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LLNL-TR-818608

SDS for A-232

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January 21, 2021

Disclaimer

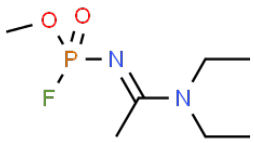
This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

Ultra-Dilute Nerve Agent in Dichloromethane
(contains 10 micrograms/milliliter A-232)
for a total maximum volume of 10 milliliters of product, in 10 ampules, each with 1 mL dichloromethane

Section 1: Identification

1.1 **Product:** Dilute chemical agent in dichloromethane, at 10 micrograms per milliliter

Components:
Dichloromethane, CAS-No. 75-09-2 (99.999%)
Methyl [(1E)-1-(diethylamino)ethylidene]phosphoramidofluoridate (A-232), CAS-No. 2387496-04-8 (0.001%)



1.2 **Identified use:** Laboratory chemical reference standard

1.3 **Provider:** Forensic Science Center, Lawrence Livermore National Laboratory, 7000 East Avenue, Livermore, CA 94551, 925-422-1100

1.4 **Emergency phone:** 925-422-1100

Section 2: Hazard(s) identification

All the properties of dilute agent in dichloromethane are not known. It is assumed that the primary hazard is associated with the dichloromethane, although the individual toxicity of A-232 should also be considered.

2.1 **Classification of the mixture in accordance with 29 CFR1910 (taken from SDS for dichloromethane):**

Skin irritation (Category 2), H315
Eye irritation (Category 2A), H319
Carcinogenicity (Category 2), H351
Specific target organ toxicity - single exposure (Category 3), Respiratory system, Central nervous system, H335, H336
Specific target organ toxicity - repeated exposure, Oral (Category 2), Liver, Blood, H373
Specific target organ toxicity - repeated exposure, Inhalation (Category 2), Central nervous system, H373

2.2 GHS Label elements, including precautionary statements

Pictogram


Dichloromethane


Dichloromethane


Agent, if present as neat materials

Hazard statement(s), Dichloromethane

H315 Causes skin irritation.
H319 Causes serious eye irritation.
H335 May cause respiratory irritation.
H336 May cause drowsiness or dizziness.
H351 Suspected of causing cancer.
H373 May cause damage to organs (Liver, Blood) through prolonged or repeated exposure if swallowed.
H373 May cause damage to organs (Central nervous system) through prolonged or repeated exposure if inhaled.

Precautionary statement(s), Dichloromethane

P201 Obtain special instructions before use.
P202 Do not handle until all safety precautions have been read and understood.
P260 Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264 Wash skin thoroughly after handling.
P271 Use only outdoors or in a well-ventilated area.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.
P302 + P352 IF ON SKIN: Wash with plenty of soap and water.
P304 + P340 + P312 IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P308 + P313 IF exposed or concerned: Get medical advice/ attention. Tell physician of potential organophosphorus exposure (acetylcholinesterase inhibitor).
P332 + P313 If skin irritation occurs: Get medical advice/ attention.
P337 + P313 If eye irritation persists: Get medical advice/ attention.
P362 Take off contaminated clothing and wash before reuse.
P403 + P233 Store in a well-ventilated place. Keep container tightly closed.
P405 Store locked up.
P501 Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazard not otherwise classified.

Section 3: Composition/information on ingredients

Dichloromethane, (99.999%)
CAS-No. 75-09-2
Formula: CH_2Cl_2

A-232, (0.001% = 10 parts-per-million = 10 micrograms per milliliter)
CAS-No. 2387496-04-8
Formula: $C_7H_{16}PO_2N_2F$
Synonym: Methyl [(1E)-1-(diethylamino)ethylidene]phosphoramidofluoridate, A-232

Section 4: First-aid measures
Assumes main health effects of agent mix are associated with dichloromethane.

4.1 **Description of first aid measures**

General advice

If exposed by skin contact, rapid removal of material is essential. Wash off with soap and plenty of water. Consult a physician. Show this safety data sheet to the doctor in attendance. Inform physician that minor component of mixture (A-232) is an acetylcholinesterase inhibitor (e.g. inform physician of organophosphorus exposure). Move out of dangerous area.

If inhaled, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of eye contact, rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed, never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 **Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11 and are expected to be associated with the dichloromethane solvent.

4.3 **Indication of any immediate medical attention and special treatment needed**

Atropine and pralidoxime chloride (2-PAM Cl) are antidotes for nerve agent toxicity; however, 2-PAM Cl must be administered within minutes to a few hours (depending on the agent) following exposure to be effective. If DuoDote® Auto-Injectors (2.1 mg atropine in 0.7 mL and 600 mg pralidoxime chloride in 2 mL sequentially through a single needle) are available, they provide the best way to administer the antidotes to healthy adults.

Section 5: Fire-fighting measures
Suitable fire-fighting measures are appropriate to those needed for dichloromethane.

5.1 **Extinguishing media**

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 **Special hazards arising from the substance or mixture**

No data available

5.3 **Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 **Further information**

No data available

Section 6: Accidental release measures

6.1 **Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. For personal protection see section 8.

6.2 **Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

6.3 **Methods and materials for containment and cleaning up**

Decontaminate spills with commercial bleach, directly from the bottle. Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 **Reference to other sections**

For disposal see section 13.

Section 7: Handling and storage

Use handling and storage precautions for dichloromethane are expected to be sufficient for appropriate handling and storage of the agent standard.

7.1 **Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapor or mist. For precautions see section 2.2. Open and use solutions only in chemical fume hood.

7.2 **Conditions for safe storage, including any incompatibilities**

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Storage class (TRGS 510): Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects.

7.3 **Specific end use(s)**

Apart from the uses mentioned in section 1.2, no other specific uses are stipulated.

Section 8: Exposure controls/personal protection

Main health concern is dichloromethane exposure:

Component	CAS-No.	Value	Control Parameters	Basis
Dichloromethane	75-09-2	Potential Occupational Carcinogen		
		TWA	50 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Carboxyhemoglobinemia Substances for which there is a Biological Exposure Index or Indices (see BEI® section); Confirmed animal carcinogen with unknown relevance to humans		
		Substance listed; for more information see OSHA document 1910.1052		
		PEL	25 ppm	OSHA specifically regulated chemicals/carcinogens
		1910.1052 This section applies to all occupational exposures to methylene chloride (MC), Chemical Abstracts Service Registry Number 75-09-2, in general industry, construction and shipyard employment. Methylene chloride (MC) means an organic compound with chemical formula, CH_2Cl_2. Its Chemical Abstracts Service Registry Number is 75-09-2. Its molecular weight is 84.9 g/mole OSHA specifically regulated carcinogen		
		STEL	125 ppm	OSHA specifically regulated chemicals/carcinogens
		PEL	25 ppm 87 mg/m^3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	125 ppm 435 mg/m^3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)

Derived No Effect Level (DNEL), dichloromethane

Workers Inhalation Acute systemic effects:	706 mg/m^3
Workers Inhalation Long-term systemic effects:	353 mg/m^3
Workers Skin contact Long-term systemic effects:	4750mg/kg BW/d
Consumers Ingestion Long-term systemic effects:	0.06mg/kg BW/d
Consumers Inhalation Long-term systemic effects:	88.3 mg/m^3
Consumers Skin contact Long-term systemic effects:	2395mg/kg BW/d
Consumers Inhalation Acute systemic effects:	353 mg/m^3

Predicted No Effect Concentration (PNEC), dichloromethane

Soil:	0.583 mg/kg
Marine water:	0.194 mg/l
Fresh water:	0.54 mg/l
Marine sediment:	1.61 mg/kg
Fresh water sediment:	4.47 mg/kg
Onsite sewage treatment plant:	26 mg/l
Aquatic intermittent release:	0.27 mg/l

Component, A-232 (present at 10 parts-per-million, micrograms per milliliter, in dichloromethane) is expected to behave somewhat similarly to VX. Some health effects of A-232 are unknown. Thus, the below values for VX provide some guidance, as values are not available for A-232:

Component	CAS-No.	Value	Estimated Control Parameters	Basis
A-232	2387496-04-8	IDLH	~0.003 mg/m^3	CDC Airborne Exposure Limit **f**or VX
		GPL	~0.0000006 mg/m^3	CDC Airborne Exposure Limit for VX
		RBC-ACh E_{50} Human dermal (undiluted liquid)	0.03 mg/kg (12 hr)	Toxnet database for VX
		RBC-ACh E50 Human iv	~0.001 mg/kg	Toxnet database for VX

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection, Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Splash contact

Material: Fluorinated rubber
Minimum layer thickness: 0.7 mm
Break through time: 148 min
Material tested:Vitoject® (KCL 890 / Aldrich Z677698, Size M) data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, the type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multipurpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

Section 9: Physical and chemical properties
The solution is expected to exhibit characteristics of dichloromethane, the dominant component (99.999%).

9.1 **Information on basic physical and chemical properties**

Dichloromethane (99.999%)

a) Appearance, Form: liquid, colourless
b) Odour: No data available
c) Odour Threshold: No data available
d) pH: No data available
e) Melting point/range: -97 °C (-143 °F)
f) Initial boiling point and boiling range: 39.8 - 40 °C (103.6 - 104 °F)
g) Flash point: No data available
h) Evaporation rate: 0.71
i) Flammability (solid, gas): No data available
j) Upper/lower flammability or explosive limits:
Upper explosion limit: 19 % (V)
Lower explosion limit: 12 % (V)
k) Vapour pressure: 470.9 hPa (353.2 mmHg) at 20.0 °C (68.0 °F)
l) Vapour density: 2.93 (Air = 1.0)
m) Relative density: 1.325 g/mL at 25 °C (77 °F)
n) Water solubility: slightly soluble
o) Partition coefficient: n-octanol/water: log Pow: 1.25
p) Auto-ignition temperature: 556.1 °C (1,033.0 °F), 662.0 °C (1,223.6 °F)
q) Decomposition temperature: No data available
r) Viscosity: No data available
s) Explosive properties: No data available
t) Oxidizing properties: No data available

Properties of neat A-232 (present at 10 parts-per-million)

a) Appearance, Form: liquid, colourless
b) Odour: No data available
c) Odour Threshold: No data available
d) pH: No data available
e) Melting point/range: No data available
f) Boiling point*: 239 ± 23 °C at 760 mm Hg
g) Flash point*: 98 ± 23 °C
h) Volatility: No data available °C)
i) Flammability (solid, gas): No data available
j) Upper/lower flammability or explosive limits: No data available
k) Vapour pressure*: 0.0 ± 0.5 mm Hg at 25 °C
l) Vapour density: No data available
m) Relative density: No data available
n) Water solubility: soluble
o) Partition coefficient: No data available
p) Auto-ignition temperature: No data available
q) Decomposition temperature: No data available
r) Viscosity: No data available
s) Explosive properties: No data available
t) Oxidizing properties: No data available

Notes: * calculated values based on ACD/Labs Percepta Platform-PhysChem Module (ChemSpider)

Section 10: Stability and reactivity
The solution is expected to exhibit characteristics of dichloromethane, the dominant component (99.999%).

10.1 Reactivity, No data available

10.2 Chemical stability, Stable under recommended storage conditions.
Contains the following stabiliser(s): 2-Methyl-2-butene (>0.005 - <0.015 %)

10.3 Possibility of hazardous reactions, No data available

10.4 Conditions to avoid, Heat, flames and sparks. Exposure to sunlight

10.5 Incompatible materials, Alkali metals, Aluminum, Strong oxidizing agents, Bases, Amines, Magnesium, Strong acids and strong bases, Vinyl compounds

10.6 Hazardous decomposition products
Other decomposition products - No data available
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas, In the event of fire: see section 5

Section 11: Toxicological information

The solution is expected to exhibit characteristics of dichloromethane, the dominant component (99.999%). However, the toxicity of A-232, present at ≤ 10 parts-per-million, should also be considered.

11.1 **Information on toxicological effects (dichloromethane)**

Acute toxicity

LD50 Oral - Rat - > 2,000 mg/kg
LC50 Inhalation - Rat - 52,000 mg/m^3
LD50 Dermal - Rat - > 2,000 mg/kg (OECD Test Guideline 402)

Skin corrosion/irritation

Skin - Rabbit
Result: Irritating to skin. - 24 h (Draize Test)

Serious eye damage/eye irritation

Eyes - Rabbit
Result: Irritating to eyes. - 24 h (Draize Test)

Respiratory or skin sensitisation

No data available

Germ cell mutagenicity

Rat, DNA damage

Carcinogenicity

Carcinogenicity - Rat - Inhalation
Tumorigenic:Carcinogenic by RTECS criteria. Endocrine:Tumors.

Limited evidence of carcinogenicity in animal studies

Suspected human carcinogens
OSHA: OSHA specifically regulated carcinogen (Methylene chloride)

Reproductive toxicity

No data available

Specific target organ toxicity - single exposure

May cause respiratory irritation.
May cause drowsiness or dizziness.

Specific target organ toxicity - repeated exposure

Inhalation - May cause damage to organs through prolonged or repeated exposure. - Central nervous system
Oral - May cause damage to organs through prolonged or repeated exposure. - Liver, Blood

Aspiration hazard
No data available

Additional Information
RTECS: PA8050000

Dichloromethane is metabolized in the body producing carbon monoxide which increases and sustains carboxyhemoglobin levels in the blood, reducing the oxygen-carrying capacity of the blood., Acts as a simple asphyxiant by displacing air., anesthetic effects, Difficulty in breathing, Headache, Dizziness, Prolonged or repeated contact with skin may cause:, defatting, Dermatitis, Contact with eyes can cause:, Redness, Blurred vision, Provokes tears., Effects due to ingestion may include:, Gastrointestinal discomfort, Central nervous system depression, Paresthesia., Drowsiness, Convulsions, Conjunctivitis., Pulmonary edema. Effects may be delayed., Irregular breathing., Stomach/intestinal disorders, Nausea, Vomiting, Increased liver enzymes., Weakness, Heavy or prolonged skin exposure may result in the absorption of harmful amounts of material., Abdominal pain.

Nerve agent (A-232) Nerve agents alter cholinergic synaptic transmission at neuroeffector junctions (muscarinic effects), at skeletal myoneural junctions and autonomic ganglia (nicotinic effects), and in the CNS. Initial symptoms depend on the dose and route of exposure. Muscarinic effects include pinpoint pupils; blurred or dim vision; conjunctivitis; eye and head pain; hypersecretion by salivary, lacrimal, sweat, and bronchial glands; narrowing of the bronchi; nausea, vomiting, diarrhea, and crampy abdominal pains; urinary and fecal incontinence; and slow heart rate. Nicotinic effects include skeletal muscle twitching, cramping, and weakness. Nicotinic stimulation can obscure certain muscarinic effects and produce rapid heart rate and high blood pressure. Relatively small to moderate vapor exposure causes pinpoint pupils, rhinorrhea, bronchoconstriction, excessive bronchial secretions, and slight to moderate dyspnea. Mild to moderate dermal exposure results in sweating and muscular fasciculations at the site of contact, nausea, vomiting, diarrhea, and weakness. The onset of these mild to moderate signs and symptoms following dermal exposure may be delayed for as long as 18 hours. Higher exposures (any route) cause loss of consciousness, seizures, muscle fasciculations, flaccid paralysis, copious secretions, apnea, and death.

Section 12: Ecological information

The solution is expected to exhibit characteristics of dichloromethane, the dominant component (99.999%). Values below are for dichloromethane.

12.1 Toxicity

Toxicity to fish
LC50 - Pimephales promelas (fathead minnow) - 193.00 mg/L - 96 h
NOEC - Cyprinodon variegatus (sheepshead minnow) - 130 mg/L - 96 h

Toxicity to daphnia and other aquatic invertebrates
EC50 - Daphnia magna (Water flea) - 1,682.00 mg/L - 48 h

12.2 Persistence and degradability

Biodegradability Result: < 26 % - Not readily biodegradable (OECD Test Guideline 301C)

12.3 Bioaccumulative potential

Does not bioaccumulate.

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

Section 13: Disposal considerations

The solution is expected to exhibit characteristics of dichloromethane, the dominant component (99.999%).

13.1 Waste treatment methods

Product

Contact with excess commercial bleach will destroy the A-232 in the dichloromethane. Note that decontamination products may also be toxic. Offer decontaminated solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

Section 14: Transport information

The solution is expected to exhibit characteristics of dichloromethane, the dominant component (99.999%).

DOT (US)

UN number: 1593 Class: 6.1 Packing group: III
Proper shipping name: Dichloromethane
Reportable Quantity (RQ): 1000 lbs
Poison Inhalation Hazard: No

IMDG

UN number: 1593 Class: 6.1 Packing group: III EMS-No: F-A, S-A
Proper shipping name: DICHLOROMETHANE

IATA

UN number: 1593 Class: 6.1 Packing group: III
Proper shipping name: Dichloromethane

Section 15: Regulatory information

The solution is expected to exhibit characteristics of dichloromethane, the dominant component (99.999%).

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313: Methylene chloride, CAS-No., 75-09-2; Revision Date: 2007-07-01

SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

Methylene chloride, CAS-No. 75-09-2, Revision Date: 2007-07-01

Pennsylvania Right To Know Components

Methylene chloride, CAS-No. 75-09-2, Revision Date: 2007-07-01

New Jersey Right To Know Components

Methylene chloride, CAS-No. 75-09-2, Revision Date: 2007-07-01

California Prop. 65 Components

WARNING! This product contains a chemical known to the State of California to cause cancer.
Methylene chloride, CAS-No. 75-09-2, Revision Date: 2007-09-28

Section 16: Other information

The solution is expected to exhibit characteristics of dichloromethane, the dominant component (99.999%).

For dichloromethane:

Full text of H-Statements referred to under sections 2 and 3.

Carc.	Carcinogenicity
Eye Irrit.	Eye irritation
H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.
H336	May cause drowsiness or dizziness.
H351	Suspected of causing cancer.
H373	May cause damage to organs through prolonged or repeated exposure if swallowed.

Skin Irrit.	Skin irritation
STOT RE	Specific target organ toxicity - repeated exposure
STOT SE	Specific target organ toxicity - single exposure

HMIS Rating
- Health hazard: 2
- Chronic Health Hazard: *
- Flammability: 0
- Physical Hazard 0

NFPA Rating
- Health hazard: 2
- Fire Hazard: 0
- Reactivity Hazard: 0

For A-232, NFPA ratings for 100% pure materials are:
- Health: 4
- Fire Hazard: 0
- Flammability: 1

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Lawrence Livermore National Laboratory shall not be held liable for any damage resulting from handling or from contact with the above product.

Information sources:
Information for dichloromethane from Sigma-Aldrich SDS for dichloromethane (Sigma-Aldrich 270997, Version 5.8, 6/2/2016)

Information for chemical agents, U.S. Centers for Disease Control and Prevention (http://www.cdc.gov/niosh/ershdb/index_name.html), and U.S. National Library of Medicine, Toxicology Data Network (https://www.toxnet.nlm.nih.gov/)

Information of properties A-232; http://www.chemspider.com/Chemical-Structure.64808785.html

Carlsen, L. 2019, “After Salisbury Nerve Agents Revisited”, Mol. Inf. 38, 1800106; available at https://onlinelibrary.wiley.com/doi/epdf/10.1002/minf.201800106

Prepared by LLNL under Contract DE-AC52-07NA27344.