is Ash/Residue from propellant burner pans at Old Bomb. Test sample for the presence and concentration of TCLP Metals. Sample is also to be tested for 2,4 DNT.

**RESULTS**

| CHARACTERISTIC | RESULTS OF TESTS | SAMPLE RESULT | DETECTION LIMIT | MAX. ALLOWABLE CONCENTRATION |
|---|---|---|---|---|
| IGNITABILITY | N/A | | | |
| CORROSIVITY | N/A | | | |
| REACTIVITY: GAP TEST INTERNAL IGNITION | N/A | | | |
| (TCLP) | | | | |
| ARSENIC | Negative | Not Detected | 0.001mg/L | 5.000mg/L |
| BARIUM | Negative | Not Detected | 0.1mg/L | 100.0mg/L |
| CADMIUM | Negative | 0.125mg/L | 0.005mg/L | 1.000mg/L |
| CHROMIUM | Negative | 0.08mg/L | 0.05mg/L | 5.00mg/L |
| LEAD | Positive | 600.0mg/L | 0.1mg/L | 5.0mg/L |
| MERCURY | Negative | Not Detected | 0.0002mg/L | 0.2000mg/L |
| SELENIUM | Negative | 0.05mg/L | 0.002mg/L | 1.000mg/L |
| SILVER | Negative | Not Detected | 0.01mg/L | 5.00mg/L |
| PENTACHLOROPHENOL (PCP) | N/A | | 0.0074mg/L | 100.000mg/L |

| DATE | ANALYST |
|---|---|
| June 8, 1992 | Carolyn Krizenesky |

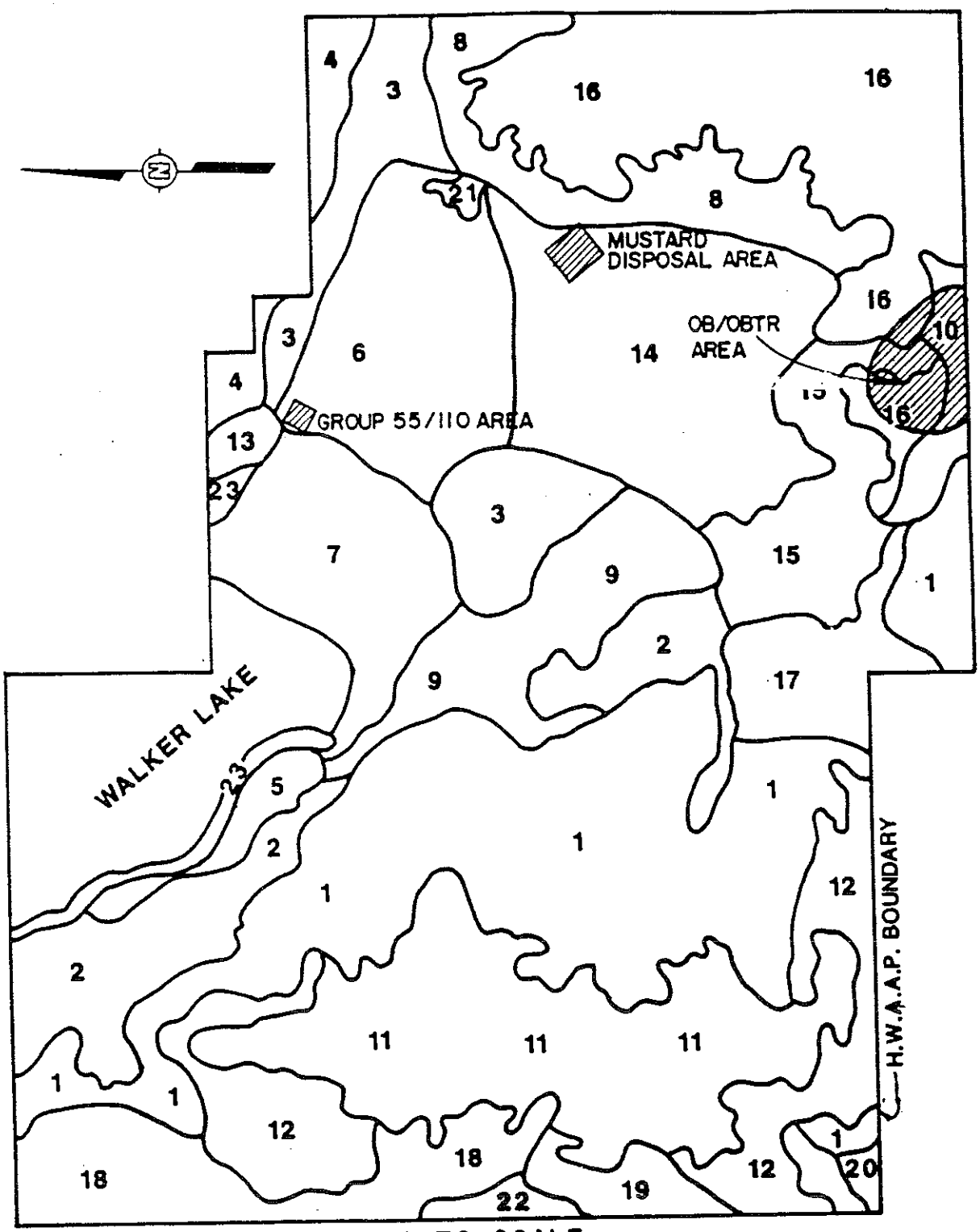
DZB-63-E

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX M

# Appendix M

## General Description of Soil




NOT TO SCALE

FIGURE 2-1

SURFACE SOILS

PREPARED FOR

ORDNANCE & ENVIRONMENTAL INVESTIGATION
HAWTHORNE ARMY AMMUNITION PLANT
HAWTHORNE, NEVADA

SEE TABLE 2-1 FOR SOIL DESCRIPTION AND CHARACTERISTICS

REFERENCE: INSTALLATION ASSESSMENT, NAVAL AMMUNITIONS DEPOT USATHAMA 1977

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IT ... Creating a Safer Tomorrow

| DRAW. BY | MJM | 12-1-88 |
|---|---|---|
| CHECKED BY | SAW | 12-1-88 |
| APPROVED BY | JRS | |

DRAWING NUMBER 190257

126076

TABLE 2-1

SOIL DESCRIPTIONS AND CHARACTERISTICS[1]

| MAP UNIT | DESCRIPTION | USCS CLASS | PHYSIOGRAPHY | COARSE FRAGMENTS SURFACE DENSITY, % | COARSE FRAGMENTS SUBSOIL, % BY VOLUME | PERME-ABILITY IN/HR | DEPTH TO HARDPAN OR BED-ROCK, IN | pH |
|---|---|---|---|---|---|---|---|---|
| 1 | Silty gravels, gravel-sand-clay mixture, silty sands, sand-silt mixture | GM-SM | Canyon, mountain slopes | 50-70 stones | 60 gravel, stones | <0.2 | 10-20 granite | 6.1-6.5 |
| 2 | Same as above | GM-SM | Mountain slopes | 50-80 gravel cobbles, stones | 50-80 gravel cobbles, stones | <0.2 | 8-12 granite | 6.6-7.3 |
| 3 | Silty sands, sand-silt mixture, poorly graded sands, gravelly sand, little or no fines | SM-SP | Alluvial fans and flood plains | <5 gravel | 20 gravel | >6.3 | >60 | 7.4-7.8 |
| 4 | Same as Unit 3 | SM-SP | Smooth alluvial fans and stream bottoms | <5 gravel | <20 gravel | >6.3 | >60 | 7.4-7.8 |
| 5 | Silty sands, sand-silt mixture, well graded sands, gravelly sands, little or no fines | SM-SW | Bars, spits, beaches alluvial fans | 10-15 gravel cobbles, stones | 50-70 gravel | >6.3 | >60 | 7.4-7.8 |
| 6 | Silty sand, sand-silt mixture | SM | Lake shoreline | <10 gravel | <10 gravel | <0.2 | 14-20 to tufa | 7.9-8.4 |
| 7 | Poorly graded sands, gravelly sand, little or no fines, silty sand, sand-silt mixture, inorganic clay | SP-SM, CH | Dunes, toe slope of alluvial fan | 0 to <1 gravel | 0 to <1 gravel | <0.2 | >60 | 7.9-8.4 |

TABLE 2-1

SOIL DESCRIPTIONS AND CHARACTERISTICS[1]
(CONTINUED)

| MAP UNIT | DESCRIPTION | USCS CLASS | PHYSIOGRAPHY | COARSE FRAGMENTS SURFACE DENSITY, % | COARSE FRAGMENTS SUBSOIL, % BY VOLUME | PERME-ABILITY IN/HR | DEPTH TO HARDPAN OR BED-ROCK, IN | pH |
|---|---|---|---|---|---|---|---|---|
| 8 | Silty gravel, gravel-sand-clay mixture, poorly graded mixture, gravel-sand mixture, little or no fines | GM-GP | Alluvial fan | 10-25 cobbles 25-50 gravel | 50-70 gravel | >6.3 | >60 | 6.6-7.8 |
| 9 | Same as Unit 3 | SM-SP | Alluvial fan | 2-10 cobbles | 30-50 gravel | >6.3 | >60 | 6.6-7.3 |
| 10 | Silty sand, sand-silt mixture, silty gravel, grave-sand-clay mixture | SM-GM | Alluvial fan | 30-50 gravel <5 cobbles | 35-50 gravel | 2.0-6.3 | >60 | 6.6-7.3 |
| 11 | Same as Unit 1 with inorganic silt and very fine sand and inorganic clays of high plasticity | GM-SM ML-CL | Mountain slopes, ravine and valley | 25-50 gravel cobbles, stone, ≤5 rock outcrop | 10-60 gravel with cobbles stone | 0.2-2.0 | 20-60 bedrock | 5.6-6.5 |
| 12 | Same as Unit 1 | GM-SM | Mountain slope | 25-50 gravel cobble, stone, ≤5 rock outcrop | 50-60 gravel cobble, stone | <0.2 | 20-36 bedrock | 5.6-6.0 |
| 13 | Poorly graded gravels, gravel-sand mixtures, little or no fines - silty gravels, gravel-sand-clay mixture | GP-GM | Toe slope of allvial fan | 15-30 gravel | 50-70 gravel | <0.2 | Weak cementation at 10-20 | 7.9-8.4 |
| 14 | Silty sand, sand-silt mixture, inorganic silt with very fine sand | SM-ML | Alluvial fan | <10 gravel | 20-40 gravel | 0.2-2.0 | >60 | 7.4-8.4 |

TABLE 2-1

SOIL DESCRIPTIONS AND CHARACTERISTICS[1]
(CONTINUED)

| MAP UNIT | DESCRIPTION | USCS CLASS | PHYSIOGRAPHY | COARSE FRAGMENTS SURFACE DENSITY, % | COARSE FRAGMENTS SUBSOIL, % BY VOLUME | PERME-ABILITY IN/HR | DEPTH TO HARDPAN OR BED-ROCK, IN | pH |
|---|---|---|---|---|---|---|---|---|
| 15 | Clayey sand, sand-clay mixture, inorganic clay of low to medium plasticity, gravelly and sandy clay | SC-CL | Alluvial fan | 2-10 cobbles 2-30 gravels | 20-30 gravel | <0.2 | >60 | 7.4-7.8 |
| 16 | Silty gravels, gravel-sand-clay mixture, clay gravel with gravel-sand-clay mixture | GM-GC | Dissected upland | 25-50 gravel, cobble, outcrop | 50-70 gravel, cobble | <0.2 | 20-36 | 7.9-8.4 |
| 17 | Silty gravel, gravel-sand-clay mixture | GM | Mountain slope | 30-50 gravel, rock | 50-60 gravel 10-20 cobble | <0.2 | 8-14 | 7.4-7.8 |
| 18 | Inorganic clay of low to medium plasticity with gravelly sandy, silty and lean clay, inorganic clay of high plasticity | CL-CH | Foothills and mountain slope | 25-50 cobble, stone, some outcrop | 20-40 gravel cobble | <0.2 | 15 bedrock | 6.6-7.3 |
| 19 | Same as Unit 18 | CL-CH | Foothills and mountain slope | 25-50 cobble stone | 20-40 gravel cobble | <0.2 | 30 bedrock | 6.6-7.3 |
| 20 | Clayey gravels, gravel-sand-clay mixture, inorganic clay of high plasticity | GC-CH | Foothills | 25-50 cobble stone | 20-40 gravel cobble | <0.2 | 15-30 bedrock | 6.6-7.8 |
| 21 | Same as Unit 18 | CL-CH | Depression | None | None | <0.2 | >60 | 7.9-9.0 |
| 22 | NA[2] | NA | NA | NA | NA | NA | NA | NA |
| 23 | NA[2] | NA | Shoreline | NA | NA | NA | NA | NA |

[1]Source USATHAMA, 1977

[2]No entry available

HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX N

# Appendix N

# MEPAS Technical Description and

# Modeling Parameters and Input/Output Files

# MEPAS TECHNICAL DESCRIPTION

PNL-7201
UC-602, 630

# SUPPLEMENTAL MATHEMATICAL FORMULATIONS:

# THE MULTIMEDIA ENVIRONMENTAL POLLUTANT ASSESSMENT SYSTEM (MEPAS)

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(a) $CH_2M$ Hill, Gainesville, Florida

# PREFACE

The Multimedia Environmental Pollutant Assessment System (MEPAS) is an integrated methodology used to assess relative health impacts from actual and potential releases of hazardous materials into the environment. MEPAS is an enhanced version of the Remedial Action Priority System (RAPS). Both RAPS and MEPAS were developed by the Pacific Northwest Laboratory (PNL)[a] for the U.S. Department of Energy's (DOE's) Office of Environment, Safety, and Health.

This document represents a supplement to the mathematical formulations of RAPS, as documented by Whelan et al. (1987)[b], and focuses on those formulations associated with the MEPAS enhancements. This document provides an overview of the MEPAS framework and detailed discussions of the enhancements by major component (i.e., groundwater, surface water and atmospheric transport and exposure assessment). RAPS components that are not affected by these enhancements are discussed in the RAPS formulation report.

This is one of nine reports documenting and analyzing MEPAS and its application to an environmental survey conducted of all DOE sites. Other documents include:

- Multimedia Environmental Pollutant Assessment System (MEPAS): Getting Started with MEPAS This report provides an introduction and overview of MEPAS for individuals just beginning to learn how to use the program. An expanded version of this report is contained in Section 3 of the User's Guide.

- Multimedia Environmental Pollutant Assessment System (MEPAS) Application and Guidance: Volume 1 - User's Guide. A description is given of the steps for making a MEPAS application.

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(a) Pacific Northwest Laboratory is operated by Battelle Memorial Institute for the U.S. Department of Energy under Contract DE-AC06-76RLO 1830.

(b) Whelan, G., D. L. Strenge, J. G. Droppo, Jr., B. L. Steelman, and J. W. Buck. 1987. The Remedial Action Priority System (RAPS): Mathematical Formulations. DOE/RL/87-09, PNL-6200, Pacific Northwest Laboratory, Richland, Washington.

- Multimedia Environmental Pollutant Assessment System (MEPAS) Application and Guidance: Volume 2 - Guidelines for Evaluating MEPAS Input Parameters. This volume contains detailed instructions on how to define values for each input parameter along with copies of parameter input worksheets.

- Remedial Action Priority System (RAPS): Mathematical Formulations. Details of the mathematical formulations and algorithms used as the basic framework for the RAPS (and subsequently, MEPAS) methodology.

- Preliminary Summary Report of the Defense Production Facilities presents the results of a preliminary application of MEPAS to ranking environmental problems at 16 of DOE's defense waste facilities.

- Chemical Data Bases for the Multimedia Environmental Pollutant Assessment System (MEPAS): Version 1. The MEPAS methodology uses a constituent data base containing values for physical, chemical, and exposure computation. This document lists these data values along with each source.

The following documents are currently in preparation:

- Multimedia Environmental Pollutant Assessment System (MEPAS) Programmer's Guide. This guide will contain details of 1) program structure, 2) parameter definition and usage, 3) input and output file usage, and 4) information needed for program modification.

- Analysis of the Hazard Potential Index (HPI) for Ranking DOE's Environmental Problems. This document will address issues that pertain to the DOE environmental survey process and the MEPAS methodology application to ranking DOE environmental problems.

- Sensitivity Analysis of the MEPAS Model. This document will provide information on the input parameters that influence the MEPAS output parameters.

A complete bibliography is included at the end of this report.

## ABSTRACT

The Multimedia Environmental Pollutant Assessment System (MEPAS) is a methodology for assessing relative health impacts from the release of hazardous chemical and radioactive materials. MEPAS is an enhanced version of the Remedial Action Priority System (RAPS). This document, a supplement to the RAPS documentation, contains an overview of MEPAS followed by detailed discussions of enhancements.

MEPAS provides outputs of health impact parameters for use in ranking and screening applications. Environmental contaminant concentrations are used to estimate potential health impacts based on major exposure pathways. These concentrations may be input directly or computed by MEPAS components. When needed, MEPAS provides a set of mathematical algorithms to predict the potential contaminant migration from a site to receptors. Groundwater, overland, surface water, and atmospheric pathway components simulate multimedia contaminant transport and dispersion.

MEPAS has been implemented on a personal computer. A MEPAS shell has been developed that guides the user in problem definition, data collection and entry, data review and documentation, and applications.

Enhancements to the groundwater, surface water, overland, atmospheric, and exposure components are documented. These enhancements include a revision in the integration method for the waterborne pathway, a wetland component, a gaseous emission (volatilization) component, an atmospheric complex terrain component, mass budget formulations, and environmental decay of chemical constituents. Several new exposure components are described along with enhancements to the exposure pathways computations.

## SUMMARY

The Multimedia Environmental Pollutant Assessment System (MEPAS) provides an integrated methodology of assessing relative health impacts from actual and potential releases of hazardous materials into the environment. In 1987, Pacific Northwest Laboratory (PNL) developed the Remedial Action Priority System (RAPS) for the U.S. Department of Energy's Office of Environment, Safety, and Health (DOE-ESH). Since that time, PNL has been developing an enhanced version of RAPS for application in the U.S. Department of Energy's (DOE) Environmental Survey effort. This version is referred to as MEPAS. MEPAS represents an environmental management tool that may be used to assess hazardous and radioactive environmental releases based on health impacts in a scientific and objective manner making optimal use of available site information. MEPAS provides DOE-ESH with a management tool for assistance in prioritizing environmental issues associated with wastes from both operating facilities and inactive waste sites.

This document represents a supplement to, and an update of, the mathematical formulation of RAPS, as documented by Whelan et al. (1987).[a] Only those formulations associated with enhanced features to the RAPS methodology (hence, MEPAS) are documented in this report. These enhancements include the following:

- algorithms to address mass-conservation within waterborne, airborne, and exposure components
- back-calculating components and techniques for site-specific calibrations using measured environmental constituent concentrations
- steady-state groundwater component
- wetlands environment
- complex-terrain model for the atmospheric component


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(a) Whelan, G., D. L. Strenge, J. G. Droppo, Jr., B. L. Steelman, and J. W. Buck. 1987. The Remedial Action Priority System (RAPS): Mathematical Formulations, DOE/RL/87-09, PNL-6200, Pacific Northwest Laboratory, Richland, Washington.

- use of measured contaminant concentrations in the surface water, groundwater, and atmospheric pathways directly in an health impact analysis (no transport modeling required)
- new exposure pathway components
- additional health impact output products
- new algorithms to enhance the efficiency and accuracy of the methodology.

MEPAS is implemented on a personal computer with a data base management program (shell) that helps in 1) problem definition, 2) data collection and entry, 3) data review and documentation, and 4) running transport and exposure scenarios.

MEPAS uses empirically, analytically, and numerically integrated analytical solution based mathematical algorithms to predict the potential for contaminant migration from a site to receptors of concern using pathways analyses. Four major pathways of contaminant migration are considered in MEPAS: groundwater, overland, surface water, and atmospheric. Simplified exposure assessments are performed for important receptors using contaminant concentrations simulated by the transport components of the code. The health impacts associated with the site can then be calculated relative to the risks of other sites for each pathway and for all pathways together.

MEPAS considers 1) specific site information and constituent characteristics associated with the transport pathways; 2) both chemical and radioactive wastes; 3) the potential direction of contaminant movement; 4) contaminant mobility and persistence, where applicable; 5) population distributions; 6) various routes of exposure (e.g., inhalation, ingestion, and external exposure); 7) contaminant toxicities; 8) duration of exposure of the surrounding population; and 9) contaminant arrival time to sensitive receptors.

Under the guidance of DOE-ESH, PNL conducted a program to review, analyze, test, and document major aspects of MEPAS. This report represents one product of this program. Other activities include:

- Independent Peer Review - The methodology and mathematical formulations for RAPS have been independently peer reviewed by appropriate experts in the private and public sectors.

- Independent Public Review - MEPAS will undergo a public review by DOE in the Environmental Survey effort.

- Demonstration of the Methodology - The various components of MEPAS have been implemented at actual sites where contaminant levels have been monitored in the environment. The monitored contaminant levels were then compared to simulated contaminant levels associated with the application of MEPAS to these sites. The purpose of the comparison was to demonstrate the applicability of MEPAS to a variety of hazardous waste sites or releases of contaminants into the environment.

- Sensitivity Analysis - A sensitivity analysis has been conducted to determine the effects of 1) specific input parameters, 2) initial and boundary conditions, 3) distributions of input parameters, and 4) interrelationships that exist among input parameters on model response over short and long time frames.

- Ranking Applications Analysis - MEPAS was applied at 16 DOE defense production facilities in a test of the system. The results of this ranking were reported in a preliminary summary report (DOE 1988). These results, supplemented with additional MEPAS analyses, are being used to study implications and uncertainties in various ranking procedures.

- Documentation - Documentation represents a key feature of this program. Key documentation will include the following:

  - complete description of MEPAS mathematical formulations

  - documentation of the sensitivity and ranking applications studies

  - a compilation of the MEPAS data base with source references

  - user manual, that include detailed application instructions with definitions and sources of all required input parameters

  - guidelines for implementing MEPAS.

Any future modifications to MEPAS will be documented in addenda and appropriately distributed.

# 1.0 INTRODUCTION

In recent years, there has been increased concern about potential impacts from the release of contaminants into the environment from a variety of sources. The potential dangers these releases present to humans and the environment is of utmost concern. To protect public health, the federal government enacted legislation to establish effluent and environmental standards controlling toxic pollutants and to help restore and/or maintain the chemical, physical, and biological integrity of the nation's natural resources.

With the passage of the Resource Conservation and Recovery Act (RCRA) of 1976; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980; Superfund Amendments Reauthorization Act (SARA) of 1986; and Hazardous and Solid Waste Amendments (HSWA) of 1984, Congress has mandated a much closer scrutiny of the management of hazardous wastes and of the restoration of contaminated disposal sites. Legislative language, regulatory intent, and prudent judgment call for the use of health impact assessment techniques to aid in the decision-making process. The development and application of an objective, scientifically based methodology for these assessments represents a useful assessment tool.

## 1.1 OBJECTIVE OF REPORT

The objective of this report is to document and explain mathematical supplemental formulations for the Multimedia Environmental Pollutant Assessment System (MEPAS). MEPAS was developed as an assessment methodology to allow prioritization of all identified hazardous and radioactive releases from DOE sites according to potential health impacts. This methodology was designed to make optimal use of available information and to provide a relative assessment of the health effects resulting from possible releases.

Releases of chemical, radioactive, or mixed wastes into the environment can occur through a number of pathways. After contaminants are released into the environment, they may undergo complex processes of transport,

degradation/decay, transformation, biological uptake, and intermedia transfer between atmospheric, overland, subsurface (groundwater), and surface water environments.

Within MEPAS, computer-based models are used to simulate the various environmental transport pathways and routes of human exposure. Employing mathematical codes to describe specific site and constituent characteristics minimizes the subjectivity of the assessment. However, to address all of the types of environmental release conditions that exist at the early stages of problem investigation the MEPAS assessment must be composed of computer codes that are not overly complex and/or based on unreasonably onerous data requirements. As a result, screening-level codes best fit the required level of detail.

MEPAS is composed of computer codes that are empirically, analytically, and numerically integrated analytical solution based. The contaminant transport and exposure components simulate contaminant migration (i.e., movement of the contaminant in the environment) and fate (i.e., form and location of the contaminant in the environment) through various environmental media and exposure, as well as health effects associated with exposures to the surrounding populations.

The MEPAS formulations were developed to provide a realistic simulation of environmental transport and exposure. A typical MEPAS analysis will encompass a number of engineering and scientific disciplines--each with its own measure of conservatism and realism. The approach taken in the development of MEPAS is to adopt the current practices for making assessments from each appropriate discipline.

## 1.2 APPLICATION LIMITATIONS

No modeling methodology can be expected to be applicable to all situations. MEPAS is no exception to this rule. The methodology described in this document is designed for use as a risk-based ranking/screening tool. Only in situations in which sufficient data are available to reasonably define the potential environmental concentrations can MEPAS be used to estimate magnitudes of potential human health impacts.

Limitations occur in problem definition, data input values, and applicability of specific model components. Component limitations are discussed in Whelan et al. (1987) and in this volume. Independent evaluations of MEPAS' strengths and weaknesses have been conducted by EPA (1988b) and Morris and Meinhold (1988). Each application will require an assessment of the limitations specific to that application. For example, modeling caveats specific to the Environmental Survey application of MEPAS were listed in DOE 1988.

Although the time series of the exposures are considered as part of this evaluation, the effects of acute exposures are not currently addressed within MEPAS. This implementation of MEPAS is designed to provide a ranking of environmental problems based on projected human-health impacts from long-term exposures.

Applications of MEPAS should be limited to initial screening and comparative rankings of environmental problems. The simplified approaches used in MEPAS components were selected as appropriate for such analyses. Each component of MEPAS has limitations related to the use of simplified approaches as discussed in Whelan (1987) and in this document. For studying the details of a problem at a site, a site-specific approach will normally be required.

Detailed mass budgets are computed for each transport scenario, although by design MEPAS does not allocate mass between transport scenarios. This approach is taken 1) to allow for evaluation of multiple transport scenarios in the same media where mass depletion between scenarios is inappropriate (e.g., groundwater transport to a well and groundwater transport linked to surface water transport), and 2) to avoid having one transport scenario incorrectly depleting the mass potentially available for a transport scenario in a different media. An example of the latter would be an air emission computation based on leakage of a clay cap that could incorrectly eliminate the source term for significant groundwater contamination.

All computer codes, no matter how complex, represent simplifications of real-world conditions. Complex codes are usually developed to address detailed mechanistic phenomena, hence, a large number of input parameters are required. Simplified codes handle less detailed phenomena of real-world

conditions by combining many of these aspects into fewer parameters; therefore, it is difficult to ensure the absolute accuracy of results at all sites under all conditions.

The uncertainties in the MEPAS outputs need to be understood. The U.S. Environmental Protection Agency (EPA) (1988a) provides an introductory discussion of the uncertainty connected with exposure assessment processes. Input uncertainty, modeling uncertainty, and scenario uncertainty are discussed along with approaches for dealing with uncertainty associated with exposure assessment uncertainty. In addition, uncertainties related to the human health response to these exposures need to be addressed.

The degrees of uncertainty will vary with the MEPAS component used, how well these components simulate the site conditions, and the accuracy of inputs. Uncertainty will need to be addressed for each application. Variations occur in the degree of characterization of the environmental problems; applications may vary from being well characterized to having little site-specific information. The level of uncertainty will generally increase as similarity in sites being compared decreases. The least uncertainty in the sorting of problems can be expected for comparisons of similar problems and constituents at a single site. Comparisons of different types of problems, types of constituents, and/or sites can be expected to increase the uncertainty in the comparisons.

As a result, there is no simple method of quantifying the absolute uncertainty for MEPAS applications associated with the sorting of sites into those that are potentially most hazardous relative to other sites. Given inherent uncertainties in all applications, MEPAS is expected to have at least an order of magnitude of uncertainty in performing most sorting operations.

## 1.3 STRUCTURE OF THE REPORT

This document is a supplement to, and an update of, the mathematical formulation of RAPS, as documented by Whelan et al. (1987). Only those formulations associated with enhanced features to the methodology (hence, MEPAS) are documented here.

Chapter 2.0 provides a review of the original RAPS framework which is also the framework of MEPAS. To emphasize the connection between RAPS and MEPAS, the framework is referred to as the RAPS/MEPAS framework in this chapter. The subsequent chapters provide details on the enhanced RAPS, or MEPAS, which is referred to as MEPAS.

A description of the data management component of MEPAS as implemented on a personal computer is given in Section 3.0. The data management component, the MEPAS shell, was developed to automate problem definition, data entry, error checking, and model execution operations. This shell also provides products that help with data collection, review, and documentation.

Sections 4.0, 5.0, 6.0, and 7.0 address the enhancements in the groundwater, surface water, atmospheric, and exposure components, respectively. These enhancements include the following:

- steady-state groundwater component
- wetlands environment
- complex-terrain model for the atmospheric component
- algorithms to address mass-conservation within waterborne, airborne, and exposure components
- back-calculating components and techniques for site-specific calibrations using measured environmental constituent concentrations
- use of measured contaminant concentrations in the surface water, groundwater, and atmospheric pathways directly in health impact analysis (no transport modeling required)
- new exposure pathway components
- additional health impact output products
- new algorithms to enhance the efficiency and accuracy of the methodology.

The appendix contains a listing of errata for the original RAPS formulation document (Whelan et al. 1987). This listing is provided as a supplement to the RAPS framework definition. Note that most of these items have been corrected in recent printings of this document; this listing is provided for users with uncorrected versions.

## 1.4 REFERENCES


Morris, S. C., and A. F. Meinhold. 1988. Report of Technical Support for the Hazardous Waste Remedial Action Program on Health and Environmental Risks of Inactive Hazardous Waste Sites. BNL-42339, Brookhaven National Laboratory, Long Island, New York.

U.S. Department of Energy. 1988. Environmental Survey Preliminary Summary Report of the defense Production Facilities. DOE/EH-0072, U.S. Department of Energy, Environment, Safety and Health, Office of Environmental Audit, Washington, D.C.

U.S. Environmental Protection Agency. 1988a. Superfund Exposure Assessment Manual. OSWER Directive 9285.5-1, Office of Remedial Response, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency. 1988b. Analysis of Alternatives to the Superfund Hazard Ranking System. Prepared by Industrial Economics, Incorporated, Cambridge, Massachusetts.

Whelan, G., D. L. Strenge, J. G. Droppo, Jr., B. L. Steelman, and J. W. Buck. 1987. The Remedial Action Priority System (RAPS): Mathematical Formulations. DOE/RL/87-09, PNL-6200, Pacific Northwest Laboratory, Richland, Washington.

# 2.0 REVIEW OF RAPS/MEPAS FRAMEWORK

MEPAS is an enhancement of the Remedial Action Priority System (RAPS). Both the MEPAS and RAPS methodologies address contaminant release, migration, fate, exposure, and risk through and among four major environmental transport pathways (i.e., groundwater, overland, surface water, and atmospheric). These four transport and exposure components are illustrated in Figure 2.1, the RAPS/MEPAS framework. The mathematical formulations underlying RAPS are included in Whelan et al. (1987). This section provides a brief review of the original structure of RAPS, which forms the framework for MEPAS, while providing an overview of the MEPAS approach.

For contaminants that decay, the parent contaminants are initially treated as conservative substances (i.e., no decay products or degradation). Upon reaching the environmental receptor, radiological decay is corrected in a separate calculation, and the code subsequently computes the temporal distribution of each decay product. The Bateman equation is then used to calculate the concentrations of all important decay products in the chain (Bateman 1910, as reported by Codell et al. 1982). The approach for analyzing each of the pathways considered in RAPS/MEPAS is briefly discussed below.

## 2.1 GROUNDWATER TRANSPORT PATHWAY

The MEPAS groundwater pathway component simulates the transport and dispersion in the environment. The MEPAS implementation allows the definition of the release rate (source term) into the groundwater by several methods. The user may input the release rate, or have the model compute the release rate. Surface and subsurface (including direct groundwater injection) inputs of release rates are allowed.

The definition of the leachate, or the water that carries the contaminants through the subsurface environment, is a critical part of the groundwater transport component. The quantity of leachate likely to be generated during the operational lifetime of a facility, and beyond, is a major factor controlling the degree to which a site will require analysis. The site leachate quantity is controlled by local meteorologic, geologic, and

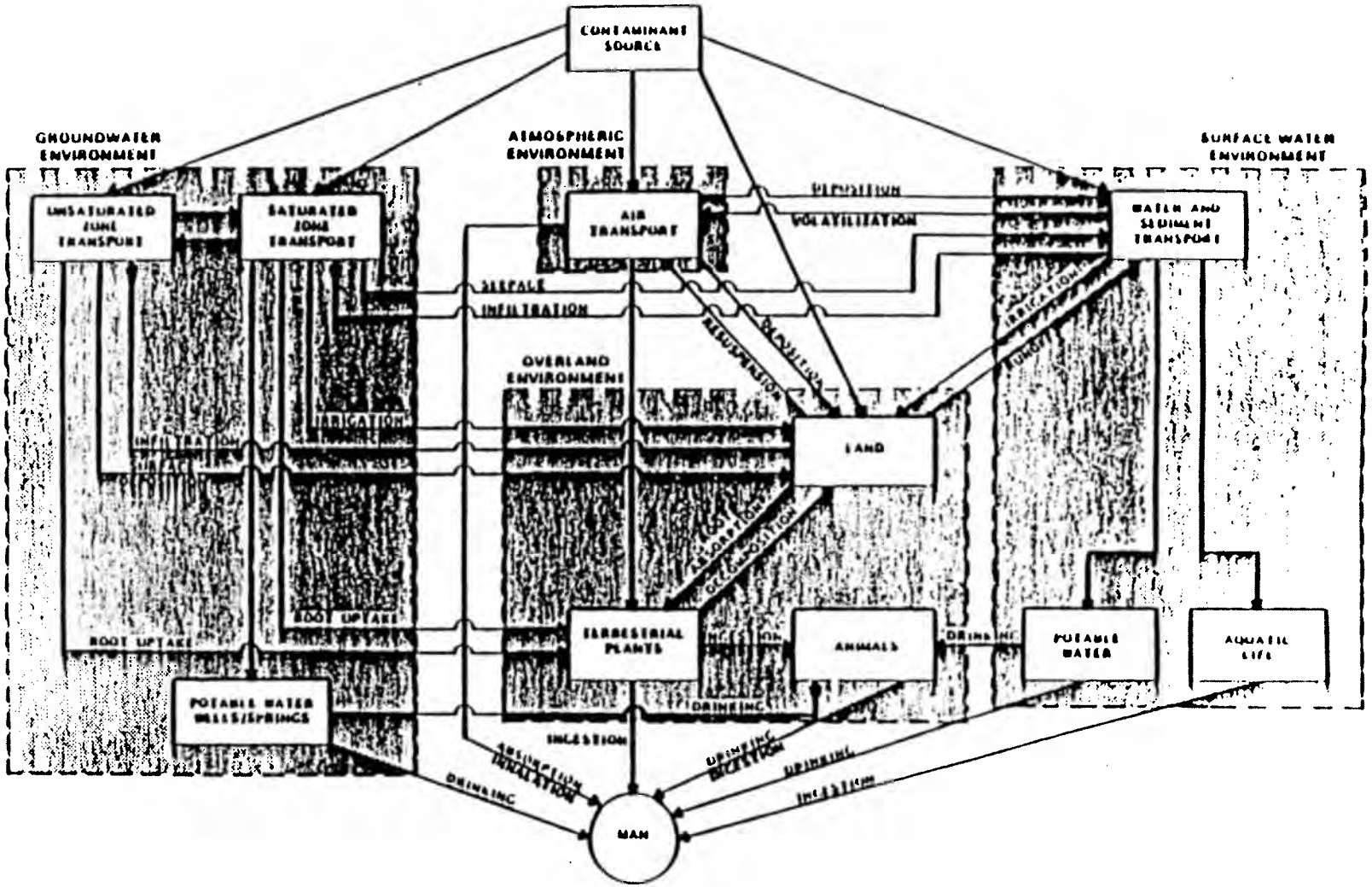


FIGURE 2.1. Schematic Diagram Illustrating the Interactions Between the Various Contaminant Transporting Media and How the Contaminants Affect Humans Through Their Environment (After Whelan et al. 1983)

hydrologic conditions and the design and operation of the facility. Given the limited availability of literature data on leachate quantities generated by landfills, available estimation techniques are used to quantify the leachate.

A modified method of the one proposed by Thornthwaite and Mather (1955, 1957), Fenn et al. (1975), and Dass et al. (1977) is used for computing leachate quantities from landfills. The methodology is based on a water-budget analysis; it estimates the quantity of leachate produced at a given landfill site and involves a water-balance calculation, using monthly estimates of precipitation, potential evapotranspiration, temperature, and runoff. The principal source of moisture is precipitation (rainfall and snowfall) over the landfill site. Of the precipitation that falls on a landfill site, a portion runs off, via the overland flow pathway, some is lost to evapotranspiration, and the remainder percolates through the landfill. Water that percolates through the landfill eventually exits as leachate. Simpler methods have been proposed (e.g., Knight et al. 1980); however, these methods are not nearly as precise. More complex methods also have been proposed and developed (e.g., ICF 1984; Schroeder et al. 1984), but their complexity precludes their use in a preliminary ranking system scheme. A review of the mathematical algorithms that describe the technique for computing leachate quantities from landfills is provided by Whelan et al. (1987).

Contaminants exiting the bottom of a landfill migrate through a partially saturated or saturated groundwater zone. In the partially saturated zone, the model assumes that flow is in a vertical direction. The RAPS/MEPAS methodology uses a one-dimensional, unsteady, semianalytical code to simulate contaminant leaching and movement through the partially saturated zone. The solution algorithm to the advective-dispersive equation is based on homogeneous and isotropic soil parameters (see Van Genuchten and Alves 1982; Donigian et al. 1983). The moisture content is assumed to fluctuate between field capacity and saturation. The partially saturated soil beneath the release site is assumed to be at a unit potential hydraulic gradient. This assumption influences the estimation of leachate movement through the partially saturated zone. If the infiltration rate (leach rate) from the release site is less than the soil transmission rate (i.e., hydraulic

conductivity at saturation), the leachate moves through the soil at the infiltration rate (see the general equation for liquid flow in the partially saturated zone in Hanks and Ashcroft 1980; Hillel 1980). For an infiltration rate equal to or greater than the transmission rate, the leaching water is assumed to move at the transmission rate.

The predominant movement of the leachate in the saturated zone is in the direction of the groundwater flow. A three-dimensional advective-dispersive equation describes the migrating plume as it disperses and attenuates through the saturated aquifer. Advection represents the transport of solute caused by the mass motion of water, while dispersion represents solute transport by unaccounted variations in the fluid velocity and molecular motion. Dispersion is considered in the longitudinal, lateral, and vertical directions. Soil properties are assumed to be homogeneous, and the flow is assumed steady and only in the longitudinal direction.

Solutions for the advective-dispersive equations for the partially saturated and saturated zones have been formulated in terms of an instantaneous contaminant release (i.e., a pulse release). The RAPS/MEPAS methodology generalizes these solutions for application to arbitrary time-varying releases.

The RAPS/MEPAS groundwater component computes contaminant levels at wells and at the edge of streams, and calculates solute fluxes from the groundwater environment to the surface water environment. The solution algorithms are based on Green's functions and have been reported by several researchers (e.g., Yeh 1981; Codell et al. 1982; Van Genuchten and Alves 1982). Figure 2.1 illustrates the potential interactions between the groundwater pathway and the other environmental transport pathways addressed by the RAPS/MEPAS methodology. A review of the mathematical algorithms describing the groundwater pathway was presented by Whelan et al. (1987).

## 2.2 SURFACE WATER PATHWAY

Nontidal rivers, estuaries, freshwater and saltwater open water bodies, open coasts, wetlands, etc., represent many of the surface water components that could be included in the RAPS/MEPAS methodology. Of the many surface water components, RAPS/MEPAS is currently capable of addressing nontidal

rivers and wetlands. Freshwater open water bodies (e.g., lakes, reservoirs, and impoundments) have been integrated into the main body of the methodology. Nontidal rivers refer to freshwater bodies with unidirectional flow in definable channels. Because RAPS/MEPAS is compositely coupled, other surface water pathways can be added when necessary.

By assuming a continuous release, contaminant releases to the surface water environment in RAPS/MEPAS are relatively long term. Because transient solutions for contaminant migration and fate calculations are most applicable for batch and infrequent releases over relatively short periods of time (Codell et al. 1982), steady-state solutions to the advective-dispersive equation are most applicable. The three-dimensional, steady-state, vertically integrated mass balance equation for contaminant transport in a riverine environment (where longitudinal advection dominates longitudinal dispersion) forms the basis for the river water solution algorithm (Codell et al. 1982). Contaminants released into a river are transported through the system by the processes of advection and dispersion. Dispersion is considered in the longitudinal and lateral directions. A description of contaminant movement is based on steady, unidirectional flow in a straight, rectangular channel.

The freshwater open water body component addresses a wide variety of aquatic environments ranging from small ponds to natural lakes and man-made impoundments. No single simple model can adequately address the range of mixing processes and various contaminant sources and risks found in the various types of open water body environments. In RAPS/MEPAS, environmental complexity is handled using a suite of relatively simple algorithms that involve different boundary conditions and idealized solutions optimized for specific process assumptions. The selection process provides criteria to objectively evaluate available data and potential transport pathways. The general advective-dispersive equation with steady, unidirectional flow is used to describe contaminant transport in the open water body environment. The spatial effects of mixing processes for determining contaminant concentrations are utilized using several different open water body types, including 1) well-mixed case, 2) two-layer, horizontally well-mixed case, and

3) vertically well-mixed case with horizontal gradients in one dimension (i.e., well suited to long, narrow lakes and run-of-the-river impoundments). Time-dependent sources are modeled as a series of instantaneous releases into the environment. An open-water-body component has been developed, but the integration of this component was not complete at the time of preparation of this documentation. Figure 2.1 illustrates the potential interactions between the surface water pathway and the other environmental transport pathways addressed in RAPS/MEPAS. A review of the mathematical algorithms describing nontidal rivers is provided by Whelan et al. (1987) and Knight and Brown (1987).

Wetlands are transitional areas between uplands and aquatic habitats. They are characterized by plant communities that are adapted to life in saturated soil conditions. Wetlands have been classified by the U.S. Fish and Wildlife Service (Cowardin et al. 1979) based on life form, water regime, substrate type, and water chemistry. Although the original RAPS formulations did not include wetlands, the MEPAS does include wetlands (see Section 5.0).

## 2.3 OVERLAND TRANSPORT PATHWAY

The overland transport or flow is that portion of precipitation and snowmelt that ultimately appears as flowing water on the ground surface. Overland transport occurs primarily because of excess water after evapotranspiration and infiltration. The overland transport pathway component in MEPAS has two main functions.

The first function is to use the results from the overland transport in computing the leachate quantities. The overland component estimates the long-term, average monthly runoff volumes for use in the water-balance calculations for estimating leachate quantities that percolate into the groundwater. These calculations are based on monthly averaged local climatology data (precipitation, temperature, wind speed, cloudiness, and humidity).

The second function of the overland transport pathway component is to estimate the migration and fate of contaminated water and sediment that moves across contaminated surface soil (e.g., exposed landfills and deposition from atmospheric releases). The overland transport of contaminated water is based

on monthly average precipitation event and snowmelt, and the soil type characteristics. The sediment (soil loss) overland transport is based on site characteristics, such as slope of land, vegetation cover, land use, and soil erodibility factors and intense precipitation events from thunderstorms.

The water movement portion of the overland transport pathway is based on estimation techniques of the Department of Agriculture's Soil Conservation Service (SCS) curve number, as presented by SCS (1972, 1982), Kent (1973), USBR (1977), and Haun and Barfield (1978). The SCS curve number technique incorporates soil classification, soil cover, land use, hydrologic conditions for infiltration, location of site, antecedent moisture conditions, and potential maximum moisture retention. The driving mechanism is based on overland water flow estimated with local monthly precipitation and temperature data; the results are annual average contaminated water flow from the site.

The overland transport of contaminated sediment is estimated using the Universal Soil Loss Equation (USLE). The USLE is empirically derived from 10,000 plot-years of erosion field research data. The USLE considers 1) the erosive force and intensity of precipitation and runoff in a normal year, 2) the susceptibility of the soil particles to detach and be transported by precipitation and runoff, 3) the combined effects of slope length and gradient, and 4) the soil loss from lands under varying vegetation conditions (Goldman et al. 1986). The results from the sediment transport portion of the overland transport pathway is an average-annual contaminated sediment loss from the site.

The overland transport component does not link directly with the exposure component of the MEPAS methodology but links with the surface water transport component, which is then linked to the exposure component.

## 2.4 ATMOSPHERIC PATHWAY

Complex phenomena are associated with the migration and fate of contaminants released to the atmosphere (Cupitt 1980). The atmospheric component of the RAPS/MEPAS methodology considers release mechanisms and characteristics, dilution and transport, washout by cloud droplets and precipitation, and deposition on the underlying surface cover. The atmospheric pathway model

provides a realistic computation of these processes within the constraints using limited, readily available site information. The interaction and coupling between the atmospheric pathway and exposure assessment components of RAPS/MEPAS are illustrated in Figure 2.1. A review of the mathematical algorithms describing the atmospheric pathway is provided by Whelan et al. (1987).

The prediction of contaminant movement through the atmospheric pathway involves using codes that address atmospheric suspension/emission, transport, diffusion, and deposition. Input to the codes includes site-specific climatologic information such as wind direction, wind speed, and precipitation. Output from the models consists of average air and surface contaminant levels that are then used as input to the exposure assessment component. Contaminant transport is assumed to occur sufficiently fast that chemical transformations can be neglected.

The atmospheric pathway is modeled in a manner that maximizes the validity of comparisons between sites. The suspension/emission rates are based mainly on empirical relationships using site characteristics. The atmospheric transport and dispersion are computed in terms of sector-average values using Gaussian dispersion principles similar to that proposed by Busse and Zimmerman (1973) and examined by Culkowski (1984). Deposition is computed as the sum of outputs from empirical wet and dry deposition algorithms.

The relative importance of the atmospheric pathway between different sites is controlled by a combination of geographic and climatic influences. Distances, directions, winds, and atmospheric stability are controlling parameters. The dispersion relationships used in the atmospheric component depend on local site characteristics. Because the dispersion is a strong function of downwind distance from the source, the physical distances between the contaminant sites and population centers are of prime importance. The relative proximity of sites and population centers is important in terms of the local frequencies of wind directions, particularly in areas with topographic channeling of winds. The relative rates of atmospheric dilution between the sites are mainly a function of local wind speeds and atmospheric stability parameters.

The atmospheric pathway component computes contaminant levels as a function of the direction and distance that coincides with population centers surrounding the site. Inhalation represents the major route of exposure to contaminants via the atmospheric pathway. RAPS/MEPAS also considers the ingestion route of exposure through the food chain, from wet and dry deposition on vegetation, and subsequent ingestion of contaminated food materials derived from the soils. In addition, external dose can be addressed, though its effects are usually insignificant as compared to the inhalation exposure route.

## 2.5 EXPOSURE ASSESSMENT COMPONENT

The RAPS/MEPAS methodology is based on evaluation of long-term average environmental exposures resulting from the release of contaminants. The analyses are performed assuming no changes in current land use, groundwater, or surface water practices (such as remedial actions or population changes). The potential health exposure associated with the migration and fate of contaminants from a release site may continue for hundreds to thousands of years, particularly for the groundwater transport pathway. The exposure analysis component of RAPS/MEPAS is currently based on 70-year increments (i.e., approximately one human life span), with average concentrations being defined for each one.

The RAPS/MEPAS methodology makes an interpretation of the exposure values in terms of human health impacts. Potential health impacts for individuals and the total population exposed are estimated for all exposure pathways defined for the analysis. Health impact outputs are provided both with and without time discounting.

The individual health hazard index is referred to as the maximum individual index (MII), and the population health hazard index is referred to as the HPI. The health index values are based on one of three contaminant types under consideration: 1) radionuclides, 2) carcinogenic chemicals, and 3) noncarcinogenic chemicals. The health indices calculated for each contaminant type must be comparable. The RAPS/MEPAS analysis is based on a

risk level of $10^{-6}$(a) as the point of comparability between radiological exposure and exposure to chemical carcinogens. For noncarcinogenic chemicals the point of comparison is exposure at the reference dose level; exposure at the reference dose level is assumed to be equivalent to exposure to radiation and carcinogens at a risk level of $10^{-6}$.

Resulting contaminant concentrations from each of the four transport pathways are used in the exposure assessment component for each important waste site contaminant. The exposure assessment component considers potential exposure of the surrounding population through the following exposure routes: 1) external dermal contact to chemicals; 2) external dose from radiation; 3) inhalation of airborne contaminants; and 4) ingestion of contaminated drinking water, soil, crops, animal products, and aquatic foods. First, the important exposure routes and populations at risk are defined. Then, based on the air, water, and soil contaminant levels provided by the transport pathway analyses, an estimate is made of the average daily human exposure to each contaminant. Estimation of the daily exposure is based on simple multiplicative models describing the transfer of pollutants from air, water, or soil to humans.

One key feature of the exposure assessment component is the estimation of the average exposure. The exposure modes included in RAPS/MEPAS are as follows:

- drinking water ingestion - for groundwater, overland, and surface water transport pathways. Factors may be applied to the water concentration to account for purification of the water in a treatment plant.
- aquatic food ingestion (fish and invertebrates) - for overland, surface water, and groundwater transport pathways. Average daily intake is estimated using bioconcentration factors and average daily ingestion rates for aquatic foods.
- crops - for all transport pathways. Crops may be contaminated from irrigation with contaminated water or by direct deposition onto

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(a) EPA (1986) noted that guidance on response actions under CERCLA "requires that the analysis of cleanup alternatives include options in the $10^{-4}$ to $10^{-7}$ risk range with at least one alternative utilizing a $10^{-6}$ risk level ..." (EPA 1985a). A typical option of choice is a $10^{-6}$ risk level.

plants and soil. Two crop types are considered: leafy vegetables with the edible portion subject to direct deposition, and other crops such as root and pod vegetables and fruit. Crop concentrations are estimated using soil-to-plant transfer factors and air-to-edible-plant transfer factors. Average daily intake is estimated using average daily ingestion rates for vegetables and leafy vegetables.

- animal products - for all transport pathways. Contaminated animal products result from animal ingestion of contaminated water and contaminated feed. Feed contamination may occur from direct deposition onto feed crops or pasture from air or through use of contaminated irrigation water. Use of contaminated animal drinking water is only considered for the three water transport pathways (i.e., overland, groundwater, and surface water). The concentration of contaminant in animal meat and milk is estimated using animal-ingestion-to-animal-product transfer factors. Average daily intake for exposed individuals is estimated using average daily ingestion rates for meat and milk.

- water immersion (domestic bathing and swimming) - for groundwater and surface water transport pathways. Dermal contact (for chemicals) and radiation exposure are included for domestic bathing for both water transport pathways. Exposure from swimming in contaminated water is also considered for the surface water pathway. For chemicals, an equivalent daily intake amount is estimated based on dermal contact time and adsorption characteristics of the chemical pollutant. For radiation exposures, the dose from immersion in water is estimated using dose conversion factors. A contribution to the radiation dose may also be included for recreational boating and shoreline fishing.

- soil ingestion - for the atmospheric transport pathway. Contaminated soil is assumed to be ingested each day with the ingestion rate based on a lifetime average.

- inhalation - for the atmospheric transport pathway. The daily average intake is estimated using an average inhalation rate for the exposed population.

The exposure assessment portions of RAPS/MEPAS are based on models recommended by the U.S. Nuclear Regulatory Commission (NRC) (1977) that are similar to models used by other organizations involved in radiological exposure assessments. These models use current environmental conditions at a site that are assumed to remain unchanged indefinitely into the future. While changes are likely, they are also difficult to predict. Rather than make estimates of future changes (which would be very uncertain), the assumption of no change is made as a reasonable approach for determining

relative health hazards between sites. The human health impact assessment is based on exposures over a human lifetime, taken to be 70 years. During the 70-year period human intake and exposure patterns are assumed to be constant. This is consistent with use of EPA lifetime cancer potency factors and reference doses, and with the radiation dose evaluations (70-year exposure period).

The interaction and coupling between the exposure assessment component and the transport pathways of the RAPS/MEPAS methodology are illustrated in Figure 2.1. A review of the mathematical algorithms describing the exposure and health effects assessments is provided by Whelan et al. (1987).

## 2.6 SUMMARY

The RAPS/MEPAS methodology prioritizes potential environmental releases of hazardous materials in a scientific and objective manner. RAPS/MEPAS bases its approach on site and constituent (i.e., chemical and radionuclide) characteristics. RAPS/MEPAS makes use of available input data. It considers four major transport pathways for contaminant migration: groundwater, overland, surface water, and atmospheric. Each pathway is described by standard mathematical algorithms that provide a variety of output products describing environmental concentrations and potential health impacts. Ranking using MEPAS is based on a dimensionless parameter, the HPI, which reflects population-based potential health impacts. MEPAS also provides release, transport, and exposure alternative outputs for interpretation of these rankings. These potential impacts, based on HPIs or other MEPAS outputs, provide an objective basis for ranking environmental problems.

## 2.7 REFERENCES

Bateman, H. 1910. "The Solution of a System of Differential Equations Occurring in the Theory of Radioactive Transformations." Proc. Cambridge Phil. Soc. 16:423-427.

Busse, A. D., and J. Zimmerman. 1973. User's Guide for the Climatological Dispersion Model. EPA-RA-73-024, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

Codell, R. B., K. T. Key, and G. Whelan. 1982. A Collection of Mathematical Models for Dispersion in Surface Water and Ground Water. NUREG-0868, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C.

Cowardin, L. M., V. Carter, F. L. Golet, and E. T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS-79/31, U.S. Fish and Wildlife Service, Washington, D.C.

Culkowski, W. M. 1984. An Initial Review of Several Meteorological Models Suitable for Low-Level Waste Disposal Facilities. NUREG/CR-3838, U.S. Nuclear Regulatory Commission, Washington, D.C.

Cupitt, L. T. 1980. Fate of Toxic and Hazardous Materials in the Air Environment. EPA-600/3-80-084, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

Dass, P., G. R. Tamke, and C. M. Stoffel. 1977. "Leachate Production at Sanitary Landfills." J. Environ. Eng. Division. Proc. Am. Soc. Civil Eng. 103:EE6.

Donigian, A. S., Jr., T. Y. R. Lo, and E. W. Shanahan. 1983. Rapid Assessment of Potential Groundwater Contamination Under Emergency Response Conditions. Prepared by Anderson-Nichols and Co., Inc., for the U.S. Environmental Protection Agency, Athens, Georgia.

Eagleson, P. S. 1970. Dynamic Hydrology. McGraw-Hill, New York.

EPA (see U.S. Environmental Protection Agency).

Fenn, D. G., K. J. Hanley, and T. V. DeGeare. 1975. Use of the Water Balance Method for Predicting Leachate Generation from Solid Waste Disposal Sites. SW-168, U.S. Environmental Protection Agency, Washington, D.C.

Hanks, R. J., and L. Ashcroft. 1980. Applied Soil Physics. Springer-Verlag, New York.

Haun, C. F., and B. J. Barfield. 1978. Hydrology and Sedimentology of Surface Mined-Lands. University of Kentucky, Lexington, Kentucky.

Hillel, D. 1980. Fundamentals of Soil Physics. Academic Press, New York.

Hjelmfelt, A. T., Jr. 1976. Modeling of Soil Movement Across a Watershed. Completion Report for Project A-076-MO, University of Missouri, Missouri Water Resources Center, Columbia, Missouri.

ICF. 1984. The Risk-Cost Analysis Model: Phase III Report. Prepared by ICF Incorporated for the Office of Solid Waste, Economic Analysis Branch, U.S. Environmental Protection Agency, Washington, D.C.

Kent, K. M. 1973. A Method for Estimating Volume and Rate of Runoff in Small Watersheds. SCS-TP-149, U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

Knight, G., E. H. Rothfuss, and K. D. Yard. 1980. FGD Sludge Disposal Manual. 2nd ed. EPRI CS-1515, Electric Power Research Institute, Palo Alto, California.

Knight, R., and S. M. Brown. 1987. Wetland Pathway Model: Documentation Report and User's Manual. Prepared by CH2M Hill for Pacific Northwest Laboratory, Richland, Washington.

Schroeder, P. R., A. C. Gibson, and M. D. Smolen. 1984. The Hydrologic Evaluation of Landfill Performance (HELP) Model. U.S. Environmental Protection Agency, Cincinnati, Ohio.

Soil Conservation Service (SCS). 1972. "Hydrology Guide for Use in Watershed Planning." SCS National Engineering Handbook, Section 4, Hydrology, Supplement A. U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

Soil Conservation Service (SCS). 1982. SCS National Engineering Handbook, Section 4, Hydrology, 1982 Update. U.S. Department of Agriculture, Soil Conservation Service, Washington, D.C.

Thornthwaite, C. W., and J. R. Mather. 1955. "The Water Balance." In Publications in Climatology, Vol. VIII, No. 1. Drexel Institute of Technology, Laboratory of Climatology, Centerton, New Jersey.

Thornthwaite, C. W., and J. R. Mather. 1957. "Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance." In Publications in Climatology, Vol. X, No. 3. Drexel Institute of Technology, Laboratory of Climatology, Centerton, New Jersey.

U.S. Department of the Interior, Bureau of Reclamation (USBR). 1977. Design of Small Dams. Government Printing Office, Washington, D.C.

U.S. Environmental Protection Agency. 1985. Alternative Concentration Limit Guidance Based on Section 264.94b Criteria. Part I. Information Required in ACL Demonstrations. U.S. Environmental Protection Agency, Washington, D.C. (Draft).

U.S. Environmental Protection Agency. 1986. "Hazardous Waste Management Land Disposal Restrictions; Proposed Rule," Part III. U.S. Environmental Protection Agency, 40 CFR (260) Fed. Reg. 1601-1766 (January 14, 1986).

U.S. Environmental Protection Agency. 1988. Superfund Exposure Assessment Manual. OSWER Directive 9285.5-1, Office of Remedial Response, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency.

U.S. Nuclear Regulatory Commission. 1977. Calculation of Annual Doses to Man from Routine Releases of Reactor Effluent for the Purpose of Evaluating Compliance with 10 CRF Part 50, Appendix I. Regulatory Guide 1.109, U.S. Nuclear Regulatory Commission, Washington, D.C.

Van Genuchten, M. T., and W. J. Alves. 1982. Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation. Technical Bulletin No. 1661, U.S. Department of Agriculture, Washington, D.C.

Whelan, G. 1980. Distributed Model for Sediment Yield. Master's Thesis, Iowa Institute of Hydraulic Research, University of Iowa, Iowa City, Iowa.

Whelan, G., F. L. Thompson, and S. B. Yabusaki. 1983. Multimedia Contaminant Environment Exposure Assessment Methodology as Applied to Los Alamos, New Mexico. PNL-4546, Pacific Northwest Laboratory, Richland, Washington.

Whelan, G., D. L. Strenge, J. G. Droppo, Jr., and B. L. Steelman. 1987. Development of the Remedial Action Priority System (RAPS): Preliminary Mathematical Formulations. PNL-6200, prepared by Pacific Northwest Laboratory for the Office of Environment, Safety, and Health, U.S. Department of Energy, Washington, D.C.

Witinok, P. M. 1979. Distributed Watershed and Sedimentation Model. Master's Thesis, University of Iowa, Iowa City, Iowa.

Witinok, P. M., and G. Whelan. 1980. "Distributed Parameter Sedimentation Model." Proc. Iowa Acad. Sci. 87(3)103-111.

Yeh, G. T. 1981. AT123D: Analytical Transient One-, Two-, and Three-Dimensional Simulation of Waste Transport in the Aquifer System. Publications No. 1439, ORNL-5602, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

# 3.0 INTEGRATED MEPAS METHODOLOGY

A description of the MEPAS shell is included as part of the formulations. The MEPAS shell is the data management component of MEPAS that integrates the operation of all of MEPAS' components (Hoopes et al. 1988).

## 3.1 MEPAS STRUCTURE

Each transport pathway addressed by MEPAS has a set of components that simulate the migration and fate of contaminants. These transport pathway codes are systematically integrated with an exposure assessment component that considers the type, time, and duration of exposure and the location and size of the population exposed. Figure 2.1 presents a simplified diagram outlining the various pathways and their interactions as considered by MEPAS.

MEPAS makes use of two types of data sources. First, the investigator inputs site and regional data. These data will be used to define the source term, transport pathway, and exposure scenarios. Second, MEPAS accesses a constituent database that contains chemical, physical, environmental, exposure, and toxicity data for each constituent. The constituent data base is documented by Strenge and Peterson (1989).

To implement MEPAS for a site, the investigator designates how the environmental concentrations for the health impact computation are to be defined. The investigator is then prompted to supply site and constituent information. The exposure route to the population is integrated into the analysis, and the transport and exposure models are run to calculate the relative human health impact to the population.

## 3.2 OVERVIEW OF SHELL

The MEPAS methodology is implemented on a desktop computer. An interactive program, referred to as the MEPAS shell, was developed to allow efficient application of MEPAS at a large number of sites. The MEPAS shell automates problem definition, data entry, documentation, and exposure computations. It allows the user interactive problem definition, data entry, and

environmental pathway analysis. It also provides easy access and manipulation of site data and files for assessing potential health impacts from environmental releases of hazardous materials.

The implementation of the enhanced RAPS/MEPAS formulations contained in this report and Whelan et al. (1987) are designed to run as a unit without the MEPAS shell. However, the MEPAS shell greatly improves the ease and accuracy for making MEPAS applications by automating file creations, making range checks on inputs, and organizing data required for MEPAS analysis. Although the MEPAS shell is most useful for applications with a large number of cases for analysis, these quality control aspects of the shell increase its utility for assessments involving a small number of cases as well.

The MEPAS shell provides user-friendly operation of data entry, file creation, and case assessment codes. An IBM PC[a] (or 100% compatible) with 640K RAM, a 20-Mb hard disk, and a 132-column printer are required. A math co-processor is not required, but it will greatly improve model performance. The data capture and storage programs are written in compiled dBase III Plus. The MEPAS transport and exposure models are written in FORTRAN, and intermediate linkage programs are in 'C.' Installation requires approximately 1 Mb of disk space. This is a file-based application; all data are stored and exchanged between major components by file input/output.

Facility, Ranking Unit, and Release Unit are terms that have been implemented because of the nature of the application for which the shell was initially to be used. The terms Site and Waste Unit can be substituted wherever appropriate without changing the meaning.

Figure 3.1 depicts the main menu of the MEPAS shell. The menu options provide access to the following components:

- Constituent Library - The investigator can view the physical properties of radionuclides and chemicals used in the MEPAS model.
- Utility Routines - Various utilities allow the investigator to reindex data base files, define the printer, and set up a color monitor.

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(a) IBM PC is a registered trademark of International Business Machines Corporation, Boca Raton, Florida.

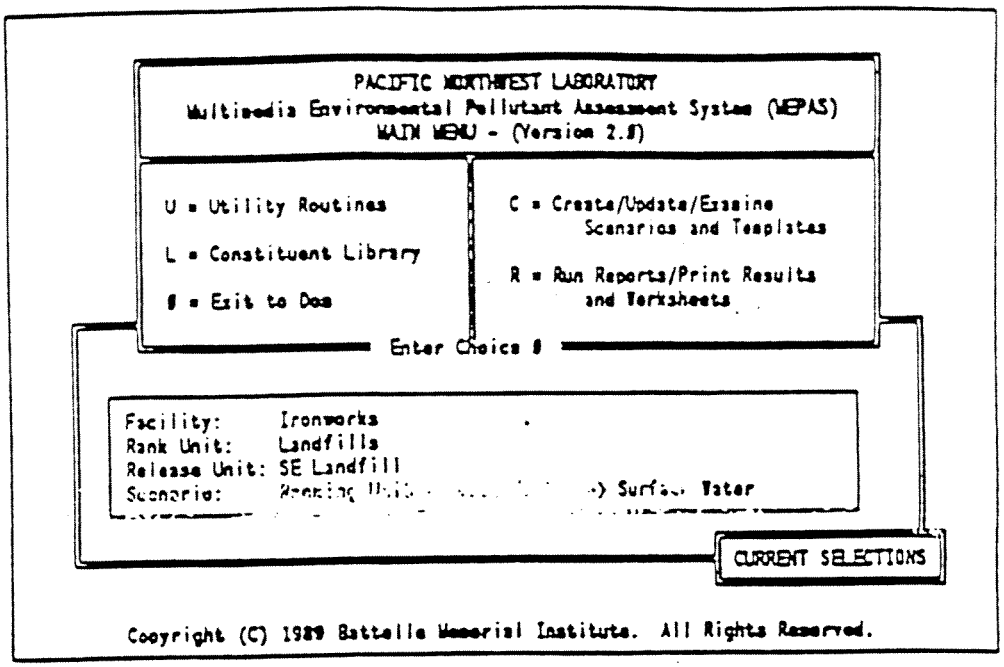


FIGURE 3.1. Main MEPAS Control Menu

- Create/Update/Examine - All data entry, edit, and review functions take place under this broad heading.
- Run/Print Reports/Worksheets - A submenu of this selection enables the investigator to specify run-time parameters, create run files, and invoke the MEPAS model. Similarly, all printing is done from this menu option, including generation of input data lists and intermediate and final reports.

For the purposes of this overview, we will describe only the Constituent Library, Create/Update/Examine, and Run/Print Reports/Worksheets components in further detail.

### 3.2.1 Constituent Library

From the main menu, the investigator has a view-only window to the constituent library. The view includes a tabular list of the properties of the constituent required by the exposure model. Properties of the constituents required by the model include 1) physical properties, such as vapor pressure, Henry's law constant, and molecular weight; 2) exposure data, such as reference dose, cancer potency factor, and bioaccumulation factor; and 3) typical

values for site data, such as $K_{ow}$, KOC, and $K_d$s. To maximize consistency in application, the investigator cannot alter the contents of this library.

### 3.2.2 File Creation/Update

Figure 3.2 shows the structure for definition of cases for analysis by MEPAS. File creation starts with the designation of the appropriate facility. This is followed by the designation of the environmental issue to be assessed. MEPAS refers to this issue as the Ranking Unit. A facility may have one or more environmental issues (Ranking Units). The environmental issues may in turn be composed of one or more releases into the environment (Release Units). Thus, MEPAS provides for multiple Release Units within a defined environmental issue. In defining each Release Unit, up to 20 constituents may be identified for assessment.

After Facility, Ranking Unit, Release Unit, and transport and exposure pathway data input is complete, the investigator can enter site data into the shell in preparation for analysis. The required site data have been grouped logically and formatted into templates that can be selectively edited and printed as worksheets.

The investigator is provided only the specific templates required to complete the scenario data in preparation for an analysis. This template

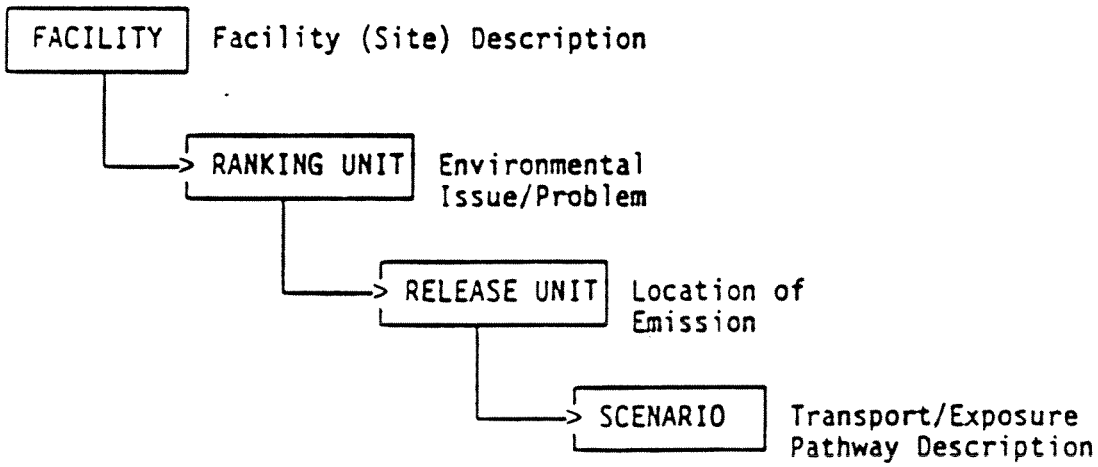


FIGURE 3.2. MEPAS Environmental Problem Configuration

selection algorithm is an important feature of the shell as the automatic determination of the required templates saves the investigator from locating unneeded data.

All data entered into the shell must be accompanied by appropriate references. Most template data have associated optional reference numbers. In situations where data source referencing is required, a reference system is included. These references can be added, modified, and searched by reference number. Reference lists can also be printed.

An example of a data worksheet is shown in Figure 3.3. A description of each required datum is provided on a line format. The first line of the screen (entitled "2.4 - partially saturated zone" in Figure 3.3) tells the user the section number and name of this worksheet. This corresponds to the section in the guidelines documentation where these data are fully described. Each line item includes the number of the item as it appears in the guidelines, the encoded parameter name, and unit of measure. In some cases, typical values may be enclosed in brackets, []. These values are provided

```
2.4  PARTIALLY SATURATED ZONE (PSZ)                 72  11/09/89  12:00:46
Facility: IRONWORKS
Ranking: LANDFILLS
Release : SE LANDFILL                                          RU010101
Scenario: Ranking Unit >Groundwater                               GW-T1
                              (Page 1 or 2)

PARTIALLY SATURATED ZONE (PSZ) - Layer 1 of 1              (Media = 13)

a.  Soil classification in the PSZ -- WP-CLASS:     Loamy sand
b.  % Sand in the PSZ -- WP-SAND:                     [ 4]  84 %  Ref: 2
c.  % Silt in the PSZ -- WP-SILT:                     [12]  12 %  Ref: 2
d.  % Clay in the PSZ -- WP-CLAY:                     [ 4]   4 %  Ref: 2
e.  % Organic matter content in the PSZ -- WP-OMC:          0.00 %  Ref: 2
f.  % Iron and aluminum in the PSZ -- WP-IRON:                0 %  Ref: 2
g.  pH of the pore water in the PSZ -- WP-PH:               7.0     Ref: 2

  Move cursor = ^X^Y,PGUP,PGDN.   Quit/Save - END.   Abort - ESC.
```

FIGURE 3.3. Data Template for MEPAS User-Friendly Shell

for informational use only. They allow the investigator to identify erroneous or nontypical input data. They also can be used as inputs if more site-specific data are not available.

An additional automatic range check is made by the MEPAS shell for entry of each input value. This range check is based on a model input range that has been defined for all input parameters. This range is a maximum credible range rather than a normal environmental range.

Other features are designed to minimize data input errors. These include allowing the investigator to copy environmental setting data (climatology, soil characteristics, and exposure locations) from an existing Facility or Ranking Unit (this is helpful for ranking units that are close to each other and have the same hydrogeology and atmospheric properties); and importing joint frequencies and population distribution data from external sources (this saves the investigator from having to input these large data matrices). The investigator exits a worksheet with the quit/save command, in which case the entered data is stored in the MEPAS data base.

### 3.2.3 Report Preparation

The investigator can 1) print the worksheets, 2) create data files for input to the MEPAS model, 3) invoke the model, and 4) print intermediate results from the model run.

#### 3.2.3.1 Printing the Worksheets

After the scenario configuration is complete, required worksheets can be printed. These printed worksheets have several functions. If printed early in the cycle, they can be used to assist in compiling the data before entering it into the shell. They can be printed at any time to reflect the current state of the data bases, and when the analysis is complete, they can accompany the analysis documentation for QA/QC. The contents of the reference list can also be printed from this option.

#### 3.2.3.2 Creating Data Files and Running MEPAS

The data set creation procedure retrieves the data required for a MEPAS analysis of the particular scenario(s) and structures the data in a format acceptable to the model. Any scenario for which all required templates are

complete can be included in an analysis. Each run configuration is called a data set, and the investigator provides a description and file ID for each data set. All of the MEPAS model intermediate files, results, and data sets will have this user-defined ID as a file name. Any data sets already created can be selected for rerun to incorporate changed data, and new data sets can be created. The configuration of a data set can be changed as desired, but will include a Facility, Ranking Unit, and up to 10 scenarios selected by the investigator.

#### 3.2.3.3 Invoking the Model

To run MEPAS, one or more data sets must be selected. When the selection is completed, the model will be invoked for each data set specified. As the model runs, each program name is echoed to the monitor as it is invoked, and in the major components, the progression through each scenario is echoed.

#### 3.2.3.4 Printing Results

Result and/or important intermediate files of the MEPAS model can be printed. The investigator first may select files for printing by data set or by file type. Intermediate files can be printed. If a run is not completed normally, or the results are in question, the intermediate files should help identify the reasons for the behavior.

## 3.4 REFERENCES

Hoopes, B. L., J. W. Buck, D. L. Friedrichs, and R. J. Aiken. 1988. "The Multimedia Environmental Pollutant Assessment System (MEPAS) User-Friendly Shell." In Proceedings of the DOE Model Conference, October 3-7, 1988, Oak Ridge, Tennessee.

Strenge, D. L., and S. R. Peterson. 1989. Chemical Databases as Applied to the U.S. Department of Energy Environmental Survey. PNL-7145, Pacific Northwest Laboratory, Richland, Washington.

Whelan, G., D. L. Strenge, J. G. Droppo, Jr., B. L. Steelman, and J. W. Buck. 1987. The Remedial Action Priority System (RAPS): Mathematical Formulations. DOE/RL/87-09, PNL-6200, Pacific Northwest Laboratory, Richland, Washington.

# MEPAS MODELING PARAMETERS AND INPUT/OUTPUT FILES

| NUS CORPORATION AND SUBSIDIARIES | | | STANDARD CALCULATION SHEET |
|---|---|---|---|
| CLIENT: SUBPART X | FILE NO.: 7T03 2005 | BY: D. OLSON | PAGE 1 OF |
| SUBJECT: HAWTHORNE ARMY AMMUNITION PLANT - MEPAS MODELLING - OB (OLD BOMB TEST RANGE) | | CHECKED BY: | DATE: 05-28-93 |

Four transport scenarios will be modeled at the Open Burning (OB) Area:

1) Overland runoff to a nearby stream;
2) Infiltration to groundwater to well;
3) Infiltration to groundwater to a nearby stream; and,
4) Resuspension of OB soil.

A) MODELLING CONTROL PARAMETERS

- Overland (SST4)

1.4a) CW-STYPE: 3

1.4b) CW-SOURC: 1

1.4e) CW-SCONF: 4

1.4F) CW-MEDIA: 5

- SS > GW > SW (SST3)

1.4a) CW-STYPE: 1

1.4b) CW-SOURC: 1

1.4c) CW-POND: 2

1.4e) CW-SCONF: 4

1.4F) CW-MEDIA: 1, 4, 5

- SS > GW (SST2)

1.4a) CW-STYPE: 1

1.4 b) CW-SOURC: 1

1.4c) CW-POND: 2

1.4e) CW-SCONF: 4

1.4f) CW-MEDIA: 1, 3

- Resuspension and Deposition (SST1)

1.5a) CA-RELTYP: 1

1.5c) CA-RELPAR: 2

1.5d) CA-RELGAS: 0

B) SOURCE TERM DATA

1) SST4, SST3, and SST2

2.1a) WS-DECAY: 2

2.1b) WS-DEPTH: 0.0 ft

2.1c) WS-DATE: 10/01/1993

Note: Modelling is for RCRA permit application and is based on predicted future operations, Remediation of past operations will not be considered.

2.1d) WS-LENGTH: 532 ft
2.1e) WS-WIDTH: 532 ft

2.1g) WS-MOISTC: 9.0 %

2.1h) WS-BULKD: 1.64 g/cc (Sand)

**HALLIBURTON NUS Environmental Corporation and Subsidiaries** — STANDARD CALCULATION SHEET

| CLIENT: | FILE NO.: | BY: | PAGE 3 OF |
|---|---|---|---|
| SUBPART X | 7T03 2005 | D. OLSON | |
| SUBJECT: HAWTHORNE ARMY AMMUNITION PLANT - MEPAS MODELLING - OB (OLD BOMB TEST RANGE) | | CHECKED BY: | DATE: 05-28-93 |

2.1d) WS-LENGTH = 532 Ft
2.1e) WS-WIDTH = 532 Ft

Area of deposition: assume a 300 Ft radius from a point equidistant from the 4 burn pans (discussion with project personnel)

Area = $\pi R^2$ = 3.1416 * (300Ft)$^2$ = 282743.34 Ft$^2$

Assume a square surface area; L = W = $\sqrt{282743.34 Ft^2}$ = 532 Ft

Source Term Calculations (Modeling will be based on 10 years of operations)

- Waste energetics destroyed / year:

20,000 lbs/day * 5 days/week * 26 weeks/yr = 2.6E6 lbs/yr or 2.6E7 lbs/10 years

There are 22 typical energetics which will be processed at the OB unit. Energetic M2 was chosen for modeling because it has the highest amount of the RCRA metal Barium (as nitrate). It also contains potassium nitrate. As a conservative assumption all of the barium nitrate and potassium nitrate will be modeled.

Barium Nitrate = 2.6E7 lbs * 0.014 = 3.64E5 lbs

Potassium Nitrate = 2.6E7 lbs * 0.0075 = 1.95E5 lbs

Energetics = 2.7E7 lbs − (3.64E5 lbs + 1.95E5 lbs) = 2.6441E7 lbs

The emission factor for energetics [amount not destroyed (lb/lb)] is 2.3E-6 (R. Stoner PoLU model value).

Energetics = 2.6441E7 lbs * 2.3E-6 lb/lb = 60.814 lbs

The energetics will be partitioned among the 6 compounds modeled by MEPAS:

| | |
|---|---|
| RDX | DNB |
| TNT | 2,4 - dinitrotoluene |
| HMX | 2,6 - dinitrotoluene |

Each energetic = $\frac{60,814 \text{ lbs}}{6}$ = 10.136 lbs

Source Term in grams is:

Barium Nitrate = 3.64E5 lbs * 453.6 $\frac{g}{lb}$ = 1.6511 E8 g

Potassium Nitrate = 1.95E5 lbs * 453.6 $\frac{g}{lb}$ = 8.8452 E7 g

Energetics = 10.136 lbs * 453.6 $\frac{g}{lb}$ = 4.5977 E3 g

- Soil Mass Calculation

The area of the OB unit is 282,743.34 $ft^2$. It is assumed that the contaminants are deposited to a depth of 3 inches (project personnel assumption). The soil is modeled as Sand and using the MEPAS supplied soil density of 1.64 g/cc the soil mass is:

282,743.34 $ft^2$ * 3 IN * $\frac{1 \text{ FT}}{12 \text{ IN}}$ * 28,320 $\frac{cc}{ft^3}$ * 1.64 $\frac{g}{cc}$ = 3.283 E9 g

| | Constituent | Inventory | Concentration g/g soil |
|---|---|---|---|
| SST2 | $Ba(NO_3)_2$ | 1.6511 E8 g | 1.6511E8 ÷ 3.283E9 = 5.0292 E-2 |
| SST3, SST4 | $KNO_3$ | 8.8452 E7 g | 8.8452 E7 ÷ 3.283E9 = 2.6942 E- |
| | Energetic | 4.5977 E3 g | 4.5977 E3 ÷ 3.283E9 = 1.4005 E-6 |

SST1 (Resuspension) 3.5 Area Particulate Emissions

$Ba(NO_3)_2$ = 5.0292 E-2 g/s = 50292 ug/g

$KNO_3$ = 2.6942 E-2 g/g = 26942 ug/g

Energetics = 1.4005 E-6 g/g = 1.4005 ug/g

C) TOP SOIL PARAMETERS, SST4, SST3, SST2

2.2a) WT-CLASS: SAND

2.2b) WT-SAND: 95%
2.2c) WT-SILT: 3%
2.2d) WT-CLAY: 2%

2.2e) WT-OMC: 0%

2.2f) WT-IRON: 0%

2.2g) WT-PH: 7

2.2h) WT-VEGCOV: 0%

2.2i) WT-AVAILW*: 0%

* Available Water Capacity • Root Zone Depth • Fraction Vegetative Cover. The Fraction Vegetative Cover is Zero.

2.2j) WT-SCSCN**: 68

OLD BOMB / OB

**Waste Feed:** M1

**Commercial Use:** Single-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 85.0 |
| Dinitrotoluene | 10.0 |
| Diphenylamine | 1.0 |
| Dibutylphthalate | 5.0 |

**Reference:** Mil-STD-652D

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**Waste Feed:** M2

**Commercial Use:** Double-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | | | |
|---|---|---|---|
| Nitrocellulose | 77.45 | | |
| Nitroglycerine | 19.50 | | |
| Barium Nitrate | 1.4 | 0.82 | BaO |
| Potassium Nitrate | 0.75 | | KOH |
| Ethyl Centralite | 0.60 | | |
| Graphite, Carbon Black | 0.30 | | |
| | 100.00 | | |

**Reference:** Mil-P-323A

M2 chosen as energetic for modeling since it has highest amount of the RCRA metal Barium (as nitrate). As a conservative assumption all of the $Ba(NO_3)_2$ and $KNO_3$ will be modeled.

**Waste Feed:** M5

**Commercial Use:** Double-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 81.95 |
| Nitroglycerine | 15.0 |
| Barium Nitrate | 1.4 |
| Potassium Nitrate | 0.75 |
| Ethyl Centralite | 0.60 |
| Graphite, Carbon Black | 0.30 |

**Reference:** Mil-P-323A

---

**Waste Feed:** M6

**Commercial Use:** Single-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 87.0 |
| Dinitrotoluene | 10.0 |
| Diphenylamine | 1.0 |
| Dibutylphthalate | 3.0 |

**Reference:** Mil-STD-652D

**Waste Feed:** M6+2

**Commercial Use:** Single-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 87.0 |
| Dinitrotoluene | 10.0 |
| Diphenylamine | 0.9 |
| Dibutylphthalate | 3.0 |
| Potassium Sulfate | 2.0 KOH |

**Reference:** Mil-STD-652D

---

**Waste Feed:** M7

**Commercial Use:** Double-base Propellant, Mortar

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 54.6 |
| Nitroglycerine | 35.5 |
| Ethyl Centralite | 0.9 |
| Potassium Perchlorate | 7.8 KCl KOH K |
| Graphite, Carbon Black | 1.2 |

**Reference:** Mil-P-14737

**Waste Feed:** M8

**Commercial Use:** Double-base Propellant, Mortar

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 52.15 |
| Nitroglycerine | 43.0 |
| Potassium Nitrate | 1.25 |
| Ethyl Centralite | 0.6 |
| Diethylphthalate | 3.0 |

**Reference:** Mil-I-60016A

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**Waste Feed:** M9

**Commercial Use:** Double-base Propellant, Mortar

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 57.75 |
| Nitroglycerine | 40.0 |
| Potassium Nitrate | 1.5 |
| Ethyl Centralite | 0.75 |

**Reference:** Mil-P-20306

**Waste Feed:** M10

**Commercial Use:** Single-base Propellant

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 98.0 |
| Diphenylamine | 1.0 |
| Potassium Sulfate | 1.0 |
| Graphite, Carbon Black | 0.1 |

**Reference:** Mil-STD-652

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**Waste Feed:** M12

**Commercial Use:** Single-base Propellant

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 97.7 |
| Dinitrotoluene | 8.0 (Coating) |
| Potassium Sulfate | 0.75 |
| Tin dioxide | 0.75 |

sm

**Reference:** Mil-P-528

**Waste Feed:** M14

**Commercial Use:** Single-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | | |
|---|---|---|
| Nitrocellulose | 90.0 | |
| Dinitrotoluene | 8.0 | |
| Diphenylamine | 1.0 | (Coating) |
| Dibutylphthalate | 2.0 | |

**Reference:** Mil-STD-652

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**Waste Feed:** M15

**Commercial Use:** Triple-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 20.0 |
| Nitroglycerine | 19.0 |
| Nitroguanadine | 54.7 |
| Ethyl Centralite | 6.0 |
| Cryolite | 0.3 |

**Reference:** Mil-STD-652

**Waste Feed:** M17

**Commercial Use:** Triple-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 22.0 |
| Nitroglycerine | 21.5 |
| Nitroguanadine | 54.7 |
| Ethyl Centralite | 1.5 |
| Cryolite | 0.3 |
| Graphite, Carbon Black | 0.1 |

**Reference:** Mil-STD-652

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**Waste Feed:** M26

**Commercial Use:** Double-base Propellant

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 67.25 |
| Nitroglycerine | 25.0 |
| √Barium Nitrate | 0.75 |
| Potassium Nitrate | 0.70 |
| Ethyl Centralite | 6.0 |
| Graphite, Carbon Black | 0.3 |

**Reference:** Mil-STD-652, Mil-P-46235

**Waste Feed:** M26A1

**Commercial Use:** Double-base Propellant

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 68.7 |
| Nitroglycerine | 25.0 |
| Ethyl Centralite | 6.0 |
| Graphite, Carbon Black | 0.3 |

**Reference:** Mil-STD-652, Mil-P-46235

---

**Waste Feed:** M26E1

**Commercial Use:** Double-base Propellant

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 68.7 |
| Nitroglycerine | 25.0 |
| Ethyl Centralite | 6.0 |
| Graphite, Carbon Black | 0.9 |

**Reference:** Mil-STD-652, Mil-P-46235

**Waste Feed:** M30

**Commercial Use:** Triple-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 28.0 |
| Nitroglycerine | 22.5 |
| Nitroguanadine | 47.7 |
| Ethyl Centralite | 1.5 |
| Cryolite | 0.3 |
| Graphite, Carbon Black | 0.2 |

**Reference:** Mil-STD-652

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**Waste Feed:** M30A1

**Commercial Use:** Triple-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 28.0 |
| Nitroglycerine | 22.5 |
| Nitroguanadine | 47.0 |
| Potassium Sulfate | 1.0 |
| Ethyl Centralite | 1.5 |
| Graphite, Carbon Black | 0.15 |

**Reference:** Mil-STD-652

**Waste Feed:** M30A2

**Commercial Use:** Triple-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 27.0 |
| Nitroglycerine | 22.5 |
| Nitroguanadine | 46.25 |
| Potassium Nitrate | 2.75 |
| Ethyl Centralite | 1.5 |
| Graphite, Carbon Black | 0.15 |

**Reference:** Mil-STD-652

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**Waste Feed:** M31

**Commercial Use:** Triple-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 20.0 |
| Nitroglycerine | 19.0 |
| Nitroguanadine | 54.7 |
| Dibutylphthalate | 4.5 |
| Cryolite | 0.3 |
| 2-Nitrodiphenylamine | 1.5 |
| Graphite, Carbon Black | 0.15 |

**Reference:** Mil-STD-652

**Waste Feed:** M31A1

**Commercial Use:** Triple-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 20.0 |
| Nitroglycerine | 19.0 |
| Nitroguanadine | 54.0 |
| Dibutylphthalate | 4.5 |
| Potassium Sulfate | 1.0 |
| 2-Nitrodiphenylamine | 1.5 |
| Graphite, Carbon Black | 0.15 |

**Reference:** Mil-STD-652

---

**Waste Feed:** M31A1E1

**Commercial Use:** Triple-base Propellant, Howitzer

**Physical Form:** Solid

**Mixture Composition (% by weight):**

| | |
|---|---|
| Nitrocellulose | 21.5 |
| Nitroglycerine | 18.0 |
| Nitroguanadine | 54.7 |
| Dibutylphthalate | 3.0 |
| Potassium Sulfate | 1.25 |
| Ethyl Centralite | 1.5 |
| Graphite, Carbon Black | 0.05 |

**Reference:** Mil-STD-652

05-19-93

HNUS PROJECT MANAGEMENT INPUT OLD BOMB OB

EXPLOSIVES INVENTORY = 20,000 lbs/day * 5 days/week * 26 weeks/year = 2.6E6 lbs/yr

4. General description of the components, items, and hazardous materials to be handled or stored at the burn area, to include explosive limits and hazard classifications.

   The burn area will be used to dispose of unserviceable bulk propellant.

   Hazard Classification - 1.3

   **Explosive Limits - ~~3000~~ 5,000 lbs. per pad* (four (4) pads can be loaded at one time - ~~12,000~~ 20,000 lbs propellant)**

*A pad consists of one (1) to four (4) burn pans bonded together.

5. Personnel limits for the burn area.

| | |
|---|---|
| Preparation of Range/Equipment | 6 Operators<br>4 Transients |
| Inspect and Unload Propellant | 6 Operators<br>2 Transients |
| Preparation for Burning (Fill pans) | 6 Operators<br>2 Transients |
| Set up Initiation System | 2 Operators<br>1 Transient (QA) |
| Demilitarization by Burning (Ignition) | 3 Operators<br>1 Transient (QA) |
| Misfires | 2 Operators |
| Inspection of Burn Area | 6 Operators<br>2 Transients |
| Partial Burn | 2 Operators |
| Inspection and Disposition of Packaging Materials | 6 Operators<br>4 Transients |

6. Explosive limits and hazard classifications of ammunition explosives, or other hazardous materials in facilities within inhabited building distance of the burn area and facilities whose inhabited building distance arcs include the burn area.

   There are no explosive handling facilities within the inhabited building distance of the burn area. The burn area is not located within the inhabited building distance of any explosive handling facility.

OLD BOMB OB

# OLD BOMB BURN AREA

## SAFETY SITE PLAN

~~September 12, 1990~~
Revised April 20, 1993

GENERAL

This site plan shows the locations and layout of the Old Bomb burn area as well as describing the safety requirements for the burn area. The burn area is utilized to dispose of unserviceable bulk propellant. Disposal is accomplished by placing the propellant in burn pans, igniting, and burning the propellant. The residue is placed in EPA approved containers, transported to a RCRA permitted storage facility, and disposed of as a hazardous waste.

In accordance with AMC-R 385-100, Para. 5-27 and Figure 1, the following information is provided:

1. Distance between burn area and other installation facilities; the installation boundaries; public traffic routes; and power transmission and utility lines.

   The location of the burn area is shown in Figure 1, Enclosure 1 and Enclosure 2 (Drawing # ~~082690-Old Bomb 1546).~~ 041693-OLDBOMB- The boundary of the burn area is shown on the attached topographic maps (Enclosures 1 & 2). The boundary is defined by a 10' wide dirt road/fire break. In addition, the overall burn area is divided into several smaller burn sites. Demarcation of the burn sites is accomplished by clearing 10' wide areas (firebreaks) as shown on the topographic map. There are no power transmission or utility lines within the inhabited building distance of the burn area.

2. Identification and brief description of the mission of all facilities within inhabited building distance of the burn area.

   The emergency personnel shelter is the only facility within the inhabited building distance of the burn area.

3. Identification and a brief description of the mission of other facilities whose inhabited building distance arcs include the burn area.

   The burn area, office, and material holding area are not located within the inhabited building distance arc of any explosive handling facility. The nearest explosive handling facility is 40 AT 20. ~~The quantity distance arc for this facility is shown on Enclosure 2.~~

Emission Factor [amount not destroyed (lb/lb)]

Table ~~2.2~~ 4.1-1. Summary of effectiveness of treatment based on bench tests ~~AMCOM OB/OD Study~~ data - OB.

| Effectiveness of Treatment Factors | BangBox | | Phase A | Manufacturing Residue | | Phase C | | Permits Recommended | |
|---|---|---|---|---|---|---|---|---|---|
| | Double Base | Composite | Triple Base | Phase B | Phase C* | M-1 | M-6 | Short Term** | Long Term*** |
| Carbon Converted to $CO_2$ (%) | 97 | 42 | 66 | 77 | 100 | 110 | 110 | — | — |
| DRE for Total Energetics (%) | 99.9998 | 99.9999+ | NTFA/NS | 99.9999+ | 99.9999+ | 99.9999+ | 99.9999+ | 99.9998 | 99.9 |
| Total (Air+Soil+Residual) Emission Factor for Energetics (lb/lb) | 2.3E-6 | 4.9E-7 | NTFA/NS | 2.3E-8 | 4.9E-7 | 2.1E-8 | 5.8E-8 | — | — |

NTFA = Not target for analysis

NS = Data not available for evaluation

DRE = Destruction and removal efficiency

* Any OB/OD tests (1988-1990) data ~~on maximum air emission factors for energetic material item tested.~~

** Worst case value applicable to ~~short~~ evaluation of exposure periods of 24 hours or less (associated with maximum emission factors considering all ~~of~~ tests results presented above)

*** Typical value (associated with average emission factors considering all ~~tests~~ results presented above) applicable to evaluation of exposure periods of greater than 24 hours

| NUS CORPORATION AND SUBSIDIARIES | | | STANDARD CALCULATION SHEET |
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** Antecedent Moisture Cover (AMC) = I
Hydrologic Soil Type = Sand
Classification of Hydrologic Soil Group = D (Worst Case)
Soil and Conditions = "Other Surface Type"
∴ AMC - II Curve Number = 84
Adjusted to I = 68

RESUSPENSION CLIMATOLOGY

3.1a) AC-MIXAM: 400 M

3.1b) AC-MIXPM: 2240 M

3.1c) AC-REGION: 2

3.1d) AC-PEI : 13

3.1e) AC-LCDREF: RENO, NV

3.1F) AC-NUMTS: 14

3.1g) AC-FASTY: 80

3.1h) AC-WINDV: 6.6 MPH

3.1(k) AC-TEMP: 49.4 °F

3.1l) AC-RAIN: 7.49 IN

3.1m) AC-PRENUM: 50.6 #/YR

RESUSPENSION ATMOSPHERIC JOINT FREQUENCY DATA

3.2a) AJ-STATNM: RENO, NEVADA

3.2b) AJ-ANEMHT: 9.1 M *

$* \ 30 Ft * 0.3048 \frac{M}{Ft} = 9.1 M$

3.2c) AJ RLEN: 10.0 Cm

3.2d) AJ-WINDS (6):

| WIND SPEED GROUP | MID POINT (m/s) |
|---|---|
| 1 | 0.77 |
| 2 | 2.57 |
| 3 | 4.37 |
| 4 | 6.95 |
| 5 | 9.78 |
| 6 | 10.81 |

3.2e) AJ-UNIT: 3

3.2f) AJ-MODE: 1

3.2g) AJ-FDATA: SOUTH 0.9994

3.2h) AJ-CALMS: A: 0.0001 B: 0.0001 C: 0.0001 D: 0.0000
E: 0.0001 F: 0.0001 G: 0.0001

- RESUSPENSION REGIONAL SURFACE AND TOPOGRAPHICAL DATA

3.3a) AR-REGSUR: 10.0

3.3b) AR-TOPTYP: 0

3.3c) AR-CHANL: 0

- RESUSPENSION AREA PARTICULATE EMISSIONS

3.5a) AP-AREA: 26266.9 $M^2$ *

$* \ 282743.34 \ Ft^2 * 0.0929 \frac{M^2}{Ft^2} = 26266.9 \ M^2$

| NUS CORPORATION AND SUBSIDIARIES | | | STANDARD CALCULATION SHEET |
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3.5 b) AP-ARATIO : 1.00

3.5 d) AP-SAND : 95%

3.5 e) AP-FAREA : 1.00

3.5 f) AP-LOCSUR: 1.0

3.5 g) AP-WET FR : 0.0

3.5 h) AP-CORRSC: 1.0

3.5 i) AP-VEGFR : 0.0

3.5 j) AP-NOCRST: 1.0

3.5 k) AP-NUMDIS: 0

3.5 l) AP-ROADS : NO

D) OVERLAND PARAMETERS

2.3a) WO-STORM I: 2

2.3b) WO-PRECIP: 1.5 IN

2.3c) WO-SLOPE : 5.71%
(Calculation attached)

2.3d) WO-K FACTOR : 0.05

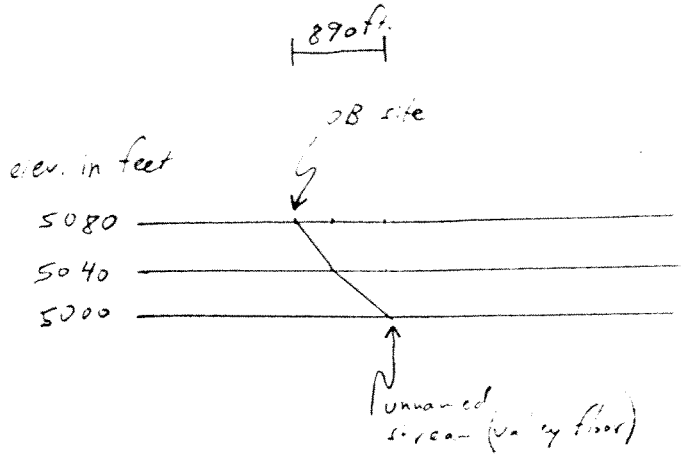
2.3e) WO-C FACTOR : 0.50

2.3f) WO-P FACTOR : 0.9

2.3 j) WO-RIVLEN : 532 ft

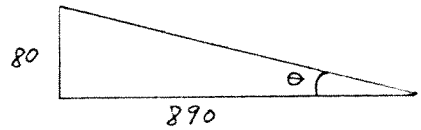
**NUS CORPORATION AND SUBSIDIARIES** — **STANDARD CALCULATION SHEET**

| CLIENT: SUBPART X | FILE NO.: 7T03 2005 | BY: J HAYNES | PAGE 2 OF 3 |
|---|---|---|---|
| SUBJECT: Hawthorne OB site Overland Slope | | CHECKED BY: | DATE: 05-28-93 |




Total elevation drop is 80 feet,

∴




$$\text{Slope} = \theta = \arctan\left(\frac{80}{890}\right) = 5.14^\circ$$

$$\frac{5.14^\circ}{90^\circ} * 100 = 5.71\ \%$$

| NUS CORPORATION AND SUBSIDIARIES | | | STANDARD CALCULATION SHEET |
|---|---|---|---|
| CLIENT: SUBPART X | FILE NO.: 7T03 2005 | BY: D. OLSON | PAGE 9 OF |
| SUBJECT: HAWTHORNE ARMY AMMUNITION PLANT: MEPAS MODELLING OB (OLD BOMB TEST RANGE) | | CHECKED BY: | DATE: 05-28-93 |

- SURFACE WATER (STREAM OB)

2.6a) WW-VELOC: 5 feet/sec

2.6b) WW-DEPTH: 4 feet

2.6c) WW-WIDTH: 5 feet

2.6d) WW-DIST: 100 feet

2.6e) WW-DISCHG*: 100 CFS

* $5 \frac{ft}{sec} * 5 ft * 4 ft = 100 ft^3/sec$

2.6f) WW-ORDER: 1

- SURFACE SOIL ADSORPTION COEFFICIENTS (Kds)

Kds were adjusted to ensure that all constituents were not leached out prior to the 10th year of operation (10 years is basis of source term).
- OB SS T2 and T3 0.814 all constituents
- OB SS T4 all constituents recommended by the model.

D) CLIMATOLOGY

2.8a) WC-ALT: 5080 ft

2.8b) WC-LCDREF: RENO NV

2.8c) WC-ELEV: 4404 ft

2.8d) WC-LAT: 39° 30' N

2.8e) WC-WINDHT: 30 ft

| NUS CORPORATION AND SUBSIDIARIES | STANDARD CALCULATION SHEET |
|---|---|

| CLIENT: SUBPART X | FILE NO.: 7T03 2005 | BY: D. OLSON | PAGE 10 OF |
|---|---|---|---|
| SUBJECT: HAWTHORNE ARMY AMMUNITION PLANT: MEPAS MODELLING OB (OLD BOMB TEST RANGE) | | CHECKED BY: | DATE: 05-28-93 |

| MONTH | f. WC-TEMP (oF) | g. WC-RAIN (Inches) | h. WC-WINDY (mph) | i WC-CLOUD (tenths) | j WC-PRENUM (#/YR) | k WCRHMAY % | l WCRHMIN % |
|---|---|---|---|---|---|---|---|
| JAN | 32.2 | 1.24 | 5.6 | 6.4 | 6.1 | 79 | 51 |
| FEB | 37.4 | 0.95 | 6.2 | 6.3 | 5.8 | 74 | 40 |
| MAR | 40.6 | 0.74 | 7.8 | 6.0 | 6.3 | 69 | 33 |
| APR | 46.4 | 0.46 | 8.2 | 5.7 | 4.0 | 66 | 28 |
| MAY | 54.6 | 0.74 | 8.0 | 4.9 | 4.4 | 66 | 25 |
| JUN | 62.4 | 0.34 | 7.6 | 3.6 | 3.2 | 65 | 22 |
| JUL | 69.5 | 0.30 | 7.0 | 2.3 | 2.4 | 63 | 18 |
| AUG | 66.9 | 0.27 | 6.5 | 2.4 | 2.3 | 66 | 20 |
| SEP | 60.2 | 0.30 | 5.8 | 2.6 | 2.5 | 69 | 22 |
| OCT | 50.3 | 0.34 | 5.4 | 4.0 | 3.0 | 73 | 27 |
| NOV | 39.7 | 0.60 | 5.5 | 5.7 | 4.9 | 75 | 42 |
| DEC | 32.5 | 1.21 | 5.2 | 6.2 | 5.9 | 77 | 51 |

E) PARTIALLY SATURATED ZONE

2.4a) WP-CLASS: SAND

2.4b) WP-SAND: 95 %

2.4c) WP-SILT: 3%

2.4d) WP-CLAY: 2%

2.4e) WP-OMC: 0%

2.4f) WP-IRON: 0%

2.4g) WP-PH: 7

2.4h) WP-THICK: 100 ft

2.4i) WP-BULKD: 1.64 g/cc

# NORMALS, MEANS, AND EXTREMES

RENO, NEVADA

LATITUDE: 39°30'N LONGITUDE: 119°47'W ELEVATION: FT. GRND 4404 BARO 4402 TIME ZONE: PACIFIC WBAN: 23185

| | (a) | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEP | OCT | NOV | DEC | YEAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TEMPERATURE °F:** | | | | | | | | | | | | | | |
| **Normals** | | | | | | | | | | | | | | |
| -Daily Maximum | | 44.8 | 51.1 | 55.8 | 63.3 | 72.3 | 81.8 | 91.3 | 88.7 | 81.4 | 70.0 | 55.6 | 46.2 | 66.9 |
| -Daily Minimum | | 19.5 | 23.5 | 25.4 | 29.4 | 36.9 | 43.0 | 47.7 | 45.2 | 38.9 | 30.5 | 23.8 | 18.9 | 31.9 |
| -Monthly | | 32.2 | 37.4 | 40.6 | 46.4 | 54.6 | 62.4 | 69.5 | 66.9 | 60.2 | 50.3 | 39.7 | 32.5 | **49.4** |
| Extremes | | | | | | | | | | | | | | |
| -Record Highest | 49 | 70 | 75 | 83 | 89 | 96 | 103 | 104 | 105 | 101 | 91 | 77 | 70 | 105 |
| -Year | | 1967 | 1986 | 1966 | 1981 | 1966 | 1988 | 1980 | 1983 | 1950 | 1980 | 1980 | 1969 | AUG 1983 |
| -Record Lowest | 49 | -16 | -16 | -2 | 13 | 18 | 25 | 33 | 24 | 20 | 8 | 1 | -16 | -16 |
| -Year | | 1949 | 1989 | 1945 | 1956 | 1964 | 1954 | 1976 | 1962 | 1965 | 1971 | 1958 | 1972 | FEB 1989 |
| **NORMAL DEGREE DAYS:** | | | | | | | | | | | | | | |
| Heating (base 65°F) | | 1017 | 773 | 756 | 558 | 333 | 124 | 16 | 59 | 171 | 456 | 759 | 1008 | 6030 |
| Cooling (base 65°F) | | 0 | 0 | 0 | 0 | 11 | 46 | 156 | 117 | 27 | 0 | 0 | 0 | 357 |
| **% OF POSSIBLE SUNSHINE** | 42 | 65 | 68 | 76 | 81 | 81 | 85 | 92 | 92 | 91 | 83 | 70 | 64 | 79 |
| **MEAN SKY COVER (tenths)** | | | | | | | | | | | | | | |
| Sunrise - Sunset | 48 | 6.4 | 6.3 | 6.0 | 5.7 | 4.9 | 3.6 | 2.3 | 2.4 | 2.6 | 4.0 | 5.7 | 6.2 | 4.7 |
| **MEAN NUMBER OF DAYS:** | | | | | | | | | | | | | | |
| Sunrise to Sunset | | | | | | | | | | | | | | |
| -Clear | 48 | 8.3 | 7.0 | 8.2 | 8.6 | 12.0 | 16.6 | 22.3 | 22.1 | 20.7 | 15.7 | 9.4 | 8.4 | 159.3 |
| -Partly Cloudy | 48 | 7.3 | 7.5 | 9.2 | 10.0 | 9.8 | 7.9 | 6.1 | 6.3 | 5.7 | 7.8 | 7.9 | 7.8 | 93.3 |
| -Cloudy | 48 | 15.4 | 13.7 | 13.6 | 11.4 | 9.2 | 5.6 | 2.6 | 2.5 | 3.6 | 7.5 | 12.7 | 14.8 | 112.6 |
| **Precipitation:** | | | | | | | | | | | | | | |
| .01 inches or more | 48 | 6.1 | 5.8 | 6.3 | 4.0 | 4.4 | 3.2 | 2.4 | 2.3 | 2.5 | 3.0 | 4.9 | 5.9 | **50.6** |
| Snow, Ice pellets 1.0 inches or more | 48 | 2.0 | 1.6 | 1.5 | 0.5 | 0.2 | 0.0 | 0.0 | 0.0 | 0.* | 0.1 | 0.7 | 1.4 | 8.1 |
| **Thunderstorms** | 48 | 0.0 | 0.* | 0.1 | 0.5 | 2.0 | 2.9 | 3.6 | 3.1 | 1.3 | 0.6 | 0.0 | 0.0 | **14.0** |
| Heavy Fog Visibility 1/4 mile or less | 48 | 2.1 | 0.8 | 0.3 | 0.1 | 0.1 | 0.0 | 0.* | 0.1 | 0.1 | 0.2 | 0.7 | 2.6 | 7.1 |
| Temperature °F | | | | | | | | | | | | | | |
| -Maximum | | | | | | | | | | | | | | |
| 90° and above | 27 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 7.3 | 20.9 | 17.0 | 4.9 | 0.1 | 0.0 | 0.0 | 51.6 |
| 32° and below | 27 | 3.0 | 0.7 | 0.* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 3.8 | 8.0 |
| -Minimum | | | | | | | | | | | | | | |
| 32° and below | 27 | 28.1 | 24.7 | 23.9 | 17.4 | 5.9 | 0.7 | 0.0 | 0.1 | 4.0 | 17.1 | 24.0 | 28.2 | 174.2 |
| 0° and below | 27 | 0.8 | 0.3 | 0.* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 2.3 |
| **AVG. STATION PRESS. (mb)** | 18 | 868.3 | 866.9 | 864.4 | 864.9 | 864.6 | 865.6 | 866.7 | 866.5 | 866.5 | 868.0 | 867.6 | 868.8 | 86[illegible] |
| **RELATIVE HUMIDITY (%)** | | | | | | | | | | | | | | |
| Hour 04 (Local Time) | 27 | 79 | 74 | 69 | 66 | 66 | 65 | 63 | 66 | 69 | 73 | 75 | 77 | 70 |
| Hour 10 (Local Time) | 27 | 70 | 58 | 48 | 38 | 33 | 30 | 27 | 29 | 34 | 42 | 57 | 67 | 44 |
| Hour 16 (Local Time) | 27 | 51 | 40 | 33 | 28 | 25 | 22 | 18 | 20 | 22 | 27 | 42 | 51 | 32 |
| Hour 22 (Local Time) | 27 | 73 | 63 | 55 | 48 | 44 | 40 | 36 | 38 | 46 | 55 | 66 | 72 | 53 |
| **PRECIPITATION (inches):** | | | | | | | | | | | | | | |
| Water Equivalent | | | | | | | | | | | | | | |
| **-Normal** | | 1.24 | 0.95 | 0.74 | 0.46 | 0.74 | 0.34 | 0.30 | 0.27 | 0.30 | 0.34 | 0.60 | 1.21 | **7.49** |
| -Maximum Monthly | 49 | 4.13 | 4.84 | 2.02 | 2.04 | 2.89 | 1.53 | 1.06 | 1.65 | 2.31 | 2.14 | 3.08 | 5.25 | 5.25 |
| -Year | | 1969 | 1986 | 1952 | 1958 | 1963 | 1989 | 1971 | 1965 | 1982 | 1945 | 1983 | 1955 | DEC 1955 |
| -Minimum Monthly | 49 | T | T | T | T | T | 0.00 | 0.00 | 0.00 | 0.00 | T | 0.00 | T | 0.00 |
| -Year | | 1966 | 1967 | 1988 | 1985 | 1985 | 1959 | 1951 | 1957 | 1974 | 1966 | 1959 | 1989 | SEP 1974 |
| -Maximum in 24 hrs | 49 | 2.37 | 1.80 | 1.21 | 1.64 | 1.76 | 0.79 | 0.80 | 0.97 | 0.91 | 1.55 | 1.65 | 2.16 | 2.37 |
| -Year | | 1943 | 1990 | 1943 | 1958 | 1987 | 1969 | 1949 | 1965 | 1982 | 1962 | 1988 | 1955 | JAN 1943 |
| Snow, Ice pellets | | | | | | | | | | | | | | |
| -Maximum Monthly | 49 | 20.0 | 23.5 | 29.0 | 7.5 | 14.1 | 0.2 | 0.0 | 0.0 | 1.5 | 5.1 | 16.5 | 25.6 | 29.0 |
| -Year | | 1956 | 1969 | 1952 | 1958 | 1964 | 1970 | | | 1982 | 1971 | 1985 | 1971 | MAR 1952 |
| -Maximum in 24 hrs | 49 | 12.0 | 18.0 | 16.9 | 7.3 | 9.0 | 0.2 | 0.0 | 0.0 | 1.5 | 3.7 | 15.4 | 14.9 | 18.0 |
| -Year | | 1956 | 1990 | 1952 | 1958 | 1962 | 1970 | | | 1982 | 1971 | 1985 | 1971 | FEB 1990 |
| **WIND:** | | | | | | | | | | | | | | |
| Mean Speed (mph) | 48 | 5.6 | 6.2 | 7.8 | 8.2 | 8.0 | 7.6 | 7.0 | 6.5 | 5.8 | 5.4 | 5.5 | 5.2 | 6.6 |
| Prevailing Direction through 1963 | | S | S | WNW | WNW | WNW | WNW | WNW | WNW | WNW | WNW | S | SW | WNW |
| **Fastest Mile** | | | | | | | | | | | | | | |
| -Direction (!!!) | 29 | SW | SW | SW | SW | NW | SE | NW | W | W | SW | S | SW | SW |
| -Speed (MPH) | 29 | 80 | 66 | 80 | 48 | 48 | 64 | 50 | 47 | 44 | 74 | 61 | 68 | **80** |
| -Year | | 1968 | 1975 | 1968 | 1982 | 1986 | 1987 | 1988 | 1984 | 1987 | 1985 | 1983 | 1968 | JAN 1968 |
| Peak Gust | | | | | | | | | | | | | | |
| -Direction (!!!) | 7 | SW | W | SW | SW | NW | SW | NW | W | W | SW | SW | S | SW |
| -Speed (mph) | 7 | 90 | 66 | 71 | 64 | 49 | 67 | 67 | 55 | 54 | 81 | 62 | 75 | 90 |
| -Date | | 1988 | 1986 | 1989 | 1988 | 1986 | 1987 | 1988 | 1984 | 1986 | 1985 | 1984 | 1987 | JAN 1988 |

(!!!) See Reference Notes on Page 68.

## PRECIPITATION (inches)

RENO, NEVADA

| YEAR | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEP | OCT | NOV | DEC | ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961 | 0.80 | 0.30 | 0.40 | 0.27 | 0.91 | 0.56 | 0.30 | 0.47 | 0.39 | 0.15 | 0.64 | 0.18 | 5.37 |
| 1962 | 0.35 | 3.69 | 0.84 | T | 1.40 | 0.04 | 0.38 | 0.08 | 0.10 | 1.55 | 0.02 | 0.60 | 9.05 |
| 1963 | 2.51 | 1.09 | 0.41 | 0.82 | 2.89 | 1.10 | T | 0.17 | 0.18 | 0.24 | 1.44 | 0.08 | 10.93 |
| 1964 | 0.68 | 0.01 | 0.72 | 0.53 | 1.79 | 0.29 | 0.13 | 0.02 | 0.00 | 0.04 | 0.63 | 2.89 | 7.73 |
| 1965 | 1.64 | 0.01 | 0.98 | 0.27 | 0.18 | 1.31 | 0.35 | 1.65 | 0.50 | 0.02 | 1.62 | 1.19 | 9.72 |
| 1966 | T | 0.20 | 0.04 | 0.03 | 0.33 | 0.03 | T | 0.02 | 0.10 | T | 1.07 | 1.45 | 3.27 |
| 1967 | 2.11 | T | 1.93 | 0.95 | 0.47 | 0.59 | 0.57 | 1.22 | 0.82 | 0.04 | 0.22 | 0.55 | 9.47 |
| 1968 | 1.11 | 0.92 | 0.84 | 0.02 | 0.30 | 0.16 | 0.05 | 0.13 | 0.15 | 0.01 | 0.73 | 1.03 | 5.45 |
| 1969 | 4.13 | 1.74 | 0.07 | 0.10 | 0.20 | 1.29 | 0.17 | T | 0.01 | 0.40 | 0.04 | 2.07 | 10.22 |
| 1970 | 1.73 | 0.32 | 0.19 | 0.60 | T | 0.88 | 0.05 | 0.02 | 0.01 | 0.03 | 1.47 | 1.65 | 6.95 |
| 1971 | 0.75 | 0.33 | 1.54 | 0.59 | 2.38 | 0.09 | 1.06 | 0.09 | 0.10 | 0.44 | 0.24 | 2.97 | 10.58 |
| 1972 | 0.37 | 0.14 | 0.03 | 0.14 | 1.02 | 0.18 | 0.01 | 0.14 | 0.30 | 1.30 | 1.00 | 0.89 | 5.52 |
| 1973 | 1.54 | 1.66 | 0.73 | 0.13 | 0.75 | 0.07 | 0.27 | 0.48 | 0.01 | 0.56 | 1.74 | 1.27 | 9.21 |
| 1974 | 1.60 | 0.34 | 1.16 | 0.23 | 0.01 | T | 0.33 | 0.19 | 0.00 | 0.69 | 0.27 | 0.56 | 5.38 |
| 1975 | 0.32 | 1.74 | 1.59 | 0.62 | 0.21 | 0.21 | 0.03 | 1.03 | 0.92 | 0.15 | 0.12 | 0.01 | 6.95 |
| 1976 | 0.16 | 1.20 | 0.36 | 0.20 | 0.10 | T | 0.96 | 0.62 | 1.10 | 0.28 | 0.07 | 0.01 | 5.06 |
| 1977 | 0.67 | 0.71 | 0.19 | T | 1.24 | 1.03 | 0.07 | 0.01 | 0.01 | 0.14 | 0.23 | 2.54 | 6.84 |
| 1978 | 1.66 | 0.98 | 1.49 | 0.20 | 0.31 | 0.07 | 0.19 | 0.15 | 0.68 | 0.08 | 1.30 | 0.82 | 7.93 |
| 1979 | 0.66 | 0.82 | 0.52 | 0.41 | 0.16 | T | 0.58 | 0.38 | T | 0.31 | 0.17 | 2.02 | 6.03 |
| 1980 | 2.77 | 1.90 | 0.76 | 0.51 | 0.78 | 0.12 | 0.54 | 0.32 | 0.48 | 0.14 | 0.28 | 0.60 | 9.20 |
| 1981 | 0.85 | 0.21 | 0.58 | 0.21 | 0.57 | T | 0.01 | 0.36 | 0.07 | 0.64 | 2.13 | 1.05 | 6.68 |
| 1982 | 1.20 | 0.41 | 1.14 | 0.34 | 0.10 | 1.07 | 0.04 | 0.09 | 2.31 | 1.65 | 1.71 | 1.04 | 11.10 |
| 1983 | 1.72 | 1.58 | 1.31 | 1.35 | 0.21 | 0.53 | T | 0.78 | 0.84 | 0.36 | 3.08 | 1.47 | 13.23 |
| 1984 | 0.36 | 0.22 | 0.20 | 0.24 | 0.06 | 0.34 | 0.45 | 0.02 | 0.04 | 0.60 | 1.68 | 0.07 | 4.28 |
| 1985 | 0.24 | 0.68 | 1.07 | T | T | 0.12 | T | 0.01 | 0.63 | 0.46 | 1.23 | 0.55 | 4.99 |
| 1986 | 0.40 | 4.84 | 0.88 | 0.77 | 0.26 | 0.31 | 0.86 | 0.07 | 0.28 | 0.06 | 0.02 | 0.19 | 8.94 |
| 1987 | 0.49 | 0.78 | 0.80 | 0.49 | 2.29 | 1.12 | 0.01 | 0.01 | 0.01 | 0.54 | 0.37 | 0.59 | 7.50 |
| 1988 | 0.50 | 0.02 | T | 0.95 | 0.12 | 0.59 | 0.22 | 0.01 | 0.04 | 0.02 | 1.99 | 0.84 | 5.30 |
| 1989 | 0.20 | 0.80 | 0.46 | 0.03 | 1.33 | 1.53 | 0.00 | 0.82 | 1.19 | 0.43 | 0.55 | T | 7.34 |
| 1990 | 0.62 | 1.98 | 0.07 | 0.33 | 0.19 | 0.03 | 0.86 | 0.21 | 0.31 | 0.06 | 0.15 | 0.45 | 5.26 |
| Record Mean | 1.30 | 1.07 | 0.76 | 0.46 | 0.64 | 0.38 | 0.28 | 0.26 | 0.31 | 0.41 | 0.69 | 1.03 | 7.60 |

See Reference Notes on Page 6B.



## AVERAGE TEMPERATURE (deg. F)

RENO, NEVADA

| YEAR | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEP | OCT | NOV | DEC | ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961 | 33.4 | 40.7 | 41.6 | 47.0 | 53.4 | 66.6 | 69.4 | 69.1 | 55.9 | 49.7 | 36.5 | 31.7 | 49.6 |
| 1962 | 26.7 | 34.1 | 39.6 | 50.1 | 51.5 | 61.7 | 67.0 | 61.5 | 60.8 | 51.2 | 40.8 | 33.9 | 48.3 |
| #1963 | 28.2 | 44.4 | 40.5 | 41.8 | 57.2 | 59.0 | 65.1 | 64.7 | 63.3 | 52.4 | 40.2 | 35.1 | 49.3 |
| 1964 | 32.5 | 34.2 | 37.7 | 45.3 | 51.9 | 61.3 | 70.7 | 66.9 | 58.1 | 55.3 | 38.0 | 36.0 | 49.0 |
| 1965 | 33.6 | 40.1 | 43.2 | 49.6 | 54.0 | 59.2 | 66.1 | 65.8 | 54.9 | 52.4 | 41.6 | 29.9 | 49.2 |
| 1966 | 33.4 | 34.8 | 43.4 | 50.2 | 60.7 | 63.7 | 65.7 | 67.5 | 58.7 | 49.6 | 41.0 | 34.0 | 50.2 |
| 1967 | 37.0 | 40.3 | 40.6 | 40.3 | 54.9 | 59.9 | 69.6 | 71.0 | 62.6 | 51.0 | 42.7 | 28.3 | 49.8 |
| 1968 | 31.7 | 42.4 | 42.4 | 44.6 | 52.8 | 62.9 | 73.0 | 64.5 | 59.6 | 50.6 | 40.8 | 31.4 | 49.7 |
| 1969 | 37.0 | 34.2 | 40.7 | 48.4 | 58.1 | 62.0 | 70.8 | 68.8 | 63.4 | 45.3 | 39.0 | 36.7 | 50.4 |
| 1970 | 37.3 | 42.0 | 41.4 | 44.1 | 58.0 | 65.1 | 73.0 | 71.5 | 57.2 | 48.0 | 45.4 | 29.2 | 51.0 |
| 1971 | 33.0 | 36.9 | 40.9 | 45.9 | 50.9 | 59.7 | 71.5 | 70.7 | 56.5 | 45.8 | 37.5 | 26.6 | 48.0 |
| 1972 | 25.5 | 40.2 | 47.1 | 46.2 | 56.9 | 65.1 | 70.7 | 67.6 | 56.6 | 48.5 | 38.0 | 25.1 | 49.0 |
| 1973 | 28.4 | 37.7 | 37.9 | 43.8 | 58.8 | 64.3 | 70.1 | 67.4 | 58.5 | 49.2 | 42.8 | 38.3 | 49.8 |
| 1974 | 31.6 | 36.2 | 42.8 | 46.5 | 54.9 | 63.9 | 67.0 | 65.7 | 61.4 | 49.3 | 40.4 | 31.1 | 49.2 |
| 1975 | 32.3 | 34.1 | 38.4 | 39.9 | 54.2 | 62.4 | 70.4 | 64.8 | 64.2 | 49.5 | 35.9 | 33.8 | 48.9 |
| 1976 | 32.1 | 35.0 | 38.3 | 44.5 | 57.5 | 61.1 | 69.0 | 62.1 | 62.0 | 51.3 | 42.4 | 30.5 | 48.8 |
| 1977 | 32.3 | 40.0 | 38.1 | 51.3 | 48.5 | 68.6 | 69.5 | 69.8 | 60.7 | 52.2 | 41.9 | 38.3 | 51.1 |
| 1978 | 37.1 | 38.4 | 47.2 | 45.3 | 52.3 | 61.6 | 69.5 | 67.2 | 57.6 | 53.5 | 37.2 | 24.9 | 49.1 |
| 1979 | 28.9 | 36.9 | 41.9 | 46.9 | 57.1 | 63.9 | 69.9 | 67.7 | 64.2 | 54.0 | 38.0 | 35.5 | 50.4 |
| 1980 | 36.9 | 40.6 | 38.5 | 49.8 | 54.4 | 60.8 | 71.3 | 67.5 | 63.0 | 50.9 | 41.8 | 36.2 | 51.0 |
| 1981 | 36.1 | 38.8 | 41.7 | 50.7 | 57.5 | 68.3 | 67.9 | 69.4 | 64.7 | 46.9 | 42.5 | 39.0 | 52.0 |
| 1982 | 28.5 | 40.3 | 40.2 | 44.0 | 55.0 | 61.8 | 70.4 | 68.8 | 57.0 | 46.9 | 36.2 | 32.3 | 48.5 |
| 1983 | 34.2 | 38.6 | 40.5 | 43.8 | 53.3 | 62.5 | 67.2 | 69.9 | 62.9 | 54.1 | 41.2 | 38.8 | 50.6 |
| 1984 | 31.9 | 37.2 | 44.3 | 45.8 | 59.4 | 67.7 | 73.4 | 69.8 | 63.1 | 46.2 | 39.6 | 30.7 | 50.9 |
| 1985 | 30.6 | 37.0 | 38.7 | 52.7 | 56.3 | 68.6 | 73.4 | 68.5 | 57.4 | 50.4 | 34.8 | 31.2 | 50.7 |
| 1986 | 40.3 | 42.8 | 47.7 | 49.2 | 57.4 | 67.5 | 69.4 | 73.0 | 56.3 | 50.9 | 43.0 | 35.3 | 52.7 |
| 1987 | 31.6 | 38.4 | 43.4 | 54.8 | 59.7 | 67.9 | 68.2 | 71.3 | 65.0 | 56.3 | 41.8 | 31.9 | 52.5 |
| 1988 | 33.0 | 40.2 | 44.1 | 51.2 | 56.6 | 67.0 | 75.2 | 73.2 | 63.4 | 58.4 | 42.7 | 31.2 | 53.0 |
| 1989 | 30.9 | 31.1 | 46.4 | 54.0 | 57.0 | 66.3 | 72.6 | 67.7 | 61.9 | 51.4 | 41.8 | 35.9 | 51.4 |
| 1990 | 34.3 | 30.8 | 45.7 | 54.5 | 56.4 | 65.7 | 73.7 | 71.1 | 65.4 | 54.7 | 40.9 | 25.8 | 51.6 |
| Record Mean | 32.0 | 36.8 | 41.4 | 47.7 | 55.0 | 62.8 | 70.3 | 68.6 | 60.8 | 51.0 | 40.8 | 33.4 | 50.0 |
| Max | 43.8 | 49.2 | 54.9 | 62.7 | 70.5 | 80.0 | 89.5 | 87.8 | 79.3 | 68.1 | 55.3 | 45.4 | 65.5 |
| Min | 20.3 | 24.3 | 27.9 | 32.6 | 39.5 | 45.6 | 51.0 | 49.3 | 42.3 | 33.9 | 26.4 | 21.3 | 34.5 |

See Reference Notes on Page 6B.

## HEATING DEGREE DAYS Base 65 deg. F

RENO, NEVADA

| SEASON | JULY | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUNE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961-62 | 9 | 7 | 267 | 470 | 848 | 1024 | 1178 | 858 | 780 | 440 | 409 | 118 | 6408 |
| 1962-63 | 7 | 110 | 127 | 422 | 718 | 957 | 1134 | 572 | 750 | 691 | 237 | 182 | 5907 |
| # 1963-64 | 38 | 62 | 82 | 389 | 738 | 921 | 1002 | 887 | 840 | 585 | 400 | 135 | 6079 |
| 1964-65 | 6 | 28 | 203 | 296 | 802 | 892 | 968 | 695 | 667 | 454 | 336 | 174 | 5521 |
| 1965-66 | 34 | 31 | 298 | 383 | 694 | 1079 | 974 | 838 | 664 | 439 | 135 | 105 | 5674 |
| 1966-67 | 45 | 45 | 184 | 473 | 715 | 951 | 859 | 685 | 750 | 737 | 317 | 177 | 5938 |
| 1967-68 | 1 | 3 | 87 | 429 | 663 | 1132 | 1025 | 650 | 694 | 606 | 369 | 113 | 5772 |
| 1968-69 | 0 | 91 | 180 | 441 | 721 | 1033 | 861 | 856 | 745 | 494 | 208 | 104 | 5734 |
| 1969-70 | 5 | 12 | 79 | 605 | 772 | 871 | 851 | 638 | 724 | 622 | 216 | 90 | 5485 |
| 1970-71 | 0 | 0 | 234 | 519 | 585 | 1102 | 985 | 780 | 739 | 567 | 429 | 164 | 6104 |
| 1971-72 | 9 | 13 | 264 | 588 | 819 | 1184 | 1216 | 709 | 548 | 558 | 259 | 54 | 6221 |
| 1972-73 | 8 | 26 | 249 | 503 | 803 | 1229 | 1127 | 760 | 834 | 630 | 199 | 87 | 6455 |
| 1973-74 | 7 | 36 | 193 | 483 | 659 | 819 | 1027 | 800 | 680 | 545 | 310 | 73 | 5632 |
| 1974-75 | 52 | 42 | 120 | 478 | 733 | 1046 | 1006 | 858 | 818 | 746 | 332 | 113 | 6344 |
| 1975-76 | 26 | 65 | 51 | 477 | 868 | 961 | 1012 | 863 | 821 | 610 | 224 | 138 | 6116 |
| 1976-77 | 15 | 116 | 116 | 419 | 670 | 1062 | 1002 | 695 | 828 | 405 | 509 | 30 | 5867 |
| 1977-78 | 10 | 12 | 154 | 392 | 687 | 821 | 858 | 739 | 544 | 582 | 387 | 113 | 5299 |
| 1978-79 | 21 | 62 | 234 | 347 | 826 | 1236 | 1113 | 781 | 709 | 536 | 247 | 91 | 6203 |
| 1979-80 | 9 | 28 | 56 | 339 | 805 | 908 | 865 | 701 | 813 | 451 | 319 | 152 | 5446 |
| 1980-81 | 13 | 35 | 79 | 430 | 688 | 885 | 890 | 727 | 715 | 424 | 228 | 48 | 5162 |
| 1981-82 | 12 | 7 | 83 | 554 | 669 | 800 | 1123 | 687 | 760 | 623 | 307 | 133 | 5758 |
| 1982-83 | 15 | 11 | 278 | 556 | 855 | 1006 | 947 | 732 | 752 | 630 | 371 | 77 | 6230 |
| 1983-84 | 40 | 8 | 104 | 332 | 708 | 805 | 1019 | 801 | 637 | 570 | 183 | 133 | 5340 |
| 1984-85 | 0 | 8 | 111 | 575 | 753 | 1056 | 1060 | 781 | 810 | 359 | 266 | 45 | 5824 |
| 1985-86 | 5 | 12 | 230 | 446 | 896 | 1039 | 757 | 618 | 528 | 469 | 285 | 32 | 5317 |
| 1986-87 | 5 | 0 | 291 | 430 | 654 | 913 | 1028 | 737 | 661 | 299 | 182 | 34 | 5234 |
| 1987-88 | 38 | 5 | 45 | 265 | 690 | 1017 | 982 | 714 | 643 | 408 | 267 | 88 | 5162 |
| 1988-89 | 0 | 0 | 132 | 202 | 663 | 1042 | 1049 | 944 | 568 | 321 | 256 | 21 | 5198 |
| 1989-90 | 0 | 21 | 99 | 417 | 688 | 895 | 943 | 954 | 590 | 312 | 260 | 64 | 5243 |
| 1990-91 | 0 | 20 | 55 | 313 | 715 | 1209 | | | | | | | |

See Reference Notes on Page 6B.


## COOLING DEGREE DAYS Base 65 deg. F

RENO, NEVADA

| YEAR | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1969 | 0 | 0 | 0 | 0 | 2 | 19 | 193 | 136 | 35 | 0 | 0 | 0 | 385 |
| 1970 | 0 | 0 | 0 | 0 | 6 | 100 | 256 | 210 | 7 | 0 | 0 | 0 | 579 |
| 1971 | 0 | 0 | 0 | 0 | 0 | 11 | 217 | 197 | 15 | 0 | 0 | 0 | 440 |
| 1972 | 0 | 0 | 0 | 0 | 12 | 65 | 191 | 113 | 4 | 0 | 0 | 0 | 385 |
| 1973 | 0 | 0 | 0 | 0 | 13 | 75 | 173 | 117 | 3 | 0 | 0 | 0 | 381 |
| 1974 | 0 | 0 | 0 | 0 | 2 | 47 | 118 | 71 | 20 | 0 | 0 | 0 | 258 |
| 1975 | 0 | 0 | 0 | 0 | 4 | 43 | 199 | 66 | 33 | 3 | 0 | 0 | 348 |
| 1976 | 0 | 0 | 0 | 0 | 0 | 25 | 144 | 34 | 33 | 0 | 0 | 0 | 236 |
| 1977 | 0 | 0 | 0 | 0 | 6 | 141 | 154 | 167 | 32 | 0 | 0 | 0 | 500 |
| 1978 | 0 | 0 | 0 | 0 | 0 | 16 | 166 | 139 | 19 | 0 | 0 | 0 | 340 |
| 1979 | 0 | 0 | 0 | 0 | 9 | 63 | 169 | 122 | 38 | 3 | 0 | 0 | 404 |
| 1980 | 0 | 0 | 0 | 0 | 2 | 32 | 218 | 119 | 25 | 1 | 0 | 0 | 397 |
| 1981 | 0 | 0 | 0 | 2 | 4 | 153 | 112 | 151 | 80 | 0 | 0 | 0 | 502 |
| 1982 | 0 | 0 | 0 | 0 | 2 | 45 | 188 | 135 | 47 | 0 | 0 | 0 | 417 |
| 1983 | 0 | 0 | 0 | 0 | 16 | 9 | 115 | 170 | 49 | 0 | 0 | 0 | 359 |
| 1984 | 0 | 0 | 0 | 0 | 16 | 42 | 264 | 162 | 61 | 0 | 0 | 0 | 545 |
| 1985 | 0 | 0 | 0 | 0 | 3 | 157 | 273 | 126 | 6 | 0 | 0 | 0 | 565 |
| 1986 | 0 | 0 | 0 | 0 | 53 | 112 | 148 | 253 | 39 | 0 | 0 | 0 | 605 |
| 1987 | 0 | 0 | 0 | 1 | 27 | 126 | 142 | 210 | 53 | 2 | 0 | 0 | 561 |
| 1988 | 0 | 0 | 0 | 0 | 11 | 152 | 323 | 264 | 92 | 2 | 0 | 0 | 844 |
| 1989 | 0 | 0 | 0 | 0 | 19 | 66 | 240 | 112 | 13 | 0 | 0 | 0 | 450 |
| 1990 | 0 | 0 | 0 | 1 | 0 | 95 | 278 | 216 | 76 | 0 | 0 | 0 | 666 |

See Reference Notes on Page 6B.

## SNOWFALL (inches)

RENO, NEVADA

| SEASON | JULY | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUNE | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1961-62 | 0.0 | 0.0 | 0.0 | T | 8.7 | 0.7 | 3.5 | 13.3 | 12.3 | T | 9.0 | 0.0 | 47.5 |
| 1962-63 | 0.0 | 0.0 | 0.0 | T | T | T | 1.7 | 0.0 | 3.4 | 5.9 | T | T | 11.0 |
| 1963-64 | 0.0 | 0.0 | 0.0 | 0.0 | 3.1 | 1.0 | 4.7 | 1.0 | 9.2 | 6.6 | 14.1 | 0.0 | 39.7 |
| 1964-65 | 0.0 | 0.0 | 0.0 | 0.0 | 5.2 | 8.0 | 5.2 | T | 4.6 | T | T | 0.0 | 23.0 |
| 1965-66 | 0.0 | 0.0 | 0.0 | T | 2.2 | 9.8 | T | 1.4 | 0.4 | T | 0.0 | 0.0 | 13.8 |
| 1966-67 | 0.0 | 0.0 | 0.0 | 0.0 | T | 5.8 | 12.4 | T | 15.6 | 6.8 | 1.5 | 0.0 | 42.1 |
| 1967-68 | 0.0 | 0.0 | 0.0 | 0.0 | T | 1.9 | 12.4 | 2.2 | 3.5 | * | T | 0.0 | 20.0 |
| 1968-69 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 9.1 | 10.7 | 23.5 | 1.9 | 0.3 | T | 0.0 | 46.8 |
| 1969-70 | 0.0 | 0.0 | 0.0 | 0.0 | T | 2.8 | T | 0.6 | 1.8 | 2.3 | T | 0.2 | 7.7 |
| 1970-71 | 0.0 | 0.0 | 0.0 | 0.2 | T | 15.4 | 11.4 | 4.9 | 7.0 | 2.3 | 6.3 | 0.0 | 48.5 |
| 1971-72 | 0.0 | 0.0 | T | 5.1 | 0.2 | 25.6 | 5.7 | 0.7 | 0.2 | 1.0 | 0.0 | 0.0 | 38.5 |
| 1972-73 | 0.0 | 0.0 | 0.0 | T | T | 8.8 | 11.9 | 8.2 | 6.5 | 0.1 | T | 0.0 | 36.1 |
| 1973-74 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 6.8 | 8.7 | 1.0 | 6.5 | 2.6 | T | 0.0 | 28.1 |
| 1974-75 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.0 | 2.7 | 19.0 | 12.1 | 4.8 | 2.2 | T | 44.8 |
| 1975-76 | 0.0 | 0.0 | 0.0 | T | 1.7 | T | 0.3 | 15.8 | 7.8 | 2.7 | T | 0.0 | 28.3 |
| 1976-77 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.7 | 1.4 | 1.2 | T | 2.9 | 0.0 | 6.7 |
| 1977-78 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 5.6 | 0.3 | 5.1 | 0.2 | 0.1 | 0.4 | 0.0 | 12.2 |
| 1978-79 | 0.0 | 0.0 | T | 0.8 | 9.7 | 9.1 | 6.4 | 3.9 | 0.2 | 1.1 | 0.3 | 0.0 | 31.5 |
| 1979-80 | 0.0 | 0.0 | 0.0 | 0.3 | T | 2.1 | 4.7 | 6.1 | 7.6 | 1.2 | T | 0.0 | 22.0 |
| 1980-81 | 0.0 | 0.0 | 0.0 | T | T | T | 3.9 | T | 2.2 | T | 0.0 | 0.0 | 6.1 |
| 1981-82 | 0.0 | 0.0 | 0.0 | 1.1 | 2.0 | 0.1 | 12.5 | 2.3 | 6.7 | 0.8 | 0.5 | 0.0 | 26.0 |
| 1982-83 | 0.0 | 0.0 | 1.5 | 0.0 | 8.6 | 1.8 | 1.5 | 1.0 | 3.0 | 2.9 | 3.5 | 0.0 | 23.8 |
| 1983-84 | 0.0 | 0.0 | 0.0 | 0.0 | 5.7 | 0.5 | 6.7 | 1.5 | 0.1 | * | 0.0 | 0.0 | 14.5 |
| 1984-85 | 0.0 | 0.0 | 0.0 | 3.4 | 3.0 | 1.3 | 4.3 | 0.8 | 7.0 | * | T | 0.0 | 19.8 |
| 1985-86 | 0.0 | 0.0 | T | 1.2 | 16.5 | 1.4 | 0.0 | T | 1.4 | 0.4 | T | 0.0 | 20.9 |
| 1986-87 | 0.0 | 0.0 | T | 0.0 | 0.2 | 0.6 | 1.8 | 8.0 | 2.5 | * | 0.0 | 0.0 | 13.1 |
| 1987-88 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 6.3 | 8.2 | 0.0 | T | * | T | 0.0 | 15.3 |
| 1988-89 | 0.0 | 0.0 | 0.0 | 0.0 | 4.1 | 11.7 | 3.3 | 13.3 | 2.2 | 0.8 | T | 0.0 | 35.4 |
| 1989-90 | 0.0 | 0.0 | 0.0 | T | T | T | 5.6 | 21.6 | 2.0 | 0.0 | 0.0 | 0.0 | 29.2 |
| 1990-91 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 2.7 | | | | | | | |
| Record Mean | 0.0 | 0.0 | T | 0.4 | 2.2 | 4.3 | 5.8 | 5.2 | 4.6 | 1.3 | 0.9 | T | 24.8 |

See Reference Notes on Page 6B.



## REFERENCE NOTES

RENO, NEVADA

GENERAL
T - TRACE AMOUNT
BLANK ENTRIES DENOTE MISSING/UNREPORTED DATA.
# INDICATES A STATION OR INSTRUMENT RELOCATION.
SEE STATION LOCATION TABLE ON PAGE 8.

SPECIFIC
PAGE 2
PM - INCLUDES LAST DAY OF PREVIOUS MONTH

PAGE 3
(a) - LENGTH OF RECORD IN YEARS, ALTHOUGH INDIVIDUAL MONTHS MAY BE MISSING.
0.* OR * THE VALUE IS BETWEEN 0.0 AND 0.05
NORMALS - BASED ON THE 1951-1980 RECORD PERIOD.
EXTREMES DATES ARE THE MOST RECENT OCCURRENCE
WIND DIR. NUMERALS SHOW TENS OF DEGREES CLOCKWISE FROM TRUE NORTH. '00' INDICATES CALM.
RESULTANT DIRECTIONS ARE GIVEN TO WHOLE DEGREES.

PAGE 4B
MAX AND MIN ARE LONG TERM MEAN DAILY MAXIMUM AND MEAN DAILY MINIMUM TEMPERATURES.

EXCEPTIONS

PAGE 3
1. PERCENT OF POSSIBLE SUNSHINE IS THROUGH 1971 AND 1984 TO DATE.
PAGES 4A, 4B, 6A
RECORD MEANS ARE THROUGH THE CURRENT YEAR, BEGINNING IN 1888 FOR TEMPERATURE
1870 FOR PRECIPITATION
1943 FOR SNOWFALL.

# RENO, NEVADA

At an elevation of 4,400 feet above mean sea level, Reno is located at the west edge of Truckee Meadows in a semi-arid plateau lying in the lee of the Sierra Nevada Mountain Range. To the west, the Sierras rise to elevations of 9,000 to 11,000 feet. Hills to the east reach 6,000 to 7,000 feet. The Truckee River, flowing from the Sierras eastward through Reno, drains into Pyramid Lake to the northeast of the city.

The daily temperatures on the whole are mild, but the difference between the high and low often exceeds 45 degrees. While the afternoon high may exceed 90 degrees, a light wrap is often needed shortly after sunset. Nights with low temperatures over 60 degrees are rare. Afternoon temperatures in winter are moderate.

Based on the 1951-1980 period, the average first occurrence of 32 degrees Fahrenheit in the fall is September 16 and the average last occurrence in the spring is June 1.

More than half of the precipitation in Reno occurs mainly as mixed rain and snow, and falls from December to March. Although there is an average of about 25 inches of snow a year, it seldom remains on the ground for more than three or four days at a time. Summer rain comes mainly as brief thunderstorms in the middle and late afternoons. While precipitation is scarce, considerable water is available from the high altitude reservoirs in the Sierra Nevada, where precipitation is heavy.

Humidity is very low during the summer months, and moderately low during the winter. Fogs are rare, and are usually confined to the early morning hours of midwinter. Sunshine is abundant throughout the year.

# STATION LOCATION

RENO, NEVADA

| LOCATION | OCCUPIED FROM | OCCUPIED TO | AIRLINE DISTANCES AND DIRECTIONS FROM PREVIOUS LOCATION | LATITUDE NORTH | LONGITUDE WEST | ELEVATION ABOVE SEA LEVEL: GROUND TEMPERATURE SITE | ELEVATION ABOVE GROUND: WIND INSTRUMENTS | EXTREME THERMOMETERS | PSYCHROMETER | SUNSHINE SWITCH | TIPPING BUCKET RAIN GAGE | WEIGHING RAIN GAGE | 8 INCH RAIN GAGE | HYGROTHERMOMETER | AUTOMATIC OBSERVING EQUIPMENT * | * TYPE: M = AMOS, T = AUTOB, S = ASOS, W = AWOS — REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COOPERATIVE | | | | | | | | | | | | | | | | |
| Southern Pacific Depot Commercial & Lake Sts. | 12/01/70 | 12/31/87 | | 39°32' | 119°48' | 4493 | | | | | | | 4 | | | Daily rainfall records by Southern Pacific Co. Agent. |
| Univ. of Nevada Campus Administration Bldg. (Morril Hall) | 1/01/88 | 11/01/05 | 0.7 mi.NNW | 39°33' | 119°49' | 4558 | | 5 | | | | | 4 | | | Max., min. and rainfall records of Univ. of Nevada. |
| CITY | | | | | | | | | | | | | | | | |
| Thoma-Biglow Building 1st & Virginia Streets | 11/11/05 | 2/28/10 | 0.7 mi.SSE | 39°32' | 119°49' | 4496 | 63 | 56 | 56 | | 47 | | 47 | | | |
| I O O F Building 2nd & N Center Streets | 3/01/10 | 2/28/34 | 0.1 mi.NE | 39°32' | 119°49' | 4495 | 81 | 74 | 74 | | 67 | | 67 | | | |
| Post Office Building S Virginia & Mill Sts. | 3/01/34 | 8/31/42 | 0.2 mi.S | 39°32' | 119°49' | 4493 | 76 | 61 | 61 | | 53 | | 53 | | | |
| AIRPORT | | | | | | | | | | | | | | | | |
| Hubbard field (Later changed to United Airlines AP) | 1/08/31 | 5/31/49 | 3.5 mi.SSE | 39°30' | 119°47' | 4397 | 52 | 20 | 20 | | 5 | 5 | 4 | | | |
| CAA Building Reno Municipal Airport | 6/01/49 | 10/23/59 | 60 ft. S | 39°30' | 119°47' | 4397 | 53 | 6 | 6 | | 4 | a5 | a3 | | | Name changed from United Airlines Airport 12/1/53. a - Shielded 10/25/57. |
| Federal Facilities Bldg Municipal Airport + * + International AP effective 2/3/70 | 10/23/59 | 8/13/80 | 0.8 mi.NNW | 39°30' | 119°47' | 4404 | 20 | c6 | c6 | %17 | NA | c5 | c4 | b4 | NA | b - Commissioned 11/3/59 about 3/4 mile SE of office and moved 2350 ft. N by W 11/16/63. c - Minor move 5/12/78. % - Commissioned 11/3/59. |
| * Cannon International Airport eff. 8/79. | | | | | | | | | | | | | | | | |
| General Aviation Bldg. Cannon International AP | 8/13/80 | Present | 0.25mi.ESE | 39°30' | 119°47' | 4404 | e30 | 5 | 5 | 17 | NA | 4 | 4 | d4 f4 | NA | d - Not moved 8/13/80. e - Not moved but raised at prior site 8/13/80. f - Type change 11/22/84. |

SUBSCRIPTION:
Price and ordering information available through: National Climatic Data Center, Federal Building, Asheville, North Carolina 28801.
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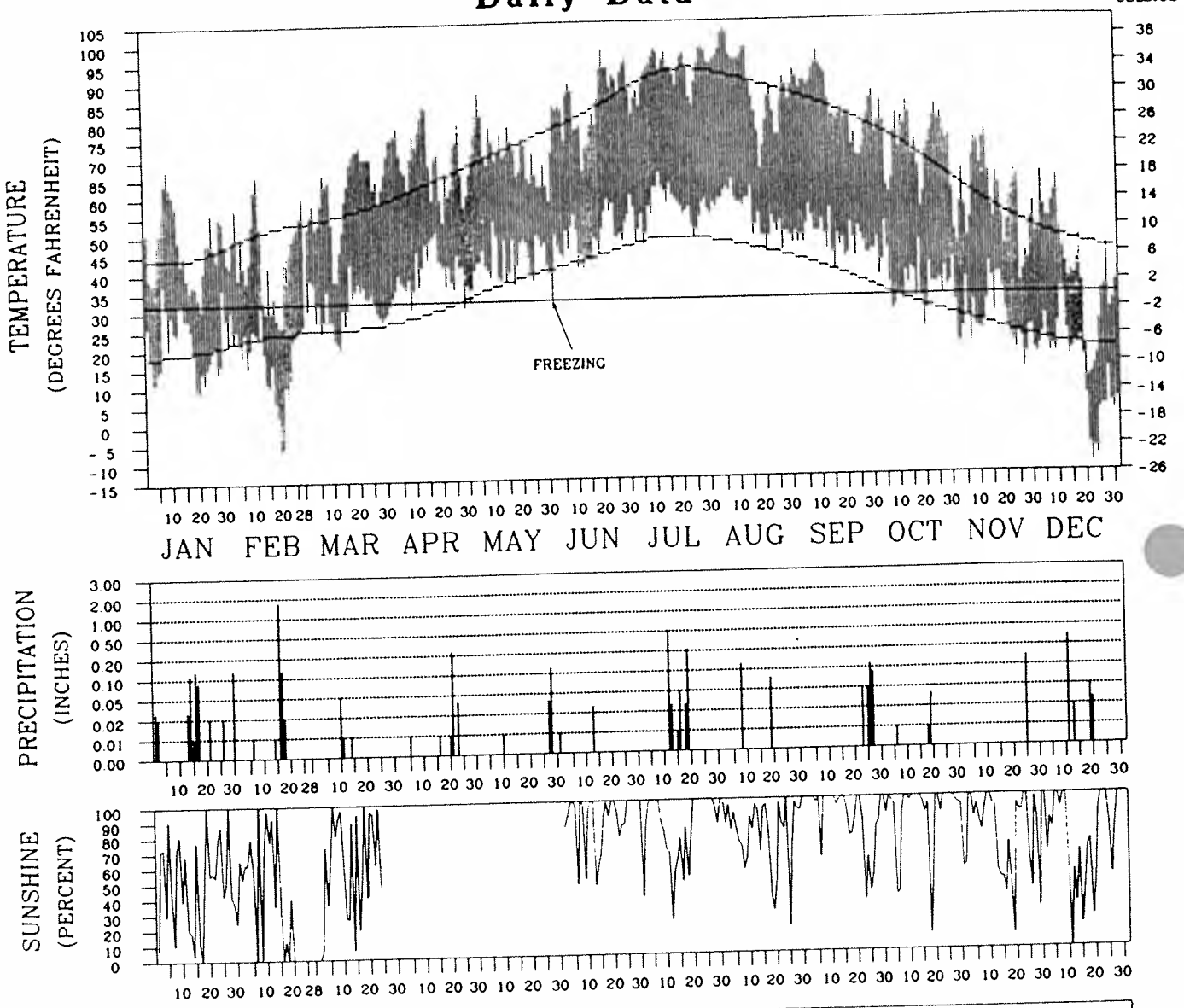
# 1990 LOCAL CLIMATOLOGICAL DATA
## ANNUAL SUMMARY WITH COMPARATIVE DATA

RENO,

NEVADA

## Daily Data




TEMPERATURE DEPICTS NORMAL MAXIMUM, NORMAL MINIMUM AND ACTUAL DAILY HIGH AND LOW VALUES (FAHRENHEIT)
PRECIPITATION IS MEASURED IN INCHES. SCALE IS NON-LINEAR
SUNSHINE IS PERCENT OF THE POSSIBLE SUNSHINE

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER, ASHEVILLE, NORTH CAROLINA, 28801

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# METEOROLOGICAL DATA FOR 1990

**RENO, NEVADA**

LATITUDE: 39°30' N LONGITUDE: 119°47' W ELEVATION: FT. GRND 4404 BARO 4402 TIME ZONE: PACIFIC WBAN: 23185

| | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEP | OCT | NOV | DEC | YEAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TEMPERATURE °F:** | | | | | | | | | | | | | |
| Averages | | | | | | | | | | | | | |
| -Daily Maximum | 47.4 | 44.4 | 60.9 | 69.7 | 70.5 | 83.8 | 91.9 | 88.7 | 83.5 | 73.2 | 56.6 | 39.5 | 67.5 |
| -Daily Minimum | 21.2 | 17.1 | 30.5 | 39.2 | 42.3 | 47.5 | 55.5 | 53.5 | 47.2 | 36.2 | 25.2 | 12.0 | 35.6 |
| -Monthly | 34.3 | 30.8 | 45.7 | 54.5 | 56.4 | 65.7 | 73.7 | 71.1 | 65.4 | 54.7 | 40.9 | 25.8 | 51.6 |
| -Monthly Dewpt. | 20.6 | 17.5 | 24.5 | 31.8 | 28.8 | 32.1 | 42.1 | 40.1 | 37.3 | 29.5 | 22.2 | 12.9 | 28.3 |
| Extremes | | | | | | | | | | | | | |
| -Highest | 68 | 66 | 73 | 84 | 87 | 98 | 98 | 103 | 97 | 86 | 75 | 64 | 103 |
| -Date | 9 | 11 | 21 | 14 | 5 | 21 | 29 | 6 | 10 | 1 | 13 | 4 | AUG 6 |
| -Lowest | 9 | -7 | 20 | 30 | 32 | 32 | 46 | 44 | 39 | 23 | 12 | -13 | -13 |
| -Date | 20 | 19 | 13 | 29 | 1 | 1 | 6 | 27 | 16 | 20 | 27 | 22 | DEC 22 |
| **DEGREE DAYS BASE 65 °F:** | | | | | | | | | | | | | |
| Heating | 943 | 954 | 590 | 312 | 260 | 64 | 0 | 20 | 55 | 313 | 715 | 1209 | 5435 |
| Cooling | 0 | 0 | 0 | 1 | 0 | 95 | 278 | 216 | 76 | 0 | 0 | 0 | 666 |
| **% OF POSSIBLE SUNSHINE** | 50 | | | | | 88 | 82 | 78 | 87 | 78 | 75 | 73 | |
| **AVG. SKY COVER (tenths)** | | | | | | | | | | | | | |
| Sunrise - Sunset | 7.1 | 6.0 | 5.4 | 7.4 | 5.2 | 3.0 | 2.5 | 3.8 | 2.6 | 3.3 | 5.6 | 4.5 | 4.7 |
| Midnight - Midnight | 6.2 | 5.5 | 4.8 | 6.5 | 5.0 | 2.9 | 2.5 | 3.5 | 2.4 | 2.7 | 4.7 | 3.9 | 4.2 |
| **NUMBER OF DAYS:** | | | | | | | | | | | | | |
| Sunrise to Sunset | | | | | | | | | | | | | |
| -Clear | 4 | 9 | 10 | 4 | 12 | 19 | 22 | 17 | 20 | 17 | 9 | 14 | 157 |
| -Partly Cloudy | 10 | 8 | 11 | 9 | 10 | 10 | 7 | 8 | 7 | 11 | 11 | 7 | 109 |
| -Cloudy | 17 | 11 | 10 | 17 | 9 | 1 | 2 | 6 | 3 | 3 | 10 | 10 | 99 |
| Precipitation .01 inches or more | 10 | 5 | 3 | 5 | 4 | 1 | 6 | 2 | 4 | 3 | 1 | 4 | 48 |
| Snow, Ice pellets 1.0 inches or more | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 |
| Thunderstorms | 0 | 0 | 0 | 3 | 1 | 1 | 10 | 7 | 3 | 0 | 0 | 0 | 25 |
| Heavy Fog, visibility 1/4 mile or less | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Temperature °F | | | | | | | | | | | | | |
| -Maximum | | | | | | | | | | | | | |
| 90° and above | 0 | 0 | 0 | 0 | 0 | 9 | 21 | 15 | 8 | 0 | 0 | 0 | 53 |
| 32° and below | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 14 |
| -Minimum | | | | | | | | | | | | | |
| 32° and below | 29 | 28 | 19 | 3 | 1 | 1 | 0 | 0 | 0 | 10 | 24 | 30 | 145 |
| 0° and below | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 6 |
| **AVG. STATION PRESS. (mb)** | 867.3 | 867.9 | 865.6 | 864.5 | 863.2 | 865.2 | 866.2 | 866.9 | 866.9 | 867.9 | 869.6 | 868.3 | 866.6 |
| **RELATIVE HUMIDITY (%)** | | | | | | | | | | | | | |
| Hour 04 | 77 | 77 | 71 | 68 | 59 | 56 | 60 | 59 | 65 | 64 | 69 | 77 | 67 |
| Hour 10 (Local Time) | 68 | 64 | 44 | 38 | 30 | 21 | 25 | 29 | 33 | 37 | 51 | 66 | 42 |
| Hour 16 | 44 | 45 | 29 | 31 | 24 | 18 | 20 | 20 | 21 | 23 | 34 | 48 | 30 |
| Hour 22 | 69 | 66 | 51 | 49 | 41 | 33 | 39 | 38 | 43 | 44 | 58 | 72 | 50 |
| **PRECIPITATION (inches):** | | | | | | | | | | | | | |
| Water Equivalent | | | | | | | | | | | | | |
| -Total | 0.62 | 1.98 | 0.07 | 0.33 | 0.19 | 0.03 | 0.86 | 0.21 | 0.31 | 0.06 | 0.15 | 0.45 | 5.26 |
| -Greatest (24 hrs) | 0.22 | 1.80 | 0.06 | 0.27 | 0.16 | 0.03 | 0.51 | 0.13 | 0.12 | 0.05 | 0.15 | 0.35 | 1.80 |
| -Date | 16-17 | 16 | 10-11 | 20-21 | 27-28 | 13 | 12 | 8 | 26 | 18-19 | 25-26 | 11 | FEB 16 |
| Snow, Ice pellets | | | | | | | | | | | | | |
| -Total | 5.6 | 21.6 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 2.7 | 32.3 |
| -Greatest (24 hrs) | 3.8 | 18.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 1.7 | 18.0 |
| -Date | 16-17 | 16 | 10-11 | | | | | | | | 25-26 | 19 | FEB 16 |
| **WIND:** | | | | | | | | | | | | | |
| Resultant | | | | | | | | | | | | | |
| -Direction (!!!) | 286 | 289 | 321 | 313 | 291 | 280 | 281 | 280 | 276 | 309 | 355 | 017 | 294 |
| -Speed (mph) | 0.6 | 1.1 | 1.6 | 4.1 | 3.6 | 4.1 | 3.5 | 3.5 | 1.4 | 0.6 | 0.7 | 0.5 | 2.0 |
| Average Speed (mph) | 5.3 | 6.2 | 7.3 | 8.8 | 10.6 | 9.0 | 8.4 | 7.5 | 6.5 | 6.3 | 5.4 | 4.2 | 7.1 |
| Fastest Mile | | | | | | | | | | | | | |
| -Direction (!!!) | SW | | NW | W | | 18 | 17 | 21 | 17 | 18 | 17 | 25 | |
| -Speed (mph) | 40 | | 40 | 30 | | 29 | 29 | 31 | 29 | 32 | 30 | 29 | |
| -Date | 30 | | 10 | 27 | | 3 | 28 | 8 | 24 | 18 | 25 | 18 | |
| Peak Gust | | | | | | | | | | | | | |
| -Direction (!!!) | S | | SW | W | S | S | S | SW | S | S | SW | W | |
| -Speed (mph) | 46 | | 45 | 39 | 47 | 46 | 44 | 45 | 43 | 43 | 43 | 55 | |
| -Date | 30 | | 7 | 27 | 20 | 3 | 28 | 8 | 24 | 18 | 25 | 18 | |

!!!! See Reference Notes on Page 6B

2.4 j) WP-TOTPOR: 38%

2.4 k) WP-FIELDC: 9.0%

2.4 l) WP-LDISP*: 1.0 ft

* DL = 0.01 (Th) where Th = Thickness of the PSZ
DL = 0.01 * 100 ft

2.4 m) WP-CONDUC**: 2.8871E3 ft/day

** Saturated Hydraulic Conductivity = $8.8E4 \frac{cm}{day} * \frac{1 IN}{2.54 cm} * \frac{1 Ft}{12 IN}$ = 2.8871E3 ft/day

F) SATURATED ZONE

2.5a) WZ-CLASS: SAND

2.5 b) WZ-SAND: 95 %

2.5 c) WZ-SILT: 3 %

2.5 d) WZ-CLAY: 2 %

2.5 e) WZ-OMC: 0%

2.5 f) WZ-IRON: 0%

2.5 g) WZ-PH: 7

2.5 h) WZ-TOTPOR: 38.0%

2.5 i) WZ-EFFPOR*: 24.40 %

* (Sand) 95% * 0.25 + (Silt) 3% * 0.15 + (Clay) 2% * 0.1 = 24.40 %

2.5 j) WZ PVELOC: 1.1524E2 ft/Day

$$PVELOC = \frac{\left[\frac{K(H_1-H_2)}{d}\right]}{Ne} = \frac{2.8871E3\ ft/day * 9.6834E-3}{0.244}$$

K = Saturated Hydraulic Conductivity = $8.8E4\ \frac{cm}{day} * \frac{1IN}{2.54cm} * \frac{1Ft}{12IN} = 2.8871E3\ \frac{ft}{day}$

$$\frac{(H_1-H_2)}{d} = \left(\frac{4885\ ft - 4833\ ft}{5370\ ft}\right) = 9.6834E-3$$

2.5k) WZ-THICK = 100 Ft

2.5l) WZ* BULKD = 1.64

2.5m) WZ-CONDUC = 2.8871E3 ft/day

- TRAVEL DISTANCE IN THE SATURATED ZONE (STREAM OB)

2.5m) WZ-DIST*: 868 ft

* Topo Map (Cannon Hoop): Nearest stream 11mm North

$$11mm * \frac{3000ft}{38mm} = 868\ ft$$

2.5n) WZ-LDISP* = 86.8 ft

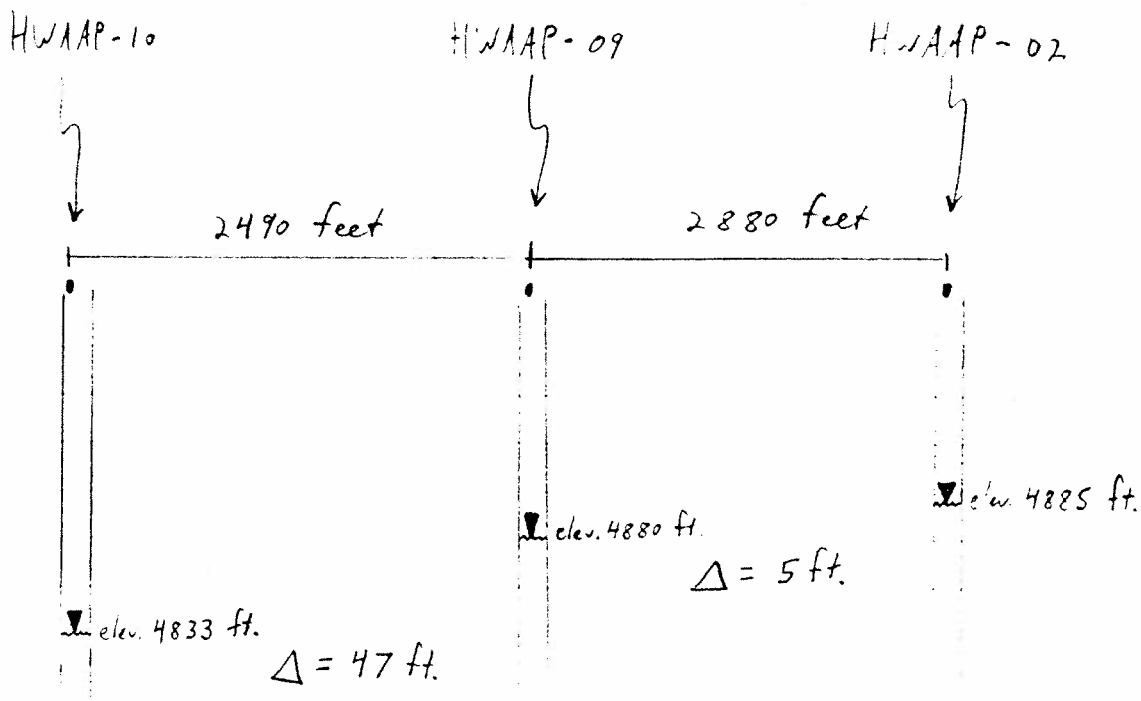
* DL = 0.1 (Tr) Where Tr = Travel Distance
= 0.1 (868 ft)
= 86.8 ft

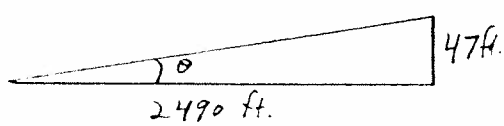
2.5o) WZ-TDISP**: 17.36 ft

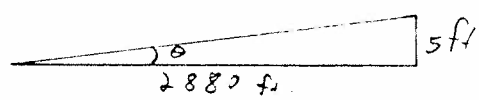
** DT = 0.2 (DL)
= 0.2 (86.8) ft
= 17.36 ft

| NUS CORPORATION AND SUBSIDIARIES | STANDARD CALCULATION SHEET |
|---|---|

| CLIENT: SUBPART X | FILE NO.: 7T03 2005 | BY: J. HAYNES | PAGE 3 OF 3 |
|---|---|---|---|
| SUBJECT: Hawthorne, groundwater gradient | | CHECKED BY: | DATE: 05-28-93 |

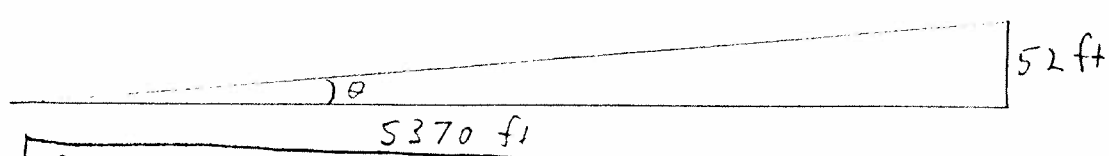



$$\text{Slope} = \theta = \arctan\left(\frac{47}{2490}\right) = 1.08^\circ$$

$$\text{Slope} = \theta = \arctan\left(\frac{5}{2880}\right) = 0.10^\circ$$




$$\text{Overall slope} = \theta = \arctan\left(\frac{52}{5370}\right) = 0.56^\circ$$

2.5 P) WZ - VDISP*** : 1.0069 E-1 Ft

DV = 1.16E-3 (DL)
= 1.16E-3 ( 86.8 ft)
= 1.0069 E-1

- TRAVEL DISTANCE IN THE SATURATED ZONE - WELL OB
Unit is approximately 8 Miles southeast of the Town of Hawthorne.

2.5m) WZ - DIST*: 42240 Ft

* 5280 $\frac{Ft}{Mile}$ * 8 Miles = 42240 Ft

2.5n) WZ - LDISP = 4224 Ft
DL = 0.1 (Tr) where Tr = Travel Distance
= 0.1 (42240 Ft)
= 4224 Ft

2.5o) WZ - TDISP = 844.8 Ft
DT = 0.2 (DL)
= 0.2 (4224)
= 844.8

2.5P) WZ - VDISP: 4.8998 Ft
DV = 1.16 E-3 (DL)
= 1.16 E-3 (4224)
= 4.8998 Ft

- RECEPTORS - SST4, SST3, SST2

4.2a) EW - POPDRW: 1

4.2b) EW - TREAT: NO

4.2c) EW - TWATER: 0.0 DAYS

OLD BOMB / 013

INTERNATIONAL TECHNOLOGY CORPORATION

VOLUME 1 OF 3

# FINAL REPORT

## Ordnance and Environmental Investigation
## Hawthorne Army Ammunition Plant
## Hawthorne, Nevada

Contract DACA87-87-C-0100

Submitted to:

U.S. Army Engineer Division
Huntsville, Alabama

March 1989

Prepared by:


INTERNATIONAL TECHNOLOGY CORPORATION
4585 Pacheco Boulevard
Martinez, California 94553

## 1.3 INVESTIGATION SITES

The specific locations and descriptions of each of the three investigation sites are provided below.

### 1.3.1 Group 55/110 Burn Area

The Group 55/110 Burn Area is located in the northeast corner of HWAAP at 5th Avenue North and Grant Road (Figure 1-2). This site consists of about 40 acres and is enclosed with a wire strand fence. One small wooden structure is located within the site near the entrance gate. Approximately two-thirds of the site was used for open burning and pit disposal of bulk explosives, propellants, metal parts, chemical warfare training compounds, and shipping containers. Limited information is available on the exact operations which took place at the site and the time frame in which these operations took place.

The site is relatively flat and located at an elevation of about 4,200 feet. Five large depressions or pits are visible on the west side of the site. These depressions appear to be the result of past burn or disposal operations. Ground water flow in the Group 55/110 Burn Area is considered to be toward Walker Lake, approximately 4.5 miles west of the site (Figure 1-2).

### 1.3.2 Old Burn/Old Bomb Test Range (OB/OBTR)

The OB/OBTR site is located in the southeast corner of HWAAP adjacent to the Whiskey Flats area, approximately eight miles southeast of the town of Hawthorne (Figure 1-2). The area of investigation at this site consists of approximately 1,300 acres and is unfenced except for a small area. The elevation of the site varies between 5,300 feet at the western end to about 5,000 feet on the east. This compares to the elevation of Walker Lake, which is approximately 3,900 feet. The OB/OBTR site has been actively involved with the disposal and demolition of large quantities of munitions since the construction of HWAAP.

Records indicate that a 50-acre section of the OB/OBTR site referred to as the Old Bomb had been used since 1944 or earlier for open burning/open detonation operations (ES&E, 1985). It was reported that during the years 1944 to 1945 an estimated 10,000 tons of mines, warheads, bombs, incendiary devices, and

NEW BOMB / OD

GW FLOW

INTERNATIONAL TECHNOLOGY CORPORATION

VOLUME 1 OF 3

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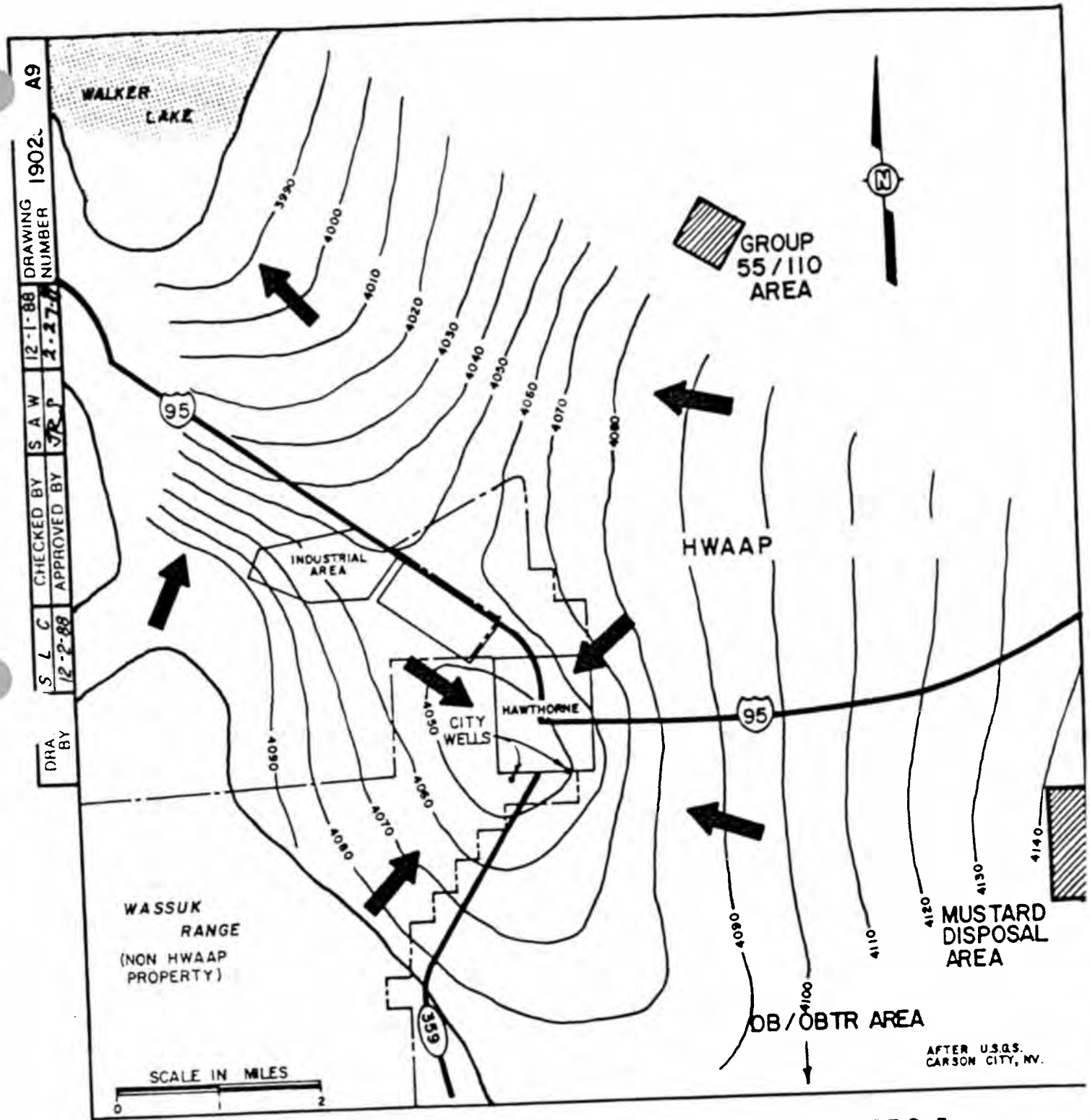
The dominant features influencing surface water flow at the HWAAP are the Wassuk Mountains to the west and Walker Lake. The annual precipitation is approximately four inches at the valley floor with higher amounts of precipitation at higher elevations. The Wassuk Mountains contribute most of the surface water flow due to the higher amount of precipitation and its larger watersheds as compared to other mountains in the Walker Lake Basin. Rainfall and thunderstorms are infrequent, and consequently streams flow intermittently. Figure 2-2 shows the general direction of surface water flow in the HWAAP. As shown on this figure, all the water courses are ephemeral, and there is significant infiltration of stream flow. Surface flows reach the Walker Lake Valley bottom and Walker Lake only during major storms.

In the vicinity of HWAAP, water and monitoring wells have been completed at depths ranging from 20 to 850 feet. The water table has been encountered at depths below the surface ranging from less than 10 feet close to Walker Lake to over 500 feet in the Whiskey Springs area.

The valley fill comprises a continuous water bearing unit of regional extent. However, there are substantial variations in permeability, which are associated with deposit types (i.e., fluvial, stream-laid deposits are more pervious than alluvial fans since they contain fewer fines). **Available information suggests ground water flow in the valley fill is toward Walker Lake.**

Bedrock beneath the valley fill is considered to include a water-bearing unit essentially distinct from the fill, although in some places there may be a hydraulic continuity between the two water-bearing units. The flow of ground water in bedrock is generally controlled by the bedrock depositional and structural characteristics. However, in the Basin and Range Province ground water flow in bedrock is not necessarily toward basin topographic lows, as is the case in the valley fill. Instead, the ground water flow in bedrock can be from one basin to another, crossing entire mountain ranges. In the Walker Lake Basin there is insufficient information available to evaluate the ground water flow regime in bedrock.




| DRAWING NUMBER | 1902 | A9 |
|---|---|---|
| | 12-1-88 | 2-27-89 |
| CHECKED BY | S A W | JRP |
| APPROVED BY | | |
| | S L C | 12-2-88 |
| DRA. BY | | |

LEGEND

4020 — WATER LEVEL CONTOURS; CONTOUR INTERVAL 10 FEET (3.0 M), DATUM IS MEAN SEA LEVEL

DIRECTION OF GROUND WATER FLOW

HWAAP BOUNDARY

REFERENCE: INSTALLATION ASSESSMENT, NAVAL AMMUNITIONS DEPOT, USATHAMA 1977

© 1984 IT CORPORATION

FIGURE 2-3

GENERALIZED GROUND WATER LEVELS IN THE HAWTHORNE AREA, 1974

PREPARED FOR

ORDNANCE & ENVIRONMENTAL INVESTIGATION
HAWTHORNE ARMY AMMUNITION PLANT
HAWTHORNE, NEVADA

IT ... Creating a Safer Tomorrow

**HALLIBURTON NUS Environmental Corporation and Subsidiaries** — STANDARD CALCULATION SHEET

| CLIENT: SUBPART X | FILE NO.: 7T03 2005 | BY: D. OLSON | PAGE OF |
|---|---|---|---|
| SUBJECT: HAWTHORNE - OLD BOMB OB | | CHECKED BY: | DATE: 05-28-93 |

- HPI FILE DISPERSION FACTORS

The shortest distance to the site boundry is to the south:

38mm = 3000 Ft (Topo Map - Connie Horga)

Distance measured = 111 mm ∴ $\frac{111\,mm}{38\,mm} * 3000\,ft = 8763\,Ft$

$8763\,Ft * 0.3048\,\frac{M}{Ft} = 2671$ Meters = 2.671 KM

Dispersion factors are given for 2.41 Km (8.75E-6) and for 4.02 Km (1.46E-6) Units S/M³

The Dispersion factor for 2.671 KM is:

$$\frac{8.75E\text{-}6\ S/M^3 - 1.46E\text{-}6\ S/M^3}{4.02\,KM - 2.41\,KM} * (2.671\,KM - 2.41\,KM)$$

$$\frac{7.29E\text{-}6\ S/M^3}{1.61\,KM} * 0.261\,KM = 1.1818E\text{-}6\ S/M^3$$

Dispersion factor (2.671 KM) = 8.75E-6 S/M³ - 1.1818E-6 S/M³ = 7.568E-6 S/M³

| Constituent | Emission Rate | | Dispersion Factor | = | Concentration mg/M³ | Concentration Ug/M³ |
|---|---|---|---|---|---|---|
| 2,4-DNT | 3.70E-8 mg/S | * | 7.568E-6 S/M³ | = | 2.80E-13 | 2.80E-10 |
| Ba | 1.30E-3 mg/S | * | " | = | 9.84E-9 | 9.84E-6 |
| HMX | 3.70E-8 mg/S | * | " | = | 2.80E-13 | 2.80E-10 |
| M-DNB | 3.70E-8 mg/S | * | " | = | 2.80E-13 | 2.80E-10 |
| K | 7.20E-4 mg/S | * | " | = | 5.45E-9 | 5.45E-6 |
| RDX | 3.70E-8 mg/S | * | " | = | 2.80E-13 | 2.80E-10 |
| TNT | 3.70E-8 mg/S | * | " | = | 2.80E-13 | 2.80E-10 |

Exposures are Computed Based on the Following Atmospheric Emission Rates:

| Deposition Class Type | Units | Constituent 1 | Constituent 2 | Constituent 3 | Constituent 4 |
|---|---|---|---|---|---|
| Start Time: | Years | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 1: | mg/s or pCi/s | 3.700E-08 | 1.300E-03 | 3.700E-08 | 3.700E-08 |
| Class 2: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 3: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 4: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 5: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 6: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 7: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |

| Deposition Class Type | Units | Constituent 5 | Constituent 6 | Constituent 7 |
|---|---|---|---|---|
| Start Time: | Years | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 1: | mg/s or pCi/s | 7.200E-04 | 3.700E-08 | 3.700E-08 |
| Class 2: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 3: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 4: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 5: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 6: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 7: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 |

**********

KEY for Constituents in Table

Constituent 1 = 2,4-DINITROTOLUENE  2 = BARIUM
Constituent 3 = HMX (H-NO2 TETZOCINE  4 = M-DINITROBENZENE
Constituent 5 = POTASSIUM ION  6 = RDX 6H-3NO2-TRIAZINE
Constituent 7 = TNT 3NO2-TOLUENE

Dispersion Factors for constituents: Class 1
All Dispersion Factors are in Units of (s/m**3)

| Sector | Distance (Km) .81 | 2.41 | 4.02 | 5.63 | 7.24 |
|---|---|---|---|---|---|
| 1 | 7.53E-05 | 8.75E-06 | 1.46E-06 | 1.11E-06 | 7.66E-07 |
| 2 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 3 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 4 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 5 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 6 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 7 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 8 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 9 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 10 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 11 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 12 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 13 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 14 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 15 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 16 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |

$\frac{\mu C}{m^3} \times \frac{mg}{\mu C}$

All Dispersion Factors are in Units of (s/m**3)

| Sector | Distance (Km) 12.10 | 24.10 | 40.20 | 56.30 | 72.40 |
|---|---|---|---|---|---|
| 1 | 1.09E-07 | 2.96E-08 | 4.40E-09 | 2.44E-09 | 4.81E-10 |
| 2 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 3 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 4 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 5 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 6 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 7 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 8 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 9 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 10 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 11 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 12 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 13 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 14 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 15 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 16 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |

Population Dispersion Factor: 5.471E-07
Maximum Individual Dispersion Factor: 7.528E-05

**HALLIBURTON NUS Environmental Corporation and Subsidiaries** — STANDARD CALCULATION SHEET

| CLIENT: SUBPART X | FILE NO.: 7703-2005 | BY: A. TOBLIN | PAGE 1 OF 1 |
|---|---|---|---|
| SUBJECT: HAWTHORNE ARMY AMMUNITION PLANT - REVISED METAL MODELING - OB (OLD BOMB) | | CHECKED BY: 7/1/93 | DATE: 7/1/93 |

Ten of the 40 sources contain lead ~~at~~ in the range of 1-3%. Accordingly, the source chosen for this analysis was extended by including lead ~~&~~ at twice the level of Barium, i.e., at 2.8% by weight.

Soil concentrations modelled were compared with measurements shown in 4.2. Concentrations modelled were generally somewhat higher but in the range of the measurements (except for one RDX measurement which appears anomalous -- may be a hot spot). Leachate concentrations for the metals were much higher in the model than measured in the field, a result of the low assumed $K_d$.

Note that the $K_d$s ~~was~~ chosen for the surface runoff pathway are higher (for the metals) than for the other pathways. For this pathway, the model suggested values were used because the analysis showed that soil transport was more significant than runoff. Accordingly, a high $K_d$ ~~is~~ yielded lower surface water concentrations.

**********10/22/1992 VERSION III**********

RADCON -- WATERBORNE TRANSPORT COMPONENT for the Multimedia
Environmental Pollutant Assessment System (MEPAS):
Models movement of radionuclides and other chemicals
in groundwater, surface water, and overland pathways.

Battelle, Pacific Northwest Laboratory (PNL)
P.O. Box 999, Richland, WA 99352

Developed for the U.S. Department of Energy

Input file for this run is OBSST2 .WIN

OB-
Groundwater

**********

Modeling Scenario Number 1

**********

Name of Facility : HAWTHORNE
Name of Waste Unit : OBSST2
Transport Scenario : SS-T2 Surface soil >Groundwater
Exposure Scenario : GW-E1
Usage Location Number : 1
Usage Location Medium : 1
Usage Location Name :

TLIFE is the duration of release for each contaminant expressed in years.
TDIFF is the time difference in years between the current date and the date when contaminants were first released into the environment.

| Constituent Name | TLIFE (years) | TDIFF (years) | TFINAL (years) |
|---|---|---|---|
| 2,4-DINI | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| BARIUM | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| LEAD | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| HMX (H-M | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| M-DINITR | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| POTASSIU | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| RDX 6H-3 | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| TNT 3NO2 | 7.001E+03 | 0.000E+00 | 7.001E+03 |

Source-Term Moisture Content (AN5) = 9.00 %
Source-Term Bulk Density (R2) = 1.64E+00 g/cm**3

**********

Station = Reno NV
Altitude in Meters = 1548.4
Latitude in Degrees = 39.3
Height of Wind Measurement in Meters = 9.14
Temperature Data is Given in Degrees : F

**********

| MONTH | TEMPERATURE (DEG F) | PRECIPITATION VOLUME (IN) | WIND (MPH) | CLOUDINESS (TENTHS) | NUMBER OF PRECIPITATION EVENTS |
|---|---|---|---|---|---|
| 1 | 3.20E+01 | 1.24E+00 | 5.60E+00 | 6.40E+00 | 6.10E+00 |
| 2 | 3.70E+01 | 9.50E-01 | 6.20E+00 | 6.30E+00 | 5.80E+00 |
| 3 | 4.10E+01 | 7.40E-01 | 7.80E+00 | 6.00E+00 | 6.30E+00 |
| 4 | 4.60E+01 | 4.60E-01 | 8.20E+00 | 5.70E+00 | 4.00E+00 |
| 5 | 5.50E+01 | 7.40E-01 | 8.00E+00 | 4.90E+00 | 4.40E+00 |
| 6 | 6.20E+01 | 3.40E-01 | 7.60E+00 | 3.60E+00 | 3.20E+00 |
| 7 | 7.00E+01 | 3.00E-01 | 7.00E+00 | 2.30E+00 | 2.40E+00 |
| 8 | 6.70E+01 | 2.70E-01 | 6.50E+00 | 2.40E+00 | 2.30E+00 |
| 9 | 6.00E+01 | 3.00E-01 | 5.80E+00 | 2.60E+00 | 2.50E+00 |
| 10 | 5.00E+01 | 3.40E-01 | 5.40E+00 | 4.00E+00 | 3.00E+00 |
| 11 | 4.00E+01 | 6.00E-01 | 5.50E+00 | 5.70E+00 | 4.90E+00 |
| 12 | 3.30E+01 | 1.21E+00 | 5.20E+00 | 6.20E+00 | 5.90E+00 |

Total Water Available for Snowmelt Sediment Flux is = 1.17E+01 cm

Source-Term Type (ISOURC) = 1
Source-Term Flux Boundary Conditions (ISOURC) = 1
Liquid Impoundment Index (IPOND) = 2
Source-Term Decay Index (IDECAY) = 2
Direct Discharge Surface Water Index (IDDSW) = 0
Number of Parent Constituents (NUMCON) = 8

Source-Term Configuration (ISCONF) = 4
Number of Media (NMED) = 2
Number of Integration Time Steps (NTIMES) = 40

Medium # 1 Equals Medium Type (MED) # 1
Medium # 2 Equals Medium Type (MED) # 3

Length of Release Unit (AL1 OR CLEN) = 1.62E+04 cm
Width of release Unit (B1) = 1.62E+04 cm

The Average-Annual Infiltration Rate = 3.21E+00 cm/yr

Water concentration units are: ATTO (1.000E-18) Ci OR g

| Constituent | CAS ID | Half-Life (Years) | Initial Conc. | Surface Equilibrium Coeff. (ml/g) | Solubility limit (g/ml) | Constituent Inventory (g OR Ci) |
|---|---|---|---|---|---|---|
| 2,4-DINI | 121142 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 2.40E-04 | 4.60E+03 |
| BARIUM | 7440393 | 1.00E+20 | 5.03E-02 | 2.52E+00 | 1.00E+23 | 1.65E+08 |
| LEAD | 7439921 | 1.00E+20 | 1.01E-01 | 2.52E+00 | 1.00E+23 | 3.30E+08 |
| HMX (H-M | 2691410 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 2.63E-06 | 4.60E+03 |
| M-DINITR | 99650 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 4.70E-04 | 4.60E+03 |
| POTASSIU | 7447407 | 1.00E+20 | 2.69E-02 | 2.52E+00 | 3.50E-02 | 8.85E+07 |
| RDX 6H-3 | 121824 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 3.84E-05 | 4.60E+03 |
| TNT 3NO2 | 118967 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 4.80E-04 | 4.60E+03 |

Constituent Flux (g/yr or Ci/yr) and Time (Years) at the Release Unit

| Constituent # | | Flux | Time | Constituent # | | Flux | Time |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 4.58E+02 | .0 | 1 | 2 | 4.58E+02 | 7001.0 |
| 2 | 1 | 1.65E+07 | .0 | 2 | 2 | 1.65E+07 | 7001.0 |
| 3 | 1 | 3.29E+07 | .0 | 3 | 2 | 3.29E+07 | 7001.0 |
| 4 | 1 | 4.58E+02 | .0 | 4 | 2 | 4.58E+02 | 7001.0 |
| 5 | 1 | 4.58E+02 | .0 | 5 | 2 | 4.58E+02 | 7001.0 |
| 6 | 1 | 8.82E+06 | .0 | 6 | 2 | 8.82E+06 | 7001.0 |
| 7 | 1 | 4.58E+02 | .0 | 7 | 2 | 4.58E+02 | 7001.0 |
| 8 | 1 | 4.58E+02 | .0 | 8 | 2 | 4.58E+02 | 7001.0 |

New Constituent Flux (g/yr or Ci/yr) and Time (Years) at the Release Unit

| Constituent # | | Flux | Time | Constituent # | | Flux | Time |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 4.58E+02 | .0 | 1 | 2 | 4.58E+02 | 10.0 |
| 2 | 1 | 1.65E+07 | .0 | 2 | 2 | 1.65E+07 | 10.0 |
| 3 | 1 | 3.29E+07 | .0 | 3 | 2 | 3.29E+07 | 10.0 |
| 4 | 1 | 4.58E+02 | .0 | 4 | 2 | 4.58E+02 | 10.0 |
| 5 | 1 | 4.58E+02 | .0 | 5 | 2 | 4.58E+02 | 10.0 |
| 6 | 1 | 8.82E+06 | .0 | 6 | 2 | 8.82E+06 | 10.0 |
| 7 | 1 | 4.58E+02 | .0 | 7 | 2 | 4.58E+02 | 10.0 |
| 8 | 1 | 4.58E+02 | .0 | 8 | 2 | 4.58E+02 | 10.0 |

The New Duration of Time that Constituents are Released from the Release Unit

| # | Constituent | New TLIFE (Years) |
|---|---|---|

Modeling Medium # 1
Medium Type (MED) : 1
Source Configuration : 4
Source Term Discharge Type : 1
PARTIALLY SATURATED ZONE

Thickness of Unsaturated Layer (H1) : 3.05E+03 cm
X-Direction Dispersivity (A1) : 3.05E+01 cm
Bulk Density (R2) : 1.60E+00 g/cm**3
Total Porosity (AN4) : 3.80E-01 (fraction)
Field Capacity (AN5) : 9.00E-02 (fraction)
Permeability (X2) : 8.80E+04 cm/day
Leach Rate (U) : 8.78E-03 cm/day
Soil-Type Coefficient (A2) : 4.05E+00

Moisture Content (AN5) : 9.00 %
Infiltration Rate (U) : 8.78E-03 cm/day

| NO | PARENT | HALFLIFE YEARS | KD CC/GM | RETARDATION FACTOR |
|---|---|---|---|---|
| 1 | 2,4-DINI | 1.00000E+20 | 2.55400E-02 | 1.45404E+00 |
| 2 | BARIUM | 1.00000E+20 | 0.00000E+00 | 1.00000E+00 |
| 3 | LEAD | 1.00000E+20 | 0.00000E+00 | 1.00000E+00 |
| 4 | HMX (H-M | 1.00000E+20 | 1.36200E-03 | 1.02421E+00 |
| 5 | M-DINITR | 1.00000E+20 | 1.08400E-02 | 1.19271E+00 |
| 6 | POTASSIU | 1.00000E+20 | 0.00000E+00 | 1.00000E+00 |
| 7 | RDX 6H-3 | 1.00000E+20 | 5.73200E-01 | 1.11902E+01 |
| 8 | TNT 3NO2 | 1.00000E+20 | 1.01000E-02 | 1.17956E+00 |

| Constituent | CAS ID | Half-Life (Years) | Initial Conc. | Surface Equilibrium Coeff. (ml/g) | Solubility limit (g/ml) | Constituent Inventory (g OR Ci) |
|---|---|---|---|---|---|---|
| 2,4-DINI | 121142 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 2.40E-04 | 4.60E+03 |
| BARIUM | 7440393 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 1.00E+23 | 1.65E+08 |
| LEAD | 7439921 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 1.00E+23 | 3.30E+08 |
| HMX (H-M | 2691410 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 2.63E-06 | 4.60E+03 |
| M-DINITR | 99650 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 4.70E-04 | 4.60E+03 |
| POTASSIU | 7447407 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 3.50E-02 | 8.85E+07 |
| RDX 6H-3 | 121824 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 3.84E-05 | 4.60E+03 |
| TNT 3NO2 | 118967 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 4.80E-04 | 4.60E+03 |

Computed Initial at the Release Unit (DMAX) : 6.04E-06

Computed Initial at the Release Unit (DMAX) : 2.17E-01

Computed Initial at the Release Unit (DMAX) : 4.34E-01

Computed Initial at the Release Unit (DMAX) : 6.04E-06

Computed Initial at the Release Unit (DMAX) : 6.04E-06

Computed Initial at the Release Unit (DMAX) : 1.16E-01

Computed Initial at the Release Unit (DMAX) : 6.04E-06

Modeling Medium # 2
Medium Type (MED) : 3
Source Configuration : 4
Source Term Discharge Type : 1
SATURATED ZONE AT A WELL

| NO | PARENT | DECAY RATE 1/YEARS | KD CC/GM | RETARDATION FACTOR |
|---|---|---|---|---|
| 1 | 2,4-DINI | 6.93147E-21 | 2.55400E-02 | 1.16816E+00 |
| 2 | BARIUM | 6.93147E-21 | 0.00000E+00 | 1.00000E+00 |
| 3 | LEAD | 6.93147E-21 | 0.00000E+00 | 1.00000E+00 |
| 4 | HMX (H-N | 6.93147E-21 | 1.36200E-02 | 1.00897E+00 |
| 5 | M-DINITR | 6.93147E-21 | 1.08400E-02 | 1.07137E+00 |
| 6 | POTASSIU | 6.93147E-21 | 0.00000E+00 | 1.00000E+00 |
| 7 | RDX 6H-3 | 6.93147E-21 | 5.73200E-01 | 4.77416E+00 |
| 8 | TNT 3NO2 | 6.93147E-21 | 1.01000E-02 | 1.06650E+00 |

Groundwater Velocity (U) : 3.51E+03 cm/day
Aquifer Thickness (H1) : 3.05E+03 cm
X-Direction Dispersivity (A1) : 1.29E+05 cm
Y-Direction Dispersivity (A2) : 2.58E+04 cm
Z-Direction Dispersivity (A3) : 1.49E+02 cm
Bulk Density (R2) : 1.60E+00 g/cm**3
Total Porosity (AN4) : 3.80E-01 (fraction)
Effective Porosity (AN5) : 2.43E-01 (fraction)
Length of Burial Area (AL1) : 1.62E+04 cm
Width of Burial Area (B1) : 1.62E+04 cm
Depth of Release Unit Below Water Table (HW) : 0.00E+00 cm
Distance Downgradient from Center of Source (X2) : 1.29E+06 cm
Lateral Hydraulic Conductivity (HC) : 0.00E+00 cm/day

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Concentrations for 2,4-DINI at run time (1993 , 0.0 years) is between:
0.000E+00 (g/ml or Ci/ml) at .0 years ( 1993)
3.202E-40 (g/ml or Ci/ml) at 155.1 years ( 2148)

Concentrations for BARIUM at run time (1993 , 0.0 years) is between:
0.000E+00 (g/ml or Ci/ml) at .0 years ( 1993)
1.210E-35 (g/ml or Ci/ml) at 106.7 years ( 2099)

Concentrations for LEAD at run time (1993 , 0.0 years) is between:
0.000E+00 (g/ml or Ci/ml) at .0 years ( 1993)
2.414E-35 (g/ml or Ci/ml) at 106.7 years ( 2099)

Concentrations for HMX (H-N at run time (1993 , 0.0 years) is between:
0.000E+00 (g/ml or Ci/ml) at .0 years ( 1993)
3.031E-40 (g/ml or Ci/ml) at 109.2 years ( 2102)

Concentrations for M-DINITR at run time (1993 , 0.0 years) is between:
0.000E+00 (g/ml or Ci/ml) at .0 years ( 1993)
3.379E-40 (g/ml or Ci/ml) at 127.3 years ( 2120)

Concentrations for POTASSIU at run time (1993 , 0.0 years) is between:
0.000E+00 (g/ml or Ci/ml) at .0 years ( 1993)
6.481E-36 (g/ml or Ci/ml) at 106.7 years ( 2099)

Concentrations for RDX 6H-3 at run time (1993 , 0.0 years) is between:
0.000E+00 (g/ml or Ci/ml) at .0 years ( 1993)
0.000E+00 (g/ml or Ci/ml) at 175.0 years ( 2168)

Concentrations for TNT 3NO2 at run time (1993 , 0.0 years) is between:
0.000E+00 (g/ml or Ci/ml) at .0 years ( 1993)
3.329E-40 (g/ml or Ci/ml) at 125.9 years ( 2118)

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Maximum Constituent Concentrations:

2,4-DINI: 8.631E-15 (g/ml or Ci/ml) at 1240.6 Years (3233)
BARIUM : 4.585E-10 (g/ml or Ci/ml) at 853.8 Years (2846)
LEAD : 9.173E-10 (g/ml or Ci/ml) at 853.8 Years (2846)
HMX (H-M: 1.241E-14 (g/ml or Ci/ml) at 873.2 Years (2866)
M-DINITR: 1.063E-14 (g/ml or Ci/ml) at 1018.4 Years (3011)
POTASSIU: 2.456E-10 (g/ml or Ci/ml) at 853.8 Years (2846)
RDX 6H-3: 2.739E-16 (g/ml or Ci/ml) at 7001.0 Years (8994)
TNT 3NO2: 1.198E-14 (g/ml or Ci/ml) at 1006.9 Years (2999)

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Multimedia Environmental Pollutant Assessment System (MEPAS)

MEPAS Hazard Potential Output (VERSION 041292)
Pacific Northwest Laboratory
Richland, WA 99352
Developed for the U.S. Department of Energy

OB-
Soil Resuspension

Run Date and Time: 6/30/1993 15:39: 0
(This run used 630. effects per million man-rem)
Run Title: OBSST1
Ranking Unit 1 : OBSST1

Number of Constituents is: 8
Time Discounted HPIs are computed using 70 year time periods (Time Index = 0)

| Num | Constituent Names | CASID |
|---|---|---|
| 1 | 2,4-Dinitrotoluene, DNT | 121142 |
| 2 | Barium | 7440393 |
| 3 | Lead, DI, Col. Pigment metal 4 | 7439921 |
| 4 | 1,3,5,7-Tetrazocine, Octahydro-1,3,5,7-tetranitro, Octagen | 2691410 |
| 5 | m-Dinitrobenzene, Dinitrobenzene | 99650 |
| 6 | Potassium ion (as Potassium chloride) | 7447407 |
| 7 | RDX, Hexahydro-1,3,4-Trinito-1,3,5-Triazine | 121824 |
| 8 | TNT, Trinitrotoluene (dry) | 118967 |

Summary of Data from MEPAS Constituent Database
COMBINED DATA LIBRARY FOR RAPS/MEPAS - UPDATED AUGUST 16, 1991
This Database Contains Entries for 397 Constituents

| Constituent Parameter | Parameter Units | Constituent 1 | Constituent 2 | Constituent 3 | Constituent 4 |
|---|---|---|---|---|---|
| ID / CAS #: | (None) | 121142 | 7440393 | 7439921 | 2691410 |
| Toxicity Type: | (None) | 2 | 5 | 5 | 5 |
| Mol. Weight: | g/mole | 1.821E+02 | 1.370E+02 | 2.070E+02 | 2.962E+02 |
| Vapor Pressure: | mm-Hg | 5.100E-03 | 0.000E+00 | 0.000E+00 | 8.400E-04 |
| Henry's Law Con: | atm*m3/mole | 5.090E-06 | 0.000E+00 | 0.000E+00 | 3.530E-06 |
| Water Sol: | mg/L | 2.400E+02 | 0.000E+00 | 0.000E+00 | 2.630E+00 |
| Carbon Mat Part: | ml/g | 4.500E+01 | 0.000E+00 | 0.000E+00 | 2.400E+00 |
| Oct Wat Part: | (None) | 1.000E+02 | 0.000E+00 | 0.000E+00 | 3.900E+00 |
| 1/2-life in AIR: | days | 6.900E+07 | 6.900E+07 | 6.900E+07 | 6.900E+07 |
| 1/2-life in GW: | days | 6.900E+07 | 6.900E+07 | 6.900E+07 | 6.900E+07 |
| 1/2-life in SW: | days | 9.680E+00 | 6.900E+07 | 6.900E+07 | 1.770E+01 |
| 1/2-life in SOIL: | days | 2.080E+05 | 6.900E+07 | 6.900E+07 | 1.170E+06 |
| Ing Dose Fact: | 1/Kg or rem/pCi | 1.430E-02 | 1.430E-02 | 1.430E-02 | 1.430E-02 |
| Inh Dose Fact: | 1/Kg or rem/pCi | 1.430E-02 | 1.430E-02 | 1.430E-02 | 1.430E-02 |
| Air Inm Fact: | rem*m3/pCi*h | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Soil Exp Fact: | rem*m2/pCi*h | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Water Inm Fact: | rem*L/pCi*h | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Fish Bioaccum: | (None) | 1.950E+01 | 4.000E+00 | 1.000E+02 | 1.657E+00 |
| Shell Bioaccum: | (None) | 3.105E+00 | 2.000E-01 | 1.000E+02 | 2.178E-01 |
| Veg Bioaccum: | (None) | 6.761E-01 | 5.000E-03 | 6.800E-02 | 4.409E+00 |
| Meat Trans Fact: | day/Kg | 2.512E-06 | 5.000E-04 | 2.900E-04 | 9.796E-08 |
| Milk Trans Fact: | day/L | 7.943E-07 | 4.000E-04 | 1.000E-05 | 3.098E-08 |
| Water Pur Fact: | (None) | 1.000E+00 | 1.000E+00 | 9.000E-01 | 1.000E+00 |
| Dep Velocity: | m/sec | 1.688E-04 | 1.000E-03 | 1.000E-03 | 4.760E-05 |
| Atmos Dis Class: | (None) | 6 | 1 | 1 | 6 |
| Inh Cancer Pot: | (Kg*day)/mg | 6.800E-01 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Ing Cancer Pot: | (Kg*day)/mg | 6.800E-01 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Inh Ref Dose: | mg/(Kg*day) | 0.000E+00 | 1.400E-04 | 4.300E-04 | 5.000E-02 |
| Ing Ref Dose: | mg/(Kg*day) | 0.000E+00 | 5.100E-02 | 1.400E-03 | 5.000E-02 |
| Inh Tox Uncert | HPI units | 10 | 5 | 5 | 10 |
| Ing Tox Uncert | HPI units | 5 | 5 | 5 | 5 |
| Phys Prop Uncert | HPI units | 8 | 3 | 3 | 12 |
| Tran Fact Uncert | HPI units | 10 | 3 | 3 | 10 |

**********
Toxicity Type 1: Radionuclide carcinogenic inhalation and ingestion
Toxicity Type 2: Chemical carcinogenic inhalation and ingestion
Toxicity Type 3: Chemical carcinogenic inhalation, non-carcinogenic ingestion
Toxicity Type 4: Chemical non-carcinogenic inhalation, carcinogenic ingestion
Toxicity Type 5: Chemical non-carcinogenic inhalation and ingestion
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KEY for Constituent Table
Constituent 1 = 2,4-DINITROTOLUENE
Constituent 2 = BARIUM
Constituent 3 = LEAD
Constituent 4 = HMX (H-NO2 TETZOCINE

Summary of Data from MEPAS Constituent Database (Cont)
COMBINED DATA LIBRARY FOR RAPS/MEPAS - UPDATED AUGUST 16, 1991
This Database Contains Entries for 397 Constituents

| Constituent Parameter | Parameter Units | Constituent 5 | Constituent 6 | Constituent 7 | Constituent 8 |
|---|---|---|---|---|---|
| ID / CAS #: | (None) | 99650 | 7447407 | 121824 | 118967 |
| Toxicity Type: | (None) | 5 | 5 | 5 | 5 |
| Mol. Weight: | g/mole | 1.681E+02 | 3.910E+01 | 2.221E+02 | 2.271E+02 |
| Vapor Pressure: | mm-Hg | 1.130E-04 | 0.000E+00 | 4.080E-04 | 8.990E-08 |
| Henry"s Law Con: | atm*m3/mole | 5.840E-08 | 0.000E+00 | 8.300E-06 | 1.370E-04 |
| Water Sol: | mg/L | 4.700E+02 | 3.500E+04 | 3.840E+01 | 4.800E+02 |
| Carbon Mat Part: | ml/g | 1.910E+01 | 0.000E+00 | 1.010E+03 | 1.780E+01 |
| Oct Mat Part: | (None) | 4.170E+01 | 0.000E+00 | 1.910E+03 | 7.760E+01 |
| 1/2-life in AIR: | days | 6.900E+07 | 6.900E+07 | 6.900E+07 | 6.900E+07 |
| 1/2-life in GW: | days | 6.900E+07 | 6.900E+07 | 6.900E+07 | 6.900E+07 |
| 1/2-life in SW: | days | 7.970E+02 | 6.900E+07 | 6.630E+00 | 5.780E-01 |
| 1/2-life in SOIL: | days | 9.520E+06 | 6.900E+07 | 2.520E+06 | 6.900E+07 |
| Ing Dose Fact: | 1/Kg or rem/pCi | 1.430E-02 | 1.430E-02 | 1.430E-02 | 1.430E-02 |
| Inh Dose Fact: | 1/Kg or rem/pCi | 1.430E-02 | 1.430E-02 | 1.430E-02 | 1.430E-02 |
| Air Inm Fact: | rem*m3/pCi*h | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Soil Exp Fact: | rem*m2/pCi*h | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Water Inm Fact: | rem*L/pCi*h | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Fish Bioaccum: | (None) | 1.003E+01 | 1.000E+03 | 1.835E+02 | 1.608E+01 |
| Shell Bioaccum: | (None) | 1.517E+00 | 8.300E+02 | 3.477E+01 | 2.522E+00 |
| Veg Bioaccum: | (None) | 1.121E+00 | 3.700E-01 | 1.229E-01 | 7.828E-01 |
| Meat Trans Fact: | day/Kg | 1.047E-06 | 1.200E-02 | 4.798E-05 | 1.949E-06 |
| Milk Trans Fact: | day/L | 3.312E-07 | 1.000E-02 | 1.517E-05 | 6.164E-07 |
| Water Pur Fact: | (None) | 1.000E+00 | 9.000E-01 | 1.000E+00 | 1.000E+00 |
| Dep Velocity: | m/sec | 8.515E-04 | 1.000E-03 | 6.180E-04 | 1.291E-05 |
| Atmos Dis Class: | (None) | 6 | 1 | 6 | 6 |
| Inh Cancer Pot: | (Kg*day)/mg | 0.000E+00 | 0.000E+00 | 1.100E-01 | 3.000E-02 |
| Ing Cancer Pot: | (Kg*day)/mg | 0.000E+00 | 0.000E+00 | 1.100E-01 | 3.000E-02 |
| Inh Ref Dose: | mg/(Kg*day) | 1.000E-04 | 5.100E+02 | 3.000E-03 | 5.000E-04 |
| Ing Ref Dose: | mg/(Kg*day) | 1.000E-04 | 5.100E+02 | 3.000E-03 | 5.000E-04 |
| Inh Tox Uncert | HPI units | 10 | 25 | 10 | 10 |
| Ing Tox Uncert | HPI units | 5 | 20 | 5 | 5 |
| Phys Prop Uncert | HPI units | 8 | 3 | 8 | 8 |
| Tran Fact Uncert | HPI units | 10 | 3 | 10 | 10 |

**********
Toxicity Type 1: Radionuclide carcinogenic inhalation and ingestion
Toxicity Type 2: Chemical carcinogenic inhalation and ingestion
Toxicity Type 3: Chemical carcinogenic inhalation, non-carcinogenic ingestion
Toxicity Type 4: Chemical non-carcinogenic inhalation, carcinogenic ingestion
Toxicity Type 5: Chemical non-carcinogenic inhalation and ingestion
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KEY for Constituent Table
Constituent 5 = M-DINITROBENZENE
Constituent 6 = POTASSIUM ION
Constituent 7 = RDX 6H-3NO2-TRIAZINE
Constituent 8 = TNT 3NO2-TOLUENE

Exposures are Computed Based on the Following Atmospheric Emission Rates:

| Deposition Class Type | Units | Constituent 1 | Constituent 2 | Constituent 3 | Constituent 4 |
|---|---|---|---|---|---|
| Start Time: | Years | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 1: | mg/s or pCi/s | 3.700E-08 | 1.300E-03 | 2.700E-03 | 3.700E-08 |
| Class 2: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 3: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 4: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 5: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 6: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 7: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |

| Deposition Class Type | Units | Constituent 5 | Constituent 6 | Constituent 7 | Constituent 8 |
|---|---|---|---|---|---|
| Start Time: | Years | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 1: | mg/s or pCi/s | 3.700E-08 | 7.200E-04 | 3.700E-08 | 3.700E-08 |
| Class 2: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 3: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 4: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 5: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 6: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| Class 7: | mg/s or pCi/s | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |

**********

KEY for Constituents in Table

Constituent 1 = 2,4-DINITROTOLUENE  2 = BARIUM
Constituent 3 = LEAD  4 = HMX (H-NO2 TETZOCINE
Constituent 5 = M-DINITROBENZENE  6 = POTASSIUM ION
Constituent 7 = RDX 6H-3NO2-TRIAZINE  8 = TNT 3NO2-TOLUENE

Population Distribution Title: Sample Fifty-Mile Radius Population

| Sector | Distance (Km) | | | | |
|---|---|---|---|---|---|
| | .81 | 2.41 | 4.02 | 5.63 | 7.24 |
| 1 | 1. | 1. | 1. | 1. | 1. |
| 2 | 1. | 1. | 1. | 1. | 1. |
| 3 | 1. | 1. | 1. | 1. | 1. |
| 4 | 1. | 1. | 1. | 1. | 1. |
| 5 | 1. | 1. | 1. | 1. | 1. |
| 6 | 1. | 1. | 1. | 1. | 1. |
| 7 | 1. | 1. | 1. | 1. | 1. |
| 8 | 1. | 1. | 1. | 1. | 1. |
| 9 | 1. | 1. | 1. | 1. | 1. |
| 10 | 1. | 1. | 1. | 1. | 1. |
| 11 | 1. | 1. | 1. | 1. | 1. |
| 12 | 1. | 1. | 1. | 1. | 1. |
| 13 | 1. | 1. | 1. | 1. | 1. |
| 14 | 1. | 1. | 1. | 1. | 1. |
| 15 | 1. | 1. | 1. | 1. | 1. |
| 16 | 1. | 1. | 1. | 1. | 1. |

| Sector | Distance (Km) | | | | |
|---|---|---|---|---|---|
| | 12.10 | 24.10 | 40.20 | 56.30 | 72.40 |
| 1 | 1. | 1. | 1. | 1. | 1. |
| 2 | 1. | 1. | 1. | 1. | 1. |
| 3 | 1. | 1. | 1. | 1. | 1. |
| 4 | 1. | 1. | 1. | 1. | 1. |
| 5 | 1. | 1. | 1. | 1. | 1. |
| 6 | 1. | 1. | 1. | 1. | 1. |
| 7 | 1. | 1. | 1. | 1. | 1. |
| 8 | 1. | 1. | 1. | 1. | 1. |
| 9 | 1. | 1. | 1. | 1. | 1. |
| 10 | 1. | 1. | 1. | 1. | 1. |
| 11 | 1. | 1. | 1. | 1. | 1. |
| 12 | 1. | 1. | 1. | 1. | 1. |
| 13 | 1. | 1. | 1. | 1. | 1. |
| 14 | 1. | 1. | 1. | 1. | 1. |
| 15 | 1. | 1. | 1. | 1. | 1. |
| 16 | 1. | 1. | 1. | 1. | 1. |

Total Population for Site is: 160.

Dispersion Factors for constituents: Class 1
All Dispersion Factors are in Units of (s/m**3)

| Sector | Distance (Km) .81 | 2.41 | 4.02 | 5.63 | 7.24 |
|---|---|---|---|---|---|
| 1 | 7.53E-05 | 8.75E-06 | 1.46E-06 | 1.11E-06 | 7.66E-07 |
| 2 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 3 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 4 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 5 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 6 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 7 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 8 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 9 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 10 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 11 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 12 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 13 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 14 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 15 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |
| 16 | 1.76E-09 | 1.68E-10 | 2.74E-11 | 2.11E-11 | 1.47E-11 |

All Dispersion Factors are in Units of (s/m**3)

| Sector | Distance (Km) 12.10 | 24.10 | 40.20 | 56.30 | 72.40 |
|---|---|---|---|---|---|
| 1 | 1.09E-07 | 2.96E-08 | 4.40E-09 | 2.44E-09 | 4.81E-10 |
| 2 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 3 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 4 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 5 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 6 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 7 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 8 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 9 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 10 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 11 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 12 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 13 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 14 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 15 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |
| 16 | 2.71E-12 | 9.25E-13 | 3.09E-13 | 1.98E-13 | 8.71E-14 |

Population Dispersion Factor: 5.471E-07
Maximum Individual Dispersion Factor: 7.528E-05

Deposition Factors for Constituent: Class 1
All Deposition Factors are in Units of (1/m**2)

| Sector | Distance (Km) .81 | 2.41 | 4.02 | 5.63 | 7.24 |
|---|---|---|---|---|---|
| 1 | 3.41E+01 | 3.97E+00 | 6.54E-01 | 4.99E-01 | 3.44E-01 |
| 2 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 3 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 4 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 5 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 6 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 7 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 8 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 9 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 10 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 11 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 12 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 13 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 14 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 15 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |
| 16 | 7.31E-04 | 7.39E-05 | 1.25E-05 | 9.61E-06 | 6.74E-06 |

All Deposition Factors are in Units of (1/m**2)

| Sector | Distance (Km) 12.10 | 24.10 | 40.20 | 56.30 | 72.40 |
|---|---|---|---|---|---|
| 1 | 4.88E-02 | 1.32E-02 | 1.96E-03 | 1.09E-03 | 2.15E-04 |
| 2 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 3 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 4 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 5 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 6 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 7 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 8 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 9 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 10 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 11 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 12 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 13 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 14 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 15 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |
| 16 | 1.27E-06 | 4.38E-07 | 1.49E-07 | 9.59E-08 | 4.27E-08 |

Population Deposition Factor: 2.478E-01
Maximum Individual Deposition Factor: 3.410E+01

**********10/22/1992 VERSION III**********

RADCON -- WATERBORNE TRANSPORT COMPONENT for the Multimedia
Environmental Pollutant Assessment System (MEPAS):
Models movement of radionuclides and other chemicals
in groundwater, surface water, and overland pathways.

Battelle, Pacific Northwest Laboratory (PNL)
P.O. Box 999, Richland, WA 99352

Developed for the U.S. Department of Energy

Input file for this run is OBSST3 .WIN

OB-
Groundwater to
Surface Water

**********

Modeling Scenario Number 1

**********

Name of Facility : HAWTHORNE
Name of Waste Unit : OBSST3
Transport Scenario : SS-T3 Surface soil >Groundwater
Exposure Scenario : SW-E1
Usage Location Number : 1
Usage Location Medium : 3
Usage Location Name :

TLIFE is the duration of release for each contaminant expressed in years.
TDIFF is the time difference in years between the current date and the date when contaminants were first released into the environment.

| Constituent Name | TLIFE (years) | TDIFF (years) | TFINAL (years) |
|---|---|---|---|
| 2,4-DINI | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| BARIUM | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| LEAD | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| HMX (H-M | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| M-DINITR | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| POTASSIU | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| RDX 6H-3 | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| TNT 3NO2 | 7.001E+03 | 0.000E+00 | 7.001E+03 |

Source-Term Moisture Content (AM5) = 9.00 %
Source-Term Bulk Density (R2) = 1.64E+00 g/cm**3

**********

Station = Reno NV
Altitude in Meters = 1548.4
Latitude in Degrees = 39.3
Height of Wind Measurement in Meters = 9.14
Temperature Data is Given in Degrees : F

**********

| MONTH | TEMPERATURE (DEG F) | PRECIPITATION VOLUME (IN) | WIND (MPH) | CLOUDINESS (TENTHS) | NUMBER OF PRECIPITATION EVENTS |
|---|---|---|---|---|---|
| 1 | 3.20E+01 | 1.24E+00 | 5.60E+00 | 6.40E+00 | 6.10E+00 |
| 2 | 3.70E+01 | 9.50E-01 | 6.20E+00 | 6.30E+00 | 5.80E+00 |
| 3 | 4.10E+01 | 7.40E-01 | 7.80E+00 | 6.00E+00 | 6.30E+00 |
| 4 | 4.60E+01 | 4.60E-01 | 8.20E+00 | 5.70E+00 | 4.00E+00 |
| 5 | 5.50E+01 | 7.40E-01 | 8.00E+00 | 4.90E+00 | 4.40E+00 |
| 6 | 6.20E+01 | 3.40E-01 | 7.60E+00 | 3.60E+00 | 3.20E+00 |
| 7 | 7.00E+01 | 3.00E-01 | 7.00E+00 | 2.30E+00 | 2.40E+00 |
| 8 | 6.70E+01 | 2.70E-01 | 6.50E+00 | 2.40E+00 | 2.30E+00 |
| 9 | 6.00E+01 | 3.00E-01 | 5.80E+00 | 2.60E+00 | 2.50E+00 |
| 10 | 5.00E+01 | 3.40E-01 | 5.40E+00 | 4.00E+00 | 3.00E+00 |
| 11 | 4.00E+01 | 6.00E-01 | 5.50E+00 | 5.70E+00 | 4.90E+00 |
| 12 | 3.30E+01 | 1.21E+00 | 5.20E+00 | 6.20E+00 | 5.90E+00 |

Total Water Available for Snowmelt Sediment Flux is = 1.17E+01 cm

Source Term Type (TSTYPE) : 1
Source-Term Flux Boundary Conditions (ISOURC) : 1
Liquid Impoundment Index (IPOND) : 2
Source-Term Decay Index (IDECAY) : 2
Direct Discharge Surface Water Index (IDDSW) : 0
Number of Parent Constituents (NUMCON) : 8

Source-Term Configuration (ISCONF) : 4
Number of Media (NMED) : 3
Number of Integration Time Steps (NTIMES) : 40

Medium # 1 Equals Medium Type (MED) # 1
Medium # 2 Equals Medium Type (MED) # 4
Medium # 3 Equals Medium Type (MED) # 5

Length of Release Unit (AL1 OR CLEN) : 1.62E+04 cm
Width of release Unit (B1) : 1.62E+04 cm

The Average-Annual Infiltration Rate : 3.21E+00 cm/yr

Water concentration units are: ATTO (1.000E-18) Ci OR g

| Constituent | CAS ID | Half-Life (Years) | Initial Conc. | Surface Equilibrium Coeff. (ml/g) | Solubility limit (g/ml) | Constituent Inventory (g OR Ci) |
|---|---|---|---|---|---|---|
| 2,4-DINI | 121142 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 2.40E-04 | 4.60E+03 |
| BARIUM | 7440393 | 1.00E+20 | 5.03E-02 | 2.52E+00 | 1.00E+23 | 1.65E+08 |
| LEAD | 7439921 | 1.00E+20 | 1.01E-01 | 2.52E+00 | 1.00E+23 | 3.30E+08 |
| HMX (H-M | 2691410 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 2.63E-06 | 4.60E+03 |
| M-DINITR | 99650 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 4.70E-04 | 4.60E+03 |
| POTASSIU | 7447407 | 1.00E+20 | 2.69E-02 | 2.52E+00 | 3.50E-02 | 8.85E+07 |
| RDX 6H-3 | 121824 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 3.84E-05 | 4.60E+03 |
| TNT 3NO2 | 118967 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 4.80E-04 | 4.60E+03 |

Constituent Flux (g/yr or Ci/yr) and Time (Years) at the Release Unit

| Constituent # | | Flux | Time | Constituent # | | Flux | Time |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 4.58E+02 | .0 | 1 | 2 | 4.58E+02 | 7001.0 |
| 2 | 1 | 1.65E+07 | .0 | 2 | 2 | 1.65E+07 | 7001.0 |
| 3 | 1 | 3.29E+07 | .0 | 3 | 2 | 3.29E+07 | 7001.0 |
| 4 | 1 | 4.58E+02 | .0 | 4 | 2 | 4.58E+02 | 7001.0 |
| 5 | 1 | 4.58E+02 | .0 | 5 | 2 | 4.58E+02 | 7001.0 |
| 6 | 1 | 8.82E+06 | .0 | 6 | 2 | 8.82E+06 | 7001.0 |
| 7 | 1 | 4.58E+02 | .0 | 7 | 2 | 4.58E+02 | 7001.0 |
| 8 | 1 | 4.58E+02 | .0 | 8 | 2 | 4.58E+02 | 7001.0 |

New Constituent Flux (g/yr or Ci/yr) and Time (Years) at the Release Unit

| Constituent # | | Flux | Time | Constituent # | | Flux | Time |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 4.58E+02 | .0 | 1 | 2 | 4.58E+02 | 10.0 |
| 2 | 1 | 1.65E+07 | .0 | 2 | 2 | 1.65E+07 | 10.0 |
| 3 | 1 | 3.29E+07 | .0 | 3 | 2 | 3.29E+07 | 10.0 |
| 4 | 1 | 4.58E+02 | .0 | 4 | 2 | 4.58E+02 | 10.0 |
| 5 | 1 | 4.58E+02 | .0 | 5 | 2 | 4.58E+02 | 10.0 |
| 6 | 1 | 8.82E+06 | .0 | 6 | 2 | 8.82E+06 | 10.0 |
| 7 | 1 | 4.58E+02 | .0 | 7 | 2 | 4.58E+02 | 10.0 |
| 8 | 1 | 4.58E+02 | .0 | 8 | 2 | 4.58E+02 | 10.0 |

The New Duration of Time that Constituents are Released from the Release Unit

| # | Constituent | New TLIFE (Years) |
|---|---|---|

| | | |
|---|---|---|
| 1 | 2,4-DINI | 1.003E+01 |
| 2 | BARIUM | 1.003E+01 |
| 3 | LEAD | 1.003E+01 |
| 4 | HMX (H-M | 1.003E+01 |
| 5 | M-DINITR | 1.003E+01 |
| 6 | POTASSIU | 1.003E+01 |
| 7 | RDX 6H-3 | 1.003E+01 |
| 8 | TNT 3NO2 | 1.003E+01 |

4

Modeling Medium # 1
Medium Type (MED) : 1
Source Configuration : 4
Source Term Discharge Type : 1
PARTIALLY SATURATED ZONE

Thickness of Unsaturated Layer (H1) : 3.05E+03 cm
X-Direction Dispersivity (A1) : 3.05E+01 cm
Bulk Density (R2) : 1.60E+00 g/cm**3
Total Porosity (AN4) : 3.80E-01 (fraction)
Field Capacity (AN5) : 9.00E-02 (fraction)
Permeability (X2) : 8.80E+04 cm/day
Leach Rate (U) : 8.78E-03 cm/day
Soil-Type Coefficient (A2) : 4.05E+00

Moisture Content (AN5) : 9.00 %
Infiltration Rate (U) : 8.78E-03 cm/day

| NO | PARENT | HALFLIFE YEARS | KD CC/GM | RETARDATION FACTOR |
|---|---|---|---|---|
| 1 | 2,4-DINI | 1.00000E+20 | 2.55400E-02 | 1.45404E+00 |
| 2 | BARIUM | 1.00000E+20 | 0.00000E+00 | 1.00000E+00 |
| 3 | LEAD | 1.00000E+20 | 0.00000E+00 | 1.00000E+00 |
| 4 | HMX (H-M | 1.00000E+20 | 1.36200E-03 | 1.02421E+00 |
| 5 | M-DINITR | 1.00000E+20 | 1.08400E-02 | 1.19271E+00 |
| 6 | POTASSIU | 1.00000E+20 | 0.00000E+00 | 1.00000E+00 |
| 7 | RDX 6H-3 | 1.00000E+20 | 5.73200E-01 | 1.11902E+01 |
| 8 | TNT 3NO2 | 1.00000E+20 | 1.01000E-02 | 1.17956E+00 |

| Constituent | CAS ID | Half-Life (Years) | Initial Conc. | Surface Equilibrium Coeff. (ml/g) | Solubility limit (g/ml) | Constituent Inventory (g OR Ci) |
|---|---|---|---|---|---|---|
| 2,4-DINI | 121142 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 2.40E-04 | 4.60E+03 |
| BARIUM | 7440393 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 1.00E+23 | 1.65E+08 |
| LEAD | 7439921 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 1.00E+23 | 3.30E+08 |
| HMX (H-M | 2691410 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 2.63E-06 | 4.60E+03 |
| M-DINITR | 99650 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 4.70E-04 | 4.60E+03 |
| POTASSIU | 7447407 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 3.50E-02 | 8.85E+07 |
| RDX 6H-3 | 121824 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 3.84E-05 | 4.60E+03 |
| TNT 3NO2 | 118967 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 4.80E-04 | 4.60E+03 |

Computed Initial at the Release Unit (DMAX) = 6.04E-06

Computed Initial at the Release Unit (DMAX) = 2.17E-01

Computed Initial at the Release Unit (DMAX) = 4.34E-01

Computed Initial at the Release Unit (DMAX) = 6.04E-06

Computed Initial at the Release Unit (DMAX) = 6.04E-06

Computed Initial at the Release Unit (DMAX) = 1.16E-01

Computed Initial at the Release Unit (DMAX) = 6.04E-06

Computed initial at the release unit (UHAX) = 0.041 00

Modeling Medium # 2
Medium Type (MED) : 4
Source Configuration : 4
Source Term Discharge Type : 1
SATURATED ZONE AT A RIVER

| NO | PARENT | DECAY RATE 1/YEARS | KD CC/GM | RETARDATION FACTOR |
|---|---|---|---|---|
| 1 | 2,4-DINI | 6.93147E-21 | 2.55400E-02 | 1.16816E+00 |
| 2 | BARIUM | 6.93147E-21 | 0.00000E+00 | 1.00000E+00 |
| 3 | LEAD | 6.93147E-21 | 0.00000E+00 | 1.00000E+00 |
| 4 | HMX (H-M | 6.93147E-21 | 1.36200E-03 | 1.00897E+00 |
| 5 | M-DINITR | 6.93147E-21 | 1.08400E-02 | 1.07137E+00 |
| 6 | POTASSIU | 6.93147E-21 | 0.00000E+00 | 1.00000E+00 |
| 7 | RDX 6H-3 | 6.93147E-21 | 5.73200E-01 | 4.77416E+00 |
| 8 | TNT 3NO2 | 6.93147E-21 | 1.01000E-02 | 1.06650E+00 |

Groundwater Velocity (U) : 3.51E+03 cm/day
Aquifer Thickness (H1) : 3.05E+03 cm
X-Direction Dispersivity (A1) : 2.65E+03 cm
Y-Direction Dispersivity (A2) : 5.29E+02 cm
Z-Direction Dispersivity (A3) : 3.07E+00 cm
Bulk Density (R2) : 1.60E+00 g/cm**3
Total Porosity (AN4) : 3.80E-01 (fraction)
Effective Porosity (AN5) : 2.43E-01 (fraction)
Length of Burial Area (AL1) : 1.62E+04 cm
Width of Burial Area (B1) : 1.62E+04 cm
Depth of Release Unit Below Water Table (HW) : 0.00E+00 cm
Distance Downgradient from Center of Source (X2): 2.65E+04 cm
Lateral Hydraulic Conductivity (HC) : 0.00E+00 cm/day

```
Modeling Medium #            3
Medium Type (MED)          : 5
Source Configuration       : 4
Source Term Discharge Type : 1
SURFACE WATER ENVIRONMENT


Number of River Receptor Locations (NUMREC)    :          1
Flow Velocity (U1)                             :  1.32E+07 cm/day
Depth of Flow (H1)                             :  1.22E+02 cm
Width of River (B1)                            :  1.52E+02 cm
Downstream Discharge at First Receptor (QNEW)  :  2.45E+11 cm**3/day
Distance Downstream from Center of Source (X3) :  3.05E+03 cm


Uniform Mixing Distance =  1.59E+02 cm

*****************************************************************************

Concentrations for 2,4-DINI at run time (1993 , 0.0 years) is between:
        0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
        0.000E+00 (g/ml or Ci/ml) at  155.0 years ( 2148)

Concentrations for BARIUM  at run time (1993 , 0.0 years) is between:
        0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
        0.000E+00 (g/ml or Ci/ml) at  106.7 years ( 2099)

Concentrations for LEAD    at run time (1993 , 0.0 years) is between:
        0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
        0.000E+00 (g/ml or Ci/ml) at  106.7 years ( 2099)

Concentrations for HMX (H-M at run time (1993 , 0.0 years) is between:
        0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
        0.000E+00 (g/ml or Ci/ml) at  109.1 years ( 2102)

Concentrations for M-DINITR at run time (1993 , 0.0 years) is between:
        0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
        0.000E+00 (g/ml or Ci/ml) at  127.3 years ( 2120)

Concentrations for POTASSIU at run time (1993 , 0.0 years) is between:
        0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
        0.000E+00 (g/ml or Ci/ml) at  106.7 years ( 2099)

Concentrations for RDX 6H-3 at run time (1993 , 0.0 years) is between:
        0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
        0.000E+00 (g/ml or Ci/ml) at  175.0 years ( 2168)

Concentrations for TNT 3NO2 at run time (1993 , 0.0 years) is between:
        0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
        0.000E+00 (g/ml or Ci/ml) at  125.8 years ( 2118)


*****************************************************************************
*****************************************************************************

Maximum Constituent Concentrations:


2,4-DINI:  3.895E-14 (g/ml or Ci/ml) at  1240.4 Years (3233)
BARIUM  :  2.071E-09 (g/ml or Ci/ml) at   853.6 Years (2846)
LEAD    :  4.143E-09 (g/ml or Ci/ml) at   853.6 Years (2846)
HMX (H-M:  5.601E-14 (g/ml or Ci/ml) at   873.0 Years (2866)
M-DINITR:  4.799E-14 (g/ml or Ci/ml) at  1018.1 Years (3011)
POTASSIU:  1.109E-09 (g/ml or Ci/ml) at   353.6 Years (2846)
RDX 6H-3:  1.234E-15 (g/ml or Ci/ml) at  6826.0 Years (8818)
TNT 3NO2:  5.408E-14 (g/ml or Ci/ml) at  1006.7 Years (2999)
```

8

```
Modeling Medium #            3
Medium Type (MED)          : 5
Source Configuration       : 4
Source Term Discharge Type : 1
SURFACE WATER ENVIRONMENT


Number of River Receptor Locations (NUMREC)    :          1
Flow Velocity (U1)                             :  1.32E+07 cm/day
Depth of Flow (H1)                             :  1.22E+02 cm
Width of River (B1)                            :  1.52E+02 cm
Downstream Discharge at First Receptor (QNEW)  :  2.45E+11 cm**3/day
Distance Downstream from Center of Source (X3) :  3.05E+03 cm


Uniform Mixing Distance =   1.59E+02 cm

*****************************************************************************

Concentrations for 2,4-DINI at run time (1993 , 0.0 years) is between:
         0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
         0.000E+00 (g/ml or Ci/ml) at  155.0 years ( 2148)

Concentrations for BARIUM   at run time (1993 , 0.0 years) is between:
         0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
         0.000E+00 (g/ml or Ci/ml) at  106.7 years ( 2099)

Concentrations for LEAD     at run time (1993 , 0.0 years) is between:
         0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
         0.000E+00 (g/ml or Ci/ml) at  106.7 years ( 2099)

Concentrations for HMX (H-M at run time (1993 , 0.0 years) is between:
         0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
         0.000E+00 (g/ml or Ci/ml) at  109.1 years ( 2102)

Concentrations for M-DINITR at run time (1993 , 0.0 years) is between:
         0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
         0.000E+00 (g/ml or Ci/ml) at  127.3 years ( 2120)

Concentrations for POTASSIU at run time (1993 , 0.0 years) is between:
         0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
         0.000E+00 (g/ml or Ci/ml) at  106.7 years ( 2099)

Concentrations for RDX 6H-3 at run time (1993 , 0.0 years) is between:
         0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
         0.000E+00 (g/ml or Ci/ml) at  175.0 years ( 2168)

Concentrations for TNT 3NO2 at run time (1993 , 0.0 years) is between:
         0.000E+00 (g/ml or Ci/ml) at     .0 years ( 1993)
         0.000E+00 (g/ml or Ci/ml) at  125.8 years ( 2118)

*****************************************************************************
*****************************************************************************

   Maximum Constituent Concentrations:


   2,4-DINI:  3.895E-14 (g/ml or Ci/ml) at  1240.4 Years (3233)
   BARIUM  :  2.071E-09 (g/ml or Ci/ml) at   853.6 Years (2846)
   LEAD    :  4.143E-09 (g/ml or Ci/ml) at   853.6 Years (2846)
```

H DIMITR: [illegible] (g/ml or Ci/ml) at [illegible] Years ([illegible])
POTASSIU: 1.109E-09 (g/ml or Ci/ml) at 853.6 Years (2846)
RDX 6H-3: 1.234E-15 (g/ml or Ci/ml) at 6826.0 Years (8818)
TNT 3NO2: 5.408E-14 (g/ml or Ci/ml) at 1006.7 Years (2999)

**********

**********

**********10/22/1992 VERSION III**********

OB- Overland Runoff

RADCON -- WATERBORNE TRANSPORT COMPONENT for the Multimedia
Environmental Pollutant Assessment System (MEPAS):
Models movement of radionuclides and other chemicals
in groundwater, surface water, and overland pathways.

Battelle, Pacific Northwest Laboratory (PNL)
P.O. Box 999, Richland, WA 99352

Developed for the U.S. Department of Energy

Input file for this run is OBSST4 .WIN

**********

Modeling Scenario Number 1

**********

Name of Facility : HAWTHORNE
Name of Waste Unit : OBSST4
Transport Scenario : SS-T4 Surface soil >Overland >Su
Exposure Scenario : SW-E1
Usage Location Number : 1
Usage Location Medium : 3
Usage Location Name :

TLIFE is the duration of release for each contaminant expressed in years.
TDIFF is the time difference in years between the current date and the date when contaminants were first released into the environment.

| Constituent Name | TLIFE (years) | TDIFF (years) | TFINAL (years) |
|---|---|---|---|
| 2,4-DINI | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| BARIUM | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| LEAD | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| HMX (H-M | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| M-DINITR | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| POTASSIU. | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| RDX 6H-3 | 7.001E+03 | 0.000E+00 | 7.001E+03 |
| TNT 3NO2 | 7.001E+03 | 0.000E+00 | 7.001E+03 |

Source-Term Moisture Content (AM5) : 9.00 %
Source-Term Bulk Density (R2) : 1.64E+00 g/cm**3

**********

Station : Reno NV
Altitude in Meters : 1548.4
Latitude in Degrees : 39.3
Height of Wind Measurement in Meters : 9.14
Temperature Data is Given in Degrees : F

**********

| MONTH | TEMPERATURE (DEG F) | PRECIPITATION VOLUME (IN) | WIND (MPH) | CLOUDINESS (TENTHS) | NUMBER OF PRECIPITATION EVENTS |
|---|---|---|---|---|---|
| 1 | 3.20E+01 | 1.24E+00 | 5.60E+00 | 6.40E+00 | 6.10E+00 |
| 2 | 3.70E+01 | 9.50E-01 | 6.20E+00 | 6.30E+00 | 5.80E+00 |
| 3 | 4.10E+01 | 7.40E-01 | 7.80E+00 | 6.00E+00 | 6.30E+00 |
| 4 | 4.60E+01 | 4.60E-01 | 8.20E+00 | 5.70E+00 | 4.00E+00 |
| 5 | 5.50E+01 | 7.40E-01 | 8.00E+00 | 4.90E+00 | 4.40E+00 |
| 6 | 6.20E+01 | 3.40E-01 | 7.60E+00 | 3.60E+00 | 3.20E+00 |
| 7 | 7.00E+01 | 3.00E-01 | 7.00E+00 | 2.30E+00 | 2.40E+00 |
| 8 | 6.70E+01 | 2.70E-01 | 6.50E+00 | 2.40E+00 | 2.30E+00 |
| 9 | 6.00E+01 | 3.00E-01 | 5.80E+00 | 2.60E+00 | 2.50E+00 |
| 10 | 5.00E+01 | 3.40E-01 | 5.40E+00 | 4.00E+00 | 3.00E+00 |
| 11 | 4.00E+01 | 6.00E-01 | 5.50E+00 | 5.70E+00 | 4.90E+00 |
| 12 | 3.30E+01 | 1.21E+00 | 5.20E+00 | 6.20E+00 | 5.90E+00 |

Total Water Available for Snowmelt Sediment Flux is : 1.17E+01 cm

OVERLAND Sediment Flux Calculations

Storm Type Index (ISTORM) : 2
2-yr, 6-hr Rainfall Event (P26) : 1.50E+00 IN
Overland Slope (OSLOPE) : 5.00E+00 %
R-FACTOR (RFACTR) : 6.82E+01
K-FACTOR (KFACTR) : 5.00E-02
SLOPE-LENGTH FACTOR (SLFACT) : 4.56E-01
C-FACTOR (CFACTR) : 5.00E-01
P-FACTOR (PFACTR) : 9.00E-01
Sediment Flux (SEDFLX) : 1.57E-03 g/cm**2/yr

Length of Surface Water Source-Term (AL1) : 1.62E+04 cm
Source-Term Type (ISTYPE) : 3
Source-Term Flux Boundary Conditions (ISOURC) : 1
Liquid Impoundment Index (IPOND) : 2
Source-Term Decay Index (IDECAY) : 2
Direct Discharge Surface Water Index (IDDSW) : 0
Number of Parent Constituents (NUMCON) : 8

Source-Term Configuration (ISCONF) : 4
Number of Media (NMED) : 1
Number of Integration Time Steps (NTIMES) : 40

Medium # 1 Equals Medium Type (MED) # 5

Length of Release Unit (AL1 OR CLEN) : 1.62E+04 cm
Width of release Unit (B1) : 1.62E+04 cm

The Average-Annual OVERLAND Water Flow Rate : 0.00E+00 cm/yr
The Average-Annual OVERLAND Sediment Soil Loss : 4.13E+05 g/yr

Water concentration units are: ATTO (1.000E-18) Ci OR g

| Constituent | CAS ID | Half-Life (Years) | Initial Conc. | Surface Equilibrium Coeff. (ml/g) | Solubility limit (g/ml) | Constituent Inventory (g OR Ci) |
|---|---|---|---|---|---|---|
| 2,4-DINI | 121142 | 1.00E+20 | 1.40E-06 | 2.55E-02 | 2.40E-04 | 4.60E+03 |
| BARIUM | 7440393 | 1.00E+20 | 5.03E-02 | 5.30E+02 | 1.00E+23 | 1.65E+08 |
| LEAD | 7439921 | 1.00E+20 | 1.01E-01 | 2.52E+00 | 1.00E+23 | 3.30E+08 |
| HMX (H-M | 2691410 | 1.00E+20 | 1.40E-06 | 1.36E-03 | 2.63E-06 | 4.60E+03 |
| M-DINITR | 99650 | 1.00E+20 | 1.40E-06 | 1.08E-02 | 4.70E-04 | 4.60E+03 |
| POTASSIU | 7447407 | 1.00E+20 | 2.69E-02 | 0.00E+00 | 3.50E-02 | 8.85E+07 |
| RDX 6H-3 | 121824 | 1.00E+20 | 1.40E-06 | 5.73E-01 | 3.84E-05 | 4.60E+03 |
| TNT 3NO2 | 118967 | 1.00E+20 | 1.40E-06 | 1.01E-02 | 4.80E-04 | 4.60E+03 |

Constituent Flux (g/yr or Ci/yr) and Time (Years) at the Release Unit

| Constituent # | | Flux | Time | Constituent # | | Flux | Time |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1.83E-01 | .0 | 1 | 2 | 1.83E-01 | 7001.0 |
| 2 | 1 | 2.07E+04 | .0 | 2 | 2 | 2.07E+04 | 7001.0 |
| 3 | 1 | 4.06E+04 | .0 | 3 | 2 | 4.06E+04 | 7001.0 |
| 4 | 1 | 1.40E-02 | .0 | 4 | 2 | 1.40E-02 | 7001.0 |
| 5 | 1 | 9.53E-02 | .0 | 5 | 2 | 9.53E-02 | 7001.0 |
| 6 | 1 | 0.00E+00 | .0 | 6 | 2 | 0.00E+00 | 7001.0 |
| 7 | 1 | 5.27E-01 | .0 | 7 | 2 | 5.27E-01 | 7001.0 |
| 8 | 1 | 8.98E-02 | .0 | 8 | 2 | 8.98E-02 | 7001.0 |

New Constituent Flux (g/yr or Ci/yr) and Time (Years) at the Release Unit

| Constituent # | Flux | Time | Constituent # | Flux | Time |
|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 4.06E+04 | .0 | 3 | 2 | 4.06E+04 | 7001.0 |
| 4 | 1 | 1.40E-02 | .0 | 4 | 2 | 1.40E-02 | 7001.0 |
| 5 | 1 | 9.53E-02 | .0 | 5 | 2 | 9.53E-02 | 7001.0 |
| 6 | 1 | 0.00E+00 | .0 | 6 | 2 | 0.00E+00 | 7001.0 |
| 7 | 1 | 5.27E-01 | .0 | 7 | 2 | 5.27E-01 | 7001.0 |
| 8 | 1 | 8.98E-02 | .0 | 8 | 2 | 8.98E-02 | 7001.0 |

The New Duration of Time that Constituents are Released from the Release Unit

| # | Constituent | New TLIFE (Years) |
|---|---|---|
| 1 | 2,4-DINI | 7.001E+03 |
| 2 | BARIUM | 7.001E+03 |
| 3 | LEAD | 7.001E+03 |
| 4 | HMX (H-M | 7.001E+03 |
| 5 | M-DINITR | 7.001E+03 |
| 6 | POTASSIU | 7.001E+03 |
| 7 | RDX 6H-3 | 7.001E+03 |
| 8 | TNT 3NO2 | 7.001E+03 |

Modeling Medium # 1
Medium Type (MED) : 5
Source Configuration : 4
Source Term Discharge Type : 3
SURFACE WATER ENVIRONMENT

Number of River Receptor Locations (NUMREC) : 1
Flow Velocity (U1) : 1.32E+07 cm/day
Depth of Flow (H1) : 1.22E+02 cm
Width of River (B1) : 1.52E+02 cm
Downstream Discharge at First Receptor (QNEW) : 2.45E+11 cm**3/day
Distance Downstream from Center of Source (X3) : 3.05E+03 cm

| Constituent | CAS ID | Half-Life (Years) | Initial Conc. | Surface Equilibrium Coeff. (ml/g) | Solubility limit (g/ml) | Constituent Inventory (g OR Ci) |
|---|---|---|---|---|---|---|
| 2,4-DINI | 121142 | 1.00E+20 | 1.40E-06 | 2.55E-02 | 2.40E-04 | 4.60E+03 |
| BARIUM | 7440393 | 1.00E+20 | 1.40E-06 | 5.30E+02 | 1.00E+23 | 1.65E+08 |
| LEAD | 7439921 | 1.00E+20 | 1.40E-06 | 2.52E+00 | 1.00E+23 | 3.30E+08 |
| HMX (H-M | 2691410 | 1.00E+20 | 1.40E-06 | 1.36E-03 | 2.63E-06 | 4.60E+03 |
| M-DINITR | 99650 | 1.00E+20 | 1.40E-06 | 1.08E-02 | 4.70E-04 | 4.60E+03 |
| POTASSIU | 7447407 | 1.00E+20 | 1.40E-06 | 0.00E+00 | 3.50E-02 | 8.85E+07 |
| RDX 6H-3 | 121824 | 1.00E+20 | 1.40E-06 | 5.73E-01 | 3.84E-05 | 4.60E+03 |
| TNT 3NO2 | 118967 | 1.00E+20 | 1.40E-06 | 1.01E-02 | 4.80E-04 | 4.60E+03 |

Uniform Mixing Distance = 1.43E+02 cm

**********

Concentrations for 2,4-DINI at run time (1993 , 0.0 years) is between:
1.413E-15 (g/ml or Ci/ml) at .0 years ( 1993)
1.413E-15 (g/ml or Ci/ml) at 175.0 years ( 2168)

Concentrations for BARIUM at run time (1993 , 0.0 years) is between:
1.598E-10 (g/ml or Ci/ml) at .0 years ( 1993)
1.598E-10 (g/ml or Ci/ml) at 175.0 years ( 2168)

Concentrations for LEAD at run time (1993 , 0.0 years) is between:
3.128E-10 (g/ml or Ci/ml) at .0 years ( 1993)
3.128E-10 (g/ml or Ci/ml) at 175.0 years ( 2168)

Concentrations for HMX (H-M at run time (1993 , 0.0 years) is between:
1.078E-16 (g/ml or Ci/ml) at .0 years ( 1993)
1.078E-16 (g/ml or Ci/ml) at 175.0 years ( 2168)

Concentrations for M-DINITR at run time (1993 , 0.0 years) is between:
7.340E-16 (g/ml or Ci/ml) at .0 years ( 1993)
7.340E-16 (g/ml or Ci/ml) at 175.0 years ( 2168)

Concentrations for POTASSIU at run time (1993 , 0.0 years) is between:
0.000E+00 (g/ml or Ci/ml) at .0 years ( 1993)
0.000E+00 (g/ml or Ci/ml) at 175.0 years ( 2168)

Concentrations for RDX 6H-3 at run time (1993 , 0.0 years) is between:
4.061E-15 (g/ml or Ci/ml) at .0 years ( 1993)
4.061E-15 (g/ml or Ci/ml) at 175.0 years ( 2168)

Concentrations for TNT 3NO2 at run time (1993 , 0.0 years) is between:

[illegible]
6.916E-16 (g/ml or Ci/ml) at 175.0 years ( 2168)

**********
**********

Maximum Constituent Concentrations:

| | | | |
|---|---|---|---|
| 2,4-DINI: | 1.413E-15 (g/ml or Ci/ml) at | .0 | Years (1993) |
| BARIUM : | 1.598E-10 (g/ml or Ci/ml) at | .0 | Years (1993) |
| LEAD : | 3.128E-10 (g/ml or Ci/ml) at | .0 | Years (1993) |
| HMX (H-M: | 1.078E-16 (g/ml or Ci/ml) at | .0 | Years (1993) |
| M-DINITR: | 7.340E-16 (g/ml or Ci/ml) at | .0 | Years (1993) |
| POTASSIU: | 0.000E+00 (g/ml or Ci/ml) at | .0 | Years (1993) |
| RDX 6H-3: | 4.061E-15 (g/ml or Ci/ml) at | .0 | Years (1993) |
| TNT 3NO2: | 6.916E-16 (g/ml or Ci/ml) at | .0 | Years (1993) |

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HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX O

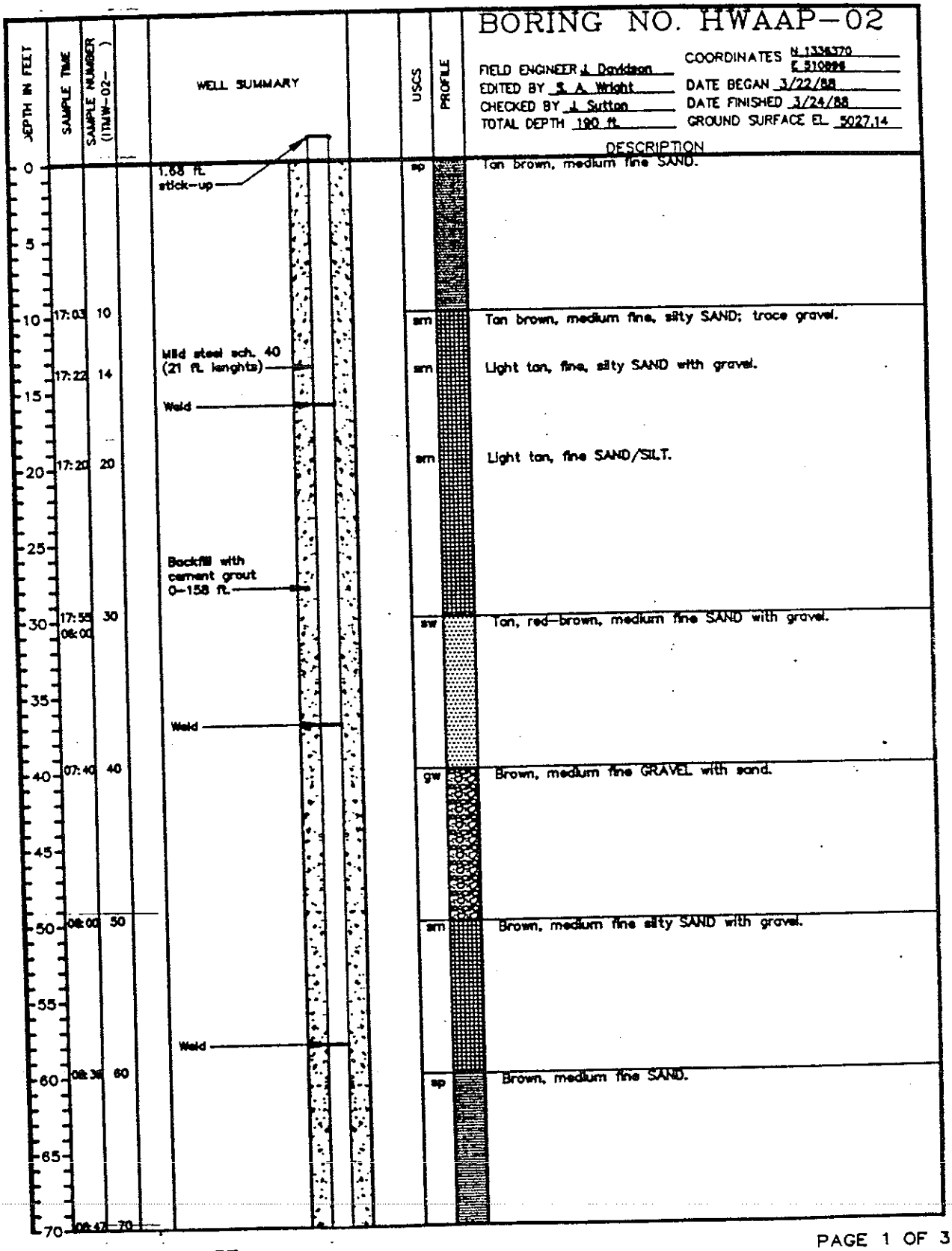
# Appendix O

## Boring Log in Old Bomb

# BORING NO. HWAAP-02

FIELD ENGINEER J. Davidson
EDITED BY S. A. Wright
CHECKED BY J. Sutton
TOTAL DEPTH 190 ft.

COORDINATES N 1336370 E 510926
DATE BEGAN 3/22/88
DATE FINISHED 3/24/88
GROUND SURFACE EL 5027.14






PROJECT NO. 190257
CLIENT: US Army Corps, of Engineers
Hunstville, Alabama

...Creating a Safer Tomorrow

SEE LEGEND FOR LOGS AND TEST PITS
FOR EXPLANATION OF SYMBOLS AND TERMS



HWAAP-02(HW1)

# BORING NO. HWAAP-02

FIELD ENGINEER J. Davidson
EDITED BY S. A. Wright
CHECKED BY J. Sutton
TOTAL DEPTH 190 ft.

COORDINATES N 1336370 E 510696
DATE BEGAN 3/22/88
DATE FINISHED 3/24/88
GROUND SURFACE EL 5027.14

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (ITMW-02-) | WELL SUMMARY | USCS | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 70 | | | | gp | | White-gray, medium, angular, GRAVEL with brown, fine sand. |
| 75 | | | | | | |
| 80 | 08:30 | 80 | Weld | sp | | Brown, medium fine SAND: trace gravel. |
| 85 | | | | | | |
| 90 | 10:10 | 90 | | SC | | Brown, fine to coarse SAND, some clay. |
| 95 | | | Backfill with cement grout 0-158 ft. | | | |
| 100 | 10:50 | 100 | Weld | sp | | Light brown-tan, medium fine SAND. |
| 105 | | | | | | |
| 110 | 11:17 | 110 | | sp | | Brown, medium fine SAND; trace gravel. |
| 115 | | | | | | |
| 120 | 11:30 | 120 | Weld | sp | | Light brown, medium fine SAND; trace gravel. |
| 125 | | | | | | |
| 130 | 11:50 | 130 | | sp | | Dark brown, medium fine SAND: trace gravel. |
| 135 | | | | | | |
| 140 | 12:20 | 140 | | sp | | Dark brown, medium SAND: trace gravel. |



PROJECT NO. 190257
CLIENT: US Army Corps of Engineers
Hunstville, Alabama

IT ...Creating a Safer Tomorrow

SEE LEGEND FOR LOGS AND TEST PITS
FOR EXPLANATION OF SYMBOLS AND TERMS

HWAAP-02(HW1)

# BORING NO. HWAAP-02

FIELD ENGINEER J. Davidson
EDITED BY S. A. Wright
CHECKED BY J. Sutton
TOTAL DEPTH 190 ft.

COORDINATES N 1336370 E 510696
DATE BEGAN 3/22/88
DATE FINISHED 3/24/88
GROUND SURFACE EL. 5027.14

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (ITMW-02-) | WELL SUMMARY | USCS | DESCRIPTION |
|---|---|---|---|---|---|
| 140 | 12:30 | 142 | Weld | sp | ▽ Water at 143.7'; 14:35 hrs., 3/24/88. Water at 142.8'; 4/10/88. Granodiorite boulder, 5' thick from 142'. |
| 145 | 15:07 | 147 | Backfill with cement grout 0–158 ft. | sp | Dark brown, medium fine SAND. |
| 150 | 16:55 | 150 | Sch. 30 S.S. blank | | |
| 155 | | | | | |
| 160 | 17:11 | 160 | #60 sand; 1/4–1/2" bentonite pellets | gp | Cemented sandy GRAVEL; moist. ▽ Water at 164'; 08:00 hrs., 3/23/88. |
| 165 | | | | | |
| 170 | 17:35 | 170 | #20 slot screen sch. 5 S.S. 172–182' | gp | Cemented medium sandy GRAVEL; moist. |
| 175 | 17:44 | 176 | #2/12 sand | | Wet cuttings at 176' during drilling. |
| 180 | 18:00 07:45 | 180 | | | Cemented sandy medium GRAVEL; wet. |
| 185 | | | Hole caved in from 190–184 ft. | SC | Brown, fine to coarse SAND with some clay. |
| 190 | 12:15 | 190 | | | TOTAL DEPTH 190 FEET |
| 195 | | | | | |
| 200 | | | | | |
| 205 | | | | | |
| 210 | | | | | |

**DRILLING INFORMATION**

SUBCONTRACTOR: The Water Developement Corporation
EQUIPMENT: Keshring SS–15THH, carrier mounted
METHOD: Air Rotary Casing Hammer

TEMPORARY DRILL CASING: 9 5/8" O.D. flush threaded

BIT: 8 1/2" Mill Tooth Roller Bit to 142' depth. 8" hole hammer, button head bit to 147'. Roller Bit to 190'.

DRILLER SUPT.: Miller Smith



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CLIENT: US Army Corps of Engineers
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HWAAP-02(HWI)

# BORING NO. HWAAP-03

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 260 ft.

COORDINATES N 1337385 E 510834
DATE BEGAN 2/27/88
DATE FINISHED 2/28/88
GROUND SURFACE EL. 5014.68

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (ITMW-04-) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | sw-sm | | Light tan, silty, fine SAND with gravel. |
| 5 | 08:15 | 5 | | sw-sm | | Light tan, silty, fine SAND with gravel. |
| 10 | 08:20 | 10 | | sw | | Light tan, medium fine SAND with gravel. |
| 15 | | | | | | |
| 20 | 08:40 | 20 | | sw | | Light tan, medium fine SAND with gravel. |
| 25 | | | | | | |
| 30 | 08:50 | 30 | | SW-SM | | Tan, fine SAND with gravel, trace silt. |
| 35 | | | Backfill with plant mix of sand to 6 bags/cyd cement 0 to 260 ft. | | | |
| 40 | 09:44 | 40 | | sw-sm | | Tan, fine SAND with gravel, trace silt. |
| 45 | | | | | | |
| 50 | 10:00 | 50 | | sw-sm | | Brown, fine SAND with gravel, trace silt. |
| 55 | | | | cl | | Dark brown, sandy, medium plastic CLAY with gravel. |
| 60 | 10:35 | 60 | | cl | | Dark brown, sandy, medium plastic CLAY with gravel. |
| 65 | | | | | | |
| 70 | | | | | | |



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# BORING NO. HWAAP-03

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 260 ft.

COORDINATES N 1337388 E 510634
DATE BEGAN 2/27/88
DATE FINISHED 2/28/88
GROUND SURFACE EL. 5014.68

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (TNW-04- ) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 70 | 11:15 | 70 | | ml | | Dark brown / black SILTY CLAY; trace gravel. |
| 75 | | | | | | |
| | | | | | | ● 80', water added to lift cuttings (through to 100') |
| 80 | 11:56 | 80 | | ml | | Gray, silty, stiff, plastic CLAY. |
| 85 | | | | | | |
| 90 | 14:00 | 90 | | ml | | Gray, silty, stiff, plastic CLAY. |
| 95 | | | | | | |
| 100 | 15:25 | 100 | | cl | | Gray, silty, sandy, plastic CLAY. |
| 105 | | | Backfill with plant mix of sand to 6 bags/cyd cement 0 to 260 ft. | | | |
| 110 | 16:23 | 110 | | cl | | Gray, silty, sandy, plastic CLAY. |
| 115 | | | | | | |
| 120 | 17:30 | 120 | | cl | | Gray, silty, sandy, plastic CLAY. |
| 125 | | | | cl/ml | | Gray CLAYEY SILT / SILTY CLAY. |
| 130 | 09:00 | 130 | | cl/ml | | Gray CLAYEY SILT / SILTY CLAY. |
| 135 | | | | | | |
| 140 | | | | | | |



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# BORING NO. HWAAP-0

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 260 ft.

COORDINATES N 1337365 E 519634
DATE BEGAN 2/27/88
DATE FINISHED 2/28/88
GROUND SURFACE EL. 5014.68

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (ITMW-04-) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 140 | 09:15 | 140 | | cl/ml | | Gray, CLAYEY SILT / SILTY CLAY. |
| 145 | | | | | | |
| 150 | 09:35 | 150 | | cl/ml | | Gray, CLAYEY SILT / SILTY CLAY. |
| 155 | | | | | | |
| 160 | 09:50 | 160 | | cl/ml | | Gray, CLAYEY SILT / SILTY CLAY. |
| 165 | | | | | | |
| 170 | 10:10 | 170 | | cl/ml | | Gray, CLAYEY SILT / SILTY CLAY. |
| 175 | | | Backfill with plant mix of sand to 6 bags/cyd cement 0 to 260 ft. | | | |
| 180 | 10:30 | 180 | | cl/ml | | Gray, CLAYEY SILT / SILTY CLAY. |
| 185 | | | | | | |
| 190 | 11:15 | 190 | | cl/ml | | Gray, CLAYEY SILT / SILTY CLAY. |
| 195 | | | | | | |
| 200 | 12:00 | 200 | | cl/ml | | Red brown, (maroon) CLAYEY SILT with gravel; (damp/moist). |
| 205 | 09:10 | 208 | | sm | | Gray, medium fine, clayey, silty SAND; dry. |
| 210 | | | | | | |



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HWAAP-03(HW4)

# BORING NO. HWAAP-03

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 260 ft.

COORDINATES N 1337369 E 510834
DATE BEGAN 2/27/88
DATE FINISHED 2/28/88
GROUND SURFACE EL. 5014.68

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (TNW-04-) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 210 | 09:20 | 210 | | sc | | Gray, medium fine, CLAYEY SILTY SAND; dry. |
| 215 | | | | | | |
| 220 | 09:35 | 220 | | SC | | Gray, fine to medium, SAND; some clay, dry. |
| 225 | | | | | | |
| 230 | 09:46 | 230 | | sc | | Gray, medium fine, clayey, silty SAND; dry. |
| 235 | | | | | | |
| 240 | 10:10 | 240 | | sc | | Gray, medium fine, clayey, silty SAND; dry. |
| 245 | | | Backfill with plant mix of sand to 8 bags/cyd cement 0 to 260 ft. | | | |
| 250 | 10:35 | 250 | | sc | | Gray, medium fine, CLAYEY SILTY SAND; dry. |
| 255 | | | | | | |
| 260 | 10:50 | 260 | | sc | | Gray, medium fine, CLAYEY SILTY SAND; dry. |
| | | | | | | TOTAL DEPTH 260 FEET |
| 265 | | | | | | |
| 270 | | | | | | |
| 275 | | | | | | |
| 280 | | | | | | |

DRILLING INFORMATION

SUBCONTRACTOR: The Water Development Corporation.
EQUIPMENT: Koehring SS-15THH, carrier mounted.
METHOD: Air Rotary Casing Hammer to 80' depth; Air Rotary 80 to 260'.
TEMPORARY DRILL CASING: 9 5/8" OD, flush threaded. to 80' depth.
BIT: 8 1/2" Mill Tooth Roller Bit.
DRILLER SUPT.: Miller Smith

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HWAAP-03(HW4)

# BORING NO. HWAAP-

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 300 ft.

COORDINATES N 1337847 E 511015
DATE BEGAN 3/13/88
DATE FINISHED 3/22/88
GROUND SURFACE EL 5006.65

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (ITAW-04- ) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| 5 | | | | | | |
| 10 | 15:25 | 10 | | sw | | Brown, medium fine SAND; trace gravel. |
| 15 | | | Backfill with plant mix of sand to 6 bags/cyd low alkali cement 0–300' | | | |
| 20 | 15:40 | 20 | | sm | | Tan / brown, medium fine, SILTY SAND with gravel. Boulders, pebbles |
| 25 | | | | | | |
| 30 | 15:55 | 30 | | sm | | Brown, medium fine SILTY SAND with gravel. |
| 35 | | | | | | |
| 40 | 16:15 | 40 | | sw | | Brown, medium fine SAND with gravel. |
| 45 | | | | | | |
| 50 | 08:30 | 50 | | ch | | Brown, sandy, plastic CLAY; trace gravel. |
| 55 | | | | | | |
| 60 | 09:10 | 60 | | SC | | Brown, medium fine, clayey SAND; trace gravel. |
| 65 | 09:17 | 65 | | sc | | Red–brown, clayey SAND; trace gravel. |
| 70 | | | | | | |

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HWAAP–04(HW4)

# BORING NO. HWAAP-04

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 300 ft.

COORDINATES N 1337847 E 511919
DATE BEGAN 3/13/88
DATE FINISHED 3/22/88
GROUND SURFACE EL. 5006.65

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (ITAW-04-) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 70 | 09:30 | 70 | | sc | | Brown (trace red), clayey, medium fine SAND; trace gravel |
| 75 | | | | | | |
| 80 | 10:17 | 80 | | cl/ml | | Dark, red black, CLAY / SILT. |
| 85 | 10:20 | 84 | Backfill with plant mix of sand to 6 bags/cyd low alkali cement 0-300' | cl/ml | | Gray, SILT / CLAY. |
| 90 | 10:40 | 90 | | sc | | Gray, clayey, medium fine SAND. |
| 95 | | | | | | |
| 100 | 11:00 | 100 | | cl/ml | | Gray SILT / CLAY. |
| 105 | | | | | | |
| 110 | 11:48 | 110 | | cl | | Gray sandy, SILTY CLAY. |
| 115 | 12:00 | 114 | | cl | | Black, SILTY CLAY. |
| 120 | 12:30 | 120 | | cl | | Gray SILTY CLAY. Casing extended to 120', then open hole. air rotary. |
| 125 | | | | | | |
| 130 | 13:30 | 130 | | cl | | Black, SILTY CLAY. |
| 135 | | | | | | |
| 140 | | | | | | |



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HWAAP-04(HW4)

# BORING NO. HWAAP-04

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 300 ft.

COORDINATES N 1337847 E 511015
DATE BEGAN 3/13/88
DATE FINISHED 3/22/88
GROUND SURFACE EL. 5006.65

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (ITMW-04-) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 140 | 14:00 | 140 | | cl | | Gray, CLAYEY SILT / SILTY CLAY. |
| 145 | | | | | | |
| 150 | 14:35 | 150 | | cl/ml | | Gray, CLAYEY SILT / SILTY CLAY. |
| 155 | | | Backfill with plant mix of sand to 8 bags/cyd low alkali cement 0-300' | | | |
| 160 | 15:10 | 160 | | sc | | Gray, CLAYEY SAND. |
| 165 | | | | | | |
| 170 | 15:40 | 170 | | sc | | Gray, medium fine CLAYEY SAND. |
| 175 | | | | | | |
| 180 | 16:05 | 180 | | cl/ml | | Gray, SANDY SILTY CLAY. |
| 185 | | | | | | |
| 190 | 16:41 | 190 | | cl/ml | | Gray-black, SILTY CLAY; medium stiff. |
| 195 | | | | | | |
| 200 | 17:35 | 200 | | cl | | Gray-black CLAY; medium stiff. |
| 205 | 09:10 | 208 | | sc | | Gray, medium fine, clayey silty SAND; dry. |
| 210 | | | | | | |

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HWAAP-04(HW4)

# BORING NO. HWAAP-04

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 300 ft.

COORDINATES N 1337847 E 511015
DATE BEGAN 3/13/88
DATE FINISHED 3/22/88
GROUND SURFACE EL. 5008.65

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (TMW-04-) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 210 | 14:00 | 210 | | sc | | Gray-black, medium, clayey SAND; plastic, trace gravel. Injecting water @ 212-217. 5 gal/min to lift cuttings. |
| 215 | | | | | | |
| 220 | | | | SC | | Gray, fine to medium, clayey SAND; plastic. |
| 225 | | | Backfill with plant mix of sand to 6 bags/cyd low alkali cement 0-300' | | | |
| 230 | 15:10 | 230 | | sc | | Gray, fine to medium, clayey SAND; highly plastic. |
| 235 | | | | | | |
| 240 | | | | | | Injecting water @ 240-300 ft., 8 gal/min to lift cuttings. |
| 245 | | | | | | |
| 250 | 16:00 | 250 | | sc | | Gray, fine to medium, clayey SAND; highly plastic. |
| 255 | | | | | | |
| 260 | | | | | | |
| 265 | | | | | | |
| 270 | 16:25 | 270 | | sc | | Gray, fine to medium, clayey SAND; highly plastic. |
| 275 | | | | | | |
| 280 | | | | | | |

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HWAAP-04(HW4)

# BORING NO. HWAAP-0

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 300 ft.

COORDINATES N 1337847 E 511018
DATE BEGAN 3/13/88
DATE FINISHED 3/22/88
GROUND SURFACE EL. 5006.65

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (ITMW-04-) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 280 | | | | sc | | Gray, fine to medium, clayey SAND; plastic. |
| 288 | | | | | | |
| 290 | | | | | | |
| 295 | | | Backfill with plant mix of sand to 6 bags/cyd low alkali cement 0-300' | | | |
| 300 | 17:11 | 300 | | | | |
| | | | | | | TOTAL DEPTH 300 FEET |
| 305 | | | | | | |
| 310 | | | | | | |
| 315 | | | | | | |
| 320 | | | | | | |
| 325 | | | | | | |
| 330 | | | | | | |
| 335 | | | | | | |
| 340 | | | | | | |
| 345 | | | | | | |
| 350 | | | | | | |

DRILLING INFORMATION
SUBCONTRACTOR: The Water Development Corporation
EQUIPMENT: Koehring SS-15THH, carrier mounted
METHOD: Air Rotary Casing Hammer to 120'; Air rotary 120' to 300'
TEMPORARY DRILL CASING: 9 5/8" O.D. flush threaded to 120'
BIT: 8 1/2" mill tooth roller bit
DRILLER SUPT.: Miller Smith

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HWAAP-04(HW4)

# BORING NO. HWAAP-05

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 200 ft.

COORDINATES N 1339377 E 306003
DATE BEGAN 2/22/88
DATE FINISHED 2/23/88
GROUND SURFACE EL. 5286.51

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (ITMW-04-) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | |
|---|---|---|---|---|---|---|
| 0 | | | | sw | | Tan - red brown, SAND; dry. |
| 5 | 10:47 | 8 | | | | Gravel, boulder. |
| 10 | 10:50 | 10 | | sm | | Tan-brown, medium to fine, silty SAND. |
| 15 | | | | | | |
| 20 | 11:11 | 20 | | sm | | Red brown, medium to fine, silty SAND. Change rotary bit from medium-mill tooth to carbide button at 20 feet. |
| 25 | | | Backfill with plant mix of sand and 6 bags/cyd low alkali cement 0-200 ft. | | | |
| 30 | 11:30 | 30 | | sm | | Brown, medium to fine, silty SAND with gravel. |
| 35 | | | | | | |
| 40 | 11:45 | 40 | | sm | | Brown, medium to fine, silty SAND with gravel. |
| 45 | | | | | | |
| 50 | 12:00 | 50 | | sw | | Brown, medium, SAND with gravel. |
| 55 | | | | | | |
| 60 | 12:30 | 60 | | sw | | Brown, medium, SAND. |
| 65 | | | | | | |
| 70 | | | | | | |

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HWAAP-05(HW5)

# BORING NO. HWAAP-0

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 200 ft.
COORDINATES N 1335377 E 509003
DATE BEGAN 2/22/88
DATE FINISHED 2/23/88
GROUND SURFACE EL. 5286.51

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (TMW-04-) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | |
|---|---|---|---|---|---|---|
| 70 | 12:50 | 70 | | sp | | Brown, medium SAND. |
| 75 | | | | | | |
| 80 | 13:40 | 80 | | sp-sm | | Gray – brown, medium SAND; with silt, trace gravel. |
| 85 | | | | | | |
| 90 | 14:10 | 90 | Backfill with plant mix of sand and 6 bags/cyd low alkali cement 0–200 ft. | gp | | Gray, medium, GRAVEL. |
| 95 | | | | | | |
| 100 | 14:55 | 100 | | gp | | Gray, fine, GRAVEL. |
| 105 | | | | | | |
| 110 | 15:10 | 110 | | gp | | Gray, fine, GRAVEL. |
| 115 | | | | | | |
| 120 | 15:50 | 120 | | gw | | Gray, fine – coarse, GRAVEL. |
| 125 | | | | | | |
| 130 | 16:15 | 130 | | gw | | Gray, fine – coarse, GRAVEL. |
| 135 | | | | | | |
| 140 | | | | | | |

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HWAAP-05(HW5)

# BORING NO. HWAAP-05

FIELD ENGINEER J.E. Davidson
EDITED BY J.E. Davidson
CHECKED BY S. Wright
TOTAL DEPTH 200 ft.
COORDINATES N 1335377 E 508003
DATE BEGAN 2/22/88
DATE FINISHED 2/23/88
GROUND SURFACE EL. 5286.51

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (ITMW-04-) | WELL SUMMARY (NOT INSTALLED) | USCS | PROFILE | |
|---|---|---|---|---|---|---|
| 140 | 07:40 | 140 | | gw | | Gray, fine – coarse, GRAVEL with fine sand. |
| 145 | | | | | | |
| 150 | 09:40 | 150 | | gw | | Gray – black, fine – coarse, GRAVEL. |
| | 10:10 | 154 | | | | Casing driven to 152' |
| 155 | | | | | | Gray – green massive basalt boulder: 154 to 162'<br>Change to button head bit/air rotary at 154' |
| 160 | 15:42 | 160 | | | | |
| | 15:56 | 164 | Backfill with plant mix of sand and 6 bags/cyd low alkali cement 0–200 ft. | gw | | Gray, fine – coarse, GRAVEL; damp. |
| 165 | | | | cl | | Brown – gray, soft, plastic, CLAY with gravel. |
| 170 | 16:07 | 170 | | sp | | Red – brown, medium , clayey SAND; trace gravel.<br>Open hole drilling.<br>● 170 ft. cuttings balling up – clay % small. |
| 175 | | | | | | |
| 180 | 16:14 | 180 | | sp | | Brown, medium fine, clayey SAND; trace gravel; damp. |
| 185 | | | | | | |
| 190 | 16:30 | 190 | | SC | | Brown, medium fine, SAND; some clay, some gravel, dry. |
| 195 | | | | | | |
| 200 | 16:42 | 200 | | sc | | Brown, medium fine, SAND; some clay, some gravel, dry. |
| 205 | | | | | | TOTAL DEPTH 200 FEET |
| 210 | | | | | | |

DRILLING INFORMATION
SUBCONTRACTOR: Tnw Water Development Corporation
EQUIPMENT: Koehring SS-15THH, carrier mounted
METHOD: Air Rotary Casing hammer to 154'; Down Hole Hammer 154 to 164': Air rotary to 200'
TEMPORARY DRILL CASING: 9 5/8" O.D. flush threaded to 154'
BIT: 8 1/2" Mill Tooth Roller Bit to 154'; Buttonhead bit from 154 to 200'
DRILLER SUPT.: Miller Smith

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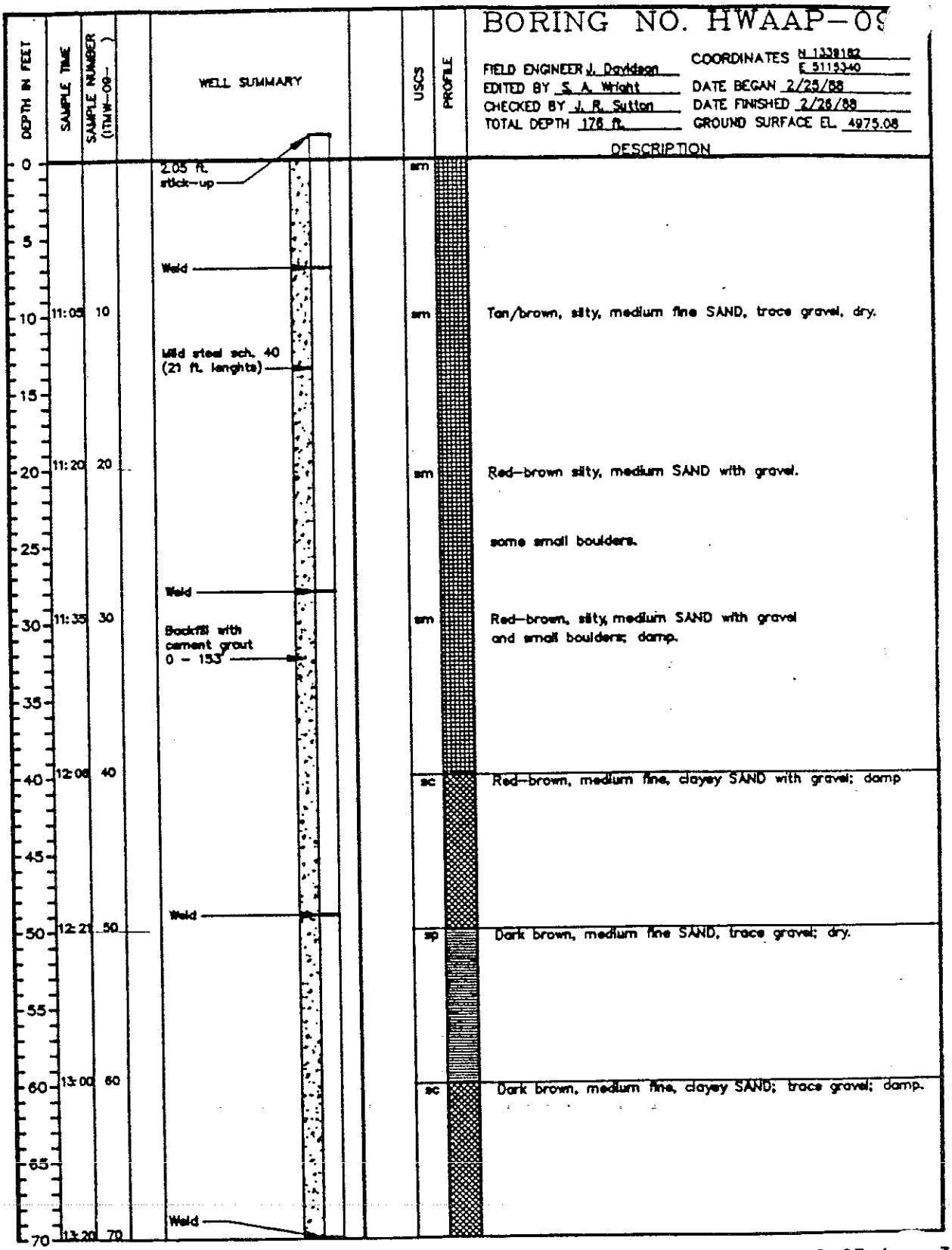
HWAAP-05(HW5)

# BORING NO. HWAAP-09

FIELD ENGINEER J. Davidson
EDITED BY S. A. Wright
CHECKED BY J. R. Sutton
TOTAL DEPTH 176 ft.

COORDINATES N 1338182 E 5119340
DATE BEGAN 2/25/88
DATE FINISHED 2/26/88
GROUND SURFACE EL. 4975.08



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HWAAP-09(HW-8)

# BORING NO. HWAAP-09

FIELD ENGINEER J. Davidson
EDITED BY S. A. Wright
CHECKED BY J. R. Sutton
TOTAL DEPTH 176 ft.

COORDINATES N 1338182 E 5116340
DATE BEGAN 2/25/88
DATE FINISHED 2/26/88
GROUND SURFACE EL. 4975.08

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (TMW-09-) | WELL SUMMARY | USCS | DESCRIPTION |
|---|---|---|---|---|---|
| 70 | | | | cl | Brown, slightly plastic, sc ty CLAY; moist. |
| 75 | | | | | |
| 80 | 14:05 | 80 | | cl | Brown, slightly plastic, sc ty CLAY; moist. |
| 85 | | | | | |
| 90 | 14:40 | 90 | Weld | cl | Brown, slightly plastic, sc ty CLAY; moist. |
| 95 | | | | | Water at 96.1', 4/10/8 |
| 100 | 15:10 | 100 | | sc | Brown, fat clayey, fine to coarse SAND. |
| 105 | | | Backfill with cement grout 0 – 153' | | Boulder |
| 110 | 15:30 | 110 | Weld | sc | Dark brown-gray, medium clayey SAND with gravel; damp. |
| 115 | | | | | |
| 120 | 16:05 | 120 | | sc | Dark brown-gray, medium clayey SAND with gravel; damp. |
| 125 | | | | | |
| 130 | 16:10 | 130 | | ch | Dark brown-gray, plastic clay, with gravel; moist. |
| 135 | | | Centralizer, weld | | |
| 140 | 16:30 | 140 | | | |

PROJECT NO. 190257
CLIENT: US Army Corps of Engineers
Huntsville, Alabama

PAGE 2 OF

IT .Creating a Safer Tomorrow

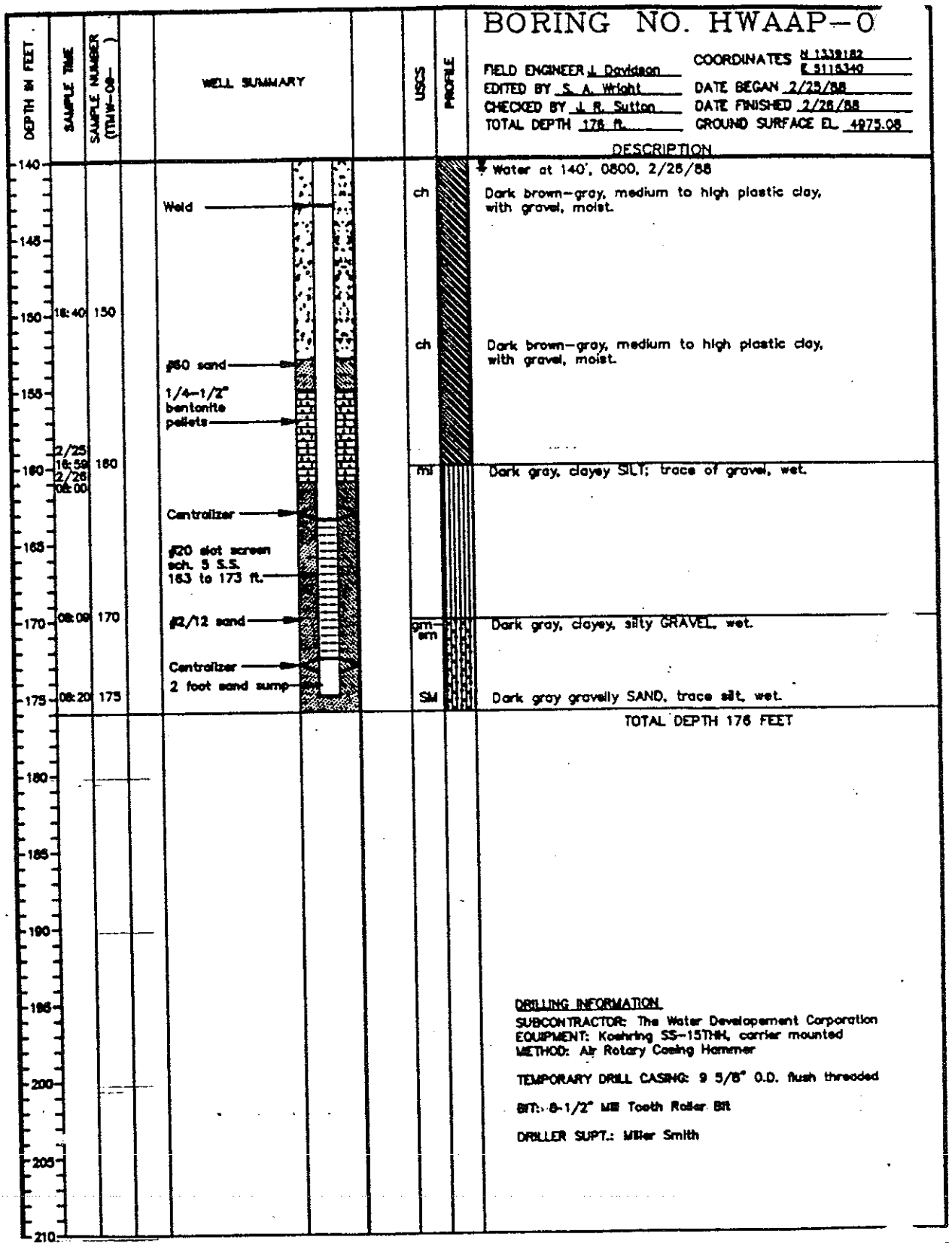
SEE LEGEND FOR LOGS AND TEST PITS
FOR EXPLANATION OF SYMBOLS AND TERMS

HWAAP-09(HW-6)

# BORING NO. HWAAP-0

FIELD ENGINEER J. Davidson
EDITED BY S. A. Wright
CHECKED BY J. R. Sutton
TOTAL DEPTH 176 ft.

COORDINATES N 1339182 E 5116340
DATE BEGAN 2/25/88
DATE FINISHED 2/26/88
GROUND SURFACE EL. 4975.08




DRILLING INFORMATION

SUBCONTRACTOR: The Water Developement Corporation
EQUIPMENT: Koehring SS-15THH, carrier mounted
METHOD: Air Rotary Casing Hammer

TEMPORARY DRILL CASING: 9 5/8" O.D. flush threaded

BIT: 8-1/2" Mill Tooth Roller Bit

DRILLER SUPT.: Miller Smith

PAGE

PROJECT NO. 190257
CLIENT: US Army Corps of Engineers
Hunstville, Alabama

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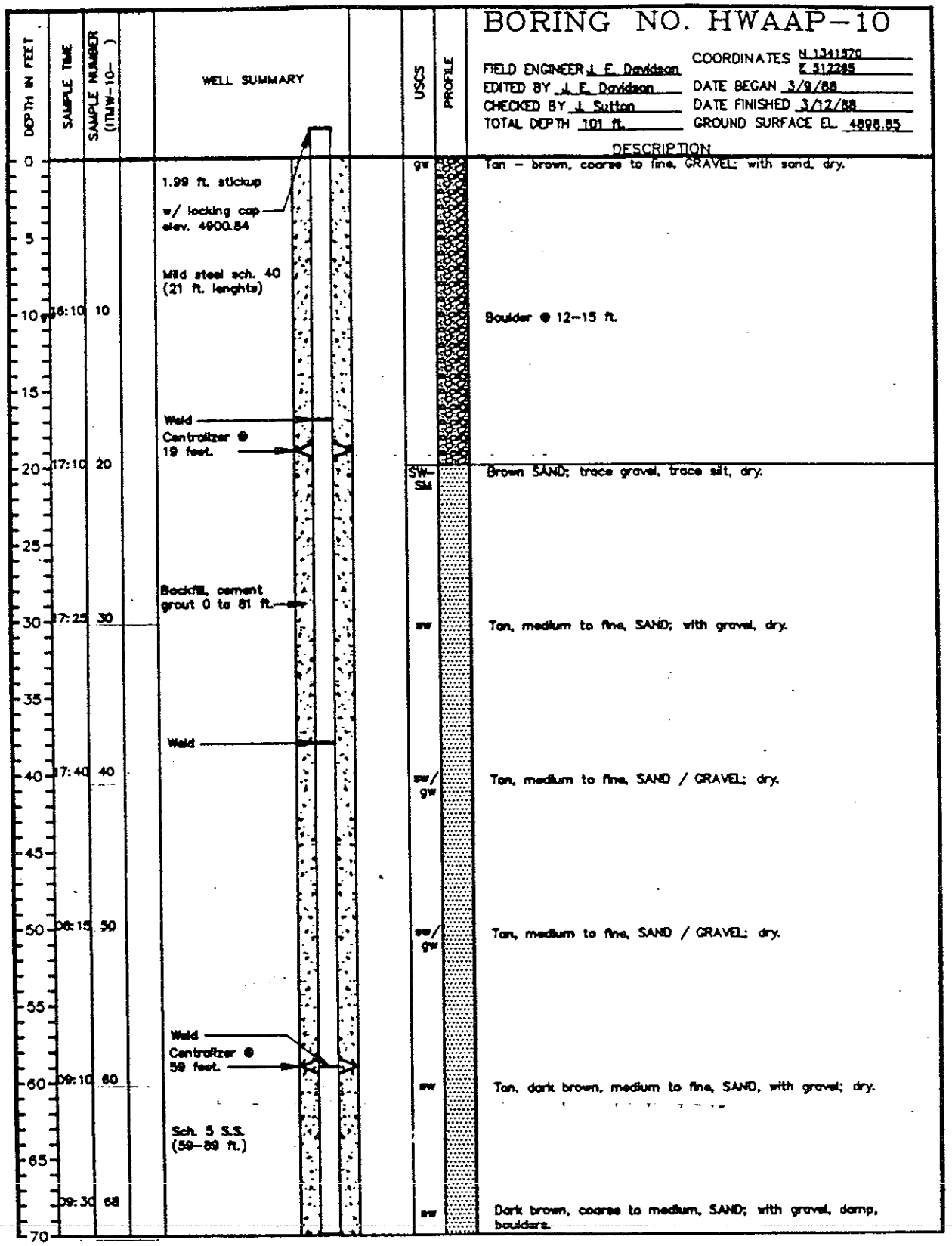
HWAAP-09(HW-8)

# BORING NO. HWAAP-10

FIELD ENGINEER J. E. Davidson
EDITED BY J. E. Davidson
CHECKED BY J. Sutton
TOTAL DEPTH 101 ft.

COORDINATES N 1341570 E 512285
DATE BEGAN 3/9/88
DATE FINISHED 3/12/88
GROUND SURFACE EL. 4898.85




PROJECT NO. 190257
CLIENT: US Army Corps of Engineers
Huntsville, Alabama

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FOR EXPLANATION OF SYMBOLS AND TERMS



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HWAAP-10(HW-3)

# BORING NO. HWAAP-1(

FIELD ENGINEER J. E. Davidson
EDITED BY J. E. Davidson
CHECKED BY J. Sutton
TOTAL DEPTH 101 ft.

COORDINATES N 1341570 E 512265
DATE BEGAN 3/9/88
DATE FINISHED 3/12/88
GROUND SURFACE EL. 4898.85

| DEPTH IN FEET | SAMPLE TIME | SAMPLE NUMBER (TMW-10-) | WELL SUMMARY | USCS | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|
| 70 | 10:25 | 70 | | sw | | Dark brown, coarse to medium, SAND; with gravel, boulders. |
| | 12:45 | | S.S. sch. 5 blank | | | Granite boulder 3–4 ft. thick in dense sandy gravel. |
| | | | | | | @74 ft. 3–4ft. thick water lens. |
| 75 | | | | | | Dark brown, coarse to medium, SAND; with gravel. |
| | | | | SW–SM | | Granite boulder at 77 ft. backed up casing to 75 ft. Changed over to down hole hammer at 75 ft. Gray sand; some fine gravel, trace silt. |
| 80 | 15:00 | 80 | | | | Gray andesite (flow). |
| | | | #60 sand 1/2–1/4 in. bentonite pellets | | | |
| 85 | | | Centralizer @ 88 feet. | | | |
| 90 | 16:00 | 90 | #1C sand | | | Fracture @ 92 ft. (wet). |
| 95 | | | #20 slot screen sch. 5 S.S. from 89 to 99' | | | |
| 100 | 17:00 | 100 | Centralizer @ 100 feet. | | | Gray andesite (flow) with fracture. |
| | | | Sch. 5 S.S. sand sump | | | TOTAL DEPTH 101 FEET |
| 105 | | | | | | |
| 110 | | | | | | |
| 115 | | | | | | |
| 120 | | | | | | |
| 125 | | | | | | |
| 130 | | | | | | |
| 135 | | | | | | |
| 140 | | | | | | |

**DRILLING INFORMATION**

SUBCONTRACTOR: The Water Developement Corporation
EQUIPMENT: Koehring SS-15THH, carrier mounted
METHOD: Air Rotary Casing Hammer to 75'; Down Hole Hammer 73 to 101'
TEMPORARY DRILL CASING: 9 5/8" O.D. flush threaded to 75'
BIT: 8 1/2" Mill Tooth Roller Bit to 75'; 8" Button Head Bit 73 to "C."
DRILLER SUPT.: Miller Smith



PROJECT NO. 190257
CLIENT: US Army Corps of Engineers
Huntsville, Alabama

SEE LEGEND FOR LOGS AND TEST PITS
FOR EXPLANATION OF SYMBOLS AND TERMS

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HWAD MAIN BASE
RCRA APPLICATION VOLUME 2

# APPENDIX P

# Appendix P

# POLU-11 Model Technical Information

# And Output Files

# POLU-11 MODEL TECHNICAL INFORMATION

# COMPUTER PREDICTIONS OF POLLUTION PRODUCTS FROM OPEN BURN AND OPEN DETONATION OF NAVY EXPLOSIVES AND PROPELLANTS

EDWARD E. BAROODY

NAVAL SURFACE WEAPONS CENTER/WHITE OAK

and

IVAN L. TOMINACK

HEAD, ORDNANCE ENVIRONMENTAL SUPPORT OFFICE

NAVAL ORDNANCE STATION, INDIAN HEAD, MD

JANUARY 1987

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## BACKGROUND

Under the sponsorship of the Ordnance Environmental Support Office at the Naval Ordnance Station, Indian Head, Maryland, a computer program has been developed to predict the pollution products caused by the open burning or open detonation (OB/OD) of explosives and like materials. Since the program is a modification of the Propellant Evaluation Program (PEP), written at the Naval Weapons Center, China Lake[1], a brief history of the PEP program is discussed below. The PEP program was designed and written by the collaboration of many contributors. Work on the program started in 1951 at NWC and continued until 1968.

Combustion products are calculated from high temperature chemical equilibria. To accomplish this, a large set of nonlinear algebraic equations must be simultaneously solved and computer codes must be general enough to handle any particular system. There have been three historic approaches to the problem.

One approach, presented by White et al[2], is the free-energy criterion for chemical equilibrium. This procedure is the method of steepest descent, which is a general method for the numerical solution of nonlinear algebraic equations.

The second approach by Brinkley[3] uses equilibrium constants. For this approach, a basis of subset molecular species is chosen that has as many species as there are chemical elements. From this basis all other species are formed by chemical reaction. A set of equations then establishes the equilibrium relationship of each nonbasis species to the basis. Another set of equations establishes the gram-atom amount of each chemical element. Both sets of equations are solved simultaneously by the Newton-Raphson method, which is a general method for the numerical solution of nonlinear algebraic equations. Huff et al[4] and Browne[5] later introduced the concept of optimized basis, in which the components are present in the greatest possible molar amounts.

The reaction-adjustment method of Villars[6,7] is the third approach. In theory, the chemical system is divided into a number of subsystems, each relating a nonbasis species to the basis. The subsystem with the greatest discrepancy in its equilibrium relationship is corrected stoichiometrically. In this way the gram-atom amounts do not change. Villars' method does not require the inversion of large matrices which simplifies coding. Its speed is greatly dependent on the choice of the basis which is quite slow. The PEP program is a combination of Villars' method and Browne optimum basis method.

The pollution computer program uses many of the PEP program's routines. Modifications of this program were made to calculate pollution products under the special conditions encountered in open burns and open detonations of explosives and propellants. These modifications are described under the general description of the pollution computer program.

THEORY AND ASSUMPTIONS FOR OPEN BURN/OPEN DETONATION CALCULATIONS

The computer program calculates the pollution combustion products under two different conditions:

1. Open Burn (OB) - under these conditions the material is mixed with air and they burn together to form the pollution products.

2. Open Detonation (OD) - under these conditions the material is detonated first, after which air is mixed with the detonation products that react to form the pollution products.

Open Burn

The necessary thermodynamic data for the material's ingredients and air, the weight ratios of material/air and the two pressure values of 1000 and 14.7 psi are read into the computer as input data. The flame temperature, combustion products, moles of gas, entropy, and other pertinent data are calculated for the material/air mixtures under a pressure of 1000 psi. The volume of the combustion products are then expanded to 14.7 psi which causes a temperature drop in the products. At this lower temperature, the products have a different composition from that at 1000 psi. The computer procedure goes through a similar routine it did at 1000 psi to recalculate the combustion products, flame temperature and other variables that changed because of expansion. The products calculated at 14.7 psi are reported as the pollution products in the output data.

Even though the calculations are conducted at 1000 and 14.7 psi, the material does not have to be disposed of under these conditions to predict the pollution products. The calculations are conducted in this manner for the following reasons:

1. It simulates the drop in temperature as the gases cool to ambient conditions.

2. The combustion products "freeze" in composition before they reach ambient temperature.

3. The combustion products of explosives and propellants formed in the combustion calorimeter are in good agreement with the products calculated by the computer[8].

4. The heats of explosion calculated from the PEP computer program closely approximates the actual values determined from calorimetric data[8].

## Simulating a Drop in Temperature

Initially, flame temperatures above 3500 K (5840 F) at the burn site can be reached by some materials burned alone or with air. The temperature then cools to the ambient temperature of the surroundings. It is important to account for this drop in temperature, because the composition of the combustion products for the initial high temperature at the burn site will be different from the composition cooled to ambient temperature.

In effect, the combustion product's temperature change can be simulated by calculating the temperature of the material burning under a pressure of 1000 psi and after the combustion products have expanded to 14.7 psi.

## Frozen Combustion Products

The composition of the combustion products will continually change with temperature until a "freeze" temperature is reached. Afterwards, the composition of the products remain constant, both quantitatively and qualitatively, even though they continue to cool to ambient temperature. The products are said to "freeze" when they no longer change with temperature. This freeze temperature is unknown and varies with each material burned. In his detonation calorimetric work, Ornellas[9] reported that the frozen temperature is between 1500 to 1800 K for most explosives. The frozen temperature for the combustion products in this study is assumed to be the temperature that is calculated when the products are expanded to 14.7 psi. For most of the explosives and propellants used by the services, this computer program calculates this temperature to be in the range of 1200 to 1500 K.

## Calculated Versus Determined Combustion Products

In this laboratory approximately a dozen explosives and propellants have been burned in a combustion calorimeter under an atmosphere of 450 psi of helium. The combustion products analyzed were in good agreement with the calculated composition of the products after they had been expanded from 1000 to 14.7 psi.

## Calculated Versus Determined Heats of Explosion

The heats of explosion have been calculated from the composition of the combustion products, expanding from 1000 to 14.7 psi, from the PEP program for numerous explosives and propellants. In general, there is good agreement between the experimental and calculated values using the PEP output data[8]. The close agreement between the calculated and the determined values for both the combustion products and heats of explosion determined at the NSWC laboratory, is the basis for using the pressure values of 1000 and 14.7 psi.

## Detonation Burn

The same input data is used for both the open burn and open detonation calculations. In open burn, the material and the air are mixed and burned together at 1000 psi and then the combustion products of this mixture are expanded to 14.7 psi. In detonation burns, the following conditions are assumed:

1. The material explodes first, forming combustion products that do not initially react with the surrounding air.

2. During the explosion, the hot gases expand, shock waves are created, etc., causing an energy loss of the combustion products.

3. The combustion products at the reduced energy are then reacted with the surrounding air to form the pollution products.

## Materials Explode First

In the open burn calculations, the air is mixed with the air initially at 1000 psi and allowed to react together. In open detonations the material explodes, forming combustion products without mixing with air.

## Loss of Energy

When an explosive detonates, shock waves and other processes occur that cause a loss of energy and a drop in temperature. The program assumes that this energy is lost before the combustion products react with air at the burn site.

## Combustion Products at Reduced Energy

The calculated energy loss is subtracted from the total energy of the explosive before the combustion products are reacted with air. The calculations then follow the open burn procedure discussed above. That is, the combustion products at a reduced energy level are mixed with air at 1000 psi and allowed to expand to 14.7 psi. This is the major difference between open burn and open detonation calculations.

## LIMITATIONS IN OPEN BURN/OPEN DETONATION (OB/OD) CALCULATIONS

### Material/Air Weight Ratios

A major problem in calculating pollution products is the material/air weight ratio that burns at the site. The weather, quantity of material to dispose of, wind speed, location, etc., are factors that greatly influence the material/air weight ratios.

To circumvent this uncontrollable variable, a series of material/air weight ratios from 100/0 to 10/90 in increments of -10/10 were calculated. The output data shows the trend in the composition of the pollution products as the ratios vary. Even though the approximate ratio isn't known, the calculations show the extremes expected of the products' compositions for disposal of materials by burning.

### Formation of Carbon Dioxide and Water

How much carbon goes to carbon dioxide and hydrogen to water would depend upon a number of factors. Two main factors would be the presence of other elements and the freeze temperature. For example, boron carbide, HCl, and HF would form if boron, chlorine and fluorine were present. Some hydrocarbons would likely form in many cases. Above the freeze temperature, most of the residual carbon and hydrogen would form carbon dioxide and water if enough oxygen were present. The ideal conditions would be for this to occur in OB/OD burns.

If analyses of future OB/OD burns could verify that this does occur, then the material/air weight ratios could be varied until all of the residual carbon and hydrogen went to those two products. That particular material/air weight ratio would then be used to predict the combustion products formed.

Even if not verified, the material/air weight ratios should be varied until all the residual carbon and hydrogen are burned to carbon dioxide and water. It would predict what combustion products are formed under ideal conditions for OB/OD burns.

### Calculating Temperature Change

As discussed above, the temperature change is simulated by calculating the material burning at 1000 psi and allowing the combustion products to expand to 14.7 psi. These two pressure values chosen were based on experimental data determined at this laboratory. As mentioned, the theoretical combustion products and heats of explosion calculated under these conditions were in good agreement with the experimental calorimetric data for

the gases formed and the heats of explosion determined. Since temperature is a function of both gases formed and heat released, the calculated temperature change between the pressures of 1000 and 14.7 psi is used for predicting pollution products.

The temperature calculated at 1000 psi simulates the initial high flame temperature of the material at the burn site before it expands. This calculated temperature is slightly higher than the calculated flame temperature if ambient pressure were used instead. For example, the flame temperature for TNT is 1992K at 1000 psi, and 1976 K at 14.7 psi (with no expansion). With such close agreement at these two pressures, it wasn't felt necessary to program the computer to obtain an initial flame temperature at ambient pressure before calculating the temperature drop. This is especially true when the initial flame temperature is subject to the conditions of the environment.

### Homogeneity of Materials

Often different types of materials are burned together. In such cases, all of the ingredients in the materials are combined and treated as one homogeneous material in the calculations.

### Detonation of Materials in Different Containers

Materials come in many types of containers. Those contained in shells, grenades and other metallic casings will be more difficult to predict than in paper containers. Such containers will influence the chemical reactions at the burn site.

## DETONATION REACTIONS BEFORE REACTING WITH AIR

Detonation burn calculations are less accurate than open burn calculations. The material explodes before it reacts with the air. For this reason two assumptions concerning pressure changes and loss of energy were made. They are discussed below.

### Pressure Changes in Detonations

Unlike an open burn, there is an initial high pressure from the detonation. It is difficult to calculate what products are formed under high pressures. This computer program uses the ideal equations of state for the combustion products that would not apply to gases under such conditions.

Since the objective is to predict pollution products at ambient conditions, these gases would not be of interest. As the combustion products decrease in pressure, their behavior is assumed to obey the ideal equations of state for gases.

## Loss of Energy

The detonation of the explosives sets up shock waves, does work against the environment that expends energy. Since energy is a major factor in determining what products are formed, the calculations assume a loss of energy by the combustion products before they react with air. The loss for each material is at best an estimation. The energy consumed in shock waves is reported by Price[10] and Dyson[11] to be 20% to 25% of the total energy of an explosive. The computer program estimates the energy loss to be 25%, plus or minus 5%, depending on the explosive. This percentage can be modified later if and when better experimental data becomes available. As discussed under detonation burn, the combustion products are then calculated at a reduced energy level by the same procedures used in open burn calculations.

# DESCRIPTION AND OPERATION OF THE POLLUTION COMPUTER PROGRAM

## Modifications of Propellant Evaluation Program

The Propellant Evaluation Program (PEP) was designed for rocket calculations and could not be used in its present form. Since many of PEP's subroutines were compatible for pollution calculations, it was easier to modify this program than to start from scratch. The following major changes were made:

1. INPUT DATA FORMAT - A different format was used for the special type of calculations for pollution work. This format is described below.

2. OUTPUT FORMAT - The PEP output was designed for data important to rocket designs. An example of the output format and data for pollution data is described below.

3. REACTION WITH AIR - The OB/OD burns are mixed with air. the program is designed to automatically mix the materials with air and calculate the results.

4. ENERGY LOSS IN DETONATIONS - The OD burns are assumed to lose energy before they react with air. A modification of several subroutines was made to account for this loss.

5. OB/OD CALCULATIONS - To facilitate the use of the program, it was designed to do either an OB or OD calculation using the same input data. As described below, only one variable must be changed to accomplish this.

General Description

The main computer program, POLU10, has two auxiliary programs to handle the necessary input data for its operation. The three programs are described as follows:

A. POLU10 - This is the source file for the main program. It is written in the FORTRAN IV language. An explanation of the input data and format is included below. The program was purposely written in FORTRAN IV to facilitate its transfer to other types of computers with the least amount of trouble.

B. PEPAUX - This is the auxiliary source file program that manages the thermodynamic data for the combustion species. The JANNAF Thermochemical Tables[12] is the source for most of this data. Heat capacity equations, entropy and enthalpy constants are stored in this program for over 1400 combustion species. Gases, liquids and solids are included. Thus, the program can predict solids and liquids as well as gaseous pollution products. When this program is run, a binary file of the data is compiled that POLU10 calls in and searches for the appropriate combustion species. The compiled form of the data must be assigned to TAPE 12 when running POLU10.

C. INGDATA - This is the auxiliary source file program that manages the ingredients that compose the propellants, explosives or other materials that are disposed of by burning. The names, heats of formation, densities, and the elemental compositions of the ingredients are included as part of the data handled by this program. The ingredients are selected from numbers by the main program. This eliminates reading in the necessary data for the ingredients every time they are used. Two data files are generated by this program:

1. File on TAPE 11 - This file has the ingredients data arranged in the format used by the main program. the data from this file must be assigned to TAPE 11 before POLU10 is run.

2. File on TAPE 6 - The INGDATA program also prints the ingredients data on TAPE 6. A copy of this file is obtained for reference by the users of the pollution program. It lists the ingredients by numbers. When a particular ingredient is used in the calculations, this number is entered as input data. The data for that ingredient will then be called in by POLU10.

## Explanation and Format Data

The data must be entered in the following sequence:

Line 1

| Column No. | Data | Description of Data |
|---|---|---|
| 3 | 0 | This is always 0. It controls the species data coming from PEPAUX. |
| 4 | 1 | 1 or 0. When set to 1, the pressure is entered as lb/sq. in (psi). When set to 0, the pressure is entered in atmospheres. |
| 9 | 1 | 1 or 0. When set to 1, all of the ingredients are read from TAPE 11 by numbers. When set to 0, some or all of the ingredients are read in directly. This is explained in Line 4. |
| 20 | 3 | 0,1,2,3 or 4. This controls what decimal place the concentrations of the combustion products are printed in the output data. Three is recommended. |

| setting | decimal place |
|---|---|
| 0 | 1xE-5* |
| 1 | 1xE-10 |
| 2 | 1xE-17 |
| 3 | 1xE-4 |
| 4 | 1xE-25 |

*E = the exponential of 10

| | | |
|---|---|---|
| 29-30 | 1-10 | This is the number of ingredients in the propellant or explosive, plus 1 for air. For example, if an explosive has 3 ingredients, this value must be 4 (right adjusted). Ten ingredients is the limit. If more than 10, two or more of the ingredients must be combined into one. |

| | | |
|---|---|---|
| 39-40 | 1-10 | This is the number of calculations or runs to be made. The output format limits this number to 10 (right adjusted). |
| 46-47 | 20 | When all of the ingredients are read in by numbers, this is set to 20. If any of the ingredients are not read in by numbers, this number (right adjusted) must equal the number of ingredients not read in by numbers. |
| 48-50 | 1,2 | When set to 1 (right adjusted), the computer does open detonation calculations. When set to 2, the computer does open burn calculations. They both use the same input data and format. |
| 51-53 | 1,2,3 | When set to 1, the output data for the pollution products are given in grams products/100 g material. When set to 2, the products are also given (both units) in grs products/liter of gases formed at STP (273.15 degrees Kelvin and 1 atmosphere pressure). |

## Line 2

This line is for naming of the material burned and other identifying information.

## Line 3

In a sequence of calculations, the weight percent of air is changed. This line is for the different weights of air that changes with each calculation. As many as ten different weights of air can be entered. Starting at column 1, each weight has a field of 6 columns. Weight 1 goes into columns 1 - 6; weight 2, into columns 7 - 12, etc.

## Line 4

The INGDATA file contains data for many of the ingredients that are used in propellants and explosives. If this file does not have the ingredients needed for the calculations, the data for these ingredients can be read in. In Line 1, column 9 must have a value of 0 and columns 46 - 47 must have the number of ingredients (right adjusted) that are read in under the format below.

When adding new ingredients to the INGDATA data file, this same format is used. The INGDATA data can also be entered under the foramt adopted by Cruise at China Lake. The postion of the data under Cruise's format is marked in the data file.

| Column No. | Description of Data |
|---|---|
| 1 - 20 | Name of the ingredient |
| 21 - 27 | Heat of formation of the ingredient in cal/g. |
| 28 - 32 | Density of ingredient in lb/cubic inch. |
| 33 - 38 | Number of atoms of the first element in the ingredients. |
| 39 - 40 | Symbol of the first element (left adjusted). |
| 41 - 46 | Number of atoms of the second element in the ingredients. |
| 47 - 48 | Symbol of the second element (left adjusted). This sequence continues for a limit of six elements. |
| 49 - 54 | Atoms of third element. |
| 55 - 56 | Symbol of third element. |
| 57 - 62 | Atoms of fourth element. |
| 63 - 64 | Symbol of fourth element. |
| 65 - 70 | Atoms of fifth element. |
| 71 - 72 | Symbol of fifth element. |
| 73 - 78 | Atoms of sixth element. |
| 79 - 80 | Symbol of sixth element. |

**Line 5** — [illegible] 14

The numbers assigned to the ingredients by the INGDATA file are entered here. Starting at column 1, each field has 5 columns. The number for the first ingredient goes into columns 1 - 5, the second ingredient into columns 6 - 10, etc. For example, if 23 is assigned to aluminum by the INGDATA file, 23 should go in columns 1 - 5 (right adjsuted). Aluminum is the first ingredient in the material. It is imperative that the ingredient number for air always be the last number in this line. If it is desired to burn the materials in pure oxygen, then the ingredient number for oxygen is used instead of air.

## Line 6

| Column No. | Data | Description of Data** |
|---|---|---|
| 1 - 6 | 1000. | This is the pressure of the chamber in which the material is initially burned. This value is normally 1000 psi for pollution calculations. Atmospheres can be used (see explanation in Line 1). The data in this line is for the first calculation. |
| 7 - 12 | 14.7 | This is the pressure that the combustion products expand to in the calculations. The value 14.7 psi is normally used here. It can also be expressed in atmospheres. |
| 13 - 18 | — | This is the weight of the first ingredient. The field for each successive ingredient is 6 columns long. For the second ingredient, columns 19 - 24; the third, columns 25 - 30, etc. The tenth and last ingredient is in columns 67 - 72.<br><br>The weights of the ingredients are entered with air as the last ingredient. Air is normally set at zero weight percent. Under some circumstances, the initial weight of oxygen is not zero. This is discussed later. The weight of air is automatically increased and the material weights decreased by the same increments in Line 3. |
| 73 - 80 | — | This is optional. Additional information can be entered here to help identify the output data. Such information is normally entered in Line 2. |

## Lines 7 - 15

| | | |
|---|---|---|
| 1 - 6 | 1000. | The data is the same as in columns 1 - 6 in Line 5. |

| | | |
|---|---|---|
| 7 - 12 | 14.7 | The data is the same as in columns 7 - 12 in Line 5. It isn't necessary to enter the weights of the material or air again. The program automatically adjusts these weights with the data in Line 3. The number of these lines is always one less than the total number of calculations made. If 10 calculations are to be computed, enter 9 of these lines with just these two values on each line. |

** All numerical data must have a decimal point.

## IDENTIFICATION OF NUMBERS ON SAMPLE OF OUTPUT DATA

NO.

1. Identifies the type of calculation. This is either open burn or open detonation.

2. Name of the material burned is identified here.

3. Name of the ingredients in the material.

4. Symbol for the elements in the ingredients. Also, the number of atoms for that element divided by 1000. This number is often in decimal form when the elements are expressed in gram-atoms.

5. Weight of the ingredient in the material.

6. Heat of formation of the ingredient in cal/gr.

7. Density of the ingredient in lbs/cu in.

8. Symbol for the elements that compose the material. Also, the elemental composition of the elements that compose the material. If the atomic wt. of the element is multiplied by the elemental composition, the total mass of the element in the material can be calculated (example: 12.01 x 3.081786 = 37.01 grs of carbon).

9. Weights of the material and air used in the calculations.

10. For open burn calculations: This is the initial flame temperature of the material/air burned before the gases start to cool. The enthalpy of the combustion products is given in kcal/gfw (gfw = gram formula weight). The temperature is expressed in both Kelvin and Fahrenheit degrees.

    For open detonation calculations: This is the temperature of the combustion products after there is a loss of energy due to detonation. The detonation products cool to this temperature before they react with air.

11. The temperature of the combustion products (for both OD/OB burns) after they have expanded from 1000 to 14.7 psi. This is also the "frozen" temperature of the products.

12. The computer can calculate the weights of the combustion products to 1.00E-17. For this work the concentration is rounded off to the value shown.

13. Symbols for the combustion products formed. They are identified in the JANNAF Thermochemical Tables[12]

14. Weights of the products formed in grams products/100 grams of material burned (or lbs products/100 lbs material burned).

15. Total combustion products considered in the calculations. Of the 73 products listed, 12 with concentrations 1.00E-04 or higher are listed above.

SAMPLE OF OUTPUT DATA

WHEN FIT MIXTURE MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR--- (1)
MATERIAL-INT (2)

| | (3) H | C | N | O | | | | | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TRINITROTOLUENE | .005 | .007 | .003 | .0040 | .0000 | .0000 | .0000 | .0000 | 100.000 | -70. | .0570 |
| AIR -18 | 0.0000 | .000 | .006 | .0010 | .0000 | .0000 | .0000 | .0000 | 0.000 | 0. | .0004 |

NUMBER ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H) | (C) | (N) | (O) | (4) |
|---|---|---|---|---|
| 2.201276 | 3.081786 | 1.320746 | 2.641531 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL (9) | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | 0.000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. (K) | 1991.587 | 1967.200 | 1941.777 | 2081.193 | 2143.154 | 2293.284 | 2453.924 | 2621.280 | 2587.360 | 1543.744 |
| FLAME TEMP. (F) (10) | 3125.312 | 3081.540 | 3035.799 | 3142.740 | 3390.274 | 3660.511 | 3957.663 | 4250.984 | 4053.849 | 2319.330 |
| ENTHALPY KCAL/GRM | -7.750 | -6.982 | -6.284 | -5.430 | -4.655 | -3.879 | -3.103 | -2.327 | -1.552 | -.774 |

--COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. (K) | 1845.051 | 1833.700 | 1822.052 | 1808.048 | 700.050 | 763.008 | 1084.619 | 1180.200 | 1004.722 | 543.132 |
| FLAME TEMP. (F) | 1421.693 | 1401.484 | 1380.293 | 1355.071 | 1319.091 | 1275.599 | 1348.913 | 1535.503 | 1493.154 | 554.230 |
| ENTHALPY KCAL/GRM (11) | -57.042 | -55.964 | -54.877 | -52.524 | -52.033 | -52.133 | -52.649 | -53.207 | -49.259 | -28.722 |
| L.VOL.BASIS -LITERS | 100.023 | 115.048 | 123.018 | 135.090 | 150.118 | 171.147 | 203.341 | 254.038 | 340.758 | 758.698 |

(BASED AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04 (12)

-----GRAMS PRODUCTS/100 GRAMS (OS/G)MATERIAL BURNED----- (14)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 57.4357 | 58.0000 | 60.5270 | 62.1614 | 62.4153 | 61.4025 | 52.6555 | 31.9719 | .0000 | .0000 |
| N2 | 10.4999 | 27.2600 | 30.2121 | 52.2923 | 71.0660 | 97.3492 | 134.7753 | 202.4849 | 333.0945 | 720.1532 |
| CO2 | 10.0577 | 12.0168 | 15.2770 | 18.0797 | 23.0764 | 34.0207 | 52.0557 | 85.3981 | 135.6325 | 135.6325 |
| CO | 9.2505 | .0000 | .0000 | .0000 | 3.2326 | 1.0016 | .0000 | .0000 | .0000 | .0000 |
| H2 | 1.9636 | 1.9451 | 1.9253 | 1.8972 | 1.8471 | 1.7765 | 1.5239 | .0001 | .0000 | .0000 |
| H2O | 1.7593 | 1.9240 | 2.1041 | 2.3505 | 2.7921 | 3.4040 | 4.1710 | 12.4700 | 19.0291 | 19.0291 |
| CH4 (13) | .2315 | .2313 | .2291 | .2203 | .2345 | .2426 | .0161 | .0000 | .0000 | .0000 |
| NH3 | .0015 | .0017 | .0019 | .0021 | .0024 | .0026 | .0016 | .0003 | .0000 | .0000 |
| CNH | .0004 | .0004 | .0004 | .0004 | .0003 | .0002 | .0001 | .0000 | .0000 | .0000 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | 10.6290 | 116.3851 |
| NO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0121 | .0000 |
| CO | .0000 | 0.1310 | 6.7203 | 5.0373 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 |

## LIMITATIONS

### Thermodynamic Data for Combustion Products

The program contains an auxiliary data file (PEPAUX) for the combustion products. Heat capacity coefficients, enthalpy and entropy constants are stored for each of the combustion products. Most of the data in this file is from the JANNAF Thermochemical Tables[12]. Currently, there are over 1400 species in this file. It contains compounds in the gaseous, liquid and solid states. The program chooses the compounds to consider in the calculations from the elemental composition of the material burned. If the material contains the elements C, H, O, N, the program searches the library for all species containing these elements and considers them as possible pollution products. The total number of combustion products considered for each calculation is listed in the output data. Obviously, any products formed at the burn site and not in this file cannot appear in the calculations. This library contains most of the species that are formed from explosives and propellants used by the armed services.

The file does not contain a large number of species for the metallic additives that are used in military explosives. There will probably be some products formed from metals that are not in the file. Since aluminum is used extensively, there is an adequate amount of species for this metal under most circumstances.

Most of the species in the thermodynamic file consist of solids and gases. The liquids and solids are identified by asterisks and dollar signs, respectively, in the output data. The PEP program is designed to calculate combustion products at high temperatures. The file does not include organic solvents or other organic compounds that cannot survive high temperatures.

### High Temperature Species

Some of the species formed only exist at high temperatures. These species would disappear as ambient temperature is approached. For example, ions would be in this catagory. These species normally disappear in the calculations as more air is added. In evaluating the pollution products, these species are assumed to disappear. For most explosives and propellants these high temperature species comprise only a small percentage of the total.

### Temperature Limitations

If the materials burned do not obtain a flame temperature above 300 K, the computer will issue a warning. For example, if a hydrocarbon without oxygen is attempted there will be no reaction above 300 K. This can occur

with a mixture of material and air if there is not sufficient amount of oxygen or fuel to properly react. In such cases several trial runs can be made by changing the material/air ratios until the program runs.

## Mixing Air With Materials

In most calculations, the first material/air weight ratios start with 100/0. The computer will accept this ratio as long as the material contains the elements oxygen and nitrogen. If a material, such as a hydrocarbon is burned with zero weight percent of air, the program cannot run. With air as an ingredient, the computer will select those species from the PEPAUX library composed of these two elements. The concentrations of these species cannot be calculated as the elemental composition of oxygen and nitrogen will be zero. When burning hydrocarbons and similar materials, the percent of air cannot be zero.

## Precautions With Detonation Calculations

The first material/air weight ratios in a series of detonation calculations must be 100 g material/0 g air, or the material burned alone. The program must use the data from this first calculation to determine the energy loss from the detonation. Since most explosives and propellants contain nitrogen and oxygen, the problem discussed in the paragraph above does not apply. Some materials, (tetrazoles, azides, etc.) do not contain oxygen or nitrogen. For detonation calculations, a small amount of air must be included in the first calculation. The air would be considered as part of the explosive's composition in the first calculation. A minimum percent of air should be used that can be determined by trial and error.

## Combustion Products Printed Twice

The thermodynamic data covers a wide temperature range. In some species (notably solid carbon and aluminum oxide), the data is stored as two heat capacity equations to properly cover the temperature range. Therefore, some species appear twice in the output data. When this occurs, one or the other of the symbols representing that species is zero. This does not affect the results.

| | Hf | | | | | |
|---|---|---|---|---|---|---|
| AB-7 | -399.920 | .03613 | 18.00000C | 16.00000H | 6.000000 | 2.0000 |
| ACETONE | -1038.300 | .02861 | 3.00000C | 6.00000H | 1.000000 | .0000 |
| ACETYLENE | 1846.150 | .02634 | 2.00000H | 2.00000C | .00000 | .0000 |
| ACETYL TRIETHYL CIT | -1257.900 | .03613 | 14.00000C | 22.00000H | 8.000000 | .0000 |
| ACRYLONITRILE | 332.640 | .03613 | 5.75400C | 6.09100H | .078000 | .0000 |
| ADIPONITRILE | 186.780 | .03436 | 6.00000C | 8.00000H | .00000N | .0000 |
| AFNOL | -587.000 | .05463 | 2.84000C | 3.92000H | 1.04000N | 2.9700 |
| AGE RITE-EST.FOR.OFF | -367.520 | .03613 | 6.72000C | 10.90300H | .356000 | .0150 |
| AGIO3 | -147.100 | .19962 | 3.000000 | 1.00000AG | 1.00000I | .0000 |
| 10 AIR -(G | .000 | .00004 | 5.57460N | 1.309100 | .00000 | .0000 |
| AIR -(L) | -102.210 | .04118 | 5.57460N | 1.309100 | .00000 | .0000 |
| ALUMINUM --AL | .000 | .09755 | 1.00000AL | .00000 | .00000 | .0000 |
| AL(BH4)3 | -1044.200 | .01965 | 1.00000AL | 3.00000B | 12.00000H | .0000 |
| AL-96.8-C-3.2( | .000 | .09683 | 3.58780AL | .26644C | .00000 | .0000 |
| ALH3 | -69.991 | .05239 | 3.00000H | 1.00000AL | .00000 | .0000 |
| 90-ALH4 "10BUT.RUBB. | -106.200 | .04936 | .71400C | 10.42900H | 3.00000AL | .0000 |
| ALUMINUM HYDRIDE | -69.991 | .05239 | 1.00000AL | 3.00000H | .00000 | .0000 |
| ALUMINUM CHLORIDE | -246.440 | .08816 | 1.00000AL | 3.00000CL | .00000 | .0000 |
| ALUMINUM HYDROXIDE | -3900.000 | .03613 | 3.000000 | 3.00000H | 1.00000AL | .0000 |
| 20 ALUMINUM NITRAT.9H2O | -2391.900 | .03613 | 1.00000AL | 18.00000H | 18.000000 | 3.0000 |
| ALUMINUM NITRIDE | -1854.200 | .11780 | 1.00000AL | 1.00000N | .00000 | .0000 |
| ALUMUNUM TRICHLORIDE | -2655.300 | .08664 | 1.00000AL | 3.00000CL | 12.00000H | 6.0000 |
| ALUMINUM TRIFLUORIDE | -4298.800 | .11092 | 1.00000AL | 3.00000F | .00000 | .0000 |
| 75-ALUMINUM25VITON A | -450.400 | .08671 | .66854C | .46791H | .86897F | 2.7798 |
| 80-ALUMINUM25VITON A | -360.300 | .08870 | .53476C | .37433H | .69518F | 2.9662 |
| AL(23.08)/SN(76.92) | .000 | .16475 | .85545AL | .64807SN | .00000 | .0000 |
| 23.08 AL+76.92 TIN | .000 | .16475 | .85545AL | .64807SN | .00000 | .0000 |
| AMINO-G4AN-EDNA | -246.010 | .06359 | 1.33300C | 6.16000H | 1.291000 | 4.0780 |
| AMMO (THIOKOL) | 207.000 | .03613 | 5.00000C | 7.00000H | 1.000000 | 3.0000 |
| 30 AMMONIA | -644.160 | .00004 | 1.00000N | 3.00000H | .00000 | .0000 |
| AMM.FLUOR. HF | -3345.000 | .05419 | 1.00000N | 5.00000H | 2.00000F | .0000 |
| AMM-5-HYDROTETRAZOLE | -339.530 | .04697 | 1.00000C | 5.00000H | 1.000000 | 5.0000 |
| AMMONIUM AZIDE | 453.380 | .04863 | 4.00000H | 4.00000N | .00000 | .0000 |
| AMMONIUM BISULFATE | -2089.000 | .06629 | 1.00000N | 5.00000H | 1.00000S | 4.0000 |
| AMMONIUM BROMIDE | -659.620 | .08780 | 1.00000N | 4.00000H | 1.00000BR | .0000 |
| AMMONIUM CHLORATE | -640.460 | .06323 | 1.00000N | 4.00000H | 1.00000CL | 3.0000 |
| AMMONIUM CHLORIDE | -1409.200 | .05528 | 4.00000H | 1.00000N | 1.00000CL | .0000 |
| AMMONIUM DICHROMATE | -1688.000 | .07760 | 8.00000H | 2.00000N | 7.000000 | 2.0000 |
| AMMONIUM IODATE | -487.300 | .12067 | 1.00000I | 4.00000H | 3.000000 | 1.0000 |
| 40 AMMONIUM NITRATE -AN | -1090.200 | .06232 | 4.00000H | 3.000000 | 2.00000N | .0000 |
| AMMONIUM OXALATE | -2165.300 | .05423 | 2.00000C | 8.00000H | 4.000000 | 2.0000 |
| AMMONIUM PHOSPHATE | -2946.800 | .06503 | 6.00000H | 4.000000 | 1.00000N | 1.0000 |
| AP | -601.630 | .07045 | 4.00000H | 4.000000 | 1.00000N | 1.0000 |
| AMMONIUM PERSULFATE | -1737.100 | .07154 | 2.00000N | 8.00000H | 2.00000S | 8.0000 |
| AM-MONOHYDRPHOSPHATE | -2847.900 | .05849 | 2.00000N | 9.00000H | 4.000000 | 1.0000 |
| AMMONIUM PRICRATE | -360.940 | .06214 | 6.00000C | 6.00000H | 7.000000 | 4.0000 |
| AMMONIUM SUCCINATE | -2168.900 | .05419 | 4.00000C | 1.00000H | 4.000000 | .0000 |
| AMMONIUM SULFATE | -2133.000 | .06430 | 8.00000H | 2.00000N | 4.000000 | 1.0000 |
| AM-MONOHYDRPHOSPHATE | -2847.900 | .05849 | 2.00000N | 9.00000H | 4.000000 | 1.0000 |
| 50 ANSIL ETHER | -965.810 | .03779 | 10.00000C | 22.00000H | 5.000000 | .0000 |
| ANNNA | -825.200 | .05716 | 2.91250H | 4.367600 | 1.94150N | .0000 |
| ANNA 81 | -1399.900 | .05138 | 4.49750H | 4.596500 | 1.56490N | .0000 |
| 10-90 ANNA | -700.280 | .05501 | 1.67810N | 1.92790H | 4.659400 | .0000 |
| 28-52 ANNA | -1405.300 | .05097 | 1.52480N | 4.44460H | 4.635100 | .0000 |
| ANSUL 141 | -1013.600 | .03432 | 6.00000C | 14.00000H | 3.000000 | .0000 |
| AO-CO-2 | -120.100 | .03526 | 6.99400C | 9.75200H | .243000 | .1630 |
| ASCORBIC ACID | -1575.900 | .00000 | 6.00000C | 6.000000 | 8.00000H | .0000 |
| ASTM OIL/NO.3 | -167.220 | .03309 | 7.33470C | 11.73600H | .00000 | .0000 |
| AS | -2133.000 | .06391 | 8.00000H | 4.000000 | 2.00000N | 1.0000 |
| 60 AS-9 | -709.510 | .03613 | 18.00000C | 16.00000H | 8.000000 | 2.0000 |
| 5-ATN | 130.326 | .06576 | 1.00000C | 4.00000H | 3.000000 | 6.0000 |
| ATP | 203.569 | .06684 | 1.00000C | 4.00000H | 4.000000 | 5.0000 |
| 5-ATT | 559.669 | .03613 | 1.00000C | 3.00000H | 5.00000N | .0000 |
| AZO-DICARBONAMIDE | -599.590 | .05420 | 2.00000C | 4.00000H | 2.000000 | 4.0000 |
| AZOX(3-AZIDOOXETANE) | 192.400 | .04841 | 3.00000C | 5.00000H | 1.000000 | 3.0000 |
| BACRO4 | -1347.000 | .16259 | 4.000000 | 1.00000BA | 1.00000CR | .0000 |

DATA LIBRARY [INFILE]

| | | | | | | |
|---|---|---|---|---|---|---|
| CASO4.2H2O | -2805.600 | .08380 | 1.00000CA | 1.00000S | 6.000000 | 4.00000 |
| CASO4..5H2O-BETA | -2593.700 | .08380 | 1.00000CA | 1.00000S | 4.500000 | 1.[illegible]00 |
| CASTOR OIL-X1320 | -621.810 | .03613 | 6.10790C | 10.31300H | .901200 | .[illegible]71 |
| CASTOL | -627.870 | .03432 | 6.10700C | 11.14000H | .942000 | .00000 |
| CEF TRIS-B-CHLOETHPH | -1050.800 | .03613 | 6.00000C | 12.00000H | 3.00000CL | 4.00000 |
| CELECON | -1358.400 | .03613 | 3.37900C | 6.58200H | 3.273000 | .00500 |
| CELL. ACETATE | -1079.000 | .05058 | 10.90000C | 14.90000H | 7.400000 | .00000 |
| CELLULOSE ACET BUTYR | -1179.500 | .04336 | 4.52710C | 6.87000H | 2.414400 | .00000 |
| CELLULOSE | -1417.000 | .04578 | 6.00000C | 10.00000H | 5.000000 | .00000 |
| CHARCOAL | .000 | .07226 | 7.33640C | 2.82740H | .565000 | .00000 |
| CHARCOAL(NSWC DATA) | -525.300 | .03613 | 6.84700C | 3.86900H | .867000 | .00000 |
| 60( CHARCOAL=40( S | .000 | .07226 | 4.40180C | 1.69640H | .339000 | 1.24740 |
| CHLOROMETHYLOXIRANE | -383.450 | .04346 | 3.00000C | 5.00000H | 1.000000 | 1.00000 |
| CHLORINE(GAS) | .000 | .00005 | 2.00000CL | .00000 | .00000 | .00000 |
| CHLOROFORM | -206.550 | .05412 | 1.00000C | 1.00000H | 3.00000CL | .00000 |
| CHLORONITROFORM | -31.000 | .05998 | 1.00000C | 6.000000 | 3.00000N | 1.00000 |
| 5-CHLOROTETRAZOLE | 822.970 | .04444 | 1.00000C | 1.00000H | 4.00000N | 1.00000 |
| CHROMIUM | .000 | .26013 | 1.00000CR | .00000 | .00000 | .00000 |
| CHROMINUMTRIFLUORIDE | -2430.800 | .13729 | 1.00000CR | 3.00000F | .00000 | .00000 |
| CITRIC ACID | -1921.000 | .05571 | 6.00000C | 8.00000H | 7.000000 | .00000 |
| CITROFLEX A-4 | -1097.400 | .03793 | 20.00000C | 34.00000H | 8.000000 | .00000 |
| COBALT TRIFLUORIDE | -1629.500 | .14018 | 1.00000CO | 3.00000F | .00000 | .00000 |
| COMPB | 12.500 | .06204 | 2.04300C | 2.50110H | 2.14890N | 2.67720 |
| COMP C-4 | 29.800 | .05874 | 3.85880H | 1.92830C | 2.43100N | 2.43100 |
| COPPER | .000 | .32228 | 1.00000CU | .00000 | .00000 | .00000 |
| COPPER CHROMATE | -1304.200 | .19870 | 1.00000CU | 2.00000CR | 4.000000 | .00000 |
| COPPER CHROMITE | .000 | .21500 | 3.000000 | 1.00000CU | 1.00000CR | .00000 |
| COPPER DIFLUORIDE | -1249.700 | .10478 | 1.00000CU | 2.00000F | .00000 | .00000 |
| CONOCO OIL | -756.450 | .02800 | 1.00000C | 2.00000H | .00000 | .00000 |
| CORDITE N | -336.400 | .05902 | 3.00690H | 1.79980C | 2.52710N | 2.51270 |
| CO(SBF6)3(HF ESTIMAT | -1440.900 | .03613 | 1.00000CO | 3.00000SB | 18.00000F | .00000 |
| CRYOLITE | -3548.500 | .10839 | 3.00000NA | 12.00000F | 3.00000AL | .00000 |
| C-S-202 | -863.500 | .03613 | 14.00000C | 10.00000H | 6.000000 | 1.00000 |
| CTBN | 4.100 | .03252 | 7.07900C | 10.50600H | .114000 | .1[illegible]00N |
| CUBANE | 1334.690 | .03721 | 8.00000C | 8.00000H | .00000 | .[illegible]0 |
| CUSAL | -870.510 | .03613 | 7.00000C | 6.00000H | 4.000000 | 1.0[illegible]00 |
| CUPRES | -1017.600 | .03252 | 7.00000C | 6.00000H | 5.000000 | 1.00000 |
| CUMENE HYDROPEROXIDE | -471.170 | .03613 | 6.15820C | 8.30360H | .941200 | .00000 |
| 1-B-CYAN-1,5-AMTETAZ | -471.630 | .04878 | 2.83100C | 4.41500H | 4.28800N | .00000 |
| 2-B-CYAN-1,5-AMTETAZ | 515.800 | .04914 | 2.88100C | 4.40500H | 4.36100N | .00000 |
| CYANACRYL-R | -1260.100 | .04336 | 4.91920C | 7.91670H | 1.925300 | .04340 |
| CYANACRYL-R (NO CL) | -1260.100 | .04336 | 4.91920C | 7.91670H | 1.925300 | .00000 |
| CYANOGAUNIDINE | 70.880 | .04336 | .00000C | 4.00000N | 4.00000H | .00000 |
| 5-CYANOTETRAZOLE-(S) | 1010.750 | .04697 | 2.00000C | 1.00000H | 5.00000N | .00000 |
| CYANURIC TRICHLORIDE | 118.763 | .03613 | 3.00000C | 3.00000N | 3.00000CL | .00000 |
| CYCLOBUTANE | 13.540 | .00004 | 4.00000C | 8.00000H | .00000 | .00000 |
| CYCLOHEXENE | -170.330 | .02926 | 6.00000C | 10.00000H | .00000 | .00000 |
| CYCLOPROPANE | 1652.310 | .00004 | 3.00000C | 4.00000H | .00000 | .00000 |
| CYCLOTOL | 35.000 | .06337 | 1.78330C | 2.75610H | 2.35610N | 2.68630 |
| DBS | -906.570 | .03613 | 18.00000C | 34.00000H | 4.000000 | .00000 |
| DDI | -548.750 | .03324 | 38.00000C | 72.00000H | 2.000000 | 2.00000N |
| DECABORANE | -129.180 | .03396 | 10.00000B | 14.00000H | .00000 | .00000 |
| N-DECANE | -505.460 | .02638 | 10.00000C | 22.00000H | .00000 | .00000 |
| DEG | -1422.900 | .04039 | 4.00000C | 10.00000H | 3.000000 | .00000 |
| DEGMBEA | 53.390 | .03541 | 10.00000C | 20.00000H | 4.000000 | .00000 |
| DEGN | -517.350 | .04986 | 4.00000C | 8.00000H | 7.000000 | 2.00000N |
| DELRIN | -1373.000 | .04336 | 3.33560C | 6.36900H | 3.335600 | .00000 |
| DER-332 | -464.320 | .04191 | 6.16880C | 7.05000H | 1.175000 | .00000 |
| DER-732 | -767.530 | .03866 | 4.67900C | 9.05800H | 1.776000 | .18000 |
| DER-736 | -482.110 | .04010 | 4.32600C | 7.80800H | 1.933000 | .26300 |
| DER-741 | -576.830 | .03996 | 5.22100C | 8.41300H | 1.584000 | .11620 |
| DER332 EPOXY RESIN | -464.310 | .04191 | 6.16880C | 7.05000H | 1.175000 | .00000 |
| DETA | -149.240 | .03443 | 4.00000C | 13.00000H | 3.00000N | .00000 |
| DFAT | 1.855 | .06865 | 6.00000C | 2.00000H | 6.000000 | 4.00000N |
| (DHE)N,N-B-2-HY-ET-N | -837.800 | .04444 | 4.01600C | 7.26200H | 2.007000 | .87700N |
| 1,4-DIAZACYL-OCT-NIT | -336.040 | .04841 | 6.00000C | 13.00000H | 3.000000 | 3.[illegible]00N |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 199 | DIAM-BIS(5TET)AMINE | 337.610 | .04697 | 2.00000C | 9.00000N | 11.00000N | .00000 |
| | DIAMMONIUMBIS5-(DBTA | 454.140 | .05419 | 2.00000C | 9.00000N | 11.00000N | .00000 |
| | DIAMMONIUM TETRAZOLE | 354.334 | .03613 | 2.00000C | 8.00000N | 10.00000N | .00000 |
| | DIAZOCINITRATE | -336.210 | .04841 | 6.00000C | 13.00000N | 3.000000 | 3.00000I |
| | DIBUTYLPETHALATE-DBP | -726.620 | .03776 | 16.00000C | 22.00000N | 4.000000 | .00000 |
| | DICHLOROMETHAN(GAS) | -270.330 | .00007 | 1.00000C | 2.00000N | 2.00000CL | .00000 |
| | DICHLORODIFLUOROMETH | -949.440 | .00018 | 1.00000C | 2.00000F | .00000CL | .00000 |
| | DIETHYLAMINE | -338.820 | .02568 | 4.00000C | 11.00000N | 1.00000N | .00000 |
| | DIETHYL PETHALATE | -809.880 | .04057 | 12.00000C | 14.00000N | 4.000000 | .00000 |
| 3-0 | DI-2-ETHYLHEXYL PETH | -686.640 | .03562 | 24.00000C | 38.00000N | 4.000000 | .00000 |
| | DIFLUOROMETHANE | -1706.800 | .06503 | 1.00000C | 2.00000N | 2.00000F | .00000 |
| | DI-GUAN-NITRATE | -239.280 | .05058 | 1.00000C | 8.00000N | 3.000000 | 6.00000N |
| | DIHYDROXYGLYO-(DIHG) | -1079.900 | .06680 | 2.00000C | 4.00000N | 4.000000 | 2.00000N |
| | DIISOBUTYL AZELATE | -925.310 | .03371 | 17.00000C | 32.00000N | 4.000000 | .00000 |
| | 4,4DINITPENTANONITRI | -83.450 | .04697 | 2.89090C | 3.98810N | 2.320000 | 1.73040N |
| | 2,4DINITRODIAZPENTA | -53.253 | .05167 | 3.00000C | 8.00000N | 4.000000 | 4.00000N |
| | 1,2DINITROXYPROPANE | -424.810 | .04336 | 3.00000C | 6.00000N | 6.000000 | 2.00000N |
| | 2,2DINITRO-DIAZAPENT | -53.253 | .05167 | 3.00000C | 8.00000N | 4.000000 | 4.00000N |
| | DIOCTYL SEBACATE-DOS | -670.860 | .03613 | 26.00000C | 50.00000N | 4.000000 | .00000 |
| 218 | DIBUTYLTINDILAURATE | -712.590 | .03613 | 32.00000C | 64.00000N | 4.000000 | 1.00000SN |
| | DIETHYLADAMANTANE | -382.180 | .03241 | 12.00000C | 20.00000N | .00000 | .00000 |
| | DIETHYL OXALATE | -1324.300 | .03898 | 6.00000C | 10.00000N | 4.000000 | .00000 |
| | DIETHYL PETHALATE | -809.880 | .04057 | 12.00000C | 14.00000N | 4.000000 | .00000 |
| | DIETHYL TRIAMINE | -664.830 | .03613 | 4.00000C | 13.00000N | 3.00000N | .00000 |
| | DIMETHYL ACETAMIDE | -818.560 | .03396 | 4.00000C | 9.00000N | 1.000000 | 1.00000N |
| | DIMETHYL AMINENITRAT | -730.870 | .04516 | 2.00000C | 8.00000N | 3.000000 | 2.00000N |
| | DIMETHYL SEBACATE | -1045.100 | .03570 | 12.00000C | 22.00000N | 4.000000 | .00000 |
| | DIMETHYLNITRAMINE | -172.300 | .03613 | 2.00000C | 6.00000N | 2.000000 | 2.00000N |
| | DIMETHYL PETHALATE | -836.320 | .05474 | 10.00000C | 10.00000N | 4.000000 | .00000 |
| 228 | P-DIMETHYL SILOXANE | -1746.500 | .03613 | 2.00000C | 6.00000N | 1.000000 | 1.00000SI |
| | 1,5-DIMETHYLTETRAZOL | 459.494 | .03613 | 3.00000C | 6.00000N | 4.00000N | .00000 |
| | DIMPETYLB(ROUGH EST) | -1652.600 | .03613 | 9.00000C | 11.00000N | 4.00000N | 1.00000B |
| | DINA | -315.610 | .05708 | 4.00000C | 8.00000N | 4.00000N | 8.000000 |
| | DINITROBITETRAZOLE | 482.260 | .04336 | 2.00000C | 4.000000 | 10.00000N | .00000 |
| | DINITRO-CHLOETHANOL | -347.960 | .05420 | 2.00000C | 3.00000N | 5.000000 | 2.00000N |
| | 2,2DINITRO-DIAZAPENT | -53.253 | .05167 | 3.00000C | 8.00000N | 4.000000 | 4.00000N |
| | DINITROHEXAFLUOROHEXA | -964.600 | .06106 | 6.00000C | 6.00000N | 4.000000 | 2.00000N |
| | DINITRO PHENOXY ETHA | -308.590 | .03613 | 9.00000C | 8.30000N | 6.700000 | 2.30000N |
| | 2,2DINITRO-PROPANOL | -620.930 | .04697 | 3.00000C | 6.00000N | 5.000000 | 2.00000N |
| 238 | DINITROTOLUENE - DNT | -57.761 | .04191 | 7.00000C | 6.00000N | 4.000000 | 2.00000N |
| | 1,4DINITROXYBUTANE | -438.860 | .04791 | 4.00000C | 8.00000N | 6.000000 | 2.00000N |
| | 2,5DINITROXYHEXANE | -508.220 | .04697 | 6.00000C | 12.00000N | 6.000000 | 2.00000N |
| | 2,3-DINITROXYPROP | -615.070 | .05781 | 3.00000C | 6.00000N | 7.000000 | 2.00000N |
| | DINIT-TRIAZOLE -(S) | 46.520 | .03613 | 2.00000C | 1.00000N | 4.000000 | 5.00000N |
| | 2,2DINPROPCYANOETHET | -205.320 | .04950 | 2.62890C | 3.65580N | 2.628400 | 1.62690N |
| | DIOCTYL ADIPATE | -733.000 | .03320 | 42.00000N | 22.00000C | 4.000000 | .00000 |
| | DIOCTYL PETHALATE | -667.800 | .03599 | 24.00000C | 38.00000N | 4.000000 | .00000 |
| | DIOCTYL SEBACATE-DOS | -670.860 | .03613 | 26.00000C | 50.00000N | 4.000000 | .00000 |
| | DIOL FC-2202 | -1800.000 | .06529 | 1.68190C | .29760N | 1.212500 | 3.16310F |
| 248 | DIOXANE | -454.010 | .03736 | 4.00000C | 8.00000N | 2.000000 | .00000 |
| | DIOXANE-NOSIH DATA | -934.510 | .03739 | 4.41750C | 8.73990N | 2.371200 | .00000 |
| | DIOXY PYROMELLIT-(S) | -1422.000 | .03613 | 10.00000C | 2.00000N | 8.000000 | .00001N |
| | DIPHENYLAMINE - DPA | 177.515 | .04191 | 12.00000C | 11.00000N | 1.00000N | .00000 |
| | (DIPAM)-----HXN-DMN | -14.975 | .06467 | 12.00000C | 6.00000N | 8.00000N | 12.0000000 |
| | 1,6DM-2,5DTH-DMTH | -394.630 | .03613 | 6.00000C | 14.00000N | 4.00000N | 6.000000 |
| | DNO-DINITROOXETANE | -267.000 | .05961 | 3.00000C | 4.00000N | 2.00000N | 5.000000 |
| | DNPA | -893.860 | .03613 | 12.00000C | 22.00000N | 4.000000 | .00000 |
| | 2,2DNPACRYL | -533.950 | .04708 | 6.00000C | 8.00000N | 6.000000 | 2.00000N |
| | DNT | -57.761 | .04191 | 7.00000C | 6.00000N | 4.000000 | 2.00000N |
| 258 | DTNT | -7.335 | .06178 | 7.00000C | 4.00000N | 6.000000 | 4.00000N |
| | DPA | 177.515 | .04191 | 12.00000C | 11.00000N | 1.00000N | .00000 |
| | DODECANE | -420.360 | .02768 | 12.00000C | 26.00000N | .00000 | .00000 |
| | DONA | -458.080 | .03844 | 6.06600C | 8.25400N | 1.141000 | .00000 |
| | DOZ | -791.000 | .03613 | 6.05900C | 11.63300N | .969000 | .00000 |
| | 1,1,-DNP | -304.110 | .04556 | 3.00000C | 6.00000N | 4.000000 | 2.00000N |
| | 1,5DNP | -403.500 | .04596 | 5.00000C | 10.00000N | 6.000000 | 2.00000N |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 265 | DUPONT 4UMOLDING POW | -1028.400 | .03396 | 5.01900C | 8.33300H | 1.958000 | .00 |
| | DYTHAL | -291.920 | .16259 | 8.00000C | 4.00000H | 6.000000 | 3.00 |
| | EMOLEIN -2911 | -714.210 | .03107 | 19.00000C | 38.00000H | .000000 | .0 |
| | EDMA.EDA | -361.380 | .05535 | 4.00000C | 14.00000H | 4.000000 | .0 |
| | EMERY-1693-73R | -815.440 | .03252 | 6.42050C | 12.79800H | .615000 | .00 |
| | (EDMA)TRIAMINOGUANID | 172.300 | .05636 | 1.12400C | 6.18000H | 1.099000 | 4.47 |
| | EMPLAS-7 | -359.190 | .03613 | 2.10320C | 4.22120H | 2.920000 | 1.68 |
| | EMPLAS-D TNITROBUTNI | -216.080 | .05420 | 1.59200C | 2.35600H | 3.614300 | 1.47 |
| | EPICHLOROHYDRAN | -383.450 | .04346 | 3.00000C | 5.00000H | 1.000000 | 1.00 |
| 274 | EPON-812 | -1244.800 | .04408 | 12.00000C | 21.00000H | 6.000000 | .00 |
| | ERL 0510 | -196.000 | .03613 | 5.41000C | 6.86000H | 1.440000 | .36 |
| | ERYTHRITOL TRINITRAT | -606.050 | .05420 | 4.00000C | 7.00000H | 9.000000 | 3.000 |
| | ESTANE | -940.010 | .03613 | 5.12660C | 9.22530H | 1.670300 | .171 |
| | ESTANE 5712 | -955.550 | .04336 | 5.05250C | 7.41070H | 1.875900 | .111 |
| | (ESW-21)HEMITRPEREDI | -69.726 | .06735 | 6.00000C | 8.00000H | 12.000000 | 8.000 |
| | 2,2(ET-DINITAM)DETNI | -213.400 | .05672 | 1.80760C | 3.64090H | 3.068100 | 1.822 |
| | ETHANOL | -1438.700 | .02851 | 2.00000C | 6.00000H | 1.000000 | .000 |
| | ETHANOL-AN(EOAN) | -1108.800 | .05419 | 2.00000C | 8.00000H | 4.000000 | 2.000 |
| | ETHER | -891.650 | .02578 | 4.00000C | 10.00000H | 1.000000 | .000 |
| 284 | 1-ETH-5HYDROXYETHTET | -56.275 | .03613 | 5.00000C | 10.00000H | 4.00000N | 1.000 |
| | ETHYLAMMONIUMNITRATE | -803.620 | .04516 | 2.00000C | 8.00000H | 3.000000 | 2.000 |
| | ETHYL BENZENE | -26.385 | .03132 | 8.00000C | 10.00000H | .00000 | .000 |
| | ETHYL CENTRALITE-EC | -116.520 | .04509 | 17.00000C | 20.00000H | 1.000000 | 2.000 |
| | ETHYLCYCLOHEXANE | -453.270 | .02824 | 8.00000C | 16.00000H | .00000 | .000 |
| | ETHYL 4,4 DINITROPTD | -63.578 | .04625 | 7.00000C | 12.00000H | 2.00000N | 6.000 |
| | ETHYLENE | 447.000 | .00005 | 2.00000C | 4.00000H | .00000 | .000 |
| | ETHYLENE DINITRAMINE | -157.600 | .06359 | 2.00000C | 6.00000H | 4.00000N | 4.000 |
| | ETHYLENE GLYCOL -EG | -1754.500 | .04028 | 2.00000C | 6.00000H | 2.000000 | .000 |
| | ETHYLENEGL)DINITRATE | -382.890 | .04986 | 2.00000C | 4.00000H | 6.000000 | 2.000 |
| 294 | ETHYLENE OXIDE | -513.730 | .00007 | 2.00000C | 4.00000H | 1.000000 | .000 |
| | ETHYL-METHYLMETHACRY | -967.000 | .05058 | 5.26000C | 8.77000H | 1.750000 | .000 |
| | 1-ETHYL-5METTETRAOLL | 365.730 | .03613 | 4.00000C | 8.00000H | 4.00000N | .000 |
| | ETHYL NITRATE | -499.630 | .03992 | 2.00000C | 5.00000H | 3.000000 | 1.000 |
| | 25-ETOH-75-DIOXANE | -700.190 | .03458 | 4.49050C | 10.06600H | 2.245300 | .000 |
| | (FAEB)TETRAFAMTETF | -1911.600 | .03613 | 1.00000N | 1.00000B | 8.00000F | .00 |
| | FAL-BINDER | -725.200 | .05015 | 4.27810H | 2.73860C | .87750N | .5 |
| | FBN | -288.070 | .03974 | 4.00000C | 9.00000H | 2.000000 | 2.000 |
| | (2,2,2-FDE)ACR(FDNEA | -668.220 | .05073 | 5.00000C | 5.00000H | 6.000000 | 2.000 |
| | (FDNEN)FLUDINITETENI | -314.370 | .06901 | 4.00000C | 4.00000H | 2.00000F | 6.000 |
| 304 | FDNOL | -740.950 | .05781 | 2.00000C | 3.00000H | 5.000000 | 2.000 |
| | FEAA | -822.630 | .03758 | 10.00000C | 14.00000H | 4.000000 | 1.000 |
| | FEFO-DERIVATIVE | -519.670 | .05781 | 10.00000C | 16.00000H | 13.000000 | 4.000 |
| | FEFO(RUSSIAN DATA) | -634.120 | .05781 | 5.00000C | 6.00000H | 10.000000 | 4.000 |
| | FE203 | -1252.300 | .18932 | 3.000000 | 2.00000FE | .00000 | .000 |
| | FERROCENE | -174.000 | .03613 | 10.00000C | 10.00000H | 1.00000FE | .000 |
| | FLNFNPP | -307.600 | .05781 | 1.00000C | 6.000000 | 3.00000N | 1.000 |
| | FLORAL 85 | -540.910 | .04336 | 6.61440C | 10.56500H | .618200 | .000 |
| | FLUOROFORM | -2379.300 | .03613 | 1.00000C | 1.00000H | 3.00000F | .000 |
| | FLUOROLUBE OIL | -1900.000 | .06847 | 1.51250C | .03470H | 2.20920F | 1.119 |
| 314 | FLUORONATED GRAPHITE | -1064.800 | .08840 | .84800C | 3.31000F | .00000 | .000 |
| | FLUOROPOLYFORMAL | -1445.000 | .05781 | 6.00000C | 6.00000H | 1.000000 | 6.000 |
| | 5-FLUOROTETRAZOLE | 454.308 | .04444 | 1.00000C | 1.00000H | 4.00000N | 1.000 |
| | FLUORINE | .000 | .00007 | 2.00000F | .00000 | .00000 | .000 |
| | FNE3CLO4 -SAP | -507.960 | .07876 | 3.00000H | 4.000000 | 1.00000N | 1.000 |
| | FORAL 85 | -540.900 | .04336 | 6.61450C | 10.56600H | .618100 | .000 |
| | FORAL 85 (NO CL) | -540.900 | .04336 | 6.61450C | 10.56600H | .618100 | .000 |
| | FORMALDEHYDE | -864.140 | .02944 | 1.00000C | 2.00000H | 1.000000 | .000 |
| | FORMIC ACID | -2124.800 | .04408 | 1.00000C | 2.00000H | 2.000000 | .000 |
| | FUEL OIL (NO.6) | -421.810 | .03252 | 7.16700C | 11.85500H | .00000 | .000 |
| 324 | FUEL-XYL-TRITA-DIETH | -254.070 | .03004 | 6.22050C | 11.99100H | .026640 | .909 |
| | FSBN | -279.070 | .03974 | 4.00000C | 9.00000H | 2.000000 | 2.000 |
| | FTBN | -224.860 | .03974 | 4.00000C | 9.00000H | 2.000000 | 2.000 |
| | GLY-ALC-50 | -1735.700 | .00000 | 3.89900C | 8.88390H | 2.763900 | .000 |
| | GLYCERINE | -1715.700 | .00455 | 3.00000C | 8.00000H | 3.000000 | .000 |
| | GLYCERINMONONITRATE | -1136.500 | .05058 | 3.00000C | 7.00000H | 5.000000 | 1.000 |
| | GLY-MONOLACTATE TRIN | -507.000 | .05311 | 6.00000C | 9.00000H | 3.00000N | 11.000 |

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|---|---|---|---|---|---|---|---|
| 333 | GMF | 109.000 | .03613 | 4.34400C | 4.34400N | 1.448000 | 1.44800N |
| | GN | -750.080 | .05022 | 1.00000C | 6.00000N | 3.000000 | 4.00000N |
| | GNAT | 58.367 | .05420 | 2.00000C | 7.00000N | 2.000000 | 9.00000F |
| | GUAND-5-NIT-TETRAZOL | 307.600 | .05636 | 1.07100C | 3.92900N | 1.098000 | 4.68900 |
| | GUANIDINE CLO4 | -464.490 | .06034 | 1.00000C | 6.00000N | 4.000000 | 3.00000N |
| | GUAN-SALT-EDNA | -210.330 | .06359 | 1.46900C | 6.03000N | 1.487000 | 3.74600N |
| | 5-GUANYLAMINO-TETRA | 579.380 | .05853 | 1.30900C | 3.64100N | 5.78000N | .00000 |
| | HAN | -850.110 | .05420 | 4.00000N | 4.000000 | 2.00000N | .00000 |
| | 54 HAN,2517DN,20H2O | -1168.500 | .04068 | .84623C | 7.87890N | 3.383900 | 1.98310N |
| 340 | 85-HAN-15-H2O | -1291.400 | .05041 | 5.20500N | 4.372400 | 1.76990N | .00000 |
| | HANEN | -1186.500 | .05610 | 5.30720N | 4.122800 | 2.04770N | .00000 |
| | HANAN | -1327.400 | .05529 | 5.33000N | 4.310000 | 1.83240N | .00000 |
| | HAP | -495.620 | .07298 | 4.00000N | 5.000000 | 1.00000N | 1.00000CL |
| | 60( HAP + 40( H2O | -1814.200 | .05203 | 6.23840N | 4.467600 | .44947N | .44947CL |
| | 70( HAP + 30( H2O | -1484.500 | .05600 | 5.42790N | 4.287100 | .52438N | .52438CL |
| | 80( HAP + 20( H2O | -1161.500 | .06070 | 4.61740N | 4.106600 | .55930N | .55930CL |
| | 82.5HAP + 17.5 H2O | -1072.500 | .06193 | 4.41480N | 4.061500 | .61802N | .61802CL |
| | 85-HAP-15-H2O | -990.080 | .06330 | 4.21220N | 4.016300 | .63675N | .63675CL |
| | 90( HAP = 10(WATER | -825.250 | .06576 | 3.80690N | 3.926100 | .67421N | .67421CL |
| 350 | 92.5(HAP=7.5WATER | -742.850 | .06720 | 3.60430N | 3.881000 | .69294N | .69294CL |
| | HCLO4 | -110.490 | .06388 | 1.00000N | 4.000000 | 1.00000CL | .00000 |
| | 50( HCLO4 + 50( H2O | -1951.200 | .04625 | 6.04830N | .49768CL | 4.766100 | .00000 |
| | 60( HCLO4 + 40( H2O | -1583.100 | .04877 | 5.03770N | .59722CL | 4.609100 | .00000 |
| | 70( HCLO4 + 30( H2O | -1214.900 | .05202 | 4.02710N | .69676CL | 4.452200 | .00000 |
| | 75 HDP + 25 H2O | -1176.600 | .06131 | 4.70680N | .64384N | 3.963000 | .64384CL |
| | HELIUM | .000 | .00003 | 1.00000HE | .00000 | .00000 | .00000 |
| | HEMT | 6.634 | .05420 | 4.00000C | 8.00000N | 1.000000 | 4.00000N |
| | HEPTAFLUOROHEXANE | -1458.400 | .06106 | 6.00000C | 7.00000N | 7.00000F | .00000 |
| | N-HEPTANE | -535.180 | .02471 | 7.00000C | 16.00000H | .00000 | .00000 |
| 360 | HEXACHLOROBENZENE | -109.900 | .05669 | 6.00000C | 6.00000CL | .00000 | .00000 |
| | HEXACHLOROETHANE | -205.290 | .07555 | 2.00000C | 6.00000CL | .00000 | .00000 |
| | HEXAFLUOROBENZENE | -1236.000 | .05812 | 6.00000C | 6.00000F | .00000 | .00000 |
| | HEXAFLUOROPROPANE | -1601.000 | .05709 | 3.00000C | 6.00000F | .00000 | .00000 |
| | HEXAFLUOROSULFIDE | -1978.600 | .04769 | 1.00000S | 6.00000F | .00000 | .00000 |
| | HEXAMETHYL-DIISO-EDI | -321.400 | .03252 | 4.76000C | 7.13000N | 1.190000 | 1.19000N |
| | HEXANE | -550.950 | .02381 | 6.00000C | 14.00000H | .00000 | .00000 |
| | HEXANEHEXOLS | -1744.000 | .05297 | 6.00000C | 14.00000H | 6.000000 | .00000 |
| | HEXANETRINITRATE | -462.890 | .05076 | 6.00000C | 11.00000H | 3.00000N | 9.000000 |
| | HEXANITROAZOBENZENE | 135.080 | .04336 | 1.00000C | 4.00000N | 1.000000 | 8.00000N |
| 370 | 2,2,4,4,6,6-HXN-DHN | -14.975 | .06467 | 12.00000C | 6.00000N | 8.00000N | 12.0000000 |
| | HEXADECANE | -481.610 | .02800 | 16.00000C | 34.00000H | .00000 | .00000 |
| | HEXANITDIAZCYCOCTANE | -85.895 | .06735 | 6.00000C | 8.00000N | 8.00000N | 12.000000 |
| | HEXANITDIAZCYCLOCTAN | -85.890 | .06735 | 6.00000C | 8.00000N | 12.000000 | 8.00000N |
| | HEXANITROETHANE -(S) | 93.308 | .08129 | 2.00000C | 12.000000 | 6.00000N | .00000 |
| | HF | -3345.700 | .03566 | 1.00000H | 1.00000F | .00000 | .00000 |
| | HIGH ENERGY X-12 | -532.300 | .05555 | 2.78140N | 2.03330C | .99573N | 3.545300 |
| | HIVELITE 134466 | -317.510 | .03396 | 8.00000C | 34.00000H | 2.00000N | 10.00000B |
| | HIVELITE 134498(HYD) | -1071.300 | .03613 | 2.00000K | 10.00000B | 14.00000H | 2.000000 |
| | HIVELITE 134498(NHY) | -534.170 | .05853 | 2.00000K | 10.00000B | 10.00000H | .00000 |
| 380 | HMX | 60.540 | .06865 | 4.00000C | 8.00000H | 8.000000 | 8.00000N |
| | HMX-SF5-ON CARBON | -566.150 | .07445 | 4.00000C | 7.00000H | 8.000000 | 8.00000N |
| | HMX-SF5-ON NITROGEN | -617.790 | .06867 | 4.00000C | 8.00000H | 6.000000 | 7.00000N |
| | HN | -640.620 | .06106 | 5.00000N | 3.000000 | 3.00000N | .00000 |
| | (HNAB)---(TNPHL)-DXN | 150.150 | .06500 | 12.00000C | 4.00000H | 8.00000N | 12.000000 |
| | (HNDS)HEXINITROPERHEDI | -69.726 | .06735 | 6.00000C | 8.00000H | 12.000000 | 8.00000N |
| | HNE-HEXANITROHEXYNE | 139.521 | .03613 | 6.00000C | 4.00000H | 6.00000N | 12.000000 |
| | HNO3 | -656.980 | .05430 | 3.000000 | 1.00000H | 1.00000N | .00000 |
| | (HNS) ETH-BISTNTBENZ | 41.528 | .06287 | 14.00000C | 6.00000H | 6.00000N | 12.000000 |
| | H2O2 | -1315.600 | .05214 | 2.00000H | 2.000000 | .00000 | .00000 |
| 390 | 90( H2O2 = 10( H2O | -1570.500 | .05008 | 6.40270H | 5.847200 | .00000 | .00000 |
| | 5-HT | 17.430 | .04697 | 1.00000C | 2.00000H | 1.000000 | 4.00000N |
| | HTBN(CN-15) | -133.870 | .03360 | 7.35700C | 10.61500H | .23500N | .00000 |
| | HTBN(LOT 20-145-1 | -116.310 | .03613 | 6.79200C | 9.66300H | .119000 | .48300N |
| | HNT | -420.380 | .05076 | 6.00000C | 11.00000H | 9.000000 | 3.00000 |
| | HTS | 85.522 | .03252 | 7.34100C | 10.96200H | .055000 | .00000 |
| | HTPA-HYCAR | -943.500 | .04336 | 5.47380C | 9.37500H | 1.545000 | .00080CL |

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|---|---|---|---|---|---|---|
| 397 HTPA-HYCAR (NO CL) | -943.500 | .04336 | 5.47380C | 9.37500N | 1.545000 | .0000 |
| HYCAR(30%ACRYL)30%AC | 20.953 | .03613 | 6.65100C | 9.23600N | .158000 | [illegible]730 |
| HYCAR 4004 | -935.160 | .04336 | 5.36340C | 8.87400N | 1.670600 | [illegible]00 |
| HYCAR-4051CG-A POCRY | -1092.600 | .04336 | 5.00660C | 8.10510N | 1.973700 | [illegible]13 |
| HYCAR-4054A POLYCRYL | -1084.200 | .04336 | 5.38460C | 9.11710N | 1.585600 | .0081 |
| HYCAR 4054 | -1075.900 | .04336 | 5.38470C | 9.11710N | 1.585600 | .0082 |
| HYCAR 4054 (NO CL) | -1075.900 | .04336 | 5.38470C | 9.11710N | 1.585600 | .0000 |
| HYCAR 4051CG | -1091.400 | .04336 | 5.00670C | 8.10520N | 1.973800 | .0113 |
| HYCAR 4051CG (NO CL) | -1091.400 | .04336 | 5.00670C | 8.10520N | 1.973800 | .0000 |
| 406 HYDRAZINE | 375.999 | .03627 | 4.00000N | 2.00000N | .00000 | .0000 |
| HYDRAZINE AZIDE | 732.550 | .05420 | 5.00000N | 5.00000N | .00000 | .0000 |
| HYDRAZ-DIPERC(HDP) | -304.750 | .07985 | 2.00000N | 6.00000N | 2.00000CL | 8.0000 |
| HYDRAZINE HCL | -685.070 | .05058 | 2.00000N | 5.00000N | 1.00000CL | .0000 |
| HYDRAZINE 2HCL | -1108.400 | .05130 | 2.00000N | 6.00000N | 2.00000CL | .0000 |
| HYDROGEN -H2 | .000 | .00001 | 2.00000H | .00000 | .00000 | .0000 |
| HYDROGEN CHLORIDE | -604.060 | .00010 | 1.00000H | 1.00000CL | .00000 | .0000 |
| HYDROGEN PEROXIDE | -1315.600 | .05214 | 2.00000H | 2.00000O | .00000 | .0000 |
| HYDROX-T-ACRYL-BUTAD | -133.870 | .03360 | 7.05700C | 10.61500H | .23500N | .0000 |
| HYDROXYLAMINE CL | -1126.600 | .07226 | 4.00000H | 1.00000O | 1.00000N | 1.0000 |
| 416 HYDROXYLAMINE SO4 | -1685.800 | .07226 | 8.00000H | 6.00000O | 2.00000N | 1.0000 |
| HYDRO-AM-CHLORIDE | -1126.600 | .07226 | 4.00000H | 1.00000O | 1.00000N | 1.0000 |
| HYDRO-AM-OXLATE | -1850.100 | .05420 | 2.00000C | 8.00000H | 6.00000O | 2.0000 |
| HYSTL 3000 | 87.817 | .03252 | 4.00000C | 6.00000H | .00000 | .0000 |
| HYTREL 4056 | -847.230 | .04227 | 5.50670C | 7.82240H | 1.61190O | .0000 |
| INOSITOL PENTANITRAT | -444.280 | .05420 | 6.00000C | 7.00000H | 16.00000O | 5.0000 |
| IODINE | .017 | .00812 | 2.00000I | .00000 | .00000 | .0000 |
| IODINE PENTOXIDE | -126.830 | .17134 | 5.00000O | 2.00000I | .00000 | .0000 |
| IRFMA-1 | -675.400 | .05672 | 1.61960H | 4.69870O | 1.62140N | .0250 |
| IRON | .000 | .28398 | 1.00000FE | .00000 | .00000 | .0000 |
| 426 IRON DIFLUORIDE | -1796.200 | .24214 | 1.00000FE | 2.00000F | .00000 | .0000 |
| IRON OXIDE- FEO | -904.660 | .20590 | 1.00000FE | 1.00000O | .00000 | .0000 |
| IRON OXIDE-FE3 O4 | -1157.000 | .18720 | 3.00000FE | 4.00000O | .00000 | .0000 |
| IRON OXIDE | -1235.400 | .01893 | 3.00000O | 2.00000FE | .00000 | .0000 |
| ISOBUTYLBENZENE | -124.270 | .03082 | 10.00000C | 14.00000H | .00000 | .0000 |
| ISODECANE | -513.750 | .02630 | 10.00000C | 22.00000H | .00000 | [illegible]00 |
| ISODECYL PELARGONATE | -707.390 | .03143 | 19.00000C | 38.00000H | 2.00000O | [illegible]00 |
| ISO-DISOCY | -278.150 | .03830 | 5.31100C | 7.67900H | .936000 | .9260 |
| ISOPRENE - 309 | -157.000 | .02460 | 7.34100C | 11.74600H | .00000 | .0000 |
| ISOPROPYLAM.-NITRATE | -821.300 | .04336 | 3.00000C | 10.00000H | 3.00000O | 2.0000 |
| 436 I-309 | -157.000 | .02460 | 7.34100C | 11.74600H | .00000 | .0000 |
| JP-4 | -423.290 | .02988 | 9.66000C | 19.00000H | .00000 | .0000 |
| 15.6JP-4=84.4CCL4 | -247.900 | .05034 | 1.66580C | 2.19550H | 2.19510CL | .0000 |
| 24.4JP-4=75.6CF4 | -2027.400 | .02988 | 2.60550C | 3.43520H | 3.43520F | .0000 |
| KBRF6 | -1023.200 | .03613 | 1.00000K | 1.00000BR | 6.00000F | .0000 |
| KCLF4 | -1155.200 | .03613 | 1.00000K | 1.00000CL | 4.00000F | .0000 |
| KCLO4 | -774.960 | .09119 | 4.00000O | 1.00000CL | 1.00000K | .0000 |
| KEL-F | -1352.200 | .00726 | 2.00000C | 3.00000F | 1.00000CL | .0000 |
| 70.7KNO3-23.7B-5.6LM | -870.200 | .07503 | .34527H | 2.19040B | .34527C | .69925 |
| K2SO4 | -1966.400 | .09611 | 4.00000O | 2.00000K | 1.00000S | .0000 |
| 446 KETENE | -347.320 | .00010 | 2.00000C | 2.00000H | 1.00000O | .0000 |
| KRATON-G1652 | -202.000 | .03613 | 7.29900C | 12.14300H | .00000 | .0000 |
| KRYTOX-143AA | -1850.000 | .06785 | 1.77350C | .07440H | .49000O | 3.7255 |
| LAMINAC | -834.870 | .04356 | 5.00000C | 5.00000H | 1.00000O | .0000 |
| LEAD | .000 | .40827 | 1.00000PB | .00000 | .00000 | .0000 |
| LEAD AZIDE | 397.930 | .06684 | 6.00000N | 1.00000PB | .00000 | .0000 |
| LEAD CARBONATE-PBCO3 | -628.700 | .23849 | 1.00000C | 3.00000O | 1.00000PB | .0000 |
| LEAD CHROMATE-PBCRO4 | -675.080 | .22762 | 4.00000O | 1.00000PB | 1.00000CR | .0000 |
| LEADETHYLHEXOAT-PBEH | -693.840 | .04697 | 16.00000C | 30.00000H | 4.00000O | 1.0000 |
| LEAD FLUORIDE | -646.380 | .29771 | 1.00000PB | 2.00000F | .00000 | .0000 |
| 456 LEAD HYDROXIDE | -510.000 | .27430 | 1.00000PB | 2.00000O | 2.00000H | .0000 |
| LEAD NITRATE | -324.120 | .16367 | 2.00000N | 6.00000O | 1.00000PB | .0000 |
| LEAD OXALATE | -694.710 | .19077 | 1.00000PB | 2.00000C | 4.00000O | .0000 |
| LEAD OXIDE (PBO) | -234.760 | .28904 | 1.00000PB | 1.00000O | .00000 | .0000 |
| LEAD OXIDE | -256.100 | .32878 | 3.00000PB | 4.00000O | .00000 | .0000 |
| LEAD SALICYLATE | -863.500 | .03613 | 14.00000C | 10.00000H | 6.00000O | 1.0000 |
| LEAD STEARATE -PBST | -424.970 | .03252 | 36.00000C | 70.00000H | 4.00000O | 1.0000 |

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|---|---|---|---|---|---|---|
| 463 LEAD STYPHNATE | -92.000 | .10911 | 6.00000C | 3.00000N | 3.00000N | 9.00000O |
| LECITHIN(LECTT) | -516.100 | .03757 | 5.60980C | 11.22000N | .89756O | .22439P |
| LIALH4 | -690.380 | .03324 | 1.00000AL | 4.00000H | 1.00000LI | .00000 |
| LICLO4 | -854.160 | .08772 | 4.00000O | 1.00000CL | 1.00000LI | .00000 |
| LIH | -2726.000 | .02959 | 1.00000H | 1.00000LI | .00000 | .00000 |
| LITHOL PM | 25.143 | .00325 | 4.00000C | 6.00000H | .00000 | .00000 |
| LIGNITE | -1696.700 | .04520 | 3.43050C | 6.84520H | 2.85000O | .05000N |
| LITHIUM | .000 | .01962 | 1.00000LI | .00000 | .00000 | .00000 |
| LITHIUM BROMIDE-CRYS | -965.710 | .12520 | 1.00000LI | 1.00000BR | .00000 | .00000 |
| 472 LITHIUM BROMIDE-LIQ | -930.810 | .03613 | 1.00000LI | 1.00000BR | .00000 | .00000 |
| LITHIUM BROMIDE-GAS | -423.730 | .03613 | 1.00000LI | 1.00000BR | .00000 | .00000 |
| LITHIUM CARBONATE | -3932.100 | .07627 | 2.00000LI | 1.00000C | 3.00000O | .00000 |
| 90-LIH*10-BUTYLRUBB. | -2497.000 | .02986 | .71400C | 12.75300H | 11.32400LI | .00000 |
| 90-LIALH4*10BUT.RUBB | -614.270 | .03306 | .71400C | 10.91500H | 2.37140LI | 2.37140AL |
| LIMNF5 | -2364.900 | .03613 | 1.00000LI | 1.00000MN | 5.00000F | .00000 |
| LP33 (-695 CAL/GR) | -695.000 | .04589 | 3.00700C | 6.01400H | 1.20280O | 1.20280N |
| LX10 | -32.500 | .06727 | 1.41660C | 2.65960H | 2.56610N | 2.56610O |
| LX14 | 14.800 | .06630 | 1.51770C | 2.91390H | 2.66420O | 2.58450N |
| LX17 | -266.600 | .06894 | 2.28460C | 2.21780H | 2.12710O | 2.16570N |
| 482 MAF-1 | -18.646 | .03140 | 3.70530C | 12.39700H | .05551O | 3.00630N |
| MAF-4 | -5.020 | .03049 | 3.54720C | 13.02600H | 3.15950N | .0000C |
| 7AGNESIUM HYDRIDE | -691.070 | .03613 | 1.00000MG | 2.00000H | .00000 | .00000 |
| MAGNESIUM DIFLUORIDE | -4312.400 | .10839 | 1.00000MG | 2.00000F | .00000 | .00000 |
| MAGNESIUM NITRIDE | -1091.700 | .03613 | 3.00000MG | 2.00000N | .00000 | .00000 |
| MANGANESEDIFLUORIDE | -2033.800 | .14379 | 1.00000MN | 2.00000F | .00000 | .00000 |
| M-26-ANALYZED WTS | -292.200 | .05715 | 2.93950H | 2.16880C | 1.00610N | 3.51490O |
| MAGNESIUM CARBONATE | -3154.700 | .10970 | 1.00000C | 3.00000O | 1.00000MG | .00000 |
| MANGANESE DIOXIDE | -1432.200 | .18159 | 1.00000MN | 2.00000O | .00000 | .00000 |
| MANNITOL PENTANITRAT | -469.220 | .05420 | 6.00000C | 9.00000H | 16.00000O | 5.00000N |
| 492 MAPO | -321.500 | .03898 | 9.00000C | 18.00000H | 1.00000O | 3.00000N |
| MBE | 117.900 | .03324 | 7.11570C | 10.72000H | .19575O | .02478N |
| MECN | 309.349 | .02829 | 2.00000C | 3.00000H | 1.00000N | .00000 |
| METHANE GAS | -1239.500 | .00001 | 1.00000C | 4.00000H | .00000 | .00000 |
| METHANE | -1336.800 | .01499 | 1.00000C | 4.00000H | .00000 | .00000 |
| METHANOL | -1779.500 | .02861 | 1.00000C | 4.00000H | 1.00000O | .00000 |
| METH.-CENT. | -89.474 | .04697 | 15.00000C | 16.00000H | 1.00000O | 2.00000N |
| 2-METH-5-CY-TETZ-(S) | 803.000 | .04299 | 3.00000H | 3.00000C | 5.00000N | .00001O |
| N-METH-HYD-AM-NITRAT | -773.400 | .05073 | .85512C | 5.43650H | 3.75750O | 1.72260N |
| METHYLAMMONIUMNITRAT | -856.790 | .05419 | 1.00000C | 6.00000H | 3.00000O | 2.00000N |
| 502 METHYL CARBITOLFORMA | -1023.900 | .03613 | 11.00000C | 24.00000H | 6.00000O | .00000 |
| METHYLCUBANE | 1112.800 | .03562 | 9.00000C | 10.00000H | .00000 | .00000 |
| METHYLETHYLKETONE | -906.420 | .02891 | 4.00000C | 8.00000H | 1.00000O | .00000 |
| 2-METHYLNAPHTHALENE | 75.421 | .03718 | 11.00000C | 10.00000H | .00000 | .00000 |
| P-METHYL-PHEN-SILOXA | -860.910 | .03613 | 7.00000C | 7.00000H | 1.00000O | 1.00000SI |
| 1-METH-5-PHEN-TETRAZ | 436.020 | .03613 | 8.00000C | 8.00000H | 4.00000N | .00000 |
| 1-METH-5TPL(1M5TPMT) | -591.780 | .05221 | 3.00000C | 3.00000H | 3.00000F | 4.00000N |
| P-METH-TRIFLUOROSILO | -1770.000 | .03613 | 4.00000C | 9.00000H | 1.00000O | 1.00000SI |
| METHYL CYANIDE | 309.350 | .02829 | 2.00000C | 3.00000H | 1.00000N | .00000 |
| METRIOL TRINITRATE | -406.000 | .05311 | 5.00000C | 9.00000H | 9.00000O | 3.00000N |
| 512 MEOH | -1779.500 | .02861 | 1.00000C | 4.00000H | 1.00000O | .00000 |
| MERCAPTO-B-ACR(MTBN) | -55.034 | .03450 | 6.65280C | 9.60320H | .46930N | .13817S |
| MERCAPTO-TER-PB(MTB) | -87.641 | .03252 | 7.22320C | 11.14100H | .08680S | .00000 |
| MERCURY FULMINATE | 224.837 | .01597 | 2.00000C | 2.00000N | 2.00000O | 1.00000HG |
| MG | .000 | .06287 | 1.00000MG | .00000 | .00000 | .00000 |
| MGO | -3567.500 | .13187 | 1.00000O | 1.00000MG | .00000 | .00000 |
| MHN | -518.990 | .05781 | 1.00000C | 7.00000H | 3.00000O | 3.00000N |
| MILORI B3UE | -371.250 | .10839 | 18.00000C | 18.00000N | 7.00000FE | .00000 |
| MMH | 284.320 | .03159 | 1.00000C | 6.00000H | 2.00000N | .00000 |
| MMHN | -519.010 | .05781 | 1.00000C | 7.00000H | 3.00000O | 3.00000N |
| 522 MN | .000 | .06287 | 1.00000MN | .00000 | .00000 | .00000 |
| MNAMNO | -310.890 | .04697 | 6.00000C | 12.00000H | 3.00000O | 2.00000N |
| MNO2 | -1432.200 | .18159 | 2.00000O | 1.00000MN | .00000 | .00000 |
| MOEMT | -166.320 | .04083 | 3.58100C | 7.45000H | .56800O | 2.87900N |
| MOLYBDENUM DISULFIDE | -412.350 | .17342 | 1.00000MO | 2.00000S | .00000 | .00000 |
| MONOMETHYLHYD.NITRAT | -519.010 | .05781 | 1.00000C | 7.00000H | 3.00000O | 3.00000N |
| MONOMETHPERFLOCTSOL | -1903.000 | .05780 | 9.00000C | 3.00000H | 1.00000O | 17.00000F |

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|---|---|---|---|---|---|---|
| 572 2-MVT | 585.452 | .05420 | 4.00000C | 6.00000N | 4.00000N | .0000 |
| MVT*AA | 357.688 | .04733 | 3.63000C | 5.40700N | .178000 | 3.4090 |
| 2-M-1,2-BDFAP | -388.960 | .04625 | 4.00000C | 8.00000N | 2.00000N | 4.0000 |
| 3-M-L-2344 | -1858.000 | .06865 | 2.49370C | 1.38890N | .015630 | [illegible] |
| M-6 | -538.800 | .05635 | 2.90860N | 2.48400C | .94176N | [illegible] |
| MAALN4 | -500.090 | .04480 | 1.00000AL | 4.00000N | 1.00000MA | .0000 |
| MAM3 | 55.460 | .06670 | 3.00000N | 1.00000MA | .00000 | .0000 |
| MAPETHALENE | 146.080 | .04137 | 10.00000C | 8.00000N | .00000 | .0000 |
| MC(12.0) | -658.460 | .05998 | 6.00000C | 7.73950N | 9.521000 | 2.2605 |
| 538 MC(12.2) | -648.000 | .05781 | 6.00000C | 7.68000N | 9.640000 | 2.3200 |
| MC (13.15 | -589.620 | .05998 | 6.00000C | 7.36000N | 10.270000 | 2.6700 |
| 50(MC12.2+50MC12.6 | -636.400 | .05998 | .60000C | 2.82540N | 3.641000 | .8845 |
| MEOPENTYLGLYAD(MPGA) | -858.500 | .03613 | 5.55000C | 9.93000N | 1.460000 | .0000 |
| MFPA | -505.600 | .04878 | 6.00000C | 8.00000N | 2.000000 | 2.0000 |
| MF4SBF4(HF ESTIMATED | -1119.000 | .03613 | 1.00000N | 1.00000SB | 8.00000F | .0000 |
| MF4SBF6(HF ESTIMATED | -1258.600 | .03613 | 1.00000N | 1.00000SB | 10.00000F | .0000 |
| 10(NH4NO3+90(HNO3 | -700.300 | .05502 | 1.92790N | 1.67810N | 4.659400 | .0000 |
| 28NH4NO3+52HNO3+20H | -1405.300 | .05101 | 4.44460N | 1.52480N | 4.635100 | .0000 |
| 68.J(NI-31.6(AL | .000 | .18636 | 1.65050NI | 1.17120AL | .00000 | .0000 |
| 540 30.5NI-28AL41.5FE2O3 | -512.300 | .16634 | .51933NI | 1.03930AL | .51934FE | .7790 |
| NIAX-260-POLYCAPLACT | -1036.700 | .04180 | 5.18500C | 8.86900N | 1.799000 | .0000 |
| NICKEL | .000 | .32156 | 1.00000NI | .00000 | .00000 | .0000 |
| NICKEL OXIDE | -781.900 | .26917 | 1.00000NI | 1.000000 | .00000 | .0000 |
| NIBTN | -359.990 | .03613 | 4.00000C | 6.00000N | 4.00000N | 11.0000 |
| 5-NITRAMINOTETRAZOLE | 461.300 | .05777 | 1.00000C | 2.00000N | 6.00000N | 2.0000 |
| NITRAPENTADIISOCYANA | -340.520 | .05024 | 2.99250C | 4.09720N | 1.985900 | 1.9929 |
| NITRIC OXIDE | 719.140 | .00007 | 1.00000N | 1.000000 | .00000 | .0000 |
| 4-NITRO-4AZAPENTNITR | 39.430 | .04697 | 3.10740C | 5.49600N | 1.543700 | 2.3280 |
| 5-NITROBARBITURIC A. | -1625.300 | .06142 | 1.76700C | 3.89900N | 3.201000 | 1.6870 |
| 548 NITROCELLULOSE(12.6) | -624.840 | .05998 | 6.00000C | 7.55000N | 9.900000 | 2.4500 |
| 2-NITRODIPHENYLAMINE | 83.180 | .04935 | 12.00000C | 10.00000N | 2.000000 | 2.0000 |
| NITROFORM -(L) | -107.610 | .05780 | 1.00000N | 1.00000C | 3.00000N | 6.0000 |
| NITROGEN-GAS | .000 | .00005 | 2.00000N | .00000 | .00000 | .0000 |
| NITROGEN(AT 900K) | 156.300 | .00005 | 2.00000N | .00000 | .00000 | .0000 |
| NITROGEN(AT 1000K) | 183.900 | .00005 | 2.00000N | .00000 | .00000 | .0000 |
| NITROGEN(AT 1500K) | 327.300 | .00005 | 2.00000N | .00000 | .00000 | [illegible] |
| NITROGEN(AT 1600K) | 356.900 | .00005 | 2.00000N | .00000 | .00000 | [illegible] |
| NITROGEN(AT 1700K) | 386.700 | .00005 | 2.00000N | .00000 | .00000 | .0000 |
| NITROGEN(AT 1800K) | 416.800 | .00005 | 2.00000N | .00000 | .00000 | .0000 |
| 568 NITROGEN(AT 1900K) | 447.200 | .00005 | 2.00000N | .00000 | .00000 | .0000 |
| NITROGEN(AT 2000K) | 447.700 | .00005 | 2.00000N | .00000 | .00000 | .0000 |
| NITROGEN -(L) | -102.460 | .04110 | 2.00000N | .00000 | .00000 | .0000 |
| NITROGEN DIOXIDE | 156.280 | .00021 | 1.00000N | 2.000000 | .00000 | .0000 |
| NITROGEN TRIFLUORIDE | -418.260 | .05535 | 1.00000N | 3.00000F | .00000 | .0000 |
| NITROGLYCERIN - NG | -392.340 | .05780 | 3.00000C | 5.00000N | 9.000000 | 3.0000 |
| NITROMETHANE | -444.380 | .04086 | 1.00000C | 3.00000N | 2.000000 | 1.0000 |
| NITRO UREA | -611.370 | .04697 | 1.00000C | 3.00000N | 3.000000 | 3.0000 |
| 5-NITR-2NIT-1(3DIAZC | -155.650 | .05419 | 4.00000C | 7.00000N | 5.000000 | 5.0000 |
| NITRONIUM PERCHLORAT | 61.046 | .08021 | 6.000000 | 1.00000N | 1.00000CL | .0000 |
| 578 5-NITRO TETRAZOL-(S) | 378.966 | .03613 | 1.00000C | 1.00000N | 2.000000 | 5.0000 |
| NITROUS OXIDE -(G) | 442.750 | .00010 | 2.00000N | 1.000000 | .00000 | .0000 |
| NITSYLTFLBRO(NOBRF4) | -530.340 | .10297 | 1.00000N | 1.000000 | 1.00000BR | 4.0000 |
| N,N-BEDE | -838.220 | .04444 | 4.01600C | 7.26200N | 2.007000 | .8770 |
| NIX-BINDER | -612.700 | .04570 | 5.82270N | 3.29230C | .87930N | 2.6417 |
| NONO (THIOKOL) | -643.000 | .03613 | 5.00000C | 9.00000N | 4.000000 | 1.0000 |
| NNTN | -495.900 | .05709 | 1.79600C | 2.62170N | 3.749300 | 1.1277 |
| N2O4 -(L) | 25.100 | .05232 | 2.00000N | 4.000000 | .00000 | .0000 |
| NQ | -207.540 | .06106 | 1.00000C | 4.00000N | 2.000000 | 4.0000 |
| NYLON-EST.HF+FORMULA | -695.110 | .03613 | 6.00000C | 11.00000N | 1.000000 | 1.0000 |
| 588 OCTAFLUOROCYCLOBUTAN | -1847.200 | .00031 | 4.00000C | 8.00000F | .00000 | .0000 |
| OCTOL | 26.000 | .06550 | 1.78330C | 2.57610N | 2.686200 | 2.3560 |
| (OMT)OCTAMITROTERPHE | -106.520 | .03613 | 3.06660C | 1.33430N | 2.694000 | 1.3225 |
| OP-4 | -423.290 | .02988 | 9.66000C | 19.00000N | .00000 | .0000 |
| OXALIC ACID | -2179.300 | .05972 | 2.00000C | 2.00000N | 4.000000 | .0000 |
| OXALIC ACIDDIHYDRATE | -2695.200 | .05972 | 2.00000C | 6.00000N | 6.000000 | .0000 |
| 33-OXYGEN-67NITROGEN | .000 | .00040 | 4.78330N | 2.062500 | .00000 | .0000 |

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|---|---|---|---|---|---|---|
| 596 OXAMIDE | -1379.600 | .06023 | 2.00000C | 4.00000N | 2.000000 | 2.00000N |
| OXID-EMO3-MIO4-EP-N | -618.720 | .05326 | 1.47360N | 4.650800 | 1.64970N | .03099P |
| OXYGEN-GAS | .000 | .00005 | 2.000000 | .00000 | .00000 | .00000 |
| OXYGEN(1000K) | 169.590 | .00005 | 2.000000 | .00000 | .00000 | .00000 |
| OXYGEN -(L) | -96.250 | .04112 | 2.000000 | .00000 | .00000 | .00000 |
| (PAC-2M)POLACETPURET | -649.260 | .03613 | 5.20500C | 8.12000N | 1.557000 | .25000N |
| PAC 2T | -690.000 | .03613 | 5.05200C | 8.43300N | 1.683000 | .27600N |
| (PACT-2T)POACETPURET | -690.000 | .03613 | 5.05200C | 8.43300N | 1.683000 | .27600N |
| PAPI | -278.200 | .03613 | 8.00000C | 6.00000N | 1.000000 | 1.00000N |
| 604 90 PBAA + 10 PACM | -92.300 | .03353 | 6.85900C | 9.93570N | .153780 | .36679N |
| PBC03 | -628.700 | .23849 | 1.00000C | 3.000000 | 1.00000PB | .00000 |
| PBEP | -436.800 | .06966 | 1.92800C | 2.67200N | .676000 | 1.21800N |
| PB(IO3)2 | -216.860 | .24279 | 6.000000 | 1.00000PB | 2.00000I | .00000 |
| PB304 | -256.110 | .32878 | 4.000000 | 3.00000PB | .00000 | .00000 |
| PBRES | -683.490 | .03252 | 7.00000C | 6.00000N | 5.000000 | 1.00000PB |
| PDMPA | -676.610 | .03613 | 2.96920C | 4.20140N | 2.994700 | .88490N |
| PELLATHANE | -628.230 | .04263 | 5.54300C | 8.84400N | 1.304000 | .25840N |
| PENTAERITHRITOL | -1609.100 | .05238 | 5.00000C | 12.00000N | 4.000000 | .00000 |
| PENTANE | -648.050 | .02247 | 5.00000C | 12.00000N | .00000 | .00000 |
| 619 PETROLATUM | -325.110 | .02890 | 7.12990C | 13.11500N | .00000 | .00000 |
| PETM | -400.770 | .06395 | 5.00000C | 8.00000N | 12.000000 | 4.00000N |
| PETRIN | -490.520 | .05781 | 5.00000C | 9.00000N | 10.000000 | 3.00000N |
| PETROLEUM JELLY | -160.600 | .02890 | 7.24310C | 13.02600N | .00000 | .00000 |
| PERSB | -722.260 | .04444 | 20.00000C | 20.00000N | 6.000000 | .00000 |
| PEPERIDINE NITRATE | -629.710 | .04552 | 5.00000C | 12.00000N | 3.000000 | 2.00000N |
| PEMAMPP | -174.110 | .03974 | 16.00000C | 13.00000N | 1.00000N | .00000 |
| PHENOL | -393.830 | .03866 | 6.00000C | 6.00000N | 1.000000 | .00000 |
| N-PHENYL MORPHOLINE | -122.700 | .03613 | 10.00000C | 13.00000N | 1.000000 | 1.00000N |
| PHOSPHONIT-FLUORO | -1543.200 | .06503 | 24.00000C | 16.00000N | 8.000000 | 4.00000N |
| 629 PHOSPHORUS | .000 | .07949 | 4.00000P | .00000 | .00000 | .00000 |
| PHOSPHORIC ACID | -3093.200 | .06626 | 3.00000N | 1.00000P | 4.000000 | .00000 |
| PICRIC ACID | -240.010 | .06370 | 6.00000C | 3.00000N | 7.000000 | 3.00000N |
| PLASTISOL-NC(PNC) | -597.200 | .05780 | 24.37000C | 30.15400N | 34.669000 | 8.72500N |
| PMVT | 432.240 | .04336 | 4.00000C | 6.00000N | 4.00000N | .00000 |
| PMVT-HF IS 52.4 | 475.830 | .04336 | 4.00000C | 6.00000N | 4.00000N | .00000 |
| 2-PMVT"HEM | 252.278 | .04697 | 3.76300N | 5.80400N | .333000 | 3.10700N |
| PNC | -597.200 | .05781 | 24.37000C | 30.15400N | 34.669000 | 8.72500N |
| POLYACRYLNITRILE | 532.720 | .04083 | 3.00000C | 3.00000N | 1.00000N | .00000 |
| POLBUTADIACRAC(PBAA) | -161.760 | .03290 | 6.91670C | 10.29800N | .169000 | .19600N |
| 634 POLBUTADIACRAC(PBAA) | -176.800 | .03350 | 7.07230C | 10.38200N | .286900 | .00000 |
| POLYBUTENE -6(CHEV) | -314.620 | .00304 | 7.15300C | 14.08008 K | .00000 | .00000 |
| POLY-1,4BUTG-(LD124) | -780.950 | .03555 | 5.42000C | 11.02200N | 1.488000 | .00000 |
| POLYDIETHGLYAD(R-18) | -802.000 | .03613 | 4.74000C | 6.57000N | 2.070000 | .24300N |
| POLY GLYCOL-ADIPATE | -1133.500 | .04299 | 10.00000C | 16.00000N | 5.000000 | .00000 |
| POL-ISOBUTLENE(L-14) | -354.240 | .03024 | 7.17100C | 14.36500N | .00000 | .00000 |
| POLYETHYLENE-FILM | -476.620 | .03378 | 2.00000C | 4.00000N | .00000 | .00000 |
| POLYETHYLENE GLYCOL | -1047.200 | .03974 | 2.00000C | 4.00000N | 1.000000 | .00000 |
| POLFLUDINITROGLYETHE | -585.380 | .05420 | 5.00000C | 7.00000N | 6.000000 | 2.00000N |
| POLFLUORONITROOXETAN | -937.990 | .05745 | 3.00000C | 4.00000N | 3.000000 | 1.00000N |
| 644 POLYMEG | -915.600 | .03559 | 5.35600C | 11.36900N | 1.509000 | .00000 |
| POLYMETHYLMETHACRYL | -1028.400 | .03396 | 5.01900C | 8.33300N | 1.958000 | .00000 |
| POLY-2MET-V-TETR-(S) | 311.490 | .07226 | 6.00000N | 4.00000C | 4.00000N | .000010 |
| POLYNITROETHYLENE | -301.160 | .03613 | 2.00000C | 3.00000N | 2.000000 | 1.00000N |
| POLYNITROFORMAL | -362.000 | .05600 | 8.00000C | 14.00000N | 6.00000N | 14.000000 |
| POLYNITROMETHYL-OXT | -701.000 | .04625 | 5.00000C | 9.00000N | 1.00000N | 4.000000 |
| POLYPROPYLENE FILM | -471.240 | .03252 | 3.00000C | 6.00000N | .00000 | .00000 |
| POLYSIL +DIPHENSIL | -1677.300 | .04625 | 3.11110C | 7.71510N | 1.244400 | 1.24440SI |
| POLYSTYRENE | 86.410 | .03288 | 8.00000C | 8.00000N | .00000 | .00000 |
| POLYURETHANE-AEROJET | -767.710 | .03613 | 4.39220C | 8.38070N | 1.878800 | .26130N |
| 654 POLYURETHANE | -871.390 | .03613 | 5.12000C | 4.59000N | 1.680000 | .14000N |
| POLY-VINYL-ALCOHOL-2 | -1657.000 | .04336 | 4.38600C | 9.53000N | 2.357000 | .00000 |
| POLY-VINYL-ALCOHOL | -1755.800 | .04335 | 4.50250C | 9.57030N | 2.267400 | .00000 |
| POLYVINYL CHLORIDE | -361.580 | .05058 | 2.00000C | 3.00000N | 1.00000CL | .00000 |
| POLY(VINYLIDENE CHL) | -371.380 | .03613 | 2.00000C | 2.00000N | 2.00000CL | .00000 |
| POT.-5-PHENTETRAZOL | 65.132 | .03613 | 7.00000C | 5.00000N | 4.00000N | 1.00000K |
| POTASSIUM CHLORIDE | -1397.000 | .07170 | 1.00000K | 1.00000CL | .00000 | .00000 |

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|---|---|---|---|---|---|---|
| 664 POTASSIUM FLUORIDE | -2339.100 | .08960 | 1.00000K | 1.00000F | .00000 | .00000 |
| POTASSIUM-HYD-OXALAT | -2114.800 | .07226 | 2.00000C | 2.00000H | 4.500000 | 1.00000K |
| POTASSIUM-HYD-SUCCIN | -2216.300 | .05839 | 4.00000C | 9.00000H | 6.000000 | 1[illegible]00K |
| POTASSIUM-HYD-TARTRA | -1918.400 | .07067 | 4.00000C | 5.00000H | 6.000000 | 1[illegible]00K |
| POTASSIUM NITRATE | -1164.700 | .07623 | 3.000000 | 1.00000N | 1.00000K | .00000 |
| PPG | -874.980 | .03623 | 3.00000C | 6.00000H | 1.000000 | .00000 |
| PROPANE | -562.850 | .00007 | 3.00000C | 8.00000H | .00000 | .00000 |
| PROPANE-LIQUID | -680.820 | .02114 | 3.00000C | 8.00000H | .00000 | .00000 |
| PROPENE | 115.970 | .00004 | 3.00000C | 6.00000H | .00000 | .00000 |
| 670 PROPYLENE CARBONATE | -1381.100 | .03613 | 4.00000C | 6.00000H | 3.000000 | .00000 |
| PROPYL NITRATE | -487.750 | .03822 | 3.00000C | 7.00000H | 3.000000 | 1.00000N |
| P-10 RESIN(LOT K09) | -893.040 | .03541 | 6.34720C | 8.64080H | .667000 | .00000 |
| N-PROPYLAMINE | -529.170 | .02598 | 3.00000C | 9.00000H | 1.00000N | .00000 |
| PRUSSIAN BLUE | -371.250 | .10839 | 18.00000C | 18.00000N | 7.00000FE | .00000 |
| PUER -(S) | -871.600 | .03613 | 5.12000C | 4.59000H | 1.680000 | .16000N |
| PVA-2 | -1657.000 | .04336 | 4.38600C | 9.53000H | 2.357000 | .00000 |
| PVP | -330.600 | .03613 | 5.19700C | 7.87700H | 1.085000 | .87600N |
| PYRIDAZINE | 670.990 | .04000 | 4.00000C | 4.00000H | 2.00000N | .00000 |
| PYRIDINE | 302.660 | .03548 | 5.00000C | 5.00000H | 1.00000N | .00000 |
| 680 PYRROLE -WET | -666.500 | .05711 | 3.24830H | 2.31870C | .85683N | 3.55460C |
| PYRO(99NC(12.6)) | -616.800 | .05972 | 2.80890H | 2.25160C | .89634N | 3.59810C |
| PYRO-MET-DI-ANHYD. | -1147.700 | .04336 | 10.00000C | 2.00000H | 6.000000 | .00000 |
| QUERCITE TETRANITRAT | -410.280 | .05420 | 7.00000C | 9.00000H | 13.000000 | 4.00000N |
| QUINONE-2,3,5DIA-(S) | -1491.300 | .03613 | 10.00000C | 8.000000 | .00001H | .00001N |
| RDR-700 | -460.300 | .03613 | 5.63000C | 6.60000H | 1.630000 | .00000 |
| RDS-500 | -396.300 | .06045 | 4.13790H | 1.27420C | .59466N | 2.26740C |
| RDX -(S) | 72.480 | .06561 | 3.00000C | 6.00000H | 6.000000 | 6.00000N |
| RESORCINOL - RES | -777.010 | .04596 | 6.00000C | 6.00000H | 2.000000 | .00000 |
| REX-17 (FDX)OXALATE | -797.710 | .06756 | 6.00000C | 4.00000H | 12.000000 | 4.00000N |
| 690 RUA | -1148.000 | .04516 | 40.00000C | 54.00000H | 27.000000 | .00000 |
| RUN GOM | -196.200 | .05118 | 4.99880H | 1.36010BE | 1.34290C | 1.72280N |
| R-45M | -.380 | .03288 | 7.33000C | 11.00000H | .083800 | .00000 |
| R-45M/AZIDE | 644.010 | .06313 | 7.33000C | 11.00000H | .083800 | 5.50000N |
| SANTICIZER 334F | -974.970 | .03613 | 5.19650C | 8.60100H | 1.797500 | .00000 |
| SALYCYLIC ACID | -1015.100 | .05213 | 7.00000C | 6.00000H | 3.000000 | [illegible]000 |
| SCOTCHCAST RESIN | -508.670 | .03902 | 6.01370C | 8.76490H | .959100 | [illegible]801 |
| SHELLDYNE -H | -340.770 | .03870 | 14.00000C | 18.00000H | .00000 | [illegible]000 |
| SILICON | .000 | .07226 | 1.00000SI | .00000 | .00000 | .00000 |
| SILICON AZIDE | 15.400 | .07230 | 1.00000SI | 6.00000N | .00000 | .00000 |
| 700 SIO2 | -3493.100 | .07949 | 2.000000 | 1.00000SI | .00000 | .00000 |
| SM | .000 | .20775 | 1.00000SM | .00000 | .00000 | .00000 |
| SOA | -1322.000 | .04589 | 28.00000C | 38.00000H | 19.000000 | .00000 |
| SODIUM | .000 | .03505 | 1.00000NA | .00000 | .00000 | .00000 |
| SODIUM ASCORBATE | -1494.200 | .00000 | 6.00000C | 6.000000 | 7.00000H | 1.00000[illegible] |
| SODIUM AZIDE | 55.460 | .06670 | 3.00000N | 1.00000NA | .00000 | .00000 |
| SODIUM BARBITUATE | -1393.300 | .03613 | 4.00000C | 3.00000H | 3.000000 | 2.00000[illegible] |
| SODIUM BICARBONATE | -2695.800 | .07912 | 1.00000NA | 1.00000H | 1.00000C | 3.00000[illegible] |
| SODIUM BORATE.10H2O | -3925.700 | .06250 | 20.00000H | 4.00000B | 17.000000 | 2.00000[illegible] |
| SODIUM CARBONATE | -2550.000 | .09065 | 2.00000NA | 1.00000C | 3.000000 | .00000 |
| 710 SODIUM FLUORIDE | -3238.100 | .10080 | 1.00000NA | 1.00000F | .00000 | .00000 |
| SODIUM HYDROXIDE | -2549.700 | .07696 | 1.00000NA | 1.00000H | 1.000000 | .00000 |
| SODIUM NITRATE | -1322.900 | .07226 | 1.00000NA | 1.00000N | 3.000000 | .00000 |
| SODIUM NITRITE | -1244.900 | .07830 | 1.00000NA | 1.00000N | 2.000000 | .00000 |
| SODIUM OXALATE | -2345.300 | .08454 | 2.00000NA | 2.00000C | 4.000000 | .00000 |
| SODIUM OXAL HYDRIDE | -2539.400 | .05520 | 1.00000NA | 2.00000C | 5.000000 | 3.00000 |
| SODIUM PERCHLORATE | -752.800 | .09033 | 4.000000 | 1.00000CL | 1.00000NA | .00000 |
| SODIUM PEROXIDE | -1546.400 | .10134 | 2.00000NA | 2.000000 | .00000 | .00000 |
| SODIUM TRICHLOROACET | -943.190 | .05419 | 2.00000C | 2.000000 | 3.00000CL | 1.00000 |
| SORBITOLPENTANITRATE | -463.480 | .06034 | 6.00000C | 9.00000H | 16.000000 | 5.00000 |
| 720 SODIUMBOROHYDRIDE | -1206.000 | .03900 | 1.00000B | 4.00000H | 1.00000NA | .00000 |
| STABELITE ESTER-10 | -503.900 | .04336 | 6.59660C | 10.26800H | .635300 | .00070 |
| STABL-ESTER10(NO CL) | -503.900 | .04336 | 6.59660C | 10.26800H | .635300 | .00000 |
| STYRENE | 205.720 | .03278 | 8.00000C | 8.00000H | .00000 | .00000 |
| STRONTIUM NITRATE | -1102.100 | .10788 | 1.00000SR | 2.00000N | 6.000000 | .00000 |
| SUCROSE | -1549.800 | .05737 | 12.00000C | 22.00000H | 11.000000 | .00000 |
| SULFUR | .000 | .07392 | 1.00000S | .00000 | .00000 | .00000 |

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| 727 SULFUR DIOXIDE | -1108.000 | .10570 | 1.00000S | 2.00000O | .00000 | .00000 |
| SULFUR HEXAFLUORIDE | -1997.800 | .00023 | 1.00000S | 6.00000F | .00000 | .00000 |
| (TACOT)TNITROBENZOTR | 221.259 | .05817 | 3.11320C | 1.05650N | 2.02060O | 2.04010N |
| TAE | 258.380 | .03613 | 2.00000C | 5.00000N | 1.00000O | 3.00000N |
| TAG.EDNA | 172.300 | .05636 | 1.14000C | 6.18000N | 1.09900O | 4.47500N |
| TAGN | -68.206 | .05022 | 1.00000C | 9.00000N | 3.00000O | 7.00000N |
| TATB | -178.540 | .07002 | 2.31430C | 2.38090N | 2.28340O | 2.32540N |
| TDFN | -379.270 | .06630 | 7.00000C | 8.00000N | 6.00000N | 8.00000O |
| TDFP | -196.960 | .06106 | 5.00000C | 7.00000N | 6.00000O | 5.00000N |
| 736 TDICY | -33.000 | .03252 | 9.00000C | 6.00000N | 2.00000O | 2.00000N |
| IDP | -707.390 | .03143 | 19.00000C | 38.00000N | 2.00000O | .00000 |
| TEFLON | -1951.600 | .08346 | 2.00000C | 4.00000F | .00000 | .00000 |
| TEFO | -258.480 | .06110 | 5.00000C | 6.00000N | 14.00000O | 6.00000N |
| TEGDN | -636.550 | .04697 | 6.00000C | 12.00000N | 8.00000O | 2.00000N |
| TETFLAMETETFB(NF4BF4) | -1911.600 | .03613 | 1.00000N | 1.00000B | 8.00000F | .00000 |
| TETRACARBONFLUORIDE | -701.070 | .03613 | 4.00000C | 1.00000F | .00000 | .00000 |
| TETRACENE | 589.942 | .03974 | 2.00000C | 8.00000N | 1.00000O | 10.00000N |
| TETRACYANOETH-(TCNE) | 1164.000 | .04697 | 6.00000C | 4.00000N | .00000 | .00000 |
| TETRAMETHAMMONITRATE | -646.340 | .06232 | 4.00000C | 12.00000N | 3.00000O | 2.00000N |
| 746 TETRAMETHYLAM.NITRAT | -624.560 | .04440 | 2.93100C | 8.71000N | 2.19900O | 1.47000N |
| TETRANITROCARBAZOLE | -116.360 | .03613 | 12.00000C | 5.00000N | 5.00000N | 8.00000O |
| TETRAPHENYL TIN | 105.362 | .05383 | 24.00000C | 20.00000N | 1.00000SN | .00000 |
| TETRAZOLE | 808.750 | .03613 | 1.00000C | 2.00000N | 4.00000N | .00000 |
| TETRYL | 28.098 | .06250 | 7.00000C | 5.00000N | 5.00000N | 8.00000O |
| (TETRYL)METH-TETRABE | 16.272 | .06250 | 7.00000C | 5.00000N | 5.00000N | 8.00000O |
| TFTA-TETRAFORMAL-TRI | 500.000 | .04119 | 4.00000C | 12.00000N | 6.00000N | .00000 |
| TH DIMER NSWC DATA | -180.370 | .03320 | 12.00000C | 20.00000N | .00000 | .00000 |
| THIONYL CHLORIDE | -413.510 | .03613 | 1.00000S | 1.00000O | 2.00000CL | .00000 |
| TIH2 | -626.210 | .12718 | 1.00000TI | 1.75000N | .00000 | .00000 |
| 756 TIN | .000 | .20775 | 1.00000SN | .00000 | .00000 | .00000 |
| TIN OXIDE(SNO2) | -921.030 | .25110 | 1.00000SN | 2.00000O | .00000 | .00000 |
| TIO2 | -2728.400 | .15391 | 2.00000O | 1.00000TI | .00000 | .00000 |
| TITANIUM | .000 | .16258 | 1.00000TI | .00000 | .00000 | .00000 |
| TITANIUM CHLORIDE | -945.030 | .06214 | 1.00000TI | 4.00000CL | .00000 | .00000 |
| TMETN | -406.000 | .05311 | 5.00000C | 9.00000N | 9.00000O | 3.00000N |
| TMP | -1329.400 | .04336 | 6.00000C | 14.00000N | 3.00000O | .00000 |
| 1,1,1-TN-4,4DF-FP | -327.170 | .06106 | 5.00000C | 6.00000N | 6.00000O | 5.00000N |
| (TNBM)TRINBUTYRONITR | 8.250 | .05420 | 1.96460C | 2.01390N | 2.93120O | 1.96040N |
| TNEOC | -221.650 | .00614 | 9.00000C | 8.00000N | 28.00000O | 12.00000N |
| 766 TNENG TNITETHNITGUAN | -63.296 | .06612 | 3.00000C | 5.00000N | 7.00000N | 8.00000O |
| TNGU-TETRANITROGLYCO | 62.092 | .03613 | 4.00000C | 2.00000N | 8.00000N | 10.00000O |
| TNM -(L) | -5.611 | .05925 | 1.00000C | 4.00000N | 8.00000O | .00000 |
| 70( TNM + 30( N2O4 | 38.950 | .05701 | .35706C | 4.16060O | 2.08030N | .00000 |
| TOLUENE | 31.150 | .03122 | 7.00000C | 8.00000N | .00000 | .00000 |
| TOLUENE DIAMINE | -16.393 | .04490 | 7.00000C | 10.00000N | 2.00000N | .00000 |
| TOF | -704.050 | .03613 | 24.00000C | 51.00000N | 4.00000O | 1.00000P |
| TP-90-B(THIOKOL) | -1228.700 | .03505 | 5.20980C | 11.12100N | 1.62810O | .00000 |
| TP-95 | -1054.500 | .03649 | 5.01300C | 10.02000N | 1.85600O | .00000 |
| TP4040 | -1088.600 | .03613 | 5.20400C | 10.77400N | 1.65600O | .00000 |
| 776 (TPTA)2,4,6-TRIPICRY | 99.209 | .03613 | 21.00000C | 6.00000N | 18.00000O | 12.00000N |
| TUFFLO-100 | -367.130 | .03287 | 7.25900C | 12.35100N | .00000 | .00000 |
| TRIACETIN - TA | -1335.200 | .04195 | 9.00000C | 14.00000N | 6.00000O | .00000 |
| TRI-AMMONIUM PHOSPH | -2695.100 | .05781 | 3.00000N | 12.00000N | 1.00000P | 4.00000O |
| TRICARBON DIOXIDE | -328.970 | .04025 | 3.00000C | 2.00000O | .00000 | .00000 |
| TRICHLOROETHYLENE | -79.933 | .05214 | 2.00000C | 1.00000N | 3.00000CL | .00000 |
| TRICYANOTRIAZIDE-(S) | 922.474 | .03613 | 6.00000C | 6.00000N | .00000 | .00000 |
| TRICYANOTRIAZINE | 1006.000 | .05020 | 6.00000C | 6.00000N | .00000 | .00000 |
| 5-TRICHLMETETH(TCMT) | 224.120 | .04336 | 2.00000C | 1.00000N | 4.00000N | 3.00000CL |
| TRIETHANOL AMINE | -1065.000 | .04061 | 6.00000C | 15.00000N | 1.00000N | 3.00000O |
| 786 TRIETHYL CITRATE | -1291.100 | .04119 | 12.00000C | 20.00000N | 7.00000O | .00000 |
| 5-TRIFLUOROMET(TFMT) | -608.430 | .05701 | 2.00000C | 1.00000N | 3.00000F | 4.00000N |
| TRIMETHYLAMMONIUMNIT | -678.000 | .04625 | 3.00000C | 10.00000N | 3.00000O | 2.00000N |
| TRIMETHYLHEXANE | -556.420 | .05062 | 9.00000C | 20.00000N | .00000 | .00000 |
| TRIMETHYLOLPROPANE | -1329.400 | .04336 | 6.00000C | 14.00000N | 3.00000O | .00000 |
| TRINITROACETONIT-(S) | 113.605 | .03613 | 2.00000C | 6.00000O | 4.00000N | .00001N |
| TRINITROASID BEN-(S) | 875.220 | .03613 | 6.00000C | 12.00000N | 6.00000O | .00001N |

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|---|---|---|---|---|---|---|---|
| 79 | 1,3,5-TRINITROBENZEN | -48.801 | .06099 | 6.00000C | 3.00000N | 6.000000 | 3.00C |
| | TRINITROTOLUENE | -77.576 | .05975 | 7.00000C | 5.00000N | 6.000000 | .00C |
| | TRINITROTRIAZINE-(S) | 74.050 | .03613 | 3.00000C | 6.000000 | 6.00000N | .00 |
| | TRINITROAZID BEN-(S) | 875.220 | .03613 | 6.00000C | 12.00000N | 6.000000 | .000 |
| | TRIS(FDE)CARBAMATE | -568.310 | .06828 | 7.00000C | 6.00000N | 14.000000 | 7.000 |
| | TRIETHYL AMINE | -301.610 | .02634 | 6.00000C | 15.00000N | 1.00000N | .000 |
| | 50(TRITA+50(XYLIDINE | -235.370 | .03009 | 6.26560C | 11.95100N | .96073N | .000 |
| | TVDPA | -431.490 | .05708 | 9.00000C | 14.00000N | 3.000000 | 6.000 |
| | TWEEN-21 POLETHSORMO | -1132.100 | .03866 | 4.99800C | 10.33700N | 1.850000 | .000 |
| 80 | UDMH | 211.307 | .02833 | 2.00000C | 8.00000N | 2.00000N | .000 |
| | U4-UNBURNED ALUMINUM | .000 | .09755 | 1.00000U4 | .00000 | .00000 | .000 |
| | UNIQUE | -525.000 | .05893 | 1.92240C | 2.59440N | 3.714000 | 1.061 |
| | URANIUM | .000 | .68286 | 1.00000U | .00000 | .00000 | .000 |
| | UREA | -1325.900 | .04823 | 1.00000C | 4.00000N | 1.000000 | 2.000 |
| | UTREX 1277 | -450.200 | .03252 | 7.00000C | 13.48200N | .141000 | .000 |
| | UV-M-35 | -102.740 | .04206 | 18.00000C | 15.00000N | 2.000000 | 1.000 |
| | VANOX -13 | -398.500 | .03613 | 6.14320C | 11.53800N | .611300 | .155 |
| | VANOX-200 | -259.300 | .03613 | 5.91920C | 6.85520N | .801300 | .192 |
| | VITON A | -1800.800 | .06503 | 5.00000C | 3.50000N | 6.50000F | .000 |
| 81 | VMO EXPERIMENTAL | -137.900 | .06739 | 2.43210N | 1.22920C | 1.67510N | 2.425 |
| | W | .000 | .69731 | 1.00000W | .00000 | .00000 | .000 |
| | WATER - H20 | -3792.000 | .03613 | 2.00000H | 1.000000 | .00000 | .000 |
| | XTX-8003 EXPLOSIVE | -390.200 | .05622 | 1.80000C | 3.64000N | 1.01000N | 3.310 |
| | XYLIDINE | -169.170 | .03512 | 8.00000C | 11.00000N | 1.00000N | .000 |
| | M-XYLENE | -52.685 | .03132 | 8.00000C | 10.00000N | .00000 | .000 |
| | ZINC | .000 | .25797 | 1.00000ZN | .00000 | .00000 | .000 |
| | ZINC CHLORIDE | -729.330 | .10514 | 2.00000CL | 1.00000ZN | .00000 | .000 |
| | ZINC OXIDE | -1021.900 | .19763 | 1.00000ZN | 1.000000 | .00000 | .000 |
| | ZIRCONIUM | .000 | .23123 | 1.00000ZR | .00000 | .00000 | .000 |
| 82 | ZIRCONIUMHYDRIDE | -444.000 | .20486 | 1.00000ZR | 2.00000H | .00000 | .000 |
| 83 | ZRAA | -1459.600 | .05112 | 4.10120C | 5.74170N | 1.640500 | .205 |

| | | | | | |
|---|---|---|---|---|---|
| | XTX-8003 EXPLOSIVE | -390.200 | .05622 | 1.80000C | 3.64000H |
| | 1.01000N | | | | |
| | XYLIDINE | -169.170 | .03512 | 8.00000C | 11.00000H |
| | 1.00000N | | | | |
| | M-XYLENE | -52.685 | .03132 | 8.00000C | 10.00000H |
| | .00000 | | | | |
| | ZINC | .000 | .25797 | 1.00000ZN | .00000 |
| | .00000 | | | | |
| | ZINC CHLORIDE | -729.330 | .10514 | 2.00000CL | 1.00000ZN |
| | .00000 | | | | |
| | ZINC OXIDE | -1021.900 | .19763 | 1.00000ZN | 1.00000O |
| | .00000 | | | | |
| | ZIRCONIUM | .000 | .23123 | 1.00000ZR | .00000 |
| | .00000 | | | | |
| Old List | ZIRCONIUMHYDRIDE | -444.000 | .20486 | 1.00000ZR | 2.00000H |
| | .00000 | | | | |
| 823 | ZRAA | -1459.600 | .05112 | 4.10120C | 5.74170H |
| | 1.64050O | | | | |
| | ACETAMIDE | -1310.000 | .03600 | 2.00000C | 5.00000H |
| | 1.00000O | | | | |
| New | ACETYL TRIETHYL CITR | -1257.000 | .04080 | 22.00000H | 14.00000C |
| | 8.00000O | | | | |
| | ACETYLENE (GASEOUS)* | 2081.000 | .00000 | 2.00000H | 2.00000C |
| | .00000 | | | | |
| | ACETYLENE | 1846.000 | .02630 | 2.00000C | 2.00000H |
| | .00000 | | | | |
| | ACETYLENE | 1892.000 | .02200 | 2.00000C | 2.00000H |
| | .00000 | | | | |
| | ACRYLIC ACID | -1282.000 | .03840 | 4.00000H | 3.00000C |
| | 2.00000O | | | | |
| | ACRYLIC NITRILE | 682.000 | .00000 | 3.00000C | 3.00000H |
| | 1.00000N | | | | |
| | ADIPIC ACID | -1480.000 | .00000 | 4.00000O | .00000 |
| | .00000 | | | | |
| | AIR (DRY AT SEA LEVE | .000 | .00000 | 835.00000N | 224.00000O |
| | 5.00000AR | | | | |
| | AIR (500K OR 900R) | 49.000 | .00000 | 835.00000N | 224.00000O |
| | 5.00000AR | | | | |
| | AIR (1000R OR 555.5 | 63.000 | .00000 | 835.00000N | 224.00000O |
| | 5.00000AR | | | | |
| | AIR (750K OR 1350R) | 113.000 | .00000 | 835.00000N | 224.00000O |
| | 5.00000AR | | | | |
| | AIR (1500R OR 833.3 | 135.000 | .00000 | 835.00000N | 224.00000O |
| | 5.00000AR | | | | |
| | AIR (1000K OR 1800R | 180.000 | .00000 | 835.00000N | 224.00000O |
| | 5.00000AR | | | | |
| | AIR (2000R OR 1111. | 201.000 | .00000 | 835.00000N | 224.00000O |
| | 5.00000AR | | | | |
| | AIR (1250K OR 2250R | 249.000 | .00000 | 835.00000N | 224.00000O |
| | 5.00000AR | | | | |
| | ALUMINUM (PURE CRYST | .000 | .09760 | 1.00000AL | .00000 |
| | .00000 | | | | |
| | ALUMINUM DIBORIDE | -1632.000 | .11520 | 2.00000B | 1.00000AL |
| | .00000 | | | | |

Additional Compounds

Last # added to Library: ~~[illegible]~~ 842

| | | | | |
|---|---|---|---|---|
| ALUMINUM BERYLLIUM ( | .000 | .08740 | 1.00000BE | 1.00000AL |
| .00000 | | | | |
| ALUMINUM BERYLLIUM ( | .000 | .07950 | 3.00000BE | 1.00000AL |
| .00000 | | | | |
| ALUMINUM BORIDE | -314.000 | .09210 | 12.00000B | 1.00000AL |
| .00000 | | | | |
| ALUMINUM BORON (ALLO | -600.000 | .09780 | 12.00000B | 1.00000AL |
| .00000 | | | | |
| ALUMINUM BOROHYDRIDE | -301.000 | .01990 | 1.00000AL | 3.00000B |
| 12.00000H | | | | |
| ALUMINUM BOROHYDRIDE | -208.000 | .00000 | 1.00000AL | 3.00000B |
| 12.00000H | | | | |
| ALUMINUM CARBIDE | -215.000 | .08520 | 4.00000AL | 3.00000C |
| .00000 | | | | |
| ALUMINUM FLOURIDE | -844.000 | .00000 | 3.00000F | 1.00000AL |
| .00000 | | | | |
| ALUMINUM HYDRIDE | -92.000 | .05160 | 1.00000AL | 3.00000H |
| .00000 | | | | |
| ALUMINUM NITRIDE | -1407.000 | .11700 | 1.00000N | 1.00000AL |
| .00000 | | | | |
| ALUMINUM (NON-REACTI | .000 | .09760 | 1.00000U4 | .00000 |
| .00000 | | | | |
| ALUMINUM OXIDE | -4000.000 | .06700 | 2.00000AL | 3.00000O |
| .00000 | | | | |
| ALUMINUM PERCHLORATE | -614.000 | .09390 | 12.00000O | 1.00000AL |
| 3.00000CL | | | | |
| AMINE TERMINATED POL | 56.000 | .03600 | 6.00000H | 4.00000C |
| .00000 | | | | |
| AMINO TETROZOLE PERC | 204.000 | .06680 | 4.00000H | 1.00000C |
| 5.00000N | | | | |
| AMMONIUM ACETATE | -1820.000 | .04220 | 2.00000C | 7.00000H |
| 2.00000O | | | | |
| AMMONIUM BICARBONATE | -2580.000 | .05700 | 1.00000C | 5.00000H |
| 3.00000O | | | | |
| AMMONIUM CARBONATE | -2340.000 | .00000 | 1.00000C | 8.00000H |
| 2.00000N | | | | |
| AMMONIUM CHLORIDE | -1410.000 | .05510 | 1.00000N | 4.00000H |
| 1.00000CL | | | | |
| AMMONIUM CYANATE | -1245.000 | .04840 | 1.00000C | 4.00000H |
| 1.00000O | | | | |
| AMMONIUM CYANIDE | .000 | .00000 | 2.00000N | 4.00000H |
| 1.00000C | | | | |
| AMMONIUM FLOURIDE | -3000.000 | .03640 | 4.00000H | 1.00000N |
| 1.00000F | | | | |
| AMMONIUM FLOUROSILIC | -3530.000 | .07260 | 2.00000N | 8.00000H |
| 1.00000SI | | | | |
| AMMONIUM FORMATE | -2105.000 | .04620 | 1.00000C | 5.00000H |
| 2.00000O | | | | |
| AMMONIUM GLYCOLLATE | -1410.000 | .00000 | 2.00000C | 7.00000H |
| 3.00000O | | | | |
| AMMONIUM GLYOXALLATE | -2100.000 | .00000 | 2.00000C | 7.00000H |
| 4.00000O | | | | |
| AMMONIUM IODIDE | -336.000 | .00000 | 3.00000H | 1.00000N |
| 1.00000I | | | | |

| | | | | |
|---|---|---|---|---|
| AMMONIUM NITRATE | -1090.000 | .06230 | 4.00000H | 2.00000N |
| 3.000000 | | | | |
| AMMONIUM OXALATE | -2160.000 | .05420 | 8.00000H | 2.00000C |
| 2.00000N | | | | |
| AMMONIUM OXALATE | -2160.000 | .00000 | 2.00000C | 8.00000H |
| 4.000000 | | | | |
| AMMONIUM OXALATE (HY | -2400.000 | .05420 | 2.00000C | 10.00000H |
| 5.000000 | | | | |
| AMMONIUM PERCHLORATE | -602.000 | .07040 | 1.00000CL | 4.00000H |
| 1.00000N | | | | |
| AMMONIUM SULFATE | -2140.000 | .06390 | 2.00000N | 8.00000H |
| 1.00000S | | | | |
| AMMONIA TRIBORANE | -867.000 | .00000 | 3.00000B | 10.00000H |
| 1.00000N | | | | |
| AMMONIA | -1004.000 | .02440 | 3.00000H | 1.00000N |
| .00000 | | | | |
| AMMONIA (GASEOUS)* | -649.000 | .00000 | 3.00000H | 1.00000N |
| .00000 | | | | |
| AMMONIUM ALUMINUM PE | -514.000 | .07560 | 12.00000H | 3.00000N |
| 24.000000 | | | | |
| AMMONIUM AZIDE | 452.000 | .04860 | 4.00000H | 4.00000N |
| .00000 | | | | |
| AMMONIUM AZIDE | 452.000 | .04860 | 4.00000H | 4.00000N |
| .00000 | | | | |
| AMMONIUM BOROFLUORID | -2860.000 | .06680 | 4.00000H | 1.00000B |
| 1.00000N | | | | |
| AMMONIUM BROMIDE | -659.000 | .08780 | 4.00000H | 1.00000N |
| 1.00000BR | | | | |
| AMMONIUM DICHROMATE* | -1688.000 | .07760 | 8.00000H | 2.00000N |
| 7.000000 | | | | |
| AMMONIUM DICYANAMIDE | 121.000 | .00000 | 2.00000C | 4.00000H |
| 4.00000N | | | | |
| AMMONIUM FLOURIDE | -1287.000 | .00000 | 4.00000H | 1.00000N |
| 1.00000F | | | | |
| AMMONIUM FORMATE | -2108.000 | .00000 | 5.00000H | 1.00000C |
| 1.00000N | | | | |
| AMMONIUM IODIDE | -334.000 | .00000 | 4.00000H | 1.00000N |
| 1.00000I | | | | |
| AMMONIUM PERIODATE | -360.000 | .12700 | 4.00000H | 1.00000N |
| 4.000000 | | | | |
| 834 AMMONIUM PERCHLORATE | -590.000 | .07040 | ~~340~~ 4.00000H | ~~340~~ 4.000000 |
| ~~84.00000~~N 8 1.000Cl | | | | |
| AMMONIUM SULPHATE | -2133.000 | .06430 | 8.00000H | 2.00000N |
| 4.000000 | | | | |
| AMYL FERROCENE | -81.000 | .04220 | 20.00000H | 15.00000C |
| 1.00000FE | | | | |
| ANILINE | 79.000 | .03670 | 7.00000H | 6.00000C |
| 1.00000N | | | | |
| ARGON | .000 | .06440 | 1.00000AR | .00000 |
| .00000 | | | | |
| ASTROGELL | -436.000 | .05400 | 30.00000H | 15.00000C |
| 1.000000 | | | | |
| AZO"BIS"ISOBUTYRONIT | 333.000 | .00000 | 8.00000C | 12.00000H |
| 4.00000N | | | | |

837 Antimony Not in combustion products. Library

| | | | | | |
|---|---|---|---|---|---|
| 833 | Barium | 0.000 | .12650 | 1.00000BA | 0.00000 |
| | BARIUM CHOMATE | -1347.000 | .00000 | 1.00000CR | 4.00000O |
| | .00000 | | | | |
| | BARIUM NITRATE * | -907.000 | .11700 | 2.00000N | 6.00000O |
| | 1.00000BA | | | | |
| 831 | BARIUM PEROXIDE | -889.000 | .17910 | 1.00000BA | 2.00000O |
| | .00000 | | | | |
| | BASIC LEAD CARBONATE | .000 | .00000 | 3.00000PB | 2.00000C |
| | 8.00000O | | | | |
| | BENZENE | 143.000 | .03170 | 6.00000H | 6.00000C |
| | .00000 | | | | |
| | BERYLLIUM BOROHYDRID | -666.000 | .02180 | 2.00000B | 1.00000BE |
| | 8.00000H | | | | |
| | BERYLLIUM HYDRIDE | -399.000 | .00000 | 1.00000BE | 2.00000H |
| | .00000 | | | | |
| | BERYLLIUM NITRIDE | -2464.000 | .00000 | 3.00000BE | 2.00000N |
| | .00000 | | | | |
| | BERYLLIUM (NON-REACT | .000 | .06680 | 1.00000U2 | .00000 |
| | .00000 | | | | |
| | BERYLLIUM (PURE CRYS | .000 | .06680 | 1.00000BE | .00000 |
| | .00000 | | | | |
| | BIS TRIAMINOGUANIDIN | 180.000 | .00000 | 2.00000C | 28.00000H |
| | 10.00000B 1 | | | | |
| | BISDIFLUOROAMINOHEPT | -320.000 | .04260 | 7.00000C | 14.00000H |
| | 4.00000F | | | | |
| | BIS(CMETHYLHYDRAZINO | 100.000 | .04040 | 4.00000C | 26.00000H |
| | 10.00000B | | | | |
| | BIS(DIFLUOROAMINO)BU | -353.000 | .04370 | 4.00000C | 8.00000H |
| | 4.00000F | | | | |
| | BIS(DIFLUOROAMINO)DI | -698.000 | .00000 | 1.00000C | 6.00000F |
| | 2.00000N | | | | |
| | BIS(DIFLUOROAMINO)ME | -309.000 | .00000 | 6.00000C | 12.00000H |
| | 4.00000F | | | | |
| | BIS(DINITROFLUORETHY | -559.000 | .05760 | 5.00000C | 6.00000H |
| | 2.00000F | | | | |
| | BIS(DINITROPROPYL)AC | -470.000 | .04850 | 8.00000C | 14.00000H |
| | 4.00000N 1 | | | | |
| | BIS(DINITROPROPYL)FO | -475.000 | .05160 | 7.00000C | 12.00000H |
| | 4.00000N 1 | | | | |
| | BIS(FLUOROXY)DIFLUOR | -1122.000 | .00000 | 1.00000C | 4.00000F |
| | 2.00000O | | | | |
| | BIS(TRINITROETHYL)NI | 13.000 | .07080 | 4.00000C | 4.00000H |
| | 8.00000N 1 | | | | |
| | BIS(DIFLUOROAMINO)BU | -348.000 | .04380 | 4.00000C | 8.00000H |
| | 4.00000F | | | | |
| | BIS(DIFLUOROAMINO)ME | -363.000 | .04150 | 6.00000C | 12.00000H |
| | 4.00000F | | | | |
| | BIS(DIFLUOROAMINO)OC | -347.000 | .03970 | 8.00000C | 16.00000H |
| | 4.00000F | | | | |
| | BIS(DINITRO) FLUOROP | -530.000 | .00000 | 3.00000C | 5.00000H |
| | 1.00000F | | | | |
| | BIS(DINITROPROPYL)AC | -485.000 | .04910 | 8.00000C | 14.00000H |
| | 4.00000N 1 | | | | |
| | BIS(DINITROPROPYL)FO | -457.000 | .05110 | 7.00000C | 12.00000H |
| | 4.00000N 1 | | | | |

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|---|---|---|---|---|---|
| BIS(FLUOROXY)DIFLUOR | -1159.000 | .04330 | 1.00000C | 4.00000F | 2.00000O |
| BIS(METHYLHYDRAZINO) | -470.000 | .00000 | 2.00000C | 24.00000H | 10.00000B |
| BORINE AMMONIATE | -1340.000 | .02640 | 1.00000B | 6.00000H | 1.00000N |
| BORON (PURE CRYSTALI | .000 | .08450 | 1.00000B | .00000 | .00000 |
| BORON (AMORPHOUS) | 37.000 | .08560 | 1.00000B | .00000 | .00000 |
| BORON CARBIDE | -221.000 | .09050 | 4.00000B | 1.00000C | .00000 |
| BORON NITRIDE | -2430.000 | .07950 | 1.00000B | 1.00000N | .00000 |
| BORON SLURRY | -425.000 | .05360 | 553.00000H | 880.99999B | 252.00000C 4 |
| BORON OXIDE | -4339.000 | .06560 | 2.00000B | 3.00000O | .00000 |
| BORON (TRONA) | -358.000 | .08450 | 67.00000B | 3.00000O | .00000 |
| BROMINE PENTAFLUORID | -627.000 | .08880 | 1.00000BR | 5.00000F | .00000 |
| BROMINE PENTAFLUORID | -586.000 | .00000 | 1.00000BR | 5.00000F | .00000 |
| BROMINE MONOFLUORIDE | -141.000 | .00000 | 1.00000BR | 1.00000F | .00000 |
| BROMINE TRIFLUORIDE | -530.000 | .10120 | 1.00000BR | 3.00000F | .00000 |
| BROMINE TRIFLUORIDE | -446.000 | .00000 | 1.00000BR | 3.00000F | .00000 |
| BTNEC | -430.000 | .06800 | 4.00000H | 5.00000C | 6.00000N 1 |
| BTNEN | 39.000 | .07040 | 4.00000H | 4.00000C | 8.00000N 1 |
| BUTAREZ (PHILLIPS IN | -21.000 | .03250 | 519.00000H | 347.00000C | 8.00000O |
| BUTANE(2,2-BISDIFLUO | -318.000 | .00000 | 4.00000C | 8.00000H | 4.00000F |
| BUTANE(2,3-BISDIFLUO | -348.000 | .00000 | 4.00000C | 8.00000H | 4.00000F |
| BUTAREZ (PHILLIPS IN | -21.000 | .03250 | 519.00000H | 347.00000C | 8.00000O |
| BUTYL SILANE | 357.000 | .00000 | 12.00000H | 4.00000C | 1.00000SI |
| BUTYLNITRAMINE (NORM | -264.000 | .03850 | 4.00000C | 10.00000H | 2.00000N |
| BUTYL RUBBER | -376.000 | .03320 | 8.00000H | 4.00000C | .00000 |
| CALCIUM BORIDE | -21.000 | .03250 | 519.00000H | 347.00000C | 8.00000O |
| CALCIUM CARBIDE | -234.000 | .08010 | 2.00000C | 1.00000CA | .00000 |
| CALCIUM CARBONATE (C | -2895.000 | .00000 | 1.00000C | 3.00000O | 1.00000CA |

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|---|---|---|---|---|---|
| 829 | CALCIUM CHLORIDE | -1710.000 | .07750 | 2.00000CL | 1.00000CA |
| | .00000 | | | | |
| | CALCIUM FLUORIDE | -3722.000 | .11490 | 2.00000F | 1.00000CA |
| | .00000 | | | | |
| | CALCIUM HYDRIDE | -1092.000 | .06140 | 2.00000H | 1.00000CA |
| | .00000 | | | | |
| | CALCIUM PEROXIDE | -2185.000 | .00000 | 1.00000CA | 2.00000O |
| | .00000 | | | | |
| | CALCIUM OXIDE (CAO) | -2710.000 | .00000 | 1.00000O | 1.00000CA |
| | .00000 | | | | |
| | CANDELILLA WAX | -453.000 | .03250 | 2.00000C | 4.00000H |
| | .00000 | | | | |
| 827 | CARBON BLACK | .000 | .06370 | 1.00000C | .00000 |
| | .00000 | | | | |
| | CARBON DIOXIDE | -2137.000 | .03980 | 1.00000C | 2.00000O |
| | .00000 | | | | |
| | CARBON DISULFIDE (WH | 276.000 | .04560 | 1.00000C | 2.00000S |
| | .00000 | | | | |
| | CARBON MONOXIDE | -943.000 | .57210 | 1.00000C | 1.00000O |
| | .00000 | | | | |
| | CARBON (GRAPHITE) | .000 | .08180 | 1.00000C | .00000 |
| | .00000 | | | | |
| | CARBON TETRACHLORIDE | -216.000 | .00000 | 1.00000CA | 4.00000CL |
| | .00000 | | | | |
| | CELLULOSE | -1417.000 | .04580 | 6.00000C | 10.00000H |
| | 5.00000O | | | | |
| | CELLULOSE ACETATE (2 | -1183.000 | .05390 | 149.00000H | 109.00000C |
| | 74.00000O | | | | |
| | CELLULOSE ACETATE (C | -1079.000 | .04480 | 149.00000H | 109.00000C |
| | 74.00000O | | | | |
| | CELLULOSE DINITRATE | -7144.000 | .05990 | 6.00000C | 8.00000H |
| | 2.00000N | | | | |
| | CELLULOSE TRINITRATE | -524.000 | .05990 | 6.00000C | 7.00000H |
| | 3.00000N 1 | | | | |
| | CELOGEN | -1001.000 | .00000 | 2.00000C | 4.00000H |
| | 2.00000O | | | | |
| | CERIUM | .000 | .24190 | 1.00000CE | .00000 |
| | .00000 | | | | |
| | CERIUM NITRIDE | -508.000 | .00000 | 1.00000CE | 1.00000N |
| | .00000 | | | | |
| | CESIUM | .000 | .06760 | 1.00000CS | .00000 |
| | .00000 | | | | |
| | CESIUM (PURE CRYSTA | .000 | .06760 | 1.00000CS | .00000 |
| | .00000 | | | | |
| 838 | CESIUM AZIDE | -12.000 | .00000 | 1.00000CS | 3.00000N |
| | .00000 | | | | |
| | CESIUM CARBONATE | -821.000 | .15210 | 1.00000C | 3.00000O |
| | 2.00000CS | | | | |
| | CESIUM HYDRIDE | 217.000 | .12310 | 1.00000CS | 1.00000H |
| | .00000 | | | | |
| | CESIUM PERCHLORATE | -447.000 | .12010 | 1.00000CS | 1.00000CL |
| | 4.00000O | | | | |
| | CESIUM TUNGSTEN FLUO | -1160.000 | .17700 | 6.00000F | 1.00000CS |
| | 1.00000W | | | | |

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|---|---|---|---|---|---|
| | 8C8H18F10N6O (FAPEMO | -273.000 | .00000 | 8.00000C | 8.00000H |
| | 18.00000F 1 | | | | |
| | 8C8H18F10N6O (FAPEMO | -240.000 | .00000 | 8.00000C | 8.00000H |
| | 18.00000F 1 | | | | |
| | 9C14H12F6N3O (TVOPA) | -385.000 | .00000 | 9.00000C | 14.00000H |
| | 12.00000F | | | | |
| | 9C14H12F6N3O(TVOPA) | -430.000 | .05540 | 9.00000C | 14.00000H |
| | 12.00000F | | | | |
| | CHLORINE TRIFLUORIDE | -480.000 | .06520 | 1.00000CL | 3.00000F |
| | .00000 | | | | |
| 828 | CHLORINE | -76.000 | .05360 | 2.00000CL | .00000 |
| | .00000 | | | | |
| | CHLORINE HEPTOXIDE | 300.000 | .00000 | 2.00000CL | 7.00000O |
| | .00000 | | | | |
| | CHLORINE MONOFLUORID | -222.000 | .00000 | 1.00000CL | 1.00000F |
| | .00000 | | | | |
| | CHLORINE PENTAFLUORI | -427.000 | .00000 | 1.00000CL | 5.00000F |
| | .00000 | | | | |
| | CHLORINE PENTAFLUORI | -464.000 | .06420 | 1.00000CL | 5.00000F |
| | .00000 | | | | |
| | CHLORINE TRIFLUORIDE | -410.000 | .00000 | 1.00000CL | 3.00000F |
| | .00000 | | | | |
| | CIRCO LIGHT PROCESS | -320.000 | .02500 | 32.00000H | 15.00000O |
| | .00000 | | | | |
| | CIRCO LIGHT PROCESS | -320.000 | .02500 | 32.00000H | 15.00000C |
| | .00000 | | | | |
| | COPPER CHLORIDE | -328.000 | .12700 | 2.00000CL | 2.00000CU |
| | .00000 | | | | |
| | COPPER OXIDE | -278.000 | .21600 | 1.00000O | 2.00000CU |
| | .00000 | | | | |
| | COPPER CHROMITE | .000 | .21500 | 3.00000O | 1.00000CU |
| | 1.00000CR | | | | |
| | COPPER HYDROXIDE | -1099.000 | .12160 | 2.00000H | 2.00000O |
| | 1.00000CU | | | | |
| | COPPER OXIDE (HYDRAT | -1099.000 | .12160 | 2.00000H | 2.00000O |
| | 1.00000CU | | | | |
| | CUPRIC OXIDE | -439.000 | .00000 | 1.00000CU | 1.00000O |
| | .00000 | | | | |
| | COPPER (PURE CRYSTAL | .000 | .32230 | 1.00000CU | .00000 |
| | .00000 | | | | |
| | CYANAMIDE | 219.000 | .00000 | 1.00000C | 2.00000H |
| | 2.00000N | | | | |
| | CYANOGAUNYL AZIDE | 881.000 | .00000 | 2.00000C | 2.00000H |
| | 6.00000N | | | | |
| | CYANOGEN (GASEOUS) | 1414.000 | .00000 | 2.00000C | 2.00000N |
| | .00000 | | | | |
| | CYCLOHEXYL AZIDE | 207.000 | .03560 | 6.00000C | 11.00000H |
| | 3.00000N | | | | |
| | CYCLOPENTYL AZIDE | 385.000 | .03530 | 5.00000C | 9.00000H |
| | 3.00000N | | | | |
| | CYCLOTETRAMETHYLENE | 61.000 | .06860 | 8.00000H | 4.00000C |
| | 8.00000N | | | | |
| | DECADIBORANE | .000 | .00790 | 6.00000H | 2.00000B |
| | .00000 | | | | |

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|---|---|---|---|---|---|
| DIMETHYLAMINE-BORANE | -516.000 | .00000 | 2.00000C | 10.00000H | 1.00000B |
| DINITRO TOLUENE | -8200.000 | .00000 | 6.00000H | 7.00000C | 2.00000N |
| DINITROPHENOXY ETHAN | -271.000 | .05650 | 98.00000H | 104.00000C | 26.00000N 7 |
| DINITROPROPYL ACRYLA | -514.000 | .04710 | 8.00000H | 6.00000C | 2.00000N |
| DIOCTYL ADIPATE | -733.000 | .03320 | 42.00000H | 22.00000C | 4.00000O |
| DIOCTYL AZELATE | -855.000 | .00000 | 48.00000H | 25.00000C | 4.00000O |
| DITRISDIFLUOROAMINOM | -203.000 | .06790 | 3.00000C | 2.00000H | 12.00000F |
| DODECAHYDRODECABORAT | -564.000 | .03610 | 10.00000B | 18.00000H | 2.00000N |
| DULCITOL | -1740.000 | .05300 | 6.00000C | 14.00000H | 6.00000O |
| DYNAMAR 732/740 | -1420.000 | .03760 | 969.99999H | 549.00000C | 11.00000N 14 |
| DYNAMAR HX-730 | -1200.000 | .04200 | 754.00000H | 445.00000C | 244.00000O |
| DYNAMAR HX-743 | -380.000 | .03600 | 942.00000H | 553.99999C | 80.00000N 8 |
| 1EA-5-85 (VICTOR) | -538.000 | 1.46300 | 378.00000H | 243.00000C | 102.00000N 8 |
| E107 (A MIXTURE) | -552.000 | .06040 | 441.00000H | 133.00000C | 52.00000N 23 |
| EPOXY 201 | -661.000 | .04040 | 24.00000H | 16.00000C | 4.00000O |
| EPON 828 | .000 | .00000 | 24.00000H | 21.00000C | 4.00000O |
| ERYTHRITOL TETRANITR | -395.000 | .00000 | 4.00000C | 6.00000H | 4.00000N 1 |
| ESTANE | -910.000 | .03790 | 987.00000H | 535.99999C | 12.00000N 14 |
| ESTANE B | -940.000 | .03760 | 55.00000H | 302.00000C | 1.00000N 1 |
| ETHANETHIOL | -258.000 | .00000 | 2.00000C | 6.00000H | 1.00000S |
| ETHANE(1,1-DINITRO) | -289.000 | .00000 | 2.00000C | 4.00000H | 2.00000N |
| ETHANE(1,1,1-TRINITR | -166.000 | .05520 | 2.00000C | 3.00000H | 3.00000N |
| ETHANE(1,2-BIS DIFLU | -356.000 | .00000 | 2.00000C | 4.00000H | 4.00000F |
| ETHANE(1,2-BIS DIFLU | -310.000 | .00000 | 2.00000C | 4.00000H | 4.00000F |
| ETHANE(1,2-DI TETRAZ | 639.000 | .00000 | 4.00000C | 6.00000H | 8.00000N |
| ETHYL CENTRALITE | -127.000 | .00000 | 17.00000C | 20.00000H | 2.00000N |
| ETHYLENE | 289.000 | .02050 | 2.00000C | 4.00000H | .00000 |

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|---|---|---|---|---|
| ETHYLENE CARBONATE | -1576.000 | .00000 | 3.00000C | 4.00000H |
| 3.00000O | | | | |
| ETHYLENE DIHYDRAZINE | 346.000 | .03960 | 12.00000H | 2.00000C |
| 4.00000N | | | | |
| ETHYLENE DINITRAMINE | -158.000 | .06320 | 2.00000C | 6.00000H |
| 4.00000N | | | | |
| ETHYLENEBIS(AMINOGUA | 496.000 | .00000 | 5.00000C | 16.00000H |
| 14.00000N | | | | |
| FAPETRIN | -318.000 | .00000 | 6.00000C | 8.00000H |
| 6.00000F | | | | |
| FAPETRIN | -268.000 | .00000 | 6.00000C | 8.00000H |
| 6.00000F | | | | |
| FERRIC OXIDE (ANHYDR | -1230.000 | .18180 | 3.00000O | 2.00000FE |
| .00000 | | | | |
| FERRIC OXIDE HEMATIT | -1235.000 | .18480 | 2.00000FE | 3.00000O |
| .00000 | | | | |
| FLOROX (CLF3O) | -371.000 | .06860 | 1.00000O | 3.00000F |
| 1.00000CL | | | | |
| FLUORINE | -82.000 | .05430 | 2.00000F | .00000 |
| .00000 | | | | |
| FLUORINE NITRATE | 31.000 | .00000 | 1.00000F | 1.00000N |
| 3.00000O | | | | |
| FLUORINE (LIQUID) | -76.000 | .05430 | 2.00000F | .00000 |
| .00000 | | | | |
| FLUORO"2,2"DINITROET | -741.000 | .00000 | .00000C | 3.00000H |
| 1.00000F | | | | |
| FLUOROETHANE(1,1-DIN | -488.000 | .00000 | 2.00000C | 3.00000H |
| 1.00000F | | | | |
| FLUOROTRINITROMETHID | -221.000 | .05730 | 1.00000C | 1.00000F |
| 3.00000N | | | | |
| FLUOROXYTRIFLUOROMET | -1769.000 | .00000 | 1.00000C | 4.00000F |
| 1.00000O | | | | |
| FORMAMIDE | -1370.000 | .04100 | 3.00000H | 1.00000C |
| 1.00000N | | | | |
| FREON 116 (ROGERS) | -2195.000 | .00000 | 2.00000C | 6.00000F |
| .00000 | | | | |
| GASOLINE (LIQUID) | -794.000 | .02570 | 46.00000H | 21.00000C |
| .00000 | | | | |
| GENPOL A-20 | -1110.000 | .00000 | 75.00000H | 554.99999C |
| 370.00000O | | | | |
| GILSINITE | -400.000 | .03840 | 865.99999H | 744.00000C |
| 6.00000N | | | | |
| GLUTAMIC ACID | -1610.000 | .05550 | 5.00000C | 9.00000H |
| 4.00000O | | | | |
| GUANIDINE | -288.000 | .00000 | 5.00000H | 1.00000C |
| 3.00000N | | | | |
| GUANADINE CARBONATE | -1290.000 | .00000 | 3.00000C | 10.00000H |
| 3.00000O | | | | |
| GUANIDINE NITRATE | -843.000 | .05030 | 6.00000H | 1.00000C |
| 4.00000N | | | | |
| GUANIDINIUMNITRAMINO | 141.000 | .00000 | 2.00000C | 7.00000H |
| 9.00000N | | | | |
| GUANYLAZIDE NITRATE | 26.000 | .00000 | 1.00000C | 4.00000H |
| 6.00000N | | | | |

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|---|---|---|---|---|---|
| H C BINDER (PAUL) | -102.000 | .00000 | 106.00000H | 71.00000C | 8.00000N |
| HEPTADYNE | -1127.000 | .02930 | 8.00000H | 7.00000C | .00000 |
| HEXANE | -464.000 | .02350 | 14.00000H | 6.00000C | .00000 |
| HEXACYANO"3"HEXENE | 860.000 | .04440 | 10.00000C | 6.00000H | 6.00000N |
| HEXACYANO"3"HEXYNE | 1045.000 | .04370 | 12.00000C | 4.00000H | 6.00000N |
| HEXACYANO"3,5"OCTADI | 1146.000 | .04660 | 14.00000C | 4.00000H | 6.00000N |
| HEXAKIS DIFLUOROAMIN | -315.000 | .05960 | 8.00000H | 12.00000F | 6.00000N |
| HEXANE (2,2,5 TRIMET | -537.000 | .02460 | 20.00000H | 9.00000C | .00000 |
| HEXANITROETHANE (HNE | 95.000 | .08120 | 2.00000C | 6.00000N | 12.00000O |
| HMX | 61.000 | .06860 | 4.00000C | 8.00000H | 8.00000N |
| HTPB (SINCLAIR) | 13.000 | .03320 | 103.00000H | 73.00000C | 1.00000O |
| HYCAR | -121.000 | .03390 | 139.00000H | 70.00000C | 1.00000O |
| HYDRATED AMMONIUM PH | -3010.000 | .00000 | 3.00000N | 18.00000H | 7.00000O |
| HYDROXYETHYL CELLULO | -1200.000 | .04840 | 35.00000H | 22.00000C | 14.00000O |
| HYDROXYL AMMONIUM NI | -908.000 | .00000 | 2.00000N | 3.00000H | 4.00000O |
| HYDROXYLAMMONIUMPERC | -497.000 | .07670 | 1.00000CL | 4.00000H | 1.00000N |
| HYDRAZINE NITRATE | -531.000 | .05950 | 5.00000H | 3.00000N | 3.00000O |
| HYDROXYL AMMONIUM NI | -908.000 | .00000 | 2.00000N | 3.00000H | 4.00000O |
| HYDRAZINE | 376.000 | .03640 | 4.00000H | 2.00000N | .00000 |
| HYDRAZINE AZIDE | 727.000 | .04700 | 5.00000H | 5.00000N | .00000 |
| HYDRAZINE CYANOFORMA | 579.000 | .04620 | 4.00000C | 5.00000H | 5.00000N |
| HYDRAZINE DIBORANE | -500.000 | .03390 | 2.00000B | 10.00000H | 2.00000N |
| HYDRAZINE HYDRATE (N | -2900.000 | .03780 | 6.00000H | 2.00000N | 1.00000O |
| HYDRAZINE NITROFORM | -95.000 | .06760 | 5.00000H | 1.00000C | 5.00000N |
| HYDRAZINE(1,1-METHYL | 339.000 | .03530 | 4.00000C | 9.00000H | 3.00000N |
| HYDRAZINE(2)BORANE(8 | -60.000 | .00000 | 8.00000B | 28.00000H | 4.00000N |
| HYDRAZINE(3)BORANE(1 | -108.000 | .00000 | 10.00000B | 24.00000H | 6.00000N |

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|---|---|---|---|---|
| HYDRAZINE(4)BORANE(1 | -92.000 | .00000 | 10.00000B | 28.00000H |
| 8.00000N | | | | |
| HYDRAZINE DIPERCHLOR | -309.000 | .07970 | 6.00000H | 2.00000N |
| 8.00000O | | | | |
| HYDRAZINIUM DIPERCHL | -296.000 | .03610 | 2.00000CL | 6.00000H |
| 2.00000N | | | | |
| HYDRAZINIUM NITROFOR | -94.000 | .06710 | 1.00000C | 5.00000H |
| 5.00000N | | | | |
| HYDRAZINIUM PERCHLOR | -320.000 | .07000 | 1.00000CL | 5.00000H |
| 2.00000N | | | | |
| HYDRAZOBISISOBUTYRON | 172.000 | .00000 | 8.00000C | 14.00000H |
| 4.00000N | | | | |
| HYDRAZOIC ACID (GASE | 1635.000 | .00000 | 1.00000H | 3.00000N |
| .00000 | | | | |
| HYDRAZOTETRAZOLE"5,5 | 804.000 | .00000 | 2.00000C | 4.00000H |
| 10.00000N | | | | |
| HYDROCARBON POLYMER | -339.000 | .03320 | 2.00000H | 1.00000C |
| .00000 | | | | |
| HYDROGEN (GASEOUS) | .000 | .00000 | 2.00000H | .00000 |
| .00000 | | | | |
| HYDROGEN AZIDE | 1460.000 | .03940 | 1.00000H | 3.00000N |
| .00000 | | | | |
| HYDROGEN AZIDE | 1630.000 | .00000 | 1.00000H | 3.00000N |
| .00000 | | | | |
| HYDROGEN CYANIDE (GA | 932.000 | .02480 | 1.00000H | 1.00000C |
| 1.00000N | | | | |
| HYDROGEN CYANIDE (LI | 1154.000 | .03250 | 1.00000H | 1.00000C |
| 1.00000N | | | | |
| HYDROGEN FLUORIDE | -3581.000 | .03570 | 1.00000H | 1.00000F |
| .00000 | | | | |
| HYDROGEN FREE RADICA | 52090.000 | .00000 | 1.00000H | .00000 |
| .00000 | | | | |
| HYDROGEN PEROXIDE (1 | -1319.000 | .05080 | 2.00000H | 2.00000O |
| .00000 | | | | |
| HYDROGEN PEROXIDE (5 | -1927.000 | .04300 | 850.00000H | 571.99999O |
| .00000 | | | | |
| HYDROGEN PEROXIDE (7 | -1684.000 | .04640 | 745.99999H | 579.00000O |
| .00000 | | | | |
| HYDROGEN PEROXIDE (9 | -1439.000 | .05010 | 641.99999H | 586.00000O |
| .00000 | | | | |
| HYDROGEN PEROXIDE (G | -958.000 | .00000 | 2.00000H | 2.00000O |
| .00000 | | | | |
| HYDROGEN SULFIDE | -141.000 | .07680 | 2.00000H | 1.00000S |
| .00000 | | | | |
| HYDROGEN (CRYOGENIC) | -1068.000 | .00260 | 2.00000H | .00000 |
| .00000 | | | | |
| HYDROXYETHYL METHACR | -1260.000 | .04200 | 10.00000H | 6.00000C |
| 3.00000O | | | | |
| HYDROXYL RADICAL | 591.000 | .00000 | 1.00000H | 1.00000O |
| .00000 | | | | |
| HYDROXYLAMINE | -793.000 | .00000 | 3.00000H | 1.00000N |
| 1.00000O | | | | |
| HYDROXYETHYL CELLULO | -1200.000 | .04840 | 35.00000H | 22.00000C |
| 14.00000O | | | | |

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| HYDROXYTERMINAT POLY | 13.000 | .03320 | 103.00000H | 73.00000C | 1.00000O |
| HYCAT (BENNETT) | 40.300 | .04410 | 36.00000H | 29.00000C | 2.00000FE |
| HYCAT (BENNETT) | 40.300 | .04410 | 36.00000H | 29.00000C | 2.00000FE |
| IDP (B. LEE) | -908.000 | .03120 | 38.00000H | 19.00000C | 2.00000O |
| IODIC ACID | -324.000 | .16710 | 1.00000H | 1.00000I | 3.00000O |
| IODINE | .000 | .17800 | 2.00000I | .00000 | .00000 |
| IODINE PENTAFLUORIDE | -928.000 | .11400 | 5.00000F | 1.00000I | .00000 |
| IODINE PENTOXIDE | -127.000 | .17320 | 5.00000O | 2.00000I | .00000 |
| IODINE TRICHLORIDE | -90.000 | .11250 | 1.00000I | 3.00000CL | .00000 |
| IODOFORM (CHI3) | -85.000 | .14430 | 1.00000H | 1.00000C | 3.00000I |
| IRON OXIDE | -1230.000 | .18400 | 3.00000O | 2.00000FE | .00000 |
| IRON OXIDE (YELLOW) | -1490.000 | .13180 | 2.00000H | 4.00000O | 2.00000FE |
| IRON | .000 | .28370 | 1.00000FE | .00000 | .00000 |
| ISO OCTANE | -470.000 | .00000 | 18.00000H | 8.00000C | .00000 |
| JP4 (LIQUID TURBOJET | -281.000 | .02540 | 17.00000H | 9.00000C | .00000 |
| JP5 (MONT STEVENS ST | -387.000 | .02960 | 19.00000H | 10.00000C | .00000 |
| KRATON | -1073.000 | .03400 | 4.00000H | 3.00000C | .00000 |
| KRATON STYRENE BUTAD | -1073.000 | .03400 | 4.00000H | 3.00000C | .00000 |
| KRATON (CO-POLYMER) | -100.000 | .03420 | 6.00000H | 4.00000C | .00000 |
| LAMINAC 4116 | -574.000 | .00000 | 554.99999H | 557.99999C | 171.00000O |
| LEAD ACETYL SALICYLA | -857.000 | .00000 | 14.00000H | 18.00000C | 8.00000O |
| LEAD OXIDE (MINIUM) | -262.000 | .32860 | 4.00000O | 3.00000PB | .00000 |
| LEAD BETA RECORCYLAT | .000 | .00000 | 21.00000H | 7.00000C | 7.00000O |
| LEAD OXIDE | -235.000 | .00000 | 1.00000PB | 1.00000O | .00000 |
| LEAD IODATE | -267.000 | .19130 | 1.00000PB | 2.00000I | 6.00000O |
| LEAD SALICYLATE | -84.000 | .03370 | 10.00000H | 14.00000C | 6.00000O |
| LEAD 2-ETHYL HEXOATE | .000 | .00000 | 34.00000H | 16.00000C | 4.00000O |

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| LEAD AZIDE | 397.000 | .00000 | 6.00000N | 1.00000PB |
| .00000 | | | | |
| LEAD IODATE | -267.000 | .19130 | 1.00000PB | 2.00000I |
| 6.00000O | | | | |
| LEAD OXIDE (LITHARGE | -235.000 | .34400 | 1.00000O | 1.00000PB |
| .00000 | | | | |
| LEAD OXIDE (MASSICOT | -235.000 | .28880 | 1.00000O | 1.00000PB |
| .00000 | | | | |
| LEAD DIOXIDE | -276.000 | .33840 | 2.00000O | 1.00000PB |
| .00000 | | | | |
| LEAD SALICYLATE | -84.000 | .03370 | 10.00000H | 14.00000C |
| 6.00000O | | | | |
| LEAD OXIDE (PLATTNER | -66.000 | .33840 | 2.00000O | 1.00000PB |
| .00000 | | | | |
| LITHIUM ALUMINUM HEX | -1417.000 | .04010 | 1.00000AL | 6.00000H |
| 3.00000LI | | | | |
| LITHIUM ALUMINUM PER | -645.000 | .08970 | 3.00000LI | 24.00000O |
| 1.00000AL | | | | |
| LITHIUM ALUMINUM TET | -690.000 | .03310 | 1.00000AL | 4.00000H |
| 1.00000LI | | | | |
| LITHIUM AMIDE* | -1894.000 | .03290 | 2.00000H | 1.00000LI |
| 1.00000N | | | | |
| LITHIUM AZIDE | 57.000 | .00000 | 1.00000LI | 3.00000N |
| .00000 | | | | |
| LITHIUM BERYLLIUM HY | -2968.000 | .00000 | 1.00000BE | 4.00000H |
| 2.00000LI | | | | |
| LITHIUM BOROHYDRIDE | -2131.000 | .02460 | 1.00000B | 4.00000H |
| 1.00000LI | | | | |
| LITHIUM CARBIDE | -375.000 | .05960 | 2.00000LI | 2.00000C |
| .00000 | | | | |
| LITHIUM CARBONATE | -3900.000 | .07620 | 2.00000LI | 1.00000C |
| 3.00000O | | | | |
| LITHIUM DICYANAMIDE | -120.000 | .00000 | 2.00000C | 1.00000LI |
| 3.00000N | | | | |
| LITHIUM FLUORIDE | -5620.000 | .09390 | 1.00000LI | 1.00000F |
| .00000 | | | | |
| LITHIUM HYDRIDE | -2726.000 | .02960 | 1.00000H | 1.00000LI |
| .00000 | | | | |
| LITHIUM HYDROXIDE | -4868.000 | .09170 | 1.00000H | 1.00000LI |
| 1.00000O | | | | |
| LITHIUM NITRATE | -1670.000 | .08590 | 1.00000LI | 1.00000N |
| 3.00000O | | | | |
| LITHIUM NITRIDE | -1355.000 | .04980 | 3.00000LI | 1.00000N |
| .00000 | | | | |
| LITHIUM PERCHLORATE | -854.000 | .08770 | 1.00000CL | 1.00000LI |
| 4.00000O | | | | |
| LITHIUM PERIODATE | -490.000 | .15200 | 1.00000LI | 4.00000O |
| 1.00000I | | | | |
| LITHIUM (PURE CRYSTA | .000 | .01930 | 1.00000LI | .00000 |
| .00000 | | | | |
| LP-33 | -696.000 | .04580 | 314.00000C | 655.00000H |
| 107.00000O 12 | | | | |
| LP-205 | -720.000 | .04080 | 416.00000C | 846.00000H |
| 85.00000O 8 | | | | |

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|---|---|---|---|---|---|
| 530 | MAGNESIUM (PURE CRYS | .000 | .06280 | 1.00000MG | .00000 |
| | .00000 | | | | |
| | MAGNESIUM ALUMINUM H | -365.000 | .03780 | 2.00000AL | 8.00000H |
| | 1.00000MG | | | | |
| | MAGNESIUM BORIDE | -478.000 | .09700 | 2.00000B | 1.00000MG |
| | .00000 | | | | |
| | MAGNESIUM CYANAMIDE | -937.000 | .00000 | 1.00000MG | 1.00000C |
| | 2.00000N | | | | |
| | MAGNESIUM FLUORIDE | -2862.000 | .10830 | 2.00000F | 1.00000MG |
| | .00000 | | | | |
| | MAGNESIUM HYDRIDE | -645.000 | .05240 | 2.00000H | 1.00000MG |
| | .00000 | | | | |
| | MAGNESIUM NITRATE | -1272.000 | .07310 | 1.00000MG | 2.00000N |
| | 6.000000 | | | | |
| | MAGNESIUM OXIDE | -3610.000 | .13000 | 1.00000O | 1.00000MG |
| | .00000 | | | | |
| | MAGNESIUM PERCHLORAT | -630.000 | .09390 | 8.00000O | 1.00000MG |
| | 2.00000CL | | | | |
| | MAGNESIUM (NON-REACT | .000 | .06280 | 1.00000U3 | .00000 |
| | .00000 | | | | |
| | MAGNESIUM OXIDE | -3567.000 | .12920 | 248.00000MG | 248.000000 |
| | .00000 | | | | |
| | N-AMYL ALCOHOL | -922.000 | .05090 | 5.00000C | 12.00000H |
| | 1.000000 | | | | |
| | MAPO (ARC) | -266.000 | .00000 | 18.00000H | 9.00000C |
| | 1.000000 | | | | |
| | N-BUTYL FERROCENE | 10.000 | .04300 | 18.00000H | 14.00000C |
| | 1.00000FE | | | | |
| | MERCURIC FLUORIDE | -398.000 | .32160 | 2.00000F | 1.00000HG |
| | .00000 | | | | |
| | MERCURIC OXIDE | -100.000 | .40230 | 1.00000O | 1.00000HG |
| | .00000 | | | | |
| | MERCUROUS AZIDE | 292.000 | .00000 | 2.00000HG | 6.00000N |
| | .00000 | | | | |
| | MERCURY (LIQUID) | .000 | .48730 | 1.00000HG | .00000 |
| | .00000 | | | | |
| | METHANE | -1271.000 | .01530 | 1.00000C | 4.00000H |
| | .00000 | | | | |
| | METHANE* | -1118.000 | .00000 | 4.00000H | 1.00000C |
| | .00000 | | | | |
| | METHANOL | -1780.000 | .02870 | 4.00000H | 1.00000C |
| | 1.000000 | | | | |
| | METHOXYAMINE | -276.000 | .00000 | 1.00000C | 5.00000H |
| | 1.00000N | | | | |
| | METHYL ACRYLATE (LIQ | -954.000 | .03840 | 6.00000H | 4.00000C |
| | 2.000000 | | | | |
| | METHYL ALCOHOL | -1781.000 | .02850 | 4.00000H | 1.00000C |
| | 1.000000 | | | | |
| | METHYL AMMONIA | -216.000 | .02360 | 5.00000H | 1.00000C |
| | 1.00000N | | | | |
| | METHYLNITROACETATE | -922.000 | .00000 | 3.00000C | 5.00000H |
| | 1.00000N | | | | |
| | MIXED HYDRAZINE FUEL | 149.000 | .03610 | 114.00000H | 12.00000C |
| | 46.00000N | | | | |

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|---|---|---|---|---|---|
| MIXED HYDRAZINE FUEL | 297.000 | .03230 | 646.99999H | 93.00000C | 231.00000N |
| MIXED OXIDES OF NITR | 43.000 | .05200 | 63.00000N | 101.00000O | .00000 |
| MON 25"75 | 69.000 | .04980 | 17.000005N | 325.00000O | .00000 |
| MONOBASIC AMMONIUM P | -3020.000 | .06510 | 1.00000N | 6.00000H | 1.00000P |
| MONOBASIC CUPRIC SAL | -700.000 | .00000 | 14.00000C | 10.00000H | 7.00000O |
| MONOBASIC LEAD SALIC | -332.000 | .00000 | 14.00000C | 10.00000H | 9.00000O |
| MONOBASIC CUPRIC RES | -2782.000 | .00000 | 14.00000C | 10.00000H | 9.00000O |
| MONOBASIC LEAD RESOR | -1900.000 | .00000 | 14.00000C | 10.00000H | 9.00000O |
| MONOMETHYL HYDRAZINE | 276.000 | .03160 | 6.00000H | 1.00000C | 2.00000N |
| N P AMINE | -1287.000 | .03290 | 7.00000H | 6.00000C | 1.00000N |
| NF4BF4 | -1640.000 | .08530 | 1.00000B | 1.00000N | 8.00000F |
| NICKEL | .000 | .32150 | 1.00000NI | .00000 | .00000 |
| NICKEL OXIDE | -773.000 | .00000 | 1.00000O | 1.00000NI | .00000 |
| NICKEL CARBIDE | 58.000 | .28720 | 3.00000NI | 1.00000C | .00000 |
| NICKEL CHLORIDE | -580.000 | .12800 | 2.00000CL | 1.00000NI | .00000 |
| NITROGEN | -104.000 | .02920 | 2.00000N | .00000 | .00000 |
| NITROGEN TETROXIDE ( | .000 | .05170 | 2.00000N | 4.00000O | .00000 |
| NITRATE | -932.000 | .00000 | 5.00000H | 3.00000N | 3.00000O |
| NITRIC ACID (GAS) | -509.000 | .00000 | 1.00000H | 1.00000N | 3.00000O |
| NITROAMINOGUANIDINE | 45.000 | .00000 | 1.00000C | 5.00000H | 5.00000N |
| NITROETHANE | -442.000 | .03760 | .00000C | 5.00000H | 1.00000N |
| NITROGEN PENTOXIDE | -93.000 | .05930 | 2.00000N | 5.00000O | .00000 |
| NITROGEN TETROXIDE ( | 24.000 | .00000 | 2.00000N | 4.00000O | .00000 |
| NITROGEN TRIFLUORIDE | -416.000 | .00000 | 3.00000F | 1.00000N | .00000 |
| NITROGEN TRIFLUORIDE | -480.000 | .05620 | 3.00000F | 1.00000N | .00000 |
| NITROGUANYL AZIDE | 548.000 | .00000 | 1.00000C | 2.00000H | 6.00000N |
| NITROMETHANE | -443.000 | .00000 | 1.00000C | 3.00000H | 1.00000N |

| | | | | |
|---|---|---|---|---|
| NITRONITRAMINOPYRIDI | 7.000 | .06500 | 5.00000C | 5.00000H |
| 1.00000CL | | | | |
| NITRONIUM ALUMINUM P | -160.000 | .00000 | 1.00000AL | 6.00000CL |
| 3.00000N 3 | | | | |
| NITRONIUM PERCHLORAT | 61.000 | .07940 | 1.00000CL | 1.00000N |
| 6.00000O | | | | |
| NITROPROPENE POLYMER | -353.000 | .00000 | 3.00000C | 5.00000H |
| 1.00000N | | | | |
| NITROSOAMINE(N,N-DIM | 16.000 | .00360 | .00000C | 6.00000H |
| 2.00000N | | | | |
| NITROSOL BINDER | -476.000 | .05150 | 143.00000H | 105.00000C |
| 46.00000N 16 | | | | |
| NITROSYL FLUORIDE | -324.000 | .00000 | 1.00000F | 1.00000N |
| 1.00000O | | | | |
| NITROSYL PERCHLORATE | -284.000 | .07830 | 1.00000CL | 1.00000N |
| 5.00000O | | | | |
| NITROSYLTETRAFLUOROC | -489.000 | .10290 | 1.00000CL | 4.00000F |
| 1.00000N | | | | |
| NITROUREA | -611.000 | .00000 | 1.00000C | 3.00000H |
| 3.00000N | | | | |
| NITRYL FLUORIDE | -290.000 | .00000 | 1.00000F | 1.00000N |
| 2.00000O | | | | |
| NITRYLTETRAFLUOROCHL | -305.000 | .00000 | 1.00000CL | 4.00000F |
| 1.00000N | | | | |
| NITRIC ACID (LIQ) | -658.000 | .05420 | 1.00000H | 1.00000N |
| 3.00000O | | | | |
| 824 NITROGUANIDINE | -209.000 | .00000 | 1.00000C | 4.00000H |
| 4.00000N 2.00000O | | | | |
| N-PHENYLMORPHOLINE | -123.000 | .04090 | 13.00000H | 10.00000C |
| 1.00000N | | | | |
| NORMAL HEPTANE | -448.000 | .00000 | 16.00000H | 7.00000C |
| .00000 | | | | |
| N,N-DINITRO-N-BUTYLA | -13.000 | .04330 | 4.00000C | 9.00000H |
| 3.00000N | | | | |
| O2/H2 (O/F =10.605 | .000 | .00000 | 888.99999H | 593.99999O |
| .00000 | | | | |
| O2/H2 (O/F =10.605 | .000 | .00000 | 888.99999H | 593.99999O |
| .00000 | | | | |
| OCTANE | -470.000 | .00000 | 18.00000H | 8.00000C |
| .00000 | | | | |
| OLEIC ACID (VEGETABL | -723.000 | .03230 | 34.00000H | 18.00000C |
| 2.00000O | | | | |
| OTTO FUEL 2 | -696.000 | .00000 | 998.99999H | 430.00000C |
| 2.00000N 50 | | | | |
| OXAMID (B. LEE) | -1376.000 | .06020 | 4.00000H | 2.00000C |
| 2.00000N | | | | |
| OXYCHLORINE TRIFLUOR | -371.000 | .06860 | 1.00000O | 3.00000F |
| 1.00000CL | | | | |
| OXYCHLORINE TRIFLUOR | -360.000 | .06690 | 1.00000O | 3.00000F |
| 1.00000CL | | | | |
| OXYGEN (GAS) | .000 | .00000 | 2.00000O | .00000 |
| .00000 | | | | |
| OXYGEN DIFLUORIDE | -155.000 | .05490 | 2.00000F | 1.00000O |
| .00000 | | | | |

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|---|---|---|---|---|---|
| | OXYGEN DIFLUORIDE | -81.000 | .00000 | 2.00000F | 1.00000O |
| | .00000 | | | | |
| | OXYGEN (LIQUID) | -97.000 | .04120 | 2.00000O | .00000 |
| | .00000 | | | | |
| | OZONE | 631.000 | .05230 | 3.00000O | .00000 |
| | .00000 | | | | |
| | PENTABORANE (GASEOU | 237.000 | .02310 | 5.00000B | 9.00000H |
| | .00000 | | | | |
| | PENTABORANE (LIQUID | 122.000 | .00000 | 5.00000B | 9.00000H |
| | .00000 | | | | |
| | PENTAERITHRITOL | -1609.000 | .05230 | 5.00000C | 12.00000H |
| | 4.00000O | | | | |
| | PENTAERYTHRITOL TETR | -401.000 | .06400 | 5.00000C | 8.00000H |
| | 4.00000N 1 | | | | |
| | PENTAKIS(HYDRAZINE)D | 40.000 | .00000 | 10.00000B | 34.00000H |
| | 10.00000N | | | | |
| 840 | PERCHLORIC ACID (ANH | -110.000 | .06390 | 1.00000CL | 1.00000H |
| | 4.00000O | | | | |
| | PERCHLORYL FLUORIDE | -50.000 | .00000 | 1.00000CL | 1.00000F |
| | 3.00000O | | | | |
| | PERFLUORO METHACRYLA | -1800.000 | .06500 | 6.00000H | 8.00000C |
| | 2.00000O | | | | |
| | PERFLUOROFORMAMIDINE | -290.000 | .00000 | 1.00000C | 4.00000F |
| | 2.00000N | | | | |
| | PERFLUOROGUANIDINE ( | 127.000 | .00000 | 1.00000C | 5.00000F |
| | 3.00000N | | | | |
| | PERFLUOROGUANIDINE ( | 162.000 | .00000 | 1.00000C | 5.00000F |
| | 3.00000N | | | | |
| | PERFLUOROPIPERIDINE | -1728.000 | .06250 | 5.00000C | 11.00000F |
| | 1.00000N | | | | |
| | PERFLUOROPIPERIDINE | -1703.000 | .00000 | 5.00000C | 11.00000F |
| | 1.00000N | | | | |
| | PETRIN | -513.000 | .05570 | 9.00000H | 5.00000C |
| | 3.00000N 1 | | | | |
| | PHENOXY | 271.000 | .05650 | 98.00000H | 104.00000C |
| | 26.00000N 7 | | | | |
| | PHENYL AZIDE | 694.000 | .03930 | 6.00000C | 5.00000H |
| | 3.00000N | | | | |
| 835 | PHOSPHORUS (RED) | -136.000 | .07940 | 1.00000P | .00000 |
| | .00000 | | | | |
| | PLEXIGLASS | -906.000 | .04260 | 8.00000H | 5.00000C |
| | 2.00000O | | | | |
| | PNC | -586.000 | .05990 | 755.00000H | 600.00000C |
| | 245.00000N 99 | | | | |
| | POLYMETHYL VINYLTETR | 470.000 | .04620 | 6.00000H | 4.00000C |
| | 4.00000N | | | | |
| | POLYPROPYLEN GLYCOL | -855.000 | .00000 | 12.00000H | 6.00000C |
| | 2.00000O | | | | |
| | POLYETHYLENE | -453.000 | .03250 | 2.00000C | 4.00000H |
| | .00000 | | | | |
| | POLYURETHANE BINDER | -910.000 | .03790 | 987.00000H | 535.99999C |
| | 12.00000N 14 | | | | |
| | POLYACRYLAMIDE | -1590.000 | .00000 | 3.00000C | 5.00000H |
| | 1.00000N | | | | |

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|---|---|---|---|---|
| POLYACRYLONITRILE | 74.000 | .03980 | 3.00000H | 3.00000C |
| 1.00000N | | | | |
| POLYAMINE COMPOSITE | -316.000 | .03420 | 30.00000C | 105.00000H |
| 25.00000N | | | | |
| POLYBUTADIENE (SEE B | 55.000 | .03640 | 6.00000H | 4.00000C |
| .00000 | | | | |
| POLYBUTADIENE ACR A | -160.000 | .03300 | 998.99999H | 670.99999C |
| 19.00000N 1 | | | | |
| POLYTETRAFLUOROETHYL | -1952.000 | .08340 | 2.00000C | 4.00000F |
| .00000 | | | | |
| POLYETHYLENEHYDRAZIN | 4.000 | .00000 | 2.00000C | 6.00000H |
| 2.00000N | | | | |
| POLYPROPYLEN GLYCOL | -855.000 | .00000 | 12.00000H | 6.00000C |
| 2.000000 | | | | |
| POLYBUTADIENE ACRYLI | -84.000 | .03370 | 104.00000H | 70.00000C |
| 4.000000 | | | | |
| 825 POTASSIUM PERCHLORAT | -742.000 | .09100 | 1.00000CL | 1.00000K |
| 4.000000 | | | | |
| 841 POTASSIUM | .000 | .05000 | 1.00000K | .00000 |
| .00000 | | | | |
| POTASSIUM AMALGAM | -48.000 | .00000 | 1.00000K | 1.00000HG |
| .00000 | | | | |
| POTASSIUM AZIDE | -5.000 | .07360 | 1.00000K | 3.00000N |
| .00000 | | | | |
| POTASSIUM CARBONATE | -1495.000 | .08770 | 1.00000C | 3.000000 |
| 2.00000K | | | | |
| POTASSIUM CHLORIDE | -1397.000 | .07170 | 1.00000CL | 1.00000K |
| .00000 | | | | |
| POTASSIUM FERRICYNAN | -126.000 | .06840 | 3.00000K | 1.00000FE |
| 6.00000C | | | | |
| POTASSIUM HYDRIDE | -339.000 | .05160 | 1.00000K | 1.00000H |
| .00000 | | | | |
| POTASSIUM IODATE (KI | -568.000 | .14050 | 1.00000K | 1.00000I |
| 3.000000 | | | | |
| POTASSIUM NITRATE | -1167.000 | .07670 | 1.00000N | 3.000000 |
| 1.00000K | | | | |
| POTASSIUM PEROXIDE | -1071.000 | .00000 | 2.00000K | 2.000000 |
| .00000 | | | | |
| 836 POTASSIUM SULFATE | -1966.000 | .09620 | 4.00000O | 1.00000S |
| 2.00000K | | | | |
| POTASSIUM SULFIDE | -907.000 | .06520 | 2.00000K | 1.00000S |
| .00000 | | | | |
| PROPANE | -591.000 | .00000 | 8.00000H | 3.00000C |
| .00000 | | | | |
| PROPYL NITRATE | -514.000 | 4.29800 | 7.00000C | 3.00000C |
| 1.00000N | | | | |
| PROPANE(1,1-DINITRO) | -297.000 | .04550 | 3.00000C | 6.00000H |
| 2.00000N | | | | |
| PROPANE(1,1-DINITRO) | -186.000 | .00000 | 3.00000C | 6.00000H |
| 2.00000N | | | | |
| PROPANE(1,1,1-TRINIT | -157.000 | .00000 | 3.00000C | 5.00000H |
| 3.00000N | | | | |
| PROPANE(1,1,1,3-TETR | -172.000 | .00000 | 3.00000C | 4.00000H |
| 4.00000N | | | | |

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PROPANE(1,2-BIS DIFL  -349.000 .00000     3.00000C      6.00000H
   4.00000F
PROPANE(1,2-BIS DIFL  -294.000 .00000     3.00000C      6.00000H
   4.00000F
PROPANE(1,3-DINITRO)  -399.000 .04890     3.00000C      6.00000H
   2.00000N
PROPANE(2-NITRO)      -491.000 .03550     3.00000C      7.00000H
   1.00000N
PROPANE(2,2-DINITRO)  -338.000 .04690     3.00000C      6.00000H
   2.00000N
PROPYLENE POLY GLYCO -1000.000 .03790   102.00000H     54.00000C
  19.00000O
PROPANE(1-NITRO)      -448.000 .03580     3.00000C      7.00000H
   1.00000N
P-QUINONEDIOXIME      -700.000 .05050   434.00000C    434.00000H
 145.00000O    14
RDX(HEXAHYDROTRINITR    66.000 .00000     3.00000C      6.00000H
   6.00000N
RED FUMING NITRIC AC  -544.000 .05670    85.00000H    114.00000N
 314.00000O
RED FUMING NITRIC AC  -654.000 .05670   151.00000H    165.00000N
 471.00000O
RP-1                 -1340.000 .02890     2.00000H      1.00000C
    .00000
RESORCINOL            -784.000 .04630     6.00000H      6.00000C
   2.00000O
RUBIDIUM                 .000 .05530     1.00000RB      .00000
    .00000
SEA WATER            -3792.000 .03610   998.00000H    499.00000O
   3.00000NA
SILICON DIOXIDE (PUR -3418.000 .07590     2.00000O      1.00000SI
    .00000
SILICON TETRACHLORID  -901.000 .05350     1.00000SI     4.00000CL
    .00000
SILICON (PURE CRYSTA     .000 .08740     1.00000SI      .00000
    .00000
SILVER IODATE         -149.000 .20100     3.00000O      1.00000I
   1.00000AG
842 SILVER METAL         .000 .37910     1.00000AG      .00000
    .00000
SILVER NITRATE        -173.000 .15710     1.00000AG     1.00000N
    .00000
"S-06"               -1145.000 .05230   368.00000C    884.00000H
 295.00000O
"S-02"               -2397.000 .05420   141.00000C    704.00000H
 352.00000O    14
SODIUM ALUMINUM AMID -1520.000 .00000     1.00000AL     8.00000H
   4.00000N
SODIUM AZIDE            80.000 .06680     3.00000N      1.00000NA
    .00000
SODIUM BARBITURATE   -1393.000 .07930     3.00000H      4.00000C
   2.00000N
SODIUM BOROHYDRIDE   -1206.000 .03900     1.00000B      4.00000H
   1.00000NA
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|---|---|---|---|---|
| SODIUM CARBONATE | -821.000 | .09140 | 1.00000C | 3.00000O |
| 2.00000NA | | | | |
| SODIUM CHLORATE | -805.000 | .08990 | 1.00000NA | 1.00000CL |
| 3.00000O | | | | |
| SODIUM CHLORIDE | -1672.000 | .07820 | 1.00000NA | 1.00000CL |
| .00000 | | | | |
| SODIUM FLUORIDE | -3245.000 | .10080 | 1.00000F | 1.00000NA |
| .00000 | | | | |
| SODIUM HYDRIDE | -571.000 | .05040 | 1.00000NA | 1.00000H |
| .00000 | | | | |
| SODIUM IODATE (AQ - | -535.000 | .15440 | 1.00000NA | 1.00000I |
| 3.00000O | | | | |
| SODIUM PERCHLORATE | -750.000 | .00000 | 4.00000O | 1.00000NA |
| 1.00000CL | | | | |
| SODIUM PEROXIDE | -1546.000 | .10110 | 2.00000NA | 2.00000O |
| .00000 | | | | |
| SODIUM POTASSIUM LIQ | -43.000 | .00000 | 3.00000K | 1.00000NA |
| .00000 | | | | |
| SODIUM THIOCYANATE | -515.000 | .00000 | 1.00000NA | 1.00000C |
| 1.00000N | | | | |
| SODIUM (PURE CRYSTAL | .000 | .03500 | 1.00000NA | .00000 |
| .00000 | | | | |
| SPAN 85 | -685.000 | .05400 | 30.00000H | 15.00000C |
| 1.00000O | | | | |
| STYRENE | 80.000 | .03880 | 8.00000H | 8.00000C |
| .00000 | | | | |
| SUCCINIC ACID | -1900.000 | .05670 | 4.00000C | 6.00000H |
| 4.00000O | | | | |
| SULFUR | .000 | .07470 | 1.00000S | .00000 |
| .00000 | | | | |
| SULPHUR | .000 | .07300 | 1.00000S | .00000 |
| .00000 | | | | |
| SULFUR DIOXIDE | -1108.000 | .10570 | 1.00000S | 2.00000O |
| .00000 | | | | |
| SULFUR TRIOXIDE | -1307.000 | .09930 | 1.00000S | 3.00000O |
| .00000 | | | | |
| SULFUR (MONOCLINIC) | 2.000 | .07080 | 1.00000S | .00000 |
| .00000 | | | | |
| SULFURIC ACID | -1977.000 | .06620 | 2.00000H | 1.00000S |
| 4.00000O | | | | |
| 2"TDMECLO4 (INFO 635 | -345.000 | .06500 | 3.00000C | 7.00000H |
| 1.00000CL | | | | |
| 2"TDMEHCL (INFO 631C | -448.000 | .06500 | 3.00000C | 7.00000H |
| 1.00000CL | | | | |
| TETRAHYDRONAPTHALENE | -13.000 | .03540 | 12.00000H | 10.00000C |
| .00000 | | | | |
| TETRACYANOCYCLOPROPA | 1007.000 | .04950 | 7.00000C | 2.00000H |
| 4.00000N | | | | |
| TETRACYANOETHYLENE | 1174.000 | .04690 | 6.00000C | 4.00000H |
| .00000 | | | | |
| TETRAETHYLPENTAMINEP | -545.000 | .04700 | 28.00000H | 8.00000C |
| 5.00000N 2 | | | | |
| TETRAETHYL LEAD | 161.000 | .05990 | 20.00000H | 8.00000C |
| 1.00000PB | | | | |

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|---|---|---|---|---|
| TETRAFLUOROHYDRAZINE | -19.000 | .00000 | 4.00000F | 2.00000N |
| .00000 | | | | |
| TETRAKIS AMLY ACRYLA | -396.000 | .05300 | 8.00000C | 10.00000H |
| 8.00000F | | | | |
| TETRAKISDIFLUOROAMIN | 18.000 | .06310 | 1.00000C | 8.00000F |
| 4.00000N | | | | |
| TETRAKISDIFLUOROAMIN | 12.000 | .00000 | 1.00000C | 8.00000F |
| 4.00000N | | | | |
| TETRAKIS(DIFLUOROAMI | -266.000 | .05790 | 4.00000C | 4.00000H |
| 8.00000F | | | | |
| TETRAKIS(HYDRAZINE)D | -10.000 | .00000 | 10.00000B | 30.00000H |
| 8.00000N | | | | |
| TETRAMETHYL LEAD | 202.000 | .07210 | 12.00000H | 4.00000C |
| 1.00000PB | | | | |
| TETRAMETHYLAMINOTRIB | -293.000 | .00000 | 4.00000C | 20.00000H |
| 3.00000B | | | | |
| TETRAMETHYLTRICYCLOD | -145.000 | .03520 | 14.00000C | 26.00000H |
| 2.00000N | | | | |
| TETRANITRO DIFLUOROE | -368.000 | .00000 | 2.00000C | 2.00000F |
| 4.00000N | | | | |
| TETRANITROETHYLENEDI | 198.000 | .06320 | 2.00000C | 4.00000H |
| 6.00000N | | | | |
| TETRANITROMETHANE | 45.000 | .05920 | 1.00000C | 4.00000N |
| 8.00000O | | | | |
| TETRAZOLE | 809.000 | .00000 | 1.00000C | 2.00000H |
| 4.00000N | | | | |
| TETRAZOLE(2-METHYL-5 | 500.000 | .00000 | 2.00000C | 5.00000H |
| 5.00000N | | | | |
| TETRAZOLE(5-AMINO) | 585.000 | .05960 | 1.00000C | 3.00000H |
| 5.00000N | | | | |
| TETRAZOLE(5-CYANO) | 1010.000 | .00000 | 2.00000C | 1.00000H |
| 5.00000N | | | | |
| TETRAZOLE(5-HYDROXY) | -17.000 | .00000 | 1.00000C | 2.00000H |
| 4.00000N | | | | |
| TETRAZOLE(5,5-HYDRAZ | 800.000 | .00000 | 2.00000C | 4.00000H |
| 10.00000N | | | | |
| TIN (GREY) | .000 | .20760 | 1.00000SN | .00000 |
| .00000 | | | | |
| TITANIUM DIOXIDE | -2551.000 | .00000 | 1.00000TI | 2.00000O |
| .00000 | | | | |
| TITANIUM BORIDE | -1000.000 | .16260 | 2.00000B | 1.00000TI |
| .00000 | | | | |
| TITANIUM DIBORIDE | -973.000 | .16250 | 2.00000B | 1.00000TI |
| .00000 | | | | |
| TMETN | -415.000 | .05370 | 5.00000C | 9.00000H |
| 3.00000N | | | | |
| TOLUENE DIRSOCYANATE | -855.000 | .00000 | 6.00000H | 9.00000C |
| 2.00000N | | | | |
| TOLUENE DIAMINE | -16.000 | .04490 | 13.00000H | 7.00000C |
| 2.00000N | | | | |
| TRIACETIN | -1334.000 | .04190 | 14.00000H | 9.00000C |
| 6.00000O | | | | |
| TRIAMINOGUANIDINE | 553.000 | .05640 | 8.00000H | 1.00000C |
| 6.00000N | | | | |

| | | | | |
|---|---|---|---|---|
| TRIAMINOGUANIDINE NI | -69.000 | .05550 | 1.00000C | 9.00000H |
| 7.00000N | | | | |
| TRIAMINOGUANIDINE (T | 553.000 | .05630 | 1.00000C | 8.00000H |
| 6.00000N | | | | |
| TRIAMINOGUANIDINECYA | 603.000 | .05160 | 5.00000C | 9.00000H |
| 9.00000N | | | | |
| TRIAMINOGUANIDINEDIC | 591.000 | .05050 | 3.00000C | 9.00000H |
| 9.00000N | | | | |
| TRIAMINOGUANIDINIUM | 718.000 | .05200 | 1.00000C | 9.00000H |
| 9.00000N | | | | |
| TRIAMINOGUANIDINIUM | 329.000 | .00000 | 1.00000C | 17.00000H |
| 3.00000B | | | | |
| TRIAMINOGUANIDINIUM | 120.000 | .00000 | .00000C | 26.00000H |
| 10.00000B | | | | |
| TRIAMINOGUANIDINIUM | 131.000 | .00000 | .00000C | 23.00000H |
| 9.00000B | | | | |
| TRIAMINOMELAMINE | 550.000 | .05890 | 9.00000H | 3.00000C |
| 9.00000N | | | | |
| TRIAZOETHANOL"2 | 258.000 | .04150 | 2.00000C | 5.00000H |
| 3.00000N | | | | |
| TRICALCIUM PHOSPHATE | .000 | .00000 | 8.00000O | 3.00000CA |
| 2.00000PW | | | | |
| TRICYANO"3"BUTENE",1 | 846.000 | .04330 | 7.00000C | 5.00000H |
| 3.00000N | | | | |
| TRICYANO"3"BUTYNE"1, | 1128.000 | .04330 | 7.00000C | 3.00000H |
| 3.00000N | | | | |
| TRICYANOETHANE"1,1,1 | 807.000 | .04300 | 5.00000C | 3.00000H |
| 3.00000N | | | | |
| TRICYANOETHYLENE | 1019.000 | .04330 | 5.00000C | 1.00000H |
| 3.00000N | | | | |
| TRICYANOTRIAZINE"S | 1006.000 | .05020 | 6.00000C | 6.00000N |
| .00000 | | | | |
| TRICYCLODECYLINEDIAM | -173.000 | .03900 | 10.00000C | 18.00000H |
| 2.00000N | | | | |
| TRIETHYLAMINE | -667.000 | .00000 | 15.00000H | 6.00000C |
| 1.00000N | | | | |
| TRIETHYLENEGLYCOLDIN | -645.000 | .04870 | 12.00000H | 6.00000C |
| 2.00000N | | | | |
| TRIFLUOROAMINE OXIDE | -413.000 | .00000 | 3.00000F | 1.00000N |
| 1.00000O | | | | |
| TRIFLUOROMETHYL HYPO | -1733.000 | .00000 | 1.00000C | 4.00000F |
| 1.00000O | | | | |
| TRIMETHYLAMINEBORANE | -468.000 | .02960 | 3.00000C | 12.00000H |
| 1.00000B | | | | |
| TRIMETHYLENE ALANF | -285.000 | .00000 | 3.00000C | 12.00000H |
| 1.00000AL | | | | |
| TRIMETHYLOLETHANETRI | -397.000 | .05570 | 9.00000H | 5.00000C |
| 3.00000N | | | | |
| TRANS-DIMETHYL-AZOTE | 975.000 | .00000 | 4.00000C | 6.00000H |
| 10.00000N | | | | |
| TRINITRO"3"HYDROXYBU | -373.000 | .00000 | 4.00000C | 7.00000H |
| 3.00000N | | | | |
| TRINITROETHYL NITRAT | -138.000 | .05960 | 2.00000C | 2.00000H |
| 4.00000N | | | | |

| | | | | |
|---|---|---|---|---|
| TRINITROHYDROXYBUTYR | -678.000 | .00000 | 4.00000C | 5.00000H |
| 3.00000N | | | | |
| TRINITROMETHANE (NIT | -61.000 | .05760 | 1.00000C | 1.00000H |
| 3.00000N | | | | |
| TRIS(AMMONIA)DECABOR | -530.000 | .00000 | 10.00000B | 23.00000H |
| 3.00000N | | | | |
| TRIS(DIFLUOROAMINO)B | -273.000 | .04330 | 4.00000C | 7.00000H |
| 6.00000F | | | | |
| TRIS(DIFLUOROAMINO)F | -248.000 | .00000 | 1.00000C | 7.00000F |
| 3.00000N | | | | |
| TRISDIFLUOROAMINOFLU | -281.000 | .05630 | 1.00000C | 7.00000F |
| 3.00000N | | | | |
| TRIS(DIFLUORAMINO)PR | -411.000 | .05560 | 14.00000H | 9.00000C |
| 6.00000N | | | | |
| TURPENTINE | -118.000 | .02980 | 16.00000H | 10.00000C |
| .00000 | | | | |
| TUNGSTEN OXIDE | -831.000 | .00000 | 1.00000W | 3.00000O |
| .00000 | | | | |
| TUNGSTEN (PURE CRYST | .000 | .69690 | 1.00000W | .00000 |
| .00000 | | | | |
| UNSYM-DIFLUOROUREA ( | -705.000 | .00000 | 1.00000C | 2.00000H |
| 2.00000F | | | | |
| UNSYM-DIMETHYLHYDRAZ | 198.000 | .02830 | 2.00000C | 8.00000H |
| 2.00000N | | | | |
| URANIUM | .000 | .67510 | 1.00000U | .00000 |
| .00000 | | | | |
| URANIUM ALUMINUM (AL | -76.000 | .29390 | 2.00000AL | 1.00000U |
| .00000 | | | | |
| URANIUM ALUMINUM (AL | -105.000 | .24610 | 3.00000AL | 1.00000U |
| .00000 | | | | |
| URANIUM ALUMINUM (AL | -129.000 | .21630 | 4.00000AL | 1.00000U |
| .00000 | | | | |
| UREA OXALATE | -1740.000 | .00000 | 4.00000C | 10.00000H |
| 6.00000O | | | | |
| UREA | -1326.000 | .04820 | 1.00000C | 4.00000H |
| 1.00000O | | | | |
| VANADIUM OXIDE | -2488.000 | .00000 | 5.00000O | 2.00000V |
| .00000 | | | | |
| VITONA | -1801.000 | .06500 | 10.00000C | 7.00000H |
| 13.00000F | | | | |
| YELLOW IRON OXIDE | .000 | .00000 | 2.00000H | 4.00000O |
| 2.00000FE | | | | |
| ZIRCONIUM | .000 | .23110 | 1.00000ZR | .00000 |
| .00000 | | | | |
| ZIRCONIUM BORIDE | -634.000 | .21990 | 2.00000B | 1.00000ZR |
| .00000 | | | | |
| ZIRCONIUM CARBIDE | -436.000 | .24300 | 1.00000ZR | 1.00000C |
| .00000 | | | | |
| ZIRCONIUM DIBORIDE | -680.000 | .22000 | 2.00000B | 1.00000ZR |
| .00000 | | | | |
| ZIRCONIUM HYDRIDE | -444.000 | .20240 | 2.00000H | 1.00000ZR |
| .00000 | | | | |
| BLACK POWDER | -1448.9 | 0.0648 | 15.0000K | 15.0000N |
| 45.0000O | | | | |

| | | | | |
|---|---|---|---|---|
| DDNP<br>4.00000N | -956.000 | .05775 | 6.00000C | 5.000000 |
| 032 POTASSIUM CHLORATE<br>3.000000 | -763.300 | .08434 | 1.00000K | 1.00000CL |
| M1 PROP<br>2.5310C | -539. | 0.0567 | 3.3656O | 3.0655H |
| M5 PROP<br>2.0415C | -574. | .0596 | 3.6425O | 2.7480H |
| M8 PROP<br>1.8883C | -504.5 | .0581 | 3.7013O | 2.5694H |
| M9 PROP<br>1.8175C | -506. | .05780 | 3.7388O | 2.4901H |
| M15 PROP<br>2.5556O | -318. | 0.0600 | 3.5218H | 2.5792N |
| RDS-522<br>0.85C | -492. | 0.063 | 4.118H | 2.85O |
| M21 PROP<br>2.280C | -628. | 0.055 | 3.490O | 3.170H |
| AN583F<br>1.440C | -611. | 0.0595 | 4.379H | 2.912O |
| AN 584J<br>1.385C | -599. | 0.0606 | 4.341H | 2.930O |
| RDS 135<br>2.073N | -900. | 0.056 | 5.383H | 3.133O |
| ZINC NAPTHENATE<br>10.00000H | 0.000 | .0355 | 1.00000ZN | 14.00000C |

# POLU-11 OUTPUT FILES

M1

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M1, SINGLE-BASE PROPELLANT, HOWITZER

| | H | C | N | O | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 85.000 | -625. | .0600 |
| DINITROTOLUENE - DNT | .006 | .007 | .002 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 10.000 | -58. | .0419 |
| DIPHENYLAMINE - DPA | .011 | .012 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | 178. | .0419 |
| DIBUTYLPHTHALATE-DBP | .022 | .016 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 5.000 | -727. | .0378 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 101.000 1.0000

| (H ) | (C ) | (N ) | (O ) | ( |
|---|---|---|---|---|
| 3.145544 | 2.614908 | .880226 | 3.380714 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 101.000 | 90.900 | 80.800 | 70.700 | 60.600 | 50.500 | 40.400 | 30.300 | 20.200 | 10.100 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1838.054 | 1935.236 | 2038.480 | 2148.529 | 2266.462 | 2393.496 | 2528.927 | 2624.942 | 2135.340 | 1318.451 |
| FLAME TEMP. T(F) | 2849.097 | 3024.024 | 3209.864 | 3407.953 | 3620.231 | 3848.893 | 4092.668 | 4265.496 | 3384.212 | 1913.811 |
| ENTHALPY KCAL/GFW | -57.145 | -51.430 | -45.716 | -40.001 | -34.287 | -28.572 | -22.858 | -17.143 | -11.429 | -5.714 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 966.469 | 958.711 | 949.422 | 943.103 | 972.245 | 1029.976 | 1099.547 | 1180.820 | 874.881 | 465.420 |
| FLAME TEMP. T(F) | 1280.245 | 1266.280 | 1249.560 | 1238.185 | 1290.641 | 1394.556 | 1519.785 | 1666.076 | 1115.386 | 378.356 |
| ENTHALPY KCAL/GFW | -105.649 | -100.018 | -94.570 | -89.321 | -84.214 | -79.157 | -74.119 | -69.071 | -51.827 | -29.526 |
| T.VOL.GASES--LITERS | 100.805 | 107.782 | 116.493 | 128.010 | 144.203 | 165.333 | 196.614 | 248.723 | 373.670 | 759.750 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 45.1578 | 45.1677 | 44.9391 | 44.0383 | 40.5587 | 34.7095 | 25.0035 | 6.3594 | .0001 | .0003 |
| CO2 | 31.3967 | 34.2972 | 38.0953 | 43.1780 | 49.9238 | 59.3925 | 74.6563 | 103.9491 | 113.9387 | 113.9322 |
| N2 | 12.2060 | 20.8799 | 31.7224 | 45.6631 | 64.2518 | 90.2762 | 129.3118 | 194.3701 | 324.4851 | 714.8329 |
| H2O | 5.5546 | 5.7934 | 6.1057 | 6.7343 | 9.0635 | 12.9330 | 18.4683 | 26.1264 | 28.0515 | 28.0485 |
| C& | 2.6262 | 1.8384 | .9073 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| H2 | 2.3366 | 2.3125 | 2.2799 | 2.2409 | 2.0976 | 1.6904 | 1.0724 | .2155 | .0000 | .0000 |
| CH4 | .7189 | .7081 | .6982 | .5731 | .1070 | .0054 | .0001 | .0001 | .0001 | .0002 |
| NH3 | .0024 | .0030 | .0036 | .0039 | .0030 | .0015 | .0005 | .0001 | .0001 | .0002 |
| CNH | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | 29.5589 | 134.2679 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0018 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | C& | H2 | CH4 | NH3 | CNH | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 |
| HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | H | | | | | | | | | | |

M2

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M2, DOUBLE-BASE PROPELLANT, HOWITZER

| | H | C | N | O | K | BA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 77.450 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 19.500 | -392. | .0578 |
| BARIUM NITRATE | .000 | .000 | .002 | .006 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | 1.400 | -912. | .1171 |
| POTASSIUM NITRATE | .000 | .000 | .001 | .003 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .750 | -1165. | .0762 |
| ETHYL CENTRALITE-EC | .020 | .017 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .600 | -117. | .0451 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .300 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

1.0000

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000

| (H ) | (C ) | (N ) | (O ) | (K ) | (BA) | ( |
|---|---|---|---|---|---|---|
| 2.620729 | 2.026557 | .976806 | 3.644279 | .007418 | .005356 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2807.416 | 2829.688 | 2851.402 | 2869.960 | 2877.689 | 2848.634 | 2697.097 | 2293.921 | 1741.049 | 1084.199 |
| FLAME TEMP. T(F) | 4593.948 | 4634.039 | 4673.124 | 4706.528 | 4720.440 | 4668.141 | 4395.375 | 3669.658 | 2674.489 | 1492.158 |
| ENTHALPY KCAL/GFW | -58.264 | -52.438 | -46.611 | -40.785 | -34.959 | -29.132 | -23.306 | -17.479 | -11.653 | -5.826 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1303.597 | 1317.257 | 1331.962 | 1348.043 | 1366.243 | 1389.312 | 1304.518 | 982.657 | 671.899 | 366.928 |
| FLAME TEMP. T(F) | 1887.074 | 1911.662 | 1938.132 | 1967.077 | 1999.837 | 2041.361 | 1888.732 | 1309.383 | 750.018 | 201.071 |
| ENTHALPY KCAL/GFW | -121.723 | -114.851 | -107.989 | -101.140 | -94.294 | -87.389 | -77.478 | -61.339 | -43.834 | -25.086 |
| T.VOL.GASES--LITERS (GASES AT STP) | 86.054 | 93.071 | 101.842 | 113.121 | 128.157 | 149.206 | 183.633 | 248.627 | 378.601 | 768.537 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 37.9569 | 41.6593 | 46.4722 | 52.9517 | 62.0805 | 75.7449 | 89.1874 | 89.1862 | 89.1840 | 89.1772 |
| CO | 32.6072 | 30.2507 | 27.1874 | 23.0633 | 17.2531 | 8.5560 | .0001 | .0001 | .0001 | .0003 |
| N2 | 13.6829 | 22.4440 | 33.3954 | 47.4758 | 66.2497 | 92.5331 | 131.9462 | 197.6644 | 329.0835 | 723.3340 |
| H2O | 13.3960 | 14.5260 | 15.8627 | 17.4617 | 19.3931 | 21.7340 | 23.5388 | 23.5388 | 23.5379 | 23.5350 |
| H2 | 1.1362 | 1.0097 | .8600 | .6810 | .4648 | .2026 | .0000 | .0000 | .0000 | .0000 |
| BaO& | .8213 | .8213 | .8212 | .8212 | .8212 | .8211 | .8211 | .8209 | .8207 | .8199 |
| KHO | .3575 | .3590 | .3614 | .3651 | .3713 | .3833 | .4149 | .4145 | .0003 | .0006 |
| K | .0406 | .0395 | .0378 | .0351 | .0308 | .0223 | .0001 | .0001 | .0002 | .0004 |
| NH3 | .0002 | .0002 | .0001 | .0001 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| Ba | .0001 | .0002 | .0002 | .0002 | .0002 | .0003 | .0003 | .0005 | .0007 | .0014 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| KCN | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .4137 | .4111 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | 4.0617 | 21.6991 | 56.9534 | 162.7090 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0256 | .0047 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CH4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0010 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | CO | N2 | H2O | H2 | BaO& | KHO | K | NH3 | Ba | K2O& | KCN | C4H10 | C4H8 | KHO& |
| KHO& | KHO* | KO | O3 | NO2 | C3H8 | C3H6 | KH | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO |
| C2H4 | CNH | C2H2 | CH4 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& |
| H | | | | | | | | | | | | | | |

M

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M5, DOUBLE-BASE PROPELLANT, HOWITZER

| | H | C | N | O | K | BA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 81.950 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 15.000 | -392. | .0578 |
| BARIUM NITRATE | .000 | .000 | .002 | .006 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | 1.400 | -912. | .1171 |
| POTASSIUM NITRATE | .000 | .000 | .001 | .003 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .750 | -1165. | .0762 |
| ETHYL CENTRALITE-EC | .020 | .017 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .600 | -117. | .0451 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .300 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (K ) | (BA) | ( |
|---|---|---|---|---|---|---|
| 2.646379 | 2.066231 | .957835 | 3.629489 | .007418 | .005356 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2728.882 | 2758.803 | 2789.215 | 2818.277 | 2840.076 | 2832.431 | 2709.647 | 2319.136 | 1761.121 | 1095.853 |
| FLAME TEMP. T(F) | 4452.587 | 4506.445 | 4561.188 | 4613.499 | 4652.736 | 4638.977 | 4417.964 | 3715.045 | 2710.618 | 1513.135 |
| ENTHALPY KCAL/GFW | -59.310 | -53.379 | -47.448 | -41.517 | -35.586 | -29.655 | -23.724 | -17.793 | -11.862 | -5.931 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1253.165 | 1270.140 | 1288.337 | 1308.052 | 1329.915 | 1355.969 | 1327.191 | 998.367 | 682.062 | 371.792 |
| FLAME TEMP. T(F) | 1796.298 | 1826.852 | 1859.606 | 1895.093 | 1934.447 | 1981.344 | 1929.543 | 1337.660 | 768.312 | 209.826 |
| ENTHALPY KCAL/GFW | -121.265 | -114.441 | -107.628 | -100.829 | -94.041 | -87.224 | -78.491 | -62.194 | -44.444 | -25.412 |
| T.VOL.GASES--LITERS (GASES AT STP) | 87.017 | 94.034 | 102.806 | 114.085 | 129.121 | 150.171 | 183.398 | 248.392 | 378.366 | 768.302 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 37.6378 | 41.2123 | 45.8551 | 52.1173 | 60.9613 | 74.2458 | 90.9333 | 90.9324 | 90.9301 | 90.9233 |
| CO | 33.9215 | 31.6465 | 28.6915 | 24.7057 | 19.0767 | 10.6215 | .0002 | .0001 | .0001 | .0003 |
| N2 | 13.4171 | 22.1782 | 33.1296 | 47.2100 | 65.9839 | 92.2673 | 131.6819 | 197.3984 | 328.8177 | 723.0679 |
| H2O | 12.5433 | 13.7259 | 15.1325 | 16.8209 | 18.8693 | 21.3665 | 23.7698 | 23.7699 | 23.7689 | 23.7661 |
| H2 | 1.2573 | 1.1249 | .9675 | .7785 | .5492 | .2696 | .0000 | .0000 | .0000 | .0000 |
| BaO& | .8213 | .8213 | .8212 | .8212 | .8212 | .8211 | .8211 | .8209 | .8207 | .8199 |
| KHO | .3643 | .3650 | .3663 | .3688 | .3734 | .3829 | .4149 | .4145 | .0003 | .0006 |
| K | .0359 | .0354 | .0344 | .0326 | .0293 | .0226 | .0001 | .0001 | .0002 | .0004 |
| NH3 | .0002 | .0002 | .0002 | .0001 | .0001 | .0000 | .0000 | .0001 | .0001 | .0002 |
| Ba | .0001 | .0002 | .0002 | .0002 | .0002 | .0003 | .0003 | .0005 | .0007 | .0014 |
| KCN | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| CH4 | .0001 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .4111 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .4137 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | 2.3519 | 19.9874 | 55.2421 | 160.9976 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0224 | .0054 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0011 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | CO | N2 | H2O | H2 | BaO& | KHO | K | NH3 | Ba | KCN | K2O& | CH4 | C4H10 | C4H8 |
| KHO& | KHO& | KHO* | KO | O3 | NO2 | C3H8 | C3H6 | KH | HO2 | O2 | NHO | C2H6 | CH2O | NO |
| CHO | C2H4 | CNH | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& |
| H | | | | | | | | | | | | | | |

M6

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M6, SINGLE-BASE PROPELLANT, HOWITZER

| | H | C | N | O | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 87.000 | -625. | .0600 |
| DINITROTOLUENE - DNT | .006 | .007 | .002 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 10.000 | -58. | .0419 |
| DIPHENYLAMINE - DPA | .011 | .012 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | 178. | .0419 |
| DIBUTYLPHTHALATE-DBP | .022 | .016 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 3.000 | -727. | .0378 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 101.000 1.0000

| (H ) | (C ) | (N ) | (O ) | ( |
|---|---|---|---|---|
| 3.042905 | 2.543999 | .898215 | 3.424662 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 101.000 | 90.900 | 80.800 | 70.700 | 60.600 | 50.500 | 40.400 | 30.300 | 20.200 | 10.100 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1981.467 | 2068.670 | 2161.250 | 2259.951 | 2365.674 | 2479.050 | 2596.551 | 2627.682 | 2085.171 | 1287.915 |
| FLAME TEMP. T(F) | 3107.240 | 3264.207 | 3430.850 | 3608.511 | 3798.812 | 4002.890 | 4214.392 | 4270.428 | 3293.908 | 1858.847 |
| ENTHALPY KCAL/GFW | -56.941 | -51.247 | -45.553 | -39.859 | -34.165 | -28.471 | -22.776 | -17.082 | -11.388 | -5.694 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 966.691 | 958.360 | 953.538 | 975.187 | 1019.509 | 1076.447 | 1140.340 | 1219.196 | 847.651 | 452.143 |
| FLAME TEMP. T(F) | 1280.644 | 1265.647 | 1256.969 | 1295.936 | 1375.716 | 1478.204 | 1593.212 | 1735.152 | 1066.372 | 354.457 |
| ENTHALPY KCAL/GFW | -107.411 | -101.799 | -96.331 | -90.966 | -85.647 | -80.342 | -75.058 | -69.649 | -50.714 | -28.904 |
| T.VOL.GASES--LITERS | 98.421 | 105.388 | 114.402 | 126.666 | 141.942 | 162.830 | 194.099 | 246.207 | 373.788 | 759.868 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 45.7312 | 45.4890 | 44.7126 | 42.1511 | 38.1026 | 31.8710 | 21.6566 | 1.9620 | .0001 | .0003 |
| CO2 | 32.0629 | 35.1371 | 39.1017 | 44.2016 | 50.9410 | 60.7747 | 76.8253 | 107.7684 | 110.8489 | 110.8423 |
| N2 | 12.4556 | 21.1295 | 31.9721 | 45.9135 | 64.5023 | 90.5262 | 129.5614 | 194.6195 | 324.7348 | 715.0826 |
| H2O | 5.4243 | 5.6831 | 6.2113 | 7.8940 | 10.5943 | 14.4109 | 19.6291 | 26.6118 | 27.1361 | 27.1330 |
| H2 | 2.2606 | 2.2334 | 2.2038 | 2.1141 | 1.8468 | 1.4238 | .8402 | .0588 | .0000 | .0000 |
| C& | 1.3905 | .6608 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH4 | .6718 | .6645 | .5465 | .1545 | .0166 | .0009 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0023 | .0029 | .0033 | .0029 | .0019 | .0009 | .0003 | .0001 | .0001 | .0002 |
| CNH | .0001 | .0001 | .0001 | .0001 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | 33.3150 | 138.0236 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0013 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |

M6

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | C& | CH4 | NH3 | CNH | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 |
| HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | H | | | | | | | | | | |

M6+2

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M6+2, SINGLE-BASE PROPELLANT, HOWITZER

| | H | C | N | O | S | K | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 87.000 | -625. | .0600 |
| DINITROTOLUENE - DNT | .006 | .007 | .002 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 10.000 | -58. | .0419 |
| DIPHENYLAMINE - DPA | .011 | .012 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .900 | 178. | .0419 |
| DIBUTYLPHTHALATE-DBP | .022 | .016 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 3.000 | -727. | .0378 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | 2.000 | -1966. | .0962 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 102.900 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | ( |
|---|---|---|---|---|---|---|
| 3.036405 | 2.536908 | .897624 | 3.470568 | .011477 | .022953 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 102.900 | 92.610 | 82.320 | 72.030 | 61.740 | 51.450 | 41.160 | 30.870 | 20.580 | 10.290 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1947.280 | 2036.431 | 2131.023 | 2231.458 | 2337.835 | 2451.518 | 2573.309 | 2608.218 | 2062.358 | 1275.698 |
| FLAME TEMP. T(F) | 3045.704 | 3206.176 | 3376.442 | 3557.224 | 3748.702 | 3953.332 | 4172.556 | 4235.392 | 3252.844 | 1836.856 |
| ENTHALPY KCAL/GFW | -60.891 | -54.802 | -48.713 | -42.624 | -36.534 | -30.445 | -24.356 | -18.267 | -12.178 | -6.089 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 964.769 | 956.614 | 955.264 | 978.710 | 1020.830 | 1071.911 | 1137.259 | 1212.143 | 842.174 | 449.343 |
| FLAME TEMP. T(F) | 1277.184 | 1262.505 | 1260.075 | 1302.278 | 1378.093 | 1470.040 | 1587.666 | 1722.457 | 1056.514 | 349.417 |
| ENTHALPY KCAL/GFW | -110.798 | -104.831 | -99.010 | -93.288 | -87.613 | -81.961 | -76.329 | -70.531 | -51.124 | -29.129 |
| T.VOL.GASES--LITERS | 96.658 | 103.499 | 112.505 | 124.429 | 139.352 | 159.855 | 190.544 | 241.924 | 367.465 | 746.411 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 44.4558 | 44.2529 | 43.2936 | 40.6864 | 36.5595 | 30.2741 | 20.1776 | 1.3292 | .0001 | .0003 |
| CO2 | 32.2696 | 35.2735 | 39.1780 | 44.2158 | 50.9987 | 60.9087 | 76.7708 | 106.4106 | 108.4979 | 108.4906 |
| N2 | 12.2167 | 20.7304 | 31.3730 | 45.0571 | 63.3027 | 88.8464 | 127.1611 | 191.0177 | 318.7304 | 701.8704 |
| H2O | 5.3436 | 5.5859 | 6.2205 | 7.9072 | 10.5240 | 14.1778 | 19.2545 | 26.0136 | 26.3772 | 26.3743 |
| H2 | 2.1699 | 2.1447 | 2.1169 | 2.0145 | 1.7496 | 1.3448 | .7772 | .0402 | .0000 | .0000 |
| C& | 1.2521 | .5251 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| KHO* | 1.1115 | 1.1231 | 1.1154 | 1.0111 | .6523 | .0001 | .0001 | .0002 | 1.2225 | .0005 |
| CH4 | .6460 | .6381 | .4657 | .1228 | .0138 | .0008 | .0000 | .0001 | .0001 | .0002 |
| H2S | .3625 | .3624 | .3625 | .3626 | .3620 | .3606 | .3574 | .0167 | .0002 | .0003 |
| KHO | .1290 | .1183 | .1263 | .2262 | .5672 | 1.1852 | 1.1875 | 1.2303 | .0269 | .0005 |
| CSO | .0302 | .0304 | .0302 | .0298 | .0307 | .0329 | .0377 | .0023 | .0003 | .0006 |
| K | .0051 | .0043 | .0042 | .0076 | .0204 | .0450 | .0439 | .0138 | .0002 | .0004 |
| KCN | .0041 | .0043 | .0040 | .0034 | .0026 | .0011 | .0002 | .0002 | .0003 | .0006 |
| NH3 | .0022 | .0028 | .0031 | .0026 | .0017 | .0009 | .0003 | .0001 | .0001 | .0002 |
| CNH | .0001 | .0001 | .0001 | .0001 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0004 | .0007 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0003 | .0009 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .6764 | .7102 | .7058 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |

M6+2

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | 1.2467 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0004 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0004 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0004 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HS | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | 33.1520 | 135.9297 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0012 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | C& | KHO* | CH4 | H2S | KHO | CSO | K | KCN | NH3 | CNH |
| K2O& | S2O | SO3 | CS2 | S2 | SO2 | C4H10 | C4H8 | KHO& | KHO& | KO | SO | O3 | NS | NO2 |
| C3H8 | CS | C3H6 | KH | HS | HO2 | S | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 |
| H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | H | | | | |

M7

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M7 DOUBLE-BASE PROPELLANT, MORTAR (MIL-P-14737)

| | H | C | N | O | CL | K | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 54.600 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 35.500 | -392. | .0578 |
| ETHYL CENTRALITE-EC | .020 | .017 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .900 | -117. | .0451 |
| POTASSIUM PERCHLORAT | .000 | .000 | .000 | .004 | .001 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | 7.800 | -742. | .0910 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.200 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (CL) | (K ) | ( |
|---|---|---|---|---|---|---|
| 2.362026 | 1.828544 | .966756 | 3.619810 | .056295 | .056295 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 3093.920 | 3079.654 | 3058.615 | 3024.583 | 2963.621 | 2841.797 | 2586.661 | 2158.802 | 1628.620 | 1026.722 |
| FLAME TEMP. T(F) | 5109.656 | 5083.976 | 5046.106 | 4984.849 | 4875.117 | 4655.834 | 4196.589 | 3426.443 | 2472.116 | 1388.699 |
| ENTHALPY KCAL/GFW | -53.937 | -48.543 | -43.149 | -37.756 | -32.362 | -26.968 | -21.575 | -16.181 | -10.787 | -5.394 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1553.234 | 1550.059 | 1547.482 | 1546.314 | 1549.240 | 1498.663 | 1199.014 | 923.586 | 626.525 | 343.947 |
| FLAME TEMP. T(F) | 2336.422 | 2330.706 | 2326.067 | 2323.966 | 2329.233 | 2238.194 | 1698.825 | 1203.054 | 668.345 | 159.705 |
| ENTHALPY KCAL/GFW | -121.959 | -115.056 | -108.149 | -101.218 | -94.187 | -85.597 | -71.876 | -56.907 | -40.823 | -23.510 |
| T.VOL.GASES--LITERS (GASES AT STP) | 79.649 | 86.664 | 95.435 | 106.715 | 121.751 | 143.967 | 182.955 | 247.949 | 377.922 | 767.857 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 40.4088 | 44.8213 | 50.5165 | 58.1071 | 68.6607 | 80.4691 | 80.4725 | 80.4714 | 80.4693 | 80.4622 |
| CO | 25.5001 | 22.6917 | 19.0668 | 14.2356 | 7.5185 | .0027 | .0001 | .0001 | .0001 | .0003 |
| H2O | 15.7059 | 16.5451 | 17.5205 | 18.6647 | 20.0128 | 21.2465 | 21.2695 | 21.2748 | 21.2735 | 21.2698 |
| N2 | 13.5422 | 22.3033 | 33.2547 | 47.3351 | 66.1089 | 92.3736 | 131.8074 | 197.5242 | 328.9420 | 723.1917 |
| KCl | 4.0679 | 4.0671 | 4.0661 | 4.0646 | 4.0617 | 4.0866 | 3.1650 | .0134 | .0004 | .0007 |
| H2 | .6202 | .5263 | .4170 | .2889 | .1379 | .0000 | .0000 | .0000 | .0000 | .0000 |
| KHO | .0755 | .0776 | .0801 | .0837 | .0896 | .0819 | .0177 | .0000 | .0000 | .0002 |
| HCl | .0628 | .0632 | .0636 | .0643 | .0656 | .0529 | .0116 | -.0001 | .0004 | .0006 |
| K | .0148 | .0137 | .0124 | .0106 | .0079 | .0001 | .0001 | .0000 | .0000 | .0002 |
| CCl4 | .0002 | .0002 | .0002 | .0002 | .0003 | .0003 | .0003 | .0002 | .0000 | .0000 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| KCl& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | 4.1822 | 4.1945 | 4.1904 |
| KCl* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | 1.0068 | .0002 | .0004 | .0007 |
| Cl2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0000 | .0012 |
| KCN | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0000 | .0000 | .0003 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0000 | .0000 | .0002 |
| HO | .0001 | .0001 | .0001 | .0001 | .0002 | .0049 | .0003 | .0001 | .0001 | .0002 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NH4Cl& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| NH4Cl& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0000 | .0000 | .0001 |
| Cl | .0000 | .0000 | .0000 | .0001 | .0001 | .0004 | .0001 | .0000 | .0002 | .0000 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | 1.6380 | 12.2239 | 29.8596 | 65.1128 | 170.8683 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NH3 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0399 | .0212 | .0027 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | CO | H2O | N2 | KCl | H2 | KHO | HCl | K | CCl4 | K2O& | KCl& | KCl* | Cl2 | KCN |
| C4H10 | C4H8 | KHO& | KHO& | KHO* | KO | HO | NH4Cl& | NH4Cl& | O3 | NO2 | C3H8 | C3H6 | KH | Cl |
| H | HO2 | O2 | NHO | NH3 | C2H6 | CH2O | NO | CHO | C2H4 | CNH | C2H2 | H2O* | HO | CH4 |
| O | NH | CH2 | N | CH | C | C& | C& | | | | | | | |

M8

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M8 DOUBLE-BASE PROPELLANT, MORTAR (MIL-I-60016A)

| | H | C | N | O | K | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 52.150 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 43.000 | -392. | .0578 |
| ETHYL CENTRALITE-EC | .020 | .017 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .600 | -117. | .0451 |
| POTASSIUM NITRATE | .000 | .000 | .001 | .003 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.250 | -1165. | .0762 |
| DIETHYL PHTHALATE | .014 | .012 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 3.000 | -810. | .0406 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (K ) | ( |
|---|---|---|---|---|---|
| 2.625871 | 1.916727 | 1.053924 | 3.692784 | .012363 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 3017.782 | 3016.111 | 3010.297 | 2995.698 | 2961.120 | 2876.896 | 2667.465 | 2253.009 | 1704.459 | 1064.185 |
| FLAME TEMP. T(F) | 4972.608 | 4969.600 | 4959.134 | 4932.856 | 4870.617 | 4719.013 | 4342.036 | 3596.017 | 2608.626 | 1456.133 |
| ENTHALPY KCAL/GFW | -53.411 | -48.070 | -42.729 | -37.388 | -32.047 | -26.706 | -21.365 | -16.023 | -10.682 | -5.341 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1456.077 | 1459.348 | 1463.259 | 1468.316 | 1475.901 | 1493.145 | 1259.726 | 955.484 | 653.474 | 358.513 |
| FLAME TEMP. T(F) | 2161.539 | 2167.426 | 2174.466 | 2183.568 | 2197.221 | 2228.260 | 1808.107 | 1260.472 | 716.854 | 185.923 |
| ENTHALPY KCAL/GFW | -122.141 | -115.217 | -108.299 | -101.379 | -94.425 | -87.223 | -74.614 | -58.997 | -42.222 | -24.242 |
| T.VOL.GASES--LITERS | 84.463 | 91.479 | 100.249 | 111.525 | 126.558 | 147.602 | 185.041 | 250.033 | 380.011 | 769.952 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 38.9520 | 42.9879 | 48.2255 | 55.2393 | 65.0530 | 79.6146 | 84.3537 | 84.3525 | 84.3503 | 84.3434 |
| CO | 28.8974 | 26.3287 | 22.9951 | 18.5309 | 12.2847 | 3.0167 | .0001 | .0001 | .0001 | .0003 |
| H2O | 15.8723 | 16.8638 | 18.0242 | 19.4015 | 21.0483 | 23.0130 | 23.5407 | 23.5406 | 23.5397 | 23.5368 |
| N2 | 14.7632 | 23.5243 | 34.4758 | 48.5561 | 67.3300 | 93.6134 | 133.0256 | 198.7451 | 330.1636 | 724.4139 |
| H2 | .8606 | .7495 | .6195 | .4651 | .2805 | .0599 | .0000 | .0000 | .0000 | .0000 |
| KHO | .5614 | .5691 | .5789 | .5919 | .6110 | .6503 | .6924 | .2835 | .0003 | .0006 |
| K | .0918 | .0865 | .0796 | .0705 | .0571 | .0296 | .0001 | .0001 | .0002 | .0004 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| NH3 | .0001 | .0001 | .0001 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| KCN | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| KH | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .6911 | .6886 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .4087 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |

M8

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | 8.3565 | 25.9952 | 61.2491 | 167.0046 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0274 | .0038 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0007 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | CO | H2O | N2 | H2 | KHO | K | K2O& | NH3 | KCN | KH | C4H10 | C4H8 | KHO& | KHO& |
| KHO* | KO | O3 | NO2 | C3H8 | C3H6 | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | CNH |
| C2H2 | H2O* | HO | HO | CH4 | O | NH | CH2 | N | CH | H | C | C& | C& | |

M9

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M9 DOUBLE-BASE PROPELLANT, MORTAR (MIL-P-20306)

| | H | C | N | O | K | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 57.750 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 40.000 | -392. | .0578 |
| POTASSIUM NITRATE | .000 | .000 | .001 | .003 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | -1165. | .0762 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .750 | -127. | .0000 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (K ) | ( |
|---|---|---|---|---|---|
| 2.540776 | 1.850976 | 1.068606 | 3.728607 | .014836 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 3100.149 | 3085.622 | 3064.559 | 3031.101 | 2972.158 | 2855.662 | 2610.146 | 2186.340 | 1652.503 | 1034.387 |
| FLAME TEMP. T(F) | 5120.868 | 5094.720 | 5056.806 | 4996.582 | 4890.484 | 4680.791 | 4238.862 | 3476.012 | 2515.106 | 1402.496 |
| ENTHALPY KCAL/GFW | -53.620 | -48.258 | -42.896 | -37.534 | -32.172 | -26.810 | -21.448 | -16.086 | -10.724 | -5.362 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1545.401 | 1542.785 | 1540.743 | 1540.033 | 1543.109 | 1515.790 | 1207.899 | 919.200 | 628.690 | 346.559 |
| FLAME TEMP. T(F) | 2322.321 | 2317.614 | 2313.937 | 2312.659 | 2318.196 | 2269.021 | 1714.819 | 1195.159 | 672.242 | 164.406 |
| ENTHALPY KCAL/GFW | -123.768 | -116.679 | -109.587 | -102.473 | -95.269 | -86.828 | -72.945 | -57.603 | -41.211 | -23.691 |
| T.VOL.GASES--LITERS (GASES AT STP) | 82.235 | 89.249 | 98.018 | 109.292 | 124.323 | 146.155 | 185.144 | 250.136 | 380.115 | 770.056 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 41.0452 | 45.3558 | 50.9309 | 58.3661 | 68.7151 | 81.4538 | 81.4599 | 81.4587 | 81.4565 | 81.4497 |
| CO | 25.7234 | 22.9799 | 19.4315 | 14.6991 | 8.1123 | .0043 | .0001 | .0001 | .0001 | .0003 |
| H2O | 16.8150 | 17.6924 | 18.7126 | 19.9148 | 21.3383 | 22.7494 | 22.7521 | 22.7518 | 22.7508 | 22.7480 |
| N2 | 14.9689 | 23.7300 | 34.6814 | 48.7618 | 67.5357 | 93.8022 | 133.2337 | 198.9514 | 330.3693 | 724.6199 |
| H2 | .6676 | .5692 | .4547 | .3198 | .1599 | .0001 | .0000 | .0000 | .0000 | .0000 |
| KHO | .6557 | .6686 | .6848 | .7060 | .7381 | .8292 | .8311 | .1289 | .0003 | .0006 |
| K | .1227 | .1138 | .1025 | .0877 | .0652 | .0015 | .0001 | .0001 | .0002 | .0004 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| KH | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KCN | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .8299 | .8273 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .7020 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0001 | .0002 | .0003 | .0006 |
| HO | .0001 | .0001 | .0001 | .0001 | .0002 | .0053 | .0004 | .0001 | .0001 | .0002 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NH3 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |

M9

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | .0001 | 1.1156 | 11.6974 | 29.3341 | 64.5872 | 170.3426 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0361 | .0224 | .0026 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | CO | H2O | N2 | H2 | KHO | K | K2O& | KH | KCN | C4H10 | C4H8 | KHO& | KHO& | KHO* |
| KO | HO | O3 | NO2 | C3H8 | C3H6 | NH3 | HO2 | H | O2 | NHO | C2H6 | CH2O | NO | CHO |
| C2H4 | CNH | C2H2 | H2O* | HO | CH4 | O | NH | CH2 | N | CH | C | C& | C& | |

SPEM BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL:PROPELLANT M10

M10 39

| | H | C | N | O | S | K | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 97.900 | -625. | .0600 |
| DIPHENYLAMINE - DPA | .011 | .012 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | 178. | .0419 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | -1966. | .0962 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .100 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | ( |
|---|---|---|---|---|---|---|
| 2.773496 | 2.235656 | .886447 | 3.581045 | .005738 | .011477 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2393.249 | 2450.426 | 2510.721 | 2574.620 | 2641.668 | 2705.540 | 2718.260 | 2434.207 | 1852.052 | 1149.821 |
| FLAME TEMP. T(F) | 3848.448 | 3951.367 | 4059.898 | 4174.916 | 4295.603 | 4410.571 | 4433.468 | 3922.173 | 2874.293 | 1610.278 |
| ENTHALPY KCAL/GFW | -62.960 | -56.664 | -50.368 | -44.072 | -37.776 | -31.480 | -25.184 | -18.888 | -12.592 | -6.296 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1063.324 | 1091.934 | 1122.740 | 1156.115 | 1192.398 | 1232.487 | 1278.873 | 1070.313 | 729.779 | 394.570 |
| FLAME TEMP. T(F) | 1455.482 | 1506.081 | 1561.532 | 1621.607 | 1686.916 | 1759.077 | 1842.571 | 1467.163 | 854.203 | 250.825 |
| ENTHALPY KCAL/GFW | -118.997 | -112.418 | -105.844 | -99.278 | -92.726 | -86.192 | -79.601 | -65.781 | -47.044 | -26.820 |
| VOL.GASES--LITERS (GASES AT STP) | 91.381 | 98.429 | 107.210 | 118.494 | 133.532 | 154.583 | 186.200 | 247.743 | 377.725 | 767.660 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 38.8197 | 36.8515 | 34.2867 | 30.8148 | 25.8944 | 18.4169 | 6.1286 | .0001 | .0001 | .0003 |
| CO2 | 37.3446 | 40.4660 | 44.5042 | 49.9607 | 57.6908 | 69.4374 | 88.7484 | 98.3885 | 98.3860 | 98.3785 |
| N2 | 12.4160 | 21.1774 | 32.1291 | 46.2097 | 64.9837 | 91.2673 | 130.6923 | 196.3967 | 327.8174 | 722.0681 |
| H2O | 8.7764 | 10.1333 | 11.7846 | 13.8030 | 16.3085 | 19.4363 | 23.3636 | 24.9233 | 24.9223 | 24.9194 |
| H2 | 1.7929 | 1.6438 | 1.4599 | 1.2344 | .9541 | .6042 | .1684 | .0000 | .0000 | .0000 |
| KHO | .5986 | .5967 | .5949 | .5937 | .5940 | .5981 | .6141 | .6423 | .0007 | .0006 |
| H2S | .1859 | .1855 | .1850 | .1843 | .1832 | .1808 | .1124 | .0001 | .0002 | .0003 |
| K | .0301 | .0318 | .0334 | .0344 | .0343 | .0313 | .0200 | .0001 | .0002 | .0004 |
| CSO | .0163 | .0169 | .0176 | .0187 | .0203 | .0226 | .0168 | .0002 | .0003 | .0006 |
| CH4 | .0148 | .0042 | .0010 | .0002 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| KCN | .0021 | .0013 | .0007 | .0003 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| NH3 | .0009 | .0008 | .0007 | .0005 | .0003 | .0001 | .0000 | .0001 | .0001 | .0002 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0620 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0004 | .0048 | .0002 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0011 | .1253 | .3153 | .3631 | .3587 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .6389 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .6410 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0005 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KM | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CNM | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| HS | .0000 | .0000 | .0000 | .0001 | .0002 | .0004 | .0008 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 12.5908 | 47.8604 | 153.6181 |
| HNO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0088 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | KHO | H2S | K | CSO | CH4 | KCN | NH3 | K2O& | S2O | SO3 |
| [illegible]2 | S2 | SO2 | C4H10 | C4H8 | KHO& | KHO& | KHO* | KO | SO | O3 | NS | NO2 | C3H8 | CS |
| [illegible]6 | KM | CNM | HS | HO2 | S | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* |
| [illegible]O | HO | O | NH | CH2 | N | CH | C | C& | C& | H | | | | |

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL:PROPELLANT M12

M12 40

| | H | C | N | O | S | K | SN | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 97.700 | -625. | .0600 |
| DIPHENYLAMINE - DPA | .011 | .012 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .800 | 178. | .0419 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .750 | -1966. | .0962 |
| TIN | .000 | .000 | .000 | .000 | .000 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .750 | 0. | .2077 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | (SN) | ( |
|---|---|---|---|---|---|---|---|
| 2.759952 | 2.208742 | .383466 | 3.568038 | .004304 | .008608 | .006318 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2411.680 | 2467.815 | 2527.035 | 2589.647 | 2654.754 | 2715.020 | 2716.490 | 2415.458 | 1835.502 | 1139.592 |
| FLAME TEMP. T(F) | 3881.625 | 3982.668 | 4089.264 | 4201.964 | 4319.158 | 4427.635 | 4430.282 | 3888.424 | 2844.504 | 1591.866 |
| ENTHALPY KCAL/GFW | -62.379 | -56.141 | -49.903 | -43.666 | -37.428 | -31.190 | -24.952 | -18.714 | -12.476 | -6.238 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1074.831 | 1102.606 | 1132.804 | 1165.432 | 1200.866 | 1240.051 | 1285.888 | 1057.968 | 720.819 | 390.139 |
| FLAME TEMP. T(F) | 1475.296 | 1525.290 | 1579.647 | 1638.377 | 1702.158 | 1772.691 | 1855.199 | 1444.942 | 838.074 | 242.850 |
| ENTHALPY KCAL/GFW | -118.475 | -111.945 | -105.422 | -98.908 | -92.409 | -85.929 | -79.370 | -65.116 | -46.565 | -26.592 |
| VOL.GASES--LITERS (GASES AT STP) | 90.656 | 97.695 | 106.473 | 117.756 | 132.793 | 153.842 | 185.467 | 247.587 | 377.567 | 767.502 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 38.0744 | 36.0984 | 33.5165 | 30.0195 | 25.0592 | 17.5210 | 5.1480 | .0001 | .0001 | .0003 |
| CO2 | 37.3470 | 40.4717 | 44.5341 | 50.0295 | 57.8222 | 69.6645 | 89.1099 | 97.2039 | 97.2015 | 97.1940 |
| N2 | 12.3745 | 21.1358 | 32.0874 | 46.1680 | 64.9420 | 91.2255 | 130.6507 | 196.3552 | 327.7758 | 722.0263 |
| H2O | 9.0690 | 10.4281 | 12.0706 | 14.0732 | 16.5531 | 19.6419 | 23.5068 | 24.7821 | 24.7812 | 24.7782 |
| H2 | 1.7481 | 1.5979 | 1.4148 | 1.1909 | .9135 | .5679 | .1394 | .0000 | .0000 | .0000 |
| Sn | .7498 | .7497 | .7497 | .7497 | .7496 | .7495 | .7494 | .7492 | .7488 | .0012 |
| KHO | .4481 | .4466 | .4453 | .4445 | .4449 | .4484 | .4616 | .4813 | .0005 | .0006 |
| H2S | .1393 | .1390 | .1386 | .1380 | .1371 | .1351 | .0627 | .0001 | .0002 | .0003 |
| K | .0233 | .0246 | .0257 | .0263 | .0260 | .0234 | .0141 | .0001 | .0002 | .0004 |
| CSO | .0123 | .0127 | .0133 | .0142 | .0154 | .0171 | .0095 | .0002 | .0003 | .0006 |
| CH4 | .0102 | .0029 | .0007 | .0001 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| KCN | .0013 | .0008 | .0004 | .0002 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| NH3 | .0008 | .0008 | .0006 | .0004 | .0003 | .0001 | .0000 | .0001 | .0001 | .0002 |
| SnO& | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0003 | .0004 | .0007 | .0013 |
| Sn& | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0004 | .0006 | .7476 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0532 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0003 | .0024 | .0002 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0012 | .1400 | .2304 | .2712 | .2668 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .4779 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .4802 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KM | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CNM | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NS | .0000 | .0000 | .0000 | .0001 | .0001 | .0003 | .0006 | .0001 | .0002 | .0003 |
| NO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 13.4632 | 48.7306 | 154.4883 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0081 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

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--LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | Sn | KHO | H2S | K | CSO | CH4 | KCN | NH3 | SnO& | Sn& |
| K2O& | S2O | SO3 | CS2 | S2 | SO2 | C4H10 | C4H8 | KHO& | KHO& | KHO* | KO | SO | O3 | NS |
| NO2 | C3H8 | CS | C3H6 | KM | CNM | HS | HO2 | S | O2 | NHO | C2H6 | CH2O | NO | CHO |
| C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& | N | |

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL:PROPELLANT M14

M14

4

| | H | C | N | O | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 90.000 | -625. | .0600 |
| DINITROTOLUENE - DNT | .006 | .007 | .002 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 8.000 | -58. | .0419 |
| DIBUTYLPHTHALATE-DBP | .022 | .016 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.000 | -727. | .0378 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | ( |
|---|---|---|---|---|
| 2.916136 | 2.404824 | .897327 | 3.475402 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2178.371 | 2252.042 | 2330.196 | 2413.365 | 2501.945 | 2594.907 | 2679.224 | 2573.080 | 1988.572 | 1229.452 |
| FLAME TEMP. T(F) | 3461.668 | 3594.275 | 3734.952 | 3884.657 | 4044.102 | 4211.433 | 4363.204 | 4172.145 | 3120.029 | 1753.614 |
| ENTHALPY KCAL/GFW | -58.151 | -52.336 | -46.521 | -40.706 | -34.891 | -29.075 | -23.260 | -17.445 | -11.630 | -5.815 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 971.089 | 985.164 | 1012.289 | 1051.206 | 1096.241 | 1145.824 | 1201.401 | 1175.944 | 796.523 | 427.098 |
| FLAME TEMP. T(F) | 1288.560 | 1313.895 | 1362.721 | 1432.771 | 1513.834 | 1603.083 | 1703.121 | 1657.298 | 974.341 | 309.376 |
| ENTHALPY KCAL/GFW | -111.208 | -105.399 | -99.626 | -93.867 | -88.116 | -82.382 | -76.669 | -68.124 | -48.882 | -27.868 |
| T.VOL.GASES--LITERS | 95.401 | 103.173 | 112.385 | 123.792 | 138.852 | 159.906 | 191.485 | 247.393 | 377.374 | 767.315 |
| ASES AT STP) | | | | | | | | | | |

BUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 44.7127 | 43.1520 | 40.9390 | 37.7986 | 33.3302 | 26.6058 | 15.4364 | .0001 | .0001 | .0003 |
| CO2 | 34.2638 | 37.4561 | 41.3641 | 46.4243 | 53.4655 | 64.0329 | 81.5819 | 105.8343 | 105.8321 | 105.8255 |
| N2 | 12.5679 | 21.3289 | 32.2806 | 46.3615 | 65.1357 | 91.4195 | 130.8448 | 196.5471 | 327.9698 | 722.2207 |
| H2O | 5.8025 | 6.8388 | 8.3701 | 10.4998 | 13.2791 | 16.8906 | 21.6143 | 26.2664 | 26.2655 | 26.2624 |
| H2 | 2.1687 | 2.1205 | 1.9887 | 1.7621 | 1.4531 | 1.0492 | .5206 | .0000 | .0000 | .0000 |
| CH4 | .4815 | .2116 | .0545 | .0085 | .0009 | .0001 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0021 | .0023 | .0019 | .0014 | .0008 | .0004 | .0001 | .0001 | .0001 | .0002 |
| CNH | .0001 | .0001 | .0001 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 4.6694 | 39.9281 | 145.6835 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0134 | .0006 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| .M | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

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M14

--LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | CH4 | NH3 | CNH | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 | HO2 |
| O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N |
| CH | C | C& | C& | H | | | | | | | | | | |

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL:PROPELLANT M15

M15 43

| | H | C | N | O | F | NA | AL | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 20.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 19.000 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 54.700 | -209. | .0000 |
| ETHYL CENTRALITE-EC | .020 | .017 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 6.000 | -117. | .0451 |
| CRYOLITE | .000 | .000 | .000 | .000 | .012 | .003 | .003 | .000 | .000 | .000 | .000 | .000 | .300 | -3549. | .1084 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (F ) | (NA) | (AL) | ( |
|---|---|---|---|---|---|---|---|
| 3.522149 | 1.597194 | 2.577925 | 2.553388 | .009526 | .002382 | .002382 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2016.454 | 2096.644 | 2182.240 | 2274.082 | 2372.753 | 2479.873 | 2580.743 | 2345.077 | 1784.826 | 1114.931 |
| FLAME TEMP. T(F) | 3170.216 | 3314.559 | 3468.633 | 3633.948 | 3811.556 | 4004.371 | 4185.937 | 3761.738 | 2753.286 | 1547.475 |
| ENTHALPY KCAL/GFW | -33.147 | -29.833 | -26.518 | -23.203 | -19.888 | -16.574 | -13.259 | -9.944 | -6.629 | -3.315 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 923.220 | 927.391 | 939.036 | 967.364 | 1012.655 | 1065.770 | 1125.491 | 990.370 | 682.168 | 376.269 |
| FLAME TEMP. T(F) | 1202.397 | 1209.903 | 1230.865 | 1281.855 | 1363.380 | 1458.985 | 1566.483 | 1323.266 | 768.503 | 217.885 |
| THALPY KCAL/GFW | -85.668 | -82.275 | -78.964 | -75.716 | -72.496 | -69.298 | -66.138 | -56.372 | -40.470 | -23.379 |
| VOL.GASES--LITERS (GASES AT STP) | 101.187 | 109.439 | 119.360 | 131.340 | 146.528 | 167.594 | 199.172 | 259.468 | 389.437 | 779.369 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N2 | 36.1066 | 44.8678 | 55.8197 | 69.9013 | 88.6764 | 114.9608 | 154.3864 | 220.0931 | 351.5116 | 745.7617 |
| CO2 | 27.3002 | 29.8677 | 32.9304 | 36.5208 | 41.2591 | 48.4959 | 61.1134 | 70.2874 | 70.2840 | 70.2739 |
| CO | 25.3361 | 24.4726 | 23.2401 | 21.3892 | 18.4688 | 13.8708 | 5.8400 | .0001 | .0001 | .0003 |
| H2O | 7.2908 | 8.3903 | 9.9831 | 12.4866 | 16.1558 | 21.1262 | 27.8660 | 31.6614 | 31.6605 | 31.6578 |
| H2 | 2.4345 | 2.4224 | 2.3475 | 2.1301 | 1.7336 | 1.1788 | .4244 | .0000 | .0000 | .0000 |
| CH4 | 1.1605 | .7191 | .3085 | .0597 | .0049 | .0002 | .0000 | .0001 | .0001 | .0002 |
| HF | .1426 | .1425 | .1425 | .1424 | .1423 | .1425 | .1452 | .1417 | .1410 | .1391 |
| Al2O3& | .1205 | .1204 | .1203 | .1201 | .1199 | .1196 | .1191 | .1184 | .1168 | .1122 |
| NaF& | .0992 | .0991 | .0990 | .0989 | .0986 | .0969 | .0858 | .0973 | .0960 | .0920 |
| NH3 | .0058 | .0057 | .0051 | .0037 | .0020 | .0008 | .0001 | .0001 | .0001 | .0002 |
| Na2CO3& | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0004 | .0005 | .0011 |
| Na2CO3* | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0004 | .0005 | .0011 |
| Al2O3* | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0003 | .0005 | .0010 |
| C2F4 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0003 | .0005 | .0010 |
| CF4 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0009 |
| Al2O2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0009 |
| AlF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| CNN | .0001 | .0001 | .0001 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CHF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0004 | .0007 |
| Al2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| CF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| COF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| AlF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| C2F2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| Na2O& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| Na2O* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| CH2F2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| O2F | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| CF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| NaCN | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NaCN& | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NaCN* | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| CHOF | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| AlF | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlO | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaF | .0000 | .0000 | .0001 | .0001 | .0002 | .0010 | .0056 | .0002 | .0002 | .0004 |
| NaF* | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaF* | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlN | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlN& | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaHO | .0000 | .0000 | .0000 | .0001 | .0001 | .0006 | .0064 | .0001 | .0002 | .0004 |
| NaHO& | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaHO* | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| F2 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HF | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 10.9200 | 46.1745 | 151.9319 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0038 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| AlH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al& | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al* | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NaH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| Na | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| F | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N2 | CO2 | CO | H2O | H2 | CH4 | HF | Al2O3& | NaF& | NH3 | Na2CO3 | Na2CO3 | Al2O3* | C2F4 | CF4 |
| Al2O2 | AlF3 | CNH | CHF3 | Al2O | CF3 | COF2 | AlF2 | C2F2 | Na2O& | Na2O* | AlOF | AlHO2 | C4H10 | C4H8 |
| 2 | O2F | CF2 | NaCN | NaCN& | NaCN* | CHOF | O3 | NO2 | AlF | C3H8 | AlO | C3H6 | NaF | NaF* |
| aF* | AlN | AlN& | NaHO | NaHO& | NaHO* | F2 | HF | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO |
| C2H4 | AlH | Al | Al& | Al* | C2H2 | NaH | Na | F | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | C& | H | | | | | | | | | |

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL:PROPELLANT M17

M17

| | H | C | N | O | F | NA | AL | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 22.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 21.500 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 54.600 | -209. | .0000 |
| ETHYL CENTRALITE-EC | .020 | .017 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | -117. | .0451 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .100 | 0. | .0816 |
| CRYOLITE | .000 | .000 | .000 | .000 | .012 | .003 | .003 | .000 | .000 | .000 | .000 | .000 | .300 | -3549. | .1084 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (F ) | (NA) | (AL) | ( |
|---|---|---|---|---|---|---|---|
| 3.293416 | 1.396576 | 2.591559 | 2.706463 | .009526 | .002382 | .002382 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2390.925 | 2444.530 | 2501.734 | 2562.628 | 2625.541 | 2674.372 | 2552.666 | 2143.019 | 1626.259 | 1022.240 |
| FLAME TEMP. T(F) | 3844.265 | 3940.753 | 4043.720 | 4153.330 | 4266.573 | 4354.470 | 4135.399 | 3398.035 | 2467.865 | 1380.632 |
| ENTHALPY KCAL/GFW | -34.833 | -31.349 | -27.866 | -24.383 | -20.900 | -17.416 | -13.933 | -10.450 | -6.967 | -3.483 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1035.689 | 1062.197 | 1091.415 | 1123.174 | 1157.662 | 1195.783 | 1143.468 | 875.310 | 605.542 | 339.128 |
| FLAME TEMP. T(F) | 1404.840 | 1452.554 | 1505.146 | 1562.313 | 1624.392 | 1693.010 | 1598.843 | 1116.157 | 630.575 | 151.030 |
| ENTHALPY KCAL/GFW | -93.874 | -89.758 | -85.648 | -81.552 | -77.478 | -73.426 | -66.220 | -52.316 | -37.512 | -21.758 |
| VOL.GASES--LITERS | 97.485 | 104.531 | 113.311 | 124.595 | 139.633 | 160.681 | 195.058 | 260.056 | 390.024 | 779.956 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N2 | 36.3007 | 45.0623 | 56.0140 | 70.0947 | 88.8688 | 115.1523 | 154.5735 | 220.2853 | 351.7025 | 745.9530 |
| CO2 | 28.2159 | 30.3736 | 33.2358 | 37.1651 | 42.9172 | 51.9420 | 61.4596 | 61.4580 | 61.4546 | 61.4445 |
| CO | 21.1361 | 19.7802 | 17.9634 | 15.4636 | 11.8026 | 6.0582 | .0001 | .0001 | .0001 | .0003 |
| H2O | 12.0003 | 13.7518 | 15.8843 | 18.5270 | 21.8397 | 26.0731 | 29.5963 | 29.6010 | 29.6001 | 29.5974 |
| H2 | 1.9659 | 1.7725 | 1.5346 | 1.2390 | .8681 | .3932 | .0000 | .0000 | .0000 | .0000 |
| HF | .1426 | .1426 | .1428 | .1437 | .1469 | .1591 | .1476 | .1417 | .1410 | .1391 |
| Al2O3& | .1205 | .1204 | .1203 | .1201 | .1199 | .1196 | .1191 | .1184 | .1168 | .1122 |
| NaF& | .0990 | .0984 | .0971 | .0930 | .0807 | .0396 | .0779 | .0973 | .0960 | .0920 |
| CH4 | .0138 | .0037 | .0008 | .0001 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0020 | .0015 | .0011 | .0007 | .0003 | .0001 | .0000 | .0001 | .0001 | .0002 |
| NaF | .0002 | .0005 | .0013 | .0033 | .0084 | .0234 | .0085 | .0001 | .0002 | .0004 |
| Na2CO3& | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0004 | .0005 | .0011 |
| Na2CO3* | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0004 | .0005 | .0011 |
| Al2O3* | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0003 | .0005 | .0010 |
| C2F4 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0003 | .0005 | .0010 |
| CF4 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0009 |
| Al2O2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0009 |
| AlF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| NaHO | .0001 | .0002 | .0007 | .0025 | .0088 | .0325 | .0113 | .0001 | .0002 | .0004 |
| CHF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0004 | .0007 |
| Al2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| CF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| COF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| AlF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| C2F2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| AlOF | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| AlHO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| CH2F2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| O2F | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| CF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| NaCN | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NaCN& | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NaCN* | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| CHOF | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| AlF | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlO | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaF* | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaF* | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlN | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlN& | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaHO& | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaHO* | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| F2 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NF | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | 3.9901 | 21.6202 | 56.8734 | 162.6310 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0085 | .0013 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| AlH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al& | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al* | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NaH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| Na | .0000 | .0000 | .0000 | .0001 | .0003 | .0008 | .0001 | .0001 | .0001 | .0002 |
| F | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

M17

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N2 | CO2 | CO | H2O | H2 | HF | Al2O3& | NaF& | CH4 | NH3 | NaF | Na2CO3 | Na2CO3 | Al2O3* | C2F4 |
| | Al2O2 | AlF3 | NaHO | CHF3 | Al2O | CF3 | COF2 | AlF2 | C2F2 | Na2O& | Na2O* | AlOF | AlHO2 | C4H10 |
| C4H8 | CH2F2 | O2F | CF2 | NaCN | NaCN& | NaCN* | CHOF | O3 | NO2 | AlF | C3H8 | AlO | C3H6 | NaF* |
| NaF* | AlN | AlN& | NaHO& | NaHO* | F2 | NF | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 |
| AlH | CNH | Al | Al& | Al* | C2H2 | NaH | Na | F | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | C& | N | | | | | | | | | |

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL:PROPELLANT M26

M26

| | H | C | N | O | K | BA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 67.250 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 25.000 | -392. | .0578 |
| ETHYL CENTRALITE-EC | .020 | .017 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 6.000 | -117. | .0451 |
| BARIUM NITRATE | .000 | .000 | .002 | .006 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .750 | -912. | .1171 |
| POTASSIUM NITRATE | .000 | .000 | .001 | .003 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .700 | -1165. | .0762 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .300 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (K ) | (BA) |
|---|---|---|---|---|---|
| 2.961549 | 2.216614 | .992497 | 3.495254 | .006923 | .002869 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2473.468 | 2524.097 | 2577.717 | 2639.174 | 2696.941 | 2750.320 | 2757.561 | 2493.456 | 1906.474 | 1180.753 |
| FLAME TEMP. T(F) | 3992.843 | 4083.975 | 4180.490 | 4291.114 | 4395.094 | 4491.176 | 4504.210 | 4028.820 | 2972.252 | 1665.955 |
| ENTHALPY KCAL/GFW | -54.027 | -48.624 | -43.222 | -37.819 | -32.416 | -27.014 | -21.611 | -16.208 | -10.805 | -5.403 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1090.051 | 1116.482 | 1145.146 | 1176.149 | 1209.661 | 1246.677 | 1290.812 | 1107.700 | 754.207 | 406.792 |
| FLAME TEMP. T(F) | 1502.692 | 1550.268 | 1601.863 | 1657.668 | 1717.990 | 1784.618 | 1864.062 | 1534.461 | 898.172 | 272.825 |
| ENTHALPY KCAL/GFW | -112.923 | -106.947 | -100.976 | -95.012 | -89.069 | -83.146 | -77.183 | -64.722 | -46.404 | -26.538 |
| VOL.GASES--LITERS (GASES AT STP) | 93.103 | 100.138 | 108.916 | 120.198 | 135.236 | 156.287 | 187.860 | 248.451 | 378.425 | 768.361 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 40.3213 | 38.3466 | 35.7837 | 32.3298 | 27.4587 | 20.0946 | 7.8786 | .0001 | .0001 | .0003 |
| CO2 | 34.1752 | 37.2954 | 41.3281 | 46.7564 | 54.4100 | 65.9801 | 85.1732 | 97.5508 | 97.5486 | 97.5417 |
| N2 | 13.9018 | 22.6631 | 33.6147 | 47.6953 | 66.4693 | 92.7528 | 132.1779 | 197.8809 | 329.3031 | 723.5536 |
| H2O | 8.8913 | 10.2531 | 11.9078 | 13.9377 | 16.4745 | 19.6755 | 23.7231 | 25.7126 | 25.7116 | 25.7088 |
| H2 | 1.8806 | 1.7298 | 1.5452 | 1.3182 | 1.0344 | .6762 | .2231 | .0000 | .0000 | .0000 |
| BaO& | .4399 | .4399 | .4399 | .4398 | .4398 | .4397 | .4397 | .4395 | .4393 | .4385 |
| KHO | .3553 | .3543 | .3536 | .3534 | .3540 | .3569 | .3666 | .3868 | .0018 | .0006 |
| K | .0222 | .0230 | .0237 | .0240 | .0235 | .0213 | .0144 | .0001 | .0002 | .0004 |
| CH4 | .0092 | .0028 | .0007 | .0002 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| KCN | .0011 | .0007 | .0004 | .0002 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| NH3 | .0009 | .0008 | .0007 | .0005 | .0003 | .0001 | .0000 | .0001 | .0001 | .0002 |
| Ba | .0001 | .0002 | .0002 | .0002 | .0002 | .0003 | .0003 | .0005 | .0007 | .0014 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .3834 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .3844 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| O2 | .0000 | .0000 | .0000 | .0000 | .0000 | | | | | |
| NNO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0119 | .0003 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | BaO& | KHO | K | CH4 | KCN | NH3 | Ba | K2O& | C4H10 | C4H8 |
| KHO& | KNO& | KHO* | KO | O3 | NO2 | C3H8 | C3H6 | CNN | KH | HO2 | O2 | NNO | C2H6 | CH2O |
| NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& |
| H | | | | | | | | | | | | | | |

M26/1

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M26/A1 DOUBLE-BASE PROPELLANT (MIL-STD-652, MIL-P-46235)

| | H | C | N | O | K | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 68.700 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 25.000 | -392. | .0578 |
| POTASSIUM NITRATE | .000 | .000 | .001 | .003 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 6.000 | -1165. | .0762 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .300 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (K ) | ( |
|---|---|---|---|---|---|
| 2.454583 | 1.868471 | 1.007503 | 3.665636 | .059342 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2944.242 | 2949.783 | 2950.849 | 2941.688 | 2907.892 | 2811.330 | 2569.644 | 2145.412 | 1619.744 | 1020.912 |
| FLAME TEMP. T(F) | 4840.235 | 4850.209 | 4852.127 | 4835.639 | 4774.805 | 4600.994 | 4165.959 | 3402.342 | 2456.138 | 1378.241 |
| ENTHALPY KCAL/GFW | -59.723 | -53.751 | -47.779 | -41.806 | -35.834 | -29.862 | -23.889 | -17.917 | -11.945 | -5.972 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1421.458 | 1427.734 | 1434.846 | 1443.390 | 1455.176 | 1484.883 | 1183.686 | 915.031 | 623.722 | 342.984 |
| FLAME TEMP. T(F) | 2099.225 | 2110.521 | 2123.323 | 2138.703 | 2159.917 | 2213.389 | 1671.234 | 1187.656 | 663.299 | 157.971 |
| ENTHALPY KCAL/GFW | -124.330 | -117.201 | -110.076 | -102.946 | -95.768 | -88.090 | -73.979 | -58.409 | -41.813 | -24.018 |
| T.VOL.GASES--LITERS | 81.549 | 88.561 | 97.324 | 108.591 | 123.610 | 144.604 | 183.518 | 248.510 | 378.489 | 768.429 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 40.5375 | 44.6578 | 50.0056 | 57.1695 | 67.1911 | 82.0228 | 82.2299 | 82.2287 | 82.2264 | 82.2196 |
| CO | 26.5366 | 23.9141 | 20.5104 | 15.9507 | 9.5723 | .1323 | .0001 | .0001 | .0001 | .0003 |
| H2O | 14.8932 | 15.8428 | 16.9480 | 18.2496 | 19.7879 | 21.5604 | 21.5748 | 21.5744 | 21.5735 | 21.5707 |
| N2 | 14.1130 | 22.8741 | 33.8255 | 47.9059 | 66.6797 | 92.9629 | 132.3799 | 198.0954 | 329.5134 | 723.7639 |
| KHO | 2.7737 | 2.8040 | 2.8453 | 2.9031 | 2.9951 | 3.2846 | 3.3283 | .1156 | .0003 | .0006 |
| H2 | .7577 | .6509 | .5265 | .3798 | .2060 | .0024 | .0000 | .0000 | .0000 | .0000 |
| K | .3869 | .3658 | .3370 | .2967 | .2326 | .0307 | .0001 | .0001 | .0002 | .0004 |
| KH | .0002 | .0002 | .0002 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KCN | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| NH3 | .0001 | .0001 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | 3.3271 | 3.3245 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | 3.2125 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0005 | 10.4662 | 28.1003 | 63.3534 | 169.1087 |

M26/A

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0006 | .0176 | .0024 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0006 | .0003 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | CO | H2O | N2 | KHO | H2 | K | KH | KCN | K2O& | NH3 | C4H10 | C4H8 | KHO& | KHO& |
| KHO* | KO | O3 | NO2 | C3H8 | C3H6 | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | CNH |
| C2H2 | H2O* | HO | HO | CH4 | O | NH | CH2 | N | CH | C | C& | C& | H | |

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M26E1 DOUBLE-BASE PROPELLANT (MIL-STD-652, MIL-P-46235)

| | H | C | N | O | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 68.700 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 25.000 | -392. | .0578 |
| ETHYL CENTRALITE-EC | .020 | .017 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 6.000 | -117. | .0451 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .300 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | ( |
|---|---|---|---|---|
| 2.901739 | 2.248553 | .992876 | 3.509966 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2471.176 | 2521.506 | 2574.893 | 2631.370 | 2690.047 | 2745.509 | 2760.965 | 2520.109 | 1929.013 | 1194.491 |
| FLAME TEMP. T(F) | 3988.717 | 4079.311 | 4175.407 | 4277.066 | 4382.684 | 4482.517 | 4510.336 | 4076.797 | 3012.823 | 1690.685 |
| ENTHALPY KCAL/GFW | -53.434 | -48.091 | -42.747 | -37.404 | -32.060 | -26.717 | -21.374 | -16.030 | -10.687 | -5.343 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1082.359 | 1108.876 | 1137.804 | 1169.089 | 1203.054 | 1240.534 | 1284.723 | 1124.662 | 763.919 | 411.844 |
| FLAME TEMP. T(F) | 1488.846 | 1536.578 | 1588.647 | 1644.959 | 1706.097 | 1773.561 | 1853.102 | 1564.992 | 915.654 | 281.919 |
| ENTHALPY KCAL/GFW | -112.682 | -106.734 | -100.790 | -94.854 | -88.933 | -83.033 | -77.107 | -65.227 | -46.783 | -26.740 |
| T.VOL.GASES--LITERS (GASES AT STP) | 94.119 | 101.160 | 109.940 | 121.220 | 136.259 | 157.311 | 188.888 | 248.773 | 378.753 | 768.693 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 41.2104 | 39.2501 | 36.7072 | 33.2810 | 28.4590 | 21.1735 | 9.0889 | .0001 | .0001 | .0003 |
| CO2 | 34.1761 | 37.2795 | 41.2822 | 46.6674 | 54.2440 | 65.6906 | 84.6774 | 98.9567 | 98.9544 | 98.9479 |
| N2 | 13.9073 | 22.6685 | 33.6201 | 47.7006 | 66.4746 | 92.7581 | 132.1833 | 197.8857 | 329.3085 | 723.5589 |
| H2O | 8.7495 | 10.1157 | 11.7817 | 13.8290 | 16.3975 | 19.6501 | 23.7853 | 26.1368 | 26.1358 | 26.1327 |
| H2 | 1.9426 | 1.7918 | 1.6061 | 1.3772 | 1.0899 | .7259 | .2632 | .0000 | .0000 | .0000 |
| CH4 | .0123 | .0038 | .0010 | .0002 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0010 | .0009 | .0007 | .0005 | .0003 | .0002 | .0000 | .0001 | .0001 | .0002 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 10.3385 | 45.5971 | 151.3523 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0131 | .0004 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |

M26E1

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | CH4 | NH3 | C4H10 | C4H8 | O3 | NO2 | CNH | C3H8 | C3H6 | HO2 |
| O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N |
| CH | C | C& | C& | H | | | | | | | | | | |

M30

OPEN BOMB---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL PROPELLANT M30

| | H | C | N | O | F | NA | AL | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 27.970 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 22.480 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 47.650 | -209. | .0000 |
| ETHYL CENTRALITE-EC | .020 | .017 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | -117. | .0451 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .100 | 0. | .0816 |
| CRYOLITE | .000 | .000 | .000 | .000 | .012 | .003 | .003 | .000 | .000 | .000 | .000 | .000 | .300 | -3549. | .1084 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (F ) | (NA) | (AL) | ( |
|---|---|---|---|---|---|---|---|
| 3.213348 | 1.474243 | 2.391086 | 2.828718 | .009526 | .002382 | .002382 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2454.995 | 2504.188 | 2556.553 | 2611.366 | 2667.586 | 2704.311 | 2573.877 | 2164.665 | 1642.031 | 1030.870 |
| FLAME TEMP. T(F) | 3959.591 | 4048.139 | 4142.395 | 4241.958 | 4342.254 | 4408.360 | 4173.579 | 3436.997 | 2496.256 | 1396.166 |
| ENTHALPY KCAL/GFW | -37.495 | -33.745 | -29.996 | -26.246 | -22.497 | -18.747 | -14.998 | -11.248 | -7.499 | -3.749 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1072.268 | 1097.518 | 1124.884 | 1154.421 | 1186.349 | 1221.791 | 1163.575 | 889.412 | 614.117 | 342.831 |
| FLAME TEMP. T(F) | 1470.683 | 1516.133 | 1565.391 | 1618.557 | 1676.029 | 1739.823 | 1635.035 | 1141.541 | 646.010 | 157.696 |
| ENTHALPY KCAL/GFW | -97.516 | -93.037 | -88.566 | -84.110 | -79.677 | -75.258 | -67.618 | -53.428 | -38.291 | -22.167 |
| VOL.GASES--LITERS (GASES AT STP) | 96.106 | 103.133 | 111.908 | 123.191 | 138.228 | 159.276 | 193.732 | 258.729 | 388.697 | 778.629 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N2 | 33.4930 | 42.2544 | 53.2060 | 67.2966 | 86.0607 | 112.3442 | 151.7646 | 217.4769 | 348.8944 | 743.1447 |
| CO2 | 29.1591 | 31.5322 | 34.6459 | 38.9358 | 45.1694 | 54.8962 | 64.8779 | 64.8762 | 64.8728 | 64.8627 |
| CO | 22.7268 | 21.2223 | 19.2423 | 16.5123 | 12.5447 | 6.3536 | .0001 | .0001 | .0001 | .0003 |
| H2O | 12.4074 | 14.0780 | 16.1093 | 18.6037 | 21.7165 | 25.6571 | 28.8716 | 28.8797 | 28.8788 | 28.8762 |
| H2 | 1.8419 | 1.6559 | 1.4288 | 1.1496 | .8006 | .3579 | .0000 | .0000 | .0000 | .0000 |
| HF | .1427 | .1429 | .1435 | .1457 | .1523 | .1708 | .1514 | .1417 | .1410 | .1391 |
| Al2O3& | .1205 | .1204 | .1203 | .1201 | .1199 | .1196 | .1191 | .1184 | .1168 | .1122 |
| NaF& | .0983 | .0970 | .0938 | .0851 | .0614 | .0001 | .0648 | .0973 | .0960 | .0920 |
| CH4 | .0049 | .0014 | .0003 | .0001 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0014 | .0011 | .0008 | .0005 | .0002 | .0001 | .0000 | .0001 | .0001 | .0002 |
| NaF | .0007 | .0014 | .0031 | .0070 | .0163 | .0384 | .0136 | .0001 | .0002 | .0004 |
| NaHO | .0003 | .0007 | .0021 | .0062 | .0189 | .0547 | .0189 | .0001 | .0002 | .0004 |
| Na2CO3& | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0004 | .0005 | .0011 |
| Na2CO3* | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0004 | .0005 | .0011 |
| Al2O3* | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0003 | .0005 | .0010 |
| C2F4 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0003 | .0005 | .0010 |
| CF4 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0009 |
| Al2O2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0009 |
| AlF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| CHF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0004 | .0007 |
| Al2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| CF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| COF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| AlF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| C2F2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Na2O* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| AlOF | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| AlHO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| CH2F2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| O2F | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| CF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| NaCN | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NaCN& | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NaCN* | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| CHOF | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| AlF | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlO | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaF* | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaF* | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlN | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlN& | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaHO& | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaHO* | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| F2 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NF | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | 4.1005 | 21.7314 | 56.9847 | 162.7422 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0100 | .0015 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| AlH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al& | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al* | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NaH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| Na | .0000 | .0000 | .0001 | .0002 | .0007 | .0015 | .0001 | .0001 | .0001 | .0002 |
| F | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

M3(

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N2 | CO2 | CO | H2O | H2 | HF | Al2O3& | NaF& | CH4 | NH3 | NaF | NaHO | Na2CO3 | Na2CO3 | Al2O3* |
| | CF4 | Al2O2 | AlF3 | CHF3 | Al2O | CF3 | COF2 | AlF2 | C2F2 | Na2O& | Na2O* | AlOF | AlHO2 | C4H10 |
| [illegible] | CH2F2 | O2F | CF2 | NaCN | NaCN& | NaCN* | CHOF | O3 | NO2 | AlF | C3H8 | AlO | C3H6 | NaF* |
| NaF* | AlN | AlN& | NaHO& | NaHO* | F2 | NF | HO2 | O2 | NaO | C2H6 | CH2O | NO | CHO | C2H4 |
| AlH | CNH | Al | Al& | Al* | C2H2 | NaH | Na | F | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | C& | H | | | | | | | | | |

M30A1

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING W IH AIR---
MATERIAL:PROPELLANT M30/A1

| | H | C | N | O | S | K | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 28.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 22.500 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 47.000 | -209. | .0000 |
| ETHYL CENTRALITE-EC | .020 | .017 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | -117. | .0451 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | -1966. | .0962 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | ( |
|---|---|---|---|---|---|---|
| 3.189637 | 1.460597 | 2.366638 | 2.341063 | .005738 | .011477 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2451.628 | 2500.251 | 2551.960 | 2607.055 | 2663.064 | 2698.219 | 2555.029 | 2143.163 | 1625.285 | 1022.219 |
| FLAME TEMP. T(F) | 3953.530 | 4041.052 | 4134.128 | 4233.299 | 4334.115 | 4397.394 | 4139.651 | 3398.294 | 2466.112 | 1380.594 |
| ENTHALPY KCAL/GFW | -38.287 | -34.458 | -30.630 | -26.801 | -22.972 | -19.143 | -15.315 | -11.486 | -7.657 | -3.829 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1072.454 | 1097.894 | 1125.563 | 1155.648 | 1188.657 | 1226.191 | 1147.686 | 880.763 | 608.262 | 339.722 |
| FLAME TEMP. T(F) | 1471.017 | 1516.809 | 1566.613 | 1620.766 | 1680.182 | 1747.744 | 1606.435 | 1125.974 | 635.472 | 152.100 |
| 'HALPY KCAL/GFW | -97.828 | -93.318 | -88.813 | -84.322 | -79.849 | -75.377 | -67.282 | -53.139 | -38.096 | -22.069 |
| JL.GASES--LITERS | 95.237 | 102.264 | 111.039 | 122.320 | 137.357 | 158.412 | 193.366 | 258.363 | 388.336 | 778.271 |

,ASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N2 | 33.1505 | 41.9120 | 52.8636 | 66.9443 | 85.7183 | 112.0018 | 151.4226 | 217.1347 | 348.5523 | 742.8024 |
| CO2 | 29.5832 | 31.9608 | 35.0870 | 39.3839 | 45.6697 | 55.4770 | 64.2786 | 64.2773 | 64.2749 | 64.2673 |
| CO | 22.0713 | 20.5633 | 18.5750 | 15.8402 | 11.8389 | 5.5962 | .0001 | .0001 | .0001 | .0003 |
| H2O | 12.5700 | 14.2395 | 16.2665 | 18.7598 | 21.8560 | 25.7697 | 28.6273 | 28.6269 | 28.6259 | 28.6229 |
| H2 | 1.7850 | 1.5990 | 1.3725 | 1.0937 | .7472 | .3097 | .0000 | .0000 | .0000 | .0000 |
| KHO | .6093 | .6083 | .6076 | .6077 | .6102 | .6185 | .6427 | .0523 | .0003 | .0006 |
| H2S | .1897 | .1895 | .1891 | .1886 | .1877 | .1785 | .0001 | .0001 | .0002 | .0003 |
| K | .0233 | .0243 | .0249 | .0248 | .0230 | .0171 | .0001 | .0001 | .0002 | .0004 |
| CSO | .0095 | .0099 | .0104 | .0111 | .0121 | .0132 | .0002 | .0002 | .0003 | .0006 |
| CH4 | .0043 | .0012 | .0003 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0014 | .0010 | .0007 | .0005 | .0002 | .0000 | .0000 | .0001 | .0001 | .0002 |
| KCN | .0009 | .0005 | .0002 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0225 | .0003 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0014 | .0002 | .0002 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0003 | .0131 | .3476 | .3646 | .3631 | .3587 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .6414 | .6389 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .5901 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| HO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .000. | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HS | .0000 | .0000 | .0000 | .0001 | .0002 | .0005 | .0001 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | 4.6450 | 22.2801 | 57.5333 | 163.2911 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0093 | .0014 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CO2 | CO | H2O | H2 | KHO | H2S | K | CSO | CH4 | NH3 | KCN | K2O& | S2O | SO3 |
| | S2 | SO2 | C4H10 | C4H8 | KHO& | KHO& | KHO* | KO | SO | O3 | NS | NO2 | C3H8 | CS |
| C3H6 | KH | HS | HO2 | S | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | CNH | C2H2 | H2O* |
| HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | | | | |

M30A2

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M30A2 TRIPLE-BASE PROPELLANT, HOWITZER (MIL-STD-652)

| | H | C | N | O | K | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 27.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 22.500 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 46.250 | -209. | .0000 |
| POTASSIUM NITRATE | .000 | .000 | .001 | .003 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.750 | -1165. | .0762 |
| ETHYL CENTRALITE-EC | .020 | .017 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | -117. | .0451 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (K ) | ( |
|---|---|---|---|---|---|
| 3.133095 | 1.431364 | 2.356017 | 2.848949 | .027199 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2488.442 | 2535.805 | 2585.967 | 2638.271 | 2688.410 | 2705.387 | 2522.183 | 2106.761 | 1597.085 | 1007.495 |
| FLAME TEMP. T(F) | 4019.796 | 4105.049 | 4195.340 | 4289.488 | 4379.738 | 4410.296 | 4080.529 | 3332.771 | 2415.354 | 1354.090 |
| ENTHALPY KCAL/GFW | -38.742 | -34.868 | -30.994 | -27.120 | -23.245 | -19.371 | -15.497 | -11.623 | -7.748 | -3.874 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1094.730 | 1117.507 | 1143.895 | 1172.479 | 1203.828 | 1240.294 | 1121.924 | 866.684 | 598.250 | 334.528 |
| FLAME TEMP. T(F) | 1511.114 | 1552.113 | 1599.610 | 1651.063 | 1707.490 | 1773.130 | 1560.063 | 1100.631 | 617.450 | 142.750 |
| ENTHALPY KCAL/GFW | -98.528 | -93.949 | -89.380 | -84.828 | -80.298 | -75.753 | -66.421 | -52.462 | -37.637 | -21.834 |
| T.VOL.GASES--LITERS | 94.021 | 101.044 | 109.817 | 121.097 | 136.132 | 157.179 | 193.111 | 258.103 | 388.082 | 778.023 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N2 | 33.0018 | 41.7633 | 52.7150 | 66.7956 | 85.5696 | 111.8531 | 151.2741 | 216.9860 | 348.4034 | 742.6539 |
| CO2 | 29.4009 | 31.8840 | 35.1069 | 39.5389 | 46.0098 | 56.1159 | 62.9923 | 62.9912 | 62.9889 | 62.9821 |
| CO | 21.3767 | 19.7989 | 17.7486 | 14.9280 | 10.8094 | 4.3770 | .0001 | .0001 | .0001 | .0003 |
| H2O | 13.0430 | 14.6731 | 16.6611 | 19.0986 | 22.1173 | 25.9106 | 27.9765 | 27.9760 | 27.9751 | 27.9722 |
| H2 | 1.6719 | 1.4900 | 1.2678 | .9950 | .6571 | .2322 | .0000 | .0000 | .0000 | .0000 |
| KHO | 1.3415 | 1.4369 | 1.4362 | 1.4380 | 1.4463 | 1.4710 | 1.5248 | .0364 | .0003 | .0006 |
| KHO* | .1027 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | 1.4881 | .0003 | .0006 |
| K | .0560 | .0613 | .0621 | .0609 | .0551 | .0377 | .0001 | .0001 | .0002 | .0004 |
| CH4 | .0020 | .0006 | .0001 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| KCN | .0013 | .0008 | .0004 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| NH3 | .0011 | .0009 | .0006 | .0004 | .0002 | .0000 | .0000 | .0001 | .0001 | .0002 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | 1.5235 | 1.5210 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |

M30A2

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | 6.2205 | 23.8504 | 59.1028 | 164.8582 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0087 | .0012 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N2 | CO2 | CO | H2O | H2 | KHO | KHO* | K | CH4 | KCN | NH3 | K2O& | C4H10 | C4H8 | KHO& |
| KHO& | KO | O3 | NO2 | C3H8 | C3H6 | KH | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 |
| CNH | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | |

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL:PROPELLANT M31

M31

| | H | C | N | O | F | NA | AL | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 20.300 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 19.290 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 55.530 | -209. | .0000 |
| DIBUTYLPHTHALATE-DBP | .022 | .016 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 4.580 | -727. | .0378 |
| CRYOLITE | .000 | .000 | .000 | .000 | .012 | .003 | .003 | .000 | .000 | .000 | .000 | .000 | .300 | -3549. | .1084 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (F ) | (NA) | (AL) | ( |
|---|---|---|---|---|---|---|---|
| 3.483581 | 1.498790 | 2.571639 | 2.635192 | .009526 | .002382 | .002382 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2146.815 | 2217.773 | 2293.621 | 2374.521 | 2462.318 | 2554.504 | 2597.087 | 2244.182 | 1705.211 | 1068.749 |
| FLAME TEMP. T(F) | 3404.868 | 3532.592 | 3669.117 | 3814.738 | 3972.773 | 4138.708 | 4215.357 | 3580.128 | 2609.979 | 1464.349 |
| ENTHALPY KCAL/GFW | -36.251 | -32.626 | -29.001 | -25.376 | -21.750 | -18.125 | -14.500 | -10.875 | -7.250 | -3.625 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 942.578 | 956.810 | 983.628 | 1021.031 | 1064.153 | 1111.890 | 1167.557 | 932.284 | 643.690 | 357.717 |
| FLAME TEMP. T(F) | 1237.240 | 1262.858 | 1311.130 | 1378.456 | 1456.075 | 1542.003 | 1642.203 | 1218.711 | 699.242 | 184.490 |
| ENTHALPY KCAL/GFW | -90.939 | -87.098 | -83.291 | -79.501 | -75.726 | -71.980 | -68.211 | -55.058 | -39.466 | -22.806 |
| T.VOL.GASES--LITERS (GASES AT STP) | 100.520 | 108.245 | 117.400 | 128.782 | 143.834 | 164.884 | 196.461 | 260.099 | 390.068 | 780.000 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N2 | 36.0194 | 44.7810 | 55.7332 | 69.8146 | 88.5892 | 114.8731 | 154.2984 | 220.0056 | 351.4234 | 745.6738 |
| CO2 | 28.7633 | 31.0367 | 33.6534 | 37.0744 | 41.9712 | 49.6608 | 63.1990 | 65.9565 | 65.9531 | 65.9430 |
| CO | 22.9235 | 21.9176 | 20.4908 | 18.3747 | 15.2670 | 10.3733 | 1.7562 | .0001 | .0001 | .0003 |
| H2O | 9.1185 | 10.5502 | 12.6332 | 15.4460 | 19.1058 | 23.8947 | 30.2518 | 31.3140 | 31.3131 | 31.3104 |
| H2 | 2.3748 | 2.2782 | 2.0797 | 1.7740 | 1.3659 | .8301 | .1178 | .0000 | .0000 | .0000 |
| CH4 | .4303 | .1776 | .0409 | .0057 | .0005 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HF | .1426 | .1425 | .1425 | .1424 | .1425 | .1437 | .1532 | .1417 | .1410 | .1391 |
| Al2O3& | .1205 | .1204 | .1203 | .1201 | .1199 | .1196 | .1191 | .1184 | .1168 | .1122 |
| NaF& | .0992 | .0991 | .0990 | .0987 | .0975 | .0920 | .0595 | .0973 | .0960 | .0920 |
| NH3 | .0048 | .0042 | .0031 | .0020 | .0010 | .0004 | .0000 | .0001 | .0001 | .0002 |
| Na2CO3& | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0004 | .0005 | .0011 |
| Na2CO3* | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0004 | .0005 | .0011 |
| Al2O3* | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0003 | .0005 | .0010 |
| C2F4 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0003 | .0005 | .0010 |
| CF4 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0009 |
| Al2O2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0009 |
| AlF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| CHF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0004 | .0007 |
| Al2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| CF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| COF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| AlF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| C2F2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| Na2O& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| Na2O* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| AlOF | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| AlHO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CNN | .0001 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CH2F2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| O2F | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| CF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| NaCN | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NaCN& | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NaCN* | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| CHOF | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| HO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| AlF | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlO | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaF | .0000 | .0000 | .0001 | .0002 | .0008 | .0033 | .0151 | .0001 | .0002 | .0004 |
| NaF* | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaF* | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlN | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlN& | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaHO | .0000 | .0000 | .0000 | .0001 | .0005 | .0031 | .0222 | .0001 | .0002 | .0004 |
| NaHO& | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaHO* | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| F2 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NF | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 15.6872 | 50.9409 | 156.6984 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0023 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| AlH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al& | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al* | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NaH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| Na | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0002 | .0001 | .0001 | .0002 |
| F | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

M3

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N2 | CO2 | CO | H2O | H2 | CH4 | HF | Al2O3& | NaF& | NH3 | Na2CO3 | Na2CO3 | Al2O3* | C2F4 | CF4 |
| Al2O2 | AlF3 | CHF3 | Al2O | CF3 | COF2 | AlF2 | C2F2 | Na2O& | Na2O* | AlOF | AlHO2 | C4H10 | C4H8 | CNN |
| CH2F2 | O2F | CF2 | NaCN | NaCN& | NaCN* | CHOF | O3 | HO2 | AlF | C3H8 | AlO | C3H6 | NaF | NaF* |
| aF* | AlN | AlN& | NaHO | NaHO& | NaHO* | F2 | NF | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO |
| C2H4 | AlH | Al | Al& | Al* | C2H2 | NaH | Na | F | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | C& | H | | | | | | | | | |

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OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M31/A1 TRIPLE-BASE PROPELLANT, HOWITZER (MIL-STD-652)

| | H | C | N | O | S | K | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 20.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 19.000 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 54.000 | -209. | .0000 |
| DIBUTYE PHTHALATE | .014 | .012 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 4.500 | -733. | .0000 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | -1966. | .0962 |
| 2-NITRODIPHENYLAMINE | .010 | .012 | .002 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | 83. | .0494 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | ( |
|---|---|---|---|---|---|---|
| 3.401581 | 1.537385 | 2.520309 | 2.635528 | .005738 | .011477 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2108.064 | 2182.449 | 2261.565 | 2345.809 | 2436.079 | 2532.952 | 2593.480 | 2256.198 | 1713.364 | 1073.799 |
| FLAME TEMP. T(F) | 3335.115 | 3469.009 | 3611.418 | 3763.057 | 3925.542 | 4099.914 | 4208.864 | 3601.757 | 2624.656 | 1473.438 |
| ENTHALPY KCAL/GFW | -36.377 | -32.739 | -29.102 | -25.464 | -21.826 | -18.188 | -14.551 | -10.913 | -7.275 | -3.638 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 938.282 | 950.115 | 973.995 | 1008.882 | 1051.263 | 1101.330 | 1159.210 | 941.432 | 649.979 | 360.213 |
| FLAME TEMP. T(F) | 1229.507 | 1250.807 | 1293.792 | 1356.588 | 1432.873 | 1522.994 | 1627.179 | 1235.177 | 710.562 | 188.983 |
| ENTHALPY KCAL/GFW | -89.740 | -86.005 | -82.316 | -78.652 | -75.005 | -71.380 | -67.739 | -55.192 | -39.593 | -22.892 |
| T.VOL.GASES--LITERS (GASES AT STP) | 99.564 | 107.404 | 116.682 | 128.114 | 143.176 | 164.231 | 195.820 | 258.971 | 388.944 | 778.879 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N2 | 35.3001 | 44.0617 | 55.0140 | 69.0954 | 87.8702 | 114.1542 | 153.5794 | 219.2868 | 350.7050 | 744.9551 |
| CO2 | 28.7458 | 31.1511 | 33.9504 | 37.5433 | 42.6035 | 50.3789 | 63.9798 | 67.6568 | 67.6544 | 67.6469 |
| CO | 23.8273 | 22.8093 | 21.3425 | 19.1481 | 15.9415 | 10.9934 | 2.3364 | .0001 | .0001 | .0003 |
| H2O | 8.4137 | 9.7455 | 11.7055 | 14.4304 | 18.0222 | 22.7765 | 29.0888 | 30.5361 | 30.5351 | 30.5321 |
| H2 | 2.3289 | 2.2538 | 2.0800 | 1.7887 | 1.3892 | .8575 | .1526 | .0000 | .0000 | .0000 |
| KHO* | .5626 | .5317 | .4434 | .2069 | .0001 | .0001 | .0001 | .4240 | .0003 | .0006 |
| CH4 | .5360 | .2423 | .0620 | .0090 | .0008 | .0000 | .0000 | .0001 | .0001 | .0002 |
| H2S | .1906 | .1906 | .1905 | .1903 | .1898 | .1891 | .1632 | .0001 | .0002 | .0003 |
| KHO | .0777 | .1078 | .1935 | .4219 | .6213 | .6219 | .6313 | .2184 | .0003 | .0006 |
| CSO | .0080 | .0079 | .0079 | .0083 | .0088 | .0098 | .0102 | .0002 | .0003 | .0006 |
| NH3 | .0049 | .0044 | .0034 | .0022 | .0011 | .0004 | .0000 | .0001 | .0001 | .0002 |
| K | .0016 | .0022 | .0041 | .0097 | .0152 | .0147 | .0080 | .0001 | .0002 | .0004 |
| KCN | .0012 | .0011 | .0009 | .0007 | .0003 | .0001 | .0002 | .0002 | .0003 | .0007 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0022 | .0002 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0437 | .3646 | .3631 | .3587 |
| CNH | .0001 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |

M3|A1

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .6414 | .6389 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HS | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0003 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 14.8382 | 50.0920 | 155.8498 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0025 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N2 | CO2 | CO | H2O | H2 | KHO* | CH4 | H2S | KHO | CSO | NH3 | K | KCN | K2O& | S2O |
| SO3 | CS2 | S2 | SO2 | CNH | C4H10 | C4H8 | KHO& | KHO& | KO | SO | O3 | NS | NO2 | C3H8 |
| CS | C3H6 | KH | HS | HO2 | S | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* |
| HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | | | | |

PLOTAE 1

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=M31/A1/E1 TRIPLE-BASE PROPELLANT, HOWITZER (MIL-STD-562)

| | H | C | N | O | S | K | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 21.500 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 18.000 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 54.700 | -209. | .0000 |
| DIBUTYE PHTHALATE | .014 | .012 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 3.000 | -733. | .0000 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | 1.250 | -1966. | .0962 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | -127. | .0000 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .050 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | ( |
|---|---|---|---|---|---|---|
| 3.402410 | 1.504133 | 2.545378 | 2.628602 | .007173 | .014346 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2116.538 | 2190.256 | 2268.569 | 2351.781 | 2440.952 | 2536.659 | 2585.566 | 2230.532 | 1693.503 | 1062.837 |
| FLAME TEMP. T(F) | 3350.368 | 3483.061 | 3624.025 | 3773.806 | 3934.313 | 4106.587 | 4194.618 | 3555.557 | 2588.905 | 1453.706 |
| ENTHALPY KCAL/GFW | -36.775 | -33.098 | -29.420 | -25.743 | -22.065 | -18.388 | -14.710 | -11.033 | -7.355 | -3.678 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 940.501 | 954.106 | 979.763 | 1014.776 | 1055.555 | 1105.246 | 1162.313 | 928.186 | 640.939 | 355.844 |
| FLAME TEMP. T(F) | 1233.501 | 1257.991 | 1304.174 | 1367.197 | 1440.598 | 1530.042 | 1632.764 | 1211.336 | 694.291 | 181.119 |
| ENTHALPY KCAL/GFW | -90.194 | -86.417 | -82.679 | -78.962 | -75.264 | -71.590 | -67.870 | -54.764 | -39.282 | -22.722 |
| T.VOL.GASES--LITERS (GASES AT STP) | 99.373 | 107.126 | 116.305 | 127.698 | 142.755 | 163.809 | 195.436 | 259.195 | 389.168 | 779.103 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N2 | 35.6514 | 44.4130 | 55.3653 | 69.4467 | 88.2214 | 114.5054 | 153.9306 | 219.6380 | 351.0559 | 745.3064 |
| CO2 | 28.7604 | 31.1011 | 33.8441 | 37.4043 | 42.4720 | 50.2490 | 63.7735 | 66.1934 | 66.1909 | 66.1834 |
| CO | 23.0309 | 21.9995 | 20.5065 | 18.3086 | 15.0932 | 10.1436 | 1.5367 | .0001 | .0001 | .0003 |
| H2O | 8.7370 | 10.1304 | 12.1534 | 14.9076 | 18.5000 | 23.2537 | 29.5346 | 30.5177 | 30.5167 | 30.5137 |
| H2 | 2.3087 | 2.2189 | 2.0291 | 1.7311 | 1.3310 | .7993 | .1013 | .0000 | .0000 | .0000 |
| KHO* | .7195 | .6828 | .5809 | .3192 | .0001 | .0001 | .0001 | .6415 | .0003 | .0006 |
| CH4 | .4529 | .1905 | .0456 | .0065 | .0006 | .0000 | .0000 | .0001 | .0001 | .0002 |
| H2S | .2385 | .2385 | .2384 | .2380 | .2375 | .2367 | .1520 | .0001 | .0002 | .0003 |
| KHO | .0818 | .1175 | .2163 | .4692 | .7771 | .7783 | .7920 | .1619 | .0003 | .0006 |
| CSO | .0097 | .0096 | .0098 | .0102 | .0109 | .0122 | .0094 | .0002 | .0003 | .0006 |
| NH3 | .0047 | .0042 | .0031 | .0020 | .0011 | .0004 | .0000 | .0001 | .0001 | .0002 |
| K | .0016 | .0024 | .0046 | .0108 | .0187 | .0179 | .0082 | .0001 | .0002 | .0004 |
| KCN | .0011 | .0010 | .0008 | .0006 | .0003 | .0001 | .0002 | .0002 | .0003 | .0007 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0045 | .0002 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .1526 | .4566 | .4551 | .4506 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |

M3/A1E1

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .8024 | .7999 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| CNH | .0001 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HS | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0003 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 15.7161 | 50.9698 | 156.7275 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0022 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N2 | CO2 | CO | H2O | H2 | KHO* | CH4 | H2S | KHO | CSO | NH3 | K | KCN | K2O& | S2O |
| SO3 | CS2 | S2 | SO2 | C4H10 | C4H8 | KHO& | KHO& | KO | CNH | SO | O3 | NS | NO2 | C3H8 |
| CS | C3H6 | KH | HS | HO2 | S | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* |
| HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | | | | |

AHH

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=AHH DOUBLE-BASE PROPELLANT (MIL-P-604320)

| | H | C | N | O | PB | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 83.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 11.400 | -392. | .0578 |
| 2-NITRODIPHENYLAMINE | .010 | .012 | .002 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | 83. | .0494 |
| LEAD STEARATE -PBST | .070 | .036 | .000 | .004 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.300 | -425. | .0325 |
| LEADETHYLHEXOAT-PBEH | .030 | .016 | .000 | .004 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.300 | -694. | .0470 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

1.0000

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000

| (H ) | (C ) | (N ) | (O ) | (PB) | ( |
|---|---|---|---|---|---|
| 2.945932 | 2.216336 | .906456 | 3.508211 | .007630 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2376.751 | 2435.191 | 2497.095 | 2562.611 | 2631.116 | 2697.942 | 2726.258 | 2476.240 | 1889.075 | 1171.980 |
| FLAME TEMP. T(F) | 3818.752 | 3923.944 | 4035.371 | 4153.299 | 4276.609 | 4396.896 | 4447.863 | 3997.833 | 2940.934 | 1650.164 |
| ENTHALPY KCAL/GFW | -58.824 | -52.942 | -47.060 | -41.177 | -35.295 | -29.412 | -23.530 | -17.647 | -11.765 | -5.882 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1052.340 | 1080.021 | 1110.754 | 1143.942 | 1179.584 | 1218.117 | 1264.491 | 1099.955 | 746.824 | 402.931 |
| FLAME TEMP. T(F) | 1434.811 | 1484.638 | 1539.956 | 1599.696 | 1663.852 | 1733.210 | 1816.684 | 1520.519 | 884.883 | 265.875 |
| ENTHALPY KCAL/GFW | -115.241 | -109.028 | -102.821 | -96.624 | -90.445 | -84.291 | -78.118 | -65.634 | -47.013 | -26.830 |
| T.VOL.GASES--LITERS (GASES AT STP) | 93.054 | 100.124 | 108.911 | 120.195 | 135.233 | 156.285 | 187.863 | 248.119 | 378.098 | 768.039 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 39.3902 | 37.5243 | 35.0808 | 31.7721 | 27.0714 | 19.9388 | 8.1160 | .0001 | .0001 | .0003 |
| CO2 | 35.5799 | 38.5627 | 42.4176 | 47.6200 | 55.0063 | 66.2127 | 84.7880 | 97.5388 | 97.5366 | 97.5300 |
| N2 | 12.6966 | 21.4578 | 32.4094 | 46.4900 | 65.2640 | 91.5475 | 130.9727 | 196.6761 | 328.0979 | 722.3486 |
| H2O | 8.7392 | 10.1434 | 11.8665 | 13.9879 | 16.6341 | 19.9850 | 24.2878 | 26.5349 | 26.5339 | 26.5307 |
| H2 | 1.9847 | 1.8323 | 1.6409 | 1.4040 | 1.1080 | .7330 | .2515 | .0000 | .0000 | .0000 |
| Pb* | 1.5394 | 1.5056 | 1.4377 | 1.3009 | 1.0182 | .4124 | .0005 | .0007 | .0010 | .0021 |
| Pb | .0400 | .0737 | .1413 | .2778 | .5601 | 1.1645 | 1.5681 | .0007 | .0010 | .0021 |
| CH4 | .0262 | .0076 | .0018 | .0004 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0011 | .0010 | .0008 | .0006 | .0004 | .0002 | .0000 | .0001 | .0001 | .0002 |
| Pb2 | .0004 | .0005 | .0005 | .0006 | .0007 | .0008 | .0010 | .0014 | .0021 | .0041 |
| PbO | .0002 | .0002 | .0003 | .0003 | .0004 | .0014 | .0095 | .2053 | .0011 | .0022 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | 1.4920 | 1.6931 | 1.6831 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbO* | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbH | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| Pb& | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |

AHH

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 10.8673 | 46.1249 | 151.8805 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0108 | .0003 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | Pb* | Pb | CH4 | NH3 | Pb2 | PbO | PbO& | PbO& | PbO* | PbH |
| Pb& | C4H10 | C4H8 | O3 | NO2 | C3H8 | CNH | C3H6 | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO |
| C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | |

/\RP

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=ARP DOUBLE-BASE PROPELLANT (MIL-P-604320)

| | H | C | N | O | PB | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 75.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 17.000 | -392. | .0578 |
| 2-NITRODIPHENYLAMINE | .010 | .012 | .002 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.000 | 83. | .0494 |
| LEAD SALICYLATE | .010 | .014 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 6.000 | -864. | .0361 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .040 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.040 1.0000

| (H ) | (C ) | (N ) | (O ) | (PB) | ( |
|---|---|---|---|---|---|
| 2.671048 | 2.166416 | .917815 | 3.492979 | .012463 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.040 | 90.036 | 80.032 | 70.028 | 60.024 | 50.020 | 40.016 | 30.012 | 20.008 | 10.004 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2463.451 | 2516.922 | 2573.125 | 2631.767 | 2691.094 | 2742.133 | 2724.418 | 2405.366 | 1823.742 | 1132.951 |
| FLAME TEMP. T(F) | 3974.812 | 4071.060 | 4172.224 | 4277.780 | 4384.569 | 4476.440 | 4444.552 | 3870.259 | 2823.336 | 1579.911 |
| ENTHALPY KCAL/GFW | -58.547 | -52.693 | -46.838 | -40.983 | -35.128 | -29.274 | -23.419 | -17.564 | -11.709 | -5.855 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1104.695 | 1131.214 | 1159.461 | 1189.436 | 1221.325 | 1255.739 | 1301.149 | 1054.978 | 715.118 | 386.814 |
| FLAME TEMP. T(F) | 1529.051 | 1576.785 | 1627.629 | 1681.585 | 1738.985 | 1800.930 | 1882.668 | 1439.561 | 827.813 | 236.866 |
| ENTHALPY KCAL/GFW | -114.884 | -108.705 | -102.536 | -96.380 | -90.243 | -84.124 | -77.891 | -63.504 | -45.481 | -26.000 |
| T.VOL.GASES--LITERS (GASES AT STP) | 89.112 | 96.135 | 104.905 | 116.181 | 131.212 | 152.256 | 183.821 | 246.489 | 376.416 | 766.201 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 37.8371 | 35.7875 | 33.1245 | 29.5218 | 24.4104 | 16.6860 | 3.9707 | .0001 | .0001 | .0003 |
| CO2 | 35.8447 | 39.0735 | 43.2601 | 48.9213 | 56.9522 | 69.0883 | 89.0661 | 95.3036 | 95.3014 | 95.2948 |
| N2 | 12.8510 | 21.6086 | 32.5558 | 46.6306 | 65.3971 | 91.6700 | 131.0794 | 196.7578 | 328.1260 | 722.2191 |
| H2O | 9.2218 | 10.5416 | 12.1330 | 14.0662 | 16.4466 | 19.4134 | 23.1347 | 24.0491 | 24.0481 | 24.0450 |
| Pb* | 2.4754 | 2.4009 | 2.2656 | 2.0177 | 1.5503 | .6282 | .0005 | .0007 | .0010 | .0021 |
| H2 | 1.6581 | 1.5112 | 1.3334 | 1.1172 | .8508 | .5188 | .1024 | .0000 | .0000 | .0000 |
| Pb | .1043 | .1785 | .3136 | .5612 | 1.0278 | 1.9461 | 2.5335 | .0007 | .0010 | .0021 |
| CH4 | .0044 | .0013 | .0003 | .0001 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0007 | .0006 | .0005 | .0004 | .0002 | .0001 | .0000 | .0001 | .0001 | .0002 |
| Pb2 | .0004 | .0005 | .0005 | .0006 | .0007 | .0008 | .0010 | .0014 | .0021 | .0041 |
| PbO | .0002 | .0002 | .0003 | .0003 | .0009 | .0043 | .0471 | .0628 | .0011 | .0022 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | 2.7119 | 2.7706 | 2.7606 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbO* | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbH | .0002 | .0002 | .0003 | .0003 | .0003 | .0005 | .0005 | .0007 | .0010 | .0021 |
| Pb& | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |

ART

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 14.3385 | 49.5806 | 155.2940 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0081 | .0001 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | Pb* | H2 | Pb | CH4 | NH3 | Pb2 | PbO | PbO& | PbO& | PbO* | PbH |
| Pb& | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 | HO2 | O2 | NHO | CNH | C2H6 | CH2O | NO | CHO |
| C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | |

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=BALLISTITE DOUBLE-BASE PROPELLANT (AMCP-706-106)

| | H | C | N | O | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 50.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 40.000 | -392. | .0578 |
| DIBUTYE PHTHALATE | .014 | .012 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 4.000 | -733. | .0000 |
| CELLULOSE | .010 | .006 | .000 | .005 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 4.000 | -1417. | .0458 |
| CANDELLIA WAX | .012 | .007 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .500 | -142. | .0343 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | -127. | .0000 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .500 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

1.0000

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000

| (H ) | (C ) | (N ) | (O ) | ( |
|---|---|---|---|---|
| 2.905328 | 2.137015 | .986047 | 3.599450 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2636.753 | 2673.516 | 2712.125 | 2751.871 | 2789.907 | 2814.030 | 2761.104 | 2436.051 | 1854.434 | 1151.241 |
| FLAME TEMP. T(F) | 4286.756 | 4352.928 | 4422.425 | 4493.968 | 4562.433 | 4605.854 | 4510.586 | 3925.491 | 2878.581 | 1612.834 |
| ENTHALPY KCAL/GFW | -55.733 | -50.160 | -44.587 | -39.013 | -33.440 | -27.867 | -22.293 | -16.720 | -11.147 | -5.573 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1184.063 | 1204.672 | 1226.791 | 1250.688 | 1276.835 | 1306.429 | 1347.076 | 1066.327 | 726.012 | 393.822 |
| FLAME TEMP. T(F) | 1671.913 | 1709.009 | 1748.823 | 1791.837 | 1838.902 | 1892.172 | 1965.337 | 1459.989 | 847.422 | 249.480 |
| ENTHALPY KCAL/GFW | -118.109 | -111.597 | -105.093 | -98.604 | -92.131 | -85.667 | -79.018 | -63.932 | -45.767 | -26.152 |
| T.VOL.GASES--LITERS (GASES AT STP) | 91.613 | 98.632 | 107.404 | 118.682 | 133.720 | 154.771 | 186.349 | 249.720 | 379.701 | 769.642 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 37.0846 | 35.0022 | 32.3158 | 28.6870 | 23.5474 | 15.7808 | 2.9801 | .0001 | .0001 | .0003 |
| CO2 | 35.7818 | 39.0547 | 43.2758 | 48.9772 | 57.0523 | 69.2547 | 89.3666 | 94.0477 | 94.0456 | 94.0390 |
| N2 | 13.8121 | 22.5732 | 33.5247 | 47.6052 | 66.3791 | 92.6625 | 132.0876 | 197.7917 | 329.2128 | 723.4638 |
| H2O | 11.7007 | 13.0067 | 14.5862 | 16.5049 | 18.8695 | 21.8127 | 25.4873 | 26.1692 | 26.1681 | 26.1651 |
| H2 | 1.6190 | 1.4729 | 1.2962 | 1.0815 | .8169 | .4876 | .0764 | .0000 | .0000 | .0000 |
| CH4 | .0006 | .0002 | .0001 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0004 | .0004 | .0003 | .0003 | .0002 | .0001 | .0000 | .0001 | .0001 | .0002 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 15.3128 | 50.5694 | 156.3246 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0094 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |

BALLISTITE

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | CH4 | NH3 | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 | HO2 | O2 |
| NHO | C2H6 | CH2O | NO | CHO | C2H4 | CNH | C2H2 | H2O* | HO | HO | O | NH | CH2 | N |
| CH | C | C& | C& | H | | | | | | | | | | |

DENITE

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=BENITE SINGLE-BASE PROPELLANT (MIL-P-45451)

| | H | C | N | O | S | K | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 40.000 | -625. | .0600 |
| POTASSIUM NITRATE | .000 | .000 | .001 | .003 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | 44.300 | -1165. | .0762 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .050 | -127. | .0000 |
| SULFUR | .000 | .000 | .000 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 6.300 | 0. | .0739 |
| CHARCOAL | .003 | .007 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 8.900 | 0. | .0723 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 99.550 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | ( |
|---|---|---|---|---|---|---|
| 1.364262 | 1.537329 | .798312 | 2.818483 | .196470 | .438145 | |

Frozen exit temp too low for frozen results to be trusted.
Calculations good up to run 10
Either the material or material W28A air ratio is such that the flame temperature is too low to burn.
Changing the material air ratio may get it to calculate.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 99.550 | 89.595 | 79.640 | 69.685 | 59.730 | 49.775 | 39.820 | 29.865 | 19.910 | 9.955 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1914.365 | 1943.469 | 1970.441 | 2058.664 | 2154.979 | 2312.389 | 2139.570 | 1749.950 | 1395.327 | 884.997 |
| FLAME TEMP. T(F) | 2986.457 | 3038.845 | 3087.394 | 3246.196 | 3419.561 | 3702.899 | 3391.825 | 2690.510 | 2052.189 | 1133.595 |
| ENTHALPY KCAL/GFW | -76.596 | -68.937 | -61.277 | -53.617 | -45.958 | -38.298 | -30.638 | -22.979 | -15.319 | -7.660 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1200.067 | 1215.161 | 1228.209 | 1238.570 | 1243.887 | 1226.527 | 1108.709 | 821.601 | 550.665 | 301.883 |
| FLAME TEMP. T(F) | 1700.721 | 1727.890 | 1751.375 | 1770.027 | 1779.597 | 1748.348 | 1536.276 | 1019.481 | 531.798 | 83.989 |
| ENTHALPY KCAL/GFW | -109.775 | -103.567 | -97.346 | -91.125 | -84.856 | -78.563 | -68.444 | -54.739 | -39.511 | -22.899 |
| T.VOL.GASES--LITERS | 64.207 | 71.386 | 80.410 | 92.108 | 107.938 | 130.896 | 168.236 | 233.719 | 364.279 | 755.978 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 30.3737 | 35.5411 | 41.9152 | 49.8212 | 59.1068 | 65.5093 | 67.9615 | 67.9602 | 67.9577 | 67.9502 |
| CO | 23.1133 | 19.8497 | 15.8596 | 10.9710 | 5.3211 | 1.4970 | .0001 | .0001 | .0001 | .0003 |
| KHO* | 20.5645 | 19.0846 | 17.2459 | 15.0626 | 12.8496 | 13.3290 | 21.8794 | 24.6839 | .0003 | .0006 |
| N2 | 11.2326 | 20.0335 | 31.0346 | 45.1788 | 64.0375 | 90.4397 | 130.0395 | 196.0482 | 328.0592 | 724.0921 |
| H2S | 5.3557 | 5.0816 | 4.5951 | 3.7110 | 2.1385 | .4886 | .0001 | .0001 | .0002 | .0003 |
| KHO | 3.5345 | 4.8746 | 6.6000 | 8.7555 | 11.1356 | 11.0318 | 2.8141 | .0091 | .0003 | .0006 |
| H2O | 3.0188 | 3.6032 | 4.3433 | 5.3418 | 6.7419 | 7.9791 | 8.3787 | 8.3782 | 8.3772 | 8.3742 |
| CSO | 1.7213 | 1.6707 | 1.5319 | 1.2293 | .6753 | .1379 | .0002 | .0002 | .0003 | .0006 |
| K | .4132 | .5111 | .5905 | .6102 | .4939 | .2320 | .0001 | .0001 | .0002 | .0004 |
| S2 | .3465 | .6304 | 1.1554 | 2.1074 | 3.4765 | 1.7495 | .0002 | .0002 | .0003 | .0006 |
| H2 | .2936 | .2468 | .1948 | .1357 | .0691 | .0217 | .0000 | .0000 | .0000 | .0000 |
| CS2 | .0204 | .0165 | .0117 | .0063 | .0016 | .0002 | .0002 | .0003 | .0004 | .0008 |
| HS | .0061 | .0082 | .0106 | .0127 | .0120 | .0043 | .0001 | .0001 | .0002 | .0003 |
| KCN | .0025 | .0017 | .0009 | .0003 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| SO2 | .0014 | .0047 | .0186 | .0944 | .8623 | 7.9506 | 11.5165 | 12.6409 | 12.6394 | 12.6349 |
| S2O | .0003 | .0009 | .0028 | .0096 | .0402 | .0698 | .0002 | .0003 | .0004 | .0008 |
| CS | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |

BENITE

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| KH | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | 1.4064 | .0003 | .0004 | .0008 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | 24.6920 | 24.6895 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| SO | .0000 | .0001 | .0003 | .0010 | .0039 | .0088 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NH3 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | 6.6704 | 24.6610 | 60.0732 | 166.3091 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0074 | .0006 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | CO | KHO* | N2 | H2S | KHO | H2O | CSO | K | S2 | H2 | CS2 | HS | KCN | SO2 |
| S2O | CS | KH | K2O& | SO3 | C4H10 | C4H8 | KHO& | KHO& | KO | SO | O3 | NH3 | NS | NO2 |
| C3H8 | C3H6 | HO2 | S | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | CNH | C2H2 | H2O* | HO |
| HO | CH4 | O | NH | CH2 | N | CH | C | C& | C& | H | | | | |

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=T20 TRIPLE-BASE PROPELLANT (PATR-2700, C34)

| | H | C | N | O | PB | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 20.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 13.000 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 59.000 | -209. | .0000 |
| DIBUTYE PHTHALATE | .014 | .012 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 5.000 | -733. | .0000 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.000 | -127. | .0000 |
| LEAD CARBONATE-PBCO3 | .000 | .001 | .000 | .003 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | -629. | .2385 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

1.0000

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000

| (H ) | (C ) | (N ) | (O ) | (PB) | ( |
|---|---|---|---|---|---|
| 3.581628 | 1.587609 | 2.635064 | 2.477097 | .003742 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1861.590 | 1953.359 | 2051.185 | 2155.944 | 2268.888 | 2391.363 | 2517.345 | 2335.001 | 1776.590 | 1110.399 |
| FLAME TEMP. T(F) | 2891.462 | 3056.646 | 3232.733 | 3421.299 | 3624.598 | 3845.053 | 4071.822 | 3743.601 | 2738.461 | 1539.318 |
| ENTHALPY KCAL/GFW | -34.476 | -31.028 | -27.581 | -24.133 | -20.686 | -17.238 | -13.790 | -10.343 | -6.895 | -3.448 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 912.199 | 905.444 | 909.718 | 924.114 | 962.603 | 1019.528 | 1084.472 | 984.881 | 678.505 | 374.470 |
| FLAME TEMP. T(F) | 1182.558 | 1170.399 | 1178.093 | 1204.006 | 1273.285 | 1375.751 | 1492.649 | 1313.386 | 761.910 | 214.645 |
| ENTHALPY KCAL/GFW | -83.750 | -80.404 | -77.200 | -74.117 | -71.118 | -68.154 | -65.232 | -56.534 | -40.568 | -23.424 |
| T.VOL.GASES--LITERS (GASES AT STP) | 101.497 | 108.587 | 118.988 | 131.749 | 147.482 | 168.613 | 200.194 | 259.467 | 389.446 | 779.387 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| N2 | 36.9067 | 45.6675 | 56.6190 | 70.7002 | 89.4759 | 115.7609 | 155.1869 | 220.8940 | 352.3125 | 746.5627 |
| CO2 | 27.3369 | 30.1015 | 33.1974 | 36.9615 | 41.4905 | 48.0951 | 59.5881 | 69.8679 | 69.8657 | 69.8591 |
| CO | 22.8102 | 22.8748 | 21.9352 | 20.4636 | 18.0131 | 13.8570 | 6.5434 | .0001 | .0001 | .0003 |
| H2O | 7.5752 | 7.9163 | 9.2935 | 11.4109 | 14.9491 | 20.1531 | 27.3549 | 32.2612 | 32.2602 | 32.2571 |
| H2 | 2.4061 | 2.3745 | 2.3668 | 2.2630 | 1.9297 | 1.3546 | .5491 | .0000 | .0000 | .0000 |
| CH4 | 1.4139 | 1.3873 | .8051 | .2758 | .0282 | .0009 | .0000 | .0001 | .0001 | .0002 |
| Pb* | .7721 | .7721 | .7715 | .7701 | .7638 | .7356 | .6109 | .0007 | .0010 | .0021 |
| C& | .7685 | .0062 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| NH3 | .0063 | .0067 | .0065 | .0055 | .0033 | .0013 | .0002 | .0001 | .0001 | .0002 |
| Pb | .0017 | .0015 | .0019 | .0030 | .0089 | .0366 | .1604 | .0007 | .0010 | .0021 |
| Pb2 | .0004 | .0005 | .0005 | .0006 | .0007 | .0008 | .0010 | .0014 | .0021 | .0041 |
| PbO | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0085 | .0011 | .0022 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .8209 | .8253 | .8152 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbO* | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbH | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| Pb& | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| CNH | .0001 | .0001 | .0001 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |

120

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 9.4694 | 44.7231 | 150.4788 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0034 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N2 | CO2 | CO | H2O | H2 | CH4 | Pb* | C& | NH3 | Pb | Pb2 | PbO | PbO& | PbO& | PbO* |
| PbH | Pb& | CNH | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 | HO2 | O2 | NHO | C2H6 | CH2O | NO |
| CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | H | |

T25

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL*T25 DOUBLE-BASE PROPELLANT (MIL-P-46235)

| | H | C | N | O | K | BA | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 73.250 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 20.000 | -392. | .0578 |
| BARIUM NITRATE | .000 | .000 | .002 | .006 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .750 | -912. | .1171 |
| POTASSIUM NITRATE | .000 | .000 | .001 | .003 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .700 | -1165. | .0762 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 5.000 | -127. | .0000 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .300 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (K ) | (BA) | ( |
|---|---|---|---|---|---|---|
| 2.866865 | 2.239458 | .975321 | 3.492808 | .006923 | .002869 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2410.681 | 2466.464 | 2525.588 | 2593.088 | 2657.717 | 2720.043 | 2743.433 | 2496.219 | 1909.598 | 1182.652 |
| FLAME TEMP. T(F) | 3879.826 | 3980.235 | 4086.658 | 4208.159 | 4324.490 | 4436.677 | 4478.779 | 4033.793 | 2977.876 | 1669.373 |
| ENTHALPY KCAL/GFW | -55.750 | -50.175 | -44.600 | -39.025 | -33.450 | -27.875 | -22.300 | -16.725 | -11.150 | -5.575 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1059.880 | 1087.497 | 1118.068 | 1151.330 | 1187.247 | 1226.785 | 1273.075 | 1111.003 | 756.287 | 407.718 |
| FLAME TEMP. T(F) | 1448.383 | 1498.094 | 1553.123 | 1612.993 | 1677.644 | 1748.812 | 1832.134 | 1540.405 | 901.917 | 274.493 |
| ENTHALPY KCAL/GFW | -113.256 | -107.253 | -101.254 | -95.259 | -89.285 | -83.333 | -77.359 | -65.304 | -46.805 | -26.745 |
| T.VOL.GASES--LITERS (GASES AT STP) | 93.445 | 100.507 | 109.293 | 120.576 | 135.615 | 156.666 | 188.240 | 248.261 | 378.235 | 768.170 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 40.6967 | 38.7658 | 36.2508 | 32.8573 | 28.0750 | 20.8380 | 8.8094 | .0001 | .0001 | .0003 |
| CO2 | 34.5543 | 37.6320 | 41.5971 | 46.9325 | 54.4470 | 65.8174 | 84.7161 | 98.5563 | 98.5539 | 98.5471 |
| N2 | 13.6609 | 22.4223 | 33.3740 | 47.4546 | 66.2286 | 92.5122 | 131.9373 | 197.6402 | 329.0624 | 723.3130 |
| H2O | 8.2943 | 9.6628 | 11.3420 | 13.4092 | 16.0030 | 19.2860 | 23.4546 | 25.7604 | 25.7595 | 25.7567 |
| H2 | 1.9494 | 1.8002 | 1.6136 | 1.3826 | 1.0925 | .7251 | .2585 | .0000 | .0000 | .0000 |
| BaO& | .4399 | .4399 | .4399 | .4398 | .4398 | .4397 | .4397 | .4395 | .4393 | .4385 |
| KHO | .3586 | .3577 | .3568 | .3562 | .3564 | .3585 | .3668 | .3868 | .0019 | .0006 |
| CH4 | .0223 | .0065 | .0016 | .0003 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| K | .0195 | .0205 | .0214 | .0219 | .0218 | .0203 | .0143 | .0001 | .0002 | .0004 |
| KCN | .0018 | .0011 | .0005 | .0002 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| NH3 | .0011 | .0010 | .0008 | .0006 | .0004 | .0002 | .0000 | .0001 | .0001 | .0002 |
| Ba | .0001 | .0002 | .0002 | .0002 | .0002 | .0003 | .0003 | .0005 | .0007 | .0014 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .3834 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .3843 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .00[illegible] |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 10.5337 | 45.7917 | 151.54[illegible] |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0118 | .0003 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | BaO& | KHO | CH4 | K | KCN | NH3 | Ba | K2O& | C4H10 | C4H8 |
| KHO& | KHO& | KHO* | KO | O3 | CNH | NO2 | C3H8 | C3H6 | KH | HO2 | O2 | NHO | C2H6 | CH2O |
| NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& |
| H | | | | | | | | | | | | | | |

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=AMMONIUM PICRATE (100%) @ 14.7 psi

| | H | C | N | O | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AMMONIUM PRICRATE | .006 | .006 | .004 | .007 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 99.990 | -361. | .0621 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 99.990

1.0000

| (H ) | (C ) | (N ) | (O ) | ( |
|---|---|---|---|---|
| 2.437334 | 2.437334 | 1.624889 | 2.843556 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 99.990 | 89.991 | 79.992 | 69.993 | 59.994 | 49.995 | 39.996 | 29.997 | 19.998 | 9.999 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1787.635 | 1895.821 | 2009.525 | 2129.254 | 2256.090 | 2391.203 | 2533.083 | 2609.379 | 2066.381 | 1270.693 |
| FLAME TEMP. T(F) | 2758.343 | 2953.077 | 3157.744 | 3373.257 | 3601.561 | 3844.766 | 4100.149 | 4237.483 | 3260.086 | 1827.847 |
| ENTHALPY KCAL/GFW | -36.090 | -32.481 | -28.872 | -25.263 | -21.654 | -18.045 | -14.436 | -10.827 | -7.218 | -3.609 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 976.927 | 968.155 | 957.600 | 944.863 | 949.594 | 1009.430 | 1085.554 | 1174.712 | 831.169 | 443.253 |
| FLAME TEMP. T(F) | 1299.068 | 1283.280 | 1264.280 | 1241.354 | 1249.869 | 1357.574 | 1494.597 | 1655.081 | 1036.705 | 338.456 |
| ENTHALPY KCAL/GFW | -81.782 | -78.388 | -75.234 | -72.329 | -69.676 | -67.120 | -64.568 | -61.938 | -45.830 | -26.393 |
| T.VOL.GASES--LITERS (GASES AT STP) | 99.022 | 106.057 | 114.842 | 126.130 | 141.847 | 163.420 | 195.024 | 247.659 | 375.800 | 765.779 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 43.2531 | 43.4619 | 43.4029 | 42.9560 | 40.6444 | 34.1511 | 23.4855 | 3.3185 | .0001 | .0003 |
| CO2 | 23.9517 | 26.7579 | 30.5007 | 35.5936 | 42.8893 | 53.5980 | 70.3764 | 102.0618 | 107.2736 | 107.2671 |
| N2 | 22.7616 | 31.5234 | 42.4757 | 56.5572 | 75.3332 | 101.6205 | 141.0503 | 206.7656 | 338.1953 | 732.4854 |
| C& | 3.8577 | 3.0070 | 2.0143 | .8185 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| H2O | 3.8056 | 4.0202 | 4.3018 | 4.6726 | 5.8570 | 9.2049 | 14.2366 | 21.1138 | 21.9546 | 21.9516 |
| H2 | 1.9179 | 1.8953 | 1.8649 | 1.8243 | 1.7527 | 1.4247 | .8637 | .0942 | .0000 | .0000 |
| CH4 | .4491 | .4430 | .4383 | .4349 | .1925 | .0078 | .0001 | .0001 | .0001 | .0002 |
| NH3 | .0024 | .0027 | .0030 | .0032 | .0030 | .0015 | .0004 | .0001 | .0001 | .0002 |
| CNH | .0001 | .0002 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | 32.6117 | 138.3779 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0010 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |

CK Atmospheric @ 14.7 psi

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | C& | H2O | H2 | CH4 | NH3 | CNH | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 |
| HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | H | | | | | | | | | | |

MK C 13

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=HPC-13 DOUBLE-BASE PROPELLANT (PATR-2700)

| | H | C | N | O | S | K | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 65.600 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 32.000 | -392. | .0578 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | -1966. | .0962 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | -127. | .0000 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .400 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | ( |
|---|---|---|---|---|---|---|
| 2.602031 | 1.968348 | 1.020675 | 3.675310 | .005738 | .011477 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2925.122 | 2934.485 | 2941.529 | 2942.427 | 2927.174 | 2866.732 | 2680.390 | 2272.365 | 1719.061 | 1072.560 |
| FLAME TEMP. T(F) | 4805.819 | 4822.673 | 4835.353 | 4836.968 | 4809.513 | 4700.717 | 4365.301 | 3630.857 | 2634.909 | 1471.209 |
| ENTHALPY KCAL/GFW | -55.637 | -50.074 | -44.510 | -38.946 | -33.382 | -27.819 | -22.255 | -16.691 | -11.127 | -5.564 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1390.505 | 1398.490 | 1407.247 | 1417.062 | 1428.231 | 1443.253 | 1277.862 | 967.172 | 661.151 | 361.971 |
| FLAME TEMP. T(F) | 2043.510 | 2057.882 | 2073.645 | 2091.311 | 2111.416 | 2138.456 | 1840.752 | 1281.510 | 730.671 | 192.148 |
| ENTHALPY KCAL/GFW | -121.971 | -115.062 | -108.161 | -101.265 | -94.356 | -87.317 | -75.861 | -59.996 | -42.919 | -24.606 |
| T.VOL.GASES--LITERS (GASES AT STP) | 84.968 | 91.983 | 100.755 | 112.038 | 127.096 | 148.229 | 184.330 | 249.326 | 379.298 | 769.234 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 38.7310 | 42.6425 | 47.7310 | 54.5516 | 64.0576 | 77.9421 | 86.6253 | 86.6240 | 86.6215 | 86.6140 |
| CO | 30.4729 | 27.9829 | 24.7437 | 20.4023 | 14.3536 | 5.5259 | .0001 | .0001 | .0001 | .0003 |
| H2O | 14.7257 | 15.7684 | 16.9891 | 18.4400 | 20.1789 | 22.2806 | 23.3338 | 23.3337 | 23.3327 | 23.3298 |
| N2 | 14.2974 | 23.0586 | 34.0100 | 48.0904 | 66.8642 | 93.1476 | 132.5600 | 198.2792 | 329.6979 | 723.9482 |
| H2 | .9547 | .8380 | .7015 | .5395 | .3467 | .1180 | .0000 | .0000 | .0000 | .0000 |
| KHO | .5349 | .5397 | .5464 | .5557 | .5699 | .5965 | .6427 | .3588 | .0003 | .0006 |
| H2S | .1791 | .1773 | .1740 | .1652 | .1299 | .0125 | .0001 | .0001 | .0002 | .0003 |
| K | .0756 | .0723 | .0675 | .0610 | .0511 | .0324 | .0001 | .0001 | .0002 | .0004 |
| CSO | .0239 | .0248 | .0257 | .0262 | .0226 | .0025 | .0002 | .0002 | .0003 | .0006 |
| HS | .0012 | .0015 | .0018 | .0023 | .0026 | .0005 | .0001 | .0001 | .0002 | .0003 |
| SO2 | .0011 | .0023 | .0054 | .0171 | .0797 | .3360 | .3576 | .3646 | .3631 | .3587 |
| S2 | .0007 | .0010 | .0017 | .0032 | .0061 | .0007 | .0002 | .0002 | .0003 | .0006 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| NH3 | .0001 | .0001 | .0001 | .0001 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0099 | .0003 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| KCN | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .6414 | .6389 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |

HPC 13

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| KHO* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .2836 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| SO | .0001 | .0001 | .0002 | .0004 | .0012 | .0016 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | 6.4385 | 24.0793 | 59.3341 | 165.0919 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0272 | .0041 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0008 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | CO | H2O | N2 | H2 | KHO | H2S | K | CSO | HS | SO2 | S2 | K2O& | NH3 | S2O |
| SO3 | CS2 | KCN | C4H10 | C4H8 | KHO& | KHO& | KHO* | KO | SO | O3 | KH | NS | NO2 | C3H8 |
| CS | C3H6 | HO2 | S | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | CNH | C2H2 | H2O* | HO |
| HO | CH4 | O | NH | CH2 | N | CH | C | C& | C& | H | | | | |

1MK

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=IMPROVED MILITARY RIFLE (IMR) SINGLE-BASE PROPELLANT (JAN-P-

| | H | C | N | O | S | K | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 91.160 | -625. | .0600 |
| DINITROTOLUENE - DNT | .006 | .007 | .002 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 7.290 | -58. | .0419 |
| DIPHENYLAMINE - DPA | .011 | .012 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .640 | 178. | .0419 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .910 | -1966. | .0962 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | ( |
|---|---|---|---|---|---|---|
| 2.808426 | 2.333509 | .903746 | 3.494116 | .005222 | .010444 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2266.191 | 2333.517 | 2404.509 | 2479.549 | 2559.288 | 2641.956 | 2704.544 | 2523.111 | 1933.312 | 1196.390 |
| FLAME TEMP. T(F) | 3619.744 | 3740.931 | 3868.716 | 4003.789 | 4147.319 | 4296.121 | 4408.778 | 4082.199 | 3020.561 | 1694.101 |
| ENTHALPY KCAL/GFW | -59.057 | -53.151 | -47.246 | -41.340 | -35.434 | -29.528 | -23.623 | -17.717 | -11.811 | -5.906 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1000.666 | 1023.094 | 1054.585 | 1092.920 | 1134.986 | 1181.146 | 1233.550 | 1132.930 | 770.533 | 414.098 |
| FLAME TEMP. T(F) | 1341.798 | 1382.170 | 1438.853 | 1507.855 | 1583.575 | 1666.663 | 1760.989 | 1579.875 | 927.559 | 285.977 |
| ENTHALPY KCAL/GFW | -113.086 | -107.108 | -101.143 | -95.184 | -89.233 | -83.298 | -77.368 | -66.810 | -47.889 | -27.326 |
| T.VOL.GASES--LITERS (GASES AT STP) | 93.703 | 101.011 | 109.893 | 121.201 | 136.243 | 157.295 | 188.872 | 247.129 | 377.106 | 767.041 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 42.8395 | 40.9694 | 38.4911 | 35.1779 | 30.4995 | 23.4441 | 11.7002 | .0001 | .0001 | .0003 |
| CO2 | 34.9570 | 38.1784 | 42.1782 | 47.4095 | 54.7637 | 65.8479 | 84.2975 | 102.6951 | 102.6926 | 102.6851 |
| N2 | 12.6575 | 21.4186 | 32.3706 | 46.4516 | 65.2258 | 91.5095 | 130.9347 | 196.6374 | 328.0598 | 722.3102 |
| H2O | 6.5904 | 7.8055 | 9.4350 | 11.5358 | 14.1939 | 17.5942 | 21.9424 | 25.2022 | 25.2013 | 25.1983 |
| H2 | 2.0345 | 1.9247 | 1.7522 | 1.5196 | 1.2226 | .8423 | .3560 | .0000 | .0000 | .0000 |
| KHO* | .3045 | .1260 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .5806 | .0006 |
| KHO | .2620 | .4292 | .5466 | .5452 | .5442 | .5452 | .5534 | .5843 | .0031 | .0006 |
| H2S | .1693 | .1692 | .1689 | .1684 | .1676 | .1663 | .1593 | .0001 | .0002 | .0003 |
| CH4 | .1528 | .0495 | .0111 | .0018 | .0002 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CSO | .0145 | .0146 | .0150 | .0158 | .0170 | .0189 | .0214 | .0002 | .0003 | .0006 |
| K | .0112 | .0190 | .0257 | .0275 | .0285 | .0278 | .0219 | .0001 | .0002 | .0004 |
| KCN | .0035 | .0036 | .0023 | .0009 | .0003 | .0001 | .0002 | .0002 | .0003 | .0007 |
| NH3 | .0016 | .0016 | .0013 | .0009 | .0005 | .0002 | .0001 | .0001 | .0001 | .0002 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0264 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| CNH | .0001 | .0001 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0012 | .0002 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0076 | .3107 | .3301 | .3256 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .5809 |

1M R

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HS | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0005 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 7.8591 | 43.1234 | 148.8813 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0122 | .0004 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | KHO* | KHO | H2S | CH4 | CSO | K | KCN | NH3 | K2O& | S2O |
| SO3 | CS2 | CNH | S2 | SO2 | C4H10 | C4H8 | KHO& | KHO& | KO | SO | O3 | NS | NO2 | C3H8 |
| CS | C3H6 | KH | HS | HO2 | S | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* |
| HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | | | | |

CB1

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=CBI (CLEAN BURNING INITIATOR) SINGLE-BASE PROPELLANT (MIL-P-

| | H | C | N | O | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 98.000 | -625. | .0600 |
| DIPHENYLAMINE - DPA | .011 | .012 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | 178. | .0419 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 5.000 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 104.500 1.0000

| (H ) | (C ) | (N ) | (O ) | ( |
|---|---|---|---|---|
| 2.813768 | 2.681273 | .890301 | 3.561726 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 104.500 | 94.050 | 83.600 | 73.150 | 62.700 | 52.250 | 41.800 | 31.350 | 20.900 | 10.450 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1968.134 | 2056.627 | 2150.668 | 2251.016 | 2358.545 | 2473.779 | 2593.010 | 2628.638 | 2093.413 | 1293.987 |
| FLAME TEMP. T(F) | 3083.241 | 3242.528 | 3411.803 | 3592.428 | 3785.982 | 3993.403 | 4208.019 | 4272.149 | 3308.743 | 1869.777 |
| ENTHALPY KCAL/GFW | -60.968 | -54.871 | -48.774 | -42.678 | -36.581 | -30.484 | -24.387 | -18.290 | -12.194 | -6.097 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 969.305 | 961.025 | 951.378 | 972.303 | 1017.185 | 1075.049 | 1140.022 | 1219.745 | 853.971 | 455.416 |
| FLAME TEMP. T(F) | 1285.350 | 1270.446 | 1253.081 | 1290.746 | 1371.532 | 1475.687 | 1592.640 | 1736.141 | 1077.749 | 360.349 |
| ENTHALPY KCAL/GFW | -111.394 | -105.380 | -99.515 | -93.773 | -88.078 | -82.395 | -76.729 | -70.939 | -51.745 | -29.445 |
| T.VOL.GASES--LITERS (GASES AT STP) | 95.826 | 102.558 | 110.973 | 122.816 | 137.591 | 157.780 | 188.000 | 238.364 | 361.425 | 734.575 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 46.5905 | 46.3380 | 45.8343 | 43.2627 | 39.0892 | 32.6935 | 22.2795 | 2.4168 | .0001 | .0003 |
| CO2 | 32.4246 | 35.4410 | 39.3482 | 44.5276 | 51.4607 | 61.5511 | 77.9151 | 109.1224 | 112.9175 | 112.9112 |
| N2 | 11.9326 | 20.3160 | 30.7955 | 44.2698 | 62.2360 | 87.3882 | 125.1160 | 187.9951 | 313.7523 | 691.0264 |
| H2O | 4.8925 | 5.1174 | 5.4077 | 6.8907 | 9.3247 | 12.7736 | 17.4687 | 23.6850 | 24.2520 | 24.2491 |
| H2 | 2.0299 | 2.0062 | 1.9757 | 1.9041 | 1.6663 | 1.2843 | .7592 | .0636 | .0000 | .0000 |
| C& | 1.5847 | .8743 | .0300 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH4 | .5424 | .5363 | .5283 | .1531 | .0161 | .0008 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0020 | .0025 | .0029 | .0025 | .0016 | .0008 | .0003 | .0001 | .0001 | .0002 |
| CNH | .0001 | .0001 | .0001 | .0001 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | 31.8483 | 133.0501 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0014 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |

C7

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | C& | CH4 | NH3 | CNH | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 |
| HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | H | | | | | | | | | | |

N12

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=N12 DOUBLE-BASE PROPELLANT (MIL-P-17689)

| | H | C | N | O | PB | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 50.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 38.000 | -392. | .0578 |
| 2-NITRODIPHENYLAMINE | .010 | .012 | .002 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.000 | 83. | .0494 |
| DIOCTYL ADIPATE | .042 | .022 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 5.850 | -733. | .0332 |
| CANDELLIA WAX | .012 | .007 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .150 | -142. | .0343 |
| LEAD SALICYLATE | .010 | .014 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.000 | -864. | .0361 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 98.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (PB) | ( |
|---|---|---|---|---|---|
| 3.038679 | 2.131095 | .970373 | 3.430417 | .004154 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 98.000 | 88.200 | 78.400 | 68.600 | 58.800 | 49.000 | 39.200 | 29.400 | 19.600 | 9.800 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2494.997 | 2543.294 | 2594.439 | 2648.386 | 2704.053 | 2755.159 | 2758.884 | 2490.443 | 1899.824 | 1177.030 |
| FLAME TEMP. T(F) | 4031.594 | 4118.529 | 4210.590 | 4307.694 | 4407.896 | 4499.886 | 4506.590 | 4023.397 | 2960.284 | 1659.254 |
| ENTHALPY KCAL/GFW | -52.021 | -46.819 | -41.617 | -36.415 | -31.213 | -26.010 | -20.808 | -15.606 | -10.404 | -5.202 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1100.327 | 1125.634 | 1152.842 | 1181.908 | 1213.253 | 1249.317 | 1292.560 | 1103.200 | 749.230 | 404.347 |
| FLAME TEMP. T(F) | 1521.189 | 1566.741 | 1615.715 | 1668.035 | 1724.455 | 1789.370 | 1867.208 | 1526.359 | 889.214 | 268.425 |
| ENTHALPY KCAL/GFW | -111.178 | -105.360 | -99.549 | -93.749 | -87.967 | -82.208 | -76.408 | -63.921 | -45.855 | -26.243 |
| T.VOL.GASES--LITERS (GASES AT STP) | 94.770 | 101.945 | 110.899 | 122.411 | 137.755 | 159.237 | 191.459 | 253.515 | 386.146 | 784.045 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 39.2967 | 37.3701 | 34.8611 | 31.4728 | 26.6748 | 19.4293 | 7.3455 | .0001 | .0001 | .0003 |
| CO2 | 33.9412 | 36.9819 | 40.9285 | 46.2534 | 53.7921 | 65.1758 | 84.1612 | 95.7013 | 95.6990 | 95.6922 |
| N2 | 13.8696 | 22.8096 | 33.9846 | 48.3524 | 67.5096 | 94.3295 | 134.5592 | 201.6033 | 335.7076 | 738.0040 |
| H2O | 10.0008 | 11.4505 | 13.2082 | 15.3673 | 18.0671 | 21.5073 | 25.8855 | 27.9289 | 27.9279 | 27.9247 |
| H2 | 2.0043 | 1.8434 | 1.6471 | 1.4057 | 1.1036 | .7187 | .2287 | .0000 | .0000 | .0000 |
| Pb* | .7749 | .7043 | .5786 | .3494 | .0003 | .0004 | .0005 | .0007 | .0011 | .0021 |
| Pb | .1018 | .1722 | .2977 | .5265 | .8750 | .8736 | .8671 | .0007 | .0011 | .0021 |
| CH4 | .0074 | .0024 | .0006 | .0001 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0009 | .0008 | .0007 | .0005 | .0003 | .0001 | .0000 | .0001 | .0001 | .0002 |
| Pb2 | .0004 | .0005 | .0005 | .0006 | .0007 | .0008 | .0010 | .0014 | .0021 | .0042 |
| PbO | .0002 | .0002 | .0003 | .0003 | .0006 | .0015 | .0076 | .2275 | .0011 | .0023 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0005 | .0006 | .7126 | .9360 | .9257 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0005 | .0006 | .0008 | .0011 | .0023 |
| PbO* | .0002 | .0002 | .0003 | .0003 | .0004 | .0005 | .0006 | .0008 | .0011 | .0023 |
| PbH | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0011 | .0021 |
| Pb& | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0011 | .0021 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |

N12

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 11.9016 | 47.8791 | 155.7930 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0118 | .0003 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | Pb* | Pb | CH4 | NH3 | Pb2 | PbO | PbO& | PbO& | PbO* | PbH |
| Pb& | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 | CNH | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO |
| C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | |

N12

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=N14 DOUBLE-BASE PROPELLANT (OS-11315)

| | H | C | N | O | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 48.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 44.500 | -392. | .0578 |
| 2-NITRODIPHENYLAMINE | .010 | .012 | .002 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.000 | 83. | .0494 |
| DIOCTYL ADIPATE | .042 | .022 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .400 | -733. | .0332 |
| CANDELLIA WAX | .012 | .007 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 5.100 | -142. | .0343 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | ( |
|---|---|---|---|---|
| 3.069842 | 2.130607 | 1.038251 | 3.548192 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2696.887 | 2727.521 | 2759.792 | 2793.086 | 2824.929 | 2845.091 | 2802.559 | 2509.383 | 1919.220 | 1189.809 |
| FLAME TEMP. T(F) | 4394.997 | 4450.137 | 4508.226 | 4568.154 | 4625.473 | 4661.763 | 4585.206 | 4057.489 | 2995.196 | 1682.256 |
| ENTHALPY KCAL/GFW | -48.300 | -43.470 | -38.640 | -33.810 | -28.980 | -24.150 | -19.320 | -14.490 | -9.660 | -4.830 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1203.051 | 1221.972 | 1242.308 | 1264.306 | 1288.411 | 1315.691 | 1351.712 | 1112.253 | 757.082 | 409.328 |
| FLAME TEMP. T(F) | 1706.092 | 1740.150 | 1776.754 | 1816.351 | 1859.740 | 1908.844 | 1973.682 | 1542.655 | 903.347 | 277.390 |
| ENTHALPY KCAL/GFW | -113.580 | -107.508 | -101.445 | -95.396 | -89.365 | -83.347 | -77.215 | -63.668 | -45.698 | -26.175 |
| T.VOL.GASES--LITERS (GASES AT STP) | 93.901 | 100.919 | 109.691 | 120.969 | 136.007 | 157.059 | 188.637 | 250.654 | 380.634 | 770.575 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 38.5466 | 36.5146 | 33.8938 | 30.3618 | 25.3665 | 17.8206 | 5.3722 | .0001 | .0001 | .0003 |
| CO2 | 33.2029 | 36.3962 | 40.5144 | 46.0637 | 53.9120 | 65.7678 | 85.3261 | 93.7657 | 93.7635 | 93.7569 |
| N2 | 14.5433 | 23.3045 | 34.2560 | 48.3364 | 67.1103 | 93.3938 | 132.8189 | 198.5211 | 329.9441 | 724.1950 |
| H2O | 11.9483 | 13.2869 | 14.9086 | 16.8895 | 19.3470 | 22.4321 | 26.3333 | 27.6511 | 27.6501 | 27.6470 |
| H2 | 1.7571 | 1.6074 | 1.4260 | 1.2043 | .9293 | .5841 | .1475 | .0000 | .0000 | .0000 |
| CH4 | .0005 | .0002 | .0001 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0005 | .0004 | .0004 | .0003 | .0002 | .0001 | .0000 | .0001 | .0001 | .0002 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 13.3794 | 48.6382 | 154.3934 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0134 | .0003 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | CH4 | NH3 | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 | HO2 | O2 |
| NHO | C2H6 | CH2O | NO | CHO | C2H4 | CNH | C2H2 | H2O* | HO | HO | O | NH | CH2 | N |
| CH | C | C& | C& | H | | | | | | | | | | |

JA 2

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=JA-2 DOUBLE-BASE PROPELLANT (DOD-P-63493, DOD-P-64035)

| | H | C | N | O | MG | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 59.500 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 14.900 | -392. | .0578 |
| CANDELLIA WAX | .012 | .007 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .700 | -142. | .0343 |
| DEGN | .008 | .004 | .002 | .007 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 24.800 | -517. | .0499 |
| MAGNESIUM | .000 | .000 | .000 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .050 | 0. | .0628 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .050 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (MG) | ( |
|---|---|---|---|---|---|
| 3.074052 | 2.065386 | .984892 | 3.640477 | .002056 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2710.486 | 2739.699 | 2770.155 | 2800.828 | 2828.059 | 2837.112 | 2759.270 | 2416.803 | 1840.197 | 1144.034 |
| FLAME TEMP. T(F) | 4419.475 | 4472.058 | 4526.879 | 4582.091 | 4631.106 | 4647.401 | 4507.285 | 3890.845 | 2852.955 | 1599.861 |
| ENTHALPY KCAL/GFW | -55.953 | -50.358 | -44.763 | -39.167 | -33.572 | -27.977 | -22.381 | -16.786 | -11.191 | -5.595 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1232.617 | 1249.702 | 1268.090 | 1288.049 | 1310.081 | 1335.586 | 1376.108 | 1053.422 | 718.477 | 390.707 |
| FLAME TEMP. T(F) | 1759.311 | 1790.063 | 1823.162 | 1859.087 | 1898.745 | 1944.655 | 2017.594 | 1436.759 | 833.858 | 243.873 |
| ENTHALPY KCAL/GFW | -120.753 | -113.960 | -107.178 | -100.410 | -93.660 | -86.911 | -79.836 | -63.780 | -45.632 | -26.067 |
| T.VOL.GASES--LITERS (GASES AT STP) | 91.933 | 98.951 | 107.721 | 119.001 | 134.038 | 155.090 | 186.667 | 251.139 | 381.118 | 771.059 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 35.8184 | 39.0715 | 43.2898 | 48.9898 | 57.0658 | 69.2695 | 89.3973 | 90.8946 | 90.8920 | 90.8843 |
| CO | 35.0555 | 32.9852 | 30.3004 | 26.6724 | 21.5322 | 13.7647 | .9538 | .0001 | .0001 | .0003 |
| N2 | 13.7960 | 22.5571 | 33.5086 | 47.5890 | 66.3629 | 92.6463 | 132.0713 | 197.7757 | 329.1965 | 723.4470 |
| H2O | 13.6781 | 14.9925 | 16.5734 | 18.4927 | 20.8571 | 23.7998 | 27.4680 | 27.6890 | 27.6879 | 27.6848 |
| H2 | 1.5679 | 1.4208 | 1.2439 | 1.0292 | .7646 | .4353 | .0248 | .0000 | .0000 | .0000 |
| MgO& | .0823 | .0823 | .0822 | .0821 | .0820 | .0818 | .0815 | .0810 | .0801 | .0772 |
| NH3 | .0003 | .0003 | .0003 | .0002 | .0001 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH4 | .0002 | .0001 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| Mg3N2& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0003 | .0005 | .0010 |
| Mg2C3& | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| MgC2& | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| MgHO | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| MgO | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| MgO* | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| MgN | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |

JA2

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 16.8802 | 52.1371 | 157.8940 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0087 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| MgH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Mg | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| Mg& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| Mg* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | CO | N2 | H2O | H2 | MgO& | NH3 | CH4 | Mg3N2& | Mg2C3& | C4H10 | C4H8 | MgC2& | O3 | NO2 |
| C3H8 | C3H6 | MgHO | MgO | MgO* | MgN | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | CNH |
| C2H2 | MgH | Mg | Mg& | Mg* | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& |
| C& | H | | | | | | | | | | | | | |

LCA 6260

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=LCA 6260 TRIPLE-BASE PROPELLANT (PATR-2700)

| | H | C | N | O | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 29.300 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 22.700 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 5.000 | -209. | .0000 |
| DIOCTYL PHTHALATE | .038 | .024 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 5.000 | -668. | .0360 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | -127. | .0000 |
| RDX -(S) | .006 | .003 | .006 | .006 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 36.500 | 72. | .0656 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | ( |
|---|---|---|---|---|
| 3.095325 | 1.894544 | 1.753374 | 3.097705 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2675.182 | 2706.684 | 2740.129 | 2775.182 | 2809.915 | 2835.156 | 2798.559 | 2496.465 | 1905.895 | 1181.785 |
| FLAME TEMP. T(F) | 4355.928 | 4412.632 | 4472.833 | 4535.927 | 4598.446 | 4643.880 | 4578.006 | 4034.237 | 2971.210 | 1667.813 |
| ENTHALPY KCAL/GFW | -29.143 | -26.229 | -23.314 | -20.400 | -17.486 | -14.571 | -11.657 | -8.743 | -5.829 | -2.914 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1159.186 | 1180.375 | 1203.156 | 1227.756 | 1254.583 | 1284.635 | 1323.299 | 1089.344 | 743.970 | 404.298 |
| FLAME TEMP. T(F) | 1627.135 | 1665.275 | 1706.280 | 1750.561 | 1798.849 | 1852.942 | 1922.538 | 1501.419 | 879.747 | 268.336 |
| ENTHALPY KCAL/GFW | -95.141 | -90.909 | -86.683 | -82.469 | -78.273 | -74.098 | -69.828 | -57.923 | -41.756 | -24.151 |
| T.VOL.GASES--LITERS (GASES AT STP) | 96.910 | 103.930 | 112.703 | 123.981 | 139.020 | 160.071 | 191.649 | 253.766 | 383.747 | 773.687 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 35.6146 | 33.7465 | 31.3492 | 28.1201 | 23.5406 | 16.5708 | 4.9171 | .0001 | .0001 | .0003 |
| CO2 | 27.4173 | 30.3552 | 34.1228 | 39.1965 | 46.3915 | 57.3422 | 75.6519 | 83.3764 | 83.3742 | 83.3676 |
| N2 | 24.5605 | 33.3217 | 44.2733 | 58.3538 | 77.1277 | 103.4112 | 142.8363 | 208.5394 | 339.9615 | 734.2121 |
| H2O | 10.4548 | 11.8971 | 13.6620 | 15.8376 | 18.5624 | 22.0181 | 26.4304 | 27.8806 | 27.8796 | 27.8766 |
| H2 | 1.9496 | 1.7885 | 1.5911 | 1.3477 | 1.0428 | .6561 | .1623 | .0000 | .0000 | .0000 |
| CH4 | .0016 | .0006 | .0002 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0008 | .0007 | .0006 | .0004 | .0003 | .0001 | .0000 | .0001 | .0001 | .0002 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 13.5229 | 48.7805 | 154.5357 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0113 | .0003 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |

LCA 62260

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | CH4 | NH3 | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 | CNH | HO2 |
| O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N |
| CH | C | C& | C& | H | | | | | | | | | | |

NACO II

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=NACO II SINGLE-BASE PROPELLANT (MIL-P-19264)

| | H | C | N | O | S | K | PB | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 93.600 | -625. | .0600 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | 1.200 | -1966. | .0962 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.030 | -127. | .0000 |
| BUTYL STEARATE | .044 | .022 | .000 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 3.000 | -692. | .0309 |
| LEAD CARBONATE-PBCO3 | .000 | .001 | .000 | .003 | .000 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | 1.000 | -629. | .2385 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 99.830 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | (PB) | ( |
|---|---|---|---|---|---|---|---|
| 3.063498 | 2.328610 | .850025 | 3.458199 | .006886 | .013772 | .003742 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 99.830 | 89.847 | 79.864 | 69.881 | 59.898 | 49.915 | 39.932 | 29.949 | 19.966 | 9.983 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2074.158 | 2155.447 | 2241.391 | 2332.250 | 2428.577 | 2531.636 | 2631.254 | 2527.599 | 1943.871 | 1204.363 |
| FLAME TEMP. T(F) | 3274.085 | 3420.405 | 3575.103 | 3738.650 | 3912.038 | 4097.545 | 4276.858 | 4090.278 | 3039.569 | 1708.454 |
| ENTHALPY KCAL/GFW | -63.680 | -57.312 | -50.944 | -44.576 | -38.208 | -31.840 | -25.472 | -19.104 | -12.736 | -6.368 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 958.445 | 969.239 | 991.621 | 1026.328 | 1070.961 | 1122.859 | 1180.459 | 1142.470 | 778.694 | 418.018 |
| FLAME TEMP. T(F) | 1265.801 | 1285.230 | 1325.518 | 1387.990 | 1468.330 | 1561.746 | 1665.426 | 1597.046 | 942.249 | 293.033 |
| ENTHALPY KCAL/GFW | -114.301 | -108.123 | -102.003 | -95.917 | -89.851 | -83.801 | -77.775 | -68.571 | -49.118 | -27.970 |
| T.VOL.GASES--LITERS | 94.765 | 102.704 | 112.117 | 123.638 | 138.744 | 159.834 | 191.466 | 248.037 | 378.234 | 768.833 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 41.4900 | 40.0946 | 38.0851 | 35.0821 | 30.8358 | 24.4406 | 13.7410 | .0001 | .0001 | .0003 |
| CO2 | 35.6914 | 38.7766 | 42.5465 | 47.4775 | 54.1888 | 64.2399 | 81.0483 | 102.6540 | 102.6515 | 102.6440 |
| N2 | 11.9248 | 20.7006 | 31.6709 | 45.7759 | 64.5825 | 90.9113 | 130.4038 | 196.2192 | 327.8646 | 722.7863 |
| H2O | 6.2511 | 7.2739 | 8.7949 | 10.9539 | 13.8732 | 17.7089 | 22.7534 | 27.5167 | 27.5157 | 27.5127 |
| H2 | 2.2048 | 2.1720 | 2.0581 | 1.8364 | 1.5137 | 1.0851 | .5207 | .0000 | .0000 | .0000 |
| Pb* | .7700 | .7677 | .7614 | .7433 | .6881 | .5189 | .0005 | .0007 | .0010 | .0021 |
| KHO* | .6524 | .6102 | .4945 | .1873 | .0001 | .0001 | .0001 | .0002 | .7677 | .0006 |
| CH4 | .6424 | .3170 | .0937 | .0161 | .0016 | .0001 | .0000 | .0001 | .0001 | .0002 |
| H2S | .2249 | .2250 | .2250 | .2246 | .2239 | .2226 | .2194 | .0001 | .0002 | .0003 |
| KHO | .1138 | .1542 | .2645 | .5564 | .7327 | .7319 | .7371 | .7724 | .0041 | .0006 |
| CSO | .0172 | .0169 | .0169 | .0174 | .0185 | .0204 | .0236 | .0002 | .0003 | .0006 |
| Pb | .0051 | .0072 | .0133 | .0310 | .0858 | .2545 | .7716 | .0007 | .0010 | .0021 |
| K | .0036 | .0048 | .0086 | .0195 | .0278 | .0287 | .0250 | .0001 | .0002 | .0004 |
| KCN | .0026 | .0027 | .0026 | .0022 | .0009 | .0002 | .0002 | .0002 | .0003 | .0007 |
| NH3 | .0024 | .0026 | .0023 | .0017 | .0010 | .0005 | .0001 | .0001 | .0001 | .0002 |
| Pb2 | .0004 | .0005 | .0005 | .0006 | .0007 | .0008 | .0010 | .0014 | .0021 | .0042 |
| PbO | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0011 | .5712 | .0011 | .0022 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .2595 | .8267 | .8166 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbO* | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbH | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| Pb& | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |

NACO II

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0266 | .0004 | .0008 |
| CNH | .0001 | .0001 | .0001 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0005 | .0002 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0014 | .4178 | .4374 | .4329 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .7690 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HS | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0003 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 5.2710 | 40.5946 | 146.5331 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0109 | .0005 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | Pb* | KHO* | CH4 | H2S | KHO | CSO | Pb | K | KCN | NH3 |
| Pb2 | PbO | PbO& | PbO& | PbO* | PbH | Pb& | K2O& | S2O | SO3 | CNH | CS2 | S2 | SO2 | C4H10 |
| C4H8 | KHO& | KHO& | KO | SO | O3 | NS | NO2 | C3H8 | CS | C3H6 | KH | HS | HO2 | S |
| O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N |
| CH | C | C& | C& | H | | | | | | | | | | |

NOSOL 18

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=NOSOL-18 SINGLE-BASE PROPELLANT (MIL-N-244 ETC)

| | H | C | N | O | S | K | PB | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 46.000 | -625. | .0600 |
| DIBUTYE PHTHALATE | .014 | .012 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 8.100 | -733. | .0000 |
| TRIMETHYLAMMONIUMNIT | .010 | .003 | .002 | .003 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 3.000 | -678. | .0463 |
| CANDELLIA WAX | .012 | .007 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .100 | -142. | .0343 |
| METRIOL TRINITRATE | .009 | .005 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 38.500 | -406. | .0531 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | 1.300 | -1966. | .0962 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.000 | -127. | .0000 |
| LEAD CARBONATE-PBCO3 | .000 | .001 | .000 | .003 | .000 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | 1.000 | -629. | .2385 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | (PB) | ( |
|---|---|---|---|---|---|---|---|
| 3.559571 | 2.424061 | .931388 | 3.290730 | .007460 | .014920 | .003742 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1858.804 | 1951.826 | 2050.891 | 2156.653 | 2269.819 | 2391.046 | 2522.276 | 2613.866 | 2110.009 | 1305.174 |
| FLAME TEMP. T(F) | 2886.447 | 3053.886 | 3232.204 | 3422.574 | 3626.273 | 3844.482 | 4080.697 | 4245.559 | 3338.615 | 1889.914 |
| ENTHALPY KCAL/GFW | -55.798 | -50.218 | -44.638 | -39.058 | -33.479 | -27.899 | -22.319 | -16.739 | -11.160 | -5.580 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 958.894 | 951.337 | 942.290 | 951.569 | 983.644 | 1035.484 | 1102.365 | 1180.424 | 864.461 | 460.783 |
| FLAME TEMP. T(F) | 1266.609 | 1253.007 | 1236.723 | 1253.424 | 1311.158 | 1404.471 | 1524.857 | 1665.362 | 1096.630 | 370.009 |
| ENTHALPY KCAL/GFW | -105.355 | -99.792 | -94.400 | -89.166 | -84.031 | -78.943 | -73.881 | -68.801 | -51.223 | -29.215 |
| T.VOL.GASES--LITERS (GASES AT STP) | 102.377 | 109.433 | 118.240 | 130.916 | 146.940 | 168.182 | 199.773 | 252.429 | 379.415 | 769.349 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 41.9985 | 42.0089 | 41.8087 | 39.9439 | 36.6050 | 31.0735 | 22.0773 | 4.5634 | .0001 | .0003 |
| CO2 | 31.2704 | 34.1572 | 37.9198 | 42.7503 | 48.9643 | 57.8351 | 71.9798 | 99.4956 | 106.6779 | 106.6704 |
| N2 | 13.0435 | 21.8040 | 32.7549 | 46.8355 | 65.6104 | 91.8953 | 131.3215 | 197.0302 | 328.4465 | 722.6976 |
| H2O | 6.4009 | 6.6766 | 7.0320 | 8.5296 | 11.2617 | 15.5019 | 21.6141 | 30.1554 | 31.9272 | 31.9242 |
| H2 | 2.6035 | 2.5761 | 2.5395 | 2.4972 | 2.2804 | 1.8231 | 1.1404 | .1867 | .0000 | .0000 |
| C& | 1.8583 | 1.0766 | .1455 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH4 | .9485 | .9342 | .9210 | .4226 | .0699 | .0042 | .0001 | .0001 | .0001 | .0002 |
| Pb* | .7684 | .7687 | .7691 | .7671 | .7582 | .7209 | .5490 | .0007 | .0010 | .0021 |
| KHO* | .7081 | .7175 | .7291 | .6926 | .5271 | .0001 | .0001 | .0002 | .7843 | .0006 |
| H2S | .2447 | .2445 | .2444 | .2446 | .2445 | .2438 | .2423 | .2034 | .0002 | .0003 |
| KHO | .1198 | .1110 | .1004 | .1361 | .2954 | .7996 | .7993 | .8150 | .0506 | .0006 |
| CSO | .0161 | .0162 | .0164 | .0159 | .0159 | .0168 | .0190 | .0203 | .0003 | .0006 |
| Pb | .0054 | .0049 | .0043 | .0060 | .0144 | .0512 | .2223 | .7662 | .0010 | .0021 |
| K | .0042 | .0036 | .0029 | .0037 | .0084 | .0248 | .0256 | .0143 | .0002 | .0004 |
| KCN | .0034 | .0036 | .0035 | .0030 | .0023 | .0013 | .0002 | .0002 | .0003 | .0007 |
| NH3 | .0030 | .0037 | .0044 | .0043 | .0031 | .0017 | .0006 | .0001 | .0001 | .0002 |
| Pb2 | .0004 | .0005 | .0005 | .0006 | .0007 | .0008 | .0010 | .0014 | .0021 | .0041 |
| PbO | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0039 | .0011 | .0022 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .8253 | .8152 |

NOSOL18

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbO* | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbH | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| Pb& | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| CNH | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0003 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0041 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0628 | .4734 | .4690 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .8321 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HS | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0005 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | 30.7950 | 136.5540 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0016 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | C& | CH4 | Pb* | KHO* | H2S | KHO | CSO | Pb | K | KCN |
| NH3 | Pb2 | PbO | PbO& | PbO& | PbO* | PbH | Pb& | CNH | K2O& | S2O | SO3 | CS2 | S2 | SO2 |
| C4H10 | C4H8 | KHO& | KHO& | KO | SO | O3 | NS | NO2 | C3H8 | CS | C3H6 | KH | HS | HO2 |
| S | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | H | | | | | | | | | | |

WC

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=WC DOUBLE-BASE PROPELLANT (MIL-P-3984)

| | H | C | N | O | S | K | CA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 75.600 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 12.000 | -392. | .0578 |
| DINITROTOLUENE - DNT | .006 | .007 | .002 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | -58. | .0419 |
| DIPHENYLAMINE - DPA | .011 | .012 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | 178. | .0419 |
| DIBUTYE PHTHALATE | .014 | .012 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 7.500 | -733. | .0000 |
| POTASSIUM NITRATE | .000 | .000 | .001 | .003 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | -1165. | .0762 |
| CALCIUM CARBONATE | .000 | .001 | .000 | .003 | .000 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | 1.000 | -2882. | .0979 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .500 | -1966. | .0962 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .400 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 101.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | (CA) | ( |
|---|---|---|---|---|---|---|---|
| 2.962507 | 2.416796 | .873168 | 3.466089 | .002869 | .020574 | .009991 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 101.000 | 90.900 | 80.800 | 70.700 | 60.600 | 50.500 | 40.400 | 30.300 | 20.200 | 10.100 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2018.657 | 2104.451 | 2195.389 | 2291.994 | 2394.828 | 2504.511 | 2613.695 | 2553.751 | 1974.915 | 1229.033 |
| FLAME TEMP. T(F) | 3174.182 | 3328.612 | 3492.300 | 3666.189 | 3851.290 | 4048.719 | 4245.251 | 4137.352 | 3095.446 | 1752.859 |
| ENTHALPY KCAL/GFW | -62.847 | -56.562 | -50.278 | -43.993 | -37.708 | -31.423 | -25.139 | -18.854 | -12.569 | -6.285 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 962.025 | 969.953 | 993.217 | 1028.092 | 1069.851 | 1123.086 | 1182.218 | 1185.257 | 801.929 | 429.549 |
| FLAME TEMP. T(F) | 1272.245 | 1286.515 | 1328.391 | 1391.165 | 1466.332 | 1562.155 | 1668.592 | 1674.063 | 984.073 | 313.788 |
| ENTHALPY KCAL/GFW | -113.119 | -106.705 | -100.602 | -94.667 | -88.765 | -82.892 | -77.056 | -69.181 | -49.808 | -28.360 |
| T.VOL.GASES--LITERS | 94.920 | 102.664 | 112.079 | 123.507 | 138.449 | 159.297 | 190.562 | 245.057 | 373.744 | 759.818 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 43.9906 | 43.1483 | 41.1700 | 38.0990 | 33.6434 | 27.1718 | 16.3989 | .0001 | .0001 | .0003 |
| CO2 | 33.5764 | 36.4923 | 40.3156 | 45.3899 | 52.4365 | 62.6103 | 79.5354 | 105.3075 | 105.3051 | 105.2976 |
| N2 | 12.1075 | 20.7816 | 31.6248 | 45.5664 | 64.1552 | 90.1791 | 129.2141 | 194.2664 | 324.3875 | 714.7346 |
| H2O | 5.4991 | 6.2741 | 7.6932 | 9.7302 | 12.4506 | 16.1434 | 21.0019 | 26.2365 | 26.2355 | 26.2326 |
| H2 | 2.1504 | 2.1352 | 2.0421 | 1.8374 | 1.5378 | 1.1253 | .5816 | .0000 | .0000 | .0000 |
| KHO* | 1.0112 | .9750 | .8541 | .5302 | .0001 | .0001 | .0001 | .0002 | 1.1323 | .0006 |
| CH4 | .6549 | .3702 | .1097 | .0188 | .0022 | .0001 | .0000 | .0001 | .0001 | .0002 |
| CaO& | .5546 | .5546 | .5545 | .5545 | .5545 | .5544 | .5543 | .5542 | .5539 | .5531 |
| C& | .2216 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| KHO | .1219 | .1561 | .2707 | .5764 | 1.0756 | 1.0740 | 1.0811 | 1.1413 | .0085 | .0006 |
| H2S | .0920 | .0920 | .0920 | .0918 | .0915 | .0909 | .0897 | .0001 | .0002 | .0003 |
| CSO | .0077 | .0076 | .0075 | .0077 | .0081 | .0089 | .0103 | .0002 | .0003 | .0006 |
| K | .0045 | .0057 | .0102 | .0231 | .0454 | .0472 | .0423 | .0001 | .0002 | .0004 |
| KCN | .0036 | .0039 | .0037 | .0031 | .0018 | .0004 | .0002 | .0002 | .0003 | .0006 |
| NH3 | .0022 | .0025 | .0023 | .0017 | .0011 | .0005 | .0001 | .0001 | .0001 | .0002 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| CNH | .0001 | .0001 | .0001 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |

WC

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0061 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0003 | .1743 | .1775 | .1731 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | 1.1379 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| CaO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CaH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| Ca | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HS | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 3.3183 | 38.2293 | 142.9404 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0121 | .0007 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0002 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | KHO* | CH4 | CaO& | C& | KHO | H2S | CSO | K | KCN | NH3 |
| K2O& | CNH | S2O | SO3 | CS2 | S2 | SO2 | C4H10 | C4H8 | KHO& | KHO& | CaO | KO | SO | O3 |
| NS | NO2 | C3H8 | CS | C3H6 | CaH | KH | Ca | HS | HO2 | S | O2 | NHO | C2H6 | CH2O |
| NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | H |

XM41

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=XM41 TRIPLE-BASE PROPELLANT (RAD-PE-736-8A)

| | H | C | N | O | S | K | CU | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 42.680 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 26.500 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 20.000 | -209. | .0000 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | 1.220 | -1966. | .0962 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.400 | -127. | .0000 |
| DIOCTYL ADIPATE | .042 | .022 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 8.000 | -733. | .0332 |
| ~~COPPER~~ Ferrous as lead salicylate | .000 | .000 | .000 | .000 | .000 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .100 | 0. | .3223 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .100 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | (CU) | ( |
|---|---|---|---|---|---|---|---|
| 3.552732 | 2.059910 | 1.513717 | 3.100073 | .007001 | .014002 | .001574 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1998.213 | 2077.613 | 2161.859 | 2252.674 | 2350.236 | 2455.598 | 2566.638 | 2503.635 | 1917.896 | 1209.679 |
| FLAME TEMP. T(F) | 3137.383 | 3280.303 | 3431.946 | 3595.414 | 3771.025 | 3960.676 | 4160.548 | 4047.143 | 2992.812 | 1718.023 |
| ENTHALPY KCAL/GFW | -49.686 | -44.717 | -39.748 | -34.780 | -29.811 | -24.843 | -19.874 | -14.906 | -9.937 | -4.969 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 942.051 | 943.411 | 954.246 | 979.519 | 1019.341 | 1069.912 | 1129.188 | 1114.722 | 759.791 | 418.473 |
| FLAME TEMP. T(F) | 1236.291 | 1238.740 | 1258.242 | 1303.734 | 1375.413 | 1466.441 | 1573.138 | 1547.100 | 908.224 | 293.851 |
| ENTHALPY KCAL/GFW | -102.581 | -97.536 | -92.574 | -87.678 | -82.818 | -77.983 | -73.178 | -65.776 | -47.268 | -25.811 |
| T.VOL.GASES--LITERS (GASES AT STP) | 100.276 | 108.189 | 118.091 | 130.103 | 145.343 | 166.419 | 197.999 | 253.782 | 383.759 | 773.693 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 35.1569 | 34.2972 | 32.7810 | 30.5145 | 27.0007 | 21.6719 | 12.7570 | .0001 | .0001 | .0003 |
| CO2 | 31.8254 | 34.7152 | 38.2064 | 42.4827 | 48.1977 | 56.5931 | 70.5993 | 90.6537 | 90.6512 | 90.6438 |
| N2 | 21.2001 | 29.9611 | 40.9127 | 54.9939 | 73.7689 | 100.0533 | 139.4790 | 205.1840 | 336.6043 | 730.8546 |
| H2O | 6.9284 | 7.7615 | 9.1863 | 11.3969 | 14.6521 | 19.1465 | 25.3188 | 31.8749 | 31.8739 | 31.8709 |
| H2 | 2.5098 | 2.4970 | 2.4391 | 2.2575 | 1.9115 | 1.4111 | .7207 | .0000 | .0000 | .0000 |
| CH4 | 1.0649 | .7447 | .3406 | .0799 | .0090 | .0005 | .0000 | .0001 | .0001 | .0002 |
| KHO* | .6953 | .6853 | .6490 | .5338 | .1799 | .0001 | .0001 | .0002 | .7812 | .0006 |
| H2S | .2307 | .2308 | .2309 | .2308 | .2304 | .2296 | .2281 | .0001 | .0002 | .0003 |
| C& | .1803 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| Cu& | .0996 | .0996 | .0995 | .0995 | .0994 | .0992 | .0990 | .0987 | .0981 | .0964 |
| KHO | .0846 | .0946 | .1299 | .2411 | .5813 | .7534 | .7562 | .7839 | .0022 | .0006 |
| CSO | .0132 | .0129 | .0126 | .0127 | .0132 | .0143 | .0164 | .0002 | .0003 | .0006 |
| NH3 | .0041 | .0044 | .0042 | .0033 | .0020 | .0010 | .0003 | .0001 | .0001 | .0002 |
| KCN | .0024 | .0022 | .0019 | .0016 | .0012 | .0003 | .0002 | .0002 | .0003 | .0007 |
| K | .0023 | .0024 | .0032 | .0061 | .0159 | .0217 | .0197 | .0001 | .0002 | .0004 |
| Cu2 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0003 | .0004 | .0006 | .0010 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| CNH | .0001 | .0001 | .0001 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |

XM41

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0308 | .0004 | .0008 |
| CuO | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| CuO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .4211 | .4440 | .4395 |
| Cu | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| Cu* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .7806 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HS | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 4.2712 | 39.5339 | 145.2915 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0079 | .0003 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | CH4 | KHO* | H2S | C& | Cu& | KHO | CSO | NH3 | KCN | K |
| Cu2 | K2O& | CNH | S2O | SO3 | CuO | CuO& | CS2 | S2 | SO2 | Cu | Cu* | C4H10 | C4H8 | KHO& |
| KHO& | KO | SO | O3 | NS | NO2 | C3H8 | CS | C3H6 | KH | HS | HO2 | S | O2 | NHO |
| C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C |
| C& | H | | | | | | | | | | | | | |

N5

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=N5 DOUBLE-BASE PROPELLANT (MIL-P-17689)

| | H | C | N | O | PB | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 50.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 34.900 | -392. | .0578 |
| DIETHYL PHTHALATE | .014 | .012 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 10.500 | -810. | .0406 |
| 2-NITRODIPHENYLAMINE | .010 | .012 | .002 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.000 | 83. | .0494 |
| LEAD HYDROXIDE | .002 | .000 | .000 | .002 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.400 | -510. | .2743 |
| CANDELLIA WAX | .012 | .007 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .200 | -142. | .0343 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (PB) | ( |
|---|---|---|---|---|---|
| 2.953288 | 2.255062 | .929421 | 3.428540 | .009949 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2327.967 | 2390.105 | 2455.935 | 2525.770 | 2599.431 | 2673.952 | 2724.328 | 2529.595 | 1937.972 | 1200.380 |
| FLAME TEMP. T(F) | 3730.941 | 3842.789 | 3961.282 | 4086.986 | 4219.576 | 4353.713 | 4444.391 | 4093.872 | 3028.949 | 1701.284 |
| ENTHALPY KCAL/GFW | -54.524 | -49.072 | -43.619 | -38.167 | -32.715 | -27.262 | -21.810 | -16.357 | -10.905 | -5.452 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1022.990 | 1049.748 | 1082.031 | 1117.707 | 1156.188 | 1197.724 | 1243.925 | 1138.044 | 771.742 | 414.677 |
| FLAME TEMP. T(F) | 1381.982 | 1430.147 | 1488.256 | 1552.472 | 1621.738 | 1696.502 | 1779.664 | 1589.079 | 929.736 | 287.019 |
| ENTHALPY KCAL/GFW | -110.200 | -104.497 | -98.800 | -93.111 | -87.436 | -81.785 | -76.142 | -65.634 | -47.116 | -26.934 |
| T.VOL.GASES--LITERS | 94.160 | 101.340 | 110.162 | 121.454 | 136.494 | 157.546 | 189.124 | 247.550 | 377.529 | 767.470 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 41.6078 | 39.8058 | 37.4045 | 34.1625 | 29.5748 | 22.6326 | 11.0986 | .0001 | .0001 | .0003 |
| CO2 | 33.6478 | 36.6384 | 40.4611 | 45.5668 | 52.7770 | 63.6846 | 81.8063 | 99.2431 | 99.2410 | 99.2343 |
| N2 | 13.0180 | 21.7792 | 32.7309 | 46.8115 | 65.5856 | 91.8692 | 131.2944 | 196.9968 | 328.4197 | 722.6704 |
| H2O | 7.4595 | 8.8161 | 10.5384 | 12.6961 | 15.4138 | 18.8869 | 23.3756 | 26.6011 | 26.6001 | 26.5970 |
| H2 | 2.1213 | 1.9841 | 1.7960 | 1.5557 | 1.2519 | .8633 | .3610 | .0000 | .0000 | .0000 |
| Pb* | 2.0379 | 2.0184 | 1.9754 | 1.8809 | 1.6718 | 1.1922 | .0005 | .0007 | .0010 | .0021 |
| CH4 | .0817 | .0236 | .0054 | .0010 | .0001 | .0000 | .0000 | .0001 | .0001 | .0002 |
| Pb | .0220 | .0413 | .0841 | .1783 | .3870 | .8658 | 2.0508 | .0007 | .0010 | .0021 |
| NH3 | .0015 | .0014 | .0011 | .0008 | .0005 | .0002 | .0001 | .0001 | .0001 | .0002 |
| Pb2 | .0004 | .0005 | .0005 | .0006 | .0007 | .0008 | .0010 | .0014 | .0021 | .0041 |
| PbO | .0002 | .0002 | .0003 | .0003 | .0004 | .0007 | .0071 | .5184 | .0011 | .0022 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | 1.6964 | 2.2107 | 2.2007 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbO* | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbH | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| Pb& | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| CNH | .0001 | .0001 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |

N S

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 8.2561 | 43.5149 | 149.2707 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0131 | .0004 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | Pb* | CH4 | Pb | NH3 | Pb2 | PbO | PbO& | PbO& | PbO* | PbH |
| Pb& | CNH | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO |
| C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | |

N8

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=N8 DOUBLE-BASE PROPELLANT (MIL-P-17689)

| | H | C | N | O | PB | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 49.550 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 37.690 | -392. | .0578 |
| DIETHYL PHTHALATE | .014 | .012 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 6.650 | -810. | .0406 |
| 2-NITRODIPHENYLAMINE | .010 | .012 | .002 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.980 | 83. | .0494 |
| LEAD SALICYLATE | .010 | .014 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 3.980 | -864. | .0361 |
| CANDELLIA WAX | .012 | .007 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .100 | -142. | .0343 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .050 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (PB) | ( |
|---|---|---|---|---|---|
| 2.809377 | 2.186048 | .962043 | 3.482641 | .008267 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2492.751 | 2542.383 | 2594.777 | 2649.763 | 2705.938 | 2755.948 | 2751.585 | 2467.474 | 1878.653 | 1165.105 |
| FLAME TEMP. T(F) | 4027.552 | 4116.889 | 4211.198 | 4310.174 | 4411.288 | 4501.305 | 4493.453 | 3982.054 | 2922.176 | 1637.789 |
| ENTHALPY KCAL/GFW | -54.420 | -48.978 | -43.536 | -38.094 | -32.652 | -27.210 | -21.768 | -16.326 | -10.884 | -5.442 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1106.424 | 1132.092 | 1159.531 | 1188.739 | 1219.886 | 1254.168 | 1298.668 | 1091.607 | 740.700 | 399.774 |
| FLAME TEMP. T(F) | 1532.164 | 1578.366 | 1627.755 | 1680.330 | 1736.395 | 1798.103 | 1878.203 | 1505.492 | 873.861 | 260.193 |
| ENTHALPY KCAL/GFW | -112.775 | -106.807 | -100.846 | -94.897 | -88.966 | -83.056 | -77.081 | -63.949 | -45.858 | -26.235 |
| T.VOL.GASES--LITERS (GASES AT STP) | 91.539 | 98.567 | 107.341 | 118.622 | 133.659 | 154.711 | 186.289 | 247.697 | 377.675 | 767.616 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 39.3022 | 37.2974 | 34.6907 | 31.1738 | 26.1966 | 18.6902 | 6.3094 | .0001 | .0001 | .0003 |
| CO2 | 34.4424 | 37.6023 | 41.7012 | 47.2277 | 55.0478 | 66.8415 | 86.2937 | 96.2058 | 96.2036 | 96.1970 |
| N2 | 13.4756 | 22.2368 | 33.1883 | 47.2688 | 66.0428 | 92.3263 | 131.7514 | 197.4550 | 328.8765 | 723.1272 |
| H2O | 9.2665 | 10.6149 | 12.2433 | 14.2332 | 16.7021 | 19.8124 | 23.7558 | 25.3048 | 25.3038 | 25.3007 |
| H2 | 1.7934 | 1.6434 | 1.4615 | 1.2390 | .9627 | .6147 | .1734 | .0000 | .0000 | .0000 |
| Pb* | 1.6015 | 1.5251 | 1.3893 | 1.1435 | .6826 | .0004 | .0005 | .0007 | .0010 | .0021 |
| Pb | .1098 | .1860 | .3216 | .5671 | 1.0272 | 1.7066 | 1.6915 | .0007 | .0010 | .0021 |
| CH4 | .0053 | .0017 | .0005 | .0001 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0008 | .0007 | .0006 | .0004 | .0003 | .0001 | .0000 | .0001 | .0001 | .0002 |
| Pb2 | .0004 | .0005 | .0005 | .0006 | .0007 | .0008 | .0010 | .0014 | .0021 | .0041 |
| PbO | .0002 | .0002 | .0003 | .0003 | .0008 | .0032 | .0187 | .1660 | .0011 | .0022 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | 1.6733 | 1.8352 | 1.8251 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbO* | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbH | .0002 | .0002 | .0003 | .0003 | .0004 | .0005 | .0005 | .0007 | .0010 | .0021 |
| Pb& | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |

N8

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 12.5097 | 47.7673 | 153.5230 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0108 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | Pb* | Pb | CH4 | NH3 | Pb2 | PbO | PbO& | PbO& | PbO* | PbH |
| Pb& | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 | CNH | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO |
| C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | |

LKL

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=LKL SINGLE-BASE PROPELLANT (DOD-P-64039)

| | H | C | N | O | S | K | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 93.600 | -625. | .0600 |
| DINITROTOLUENE - DNT | .006 | .007 | .002 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 3.000 | -58. | .0419 |
| DIPHENYLAMINE - DPA | .011 | .012 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | 178. | .0419 |
| DIBUTYE PHTHALATE | .014 | .012 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.000 | -733. | .0000 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | 1.400 | -1966. | .0962 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.000 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | ( |
|---|---|---|---|---|---|---|
| 2.821131 | 2.301905 | .880713 | 3.517828 | .008034 | .016067 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.000 | 90.000 | 80.000 | 70.000 | 60.000 | 50.000 | 40.000 | 30.000 | 20.000 | 10.000 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2259.418 | 2327.123 | 2398.313 | 2473.425 | 2553.482 | 2636.651 | 2696.310 | 2490.641 | 1902.987 | 1179.712 |
| FLAME TEMP. T(F) | 3607.553 | 3729.421 | 3857.563 | 3992.764 | 4136.867 | 4286.571 | 4393.958 | 4023.754 | 2965.976 | 1664.081 |
| ENTHALPY KCAL/GFW | -61.966 | -55.770 | -49.573 | -43.376 | -37.180 | -30.983 | -24.786 | -18.590 | -12.393 | -6.197 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1006.241 | 1029.907 | 1058.340 | 1096.497 | 1138.364 | 1184.391 | 1236.820 | 1110.118 | 756.812 | 407.375 |
| FLAME TEMP. T(F) | 1351.834 | 1394.432 | 1445.612 | 1514.294 | 1589.654 | 1672.504 | 1766.877 | 1538.812 | 902.861 | 273.875 |
| ENTHALPY KCAL/GFW | -115.581 | -109.343 | -103.119 | -96.906 | -90.700 | -84.512 | -78.321 | -66.850 | -47.869 | -27.295 |
| T.VOL.GASES--LITERS (GASES AT STP) | 93.047 | 100.290 | 109.142 | 120.444 | 135.485 | 156.537 | 188.118 | 247.236 | 377.216 | 767.152 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 41.3859 | 39.5056 | 36.9587 | 33.6545 | 28.9873 | 21.9038 | 10.1259 | .0001 | .0001 | .0003 |
| CO2 | 35.9488 | 39.1208 | 43.1957 | 48.4069 | 55.7421 | 66.8698 | 85.3722 | 101.3041 | 101.3017 | 101.2942 |
| N2 | 12.3350 | 21.0962 | 32.0479 | 46.1289 | 64.9032 | 91.1868 | 130.6120 | 196.3156 | 327.7372 | 721.9879 |
| H2O | 7.0372 | 8.2997 | 9.9169 | 12.0286 | 14.6951 | 18.0772 | 22.3954 | 25.2660 | 25.2650 | 25.2621 |
| H2 | 1.9958 | 1.8747 | 1.7010 | 1.4666 | 1.1687 | .7904 | .3079 | .0000 | .0000 | .0000 |
| KHO* | .5940 | .3872 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .8973 | .0006 |
| KHO | .2875 | .4813 | .8436 | .8413 | .8397 | .8418 | .8554 | .8998 | .0020 | .0006 |
| H2S | .2609 | .2607 | .2603 | .2595 | .2583 | .2561 | .2397 | .0001 | .0002 | .0003 |
| CH4 | .1148 | .0354 | .0085 | .0014 | .0002 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CSO | .0219 | .0223 | .0229 | .0241 | .0260 | .0289 | .0323 | .0002 | .0003 | .0006 |
| K | .0119 | .0208 | .0383 | .0409 | .0424 | .0410 | .0313 | .0001 | .0002 | .0004 |
| KCN | .0030 | .0032 | .0028 | .0011 | .0004 | .0001 | .0002 | .0002 | .0003 | .0007 |
| NH3 | .0015 | .0014 | .0012 | .0008 | .0005 | .0002 | .0000 | .0001 | .0001 | .0002 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0528 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0036 | .0002 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0003 | .0195 | .4697 | .5102 | .5057 |
| CNH | .0001 | .0001 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |

LKL

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .8965 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HS | .0000 | .0000 | .0000 | .0000 | .0001 | .0002 | .0008 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 9.0088 | 44.2776 | 150.0353 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0107 | .0003 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | KHO* | KHO | H2S | CH4 | CSO | K | KCN | NH3 | K2O& | S2O |
| SO3 | CS2 | S2 | SO2 | CNH | C4H10 | C4H8 | KHO& | KHO& | KO | SO | O3 | NS | NO2 | C3H8 |
| CS | C3H6 | KH | HS | HO2 | S | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* |
| HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | | | | |

NA 80 I

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=NACO I SINGLE-BASE PROPELLANT, NAVAL ORDNANCE (DOD-P-19264)

| | H | C | N | O | S | K | PB | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 90.000 | -625. | .0600 |
| POTASSIUM SULFATE | .000 | .000 | .000 | .004 | .001 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | 3.400 | -1966. | .0962 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.060 | -127. | .0000 |
| BUTYL STEARATE | .044 | .022 | .000 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 4.290 | -692. | .0309 |
| LEAD CARBONATE-PBCO3 | .000 | .001 | .000 | .003 | .000 | .000 | .001 | .000 | .000 | .000 | .000 | .000 | 1.230 | -629. | .2385 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 99.980 1.0000

| (H ) | (C ) | (N ) | (O ) | (S ) | (K ) | (PB) | ( |
|---|---|---|---|---|---|---|---|
| 3.132745 | 2.335520 | .817884 | 3.388015 | .019510 | .039021 | .004603 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 99.980 | 89.982 | 79.984 | 69.986 | 59.988 | 49.990 | 39.992 | 29.994 | 19.996 | 9.998 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1883.873 | 1979.719 | 2080.955 | 2187.564 | 2298.842 | 2417.062 | 2545.137 | 2526.605 | 1950.240 | 1211.558 |
| FLAME TEMP. T(F) | 2931.572 | 3104.094 | 3286.318 | 3478.215 | 3678.515 | 3891.312 | 4121.846 | 4088.489 | 3051.032 | 1721.405 |
| ENTHALPY KCAL/GFW | -66.798 | -60.118 | -53.438 | -46.758 | -40.079 | -33.399 | -26.719 | -20.039 | -13.360 | -6.680 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 952.236 | 944.416 | 954.210 | 982.156 | 1026.568 | 1074.375 | 1136.180 | 1150.350 | 788.816 | 422.207 |
| FLAME TEMP. T(F) | 1254.625 | 1240.549 | 1258.178 | 1308.481 | 1388.422 | 1474.474 | 1585.723 | 1611.231 | 960.468 | 300.572 |
| ENTHALPY KCAL/GFW | -113.688 | -107.401 | -101.256 | -95.203 | -89.198 | -83.223 | -77.287 | -69.592 | -49.882 | -28.406 |
| T.VOL.GASES--LITERS | 95.115 | 102.169 | 112.054 | 124.146 | 139.390 | 160.474 | 192.063 | 247.053 | 377.058 | 767.071 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 39.8736 | 39.7172 | 38.2201 | 35.6904 | 31.6408 | 25.3834 | 15.2435 | .0001 | .0001 | .0003 |
| CO2 | 34.8595 | 37.9123 | 41.7123 | 46.4791 | 53.0345 | 62.8839 | 78.8110 | 102.8042 | 102.8017 | 102.7942 |
| N2 | 11.4566 | 20.2189 | 31.1724 | 45.2562 | 64.0347 | 90.3242 | 129.7577 | 195.4755 | 326.9224 | 721.2519 |
| H2O | 6.1496 | 6.3972 | 7.5578 | 9.5373 | 12.4510 | 16.3658 | 21.7589 | 27.8718 | 27.8708 | 27.8678 |
| H2 | 2.1974 | 2.1728 | 2.1428 | 1.9940 | 1.6863 | 1.2512 | .6485 | .0000 | .0000 | .0000 |
| KHO* | 2.0854 | 2.0933 | 2.0599 | 1.9351 | 1.5366 | .4661 | .0001 | .0002 | 2.1819 | .0006 |
| Pb* | .9480 | .9482 | .9465 | .9398 | .9164 | .8447 | .5605 | .0007 | .0010 | .0021 |
| C& | .8540 | .0974 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH4 | .7776 | .7648 | .3674 | .0787 | .0079 | .0004 | .0000 | .0001 | .0001 | .0002 |
| H2S | .6379 | .6376 | .6382 | .6381 | .6369 | .6346 | .6282 | .0001 | .0002 | .0003 |
| KHO | .0979 | .0903 | .1226 | .2425 | .6234 | 1.6461 | 2.0991 | 2.1881 | .0057 | .0006 |
| CSO | .0471 | .0475 | .0464 | .0464 | .0484 | .0522 | .0600 | .0002 | .0003 | .0006 |
| Pb | .0043 | .0039 | .0054 | .0118 | .0348 | .1059 | .3893 | .0007 | .0010 | .0021 |
| K | .0030 | .0025 | .0033 | .0069 | .0195 | .0531 | .0624 | .0001 | .0002 | .0004 |
| NH3 | .0025 | .0031 | .0032 | .0026 | .0016 | .0008 | .0002 | .0001 | .0001 | .0002 |
| KCN | .0023 | .0026 | .0024 | .0021 | .0016 | .0009 | .0002 | .0002 | .0003 | .0007 |
| Pb2 | .0004 | .0005 | .0005 | .0006 | .0007 | .0008 | .0010 | .0014 | .0021 | .0041 |
| PbO | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .6818 | .0011 | .0022 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .3398 | 1.0176 | 1.0075 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbO* | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbH | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |

NACO I

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Pb& | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| K2O& | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0009 |
| S2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| SO3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0518 | .0004 | .0008 |
| CS2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| CNH | .0001 | .0001 | .0001 | .0001 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| S2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0012 | .0002 | .0003 | .0006 |
| SO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0007 | 1.2060 | 1.2457 | 1.2412 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | 2.1848 |
| KHO& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| KO | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| SO | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NS | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| CS | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| KH | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HS | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0004 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| S | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 2.7411 | 38.0154 | 143.7951 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0083 | .0005 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | KHO* | Pb* | C& | CH4 | H2S | KHO | CSO | Pb | K | NH3 |
| KCN | Pb2 | PbO | PbO& | PbO& | PbO* | PbH | Pb& | K2O& | S2O | SO3 | CS2 | CNH | S2 | SO2 |
| C4H10 | C4H8 | KHO& | KHO& | KO | SO | O3 | NS | NO2 | C3H8 | CS | C3H6 | KH | HS | HO2 |
| S | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | H | | | | | | | | | | |

T29 p. 10

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=T29 TRIPLE-BASE PROPELLANT (PATR-2700, C34)

| | H | C | N | O | F | NA | AL | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 46.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 21.500 | -392. | .0578 |
| NITROGUANIDINE | .004 | .001 | .004 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 30.700 | -209. | .0000 |
| ETHYL CENTRALITE | .020 | .017 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.500 | -127. | .0000 |
| CRYOLITE | .000 | .000 | .000 | .000 | .012 | .003 | .003 | .000 | .000 | .000 | .000 | .000 | .300 | -3549. | .1084 |
| CARBON (GRAPHITE) | .000 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .100 | 0. | .0816 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.100 1.0000

| (H ) | (C ) | (N ) | (O ) | (F ) | (NA) | (AL) | ( |
|---|---|---|---|---|---|---|---|
| 3.047143 | 1.701601 | 1.889562 | 3.113849 | .009526 | .002382 | .002382 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.100 | 90.090 | 80.080 | 70.070 | 60.060 | 50.050 | 40.040 | 30.030 | 20.020 | 10.010 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2538.428 | 2582.183 | 2628.451 | 2676.638 | 2723.439 | 2750.019 | 2640.416 | 2243.495 | 1701.083 | 1063.989 |
| FLAME TEMP. T(F) | 4109.770 | 4188.530 | 4271.812 | 4358.548 | 4442.791 | 4490.635 | 4293.349 | 3578.891 | 2602.548 | 1455.780 |
| ENTHALPY KCAL/GFW | -44.849 | -40.364 | -35.879 | -31.395 | -26.910 | -22.425 | -17.940 | -13.455 | -8.970 | -4.485 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1125.431 | 1148.484 | 1173.154 | 1199.517 | 1227.744 | 1261.568 | 1234.307 | 939.742 | 645.503 | 356.849 |
| FLAME TEMP. T(F) | 1566.376 | 1607.870 | 1652.277 | 1699.730 | 1750.539 | 1811.423 | 1762.353 | 1232.135 | 702.504 | 182.928 |
| ENTHALPY KCAL/GFW | -105.811 | -100.512 | -95.223 | -89.951 | -84.699 | -79.454 | -72.019 | -56.964 | -40.782 | -23.481 |
| T.VOL.GASES--LITERS | 93.633 | 100.646 | 109.410 | 120.681 | 135.703 | 156.729 | 190.181 | 255.113 | 384.952 | 774.493 |

(GASES AT STP)
COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | 31.8588 | 34.6290 | 38.2590 | 43.2189 | 50.3470 | 61.2718 | 74.8093 | 74.8076 | 74.8042 | 74.7941 |
| CO | 27.3355 | 25.5739 | 23.2640 | 20.1073 | 15.5703 | 8.6167 | .0001 | .0001 | .0001 | .0003 |
| N2 | 26.4417 | 35.1942 | 46.1348 | 60.2012 | 78.9564 | 105.2136 | 144.5930 | 210.2407 | 341.5276 | 735.3835 |
| H2O | 12.3134 | 13.8210 | 15.6370 | 17.8498 | 20.5841 | 24.0384 | 27.3291 | 27.3552 | 27.3543 | 27.3516 |
| H2 | 1.6827 | 1.5142 | 1.3109 | 1.0627 | .7553 | .3683 | .0000 | .0000 | .0000 | .0000 |
| HF | .1431 | .1441 | .1465 | .1527 | .1676 | .1718 | .1711 | .1415 | .1409 | .1390 |
| Al2O3& | .1204 | .1203 | .1201 | .1200 | .1198 | .1195 | .1190 | .1182 | .1167 | .1121 |
| NaF& | .0950 | .0905 | .0805 | .0578 | .0061 | .0001 | .0001 | .0972 | .0959 | .0919 |
| NaF | .0026 | .0049 | .0096 | .0191 | .0393 | .0358 | .0366 | .0001 | .0002 | .0004 |
| CH4 | .0014 | .0005 | .0001 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NaHO | .0014 | .0032 | .0078 | .0192 | .0469 | .0560 | .0585 | .0001 | .0002 | .0004 |
| NH3 | .0008 | .0007 | .0005 | .0003 | .0002 | .0001 | .0000 | .0001 | .0001 | .0002 |
| Na2CO3& | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0004 | .0005 | .0011 |
| Na2CO3* | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0004 | .0005 | .0011 |
| Al2O3* | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0003 | .0005 | .0010 |
| C2F4 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0002 | .0003 | .0005 | .0010 |
| CF4 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0009 |
| Al2O2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0009 |
| AlF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0004 | .0008 |
| Na | .0001 | .0002 | .0004 | .0010 | .0023 | .0021 | .0001 | .0001 | .0001 | .0002 |
| CHF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |

T29 p.2c

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Al2O | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| CF3 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| COF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0007 |
| AlF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| C2F2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| Na2O& | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| Na2O* | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| AlOF | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0003 | .0006 |
| AlHO2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| CH2F2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| O2F | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0005 |
| CF2 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NaCN | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NaCN& | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NaCN* | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| CHOF | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| AlF | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlO | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaF* | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaF* | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlN | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| AlN& | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaHO& | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NaHO* | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| F2 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| NF | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | 2.7121 | 20.3266 | 55.5454 | 161.1972 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0136 | .0028 | .0001 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| AlH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al& | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| Al* | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NaH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0002 |
| F | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0004 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 | CO | N2 | H2O | H2 | HF | Al2O3& | NaF& | NaF | CH4 | NaHO | NH3 | Na2CO3 | Na2CO3 | Al2O3* |
| C2F4 | CF4 | Al2O2 | AlF3 | Na | CHF3 | Al2O | CF3 | COF2 | AlF2 | C2F2 | Na2O& | Na2O* | AlOF | AlHO2 |
| C4H10 | C4H8 | CH2F2 | O2F | CF2 | NaCN | NaCN& | NaCN* | CHOF | O3 | NO2 | AlF | C3H8 | AlO | C3H6 |
| NaF* | NaF* | AlN | AlN& | NaHO& | NaHO* | F2 | NF | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO |
| C2H4 | AlH | CNH | Al | Al& | Al* | C2H2 | NaH | F | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | C& | H | | | | | | | | | |

7 238

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=T238 DOUBLE-BASE PROPELLANT (PATR-2700, C34)

| | H | C | N | O | PB | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NITROCELLULOSE(12.6) | .008 | .006 | .002 | .010 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 67.000 | -625. | .0600 |
| NITROGLYCERIN - NG | .005 | .003 | .003 | .009 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 27.000 | -392. | .0578 |
| 2-NITRODIPHENYLAMINE | .010 | .012 | .002 | .002 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 1.600 | 83. | .0494 |
| DIMETHYL PHTHALATE | .010 | .010 | .000 | .004 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.900 | -836. | .0547 |
| LEAD STEARATE -PBST | .070 | .036 | .000 | .004 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 2.200 | -425. | .0325 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 100.700 1.0000

| (H ) | (C ) | (N ) | (O ) | (PB) | ( |
|---|---|---|---|---|---|
| 2.874448 | 2.173735 | .974228 | 3.591125 | .002842 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 100.700 | 90.630 | 80.560 | 70.490 | 60.420 | 50.350 | 40.280 | 30.210 | 20.140 | 10.070 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 2597.429 | 2637.603 | 2679.932 | 2723.902 | 2767.201 | 2799.455 | 2763.205 | 2454.310 | 1869.898 | 1160.649 |
| FLAME TEMP. T(F) | 4215.973 | 4288.286 | 4364.477 | 4443.623 | 4521.563 | 4579.618 | 4514.368 | 3958.358 | 2906.416 | 1629.768 |
| ENTHALPY KCAL/GFW | -55.685 | -50.116 | -44.548 | -38.979 | -33.411 | -27.842 | -22.274 | -16.705 | -11.137 | -5.568 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1161.380 | 1182.839 | 1205.984 | 1231.715 | 1259.797 | 1291.324 | 1332.355 | 1080.093 | 734.888 | 397.857 |
| FLAME TEMP. T(F) | 1631.084 | 1669.710 | 1711.371 | 1757.686 | 1808.235 | 1864.983 | 1938.838 | 1484.767 | 863.399 | 256.743 |
| ENTHALPY KCAL/GFW | -117.212 | -110.794 | -104.385 | -97.989 | -91.610 | -85.243 | -78.746 | -64.310 | -46.062 | -26.322 |
| T.VOL.GASES--LITERS (GASES AT STP) | 91.381 | 98.351 | 107.061 | 118.263 | 133.196 | 154.101 | 185.459 | 247.622 | 376.697 | 763.927 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 37.9385 | 35.8737 | 33.2020 | 29.6289 | 24.5678 | 16.9184 | 4.3064 | .0001 | .0001 | .0003 |
| CO2 | 35.3898 | 38.6358 | 42.8342 | 48.4483 | 56.4000 | 68.4185 | 88.2337 | 94.9989 | 94.9966 | 94.9901 |
| N2 | 13.5516 | 22.2519 | 33.1272 | 47.1098 | 65.7532 | 91.8540 | 131.0050 | 196.2520 | 326.7600 | 718.2702 |
| H2O | 10.8726 | 12.1708 | 13.7365 | 15.6613 | 18.0370 | 21.0003 | 24.7126 | 25.7110 | 25.7099 | 25.7069 |
| H2 | 1.6602 | 1.5151 | 1.3400 | 1.1246 | .8588 | .5272 | .1118 | .0000 | .0000 | .0000 |
| Pb* | .2977 | .1535 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| Pb | .2854 | .4294 | .5824 | .5820 | .5813 | .5798 | .5687 | .0007 | .0010 | .0021 |
| CH4 | .0011 | .0004 | .0001 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH3 | .0005 | .0005 | .0004 | .0003 | .0002 | .0001 | .0000 | .0001 | .0001 | .0002 |
| Pb2 | .0004 | .0005 | .0005 | .0006 | .0007 | .0008 | .0010 | .0014 | .0021 | .0041 |
| PbO | .0002 | .0002 | .0003 | .0004 | .0007 | .0018 | .0128 | .1234 | .0011 | .0022 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .5006 | .6199 | .6099 |
| PbO& | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbO* | .0002 | .0002 | .0003 | .0003 | .0004 | .0004 | .0006 | .0007 | .0011 | .0022 |
| PbH | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| Pb& | .0002 | .0002 | .0003 | .0003 | .0003 | .0004 | .0005 | .0007 | .0010 | .0021 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |

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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | 14.1073 | 49.1194 | 154.1400 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0102 | .0002 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| CNH | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | CO2 | N2 | H2O | H2 | Pb* | Pb | CH4 | NH3 | Pb2 | PbO | PbO& | PbO& | PbO* | PbH |
| Pb& | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 | HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 |
| CNH | C2H2 | H2O* | HO | HO | O | NH | CH2 | N | CH | C | C& | C& | H | |

(p.1)

OPEN BURN---MATERIAL DOES NOT DETONATE BEFORE REACTING WITH AIR---
MATERIAL=TRINITROTOLUENE (TNT), 100%, OB'd @ 14.7 psi

| | H | C | N | O | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TRINITROTOLUENE | .005 | .007 | .003 | .006 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 99.990 | -78. | .0597 |
| AIR -(G | .000 | .000 | .006 | .001 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | 0. | .0000 |

GRAM ATOM AMOUNTS FOR MATERIAL WEIGHT OF 99.990 1.0000

| (H ) | (C ) | (N ) | (O ) | ( |
|---|---|---|---|---|
| 2.201056 | 3.081478 | 1.320633 | 2.641267 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WT. MATERIAL | 99.990 | 89.991 | 79.992 | 69.993 | 59.994 | 49.995 | 39.996 | 29.997 | 19.998 | 9.999 |
| WT. AIR | .000 | 10.000 | 20.000 | 30.000 | 40.000 | 50.000 | 60.000 | 70.000 | 80.000 | 90.000 |

---COMBUSTION CONDITIONS: THE MATERIAL AND AIR ARE BURNED TOGETHER AT 1000.00 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1991.560 | 1967.234 | 1941.794 | 2001.196 | 2143.164 | 2293.302 | 2453.950 | 2621.302 | 2507.124 | 1543.461 |
| FLAME TEMP. T(F) | 3125.407 | 3081.621 | 3035.828 | 3142.753 | 3398.295 | 3668.544 | 3957.710 | 4258.944 | 4053.423 | 2318.830 |
| ENTHALPY KCAL/GFW | -7.757 | -6.981 | -6.205 | -5.430 | -4.654 | -3.878 | -3.103 | -2.327 | -1.551 | -.776 |

---COMBUSTION CONDITIONS: THE COMBUSTION PRODUCTS FROM MATERIAL AND AIR AFTER EXPANDING FROM 1000.00 PSI TO 14.70 PSI---

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FLAME TEMP. T(K) | 1045.047 | 1033.771 | 1022.044 | 1008.026 | 988.041 | 963.878 | 1004.638 | 1108.299 | 1084.581 | 563.006 |
| FLAME TEMP. T(F) | 1421.684 | 1401.388 | 1380.280 | 1355.047 | 1319.073 | 1275.581 | 1348.949 | 1535.538 | 1492.845 | 554.010 |
| ENTHALPY KCAL/GFW | -57.835 | -55.960 | -54.072 | -52.520 | -52.029 | -52.130 | -52.666 | -53.205 | -49.251 | -28.716 |
| T.VOL.GASES--LITERS (GASES AT STP) | 108.022 | 115.040 | 123.819 | 135.100 | 150.122 | 171.152 | 203.369 | 256.051 | 368.790 | 758.770 |

COMBUSTION PRODUCTS ROUNDED OFF TO 1.00E-04

-----GRAMS PRODUCTS/100 GRAMS (GS/G)MATERIAL BURNED-----

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | 57.4339 | 58.7985 | 60.5252 | 62.1605 | 62.4138 | 61.3997 | 52.6485 | 31.9615 | .0001 | .0003 |
| N2 | 18.4998 | 27.2616 | 38.2140 | 52.2956 | 71.0711 | 97.3570 | 136.7869 | 202.5029 | 333.9276 | 728.2233 |
| CO2 | 10.8586 | 12.8177 | 15.2793 | 18.8809 | 25.0784 | 34.8250 | 52.8638 | 85.4102 | 135.6259 | 135.6193 |
| C& | 9.2507 | 8.1311 | 6.7205 | 5.0369 | 3.2322 | 1.0010 | .0000 | .0000 | .0001 | .0001 |
| H2 | 1.9635 | 1.9451 | 1.9252 | 1.8971 | 1.8470 | 1.7764 | 1.5237 | .7998 | .0000 | .0000 |
| H2O | 1.7594 | 1.9241 | 2.1062 | 2.3587 | 2.7924 | 3.4041 | 6.1725 | 12.6793 | 19.8260 | 19.8230 |
| CH4 | .2315 | .2313 | .2291 | .2283 | .2344 | .2426 | .0161 | .0001 | .0001 | .0002 |
| NH3 | .0015 | .0017 | .0019 | .0021 | .0024 | .0026 | .0016 | .0003 | .0001 | .0002 |
| CNH | .0004 | .0004 | .0004 | .0004 | .0003 | .0002 | .0001 | .0001 | .0001 | .0003 |
| C4H10 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| C4H8 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 | .0006 |
| O3 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| NO2 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0002 | .0005 |
| C3H8 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| C3H6 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0001 | .0001 | .0002 | .0004 |
| HO2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | | |

TNT 0.5 d @ 14.7 psi (p.2)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| .0002 | .0003 | | | | | | | | | |
| O2 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | 10.6446 | 116.4166 |
| NHO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| C2H6 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| CH2O | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0002 | .0003 |
| NO | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0121 | .0003 |
| CHO | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H4 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| C2H2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0001 | .0001 | .0003 |
| H2O* | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| HO | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| O | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| NH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 | .0002 |
| CH2 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| N | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| CH | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |
| C& | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0000 | .0001 | .0001 |

---LIST OF TOTAL COMBUSTION PRODUCTS CONSIDERED---

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | N2 | CO2 | C& | H2 | H2O | CH4 | NH3 | CNH | C4H10 | C4H8 | O3 | NO2 | C3H8 | C3H6 |
| HO2 | O2 | NHO | C2H6 | CH2O | NO | CHO | C2H4 | C2H2 | H2O* | HO | HO | O | NH | CH2 |
| N | CH | C | C& | H | | | | | | | | | | |