

ANNEX E
SINGLE CHEMICAL AGENT IDENTIFICATION SET
ACCESS AND NEUTRALIZATION SYSTEM
HEALTH AND SAFETY PLAN FOR DEPLOYMENT

**U.S. Army
Chemical Materials Agency (Provisional)
Program Manager for Elimination
of Chemical Weapons**

**Product Manager for
Non-Stockpile Chemical Materiel**

**Single Chemical Agent Identification Set
Access and Neutralization System
Health and Safety Plan for Deployment**

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U.S. Army Chemical Materials Agency (Provisional)
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Deployment**

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1. INTRODUCTION

This Health and Safety Plan (HASP) is written to support the Single Chemical Agent Identification Set (CAIS) Access and Neutralization System (SCANS) program for the Product Manager for Non-Stockpile Chemical Materiel (PMNSCM). This HASP has been written as a general guideline for safe operation of the SCANS during deployment in the field at recovery sites.

SCANS is likely to be deployed to various sites including: formerly used defense sites (FUDS), active Department of Defense (DoD) installations, or to civilian or local/state-owned properties. While operating under each profile, the mission concept is somewhat similar, but operating conditions could vary greatly. For example, SCANS could be deployed to sites where remedial investigations or environmental restoration is underway, or active military or industrial operations could be taking place. Such conditions could result in exposure to additional health and safety hazards.

The scope of this HASP is limited to the general operation of SCANS and does not address site-specific hazards. The HASP normally will be supplemented by a site HASP at established sites and/or by a Tech Escort operations order or work order that is prepared for each deployment.

1.1 SCANS Description

The SCANS is comprised of the following major components:

- Reagent chemicals
- SCANS container
- Shipping containers/overpacks.

1.1.1 Reagent Chemicals. Reagent chemicals are chemicals used to treat the individual CAIS items in the SCANS container. Reagent chemicals will be pre-packaged to facilitate field operations. Depending on the CAIS item to be treated, reagent chemicals will include the following:

- BLUE Process chemicals (to be used for all CAIS items except mustard agent on charcoal or nitrogen mustards on charcoal) include 2,700 milliliters of liquid reagent (comprised of 1,304 milliliters chloroform, 1,304 milliliters t-butyl alcohol, and 92 milliliters water) shipped in a 4-liter glass jar in a shipping container and 282 grams 1,3-dichloro-5,5-dimethylhydantoin (DCDMH) shipped inside the SCANS container in shipping container #1.
- CHARCOAL Process chemicals (to be used for charcoal-containing CAIS items containing mustard agent or nitrogen mustards) include 2,700 milliliters of liquid reagent (chloroform) and 282 grams DCDMH.

Reagent chemicals are pre-measured and both 4-liter glass jars will be pre-loaded into the SCANS container to check their fit prior to being deployed to the operational site.

1.1.2 SCANS Container. The SCANS container is a spherical plastic vessel and contains a cradle that holds the individual CAIS item and reagent bottle. The container is sealed after loading the CAIS item and reagent, and the bottles are broken by a metallic breaker rod that slides through double O-ring seals in a fitting that screws into the top side of the container. The reagents and CAIS contents are then manually mixed in the container to allow the reagents to contact the agent, thereby neutralizing it.

1.1.3 Shipping Container/Overpack. After mixing is completed, the used container is then loaded into a 20-gallon overpack for future transport to a permitted treatment, storage, and disposal facility (TSDF) for final disposition of the container and contents. The overpack will include an absorptive material to absorb neutralent in the event of a

container leak. The overpack (and the SCANS container as well) will be compatible with TSDF processing requirements.

1.2 SCANS Operations Description

There are five basic steps in the SCANS operation.

1. *Unpacking the SCANS Shipping Containers.* In this operation the operators open and unpack the SCANS and DCDMH from one 20-gallon shipping container and pre-measured 4-liter glass jar of liquid reagent from the second 20-gallon shipping container. The shipping containers and the contents are inspected for damage before use. These steps are executed outside the Exclusion Area to prevent agent contamination of the shipping container (which later becomes the SCANS overpack).
2. *SCANS Setup.* This operation begins outside the SCANS Exclusion Area and progresses into the Exclusion Area. The container and process reagents are moved to the chosen location where treatment will occur. This operation ends with the container and reagents ready for loading and treatment.
3. *Loading the Container.* The CAIS item is loaded into the container in the SCANS exclusion area. The CAIS item has already been characterized and is ready for neutralization. The appropriate liquid reagent is selected, the DCDMH is added to the reagent in the 4-liter glass jar, and the bottle is agitated manually to dissolve the DCDMH. The reagent mixture and the CAIS item are loaded into the SCANS and the two halves of the SCANS are bolted together and sealed. This operation ends with a fully loaded and sealed container, ready for treatment.
4. *Treatment.* Treatment of the CAIS item occurs in the SCANS exclusion area. The breaker rod is used to break the reagent bottle and the CAIS

item, and SCANS is shaken for a set period of time to provide mixing to ensure adequate contact for the neutralization. This operation ends when the CAIS item has been breached, and the CAIS contents have been mixed with reagent and agitated for the proper process reaction time.

5. *Repack of the Spent Container.* This operation begins in the SCANS Exclusion Area. It accomplishes monitoring of the container to verify that no contamination is present, and loading the spent container into its lab pack. All SCANS-related items leaving the Exclusion Area must be monitored to ensure they are clean and have no residual chemical agent. The container remains sealed throughout. This operation ends with a loaded, sealed, and labeled lab pack ready for transfer to a TSDf for final disposal.

1.2.1 Deployment Scenarios. SCANS is likely to be deployed under the following mission concepts, prioritized from most likely to least likely:

Profile 1: To a FUDS

Profile 2: To an active DoD installation or Base Realignment and Closure Act site where host facility support is in place

Profile 3: To civilian or local/state-owned property.

While operating under each profile, the operational mode summary is somewhat similar, but logistical support conditions vary slightly. All profiles assume that the SCANS is a subset of the overarching remediation mission at sites containing discovered CAIS items. The overall mission includes tasks such as site setup, monitoring, establishment of a Contamination Reduction Zone and Exclusion Area, and conducting confirmatory analysis (for example, raman spectrophotometry). The SCANS-specific task is a limited subset of the overarching mission, concentrating on treatment (neutralization) of the identified CAIS item(s). The U.S. Army Technical Escort Unit (TEU) is responsible for

neutralizing the recovered CAIS item(s), but they do not own the mission site. All other site support functions fall under other agencies, such as the installation/host facility commander, Army Corps of Engineers, or state/local governments. All three operational deployment scenarios will have a similar site security, health, and safety approach.

Specific SCANS operating principles are as follows:

- Once the CAIS item(s) are characterized as agent-laden, they are treated in individual SCANS process reactors. The marriage of the CAIS items to its reactor remains in place from cradle-to-grave.
- The reactor contains a cradle into which the CAIS item is placed. The DCDMH and co-solvent reagents are pre-mixed in a 4-liter glass jar, then loaded into the SCANS container, and the SCANS is then closed/sealed.
- A breaching mechanism is activated, breaking the CAIS item open and allowing the reagents to neutralize the CAIS item contents.
- A specific elapsed time period and agitation ensure that a thorough reaction has occurred.

Once this cycle is complete, the reactor is returned to its shipping container (now renamed the Lab pack) for redundant containment, transport protection, and retrieval by the TSDF contractor.

2. HEALTH AND SAFETY ORGANIZATION AND ADMINISTRATION

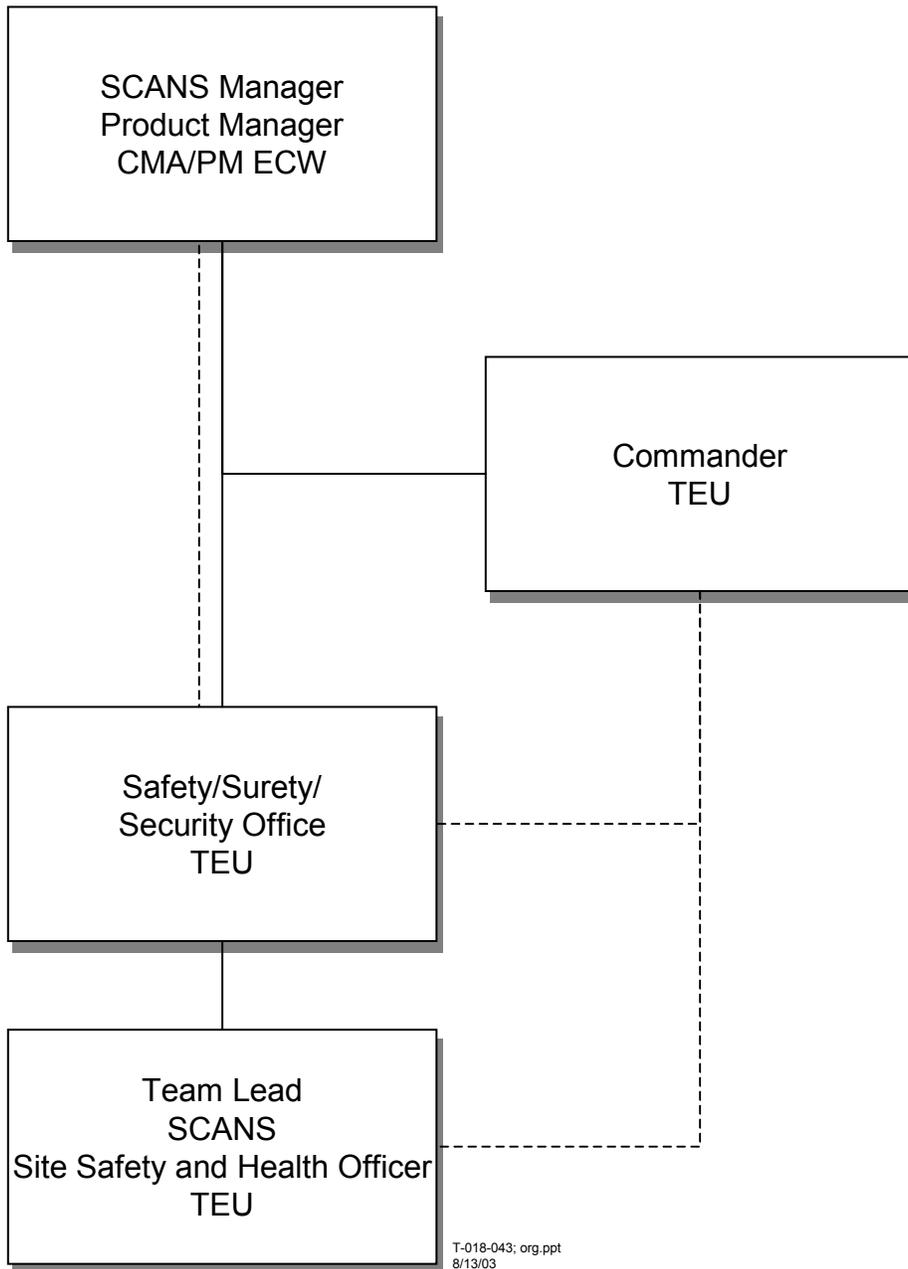
Organizational responsibilities are shown in table 1. An outline of the safety and health organization is shown in figure 1.

Table 1. Health and Safety Responsibilities

Title	Responsibilities
PMNSCM, SCANS System Manager	<ul style="list-style-type: none"> • HASP review and approval • HASP modification/deviation approval
CMA Risk Management and Quality Assurance	<ul style="list-style-type: none"> • HASP preparation • HASP review and concurrence • HASP modification/deviation concurrence • Conflict resolution • Reporting/recording accidents or injuries IAW Army and PM ECW policies
SCANS Team Leader TEU	<ul style="list-style-type: none"> • HASP review and concurrence • HASP modification/deviation concurrence • HASP implementation and enforcement
SCANS SSHO (May be Team Leader or designated crew member) TEU	<ul style="list-style-type: none"> • HASP review and concurrence • HASP modification/deviation concurrence • HASP compliance confirmation • Documentation/reporting • Notification • Safety inspections and audits • Site safety training • Accident prevention • Coordinate with site monitoring personnel
Operations Personnel (All) TEU	<ul style="list-style-type: none"> • HASP adherence • Accident prevention • Notification

Notes:

- CMA = U.S. Army Chemical Materials Agency (Provisional)
- HASP = Health and Safety Plan
- IAW = in accordance with
- PM ECW = Program Manager for Elimination of Chemical Weapons
- PMNSCM = Product Manager for Non-Stockpile Chemical Materiel
- SCANS = Single Chemical Agent Identification Set Access and Neutralization System
- SDO = Staff Duty Officer
- SSHO = Site Safety and Health Officer
- TEU = U.S. Army Technical Escort Unit



----- Coordination
 _____ Direct Support

Figure 1. SCANS Safety and Health Organization

3. TASK SAFETY AND HEALTH RISK ANALYSIS

This section addresses the potential health and safety hazards that may be encountered during operation of SCANS. Detailed descriptions of the process tasks are provided in the User's Manual, Maintenance Operating Procedures, and the Standing Operating Procedures (SOPs) for SCANS.

This safety and health analysis is limited to the interface between the SCANS operators and associated instruments/support equipment. There may be other site-specific hazards associated with each site where the SCANS will be used. These will be detailed in the site-specific HASP for each location. SCANS operators are required to read and follow the site-specific HASP for each location where SCANS operates.

3.1 Chemical Hazards

This section addresses the potential chemical-related health and safety hazards that may be encountered during operation of the SCANS.

3.1.1 Chemicals of Concern. Chemical hazards result from the following items:

- a. CAIS containing the following:
 - (1) Mustard (H), distilled mustard (HD), or both
 - (2) Lewisite (L).
- b. SCANS neutralization materials:
 - (1) DCDMH

- (2) Chloroform
 - (3) T-butyl alcohol.
- c. The decontaminant for cleanup of spills:
- (1) Bleach – 5.00 percent in water.

Appendix C contains copies of the required Material Safety Data Sheets (MSDSs). The Team Leader will maintain a list of all chemicals used or handled at the site. This list will include any hazardous materials used for maintenance. MSDSs for all chemicals will be maintained at the SCANS site.

Training in accordance with 29 Code of Federal Regulations (CFR) 1910.1200, Hazard Communication, will be conducted for military-unique chemicals, industrial chemical agents, and any other hazardous chemicals used at the site.

3.1.2 Exposure Pathways. The following paragraphs describe the various exposure pathways through which contaminants can be introduced and the general precautions required to reduce the potential for human exposure. The SCANS is designed to minimize exposure of personnel to hazardous chemicals.

- a. *Inhalation.* The inhalation of chemical vapors and mists is considered a significant means of potential exposure to the chemicals of concern. The potential for chemical exposure via inhalation exists during spill situations, or in the unlikely event that the SCANS container fails.
- b. *Dermal Contact.* Absorption through the skin from direct physical contact with chemical material is another potential means of exposure to the chemicals of concern involved in this project. Personal protective equipment (PPE) worn during SCANS site tasks is resistant to the types of chemicals being handled.

- c. *Ingestion.* The potential for ingestion of contaminated media will be controlled through the use of good personal hygiene.

3.1.3 Health Hazard Information. Summary health hazard information on the primary chemical constituents of SCANS is presented in the following.

- a. *Chloroform.* Chloroform is a colorless liquid with a pleasant odor. The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL) for chloroform is 2 parts per million (ppm) (9.78 milligrams per cubic meter [mg/m^3]) expressed as a short-term exposure limit, time-weighted-average (TWA). This implies that exposure can exceed 2 ppm momentarily as long as the average exposure in any 60-minute period is below 2 ppm. The Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for chloroform is 50 ppm equivalent to $240 \text{ mg}/\text{m}^3$ as a ceiling concentration. The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value for chloroform is 10 ppm as an 8-hour TWA. OSHA, ACGIH, and NIOSH list chloroform as a potential occupational carcinogen. Chloroform has an immediately dangerous to life and health (IDLH) limit of 500 ppm. The reported exposure routes are inhalation, dermal contact, and ingestion. The chemical can be absorbed through the skin in quantities sufficient to cause systemic toxic effects. Symptoms of exposure include: irritation to eyes or skin, dizziness, mental dullness, nausea, confusion, headache, fatigue, anesthesia, and enlarged liver. Chloroform is a noncombustible liquid. However, when heated to decomposition, it forms phosgene gas (NIOSH, 1999).

Note: For the purposes of this HASP, the most stringent (that is, protective) workplace exposure limit (or guideline) will be used for worker protection. Therefore, the NIOSH REL for chloroform of 2 ppm will apply to SCANS operations.

Respirator Recommendations. At airborne concentrations above the NIOSH REL, use either: (1) any self-contained breathing apparatus (SCBA) that has a full face piece and is operated in a pressure-demand or other positive-pressure mode having an assigned protection factor equal to 10,000 or (2) any supplied air respirator that has a full face piece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary positive-pressure SCBA (NIOSH, 1999). At concentrations below the REL, no respirator is required. Note that there is no approved air-purifying respirator (APR) cartridge (military or commercial) for chloroform. Therefore, a Level C type APR should not be used for protection against chloroform. The NIOSH revised policy on carcinogens (including chloroform) permits working with chloroform below the REL without a respirator.

- b. *DCDMH.* DCDMH is a white powder with a chlorine-like odor. DCDMH is slightly soluble in water with liberation of hypochlorous acid; it is soluble in benzene, chloroform, and alcohol. The OSHA PEL for DCDMH is 0.2 mg/m³ as an 8-hour TWA. The ACGIH Threshold Limit Value is 0.2 mg/m³ with a short-term exposure limit of 0.4 mg/m³. The NIOSH REL is the same as the PEL. The IDLH limit is 5 mg/m³. DCDMH is incompatible with water and strong acids, and is easily oxidized in materials such as ammonia salts and sulfides. The routes of exposure are inhalation, ingestion, and dermal contact. Symptoms of exposure are irritation of the eyes, mucous membranes, and respiratory system (NIOSH, 1999).

- c. *T-butyl alcohol.* T-butyl alcohol is a colorless liquid with a camphor-like odor. The OSHA PEL for t-butyl alcohol is 100 ppm (equivalent to 300 mg/m³) as an 8-hour TWA. The NIOSH REL and the ACGIH Threshold Limit Value are the same as the PEL. The IDLH limit for this chemical is 1,600 ppm. The reported exposure routes are inhalation, ingestion, and dermal contact. T-butyl alcohol is a flammable liquid with a

flash point of 52°F. Symptoms of exposure include irritation of the eyes, skin, nose, and throat; and drowsiness and narcosis. T-butyl alcohol is incompatible with strong mineral acids, strong hydrochloric acid, and oxidizers (NIOSH, 1999).

- d. *Bleach (5 percent mixed with water)*. Irritant to skin, eyes, nose, throat, and gastrointestinal tract. Eye contact may cause severe irritation and damage. NIOSH, OSHA, and ACGIH have not established allowable limits for bleach.

- e. *H/HD/sulfur mustard (HS) and L*. H/HD/HS and L are blister agents. They can be absorbed through the eyes, lungs, and skin. They destroy cells of living tissues, causing blisters on skin and damage to eyes, mucous membranes, respiratory tract, and internal organs. Acute exposure to the eye causes severe damage, instant pain, conjunctivitis, and blepharospasm leading to closure of eyelids, followed by corneal scarring and irritation. Mild exposure produces reversible eye damage if decontamination is immediate. Exposure to the skin causes immediate stinging pain increasing in severity with time. The airborne exposure limit of L and H/HD/HS is 0.003 mg/m³ (as an 8-hour TWA for an 8-hour workday or a 40-hour workweek). This concentration is also a ceiling value. A ceiling value may not be exceeded at any time. The ceiling value is based upon the present technologically feasible detection limits of 0.003 mg/m³. This value can be found in Department of the Army Pamphlet (DA Pam) 40-173, *Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT*. OSHA, NIOSH, and ACGIH have not established exposure limits for H/HD/HS and L.

MSDSs for agent and non-agent SCANS chemicals are presented in appendix C.

3.1.4 Identification of Chemical Hazards. The system components/processes described in section 3 are reviewed for toxic and/or combustible material hazards. Specific toxic and/or combustible hazards are summarized in table 2.

3.2 Heat Stress/Cold Stress

Heat stress is of major concern for this project. Heat stress is the net heat load to which a worker is exposed from the combined contributions of metabolic work, environmental factors including air temperature, humidity, and radiant heat exchange, and clothing requirements. The risk of heat stress and heat illness is increased because of the recommended PPE control measures (for example, Level C ensemble including encapsulating butyl rubber suit and hood).

The SCANS program period of operation may include the summer months of July through September, which may (depending on location) present additional heat stress related challenges for personnel required to work in PPE.

Cold stress can be of concern, especially if work is being performed during winter months when a wind-chill adjusted temperature is equal to or below 10°F. Injuries due to cold stress can range from frostbite to hypothermia, which can result in death if not attenuated.

Heat stress/cold stress hazards will need to be assessed on a site-specific basis.

3.3 Physical Hazards

The SCANS operations require handling the 20-gallon overpack drums containing the SCANS container and associated reagents. The risk of slip, trip, and fall hazards is increased because of the required PPE (Level C) and the diminished field of view associated with wearing a full-face mask. Physical hazards are identified and summarized in table 3.

Table 2. Identification of Chemical Hazards

Operation	Potential Hazard	Notation
Loading Container and Treatment	Dermal contact with chemical agent (H/HD/HS or L)	In the event of system failure (such as container rupture or CAIS rupture)
Loading Container and Treatment	Inhalation of airborne chemical agent	In the event of system failure (such as container rupture)
Loading Container	Dermal contact with DCDMH	During reagent preparation or accidental spill
Loading Container	Contact with chloroform	During reagent preparation or accidental spill
Loading Container	Inhalation of chloroform vapor	During reagent preparation or accidental spill
Loading Container	Contact with t-butyl alcohol	During reagent preparation or accidental spill
Loading Container	Inhalation of t-butyl alcohol vapor	During reagent preparation or accidental spill
Spill Response	Contact with chloroform, agent, other reagents, or bleach/water solution	During spill cleanup
Spill Response	Contact with chloroform; contact with agent/neutralant mixture	During spill cleanup

Notes:

CAIS = chemical agent identification set
DCDMH = 1,3-dichloro-5,5-dimethylhydantoin
H/HD/HS = mustard/distilled mustard/sulfur mustard
L = lewisite

Table 3. Identification of Physical Hazards

Operation/Activity	Potential Hazard	Notes
Unpacking and Setup/Lifting Container from Shipping Container	Personal injury (strain) during lifting	
Unpacking, Setup, and Repacking/Moving Drums and Equipment by Hand	Personal injury	Each overpack drum weighs 50 pounds
Unpacking SCANS/Moving Drum Scale to Treatment Site	Personal injury	
Treatment/SCANS – Shaking Container	Personal injury/Stress	SOP requires 10-minute shaking/mixing duration

Notes:

SCANS = Single Chemical Agent Identification Set Access and Neutralization System

SOP = Standing Operating Procedure

3.4 Noise

Workers are enrolled in hearing conservation programs that comply with 29 CFR 1910.95 and Army Regulation (AR) 40-5, *Preventive Medicine*. Should any areas have noise levels above 85 decibels using an “A” weighted scale [abbreviated dB (A)], they must be addressed in the site-specific HASP. Earmuffs and/or earplugs will be available and used in high-noise areas.

3.5 Biological Hazards

When work is scheduled for the warmer seasons, biological hazards may include insects, poison ivy, rodents, snakes, or other animals. Basic precautions are to identify the types of hazards on the site, wear proper clothing, avoid contact with plants or animals, and practice prudent hygiene as necessary to minimize the hazards.

Biological hazards will be addressed in the site-specific HASP.

3.6 Work Areas

The deploying TEU team will establish the required controls and effect monitoring to determine the site-specific health and safety criteria, both to the environment and to the operators.

Three clearly defined work areas must be established.

- *Exclusion Zone*—a controlled area where only the SCANS operators may enter to accomplish SCANS neutralization activities including loading the reactor and treatment
- *Contamination Reduction Zone*—an area where PPE can be doffed and any required decontamination can be accomplished
- *Support Zone*—an area away from the Exclusion Zone and Contamination Reduction Zone for such activities as unpacking the SCANS shipping container, SCANS reactor setup.

All distances measured for the exclusion and contamination reduction zones will be determined prior to SCANS deployment to each site and will be included in the site-specific HASP for that site. The distances must be based on calculations from the DA Safety Office-approved, chemical agent, downwind hazard prediction computer models (D2PC), and must be based on evaporative release of the specific CAIS contents.

3.7 Assessment of Hazards

Hazard severity is an assessment of the worst potential consequence. This assessment is defined by degree of bodily injury, occupational illness, health-related performance degradation, or bodily system damage that could occur. Hazard severity categories and definitions are presented in table 4.

Table 4. Hazard Severity Categories

Description	Category	Mishap Definition
Catastrophic	I	May cause death, system loss, or severe environmental damage
Critical	II	May cause severe injury, severe occupational illness, or major system or environmental damage
Marginal	III	May cause minor injury, minor occupational illness, or minor system or environmental damage
Negligible	IV	May cause less-than-minor injury, occupational illness, or less-than-minor system or environmental damage

Hazard probability refers to the likelihood that a hazard will occur. This probability is based on an assessment of such factors as location, exposure in terms of cycles or hours of operation, and affected population. Hazard probability categories are described in table 5.

Based on a combination of the hazard severity categories and probability levels, hazards will be assigned a risk assessment code (RAC). The system safety criteria presented in the *System Safety Management Plan for the Non-Stockpile Chemical Materiel Product* (PMCD, 2001) will serve as the basis for categorizing hazard severity and hazard probability, and assigning RACs. These criteria are summarized in table 6. RAC 1 reflects the most hazardous combination and RAC 4 the least. RAC values of 1 or 2 require action to correct or reduce the hazard (RAC value) to a level acceptable to management.

3.7.1 Chemical Substances. The chemicals identified in table 2 as potential health hazards are assessed in table 7. The table contains summary hazard assessments for each potential exposure pathway for each chemical. The table presents recommendations and controls for hazards and also includes RACs. The recommendations and controls used to correct identified hazards reduce the RAC value to acceptable levels.

Table 5. Hazard Probability Categories

Frequency of Occurrence	Level	Description
Frequent	A	Will be continuously experienced
Probable	B	Will occur frequently in the life of the system
Occasional	C	Will occur several times in the life of the system
Remote	D	Unlikely, but can reasonably be expected to occur in the life of the system
Improbable	E	Unlikely, but possible to occur in the life of the system

Table 6. RAC Matrix

Hazard Probability (Frequency) Category	Hazard Severity (Consequence) Category			
	I Catastrophic	II Critical	III Marginal	IV Negligible
A - Frequent	1	1	1	3
B - Probable	1	1	2	3
C - Occasional	1	2	3	4
D - Remote	2	2	3	4
E - Improbable	3	3	3	4
Hazard Risk Index	Risk Assessment Code	Action Required		
IA, IB, IC, IIA, IIB, IIIA	1	Unacceptable – Immediate corrective action required; Assistant Secretary of Army decision		
ID, IIC, IID, IIIB	2	Undesirable – Reduced priority, corrective action required; Project Manager for Non-Stockpile Chemical Materiel decision		
IE, IIE, IIIC, IIID, IIIE, IVA, IVB	3	Acceptable – Low priority for corrective action (may not warrant action); System Safety Program Manager decision		
IVC, IVD, IVE	4	Acceptable – No corrective action required		

Source: *System Safety Management Plan for the Non-Stockpile Chemical Materiel Product* (PMCD, 2001).

Significant health hazards for SCANS operations include dermal and airborne exposure to chemical agents. If uncontrolled, these hazards would present an unacceptable risk.

Exposure to chloroform above the REL during routine SCANS operations is improbable due to the limited time that chloroform is handled in open containers (usually less than one minute). Previous studies (PM ECW, 2003) demonstrated the chloroform concentration during routine SCANS operations was well below the REL.

Exposure to t-butyl alcohol and DCDMH above the allowable limits during routine operations also is improbable due to the limited time that these materials are handled in open containers.

The potential for ingestion of contaminated media will be controlled through the use of good personal hygiene practices and by not allowing eating or drinking except in designated areas. It is assumed that the ingestion pathway presents a negligible risk.

3.7.2 Physical Hazards. The physical hazards identified in paragraph 3.3 are assessed in table 8.

3.8 Recommendations

All personnel working with military chemical agents must comply with the requirements of AR 385-61, *The Army Chemical Agent Safety Program*, and DA Pam 385-61, *Toxic Chemical Agent Safety Standards*. These requirements specify minimum safety criteria and standards for processing, handling, storage, transport, disposal, and decontamination of the various chemical agents.

3.8.1 Recommendations for PPE. General recommendations for protection against chemical hazards are presented in table 7. Specific PPE recommendations for protection against chemical hazards for SCANS operations are presented in section 5.

Table 7. Assessment of Chemical Hazards

Operation	Chemical	Potential Hazard	Uncontrolled Hazard Severity/ Probability	Controls	Controlled Hazard and RAC
Loading Container	Chloroform	Dermal contact with liquid chloroform in the event of a spill; can be absorbed through the skin	III/B	Chemical protective gloves will be worn. Training will emphasize care while handling reagents. Procedure requires PPE change if reagent is spilled on glove/suit.	III/D = RAC 3
Loading Container	T-Butyl alcohol	Dermal contact with liquid; can be absorbed through skin	III/C	Chemical protective gloves will be worn. Training will emphasize care while handling reagents.	III/D = RAC 3
Loading Container	DCDMH	Dermal contact with DCDMH; may cause skin burns	III/C	Chemical protective gloves will be worn. Training will emphasize care while handling reagents.	III/D = RAC 3
Loading Container	H/HD/HS/L	Inhalation of agent vapor above the AEL; may cause severe injury	I/D	Level C PPE (including military mask) will be worn. Agent monitoring and alarms will document exposure.	I/E = RAC 3
Loading Container	H/HD/HS/L	Dermal contact with agent; may cause severe injury	II/D	Level C PPE will be worn.	II/E = RAC 3
Spill	Agent or chloroform	Inhalation or dermal contact	II/B	Level B PPE (including SCBA) will be worn.	III/E = RAC 3

Notes:

- AEL = airborne exposure limit
- DCDMH = 1,3-dichloro-5,5-dimethylhydantoin
- H/HD/HS = mustard/distilled mustard/sulfur mustard
- L = lewisite
- PPE = personal protective equipment
- RAC = risk assessment code
- SCBA = self-contained breathing apparatus

Table 8. Assessment of Physical Hazards

Operation	Control	Controlled Hazard and RAC
Unpacking and Setup/Lifting Container from Shipping Container	Use 2 operators for this operation	III/D = RAC 3
Unpacking, Setup, and Repacking/Moving Drums and Equipment by Hand	Use 2 operators for this operation	III/D = RAC 3
Unpacking SCANS/Moving Drum Scale to Treatment Site	Use 2 operators for this operation	III/D = RAC 3
Treatment/SCANS – Agitating Container	Place SCANS container on table or bench; have workers shake SCANS individually.	III/D = RAC 3
Storage/Positioning Containers in Test Chamber	Use 2 operators for this operation	III/D = RAC 3

Notes:

RAC = risk assessment code
 SCANS = Single Chemical Agent Identification Set Access and Neutralization System

3.8.2 Physical Hazards. Hazards can be controlled to acceptable levels if operators use a 2-person lift technique for items weighing more than 42 pounds. The current SOP requires a 2-person lift.

Placing SCANS on a table rather than holding it while agitating the container will significantly reduce the amount of stress placed on the worker. Requiring workers to shake the SCANS individually will further reduce stress. Note: Two workers shaking the SCANS in tandem is not an efficient agitation process and constant pulling by one worker places additional strain on that worker’s upper extremity.

The recommended procedure is to have one worker shaking for 1 minute followed by the second worker shaking for 1 minute until the 10-minute operation is complete.

Workers should have the option of alternating hands with each cycle.

If the weight of an object exceeds that which can be safely lifted by two workers, a lifting device will be used. Workers will be trained in proper lifting techniques in order to avoid personal injury and will receive specific drum handling training.

Workers will be apprised of potential tripping hazards through the regular health and safety briefings conducted by the Team Leader and Site Safety and Health Officer (SSHO). Whenever possible, trip and fall hazards will be eliminated or will be clearly marked.

3.8.3 Chloroform Exposure Monitoring. Baseline worker exposure monitoring indicated that worker exposure to chloroform was well below the NIOSH REL of 2 ppm. Worker exposure monitoring should be repeated periodically to validate baseline monitoring. Monitoring should also be repeated whenever major changes to the SOP occur.

4. AIR MONITORING

4.1 Monitoring Instruments

Air monitoring for chemical agent during SCANS operations will be performed with the MINICAMS[®] units according to TEU *Standing Operating Procedures for Operating MINICAMS[®] and Hewlett Packard Dynatherm (HPD) System* (TEU, 2002).

Monitoring for chloroform vapor inside the overpack containers to determine if a leak occurred will be performed with a photo ionization detector (PID) instrument. These instruments measure the total concentration of all volatile organic compounds (VOCs) present. PIDs cannot, however, differentiate between specific VOCs, such as chloroform, and t-butyl alcohol, both of which are used in SCANS operations. The instrument will produce a single combined reading for all VOCs present. Note that the PID reading should be interpreted as indicating chloroform (worst-case scenario) even though t-butyl alcohol may be present inside the overpack container. Confirmation monitoring for chloroform can be performed using chloroform-specific Draeger colorimetric tubes.

4.2 Calibration Requirements

All MINICAMS units will be challenged daily and calibrated weekly in accordance with the SOP. One copy of the operation manual for each instrument used in the field will be kept in the site office. The calibration data, including date, time span, gas or other standard, and name of the qualified individual performing the calibration will be recorded. The PID will be calibrated daily using manufacturer supplied calibration gas. Colorimetric tubes and sample pumps will be inspected and calibrated in accordance with manufacturer's instructions. Inspections will be recorded.

4.3 Air Monitoring Log

The Site Manager will ensure that all air monitoring data are recorded and available onsite. The detailed results of monitoring conducted in support of chemical operations will include date, sample number, duration, location, results of each sample taken, type of protective clothing and equipment used, roster of personnel entering the area, and sampling and analytical methods used.

4.4 Alarm Levels/Required Action

MINICAMS monitors are set to alarm according to the TEU SOPs for operating MINICAMS units.

The PID instrument should be set to alarm at 50 ppm. This level was selected because it is believed that it would be indicative of a leaking or broken chloroform bottle.

If after inserting the PID probe into the partially open overpack drum a reading of 50 ppm or higher is reached, the drum should be resealed. The drum should not be used for SCANS operations and should be disposed of as "hazardous material."

Detailed response information is provided in the Emergency Response Plan and included as section 8 of this document.

5. PPE

PPE is designed to protect workers from known or suspected airborne, solid, and liquid contamination. The PPE levels for the individual work tasks are specified and have been selected based upon the anticipated concentrations of contaminants that may be encountered, their chemical properties, toxicity, exposure routes, and contaminant matrix.

5.1 PPE Recommendations for Chemical Hazards

5.1.1 Rationale for PPE Selection. Potential significant health hazards include worker exposure to chemical agents. Near real-time chemical agent monitors and alarms will warn of agent exposure at or above the airborne exposure limit.

Dermal contact with the reagents or chemical agent is less likely to occur and procedures will require immediate changeout of PPE (suit or glove) in the event of contamination.

5.1.2 Required PPE and Commercial Alternatives. The basic PPE requirement for SCANS operations is Level C (based on DA Pam 385-61). This level is required for protection against chemical agent (H, HD, and L). Level C is defined as full-face, air-purifying respirators (NIOSH-approved or military mask); hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; sleeved chemical-resistant apron; disposable chemical-resistant overalls); gloves, outer, chemical resistant; gloves, inner; boots, outer, chemical resistant, steel toe and shank; coveralls (optional); boot covers, outer, chemical resistant (optional); hard hat (optional); face shield (optional).

Note that the air-purifying respirator component of the Level C ensemble is for protection against potential chemical agent. The respirator does not provide protection against chloroform. A respirator is not required for chloroform due to the low chloroform concentrations associated with SCANS operations.

To protect against dermal contact with chemical agent and SCANS neutralization chemicals the recommended glove combination is commercial butyl outer gloves worn with 4H or Silver Shield liners.

The use of commercial PPE will be in accordance with the DA Safety memorandum dated 28 February 2002, *Generic Approval of Commercial Protective Clothing and Equipment*.

A proposed commercial alternative chemical protective suit, which currently meets generic approval, is Tyvek® “F.” This suit has advantages over military butyl coveralls in that it is lighter and easier to work in. Tyvek “F” is not reusable if contaminated with vapor and/or liquid chemical agent. This is a one-time use suit. Limitations and additional requirements for Tyvek “F” that relate to the SCANS operations include the following:

- The suit must be removed immediately if it is contaminated with liquid chloroform or HD and the wearer must be decontaminated within 30 minutes.
- If workers encounter leaking CAIS, they will immediately evacuate the area and don other approved chemical protective clothing.
- Chemical protective undergarments must be worn for HD operations.
- The suit may not be used if fire is expected (suit is not National Fire Protection Association-certified for flame resistance).
- Suit must be thoroughly inspected before and during use for signs of wear.

5.2 Different Levels of PPE

The following defines the general personal protective levels and associated PPE available for use by SCANS personnel for specific work tasks. If unexpected hazards at a site indicate the need for a different level of PPE than that listed in the HASP, the plan will be modified, subject to the approval of the SSHO. The levels of protection are based on those described in the DA Pam 385-61, dated 27 March 2002.

5.2.1 Level A. Level A protection (a fully encapsulating suit) is used when airborne concentrations may exceed the IDLH limit and percutaneous hazards exist, or when no data are available that can conclusively eliminate skin hazards. Level A protection is not anticipated to be required during SCANS operations.

5.2.2 Level B. Level B should be used when the highest level of respiratory protection is required, but a lesser level of skin protection is warranted. Level B is recommended for use for SCANS emergency activities such as a chemical agent or chloroform spill.

5.2.3 Level C. Level C protection should only be worn when all the criteria for APR protection are satisfied, and the potential for skin hazard is limited. Level C is recommended for use for all routine SCANS activities inside the Exclusion Zone.

5.2.4 Level D. Level D protection will include the following equipment:

- a. Army M40 emergency escape mask (slung) (required)
- b. Hard-toe safety boots or high-top shoes (required)
- c. Gloves (as needed)
- d. Face shield or goggles (as needed).

Support staff in the Setup Zone or Contamination Reduction Zone should wear Level D. Visitors and observers should wear Level D.

5.2.5 Additional Safety Equipment. Depending on the task, additional safety equipment may be required. The Site Manager will enforce the use of additional task-related equipment.

5.3 PPE Deviation/Modification

PMNSCM must approve any change (other than editorial) such as downgrading/upgrading PPE. Any deviation from or modification to this HASP will require prior written approval from the Risk Management and Quality Assurance Office. The SCANS Team Leader will initiate requests for deviation/modification and obtain concurrence from all parties, as outlined in table 1, Health and Safety Responsibilities.

5.4 Limitations of PPE

PPE ensembles designated for use during work tasks have been selected to provide protection against contaminants at known or anticipated concentrations. However, no protective garment, glove, or boot is chemical-proof, or affords protection against all chemical types. Permeation of a given chemical through PPE is a complex process governed by contaminant concentrations, environmental conditions, physical condition of the protective garment, and the resistance of a garment to a specific contaminant. Chemical permeation may continue even after the source of contamination has been removed from the garment.

In order to obtain optimum performance of PPE, the following procedures are to be followed by all site personnel using PPE:

- a. Disposable (commercially procured) protective clothing will be inspected both prior to and during use for imperfect seams, nonuniform coatings, tears, and poorly functioning closures.

- b. Reusable garments, boots, and gloves will be inspected both prior to and during use for visible signs of chemical permeation, swelling, discoloration, stiffness, brittleness, cracks, any sign of puncture, and any sign of abrasion.

Commercial gloves, boots, or coveralls exhibiting any of the previously listed characteristics will be discarded. Military equipment exhibiting any of these symptoms will not be used and will be returned to the clothing issue point.

Any PPE that has been contaminated with blood must be separated from normally laundered PPE. This is to prevent laundry workers from coming into contact with blood-borne pathogens.

Blood-contaminated PPE will be placed in appropriate containers that are labeled as BIOHAZARD per OSHA 1910.1030 (g)(1).

5.5 Donning of PPE

Work uniforms will be donned in the Setup Zone. Workers will don hearing protection before entering areas requiring it.

Before a worker wears any level of PPE, it will be checked to ensure that it is in proper condition for the purpose for which it is intended. Workers with any minor injuries and/or openings in the skin surface, such as cuts and scratches, will be given special attention in order to protect such areas, which may potentially enhance exposure effects. Workers with large cuts, rashes, or other such skin damage will not be allowed to don PPE. The SSHO, based on the recommendation of qualified occupational health personnel, will determine when an employee may not be able to wear PPE or perform other duties.

After donning the equipment, proper fit will be evaluated by the SSHO or another qualified person before the worker is allowed to enter the Exclusion Zone.

6. RESPIRATORY PROTECTION

6.1 Supplied Air Respirators and SCBA

Personnel who may be exposed to chloroform vapors above the REL, or who may be responding to situations involving unknown concentrations of hazardous chemicals, will wear NIOSH-approved SCBA.

According to 29 CFR 1910.134, breathing air must meet the specification for grade D breathing air as described in the Compressed Gas Association Specification G7-1966. Vendors who supply breathing air will be required to provide a certificate of analysis specific to each batch of air delivered to the project and not for the general lot from which the batch came. This certificate of analysis will state that the batch of air meets the specification for grade D breathing air. A similar certificate of analysis is required for every delivery, unique to that delivery. This certification will be checked prior to using air from that source.

6.2 APRs

6.2.1 Slung Mask. Military issue M40 masks (or approved commercial alternatives) will be used. The M40 is a full-face APR with a C3 chemical cartridge that is effective for use with the military-unique chemicals contained in the CAIS.

6.2.2 Escape Mask. Military issue M40 masks will be used for emergency escape. The M40 is a full-face APR with a C3 chemical cartridge that is used for escape from areas contaminated by the military-unique chemicals contained in the CAIS.

6.2.3 Cartridge Change Frequency. The M40 masks will be turned in to the mask issue point in accordance with site policies.

6.2.4 APR Limitations. APRs are not to be used in situations when contaminants in the air are unknown, or when oxygen levels are below 19.5 percent or above 23.0 percent.

6.3 Fit-Testing for APRs

M40 masks will be fit-tested by personnel assigned to the mask issue point. The test will be quantitative for the M40 mask. Personnel trained in fitting military masks perform all fit-testing. A fit-test record will be maintained at the mask issue point and will include information such as the name of the person wearing the respirator, name of person supervising the test, location, date and time, signatures of personnel involved, details of respirator type, and test(s) performed.

When donning the mask, operators will perform a positive- and negative-pressure fit-test when clearing and checking the mask. Workers are trained annually in donning, clearing, and checking both types of masks.

6.4 General Safety for Respirator Use

The following general safety guidelines for respirator use will be adhered to during SCANS operations activities.

6.4.1 Inspection and Cleaning. In addition to the inspection and testing done by the mask issue point, the APRs will be checked periodically by the SSHO and by the person issued the mask. Masks issued to individuals at the mask issue point will not be used by different personnel. Workers at the mask issue point may assign masks to different personnel, at which time the respirators will be decontaminated, hygienically cleaned, and fit-tested before reuse.

Personnel trained and certified to use the specific respirator will inspect the supplied air respirators. The SSHO will record this inspection. The respirators will be hygienically cleaned after each use according to the manufacturer's instructions. If the face masks,

lenses, or hoses were contaminated by liquid chloroform, they will be checked for deterioration and replaced if necessary. Air bottles will be refilled only at facilities that produce grade D breathing air as specified in paragraph 6.1.

6.4.2 Respirator Restrictions. The following respirator restrictions will be strictly adhered to during all field activities:

- a. *Facial Hair.* Personnel with facial hair, such as a beard or a mustache that may interfere with the respirator seal, will not be permitted to wear the respirator and hence not be permitted to work at the site.
- b. *Corrective Lenses.* Normal eyeglasses cannot be worn under full-face respirators because temple bars interfere with the respirator sealing surfaces. Workers requiring corrective lenses will be provided with glasses designed for use with respirators. Contact lenses will not be permitted with any type of respirator.

7. DECONTAMINATION

Decontamination is the process of removing or treating contaminants from personnel or equipment. When performed correctly, decontamination protects the worker from contaminants that may have come in contact with PPE, tools, and other equipment and also serves as the principal means of preventing the transport of potentially harmful materials into uncontrolled areas.

7.1 Personnel Decontamination

Due to the nature of the SCANS process (closed system) and procedures as well as the small amounts of agent and neutralents in use, the likelihood of gross contamination is remote. Spills of small amounts of material are possible. Whenever visible amounts of material contaminate workers' PPE, decontamination and/or removal of affected clothing within 30 minutes is required. The Tyvek "F" must be removed immediately if it

is contaminated with liquid chloroform or H/HD/HS and L and the wearer decontaminated within 30 minutes.

8. EMERGENCY RESPONSE/CONTINGENCY PLAN

8.1 Specific Contingency Plans

Contingency plans for the site include measures to prevent emergencies or, if any emergency occurs, to limit the negative impact. The following are the major aspects of these plans:

- a. *Preventive Measures.* Measures that should prevent or limit an emergency incident
- b. *Response Actions.* Specific actions to be taken as a specific response to an emergency situation
- c. *Notification.* Response organizations or personnel to be notified in case of an emergency.

8.1.1 Preventive Measures. The following measures will be implemented to prevent or limit an emergency incident:

- a. Strictly adhere to the SOPs, including the use of prescribed PPE during all onsite activities.
- b. Set up the Personnel Decontamination Station (PDS) prior to work with hazardous materials.
- c. Determine the evacuation route and rally point, and communicate it to workers during the daily safety briefing.

- d. Keep standard absorbent materials, shovels, and overpacks onsite to contain a spill or leak. A review of the SCANS consumable list and verification checklist will be used to ensure appropriate inventories of these materials.

8.1.2 Response Actions.

- a. *Medical Emergency.* In the event of a medical emergency (potential or actual, serious or life-threatening injuries or illnesses) at the site, perform the following procedures:
 - The injured SCANS team member's buddy shall signal the SSHO/Team Leader via hand signals, voice, or radio that an injury has occurred.
 - Emergency medical services will be called. The answering party will be told of the type and nature of the emergency, the current location, and what, if any, first aid was administered.
 - A trained and qualified SCANS team member may administer first aid to the worker, as needed.
 - The victim shall be transported to the nearest hospital or medical center by ambulance, as needed.

The Team Leader and the SSHO will be responsible for completing an accident report (DA Form 285) within 24 hours of the incident. Copies of the accident report shall be provided to Directorate of Safety, Health, and Environment-Installation Safety Division, U.S. Army Chemical Materials Agency (CMA) Risk Management and Quality Assurance (RM&QA), and the Supervisor and Safety Manager of the affected organization (Edgewood Chemical Biological Center [ECBC]/TEU).

Any occurrence involving the potential exposure of site personnel to chemical warfare materiel must be treated as an emergency situation as the effects of the exposure may be immediate or delayed.

- b. *Spill Containment Program.* Any spill outside the SCANS site will be handled in accordance with the host site response plan.

- c. *General Response Actions.* Take the following initial steps to control an incident and/or protect personnel, then notify appropriate authorities per paragraph 8.1.3. All other SCANS workers not in the immediate vicinity will be notified by use of a radio system or voice.
 - (1) *Evacuation.* In the event of an emergency situation, such as fire, visible release of toxic materials, or sounding of the alarm indicating hazardous concentrations of chemicals in the workspace, individuals will evacuate to the PDS area or rally point. The Team Leader/SSHO will initiate proper action if outside services are required. Under no circumstances will unauthorized incoming personnel or visitors be allowed to proceed into the Contamination Reduction Zone once the emergency signal has been given.

 - (2) *Potential or Actual Fire.* The SCANS has been designed to minimize the possibility of a fire associated with the system.

When a team member spots a fire, he or she will sound an alarm. The operator must inform the Team Leader of the size and location of the fire.

If the fire is small, the operators may attempt to put it out using a portable fire extinguisher. If this attempt is successful, the crew member will inform the Team Leader of the fire status. If the fire is large, involves materials that present an increased hazard to the

crew member, or the first attempt to control the fire was unsuccessful, the crew members will evacuate the area and inform the Team Leader.

The Team Leader will contact the fire department and request assistance. This contact should include the type and size of the fire, the location of the fire, and the method for contacting the Team Leader. The Team Leader will account for all personnel, including visitors, on the site.

- (3) *PPE Failure.* If any site worker experiences a PPE failure that affects the protective ability of the equipment, that person will immediately inform the Team Leader and report to the PDS for assistance. Reentry to the SCANS operations area will not be permitted until the equipment has been repaired or replaced and the SCANS Team Leader has granted permission.
- (4) *Physical Injury.* Emergency first aid shall be applied onsite as necessary. A first-aid kit is available at the PDS. For minor non-emergency physical injuries requiring medical treatment beyond onsite first aid, the casualty will be transported to the nearest healthcare facility.
- (5) *Industrial Chemical Exposure.* Typical responses to chemical exposure emergencies shall include the following:
 - *Inhalation.* Move to fresh air and call for emergency assistance as indicated in the subsequent paragraphs.
 - *Dermal Contact.* Use copious amounts of soap and water. Wash and rinse affected area thoroughly, and then provide appropriate medical attention. An eyewash will be provided

at the SCANS PDS. Eyes should be rinsed for 15 minutes upon industrial compound exposure. Drenching, if required, will be performed at the PDS.

- *Ingestion.* Call for emergency assistance as indicated in the following paragraphs and process through the PDS immediately.
- *Puncture Wound or Laceration.* Call for emergency assistance as indicated in the subsequent paragraphs. If chemicals are involved, process through the PDS immediately. If no chemicals are involved, processing through the PDS is not required.

For emergency injuries, medical assistance must be summoned onsite through notification as follows:

- Dial the emergency number as defined in the TEU Work Plan.
- If the casualty was exposed to any chemicals, the Team Leader/SSHO will supply MSDSs to the medical personnel.

Also, proper notifications will be made as directed in paragraph 8.1.3 in both minor non-emergency (requiring more than first aid administered at the site) and emergency/critical cases.

- (6) *Exposure to Chemical Agent.* If exposure to chemical agent is suspected or symptoms of agent exposure develop, operators will hold their breath and immediately don escape masks, sound the air

horn (one long blast), or give a verbal warning (if workspace alarm has not sounded), and report to the PDS.

The Team Leader/SSHO will notify the Fire Department. The Fire Department will then notify the Chemical Accident/Incident Response Officer (CAIRO). The CAIRO will be informed of any casualty requiring immediate medical attention.

Casualties will be processed through the PDS as injuries permit. Decontamination will not be delayed until the arrival of medical personnel unless physical injuries prevent safe movement of the casualty. Operators not showing symptoms of agent exposure will be processed through the PDS and stand by for further instructions.

8.1.3 Notification. The primary responsibility for notification will lie with the Team Leader with assistance from all other field personnel. The appropriate notification numbers will be provided in the TEU work plan/operations order.

The Program Manager for Elimination of Chemical Weapons (PM ECW) and/or the supporting safety office in accordance with procedures identified in AR 385-40, *Accident Reporting and Records*, will conduct a formal accident investigation. Should changes to SCANS operations be required, CMA RM&QA and the supporting safety office, prior to resumption of SCANS operations, will approve those changes.

8.2 Emergency Equipment

Emergency equipment will be positioned at the PDS as follows:

- a. *Emergency eyewash*
- b. *First-aid kits*

- c. *Stretcher*
- d. *Fire extinguishers.*

8.3 Emergency Signals

Emergency communication will be via the radio communication sets worn by the SCANS operators, two-way radios, and/or cellular phone. Should a chemical event from another area of the site threaten SCANS personnel, SCANS workers will be notified by radio. All workers will don escape masks and evacuate as instructed. If the radio communication sets worn by the SCANS operators (worn around throat) fail to function, onsite emergency communication for personnel wearing respirators will be achieved by the following hand/body signals:

<u>Signal</u>	<u>Translation</u>
Hand clutching throat	Out of air/cannot breathe
Hands on top of head	Need assistance
Thumbs up	OK/I am all right/I understand
Grip partner's wrist or place both hands around partner's waist	Leave area immediately

The Team Leader/SSHO will discuss emergency communications and the impact of possible emergencies from operations in adjacent areas during team safety briefings.

9. GENERAL SAFETY

9.1 General Work Rules

9.1.1 Site Safety Training. Safety briefings will be held daily and all site safety briefings will be documented in a daily log.

- a. *Initial Training.* Prior to being assigned to SCANS operations, personnel will, as a minimum, demonstrate proficiency in SCANS operations.

The training program consists of familiarization training on the SCANS container and reaction chemistry. The students demonstrate familiarity with the SCANS container and operating procedures during written examinations and evaluated practical exercises. Upon successful completion of this training, the students are considered qualified to operate the SCANS under supervision in accordance with the standards outlined in the PMNSCM Training Concept Plan and the SCANS Qualification and Certification Program.

- b. *Daily Safety Briefings.* At the start of each workday, a safety briefing will be held with all SCANS personnel. Selected topics associated with the work for the day will be outlined with applicable safety considerations. In addition, safety topics will be discussed (for example, use of respirators, location of safety equipment, proper decontamination, emergency procedures, electrical hazards, proper sampling techniques, and pinch points). Any changes associated with SOPs and/or this HASP will be addressed during these daily briefings.

9.1.2 Buddy System. Because treatment of recovered chemical munitions is a hazardous waste operation, all work will be performed in accordance with the “buddy system” requirements, as defined in 29 CFR 1910.120.

9.1.3 Housekeeping. All areas within the work area will be kept in a neat and orderly condition.

9.1.4 Fire Lanes. Designated access areas (fire lanes) surrounding the SCANS site will be maintained at all times.

9.1.5 Restrictions. No eating, drinking, smoking, or other practices that can increase the probability of hand-to-mouth transfer and ingestion of contaminated material will be allowed within the SCANS operations area. Drinking water will be located in the break areas of the SCANS site. Workers may drink water at this location. Smoking materials will be permitted only within administrative areas of the site. Smoking is allowed only in designated areas, away from explosives storage areas.

No jewelry or other articles that interfere with the use of protective clothing will be worn. No beards, sideburns, mustaches, or other facial hair that could interfere with face mask seals will be permitted.

In case of conflict, the Team Leader (with input from the SSHO) will be the final judge in determining the appropriateness of any object, feature, or activity that could cause interference or lead to a potentially unsafe condition.

9.1.6 Documentation. The following documentation will be adhered to during all SCANS activities:

- a. *Log In/Out Form.* Each person (including visitors) entering the SCANS test site will be required to sign in and out in the daily log located in the Command Post. Each person entering or exiting the SCANS Exclusion Area will log in and out on the daily log at the PDS. The log will include the person's name, as well as the date and time of entry and exit.

- b. *Accident/Mishap Report.* An accident report will be made via telephone by the Team Leader (or the SSHO in his or her absence) when any one or more of the following occur as a result of an accident or incident: fatality, injury that requires medical attention, occupational illness, damage to any safety equipment, fire, chemical exposure, or hazardous materials spill. The telephone report will be made to the supporting safety office. These offices will make further notifications in accordance with existing policies. The Program Safety Manager will notify CMA RM&QA in accordance with

Program Manager for Chemical Demilitarization (PMCD) Regulation 385-3 and PMCD Policy Statement Number 25 as soon as possible after occurrence.

The SCANS Team Leader will document circumstances surrounding the accident. Additional documentation may be required by the supporting safety office or CMA RM&QA.

DA Form 285, *U.S. Army Accident Investigation Report*, will be prepared by the Site Safety Office or Program Assurance Manager, as required by Army regulations.

- c. *Site Safety Record.* The Team Leader/SSHO will maintain a daily record of safety briefings, attendance, and topics; inspection of safety equipment; and records of accidents and incidents.

- d. *Informative Documents.* The following informative documents will be maintained at the site:
 - (1) *MSDSs for All Industrial/Military Compounds Brought to the Site by SCANS Personnel and for Chemical Warfare Materiel.* In accordance with 29 CFR 1910.1200, OSHA Hazard Communication Standard, the SSHO will discuss the MSDSs at the safety meetings. Copies of MSDSs will be maintained and be available at the Command Post.

 - (2) *HASP.* This plan will be kept at an easily accessible location onsite.

 - (3) *User's Manual for the SCANS.* A copy of the final User's Manual and SOPs for SCANS use will be maintained onsite.

- (4) *MOP.*
- (5) *Manuals of Other Site Equipment, as Appropriate.* Examples are manuals for respiratory protection devices, air monitoring SOPs, and leak detection equipment.

9.1.7 Deviation from or Modification of HASP. Any change (other than editorial) such as upgrading/downgrading PPE must be approved by CMA RM&QA prior to implementation. Any deviation from or modification to this HASP will require prior written approval from the SCANS System Manager. The SCANS Team Leader will initiate requests for deviation/modification and obtain concurrence from all parties, as outlined in table 1, Health and Safety Responsibilities.

9.1.8 Administration.

- a. *Administrative Responsibilities.* The primary responsibility for effecting the Accident Prevention Plan shall be with the Team Leader. The Team Leader must ensure that all SCANS personnel are knowledgeable about the specific accident prevention measures designated. It will be the responsibility of each worker to implement this plan. Refer to figure 1 for a breakdown of the project administration with respect to health and safety issues.
- b. *Local Requirements.* All site requirements for safety and security will be followed.
- c. *Safety Training.* All SCANS personnel shall undergo site-specific and task-specific health and safety training.
- d. *Hazard Marking.* Hazard marking will be accomplished in accordance with the AR 385 series with input from the supporting safety office or fire chief. The work site will be marked with the appropriate chemical agent symbols.

- e. *Fire Protection/Emergencies.* Fire protection onsite shall be in accordance with 29 CFR 1910.120.
- f. *Inspection.* The Team Leader shall conduct periodic inspections of the SCANS site and equipment. All observed physical and chemical hazards not specifically addressed in the HASP, but which require corrective actions, shall be documented. The daily log maintained onsite shall include daily reporting of treatment activities, site access, and site safety meetings.
- g. *Accident Investigation Procedures.* Should an accident occur onsite, an accident investigation will be conducted in accordance with AR 385-40.

10. MEDICAL SURVEILLANCE

10.1 Health Monitoring

All personnel involved in SCANS activities will participate in a comprehensive health-monitoring program as required by AR 40-5, *Preventive Medicine*, and OSHA 29 CFR 1910.120(s). The medical surveillance program shall be developed based on the specific SCANS, location, and potential exposure of workers at the work site. The program will include preplacement, periodic, and termination physical examinations.

Contractor personnel involved in SCANS operations are required to be enrolled in a corporate medical surveillance program, as required by OSHA 29 CFR 1910.120(f).

10.1.1 Initial Medical Monitoring. The initial screening of all U.S. Army personnel will be performed in accordance with AR 40-5. The screening will include a physical examination to determine the worker's ability to wear protective clothing, including APRs.

As a minimum, the following initial medical screening is required:

- Occupational history
- Medical history
- Physical exam
- Clearance for respiratory protection.

10.1.2 Periodic Monitoring. Periodic monitoring will include annual updates based on exposure information obtained during the intervening year. If no exposures at or above established exposure limits have taken place, periodic physicals will be performed as determined by the physician. More frequent examinations will occur if determined necessary. As new exposure hazards are identified, the baseline health hazard inventory will be expanded, and the content of the medical surveillance examinations will be appropriately modified. The site monitoring lead will provide any monitoring records to appropriate Army and contractors' safety offices for any employee exposed to chemical materiel.

10.1.3 Specific Monitoring. If any worker is injured or develops signs or symptoms indicating possible exposure to hazardous substances or health hazards, medical examinations and consultations shall be made according to the following schedules:

- a. As soon as possible following an injury or development of signs or symptoms
- b. At times when an examining physician or certified industrial hygienist determines a worker is at risk due to overexposure
- c. At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.

10.1.4 Project Completion Examination. SCANS workers will be medically examined at termination of their employment or reassignment to an area where the employee would not be covered by medical monitoring requirements if the worker has not had an examination within the last 6 months.

10.2 Documentation and Recordkeeping Requirements

At the SCANS site, the Team Leader will maintain a current chemical duty position roster noting personnel that are certified SCANS operators. Personnel listed on this roster are certified as currently meeting medical training and medical surveillance requirements. Any visitor or observer approved for entry into any work area will be required to provide a copy of a physician's written opinion or acceptable substitute to the Team Leader prior to site entry. The physician's written opinion of approval must be dated within 12 months of site entry.

The Team Leader/SSHO will be responsible for recording and reporting illnesses and injuries in accordance with OSHA requirements. Maintenance of OSHA Log 200 will be the responsibility of the injured individual's supporting safety office. Recordable occupational accidents and illnesses are those defined in OSHA standards 29 CFR 1910 and 1926. Should a recordable injury or illness involve a U.S. Army employee, it will be reported to the supporting safety office. Recording and reporting for PM ECW personnel will be handled by that office in accordance with PMCD Regulation 385-3. Should an accident or illness involve a contract employee, it will be reported in accordance with respective corporate plans, as well as the supporting government safety office.

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APPENDIX A
ACRONYMS/ABBREVIATIONS

APPENDIX A
ACRONYMS/ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
APR	air-purifying respirator
AR	Army Regulation
CAIRO	Chemical Accident/Incident Response Officer
CAIS	Chemical Agent Identification Set
CFR	Code of Federal Regulations
DA	Department of the Army
dB(A)	decibels using an “A” weighted scale
DCDMH	1,3-dichloro-5,5-dimethylhydantoin
DoD	Department of Defense
ECBC	Edgewood Chemical Biological Center
FUDS	formerly used defense site
H	mustard
HASP	Health and Safety Plan
HD	distilled mustard
HS	sulfur mustard
IDLH	immediately dangerous to life and health
L	lewisite
mg/m ³	milligrams per cubic meter
MSDS	Material Safety Data Sheet

NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
Pam	Pamphlet
PDS	Personnel Decontamination Station
PEL	permissible exposure limit
PID	photo ionization detector
PMCD	Program Manager for Chemical Demilitarization
PM ECW	Program Manager for Elimination of Chemical Weapons
PMNSCM	Product Manager for Non-Stockpile Chemical Materiel
PPE	personal protective equipment
ppm	parts per million
RAC	risk assessment code
REL	recommended exposure limit
RM&QA	Risk Management and Quality Assurance
SCANS	Single CAIS Access and Neutralization System
SCBA	self-contained breathing apparatus
SOP	Standing Operating Procedure
SSHO	Site Safety and Health Officer
TEU	U.S. Army Technical Escort Unit
TSDF	treatment, storage, and disposal facility
TWA	time-weighted average
VOC	volatile organic compound

APPENDIX B
REFERENCES

APPENDIX B

REFERENCES

American Conference of Governmental Industrial Hygienists (ACGIH), *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*, 2002.

Army Regulation (AR) 40-5, *Preventive Medicine*, 15 October 1990.

AR 385-40, *Accident Reporting and Records*, 1 November 1994.

AR 385-61, *The Army Chemical Agent Safety Program*, 12 October 2001.

Department of the Army (DA) Pamphlet (Pam) 40-173, *Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT*, 30 August 1991.

DA Pam 385-61, *Toxic Chemical Agent Safety Standards*, 27 March 2002.

DA Safety memorandum, *Generic Approval of Commercial Protective Clothing and Equipment*, 28 February 2002.

National Institute for Occupational Safety and Health (NIOSH), *NIOSH Pocket Guide to Chemical Hazards Database*, April 1999.

National Toxicology Program (NTP), *Fact Sheet for 1,3-Dichloro-5,5-dimethylhydantoin*, National Institute of Environmental Health Sciences, Research Triangle Park, North Carolina, August 2001.

Program Manager for Chemical Demilitarization (PMCD), *System Safety Management Plan for the Non-Stockpile Chemical Materiel Product*, PMCD-R 385-2, Final, Revision 1, August 2001.

Program Manager for Elimination of Chemical Weapons (PM ECW), *Chloroform Exposure Study Report*, Final, June 2003.

U.S. Army Technical Escort Unit (TEU), *Standing Operating Procedures for Operating MINICAMS[®] and Hewlett Packard Dynatherm (HPD) System*, TEU SOP No. TU-0000-M-015, 12 August 2002.

APPENDIX C
REQUIRED MATERIAL SAFETY DATA SHEETS

APPENDIX C
REQUIRED MATERIAL SAFETY DATA SHEETS

The following Material Safety Data Sheets are included in this appendix.

- Chloroform
- Mustard
- Lewisite
- 1,3-dichloro-5,5-dimethylhydantoin (DCDMH)
- T-butyl alcohol
- Sodium hypochlorite (bleach).

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MALLINKRODT-BAKER -- CHLOROFORM - CHLOROFORM,NF
MATERIAL SAFETY DATA SHEET
NSN: 6505007534775
Manufacturer's CAGE: 70829
Part No. Indicator: A
Part Number/Trade Name: CHLOROFORM

=====
General Information
=====

Item Name: CHLOROFORM,NF
Company's Name: MALLINKRODT-BAKER (FORMALLY J.T. BAKER COMPANY)
Company's Street: 222 RED SCHOOL LANE
Company's City: PHILLIPSBURG
Company's State: NJ
Company's Country: US
Company's Zip Code: 08865-2219
Company's Emerg Ph #: 908-859-2151/800-424-9300(CHEMTREC)
Company's Info Ph #: 908-859-6975/800-354-2050
Distributor/Vendor # 1: MALLINCKRODT INC (314-539-1600)
Distributor/Vendor # 1 Cage: 37940
Record No. For Safety Entry: 001
Tot Safety Entries This Stk #: 001
Status: SE
Date MSDS Prepared: 08DEC95
Safety Data Review Date: 08MAY97
Supply Item Manager: KX
MSDS Preparer's Name: UNKNOWN
MSDS Serial Number: CDQLX
Specification Number: NONE
Spec Type, Grade, Class: NONE
Hazard Characteristic Code: T3
Unit Of Issue: BT
Unit Of Issue Container Qty: 1 PT
Type Of Container: BOTTLE
Net Unit Weight: 1.5 LBS
NRC/State License Number: NOT RELEVANT

=====
Ingredients/Identity Information
=====

Proprietary: NO
Ingredient: CHLOROFORM (SARA 302/313) (CERCLA)
Ingredient Sequence Number: 01
Percent: 100
NIOSH (RTECS) Number: FS9100000
CAS Number: 67-66-3
OSHA PEL: C 50 PPM
ACGIH TLV: 10 PPM; A2; 9596
Other Recommended Limit: NONE RECOMMENDED

=====
Physical/Chemical Characteristics
=====

Appearance And Odor: CLEAR, COLORLESS LIQUID WITH A PLEASANT (ETHEREAL)
ODOR

Boiling Point: 142F,61C
Melting Point: -82F,-63C
Vapor Pressure (MM Hg/70 F): 100 @ 51F
Vapor Density (Air=1): 4.1
Specific Gravity: 1.49
Decomposition Temperature: UNKNOWN
Evaporation Rate And Ref: 11.6 (N-BUTYL ACETATE=1)
Solubility In Water: 0.8% @ 20C/68F
Percent Volatiles By Volume: 100
Viscosity: NOT RELEVANT
Radioactivity: NOT RELEVANT
Corrosion Rate (IPY): UNKNOWN

=====
Fire and Explosion Hazard Data
=====

Flash Point: NONE
Lower Explosive Limit: NOT RELEVANT
Upper Explosive Limit: NOT RELEVANT
Extinguishing Media: USE MEDIA APPROPRIATE FOR SURROUNDING FIRE. MOVE CONTAINER AWAY FROM FIRE, IF POSSIBLE. COOL CONTAINER WITH WATER SPRAY.
Special Fire Fighting Proc: WEAR FULL PROTECTIVE CLOTHING AND NIOSH-APPROVED SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN THE POSITIVE PRESSURE MODE.
Unusual Fire And Expl Hazrds: MAY RELEASE TOXIC AND CORROSIVE GASES, INCLUDING CHLORINE, PHOSGENE AND HYDROGEN CHLORIDE.

=====
Reactivity Data
=====

Stability: YES
Cond To Avoid (Stability): HEAT, OPEN FLAMES, LIGHT, MOISTURE
Materials To Avoid: STRONG CAUSTICS AND CHEMICALLY ACTIVE METALS SUCH AS ALUMINUM, MAGNESIUM POWDER, SODIUM, POTASSIUM; ACETONE, METHANOL
Hazardous Decomp Products: MAY RELEASE TOXIC/CORROSIVE FUMES, INCLUDING OXIDES OF CHLORINE AND CARBON, PHOSGENE, CHLORINE GAS AND HYDROGEN CHLORIDE
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT

=====
Health Hazard Data
=====

LD50-LC50 Mixture: LD50 (ORAL, RAT) IS 908 MG/KG.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: TARGET ORGANS:LIVER, KIDNEY, HEART, EYE, SKIN, LUNG. ACUTE- EYE:IRRITATION. MAY CAUSE EYE DAMAGE. SKIN:RAPID ABSORPTION. MAY CAUSE PAIN, IRRITATION. INHALED:MAY CAUSE IRRITATION, LIVER INJURY, DIZZINESS, UNCONSCIOUSNESS, EVEN DEATH. ORAL:CAUSES SEVERE BURNING. MAY BE FATAL. CHRONIC- DERMATITIS, KIDNEY, LIVER DAMAGE.
Carcinogenicity - NTP: YES
Carcinogenicity - IARC: YES
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: THE AGENT IS POSSIBLY CARCINOGENIC TO HUMAN.
Signs/Symptoms Of Overexp: SEVERE IRRITATION, HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, DRYNESS OF MOUTH AND THROAT, UNCONSCIOUSNESS, SKIN DERMATITIS, BURNS TO MOUTH AND THROAT, PAIN, DEATH

MSDS for Chloroform

Med Cond Aggravated By Exp: PERSONS WITH PRE-EXISTING SKIN DISORDERS, EYE PROBLEMS OR IMPAIRED LIVER, KIDNEY OR RESPIRATORY FUNCTION MAY BE MORE SUSCEPTIBLE TO THE EFFECTS OF THIS PRODUCT.

Emergency/First Aid Proc: GET MEDICAL ATTENTION IF SYMPTOMS PERSIST. EYES/SKIN:IMMEDIATELY FLUSH WITH WATER FOR 15 MINUTES. HOLD EYELIDS OPEN. INHALED:REMOVE TO FRESH AIR. PROVIDE OXYGEN/CPR IF NEEDED. ORAL:IF CONSCIOUS, INDUCE VOMITING IMMEDIATELY AS DIRECTED BY MEDICAL PERSONNEL. CALL A PHYSICIAN/POISON CONTROL CENTER IMMEDIATELY. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: CONTAIN SPILL IMMEDIATELY. DO NOT ALLOW SPILL TO ENTER SEWERS OR WATER COURSES. VENTILATE AREA. USE WATER SPRAY TO REDUCE VAPORS. ABSORB MATERIAL WITH CLAY, SAND, OR SIMILAR ABSORBENT MATERIAL. PLACE IN DISPOSAL CONTAINER. FOR LARGE SPILL, DIKE AHEAD

Neutralizing Agent: NOT RELEVANT

Waste Disposal Method: DISPOSED OF IN ACCORDANCE WITH ALL APPLICABLE U044 (TOXIC WASTE). NATIONAL RESPONSE CENTER PHONE NUMBER: 800-424-8802. REPORTABLE QUANTITY (RQ): 10 LBS.

Precautions-Handling/Storing: STORE IN COOL, DRY, VENTILATED PLACE. KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA AWAY FROM INCOMPATIBLE MATERIALS.

Other Precautions: STORAGE COLOR CODE IS BLUE (HEALTH). CONTAINERS MAY EXPLODE IN HEAT OF FIRE. KEEP AWAY FROM REACH OF CHILDREN. AVOID CONTACT WITH EYES AND SKIN. DO NOT BREATHE VAPORS OR MISTS. USE UNDER THE HOOD OR WELL VENTILATED PLACE. AVOID INGESTION.

Control Measures

Respiratory Protection: IF TLV IS EXCEEDED (ABOVE 10 PPM) OR FOR SYMPTOMS OF OVER EXPOSURE, WEAR NIOSH-APPROVED POSITIVE-PRESSURE SELF-CONTAINED BREATHING APPARATUS.

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

Protective Gloves: POLYVINYL ALCOHOL

Eye Protection: CHEMICAL SAFETY GOGGLES & FACE SHIELD

Other Protective Equipment: EYE WASH STATION, SAFETY SHOWER, UNIFORM, PROTECTIVE SUIT

Work Hygienic Practices: DO NOT TAKE INTERNALLY. AVOID SKIN CONTACT. WASH SKIN AFTER USING PRODUCT. DO NOT EAT, DRINK OR SMOKE IN WORK AREA.

Transportation Data

Trans Data Review Date: 97128

DOT PSN Code: DHF

DOT Proper Shipping Name: CHLOROFORM

DOT Class: 6.1

DOT ID Number: UN1888

DOT Pack Group: II

DOT Label: 6.1

DOT/DoD Exemption Number: NOT RELEVANT

IMO PSN Code: EEH

IMO Proper Shipping Name: CHLOROFORM

IMO Regulations Page Number: 6103

IMO UN Number: 1888
IMO UN Class: 6.1
IMO Subsidiary Risk Label: -
IATA PSN Code: GJO
IATA UN ID Number: 1888
IATA Proper Shipping Name: CHLOROFORM
IATA UN Class: 6.1
IATA Label: TOXIC
AFI PSN Code: GJO
AFI Prop. Shipping Name: CHLOROFORM
AFI Class: 6.1
AFI ID Number: UN1888
AFI Pack Group: II
AFI Special Prov: N36
AFI Basic Pac Ref: A10.5

=====
Disposal Data
=====

=====
Label Data
=====

Label Required: YES
Technical Review Date: 08MAY97
MFR Label Number: UNKNOWN
Label Status: F
Common Name: CHLOROFORM
Signal Word: DANGER!
Acute Health Hazard-Severe: X
Contact Hazard-Moderate: X
Fire Hazard-None: X
Reactivity Hazard-None: X
Special Hazard Precautions: TARGET ORGANS:LIVER, KIDNEY, HEART, EYE, SKIN,
LUNG. ACUTE- EYE:MAY CAUSE INJURY. SKIN:RAPID ABSORPTION. MAY CAUSE PAIN.
INHALED:IRRITATION, LIVER INJURY, CNS EFFECTS. ORAL:SEVERE BURNING.
CHRONIC- DERMATITIS, KIDNEY, LIVER DAMAGE. STORE IN VENTILATED AREA AWAY
FROM INCOMPATIBLES. ABSORB SPILL WITH CLAY. PLACE IN DISPOSAL CONTAINER FOR
REMOVE TO FRESH AIR. PROVIDE OXYGEN/CPR IF NEEDED. ORAL:IF CONSCIOUS,
INDUCE VOMITING IMMEDIATELY AS DIRECTED BY MEDICAL PERSONNEL. CALL A
PHYSICIAN IMMEDIATELY.
Protect Eye: Y
Protect Skin: Y
Label Name: MALLINKRODT-BAKER (FORMALLY J.T. BAKER
COMPANY)
Label Street: 222 RED SCHOOL LANE
Label City: PHILLIPSBURG
Label State: NJ
Label Zip Code: 08865-2219
Label Country: US
Label Emergency Number: 908-859-2151/800-424-9300(CHEMTREC)

DISTILLED MUSTARD (HD)

SECTION I - GENERAL INFORMATION

DATE: 22 September 1988
REVISED: 28 February 1996

MANUFACTURER'S ADDRESS:

U.S. ARMY CHEMICAL BIOLOGICAL DEFENSE COMMAND
EDGEWOOD RESEARCH DEVELOPMENT, AND ENGINEERING CENTER (ERDEC)
ATTN: SCBRD-ODR-S
ABERDEEN PROVING GROUND, MD 20101-5423

Emergency telephone #' s: 0700-1630 EST: 410-671-4411/4414
After: 1630 EST: 410- 278-5201, Ask for Staff Duty Officer

CAS REGISTRY NUMBERS: 505-60-2, 39472-40-7, 68157-62-0

CHEMICAL NAME:

Bis-(2-chloroethyl)sulfide

TRADE NAMES AND SYNONYMS:

Sulfide, bis (2-chloroethyl)
Bis(beta-chloroethyl)sulfide
1,1'-thiobis(2-chloroethane)
1-chloro-2(beta-chloroethylthio)ethane
Beta, beta'-dichlorodiethyl sulfide
2,2'dichlorodiethyl sulfide
Di-2-chloroethyl sulfide
Beta, beta'-dichloroethyl sulfide
2,2'-dichloroethyl sulfide
H; HD; HS
Iprit
Kampstoff "Lost"; Lost
Mustard Gas
S-Lost; S-yperite; Schwefel-lost
Senfgas
Sulfur mustard; Sulphur mustard gas
Yellow Cross Liquid
Yperite
Y

CHEMICAL FAMILY: Chlorinated sulfur compound

FORMULA/CHEMICAL STRUCTURE:
C4H8Cl2S

<Picture>

NFPA 704 HAZARD SIGNAL:

<Picture>

Health - 4
Flammability - 1
Reactivity - 1
Special - 0

SECTION II - HAZARDOUS INGREDIENTS

INGREDIENTS NAME FORMULA PERCENTAGE BY WEIGHT AIRBORNE EXPOSURE LIMIT
(AEL) Sulfur Mustard C₄H₈Cl₂S 1000.003 mg/m³

SECTION III - PHYSICAL DATA

BOILING POINT: 422 F 217 C

VAPOR PRESSURE (mm Hg):

0.072 mm Hg @ 20 C
0.11 mm Hg @ 25 C
VAPOR DENSITY (AIR=1): 5.5

SOLUBILITY IN WATER: Negligible. Soluble in fats and oils, gasoline, kerosene, acetone, carbon tetrachloride, alcohol, tetrachloroethane, ethylbenzoate, and ether. Miscible with the organophosphorus nerve agents.

SPECIFIC GRAVITY (H₂O=1): 1.27 @ 20 C

FREEZING POINT: 14.45 C

LIQUID DENSITY (g/cc):

1.268 @ 25 C
1.27 @ 20 C

PERCENTAGE VOLATILE BY VOLUME:

610 mg/m³ @ 20 C
920 mg/m³ @ 25 C

APPEARANCE AND ODOR: Normally amber to black colored liquid with garlic or a horseradish odor. Water clear if pure. The odor threshold for HD is 0.6 mg/m³ (.0006 mg/L).

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT : 105 C (Can be ignited by large explosive charges)

FLAMMABILITY LIMITS (% by volume): Unknown

MSDS for Mustard Agent

EXTINGUISHING MEDIA: Water, fog, foam, CO₂. Avoid use of extinguishing methods that will cause splashing or spreading of HD.

SPECIAL FIRE FIGHTING PROCEDURES: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving HD should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing agents, firefighting personnel should wear full firefighter protective clothing (without TAP clothing) during chemical agent firefighting and fire rescue operations. Respiratory protection is required. Positive pressure, full face piece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance purposes they will wear appropriate levels of protective clothing (See Section VIII).

Do not breathe fumes. Skin contact with agents must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with the agent liquid or vapor can be fatal.

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMIT (AEL): The AEL for HD is 0.003 mg/m³ as found in "AR 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, HT." To date, the Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure concentration for HD.

EFFECTS OF OVEREXPOSURE: HD is a vesicant (causing blisters) and alkylating agent producing cytotoxic action on the hematopoietic (blood-forming) tissues which are especially sensitive. The rate of detoxification of HD in the body is very slow and repeated exposures produce a cumulative effect. HD has been found to be a human carcinogen by the International Agency for Research on Cancer (IARC).

Median doses of HD in man are:

LD₅₀ (skin) = 100 mg/kg ICT₅₀ (skin) = 2000 mg-min/m³ at 70 - 80 F (humid environment)
= 1000 mg-min/m³ at 90 F (dry environment)

ICT₅₀ (eyes) = 200 mg-min/m³

ICT₅₀ (inhalation) = 1500 mg-min/m³ (Ct unchanged with time)

LD₅₀ (oral) = 0.7 mg/kg

Maximum safe Ct for skin and eyes are 5 and 2 mg-min/m³, respectively.

ACUTE PHYSIOLOGICAL ACTION OF HD IS CLASSIFIED AS LOCAL AND SYSTEMIC.

MSDS for Mustard Agent

LOCAL ACTIONS: HD effects both the eyes and the skin. SKIN damage occurs after percutaneous absorption. Being lipid soluble, HD can be absorbed into all organs. Skin penetration is rapid without skin irritation. Swelling (blisters) and reddening (erythema) of the skin occurs after a latency period of 4-24 hours following the exposure, depending on degree of exposure and individual sensitivity. The skin healing process is very slow. Tender skin, mucous membrane and perspiration-covered skin are more sensitive to the effects of HD. HD's effect on the skin, however, is less than on the eyes. Local action on the eyes produces severe necrotic damage and loss of eyesight. Exposure of eyes to HD vapor or aerosol produces lacrimation, photophobia, and inflammation of the conjunctiva and cornea.

SYSTEMIC ACTIONS: Occurs primarily through inhalation and ingestion. The HD vapor or aerosol is less toxic to the skin or eyes than the liquid form. When inhaled, the upper respiratory tract (nose, throat, tracheae) is inflamed after a few hours latency period, accompanied by sneezing, coughing, and bronchitis, loss of appetite, diarrhea, fever, and apathy. Exposure to nearly lethal doses of HD can produce injury to bone marrow, lymph nodes, and spleen as showed by a drop in white blood cell count, thus resulting in increased susceptibility to local and systemic infections. Ingestion of HD will produce severe stomach pains, vomiting, and bloody stools after a 15-20 minute latency period.

CHRONIC EXPOSURE : HD can cause sensitization, chronic lung impairment, (cough, shortness of breath, chest pain), cancer of the mouth, throat, respiratory tract and skin, and leukemia. It may also cause birth defects.

EMERGENCY AND FIRST AID PROCEDURES:

INHALATION: Hold breath until respiratory protective mask is donned. Remove from the source IMMEDIATELY. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination exists. Seek medical attention IMMEDIATELY.

EYE CONTACT: Speed in decontaminating the eyes is absolutely essential. Remove the person from the liquid source, flush the eyes immediately with water for at least 15 minutes by tilting the head to the side, pulling the eyelids apart with the fingers and pouring water slowly into the eyes. Do not cover eyes with bandages but, if necessary, protect eyes by means of dark or opaque goggles. Transfer the patient to a medical facility IMMEDIATELY.

SKIN CONTACT: Don respiratory protective mask. Remove the victim from agent sources immediately. Immediately wash skin and clothes with 5% solution of sodium hypochlorite or liquid household bleach within one minute. Cut and remove contaminated clothing, flush contaminated skin area again with 5% sodium hypochlorite solution, then wash contaminated skin area with soap and water. Seek medical attention IMMEDIATELY.

INGESTION: Do not induce vomiting. Give victim milk to drink. Seek medical attention IMMEDIATELY.

SECTION VI - REACTIVITY DATA

STABILITY: Stable at ambient temperatures. Decomposition temperature is 149 C to 177 C. Mustard is a persistent agent depending on pH and moisture, and has been known to remain active for up to three years in soil.

INCOMPATIBILITY: Rapidly corrosive to brass @ 65 C. Will corrode steel at a rate of .0001 in. of steel per month @ 65 C.

HAZARDOUS DECOMPOSITION: Mustard will hydrolyze to form HCl and thiodiglycol.

HAZARDOUS POLYMERIZATION: Does not occur.

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: If spills or leaks occur, only personnel in full protective clothing will remain in the area (See Section VIII). In case of personnel contamination See Section V for emergency and first aid instructions.

RECOMMENDED FIELD PROCEDURES: The HD should be contained using vermiculite, diatomaceous earth, clay or fine sand and neutralized as soon as possible using copious amounts of 5.25% sodium hypochlorite solution. Scoop up all material and clothing and place in a approved DOT container. Cover the contents of the container with decontaminating solution as above. The exterior of the container will be decontaminated and labeled according with EPA and DOT regulations. All leaking containers will be over packed with vermiculite placed between the interior and exterior containers.

Decontaminate and label in accordance with EPA and DOT regulations. Dispose of the material in accordance with waste disposal methods provided below. Dispose of the decontaminate according to Federal, state and local regulations. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

If 5.25 % sodium hypochlorite solution is not available then the following decontaminants may be used instead and are listed in the order of preference: Calcium Hypochlorite, contamination Solution No. 2 (DS2), and Super Tropical Bleach Slurry (STB).

WARNING: Pure, undiluted calcium hypochlorite will burn on contact with liquid HD.

RECOMMENDED LABORATORY PROCEDURES: A minimum of 65 grams of decon solution per gram of HD is allowed to agitate for a minimum of one hour. Agitation is not necessary following the first hour if a single phase is obtained. At the end of 24 hours, the resulting solution will be adjusted to a pH between 10 and 11. Test for presence of active chlorine by use of acidic potassium iodide solution to give free iodine color. Place 3 ml of the decontaminate in a test tube. Add several crystals of potassium iodine and swirl to dissolve. Add 3 ml of 50 wt.% sulfuric acid:water and swirl. IMMEDIATE iodine color shows the presence of active chlorine. If negative, add additional 5.25% sodium hypochlorite solution to the decontamination solution, wait two hours, then test again for active chlorine. Continue procedure until positive chlorine is given by solution. A 10 wt.% calcium hypochlorite (HTH) mixture may be substituted for sodium hypochlorite. Use 65 grams of decon per gram of HD and continue the test as described for sodium hypochlorite. Scoop up all material and clothing and place in a approved DOT container. Cover the contents of the container with decontaminating solution as above. The

exterior of the container will be decontaminated and labeled according with EPA and DOT regulations. All leaking containers will be over packed with vermiculite placed between the interior and exterior containers. Decontaminate and label in accordance with EPA and DOT regulations. Dispose of the material in accordance with waste disposal methods provided below. Dispose of the decontaminate according to Federal, state and local regulations. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Section VIII).

NOTE: Surfaces contaminated with HD, then rinse and decontaminated may evolve sufficient HD vapor to produce a physiological response. HD on laboratory glassware may be oxidized by its vigorous reaction with concentrated nitric acid.

WASTE DISPOSAL METHOD: Open pit burning or burying of HD or items containing or <Picture>contaminated with HD in any quantity is prohibited. Decontamination of waste or excess material will be accomplished according to the procedures outlined above can be destroyed by incineration in EPA approved incinerators according to appropriate provisions of Federal, State and local Resource Conservation Recovery Act (RCRA) regulations.

NOTE: Some states define decontaminated surety material as a RCRA hazardous waste.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

CONCENTRATIONRESPIRATORY PROTECTIVE EQUIPMENT.< 0.003 mg/m³A full face piece, chemical canister, air purifying protective mask will be on hand for escape. (The M9-, M17-, or M40-series masks are acceptable for this purpose. Other masks certified as equivalent may be used)> 0.003 mg/m³A NIOSH/MSHA approved pressure demand full face piece SCBA suitable for use in high agent concentrations with protective ensemble. (See DA PAM 385-61 for examples).

VENTILATION:

Local Exhaust: Mandatory. Must be filtered or scrubbed. Air emissions will meet local, state and federal regulations.

Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) +/- 10% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm +/- 20%. Laboratory hoods will be located such that cross drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke producing devices will be performed in assessing the ability of the hood to contain agent HD.

MSDS for Mustard Agent

Other: Recirculation of exhaust air from agent areas is prohibited. No connection between agent area and other areas through the ventilation system are permitted. Emergency backup power is necessary. Hoods should be tested semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hoods.

PROTECTIVE GLOVES: Butyl Rubber Gloves M3 and M4 Norton, Chemical Protective Glove Set

EYE PROTECTION: As a minimum, chemical goggles will be worn. For splash hazards use goggles and face shield.

OTHER PROTECTIVE EQUIPMENT: For laboratory operations, wear lab coats, gloves and have mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab animals.

MONITORING: Available monitoring equipment for agent HD is the M8/M9 detector paper, blue band tube, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAMMS), Automated Continuous Air Monitoring System (ACAMS), CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and Real Time Analytical Platform (RTAP).

Real-time, low-level monitors (with alarm) are required for HD operations. In their absence, an Immediately Dangerous to Life and Health (IDLH) atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: When handling agents, the buddy system will be incorporated. No smoking, eating, or drinking in areas containing agents is permitted. Containers should be periodically inspected for leaks, (either visually or using a <Picture> detector kit). Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently placed. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the work day .

OTHER PRECAUTIONS: HD should be stored in containers made of glass for Research, Development, Test and Evaluation (RDTE) quantities or one-ton steel containers for large quantities. Agent will be double-contained in liquid and vapor tight containers when in storage.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA PAM 385-61, Toxic Chemical Agent Safety Standards," and "AR 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to HD Agents H, HD, and HT."

SECTION X - TRANSPORTATION DATA

MSDS for Mustard Agent

FORBIDDEN FOR TRANSPORT OTHER THAN VIA MILITARY (TECHNICAL ESCORT UNIT)
TRANSPORT ACCORDING TO 49 CFR 172

PROPER SHIPPING NAME: Poisonous liquids, n.o.s.

DOT HAZARD CLASS: 6.1, Packing Group I, Hazard Zone B

DOT LABEL: Poison

DOT MARKING: Poisonous liquids, n.o.s. Bis-(2-chloroethyl) sulfide UN 2810,
Inhalation Hazard

DOT PLACARD: POISON <Picture>

EMERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES: See Sections IV, VII and VIII.

PRECAUTIONS TO BE TAKEN IN TRANSPORTATION: Motor vehicles will be placarded regardless of quantity. Drivers shall be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

While the Edgewood Research Development, and Engineering Center, Department of the Army believes that the data contained herein are actual and the opinions expressed are those of the experts regarding the results of the tests conducted, the data are not to be taken as a warranty or representation for which the Department of the Army or Edgewood Research Development, and Engineering Center assume legal responsibility. They are offered solely for your consideration, investigation, and verification. Any use of these data and information must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

ADDENDUM A

ADDITIONAL INFORMATION FOR THICKENED HD

TRADE NAME AND SYNONYMS: Thickened HD, THD

HAZARDOUS INGREDIENTS: K125 (acryloid copolymer, 5%) is used to thicken HD. K125 is not known to be hazardous except in a finely-divided, powder form.

PHYSICAL DATA: Essentially the same as HD except for viscosity. The viscosity of HD is between 1000 and 1200 centistoke @ 25 C.

FIRE AND EXPLOSION DATA: Same as HD.

HEALTH HAZARD DATA: Same as HD except for skin contact. For skin contact, don respiratory protective mask and remove contaminated clothing IMMEDIATELY. IMMEDIATELY scrape the HD from the skin surface, then wash the contaminated surface with acetone. Seek medical attention IMMEDIATELY.

SPILL, LEAK, AND DISPOSAL PROCEDURES: If spills or leaks of HD occur, follow the same procedures as those for HD, but dissolve THD in acetone before introducing any decontaminating solution. Containment of THD is generally not necessary. Spilled THD can be carefully scraped off the contaminated surface and placed in a fully removable head drum with a high density, polyethylene lining. THD can then be decontaminated, after it has been dissolved in

MSDS for Mustard Agent

acetone, using the same procedures used for HD. Contaminated surfaces should be treated with acetone, then decontaminated using the same procedures as those used for HD.

NOTE: Surfaces contaminated with THD or HD and then rinse-decontaminated may evolve sufficient HD vapor to produce a physiological response.

SPECIAL PROTECTION INFORMATION: Same as HD.

SPECIAL PRECAUTIONS: Same as HD with the following addition. Handling THD requires careful observation of the "stringers" (elastic, threadlike attachments) formed when the agents are transferred or dispensed. These stringers must be broken cleanly before moving the contaminating device or dispensing device to another location, or unwanted contamination of a working surface will result.

TRANSPORTATION DATA: Same as HD.

Material Safety Data Sheet

Lewisite

Date: 16 April 1988

Revised: 4 October 1999

In the event of an emergency
Telephone the SBCCOM Operations
Center's 24-hour emergency
Number: 410-436-2148

Section I - General Information

Manufacturer's Address:

U.S. Army Soldier & Biological Chemical Command (SBCCOM)
Edgewood Chemical Biological Center (ECBC)
ATTN: AMSSB-RCB-RS
Aberdeen Proving Ground, MD 21010-5424

CAS Registry Number: 541-25-3

Chemical Name: Dichloro- (2-chlorovinyl) arsine

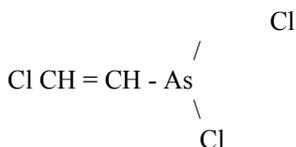
Trade name and synonyms:

Arsine, (2-chlorovinyl) dichloro-
Arsonous dichloride, (2-chloroethenyl)
Chlorovinylarsine dichloride
2-Chlorovinyl dichloroarsine
Beta-Chlorovinyl dichloroarsine
Lewisite
L
EA 1034

Chemical Family: Arsenical (vesicant)

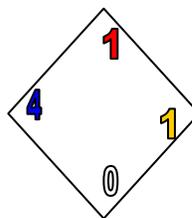
Formula/Chemical Structure:

$C_2 H_2 As Cl_3$



NFPA 704 Signal:

Health - 4
Flammability - 1
Reactivity - 1



C-16

Special - 0

Section II - Ingredients

Ingredients/Name: Lewisite

Percentage by Weight: 100%

Threshold Limit Value (TLV): 0.003 mg/m³ (This is a ceiling value)

Section III - Physical Data

Boiling Point °F (°C): Calculated 374 °F (190 °C)

Vapor Pressure (mm Hg): 0.22 @ 20 °C
0.35 @ 25 °C

Vapor Density (Air=1): 7.1

Solubility (g/100g solvent): Insoluble in water and dilute mineral acids. Soluble in organic solvents, oils and alcohol.

Specific Gravity (H₂O=1): 1.891 @ 20 °C

Freezing/Melting Point (°C): -18.2 to 0.1 (Depending on purity)

Liquid Density (g/mL): 1.888 @ 20 °C

Volatility (mg/m³): 2,500 @ 20 °C

Viscosity (CENTIPOISE): 2.257 @ 20 °C

Molecular Weight (g/mol): 207.32

Appearance And Odor: Pure Lewisite is a colorless oily liquid, and is amber to dark brown in color. A characteristic odor is usually geranium-like; very little odor when pure.

Section IV - Fire and Explosion Data

Flashpoint: Does not flash

Flammability Limits (% by volume): Not Applicable

Extinguishing Media: Water, fog, foam, CO₂. Avoid use of extinguishing methods that will cause splashing or spreading of L.

Special Fire Fighting Procedures: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving L should be contained to prevent contamination to uncontrolled areas. When responding to a fire alarm in buildings or areas containing agents, fire-fighting personnel should wear full firefighter protective clothing (flame resistant) during chemical agent fire-fighting and fire rescue operations. Respiratory protection is required. Positive pressure, full facepiece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or

chemical accident/incident (CAI) operations officer. In cases where firefighters are responding to a chemical accident/incident for rescue/reconnaissance purposes they will wear appropriate levels of protective clothing (See Section VIII).

Do not breathe fumes. Skin contact with agent must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with the agent liquid or vapor can be fatal.

Unusual Fire and Explosion Hazards: None known

Section V - Health Hazard Data

Airborne Exposure Limit (AEL): The permissible airborne exposure concentration of L for an 8-hour workday or a 40-hour workweek is an 8-hour time weighted average (TWA) of 0.003 mg/m³ as a ceiling value. A ceiling value may not be exceeded at anytime. The ceiling value for Lewisite is based upon the present technologically feasible detection limits of 0.003 mg/m³. This value can be found in "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard H, HD, and HT." To date, however, the Occupational Safety and Health Administration (OSHA) has not promulgated permissible exposure concentration for L.

Effects Of Overexposure: L is a vesicant (blister agent), also, it acts as a systemic poison, causing pulmonary edema, diarrhea, restlessness, weakness, subnormal temperature, and low blood pressure. In order of severity and appearance of symptoms, it is a blister agent, a toxic lung irritant, absorbed in tissues, and a systemic poison. When inhaled in high concentrations, L may be fatal in as short a time as 10 minutes. L is not detoxified by the body. Common routes of entry into the body are ocular, percutaneous, and inhalation.

Lewisite is generally considered a suspect carcinogen because of its arsenic content.

Toxicological Data:

Man:

LCt50 (inhalation, man) = 1200 - 1500 mg min/m³

LCt50 (skin vapor exposure, man) = 100,000 mg min/m³

LDLO (skin, human) = 20 mg/kg

LCt50 (skin, man): >1500 mg/min³.

L irritates eyes and skin and gives warning of its presence.

Minimum effective dose (ED min) = 200 mg/m³ (30 min).

ICt50 (eyes, man): <300 mg min/m³.

Animal:

LD50 (oral, rat) = 50 mg/kg

LD50 (subcutaneous, rat) = 1 mg/kg

LCtLO (inhalation, mouse) = 150 mg/m³ 10m

LD50 (skin, dog) = 15 mg/kg

LD50 (skin, rabbit) = 6 mg/kg

LD50 (subcutaneous, rabbit) = 2 mg/kg

LD50 (intravenous, rabbit) = 2 mg/kg

LD50 (skin, guinea pig) = 12 mg/kg

LD50 (subcutaneous, guinea pig) = 1 mg/kg

LCt50 (inhalation, rat) = 1500 mg min/m³ (9 min)

LD50 (vapor skin, rat) = 20,000 mg min m 25 min)

LD50 (skin, rat) = 15 - 24 mg/kg

LD50 (ip, dog) = 2 mg/kg

Acute Exposure:

Eyes: Severe damage. Instant pain, conjunctivitis and blepharospasm leading to closure of eyelids, followed by corneal scarring and iritis. Mild exposure produces reversible eye damage if decontaminated instantly. More permanent injury or blindness is possible within one minute of exposure.

Skin: Immediate stinging pain increasing in severity with time. Erythema (skin reddening) appears within 30 minutes after exposure accompanied by pain with itching and irritation for 24 hours. Blisters appear within 12 hours after exposure with more pain that diminishes after 2-3 days. Skin burns are much deeper than with HD. Tender skin, mucous membrane, and perspiration-covered skin are more sensitive to the effects of L. This, however, is counteracted by L's hydrolysis by moisture, producing less vesicant and higher vapor pressure product.

Respiratory Tract: Irritating to nasal passages and produces a burning sensation followed by profuse nasal secretions and violent sneezing. Prolonged exposure causes coughing and production of large quantities of froth mucus. In experimental animals, injury to respiratory tracts, due to vapor exposure is similar to mustards; however, edema of the lung is more marked and frequently accompanied by pleural fluid.

Systemic Effects: L on the skin and inhaled vapor, cause systemic poisoning. A manifestation of this is a change in capillary permeability, which permit's loss of sufficient fluid from the bloodstream to cause hemoconcentration, shock and death. In nonfatal cases, hemolysis of erythrocytes has occurred with a resultant hemolytic anemia. The excretion of oxidized products into the bile by the liver produces focal necrosis of that organ, necrosis of the mucosa of the biliary passages with periobiliary hemorrhages, and some injury to the intestinal mucosa. Acute systematic poisoning from large skin burns cause's pulmonary edema, diarrhea restlessness, weakness, subnormal temperature, and low blood pressure in animals.

Chronic Exposure: Lewisite can cause sensitization and chronic lung impairment.

Emergency And First Aid Procedures:

Inhalation: Hold breath until respiratory protective mask is donned. Remove from the source **Immediately**. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination is present. Seek medical attention **Immediately**.

Eye Contact: Speed in decontaminating the eyes is absolutely essential. Remove the person from the liquid source, flush the eyes immediately with water for at least 15 minutes by tilting the head to the side, pulling the eyelids apart with the fingers and pouring water slowly into the eyes. Do not cover eyes with bandages but, if necessary, protect eyes by means of dark or opaque goggles. Transfer the patient to a medical facility **Immediately**.

Skin Contact: Don respiratory protective mask. Remove the victim from agent sources immediately. Immediately wash skin and clothes with 5% solution of sodium hypochlorite or liquid household bleach within one minute. Cut and remove contaminated clothing, flush contaminated skin area again with 5% sodium hypochlorite solution, then wash contaminated skin area with soap and water. Seek medical attention **Immediately**.

Ingestion: Do not induce vomiting. Give victim milk to drink. Seek medical attention **Immediately**.

Section VI - Reactivity Data

Stability: Stable in steel or glass containers at temperatures below 50 °C

Incompatibility: Corrosive to steel at a rate of 1×10^{-5} to 5×10^{-5} in/month at 65 °C

Hazardous Decomposition Products: Reasonably stable; however, in presence of moisture, it hydrolyses rapidly, losing its vesicant property. It also hydrolyses in acidic medium to form HCl and non-volatile (solid) chlorovinylarsenious oxide, which is less vesicant than Lewisite. Hydrolysis in alkaline medium, as in decontamination with alcoholic caustic or carbonate solution or DS2, produces acetylene and trisodium arsenate

(Na₃ As O₄). Therefore, decontaminated solution would contain toxic arsenic.

Hazardous Polymerization: Does not occur.

Section VII - Spill, Leak, And Disposal Procedures

Steps To Be Taken In Case Material Is Released Or Spilled: If leaks or spills of L occur only personnel in full protective clothing will be allowed in the area (See Section VIII). See Section V for emergency and first aid instructions.

Recommended Field Procedures: Lewisite should be contained using vermiculite, diatomaceous earth, clay, or fine sand and neutralized as soon as possible using copious amounts of alcoholic caustic, carbonate, or Decontaminating Agent (DS2). Caution must be exercised when using these decontaminates since acetylene will be given off. Household bleach can also be used if accompanied by stirring to allow contact. (%) . Scoop up all material and place in a DOT approved container. Cover the contents with decontaminating solution as above. After sealing, the exterior decontaminated and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of decontaminate according to Federal, state, and local laws. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

Recommended Laboratory Procedures: A 10 wt.% alcoholic sodium hydroxide solution is prepared by adding 100 grams of denatured ethanol to 900 grams of 10 wt.% NaOH in water. A minimum of 200 grams of decon is required for each gram of L. The decon and agent solution is agitated for a minimum of one hour. At the end of the hour the resulting pH should be checked and adjusted to above 11.5 using additional NaOH, if required. It is permitted to substitute 10 wt.% alcoholic sodium carbonate made and used in the same ratio as the NaOH listed above. Reaction time should be increased to 3-hours with agitation for the first hour. Final pH should be adjusted to above 10. Scoop up all material and place in an approved DOT container. Cover the contents with decontaminating solution as above. The exterior of the container will be decontaminated and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of the material in accordance with waste disposal methods provided below. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

It is permitted to substitute 5.25% sodium hypochlorite for the 10% alcoholic sodium hydroxide solution above. Allow one hour with agitation for the reaction. Adjustment of the pH is not required. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (See Section VIII).

Waste Disposal Method: All neutralized material should be collected and contained for disposal according to land ban RCRA regulations or thermally decomposed in an EPA permitted incinerator equipped with a scrubber that will scrub out the chlorides and equipped with an electrostatic precipitator or other filter device and containerize and label according to DOT and EPA regulations. The arsenic will be disposed of according to land ban RCRA regulations. Any contaminated materials or protective clothing should be decontaminated using alcoholic caustic, carbonates, or bleach analyzed to assure it is free of detectable contamination (3X) level. The clothing should then be sealed in plastic bags inside properly labeled drums and held for shipment back to the DA issue point.

Note: Some decontaminate solutions are hazardous waste according to RCRA regulations and must be disposed according to those regulations.

Section VIII - Special Protection Information

Concentration

< 0.003 mg/m³

Respiratory Protective Equipment

A full face piece, chemical canister air-purifying, protective masks will be on hand for escape. The M-40 series protective masks are acceptable for this use.

> or = 0.003 mg/m³

NIOSH/MSHA approved, full face or unknown piece SCBA suitable for use in high Lewisite concentrations with a protective ensemble. (See DA Pam 386-61 for examples)

Ventilation

Local Exhaust: Mandatory. Must be filtered or scrubbed. Air emissions shall meet local, state and federal regulations.

Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) +/- 20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm +/- 20%. Laboratory hoods will be located such that cross drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke producing devices will be performed in assessing the ability of the hood to contain Lewisite.

Other: Recirculation of exhaust air from agent areas is prohibited. No connection between agent area and other areas through the ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hoods.

Protective Gloves: Butyl Rubber gloves M3 and M4
Norton, Chemical Protective Glove Set

Eye Protection: As a minimum, chemical goggles will be worn. For splash hazards use goggles and face shield.

Other Protective Equipment: For laboratory operations, wear lab coats, gloves and have mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab animals.

Monitoring: Available monitoring equipment for agent L is the M18A2 (yellow band), bubblers (arsenic and GC method), M256 and A1 Kits, and the Miniature Chemical Agent Monitor (MINICAM).

Real-time, low-level monitors (with alarm) are required for L operations. In their absence, an Immediately Dangerous to Life and Health (IDLH) atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

Section IX - Special Precautions

Precautions To Be Taken In Handling And Storing: When handling agents, the buddy system will be incorporated. No smoking, eating, or drinking in areas containing agents is permitted. Containers should be periodically inspected for leaks, (either visually or using a detector kit). Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using

plenty of soap and water before leaving at the end of the workday.

Other Precautions: L should be stored in containers made of glass for Research, Development, Test and Evaluation (RDTE) quantities or one-ton steel containers for large quantities. Agent will be stored in a single containment system within a laboratory hood or in a double containment system.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT."

Section X - Transportation Data

Proper Shipping Name: Toxic liquids, n.o.s.

Dot Hazard Class: 6.1, Packing Group I

Dot Label: Poison

Dot Marking: Toxic liquids, n.o.s. Dichloro-(2-chlorovinyl)arsine UN 2810

Dot Placard: Poison

Emergency Accident Precautions And Procedures: See Sections IV, VII and VIII.

Precautions To Be Taken In Transportation: Motor vehicles will be placarded regardless of quantity. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

The Edgewood Chemical Biological Center (ECBC), Department of the Army believes that the data contained herein are actual and are the results of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this MSDS must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

Valid 02/2000 - 04/2000

Aldrich Chemical Co., Inc.
1001 West St. Paul
Milwaukee, WI 53233 USA
Tel: 414-273-3850

MATERIAL SAFETY DATA SHEET

SECTION 1. ----- CHEMICAL IDENTIFICATION-----

CATALOG #: 232807
NAME: 1,3-DICHLORO-5,5-DIMETHYLHYDANTOIN

SECTION 2. ----- COMPOSITION/INFORMATION ON INGREDIENTS -----

CAS #: 118-52-5
MF: C5H6CL2N2O2
EC NO: 204-258-7

SYNONYMS

DACTIN * DAKTIN * DANTOIN * DICHLORANTIN * 1,3-DICHLORO-5,5-DIMETHYLHYDANTOIN * 1,3-DICHLORO-5,5-DIMETHYL HYDANTOIN (ACGIH:OSHA) * 1,3-DICHLORO-5,5-DIMETHYL-2,4-IMIDAZOLIDINEDIONE * 1,3-DICHLORO-5,5'-METHYLHYDANTOIN * DWUCHLORANTYNY (POLISH) * 1,3-DWUCHLORO-5,5-DWUMETYLOHYDANTOINA (POLISH) * HALANE * HYDAN * HYDAN (ANTISEPTIC) * HYDANTOIN, DICHLORODIMETHYL- * 2,4-IMIDAZOLIDINEDIONE, 1,3-DICHLORO-5,5-DIMETHYL- (9CI) * NCI-C03054 * OMCHLOR *

SECTION 3. ----- HAZARDS IDENTIFICATION -----

LABEL PRECAUTIONARY STATEMENTS

OXIDIZING

HARMFUL

CONTACT WITH COMBUSTIBLE MATERIAL MAY CAUSE FIRE.

HARMFUL BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.

CAUSES SEVERE IRRITATION.

KEEP AWAY FROM COMBUSTIBLE MATERIAL.

IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF

WATER AND SEEK MEDICAL ADVICE.
TAKE OFF IMMEDIATELY ALL CONTAMINATED CLOTHING.
WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE
PROTECTION.
MOISTURE SENSITIVE

SECTION 4. ----- FIRST-AID MEASURES-----

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS
AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED
CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS
WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL
RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IF SWALLOWED, WASH OUT MOUTH WITH WATER PROVIDED PERSON IS CONSCIOUS.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

SECTION 5. ----- FIRE FIGHTING MEASURES -----

EXTINGUISHING MEDIA
CARBON DIOXIDE.
DRY CHEMICAL POWDER.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO
PREVENT CONTACT WITH SKIN AND EYES.
OXIDIZER.
UNUSUAL FIRE AND EXPLOSIONS HAZARDS
CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

SECTION 6. ----- ACCIDENTAL RELEASE MEASURES-----

EVACUATE AREA.
SHUT OFF ALL SOURCES OF IGNITION.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY
RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.

VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

SECTION 7. ----- HANDLING AND STORAGE-----

REFER TO SECTION 8.

SECTION 8. ----- EXPOSURE CONTROLS/PERSONAL PROTECTION-----

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.

USE ONLY IN A CHEMICAL FUME HOOD.

SAFETY SHOWER AND EYE BATH.

FACESHIELD (8-INCH MINIMUM).

DO NOT BREATHE DUST.

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.

AVOID PROLONGED OR REPEATED EXPOSURE.

WASH THOROUGHLY AFTER HANDLING.

HARMFUL SOLID.

SEVERE IRRITANT.

HARMFUL DUST.

KEEP TIGHTLY CLOSED.

KEEP AWAY FROM COMBUSTIBLE MATERIALS, HEAT, SPARKS, AND OPEN FLAME.

MOISTURE SENSITIVE

STORE IN A COOL DRY PLACE.

SECTION 9. ----- PHYSICAL AND CHEMICAL PROPERTIES -----

APPEARANCE AND ODOR

WHITE POWDER

PHYSICAL PROPERTIES

MELTING POINT: 134 C TO 136 C

SECTION 10. -----STABILITY AND REACTIVITY -----

INCOMPATIBILITIES

ACIDS

REDUCING AGENTS

MOISTURE

STRONG BASES

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

TOXIC FUMES OF:

CARBON MONOXIDE, CARBON DIOXIDE

HYDROGEN CHLORIDE GAS

PHOSGENE GAS
NITROGEN OXIDES

SECTION 11. ----- TOXICOLOGICAL INFORMATION -----

ACUTE EFFECTS

HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.

CAUSES SEVERE IRRITATION.

HIGH CONCENTRATIONS ARE EXTREMELY DESTRUCTIVE TO TISSUES OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.

SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.

RTECS #: MU0700000

HYDANTOIN, 1,3-DICHLORO-5,5-DIMETHYL-

IRRITATION DATA

SKN-RBT 500 MG/24H SEV EPASR* 8EHQ-0281-0382

SKN-RBT 100 MG/24H SEV EPASR* 8EHQ-0281-0382

TOXICITY DATA

ORL-RAT LD50:542 MG/KG 85INA8 5,183,1986

UNR-RAT LD50:550 MG/KG BCTKAG 19,52,1986

ORL-RBT LD50:1520 MG/KG GISAAA 47(6),76,1982

SKN-RBT LD50:>20 GM/KG EPASR* 8EHQ-0281-0382

ORL-GPG LD50:1350 MG/KG GISAAA 47(6),76,1982

UNR-MAM LD50:500 MG/KG GWXXBX #2550828

TARGET ORGAN DATA

BEHAVIORAL (SOMNOLENCE)

BEHAVIORAL (TREMOR)

BEHAVIORAL (WITHDRAWAL)

LUNGS, THORAX OR RESPIRATION (DYSPPNAE)

LUNGS, THORAX OR RESPIRATION (RESPIRATORY STIMULATION)

GASTROINTESTINAL (CHANGES IN STRUCTURE OR FUNCTION OF SALIVARY GLANDS)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES

(RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR

COMPLETE INFORMATION.

SECTION 12. ----- ECOLOGICAL INFORMATION -----

DATA NOT YET AVAILABLE.

SECTION 13. ----- DISPOSAL CONSIDERATIONS -----

THE MATERIAL SHOULD BE IGNITED IN THE PRESENCE OF SODIUM CARBONATE

AND SLAKED LIME (CALCIUM HYDROXIDE). THE SUBSTANCE SHOULD BE MIXED WITH VERMICULITE AND THEN WITH THE DRY CAUSTICS, WRAPPED IN PAPER AND BURNED IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.

OBSERVE ALL FEDERAL, STATE AND LOCAL ENVIRONMENTAL REGULATIONS.

SECTION 14. ----- TRANSPORT INFORMATION -----

CONTACT ALDRICH CHEMICAL COMPANY FOR TRANSPORTATION INFORMATION.

SECTION 15. ----- REGULATORY INFORMATION -----

EUROPEAN INFORMATION

OXIDIZING

HARMFUL

R 8

CONTACT WITH COMBUSTIBLE MATERIAL MAY CAUSE FIRE.

R 20/21/22

HARMFUL BY INHALATION, IN CONTACT WITH SKIN AND IF SWALLOWED.

S 17

KEEP AWAY FROM COMBUSTIBLE MATERIAL.

S 26

IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATELY WITH PLENTY OF WATER AND SEEK MEDICAL ADVICE.

S 27

TAKE OFF IMMEDIATELY ALL CONTAMINATED CLOTHING.

S 36/37/39

WEAR SUITABLE PROTECTIVE CLOTHING, GLOVES AND EYE/FACE PROTECTION.

REVIEWS, STANDARDS, AND REGULATIONS

OEL=MAK

ACGIH TLV-STEL 0.4 MG/M3

DTLVS* TLV/BEI,1997

ACGIH TLV-TWA 0.2 MG/M3

DTLVS* TLV/BEI,1997

EPA FIFRA 1988 PESTICIDE SUBJECT TO REGISTRATION OR RE-REGISTRATION

FEREAC 54,7740,1989

MSHA STANDARD-AIR:TWA 0.2 MG/M3

DTLVS* 3,78,1971

OSHA PEL (GEN INDU):8H TWA 0.2 MG/M3

CFRGBR 29,1910.1000,1994

OSHA PEL (CONSTRUC):8H TWA 0.2 MG/M3

CFRGBR 29,1926.55,1994

OSHA PEL (SHIPYARD):8H TWA 0.2 MG/M3

CFRGBR 29,1915.1000,1993

OSHA PEL (FED CONT):8H TWA 0.2 MG/M3

CFRGBR 41,50-204.50,1994

OEL-AUSTRALIA:TWA 0.2 MG/M3;STEL 0.4 MG/M3 JAN 1993

OEL-BELGIUM:TWA 0.2 MG/M3;STEL 0.4 MG/M3 JAN 1993

OEL-FINLAND:TWA 0.2 MG/M3;STEL 0.6 MG/M3 JAN 1993

OEL-THE NETHERLANDS:TWA 0.2 MG/M3 JAN 1993

OEL-THE PHILIPPINES:TWA 0.2 MG/M3 JAN 1993

OEL-SWITZERLAND:TWA 0.2 MG/M3 JAN 1993

OEL-UNITED KINGDOM:TWA 0.2 MG/M3;STEL 0.4 MG/M3 JAN 1993

OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA CHECK ACGIH TLV

OEL IN NEW ZEALAND, SINGAPORE, VIETNAM CHECK ACGIH TLV

NIOSH REL TO THE CHEMICAL-AIR:10H TWA 0.2 MG/M3;STEL 0.4 MG/M3

NIOSH* DHHS #92-100,1992

NOHS 1974: HZD 24100; NIS 5; TNF 729; NOS 6; TNE 2224

NOES 1983: HZD 24100; NIS 9; TNF 436; NOS 10; TNE 3502; TFE 1780

EPA TSCA SECTION 8(B) CHEMICAL INVENTORY

EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, SEPTEMBER 1999

SECTION 16. ----- OTHER INFORMATION-----

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA, ALDRICH, FLUKA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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BOUGHT ACCORDING TO ACS SPEC -- N-BUTYL ALCOHOL - N-BUTYL ALCOHOL,ACS
MATERIAL SAFETY DATA SHEET
FSC: 6810
NIIN: 001240509
Manufacturer's CAGE: 81348
Part No. Indicator: A
Part Number/Trade Name: N-BUTYL ALCOHOL

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General Information
=====

Item Name: N-BUTYL ALCOHOL,ACS
Company's Name: BOUGHT ACCORDING TO ACS SPEC
Record No. For Safety Entry: 007
Tot Safety Entries This Stk#: 007
Date MSDS Prepared: 01JAN85
Safety Data Review Date: 12SEP78
MSDS Serial Number: BCZVH
Hazard Characteristic Code: F4
Unit Of Issue: BT
Unit Of Issue Container Qty: 32 OZ

=====
Ingredients/Identity Information
=====

Proprietary: NO
Ingredient: N-BUTYL ALCOHOL (SARA III)
Ingredient Sequence Number: 01
NIOSH (RTECS) Number: E01400000
CAS Number: 71-36-3
OSHA PEL: 100 PPM
ACGIH TLV: S, C 50 PPM; 9293

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Physical/Chemical Characteristics
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Fire and Explosion Hazard Data
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Flash Point: 85F CC

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Reactivity Data
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Health Hazard Data
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Precautions for Safe Handling and Use
=====

=====
Control Measures
=====

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Transportation Data
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Trans Data Review Date: 82258

DOT PSN Code: CFV
DOT Proper Shipping Name: BUTANOLS
DOT Class: 3
DOT ID Number: UN1120
DOT Pack Group: II
DOT Label: FLAMMABLE LIQUID
IMO PSN Code: CNX
IMO Proper Shipping Name: NORMAL- BUTANOL *
IMO Regulations Page Number: SEE 3313
IMO UN Number: 1120
IMO UN Class: 3.3
IMO Subsidiary Risk Label: -
IATA PSN Code: EAF
IATA UN ID Number: 1120
IATA Proper Shipping Name: BUTANOLS
IATA UN Class: 3
IATA Label: FLAMMABLE LIQUID
AFI PSN Code: EAF
AFI Prop. Shipping Name: BUTANOLS
AFI Class: 3
AFI ID Number: UN1120
AFI Pack Group: III
AFI Label: FLAMMABLE LIQUID
AFI Basic Pac Ref: 7-7

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Disposal Data
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Disposal Data Review Date: 88229
Rec # For This Disp Entry: 04
Tot Disp Entries Per NSN: 004
Landfill Ban Item: YES
Disposal Supplemental Data: DIRECT QUESTIONS RELATED TO DISPOSAL TO
COMPETENT FEDERAL, STATE OR LOCAL AUTHORITY.
1st EPA Haz Wst Code New: U031
1st EPA Haz Wst Name New: 1-BUTANOL; N-BUTYL ALCOHOL
1st EPA Haz Wst Char New: IGNITABLE (I)
1st EPA Acute Hazard New: NO

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Label Data
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Label Required: YES
Label Status: G
Common Name: N-BUTYL ALCOHOL
Label Name: BOUGHT ACCORDING TO ACS SPEC

=====
URL for this msds <http://hazard.com>. If you wish to change, add to, or
delete information in this archive please sent updates to dan@hazard.com.
=====

ELITE CHEMICALS -- BLEACH
MATERIAL SAFETY DATA SHEET
NSN: 681000N074945
Manufacturer's CAGE: ELTEC
Part No. Indicator: A
Part Number/Trade Name: BLEACH

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General Information

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Company's Name: ELITE CHEMICALS
Company's Street: 270 ROCUS ST
Company's City: SPRINGFIELD
Company's State: MA
Company's Country: US
Company's Zip Code: 01104
Company's Emerg Ph #: 800-424-9300(CHEMTREC)
Company's Info Ph #: 800-457-4449
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 10JAN95
Safety Data Review Date: 20NOV96
MSDS Serial Number: CCSLW

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Ingredients/Identity Information

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Proprietary: NO
Ingredient: HYPOCHLOROUS ACID, SODIUM SALT; (SODIUM HYPOCHLORITE)
(CERCLA)
Ingredient Sequence Number: 01
Percent: 5.25
NIOSH (RTECS) Number: NH3486300
CAS Number: 7681-52-9
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

Proprietary: NO
Ingredient: SODIUM HYDROXIDE (CERCLA)
Ingredient Sequence Number: 02
Percent: 0.1-0.2
NIOSH (RTECS) Number: WB4900000
CAS Number: 1310-73-2
OSHA PEL: 2 MG/M3
ACGIH TLV: 2 MG/M3, C

Proprietary: NO
Ingredient: SUPDAT: OBTAIN EPA REGISTRATION AND ESTABLISHMENT NUMBERS.
Ingredient Sequence Number: 03
NIOSH (RTECS) Number: 9999999ZZ

OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: EYE PROT: & FULL LENGTH FACESHIELD (FP N).
Ingredient Sequence Number: 04
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE
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Physical/Chemical Characteristics

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Appearance And Odor: CLEAR-LIGHT YELLOW LIQUID WITH CHARACTERISTIC
CHLORINE ODOR.
Boiling Point: 220F,104C
Melting Point: >25F,>-4C
Specific Gravity: SUPDAT
Solubility In Water: COMPLETELY SOLUBLE
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Fire and Explosion Hazard Data

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Flash Point: NON-FLAMMABLE
Lower Explosive Limit: N/A
Upper Explosive Limit: N/A
Extinguishing Media: SUITABLE FOR SURROUNDING FIRE.
Special Fire Fighting Proc: USE NIOSH APPROVED SCBA AND FULL PROTECTIVE
EQUIPMENT (FP N). AVOID BODY CONTACT AND INHALATION OF FUMES.
Unusual Fire And Expl Hazrds: STRONG OXIDIZER. CONTACT W/COMBUSTS MAY
IRRITATE OR PROMOTE COMBUST. ACIDS & HEAT ACCELERATE DECOMP. DECOMP
PRODS
MAY INCL CHLORINE. TOXIC FUMES CAN BE (SUPDAT)
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Reactivity Data

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Stability: YES
Cond To Avoid (Stability): PROD IS STABLE & DECOMPOSES NATURALLY W/AGE.
AVOID EXCESSIVE EXPOSURE TO HEAT & LIGHT OR CONTACT W/INCOMPATIBLE
MATLS.
Materials To Avoid: ACIDS, AMMONIA, METALS, COMBUSTIBLES, DETERGENTS,
REDUCING AGENTS, OXIDIZABLE MATERIALS, CHLORINATED ISOCYANURATES.
Hazardous Decomp Products: CHLORINE, HYDROCHLORIC ACID, HYPOCHLOROUS
ACID,
OXYGEN.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT
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Health Hazard Data

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 LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
 Route Of Entry - Inhalation: YES
 Route Of Entry - Skin: YES
 Route Of Entry - Ingestion: YES
 Health Haz Acute And Chronic: ACUTE: SEVERE IRRITANT TO SKIN, EYES,
 NOSE,
 THROAT & GI TRACT. PROMPT TREATMENT IS IMPORTANT TO MINIMIZE EFTS OF
 OVEREXP. CHRONIC: EYES: SEV IRRITANT. SKIN: SEV IRRITANT. INHAL:
 IRRITANT
 TO RESP TRACT. INGEST: CORROSION OF MUCOUS MEMBRANES; PERFORATION OF
 ESOPHAGUS & STOMACH. MAY LEAD TO CONVULSIONS, COMA & DEATH.
 Carcinogenicity - NTP: NO
 Carcinogenicity - IARC: NO
 Carcinogenicity - OSHA: NO
 Explanation Carcinogenicity: NOT RELEVANT
 Signs/Symptoms Of Overexp: EYES AND SKIN: SEVERE IRRITATION AND
 REDDENING.
 RESPIRATORY TRACT: COUGHING AND IRRITATION. MAY CAUSE SHORTNESS OF
 BREATH,
 SORE THROAT AND LABORED BREATHING. INGESTION: NAUSEA AND VOMITING,
 POSSIBLE
 PERFORATION OF ESOPHAGUS AND STOMACH, CONVULSIONS, COMA AND DEATH.
 Med Cond Aggravated By Exp: VAPORS MAY AGGRAVATE RESPIRATORY AILMENTS.
 Emergency/First Aid Proc: EYES: FLUSH W/WATER FOR AT LEAST 15 MINUTES &
 CALL MD. SKIN: FLUSH AFFECTED AREAS W/PLENTY OF WATER. REMOVE
 CONTAMINATED
 CLOTHING & WASH W/SOAP & WATER. IF SKIN IS BURNED, CALL MD. INHAL:
 REMOVE
 VICTIM TO FRESH AIR & CALL MD IF BREATHING IS DIFFICULT. INGEST: RINSE
 MOUTH W/WATER. DRINK LARGE AMOUNTS OF WATER &/OR MILK. DO NOT INDUCE
 VOMITING. CALL MD. DO NOT USE BAKING SODA OR ACIDIC ANTIDOTES.

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Precautions for Safe Handling and Use

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Steps If Matl Released/Spill: TOXIC TO FISH & AQUATIC LIFE. DO NOT
 ALLOW
 MATL TO ENTER SEWERS, STREAMS, PONDS, STORM DRAINS. PERSONNEL INVOLVED
 W/
 CLEAN-UP MUST BE EQUIPPED W/NIOSH APPROVED RESPIRATORY PROTECTION, EYE
 PROTECTION, RUBBER BOOTS, RUBBER GLOVES & PROTECTIVE CLOTHING.
 Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
 Waste Disposal Method: DO NOT ABSORB SPILLS W/FLAM MATLS SUCH AS
 SAWDUST
 OR COMBUSTIBLE ABSORBS. CONTAIN SPILLS IN AS SMALL AN AREA AS POSS FOR
 NEUTRALIZATION & DILUTION. ABSORB MATL IS BEST PLACED IN PLASTIC
 CNTNRS.
 DISPOSE OF RESIDUE I/A/W FEDERAL, STATE & LOCAL REGS.
 Precautions-Handling/Storing: STORE IN VENTD CNTNRS AWAY FROM SUNLIGHT;
 SEPARATE FROM ACIDS, HEAT, OXIDIZING MATLS, AMMONIA, HYDROCARBS,
 ALCOHOLS,
 ETHERS OR ISOCYANURATES. (SUPDAT)

Other Precautions: DO NOT MIX W/OTHER CLEANING AGENTS CONTAINING ACIDS OR AMMONIA. THESE MAY LIBERATE CHLORINE & CHLORAMINES UPON MIXING. AVOID WEARING CONTACT LENSES WHEN HNDLG THIS PROD. DO NOT STORE IN METAL CNTNRS. WHEN EMPTY, RETURNABLE CNTNRS (SUPDAT)

Control Measures

Respiratory Protection: NIOSH APPROVED SELF-CONTAINED BREATHING APPARATUS
SUITABLE FOR ACID GAS AND CHLORINE SHOULD BE USED FOR STRONG CONCENTRATION.
Ventilation: LOCAL EXHAUST. MECHANICAL (GENERAL) RECOMMENDED.
Protective Gloves: RUBBER GLOVES.
Eye Protection: ANSI APPRVD CHEM WORKERS GOGGS (ING 4)
Other Protective Equipment: ANSI APPROVED EYE WASH & DELUGE SHOWER (FP N).
HARD HATS, RUBBER BOOTS, PROTECTIVE CLOTHING.
Work Hygienic Practices: AVOID SKIN AND VAPOR CONTACT. WASH THOROUGHLY AFTER USING.
LIBERATED BY HEAT/DECOMP. HNDLG/STOR PRECS: STORE IN COOL AREA. OTHER PRECS: MUST BE SHIPPED I/A/W FED, STATE & DOT REGS. ALL RESIDUAL PROD MUST BE REMOVED BY TRIPLE RINSING CNTNR W/WATER. PROD IS REGULATED BY FIFRA IF USED AS SANITIZER/DISINFECTANT.. REPACKAGERS MUST (ING 3)

Transportation Data

Disposal Data

Label Data

Label Required: YES
Technical Review Date: 03DEC96
Label Date: 20NOV96
Label Status: G
Common Name: BLEACH
Chronic Hazard: YES
Signal Word: DANGER!
Acute Health Hazard-Severe: X
Contact Hazard-Severe: X
Fire Hazard-None: X
Reactivity Hazard-Slight: X

MSDS for T-butyl alcohol

Special Hazard Precautions: DECOMPOSITION PRODUCTS MAY BE HAZARDOUS.
ACUTE: EYES: SEVERE IRRITATION AND REDDENING. SKIN: SEVERE IRRITATION
AND
REDDENING. INHALATION: COUGHING AND IRRITATION. MAY CAUSE SHORTNESS OF
BREATH, SORE THROAT AND LABORED BREATHING. INGESTION: SEVERE IRRITANT
TO
GASTROINTESTINAL TRACT, NAUSEA AND VOMITING, POSSIBLE PERFORATION OF
CORROSION OF MUCOUS MEMBRANES; PERFORATION OF ESOPHAGUS AND STOMACH.
MAY
LEAD TO CONVULSIONS, COMA AND DEATH.

Protect Eye: Y

Protect Skin: Y

Protect Respiratory: Y

Label Name: ELITE CHEMICALS

Label Street: 270 ROCUS ST

Label City: SPRINGFIELD

Label State: MA

Label Zip Code: 01104

Label Country: US

Label Emergency Number: 800-424-9300(CHEMTREC)

ELITE CHEMICALS -- BLEACH
MATERIAL SAFETY DATA SHEET
NSN: 681000N074945
Manufacturer's CAGE: ELTEC
Part No. Indicator: A
Part Number/Trade Name: BLEACH

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General Information
=====

Company's Name: ELITE CHEMICALS
Company's Street: 270 ROCUS ST
Company's City: SPRINGFIELD
Company's State: MA
Company's Country: US
Company's Zip Code: 01104
Company's Emerg Ph #: 800-424-9300(CHEMTREC)
Company's Info Ph #: 800-457-4449
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 10JAN95
Safety Data Review Date: 20NOV96
MSDS Serial Number: CCSLW

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Ingredients/Identity Information
=====

Proprietary: NO
Ingredient: HYPOCHLOROUS ACID, SODIUM SALT; (SODIUM HYPOCHLORITE) (CERCLA)
Ingredient Sequence Number: 01
Percent: 5.25
NIOSH (RTECS) Number: NH3486300
CAS Number: 7681-52-9
OSHA PEL: N/K (FP N)
ACGIH TLV: N/K (FP N)

Proprietary: NO
Ingredient: SODIUM HYDROXIDE (CERCLA)
Ingredient Sequence Number: 02
Percent: 0.1-0.2
NIOSH (RTECS) Number: WB4900000
CAS Number: 1310-73-2
OSHA PEL: 2 MG/M3
ACGIH TLV: 2 MG/M3, C

Proprietary: NO
Ingredient: SUPDAT: OBTAIN EPA REGISTRATION AND ESTABLISHMENT NUMBERS.
Ingredient Sequence Number: 03
NIOSH (RTECS) Number: 9999999ZZ
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

Proprietary: NO
Ingredient: EYE PROT: & FULL LENGTH FACESHIELD (FP N).
Ingredient Sequence Number: 04
NIOSH (RTECS) Number: 9999999ZZ

OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE

=====
Physical/Chemical Characteristics
=====

Appearance And Odor: CLEAR-LIGHT YELLOW LIQUID WITH CHARACTERISTIC
CHLORINE ODOR.
Boiling Point: 220F,104C
Melting Point: >25F,>-4C
Specific Gravity: SUPDAT
Solubility In Water: COMPLETELY SOLUBLE
=====

=====
Fire and Explosion Hazard Data
=====

Flash Point: NON-FLAMMABLE
Lower Explosive Limit: N/A
Upper Explosive Limit: N/A
Extinguishing Media: SUITABLE FOR SURROUNDING FIRE.
Special Fire Fighting Proc: USE NIOSH APPROVED SCBA AND FULL PROTECTIVE
EQUIPMENT (FP N). AVOID BODY CONTACT AND INHALATION OF FUMES.
Unusual Fire And Expl Hazrds: STRONG OXIDIZER. CONTACT W/COMBUSTS MAY
IRRITATE OR PROMOTE COMBUST. ACIDS & HEAT ACCELERATE DECOMP. DECOMP PRODS
MAY INCL CHLORINE. TOXIC FUMES CAN BE (SUPDAT)
=====

=====
Reactivity Data
=====

Stability: YES
Cond To Avoid (Stability): PROD IS STABLE & DECOMPOSES NATURALLY W/AGE.
AVOID EXCESSIVE EXPOSURE TO HEAT & LIGHT OR CONTACT W/INCOMPATIBLE MATLS.
Materials To Avoid: ACIDS, AMMONIA, METALS, COMBUSTIBLES, DETERGENTS,
REDUCING AGENTS, OXIDIZABLE MATERIALS, CHLORINATED ISOCYANURATES.
Hazardous Decomp Products: CHLORINE, HYDROCHLORIC ACID, HYPOCHLOROUS ACID,
OXYGEN.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT
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Health Hazard Data
=====

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: ACUTE: SEVERE IRRITANT TO SKIN, EYES, NOSE,
THROAT & GI TRACT. PROMPT TREATMENT IS IMPORTANT TO MINIMIZE EFTS OF
OVEREXP. CHRONIC: EYES: SEV IRRITANT. SKIN: SEV IRRITANT. INHAL: IRRITANT
TO RESP TRACT. INGEST: CORROSION OF MUCOUS MEMBRANES; PERFORATION OF
ESOPHAGUS & STOMACH. MAY LEAD TO CONVULSIONS, COMA & DEATH.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT
Signs/Symptoms Of Overexp: EYES AND SKIN: SEVERE IRRITATION AND REDDENING.
RESPIRATORY TRACT: COUGHING AND IRRITATION. MAY CAUSE SHORTNESS OF BREATH,
SORE THROAT AND LABORED BREATHING. INGESTION: NAUSEA AND VOMITING, POSSIBLE
PERFORATION OF ESOPHAGUS AND STOMACH, CONVULSIONS, COMA AND DEATH.

MSDS for Sodium Hypochlorite

Med Cond Aggravated By Exp: VAPORS MAY AGGRAVATE RESPIRATORY AILMENTS.
Emergency/First Aid Proc: EYES: FLUSH W/WATER FOR AT LEAST 15 MINUTES &
CALL MD. SKIN: FLUSH AFFECTED AREAS W/PLENTY OF WATER. REMOVE CONTAMINATED
CLOTHING & WASH W/SOAP & WATER. IF SKIN IS BURNED, CALL MD. INHAL: REMOVE
VICTIM TO FRESH AIR & CALL MD IF BREATHING IS DIFFICULT. INGEST: RINSE
MOUTH W/WATER. DRINK LARGE AMOUNTS OF WATER &/OR MILK. DO NOT INDUCE
VOMITING. CALL MD. DO NOT USE BAKING SODA OR ACIDIC ANTIDOTES.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: TOXIC TO FISH & AQUATIC LIFE. DO NOT ALLOW
MATL TO ENTER SEWERS, STREAMS, PONDS, STORM DRAINS. PERSONNEL INVOLVED W/
CLEAN-UP MUST BE EQUIPPED W/NIOSH APPROVED RESPIRATORY PROTECTION, EYE
PROTECTION, RUBBER BOOTS, RUBBER GLOVES & PROTECTIVE CLOTHING.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: DO NOT ABSORB SPILLS W/FLAM MATLS SUCH AS SAWDUST
OR COMBUSTIBLE ABSORBS. CONTAIN SPILLS IN AS SMALL AN AREA AS POSS FOR
NEUTRALIZATION & DILUTION. ABSORB MATL IS BEST PLACED IN PLASTIC CNTNRS.
DISPOSE OF RESIDUE I/A/W FEDERAL, STATE & LOCAL REGS.
Precautions-Handling/Storing: STORE IN VENTD CNTNRS AWAY FROM SUNLIGHT;
SEPARATE FROM ACIDS, HEAT, OXIDIZING MATLS, AMMONIA, HYDROCARBS, ALCOHOLS,
ETHERS OR ISOCYANURATES. (SUPDAT)
Other Precautions: DO NOT MIX W/OTHER CLEANING AGENTS CONTAINING ACIDS OR
AMMONIA. THESE MAY LIBERATE CHLORINE & CHLORAMINES UPON MIXING. AVOID
WEARING CONTACT LENSES WHEN HNDLG THIS PROD. DO NOT STORE IN METAL CNTNRS.
WHEN EMPTY, RETURNABLE CNTNRS (SUPDAT)

Control Measures

Respiratory Protection: NIOSH APPROVED SELF-CONTAINED BREATHING APPARATUS
SUITABLE FOR ACID GAS AND CHLORINE SHOULD BE USED FOR STRONG CONCENTRATION.
Ventilation: LOCAL EXHAUST. MECHANICAL (GENERAL) RECOMMENDED.
Protective Gloves: RUBBER GLOVES.
Eye Protection: ANSI APPRVD CHEM WORKERS GOGGS (ING 4)
Other Protective Equipment: ANSI APPROVED EYE WASH & DELUGE SHOWER (FP N).
HARD HATS, RUBBER BOOTS, PROTECTIVE CLOTHING.
Work Hygienic Practices: AVOID SKIN AND VAPOR CONTACT. WASH THOROUGHLY
AFTER USING.
LIBERATED BY HEAT/DECOMP. HNDLG/STOR PRECS: STORE IN COOL AREA. OTHER
PRECS: MUST BE SHIPPED I/A/W FED, STATE & DOT REGS. ALL RESIDUAL PROD MUST
BE REMOVED BY TRIPLE RINSING CNTNR W/WATER. PROD IS REGULATED BY FIFRA IF
USED AS SANITIZER/DISINFECTANT.. REPACKAGERS MUST (ING 3)

Transportation Data

Disposal Data

Label Data

Label Required: YES
Technical Review Date: 03DEC96
Label Date: 20NOV96
Label Status: G

MSDS for Sodium Hypochlorite

Common Name: BLEACH
Chronic Hazard: YES
Signal Word: DANGER!
Acute Health Hazard-Severe: X
Contact Hazard-Severe: X
Fire Hazard-None: X
Reactivity Hazard-Slight: X
Special Hazard Precautions: DECOMPOSITION PRODUCTS MAY BE HAZARDOUS.
ACUTE: EYES: SEVERE IRRITATION AND REDDENING. SKIN: SEVERE IRRITATION AND REDDENING. INHALATION: COUGHING AND IRRITATION. MAY CAUSE SHORTNESS OF BREATH, SORE THROAT AND LABORED BREATHING. INGESTION: SEVERE IRRITANT TO GASTROINTESTINAL TRACT, NAUSEA AND VOMITING, POSSIBLE PERFORATION OF CORROSION OF MUCOUS MEMBRANES; PERFORATION OF ESOPHAGUS AND STOMACH. MAY LEAD TO CONVULSIONS, COMA AND DEATH.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: ELITE CHEMICALS
Label Street: 270 ROCUS ST
Label City: SPRINGFIELD
Label State: MA
Label Zip Code: 01104
Label Country: US
Label Emergency Number: 800-424-9300(CHEMTREC)

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ANNEX F
MATERIAL SAFETY DATA SHEETS

ANNEX F

MATERIAL SAFETY DATA SHEETS

This annex contains the Material Safety Data Sheets (MSDSs) for mustard agent (HD) and nitrogen mustard (HN-1). The MSDS for HD is an update of the MSDS that appears in the Health and Safety Plan (HASP). The MSDS for HN-1 is included here because it was not included in the HASP. The MSDSs for other chemicals used during operations can be found in appendix C to the HASP (which is annex E to this Emergency Destruction Plan).

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Material Safety Data Sheet

Distilled Mustard (HD)

Date: 22 September 1988

Revised: 13 August 2001

In the event of an emergency
Telephone the SBCCOM Operations
Center's 24-hour emergency
Number: 410-436-2148

Section I - General Information

Manufacturer's Address:

U.S. Army Soldier & Biological Chemical Command (SBCCOM)
Edgewood Chemical Biological Center (ECBC)
ATTN: AMSSB-RCB-RS
Aberdeen Proving Ground, MD 21010-5424

Chemical Name: Bis-(2-chloroethyl)sulfide

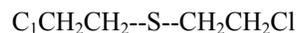
Trade name and synonyms:

H; HD; HS
Mustard Gas
Sulfur mustard; Sulphur mustard gas
Sulfide, bis (2-chloroethyl)
Bis(beta-chloroethyl)sulfide
1,1'-thiobis(2-chloroethane)
1-chloro-2(beta-chloroethylthio)ethane
Beta, beta'-dichlorodiethyl sulfide
2,2'dichlorodiethyl sulfide
Di-2-chloroethyl sulfideBeta, beta'-dichloroethyl sulfide
2,2'-dichloroethyl sulfide
EA 1033
Iprit
Kampstoff "Lost"; Lost
S-Lost; S-yperite; Schwefel-lost
Senfgas
Yellow Cross Liquid
Yperite;Y

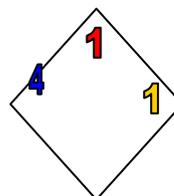
Chemical Family: Chlorinated sulfur compound

Formula/Chemical Structure:

C₄ H₈ C₁₂ S



NFPA 704 Signal:



Health - 4
Flammability - 1
Reactivity - 1
Special - 0

0

Section II - Ingredients

Ingredients/Name: Sulfur Mustard

Percentage by Weight: 100%

Threshold Limit Value (TLV): 0.003mg/m³

Section III - Physical Data

Boiling Point °F (°C): Calculated 423.5 °F (217.5 °C) (decomposed)

Vapor Pressure (mm Hg): 0.069 @ 20 °C
0.11 @ 25 °C

Vapor Density (Air=1): 5.5

Solubility (g/100g solvent): Negligible in water (0.92 @ 22 °C). Soluble in fats and oils, gasoline, kerosene, acetone, carbon tetrachloride, alcohol, tetrachloroethane, ethylbenzoate, and ether. Miscible with the organophosphorus nerve agents.

Specific Gravity (H₂O=1): 1.27 @ 25 °C

Freezing/Melting Point (°C): 14.45

Liquid Density (g/mL): 1.274 g/mL @ 20 °C
1.268 g/mL @ 25 °C

Volatility (mg/m³): 600 @ 20 °C
910 @ 25 °C

Viscosity (Centipoise): 5.175 @ 20 °C

Molecular Weight (g/mol): 159.08

Appearance and Odor: Normally amber to black colored liquid with garlic or horseradish odor. Water clear if pure. The odor threshold for HD is 0.6 mg/m³ (0.0006 mg/L).

Section IV - Fire and Explosion Data

Flashpoint: 105 °C (Can be ignited by large explosive charges)

Flammability Limits (% by volume): Unknown

Extinguishing Media: Water, fog, and foam, CO₂. Avoid use of extinguishing methods that will cause splashing or spreading of HD.

Special Fire Fighting Procedures: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving HD should be contained to prevent contamination to uncontrolled areas.

When responding to a fire alarm in buildings or areas containing agents, fire-fighting personnel should wear full firefighter protective clothing (flame resistant) during chemical agent fire-fighting and fire rescue operations. Respiratory protection is required. Positive pressure, full facepiece, NIOSH-approved self-contained breathing apparatus (SCBA) will be worn where there is danger of oxygen deficiency and when directed by the fire chief or chemical accident/incident (CAI) operations officer. In cases where fire-fighters are responding to a chemical accident/incident for rescue/reconnaissance purposes they will wear appropriate levels of protective clothing (See Section VIII).

Do not breathe fumes. Skin contact with agent must be avoided at all times. Although the fire may destroy most of the agent, care must still be taken to assure the agent or contaminated liquids do not further contaminate other areas or sewers. Contact with the agent liquid or vapor can be fatal.

Section V - Health Hazard Data

Airborne Exposure Limit (AEL): The AEL for HD is 0.003 mg/m³ as found in "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT". To date, the Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure concentration for HD.

Effects Of Overexposure: HD is a vesicant (causing blisters) and alkylating agent producing cytotoxic action on the hematopoietic (blood-forming) tissues which are especially sensitive. The rate of detoxification of HD in the body is very slow and repeated exposures produce a cumulative effect. HD is a human carcinogen as cited by the International Agency for Research on Cancer (IARC).

Median doses of HD in man are:

LD50 (skin, liquid) = 100 mg/kg

ICt50 (skin, vapor) = 2000 mg-min/m³ at 70 - 80 °F (humid environment)

= 1000 mg-min/m³ at 90 °F (dry environment)

ICt50 (eyes, vapor) = 200 mg-min/m³

LCt50 (inhalation) = 1500 mg-min/m³

LCt50 (skin, vapor) = 10,000 mg-min/m³

LD50 (oral) = 0.7 mg/kg

Acute Physiological Action of HD is classified as Local and Systemic.

Local Actions: HD effects both the eyes and the skin. Skin damage occurs after percutaneous absorption. Being lipid soluble, HD can be absorbed into all organs. Skin penetration is rapid without skin irritation. Swelling (blisters) and reddening (erythema) of the skin occurs after a latency period of 4-24 hours following the exposure, depending on degree of exposure and individual sensitivity. The skin healing process is very slow. Tender skin, mucous membrane and perspiration-covered skin is more sensitive to the effects of HD. HD's effect on the skin, however, is less than on the eyes. Local action on the eyes produces severe necrotic damage and loss of eyesight. Exposure of eyes to HD vapor or aerosol produces lacrimation, photophobia, and inflammation of the conjunctiva and cornea.

Systemic Actions: Occurs primarily through inhalation and ingestion. The HD vapor or aerosol is less toxic to the skin or eyes than the liquid form. When inhaled, the upper respiratory tract (nose, throat, trachea) is inflamed after a few hours latency period, accompanied by sneezing, coughing, and bronchitis, loss of appetite, diarrhea, fever, and apathy. Exposure to nearly lethal doses of HD can produce injury to bone marrow, lymph nodes, and spleen as shown by a drop in white blood cell count, thus resulting in increased susceptibility to local and systemic infections. Ingestion of HD will produce severe stomach pains, vomiting, and bloody stools after a 15-20 minute latency period.

Chronic Exposure: HD can cause sensitization, chronic lung impairment, (cough, shortness of breath, chest pain), cancer of the mouth, throat, respiratory tract and skin, and leukemia. It may also cause birth defects.

Emergency And First Aid Procedures:

Inhalation: Hold breath until respiratory protective mask is donned. Remove from the source **Immediately**. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Mouth-to-mouth resuscitation should be used when approved mask-bag or oxygen delivery systems are not available. Do not use mouth-to-mouth resuscitation when facial contamination is present. Seek medical attention **Immediately**.

Eye Contact: Speed in decontaminating the eyes is absolutely essential. Remove the person from the liquid source, flush the eyes **Immediately** with water for at least 15 minutes by tilting the head to the side, pulling the eyelids apart with the fingers and pouring water slowly into the eyes. Do not cover eyes with bandages but, if necessary, protect eyes by means of dark or opaque goggles. Transfer the patient to a medical facility **Immediately**.

Skin Contact: Don respiratory protective mask. Remove the victim from agent sources **immediately**. Immediately wash skin and clothes with 5% solution of sodium hypochlorite or liquid household bleach within one minute. Cut and remove contaminated clothing, flush contaminated skin area again with 5% sodium hypochlorite solution, then wash contaminated skin area with soap and water. Seek medical attention **Immediately**.

Ingestion: Do not induce vomiting. Give victim milk to drink. Seek medical attention **Immediately**.

Section VI - Reactivity Data

Stability: Stable at ambient temperatures. Decomposition temperature is 300-351 ° F (149 -177 ° C). Mustard is a persistent agent depending on pH and moisture, and has been known to remain active for up to three years in soil.

Incompatibility: Rapidly corrosive to brass at 65 ° C. Will corrode steel at a rate of .0001 in. of steel per month at 65 ° C.

Hazardous Decomposition: Mustard will hydrolyze to form HCl and thiodiglycol.

Hazardous Polymerization: Does not occur.

Section VII - Spill, Leak, And Disposal Procedures

Steps To Be Taken In Case Material Is Released Or Spilled: Only personnel in full protective clothing (See Section VIII) will be allowed in an area where HD is spilled. See Section V for emergency and first aid instructions.

Recommended Field Procedures: The HD should be contained using vermiculite, diatomaceous earth, clay or fine sand and neutralized as soon as possible using copious amounts of 5.25% sodium hypochlorite solution. Scoop up all material and place in an approved DOT container. Cover the contents with decontaminating solution as above. The exterior of the container will be decontaminated and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of the material in accordance with waste disposal methods provided below. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Sections II and VIII).

If 5.25% sodium hypochlorite solution is not available then the following decontaminants may be used instead and are listed in the order of preference: Calcium Hypochlorite, Decontamination Agent (DS2), and Super Tropical Bleach Slurry (STB).

Warning: Pure, undiluted calcium hypochlorite (HTH) will burn on contact with liquid HD.

Recommended Laboratory Procedures: Use a minimum of 65 grams of decontamination solution for each gram of HD. Allow 24 hours for decontamination to take place. Agitate solution at least one hour. Agitation is not necessary after the first hour. Test for presence of active chlorine by use of acidic potassium iodide solution to give free iodine color. Adjust the resulting solution pH to between 10 and 11.

Place three milliliters (ml) of decontaminated solution in a test tube. Add several crystals of potassium iodine and swirl to dissolve. Add 3 ml of 50 wt.% sulfuric acid:water and swirl. **Immediate** iodine color shows the presence of active chlorine. If negative, add additional decontaminant to the decontaminated solution, wait two hours and test again for active chlorine. This works for either 5.5% sodium hypochlorite or 10% calcium hypochlorite decontamination solutions. Scoop up all materials and clothing and place in an approved DOT container. The exterior of the container will be decontaminated and labeled according to EPA and DOT regulations. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Decontaminate and label according to EPA and DOT regulations. Dispose of contents according to Federal, state and local regulations. Conduct general area monitoring with an approved monitor to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (See Section VIII).

Note: Surfaces contaminated with HD, then rinsed and decontaminated may evolve sufficient HD vapor to produce a physiological response. HD on laboratory glassware may be oxidized by its vigorous reaction with concentrated nitric acid.

Waste Disposal Method: Open pit burning or burying of HD or items containing or contaminated with HD in any quantity is prohibited. Decontamination of waste or excess material shall be accomplished according to the procedures outlined above and can be destroyed by incineration in EPA approved incinerators according to appropriate provisions of Federal, State and local Resource Conservation Recovery Act (RCRA) regulations.

Note: Some decontaminant solutions are hazardous wastes according to RCRA regulations and must be disposed of according to those regulations.

Section VIII - Special Protection Information

Respiratory Protection:

Concentration
< 0.003 mg/m³

Respiratory Protective Equipment

Protective mask not required to be worn as an 8-hr TWA provided that:

- (a) Monitoring will be conducted to confirm that engineering controls are properly maintaining concentrations < 0.003 mg/m³ as an 8-hr TWA.
- (b) M40-series mask is available for emergency escape purposes.
- (c) Exposure has been limited to the extent practicable by engineering controls (remote operations ventilation, and process isolation) and work practices.

If these conditions are not met then follow the guidance for > 0.003 mg/m³ as an 8-hr TWA.

>= 0.003 mg/m³
as an 8-hr TWA

NIOSH/MSHA approved pressure demand full face piece SCBA suitable for use in high agent concentrations with protective ensemble. (See DA Pam 386-61 for examples)

Ventilation

Local Exhaust: Mandatory. Must be filtered or scrubbed. Air emissions shall meet local, state and federal regulations.

Special: Chemical laboratory hoods will have an average inward face velocity of 100 linear feet per minute (lfpm) +/- 20% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods will have an inward face velocity of 150 lfpm +/- 20%. Laboratory hoods will be located such that cross drafts do not exceed 20% of the inward face velocity. A visual performance test using smoke producing devices will be performed in assessing the ability of the hood to contain agent HD.

Other: Recirculation of exhaust air from agent areas is prohibited. No connection between agent area and other areas through the ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested semiannually or after modification or maintenance operations. Operations should be performed 20 centimeters inside hoods.

Protective Gloves: Butyl Rubber gloves M3 and M4
Norton, Chemical Protective Glove Set

Eye Protection: As a minimum, chemical goggles will be worn. For splash hazards use goggles and face shield.

Other Protective Equipment: For laboratory operations, wear lab coats, gloves and have mask readily accessible. In addition, daily clean smocks, foot covers, and head covers will be required when handling contaminated lab animals.

Monitoring: Available monitoring equipment for agent HD is the M8/M9 detector paper, blue band tube, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automated Continuous Air Monitoring System (ACAMS), CAM-M1, Hydrogen Flame Photometric Emission Detector (HYFED), the Miniature Chemical Agent Monitor (MINICAM), and Real Time Analytical Platform (RTAP). Real-time, low-level monitors (with alarm) are required for HD operations. In their absence, an Immediately Dangerous to Life and Health (IDLH) atmosphere must be presumed. Laboratory operations conducted in appropriately maintained and alarmed engineering controls require only periodic low-level monitoring.

Section IX - Special Precautions

Precautions To Be Taken In Handling and Storing: When handling agents, the buddy system will be incorporated. No smoking, eating, or drinking in areas containing agents is permitted. Containers should be periodically inspected for leaks, (either visually or using a detector kit). Stringent control over all personnel practices must be exercised. Decontaminating equipment will be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap and water before leaving at the end of the work day.

Other Precautions: HD should be stored in containers made of glass for Research, Development, Test and Evaluation (RDTE) quantities or one-ton steel containers for large quantities. Agent containers will be stored in a single containment system with in a laboratory hood or in double containment system.

For additional information see "AR 385-61, The Army Toxic Chemical Agent Safety Program," "DA Pam 385-61, Toxic Chemical Agent Safety Standards," and "DA Pam 40-173, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT."

Section X - Transportation Data

Note: Forbidden for transport other than via military (Technical Escort Unit) transport according to 49 CFR 172

Proper Shipping Name: Toxic liquids, n.o.s.

Dot Hazard Class: 6.1, Packing Group I, Hazard Zone B

Dot Label: Poison

Dot Marking: Toxic liquids, n.o.s. Bis-(2-chloroethyl) sulfide UN 2810, Inhalation Hazard

Dot Placard: Poison

Emergency Accident Precautions and Procedures: See Sections IV, VII and VIII.

Precautions To Be Taken In Transportation: Motor vehicles will be placarded regardless of quantity. Drivers will be given full information regarding shipment and conditions in case of an emergency. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

The Edgewood Chemical Biological Center (ECBC), Department of the Army believes that the data contained herein are actual and are the results of the tests conducted by ECBC experts. The data are not to be taken as a warranty or representation for which the Department of the Army or ECBC assumes legal responsibility. They are offered solely for consideration. Any use of this data and information contained in this MSDS must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

Addendum A

Additional Information For Thickened HD

Trade Name And Synonyms: Thickened HD, THD

Trade Name and Synonyms for Thickener:

Acrylic acid butyl ester
Polymer with styrene
Butyl acrylate-styrene polymer
Butyl acrylate-styrene copolymer
N-Butyl acrylate-styrene polymer
Polymer with styrene acrylic acid butyl ester
2-Propenoic acid
Butyl ester
Polymer with ethenylbenzene
Styrene -butyl acrylate polymer
Acronal 4D
Acronal 290D
Acronal 295D
Acronal 320D
Mowilith DM60
Sokrate LX 75
OSH22097

Hazardous Ingredients: Styrene-butyl acrylate copolymer is used to thicken HD and is not known to be hazardous except in a finely-divided, powder form.

Physical Data: Essentially the same as HD.

Fire And Explosion Data: Same as HD. Thickener is a slight fire hazard when exposed to heat or flame.

Health Hazard Data: Same as HD except for skin contact. For skin contact, don respiratory protective mask and remove contaminated clothing **Immediately. Immediately** scrape the HD from the skin surface, then wash the contaminated surface with acetone. Seek medical attention **Immediately**.

Spill, Leak, and Disposal Procedures: If spills or leaks of HD occur, follow the same procedures as those for HD, but dissolve THD in acetone before introducing any decontaminating solution. Containment of THD is generally not necessary. Spilled THD can be carefully scraped off the contaminated surface and placed in a fully removable head drum with a high density, polyethylene lining. THD can then be decontaminated, after it has been dissolved in acetone, using the same procedures used for HD. Contaminated surfaces should be treated with acetone, then decontaminated using the same procedures as those used for HD.

Note: Surfaces contaminated with THD and then rinse-decontaminated may evolve sufficient HD vapor to produce a physiological response.

Special Protection Information: Same as HD.

Special Precautions: Same as HD with the following addition. Handling the THD requires careful observation of the "stringers" (elastic, thread like attachments) formed when the agents are transferred or dispensed. These stringers must be broken cleanly before moving the contaminating device or dispensing device to another location, or unwanted contamination of a working surface will result. Avoid contact with strong oxidizers, excessive heat, sparks, or open flame.

Transportation Data: Same as HD.

DATE: January 12, 1990



US ARMY CHEMICAL
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER

Emergency Telephone #s:
CRDEC Safety Office
301-671-4411, 0800-1630
EST. After normal duty
hours: 301-278-5201
Ask for CRDEC Staff
Duty Officer

HN1 MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME: Department of the Army

MANUFACTURER'S ADDRESS: US ARMY ARMAMENT, MUNITIONS AND CHEMICAL
COMMAND
CHEMICAL RESEARCH, DEVELOPMENT AND ENGI-
NEERING CENTER
ATTN: SMCCR-SFS
ABERDEEN PROVING GROUND, MD 21010-5423

CAS REGISTRY NUMBER: 538-07-8

CHEMICAL NAME: 2,2'-Dichlorotriethylamine

Alternate Chemical Names:

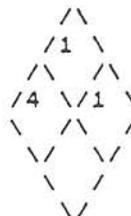
Ethylbis(beta-chloroethyl)amine
Ethylbis(2-chloroethyl)amine
2-Chloro-N-(2-chloroethyl)-N-ethylethanamine

TRADE NAME AND SYNONYMS: Ethyl-S
HN1
TL 329
TL 1149

CHEMICAL FAMILY: Chloroamino hydrocarbon

FORMULA/CHEMICAL STRUCTURE: (C1 CH2 CH2)2 NC2 H5

NFPA 704 SIGNAL: Health - 4
Flammability - 1
Reactivity - 1



SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	TLV
Nitrogen Mustard 1	(C1 CH2 CH2)2 N C2 H5	100%	*

*None established/available

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 150.8 (66) at 3 torr
185.9 (88.5) at 12 torr
381.2 (194) at 760 torr (Calculated)
Decomposes before boiling at 760 torr.

VAPOR PRESSURE (mm Hg): 0.0773 at 10 DEG C
0.25 at 25 DEG C
0.744 at 40 DEG C

VAPOR DENSITY (AIR=1): 5.9

LIQUID DENSITY (g/cc): 1.09 at 25 DEG C (77 DEG F)

SOLUBILITY IN WATER: Miscible with many organic solvents and oils.
Very slightly soluble in water.

SPECIFIC GRAVITY (H2O=1): 1.0861 at 23 DEG C
1.09 at 25 DEG C

FREEZING (MELTING) POINT: -34 DEG C

AUTOIGNITION TEMPERATURE DEG F (DEG C): Data not available

VISCOSITY (CENTISTOKES): Data not available

VOLATILITY: 127 mg/m³ at -10 DEG C
308 mg/m³ at 0 DEG C
744 mg/m³ at 10 DEG C
1520 mg/m³ at 20 DEG C
2290 mg/m³ at 25 DEG C
3100 mg/m³ at 30 DEG C
6290 mg/m³ at 40 DEG C

EVAPORATION RATE: Data not available

APPEARANCE AND ODOR: Pale amber to yellow oily liquid
Faint "fishy or musty" odor

SECTION IV - FIRE AND EXPLOSION DATA

FLASH POINT: No immediate danger of fire or explosion

FLAMMABILITY LIMITS (% BY VOLUME): Data not available

EXTINGUISHING MEDIA: Water, fog, foam, CO₂. Avoid use of extinguishing methods that will splash or spread HN1.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapors of unburned agent will exhibit toxic effects.

SPECIAL FIRE FIGHTING PROCEDURES: Full protective clothing (see Section VIII) and full respiratory protection must be worn when fighting fires inside buildings and areas where HN1 is stored. Full protective clothing and canister or filter type masks can be worn where oxygen deficiency is not a problem. All persons not engaged in extinguishing the fire should be evacuated. Skin contact and inhalation of HN1 and its vapors must be avoided at all times. Although the fire may destroy most of the HN1, care must be taken to assure that the HN1 does not contaminate uncontrolled areas and that the fire fighters are adequately protected from physical contact with the agent and agent fumes. Contact may be fatal.

SECTION V - HEALTH HAZARD DATA

RECOMMENDED EXPOSURE LIMITS (REL): An REL is not available for HN1. No individual should be exposed to any direct skin or eye contact or any detectable airborne concentrations. Nitrogen mustards are classified as carcinogens by the International Agency for Research on Cancer (IARC).

EFFECTS OF OVEREXPOSURE: The vapors are irritating to the eyes and nasal membranes even in low concentration. HN1 is a vesicant (causing blisters) and alkylating agent producing cytotoxic action on the hematopoietic (blood-forming) tissues. HN1 is not naturally detoxified by the body, therefore repeated exposure produces a cumulative effect.

Median lethal dosages of HN1 in man are the following:

LCt₅₀ (man, inhalation) = 1500 mg-min/m³

LCt₅₀ (man, percutaneous vapor) = 20,000 mg-min/m³

Median incapacitating dosages of HN1 in man are the following:

ICt₅₀ (man, eye contact) = 200 mg-min/m³

ICt₅₀ (man, percutaneous) = 9000 mg-min/m³

Vesicancy doses in man are the following:

Liquid:

43.6 microliters produced 28 percent erythema
218 microliters produced 72 percent erythema
218 microliters produced 20 percent blisters (4 mm. av.
diameter.)

ACUTE PHYSIOLOGICAL ACTION OF HN1 IS LOCAL AND SYSTEMIC.

Locally, HN1 affects both the eyes and the skin. Skin damage occurs after percutaneous resorption. Skin penetration is rapid and skin irritation is noted very shortly after contact with the agent. Reddening (erythema) of the skin may occur within 30 minutes to 1 hour following the exposure, depending on degree of exposure and individual sensitivity. Blistering may not occur for more than 12 hours following exposure. Tender skin, mucous membrane and perspiration covered skin are more sensitive to the effects of HN1. Local action on the eyes is extremely rapid, and produces severe neurotic damage and loss of eyesight. Exposure of eyes to HN1 vapor or aerosol produces lacrimation, photophobia, and inflammation of the conjunctiva and cornea. Greatest immediate effect on HN-1 is on the eyes.

Systemic actions occur primarily through inhalation and ingestion. When inhaled, the lesions caused by nitrogen mustards are similar to those caused by mustards. They decrease in severity down the respiratory tract from the point of entry. The upper respiratory tract (nose, throat, trachea) is inflamed after a few hours latency period, accompanied by sneezing, coughing, hoarseness progressing to loss of voice, and persistent cough. Fever and moist rills develop followed by loss of appetite, diarrhea, and apathy. Broncho pneumonia may appear after the first twenty four hours. Exposure to near lethal doses of HN1 can produce injury to bone marrow, lymph nodes, and spleen as indicated by a drop in WBC count, and results in increased susceptibility to local and systemic infections. Ingestion of HN1 will produce severe stomach pains, vomiting, and bloody stools.

Chronic exposure to HN1 can cause sensitization and chronic lung impairment (cough, shortness of breath, chest pain). In mild vapor exposures there may be no skin lesions. After severe exposure or after exposure to liquid nitrogen mustard, reddening may appear earlier than in mustard contamination. There may be irritation and itching as with mustard; blisters may appear later. However, blisters may not occur for more than 12 hours following exposure. Skin lesions are similar to those caused by mustard.

EMERGENCY AND FIRST AID PROCEDURES:

Inhalation: Remove from the source immediately. If breathing has stopped, give artificial respiration. If breathing

is difficult, administer oxygen. Seek medical attention immediately.

Eye Contact: immediately flush eyes with water for 10-15 minutes, pulling eyelids apart with fingers and pouring water into eyes. Do not cover eyes with bandages. After flushing eyes with water, protect eyes with dark or opaque goggles. Seek medical attention immediately.

Skin Contact: Don respiratory protective mask and gloves; remove victim from source immediately and remove contaminated clothing. immediately decontaminate skin by flushing with a 5% solution of liquid household bleach. After 3-4 minutes, wash off with soap and water to remove decon agent and protect against erythema. Seek medical attention immediately.

The rate of absorption of liquid nitrogen mustards through the skin is slower than that of mustard. Therefore, to prevent systemic toxicity, decontamination should be done as late as 2 or 3 hours after exposure even if it increases the severity of the local reaction. Further cleansing may be done with soap and water.

Ingestion: Do not induce vomiting. Give victim milk to drink. Seek medical attention immediately.

SECTION VI - REACTIVITY DATA

STABILITY: Polymerizes slowly

RATE OF HYDROLYSIS: Slow

HYDROLYSIS PRODUCTS: Hydroxyl derivatives and condensation products.

INCOMPATIBILITY: Corrosive to ferrous alloys beginning at 65 DEG C (149 DEG F)

HAZARDOUS DECOMPOSITION: Toxic intermediate products are produced during hydrolysis. Approximate half-life in water at 25 DEG C in 1.3 minutes. Decomposition comes through slow change into quaternary ammonium salts. Decomposition point is below 194 DEG C (381.2 DEG F)

HAZARDOUS POLYMERIZATION: Slowly

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Only personnel in full protective clothing will be allowed in an area where HN1 is spilled. HN1 should be contained using vermiculite,

diatomaceous earth, clay or fine sand and neutralized as soon as possible. A minimum of 65 grams of decon solution (5.25% Sodium Hypochlorite solution) is required for each gram of HN1. HN1 must be added to the decon solution and NOT DECON SOLUTION TO HN1. Decontamination/agent solution is allowed to agitate for a minimum of one hour. Agitation is not necessary following the first hour if a single phase is obtained. At the end of 24 hours, the resulting solution shall be adjusted to a pH between 10 to 11. Test for presence of active chlorine by use of acidic potassium iodide solution to give free iodine color. Place 3 ml of the decontaminant in a test tube. Add several crystals of potassium iodide and swirl to dissolve. Add 3 ml of 50 wt% sulfuric acid:water and swirl. IMMEDIATE iodine color indicates the presence of active chlorine. If negative, add additional 5.25% sodium hypochlorite solution to the decontamination solution, wait two hours, then test again for active chlorine. Continue procedure until positive chlorine is given by solution.

A 10 wt % HTH mixture may be substituted for sodium hypochlorite. Use 65 grams of decon per gram of HN1 and continue the test as described for sodium hypochlorite.

Do not use dry STB or HTH as they react violently with some chemicals. Scoop up all contaminated material and place in approved DOT containers. Pour in STB slurry or HTH solution. Decontaminate the outside of containers and label in accordance with federal, state and local regulations and hold for disposal.

NOTE: Surfaces contaminated with HN1 and then rinsed with water may evolve sufficient HN1 vapor to produce a physiological response.

WASTE DISPOSAL METHOD: All decontaminated material should be collected, contained, and chemically decontaminated, then thermally decomposed in an approved incinerator for HN1, which will filter or scrub toxic by-products from effluent air before discharge to the atmosphere. Any contaminated protective clothing should be decontaminated using HTH or bleach and analyzed to assure it is free of detectable contamination. The clothing should then be sealed in plastic bags inside properly labeled drums and held for shipment back to the Department of Army issue point. Decontamination of waste or excess material shall be accomplished in accordance with the following procedure:

(a) HN1 on laboratory glassware may be oxidized reacting it with strong bleaches, alkalies, or other oxidizers.

(b) Chemical decontamination of HN1 should be accomplished as described above. HN1 has poor solubility in water.

Decontaminated waste and/or HN1 shall be transported according to local SOP (in accordance with AR 55-355). Final disposition will be controlled according to AMCR 385-131 and AFG 200-2 and RCRA state regulations which take precedence (NOTE: Some states

consider certain decontaminated surety agents as RCRA hazardous waste. Local regulations must be considered before disposal action is taken).

SECTION VIII - SPECIAL PROTECTION INFORMATION

(U) RESPIRATORY PROTECTION:

HN1 Concentration

Respiratory Protective Equipment

Less than or equal to 0.003 mg/m³ as an 8-hr TWA

- Protective mask not required provided that:
- (a) Continuous real-time monitoring (with alarm capability) is conducted in the work area at the 0.003 mg/m³ level of detection.
 - (b) M9, M17 or M40 mask is available and donned if concentrations exceed 0.003 mg/m³.
 - (c) Exposure has been limited to the extent practicable by engineering control (remote operations, ventilations, and process isolation) or work practices.

If those conditions are not met then the following applies:

Full facepiece, chemical canister, air-purifying respirators. (The M9, M17 or M40 series or other certified equivalent masks acceptable for this purpose in conjunction with the M3 toxicological agent protective (TAP) suit for dermal protection.)

Greater than 0.003 as an 8-hr TWA

The Demilitarization Protective Ensemble (DPE), 30 mil, may be used with prior approval from the AMC Field Safety Activity. Use time for the 30 mil DPE must be restricted to two hours or less.

NOTE: When 30 mil DPE is not available the M17 or M40 mask with Level A protective ensemble including impregnated innerwear can be used. However, use time shall be restricted to the extent operationally feasible, and may not exceed one hour.

As an additional precaution, the cuffs of the sleeves and the legs of the M3 suit shall be taped to the gloves and boots to reduce aspiration.

VENTILATION: Local Exhaust: Mandatory must be filtered or scrubbed to limit exit concentration to 0.003 mg/m³ averaged over 8 hr/day. Filtration must be adequate to maintain stack concentration below 0.03 mg/m³ as a 1 hour TWA. These values are based on structural similarity to HD.

SPECIAL: Chemical laboratory hoods shall have an average inward face velocity of 100 linear feet per minute (1fpm) plus or minus 10% with the velocity at any point not deviating from the average face velocity by more than 20%. Laboratory hoods shall be located such that cross drafts do not exceed 20 percent of the inward face velocity. A visual performance test utilizing smoke producing devices shall be performed in the assessment of the inclosure's ability to contain agent HN1.

Other: Recirculation of exhaust air from agent areas is prohibited. No connection between agent areas and other areas through ventilation system is permitted. Emergency backup power is necessary. Hoods should be tested semi-annually or after modification or maintenance operations. Operations should be performed 20 cm inside hoods.

PROTECTIVE GLOVES: MANDATORY - Butyl Toxicological Agent Protective Gloves (M3, M4, or glove set).

EYE PROTECTION: As a minimum, chemical goggles will be worn. For splash hazard use goggles and face-shield.

OTHER PROTECTIVE EQUIPMENT: Full protective clothing will consist of the M3 butyl rubber suit with hood, M2A1 boots, M3 gloves, underwear, M9 series mask and coveralls (if desired), STEPOI or the DPE. For general lab work, gloves and lab coat shall be worn with M9, M17, or M40 Mask readily available.

In addition, when handling contaminated lab animals wearing clean smock, foot covers, and head covers are required daily.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: During handling, the "buddy" (two man) system will be used. Containers should be periodically inspected for leaks (either visually or by a detector kit), and prior to transferring the containers from storage to work areas. Stringent control over all personnel handling HN1 must be exercised. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Wash hands before meals and at the end of the workday. No smoking, eating, or drinking is permitted at the work site.

smoking, eating, or drinking is permitted at the work site. Decontamination equipment shall be conveniently located. Exits must be designed to permit rapid evacuation. HN1 should be stored in containers made of glass for Research Development Test and Evaluation (RDTE) quantities or one-ton steel containers for large quantities. Agent shall be double-contained in liquid-tight containers when in storage.

SECTION X - TRANSPORTATION DATA

PROPER SHIPPING NAME: Poisonous liquid, n.o.s.

DOT HAZARD CLASSIFICATION: Poison A

DOT LABEL: Poison Gas

DOT MARKING: Poison Liquid, n.o.s. (2,2'-Dichlorotriethylamine)
NA 1955

DOT PLACARD: POISON GAS

PRECAUTIONS TO BE TAKEN IN TRANSPORTATION: Motor vehicles will be placarded regardless of quantity. Driver shall be given full and complete information regarding shipment and conditions in case of emergency. All shipments will be handled per local SOP. (AR 55-355)

EMERGENCY ACCIDENT PRECAUTIONS AND PROCEDURES: See sections IV, VII, and VIII.

While the Chemical Research, Development and Engineering Center, Department of the Army believes that the data contained herein are factual and the opinions expressed are those of qualified experts regarding the results of the tests conducted, the data are not to be taken as a warranty or representation for which the Department of the Army or Chemical Research, Development and Engineering Center assumes legal responsibility. They are offered solely for your consideration, investigation, and verification. Any use of these data and information must be determined by the user to be in accordance with applicable Federal, State, and local laws and regulations.

LIST OF REFERENCES FOR MSDS FOR HN1

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10. AMC-R 385-131, Safety Regulation for Chemical Agents H, HD, HT, GB, and VX, Department of the Army, Headquarters, United States Army Material Command, Alexandria, VA, 9 October 1987.
11. AR 385-64, Ammunition and Explosives Safety Standards, Headquarters, Department of the Army, Washington, DC, 22 May 1987.
12. CRDECR 385-1, Chemical, Explosive, and Occupational Safety and Health Program, Department of the Army, US Army Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD, 15 August 1986.

ADDENDUM A

Equipment Description

M-9	Mask	----	Mask, Chemical Biological Special Purpose M9, M9A1.
M-40	Mask	----	Mask, Protective
M-17	Mask	----	(M-17, M-17A1, M17-A2) - Biological/Chemical Field Protective Mask.
M-3	Tap	----	Toxicological Agent Protective Ensemble
M-3	Hood	----	Toxicological Agent Protective
M-2A1	Boots	----	Butyl-Safety Toe-TAP-Toxicological Agent Protective
M3		----	M3 Gloves Toxicological Protective
M4		----	M4 Gloves Toxicological Protective
Gloves		----	Gloves-Norton-Toxicological Protective

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