Malathion

sc-211768

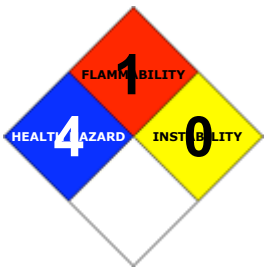
Material Safety Data Sheet

Hazard Alert Code Key:	EXTREME	HIGH	MODERATE	LOW

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
Malathion

STATEMENT OF HAZARDOUS NATURE
CONSIDERED A HAZARDOUS SUBSTANCE ACCORDING TO OSHA 29 CFR 1910.1200.

NFPA


SUPPLIER
Company: Santa Cruz Biotechnology, Inc.
Address:
2145 Delaware Ave
Santa Cruz, CA 95060
Telephone: 800.457.3801 or 831.457.3800
Emergency Tel: **CHEMWATCH: From within the US and Canada: 877-715-9305**
Emergency Tel: **From outside the US and Canada: +800 2436 2255 (1-800-CHEMCALL) or call +613 9573 3112**

PRODUCT USE
Concentrate which is used for preparation of semi-persistent insecticides effective against Mediterranean fruit fly, thrip and mites. Sold as emulsifiable concentrate, wettable powder and dusting powder. Used as a spray on fruit, vegetables, ornamentals and livestock.

SYNONYMS
C10-H19-O6-P-S2, "S-(1, 2-bis(carbethoxy)ethyl) O, O-dimethyl dithiophosphate", "S-(1, 2-bis(ethoxycarbonyl)ethyl) O, O-dimethyl phosphorodithioate", "S-1, 2-bis(ethoxycarbonyl)ethyl-O, O-dimethyl thiophosphate", "diethyl (dimethoxyphosphinothioylthio) butanedioate", "diethyl mercaptosuccinate, O, O-dimethyl dithiophaphate, S-ester", "diethyl mercaptosuccinic acid O, O-dimethyl phosphorodithioate", "((dimethoxyphosphinothioyl)thio)butanedioic acid diethyl ester", "O, O-dimethyldithiophosphate diethylmercaptosuccinate", "mercaptosuccinic acid diethyl ester", mercaptothion, "O, O--dimethyl-S-(1, 2-dicarbethoxyethyl) dithiophosphate", Calmathion, Carbetox, "Carbethoxy malathion", Carbophos, Celthion, Chemathion, Cimexam, Cythion, "Detmol MA", Emmatos, Ethiolacar, Etiol, Extermathion, Formal, Forthion, "Fyfanon ULV", Hilthion, "Insecticide No. 4049", -, Karbofos, Kypfos, Malacide, Malmed, Malafor, Malakill, Malagran, Malamar, Malaphos, Malasol, Malaspray, Malathon, Malatox, Maldison, Maltox, Prioderm, Oleophosphothion, "Orthomalathion Sadophos", Sumitox

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

		Min	Max
Flammability:	1		
Toxicity:	4		
Body Contact:	2		
Reactivity:	1		
Chronic:	2		

Min/Nil=0
Low=1
Moderate=2
High=3
Extreme=4

CANADIAN WHMIS SYMBOLS

EMERGENCY OVERVIEW

RISK

Harmful if swallowed.
Very toxic by inhalation.
May cause SENSITIZATION by skin contact.
Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

■ Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual.
■ Ingestion may produce nausea, vomiting, depressed appetite, abdominal cramps,and diarrhea.
■ Over many years, clinical experience indicates man may be more susceptible to the effects of malathion than rats. Even so malathion is about 1000 times less potent as a cholinesterase inhibitor than parathion due in part to ali-esterases that metabolise malathion to inactive products. Malaoxon the active anticholinesterase metabolite of malathion also has aliesterase inhibiting activity. Crude grades may contain malaoxon as an impurity. The mean lethal dose by mouth in an untreated adult is probably as low as 250 mg/kg; i.e. about 15.5 gram for 70 kg adult.
Acute exposures may result in anorexia, nausea, vomiting, diarrhoea, excessive salivation, constriction of the pupils, bronchioconstriction, muscular twitchings, convulsions, coma and respiratory failure. Symptoms may develop over 8 or more hours.
■ Thiophosphates (phosphothioate esters) do not generally produce the same degree of cholinesterase inhibition associated with other organophosphates. They may however react with a range of compounds to produce such inhibitors. Ingestion of large quantities may produce severe abdominal pains, thirst, acidaemia, difficult breathing, convulsions, collapse, shock and even death. Organophosphates may suppress the immune system in some animal species.

EYE

■ There is some evidence to suggest that this material can causeeye irritation and damage in some persons.
■ Direct eye contact can produce tears, eyelid twitches, pupil contraction, loss of focus, and blurred or dimmed vision. Dilation of the pupils occasionally occurs.

SKIN

■ The liquid may be miscible with fats or oils and may degrease the skin, producing a skin reaction described as non-allergic contact dermatitis. The material is unlikely to produce an irritant dermatitis as described in EC Directives .
■ Skin contact with the material may damage the health of the individual; systemic effects may result following absorption.
■ There may be sweating and muscle twitches at site of contact. Reaction may bedelayed by hours.
■ Two suspected poisonings in children have occurred under circumstances suggestive that percutaneous absorption was the major route of exposure.
In an experimental study, malathion was found to be a weak contact sensitiser, inducing a mild cutaneous reaction in a high proportion of subjects. Development of sensitisation has, however, not been a significant problem in its wide-spread use.
■ Open cuts, abraded or irritated skin should not be exposed to this material.
■ Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

INHALED

■ The material is not thought to produce respiratory irritation (as classified using animal models). Nevertheless inhalation of vapors, fumes or aerosols, especially for prolonged periods, may produce respiratory discomfort and occasionally, distress.
■ Poisoning due to cholinesterase inhibitors causes symptoms such as increased blood flow to the nose, watery discharge, chest discomfort, shortness of breath and wheezing. Other symptoms include increased production of tears, nausea and vomiting, diarrhea, stomach pain, involuntary passing of urine and stools, chest pain, breathing difficulty, low blood pressure, irregular heartbeat, loss of reflexes, twitching, visual disturbances, altered pupil size, convulsions, lung congestion, coma and heart failure. Nervous system effects include inco-ordination, slurred speech, tremors of the tongue and eyelids, and paralysis of the limbs and muscles of breathing, which can cause death, although death is also seen due to cardiac arrest.
■ Large-scale occupational poisonings of 5350 spraymen, 1070 mixers and 1070 supervisors (in 1976) resulted in the resignation of many too ill to continue in their jobs and at least 5 deaths.. the high toxicity of this particular preparation was associated with 2% to 3% isomalathion a compound that potentiates the toxicity of the insecticide.
Acute intoxication at high doses alters the electroencephalogram (EEG) as do repeated exposures at low doses.

CHRONIC HEALTH EFFECTS

■ There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment.
Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.
There is limited evidence that, skin contact with this product is more likely to cause a sensitization reaction in some persons compared to the general population.
Repeated or prolonged exposures to cholinesterase inhibitors produce symptoms similar to acute effects. In addition workers exposed repeatedly to these substances may exhibit impaired memory and loss of concentration, severe depression and acute psychosis, irritability, confusion, apathy, emotional liability, speech difficulties, headache, spatial disorientation, delayed reaction times, sleepwalking, drowsiness or

insomnia. An influenza-like condition with nausea, weakness, anorexia and malaise has been described. There is a growing body of evidence from epidemiological studies and from experimental laboratory studies that short-term exposure to some cholinesterase-inhibiting insecticides may produce behavioral or neuro- chemical changes lasting for days or months, presumably outlasting the cholinesterase inhibition. Although the number of adverse effects following humans poisonings subside, there are still effects in some workers months after cholinesterase activity returns to normal. These long-lasting effects include blurred vision, headache, weakness, and anorexia. The neurochemistry of animals exposed to chlorpyrifos or fenthion is reported to be altered permanently after a single exposure. These effects may be more severe in developing animals where both acetyl- and butyrylcholinesterase may play an integral part in the development of the nervous system. Padilla S., The Neurotoxicity of Cholinesterase-Inhibiting Insecticides: Past and Present Evidence Demonstrating Persistent Effects. Inhalation Toxicology 7:903-907, 1995.
BE AWARE: Repeated minor exposures with only mild symptoms may have serious cumulative poisoning effect.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
malathion	121-75-5	>95
impurities may include		
O,O,S-trimethyl phosphorodithioate	2953-29-9	

Section 4 - FIRST AID MEASURES

SWALLOWED

■ If swallowed:

- Contact a Poisons Information Center or a doctor at once.
- If swallowed, activated charcoal may be advised.
- Give atropine if instructed.
- REFER FOR MEDICAL ATTENTION WITHOUT DELAY.
- In the mean time, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
- If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided.
- Further action will be the responsibility of the medical specialist.
- If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS.

EYE

■ If this product comes in contact with the eyes:

- Immediately hold eyelids apart and flush the eye continuously with running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Continue flushing until advised to stop by the Poisons Information Center or a doctor, or for at least 15 minutes.
- Transport to hospital or doctor without delay.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

SKIN

■ If product comes in contact with skin:

- Contact a Poisons Information Center or a doctor.
- DO NOT allow clothing wet with product to remain in contact with skin, strip all contaminated clothing including boots.
- Quickly wash affected areas vigorously with soap and water.
- DO NOT give anything by mouth to a patient showing signs of narcosis, i.e. losing consciousness.
- Give atropine if instructed.
- DO NOT delay, get to a doctor or hospital quickly.

INHALED

■

- If spray mist, vapor are inhaled, remove from contaminated area.
- Contact a Poisons Information Center or a doctor at once.
- Lay patient down in a clean area and strip any clothing wet with spray.
- Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
- Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
- DO NOT give anything by mouth to a patient showing signs of narcosis, i.e. losing consciousness.
- Give atropine if instructed.
- Get to doctor or hospital quickly.

NOTES TO PHYSICIAN

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- Most organophosphate compounds are rapidly well absorbed from the skin, conjunctiva, gastro-intestinal tract and lungs.
- They are detoxified by Cytochrome P450-mediated monoxygenases in the liver but some metabolites are more toxic than parent compounds.
- Metabolites are usually detected 12-48 hours postexposure.

- Organophosphates phosphorylate acetylcholinesterase with resultant accumulation of large amounts of acetylcholine causing initial stimulation, then exhaustion of cholinergic synapse.
- gamma-aminobutyric acid (GABA)-ergic and dopaminergic pathways provide compensatory inhibition.
- The clinical manifestation of organophosphate toxicity results from muscarinic, nicotinic and CNS symptoms.
- A garlic-like odor emanating from the patient or involved container may aid the diagnosis.
- Immediate life-threatening symptoms usually are respiratory problems.
- Frequent suction and, if necessary, endotracheal intubation and assisted ventilation may be necessary to maintain adequate oxygenation.
- Theophylline compounds, to treat bronchospasm, should be used cautiously as they may lower the seizure threshold.
- Excessive secretions and bronchospasm should respond to adequate doses of atropine.
- Diazepam is the drug of choice for convulsions.
- Usual methods of decontamination, (activated charcoal and cathartics) should be used when patients present 4-6 hours postexposure.
- The administration of atropine, as an antidote, does not require confirmation by acetylcholinesterase levels. Severely poisoned patients develop marked resistance to the usual doses of atropine. [Atropine should not be given to a cyanosed patient - ICI] NOTE: Hypoxia must be corrected before atropine is given. For adult: 2 mg repeatedly SC or IV until atropinization is achieved and maintained (atropinization is characterised by decreased bronchial secretions, heart rate >100 bpm, dry mouth, diluted pupils).
- Pralidoxime (2-PAM, Protopam) is a specific antidote when given within 24 hours and perhaps up to 36-48 hours postexposure. Although it ameliorates muscle weakness, fasciculations and alterations of consciousness, it does not relieve bronchospasm or bronchorrhea and must be given concurrently with atropine. NOTE: Pralidoxime should be given as an adjunct to, NOT a replacement for atropine and should be given in every case where atropine therapy is deemed necessary. Traditional dose: 1 g (or 2 g in severe cases) by slow IV injection over 5-10 minutes. 1-2 g, 4 hourly (maximum dose 12 g in 24 hours) until clinical and analytical recovery is achieved and maintained.
- Avoid parasympathomimetic agents. Phenothiazines and antihistamines may potentiate organophosphate activity. [Ellenhorn and Barceloux: Medical Toxicology]

NOTE: Acute pancreatitis in organophosphate intoxication may be more common than reported. The possible pathogenesis of pancreatic insult are excessive cholinergic stimulation of the pancreas and ductular hypertension. Early recognition and appropriate therapy for acute pancreatitis may lead to an improved prognosis. Cheng-Tin Hsiao, et al; Clinical Toxicology 34(3), 343-347 (1996)BIOLOGICAL EXPOSURE INDEX - BEI These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
1. Cholinesterase activity in red cells	70% of individual's baseline	Discretionary	NS

B: Background levels occur in specimens collected from subjects NOT exposed
NS:Non-specific determinant; Also observed after exposure to other materials
SQ:Semi-quantitative determinant; Interpretation may be ambiguous. Should be used as a screening test or confirmatory test.
Some jurisdictions require that health surveillance be conducted on occupationally exposed workers. Such surveillance should emphasise

- demography, occupational and medical history and health advice
- physical examination
- baseline estimation of red cell and plasma cholinesterase activity levels by the Ellman method. Estimation of red cell and plasma cholinesterase activity towards the end of the working day

Section 5 - FIRE FIGHTING MEASURES

Vapour Pressure (mmHG):	Negligible.
Upper Explosive Limit (%):	Not available.
Specific Gravity (water=1):	1.23 @ 25 C.
Lower Explosive Limit (%):	Not available.

EXTINGUISHING MEDIA

- Foam.
- Dry chemical powder.
- BCF (where regulations permit).
- Carbon dioxide.
- Water spray or fog - Large fires only.

FIRE FIGHTING

- Alert Emergency Responders and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Use fire fighting procedures suitable for surrounding area.
- DO NOT approach containers suspected to be hot.
- Cool fire exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.
- Equipment should be thoroughly decontaminated after use.

GENERAL FIRE HAZARDS/HAZARDOUS COMBUSTIBLE PRODUCTS

- Combustible.

- Slight fire hazard when exposed to heat or flame.
- Heating may cause expansion or decomposition leading to violent rupture of containers.
- On combustion, may emit toxic fumes of carbon monoxide (CO).
- May emit acrid smoke.
- Mists containing combustible materials may be explosive.

Combustion products include: carbon dioxide (CO_2), phosphorus oxides (POx), sulfur oxides (SOx), other pyrolysis products typical of burning organic material.
May emit poisonous fumes.

FIRE INCOMPATIBILITY

■ Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids,chlorine bleaches, pool chlorine etc. as ignition may result.

PERSONAL PROTECTION

Glasses:
Chemical goggles.
Gloves:
Respirator:
Type A-P Filter of sufficient capacity

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS

■

- Remove all ignition sources.
- Clean up all spills immediately.
- Avoid breathing vapors and contact with skin and eyes.
- Control personal contact by using protective equipment.
- Contain and absorb spill with sand, earth, inert material or vermiculite.
- Wipe up.
- Place in a suitable labeled container for waste disposal.

MAJOR SPILLS

■ Chemical Class: organophosphates
For release onto land: recommended sorbents listed in order of priority.

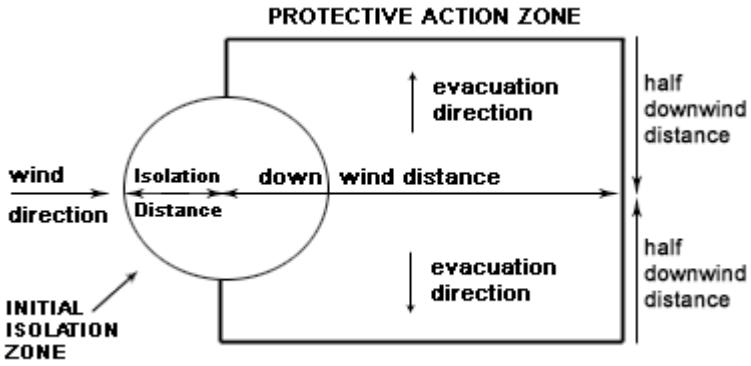
SORBENT TYPE	RANK	APPLICATION	COLLECTION	LIMITATIONS
LAND SPILL - SMALL				
cross-linked polymer - particulate	1	shovel	shovel	R, W, SS
cross-linked polymer - pillow	1	throw	pitchfork	R, DGC, RT
wood fiber - pillow	1	throw	pitchfork	R,P, DGC, RT
foamed glass - pillow	2	shovel	shovel	R, W, P, DGC
sorbent clay - particulate	2	shovel	shovel	R, I, P
wood fibre - particulate	3	shovel	shovel	R,W, P, DGC
LAND SPILL - MEDIUM				
cross-linked polymer -particulate	1	blower	skiploader	R, W, SS
sorbent clay - particulate	2	blower	skiploader	R, I, P
polypropylene - particulate	2	blower	skiploader	R, SS, DGC
expanded mineral - particulate	3	blower	skiploader	R,I, W, P, DGC
wood fiber- particulate	3	blower	skiploader	R, W, P, DGC
polypropylene - mat	3	throw	skiploader	DGC, RT

Legend
DGC: Not effective where ground cover is dense
R; Not reusable
I: Not incinerable
P: Effectiveness reduced when rainy
RT:Not effective where terrain is rugged
SS: Not for use within environmentally sensitive sites
W: Effectiveness reduced when windy
Reference: Sorbents for Liquid Hazardous Substance Cleanup and Control;
R.W Melvold et al: Pollution Technology Review No. 150: Noyes Data Corporation 1988.

- Clear area of personnel and move upwind.
- Alert Emergency Responders and tell them location and nature of hazard.
- Wear full body protective clothing with breathing apparatus.
- Prevent, by any means available, spillage from entering drains or water course.
- Stop leak if safe to do so.
- Contain spill with sand, earth or vermiculite.
- Collect recoverable product into labeled containers for recycling.
- Neutralize/decontaminate residue.

- Collect solid residues and seal in labeled drums for disposal.
- Wash area and prevent runoff into drains.
- After clean up operations, decontaminate and launder all protective clothing and equipment before storing and re-using.
- If contamination of drains or waterways occurs, advise emergency services.

PROTECTIVE ACTIONS FOR SPILL



From IERG (Canada/Australia)	
Isolation Distance	25 meters
Downwind Protection Distance	250 meters

From US Emergency Response Guide 2000 Guide 152

FOOTNOTES

1 PROTECTIVE ACTION ZONE is defined as the area in which people are at risk of harmful exposure. This zone assumes that random changes in wind direction confines the vapour plume to an area within 30 degrees on either side of the predominant wind direction, resulting in a crosswind protective action distance equal to the downwind protective action distance.
2 PROTECTIVE ACTIONS should be initiated to the extent possible, beginning with those closest to the spill and working away from the site in the downwind direction. Within the protective action zone a level of vapour concentration may exist resulting in nearly all unprotected persons becoming incapacitated and unable to take protective action and/or incurring serious or irreversible health effects.
3 INITIAL ISOLATION ZONE is determined as an area, including upwind of the incident, within which a high probability of localised wind reversal may expose nearly all persons without appropriate protection to life-threatening concentrations of the material.
4 SMALL SPILLS involve a leaking package of 200 litres (55 US gallons) or less, such as a drum (jerrican or box with inner containers). Larger packages leaking less than 200 litres and compressed gas leaking from a small cylinder are also considered "small spills". LARGE SPILLS involve many small leaking packages or a leaking package of greater than 200 litres, such as a cargo tank, portable tank or a "one-tonne" compressed gas cylinder.
5 Guide 152 is taken from the US DOT emergency response guide book.
6 IERG information is derived from CANUTEC - Transport Canada.

ACUTE EXPOSURE GUIDELINE LEVELS (AEGL) (in ppm)

AEGL 1: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
AEGL 2: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
AEGL 3: The airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

- DO NOT allow clothing wet with material to stay in contact with skin
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- Prevent concentration in hollows and sumps.
- DO NOT enter confined spaces until atmosphere has been checked.
- DO NOT allow material to contact humans, exposed food or food utensils.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.

- Work clothes should be laundered separately.
- Launder contaminated clothing before re-use.
- Use good occupational work practice.
- Observe manufacturer's storing and handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

RECOMMENDED STORAGE METHODS

■

- DO NOT use unlined steel containers
- Lined metal can, Lined metal pail/drum
- Plastic pail
- Polyliner drum
- Packing as recommended by manufacturer.
- Check all containers are clearly labeled and free from leaks.

For low viscosity materials

- Drums and jerricans must be of the non-removable head type.
- Where a can is to be used as an inner package, the can must have a screwed enclosure.

For materials with a viscosity of at least 2680 cSt. (23 deg. C) and solids (between 15 C deg. and 40 deg C.):

- Removable head packaging;
- Cans with friction closures and
- low pressure tubes and cartridges may be used.

- Where combination packages are used, and the inner packages are of glass, there must be sufficient inert cushioning material in contact with inner and outer packages * . - In addition, where inner packagings are glass and contain liquids of packing group I and II there must be sufficient inert absorbent to absorb any spillage *. - * unless the outer packaging is a close fitting molded plastic box and the substances are not incompatible with the plastic. All inner and sole packagings for substances that have been assigned to Packaging Groups I or II on the basis of inhalation toxicity criteria, must be hermetically sealed.

STORAGE REQUIREMENTS

■

- Store in original containers.
- Keep containers securely sealed.
- Store in a cool, dry, well-ventilated area.
- Store away from incompatible materials and foodstuff containers.
- Protect containers against physical damage and check regularly for leaks.
- Observe manufacturer's storing and handling recommendations.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS

X X + X X +

X: Must not be stored together
O: May be stored together with specific preventions
+: May be stored together

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m³	STEL ppm	STEL mg/m³	Peak ppm	Peak mg/m³	TWA F/CC	Notes
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)	malathion (MALATHION)		0.2						
US - Minnesota Permissible Exposure Limits (PELs)	malathion (Malathion - Respirable fraction)		5						
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)	malathion (MALATHION)		0.02						
Canada - British Columbia Occupational Exposure Limits	malathion (Malathion, Inhalable Revised 2003)		1 (V)						Skin

Canada - Alberta Occupational Exposure Limits	malathion (Malathion)		1			
US - Minnesota Permissible Exposure Limits (PELs)	malathion (Malathion - Total dust)		10			
Canada - Ontario Occupational Exposure Limits	malathion (Malathion, inhalable, vapour and aerosol)		1			Skin
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	malathion (Malathion - Respirable fraction)		5			
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants	malathion (Malathion - Total dust)		15			
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	malathion (Malathion - Respirable fraction)		5			
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants	malathion (Malathion - Total dust)		10			
US - California Permissible Exposure Limits for Chemical Contaminants	malathion (Malathion; o,o-dimethyl S-1(1,2-dicarboethyoxyethyl) phosphorodithioate)		10			
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants	malathion (Malathion Total dust)		10			
US - Idaho - Limits for Air Contaminants	malathion (Malathion - Total dust)		15			
US - Alaska Limits for Air Contaminants	malathion (Malathion - Respirable fraction)		5			
US - Alaska Limits for Air Contaminants	malathion (Malathion - Total dust)		10			
US - Oregon Permissible Exposure Limits (Z-1)	malathion (Malathion)		10			*
US - Michigan Exposure Limits for Air Contaminants	malathion (Malathion dust)		10			
US - Washington Permissible exposure limits of air contaminants	malathion (Malathion - Total particulate)		10		20	
Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances	malathion (Malathion - Skin)	-	10	-	10	
US - Hawaii Air Contaminant Limits	malathion (Malathion - Total dust)		10			
Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits	malathion (Malathion, (inhalable fraction++ and vapour))		1		3	Skin
US OSHA Permissible Exposure Levels (PELs) - Table Z1	malathion (Malathion - Total dust)		15			
Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)	malathion (Malathion)		10			
US NIOSH Recommended Exposure Limits (RELs)	malathion (Malathion)		10			[skin]

US ACGIH Threshold Limit Values (TLV)	malathion (Malathion)	1		TLV Basis: cholinesterase inhibition. BEI-A
Canada - Nova Scotia Occupational Exposure Limits	malathion (Malathion)	1		TLV Basis: cholinesterase inhibition. BEI-A
Canada - Northwest Territories Occupational Exposure Limits (English)	malathion (Malathion - Skin)	10	20	
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants	malathion (Malathion-Total dust)	15		
Canada - Prince Edward Island Occupational Exposure Limits	malathion (Malathion)	1		TLV Basis: cholinesterase inhibition. BEI-A

The following materials had no OELs on our records

• O,O,S-trimethyl phosphorodithioate: CAS:2953-29-9

MATERIAL DATA

MALATHION:

■ For malathion

The derivation of the TLV-TWA takes into consideration the fact that individuals have tolerated, without ill-effect, single oral doses of 0.84 mg/kg, repeated oral doses of 0.34 mg/kg/day, or repeated dermally absorbed doses of 3.2 mg/kg/day with no change to their cholinesterase activity.

Exposure at the TLV-TWA results in an absorbed dose of no more than 1.4 mg/kg/day; an amount less than the doses absorbed by humans without significant health deficits.

O,O,S-TRIMETHYL PHOSPHORODITHIOATE:

■ Sensory irritants are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers' responses to various airborne concentrations. Present day expectations require that nearly every individual should be protected against even minor sensory irritation and exposure standards are established using uncertainty factors or safety factors of 5 to 10 or more. On occasion animal no-observable-effect-levels (NOEL) are used to determine these limits where human results are unavailable. An additional approach, typically used by the TLV committee (USA) in determining respiratory standards for this group of chemicals, has been to assign ceiling values (TLV C) to rapidly acting irritants and to assign short-term exposure limits (TLV STELs) when the weight of evidence from irritation, bioaccumulation and other endpoints combine to warrant such a limit. In contrast the MAK Commission (Germany) uses a five-category system based on intensive odour, local irritation, and elimination half-life. However this system is being replaced to be consistent with the European Union (EU) Scientific Committee for Occupational Exposure Limits (SCOEL); this is more closely allied to that of the USA.

OSHA (USA) concluded that exposure to sensory irritants can:

- cause inflammation
- cause increased susceptibility to other irritants and infectious agents
- lead to permanent injury or dysfunction
- permit greater absorption of hazardous substances and
- acclimate the worker to the irritant warning properties of these substances thus increasing the risk of overexposure.

PERSONAL PROTECTION

Consult your EHS staff for recommendations

EYE

■

- Safety glasses with side shields.
- Chemical goggles.
- Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. DO NOT wear contact lenses.

HANDS/FEET

■ NOTE: The material may produce skin sensitization in predisposed individuals. Care must be taken, when removing gloves and other protective equipment, to avoid all possible skin contact.

Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include: such as:

- frequency and duration of contact,
- chemical resistance of glove material,
- glove thickness and
- dexterity

Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739).

- When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374) is recommended.
- When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374) is recommended.
- Contaminated gloves should be replaced.

Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.

- Nitrile rubber gloves

Nitrile gloves can be used for at least 4 hours to protect against diluted solutions of formulations in water carrier, such as when sprayed in the field. [Appl.Occup.Environ.Hyg. 13(3)]

OTHER

■

- Overalls.
- Eyewash unit.
- Barrier cream.
- Skin cleansing cream.
- Ensure that there is a supply of atropine tablets on hand
- Ensure all employees have been informed of symptoms of carbamate poisoning and that the use of atropine in first aid is understood .

RESPIRATOR

■ Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

Breathing Zone Level ppm (volume)	Maximum Protection Factor	Half-face Respirator	Full-Face Respirator
1000	10	A-1 P	-
1000	50	-	A-1 P
5000	50	Airline*	-
5000	100	-	A-2 P
10000	100	-	A-3 P
	100+		Airline* *

* - Continuous Flow ** - Continuous-flow or positive pressure demand.

The local concentration of material, quantity and conditions of use determine the type of personal protective equipment required.

Use appropriate NIOSH-certified respirator based on informed professional judgement. In conditions where no reasonable estimate of exposure can be made, assume the exposure is in a concentration IDLH and use NIOSH-certified full face pressure demand SCBA with a minimum service life of 30 minutes, or a combination full facepiece pressure demand SAR with auxiliary self-contained air supply. Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

ENGINEERING CONTROLS

■ Local exhaust ventilation usually required. If risk of overexposure exists, wear an approved respirator. Correct fit is essential to obtain adequate protection an approved self contained breathing apparatus (SCBA) may be required in some situations. Provide adequate ventilation in warehouse or closed storage area.

Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

Type of Contaminant:	Air Speed:
solvent, vapors, degreasing etc., evaporating from tank (in still air).	0.25-0.5 m/s (50-100 f/min.)
aerosols, fumes from pouring operations, intermittent container filling, low speed conveyer transfers, welding, spray drift, plating acid fumes, pickling (released at low velocity into zone of active generation)	0.5-1 m/s (100-200 f/min.)
direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion)	1-2.5 m/s (200-500 f/min.)
grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion).	2.5-10 m/s (500-2000 f/min.)

Within each range the appropriate value depends on:

Lower end of the range	Upper end of the range
1: Room air currents minimal or favorable to capture	1: Disturbing room air currents
2: Contaminants of low toxicity or of nuisance value only.	2: Contaminants of high toxicity
3: Intermittent, low production.	3: High production, heavy use
4: Large hood or large air mass in motion	4: Small hood-local control only

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min) for extraction of solvents generated in a tank 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

Concentrate material is measured and mixed, preferably outdoors, in proportions as recommended by manufacturer.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL PROPERTIES

Liquid.
Does not mix with water.
Sinks in water.
Toxic or noxious vapors/ gas.

State	Liquid	Molecular Weight	330.36
Melting Range (°F)	37.22	Viscosity	Not Available
Boiling Range (°F)	312.8- 314.6 (7mmHg)	Solubility in water (g/L)	Partly miscible
Flash Point (°F)	>325.4	pH (1% solution)	Not applicable.
Decomposition Temp (°F)	Not Available	pH (as supplied)	Not applicable
Autoignition Temp (°F)	Not available.	Vapour Pressure (mmHG)	Negligible.
Upper Explosive Limit (%)	Not available.	Specific Gravity (water=1)	1.23 @ 25 C.
Lower Explosive Limit (%)	Not available.	Relative Vapor Density (air=1)	Not available.
Volatile Component (%vol)	Not available.	Evaporation Rate	Not available

MALATHION

■ log Kow (Sangster 1997): 2.36

APPEARANCE

Deep brown to yellow, or colourless oily liquid, with a characteristic unpleasant odour. Miscible with most polar organic solvents, slightly soluble in water (145 ppm). At high temperatures, Malathion may isomerise to form the more toxic isomalathion

Modeling data indicates that these substances have low water solubility and that the log of the octanol-water partition coefficient (log Kow) of these substances range from 4.48-7.99. The low water solubility is consistent with the high lipophilic nature of these substances. Unpublished company data on a commercial zinc dialkyldithiophosphate with a carbon chain length of less than eight yielded a log Kow value of 2.49. Longer chain materials are likely to have higher octanol/water partition coefficients. The log Kow is a measure of the lipophilicity of a substance and is used as a surrogate indicator of the potential of a chemical substance to bioaccumulate in aquatic organisms. While Log Kow is a good predictor of bioaccumulation for nonpolar organic compounds, the mechanisms for uptake and depuration of metals and metal compounds are very complex and variable. For metal compounds, the Log Kow data are not indicative of the bioaccumulation potential .

Material	Value
■ log Kow (Sangster 1997)	2.36

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

■

- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerization will not occur.

STORAGE INCOMPATIBILITY

■ A number of phosphate and thiophosphate esters are of limited thermal stability and undergo highly exothermic self-accelerating decomposition reactions which may be catalyzed by impurities. The potential hazards can be reduced by appropriate thermal control measures.
BRETHERICK L.: Handbook of Reactive Chemical Hazards.

- Alkyl esters of thiophosphates are often temperature sensitive and decompose if overheated. Thermal decomposition products include highly toxic and odiferous hydrogen sulfide and extremely odorous alkyl mercaptans. Both species can be detected at extremely low concentrations and vapors may travel long distances.
- Low temperature storage may produce crystallization from solution.
- CARE: If heating to liquefy, use tepid water, Avoid temperatures in excess of 50 deg. C.
- Head-space of drums may contain hydrogen sulfide.

Avoid reaction with oxidizing agents.

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

MALATHION

TOXICITY AND IRRITATION

■ unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

TOXICITY	IRRITATION
Oral (man) LDLo: 471 mg/m³	Nil Reported
Oral (woman) LDLo: 246 mg/m³ [Manufacturer]*	
Oral (rat) LD50: 290 mg/kg	
Inhalation (rat) LC50: 84.6 mg/m³/4h	
Dermal (rabbit) LD50: 4100 mg/kg	
Dermal (rat) LD50: 4444 mg/kg	
Oral (rat) LD50: 2800 mg/kg*	

■ For malathion:

Numerous malathion intoxication incidents have occurred among pesticide workers and with small children through accidental exposure. Human exposures can occur through ingestion, inhalation, and absorption through the skin.

Several factors affect the toxicity of the pesticide. For example, the toxicity of malathion appeared to be strongly linked to the amount of protein in the diet of laboratory rats . As protein intake decreased, malathion was increasingly toxic to the rats. Malathion has been shown to have different toxicities in male and female rats and humans due to metabolism, storage and excretion differences between the sexes. For humans, the lowest dose at which lethal effects have been observed was nearly three times higher for males than for females. Acute symptoms in humans include nausea, headache, tightness in the chest, and other symptoms typical of acetyl- cholinesterase inhibition. Unconsciousness, convulsions, and a "prolonged worsening illness" are also typical of malathion poisoning at high doses.

Human volunteers fed very low doses of malathion for one and a half months showed no significant effects on blood cholinesterase activity. Rats fed diets containing 100-1,500 ppm of malathion in their food for two years showed no symptoms apart from depressed cholinesterase activity. When small amounts of the compound were administered for eight weeks, rats showed no adverse effects on whole-blood cholinesterase activity. Weanling male rats were twice as susceptible to malathion as adults.

Reproductive and Teratogenic Effects: Several studies have documented developmental and reproductive effects due to high doses of malathion in test animals. However, malathion fed to rats at a low dosages caused no reproductive effects.

Malathion and its metabolites can cross the placenta of the goat and depress cholinesterase activity of the foetus . Rats fed high doses (240 mg/kg) showed no teratogenic effects, but similar doses (300 mg/kg) administered by stomach tube during pregnancy caused an increased rate of newborn mortality. Chickens fed diets at low doses for two years showed no adverse effects on egg hatching. There is no direct evidence that malathion is teratogenic in mammals.

Mutagenic Effects: Malathion produced detectable mutations in three different types of cultured human cells, including white blood cells and lymph cells. It is possible that malathion could pose a mutagenic risk to humans chronically exposed.

Carcinogenic Effects: Female mice fed approximately 1% diets of malathion for over three years showed no significant increased tumour incidence. Female rats on diets containing high concentrations of malathion for two years did not develop tumors. Adrenal tumors developed in the males at low doses, but not at the high doses, suggesting that malathion may not have been the cause. Three of five studies that have investigated the carcinogenicity of malathion have found that the compound does not produce tumours in the test animals. The two other studies have been determined to be unacceptable studies and the results discounted. While it seems unlikely that the compound would pose a significant cancer risk to humans exposed at low levels there is not enough data to draw definitive conclusions.

Organ Toxicity: The pesticide has been shown to affect both the adrenal glands and the liver of rats. It also has effects on blood clotting time in test animals.

Fate in Humans and Animals: Malathion is rapidly and effectively absorbed by practically all routes including the gastrointestinal tract, skin, mucous membranes, and lungs. In rats, 44% was excreted in the urine in eight hours and 83% after 24 hours. Of the remainder 6% appeared in faeces, 3% was in expired air and 8% remained in the gastrointestinal tract. Cows excreted malathion less rapidly with 69% in the urine in four days, 8% in the faeces and 0.2% in the milk.

Autopsy samples from one individual who had ingested large amounts of malathion showed a substantial portion in the stomach and intestines, a small amount in fat tissue and no detectable levels in the liver. Malathion requires conversion to malaoxon to become an active anticholinesterase agent. Most of the occupational evidence indicates a low chronic toxicity for malathion. One important exception to this was traced to impurities in the formulation of the pesticide.

Although the liver is the richest source of the bioactivation enzyme among various mammalian organs, the source organ of malaoxon responsible for acute toxicity has not been determined. The overriding factor that makes the mammalian toxicokinetics of malathion unique is the rapid hydrolytic cleavage of carboxylic ester linkages that counters the buildup of the neurotoxic metabolite malaoxon.

Malathion also undergoes various other forms of biotransformation. Both malathion and malaoxon are subject to phosphate linkage hydrolysis as well as glutathione-linked cleavage, both of which are detoxicative. Carboxylesterase is quite active in rat blood, but not in human blood . In contrast, in both species, the enzyme is highly active in the liver. Since the blood enzyme in the rat apparently plays a major role in keeping the toxicity of this insecticide low, whether rats serve as a correct toxicokinetic model for humans is uncertain, particularly in view of the observed inter-specific variations.

The substance is classified by IARC as Group 3:

NOT classifiable as to its carcinogenicity to humans.

Evidence of carcinogenicity may be inadequate or limited in animal testing.

Reproductive effector in rats

ADI: 0.02 mg/kg/day

NOEL: 0.26 mg/kg/day

CARCINOGEN

Malathion	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	3
Non-arsenical insecticides (occupational exposures in spraying and application of)	International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs	Group	2A
Malathion	ND	Carcinogen Category	A4

ORGANOPHOSPHATE PESTICIDES	US Environmental Defense Scorecard Suspected Carcinogens	Reference(s)	P65-MC

SKIN

malathion	ND	Notes	Skin
malathion	ND	Skin	Yes
malathion	US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants - Skin	Skin Designation	X
malathion	US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants - Skin	Skin Designation	X
malathion	US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants - Skin	Skin Designation	X
malathion	US - Washington Permissible exposure limits of air contaminants - Skin	Skin	X
malathion	ND	Skin Designation	Yes
malathion	ND	Notation	Skin
malathion	US - Minnesota Permissible Exposure Limits (PELs) - Skin	Skin Designation	X
malathion	US - Hawaii Air Contaminant Limits - Skin Designation	Skin Designation	X
malathion	ND	Skin Designation	X
malathion	US OSHA Permissible Exposure Levels (PELs) - Skin	Skin Designation	X
malathion	ND	Skin	X
malathion	US - California Permissible Exposure Limits for Chemical Contaminants - Skin	Skin	X
malathion	US - California Permissible Exposure Limits for Chemical Contaminants - Skin	Skin	S
malathion	Canada - Alberta Occupational Exposure Limits - Skin	Substance Interaction	1

Section 12 - ECOLOGICAL INFORMATION

Refer to data for ingredients, which follows:
O,O,S-TRIMETHYL PHOSPHORODITHIOATE:
MALATHION:
■ DO NOT discharge into sewer or waterways.
■ Studies on various thiophosphates indicated complete mineralization within three weeks by acclimation. A water stability study demonstrated the nature of hydrolysis involves the attack of water molecule on the phosphorus ester involving P-O bond fission. .
■ Organophosphorus pesticides are relatively non-persistent in the environment with half-lives ranging from hours to several weeks or months. Only rarely are they found in crops beyond the growing season during which they are applied. Chemical or photochemical mechanisms may produce a leaving group which is easily degraded. As a rule these compounds do not represent a serious problem as contaminants of soil and water. Breakdown products are usually non-toxic being composed of low-molecular weight, volatile molecules that are easily degraded and utilized by micro-organisms.
Being esters they are also susceptible to hydrolysis. Most organophosphorus pesticides are stable to acid pHs but under alkaline conditions hydrolysis is rapid with the breakdown rate increasing 10-fold for each pH unit above 7. An increase of 10 deg. C of temperature will increase the hydrolysis rate approximately 4-fold. When these compounds are present in the soil their disappearance is affected by their interaction with the physical characteristics and water content of the soil, and the microflora present.
In certain types of soil strong binding may make them unavailable for biological decomposition. In such soils even running water produces little movement and thus minimal contamination of water supplies. Less tightly bound substances are similarly unlikely to produce substantial contamination because of rapid breakdown. Metallic ions in the soil interact with organophosphorus pesticides through hydrogen linkage whilst increased organic matter facilitates further binding.
In general only minute amounts of pesticide residue and their breakdown products are found in natural water systems. In soil however there is a greater likelihood of the presence and buildup of toxic residues.
■ Do NOT allow product to come in contact with surface waters or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment wash-waters.
Wastes resulting from use of the product must be disposed of on site or at approved waste sites.
■ Very toxic to aquatic organisms.
MALATHION:

Marine Pollutant:	Yes
■ Fish LC50 (96hr.) (mg/l):	0.027- - 3.2
■ Daphnia magna EC50 (48hr.) (mg/l):	0.0018- 0.0
■ log Kow (Sangster 1997):	2.36
■ Half- life Soil - High (hours):	168
■ Half- life Soil - Low (hours):	72
■ Half- life Air - High (hours):	9.8
■ Half- life Air - Low (hours):	1
■ Half- life Surface water - High (hours):	1236

■ Half- life Surface water - Low (hours):	100
■ Half- life Ground water - High (hours):	2472
■ Half- life Ground water - Low (hours):	200
■ Aqueous biodegradation - Aerobic - High (hours):	1236
■ Aqueous biodegradation - Aerobic - Low (hours):	100
■ Aqueous biodegradation - Anaerobic - High (hours):	4944
■ Aqueous biodegradation - Anaerobic - Low (hours):	400
■ Aqueous photolysis half- life - High (hours):	20000
■ Aqueous photolysis half- life - Low (hours):	990
■ Aqueous photolysis half- life - High (hours):	20000
■ Aqueous photolysis half- life - Low (hours):	990
■ Photooxidation half- life air - High (hours):	9.8
■ Photooxidation half- life air - Low (hours):	1
■ First order hydrolysis half- life (hours):	7.70E- 04
■ Base rate constant [MOH)- HR]- 1:	1.4M- 1s- 1

/53#90malathion#90etox1
O,O,S-TRIMETHYL PHOSPHORODITHIOATE:

Marine Pollutant:	Yes

■ For dithiophosphate alkyl esters and their (zinc) salts:
The physicochemical properties of dithiophosphate alkyl esters parallel their structural similarity. All members of this category are within a narrow molecular weight range (256-354 daltons) and are highly acidic. In addition, modeling data indicate they have similar melting and boiling points, low water solubility, low vapor pressure, and are lipophilic in nature.
Modeling data indicates that the vapor pressure of these substances range from 3.46 x 10-3 to 1.9 x 10-5 mm Hg at 25 C and generally follow a pattern based upon their molecular weight and the extent of branching of the alkyl side chain.
Modeling data indicates that these substances have low water solubility and that the log of the octanol-water partition coefficient (log Kow) of these substances range from 4.48-7.99. The low water solubility is consistent with the high lipophilic nature of these substances.
Members of the zinc dialkyldithiophosphate category, described here, contain alkyl chain lengths that range from C3-10, or tetrapropenylphenol (range = C10-15, C12 enriched). It is common for zinc dialkyldithiophosphates to contain mixed alkyl esters (e.g., C4, C5), although derivatives with single chain lengths (e.g., C8) are included in the category . As a result of this diversity in alkyl side chain length, the molecular weight distribution for the members of the category is broad, 578 to 1303 gm/mol. Due to the predominant influence of carbon chain length on molecular weight.
Vapour pressures for the zinc dialkyldithiophosphates are thought to be less than 0.5 mm Hg.
Unpublished data for a commercial zinc dialkyldithiophosphate with an alkyl group less than C8 indicates a water solubility of 1.6 mg/L. The zinc dialkyldithiophosphates are generally regarded to be poorly soluble in water.
Unpublished company data on a commercial zinc dialkyldithiophosphate with a carbon chain length of less than eight yielded a log Kow value of 2.49. Longer chain materials are likely to have higher octanol/water partition coefficients. The log Kow is a measure of the lipophilicity of a substance and is used as a surrogate indicator of the potential of a chemical substance to bioaccumulate in aquatic organisms. While Log Kow is a good predictor of bioaccumulation for nonpolar organic compounds, the mechanisms for uptake and depuration of metals and metal compounds are very complex and variable. For metal compounds, the Log Kow data are not indicative of the bioaccumulation potential .
Fate and Transport Characteristics. Members of this category are expected to be poorly biodegradable.
The members of the category are resistant to hydrolysis at room temperature because they lack readily hydrolysable moieties. When heated hydrolytic degradation results in the formation of the phosphorothioic acid ester and hydrogen sulfide. Continued heating at high temperatures results in the formation of the mono-ester and eventually, phosphorothioic acid itself.
These materials are known to be thermally labile at temperatures >120 C. This decomposition mechanism is key to how the zinc salts provide anti-wear and anti-oxidation performance enhancements in engine oils.
Photodegradation is not expected to cause significant physical degradation of dithiophosphate alkyl esters. Category members do not contain bonds that have a high potential to absorb UV light above 290 nm. These substances have low vapor pressure, which indicates that they have a low potential to partition into the air to a significant extent where they would be subject to indirect photodegradation.
These substances are not expected to partition to water or air if released into the environment due to their low water solubility and low vapor pressure. They are also hydrophobic in nature, which suggests that any which reaches the water compartment will be immobilized through binding to the organic component of soils and sediments.
A Japanese MITI publication cited a bioaccumulation factor of less than 100 for a C4-5 ester zinc dithiophosphate indicating a low potential for bioconcentration or cumulative effects. .
The hydrocarbon portion of these compounds that is susceptible to biodegradation is present in both the zinc dialkyldithiophosphates and the dithiophosphate alkyl esters. Therefore, it is expected that the dithiophosphate alkyl esters will behave similarly. The zinc salts are poorly biodegradable.
Ecotoxicity:
The low water solubility suggests that the acute aquatic toxicity of these substances should be low due to limited bioavailability to aquatic organisms. However, the length of the alkyl side chains on these substances will influence their relative water solubility, and, hence, their relative toxicity. Diethyl dithiophosphate for example is highly toxic to Daphnids
Zinc O,O-bis(isooctyl)dithiophosphate (CAS RN 28629-66-5) also appears to be harmful to aquatic organisms such as fish and Daphnids.

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
malathion	LOW	LOW	LOW	HIGH
O,O,S-trimethyl phosphorodithioate	HIGH		LOW	HIGH

Section 13 - DISPOSAL CONSIDERATIONS

Disposal Instructions

All waste must be handled in accordance with local, state and federal regulations.
¦ Puncture containers to prevent re-use and bury at an authorized landfill.
Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.
A Hierarchy of Controls seems to be common - the user should investigate:

- Reduction
- Reuse
- Recycling
- Disposal (if all else fails)

This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. If it has been contaminated, it may be possible to reclaim the product by filtration, distillation or some other means. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.
DO NOT allow wash water from cleaning equipment to enter drains. Collect all wash water for treatment before disposal.

- Recycle wherever possible. Special hazard may exist - specialist advicemay be required.
- Consult manufacturer for recycling options.
- Consult Waste Management Authority for disposal.
- Bury or incinerate residue at an approved site.
- Decontaminate empty containers. Observe all label safeguards untilcontainers are cleaned and destroyed.
- Puncture containers to prevent re-use and bury at an authorized landfill.

Section 14 - TRANSPORTATION INFORMATION

DOT:

Symbols:	None	Hazard class or Division:	6.1
Identification Numbers:	UN3018	PG:	II
Label Codes:	6.1	Special provisions:	IB2, N76, T11, TP2, TP13, TP27
Packaging: Exceptions:	153	Packaging: Non-bulk:	202
Packaging: Exceptions:	153	Quantity limitations: Passenger aircraft/rail:	5 L
Quantity Limitations: Cargo aircraft only:	60 L	Vessel stowage: Location:	B
Vessel stowage: Other:	40	S.M.P.:	YES

Hazardous materials descriptions and proper shipping names:
Organophosphorus pesticides, liquid, toxic

Air Transport IATA:

ICAO/IATA Class:	6.1	ICAO/IATA Subrisk:	None
UN/ID Number:	3018	Packing Group:	II
Special provisions:	A3		

■ Air transport may be forbidden if this material is flammable, corrosive or toxic gases may be released under normal conditions of transport.

Shipping Name: ORGANOPHOSPHORUS PESTICIDE, LIQUID, TOXIC *(CONTAINS MALATHION)

Maritime Transport IMDG:

IMDG Class:	6.1	IMDG Subrisk:	None
UN Number:	3018	Packing Group:	II
EMS Number:	F-A , S-A	Special provisions:	61 274
Limited Quantities:	100 ml	Marine Pollutant:	Yes

Shipping Name: ORGANOPHOSPHORUS PESTICIDE, LIQUID, TOXIC(contains malathion)

Section 15 - REGULATORY INFORMATION

REGULATIONS

malathion (CAS: 121-75-5) is found on the following regulatory lists;

"Canada - Alberta Occupational Exposure Limits","Canada - British Columbia Occupational Exposure Limits","Canada - Northwest Territories Occupational Exposure Limits (English)","Canada - Nova Scotia Occupational Exposure Limits","Canada - Ontario Occupational Exposure Limits","Canada - Prince Edward Island Occupational Exposure Limits","Canada - Prince Edward Island Occupational Exposure Limits - Carcinogens","Canada - Quebec Permissible Exposure Values for Airborne Contaminants (English)","Canada - Saskatchewan Environmental Persistent or Chronic Hazardous Substances","Canada - Saskatchewan Occupational Health and Safety Regulations - Contamination Limits","Canada - Yukon Permissible Concentrations for Airborne Contaminant Substances","Canada Domestic Substances List (DSL)","Canada Environmental Quality Guidelines (EQGs) Water: Community","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (English)","Canada Toxicological Index Service - Workplace Hazardous Materials Information System - WHMIS (French)","International Agency for Research on Cancer (IARC) - Agents Reviewed by the IARC Monographs","OECD Representative List of High Production Volume (HPV) Chemicals","US - Alaska Limits for Air Contaminants","US - California Occupational Safety and Health Regulations (CAL/OSHA) - Hazardous Substances List","US - California Permissible Exposure Limits for Chemical Contaminants","US - Connecticut Hazardous Air Pollutants","US - Hawaii Air Contaminant Limits","US - Idaho - Limits for Air Contaminants","US - Massachusetts Oil & Hazardous Material List","US - Michigan Exposure Limits for Air Contaminants","US - Minnesota Hazardous Substance List","US - Minnesota Permissible Exposure Limits (PELs)","US - New Jersey Right to Know Hazardous Substances","US - Oregon Permissible Exposure Limits (Z-1)","US - Pennsylvania - Hazardous Substance List","US - Rhode Island Hazardous Substance List","US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants","US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants","US - Washington Permissible exposure limits of air contaminants","US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants","US ACGIH Threshold Limit Values (TLV)","US ACGIH Threshold Limit Values (TLV) - Carcinogens","US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)","US CWA (Clean Water Act) - List of Hazardous Substances","US CWA (Clean Water Act) - Reportable Quantities of Designated Hazardous Substances","US Department of Transportation (DOT) List of Hazardous Substances and Reportable Quantities - Hazardous Substances Other Than Radionuclides","US Department of Transportation (DOT) Marine Pollutants - Appendix B","US DOE Temporary Emergency Exposure Limits (TEELs)","US EPA Acute Exposure Guideline Levels (AEGLs) - Interim","US EPCRA Section 313 Chemical List","US List of Lists - Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) and Section 112(r) of the Clean Air Act","US NIOSH Recommended Exposure Limits (RELs)","US OSHA Permissible Exposure Levels (PELs) - Table Z1","WHO Guidelines for Drinking-water Quality - Chemicals for which guideline values have not been established"

Regulations for ingredients

O,O,S-trimethyl phosphorodithioate (CAS: 2953-29-9) is found on the following regulatory lists;

"US - California Air Toxics ""Hot Spots"" List (Assembly Bill 2588) Substances for which emissions must be quantified"

Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

■ Skin contact may produce health damage*.
■ Cumulative effects may result following exposure*.
■ May produce discomfort of the eyes*.
■ Limited evidence of a carcinogenic effect*.
* (limited evidence).

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■ Classification of the mixture and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.
A list of reference resources used to assist the committee may be found at:
www.chemwatch.net/references.

■ The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

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