NIOSH EMERGENCY RESPONSE CARD

NERVE AGENT	VX
UN #: 2810 (Guide 153) CAS #: 50782-69-9 Alternate CAS #: 51848-47-6 Alternate CAS #: 53800-40-1 Alternate CAS #: 70938-84-0 RTECS #: TB109000	methylphosphonothioic acid, S-[2-[bis(1-methylethyl)amino]ethyl]- O-ethyl ester O-ethyl-S-(2-diisopropylaminoethyl) methylphosphonothioate EA 1701 Chemical Formula: $C_{11}H_{26}NO_2PS$ Molecular weight: 267.37

TYPES OF HAZARD/ EXPOSURE	ACUTE HAZARDS/ CLINICAL SIGNS/ SYMPTOMS	PREVENTION/ PERSONAL PROTECTIVE EQUIPMENT	FIRST AID/ FIRE FIGHTING
FIRE	N/A	Contain to prevent contamination to uncontrolled areas.	Water mist, fog, foam, CO_2. Avoid methods that will cause splashing or spreading.
EXPLOSION	N/A	N/A	N/A
ROUTE OF EXPOSURE			
Synopsis:	**Lethal cholinesterase inhibitor in liquid or vapor form.** **There is only a slight difference between a fatal dose and a dose that produces more mild health effects.** **Clothing releases agent for about 30 minutes after contact with vapor.**	**Do not breathe fumes.** **Skin contact must be avoided at all times.**	**Seek medical attention immediately**. *(See Decontamination section.)* Triage procedures and medical management guidelines - see ATSDR medical management guidelines for Nerve Agents.

	Contaminated surfaces present long-term contact hazard.		
Inhalation:	Symptoms may occur within minutes or hours, depending upon dose. Death usually occurs within 15 minutes after absorption of a fatal dose. **Same sequence of symptoms despite the route of exposure:** **MILD** • Runny nose • Tightness of the chest and breathing difficulty • Eye pain, dimness of vision and pin pointing of pupils (miosis) • Difficulty in breathing and cough **MODERATE** • Increased eye symptoms with blurred vision • Drooling and excessive sweating • Severe nasal congestion • Increased tightness of the chest and breathing difficulty • Nausea, vomiting, diarrhea, and cramps • Generalized weakness, twitching of large muscle groups • Headache,	Hold breath until respiratory protective mask is donned. Fire-Fighting personnel should wear full protective clothing and respiratory protection during fire fighting and rescue. Pressure demand, self-contained breathing apparatus (SCBA) (SCBA CBRN, if available) is recommended in response to non-routine emergency situations. CBRN, Full Facepiece APR (when available) is recommended in non-routine, emergency situation environments less than IDLH but above REL or PEL levels.	For severe signs, immediately administer, in rapid succession, all three Nerve Agent Antidote Kit(s), Mark I injectors (or atropine if directed by a physician). If signs and symptoms are progressing, use injectors at 5 to 20 minute intervals. (No more than 3 injections unless directed by medical personnel.) Maintain record of all injections given. Give artificial respiration if breathing has stopped. Use mouth-to-mouth when mask-bag or oxygen delivery systems not available. Do not use mouth-to-mouth if face is contaminated. Administer oxygen if breathing is difficult. Seek medical attention immediately.

	confusion, and drowsiness **SEVERE** • Involuntary defecation and urination • Very copious secretions • Twitching, jerking, staggering and convulsions • Cessation of breathing, loss of consciousness, coma and death.		
Skin:	Very rapid onset of symptoms. Pupil size may range from normal to moderately reduced. *(See Inhalation for other symptoms.)*	Butyl rubber glove M3 and M4 Norton, Responder® CSM protective clothing.	Don gloves and respiratory protection and then remove contaminated clothing from victim and wash exposed area thoroughly with soap and water. Contaminated clothing can expose rescue workers through direct contact or through off-gassing vapor. *(See 'Antidote Administration' in Inhalation.)* *(See Decontamination section.)* Seek medical attention immediately.

Eyes:	Very rapid onset of symptoms. Pupil size may range from normal to moderately reduced. *(See Inhalation for other symptoms.)*	Chemical goggles and face shield.	Immediately flush with large amounts of tepid water for at least 15 minutes. Seek medical attention immediately.
Ingestion:	First symptoms are likely to be gastrointestinal. Pupil size may range from normal to moderately reduced. *(See Inhalation for other symptoms.)*	Do not eat, drink, or smoke during work. Wash hands before eating.	Do not induce vomiting. Immediately administer Nerve Agent Antidote Kit, Mark I. Seek medical attention immediately.

OCCUPATIONAL EXPOSURE LIMITS (OELs):	OSHA PEL: N/A NIOSH REL: N/A ACGIH TLV: N/A TLV : 0.00001 mg/m^3 (U.S. military) NIOSH IDLH: N/A 1 mg/m^3=0.09145ppm *(See Acute Exposure Guideline Levels below.)*
SAMPLING AND ANALYTICAL METHODS	NIOSH: N/A OSHA: N/A

DECONTAMINATION	• **Patient/Victim:** Don gloves and respiratory protection and then remove contaminated clothing from victim and wash exposed area thoroughly with soap and water. Contaminated clothes and personal belongings should be placed in a sealed double bag. Decontaminate within 1 or 2 minutes following exposure by washing exposed area thoroughly with soap and water. If the hazard is from vapor alone, evacuation of the patient upwind from the exposure source may be sufficient. (1) Patients exposed to nerve agent by vapor only should be decontaminated by removing all clothing in a clean air environment and shampooing or rinsing the hair to prevent vapor-off gassing. (2) Patients exposed to liquid nerve agent should be decontaminated by –

a. Washing in warm or hot water at least three times. Use liquid soap (dispose of container after use and replace), large amounts of water, and mild to moderate friction with a single-use sponge or washcloth in the first and second washes. Scrubbing of exposed skin with a brush is discouraged, because skin damage may occur and may increase absorption. The third wash should be to rinse with large amounts of warm or hot water. Shampoo can be used to wash the hair. The rapid physical removal of a chemical agent is essential. If warm or hot water is not available, but cold water is, use cold water. Do not delay decontamination to obtain warm water.

b. Rinsing the eyes, mucous membranes, or open wounds with sterile saline or water.

(3) The healthcare provider should –

a. Check the patient after the three washes to verify adequate decontamination before allowing entry to the medical treatment facility. If the washes were inadequate, repeat the entire process.

b. Be prepared to administer antidote and or to stabilize conventional injuries during the decontamination process.

c. Protect the airway while conducting decontamination and assure appropriate placement of the respirator over the uncontaminated face. The initial assessment of the casualty can best be performed in an agent-free environment where the health care provider is able to "look, listen, and feel" unencumbered by protective clothing. However, careful decontamination can be a time consuming process. The health care provider may have to enter the contaminated area to treat the casualty during the process. Medical personnel should wear the proper PPE and evaluate the exposed workers.

(For further information see ATSDR medical management guidelines for Nerve Agents, SBCCOM Guidelines for Mass Casualty Decontamination During a Terrorist Chemical Agent Incident (January 2000), and SBCCOM Guidelines for Cold Weather Mass Decontamination During a Terrorist Chemical Agent Incident (January 2002)).

Equipment: N/A

Environment: Large scale procedure (greater than 50g) -- use both calcium hypochlorite (HTH) and NaOH. (*See Spillage Disposal*.)

The small-scale decontamination procedure uses sufficient alcoholic HTH to

	oxidize. If alcoholic HTH mixture is not available, then use following in the order of preference: Decontaminating Agent (DS2), Supertropical Bleach Slurry (STB), and Sodium Hypochlorite.
SPILLAGE DISPOSAL	Cover with vermiculite, diatomaceous earth, clay or fine sand. An alcoholic HTH mixture is prepared by adding 100 milliliters of denatured ethanol to a 900-milliliter slurry of 10% HTH in water just prior to use since the HTH can react with the ethanol. Mix 14g of alcoholic HTH solution for each 1g of VX and agitate as added for a minimum of 1 hr. The mixture will give off heat and gas which should be routed through a decontaminate filled scrubber before release through filtration systems. After the 1hr minimum agitation, 10% sodium hydroxide is added to produce a pH of 12.5 which is maintained for not less than 24 hr. Hold the material at a pH 10 - 12 for 90 days. Scoop decontaminated material and place in approved container. After sealing, decontaminate the exterior and label. All leaking containers will be over packed with sorbent (e.g. vermiculite) placed between the interior and exterior containers. Label and dispose according to regulations. Conduct general area monitoring.
PACKAGING & LABELLING	UN#: 2810 (Guide 153) Proper Shipping Name: Toxic liquids, organic, n.o.s. Hazard Class: 6.1, Packing Group I, Hazard Zone A. Label: Poison. Marking: Toxic liquids, organic, n.o.s. (O-ethyl S-(2-diisopropylaminoethyl)methylphosphonothioate) UN 2810, Inhalation Hazard. Placard: N/A NFPA 704 Signal: Health - 4 Flammability - 1 Reactivity - 1 Special - 0

IMPORTANT DATA	**PHYSICAL STATE; APPEARANCE:** Colorless to straw-colored liquid and odorless, similar in appearance to motor oil. **PHYSICAL DANGERS:** N/A **CHEMICAL DANGERS:** Relatively stable at room temperature. Unstabilized VX of 95% purity decomposes at a rate of 5% a month at 159.8°F. (71°C) At pH 12, the toxic by-product has a half-life of about 14 days and in 90 days there is about a 64-fold reduction. **ROUTES OF EXPOSURE:** The substance can be absorbed into the body by all routes. **INHALATION RISK:** Usually liquid in normal state. It has low volatility and is about 2000 times less volatile than Sarin (GB); however, it is about 10 times more toxic. **EFFECTS OF SHORT-TERM EXPOSURE:** VX, an organophosphorous compound, is a lethal acetylcholinesterase inhibitor similar in action to Sarin (GB). There is only a slight difference between a fatal dose and a dose that produces little health effects. Death usually occurs within 15 minutes after absorption of a fatal dose. The aging half-life for VX is about 48 hours and is the slowest aging nerve agent. **EFFECTS OF LONG-TERM OR REPEATED EXPOSURE:** Limited data suggest delayed neuropathy (postural sway, psychomotor performance). Constricted or pin-point pupils (miosis) has been noted up to 62 days.
PHYSICAL PROPERTIES	Melting Point: -58°F(-50°C) Boiling Point: 568.4°F (298°C) Vapor Pressure (25°C): 0.00063 mm Hg Density (25°C): 1.0083 g /ml Volatility: 8.9-10.5 mg/m^3 at 25°C Vapor density (air=1): 9.2 Aqueous solubility: miscible below 9.4°C; 30 g/L at 25°C Soluble in organic solvents. Estimated log K_{ow}: 2.06 log $K_{benzene\text{-}water}$: unknown Flashpoint: 159°F (70.6°C) Flammability: unknown

ENVIRONMENTAL DATA

Sunlight and/or heat causes reversible photoisomerization.
VX is hydrolyzed only slowly, and the hydrolysis products include EA2192, which is nearly as toxic as VX and is hydrolyzed over 1,000 times more slowly. Oxidation using common bleach (Na(OCl) and superchlorinated bleach ($Ca(OCl)_2$) will decontaminate.

VX is on the Superfund Extremely Dangerous Substances List.

ACUTE EXPOSURE GUIDELINES (AEGLs) Interim

	10 min	30 min	1hr	4 hr	8 hr
AEGL 1 (discomfort, non-disabling) - ppm	0.000052	0.000030	0.000016	0.0000091	0.0000065
AEGL 2 (irreversible or other serious, long-lasting effects or impaired ability to escape) - ppm	0.00065	0.00038	0.00027	0.00014	0.000095
AEGL 3 (life-threatening effects or death) -ppm	0.0027	0.0014	0.00091	0.00048	0.00035

NOTES

ADDITIONAL INFORMATION

Trade Names and Other Synonyms

- Phosphonothioic acid, methyl-,
- O-ethyl S-(2-bis(1-methylethylamino)ethyl) 0-ethyl ester
- S-(2-diisopropylaminoethyl) methylphosphonothioate
- S-2-Diisopropylaminoethyl O-ethyl methylphosphonothioate
- S-2((2-Diisopropylamino)ethyl) O-ethyl methylphosphonothiolate
- O-ethyl S-(2-diisopropylaminoethyl) methylphosphonothioate
- O-ethyl S-(2-diisopropylaminoethyl) methylthiolphosphonoate
- S-(2-diisopropylaminoethyl) o-ethyl methyl phosphonothiolate
- Ethyl-S-dimethylaminoethyl methylphosphonothiolate
- TX60

GLOSSARY OF ACRONYMS	**APR -** Air-purifying Respirator **CBRN -** Chemical, Biological, Radiological, Nuclear **IDLH -** Immediately Dangerous to Life and Health **REL -** Recommended Exposure Limit **PEL -** Permissible Exposure Limit **SCBA** - Self-Contained Breathing Apparatus

IMPORTANT NOTICE:	**VX (ERC50782-69-9)** The user should verify compliance of the cards with the relevant STATE or TERRITORY legislation before use. NIOSH, CDC 2003