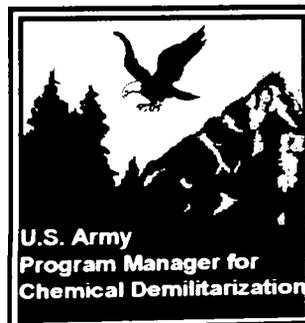




B108



**U.S. Army
Program Manager for
Chemical Demilitarization**

**Chemical Agent Identification Sets (CAIS)
Information Package**

November 1995

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CHEMICAL AGENT IDENTIFICATION SETS (CAIS) INFORMATION PACKAGE

1. **PURPOSE:** The purpose of this information package is to provide data on Chemical Agent Identification Sets (CAIS) to military services, Government contractors, and state and local authorities as required. This package is cleared for release to Government agencies, to Government contractors, and to the general public.

2. **BACKGROUND:** More than 100,000 CAIS were produced for use by all branches of the military between the 1930s and the 1960s. In the late 1970s and early 1980s, a program to destroy CAIS was successfully completed at Rocky Mountain Arsenal. In this operation, 21,458 CAIS were destroyed. The remaining 80,000 sets are thought to have been primarily expended through training, although some were disposed of by the military. In the past, one of the standard and approved procedures for disposing of CAIS was burial.

Three major varieties including 17 different types of CAIS were produced over three years. These sets were used by the military to train soldiers to identify chemical agents in the field. Materiel safety data sheets for these agents are provided in the appendices.

One major variety of CAIS was an instructional "sniff set" that contained agent-impregnated charcoal. It was intended for use indoors to instruct military personnel in recognizing the odors of chemical agents. This type of set contained only small amounts of chemical agent.

A second major variety, designed for use outdoors, consisted of agent (pure or in solution) in sealed Pyrex tubes. The gas tubes would be detonated, creating an agent cloud. Soldiers would then try to identify the agent based on its odor and other characteristics. These tubes typically contained more agent than the instructional "sniff sets" and could produce a much greater hazard.

A third major variety of CAIS were those containing bulk mustard. These CAIS were used in decontamination training by purposely contaminating terrain or equipment with mustard, and then teaching the soldiers how to don the correct protective clothing and decontaminate the area or equipment. These CAIS contained relatively large quantities of pure mustard.

Figure 1 shows four ways that CAIS were packaged. The upper left corner shows the K941 Toxic Gas Set, M1. The lower left corner shows the K945 Training Set, Chemical Agent Identification, M72. The upper right corner shows the K951/K952/K953/K954 War Gas Identification Set, Instructional M1/AN-M1A1. The lower right corner shows the X302/X545-X552 Replacement Set, Gas Identification, Instructional (Navy).

3. **PREPARED BY:** This package has been prepared by the U.S. Army Program Manager for Chemical Demilitarization, Project Manager for Non-Stockpile Chemical Materiel, ATTN: SFAE-CD-N, Bldg. 4405, Aberdeen Proving Ground, MD 21010. For questions or comments about this package, please contact the U.S. Army Program Manager for Chemical Demilitarization, Public Affairs Office, at (410) 671-1411 or DSN: 584-1411.



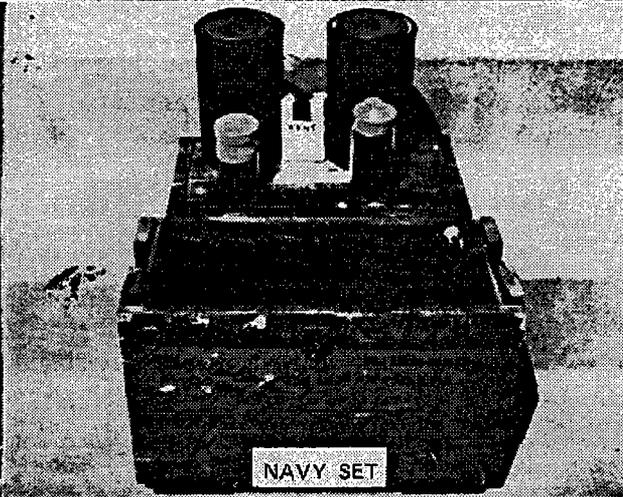
TOXIC GAS SET



WAR GAS ID SET



CHEMICAL AGENT
IDENT & TRAINING SET
(CAITS)



NAVY SET

095-033/idssets.cdr
11/08/95

Figure 1. Identification and Training Sets

REFERENCES:

Chemical Agent Identification Set Training Package, Brankowitz, William R.

Gas Identification Sets: Ordnance Pamphlet 1447, Navy Department, Bureau of Ordnance, Washington DC, 14 June 1945.

Instructions for Using Gas Identification Sets: Pamphlet No. 4, Chemical Warfare School, Edgewood Arsenal, Maryland, January 1942.

OPLAN SETCON II: Disposal of Chemical Agent Identification Sets at Rocky Mountain Arsenal, Colorado; Headquarters, Department of the Army, U.S. Army Armament Materiel Readiness Command, Rock Island, IL, February 1978.

Technical Aspects of Chemical Operation: Handout B 040.1, Department of the Army, U.S. Army Chemical Center and School, Fort McClellan, Alabama, November 1971.

Potential Military Chemical/Biological Agents and Compounds: FM 3-9, NAVFAC P-467, AFR 355-7, Headquarters, Departments of the Army, Navy, and Air Force, Washington DC, 12 December 1990.

SET K941

TOXIC GAS SET, M1

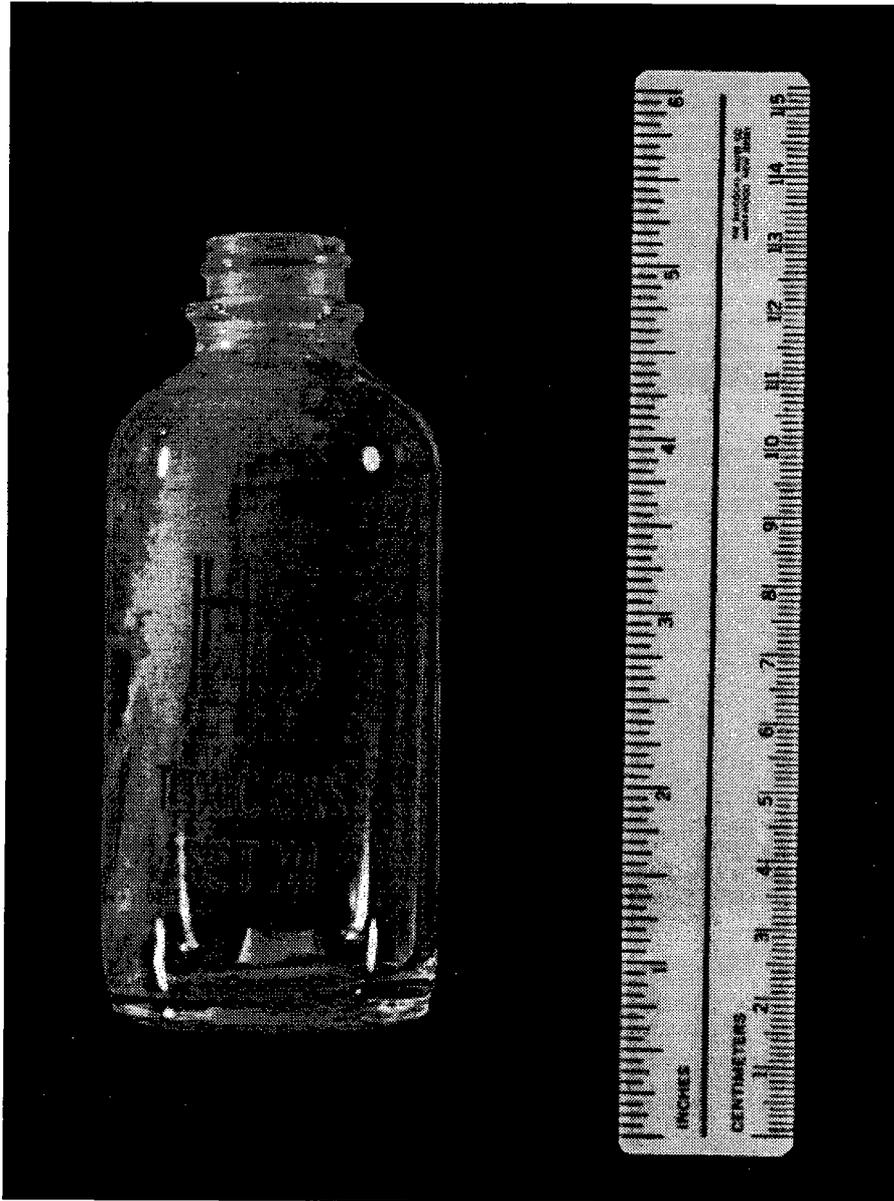
OLD STOCK NUMBER: FSN 1365-219-8574

TIME FRAME OF USE: WWII - LATER 1950s

The K941 CAIS contains 24 glass bottles, each containing 3½ ounces of mustard (H and HS) or distilled mustard (HD) for a total of 84 ounces (2.48 liters) per set (see figure 2).

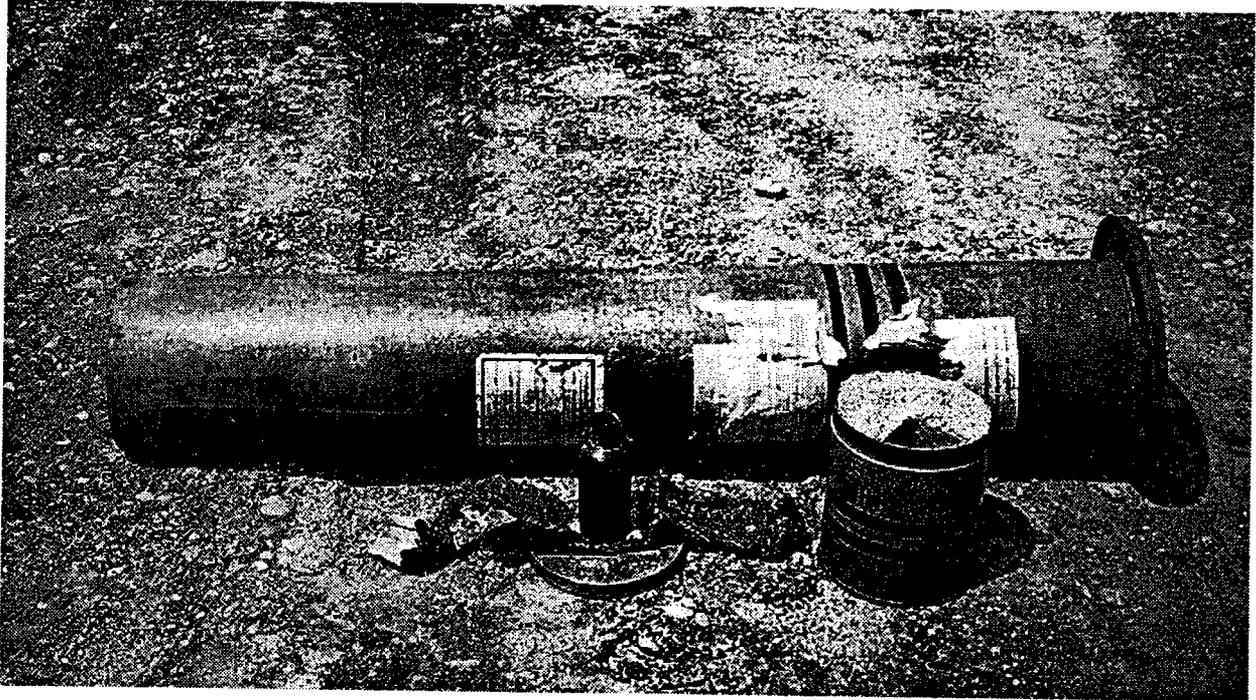
Bottles are round and have a small screw top. Heat resistant paint on the bottles indicates "H," "HS," "HD," or "TOXIC GAS SET, M1." Four bottles are packed in a one-half inch layer of sawdust within a sealed metal can. The cans are pressure sealed, 6¼ inches high, and have a sardine-type key on the bottom. Six of these metal cans are fitted into a steel shipping cylinder that is 6⅝ inches in diameter, approximately 38 inches long, and 0.145 inch thick. The open end of this container is closed by a flanged end cover which is secured by eight bolts tightened over a ⅛ inch thick lead gasket (see figure 3).

In former WWII training areas, K941 shipping containers (also called pigs) or loose K941 bottles are frequently found buried. Loose bottles should be handled carefully by field personnel during recovery using appropriate protective measures as the plastic/bakelite tops on these bottles are prone to leak.



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Figure 2. 3 1/2 Ounce Mustard Bottle



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Figure 3. Toxic Gas Set, M1, K941: HD, 2.5 Liters, 24 Bottles

SET K942

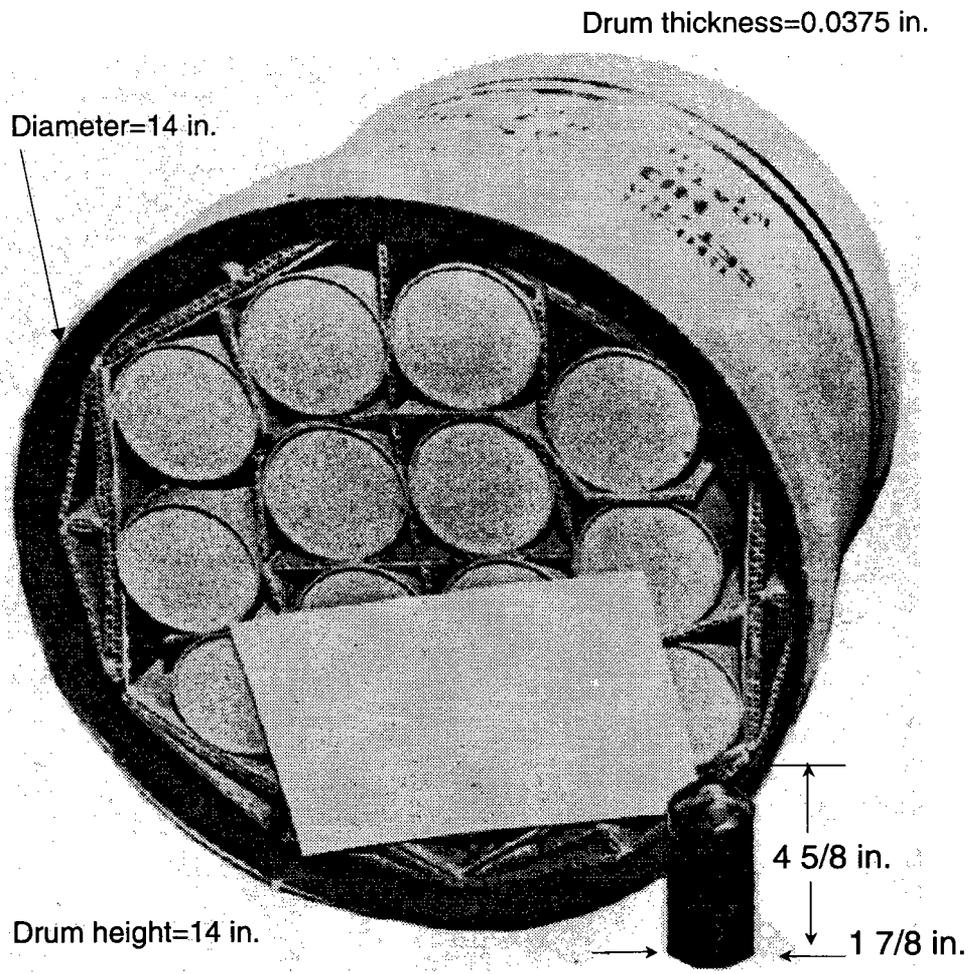
TOXIC GAS SET, M2/E11

OLD STOCK NUMBER: FSN 1365-563-4146

TIME FRAME OF USE: KOREAN CONFLICT ERA

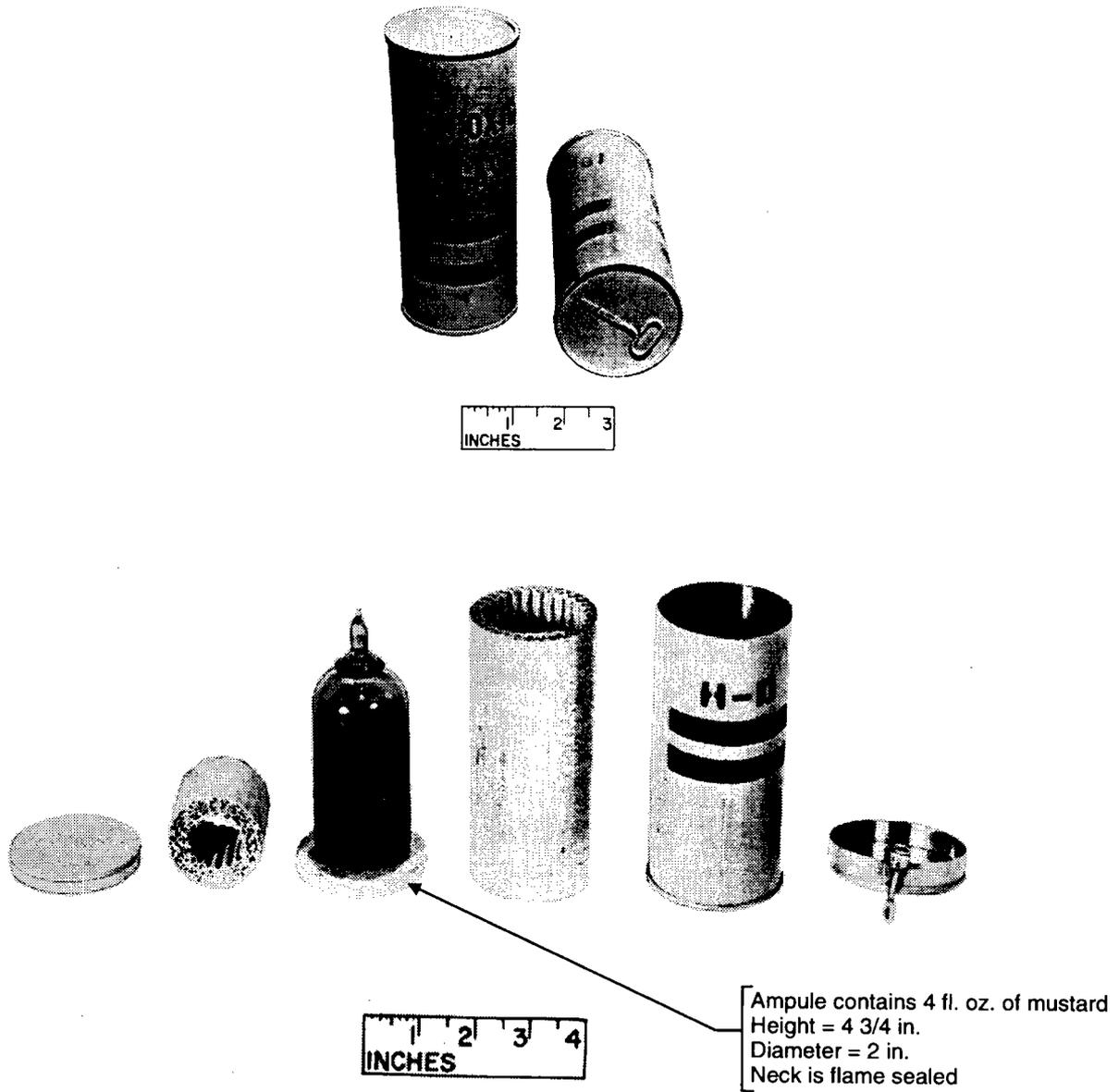
The K942 CAIS contains 28 heat-sealed ampules, each containing 3.8 ounces of mustard (H, HD, or HS) for a total of 106.4 ounces (3.15 liters) per set (see figure 4).

Each ampule is $1\frac{7}{8}$ inches in diameter and $4\frac{5}{8}$ inches in length and packed in its own can. Ampules are flame sealed at the neck to produce a leakproof container for the mustard. Each ampule is stored in a hermetically sealed metal tear strip container made of tinplate. The ampules are protected from movement and breakage by foam rubber disks at the ends and a corrugated fiberboard lining. Twenty-eight cans (which are gray with green stencil markings) are packed in a cold-rolled carbon steel drum 14 inches in diameter, 14 inches high, and 0.0375 inch thick (20 gauge) in 2 layers (14 cans per layer) (see figure 5). The cans are separated into individual compartments by a fiberboard packaging (see figure 6). The drum is sealed by a bolted ring-closure cover seated on a rubber gasket (see figure 7).



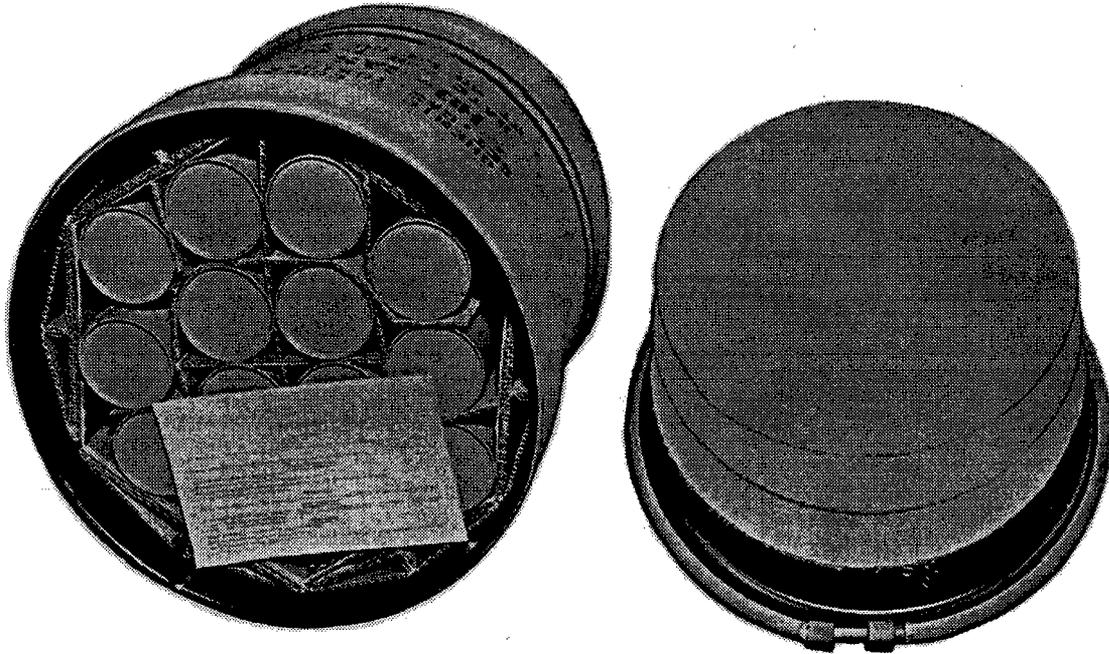
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11/07/95

Figure 4. Toxic Gas Set, M2, K942: HD, 3.2 Liters, 28 Ampules



095-033/ampuprot.cdr
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Figure 5. K942 Toxic Gas Set Can



095-033/drum.cdr
11/07/96

Figure 6. K942 Drum Opened

Contains 28 glass ampules of liquid mustard in individual metal containers



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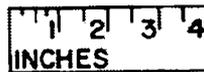


Figure 7. K942/E11 Toxic Gas Sets

SET K945

TRAINING SET, CHEMICAL AGENT IDENTIFICATION, M72

OLD STOCK NUMBER: FSN 1365-051-1807

TIME FRAME OF USE: LATER 1960s

The K945 CAITS contains four bottles of nerve agent sarin (GB), one bottle of Lewisite (L), one bottle of triphosgene (a simulant of phosgene (CG)), one bottle of potassium cyanide (KCN), and one bottle of mustard (H). Each K945 CAITS bottle contains about 0.7 fluid ounce of agent absorbed in plastic pellets. The K945 CAITS also contains three vials of simulants (see figure 8).

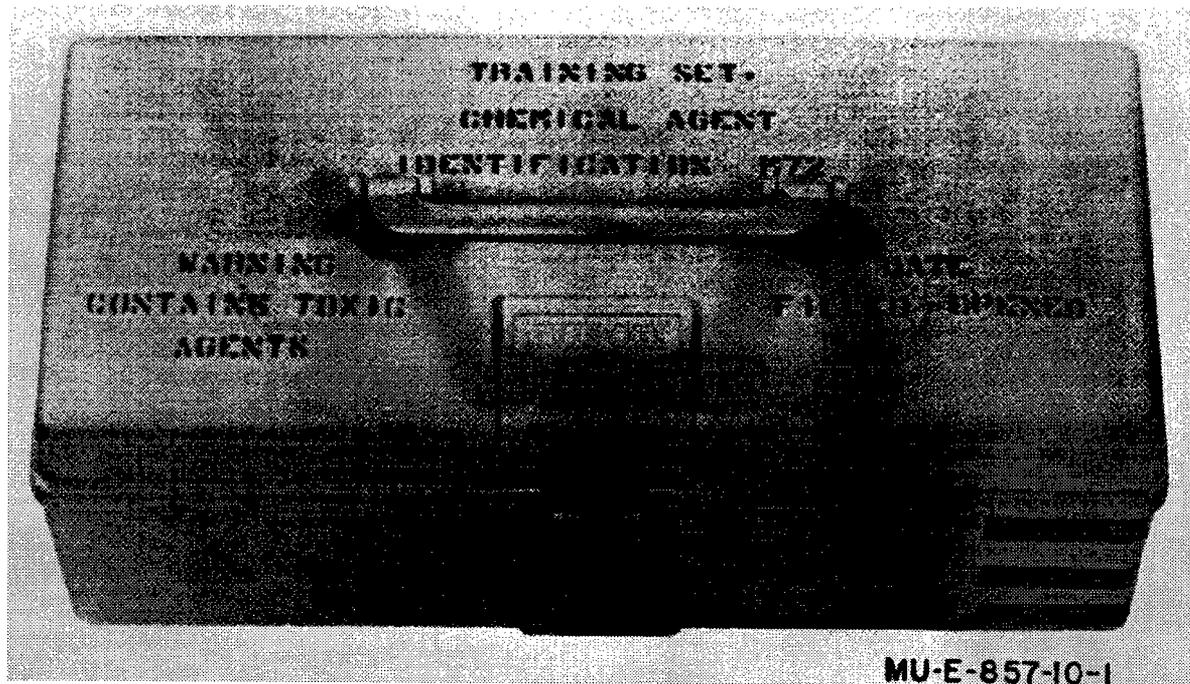
Eight square bottles and three small round bottles are enclosed in a plastic carrying case measuring 12 by 5½ by 4 inches and weighing about three pounds (see figure 9). This case is described as “tackle box” type. The plastic case is sealed in two-layer laminated plastic bags that are packed in a fiberboard box which is in turn packed into a wooden box sealed with metal straps (see figure 3).

These sets are believed to have all been destroyed in disposal operations at Rocky Mountain Arsenal between 1979-82. It is unlikely that any remain. They are physically similar to the M72A1 Simulant Chemical Agent Identification Training Set (SCAITS). The discovery of a set resembling this description should provoke a careful comparison of labels to determine if it is really a K945 CAITS (M72) or a SCAITS (M72A1).



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Figure 8. Components of the CAITS



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Figure 9. Training Set, Chemical Agent Identification: K945, M72 (CAITS), Closed

SET K951/K952

WAR GAS IDENTIFICATION SET, INSTRUCTIONAL M1

SET GAS IDENTIFICATION, DETONATION M1

OLD STOCK NUMBER: FSN 1365-025-3272 (K951)
FSN 1365-025-3783 (K952)

TIME FRAME OF USE: EARLY 1930s TO LATE 1950s

The K951/K952 CAIS contained 48 Pyrex, flame sealed ampules, 12 each containing 1.4 ounce solution of mustard (H, 5 percent in chloroform), Lewisite (L, 5 percent in chloroform), chloropicrin (PS, 50 percent in chloroform), and phosgene (CG) for a total of 26 ounces (0.768 liters) of agent, less the chloroform, per set (see figure 10). The amount of agent and solvent in each ampule is:

Pyrex Ampule	Agent	Chloroform
H	2 ml	38 ml
L	2 ml	38 ml
PS	20 ml	20 ml
CG	40 ml	0 ml

Each ampule is 1 inch in diameter and 7½ inches long. Each ampule is packed in a cardboard screw cap container (mailing tube-type) with agent type indicated by letters on the cardboard container (see figure 11). Twelve cardboard containers each are packaged into 4 press fit metal cans which are 9¼ inches high (see figure 12). The cans are packed into a steel cylinder 6⅝ inches in diameter, approximately 38 inches long, and 0.145 inch thick. The open end of the cylinder is closed by a flanged end cover which is secured by eight bolts (see figure 13).

The only difference between the K951 and K952 is that the K951 was issued with blasting caps that were packed and shipped in a separate container (see figure 14).

The K951 ampules (also called vials) are frequently found in burial sites at old WWII training areas. They are sometimes found loose, sometimes found in their original steel cylinders (also called "pigs") (see figure 13), and are sometimes found in drums, cans, or other disposal containers. When found loose, the agent type cannot be readily identified without sophisticated spectrographic equipment, and a worst case assumption of phosgene should be made by field personnel.

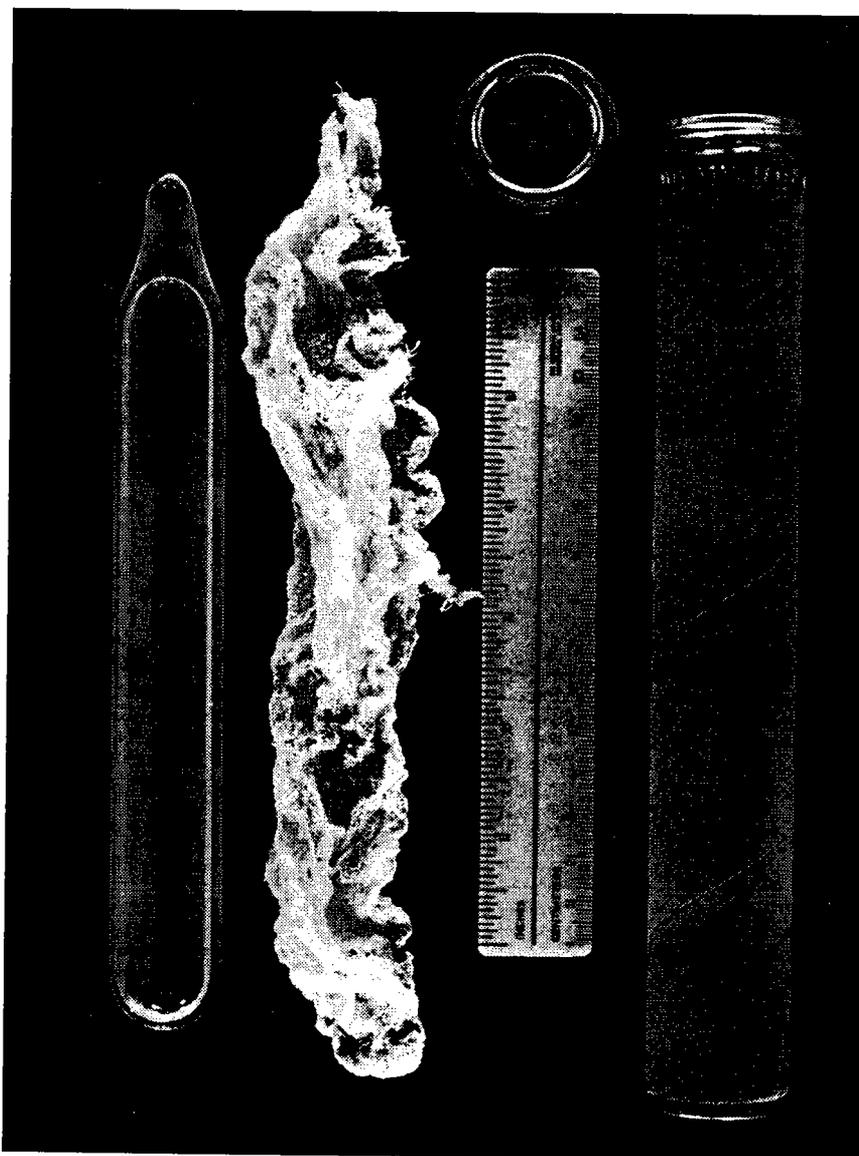
Contains hemetically sealed glass tube
Diameter - 1 in.
Length = 7 1/2 in.

Length = 38 in.
Diameter = 6 5/8 in.
Wall thickness = 0.145 in.



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Figure 10. K951 and K952 War Gas Identification Sets



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Figure 11. K951/952 Ampule, Packing Material, and Cardboard Container



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Figure 12. Multiple-Tube Container, Opened

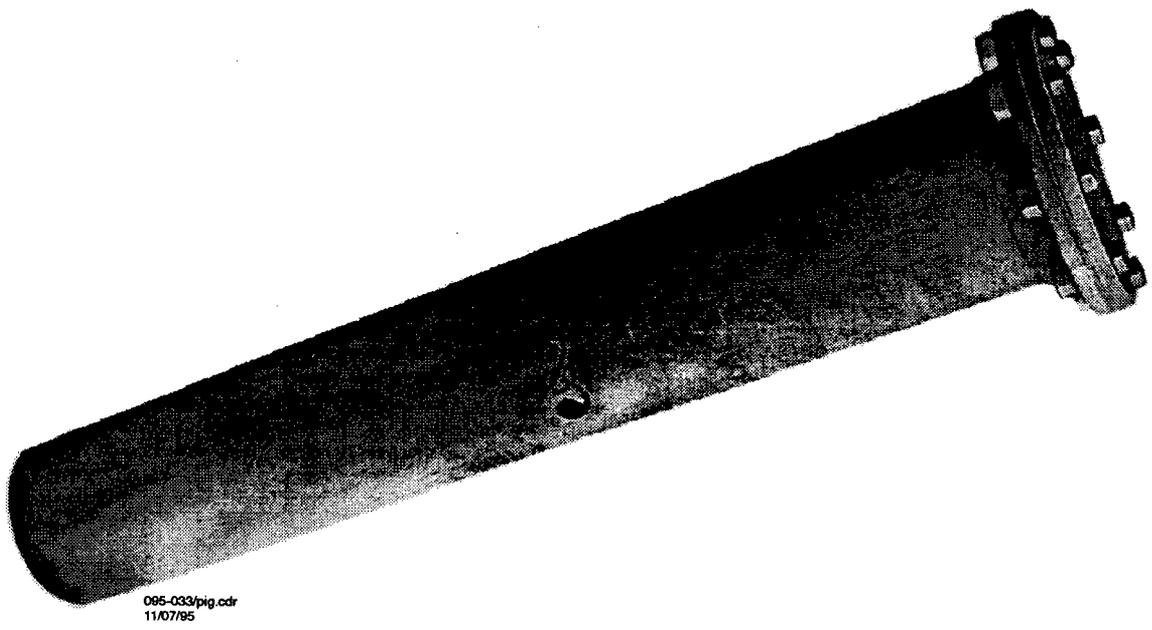
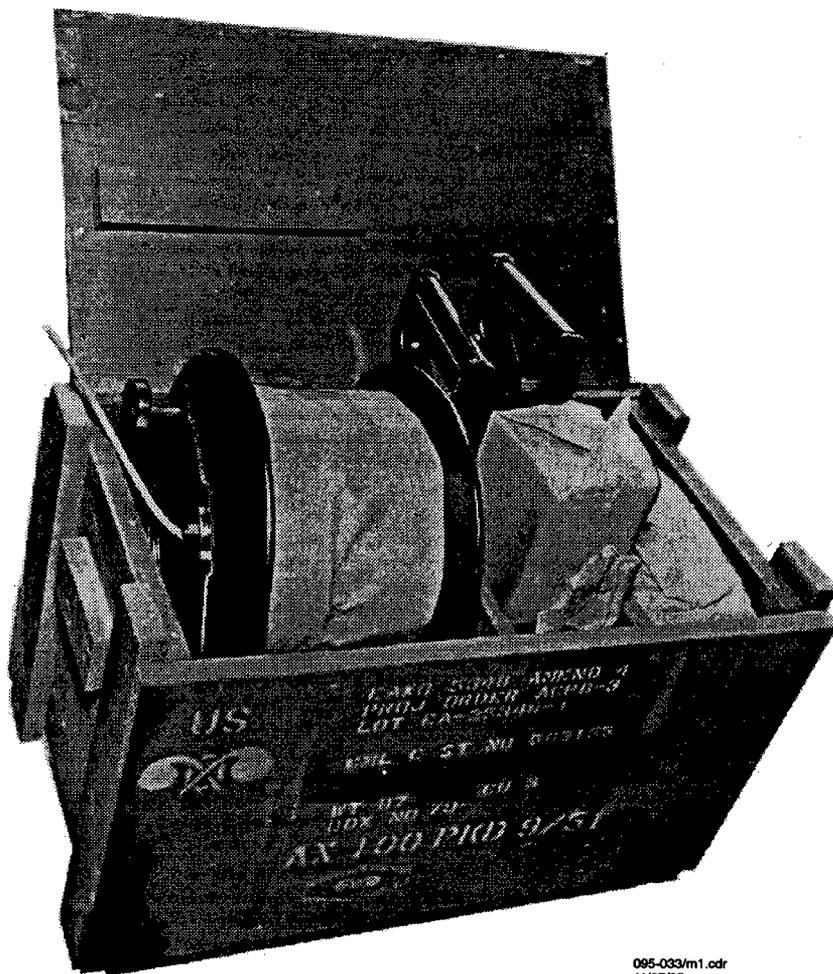


Figure 13. K951/952 Set Closed (Pig)



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Figure 14. M1 War Gas Identification Detonating Set

SET K953/K954

WAR GAS IDENTIFICATION SET, INSTRUCTIONAL, AN-M1A1

SET GAS IDENTIFICATION, DETONATION, AN-M1A1

OLD STOCK NUMBER: FSN 1365-323-7728 (K953)
FSN 1365-323-0735 (K954)

TIME FRAME OF USE: KOREAN CONFLICT ERA

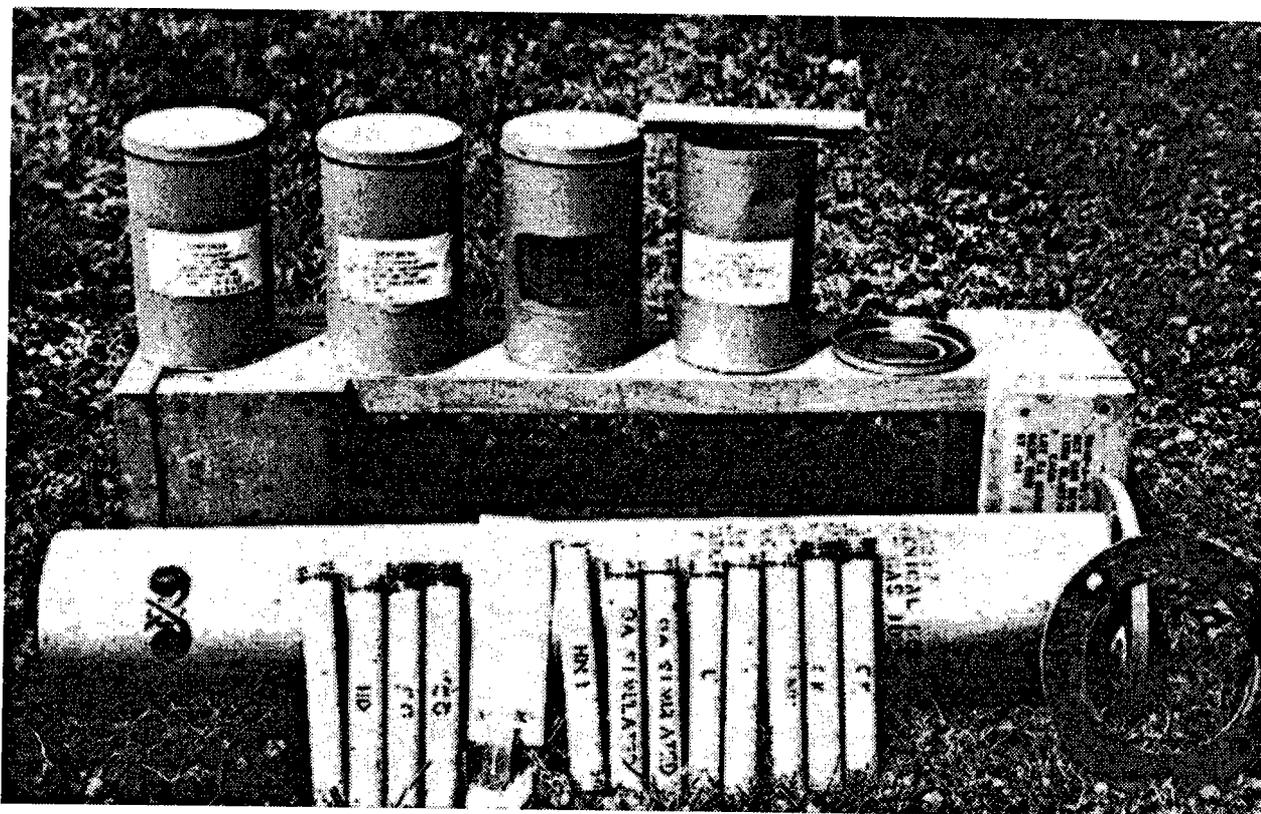
The K953/K954 are identical in configuration to the K951 and K952 except that they contain eight ampules each of phosgene (CG), Lewisite (L, 5 percent in chloroform), distilled mustard (HD, 5 percent in chloroform), cyanogen chloride (CK), nitrogen mustard (HN-1, 10 percent in chloroform) and GA simulant for a total of 23.8 fluid ounces (0.704 liter) of agent, less the chloroform, per set. The amount of agent and solvent in each ampule is:

Pyrex Ampule	Agent	Chloroform
H	2 ml	38 ml
HN	4 ml	36 ml
L	2 ml	38 ml
CG	40 ml	0 ml
CK	40 ml	0 ml
GA-sim	40 ml	0 ml

These sets are packed in containers identical to the K951 and K952 (see figure 15).

The only difference between the K953 and K954 CAIS is that the K953 was issued with the blasting caps (see figure 14). These were not packaged in the steel cylinder, and were in a separate box.

The discovery of loose ampules in a Korean Conflict-era burial should assume that the ampules could contain either a worst case of phosgene or cyanogen chloride. Responding personnel must take these hazards into account.



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Figure 15. War Gas Identification Set, Instructional, Detonation, AN-M1A1

SET K955

SET, GAS IDENTIFICATION, INSTRUCTIONAL, M1 (NAVY SET)

OLD STOCK NUMBER: FSN 1365-368-6154

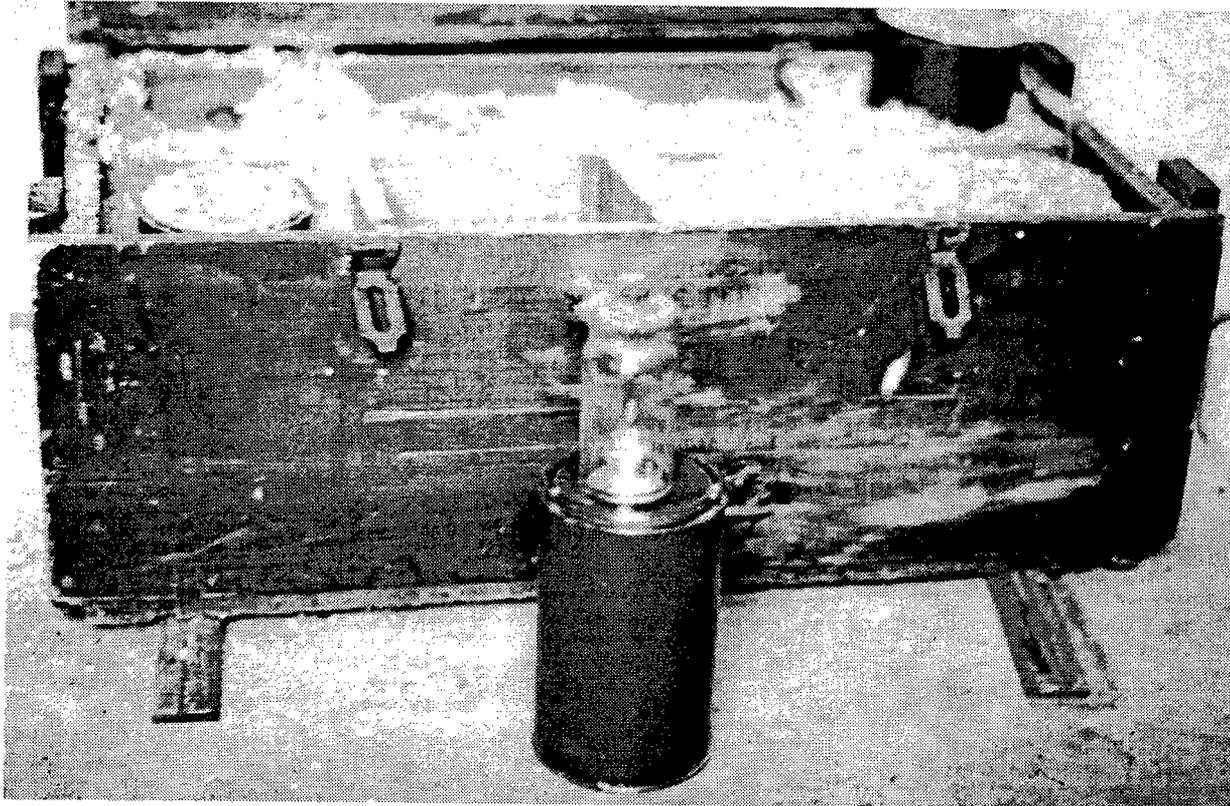
TIME FRAME OF USE: LATE 1930s TO WWII

Each K955 CAIS contains seven glass bottles with a total of 3.5 fluid ounces (0.103 liters) of agent per CAIS of the seven bottles. Four contain 3 ounces (90 cc) of activated charcoal on which agent is absorbed. Of the seven bottles, one bottle contains Lewisite (L or M-1), one bottle contains chloropicrin (PS), and two bottles contain mustard (HS), one contains 6 grams of triphosgene [a simulant for phosgene (CG)], one 15 grams of chloroacetophenone (CN) and one with 15 grams of adamsite (DM) (see figure 16). The amount of agent and charcoal in each bottle is:

Bottle	Agent	Charcoal
HS	25 ml	90 cc
L/M-1	25 ml	90 cc
PS	25 ml	90 cc
CG-sim	6 g	0
CN	15 g	0
DM	15 g	0

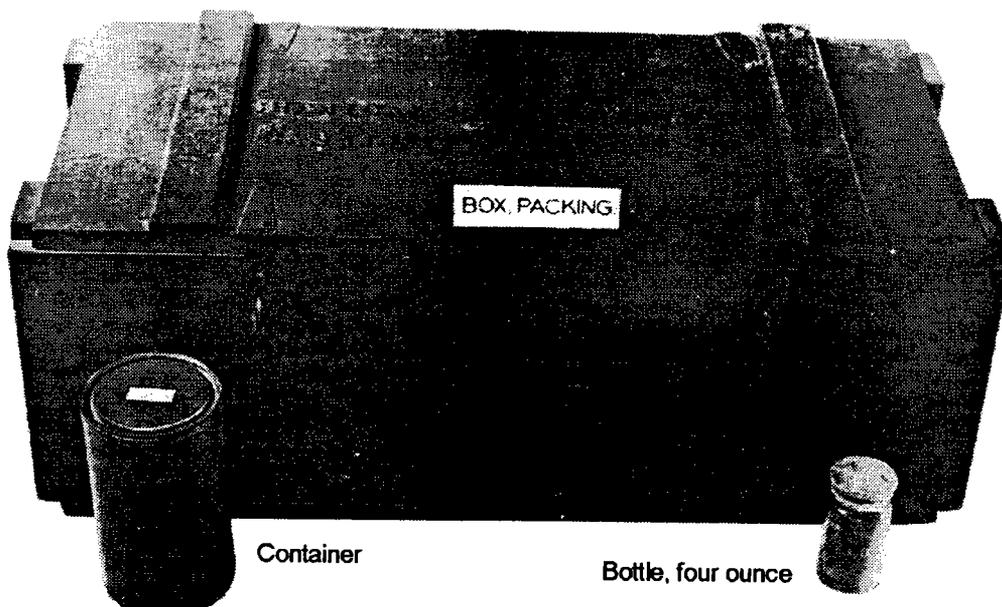
These sets are packed in a hinged covered wood box that resembles a foot locker and measures 30³/₈ inches wide, 15¹/₂ inches long and 11³/₄ inches high. The inside of the box is divided into eight sections. Seven of the sections contain sealed metal cans in sawdust and the eighth has instructions. The cans are 4 inches in diameter and 7 inches high and have a paint can-type lid. Inside each can is one round bottle with a large screw top or glass stopper which is usually wax coated. The bottles are frequently filled with charcoal (see figure 17).

These bottles are frequently found loose in WWII disposal/burial sites. Their contents are easily identified by the letter and number code etched into the side of the glass bottle. Older sets use the code "M-1" for Lewisite (see figure 18), while newer sets use the familiar code "L." Triphosgene is found as CG simulant.



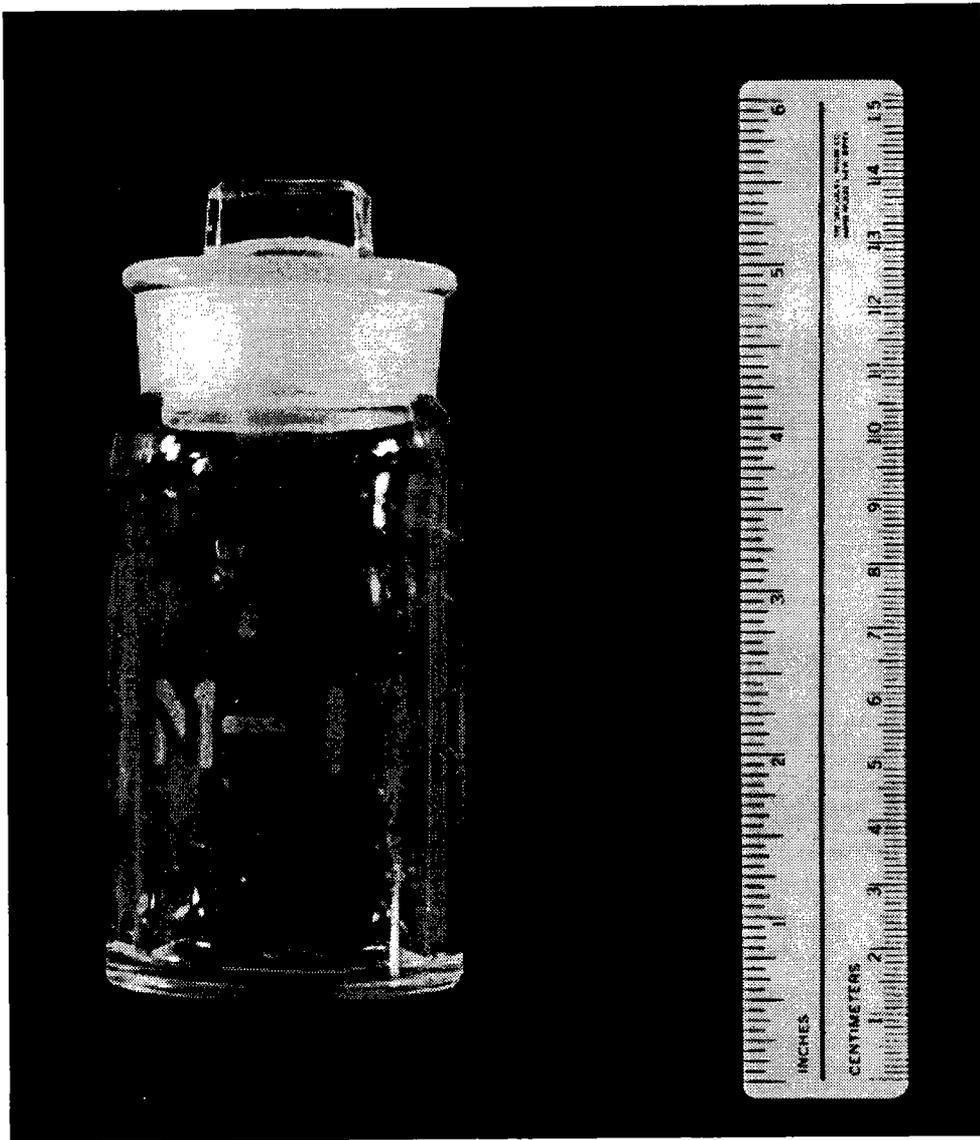
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Figure 16. K955 Gas Identification Set, Instructional, M1 (Navy Set)



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Figure 17. Components of K955 Gas Identification, Instructional, M1 (Navy Set)



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Figure 18. Lewisite (M-1) Bottle

NAVY X SETS

REPLACEMENT SET, GAS IDENTIFICATION, INSTRUCTIONAL, (NAVY)

OLD STOCK NUMBER: FSN: 1365-038-5183 (X302)
FSN: 1365-608-5322 (X545)
FSN: 1365-608-5323 (X546)
FSN: 1365-608-5324 (X547)
FSN: 1365-608-5325 (X548)
FSN: 1365-608-5326 (X549)
FSN: 1365-608-5327 (X550)
FSN: 1365-608-5328 (X551)
FSN: 1365-608-5329 (X552)

TIME FRAME OF USE: WWII TO KOREAN CONFLICT ERA

These include nine different types of replacement CAIS used by the Navy to replace components of the K955 CAIS.

The X302 contains .7 fluid ounces (0.050 liter of agent per set) including one bottle containing 0.9 fluid ounce (0.025 liters) of nitrogen mustard (HN1), and one 0.9 fluid ounces (0.025 liter) bottle of nitrogen mustard (HN3) absorbed in three ounces (90 cc) of activated charcoal.

The sample replacement sets X545 through X552 contain two bottles with either a total of 1.7 fluid ounces (0.05 liter) of liquid agent absorbed in activated charcoal or solid agent as outlined below. The contents of these sets are:

X545	Triphosgene, a simulant for phosgene (CG) - 6 grams per set (no charcoal)
X546	Chloroacetophenone (CN) - 30 grams per set (no charcoal)
X547	Mustard (HS)
X548	Lewisite (L)
X549	Adamsite (DM) - 30 grams per set (no charcoal)
X550	Nitrogen mustard (HN1)
X551	Nitrogen mustard (HN3)
X552	Chloropicrin (PS)

Each of the X-sets is packaged in a wooden box, with a hinged cover, measuring 7½ inches wide, 16 inches long, and 11¾ inches high. The box is divided into two sections. Each contains a 4 by 7-inch can with a paint can-type top packed in sawdust. Each can contains one round bottle with a large screw top or glass stopper which is usually wax coated (see figure 18).

AGENT INFORMATION QUICK REFERENCE

All of the blister agents are persistent. Blister agents cause inflammation, blisters, and general destruction of tissues. They affect the eyes and lungs and blister the skin. They damage the respiratory tract and mucous membranes when inhaled and cause vomiting and diarrhea when absorbed.

Mustard H, HS, or HD (Sulfur Mustards)

Levinstein mustard (H) is the original mustard (gas) or WWI vintage and is, in reality, a dark colored liquid. A WWII era abbreviation of H which was also used was HS (signifying sulfur mustard), as opposed to HN (or nitrogen mustard) which had been stockpiled by Germany. It contains about 30 percent sulfur impurities, which give it a pronounced odor similar to garlic or horseradish. The impurities lessen the effectiveness of H and lower its freezing point 2 to 5°F. Other properties of H are essentially the same as those for distilled mustard, which is discussed in the following paragraph.

Distilled mustard (H) is a purified form of H (about 10 percent sulfur impurities) and is a colorless to amber-colored liquid with a garlic-like odor. The effects of HD are usually delayed 4 to 6 hours, but latent periods have been observed for up to 24 hours. The higher the concentration, the shorter the interval of time from exposure to the first symptoms. Mustard acts first as a cell irritant and finally as a cell poison on all tissue surfaces contacted. Early symptoms include inflammation of the eyes; inflammation of the nose, throat, trachea, bronchi, and lung tissue; and redness of the skin; blistering or ulceration may follow. Effects may include a more "at ease" attitude, vomiting, and fever, beginning about the same time as the skin reddening.

Nitrogen Mustard HN1 or HN3

HN1 is an oily, colorless to pale yellow liquid with a fishy or musty odor. HN3 is any oily liquid with no odor. Many German munitions were filled with this agent during WWII.

HN1/HN3 irritate the eyes in dosages which do not significantly damage the skin or respiratory tract, insofar as single exposures are concerned. Eye irritation appears in a shorter time than that from HD. Mild vapor exposure may not result in skin lesions. After severe vapor or liquid exposure irritation, itching and reddening of the skin may occur. Blisters may form later on the affected areas. Effects on the respiratory tract include irritation of the nose and throat, hoarseness progressing to loss of voice, and persistent cough. Fever, labored respiration, and moist rales (abnormal sounds) may develop. Bronchopneumonia may appear after the first 24 hours. Following ingestion or systemic absorption, the agent causes inhibition of cell division, resulting in depression of the blood forming mechanism and injury to other tissues. Severe diarrhea, which may be accompanied by bleeding, occurs.

Lewisite
L (Arsenical)

The arsenical vesicants are a group of blister agents in which arsenic is the central atom, as opposed to sulfur (H, HS, HD) or nitrogen (HN).

Lewisite is a liquid with an odor similar to geraniums and very little odor when pure. L warns of its presence by irritating the eyes and skin and has a rapid rate of action. Liquid L causes immediate burning sensation in the eyes and permanent loss of sight if not decontaminated within one minute with large amounts of water. It has about the same blistering action on the skin as does mustard (HD), even though the lethal dosage for L is much higher. Skin exposure to L produces an immediate and strong stinging sensation; reddening of the skin starts within 30 minutes. Blistering does not appear until after about 13 hours.

Vomiting agents produce strong, pepperlike irritation in the upper respiratory tract, with irritation of the eyes and tearing. They cause violent, uncontrollable sneezing; cough; nausea; vomiting; and a general feeling of bodily discomfort. They cause pain in the nose and throat, nasal discharge, and possible headache. The vomiting compounds are normally solids that vaporize when heated then condense to form aerosols. They produce their effects by inhalation or by direct action on the eyes.

Adamsite DM

The physical state of DM is a light yellow to green crystalline solid. It has no pronounced odor, but is irritating. DM as a solid forms no appreciable vapor; DM was disseminated as an aerosol for tactical operations.

Symptoms are irritation of the eyes and mucous membranes, viscous discharge from the nose similar to that caused by a cold, sneezing and coughing, severe headache, acute pain and tightness in the chest, nausea, and vomiting. DM has no irritant effect on the skin. The effects of DM for moderate concentrations last about 30 minutes after exposure. At high concentrations the effects may last up to one hour.

Choking agents attack lung tissue, primarily causing pulmonary edema ("dryland drowning" or chemical pneumonia). These chemical agents irritate and inflame tissues from the nose to the lung, causing a choking sensation.

Phosgene CG

Phosgene is a colorless gas with an odor similar to new-mown hay, grass, or green corn.

Phosgene, an industrial chemical, also known as carbonyl chloride, is a volatile gas which produces irritant and inflammatory effects on the eyes, nose, upper airways, and lungs. CG is stored as a liquid in its military container, but rapidly volatilizes into a gas when released. Following the inhalation of high concentrations of phosgene, within 10 minutes to 2 hours later, the individual may experience tearing of the eyes, burning of the nose and upper airways, as well as coughing and chest tightness. Following exposure to as little as 1 to 2 parts per million (ppm), the individual can experience eye irritation and tearing, burning of the nose, coughing, and chest tightness within 10 minutes to 2 hours. The mildness of the early signs and symptoms can be misleading, the individual may later develop severe cough, shortness of breath, and inflammation so severe that the lungs fill up with fluid.

Tear compounds cause a flow of tears and irritation of the skin. some of these compounds are very irritating to the respiratory tract. They sometimes cause nausea and vomiting. Because tear compounds produce only transient effects, they are widely used for training and riot control.

Chloropicrin PS

PS is a pungent, colorless, oily liquid. The odor of PS is described as stinging and pungent.

PS is a powerful irritant whose vapors cause eye, nose and throat irritation, coughing, nausea and vomiting. As an eye irritant, it produces immediate burning, pain, and tearing. Even in very limited concentrations PS causes the eyelids to close. In high concentrations PS damages the lungs, causes pulmonary edema. As a liquid, it causes severe burns on the skin that generally result in blisters and lesions.

Chloroacetophenone CN

The physical state of CN is a solid powder. CN is described as having an odor similar to apple blossoms.

CN identifies the riot control agent popularly known as tear gas. CN quickly irritates the eyes and upper respiratory passages. In higher concentrations it causes copious tearing; a tingling sensation, irritation, burning, and pain of the nose and throat; and burning and itching on tender areas of the skin, especially areas wet by perspiration. High concentrations can cause blisters. The effects are similar to those of a sunburn and disappear in a few hours.

These agents inhibit cholinesterase enzymes when inhaled, ingested, or absorbed. As a result, acetylcholine collects at the action sites. The major effects are:

- *pinpointed pupils, tightness in the chest, nausea, vomiting, and diarrhea; secretions from nose, mouth, and air passages.*
- *muscle stimulation with uncoordinated contractions, followed by fatigue and eventual paralysis.*
- *disturbances in thought, convulsions, coma, and depressions of the brain's vital centers, leading to death.*

Sarin GB

GB is a volatile, rapid acting, lethal nerve agent. It is an odorless and colorless volatile liquid at room temperature. It is an inhibitor of the enzyme acetylcholinesterase (AChE), which is required for the function of many nerves and muscles in every multicellular animal. Normally, AChE prevents the accumulation of acetylcholine after its release in the nervous system. Acetylcholine plays a vital role in stimulation of voluntary muscles and nerve endings of the autonomic nervous system and many structures within the central nervous system. Thus, this type of nerve agent permits acetylcholine to accumulate at those sites, mimicking the effects of a massive release of acetylcholine. The major effects will be on skeletal muscles, parasympathetic end organs, and the central nervous system.

Accidental skin contact with liquid agent or inhalation of agent aerosol or vapor are the most likely causes of exposure. The agent absorption rate is accelerated through cuts and abrasions in the skin.

The number and severity of the symptoms depend on the quantity and route of entry of the nerve agent into the body. The agent is quick acting, and within 15 minutes the exposed person can experience symptoms.

Mild symptoms of nerve agent exposure include:

- Runny nose.
- Pinpointed eye pupils (miosis) and dimness of vision.
- Chest tightness and difficulty breathing.
- Localized muscle twitching.

Symptoms of severe nerve agent poisoning include:

- Nausea and vomiting.
- Cramps.
- Involuntary defecation or urination.
- Coma.
- Cessation of respiration and death.

U.S. ARMY TECHNICAL ESCORT UNIT SITE MONITORING SCHEDULE SENSITIVITIES AND ACTION LEVELS

Contaminant or Hazard	Monitoring Equipment	Lowest Level of Detection	Monitoring Frequency	Action Level (TWA)
Mustard (H, HD, HS)	MINICAMS®	.0006 mg/m ³	Continuous	.003 mg/m ³
	CAM	.01 mg/m ³	As Required	
	M18A2	.5 mg/m ³	As Required	
	ICAD	10 mg/m ³	Continuous	
	DAAMS (TENAX)	Positive indication	Perimeter	
Lewisite (L)	Draeger (Arsine)	.05 ppm	Every 45 minutes	.003 mg/m ³
	CAM	2 mg/m ³	As Required	
	M18A2	10 mg/m ³		
Chloroform (As 95 percent carrier of L)	MINICAMS®	74 ng/15 ppbv	Continuous	10 ppm
	Draeger	2 ppm	Every 45 minutes	49 mg/m ³
	MONITOX	.1 ppm	Continuous	.4 mg/m ³
Phosgene (CG)	Draeger	.02 ppm	Every 45 minutes	.1 ppm
	M18A2	12 mg/m ³	As Required	
	ICAD	12 mg/m ³	Continuous	
	Draeger	.05 ppm	Every 45 minutes	.1 ppm/.67 mg/m ³
Chloropicrin (PS)	Draeger (Arsine)	.05 ppm	Every 45 minutes	.05 ppm/.16 mg/m ³
	DAAMS (TENAX)	Positive Indicator	Daily	.05 ppm/.32 mg/m ³
Dust	Commercial Dust Meter	.01 mg/m ³	Continuous	.01 mg/m ³
Heat Stress	Wet Bulb		Continuous	

Upon attaining action levels, site personnel will don appropriate personal protective equipment.

APPENDIX A

Material Safety Data Sheet (MSDS)

Mustard (HD)



U.S. ARMY EDGEWOOD
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER

REVISED: 30 June 95
DATE: 22 September 1988
HCSDS NO: 20058A

Emergency Telephone #s:
ERDEC Safety Office
410-671-4411 0700-1700
EST After normal duty
hours: 410-278-5201
Ask for ERDEC Staff
Duty Officer

HD, AND THD (See Addendum A)

MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME: Department of the Army

MANUFACTURER'S ADDRESS:

U.S. ARMY CHEMICAL AND BIOLOGICAL DEFENSE COMMAND
EDGEWOOD RESEARCH DEVELOPMENT AND ENGINEERING CENTER
ATTN: SCBRD-ODR-S
ABERDEEN PROVING GROUND, MD 21010-5423

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

CHEMICAL NAME AND SYNONYMS:

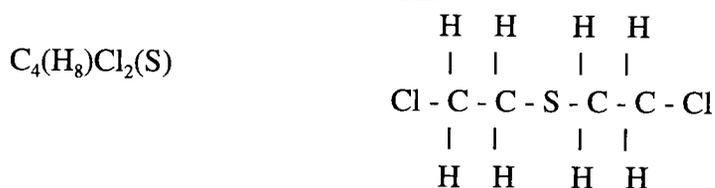
Sulfide, bis (2-chloroethyl)
Bis(beta-chloroethyl)sulfide
Bis(2-chloroethyl)sulfide
1-chloro-2(beta-chloroethylthio)ethane
beta, beta'-dichlorodiethyl sulfide
2,2'dichlorodiethyl sulfide
Di-2-chloroethyl sulfide
beta, beta'-dichloroethyl sulfide
2,2'-dichloroethyl sulfide

TRADE NAME AND SYNONYMS:

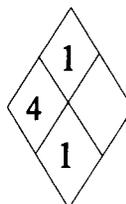
HD	HS	Lost
Senfgas	Iprit	Yellow Cross Liquid
H	Sulphur mustard gas	Mustard Gas
Sulfur mustard	Kampstoff "Lost"	Yperite
S-lost	S-yperite	

CHEMICAL FAMILY: chlorinated sulfur compound

FORMULA/CHEMICAL STRUCTURE:



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



SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
Sulfur Mustard	$C_4(H_8)Cl_2(S)$	100	0.003 mg/m ³ (8 hr-TWA)

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 422 DEG F (217 DEG C)

VAPOR PRESSURE (mm Hg): 0.072 mm Hg @ 20 DEG C (0.11 mm Hg @ 25 DEG C)

VAPOR DENSITY (AIR=1): 5.5

SOLUBILITY IN WATER: Negligible. Soluble in acetone, CH₃(Cl), tetrachloroethane, ethylbenzoate, and ether.

SPECIFIC GRAVITY (H₂O=1): 1.27 @ 20 DEG C

FREEZING POINT: 14.45 DEG C

LIQUID DENSITY (g/cc): 1.268 @ 25 DEG C
1.270 @ 20 DEG C

PERCENTAGE VOLATILE BY VOLUME: 610 mg/m³ @ 20 DEG C
920 mg/m³ @ 25 DEG C

APPEARANCE AND ODOR: Water clear if pure. Normally pale yellow to black. Slight garlic type odor. The odor threshold for HD is 0.0006 mg/m³.

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT (METHOD USED): 105 DEG C (ignited by large explosive charges)

FLAMMABILITY LIMITS (% by volume): Unknown

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

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 (without TAP clothing) during chemical agent firefighting 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 vice firefighting, they will wear appropriate levels of protective clothing (see Section 8).

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, however, 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
- IC_{t50} (skin) = 2000 mg-min/m³ at 70 - 80 DEG F (humid environment)
= 1000 mg-min/m³ at 90 DEG F (dry environment)
- IC_{t50} (eyes) = 200 mg-min/m³
- IC_{t50} (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.

LOCALLY, HD affects both the eyes and the skin. SKIN damage occurs after percutaneous resorption. Being lipid soluble, HD can be resorbed 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 occur 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 dose of HD can produce injury to bone marrow, lymph nodes, and spleen as indicated by a drop in WBC count and, therefore, results 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 to HD can cause sensitization, chronic lung impairment, (cough, shortness of breath, chest pain), and cancer of the mouth, throat, respiratory tract, skin, and leukemia. It may also cause birth defects.

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. Speed in decontaminating the eyes is absolutely essential. Remove person from the liquid source, flush the eyes immediately with water 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 and gloves; remove victim from agent source immediately. Flush skin and clothes with 5 percent solution of sodium hypochlorite or liquid household bleach within one minute. Cut and remove contaminated clothing, flush contaminated skin area again with 5 percent sodium hypochlorite solution, then wash contaminated skin area with soap and water. If shower facilities are available, wash thoroughly and transfer to medical facility. If the skin becomes contaminated with a thickened agent, blot/wipe the material off immediately with an absorbent pad/paper towel prior to using decontaminating solution.

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 DEG C to 177 DEG 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: Conditions to avoid. Rapidly corrosive to brass @ 65 DEG C. Will corrode steel at a rate of .0001 in. of steel per month @ 65 DEG C.

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

HAZARDOUS POLYMERIZATION: Will 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 8) will be allowed in an area where mustard is spilled.

RECOMMENDED FIELD PROCEDURES:

The mustard should be contained using vermiculite, diatomaceous earth, clay or fine sand and neutralized as soon as possible using copious amounts of 5.25 percent Sodium Hypochlorite solution.

Scoop up all material and place in an approved DOT container. Cover the contents of the drum with decontaminating solution as above. The exterior of the drum shall be decontaminated and then labeled IAW EPA and DOT regulations. All leaking containers shall be overpacked with vermiculite placed between the interior and exterior containers. Decontaminate and label IAW EPA and DOT regulations. Dispose of the material IAW waste disposal methods provided below. Dispose of the material used to decontaminate exterior of drum IAW Federal, state and local regulations. Conduct general area monitoring with an approved monitor (see Section 8) to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (see Sections 2 and 8).

If 5.25 percent 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 Solution No. 2 (DS2), and Super Tropical Bleach Slurry (STB). **WARNING:** Pure, undiluted Calcium Hypochlorite (HTH) will burn on contact with liquid blister agent.

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 shall 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 Iodide and swirl to dissolve. Add 3 ml of 50 wt percent Sulfuric Acid: water and swirl. IMMEDIATE Iodine color indicates the presence of active chlorine. If negative, add additional 5.25 percent 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 percent 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 place in approved DOT containers. Cover the contents of the drum with decontaminating solution as above. The exterior of the drum shall be decontaminated and then labeled IAW EPA and DOT regulations. All leaking containers shall be overpacked with vermiculite placed between the interior and exterior containers. Decontaminate and label IAW EPA and DOT regulations. Dispose of the material IAW waste disposal methods provided below. Dispose of the material used to decontaminate exterior of drum IAW Federal, state and local regulations. Conduct general area monitoring with an approved monitor (see Section 8) to confirm that the atmospheric concentrations do not exceed the airborne exposure limits (see Section 8).

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

WASTE DISPOSAL METHOD: All decontaminated material should be collected, contained and chemically decontaminated or thermally decomposed in an EPA approved incinerator, 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 (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. Decontamination of waste or excess material shall be accomplished in accordance with the procedures outlined above with the following exception:

---- HD on laboratory glassware may be oxidized by its vigorous reaction with concentrated nitric acid.

Open pit burning or burying of HD or items containing or contaminated with HD in any quantity is prohibited.

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

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

Concentration mg/m ³ -----	Respiratory Protection/Ensemble Required -----
Less than or equal to 0.003	A full facepiece, chemical canister, air-purifying protective mask will be onhand for escape. (The M9-, M17-, and M40-series masks are acceptable for this purpose. Other masks certified as equivalent may be used.)
Greater than 0.003	NIOSH/MSHA approved pressure demand full facepiece 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 shall meet local, state and federal regulations.

Special. Chemical laboratory hoods shall have an average inward face velocity of 100 linear feet per minute (lfpm) plus or minus 10% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods shall have an inward face velocity of 150 lfpm plus or minus 20 percent. Laboratory hoods shall be located such that cross drafts do not exceed 20% of the inward face velocity. A visual performance test utilizing smoke producing devices shall 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 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, gloveset).

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

OTHER PROTECTIVE EQUIPMENT: For general lab work, gloves and lab coat shall be worn with M9 or M17 mask readily available.

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

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 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:

During handling, the "buddy" (two-man) system will be used. Containers should be periodically inspected for leaks, either visually or using a detector kit, and prior to transferring the containers from storage to work areas. Stringent control over all personnel handling HD must be exercised. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Each worker will wash their hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap before leaving at the end of the work day. No smoking, eating, or drinking is permitted at the work site. Decontaminating equipment shall be conveniently located. Exits must be designed to permit rapid evacuation. 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 shall be double-contained in liquid-tight containers when in storage.

OTHER PRECAUTIONS: 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 Mustard Agents H, HD, and HT".

SECTION X - TRANSPORTATION DATA

FORBIDDEN FOR TRANSPORT OTHER THAN VIA MILITARY (TECHNICAL ESCORT UNIT)

TRANSPORT AS PER 49 CFR 172

PROPER SHIPPING NAME: Poisonous liquids, n.o.s.(Sulfide, bis2-chloroethyl)

DOT HAZARD CLASS: 6.1 Packing Group I Hazard Zone B

DOT LABEL: Poison

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

DOT PLACARD: POISON

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

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. 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 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 Edgewood 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.

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 centistokes @ 25 DEG 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 HV occur, follow the same procedures as those for HD, but dissolve the THD in acetone prior to 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. The 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 or HD and then rinse-decontaminated may evolve sufficient mustard 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.

TRANSPORTATION DATA: Same as HD.

APPENDIX B

Material Safety Data Sheet (MSDS)

Nitrogen Mustard (HN1)

REVISED: 12 January 90



U.S. ARMY EDGEWOOD
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER

Emergency Telephone #:
ERDEC Safety Office
410-671-4411 0700-1700
EST After normal duty
hours: 410-278-5201
Ask for ERDEC Staff
Duty Officer

MATERIAL SAFETY DATA SHEET

HN1

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME: Department of the Army

MANUFACTURER'S ADDRESS:

U.S. ARMY CHEMICAL AND BIOLOGICAL DEFENSE COMMAND
EDGEWOOD RESEARCH DEVELOPMENT AND ENGINEERING CENTER
ATTN: SCBRD-ODR-S
ABERDEEN PROVING GROUND, MD 21010-5423

CAS REGISTRY NUMBER: 538-07-8

CHEMICAL NAME AND SYNONYMS:

2,2'-Dichlorotriethylamine
Ethylbis(beta-chlorethyl)amine
Bis-(2-chloroethyl)ethylamine
Ethylbis(2-chloroethyl)amine
2-Chloro-N-(2-chloroethyl)-N-ethylethanamine

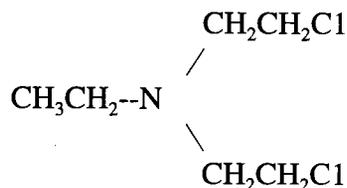
TRADE NAME AND SYNONYMS:

Ethyl-S TL329
HN1 TL1149
TL 329

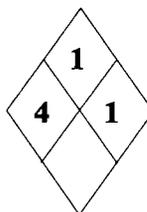
NITROGEN MUSTARD/HN1

CHEMICAL FAMILY: Chloroamino hydrocarbon

FORMULA/CHEMICAL STRUCTURE:



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



SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
Nitrogen Mustard 1	(C ₁ CH ₂ CH ₂) ₂ NC ₂ H ₅	100	None established/ available

SECTION III - PHYSICAL DATA

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

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

VAPOR DENSITY (AIR=1): 5.9

SOLUBILITY IN WATER: Very slightly soluble in water. Freely soluble in acetone and other organic solvents.

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

FREEZING POINT: 34 DEG C

LIQUID DENSITY (g/cc): 1.09 @ 25 DEG C

PERCENTAGE VOLATILE BY VOLUME:

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

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

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT (METHOD USED): No immediate danger of fire or explosion; flash point is high enough not to interfere with military use of the agent.

FLAMMABILITY LIMITS (% by volume): Data not available

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

SPECIAL FIRE FIGHTING PROCEDURES: Full protective clothing (see section VIII) and full respiratory protection must be worn when fighting fire 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 LIMIT (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 doses of HD in man are:

LCt₅₀ (inhalation) = 1500 mg-min/m³

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

ICt₅₀ (eye contact) = 200 mg-min/m³

ICt₅₀ (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 avg. diameter)

ACUTE PHYSIOLOGICAL ACTION OF HN1 IS CLASSIFIED AS 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 HN1 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 rales 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.

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

SECTION VI - REACTIVITY DATA

STABILITY: Polymerizes slowly

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 IF 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 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 decontaminant in a test tube. Add several crystals of potassium iodide and swirl to dissolve. Add 3ml 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 or 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:

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

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 APG 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

RESPIRATORY PROTECTION:

Concentration
mg/m³

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

Respiratory Protection/Ensemble Required

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 included 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 be 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 area and other areas through the 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 gloveset).

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, a daily clean smock, foot covers, and head covers are required.

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 using 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. Each worker will wash their hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap before leaving at the end of the work day. No smoking, eating, or drinking is permitted at the work site. Decontaminating 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 liquids, n.o.s.

DOT HAZARD CLASS: Poison A

DOT LABEL: Poison Gas

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

DOT PLACARD: POISON GAS

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

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)

While the Edgewood 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 Edgewood 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.

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 JToxicological Protective
Gloves	Gloves-Norton-Toxicological Protective

APPENDIX C

Material Safety Data Sheet (MSDS)

Nitrogen Mustard (HN3)

REVISED: 13 April 1989



ALDRICH CHEMICAL
COMPANY
414-273-3850

Emergency Telephone #s:
ERDEC Safety Office
410-671-4411 0700-1700
EST After normal duty
hours: 410-278-5201
Ask for ERDEC Staff
Duty Officer

Nitrogen Mustard/HN3

MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME: Aldrich Chemical Co.

MANUFACTURER'S ADDRESS:

Aldrich Chemical Co.
P.O. Box 355
Milwaukee, WI 53201

CAS REGISTRY NUMBER: 817-09-4

CHEMICAL NAME AND SYNONYMS:

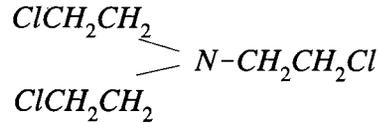
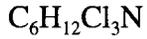
Tris (2-chloroethyl) amine hydrochloride
HN3 Hydrochloride
Lekamin
Sinalost
Trichlormethine
Trichlorotriethylamine Hydrochloride
Trichlormethinium Chloride
Monohydrochloride

TRADE NAME AND SYNONYMS:

Nitrogen Mustard HN3

BIOLOGICAL TYPE COMPOUND: Lethal Agent

FORMULA/CHEMICAL STRUCTURE:



SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
Nitrogen Mustard	$C_6H_{12}Cl_3N$	96 to 99%	

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 256 DEG C (calculated); decomposes at 150 DEG C

VAPOR PRESSURE (mm Hg): 0.011 mm Hg @ 25 DEG C (0.11 mm Hg @ 25 DEG C)

VAPOR DENSITY (AIR=1): 7.1

SOLUBILITY IN WATER: (g/100 g solvent):

- a. Water (distilled): 0.008 g/100 g solvent
- b. Other: Soluble in ether, benzene, and most organic solvents
- c. Best Solvent: Organic solvents

FREEZING POINT: -3.7 DEG C

LIQUID DENSITY (g/ml): 1.24 @ 25 DEG C

PERCENTAGE VOLATILE BY VOLUME: 120 mg/m³ @ 25 DEG C

APPEARANCE AND ODOR: Dark to bright yellow liquid

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT (METHOD USED): High enough not to interfere with military use of the agent.

EXTINGUISHING MEDIA: Water spray, carbon dioxide, dry chemical powder, alcohol or polymer foam.

SPECIAL FIRE FIGHTING PROCEDURES: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. When responding to a fire alarm in buildings or areas containing agents, fire-fighting personnel should wear full firefighter protective clothing (without TAP clothing) during chemical agent firefighting and fire rescue operations to prevent contact with skin and eyes.

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.

SECTION V - HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE: HN3 is a vesicant, and similar to HD, produces eye injury, damage to the respiratory tract and, after absorption into the body, produces cytotoxic actions in a variety of tissues. The hematopoietic and lymphoid tissues are especially sensitive. These cytotoxic effects follow absorption through the intact skin, respiratory or gastrointestinal tracts.

Median doses of HN3 in man are:

LD₅₀ (skin) = 0.7 g/70 kg man

IC₅₀ (skin) = 2500 mg-min/m³

IC₅₀ (eyes) = 200 mg-min/m³

IC₅₀ (inhalation) = no data

ACUTE PHYSIOLOGICAL ACTION OF HN3 IS CLASSIFIED AS LOCAL AND SYSTEMIC.

LOCALLY, HN3 affects both the eyes and the skin. SKIN lesions occur after severe vapor exposure. There may be irritation and itching as with mustard. Later, blisters may appear in the erythematous areas.

In the EYES, mild or moderate exposure causes slight smarting and lacrimation within 20 minutes. Mild exposure produces erythema and edema of the palpebral and bulbar conjunctivae and

superficial, steamy haziness of the cornea. After more severe exposure, symptoms begin immediately and progress for 24 hours or longer. Also, the corneal epithelium may exfoliate. Slit lamp examinations will reveal clouding and edema of the corneal substance extending deep below the Bowman's membrane. Local necrosis of the cornea may rupture the globe.

SYSTEMIC ACTIONS occur primarily through inhalation and ingestion. Effects on the **RESPIRATORY TRACT** are the same as those caused by mustard. Symptoms include delay in appearance, irritation of the nose and throat, hoarseness progressing to aphonia, and a persistent cough. Bronchopneumonia may appear after the first 24 hours. Mild tracheitis may result in a persistent cough. Late deaths due to pneumonia may occur. Following oral administration or systemic absorption, the nitrogen mustards injure the intestinal tract. Lesions are most marked in the small intestine and consist of degenerative changes and necrosis in the mucosa. The ingestion of 2 to 6 milligrams causes nausea and vomiting.

CHRONIC EXPOSURE to HN3 can cause scarring of the cornea and discoloration and atrophy of the iris. Repeated skin burns may lead to hypersensitivity of the skin, manifested in the same manner as sensitivity to HD.

EMERGENCY AND FIRST AID PROCEDURES: (Same as for HD)

INHALATION. Remove from the source **IMMEDIATELY** to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, administer oxygen. Seek medical attention **IMMEDIATELY**.

EYE CONTACT. Speed in decontaminating the eyes is absolutely essential. Remove person from the liquid source, flush the eyes immediately with copious amounts of water for 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 and gloves; remove victim from agent source immediately. Flush skin and clothes with copious amounts of water for at least 15 minutes while removing contaminated clothing and shoes. If shower facilities are available, wash thoroughly and transfer to medical facility. If the skin becomes contaminated with a thickened agent, blot/wipe the material off immediately with an absorbent pad/paper towel prior to using decontaminating solution.

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

SECTION VI - REACTIVITY DATA

STABILITY: Is persistent in soil and on surfaces (i.e., wood, metal, rubber, paint). Does not completely hydrolyze by water after standing for days.

INCOMPATIBILITY: Incompatible with strong oxidizing agents and strong bases.

HAZARDOUS DECOMPOSITION: toxic fumes of carbon monoxide, carbon dioxide, nitrogen oxides, and hydrogen chloride gas.

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 8) will be allowed in an area where mustard is spilled. All personnel shall wear self-contained breathing apparatus, rubber boots, and heavy rubber gloves. The agent should be swept up, placed in a bag, and held for waste disposal. Avoid raising dust. Ventilate the area and wash the spill site after material pickup is complete.

WASTE DISPOSAL METHOD: Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an after burner and scrubber.

SECTION VIII - SPECIAL PROTECTION INFORMATION

PROTECTIVE GLOVES: MANDATORY. Heavy rubber gloves

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

OTHER PROTECTIVE EQUIPMENT: For general lab work, rubber gloves rubber boots, and lab coat shall be worn with M9 or M17 mask readily available.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:

During handling, the "buddy" (two-man) system will be used. Wear appropriate NIOSH/MSHA approved respirator, chemical resistant gloves, safety goggles, and other protective clothing. There should be access to a safety shower and eye bath, and HN3 should only be used in a chemical fume hood. Do not breathe dust, and do not get the agent in eyes, on skin, or on clothing. Avoid prolonged or repeated exposure. Wash thoroughly after handling. Keep containers tightly closed, and store in a cool dry place.

MONITORING: can be detected by D8-3 test, Spotted Disk (SD) test, Dragendorff test.

SECTION X - TRANSPORTATION DATA

FORBIDDEN FOR TRANSPORT OTHER THAN VIA MILITARY (TECHNICAL ESCORT UNIT)

TRANSPORT AS PER 49 CFR 172

DOT HAZARD CLASS: Poison A

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

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. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. Aldrich shall not be held liable for any damage resulting from handling or form contact with the above product. See reverse side of invoice or packing slip for additional terms and condition of sale.

APPENDIX D

Material Safety Data Sheet (MSDS)

Lewsite (L)

REVISED: 30 June 95

DATE: 16 April 1988



U.S. ARMY EDGEWOOD
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER

Emergency Telephone #s:
ERDEC Safety Office
410-671-4411 0700-1700
EST After normal duty
hours: 410-278-5201
Ask for ERDEC Staff
Duty Officer

MATERIAL SAFETY DATA SHEET

LEWISITE

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME: Edgewood Research, Development and Engineering Center

MANUFACTURER'S ADDRESS:

U.S. ARMY CHEMICAL AND BIOLOGICAL DEFENSE COMMAND
EDGEWOOD RESEARCH, DEVELOPMENT & ENGINEERING CENTER
ATTN: SCBRD-ODR-S
ABERDEEN PROVING GROUND, MD 21010-5423

CAS REGISTRY NUMBER: 541-25-3

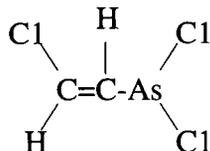
CHEMICAL NAME AND SYNONYMS:

Arsine, (2-chlorovinyl) dichloro-
Arsonous dichloride, (2-chloroethenyl)-
Chlorovinylarsine dichloride
2-Chlorovinyl dichloroarsine
beta-Chlorovinyl dichloroarsine
Dichloro (2-chlorovinyl) arsine

TRADE NAME AND SYNONYMS: Lewisite, L, EA 1034

CHEMICAL FAMILY: Arsenical (vesicant)

FORMULA/CHEMICAL STRUCTURE:



NFPA 702 SIGNAL: Health - 4
 Flammability - 1
 Reactivity - 1

 SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
Lewisite	$C_2H_2AsCl_3$	100	* 0.003 mg/m ³

* This is a ceiling value

 SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 374 (190)

VAPOR PRESSURE (mm Hg): 0.35 @ 25 DEG C
 0.22 @ 20 DEG C

VAPOR DENSITY (AIR=1): 7.2

SOLUBILITY: Negligible in water, completely soluble in Et₂O, CHCl₃, all common organic solvents, mustard, oils, and alcohol.

SPECIFIC GRAVITY (H₂O=1): 1.88 @ 25 DEG C

VOLATILITY (mg/m³): 3.9 x (10)³ @ 25 DEG C
2.5 x (10)³ @ 20 DEG C

MOLECULAR WEIGHT: 207.32

APPEARANCE AND ODOR: Pure L is a colorless oily liquid. "War gas" is an amber to dark brown liquid; characteristic odor is usually geranium-like; very little odor when pure.

SECTION IV- FIRE AND EXPLOSION DATA

FLASHPOINT (Method Used): Does not flash

FLAMMABILITY LIMITS: N/A.

EXTINGUISHING MEDIA: N/A.

SPECIAL FIRE FIGHTING PROCEDURES: Fires involving L should be contained to prevent contamination of uncontrolled areas. All persons not engaged in extinguishing the fire should be evacuated immediately. Contact with L or its vapors can be fatal. When responding to a fire alarm in building or areas containing agents, firefighting personnel should wear full firefighter protective clothing during chemical agent firefighting 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 vice firefighting, they will wear appropriate levels of protective clothing (see Section 8).

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 work week 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 any time. The ceiling value for Lewisite is based upon the present technologically feasible detection limit 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, HT, and L". 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). It also 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, and absorbed in tissues, a systemic poison. When inhaled in high concentrations, it 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 include ocular, percutaneous, and inhalation.

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 TOXICOLOGICAL DATA:

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 RTECS) or 38 mg/kg (CRDEC chemical agent data sheets)

LD₅₀ (skin, rabbit) = 6 mg/kg

LD₅₀ (subcutaneous, rabbit) = 2 mg/kg

LD₅₀ (intravenous, rabbit) = 500 mg/kg

LD₅₀ (skin, guineapig) = 12 mg/kg

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

LD₅₀ (skin, domestic farm animals) = 15 mg/kg

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

LCt₅₀ (vapor skin, rat) = 20,000 mg min m (25 min)

LCD₅₀ (skin, rat) = 15 - 24 mg/kg

LD₅₀ (ip, dog) = 2 mg/kg

EDmin (skin, dog) = 50 mg/m³ (30 min)

EDmin (eye, dog) = 20 mg/m³ (30 min)

EDmin (skin, rabbit) = 25 mg/m³ (30 min)

EDmin (eye, rabbit) = 1 mg/m³ (30 min)

a. Acute Exposure:

(1) 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, otherwise more permanent injury or blindness is possible within 1 minute of exposure.

(2) 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 which diminished after 2-3 days. Skin burns are much deeper than with HD. Tender and moist skin (mucous membrane, perspiration covered;...) absorb more L and are therefore more sensitive than the skin. This, however, is counteracted by L's hydrolysis by moisture, producing less vesicant and a higher vapor pressure product.

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

(4) Systemic Effects. L on the skin, as well as in inhaled vapor, are absorbed and may cause systemic poisoning. A manifestation of this is a change in capillary permeability, which permits loss of sufficient fluid from the bloodstream to cause hemoconcentration, shock and death. In non-fatal 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 causes pulmonary edema, diarrhea, restlessness weakness, subnormal temperature, and low blood pressure in animals.

b. Chronic Exposure. L can cause sensitization and chronic lung impairment. Also, by comparison to agent mustard and arsenical compounds, it can be considered as a suspected human carcinogen.

EMERGENCY AND FIRST AID PROCEDURES: Always don your own protective mask and gloves before administering first aid.

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: Speed in decontaminating the eyes is absolutely essential. Remove person from the liquid source, flush the eyes immediately with water for 10-15 minutes by tilting the head to the side, pulling eyelids apart with 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. See medical attention IMMEDIATELY.

SKIN CONTACT: Remove victim from source immediately and remove contaminated clothing. Immediately decon affected areas by flushing with 10 percent sodium carbonate solution. After 3-4 minutes, wash off with soap and water to protect against erythema. Seek medical attention immediately.

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

SECTION VI - REACTIVITY DATA

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

HAZARDOUS DECOMPOSITION PRODUCTS:

Stability: 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 ($\text{Na}_3 \text{ASO}_4$). Therefore, decontaminated solution would contain toxic arsenic.

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 area where L is spilled (see Section 8).

RECOMMENDED FIELD PROCEDURES: The L 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 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 contaminated material and place in approved DOT containers. Cover with additional decontaminant. Decontaminate the outside of the container, label IAW DOT and EPA requirements, and dispose of as specified below. Conduct general area monitoring to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (see Sections 2 and 8).

RECOMMENDED LABORATORY PROCEDURES: A 10 wt percent alcoholic Sodium Hydroxide solution is prepared by adding 100 grams of denatured ethanol to 900 grams of 10 wt percent NaOH in water. A minimum of 200 grams of decon is required for each gram of L. The decon/agent solution is agitated for a minimum of one (1) hour. At the end of one 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 percent 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.

It is permitted to substitute 5.25 percent sodium hypochlorite for the 10 percent 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 8).

WASTE DISPOSAL METHOD:

All neutralized material should be collected and contained for disposal IAW land ban RCRA regulations or thermally decomposed in an EPA permitted incinerator equipped with a scrubber which will scrub out the chlorides and be equipped with an electrostatic precipitator or other filter device to remove arsenic. Collect all the arsenic dust from the electrostatic precipitator or other filter device and containerize and label IAW DOT and EPA regulations. The arsenic will be disposed of IAW land ban RCRA regulations. Any contaminated materials or protective clothing should be decontaminated using alcoholic caustic, carbonate, 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 states define decontaminated surety material as a RCRA hazardous waste.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

Concentration (mg/m ³)	Respiratory Protection/Ensemble Required
-----	-----
Less than or equal to 0.003	A full facepiece, chemical canister, air-purifying, protective mask shall be on hand for escape (the M9, M17 and M40 series protective masks are acceptable for this use).
Greater than 0.003 or unknown	A NIOSH/MSHA-approved, full facepiece SCBA suitable for use in high agent concentrations with protective ensemble. (See DA Pam 385-61)

* This represents the ceiling value determined by continuous real time monitoring (with alarm) at the 0.003 mg/m³ level of detection.

VENTILATION: Local exhaust - Mandatory, must be filtered or scrubbed to limit exit concentration to non-detectable level. Air emissions shall meet local, state and federal regulations.

Special: Chemical laboratory hoods shall have an average inward face velocity of 100 linear feet per minute (1fpm) + 10% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods shall have an inward face velocity of 150 1fpm plus or minus 20 percent. Laboratory hoods shall be located such that cross drafts do not exceed 20 % 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 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 semi-annually or after modification or maintenance operations. Operations should be performed 20 cm inside hoods. Procedures should be developed for disposal of contaminated filters.

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

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

OTHER PROTECTIVE EQUIPMENT: For laboratory operations, gloves and lab coat will be worn with M9, M17, or M40 mask readily available.

MONITORING: Available monitoring equipment for agent L is the M18A2 (yellow band), bubblers (arsenic and GC method), and M256 & A1 Kits.

Real-time, low-level monitors (with alarm) are required for L operations. In their absence, an 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:

During handling, the “buddy” (two man) system will be used. Containers should be periodically inspected for leaks, either visually or using a detector kit. Stringent control over all personnel handling L must be exercised. Chemical showers, eye wash stations, and personal cleanliness facilities must be provided; wash hands before meals and each worker will shower thoroughly with special attention given to hair, face, neck, and hands, using plenty of soap before leaving at the end of the workday. The storage or consumption of food or beverages; the storage or application of cosmetics; the smoking or storage of smoking materials, tobacco products or other products for chewing; or the chewing of such product in all laboratory areas, is prohibited. Laboratory glasswear will not be used to prepare or consume food or beverages. Decontaminating equipment shall be conveniently located. Exits must be designed to permit rapid evacuation. 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 shall be double contained in liquid tight containers when in storage or during transportation.

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 H, HD, HT, and L”.

SECTION X - TRANSPORTATION DATA

PROPER SHIPPING NAME: Poisonous liquids, n.o.s. (Chlorovinylarsine dichloride)

DOT HAZARD CLASSIFICATION: 6.1, Packing Group I

DOT LABEL: Poison

DOT MARKING: Poisonous liquids, n.o.s. (Chlorovinylarsine dichloride) UN 2810

DOT PLACARD: Poison

EMERGENCY ACCIDENT PRECAUTIONS & PROCEDURES: See Sections IV and VIII.

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. 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 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 Edgewood 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.

APPENDIX E

Material Safety Data Sheet (MSDS)

Chloropicrin (PS)

REVISED: 12 December 90



OCCUPATIONAL
HEALTH SERVICES, INC.

Emergency Telephone #s:
818-366-2000

CHLOROPICRIN

MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME:

OCCUPATIONAL HEALTH SERVICES, INC.

MANUFACTURER'S ADDRESS:

OCCUPATIONAL HEALTH SERVICES, INC.

11 WEST 42ND STREET, 12TH FLOOR

NEW YORK, NY 10036

800-445-MSDS OR 212-789-3535

CAS REGISTRY NUMBER: 76-06-2

CHEMICAL NAME AND SYNONYMS:

Trichloronitromethane

Nitrochloroform

Chloropicrin

Nitrotrichloromethane

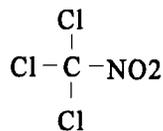
TRADE NAME AND SYNONYMS:

Chloropicrin

PS

CHEMICAL FAMILY: Nitro (Aliphatic halogen compound)

FORMULA/CHEMICAL STRUCTURE:



NFPA 704 SIGNAL: Health - 4
 Flammability - 0
 Reactivity - 3

SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
Chloropicrin	CCl_3NO_2	100	0.7 mg/m ³ (8hr-TWA)

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 234 DEG F (112 DEG C)

VAPOR PRESSURE (mm Hg): 20 mm Hg @ 20 DEG C

VAPOR DENSITY (AIR=1): 5.7

SOLUBILITY IN WATER (g/100 g water): 0.18 @ 20 DEG C. Soluble in organic solvents, lipids, organophosphorus compounds, mustards, phosgene, diphosgene, and Cl₂

SPECIFIC GRAVITY (H₂O=1): 1.7 @ 25 DEG C

FREEZING POINT: -83 DEG F (-64 DEG C)

LIQUID DENSITY (g/cc): 1.66

PERCENTAGE VOLATILE BY VOLUME: 165,000 mg/m³ @ 20 DEG C

APPEARANCE AND ODOR: Colorless, oily liquid with a sharp, penetrating odor that causes tears.

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT (METHOD USED): Negligible fire hazard when exposed to heat or flame.

EXTINGUISHING MEDIA: Dry chemical, carbon dioxide, water spray or regular foam. For larger fires, use water spray, fog or regular foam.

SPECIAL FIRE FIGHTING PROCEDURES: Wear chemical protective suit with self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. Move container from fire area if you can do so without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

WARNING: Extinguish with agents suitable for type of surrounding fire. Use flooding amounts of water and fog, avoid breathing poisonous vapors; keep upwind. Consider evacuation of downwind area if material is leaking.

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMIT (AEL): 0.7 mg/m³

EFFECTS OF OVEREXPOSURE:

Short-term exposure: Chloropicrin causes eye irritation and tearing. It also causes cough, nausea, and vomiting, and severe irritation of the skin. Breathing chloropicrin vapors may also cause delayed severe breathing difficulties and which may cause death. Additional effects may include bluish color of skin, lips and fingernails.

Long-term exposure: Overexposure to chloropicrin may cause increased susceptibility to future overexposure. In addition to effects from short term exposure, redness and swelling of the skin and eyes and heart and lung damage may occur.

Median doses of PS in man are:

LCt50 = 2,000 mg-min/m³

LOCALLY, PS affects both the eyes and the skin. The liquid irritates and burns the skin and causes severe burns of the eyes. Concentrations of 0.3 to 0.37 ppm result in painful eye irritation in 3 to 30 seconds. Short contacts with the skin can cause second and third degree burns.

SYSTEMIC ACTIONS occur primarily through inhalation and ingestion. Inhalation causes nausea, eye watering, vomiting, bronchitis, and pulmonary edema (the result of a lethal exposure of 119 ppm for 30 minutes). Ingestion causes severe irritation of mouth and stomach.

CHRONIC EXPOSURE to PS can result in increased susceptibility to future overexposure.

EMERGENCY AND FIRST AID PROCEDURES:

Get medical attention following all exposures to this compound

INHALATION. If a person breathes in large amounts of chloropicrin, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Maintain airway and blood pressure and administer oxygen if available. Keep the affected person warm and at rest. Treat symptomatically and supportively. Get medical attention as soon as possible.

EYE CONTACT. If liquid chloropicrin or high concentrations of chloropicrin vapor get into the eyes, wash eyes immediately with copious quantities of water for at least 15 minutes, lifting the lower and upper lids occasionally. Continue irrigating with normal saline until the pH has returned to normal (30-60 minutes). Cover with sterile bandages. If irritation persists after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

SKIN CONTACT. If liquid chloropicrin gets on the skin, immediately wash the skin using soap or mild detergent and large amounts of water until no evidence of chemical remains (15-20 minutes). If liquid chloropicrin soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. In case of chemical burns, cover area with sterile, dry dressing, bandage securely, but not too tightly. If irritation persists after washing, get medical attention.

INGESTION. Remove by gastric lavage or emesis using activated charcoal. Gastric lavage or emesis should not be performed on an unconscious person. Treatment should be administered by qualified medical personnel. Get medical attention immediately.

SECTION VI - REACTIVITY DATA

STABILITY: Unstable liquid that decomposes under the influence of light. High temperatures or severe shock (particularly in containers larger than 30 gallons) also contribute to instability.

INCOMPATIBILITY: Contact with strong oxidizers may cause fires or explosions.

Aniline: violent reaction

Bromo-2-propyne: explosive, shock and heat sensitive

Sodium Hydroxide: reacts violently

Sodium Methoxide: below 50 DEG C, nitro compound will accumulate and cause a violent and dangerous exothermic reaction

Strong Oxidizers: possible violent reaction

HAZARDOUS DECOMPOSITION: Toxic gases and vapors (oxides of nitrogen, phosgene, nitrosyl chloride, chlorine, and carbon monoxide) may be released when chloropicrin decomposes. Decomposition occurs at temperatures above 400 DEG C.

HAZARDOUS POLYMERIZATION: Has not been reported to occur under normal temperatures and pressures.

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Do not touch spilled material. Stop leak if you can do so without risk. Use water spray to reduce vapors. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For small dry spills, place material into clean dry containers with clean shovel and cover. Move containers from spill area. For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry. Ventilate closed spaces before entering.

WASTE DISPOSAL METHOD: Chloropicrin may be disposed of by absorbing in vermiculite, dry sand, earth, or a similar material and disposing in sealed containers in a secured sanitary landfill.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

Concentration ppm -----	Respiratory Protection/Ensemble Required -----
2.5 ppm or less	Any supplied air respirator operated in a continuous flow mode. Any powered air surviving respirator with organic vapor cartridge(s).
2.5 to 4 ppm	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge. A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 4 ppm or entry & escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure demand or other positive pressure mode.

VENTILATION:

Local Exhaust. Provide local exhaust or process enclosure ventilation to meet published exposure limits.

PROTECTIVE GLOVES: MANDATORY. Rubber

EYE PROTECTION: Employee must wear splash-proof or dust-resistant safety goggles and a faceshield to prevent contact with this substance.

OTHER PROTECTIVE EQUIPMENT: Impervious clothing should be worn, as well as any other appropriate protective clothing necessary to prevent any possibility of skin contact with liquid chloropicrin.

MONITORING: Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:

Observe all federal, state and local regulations when storing or disposing of this substance. For assistance, contact the district director of the environmental protection agency.

Protect against physical damage. Outside or detached storage is preferred. Inside storage should be in a well-ventilated area. Where there is any possibility that employees' eyes may be exposed to liquid chloropicrin, an eye-wash fountain should be provided within the immediate work area for emergency use. Where there is any possibility of exposure of an employee's body to liquid PS, facilities for quick drenching of the body should be provided within the immediate work area for emergency use. Eating and smoking should not be permitted in areas where liquid chloropicrin is handled, processed, or stored. Employees who handle liquid chloropicrin should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

SECTION X - TRANSPORTATION DATA

FORBIDDEN FOR TRANSPORT OTHER THAN VIA MILITARY (TECHNICAL ESCORT UNIT)

TRANSPORT AS PER 49 CFR 172

PROPER SHIPPING NAME: Chloropicrin UN 1580

DOT HAZARD CLASS: 6.1-Poisonous Materials Packing Group I

DOT LABEL: Poison

APPENDIX F

Material Safety Data Sheet (MSDS)

Adamsite (DM)

REVISED: 12 December 1990

Emergency Telephone #s:
ERDEC Safety Office
410-671-4411 0700-1700
EST After normal duty
hours: 410-278-5201
Ask for ERDEC Staff
Duty Officer

MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

CAS REGISTRY NUMBER: 578-94-9

CHEMICAL NAME AND SYNONYMS:

10-chloro-5,10-dihydrophenarsazine
Diphenylaminochloroarsine
phenarsazine chloride

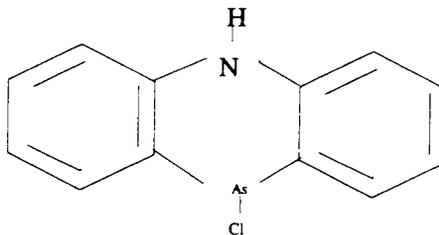
TRADE NAME AND SYNONYMS:

Adamsite
DM

BIOLOGICAL TYPE COMPOUND: Incapacitating Sternutator

FORMULA/CHEMICAL
STRUCTURE:

$C_{12}H_{9}AsClN$



SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
Adamsite	$C_{12}H_9ClN$	95-99	

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 770 DEG F (410 DEG C)

VAPOR PRESSURE (mm Hg): 2×10^{-13} @ 20 DEG C

VAPOR DENSITY (AIR=1): 9.6 (does not vaporize at ordinary temperatures)

SOLUBILITY: (g/100 g solvent)

Water (distilled) = 0.0064 at room temperature

tetrachlorethane - 1.16 @ 17 DEG C

chlorobenzene = 1.06 @ 16 DEG C

benzene = 2.3 @ 15 DEG C

acetone = 13.03 @ 15 DEG C (best solvent)

FREEZING POINT: 195 DEG C

LIQUID DENSITY (g/cc): not applicable

PERCENTAGE VOLATILE BY VOLUME: not of practical significance.

APPEARANCE AND ODOR: Light yellow to green crystals. No pronounced odor; irritates nasal passages similar to pepper.

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT (Method Used): Does not flash

SECTION V - HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE: DM produces strong pepper-like local inflammation of the upper respiratory tract, the nasal accessory sinuses, with irritation of the eyes and lacrimation. It causes violent uncontrollable sneezing, coughing, nausea, vomiting, and a general feeling of malaise.

Median doses of DM in man are:

$LCt_{50} = 11,000 \text{ mg min/m}^3$
 $ICt_{50} = 22 \text{ to } 150 \text{ mg min/m}^3$
 $= 37 \text{ mg min/m}^3$ (nausea and vomiting)

The lowest concentrations (sprayed from alcoholic solutions) that are irritating to the throat and lower respiratory tract are 0.38 and 0.5 mg/m^3 , respectively. The lowest concentration causing cough is 0.75 mg/m^3 .

Locally, DM irritates the eyes and skin, but is relatively non-toxic. Irritation of the eyes and lacrimation are produced. By far the most disturbing result of prolonged exposure to DM is dermatitis which appears in a quarter of the workers so exposed. Mild symptoms, caused by exposure to very low concentrations, resemble those of a severe cold. The onset of symptoms may be delayed for several minutes after initial exposure.

Individual variations in tolerance are very large and undoubtedly play a part in the development of dermatitis.

The effect of concentration of DM. Dermatitis may develop in workers exposed to only a very light concentration. Heavy concentrations certainly play a part in the precipitation of frank dermatitis in certain workers.

Effect of moisture and heat. These factors probably increase the sensitivity of the skin and certainly precipitate dermatitis.

Incubation period. Almost every case of dermatitis began three weeks after the beginning of exposure.

Avoidance of DM after dermatitis developed did not result in improvement in the severe cases. In a very mild early case, avoidance of DM was sometimes followed by remission.

Effect of prolonged exposure. Many subjects continue to work with a severe dermatitis. In some of these the dermatitis improved despite continued exposure. In most of the cases the dermatitis persisted.

SYSTEMIC ACTIONS occur primarily through inhalation. DM produces a feeling of pain and a sense of fullness in the nose and sinuses, accompanied by a severe headache, intense burning in the throat, and tightness and pain in the chest. Irritation of the eyes and lacrimation are produced. Coughing is uncontrollable, sneezing violent and persistent. Nasal secretion is greatly increased, and quantities of ropy saliva flow from the mouth. Nausea and vomiting are prominent. Mental depression may occur during progression of symptoms.

CHRONIC EXPOSURE TO DM can cause chronic hoarseness, burned skin, and hyperpigmentation of the skin. The vital capacity of the lungs may also be reduced.

EMERGENCY AND FIRST AID PROCEDURES: Put on mask and wear it in spite of coughing, sneezing, salivation, and nausea. Lift the mask from the face briefly if necessary to permit vomiting or to drain saliva from the face piece. Carry on duties as vigorously as possible; this will help to lessen and shorten the symptoms. Combat duties usually can be performed in spite of the effects of sternutators.

SECTION VI - REACTIVITY DATA

STABILITY: Stable in steel when pure. After 3 months, causes extensive corrosion of aluminum, anodized aluminum, and stainless steel. Will corrode iron, bronze, and brass when moist.

INCOMPATIBILITY: (Corrosive Properties)

Titanium	71 deg C	6 months	appeared good
Stainless Steel	43 deg C	30 days	slight discoloration
Common Steel	43 deg C	30 days	covered with rust
Aluminum Anodized	43 deg C	30 days	minor corrosion & pitting
Aluminum	43 deg C	30 days	severe corrosion

HYDROLYSIS PRODUCTS: $[\text{NH}(\text{C}_6\text{H}_4)_2\text{As}]_2\text{O}$ (poisonous if taken internally)
HCl

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

No data available.

SECTION VIII - SPECIAL PROTECTION INFORMATION

EYE PROTECTION: Protective mask

MONITORING: For vapor or solid, adamsite can be detected with an M19 Kit of DPT Test.

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 using a detector kit, and prior to transferring the containers from storage to work area. Stringent control over all personnel handling L must be exercised. Chemical showers, eye wash stations, and personal cleanliness facilities must be provided; wash hands before meals and each worker will shower thoroughly with special attention given to hair, face, neck, and hands, using plenty of soap before leaving at the end of the workday. The storage or consumption of food or beverages; the storage or application of cosmetics; the smoking or storage of smoking materials, tobacco products or other products for chewing; or the chewing of such product in all laboratory areas, is prohibited. Laboratory glasswear will not be used to prepare or consume food or beverages. Decontaminating equipment shall be conveniently located. Exits must be designed to permit rapid evacuation. 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 shall be double contained in liquid tight containers when in storage or during transportation.

TYPES OF CONTAINERS REQUIRED FOR STORAGE: Heresite, Teflon (unaffected, 3 month) and Kynar (at 71 deg F).

SECTION X - TRANSPORTATION DATA

FORBIDDEN FOR TRANSPORT OTHER THAN VIA MILITARY (TECHNICAL ESCORT UNIT)

TRANSPORT AS PER 49 CFR 172

DOT HAZARD CLASS: Irritating Material

DOT LABEL: Irritating Material

APPENDIX G

Material Safety Data Sheet (MSDS)

Phosgene (CG)

REVISED: January 1993

SIGMA-ALDRICH CORPORATION
1001 WEST SAINT PAUL AVE.
MILWAUKEE, WI 53233

Emergency Telephone #s:
ERDEC Safety Office
410-671-4411 0700-1700
EST After normal duty
hours: 410-278-5201
Ask for ERDEC Staff
Duty Officer

MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME: Sigma-Aldrich Corporation

MANUFACTURER'S ADDRESS:
SIGMA-ALDRICH CORPORATION
1001 WEST SAINT PAUL AVE
MILWAUKEE, WI 53233

CAS REGISTRY NUMBER: 75-44-5

CHEMICAL NAME AND SYNONYMS:

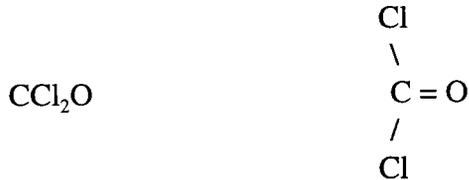
Carbon dichloride oxide
Carbone (Oxychlorure DE) (French)
Carbonic Chloride
Carbonio (Ossicloruro DI) or Fosgene (Italian)
Carbon Oxychloride
Carbonylchloride or Phosgen (German)
Carbonyl Chloride
Carbonyl Chloride (DOT, OSHA)
Carbonyl Dichloride
Chloroformyl Chloride
Fosgeen or Koolstofoxychloride (Dutch)
Fosgen (Polish)

TRADE NAME AND SYNONYMS:

Phosgene
CG

BIOLOGICAL TYPE COMPOUND: Lethal Agent

FORMULA/CHEMICAL STRUCTURE:



SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
CG	CCl ₂ O	99+	0.8 mg/m ³ (8 hr-TWA)

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 45.7 DEG F (7.6 DEG C)

VAPOR PRESSURE (mm Hg): 1180 mm Hg @ 20 DEG C (1400 mm Hg @ 25 DEG C)

VAPOR DENSITY (AIR=1): 3.4

SOLUBILITY IN WATER: (g/100 g solvent @ 25 DEG C)

- a. Water (distilled): very slight, with decomposition
- b. Other: very soluble with almost all organic solvents, i.e., benzene, toluene. Unstable in some.
- c. Best solvent: organic solvents

FREEZING POINT: 128 DEG C

LIQUID DENSITY (g/cc): 1.370 @ 20 DEG C

PERCENTAGE VOLATILE BY VOLUME: 4.3 x 10⁶ mg/m³ @ 7.6 DEG C
2.2 x 10⁶ mg/m³ @ -10 DEG C
5.28 x 10⁵ mg/m³ @ -40 DEG C

APPEARANCE AND ODOR: Colorless gas at room temperature. Odor of new-mown hay, grass, or green corn.

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT (METHOD USED): Does not flash

EXTINGUISHING MEDIA: Use water spray or fog nozzle to keep cylinder cool. Move cylinder away from fire if there is not risk.

SPECIAL FIRE FIGHTING PROCEDURES: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Protective clothing and a self-contained breathing apparatus should be worn to prevent contact with skin and eyes.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS: Contents under pressure. Container explosion may occur under fire conditions. Toxic fumes are emitted under fire conditions.

DANGER: POISONOUS AND CORROSIVE NONFLAMMABLE LIQUID AND GAS UNDER PRESSURE.

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMIT (AEL): The AEL for CG is 0.8 mg/m³.

EFFECTS OF OVEREXPOSURE: CG is a burning agent that is extremely destructive to the tissue of the mucous membranes and upper respiratory tract, eyes and skin. Inhalation may be fatal as a result of spasm, inflammation and edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema. Symptoms of exposure may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting.

Median doses of CG in man are:

ICt₅₀ = 1600 mg-min/m³ at 70 - 80 DEG F (humid environment)

LCt₅₀ = 3200 mg-min/m³ (Ct does not significantly change with time since the effects are cumulative)

Locally, CG causes mild irritation to the eyes

SYSTEMIC ACTIONS occur primarily through inhalation. Phosgene is a lung irritant. The characteristic feature of phosgene poisoning is massive pulmonary edema. The edema results from the passage of fluid into the alveoli from capillaries whose permeability has been affected by the corrosive action of the compound. Hemoconcentration results from loss of plasma into the alveoli. The edema interferes with the interchange of oxygen and carbon dioxide and the capillary blood. As the edema progresses, discomfort, apprehension, and dyspnea increase, and frothy, often blood-tinged sputum is raised. Rales and rhonchi are audible in the chest. Death results from anoxemia and may occur in less than 5 hours.

During and immediately after exposure, symptoms include coughing, choking, a feeling of tightness in the chest, nausea, and occasionally headache and lacrimation. Some patients with severe cough fail to develop serious lung injury, while others with no signs of early respiratory tract irritation incur fatal pulmonary edema. Following the above discomfort, there may be a delay in which the patient has few symptoms, not even abnormal chest signs.

CHRONIC EXPOSURE: Five industrial workers who had been chronically exposed to low concentrations of CG exhibited disturbances in lung function. All of the patients developed the following signs and symptoms over a period of several months with varying degrees of severity: cough, shortness of breath on exertion, and pain or tightness in the chest. Two of the patients also expectorated small amounts of glairy, mucoid sputum. Residual pulmonary deficit may be expected from chronic exposure to CG.

EMERGENCY AND FIRST AID PROCEDURES:

INHALATION. The protective mask should be put on immediately upon detection of the odor of phosgene (like green corn or grass), irritation of the eyes, or change in the taste of a cigarette (smoking may become tasteless or offensive in taste). The individual should hold his breath while masking.

If some phosgene has been inhaled, normal combat duties should be continued unless there is difficulty in breathing, nausea, and vomiting, or more than the usual shortness of breath on exertion.

If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

EYE CONTACT. Immediately flush eyes 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.

SKIN CONTACT. Immediately flush skin with copious amounts of water for at least 15 minutes while removing contaminated clothing and shoes. Discard contaminated clothing and shoes.

INGESTION. Wash out mouth with water, provided the person is conscious. Call a physician immediately.

SECTION VI - REACTIVITY DATA

STABILITY: Stable in steel containers if CG is dry. Decomposition temperature is 800 DEG C. No action on metals when CG is dry; acidic and corrosive when moist.

INCOMPATIBILITY: Rapid hydrolysis to hydrochloric acid and carbon dioxide under acidic conditions. Under basic conditions, hydrolysis products are sodium chloride and sodium carbonate. Rain destroys effectiveness. Heavy vegetation, jungle, and forests cause considerable loss by hydrolysis on leafy surfaces. Incompatible materials include water, amines, ammonia, alcohols, sodium, and potassium.

HAZARDOUS DECOMPOSITION: Toxic fumes of carbon monoxide, carbon dioxide, and hydrogen chloride gas.

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Evacuate the area and keep personnel upwind. Wear full protective equipment such as a butyl rubber chemical-proof air suit, with breathing air supplied. If no risk exists, then shut off leak. Ventilate area and wash spill site after material pickup is complete.

RECOMMENDED FIELD PROCEDURES: Caution: no-return cylinder. Do not reuse. Empty cylinders will contain hazardous residue. Follow proper disposal techniques, and observe all federal, state, and local laws.

SECTION VIII - SPECIAL PROTECTION INFORMATION

VENTILATION: Use only in a chemical fume hood. NIOSH/MSHA-Approved respirator in nonventilated areas and/or for exposure above the ACGIH TLV.

PROTECTIVE GLOVES: MANDATORY. Rubber gloves

EYE PROTECTION: Chemical safety goggles

MONITORING: Can be detected using M18A2 and M19 Kits, and M8 Alarm

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:

Phosgene is a compressed gas; cylinder temperature should not exceed 125 DEG F (52 DEG C). It should be used with equipment rated for cylinder pressure of compatible construction material. Be sure that the cylinder is properly secured when in use or stored.

SECTION X - TRANSPORTATION DATA

FORBIDDEN FOR TRANSPORT OTHER THAN VIA MILITARY (TECHNICAL ESCORT UNIT)

TRANSPORT AS PER 49 CFR 172

DOT HAZARD CLASS: Poison A

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.

APPENDIX H

Material Safety Data Sheet (MSDS)

Chloroacetophenone (CN)

REVISED: September 1978

Emergency Telephone #s:
ERDEC Safety Office
410-671-4411 0700-1700
EST After normal duty
hours: 410-278-5201
Ask for ERDEC Staff
Duty Officer

MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

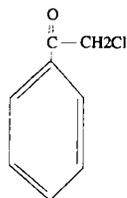
CHEMICAL NAME AND SYNONYMS:

Phenyacyl chloride
alpha-Chloroacetophenone
Chloromethyl phenyl ketone
Phenyl chloromethyl ketone

TRADE NAME AND SYNONYMS:

Chloroacetophenone
CN

FORMULA/CHEMICAL
STRUCTURE:



SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
Chloroacetophenone	$C_6H_5COCH_2Cl$		0.3 mg/m ³ (8 hr-TWA)

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 477 DEG F (247 DEG C)

VAPOR PRESSURE (mm Hg): 0.012 mm Hg @ 20 DEG C

VAPOR DENSITY (AIR=1): 5.2

SOLUBILITY IN WATER: Insoluble

SPECIFIC GRAVITY (H₂O=1): 1.32

FREEZING POINT: 138 DEG F (59 DEG C)

APPEARANCE AND ODOR: Colorless to gray solid with a sharp, irritating odor.

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT (METHOD USED): 244 DEG F (118 DEG C)

FLAMMABILITY LIMITS (% by volume): Not applicable

EXTINGUISHING MEDIA: Carbon Dioxide or dry chemical

SPECIAL FIRE FIGHTING PROCEDURES: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. Fires involving CN 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 (without TAP clothing) during chemical agent firefighting 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 vice firefighting, they will wear appropriate levels of protective clothing (see Section 8).

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMIT (AEL): The AEL for CN is 0.3 mg/m³, according to OSHA.

EFFECTS OF OVEREXPOSURE: alpha-Chloroacetophenone can cause irritation of the eyes and skin upon contact and irritation of the lungs if it is inhaled. It can also cause difficulty if it is swallowed.

alpha-Chloroacetophenone vapors may cause a tingling or runny nose, burning and/or pain of the eyes, blurred vision, and tears. Burning in the chest, difficult breathing, and nausea may occur. Skin irritation, rash, or burns may occur.

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to alpha-chloroacetophenone.

EMERGENCY AND FIRST AID PROCEDURES:

INHALATION. If a person breathes in large amounts of alpha-chloroacetophenone, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

EYE CONTACT. If alpha-chloroacetophenone gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

SKIN CONTACT. If alpha-chloroacetophenone gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If alpha-chloroacetophenone soaks

through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. When there are chemical burns or evidence of skin irritation, get medical attention.

INGESTION. When alpha-chloroacetophenone has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

SECTION VI - REACTIVITY DATA

STABILITY: Heat contributes to instability

INCOMPATIBILITY: Incompatible to water or steam

HAZARDOUS DECOMPOSITION: Toxic and corrosive vapors are produced when combined with steam or water

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

If alpha-chloroacetophenone is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. For small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device

WASTE DISPOSAL METHOD: alpha-Chloroacetophenone may be disposed of:

1. By making packages of alpha-chloroacetophenone in paper or other flammable material and burning in a suitable combustion chamber equipped with an appropriate combustion chamber equipped with an appropriate effluent gas cleaning device.
2. By dissolving alpha-chloroacetophenone in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

Concentration mg/m³

Respiratory Protection/Ensemble Required

Less than or equal to 15

A chemical cartridge respirator with a full facepiece and an organic vapor cartridge and high efficiency particulate filter.

A gas mask with a chin-style or a front- or back-mounted organic vapor canister with a high efficiency particulate filter.

Any supplied air respirator with a full facepiece, helmet, or hood.

Any self-contained breathing apparatus with a full facepiece.

Less than 100

Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.

Greater than 100

Self-contained breathing apparatus with a full facepiece operated in pressure demand or other positive pressure mode.

A combination respirator which includes a the type mentioned for exposure less than 100.

VENTILATION:

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

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

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 semi-annually or after modification or maintenance operations. Operations should be performed 20 cm inside hoods.

PROTECTIVE GLOVES: MANDATORY.

EYE PROTECTION: Eight-inch face shields

OTHER PROTECTIVE EQUIPMENT: For general lab work, gloves and lab coat shall be worn to prevent any possibility of skin contact with solid alpha-chloroacetophenone or liquids containing alpha-chloroacetophenone.

MONITORING: Analytical method is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 5, 1979, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00349-1)

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 using a detector kit, and prior to transferring the containers from storage to work areas. Stringent control over all personnel handling CN must be exercised. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Each worker will wash their hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap before leaving at the end of the work day. No smoking, eating, or drinking is permitted at the work site. Decontaminating equipment shall be conveniently located. Exits must be designed to permit rapid evacuation. CN 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

FORBIDDEN FOR TRANSPORT OTHER THAN VIA MILITARY (TECHNICAL ESCORT UNIT)

TRANSPORT AS PER 49 CFR 172

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

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. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

APPENDIX I

Material Safety Data Sheet (MSDS)

Sarin (GB)



REVISED: 30 June 95
DATE: 14 September 1988

U.S. ARMY EDGEWOOD
RESEARCH, DEVELOPMENT
AND ENGINEERING CENTER
POISON

Emergency Telephone #s:
ERDEC, Safety Office
410-671-4411 0700-1700
EST After normal duty
hours: 410-278-5201
Ask for ERDEC Staff
Duty Officer

MATERIAL SAFETY DATA SHEET

LETHAL NERVE AGENT (GB)

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME: Department of the Army

MANUFACTURER'S ADDRESS:

U.S. ARMY CHEMICAL AND BIOLOGICAL DEFENSE COMMAND
EDGEWOOD RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
ATTN: SCBRD-ODR-S
ABERDEEN PROVING GROUND, MD 21010-5423

CAS REGISTRY NUMBER: 107-44-8 or 50642-23-4

CHEMICAL NAME AND SYNONYMS:

Phosphonofluoridic acid, methyl-, isopropyl ester
Phosphonofluoridic acid, methyl-, 1-methylethyl ester

ALTERNATE CHEMICAL NAMES:

Isopropyl methylphosphonofluoridate
Isopropyl ester of methylphosphonofluoridic acid
Methylisopropoxfluorophosphine oxide
Isopropyl Methylfluorophosphonate
O-Isopropyl Methylisopropoxfluorophosphine oxide
O-Isopropyl Methylphosphonofluoridate
Methylfluorophosphonic acid, isopropyl ester
Isopropoxymethylphosphonyl fluoride

SOLUBILITY IN WATER: Complete

SPECIFIC GRAVITY (H₂O=1): 1.0887 @ 25 DEG C

FREEZING/MELTING POINT: -56 DEG C

LIQUID DENSITY (g/cc): 1.0887 @ 25 DEG C
1.102 @ 20 DEG C

PERCENTAGE VOLATILE BY VOLUME: 22,000 m/m³ @ 25 DEG C
16,090 m/m³ @ 20 DEG C

APPEARANCE AND ODOR: Colorless liquid; Odorless in pure form

SECTION IV - FIRE AND EXPLOSION DATA

FLASH POINT (METHOD USED): Did not flash to 280 DEG F

FLAMMABLE LIMIT: Not applicable

LOWER EMPLOSIVE LIMIT: Not available

UPPER EXPLOSIVE LIMIT: Not available

EXTINGUISHING MEDIA: Water mist, fog, foam, CO₂. Avoid using extinguishing methods that will cause splashing or spreading of the GB.

SPECIAL FIRE FIGHTING PROCEDURES: GB will react with steam or water to produce toxic & corrosive vapors. All persons not engaged in extinguishing the fire should be evacuated. Fires involving GB 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 firefighting protective clothing (without TAP clothing) during chemical agent firefighting 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 vice firefighting, they will wear appropriate levels of protective clothing (see Section 8).

UNUSUAL FIRE AND EXPLOSION HAZARDS: Hydrogen may be present.

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMIT (AEL): The permissible airborne exposure concentration for GB for an 8-hour workday or a 40 hour work week is an 8-hour time weight average (TWA) of 0.0001 mg/m³. This value is based on the TWA of GB which can be found in "AR 40-8, "Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX". To date, however, the Occupational Safety and Health Administration (OSHA) has not promulgated a permissible exposure concentration for GB.

EFFECTS OF OVEREXPOSURE:

It is a lethal anticholinestase agent. Doses which are potentially life-threatening may be only slightly larger than those producing minimal effects.

GB

Route	Form	Effect	Type	Dosage
ocular	vapor	miosis	EC _{t50}	<2 mg-min/m ³
inhalation	vapor	runny nose	EC _{t50}	<2 mg-min/m ³
inhalation (15 l/min)	vapor	severe incapacitation	IC _{t50}	35 mg-min/m ³
inhalation (15 l/min)	vapor	death	LC _{t50}	70 mg-min/m ³
percutaneous	liquid	death	LD ₅₀	1700 mg/70 kg man

Effective dosages for vapor are estimated for exposure durations of 2-10 minutes.

Symptoms of overexposure may occur within minutes or hours, depending upon dose. They include: miosis (constriction of pupils) and visual effects, headache and pressure sensation, runny nose and nasal congestion, salivation, tightness in the chest, nausea, vomiting, giddiness, anxiety, difficulty in thinking, difficulty sleeping, nightmares, muscle twitches, tremors, weakness, abdominal cramps, diarrhea, involuntary urination and defecation.

With severe exposure symptoms progress to convulsions and respiratory failure.

GB is not listed by the International Agency for Research on Cancer (IARC), American Conference of Governmental Industrial Hygienists (ACGIH), Occupational Safety and Health Administration (OSHA), or National Toxicology Program (NTP) as a carcinogen.

EMERGENCY AND FIRST AID PROCEDURES:

INHALATION: Hold breath until respiratory protective mask is donned. If severe signs of agent exposure appear (chest tightens, pupil constriction, uncoordination, etc.), immediately administer, in rapid succession, all three Nerve Agent Antidote Kit(s), Mark I injectors (or atropine if directed by the local physician). Injections using the Mark I kit injectors may be repeated at 5 to 20 minute intervals if signs and symptoms are progressing until three series of injections have been administered. No more injections will be given unless directed by medical personnel. In addition, a record will be maintained of all injections given. 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. If breathing is difficult, administer oxygen. Seek medical attention IMMEDIATELY.

EYE CONTACT: Immediately flush eyes with water for 10-15 minutes, then don respiratory protective mask. Although miosis (pinpointing of the pupils) may be an early sign of agent exposure, an injection will not be administered when miosis is the only sign present. Instead, the individual will be taken IMMEDIATELY to the medical treatment facility for observation.

SKIN CONTACT: Don respiratory protective mask and remove contaminated clothing. Immediately wash contaminated skin with copious amounts of soap and water, 10% sodium carbonate solution, or 5% liquid household bleach. Rinse well with water to remove decontaminant. Administer an intramuscular injection with the MARK I kit injectors only if local sweating and muscular twitching symptoms are observed. Seek medical attention IMMEDIATELY.

INGESTION: Do not induce vomiting. First symptoms are likely to be gastrointestinal. Immediately administer an intramuscular injection of the MARK I kit auto-injectors. SEEK MEDICAL ATTENTION IMMEDIATELY.

SECTION VI - REACTIVITY DATA

STABILITY: Stable when pure.

INCOMPATIBILITY: Attacks tin, magnesium, cadmium plated steel, some aluminums. Slight attack on copper, brass, lead, practically no attack on 1020 steel, Inconel & K-monel.

Hydrolyzes to form HF under acid conditions and isopropyl alcohol & polymers under basic conditions.

SECTION VII - SPILL, LEAK AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: If leak or spills occur, only personnel in full protective clothing (see section 8) will remain in area. In case of personnel contamination see section V "Emergency and First Aid Instructions".

RECOMMENDED FIELD PROCEDURES: Spills must be contained by covering with vermiculite, diatomaceous earth clay, fine sand, sponges, and paper or cloth towels. Decontaminate with copious amounts of aqueous Sodium Hydroxide solution (a minimum 10 wt percent). Scoop up all material and place in a fully removable head drum with a high density polyethylene liner. Cover the contents of the drum with decontaminating solution as above before affixing the drum head. After sealing the head, the exterior of the drum shall be decontaminated and then labeled IAW EPA and DOT regulations. All leaking containers shall be overpacked with vermiculite placed between the interior and exterior containers. Decontaminate and label IAW EPA and DOT regulations. Dispose of the material IAW waste disposal methods provided below. Dispose of material used to decontaminate exterior of drum IAW Federal, state and local regulations. Conduct general area monitoring with an approved monitor (see Section 8) to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (see Sections 2 and 8).

If 10 wt percent aqueous Sodium Hydroxide solution is not available then the following decontaminants may be used instead and are listed in the order of preference: Decontamination Solution No. 2 (DS2), Sodium Carbonate, and Supertropical Bleach Slurry (STB).

RECOMMENDED LABORATORY PROCEDURES: A minimum of 56 grams of decon solution is required for each gram of GB. Decontaminant/agent solution is allowed to agitate for a minimum of one hour. Agitation is not necessary following the first hour. At the end of the one hour, the resulting solution should be adjusted to a pH greater than 11.5. If the pH is below 11.5, NaOH should be added until a pH above 11.5 can be maintained for 60 minutes.

An alternate solution for the decontamination of GB is 10 wt percent Sodium Carbonate in place of the 10 percent Sodium Hydroxide solution above. Continue with 56 grams of decon to 1 gram of agent. Agitate for one hour but allow three (3) hours for the reaction. The final pH should be adjusted to above 10. It is also permitted to substitute 5.25% Sodium Hypochlorite or 25 wt percent Monoethylamine (MEA) for the 10% Sodium Hydroxide solution above. MEA must be completely dissolved in water prior to addition of the agent. Continue with 56 grams of decon for each gram of GB and provide agitation for one hour. Continue with same ratios and time stipulations.

Scoop up all material and place in a fully removable head drum with a high density polyethylene liner. Cover the contents of the drum with decontaminating solution as above before affixing the drum head. After sealing the head, the exterior of the drum shall be decontaminated and then

labeled IAW EPA and DOT regulations. All leaking containers shall be overpacked with vermiculite placed between the interior and exterior containers. Decontaminate and label IAW EPA and DOT regulations. Dispose of the material IAW waste disposal methods provided below. Dispose of material used to decontaminate exterior of drum IAW Federal, state and local regulations. Conduct general area monitoring with an approved monitor (see Section 8) to confirm that the atmospheric concentrations do not exceed the airborne exposure limit (see Sections 2 and 8).

WASTE DISPOSAL METHOD: Open pit burning or burying of GB or items containing or contaminated with GB in any quantity is prohibited. The detoxified GB using procedures above) can be thermally destroyed by incineration in an EPA approved incinerator in accordance with appropriate provisions of Federal, state and local RCRA regulations.

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

 SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

Concentration -----	Respiratory Protective Equipment -----
< 0.0001 mg/m ³	A full facepiece, chemical canister, air-purifying protective mask will be on hand for escape. (The M9-, M17-, or M40-series masks are acceptable for this purpose)
0.0001 to 0.2 mg/m ³	A NIOSH/MSHA approved pressure demand full facepiece SCBA or supplied air respirator with escape air cylinder may be used. Alternatively, a full facepiece, chemical canister air-purifying protective mask is acceptable for this purpose (for example, M9-, M17-, or M40-series mask or other mask certified as equivalent) is acceptable. (See DA PAM 385-61 for determination of appropriate level)

> 0.2 mg/m³

NIOSH/MSHA approved pressure demand full face- or unknown 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 to limit exit concentration to < 0.0001 mg/m³ averaged over 8 hrs/day indefinitely. Air emissions shall meet local, state and federal regulations.

SPECIAL: Chemical laboratory hoods shall have an average inward face velocity of 100 linear feet per minute (lfpm) plus or minus 10% with the velocity at any point not deviating from the average face velocity by more than 20%. Existing laboratory hoods shall have an inward face velocity of

150 lfpm plus or minus 20 percent. 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 hood's ability to contain agent GB. Emergency backup power necessary. Hoods should be tested semi-annually or after modification or maintenance operations. Operations should be performed 20 cm inside hood face.

Other: Recirculation of exhaust air from agent areas is prohibited. No connection is allowed between agent areas and other areas through ventilation system.

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

EYE PROTECTION: Chemical goggles. For splash hazards use goggles and faceshield.

OTHER PROTECTIVE EQUIPMENT: For general lab work, gloves and lab coat shall be worn with M9, M17 or M40 mask readily available.

MONITORING: Available monitoring equipment for agent GB is the M8/M9 Detector paper, detector ticket, blue band tube, M256/M256A1 kits, bubbler, Depot Area Air Monitoring System (DAAMS), Automatic Continuous Air Monitoring System (ACAMS), real time monitoring (RTM), Demilitarization Chemical Agent Concentrator (DCAC), M8/M43, M8A1/M43A2, Hydrogen Flame Photometric Emission Detector (HYFED), CAM-M1, Miniature Chemical Agent Monitor (MINICAM) and the Real Time Analytical Platform (RTAP).

Real-time, low-level monitors (with alarm) are required for GB operations. In their absence, an 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:

In handling, the buddy system will be incorporated. No smoking, eating and drinking in areas containing agent is permitted. Containers should be periodically inspected for leaks (either visually or by a detector kit). Stringent control over all personnel practices must be exercised. Decontamination equipment shall be conveniently located. Exits must be designed to permit rapid evacuation. Chemical showers, eye-wash stations, and personal cleanliness facilities must be provided. Wash hands before meals and each worker will shower thoroughly with special attention given to hair, face, neck, and hands, using plenty of soap before leaving at the end of the work day.

OTHER PRECAUTIONS: Agents must be double contained in liquid and vapor tight containers when in storage or when outside of ventilation hood.

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 40-8, Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX".

SECTION X - TRANSPORTATION DATA

PROPER SHIPPING NAME: Poisonous liquids, n.o.s.(Isopropyl methylphosphonofluoridate)

DOT HAZARD CLASSIFICATION: 6.1 Packing Group I Hazard Zone A

DOT LABEL: Poison

DOT MARKING: Poisonous liquid, n.o.s. (Isopropyl methylphosphonofluoridate) UN2810, Inhalation Hazard

DOT PLACARD: POISON

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.

AR 50-6 deals specifically with the shipment of chemical agents. Shipments of agent will be escorted in accordance with AR 740-32.

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

While the Edgewood Research, Development and Engineering Center, Dept. of the Army believes that the data contained herein are factual and the opinion 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 Edgewood 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.

APPENDIX J

Material Safety Data Sheet (MSDS)

Cyanogen Chloride (CK)

REVISED: 12 December 1990

ATOMERGIC CHEMETALS CORPORATION
222 SHERWOOD AVENUE
FARMINGDALE, NY 11735

Emergency Telephone #s:
516-694-9000

MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

CAS REGISTRY NUMBER: 506-77-4

CHEMICAL NAME AND SYNONYMS:

Cyanogen chloride
Chlorcyan
Chlorine cyanide
Chlorocyanogen

TRADE NAME AND SYNONYMS:

Cyanogen Chloride
CK

FORMULA/CHEMICAL STRUCTURE:

CCIN

Cl - C \equiv N

SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
Cyanogen Chloride	CCIN	95-99	0.6 mg/m ³

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 55.6 DEG F (13.1 DEG C)

VAPOR DENSITY (AIR=1): 2.1

SOLUBILITY IN WATER: Slightly soluble in water (6.9 g/100 g water @ 20 DEG C).
Dissolves readily in alcohol, carbon disulfide, acetone, benzene, carbon tetrachloride,
chloropicrin, HD, and AC.

SPECIFIC GRAVITY (H₂O=1): 1.39 @ 21.1 DEG C

FREEZING POINT: -6.9 DEG C

LIQUID DENSITY (g/cc): 1.2 @ 10 DEG C
1.18 @ 20 DEG C

PERCENTAGE VOLATILE BY VOLUME: 2.6 x 10⁶ mg/m³ @ 12.8 DEG C
6.132 x 10⁶ mg/m³ @ 25 DEG C

APPEARANCE AND ODOR: Colorless liquid that evaporates quickly. Odor is pungent and
biting (detectable at 2.5 mg/m³, but will go unnoticed because of its intense irritating and tearing
properties.

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT (METHOD USED): Does not flash

FLAMMABILITY LIMITS (% by volume): N/A

EXTINGUISHING MEDIA: N/A

SPECIAL FIRE FIGHTING PROCEDURES: Wear chemical protective suit with NIOSH/OSHA
approved self-contained breathing apparatus. Cool exposed containers with water.

Poisonous gases are produced when heated in fire.

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMIT (AEL): The AEL for CK is 0.6 mg/m³.

EFFECTS OF OVEREXPOSURE: Causes a marked irritation of the respiratory tract, hemorrhagic exudate of the bronchi and trachea and pulmonary edema. Liquid will burn skin and eyes. Disrupts the oxidative processes of the body by inhibiting the essential enzyme cytochrome oxidase.

Median doses of DM in man are:

LCt₅₀ = 11,000 mg-min/m³

Ict₅₀ = 7,000 mg-min/m³

LOCALLY, CK affects the eyes, upper respiratory tract, and lungs.

SYSTEMIC ACTIONS are believed to arise from the conversion of CK to AC in the body. Initially, there is an intense irritation of the nose, throat and eyes with coughing, tightness in the chest, and lacrimation. Moderate physiological effects include dizziness, dyspnea, retching, and involuntary urination and defecation. In severe cases, convulsions, unconsciousness, and failing respiration occur. If the above effects are not fatal, signs and symptoms of pulmonary edema may develop.

CHRONIC EXPOSURE to CK results in residual damage to the central nervous system.

EMERGENCY AND FIRST AID PROCEDURES:

INHALATION. Put on the mask immediately if any irritation of the eyes, nose, or throat is noticed.

The first emergency therapeutic measure is the inhalation of amyl nitrate. If hydrocyanic acid or cyanogen chloride are no longer present in the atmosphere, two ampules of amyl nitrite should be crushed in the hollow of the hand and held close to the patient's nose. This may be repeated every few minutes until a total of eight ampules have been used.

Artificial respiration should be given if respirations have ceased or are feeble. This will also facilitate the inhalation of the amyl nitrite. The artificial respiration must be continued until spontaneous breathing returns or until 10 minutes after the last sign of heart activity. If hydrocyanic acid or cyanogen chloride vapors are still present in the air, crushed ampules of amyl nitrite, in the dosages given above, must then be inserted in the region of the eyelenses of the

protective mask near the deflector tube openings; make certain after the insertion of amyl nitrite that the seal of the mask around the face is unbroken. Artificial respiration is to be instituted on the patient if he is not breathing or if respiration is feeble.

SKIN OR EYE CONTACT. Flush affected areas with plenty of water. If in eyes, hold open while flushing.

INGESTION. Have victim drink water or milk. Do not induce vomiting.

SECTION VI - REACTIVITY DATA

STABILITY: Stable at 65 DEG C for 30 days. Will polymerize to form the solid cyanuric chloride which is corrosive. Impurities promote polymerization; may explode. Hydrolyzes to Hcl and HOCN in acidic conditions; to NaCl and LaCNO in basic conditions.

INCOMPATIBILITY: When dry, not corrosive to ordinary metals.

HAZARDOUS DECOMPOSITION: 2,4,6-Trichloro-s-Triazine which can polymerize violently.

HAZARDOUS POLYMERIZATION: May occur if exposed to high temperature storage and moisture.

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Keep people away. Evacuate area in case of large discharges. Stay upwind and use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.

SECTION VIII - SPECIAL PROTECTION INFORMATION

VENTILATION: Hood with forced ventilation

Local Exhaust. Shall prevent accumulations above 0.3 ppm

Special. N/A

Other. N/A

PROTECTIVE GLOVES: MANDATORY. Rubber

EYE PROTECTION: Chemical safety goggles

OTHER PROTECTIVE EQUIPMENT: Safety shoes, safety shower, eyewash fountain

MONITORING: Can be detected with M15A2A, M18A2, M19 Kits and M8 Alarm.

SECTION IX - SPECIAL PRECAUTIONS¹

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING:

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlets piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130 DEG F (54 DEG C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders being stored excessive periods of time. Post "No Smoking or Open Flames" signs in the storage or use area. There should be no sources of ignition in the storage or use area.

OTHER PRECAUTIONS: Compressed gas cylinders should not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with his (written) consent is a violation of Federal Law (49 CFR).

¹Various Government agencies (i.e., Department of Transportation, Occupational Safety & Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which will not be reflected in this data sheet. The customer should review these regulations to ensure that he is in full compliance.

SECTION X - TRANSPORTATION DATA

FORBIDDEN FOR TRANSPORT OTHER THAN VIA MILITARY (TECHNICAL ESCORT UNIT)

TRANSPORT AS PER 49 CFR 172

PROPER SHIPPING NAME: Cyanogen Chloride

DOT HAZARD CLASS: Poison A

DOT LABEL: Poison Gas and Flammable Gas

DOT PLACARD: POISON

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

APPENDIX K

Material Safety Data Sheet (MSDS)

GA Simulant/GA Sim

The attached MSDSs are for the major constituents that were used in the formulation of GA Simulant at manufacture:

Diethyl Malonate	K-1
Ethyl Heptanoate	K-2
Benzonitrile	K-3

APPENDIX K-1

Material Safety Data Sheet (MSDS)

Diethyl Malonate

REVISED: 26 January 1987

MALLINCKRODT, INC
SCIENCE PRODUCTS DIVISION

Emergency Telephone #:
314-982-5000

MATERIAL SAFETY DATA SHEET

SECTION I - GENERAL INFORMATION

MANUFACTURER'S NAME: Mallinckrodt, Inc.

MANUFACTURER'S ADDRESS:
MALLINCKRODT, INC
SCIENCE PRODUCTS DIVISION
P.O. BOX M
PARIS, KY 40361

CAS REGISTRY NUMBER: 105-53-3

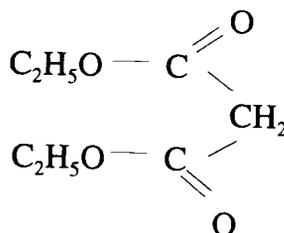
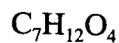
CHEMICAL NAME AND SYNONYMS:

Propanedioic acid
Diethyl ester
Ethyl malonate

TRADE NAME AND SYNONYMS:

Diethyl malonate

FORMULA/CHEMICAL STRUCTURE:



NFPA 704 SIGNAL: Health - 0
Flammability- 1
Reactivity- 0

SECTION II - COMPOSITION

INGREDIENTS NAME	FORMULA	PERCENTAGE BY WEIGHT	AIRBORNE EXPOSURE LIMIT (AEL)
Ethyl Malonate	C ₇ H ₁₂ O ₄		None established

SECTION III - PHYSICAL DATA

BOILING POINT DEG F (DEG C): 390 DEG F (199 DEG C)

VAPOR PRESSURE (mm Hg): 1 mm Hg @ 40 DEG C

VAPOR DENSITY (AIR=1): 5.52

SOLUBILITY IN WATER: Insoluble in water

SPECIFIC GRAVITY (H₂O=1): 1.055

FREEZING POINT: -58 DEG F (-50 DEG C)

APPEARANCE AND ODOR: Colorless liquid with sweet ester odor

SECTION IV - FIRE AND EXPLOSION DATA

FLASHPOINT (METHOD USED): 212 DEG F (100 DEG C) Slight fire hazard when exposed to heat or flame. Above the flash point, explosive vapor-air mixtures may be formed. White emulsion.

EXTINGUISHING MEDIA: Water spray, dry chemical, alcohol foam, or carbon dioxide.

SPECIAL FIRE FIGHTING PROCEDURES: All persons not engaged in extinguishing the fire should be immediately evacuated from the area. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

SECTION V - HEALTH HAZARD DATA

AIRBORNE EXPOSURE LIMIT (AEL): there is no established AEL for Diethyl Malonate.

EFFECTS OF OVEREXPOSURE:

INHALATION: Inhalation of vapors irritates the respiratory tract. At room temperature, the substance has such a low vapor pressure that inhalation of the vapor is unlikely.

INGESTION: Ingestion may cause sore throat, abdominal pain and diarrhea.

SKIN CONTACT: Causes skin irritation with redness and pain.

EYE CONTACT: Causes eye irritation with redness and pain

CHRONIC EXPOSURE: No information found.

EMERGENCY AND FIRST AID PROCEDURES:

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

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

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

INGESTION. If swallowed, call a physician immediately.

SECTION VI - REACTIVITY DATA

STABILITY: Stable under ordinary conditions of use and storage.

INCOMPATIBILITY: Strong oxidizers.

HAZARDOUS DECOMPOSITION: Carbon dioxide and carbon monoxide may form when heated to decomposition.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION VII - SPILL, LEAK, AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Ventilate area of leak or spill. Remove all sources of ignition. Clean-up personnel require protective clothing and respiratory protection from vapors. Contain and recover liquid when possible. Collect as hazardous waste and atomize in a suitable RCRA approved combustion chamber, or absorb with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility. Do not flush to sewer!

Ensure compliance with local, state and federal regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

PERSONAL RESPIRATORS: (NIOSH Approved) For conditions of use where exposure to the vapor is apparent, a half mask chemical cartridge respirator may be worn. For emergencies, a self-contained breathing apparatus may be necessary.

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

SKIN PROTECTION: Wear protective gloves and clean body-covering clothing.

EYE PROTECTION: Use chemical safety goggles. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

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 using a detector kit, and prior to transferring the containers from storage to work areas. Stringent control over all personnel handling Diethyl Malonate must be exercised. Chemical showers, eyewash stations, and personal cleanliness facilities must be provided. Each worker will wash their hands before meals and shower thoroughly with special attention given to hair, face, neck, and hands using plenty of soap before leaving at the end of the work day. No smoking, eating, or drinking is permitted at the work site. Decontaminating equipment shall be conveniently located. Exits must be designed to permit rapid evacuation. Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage.

SECTION X - TRANSPORTATION DATA

FORBIDDEN FOR TRANSPORT OTHER THAN VIA MILITARY (TECHNICAL ESCORT UNIT)

TRANSPORT AS PER 49 CFR 172

DOT HAZARD CLASS: Not Regulated

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

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. AR 50-6 deals specifically with the shipment of chemical agents. Shipment of agents will be escorted in accordance with AR 740-32.

Mallinckrodt provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. Individuals receiving the information must exercise their independent judgment in determining its appropriateness or a particular purpose. Mallinckrodt makes no representations, or warranties, either express or implied, of merchantability, fitness for a particular purpose with respect to the information set forth herein or to the product to which the information refers. Accordingly, Mallinckrodt will not be responsible for damages resulting from use of or reliance upon this information.

APPENDIX K-2

Material Safety Data Sheet (MSDS)

Ethyl Heptanoate

ETHYL HEPTANOATE, 99%

REVISED: 09 May 1995

ALDRICH CHEMICAL CO., INC.

PHONE: (414) 273-3850

MATERIAL SAFETY DATA SHEET

SECTION I - CHEMICAL IDENTIFICATION

MANUFACTURER'S NAME: Aldrich Chemical Co., Inc.

MANUFACTURER'S ADDRESS:

Aldrich Chemical Co., Inc.
P.O. BOX 355
MILWAUKEE, WISCONSIN 53201

PRODUCT #: 11236-4

CHEMICAL NAME AND SYNONYMS:

Ethyl Heptanoate, 99%

SECTION II - COMPOSITION/INFORMATION ON INGREDIENTS

CAS #: 106-30-9

MF: C9H18O2

SYNONYMS: cognac oil, enanthylic ether, ethyl enanthate, ethyl heptanoate, ethyl n-heptanoate, ethyl heptoate, ethyl heptylate, ethyl oenanthate, ethyl oenanthylate, oenanthic ether

SECTION III - HAZARDS IDENTIFICATION

LABEL PRECAUTIONARY STATEMENTS: Irritant. Irritating to eyes, respiratory system and skin. Combustible. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. Wear suitable protective clothing.

SECTION IV - FIRST-AID MEASURES

In case of contact, immediately flush eyes with copious amounts of water for at least 15 minutes. In case of contact, immediately wash skin with soap and copious amounts of water. 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 V - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Water Spray. Carbon dioxide, dry chemical powder or appropriate foam.

SPECIAL FIREFIGHTING PROCEDURES: Wear self-contained breathing apparatus and protective clothing. Prevent contact with skin and eyes. Combustible liquid.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS: Emits toxic fumes under fire conditions.

SECTION VI - ACCIDENTAL RELEASE MEASURES

Wear respirator, chemical safety goggles, rubber boots and heavy rubber gloves. Cover with dry lime or soda ash, pick-up, keep in a closed container and hold for waste disposal. Ventilate area and wash spill site after material pickup is complete.

SECTION VII - HANDLING AND STORAGE

Refer to Section 8.

SECTION VIII - EXPOSURE CONTROLS/PERSONAL PROTECTION

Chemical Safety Goggles
Compatible Chemical-Resistant Gloves
NIOSH/MSHA-Approved Respirator
Safety Shower and Eye Bath
Mechanical Exhaust Required
Do Not Breathe Vapor
Avoid Contact with Eyes, Skin and Clothing
Wash Thoroughly After Handling
Irritant
Keep Tightly Closed
Keep Away From Heat and Open Flame
Store in a Cool Dry Place

SECTION IX - PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR: Colorless liquid

BOILING POINT: 188°C to 189°C

MELTING POINT: -66°C

FLASHPOINT: 151°F (66°C)

SPECIFIC GRAVITY: 0.868

SECTION X - STABILITY AND REACTIVITY

INCOMPATIBILITIES: Strong oxidizing agents, strong bases

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS: Toxic fumes of carbon monoxide, carbon dioxide

SECTION XI - TOXICOLOGICAL INFORMATION

ACUTE EFFECTS: May be harmful by inhalation, ingestion, or skin absorption. Vapor or mist is irritating to the eyes, mucous membranes and upper respiratory tract. Causes skin irritation. To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

RTECS NO: MJ2087000
Heptanoic acid, ethyl ester

TOXICITY DATA: ORL-RAT LD50:>34640 MG/KG FCTXAV 2,327,64
 SKN-RBT LD50:>5 GM/KG FCTXAV 19,247,81
Only selected registry of toxic effects of chemical substances (RTECS) data is presented here. See actual entry in RTECS for complete information.

SECTION XII - ECOLOGICAL INFORMATION

DATA NOT YET AVAILABLE.

SECTION XIII - DISPOSAL CONSIDERATIONS

This combustible material may be burned in a chemical incinerator equipped with an afterburner and scrubber. Observe all federal, state and local environmental regulations.

SECTION XIV - TRANSPORT INFORMATION

Contact Aldrich Chemical Company for transportation information.

SECTION XV - REGULATORY INFORMATION

REVIEWS, STANDARDS, AND REGULATIONS:

NOHS 1974: HZD 83911; NIS 1; TNF 5; NOS 3; TNE 38

NOES 1983: HZD 83911; NIS 10; TNF 1486; NOS 30; TNE 15729; TFE 3573

EPA TSCA CHEMICAL INVENTORY, JUNE 1993

SECTION XVI - 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. Aldrich 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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APPENDIX K-3

Material Safety Data Sheet (MSDS)

Benzonitrile

REVISED: 16 November 1994

MDL INFORMATION SYSTEMS, INC.

Emergency Telephone #:
615-366-2000

MATERIAL SAFETY DATA SHEET

SECTION I - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MANUFACTURER'S NAME: MDL Information Systems, Inc.

MANUFACTURER'S ADDRESS:

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

CAS REGISTRY NUMBER: 100-47-0

RTECS NUMBER: D12450000

SUBSTANCE: BENZONITRILE

TRADE NAMES/SYNONYMS: Benzenenitrile; Benzoic Acid Nitrile; Benzonitril;
Cyanobenzene; Phenyl Cyanide; UN 2224; STCC 4913134; C7H5N; OHS02730

CHEMICAL FAMILY: Nitrile, aromatic

CREATION DATE: 11/01/84

REVISION DATE: 11/16/94

SECTION II - COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: Benzonitrile

CAS NUMBER: 100-47-0

PERCENTAGE: 100.0

OTHER CONTAMINANTS: None

SECTION III - HAZARDS IDENTIFICATION

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=2 REACTIVITY=0 PERSISTENCE=2
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=2 REACTIVITY=0

EMERGENCY OVERVIEW: Transparent, colorless to pale-yellow viscous liquid with an almond-like odor and a sharp taste. Harmful if inhaled. Causes skin and eye irritation. May be irritating to the respiratory tract. Combustible liquid and vapor. Keep away from all ignition sources. Avoid breathing vapor or mist. Avoid contact with eyes, skin and clothing. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation.

POTENTIAL HEALTH EFFECTS:

INHALATION:

Short Term Effects: May cause irritation. Additional effects may include nausea, vomiting, drowsiness, dizziness, bluish skin color and convulsions. May also cause death.

Long Term Effects: No information is available.

SKIN CONTACT:

Short Term Effects: May cause irritation.

Long Term Effects: Same effects as short term exposure.

EYE CONTACT:

Short Term Effects: May cause irritation. Additional effects may include burns.

Long Term Effects: Same effects as short term exposure.

INGESTION:

Short Term Effects: No information available on significant adverse effects.

Long Term Effects: No information is available.

CARCINOGEN STATUS: OSHA: N
NTP: N
IARC: N

SECTION IV - FIRST AID MEASURES

INHALATION:

FIRST AID: Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Keep person warm and at rest. Treat symptomatically and supportively. Get medical attention immediately.

SKIN CONTACT:

FIRST AID: Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

EYE CONTACT:

FIRST AID: Wash eyes immediately with large amounts of water or normal saline, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Get medical attention immediately.

INGESTION:

FIRST AID: If vomiting occurs, keep head lower than hips to help prevent aspiration. Treat symptomatically and supportively. Get medical attention if needed.

NOTE TO PHYSICIAN

ANTIDOTE: The following antidote has been recommended. However, the decision as to whether the severity of poisoning requires administration of any antidote and actual dose required should be made by qualified medical personnel.

FOR CYANIDE POISONING: If symptoms of cyanide poisoning are evident, administer immediately before any other first aid measures. Administer amyl nitrite (amyl nitrite perles) by inhalation for 15 to 30 seconds of every minute, while sodium nitrite solution is being prepared. Discontinue amyl nitrite and immediately inject 10 mL of a 3 percent solution of sodium nitrite intravenously over a period of 2 to 4 minutes. If necessary, inject a non-sterile solution. Do not remove the needle. **CAUTION:** Appropriate adjustments in the dose should be made on a body weight basis. Through the same needle, infuse intravenously 50 mL of a 25 percent aqueous solution of sodium thiosulfate. The injection should take about 10 minutes. Other concentrations (5 to 50 percent) are permissible if the total dose is held at approximately 12 grams. Oxygen therapy may be of value in combination with nitrite and sodium thiosulfate therapy. If symptoms recur, the injections of nitrite and thiosulfate may be repeated at half the above doses. In very severe poisonings it is safer and perhaps more efficient to keep repeating the thiosulfate injections instead of the nitrite (Gosselin, Smith, Hodge, Clinical Toxicology of Commercial Products, 5th Ed.). Antidote should be administered by qualified medical personnel.

SECTION V - FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:

Moderate fire hazard when exposed to heat or flame.

Vapor-air mixtures are explosive above flash point

Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back.

EXTINGUISHING MEDIA:

Dry chemical, water spray or regular foam

(1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog, or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

FIREFIGHTING:

Move container from fire area if you can do it without risk. Fight fire from maximum distance. Stay away from ends of tanks. Dike fire-control water for later disposal; do not scatter the material (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 55).

Extinguish only if flow can be stopped. Extinguish using agent indicated. Use flooding amounts of water as a fog. Cool containers with flooding amounts of water from as far a distance as possible.

Avoid breathing poisonous vapors, keep upwind. Consider evacuation of downwind area if material is leaking.

FLASH POINT: 160°F (71 °C) (CC)
LOWER FLAMMABLE LIMIT: 1.4%
UPPER FLAMMABLE LIMIT: 7.2%
AUTOIGNITION: 1022°F (550°C)
FLAMMABILITY CLASS(OSHA): IIIA

HAZARDOUS COMBUSTION PRODUCTS: Thermal decomposition products may include highly toxic fumes of hydrogen cyanide and toxic oxides of carbon and nitrogen.

SECTION VI - ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL: Do not touch spilled material. Stop leak if you can do it without risk. Use water spray to reduce vapors. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For small dry spills, with a clean shovel place material into clean, dry containers and cover. Move containers from spill area. For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry. Ventilate closed spaces before entering.

Reportable Quantity (RQ): 5,000 pounds

The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800)424-8802 or (202)426-2675 in the metropolitan Washington, D.C. area (40 CFR 302.6).

SECTION VII - HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Bonding and grounding: Substances with low electroconductivity, which may be ignited by electrostatic sparks, should be stored in containers which meet the bonding and grounding guidelines specified in NFPA 77-1983, Recommended Practice on Static Electricity.

Store in accordance with 29 CFR 1910.106.

Store in a cool, dry place; keep container tightly closed when not in use.

Store away from incompatible substances.

SECTION VIII - EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS: No occupational exposure limits established by OSHA, ACGIH, or NIOSH.

BENZONITRILE: 5,000 pounds CERCLA Section 103 Reportable Quantity

VENTILATION: Provide local exhaust or process enclosure ventilation. Ventilation equipment should be explosion-proof if explosive concentrations of dust, vapor or fume are present.

EYE PROTECTION: Employee must wear splash-proof or dust-resistant safety goggles and a faceshield to prevent contact with this substance.

EMERGENCY WASH FACILITIES: Where there is any possibility that an employee's eyes and/or skin may be exposed to this substance, the employer should provide an eye wash fountain and quick drench shower within the immediate work area for emergency use.

CLOTHING: Employee must wear appropriate protective (impervious) clothing and equipment to prevent any possibility of skin contact with this substance.

GLOVES: Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR: The following respirators are recommended based on information found in the physical data, toxicity and health effects sections. They are ranked in order from minimum to maximum respiratory protection.

The specific respirator selected must be based on contamination levels found in the work place, must be based on the specific operation, must not exceed the working limits of the respirator and must be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

Any chemical cartridge respirator with organic vapor cartridge(s) and a full facepiece.

Any gas mask with organic vapor canister (chin-style or front- or back-mounted canister), with a full facepiece.

Any type "C" supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet or hood operated in a continuous-flow mode.

Any self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

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

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

SECTION IX - PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Transparent, colorless to pale-yellow viscous liquid with an almond-like odor and a sharp taste.

MOLECULAR WEIGHT: 103.12

MOLECULAR FORMULA: C₆H₅CN

BOILING POINT: 370-376°F (188-191°C)

FREEZING POINT: 9°F (-13°C)

VAPOR PRESSURE: 1 mmHg @ 20°C

VAPOR DENSITY: 3.6

SPECIFIC GRAVITY: 1.004-1.3441

WATER SOLUBILITY: 1 percent @ 100°C

PH: no data available

ODOR THRESHOLD: no data available

EVAPORATION RATE: no data available

VISCOSITY: 1.054 cSt @ 100°F

SOLVENT SOLUBILITY: Soluble in alcohol, acetone, benzene, chloroform, ether, ethyl acetate, ethylene chloride, and most organic solvents.

SECTION X - STABILITY AND REACTIVITY

REACTIVITY: Stable under normal temperatures and pressures.

CONDITIONS TO AVOID: May burn but does not ignite readily. Containers may explode in heat of fire.

INCOMPATIBILITIES:

BENZONITRILE:

ACIDS (STRONG): Evolves highly toxic and inflammable hydrogen cyanide.

BASES (STRONG): Incompatible.

OXIDIZERS (STRONG): Fire and explosion hazard.

REDUCING AGENTS: Incompatible.

HAZARDOUS DECOMPOSITION: Thermal decomposition products may include highly toxic fumes of hydrogen cyanide and toxic oxides of carbon and nitrogen.

POLYMERIZATION: Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

SECTION XI - TOXICOLOGICAL INFORMATION

BENZONITRILE:

IRRITATION DATA: 500 mg/24 hours skin-rabbit moderate.

TOXICITY DATA: 6 gm/m³ inhalation-mouse LC50; 950 ppm/8 hours inhalation-rat LCLo; 1200 mg/kg skin-rat LD50; 720 mg/kg oral-rat LDLo; 971 mg/kg oral-mouse LD50; 800 mg/kg oral-cat LD50; 800 mg/kg oral-rabbit LD50; 200 mg/kg subcutaneous-rabbit LDLo; 400 mg/kg intraperitoneal-mouse LD50; 740 mg/kg intraperitoneal-rabbit LD50; 1,250 mg/kg intraperitoneal-rabbit LD50; mutagenic data (RTECS).

CARCINOGEN STATUS: None.

LOCAL EFFECTS: Irritant-skin, eye.

ACUTE TOXICITY LEVEL: Toxic by inhalation; moderately toxic by dermal absorption and ingestion.

TARGET EFFECTS: Poisoning may affect the central nervous system.

HEALTH EFFECTS:

**INHALATION:
BENZONITRILE:
TOXIC.**

ACUTE EXPOSURE - May cause irritation, dizziness, and drowsiness. Inhalation of low concentrations of cyanides or nitriles may cause weakness, headache, confusion, nausea and vomiting. Higher concentrations may cause cyanosis, shallow respiration, convulsions, and collapse. Death is due to respiratory arrest.

CHRONIC EXPOSURE - No data available.

**SKIN CONTACT:
BENZONITRILE:
IRRITANT.**

ACUTE EXPOSURE - May cause moderate irritation. May cause effects associated with cyanides and nitriles, as detailed in acute inhalation.

CHRONIC EXPOSURE - Repeated or prolonged exposure to irritants may cause dermatitis.

**EYE CONTACT:
BENZONITRILE:
IRRITANT.**

ACUTE EXPOSURE - May cause severe irritation and possibly burns.

CHRONIC EXPOSURE - Repeated or prolonged contact with irritants may cause conjunctivitis.

**INGESTION:
BENZONITRILE:**

ACUTE EXPOSURE - May cause effects associated with cyanides and nitriles, as detailed in acute inhalation.

CHRONIC EXPOSURE - No data available.

SECTION XII - ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): No data available

ACUTE AQUATIC TOXICITY: No data available

DEGRADABILITY: No data available

LOG BIOCONCENTRATION FACTOR (BCF): No data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: No data available

SECTION XIII - DISPOSAL CONSIDERATIONS

Observe all federal, state and local regulations when disposing of this substance.

SECTION XIV - TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER,
49 CFR 172.101: Benzonitrile-UN 2224

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION,
49 CFR 172.101: 6.1 - Poisonous materials

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101: PG II

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR
172.101 AND SUBPART E: Poison

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:

EXCEPTIONS: None

NON-BULK PACKAGING: 49 CFR 173.202

BULK PACKAGING: 49 CFR 173.243

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 5 L
CARGO AIRCRAFT ONLY: 60L

SECTION XV - REGULATORY INFORMATION

TSCA STATUS: Y

CERCLA SECTION 103 (40 CFR 302.4):	Y	
BENZONITRILE		5,000 POUNDS RQ
SARA SECTION 302 (40 CFR 355.30):	N	
SARA SECTION 304 (40 CFR 355.40):	N	
SARA SECTION 313 (40 CFR 372.65):	N	
OSHA PROCESS SAFETY (29 CFR 1910.119):	N	
CALIFORNIA PROPOSITION 65:	N	

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

ACUTE HAZARD:	Y
CHRONIC HAZARD:	Y
FIRE HAZARD:	Y
REACTIVITY HAZARD:	N
SUDDEN RELEASE HAZARD:	N

SECTION XVI - OTHER INFORMATION

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APPENDIX L

Material Safety Data Sheet (MSDS)

Chloroform

OCCIDENTAL CHEMICAL CORPORATION
REVISÉD: 30 December 1993
Emergency Telephone #:
1-800-733-3665
or 716-278-7021

MATERIAL SAFETY DATA SHEET

SECTION I - PRODUCT IDENTIFICATION

HMIS HAZARD RATINGS:

HEALTH HAZARD 2* FIRE HAZARD 0 REACTIVITY 0
Based on the National Paint & Coating Association HMIS rating system.

SARA/TITLE III HAZARD CATEGORIES: (See Section X)

Immediate (Acute) Health: Yes Reactive Hazard: No
Delayed (Chronic) Health: Yes Sudden Release of Pressure: No
Fire Hazard: No

MANUFACTURER'S NAME: Occidental Chemical Corporation

MANUFACTURER'S ADDRESS:

OCCIDENTAL CHEMICAL CORPORATION
Customer Service, Occidental Tower
P.O. Box 809050, Dallas Texas 75380

CHEMICAL NAME AND SYNONYMS:

Trichloromethane

CHEMICAL FORMULA: CHCl₃

CAS NUMBER: 67-66-3

PRODUCT USE:

Pharmaceutical and Reagent Solvent for Laboratories

DOT PROPER SHIPPING NAME: Chloroform

DOT HAZARD CLASS: 6.1

DOT IDENTIFICATION NUMBER: UN1888

DOT PACKING GROUP: II

DOT HAZARDOUS SUBSTANCE: RQ 10 lbs. (Chloroform)
RQ 10 lbs. (Carbon Tetrachloride)

DOT MARINE POLLUTANT: Marine Pollutant (Trichloromethane)
ADDITIONAL DESCRIPTION REQUIREMENT: NA

TDG SHIPPING NAME: Chloroform
TDG PRIMARY CLASS: 6.1
TDG SUBSIDIARY CLASS(ES): (9.2)
TDG IDENTIFICATION NUMBER: UN1888
TDG PACKING GROUP: II
RL FOR DIVISION 9.2: 230 kg (Chloroform)

SECTION II - HEALTH HAZARD INFORMATION

EMERGENCY AND FIRST AID PROCEDURES:

EYES: IMMEDIATELY flush eyes with large amounts of water for at least 15 minutes holding eyelids apart to ensure flushing of the entire eye surface. **SEEK MEDICAL ATTENTION.**

SKIN: Wash with plenty of soap and water. Remove contaminated clothing and footwear and wash clothing before reuse. Discard footwear which cannot be decontaminated. **SEEK MEDICAL ATTENTION IF SYMPTOMS OCCUR.**

INHALATION: Remove to fresh air. If breathing is difficult, have trained person administer oxygen. If breathing has stopped, give mouth to mouth resuscitation. **GET IMMEDIATE MEDICAL ATTENTION.**

INGESTION: **DO NOT INDUCE VOMITING.** This material is not soluble. **DO NOT GIVE FLUIDS.** If spontaneous vomiting is inevitable, **PREVENT ASPIRATION** by keeping the victims head below the knees. **GET IMMEDIATE MEDICAL ATTENTION.** A qualified physician can perform gastric lavage only when the airway (trachea) has been secured to prevent aspiration.

FURTHER MEDICAL TREATMENT: Following ingestion, adsorbents such as activated charcoal may be of value. Gastric lavage may be effective when performed by a physician within 4 hours of ingestion.

NOTES TO PHYSICIAN: No specific antidote for product poisoning is known. Treatment is symptomatic and supportive. Patient should be kept under observation long enough to determine if liver or kidney damage has occurred.

ROUTES OF EXPOSURE:

INHALATION: Can cause central nervous system depression which may progress rapidly to unconsciousness. Moderate irritant of the respiratory tract. Concentrations insufficient to produce unconsciousness may produce gastrointestinal upset. Delayed toxic effect may cause severe damage to heart, liver, and kidneys.

SKIN: Mildly irritating to skin. Skin contact may produce a burning sensation. Prolonged or repeated contact may cause skin to become red, rough, and dry due to the removal of natural oils and may result in dermatitis. Liquid can be absorbed through the skin in toxic quantities. Prolonged and/or repeated skin contact can cause systemic (toxic) effects.

EYE CONTACT: Slight irritant of the eyes causing pain, tearing, and general inflammation.

INGESTION: In industrial environments, ingestion is unlikely but, if ingested, it can irritate the gastrointestinal tract. It may produce chemical pneumonia if vomiting results in aspiration of product into the lungs. Ingestion can result in serious or fatal effects.

EFFECTS OF OVEREXPOSURE:

ACUTE: The effects of overexposure may be both immediate and delayed. The immediate effects may include headache, dizziness and stupor, nausea and vomiting. Severe overexposure may cause muscular incoordination, unconsciousness, and death. Delayed effects may include severe damage to heart, liver, and kidneys. (Has been shown to be fetotoxic in some studies).

CHRONIC: Can cause headache, mental confusion, depression, fatigue, loss of appetite, nausea, vomiting, cough, loss of sense of balance, and visual disturbances. Prolonged or repeated skin contact may cause dermatitis. Prolonged and/or repeated breathing of vapor may cause poisoning. Has been shown to cause liver tumors in mice and kidney tumors in rats. In laboratory animals exposed to maternally toxic doses, chloroform has the potential for causing embryo lethality fetal stunting and birth defects.

TOXICOLOGY DATA:

Acute Oral LD50	(rat)	908 mg/kg
Acute Inhalation LC50	(mouse)	28 gm/m ³
LC50	(dog)	100 gm/m ³
LC50	(rabbit)	59 gm/m ³

IARC lists this product as having inadequate evidence in humans and sufficient evidence in animals (liver and kidney tumors) to evaluate carcinogenicity. (Group 2B).

NTP lists this product as may reasonably be anticipated to be carcinogenic in laboratory animals.

MEDICAL LIMITATIONS: Chloroform toxicity may be increased by exposure with: alcohol, steroids, polybrominated biphenyls, acetone, or chlordecone. Women who are pregnant or expect to become pregnant are advised to avoid exposure to this product.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:

Persons with a history of liver disease or alcoholism should not be exposed to chloroform. Alcohol ingestion may add to the toxic effects of chloroform.

SYNERGISTIC MATERIALS:

See Medical Limitations (above).

SECTION III - IMPORTANT COMPONENTS

CAS NUMBER/NAME:

7732185 Water

EXPOSURE LIMITS:

PEL: Not Established

TLV: Not Established

COMMON NAMES:

Listed on (List Legend Next Page):

19 23

PERCENTAGE:

VOL ND

WT 48.50-91

1310732 Sodium hydroxide (Na(OH))

EXPOSURE LIMITS:

PEL: 2 mg/m3, Ceiling

TLV: 2 mg/m3, Ceiling

COMMON NAMES:

CAUSTIC SODA

Listed on (List Legend Next Page):

13 18 21

PERCENTAGE:

VOL ND

WT 9-51.50

7647145 Sodium chloride (NaCl)

EXPOSURE LIMITS:

PEL: None Established

TLV: None Established

COMMON NAMES:

SALT

Listed on (List Legend Next Page):

23

PERCENTAGE:

VOL ND

WT 0-1.30

7775099 Chloric acid, sodium salt

EXPOSURE LIMITS:

PEL: Not Established

TLV: Not Established

COMMON NAMES:

SODIUM CHLORATE

Listed on (List Legend Below):

12 21

PERCENTAGE:

VOL ND

WT 0-0.30

See Section II

All components of this product that are required to be on the TSCA Inventory are listed on the inventory.

LIST LEGEND

12 PA HAZARDOUS SUBSTANCE	13 PA ENVIRONMENTAL HAZ SUBSTANCE
18 NY HAZARDOUS SUBSTANCE	19 PA REQUIREMENT-3 PERCENT OR GREATER
21 NJ SPECIAL HEALTH HAZ SUB	23 NJ REQUIREMENT-1 PERCENT OR GREATER

SECTION IV - FIRE AND EXPLOSION DATA

FLASH POINT: Nonflammable

AUTOIGNITION TEMPERATURE: 1000+°C (1832°F)

FLAMMABLE LIMITS IN AIR, % BY VOLUME- UPPER: Not applicable

LOWER: Not applicable

EXTINGUISHING MEDIA:

Fires in the vicinity of this product may be controlled by carbon dioxide, dry chemicals or water spray.

SPECIAL FIRE FIGHTING PROCEDURES:

Pressure-demand, self-contained respiratory protection should be provided for fire fighters in buildings or confined areas where this product is stored. Storage containers exposed to fire should be kept cool with a water spray, in order to prevent pressure build-up.

UNUSUAL FIRE AND EXPLOSION HAZARD:

This product is nonflammable and nonexplosive under normal conditions of use. At high temperatures, this product can decompose to give off hydrogen chloride gas plus other toxic and irritating gases such as phosgene. If storage containers are exposed to excessive heat, over-pressurization of the containers can result.

SENSITIVITY TO MECHANICAL IMPACT:

Not applicable.

SENSITIVITY TO STATIC DISCHARGE:

Not applicable.

SECTION V - SPECIAL PROTECTION

VENTILATION REQUIREMENTS:

Work in well ventilated areas. Maintain exposure level below the PEL. Where engineering controls are not feasible use adequate local exhaust ventilation wherever mist, spray or vapor may be generated. The odor of chloroform may indicate an air concentration in excess of 100 ppm.

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT:

RESPIRATORY:

Use a NIOSH/MSHA approved air supplied respirator following manufacturer's recommendations whenever an air concentration over the PEL is expected. Use supplied air respirator in positive pressure mode following ANSI Z117, 1-for tank and confined space entry.

EYE:

Wear chemical safety goggles, plus full face shield to protect against splashing when appropriate (ANSI Z87.1).

GLOVES:

Solvent resistant gloves should be worn, such as viton, polyvinyl alcohol, or equivalent. Gloves contaminated with product should be discarded.

OTHER CLOTHING AND EQUIPMENT:

Protective clothing should be worn to minimize skin contact. Use standard work shoes; discard if shoes cannot be decontaminated. Store contaminated clothing in well ventilated cabinets or closed containers. Wash and dry contaminated clothing before reuse. Emergency shower and eyewash facility should be in close proximity.

SECTION VI - PHYSICAL DATA

BOILING POINT @ 760 mm Hg: 61.2°C
FREEZING POINT: -63.5°C
VAPOR PRESSURE: 159 mm Hg @ 20°C
SPECIFIC GRAVITY (H₂O=1): 1.48
SOLUBILITY IN H₂O % BY WT: 0.79
VAPOR DENSITY (Air=1): 4.13
APPEARANCE AND ODOR: Clear, colorless liquid with ether-like odor
ODOR THRESHOLD (ppm): 85 ppm
pH: Not applicable
DENSITY AT 20°C: 1.47 gm/cc
% VOLATILES BY VOL.: 100
EVAPORATION RATE (BuAc=1): 7.4 (estimated) / 0.5 (Ether=1)
COEFFICIENT WATER/OIL DISTRIBUTION: 1.97

SECTION VII - REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY:

Under normal conditions of use, this product is stable. Avoid open flames, welding arcs, or other high temperature sources which induce thermal decomposition to irritating and corrosive HCl from solvent vapor. Strong UV light (e.g., welding arc) can cause significant phosgene to be generated.

INCOMPATIBILITY:

Avoid contacting this product with strong alkalis (such as sodium hydroxide), alkali metals, open flames, and electrical arcs.

HAZARDOUS DECOMPOSITION PRODUCTS:

Involvement in fire or high temperatures forms hydrogen chloride and very small amounts of phosgene and chlorine. Solvent decomposition occurs when catalyzed by metal chlorides which can be produced by reaction of HCl and metals in the system.

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION:

None.

SECTION VIII - HANDLING AND STORAGE

HANDLING AND STORAGE PRECAUTIONS:

Do not take internally.

Do not breathe vapors.

Do not get in eyes, on skin, or clothing.

Use with adequate ventilation to maintain exposure level below the PEL. Perform personal monitoring to assess the exposure level.

When handling, wear chemical splash goggles, protective clothing, and solvent resistant gloves. Wash thoroughly after handling or contact. Do not eat, drink, or smoke in areas where chloroform is used.

Never enter a pit or tank without following safety procedures - never alone, always with a life line, and always with a positive pressure supply of fresh air. Chloroform vapors are heavier than air and will tend to collect in low areas. Avoid use in confined spaces. Areas of poor ventilation could contain concentrations high enough to cause unconsciousness and death.

Use NIOSH/MSHA approved supplied air respirator following manufacturer's recommendations where vapors may be generated.

Avoid contact with pure oxygen, flames, pilot lights, hot glowing surfaces, welding arcs or alkali metals to prevent decomposition resulting in toxic and irritating vapors.

Avoid exposure to strong UV light, can cause generation of phosgene.

Keep containers tightly closed and properly labeled.

Store containers in cool, dry, ventilated place out of direct sunlight.

Under normal conditions this product can be stored satisfactorily in mild steel without an interior lining.

Aluminum is not recommended for storage and handling. Dike storage tanks separately to contain 110% of tank volume. Vent indoor tanks to an outside location so escaping vapors will not contaminate any work areas.

SECTION IX - ENVIRONMENTAL PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

Leaks should be stopped. Spills should be contained and cleaned up immediately. Recovery and reuse of spilled product, rather than disposal, should be the ultimate goal of a clean up operation. Evacuate unnecessary personnel. Prevent discharge or flushing to streams and sewer systems. Large spills should be removed by vacuum truck. Smaller spills may be soaked up with compatible absorbent material (sand, diatomaceous earth, kitty litter, etc.) which should be placed in closed containers, labeled and stored in a safe place outdoors to await proper disposal. Flush the spill area with water if the rinse water can be collected and placed in appropriate containers

for proper disposal. Spills on areas other than pavement, e.g., dirt or sand, may be handled by removing the affected soils and placing in approved containers. People performing the clean up should have full protective equipment including NIOSH/MSHA approved positive pressure self contained breathing apparatus.

According to 40 CFR 302 Table 302.4 (CERCLA), environmental releases of more than 10 pounds (approximately 3 quarts) of chloroform must be reported to the National Response Center by calling 800-424-8802 (202-426-2675). Releases of over 10 pounds must also be reported to the State Emergency Response Commission and the Local Emergency Planning Committee (40 CFR 355.40). In addition, state and local regulations may have additional reporting requirements. Check with the proper state or local authorities.

WASTE DISPOSAL METHOD:

According to RCRA, disposal of chloroform waste will require assignment of a EPA Hazardous Waste Number. For example, chloroform is classed as Hazardous Waste U044 (40 CFR 261.33). Always package, store, transport, and dispose of all waste and contaminated equipment in accordance with all applicable federal, state and local health and environmental regulations. Shipments of waste materials containing chloroform are subject to manifesting per applicable regulation. Appropriate disposal will depend on the nature of each waste material and should be done by a competent and properly permitted contractor.

SECTION X - ADDITIONAL INFORMATION

OSHA Standard 29 CFR 1910.1200 requires that information be provided to employees regarding the hazards of chemicals by means of a hazard communication program including labeling, material safety data sheets, training and access to written records. We request that you, and it is your legal duty to, make all information in this Material Safety Data Sheet available to your employees.

To aid our customers in complying with regulatory requirements, SARA Title III hazard categories for this product are indicated in section I. If the word "YES" appears next to any category, this product may be reportable by you under the requirements of 40 CFR Part 370. Please consult those regulations for details.

California South Coast Air Quality Management District Rule 443.1:

Maximum Volatile Organic Carbon (VOC)	1490 grams/liter
VOC Vapor Pressure at 20°C	159 mm Hg

WHMIS CLASSIFICATION D2A, D2B

SECTION XI - PREPARATION INFORMATION

For additional non-emergency health, safety, or environmental information telephone (716) 286-3081, or write to:

Occidental Chemical Corporation
Product Stewardship Department
360 Rainbow Boulevard South
Niagara Falls, NY 14302

For Emergencies: 24 HOUR EMERGENCY PHONE: 1-800-733-3665
To request an MSDS: 716-286-3400

This MSDS replaces MSDS Number M4809 dated 05/09/90.

WARNING LABEL INFORMATION

SIGNAL WORD: WARNING

STATEMENT OF HAZARDS:

Volatile solvent.

Prolonged breathing of vapor can cause dizziness, loss of consciousness, and may result in death.

Overexposure to vapor may cause delayed severe injury to heart, liver and kidneys.

Causes irritation of the eyes, skin, and respiratory tract.

May be fatal if swallowed.

Possible cancer hazard: May cause cancer based on animal data.

Risk of cancer depends on duration and level of exposure.

Suspect reproductive hazard.

May injure unborn child based on animal data.

Persons with liver or heart disease should not be exposed.

PRECAUTIONARY STATEMENTS:

Do not take internally.

Do not breathe vapors, use with adequate ventilation or wear an approved respirator.

Do not get in eyes, on skin or clothing.

Wear chemical splash goggles, protective clothing, and solvent resistant gloves. Wash thoroughly after handling.

Do not eat, drink or smoke in areas where this chemical is used.

Never enter a pit or tank without following safety procedures - never alone, always with a life line, and always with a positive pressure supply of fresh air.

Avoid contact with pure oxygen, flames, pilot lights, hot glowing surfaces, welding arcs, strong alkalis or alkali metals.

Avoid exposure to strong UV light.

Keep containers tightly closed and properly labeled.

Store containers in cool, dry, ventilated place out of direct sunlight.

Under normal conditions this product can be stored satisfactorily in mild steel without an interior lining. Aluminum is not recommended for storage and handling.

According to RCRA, disposal of this material as a waste will require assignment of an EPA Hazardous Waste Number.

Before using, read Material Safety Data Sheet (MSDS) for this chemical.

FIRST AID:

IN CASE OF CONTACT:

FOR EYES:

IMMEDIATELY flush eyes with large amounts of water for at least 15 minutes holding eyelids apart to ensure flushing of the entire eye surface. **SEEK MEDICAL ATTENTION.**

SKIN:

Wash with plenty of soap and water. Remove contaminated clothing and footwear. Wash clothing before reuse and discard footwear which cannot be decontaminated. **SEEK MEDICAL ATTENTION IF SYMPTOMS OCCUR.**

INHALATION:

Remove to fresh air. If breathing is difficult, have trained person administer oxygen. If breathing has stopped, give mouth to mouth resuscitation. **GET IMMEDIATE MEDICAL ATTENTION.**

INGESTION:

DO NOT INDUCE VOMITING. This material is not soluble. **DO NOT GIVE FLUIDS.** If spontaneous vomiting is inevitable, **PREVENT ASPIRATION** by keeping the victims head below the knees. **GET IMMEDIATE MEDICAL ATTENTION.** A qualified physician can perform gastric lavage only when the airway (trachea) has been secured to prevent aspiration.

FURTHER MEDICAL TREATMENT: Following ingestion, adsorbents such as activated charcoal may be of value. Gastric lavage may be effective when performed by a physician within 4 hours of ingestion.

IN CASE OF:

SPILL OR LEAK:

Evacuate unnecessary personnel and provide full protective equipment for the clean up crew including a NIOSH/MSHA approved positive pressure self-contained breathing apparatus. Contain the spill and prevent discharge to waterways and sewers. Smaller spills may be soaked up with compatible absorbent material and then placed in closed containers to await proper disposal. Large spills should be removed by vacuum truck.

INFORMATION REQUIRED BY FEDERAL, STATE OR LOCAL REGULATIONS:

This product contains:

CAS#	NAME
7732185	Water
1310732	Sodium hydroxide (Na(OH))
7647145	Sodium chloride (NaCl)
7775099	Chloric acid, sodium salt

HMIS RATING SYSTEM: HEALTH 2* FLAMMABILITY 0 REACTIVITY 0

FOR INDUSTRIAL USE ONLY LABEL 031M4809

APPENDIX M

Material Safety Data Sheet (MSDS)

Triphosgene

This information valid through October 31, 1994

SIGMA-ALDRICH CORPORATION

Emergency Telephone #:

Sigma 800-325-5832

314-771-5765

Aldrich 800-321-8327

414-273-3850

MATERIAL SAFETY DATA SHEET

SECTION I - CHEMICAL IDENTIFICATION

MANUFACTURER'S NAME: Sigma-Aldrich Corporation

MANUFACTURER'S ADDRESS:

SIGMA-ALDRICH CORPORATION

1001 West Saint Paul Ave

Milwaukee, WI 53233 USA

CHEMICAL NAME AND SYNONYMS:

Triphosgene 98%

PRODUCT #: 33075-2

SECTION II - COMPOSITION

CAS REGISTRY NUMBER: 32315-10-9

MF: C3CL603

SECTION III - HAZARDS IDENTIFICATION

HARMFUL

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

IRRITATING TO EYES, RESPIRATORY SYSTEM AND SKIN.

SEVERE LACHRYMATOR.

HANDLE WITH GLOVES IN HOOD.

DO NOT BREATHE VAPOR/FUMES.

IN CASE OF INSUFFICIENT VENTILATION, WEAR SUITABLE RESPIRATORY EQUIPMENT.

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

TAKE OFF IMMEDIATELY ALL CONTAMINATED CLOTHING.

MOISTURE SENSITIVE

KEEP TIGHTLY CLOSED.

REFRIGERATE.

STORE UNDER NITROGEN.

SECTION IV - 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.

Discard contaminated shoes.

SECTION V - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Carbon Dioxide, dry chemical powder or appropriate foam.

SPECIAL FIREFIGHTING PROCEDURES: Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS: Emits toxic fumes under fire conditions.

SECTION VI - ACCIDENTAL RELEASE MEASURES

EVACUATE AREA.

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.

COVER WITH DRY LIME OR SODA ASH, PICK UP, KEEP IN A CLOSED CONTAINER, AND HOLD FOR WASTE DISPOSAL.

SECTION VII - HANDLING AND STORAGE

REFER TO SECTION 8

This substance may react to form phosgene gas. When using this material, handle with extreme caution. Avoid skin contact and ingestion. Avoid breathing this substance.

SECTION VIII - 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.

Severe lachrymator.

Severe irritant.

Harmful vapor.

Keep tightly closed.

Moisture sensitive

Store in a cool dry place.

SECTION IX - PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR: White to off-white crystals and
BOILING POINT: 203C TO 206C
MELTING POINT: 79C TO 83C

SECTION X - STABILITY AND REACTIVITY

INCOMPATIBILITIES:

Strong oxidizing agents

Strong bases

Acids

Amines

May decompose on exposure to moist air or water.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

Carbon Monoxide, Carbon Dioxide

Hydrogen Chloride Gas

Phosgene Gas

SECTION XI - TOXICOLOGICAL INFORMATION

ACUTE EFFECTS:

Harmful if swallowed, inhaled, or absorbed through skin.

High concentrations are extremely destructive to tissues of the mucous membranes and upper respiratory tract, eyes and skin.

Inhalation may be fatal as a result of spasm, inflammation and edema of the larynx and bronchi, chemical pneumonitis and pulmonary edema.

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

ADDITIONAL INFORMATION:

As specified by the E.P.A., this chemical may cause irritation, respiratory complications, central nervous system effects, and cancer. Avoid contact, inhalation and ingestion.

SECTION XII - ECOLOGICAL INFORMATION

DATA NOT YET AVAILABLE

SECTION XIII - DISPOSAL CONSIDERATIONS

Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Observe all Federal, State and Local environmental regulations.

SECTION XIV - TRANSPORT INFORMATION

Contact Aldrich Chemical Company for transportation information.

SECTION XV - REGULATORY INFORMATION

DATA NOT AVAILABLE

SECTION XVI - OTHER INFORMATION

The above information is believed to be correct but does to 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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