ECO$_2$FUME® Fumigant Gas

A phosphine-containing fumigant for use in controlling pests in listed raw agricultural commodities, processed foods, stored tobacco, animal feeds and non-food products.

RESTRICTED USE PESTICIDE

DUE TO ACUTE INHALATION TOXICITY OF HIGHLY
TOXIC PHOSPHINE (HYDROGEN PHOSPHIDE, PH_3) GAS

READ THE ENTIRE LABEL, WHICH INCLUDES THE APPLICATION MANUAL AND GUIDANCE FOR PREPARATION OF A FUMIGATION MANAGEMENT PLAN BEFORE USING

THIS PRODUCT MUST BE USED IN CONJUNCTION WITH A DETAILED FUMIGATION MANAGEMENT PLAN

A FUMIGATION MANAGEMENT PLAN MUST BE WRITTEN FOR ALL FUMIGATIONS PRIOR TO ACTUAL TREATMENT

IN FACILITIES THAT USE THIS PRODUCT, ALL EMPLOYEES MUST COMPLETE MANDATORY ANNUAL TRAINING ON THE HAZARDS OF THIS PRODUCT, THE USE OF SAFETY EQUIPMENT (*i.e.*, RESPIRATORY PROTECTION AND PERSONAL MONITORS), AND THE EXPOSURE LIMIT OF 0.1 PPM. **IT IS THE RESPONSIBILITY OF THE CERTIFIED/LICENSED APPLICATOR TO INFORM THE PERSON IN CHARGE OF THE FACILITY OR AGRICULTURAL ESTABLISHMENT, WHERE THE FUMIGATION WILL TAKE PLACE, OF THE REQUIREMENT FOR THE MANDATORY TRAINING.**

INSECTICIDE, RODENTICIDE

ACTIVE INGREDIENT:	By Weight
Phosphine Gas (PH_3)……..…….	2%*

*2.6% by volume

Registration No. 27684 PEST CONTROL PRODUCTS ACT

Pressurized Product

DANGER

POISON **EXPLOSIVE**

LIQUID IS CORROSIVE TO EYES AND SKIN

KEEP OUT OF REACH OF CHILDREN AND PREVENT ACCESS BY UNAUTHORIZED PERSONNEL

Net Contents: 31.0 kg (68.3 lb)

CYTEC CANADA INC.
9061 Garner Road
Niagara Falls, Ontario, Canada,
L2H 0Y2
Emergency Phone: Canada (905)356-8310 US 1-800/424-9300 or 703/527-3887

NOTICE TO USER
This pest control product is to be used only in accordance with the directions on this label. It is an offence under the *Pest Control Products Act* to use this product in a way that is inconsistent with the directions on the label.

NATURE OF RESTRICTION
ECO2FUME® Fumigant Gas is a Restricted Use Pesticide due to the high acute inhalation toxicity of phosphine, PH_3 gas.

This product is for retail sale to and use only by individuals holding an appropriate pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the pesticide application occurs or by persons trained in accordance with the Application Manual working under the direct supervision and in the physical presence of an applicator holding an appropriate pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the pesticide application occurs. Physical presence means on-site or on the premises. ECO2FUME® Fumigant Gas is a hazardous material and may be used only by individuals trained in its proper use. Consult local pesticide regulatory authorities about use permits that may be required.

This product is accompanied by an approved label, which includes the Application Manual and Guidance for Preparation of a Fumigation Management Plan. BEFORE USING, READ AND UNDERSTAND THE ENTIRE LABEL AND THE APPLICATION MANUAL. All parts of the label and Application Manual are equally important for safe and effective use of this product. Call Cytec Canada, Inc. if you have any questions or do not understand any part of the label or Application Manual. If the Application Manual is lost, contact Cytec Canada Inc. to obtain a replacement copy.

In facilities where this product is used, all employees MUST complete mandatory annual training as outlined in the Applicator's Manual – MANDATORY ANNUAL TRAINING. Training includes information on the hazards of this product, the use of safety equipment (i.e., respiratory protection and personal monitors), and the exposure limit of 0.1 ppm. It is the responsibility of the certified/licensed applicator to inform the person in charge of the facility or agricultural establishment, where the fumigation will take place, of the requirement for the mandatory training.

Appropriate respiratory protection MUST be worn at all times when levels of phosphine gas are above 0.1 ppm, and/or levels of carbon dioxide are above 5,000 ppm or are unknown, as outlined in the Application Manual – Section V.E, RESPIRATORS. If phosphine levels are unknown, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm, must be worn. If carbon dioxide levels are unknown, a NIOSH-approved self-contained breathing apparatus with a full face piece operated in a pressure-demand or other positive-pressure mode, OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus is required (See Section V.E, RESPIRATORS). If at any time, phosphine levels exceed 0.1 ppm or carbon dioxide levels exceed 5,000 ppm, all individuals who are not wearing respiratory protection as outlined in Section V.E. RESPIRATORS MUST vacate the area until phosphine levels are at or below 0.1 ppm and carbon dioxide levels are at or below 5,000 ppm. **IT IS IMPORTANT TO CONSIDER BOTH PHOSPHINE AND CARBON DIOXIDE CONCENTRATIONS TO DETERMINE THE USE OF APPROPRIATE RESPIRATORY PROTECTION.**

Entry by unprotected workers into the fumigated site is only permitted after the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm and the CO2 level is at or below 5000 ppm in the fumigated site and the fumigation zone. Only if necessary should workers be present in the fumigation zone. All workers present in the fumigation zone during the fumigation or aeration periods MUST wear appropriate respiratory protection, as outlined in the Applicator's Manual – Section V.E, RESPIRATORS, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm. Each unprotected worker in the fumigation zone must have a personal phosphine monitor that is functional for the duration of the work period, must know how to operate the personal phosphine monitor and be informed of procedures required if the air levels of phosphine gas exceed 0.1 ppm.

A fumigation zone must be established for all fumigated sites (with the exception of ships and railcars that are in motion), refer to the Application Manual – FUMIGATION ZONE REQUIREMENTS. Note that the term "fumigated site/application site" refers to the site under fumigation treatment. Placarding is required for both the fumigated site and the buffer zone perimeter.

Note that transport of non-aerated commodities is permitted by rail or ship only. Other transport vehicles, such as trucks, vans, and trailers, are prohibited from travel over public roads or highways until completely aerated to a phosphine level at or below 0.1 ppm.

This product is to be stored apart from lodging for humans, animals, animal quarters, and normal work areas to avoid inadvertent exposure. Refer to the Application Manual for detailed storage instructions.

To guarantee compliance with maximum residue limits for phosphine residues, fumigated commodities must be aerated for 48 hours prior to offering them to the end consumer. For tobacco, aeration in hogsheads should be not less than three days; on any other type of storage, two days. It is the user's responsibility to ensure that there is no residue on such commodities in excess of these amounts. The licensed/certified applicator is only required to be present until the air concentrations of phosphine gas are at or below the exposure limit of 0.1 ppm.

This product is highly toxic to birds and mammals. Carefully inspect the outside and inside of the structure prior to application of the fumigant to ensure the absence of nesting or roosting birds. Avoid application if birds are present.

This product is not to be used for vacuum fumigations.

Phosphine will corrode certain metals, especially at high concentrations and humidity levels. Protection or removal of wiring, sensitive equipment or precious metals is recommended under these conditions.

SEE BELOW AND OPPOSITE SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS.

PRECAUTIONS
Contains Extremely Hazardous Gas.
DANGER – POISON.
KEEP OUT OF REACH OF CHILDREN AND PREVENT ACCESS BY UNAUTHORIZED PERSONNEL.
Fatal if inhaled. DO NOT inhale vapour.
The liquid may cause burns. **DO NOT get in eyes, on skin or on clothing.**
DO NOT eat, drink or smoke while handling ECO_2FUME®Fumigant Gas.

Wear a loose fitting long sleeve shirt, long pants, socks, safety shoes, safety glasses, and wear gloves (leather or leather faced cotton gloves) when handling this product. Hand trucks designed specifically for compressed gas cylinders and equipped with a suitable chain or strap are required to move individual ECO_2FUME® Fumigant Gas cylinders about the fumigation site. Never move an ECO_2FUME® Fumigant Gas cylinder without valve cap and cylinder cap in place.

Use in well ventilated areas. Contains phosphine (hydrogen phosphide) gas and carbon dioxide. Phosphine is flammable and toxic. Carbon dioxide at elevated concentrations is toxic. For worker safety, the monitoring for phosphine gas and carbon dioxide is required and appropriate respiratory protection must be worn. Phosphine gas may deaden the sense of smell. Do not depend solely on the odour to detect ECO_2FUME® Fumigant Gas.

A fumigation zone must be established for all fumigated sites (with the exception of ships and railcars that are in motion), as outlined in the Applicator's Manual – FUMIGATION ZONE REQUIREMENTS, and the table below.

SITE	**Minimum Distance of Fumigation Zone**	
	Fumigation Period	**Aeration Period**
Indoor Application Sites	10 metres OR all workers inside the facility MUST wear a personal phosphine monitor.	Fumigation zone determined by
Vessels	Fumigation zone determined by licensed/certified applicator	

Outdoor Application Sites	Fumigation zone determined by licensed/certified applicator	licensed/certified applicator
Tarpaulins	30 metres OR boundary of the room	
Railcars	30 metres	

Entry by unprotected workers into the fumigated site is only permitted after the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. Only if necessary, should workers be present in the fumigation zone. All workers present in the fumigation zone during the fumigation or aeration periods MUST wear appropriate respiratory protection, as outlined in the Application Manual – SECTION V.E. RESPIRATORS, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm. Each unprotected worker in the fumigation zone must have a personal phosphine monitor that is functional for the duration of the work period, must know how to operate the personal phosphine monitor and be informed of procedures required if the air levels of phosphine gas exceed 0.1 ppm. If at any time phosphine levels exceed 0.1 ppm, all individuals who are not wearing respiratory protection, as outlined in Section V.E. RESPIRATORS, MUST vacate the area until phosphine levels are at or below 0.1 ppm.

Appropriate respiratory protection MUST be worn at all times, when levels of phosphine are above 0.1 ppm and/or levels of carbon dioxide are above 5,000 ppm or are unknown, as outlined below and in the Application Manual – Section V.E, RESPIRATORS. If phosphine levels are unknown, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm must be worn. If a beard or long sideburns interfere with the fit of respiratory protection, they must be shaven. **IT IS IMPORTANT TO CONSIDER BOTH PHOSPHINE AND CARBON DIOXIDE CONCENTRATIONS TO DETERMINE THE USE OF APPROPRIATE RESPIRATORY PROTECTION.**

Required Respiratory Equipment

Phosphine Level (PPM)	**Minimum Required Respiratory Equipment**
Unknown	Personal phosphine monitor or respiratory equipment required for phosphine levels greater than 5 ppm.
>0.1 ≤ 5 ppm	NIOSH-approved air-purifying, full face piece respirator (gas mask) with a chin-style, front- or back-mounted canister approved for phosphine OR a NIOSH-approved supplied-air respirator (i.e., air-line respirator or self-contained breathing apparatus) with a full face piece.
>5 ppm	NIOSH-approved self-contained breathing apparatus with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus.
Emergency use or Immediately Dangerous to Life or Health Conditions	NIOSH-approved self-contained breathing apparatus with a full face piece operated in a pressure-demand or other positive-pressure mode.
Carbon Dioxide Level (PPM)	
5,000 – 30,000 ppm	1) persons may enter the treated area without respiratory protection for 15 minutes or less; 2) for periods longer

	than 15 minutes, use a NIOSH-approved supplied-air respirator (i.e., air-line respirator or self-contained breathing apparatus) with a full face piece.
Unknown or > 30,000 ppm	NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus must be worn.

For emergency use and/or to escape from conditions which are Immediately Dangerous to Life or Health (IDLH), keep available for use an adequate number of NIOSH- approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode.

Theft of products: Immediately report to the local police department thefts of ECO_2FUME® cylinders. Registrant must be informed of any incident involving the use of this product.

ENVIRONMENTAL HAZARDS
Toxic to birds and mammals. Exposure to non-target organisms should be avoided. Phosphine gas may be hazardous to birds nesting on or near structures being fumigated. Carefully inspect the outside and inside of the structure prior to application of the fumigant to ensure the absence of nesting or roosting birds. Avoid application if birds are present. The aeration phase should be initiated early in the day to allow for maximum phosphine dissipation, which will occur during daylight hours.

STORAGE INSTRUCTIONS
INDOOR STORAGE: The storage of poison gases in occupied spaces is prohibited. Indoor storage in a separate building with no other occupancy is suitable. The building should be of non-combustible construction, adequately ventilated and equipped with a continuous phosphine monitoring and alarm system that is activated at 0.1 ppm. In some jurisdictions, the indoor storage of toxic gases is prohibited.

OUTDOOR STORAGE: It is recommended that both full and used ECO_2FUME® Fumigant Gas cylinders be stored outdoors in a dedicated and properly designed and labelled storage area. The following are recommended for outdoor storage:
1) A firm and level surface, preferably reinforced concrete, well drained.
2) A secured and locked areasuch as a chain link fence topped with three strands of barbed wire with gate and lock.
3) Covered, if snow accumulation is likely to cause handling problems. Non-combustible construction.
4) Shaded, if high temperatures are expected. Non-combustible construction.
5) Protected from vehicle traffic.
6) Equipped with a windsock to indicate wind direction.
7) A means of securing all cylinders.
8) Away from building ventilation intakes.

TEMPERATURE LIMITATIONS: ECO_2FUME® Fumigant Gas cylinders should never be stored where the temperature will exceed 51.7 °C (125 °F). Low temperatures will not affect ECO_2FUME® Fumigant Gas.

SECURING CYLINDERS:
Cylinders must be stored in an upright position and protected from falling. Protection against falls can include the use of cylinder pallets with straps, walls and securing chains, or pens constructed from steel hand rail or like construction.

DISPOSAL
Do not reuse this cylinder for any purpose. Once used, ECO_2FUME® Fumigant Gas cylinders are to be returned only to an authorized distributor or their designated point of return. This applies to all cylinders, regardless of the quantity

of material remaining in the cylinder. If the cylinder is partially full, do not release the remaining gases, disposal of the cylinder contents is prohibited.

SPILL AND LEAK PROCEDURES
GENERAL: All releases can produce high levels of gas, and therefore, attending personnel must wear appropriate respiratory protection and personal protective equipment as specified below under EMERGENCY RESPONDER PROTECTION.

IMPORTANT: Emergency responders must be familiar with the "Emergency Response Guidebook", which is maintained by Transport Canada.

WHAT TO DO: In the event of an accidental release, evacuate the area immediately. A response into the leak area should only be attempted by trained emergency responders. If it is possible to shut off the source of the leak from a remote area, it should be done. Otherwise, evacuate the area and call for assistance. As a reference, small and large spills may require isolation distances between 60 – 400 metres and may also require protective distances between 200 metres and 4.1 kilometres (refer to "Emergency Response Guidebook").

CYTEC operates a 24-hour Emergency Response and Incident Management System (ERIM). For emergencies involving spill, leak, fire, exposure or accident call Canadian Transport Emergency Centre (CANUTEC) 613/996-6666 or CHEMTREC: 1-800/424-9300. Outside the US or Canada call 703/527-3887.

Emergency responders must follow the detailed specifications for phosphine (ID Number 2199, Guide Number 119) in the "Emergency Response Guidebook", which is maintained by Transport Canada (www.tc.gc.ca/eng/canutec/guide-menu-227.htm).

EMERGENCY RESPONDER PROTECTION:
Wear a NIOSH-approved self-contained breathing apparatus (SCBA) with full face piece and operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus when the concentration of phosphine gas is unknown. If the concentration is known, other appropriate respiratory protection must be worn as specified in the Application Manual (Section V.E, RESPIRATORS).

All emergency responses should be made wearing personal protective equipment as specified in the Application Manual (Section V, PERSONAL PROTECTIVE EQUIPMENT) including chemical-resistant gloves (neoprene, butyl rubber or PVC), a Seranex coated Tyvek suit and rubber boots. Note that the chemical protective clothing listed may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire station situations only; it is not effective in spill situations where direct contact with the chemical is possible.

FIRST AID
Symptoms of exposure to phosphine gas can include headache, dizziness, nausea, difficult breathing, vomiting and diarrhea. In all cases of exposure, protect yourself, remove the person from the source of exposure and get them to an Emergency department. If possible, bring this Application Manual, the container, label or product name and Pest Control Product Registration Number with you when seeking medical attention.

FIRST AID RESPONDER PROTECTION: Phosphine gas is a highly toxic systemic poison and a severe respiratory tract irritant. First Aid responders should protect themselves through the use of appropriate personal protective equipment before attempting to rescue or care for a person who has been exposed to phosphine gas, and/or if entering a zone with potentially unsafe phosphine levels. A NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus is recommended in response situations that involve exposure to potentially unsafe or unknown levels of phosphine (see PRECAUTIONS section of product label or Application Manual for further guidance regarding personal protective equipment).

IF INHALED: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, using a bag-valve-mask device to prevent possible secondary exposure to phosphine gas to the first aid

responder. Do not perform mouth-to-mouth resuscitation. Do not give anything by mouth to an unconscious person. Call a poison control centre or doctor for further treatment advice.

IF ON SKIN OR CLOTHING: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. May cause frostbite to unprotected skin upon contact with dispensing equipment while gas is discharging rapidly. Treat as thermal burn. Call a poison control centre or doctor for treatment advice.

IF IN EYES: In case of freezing or cryogenic burns, hold eye open and rinse slowly and gently with plenty of COOL water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Do not rinse eyes with hot or even tepid water. Call a poison control centre or doctor for treatment advice.

TOXICOLOGICAL INFORMATION
NOTE TO PHYSICIAN – THIS IS PHOSPHINE, IT IS NOT PHOSGENE
$ECO_2FUME^{®}$Fumigant Gas is a gaseous mixture of phosphine and carbon dioxide. Mild exposure by inhalation causes malaise (indefinite feeling of sickness), ringing of ears, fatigue, nausea and pressure in chest, which is relieved by removal to fresh air. Moderate poisoning causes weakness, vomiting, pain just above the stomach, chest pain, diarrhea and dyspnea (difficulty in breathing). Symptoms of severe poisoning may appear within a few hours to several day. Severe poisoning may result in pulmonary edema (fluid in lungs) and may lead to dizziness, cyanosis (blue or purple skin colour), unconsciousness and death.

In sufficient quantity, phosphine affects the liver, kidneys, lungs, nervous system, and circulatory system, and may result in (1) pulmonary edema, (2) liver elevated serum AST, ALT and ALP, reduced prothrombin, hemorrhage and jaundice (yellow skin colour) and (3) kidney hematuria (blood in urine) and anuria (abnormal or lack of urination). Pathology is characteristic of hypoxia (oxygen deficiency in body tissue). Frequent exposure to concentrations above permissible levels over a period of days or weeks may cause poisoning. Inhalation can cause lung edema (fluid in lungs) and hyperaemia (excess of blood in a body part), small perivascular brain hemorrhages and brain edema (fluid in brain). Treatment is symptomatic.

The following measures are suggested for use by the physician in accordance with the physician's own judgment:

1. Exposure of skin to rapidly evaporating liquid may cause cryogenic "burn." Treat the "burn" in a similar manner as a thermal burn.
2. In case of freezing or cryogenic "burns" to eyes by rapidly evaporating liquid, RINSE EYES WITH COOL WATER. Do not rinse eyes with hot or even tepid water.
3. In its milder to moderate forms symptoms of poisoning may take up to 24 hours to appear. Monitoring should continue for at least this long. Manifestations of severe poisoning appear early. Hypoxia and hypotension should be treated with usual supportive measures of oxygenation, intubation, ventilation and positive pressure as needed, and intravenous fluids, pressors and inotropes as required, respectively. There is no specific antidote. Hemodialysis may be indicated if renal failure develops but does not remove the toxin.

PHYSICAL AND CHEMICAL HAZARDS
Phosphine may ignite spontaneously at levels above its lower flammability limit of 1.8% v/v. It is important not to exceed this concentration. Ignition of high concentration of phosphine can produce a very energetic reaction. Explosions can occur under these conditions and may cause severe personal injury. **Never allow the buildup of phosphine to exceed explosive concentrations.**

Contents under pressure. Do not use or store near heat or open flame. Do not puncture or incinerate container. Exposure to temperatures above 54°C (130°F) may cause bursting. Do not drop the container.

DO NOT open cylinder in confined space without a NIOSH-approved self-contained breathing apparatus (SCBA) with full facepiece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus. DO NOT enter a space under fumigation with $ECO_2FUME^{®}$ Fumigant Gas without first checking the gas concentration levels and wearing the appropriate respiratory protection. These precautions will also reduce the applicator's exposure to gas. Phosphine gas has a low solubility in water and oils and is stable at normal fumigation temperatures. However, it may react with certain metals and cause corrosion, especially at higher temperatures and relative humidities. Metals such as copper, brass and other copper alloys, and precious metals such as gold and silver are susceptible to corrosion. Thus, small electric motors, smoke detectors, brass sprinkler heads, batteries and battery chargers, fork lifts, temperature monitoring

systems, switching gears, communication devices, computers, calculators and other electronic or electrical equipment should be protected or removed before fumigation. In most cases all electronic equipment must be removed. Phosphine gas will also react with certain metallic salts and therefore, sensitive items such as photographic film, some inorganic pigments, etc., should not be exposed. Under high vacuum conditions, phosphine gas may cause an explosive hazard. Do not apply fumigant in vacuum chambers.

PEST MANAGEMENT PRACTICES

An operational pest management plan must be put in place in food processing facilities and/or other relevant sites where insects/rodents forage or seek refuge in order that the facility, its equipment and its exterior surroundings do not promote pest populations, and are amenable to control and treatment methods. The plan should include the following:

- Practices to reduce or eliminate infestations in incoming food and ingredients through strict purchase specifications, audits of suppliers, and inspection of incoming material.
- Good sanitation practices involving thorough and regular cleaning, prevention of dust generation and accumulation, and removal of food sources and harbourages for pests.
- Building maintenance to eliminate holes and cracks in floors, walls, ceilings, roofs, doors and windows that allow access for pests.
- Regular inspections and monitoring to guide schedules and locations of treatments, and to monitor the effectiveness of the overall management strategy.
- Pest identification and understanding of each pest's lifecycle to select the most appropriate control methods.
- Other practices including physical and mechanical treatments, controlled atmospheres, and applications of registered pesticides. Each treatment should be used as one component of an overall pest management plan. All pesticides must be stored, handled, and used according to label instructions.

RESTRICTED USE PESTICIDE
DUE TO ACUTE INHALATION TOXICITY OF HIGHLY
TOXIC PHOSPHINE (HYDROGEN PHOSPHIDE, PH3) GAS

APPLICATION MANUAL
FOR

ECO$_2$FUME® Fumigant Gas

Pressurized Product
INSECTICIDE, RODENTICIDE

A phosphine-containing fumigant for use in controlling pests in listed raw agricultural commodities, processed foods, stored tobacco, animal feeds, and non-food products. Refer to the Application Manual for a list of commodities and pests controlled.

ACTIVE INGREDIENT: By Weight
Phosphine Gas (PH_3)……..2%*
* 2.6% by volume
Registration No. 27684
Pest Control Products Act

POISON

DANGER

EXPLOSIVE

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KEEP OUT OF REACH OF CHILDREN AND PREVENT ACCESS BY UNAUTHORIZED PERSONNEL.
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A FUMIGATION MANAGEMENT PLAN MUST BE WRITTEN FOR ALL FUMIGATIONS PRIOR TO ACTUAL TREATMENT

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NOTICE TO USER
This pest control product is to be used only in accordance with the directions on this label. It is an offence under the

Pest Control Products Act to use this product in a way that is inconsistent with the directions on the label.

NATURE OF RESTRICTION
ECO2FUME® Fumigant Gas is a Restricted Use Pesticide due to the high acute inhalation toxicity of phosphine, PH_3 gas.

This product is for retail sale to and use only by individuals holding an appropriate pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the pesticide application occurs or by persons trained in accordance with the Application Manual working under the direct supervision and in the physical presence of an applicator holding an appropriate pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the pesticide application occurs. Physical presence means on-site or on the premises. ECO2FUME®Fumigant Gas is a hazardous material and may be used only by individuals trained in its proper use. Consult local pesticide regulatory authorities about use permits that may be required.

This product is accompanied by an approved label, which includes the Application Manual and Guidance for Preparation of a Fumigation Management Plan. BEFORE USING, READ AND UNDERSTAND THE ENTIRE LABEL AND THE APPLICATION MANUAL. All parts of the label and Application Manual are equally important for safe and effective use of this product. Call Cytec Canada Inc. if you have any questions or do not understand any part of the label or Application Manual. If the Application Manual is lost, contact Cytec Canada Inc. to obtain a replacement copy.

In facilities where this product is used, all employees MUST complete mandatory annual training as outlined in the Application Manual – MANDATORY ANNUAL TRAINING. Training includes information on the hazards of this product, the use of safety equipment (i.e., respiratory protection and personal monitors), and the exposure limit of 0.1 ppm. It is the responsibility of the certified/licensed applicator to inform the person in charge of the facility or agricultural establishment, where the fumigation will take place, of the requirement for the mandatory training.

A fumigation zone must be established for all fumigated sites (with the exception of ships and railcars that are in motion), refer to the Application Manual – FUMIGATION ZONE REQUIREMENTS. Note that the term "fumigated site/application site" refers to the site under fumigation treatment. Placarding is required for both the fumigated site and the fumigation zone perimeter.

Appropriate respiratory protection MUST be worn at all times when levels of phosphine gas are above 0.1 ppm and/or levels of carbon dioxide are above 5,000 ppm or are unknown, as outlined in the Application Manual – Section V.E, RESPIRATORS. If phosphine levels are unknown, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm, must be worn. If carbon dioxide levels are unknown, a NIOSH-approved self-contained breathing apparatus with a full face piece operated in a pressure-demand or other positive-pressure mode, OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus is required (See Section V.E, RESPIRATORS). If at any time, phosphine levels exceed 0.1 ppm or carbon dioxide levels exceed 5,000 ppm, all individuals who are not wearing respiratory protection as outlined in Section V.E. RESPIRATORS MUST vacate the area until phosphine levels are at or below 0.1 ppm and carbon dioxide levels are at or below 5,000 ppm. **IT IS IMPORTANT TO CONSIDER BOTH PHOSPHINE AND CARBON DIOXIDE CONCENTRATIONS TO DETERMINE THE USE OF APPROPRIATE RESPIRATORY PROTECTION.**

Entry by unprotected workers into the fumigated site is only permitted after the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm and the CO2 level is at or below 5000 ppm in the fumigated site and the fumigation zone.
Only if necessary, should workers be present in the fumigation zone. All workers present in the fumigation zone during the fumigation or aeration periods MUST wear appropriate respiratory protection, as outlined in the Application Manual – Section V.E, RESPIRATORS, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm. Each unprotected worker in the fumigation zone must have a personal phosphine monitor that is functional for the duration of the work period, must know how to operate the personal phosphine monitor and be informed of procedures required if the air levels of phosphine gas exceed 0.1 ppm.

Note that transport of non-aerated commodities is permitted by rail or ship only. Other transport vehicles, such as trucks, vans, and trailers, are prohibited from travel over public roads or highways until completely aerated to a

phosphine level at or below 0.1 ppm.

This product is to be stored apart from lodging for humans, animals, animal quarters, and normal work areas to avoid inadvertent exposure. Refer to the Application Manual for detailed storage instructions.

To guarantee compliance with maximum residue limits for phosphine residues, fumigated commodities must be aerated for 48 hours prior to offering them to the end consumer. For tobacco, aeration in hogsheads should be not less than three days; on any other type of storage, two days. It is the user's responsibility to ensure that there is no residue on such commodities in excess of these amounts. The licensed/certified applicator is only required to be present until the air concentrations of phosphine gas are at or below the exposure limit of 0.1 ppm.

This product is highly toxic to birds and mammals. Carefully inspect the outside and inside of the structure prior to application of the fumigant to ensure the absence of nesting or roosting birds. Avoid application if birds are present.

This product is not to be used for vacuum fumigations.

Phosphine will corrode certain metals, especially at high concentrations and humidity levels. Protection or removal of wiring, sensitive equipment or precious metals is recommended under these conditions.

FIRST AID

Symptoms of exposure to phosphine gas can include headache, dizziness, nausea, difficult breathing, vomiting and diarrhea. In all cases of exposure, protect yourself, remove the person from the source of exposure and get them to an Emergency department. If possible, bring this Application Manual, the container, label or product name and Pest Control Product Registration Number with your when seeking medical attention.

FIRST AID RESPONDER PROTECTION: Phosphine gas is a highly toxic systemic poison and a severe respiratory tract irritant. First Aid responders should protect themselves through the use of appropriate personal protective equipment before attempting to rescue or care for a person who has been exposed to phosphine gas, and/or if entering a zone with potentially unsafe phosphine levels. A NIOSH- approved self-contained breathing apparatus (SCBA) with full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus is recommended in response situations that involve exposure to potentially unsafe or unknown levels of phosphine (see the PRECAUTIONS section of product label or Application Manual for further guidance regarding personal protective equipment).

If Inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration using a bag-valve-mask device to prevent possible secondary exposure to phosphine gas to the first aid responder. Do not perform mouth-to-mouth resuscitation. Do not give anything by mouth to an unconscious person. Call a poison control centre or doctor immediately for further treatment advice. • **Rescuers within the areas of potentially unsafe levels of this product must wear appropriate respiratory protection such as NIOSH-approved SCBA with a full face piece operated in a pressure-demand or positive-pressure mode during the resuscitation of the victim.**
If on Skin or Clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • May cause frostbite to unprotected skin upon contact with dispensing equipment while gas is discharged rapidly. • Treat as a thermal burn. • Call a poison control center or doctor for treatment advice.
If in Eyes	• In case of freezing or cryogenic burns, hold eye open and rinse slowly and gently with plenty of COOL water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Do not rinse eyes with hot or even tepid water. • Call a poison control center or doctor for treatment advice.

TOXICOLOGICAL INFORMATION

NOTE TO PHYSICIAN – THIS IS PHOSPHINE, <u>IT IS NOT PHOSGENE</u>

$ECO_2FUME^{®}$Fumigant Gas is a gaseous mixture of phosphine and carbon dioxide. Mild exposure by inhalation causes malaise (indefinite feeling of sickness), ringing of ears, fatigue, nausea and pressure in chest, which is relieved by removal to fresh air. Moderate poisoning causes weakness, vomiting, pain just above the stomach, chest pain, diarrhea and dyspnea (difficulty in breathing). Symptoms of severe poisoning may appear within a few hours to several day. Severe poisoning may result in pulmonary edema (fluid in lungs) and may lead to dizziness, cyanosis (blue or purple skin colour), unconsciousness and death.

In sufficient quantity, phosphine affects the liver, kidneys, lungs, nervous system, and circulatory system, and may result in (1) pulmonary edema, (2) liver elevated serum AST, ALT and ALP, reduced prothrombin, hemorrhage and jaundice (yellow skin colour) and (3) kidney hematuria (blood in urine) and anuria (abnormal or lack of urination). Pathology is characteristic of hypoxia (oxygen deficiency in body tissue). Frequent exposure to concentrations above permissible levels over a period of days or weeks may cause poisoning. Inhalation can cause lung edema (fluid in lungs) and hyperaemia (excess of blood in a body part), small perivascular brain hemorrhages and brain edema (fluid in brain). Treatment is symptomatic.

The following measures are suggested for use by the physician in accordance with the physician's own judgment:

1. Exposure of skin to rapidly evaporating liquid may cause cryogenic "burn." Treat the "burn" in a similar manner as a thermal burn.
2. In case of freezing or cryogenic "burns" to eyes by rapidly evaporating liquid, RINSE EYES WITH COOL WATER. Do not rinse eyes with hot or even tepid water.
3. In its milder to moderate forms symptoms of poisoning may take up to 24 hours to appear. Monitoring should continue for at least this long. Manifestations of severe poisoning appear early. Hypoxia and hypotension should be treated with usual supportive measures of oxygenation, intubation, ventilation and positive pressure as needed, and intravenous fluids, pressors and inotropes as required, respectively. There is no specific antidote. Hemodialysis may be indicated if renal failure develops but does not remove the toxin.

CYTEC Canada Inc., 9061 Garner Road, Niagara Falls, Ontario L2H 0Y2 Canada
Emergency Phone: 905/356-8310; US 1-800/424-9300 or 703/527-3887

REFER TO THE APPLICATION MANUAL FOR ADDITIONAL DETAILED PRECAUTIONS (SECTION III), SAFETY REQUIREMENTS (SECTION II) AND DIRECTIONS FOR USE (SECTION IV).

APPLICATION MANUAL FOR
FOR
ECO$_2$FUME® Fumigant Gas

TABLE OF CONTENTS

I. INTRODUCTION

A. PRODUCT DESCRIPTION

$ECO_2FUME^®$ Fumigant Gas is a cylinderized source of phosphine. A mixture of phosphine and carbon dioxide gases, it is packaged in compressed gas cylinders. Phosphine makes up 2 percent (by weight) of the product. $ECO_2FUME^®$ Fumigant Gas cylinders contain carbon dioxide as liquefied gas under pressure. Pressurized carbon dioxide serves as a propellant for delivering the product and retards flammability.

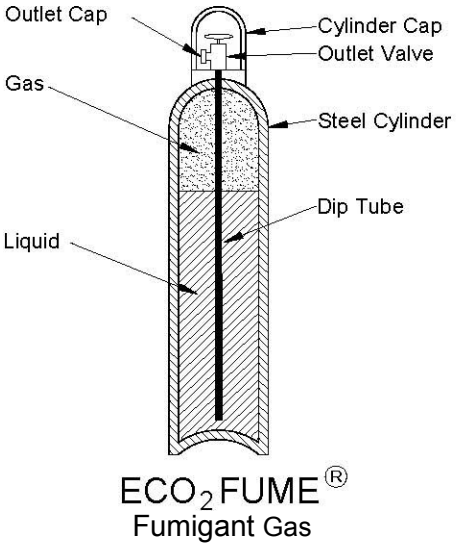
Phosphine and carbon dioxide are both gases that, under sufficient pressure, can exist in a liquid state. It is this "liquefied gas" that is stored in the cylinder. The product is withdrawn from the cylinder as a liquid, but dispensed as a gas. In expanding from a liquid to a gas, it increases in volume by hundreds of times. Proper dispensing equipment is necessary to ensure a safe and effective fumigation.

Unlike metallic phosphide fumigants, phosphine is not generated through a chemical reaction and its release is instantaneous. The choice of dispensing methods will depend on the type and duration of the fumigation planned.

B. PRODUCT PACKAGING

1. Packaging

$ECO_2FUME^®$ Fumigant Gas is packaged in a steel compressed gas cylinder, designed, manufactured, maintained and filled in compliance with regulations established by Transport Canada. The product flows to the dispensing equipment through the cylinder outlet valve, which is equipped with a "dip tube". This tube extends to the bottom of the cylinder to facilitate the withdrawal of the liquefied gas mixture. As liquid is withdrawn from the cylinder, some of the product vapourizes to fill the remaining space in the cylinder. Through this vapourization, the cylinder pressure is maintained.



Representative Package:

Overall Height: 152.4 cm (60 inches)
Diameter: 23.5 cm (9 1/4 inches)
Material: Steel
Empty Weight: 62.6 kg (138 pounds)
Product Weight: 31 kg (68.34 pounds)
0.61 kg (1.34 pounds) phosphine
30.39 kg (67 pounds) carbon dioxide

The valve outlet fitting is a CGA350, which was established by the Compressed Gas Association (CGA). The valve outlet is protected by a threaded gas tight outlet cap, which must be secured whenever the cylinder is not in use. Attach only CYTEC provided (or approved) dispensing equipment to the cylinder valve outlet to dispense $ECO_2FUME^®$Fumigant Gas at the time of fumigation. Use of any other dispensing equipment is prohibited.

Most compressed gas cylinder valves are equipped with a safety device that releases the cylinder contents due to fire exposure or over pressurization. Because $ECO_2FUME^®$ Fumigant Gas is a poisonous gas, Transport Canada regulations prohibit the use of such a device.

Each cylinder is supplied with a cylinder cap, which is designed to protect the outlet valve. This cap must be secured whenever a cylinder is not in use. It is unlawful to transport an $ECO_2FUME^®$ Fumigant Gas cylinder without the valve outlet cap and the cylinder cap securely in place.

$ECO_2FUME^®$ Fumigant Gas cylinders can only be refilled through authorized distributors. They can be filled repeatedly within a five year period. Every five years, however, the cylinder is required by law to be tested by a qualified facility.

2. Dispensing Equipment

A typical $ECO_2FUME^®$ Fumigant Gas dispensing unit (see diagram on next page) uses a heating vapourizer to provide the energy required to vapourize the liquid fumigant. This regulator is limited to a dispensing rate of approximately 11 kg (24 lb) of $ECO_2FUME^®$ Fumigant Gas per hour. The equipment is designed for a service pressure up to 20,685 kPa (3000 psig).

From the cylinder the liquid mixture flows down a flexible hose or pigtail through a filter and into a heater. The heater is thermostatically controlled. Exiting the heater $ECO_2FUME^®$ Fumigant Gas flows through an actuated valve that can be used for emergency shutdown purposes. $ECO_2FUME^®$ Fumigant Gas then flows through a gas regulator that drops the pressure to less than 690 kPa (100 psig).

A diaphragm valve is used to control the gas flow at any desired value up to 100 litres/minute as indicated by the flow rotameter. The heater provides 1000 watts of power that can vapourize a maximum of 100 ppm. Lower rotameter ranges are possible.

$ECO_2FUME^®$ Fumigant Gas regulator assemblies, equipped with basic features, are available through authorized $ECO_2FUME^®$ Fumigant Gas distributors. Multiple dispensers may be used together to achieve higher fumigant flows than available through a single dispensing unit and custom equipment can be developed for specific types of applications.

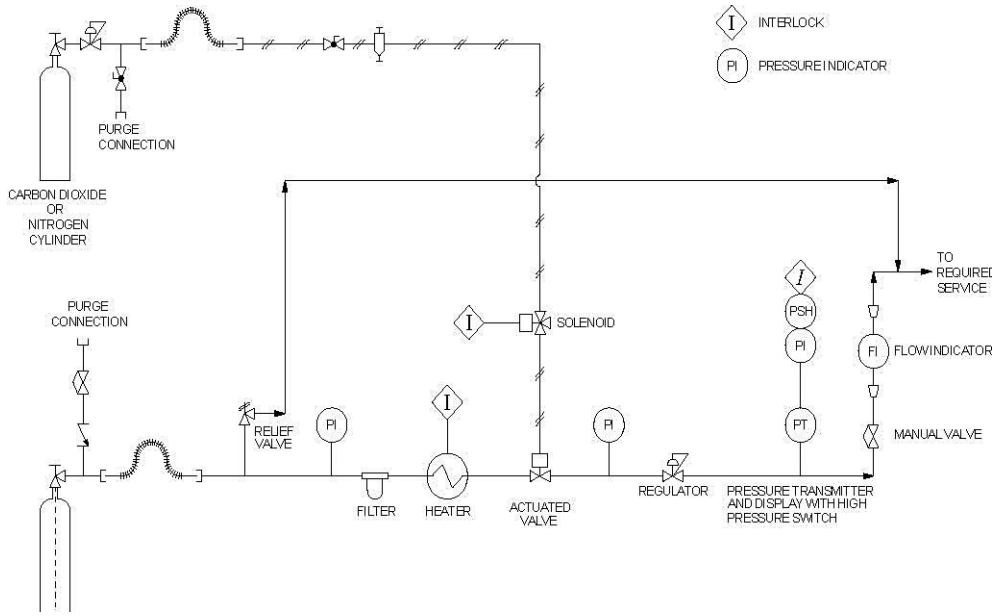


Diagram of a Representative Type of $ECO_2FUME^{®}$ Fumigant Gas Dispensing Equipment

C. PHOSPHINE AND CARBON DIOXIDE

Phosphine is a colourless gas, which is toxic to insects, humans and other forms of animal life. It is very mobile with a high vapour pressure. Thus, the penetrating capability of phosphine is great. The combination of high molecular activity, vapour pressure and toxicity to insects at low dosages accounts for its wide acceptance as a fumigant.

Carbon dioxide is colourless, non-flammable gas, which at elevated concentrations is toxic. For worker safety, the monitoring for carbon dioxide and phosphine gas is required and appropriate respiratory protection must be used. Sometimes phosphine may have an odour due to the presence of impurities in the product; however, this odour cannot always be relied upon as an adequate indicator of phosphine exposure.

*** $ECO_2FUME^{®}$ Fumigant Gas does not have an expiration date.*
*Contact CYTEC Industries Inc. for any questions ***

D. ENVIRONMENTAL FATE

$ECO_2FUME^{®}$ Fumigant Gas is a volatile gaseous mixture. The environmental fate is affected by being dispersed, diluted and decomposed in ambient air after aeration from fumigated commodities where it is present in rapidly decaying low concentrations that are oxidized to non-toxic degradation products. On airing the commodity after fumigation the volatile gaseous phosphine is dispersed to the atmosphere where it decomposes. On irradiation with UV-light, phosphine reacts with the oxygen in the atmosphere in the presence of water vapour to produce traces of H_3PO_4 (phosphoric acid). Phosphine is slightly soluble in water, 26 cm^3 phosphine in 100 mL of water at 20 ^oC, in which it gradually decomposes into phosphorus, hydrogen, and the lower hydrides of phosphorus.

II. <u>SAFETY REQUIREMENTS</u>

$ECO_2FUME^{®}$ Fumigant Gas is a restricted use product for retail sale to and use only by individuals holding an appropriate pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the pesticide application occurs or by persons trained in accordance with the Application Manual working under the direct supervision and in the physical presence of an applicator holding an appropriate

pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the pesticide application occurs. Physical presence means on-site or on the premises.

A. SAFETY RECOMMENDATIONS

1. Carefully read the label and Application Manual and follow instructions explicitly.
2. Licensed/certified applicator must develop and follow a Fumigation Management Plan.
3. Notify appropriate owners, employees, and/or operators at the facility where the fumigation will occur and provide relevant safety, health, and environmental information to local fire and rescue officials annually for use in the event of an emergency.
4. Never work alone when applying fumigant from within the storage structure or aerating commodities after the fumigation is over.
5. At least two persons, a licensed/certified applicator and trained person, or two persons trained in accordance with the Application Manual working under the direct supervision of the licensed/certified applicator, must be present during fumigation of structures when entry into the structure for application of the fumigant is required.
6. Person supervising must be a licensed fumigator and personnel assisting must be trained and appropriately licensed in the use of phosphine. Never allow uninstructed personnel to handle phosphine. Observe all provincial pesticide legislation requirements.
7. The licensed/certified applicator must maintain visual and/or voice contact with all fumigation workers during the application of the fumigants.
8. Appropriate respiratory protection, as outlined in Section V.E. RESPIRATORS, MUST be worn at all times when levels of phosphine gas are above 0.1 ppm. If phosphine levels are unknown, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm, must be worn. If at any time phosphine levels exceed 0.1 ppm, all individuals who are not wearing respiratory protection as outlined in Section V.E. RESPIRATORS MUST vacate the area until phosphine levels are at or below 0.1 ppm. If carbon dioxide levels are unknown, or above 30,000 ppm, or if a person must be in an area with carbon dioxide levels between 5,000 and 30,000 ppm for more than 15 minutes, then self-contained breathing apparatus as described in Section V.E. RESPIRATORS MUST be worn.
9. To protect workers from phosphine exposure, appropriate respiratory protection is required for all the following operations: delivery/dispensing of product, attending to spills and leaks, and while monitoring phosphine levels during fumigation and aeration periods (i.e. worn at all time when levels of phosphine gas are above 0.1 ppm or are unknown).
10. A NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus must be worn in confined spaces and in fumigation structures.
11. Worker exposure to phosphine must not exceed 0.1 ppm. Entry by unprotected workers into the fumigated site is only permitted after the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. Only if necessary should workers be present in the fumigation zone. All workers present in the fumigation zone during the fumigation or aeration periods MUST wear appropriate respiratory protection, as outlined in the Application Manual, Section V.E. RESPIRATORS, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm. Each unprotected worker in the fumigation zone must have a personal phosphine monitor that is functional for the duration of the work period, must know how to operate the personal phosphine monitor and be informed of procedures required if the air levels of phosphine gas exceed 0.1 ppm.
12. Worker exposure to carbon dioxide must not exceed the Threshold Limit Value (TLV) of 5,000 ppm (0.5 % by volume) at any time, either during or after application.
13. Workers required to use SCBA should be assessed for impaired pulmonary function prior to initial use and at least annually thereafter. Any employees found to have impaired pulmonary function should be referred for medical attention.
14. Wear a loose fitting long sleeve shirt, long pants, socks, safety shoes, safety glasses, and wear gloves (leather or leather faced cotton gloves) when handling this product (refer to Section V, PERSONAL PROTECTIVE EQUIPMENT).

15. A fumigation zone must be established for all fumigated sites (with the exception of ships and railcars that are in motion) as per the instructions outlined under Section VII, FUMIGATION ZONE REQUIREMENTS.
16. Note that transport of non-aerated commodities is permitted by rail or ship only. Other transport vehicles, such as trucks, vans, and trailers, are prohibited from travel over public roads or highways until completely aerated to a hydrogen phosphide level at or below 0.1 ppm. If workers must handle an incompletely aerated commodity, or are indoors (e.g., an enclosed elevator head) they are to wear appropriate respiratory protection (see Section V.E., RESPIRATORS).
17. Post warning placards around both the fumigated site and the fumigation zone perimeter as per instructions in Section X, PLACARDING OF FUMIGATION AREAS.
18. The fumigated site and several locations along the perimeter of the fumigation zone, especially downwind and in adjacent or nearby buildings, must be monitored to ensure that phosphine concentrations are kept within acceptable levels outside these areas. Large leaks must be repaired to minimize loss of fumigant and the fumigation zone extended accordingly to reduce risk of exposure to bystanders and/or occupants of nearby buildings.
19. Protect or remove materials containing metals such as copper, silver, gold and their alloys and salts from corrosive exposure to phosphine.
20. Do not connect cylinders to dispensing equipment until all fumigation notice placards have been posted and the space to be fumigated is clear and secured.
21. Phosphine fumigants are not to be used for vacuum fumigations.
22. Theft of products: Immediately report to the local police department thefts of $ECO_2FUME^{®}$ cylinders.
23. Registrant must be informed of any incident involving the use of this product.

B. SECURING CYLINDERS

Cylinders must be secured upright at all times to prevent their being inadvertently knocked over. When cylinder is not connected to dispensing equipment, the valve cap and cylinder cap must be securely installed.

C. POISON GAS HAZARDS – LEAK DETECTION AND REPAIR

Because $ECO_2FUME^{®}$ Fumigant Gas is comprised of poisonous gases, care must be taken to avoid direct exposure. Appropriate procedures must be followed to detect and repair leaks in dispensing equipment and structures. These are discussed below. Also, see Section XV of this manual, "SPILL AND LEAK PROCEDURES."

1. Dispensing Equipment

Although the dispensing equipment is designed to contain the gas, small leaks can occur. A phosphine detector must be used at the beginning of each application to check the integrity of the equipment and any leaks must be corrected immediately. Nitrogen or Carbon Dioxide should be used to pressurize and leak check equipment with soap solution prior to use.

If any leak is encountered while using $ECO_2FUME^{®}$ Fumigant Gas, clear the immediate area of all personnel.

Only persons wearing appropriate respiratory protection such as a NIOSH- approved self-contained breathing apparatus (SCBA) with full face piece operated in pressure-demand or other positive-pressure mode, are permitted in the area to address the leak (refer to Section V.E, RESPIRATORS). Once the leak has been stopped, the area must be thoroughly ventilated and the air tested with a phosphine detector. Only after the phosphine level is at or below 0.1 ppm, are unprotected personnel permitted to enter.

If a cylinder leak is detected, refer to Section IV.H. 2.g.(3) of this manual for guidance on troubleshooting. Further troubleshooting assistance for a particular piece of dispensing equipment is addressed in the respective equipment manual.

2. Storage Structures

To reduce the potential for leakage, careful attention should be given to inspection of the storage structure and proper sealing prior to fumigation. Refer to the DIRECTIONS FOR USE, Sections IV A. ("GENERAL") and IV F.

("SEALING") in this manual, for related guidance.

The perimeter of the fumigated site, especially downwind and in adjacent or nearby buildings, must be monitored to ensure that phosphine and carbon dioxide concentrations are kept within acceptable levels outside the fumigated site. This involves walking around the site/structure with a personal monitoring device to determine whether excessive amounts of fumigant are escaping.

If a high level of phosphine is detected at concentrations greater than 0.1 ppm outside the area under fumigation, the addition of fumigant must be stopped. Large leaks must be repaired to minimize loss of fumigant and the fumigation zone extended accordingly to reduce the risk of exposure to bystanders and/or occupants of nearby buildings (refer to Section VII, FUMIGATION ZONE REQUIREMENTS). Appropriate personal protective equipment must be worn when sealing leaks (refer to Section V, PERSONAL PROTECTIVE EQUIPMENT). These repairs must be made from the exterior of the structure whenever possible. If it is necessary to seal a leak from the interior of the structure, the applicator must follow all proper procedures for confined space entry including wearing appropriate respiratory protection such as a NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode (refer to Section V.E, RESPIRATORS).

D. COMPRESSED GAS HAZARDS

ECO_2FUME® Fumigant Gas cylinders and dispensing equipment can achieve pressures of over 6900 kPa (1000 psig). Because of this high pressure, care must be taken to avoid unintentional releases of the product.

1. Gas Discharge

The release of high-pressure gas can be forceful and there is potential for personal injury. High-speed discharge from unsecured flexible components such as hoses or tubing can result in a whipping action. The gas released can also propel small objects in the area. Such airborne objects can injure the eyes and bodies of people in the area.

2. Temperature

The rapid discharge of ECO_2FUME® Fumigant Gas through fast dispensing equipment will result in a chilling effect on parts of the equipment and cylinders. This thermodynamic effect can create temperatures low enough to cause frostbite to unprotected skin, if touched. While this chilling is typically evidenced by the formation of ice on the equipment and cylinders, the cold hazard may exist without the formation of ice.

3. Residual Pressure

The chilling of cylinders is the result of the liquefied gas mixture boiling to maintain the pressure in the gas space of the cylinder.

A small amount of dry ice (solid carbon dioxide) may form in the cylinder when the product is dispensed very quickly and the liquid product level falls below the bottom of the dip tube. The pressure in a cylinder that has formed dry ice will be very low. When the cylinder is allowed to warm, this ice will again turn to liquid or gas and the pressure in the cylinder will rise accordingly. For this reason, all cylinders must be treated as if they contain high-pressure gas. Cylinder valves must always be closed before disconnecting the dispensing equipment.

Prior to the dismantling of ECO_2FUME® Fumigant Gas dispensing equipment at the conclusion of fumigation, all residual gas in the equipment must be vented to atmospheric pressure. Appropriate respiratory protection must be worn during this process (refer to Section V.E, RESPIRATORS). The cylinder valve must be closed and the remaining product within the supply line discharged through the dispensing equipment. Cylinders must not be disconnected before ensuring that the line is fully vented.

4. Liquid Expansion

Liquefied gases expand rapidly when they are warmed. Because of this characteristic, liquid ECO_2FUME® Fumigant Gas must never be trapped between the shutoff valve on the cylinder and the shutoff valve on the dispensing equipment, without adequate safety relief devices in place. Only approved application equipment should be used because of this hazard.

III. PRECAUTIONARY STATEMENTS

$ECO_2FUME^®$Fumigant Gas is a restricted use product for retail sale to and use only by individuals holding an appropriate pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the pesticide application occurs or by persons trained in accordance with the Application Manual working under the direct supervision and in the physical presence of an applicator holding an appropriate pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the pesticide application occurs. Physical presence means on-site or on the premises.

A. HAZARDS TO HUMANS, BIRDS AND MAMMALS

DANGER – POISON, KEEP OUT OF REACH OF CHILDREN AND PREVENT ACCESS BY UNAUTHORIZED PERSONNEL. Contains Extremely Hazardous Gas. Fatal if inhaled. Do not inhale gas. The liquid may cause burns. Do not get in eyes, on skin or on clothing. Do not eat, drink or smoke while handling $ECO_2FUME^®$ Fumigant Gas.

Use in well ventilated areas. Contains phosphine (hydrogen phosphide) gas and carbon dioxide. Phosphine is flammable and toxic. Carbon dioxide at elevated concentrations is toxic. For worker safety, the monitoring for phosphine gas and carbon dioxide is required and appropriate respiratory protection must be worn. Phosphine gas may deaden the sense of smell. Do not depend solely on the odour to detect $ECO_2FUME^®$ Fumigant Gas.

Appropriate respiratory protection MUST be worn at all times, when levels of phosphine are above 0.1 ppm and/or levels of carbon dioxide are above 5,000 ppm or are unknown, as outlined below and in the Application Manual – Section V.E, RESPIRATORS. If phosphine levels are unknown, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set to 0.1 ppm must be worn. If a beard or long sideburns interfere with the fit of respiratory protection, they must be shaven. **IT IS IMPORTANT TO CONSIDER BOTH PHOSPHINE AND CARBON DIOXIDE CONCENTRATIONS TO DETERMINE THE USE OF APPROPRIATE RESPIRATORY PROTECTION.**

To protect workers from phosphine exposure, appropriate respiratory protection is required for all the following operations: delivery/dispensing of product, attending to spills and leaks, and while monitoring phosphine levels during fumigation and aeration periods (*i.e.* worn at all times when levels of phosphine gas are above 0.1 ppm or are unknown).

Entry by unprotected workers is only permitted after the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone.

For phosphine levels between 0.1–5 ppm, the minimum protection required is a NIOSH-approved air-purifying full face piece respirator (gas mask) with a chin-style, front- or back-mounted canister approved for phosphine OR a NIOSH-approved supplied-air respirator (i.e., air-line respirator or self-contained breathing apparatus) with a full face-piece.

For phosphine levels above 5 ppm or at unknown concentrations , a NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus must be worn.

For emergency use and/or to escape from conditions which are Immediately Dangerous to Life or Health (IDLH), keep available for use an adequate number of NIOSH- approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive pressure mode.

For carbon dioxide levels between 5,000 and 30,000 ppm, 1) persons may enter the treated area without respiratory protection for 15 minutes or less; 2) for periods longer than 15 minutes, use a NIOSH-approved supplied-air respirator (i.e., air-line respirator or self-contained breathing apparatus) with a full face piece.

For carbon dioxide levels above 30,000 ppm or at unknown concentrations, a NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus must be worn.

EXPOSURE TO CONCENTRATIONS OF PHOSPHINE AND/OR CARBON DIOXIDE ABOVE PERMISSIBLE LEVELS MAY CAUSE POISONING.

B. FIRST AID

Symptoms of exposure to phosphine gas can include headache, dizziness, nausea, difficult breathing, vomiting and diarrhea. In all cases of exposure, protect yourself, remove the person from the source of exposure and get them to an Emergency department. If possible, bring this Application Manual, the container, label or product name and Pest Control Product Registration Number with you when seeking medical attention.

FIRST AID RESPONDER PROTECTION: Phosphine gas is a highly toxic systemic poison and a severe respiratory tract irritant. First Aid responders should protect themselves through the use of appropriate personal protective equipment before attempting to rescue or care for a person who has been exposed to phosphine gas, and/or if entering a zone with potentially unsafe phosphine levels. A NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus is recommended in response situations that involve exposure to potentially unsafe or unknown levels of phosphine (see the PRECAUTIONS section of product label or Application Manual for further guidance regarding personal protective equipment).

IF INHALED: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration using a bag-valve-mask device to prevent possible secondary exposure to phosphine gas to the first aid responder. Do not perform mouth-to-mouth resuscitation. Do not give anything by mouth to an unconscious person. Call a poison control centre or doctor immediately for further treatment advice.

IF ON SKIN OR CLOTHING: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. May cause frostbite to unprotected skin upon contact with dispensing equipment while gas is discharging rapidly. Treat as thermal burn. Call a poison control centre or doctor for treatment advice.

IF IN EYES: In case of freezing or cryogenic burns, hold eye open and rinse slowly and gently with plenty of COOL water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Do not rinse eyes with hot or even tepid water. Call a poison control centre or doctor for treatment advice.

C. TOXICOLOGICAL INFORMATION

NOTE TO PHYSICIAN - THIS IS PHOSPHINE; IT IS NOT PHOSGENE.

$ECO_2FUME^{®}$ Fumigant Gas is a gaseous mixture of phosphine and carbon dioxide. Mild exposure by inhalation causes malaise (indefinite feeling of sickness), ringing of ears, fatigue, nausea and pressure in chest which is relieved by removal to fresh air. Moderate poisoning causes weakness, vomiting, pain just above the stomach, chest pain, diarrhea and dyspnea (difficulty in breathing). Symptoms of severe poisoning may appear within a few hours to several days. Severe poisoning may result in pulmonary edema (fluid in lungs) and may lead to dizziness, cyanosis (blue or purple skin colour), unconsciousness, and death.

In sufficient quantity, phosphine affects the liver, kidneys, lungs, nervous system, and circulatory system, and may result in (1) pulmonary edema, (2) liver elevated serum AST, ALT and ALP, reduced prothrombin, hemorrhage and jaundice (yellow skin colour) and (3) kidney haematuria (blood in urine) and anuria (abnormal or lack of urination). Pathology is characteristic of hypoxia (oxygen deficiency in body tissue). Frequent exposure to concentrations above permissible levels over a period of days or weeks may cause poisoning. Inhalation can cause lung edema (fluid in lungs) and hyperaemia (excess of blood in a body part), small perivascular brain hemorrhages and brain edema (fluid in brain).

Treatment is symptomatic. The following measures are suggested for use by the physician in accordance with the physician's own judgment:

1. Exposure of skin to rapidly evaporating liquid may cause cryogenic "burn". Treat the "burn" in a similar manner as a thermal burn.

2. In case of freezing or cryogenic "burns" to eyes by rapidly evaporating liquid, RINSE EYES WITH COOL WATER. Do not rinse eyes with hot or even tepid water.
3. In its milder to moderate forms symptoms of poisoning may take up to 24 hours to appear. Monitoring should continue for at least this long. Manifestations of severe poisoning appear early. Hypoxia and hypotension should be treated with usual supportive measures of oxygenation, intubation, ventilation and positive pressure as needed and intravenous fluids, pressors and inotropes are required, respectively. There is no specific antidote. Hemodialysis may be indicated if renal failure develops but does not remove the toxin.

D. ENVIRONMENTAL HAZARDS

Toxic to birds and mammals. Exposure to non-target organisms should be avoided. Phosphine gas may be hazardous to birds nesting on or near structures being fumigated. Carefully inspect the outside and inside of the structure prior to application of the fumigant to ensure the absence of nesting or roosting birds. Avoid application if birds are present. The aeration phase should be initiated early in the day to allow for maximum phosphine dissipation, which will occur during daylight hours.

E. PHYSICAL AND CHEMICAL HAZARDS

Phosphine may ignite spontaneously at levels above its lower flammability limit of 1.8% v/v (18,000 ppm). It is important not to exceed this concentration. Ignition of high concentration of phosphine can produce a very energetic reaction. Explosions can occur under these conditions and may cause severe personal injury. **Never allow the buildup of phosphine to exceed explosive concentrations**. For this reason, the ratio of phosphine and carbon dioxide in $ECO_2FUME^{®}$ Fumigant Gas was specifically chosen to ensure the mixture is non-flammable in all proportions with air.

Contents under pressure. Do not use or store near heat or open flame. Do not puncture or incinerate container. Exposure to temperatures above 54°C (130°F) may cause bursting. Do not drop the container.

DO NOT open cylinder in a confined space without wearing appropriate respiratory protection such as a NIOSH-approved self-contained breathing apparatus (SCBA) with full face piece operated in a pressure-demand or other positive-pressure mode. **DO NOT** enter a space under fumigation with $ECO_2FUME^{®}$ Fumigant Gas without first checking the gas concentration levels and wearing the appropriate respiratory protection (refer to Section V.E, RESPIRATORS). Phosphine gas has a low solubility in water and oils and is stable at normal fumigation temperatures. However, it may react with certain metals and cause corrosion, especially at higher temperatures and relative humidities. Metals such as copper, brass and other copper alloys, and precious metals such as gold and silver are susceptible to corrosion. Thus, small electric motors, smoke detectors, brass sprinkler heads, batteries and battery chargers, fork lifts, temperature monitoring systems, switching gears, communication devices, computers, calculators and other electronic or electrical equipment should be protected or removed before fumigation. In most cases all electronic equipment must be removed. Phosphine gas will also react with certain metallic salts and therefore, sensitive items such as photographic film, some inorganic pigments, etc. should not be exposed. Under high vacuum conditions, phosphine gas may cause an explosive hazard. Do not apply fumigant in vacuum chambers.

IV. DIRECTIONS FOR USE

A. GENERAL

1. **It is an offence under the *Pest Control Products Act* to use this product in a manner inconsistent with its labeling.** $ECO_2FUME®$ Fumigant Gas is a Restricted Use Pesticide due to the acute inhalation toxicity of phosphine, PH_3 gas. These products are for retail sale to and use only individuals holding an appropriate pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the pesticide application occurs or by persons trained in accordance with this product's Application Manual working under the direct supervision and in the physical presence of an applicator holding an appropriate pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the pesticide application occurs. Physical presence means on-site or on the premises. Read and follow the label and this Application Manual which contains complete instructions for

the safe use of this pesticide.

2. A fumigation zone must be established for all fumigated sites (with the exception of ships and railcars that are in motion) according to the distances listed in Section VII, FUMIGATION ZONE REQUIREMENTS during the fumigation period (i.e., from the beginning of the fumigant application until the beginning of aeration. Prior to entry by unprotected workers, the fumigated site must be aerated and the phosphine level must be at or below 0.1 ppm in the fumigated site and the fumigation zone determined by the licensed/certified applicator.

3. $ECO_2FUME^{®}$ Fumigant Gas is a hazardous material and may be used only by individuals trained in its proper use. Before using, read and follow the label precautions, safety recommendations and use directions on the label and in the $ECO_2FUME^{®}$ Fumigant Gas Application Manual. Persons working with phosphine must be knowledgeable of the hazards of this product and trained in the use of required respiratory equipment and detector devices, emergency procedures and use of the fumigant.

4. Two persons trained in accordance with the Application Manual under the direct supervision of a licensed/certified applicator, or a licensed/certified applicator and trained person, must be present if entry into fumigated or partially aerated structures is required. Two trained persons must be present when phosphine is applied from outside the site to be treated, unless Provincial pesticide regulations require otherwise. The licensed/certified applicator must maintain visual and/or voice contact with all fumigation workers during the application of fumigants.

   Appropriate respiratory protection, as outlined in Section V.E, RESPIRATORS, MUST be worn at all times when levels of phosphine gas are above 0.1 ppm, which may occur during delivery/dispensing of product, attending to spills and leaks, and while monitoring phosphine levels during the fumigation and aeration periods. If phosphine levels are unknown, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm, must be worn. Respiratory protection specified in Section V.E. RESPIRATORS must be worn if levels of carbon dioxide are above 5,000 ppm or are unknown. **IT IS IMPORTANT TO CONSIDER BOTH PHOSPHINE AND CARBON DIOXIDE CONCENTRATIONS TO DETERMINE THE USE OF APPROPRIATE RESPIRATORY PROTECTION.** The licenced/certified applicator must maintain visual and or voice contact with all fumigation workers during the application of the fumigant.

   To protect workers from phosphine exposure, appropriate respiratory protection is required for all the following operations: delivery/dispensing of product, attending to spills and leaks, and while monitoring phosphine levels during the fumigation and aeration periods (i.e. worn at all times when levels of phosphine are above 0.1 ppm or are unknown).

   For phosphine levels between 0.1 – 5 ppm, the minimum protection required is a NIOSH-approved air-purifying, full face piece respirator (gas mask) with a chin-style, front- or back-mounted canister approved for phosphine OR a NIOSH-approved supplied-air respirator (i.e., air-line respirator or self-contained breathing apparatus) with a full face piece.

   For phosphine levels above 5 ppm or at unknown concentrations, a NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus must be worn.

   For carbon dioxide levels between 5,000 and 30,000 ppm, 1) persons may enter the treated area without respiratory protection for 15 minutes or less; 2) for periods longer than 15 minutes, use a NIOSH-approved supplied-air respirator (i.e., air-line respirator or self-contained breathing apparatus) with a full face piece.

   For carbon dioxide levels over 30,000 ppm or unknown, a NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus must be worn.

For emergency use and/or to escape from conditions which are Immediately Dangerous to Life or Health (IDLH), keep available for use an adequate number of NIOSH-approved self-contained breathing apparatus with a full face piece operated in a pressure-demand or other positive-pressure mode.

5. Large scale fumigations may require the posting of watchmen to prevent entry into the site under fumigation. Refer to Provincial pesticide regulations.

6. Prior to applying this product, the storage site/structure must be inspected to determine if it can be made sufficiently gas tight. A Fumigation Management Plan must be developed prior to actual treatment to provide for safe and efficient application of the fumigant (refer to Section G, FUMIGATION MANAGEMENT PLAN). The storage site/structure should be sealed so as to maintain a suitable gas concentration over the time period required for control of insects and rodents.

7. Wear a loose fitting long sleeve shirt, long pants, socks, safety shoes, safety glasses, and wear gloves (leather or leather faced cotton gloves) when handling this product. Personal exposure monitoring should be conducted by use of personal electronic monitors or low level detection tubes, as appropriate.

8. Protect or remove copper, silver, gold and their alloys from corrosive exposure to phosphine. Sensitive equipment and items containing these elements should be removed or protected prior to fumigation with $ECO_2FUME^{®}$ Fumigant Gas.

9. Ship holds, containers on ships, railroad cars, trucks, vans and other transport vehicles and containers shipped piggyback by rail may be fumigated in transit. However, trucks, vans, trailers and similar transport vehicles are prohibited from travel over public roads or highways until completely aerated to a phosphine level at or below 0.1 ppm and warning placards removed.

10. Notify appropriate owners, employees, and/or operators at the facility where and when the fumigation will occur, and provide relevant safety, health and environmental information to local fire and rescue officials for use in the event of an emergency. For additional information consult the manufacturer manuals and training information about safe and effective use of $ECO_2FUME^{®}$ Fumigant Gas. Observe all Provincial pesticide regulations.

B. EFFICACY

Complete control of listed pests may not always be achieved. Factors contributing to less than 100% control include gas leak age, poor gas distribution, unfavorable exposure conditions, etc. In addition, some insects are less susceptible to phosphine than others. To maximize control, extreme care must be observed in sealing, higher dosages must be used, exposure periods must be lengthened, proper application procedures must be followed, and temperature and humidity must be favourable.

C. USE PATTERN

1. Pests

$ECO_2FUME^{®}$ Fumigant Gas will control the following pests:

a) Rodents

including: rats, mice, and other rodent pests in structures (not for use in burrows)

b) Insects

Almond Moth
Angoumois Grain Moth
Bean Weevil
Cadelle
Carpet Beetle
Cereal Leaf Beetle
Hessian Fly
Khapra Beetle
Indian Meal Moth
Lesser Grain Borer
Maize Weevil
Mediterranean Flour Moth

Cigarette Beetle
Confused Flour Beetle
Dermestid Beetle
Dried Fruit Beetle
Dried Fruit Moth
European Grain Moth
Flat Grain Beetle
Fruit Fly
Granary Weevil
Greater Wax Moth
Hairy Fungus Beetle
Honey bees with tracheal mites
Pea Weevil
Pink Bollworm
Raisin Moth
Red Flour Beetle
Rice Weevil
Rusty Grain Beetle
Saw-toothed Grain Beetle
Spider Beetle
Tobacco Moth
Warehouse Beetle
Yellow Meal Worm

c) Wood pests

Nematodes*
Wood boring beetles
*ECO_2FUME® Fumigant Gas has not been demonstrated to control any species of Golden or Pale Nematode, which are quarantine pests in Canada.

2. Commodities

The following food commodities can be fumigated with ECO_2FUME® Fumigant Gas:

a) Raw Agricultural Commodities

Alfalfa
Almonds
Avocado
Banana (includes Plantain)
Barley
Brazil Nuts
Cabbage, Chinese
Cashews
Citrus Citron
Cocoa Beans
Coffee Beans
Corn
Cottonseed
Dates
Dill
Eggplant
Endive
Filberts
Flower Seed
Grapefruit
Grass Seed
Kumquats
Legume Vegetables (succ. or dried)
Lemon
Lettuce
Lime
Mango
Millet
Oats
Okra
Orange
Papaya
Pecans
Peanuts
Pepper
Persimmon
Pimento
Potato, Sweet
Rice
Rye
Safflower Seed
Salsify Tops
Sesame Seed
Sorghum
Soybeans
Sunflower Seed
Tangelo
Tangerine
Tomato
Triticale
Walnuts
Wheat

b) Processed Foods

The listed processed foods may be fumigated with ECO_2FUME® Fumigant Gas:

- Processed candy and sugar
- Cereal flours and bakery mixes
- Cereal foods (including cookies, crackers, macaroni, noodles, pasta, pretzels, snack foods and spaghetti)
- Processed cereals (including milled fractions and packaged cereals)
- Cheese and cheese by-products
- Chocolate and chocolate products (such as assorted chocolate, chocolate liquor, cocoa, cocoa powder, dark chocolate coating and milk chocolate)
- Processed coffee
- Corn grits
- Cured, dried and processed meat products and dried fish
- Dates

- Dried eggs and egg yolk solids
- Dried milk, dried powdered milk, non-dairy creamers, and non-fat dried milk
- Dried or dehydrated fruits (such as apples, dates, figs, peaches, pears, prunes, raisins and sultanas)
- Dried and dehydrated vegetables (such as beans, carrots, lentils, peas, potato flour, potato products and spinach)
- Figs
- Malt
- Peanuts
- Processed herbs, spices, seasonings and condiments
- Processed nuts (almonds, apricot kernels, Brazil nuts, cashews, filberts, peanuts, pecans, pistachio nuts, walnuts and other processed nuts)
- Processed oats (including oatmeal)
- Rice (brewers rice grits, enriched and polished, wild rice)
- Soybean flour and milled fractions
- Processed tea
- Yeast (including primary yeast)

c) Animal Feed and Feed Ingredients

d) Non-food Commodities Including Tobacco

The listed non-food items may be fumigated with $ECO_2FUME^{®}$ Fumigant Gas:

- Animal hide
- Processed or unprocessed cotton, wool and other natural fibers or cloth
- Clothing, feathers, furs, human hair, rubberized hair, vulcanized hair, mohair
- Leather products
- Tobacco
- Wood, cut trees, wood chips and wood and bamboo products
- Paper and paper products
- Non-food flour
- Dunnage
- Non-food starch
- Dried plants and flowers
- Seeds (grass seed, ornamental herbaceous plant seed, and vegetable seed)
- Straw or hay
- Psyllium seed and psyllium seed husks*

  *Psyllium seed and Psyllium seed husks destined for shipment to pharmaceutical manufacturers may be fumigated. Such dedicated lots may be fumigated in transport vehicles (truck trailers, railcars and containers) prior to shipment. In addition, psyllium seed and husks may be fumigated at other locations only under direct instructions from the pharmaceutical company.

D. DOSAGE GUIDE

Recommended Dosages For $ECO_2FUME^{®}$ Fumigant Gas Phosphine[1,2]		
Temperature	Concentration Maintained	Duration
Below 0ºC (32 ºF)	Do not fumigate	Do not fumigate
0-4ºC (32-39ºF)	200 - 1000 ppm	6-14 days
5-12ºC (40-53ºF)	200 - 1000 ppm	4-10 days
12-15ºC (54-59ºF)	200 - 1000 ppm	3-5 days
16ºC (60ºF)-above	200 - 1000 ppm	2-3 days

[1] When fumigating wood or wood products, the fumigation rate may need to be adjusted depending upon the moisture content of the wood or wood product. The use of the higher concentrations and longer fumigations times registered on this label are recommended to counter the solubility of phosphine in water or moisture present in the

wood or wood product. Additional phosphine gas may be needed in order to maintain the phosphine concentration after the initial dose has been applied. If fumigating for quarantine purposes, check with the receiving country concerning accepted fumigation methods for the specific product being fumigated. Do not apply using any method other than those specified on this label. Do not exceed the maximum concentration of phosphine that is specified on this label.

[2] Rodents in storages may be controlled with short-term fumigations within 1 to 4 hours after achieving distribution of phosphine throughout the structure.

E DOSAGE GUIDELINES

Phosphine is a mobile gas and will penetrate to all parts of the storage structure. Therefore, dosage must be based upon the total volume of the space being treated and not on the amount of commodity it contains.

The above table may be used as a guide in determining the minimum length of the exposure at the indicated temperatures. These are the temperatures found within the immediate surroundings of the target pest (cold walls, centre of grain mass, etc.). For example, this means that 200 parts per million of phosphine from $ECO_2FUME^{®}$ Fumigant Gas is necessary for 2-3 days at 15-20ºC (60-68ºF) at the location of the pest insect. This does not mean the ambient temperature the fumigator is experiencing but the localized concentration and temperature next to the pest insects.

Some insect species and life stages are harder to kill than others. It is important that you know and understand your target pest(s). For example, overwintering dormant larva may be more difficult to kill than an active larva of the same species. Use the maximum duration on the above table when possible. Insects, in general, are more difficult to control at lower temperatures because their respiration is slower.

Certain stored product insects are more tolerant and harder to kill. Here is a partial list of those insect species: Rice weevil, Granary weevil, Maize weevil (*Sitophilus* spp.), Lesser grain borer (*Rhyzopertha dominica*), Warehouse beetle (*Trogoderma* spp.), Carpet beetle (*Attagenus/Anthrenus* spp.), Cigarette beetle (*Lasioderma serricorne*).

Consequently, exposure periods recommended in the table are minimum periods and may not be adequate to control all stages of stored product pests under all conditions. This is particularly true at lower temperatures (below 15ºC (60ºF)) due to the lower activity and respiration levels of insects. Fumigators also should be aware that different types of packaging will influence the penetration rate of the gas. Selection of appropriate exposure should be considered accordingly.

The key to a successful fumigation remains with correct dosage, adequate exposure periods, proper application procedures and well-sealed enclosures.

F. SEALING

Good sealing is necessary for an effective fumigation. Turn off all ventilation, supply air, air conditioning, and any other air moving systems which could negatively affect the fumigation. Thoroughly inspect the area to be fumigated and seal all cracks, holes and openings. These areas could include, but are not limited to: windows, doors, vents, chimneys and structural flaws. Sealing techniques can vary, but most often include polyethylene sheeting, adhesive tapes and adhesive sprays. Expandable foam or caulking material can work well on structural flaws. Proper sealing will ensure sufficient gas levels within the area to be fumigated and will decrease the chance of unwanted exposure outside of this area.

As with all fumigations, fumigated site and fumigation zone perimeter monitoring for leaks and potential exposures is required. Appropriate respiratory protection must be worn while monitoring phosphine levels during fumigation as outlined under Section V.E, RESPIRATORS. If a high level of phosphine (greater than 0.1 ppm) is detected outside the site/structure, the addition of fumigant must be stopped. Using the proper protective equipment, the applicator must attempt to seal the leak from the exterior of the structure. Failing this, the applicator must follow all proper procedures for confined space entry including wearing appropriate respiratory protection, such as a NIOSH-approved self-contained breathing apparatus (SCBA) with full face piece operated in a pressure-demand or other positive-pressure mode, and seal the leak from the interior. At times the applicator may find that all the calculated amount of fumigant has been added, however the target concentration has not been reached. In this case, the fumigator must first check the calculations. It is possible the phosphine concentration is localized and has not had

enough time to disperse evenly. Continue to monitor the inside concentration while checking for leaks as above. All sites/structures will leak to some degree. Large leaks must be repaired to minimize loss of fumigant to the environment and reduce risk of potential exposure to personnel. Fence-line concentrations must never be allowed to exceed 0.1 ppm.

Do not fumigate a structure which is connected to other occupied structures. All people must be removed from structures connected to fumigated structures.

G. FUMIGATION MANAGEMENT PLAN

A FUMIGATION MANAGEMENT PLAN MUST BE WRITTEN FOR ALL FUMIGATIONS PRIOR TO ACTUAL TREATMENT

A fumigation management plan template is available from the manufacturer.

A Fumigation Management Plan must be devised to cover application and exposure period, aeration and disposal of the fumigant so as to keep to a minimum any human exposures to phosphine and to help ensure adequate control of pests.

The licensed/certified applicator is responsible for working with the owners and/or responsible employees of the site to be fumigated to develop and follow a Fumigation Management Plan. The Fumigation Management Plan is intended to ensure a safe and effective fumigation. The Fumigation Management Plan must address characterization of the site, and include appropriate monitoring and notification requirements and include a record that the following have been completed:

1. Inform the person in charge of the facility where the fumigation will take place that all workers must complete mandatory annual training as outlined in the Application Manual – Section VIII. MANDATORY ANNUAL TRAINING. Training includes information on the hazards of the product, the use of safety equipment (i.e., respiratory protection and personal monitors), and the exposure limit of 0.1 ppm.
2. Inspect the site to determine its suitability for fumigation.
3. When sealing is required, consult previous records for any changes to the site/structure, seal leaks, and monitor any occupied adjacent buildings to ensure safety.
4. Prior to each fumigation, review any existing Fumigation Management Plans, MSDS, Application Manual and other relevant safety procedures with company officials and appropriate employees.
5. Consult company officials in the development of procedures and appropriate safety measures for nearby workers that will be in and around the area during application and aeration.
6. Consult with company officials to ensure that an appropriate monitoring plan will be in place to confirm that nearby workers and bystanders will not be exposed to levels above the allowed phosphine safety limit *(i.e.* 0.1 ppm) and/or the carbon dioxide limit (i.e. 5,000 ppm) during application, fumigation and aeration. This plan must take into consideration all of the fumigation zone requirements and demonstrate that nearby residents will not be exposed to concentrations above the allowable limits.
7. Consult with company officials to develop procedures for local authorities to notify nearby residents in the event of an emergency.
8. Confirm the placement of placards to secure entrance and along other routes of approach into any site under fumigation and along the fumigation zone perimeter.
9. Confirm the required safety equipment is in place and the necessary manpower is available to complete a safe and effective fumigation.
10. Written notification must be provided to the receiver of a vehicle that is fumigated in transit (i.e. fumigation in transit is permitted by rail or ship only).

It is important to note that some Fumigation Management Plans will be more comprehensive than others. All Fumigation Management Plans should reflect the experience and expertise of the licensed/certified applicator and circumstances at and around the site/structure and the fumigation zone.

In addition to the development of the Fumigation Management Plan, the licensed/certified applicator must read the entire label and the Application Manual and follow its directions carefully. If the licensed/certified applicator has

any questions about the development of a Fumigation Management Plan, contact the product manufacturer for further assistance.

The Fumigation Management Plan and related documentation, including monitoring records, must be maintained for a minimum of 2 years.

1. Guidance for Preparation of a Fumigation Management Plan

Purpose

A Fumigation Management Plan (FMP) is an organized, written description of the required steps involved to help ensure a safe, legal and effective fumigation. It will also assist you and others in complying with pesticide product label requirements. The guidance that follows is designed to help assist you in addressing all the necessary factors involved in preparing for and fumigating a structure and/or area.

This guidance is intended to help you organize any fumigation that you might perform, PRIOR TO ACTUAL TREATMENT. It is meant to be somewhat prescriptive, yet flexible enough to allow the experience and expertise of the fumigator to make changes based on circumstances which may exist in the field. By following a step-by-step procedure, yet allowing for flexibility, a safe and effective fumigation can be performed.

Before any fumigation begins, carefully read and review the product label and the Application Manual. This information must also be given to the appropriate company officials (supervisors, foreman, safety officer, etc.) in charge of the site. Preparation is the key to any successful fumigation. If you do not find specific instructions for the type of fumigation that you are to perform listed in this Guidance Document, you will want to construct a similar set of procedures using this document as your guide or contact Cytec Canada Inc, at (905) 374 5899 for assistance. Finally, before any fumigation begins, you must be familiar with and comply with all applicable federal, provincial and municipal laws and regulations. The success of the fumigation is not only dependent on your ability to do your job but also upon carefully following all rules, regulations, and procedures required by governmental agencies.

2. A Checklist Guide for a Fumigation Management Plan

This checklist is provided to help you take in account factors that must be addressed prior to performing all fumigations. It emphasizes safety steps to protect people and property. The checklist is general in nature and cannot be expected to apply to all types of fumigation situations. It is to be used as a guide to prepare the required Fumigation Management Plan. Each item must be included if it is applicable to the fumigation. However, it is understood that each fumigation is different and not all items will be necessary for each fumigation site.

A. PRELIMINARY PLANNING AND PREPARATION

1. Determine the purpose of the fumigation.
   a. Control of insect infestation.
   b. Control of vertebrate pests.
   c. Plant pest quarantine.

2. Determine the type of fumigation. For example:
   a. Space: tarp, mill, warehouse, food processing plant,
   b. Vehicle: railcar, truck, van, container
   c. Commodity: raw agricultural or processed foods or non-food
   d. Type of storage: vertical silo, farm storage, flat storage, etc.
   e. Vessels: ship or barge. In addition to the Application Manual, read the Cargo, Fumigation and Tackle Regulations under the *Canada Shipping Act, current to August 5, 2014*.

3. Fully acquaint yourself with the site and commodity to be fumigated, including:
   a. The general structure layout, construction (materials, design, age, maintenance), of the structure, fire or combustibility hazards, connecting structures and escape routes, above and below ground, and other unique hazards or structural characteristics. Prepare, with the owner/operator/person in charge, a drawing or sketch of structure to be fumigated, delineating features, hazards, and other structural characteristics.
   b. The number and identification of persons who routinely enter the area to be fumigated (i.e.

employees, visitors, customers, etc.)

c. The specific commodity to be fumigated, its mode of storage, and its condition.
d. The previous treatment history of the commodity, if available
e. Accessibility of utility service connections.
f. Nearest telephone or other means of communication. Mark the location of these items on the drawing/sketch.
g. Emergency shut-off stations for electricity, water and gas. Mark the location of these items on the drawing/sketch.
h. Current emergency telephone numbers of local health, fire, police, hospital and physician responders.
i. Name and phone number (both day and night) of appropriate company officials
j. Check, mark and prepare the points of fumigant application locations if the job involves entry into the structure for fumigation.
k. Review labeling and Application Manual.
l. Location of command centre.
m. Exposure time considerations:
    1. Product to be used.
    2. Minimum fumigation period, as defined and described by the label use directions.
    3. Down time required to be available.
    4. Aeration requirements.
    5. Cleanup requirements, equipment, and personnel needs, if necessary
    6. Measured and recorded commodity temperature and moisture
n. Determination of dosage:
    1. Cubic footage or other appropriate space/location calculations
    2. Structure sealing capability and methods
    3. Label recommendations
    4. Temperature, wind
    5. Commodity/space volume
    6. Past history of fumigation of the site/structure
    7. Exposure time
    8. Amount of fumigant used
    9. Actual concentration achieved
o. Distance to other on-site and neighbouring off-site structures, recreational areas or areas where bystanders may be exposed
p. Site of aeration vent(s) to be opened to aerate site/structure
q. Fumigation zone requirements, including provisions for areas not under the control of the owner/operator of the application site (e.g. agricultural areas, roads and rights of way, publically owned and/or operated areas, difficult to evacuate sites and other residential areas).

B. PERSONNEL

1. Confirm in writing that all personnel in and around the site to be fumigated have been notified prior to application of the fumigant. Consider using a checklist that each employee initials indicating they have been notified.
2. Instruct all fumigation personnel to read the Application Manual concerning the hazards that may be encountered, and about the selection of personal protection devices, including sufficiently sensitive detection equipment.
3. Confirm that all personnel are aware of and know how to proceed in case of an emergency situation.
4. Instruct all personnel on how to report any accident and/incidents related to fumigant exposure. Provide a telephone number for emergency response reporting.
5. Instruct all personnel to report to proper authorities any theft of fumigant and/or equipment related to fumigation.
6. Establish a meeting area for all personnel in case of an emergency.

C. MONITORING

1. Safety
    a. Scheduled ambient air monitoring of phosphine concentrations must be conducted, downwind, along the fumigation zone perimeter to prevent exposure of unprotected workers and bystanders

to concentrations of phosphine greater than 0.1 ppm*** and to determine where exposures may occur. It may be necessary to monitor gas levels in other areas as well. Document where monitoring will occur.

b. Monitor (and record) the wind direction and adjust the phosphine monitoring if wind direction changes over the fumigation/aeration period.

c. Keep a log or manual of monitoring records for each fumigated site and the fumigation zone. This log must, at a minimum, contain the timing, number of readings taken and level of concentrations found in each location.

d. When monitoring, document any phosphine level even if it is present below the limit of detection.

e. From the beginning of the fumigant application and until the end of the fumigation period, a supervising fumigant applicator/handler or someone under his/her supervision must periodically monitor (*i.e.*, according to a schedule made by the licensed/certified applicator as per site characteristics and environmental conditions)phosphine levels at several locations along the fumigation zone perimeter. During aeration, the licensed/certified applicator must periodically monitor (*i.e.*, according to a schedule made by the licensed/certified applicator as per site characteristics and environmental conditions) phosphine levels at several locations along the fumigation zone perimeter.

If at any time the person monitoring phosphine levels detects phosphine concentrations greater than 0.1 ppm, the area must immediately be cleared of all individuals who are not wearing respiratory protection as outlined in Section V.E. RESPIRATORS, and the fumigation zone must be extended until the phosphine level is at or below 0.1 ppm along the perimeter. If an extension of the fumigation zone is not feasible, appropriate measures must be implemented (e.g. cease the delivery/dispensing of product, sealing of leaks, limiting aeration, etc.) until such time that the phosphine level is at or below 0.1 ppm at the fumigation zone perimeter at which time fumigation activities may continue.

*****NOTE: An evacuation action may be necessary when phosphine levels exceed 0.1ppm.**
To determine phosphine levels, readings may be taken using low level detector tubes or electronic metering devices.

2. Efficacy

a. Phosphine readings should be taken from within the fumigated site and/or structure to ensure proper gas concentrations, along with temperature and relative humidity readings. Readings must be taken immediately after introduction of the product, six hours after the introduction of the product followed by a reading every twelve hours during the fumigation period. Finally, phosphine readings should be taken every thirty minutes until aeration is complete. Refer to the above Directions for Use for specific information.

b. All phosphine, temperature and relative humidity readings should be documented.

D. NOTIFICATION

1. Confirm all the appropriate local authorities (fire departments, police departments, etc.) have been notified as per label instructions, local ordinances, or instructions of the client.
2. Prepare written procedure ("Emergency Response Plan"), which contains explicit instructions, names, and telephone numbers so as to be able to notify local authorities if phosphine levels are exceeded in an area that could be dangerous to bystanders and/or domestic animals. Elaborate in this section the key elements of an Emergency Response Plan including reference to evacuation procedures. Evacuation procedures must take into consideration any difficult-to-evacuate sites, which may take longer to evacuate. Difficult-to-evacuate sites are defined as schools (preschool to Grade 12), provincially licensed day care centres, nursing homes, assisted living facilities, hospitals, in-patient clinics and prisons.
3. Confirm that the receiver of in-transit vehicles under fumigation have been notified and are trained according to Section IV, H, 6, a, Application to Containers and Trailers, of this Application Manual.

E. SEALING PROCEDURES

1. Sealing must be adequate to control the pests. Care should be taken to ensure that sealing materials will remain intact until the fumigation is complete.
2. If the site has been fumigated before, review the previous Fumigation Management Plan for previous

sealing information.

3. Make sure that construction/remodeling has not changed the site/structure in a manner that will affect the fumigation.
4. Warning placards must be placed to secure any entrance into the fumigated site and along other likely routes of approach.

F. APPLICATION PROCEDURES & FUMIGATION PERIOD

1. Plan carefully and apply the product in accordance with the label requirements.
2. At least two persons, a licenced/certified applicator and trained person, or two persons trained in accordance with the Application Manual working under the direct supervision of the licensed/certified applicator must be present during fumigation of structures when entry into the structure for application of the fumigant is required. Appropriate respiratory protection, as outlined in Section V.E RESPIRATORS, MUST be worn at all times when levels of phosphine gas are above 0.1 ppm, or are unknown and/or levels of carbon dioxide are above 5,000 ppm or are unknown. To protect workers from phosphine exposure, appropriate respiratory protection is required for the following operations: delivery/dispensing of product, attending to spills and leaks and while monitoring phosphine during the fumigation period. If phosphine levels are unknown, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm, must be worn.
3. Apply fumigant from the outside when and where appropriate.
4. Provide watchmen when you cannot secure the fumigated site and the fumigation zone from entry by unauthorized persons (e.g., by secondary locks, barricade, etc.) during the fumigation process.
5. When entering sites/structures, always follow applicable provincial legislation for confined spaces.
6. Document that the receiver of transport vehicles shipped piggyback by rail and/or containers fumigated in-transit has been notified.
7. Turn off any electric lights in the fumigated site and/or structure, as well as all non-essential electrical motors.

G. POST-APPLICATION OPERATIONS

1. Provide watchmen when you cannot secure the fumigated site and the fumigation zone from entry (e.g., by secondary locks, barricades, etc.) by unauthorized persons during the aeration process.
2. Ventilate and aerate the fumigated site in accordance with site and/or structural limitations and nearby occupied areas so as to minimize bystander exposure.
3. Turn on ventilation or aeration fans where appropriate.
4. Determine phosphine gas concentration in the fumigated environment from outside if possible. As much as possible limit exposure, for example, by using monitoring equipment that measures indoor concentrations and displays results outside of the fumigated site. Use a sufficiently sensitive gas detector before entry into a fumigated site and/or structure to determine fumigant concentration.
5. During aeration, monitor gas levels periodically (i.e., according to a schedule made by the licenced/certified applicator as per site characteristics and environmental conditions) until the fumigated site and/or structure is ready for entry.
6. Keep written records of monitoring to document completion of aeration.
7. Consider temperature when aerating.
8. Ensure that aeration is complete before moving treated transport vehicles onto public roads.
9. Remove fumigation warning placards, when authorized by a licensed/certified applicator, after aeration of the fumigated site is complete and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone as determined by using a detection device of sufficient sensitivity.
10. Inform business/client that employees/other persons may return to work or otherwise be allowed to enter the aerated site and/or structure.

H. APPLICATION PROCEDURES

1. General Statement

The following instructions are intended to provide general guidelines for typical fumigation. There are a number of critical factors involved in the design of dispensing equipment. As such, dispensing equipment must meet both high-pressure standards and chemical compatibility requirements. Improper or inappropriate use of dispensing equipment may result in severe injury or death. Application inconsistent with the labeling and Application Manual is a violation

of Federal law. Buyer assumes all risk should the product be used contrary to label or Application Manual instructions.

2. Equipment Specification And Use

a) General

The equipment used to dispense ECO_2FUME® Fumigant Gas provides a means of containing the gas during the fumigation and controlling the release of the product into the space to be fumigated. While some dispensing equipment have been developed and used to date, they cannot be expected to cover all possible fumigation scenarios. The development of suitable dispensing equipment is an ongoing process, based on the needs of the users and available technology.

The design of dispensing equipment must account for a number of technical issues, including pressure rating, material compatibility, temperature limitations and operator safety. For this reason, only appropriate equipment must be used in the dispensing of ECO_2FUME® Fumigant Gas. Only persons trained in the proper use of ECO_2FUME® Fumigant Gas and the dispensing equipment shall be permitted to use ECO_2FUME® Fumigant Gas for fumigation.

The instruction materials provided with the dispensing equipment must be consulted for their proper use and maintenance.

b) Unapproved Dispensing Methods

It has been common practice, with other cylinderized fumigants, to place the cylinder in the space to be fumigated and the cylinder outlet valve opened to allow the fumigant to release. However, this is not an approved dispensing method and must not be used with ECO_2FUME® Fumigant Gas.

c) Approved Dispensing Methods

The approved dispensing methods for ECO_2FUME® Fumigant Gas include placing the cylinder outside the fumigation site. Pressure reducing regulators should be used for slow release, and selected piping components should be used for quick release. The slow release of ECO_2FUME® Fumigant Gas is generally used for fumigating bulk storage facilities such as silos or bins, or for small fumigation chambers or spaces and for fumigation of stacked materials under tarpaulins. The quick release method is used for space fumigation, or where the commodity to be treated is warehoused. The selection of the dispensing method will depend on the size of the fumigation, the time required and facility limitations.

d) Regulated Dispensing Equipment

Regulated dispensing equipment has been developed for use with ECO_2FUME® Fumigant Gas. The Regulated dispensers are designed to reduce the high cylinder pressure to a low pressure (less than 700 kPa (100 psig)) and provide the heat necessary to vapourize the fumigant. Once reduced to this lower pressure, the fumigant may be distributed to the desired dispensing points using inexpensive and easy to use materials, such as plastic tubing. Flow indicators are used with regulated dispensers to measure and set the dispensing rate. ECO_2FUME® Fumigant Gas regulator assemblies, equipped with basic features, are available through authorized ECO_2FUME® Fumigant Gas distributors. Multiple regulators may be used together to achieve higher fumigant flows than available through a single regulator and custom equipment can be developed for specific types of applications.

e) Quick Release Dispensing Equipment

For cases where the fumigation space is very large, such as a mill, warehouse or large fumigation chamber, and the use of a number of cylinders is anticipated, a quick means of dispensing ECO_2FUME® Fumigant Gas is available. Specially selected components can be used to direct the cylinder discharge into the fumigation space, without the need to enter the space itself during the fumigation. A single cylinder can be discharged using this method in as little as 15 minutes. Unlike the regulated dispensing methods, the dispensing rate is not adjustable and generally, entire cylinders are emptied using this process. If partial cylinder contents are needed, the ECO_2FUME® Fumigant Gas cylinder can be placed on a weight scale and the amount of fumigant released can be measured.

f) Calculating the Amount of $ECO_2FUME®$ Fumigant Gas Required

The amount of $ECO_2FUME®$ Fumigant Gas required to perform a fumigation will depend on i) the type of space to be fumigated and its sealability, ii) type of commodity, iii) type of insect pest, its life stage and resistance level, iv) temperature at the infestation site, v) duration of the fumigation, vi) use of any re-circulation or temperature control devices and vii) whether or not it is stationary or in-transit fumigation. An initial dose of $ECO_2FUME®$ Fumigant Gas is used to establish a pesticidal atmosphere in the fumigation space, and through active monitoring of the phosphine concentrations, additional $ECO_2FUME®$ Fumigant Gas added as required to maintain the target concentration for the prescribed time period.

The initial dose of fumigant is based on the total volume of the space to be fumigated and the target phosphine concentration desired. When dispensing $ECO_2FUME®$ Fumigant Gas, it is sometimes easier to speak in terms of the amount of phosphine that is required rather than the amount of $ECO_2FUME®$ Fumigant Gas.

One gram of phosphine (PH_3) will produce a concentration of 0.71 parts per million (ppm) in a volume of 1000 cubic meters (m^3) at 20°C (25 ppm in 1000 cubic feet (ft^3) at 68°F). This is the fundamental conversion used when calculating the amount of $ECO_2FUME®$ Fumigant Gas needed to dose a space.

1 gram PH_3/1000 m^3 = 0.71 ppm (25 ppm PH_3/1000 ft^3)
1 kg $ECO_2FUME®$ Fumigant Gas = 20 grams PH_3
(1 lb $ECO_2FUME®$ Fumigant Gas = 9.07 grams PH_3)

To calculate the total amount of $ECO_2FUME®$ Fumigant Gas required to fumigate a known volume:

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Kg $ECO_2FUME®$ Fumigant Gas = (Target ppm x Volume m^3)/14,200
(lb $ECO_2FUME®$ Fumigant Gas = (Target ppm x Volume ft^3)/226,800)

"Target" is the desired phosphine concentration in parts per million (ppm)
"Volume" is the total volume of the space to be fumigated in cubic meters (m^3) (or ft^3)

Therefore:
Fumigation at 200 ppm requires 14.1 kg $ECO_2FUME®$ Fumigant Gas per 1000 m^3 (0.88 lb/1000 ft^3)
Fumigation at 500 ppm requires 35.2 kg $ECO_2FUME®$ Fumigant Gas per 1000 m^3 (2.2 lb/1000 ft^3)

One cylinder of $ECO_2FUME®$ Fumigant Gas, 31 kg (68.34 lb), will generate 440 ppm phosphine in a fumigation volume of 1,000 m^3 (35,315 ft^3).

To calculate the amount of phosphine or $ECO_2FUME®$ Fumigant Gas to be added to a space to re-establish the Target concentration:

Kg $ECO_2FUME®$ Fumigant Gas = ((Target ppm – Actual ppm) x Volume m^3/14,200
(lb $ECO_2FUME®$ Fumigant Gas = ((Target ppm – Actual ppm) x Volume ft^3)/226,800

"Target" is the desired phosphine concentration in parts per million (ppm)
"Volume" is the total volume of the space to be fumigated in cubic meters (m^3)
"Actual" is the measured phosphine concentration in parts per million (ppm)

As a general rule, 200 ppm of PH_3 in $ECO_2FUME®$ Fumigant Gas will release 7,700 ppm of carbon dioxide in the fumigation space.

When adding $ECO_2FUME®$ Fumigant Gas to a space, the phosphine concentration must be actively monitored. This can be accomplished from outside the space by use of plastic sample tubing run through an opening and securely attached to a point inside the space. If the desired concentration is achieved before the calculated amount of $ECO_2FUME®$ Fumigant Gas has been added, the addition of $ECO_2FUME®$ Fumigant Gas must be stopped and the calculations must be checked. It is possible that a localized higher concentration has been detected and the $ECO_2FUME®$ Fumigant Gas requires more time to evenly disperse.

When a partial cylinder of ECO_2FUME® Fumigant Gas is required, the cylinder can be placed on a scale and the amount of fumigant released can be measured. The scale can also be used to check how much ECO_2FUME® Fumigant Gas is left in the cylinder by comparing this weight to the tare weight. The tare weight is stamped near the top of the cylinder and distinguished with the letters "TW". Subtract the tare weight from the measured weight and the difference is the amount of product left in the cylinder.

g) Troubleshooting

This section is provided to assist in addressing problems that may be encountered while using ECO_2FUME®Fumigant Gas cylinders. In the event of potential leaking structures, refer to Section F. SEALING. When troubleshooting leaking cylinders, NIOSH-approved self-contained breathing apparatus (SCBA) with full face piece operated in pressure-demand or other positive pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus is required when levels of phosphine are unknown, or known to exceed 0.1 ppm (refer to Section V.E., RESPIRATORS). Troubleshooting assistance for a particular piece of dispensing equipment is addressed in the respective equipment manual. Questions for problems other than those listed below should be directed to the authorized ECO_2FUME® Fumigant Gas distributor.

(1) Condensation is forming on the outside of the cylinder.

This is normal. As the fumigant is removed from the cylinder, the liquefied gas mixture boils to maintain the pressure in the cylinder gas space. This results in a chilling of the cylinder, and the condensing of moisture from the air.

(2) Ice has formed on the bottom of the cylinder.

This is normal. When the liquid fumigant level in the cylinder falls below the dip tube, gas only can be withdrawn, and the liquid that remains in the cylinder must vapourize in order to be released. If the dispensing rate is high enough, the temperature that results from chilling can be below the freezing point for water. Instead of ambient moisture simply condensing, it freezes on the cylinder surface.

(3) There is a leak at the cylinder valve. REFER TO SECTION XV, SPILL AND LEAK PROCEDURES.

(a) There is a leak at the cylinder valve outlet.

(i) If the cylinder is attached to the dispensing equipment:
The connection to the valve outlet might be the problem. If tightening (but not over-tightening) the outlet connection does not solve the problem, close the cylinder valve and use the dispensing equipment to vent the remaining fumigant in the line. Disconnect the connection to the cylinder and inspect the fitting and valve outlet for damage. If the fitting is damaged, replace it. If the valve outlet is damaged, do not use the cylinder. Attach a tag to the cylinder conspicuously indicating “Bad Valve Outlet” and return it.

(ii) If the cylinder is not attached to the dispensing equipment: Check to see if the cylinder valve is fully closed. If it is fully closed and the leak continues, the cylinder should be moved to a well-ventilated area, away from personnel. Refer to Spill and Leak Procedures.

(b) The leak is not at the cylinder valve outlet.

Assistance is required. Refer to XV, SPILL AND LEAK PROCEDURES.

(4) Gas is not dispensing

Check to see if the cylinder is empty. First connect a 6,895 kPa (1000 psig) pressure gauge to the cylinder outlet using a CGA 350 fitting. Open the cylinder valve and check the pressure gauge. If pressure is measured, the cylinder is not empty and a problem with the dispensing equipment is possible. Consult the dispensing equipment instructions for troubleshooting assistance. If no pressure is measured, weigh the cylinder (Without the cap) and compare it to the cylinder tare (empty) weight. The tare weight is stamped near the top of the cylinder and distinguished with the letters “TW”. Subtract the tare weight from the

measured weight. The difference is the amount of product in the cylinder. If there is a weight difference, then the cylinder has product and the outlet valve is faulty. Do not attempt to use the cylinder. Attach a tag to the cylinder indicating "bad valve" and return it to your distributor.

3. APPLICATION TO BULK COMMODITIES

a) Storage

$ECO_2FUME^®$ Fumigant Gas can be used to fumigate any type of storage used to hold listed bulk commodities. These include, but are not limited to bins, tanks, flat storage, and bunkers. The most important aspects of a successful fumigation, as with any fumigant, are the degree to which the space is sealed and the assurance that the minimum fumigant concentrations are maintained for the required time.

b) Procedure for Fumigating Bulk Commodities

1. A Fumigation Management Plan must be written for all fumigations prior to actual treatment.
2. Determine the target phosphine concentration desired and the duration of the fumigation based on site to be fumigated, the insect pest(s) involved and the prevailing temperature.
3. Calculate the empty volume space to be treated.
4. Calculate how much fumigant will be required and the means by which it will be dispensed.
5. Determine where the fumigant will be dispensed into the site/space, and plan for and install required equipment.
6. To establish a system for gas monitoring performed from outside the fumigated site/structure, Polyethylene tubing is used for remote monitoring. This tubing can be run from each area under fumigation to an outside location where gas samples can be taken safely. At least one monitoring line must be run in each fumigated site/structure. In the event of multi-floored structures or compartmentalized buildings, monitoring must be performed in all major areas of the fumigated site/structure. Fans can be used to help distribute gas into smaller areas and the outer reaches of these sites/structures.
7. Isolate and seal all connections to other storage and spaces that are not intended for fumigation.
8. Seal all openings including cracks, windows, doors, vents, eaves, hatches, loading and unloading connections and ventilation fans. Seal all penetrations used for fumigant dispensing and monitoring. Use proper safety equipment and entry procedures if confined space entry is required.
9. A fumigation zone must be established as per Section VII, FUMIGATION ZONE REQUIREMENTS.
10. Lock all entrances to the space.
11. Ensure that all personnel, animals, and damageable goods are clear of the space to be treated as well as the fumigation zone. Post fumigation warning placards at all usual points of entry and along other likely routes of approach to the fumigated site and the fumigation zone and any unloading penetrations (refer to Section X. PLACARDING OF FUMIGATION AREAS).
12. Verify that all required safety equipment is available and in good working order. Appropriate respiratory protection, as outlined in the Application Manual – Section V.E, RESPIRATORS, must be worn when levels of phosphine gas are above 0.1 ppm or are unknown and/or levels of carbon dioxide are above 5,000 ppm or are unknown. **IT IS IMPORTANT TO CONSIDER BOTH PHOSPHINE AND CARBON DIOXIDE CONCENTRATIONS TO DETERMINE THE USE OF APPROPRIATE RESPIRATORY PROTECTION.** To protect workers from phosphine exposure, appropriate respiratory protection is required for all the following operations: delivery/dispensing of the product, attending to spills and leaks, while monitoring phosphine levels during fumigation and aeration periods (i.e. worn at all times when levels of phosphine gas are above 0.1 ppm or are unknown). Entry by unprotected workers is only permitted after the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone.
13. Notify all personnel in nearby buildings at the facility that fumigant release is about to commence.
14. Connect the $ECO_2FUME^®$ Fumigant Gas cylinders to the dispensing equipment.
15. Dispense the initial dose of fumigant.
16. Periodically monitor the phosphine concentrations within the site/space, using suitable gas detection equipment, to ensure that the minimum concentrations are being maintained.
17. During and immediately after dispensing of $ECO_2FUME^®$ Fumigant Gas, the fumigated site must be monitored hourly for phosphine concentrations until stabilized at the desired phosphine level. If concentration is falling rapidly, the applicator must investigate the site/structure for possible leak points. Seal any leak points found. In a well-sealed site/structure, the phosphine concentration should stabilize quickly and monitoring frequency can be reduced to daily measurements. The sampling frequency should

be adjusted and additional $ECO_2FUME^®$ Fumigant Gas added as required to ensure the desired phosphine concentrations are maintained during the fumigation period.

18. Dispense additional fumigant as required to maintain the desired phosphine concentrations.
19. Periodically monitor phosphine gas levels at several locations along the fumigation zone perimeter (i.e., according to a schedule made by the licensed/certified applicator as per site characteristics and environmental condition). If at any time the person monitoring phosphine levels detects phosphine concentrations greater than 0.1 ppm, the area must immediately be cleared of all individuals who are not wearing respiratory protection as outlined in Section V. E. RESPIRATORS, and the fumigation zone must be extended until the phosphine levels are at or below 0.1 ppm along the perimeter and warning signs relocated to reflect the new fumigation zone perimeter. Refer to the sections on FUMIGATION ZONE REQUIREMENTS and PLACARDING OF FUMIGATION AREAS for detailed instructions.
20. When no further fumigant is required, close all cylinder valves. Depressurize the dispensing equipment and disconnect all $ECO_2FUME^®$ Fumigant Gas cylinders. Ensure that the valve discharge cap is securely installed and replace the cylinder cap.
21. When the fumigation is complete, unseal the site/space and aerate (see Section IX.E, AERATION AND REENTRY and XI. MAXIMUM RESIDULE LIMITS OF FUMIGATED COMMODITIES). Recheck barricades and placards at all open entries into the site/space to prevent entry by unauthorized personnel.
22. Appropriate respiratory protection must be worn if entry into the fumigated site and the fumigation zone is required at any point from the beginning of application until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. If entry into the fumigation zone is required at any point, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm, MUST be worn until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. Use low level detector tubes or electronic metering devices to check both the carbon dioxide and phosphine concentrations before allowing entry into the fumigated site and the fumigation zone. Use appropriate breathing apparatus and entry procedures to avoid undue worker exposure.
23. Remove fumigation warning placards when the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. (See Section X. PLACARDING OF FUMIGATION AREAS).
24. Remove all dispensing and gas monitoring lines.

Additional Considerations:

1. Dispensing and monitoring lines should be installed with loading, unloading and other operations in mind. If frequent fumigations are expected, permanently mounted lines should be secured within the site/space. If temporary lines are to be used, they should be installed so they can easily be removed at the end of the fumigation.
2. The use of additional tarpaulins or plastic sheeting atop the commodity should be considered, if there is a substantial open space above the stored product. This will help minimize the loss of phosphine from the commodity and the total amount of fumigant required.
3. Recirculation of fumigant by specially installed small blowers is an excellent means of distributing $ECO_2FUME^®$ Fumigant Gas throughout the space being treated. The use of existing aeration blowers is not suggested since their capacity is often so high that it assists in the loss of the fumigant. Small commercial blowers can be used to recirculate the atmosphere within the space being treated. $ECO_2FUME^®$ Fumigant Gas should be dispensed into the discharge of recirculation blowers. The blowers should not be run continuously, but long enough to ensure good fumigant distribution and each time fumigant is added.
4. For large storage facilities, multiple dispensing points should be considered to assist in the distribution of the fumigant.

4. APPLICATION TO SPACE FUMIGATIONS

a) Spaces

$ECO_2FUME^®$ Fumigant Gas can be used to fumigate any type of space where listed commodities are stored or processed, except barges. These include, but are not limited to mills, warehouses, processing facilities, packaging plants, empty greenhouses and other structures. The most important aspects of a successful fumigation, as with any fumigant, are the degree to which the space is sealed and the assurance that the minimum fumigant concentrations are maintained for the required time.

b) Procedure for Fumigating Spaces

1. A Fumigation Management Plan must be written for all fumigations prior to actual treatment.
2. Determine the target phosphine concentration desired and the duration of the fumigation. This should be based on the target pests and the temperature of the site/space to be fumigated.
3. Calculate the empty volume of the space to be treated.
4. Calculate how much fumigant will be required and the means by which it will be dispensed. Since space fumigations generally involve large volumes, fast dispensing methods are the best way to quickly achieve and maintain the desired phosphine concentrations.
5. Determine where the fumigant will be dispensed into the site/space, and plan for and install required components. Dispensing points should not be located in or attached to commodity packages. Securing the dispensing lines is important, for fast dispensing, to minimize the chance of unwanted movement of the lines during discharge. Direct the discharge toward the center of the site/space being treated and away from equipment if possible.
6. Determine the number and location of circulating fans. Low speed fans should be placed on the floor and angled upwards. A means of turning the fans off from outside the treated space should be provided.
7. Determine where the fumigant concentrations will be measured and plan for and install required gas sampling lines.
8. Identify one access door and lock all others. Lock all ground level and other accessible windows if possible.
9. Except for the access door, seal all openings including cracks, windows, doors, vents, eaves, ventilation fans and points of material transfer. Seal all penetrations used for fumigation dispensing and monitoring. Isolate and seal all connections to other spaces that are not intended for fumigation.
10. Remove from the space, or protect sensitive equipment, material and food.
11. A fumigation zone must be established as per Section VII, FUMIGATION ZONE REQUIREMENTS.
12. Ensure that all personnel, animals and damageable goods are clear of the space to be treated as well as the fumigation zone. Post fumigation warning placards at all usual points of entry and along other likely routes of approach to the fumigated site and fumigation zone (refer to Section X, PLACARDING OF FUMIGATION AREAS) and lock all points of access. The only exception to this is silo complexes connected by tunnels. Separate ventilation and monitoring must be in place to protect workers in adjacent areas.
13. Close, lock, seal and placard the access door (refer to Section X, PLACARDING OF FUMIGATION AREAS).
14. Verify that all required safety equipment is available and in good working order. Appropriate respiratory protection, as outlined in the Application Manual – Section V.E, RESPIRATORS, must be worn when levels of phosphine gas are above 0.1 ppm or are unknown and/or levels of carbon dioxide are above 5,000 ppm or are unknown. **IT IS IMPORTANT TO CONSIDER BOTH PHOSPHINE AND CARBON DIOXIDE CONCENTRATIONS TO DETERMINE THE USE OF APPROPRIATE RESPIRATORY PROTECTION.** To protect workers from phosphine exposure, appropriate respiratory protection is required for all the following operations: delivery/dispensing of the product, attending to spills and leaks, while monitoring phosphine levels during fumigation and aeration periods (i.e. worn at all times when levels of phosphine gas are above 0.1 ppm or are unknown). Entry by unprotected workers is only permitted after the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone.
15. Notify all personnel that fumigant release is about to commence.
16. Connect the $ECO_2FUME^{®}$ Fumigant Gas cylinders to the dispensing equipment.
17. Dispense the initial dose of fumigant.
18. Periodically monitor the phosphine concentrations within the site/space, using suitable gas detection equipment, to ensure that the minimum concentrations are being maintained.
19. Dispense additional fumigant as required to maintain the desired phosphine concentrations.
20. Periodically monitor phosphine gas levels at several locations along the fumigation zone perimeter (i.e., according to a schedule made by the licensed/certified applicator as per site characteristics and environmental conditions. If at any time the person monitoring phosphine levels detects phosphine concentrations greater than 0.1 ppm, the area must immediately be cleared of individuals who are not wearing respirator protection as outlined in Section V.E. RESPIRATORS and the fumigation zone must be extended until the phosphine levels are at or below 0.1 ppm along the perimeter and warning signs relocated to reflect the new fumigation zone perimeter. Refer to the sections on FUMIGATION ZONE REQUIREMENTS and PLACARDING OF FUMIGATION AREAS for detailed instructions.
21. When no further fumigant is required close all cylinder valves. Depressurize the dispensing equipment and

disconnect all $ECO_2FUME^{®}$ Fumigant Gas cylinders. Ensure that the valve discharge cap is securely installed and replace the cylinder cap.

22. When the fumigation is complete, unseal the site/space and aerate (see IX.E, AERATION AND REEENTRY and XI. MAXIMUM RESIDUE LIMITS OF FUMIGATED COMMODITIES). Barricade and placard all open entries into the space to prevent entry by unauthorized personnel.
23. Appropriate respiratory protection must be worn if entry into the fumigated site and the fumigation zone is required at any point from the beginning of application until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. If entry into the fumigation zone is required at any point, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm, MUST be worn until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. Use low level detector tubes or electronic metering devices to check both the carbon dioxide and phosphine concentrations before allowing entry into the fumigated site and the fumigation zone. Use appropriate breathing apparatus and entry procedures to avoid undue worker exposure (see Section V.E. RESPIRATORS).
24. Workers should be aware that some residual gas may be entrapped within the fumigated commodity container (i.e. bagged product such as SUPERSACKS). Adequate monitoring and aeration must be performed to reduce any residual phosphine levels to below 0.1 ppm.
25. Remove fumigation warning placards when the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone (See Section X, PLACARDING OF FUMIGATION AREAS).
26. Remove all dispensing and gas monitoring lines.

5. APPLICATION TO TARPAULIN FUMIGATIONS

a) General

$ECO_2FUME^{®}$ Fumigant Gas can be used to fumigate stacked materials by covering the material with a tarpaulin made from plastic sheeting. This allows the fumigant to be contained to the treated material only. The most important aspects of a successful fumigation, as with any fumigant, are the degree to which the space is sealed and the assurance that the minimum fumigant concentrations are maintained for the required time.

This product is highly toxic to fish, birds and other forms of wildlife. Do not fumigate stacked materials under tarpaulins in the proximity of wildlife.

b) Procedure for Tarpaulin Fumigations

1. A Fumigation Management Plan must be written for all fumigations prior to actual treatment.
2. Determine the target phosphine concentration desired and the duration of the fumigation. This should be based on the target pests and the temperature of the material being treated.
3. Since the volume of tarped materials can vary widely, it is important to make a good estimate of the volume enclosed by the tarp. Calculate the volume taken up by the material itself (palletized stacks for example) or any containers used to hold it. After tarping is complete, revise the volume estimate based on the additional space contained within the tarp.
4. Calculate how much fumigant will be required, based on the volume calculation, and the means by which it will be dispensed. A regulated dispenser may be required, since high-speed discharge from fast dispensing can damage the tarp and undo any sealing that was done. The approved dispensing equipment includes a pressure regulator to reduce the cylinder pressure to less than 690 kPa (100 psig). From this pressure $ECO_2FUME^{®}$ Fumigant Gas flows through flow indicators, and the discharge side of the flow indicators is maintained near atmospheric pressure. The use of flow restricting nozzles is another option to control the rate of $ECO_2FUME^{®}$ Fumigant Gas dispensing to prevent damage to tape and seals.
5. Determine where the fumigant will be dispensed into the site/space, and plan for and install required components. Dispensing points must not be located in or attached to commodity packages or within containers.
6. Determine where the fumigant concentrations will be measured and plan for and install required gas sampling lines. Sampling points must not be located near dispensing points to avoid incorrect readings.
7. Cover the material with plastic sheeting using tape, glue or clamps to join individual sheets. If the material rests on soil or flooring of wood or other porous material, it must be repositioned onto poly prior to

covering for fumigation. Seal the plastic covering to the floor using tape, glue, sand or water "snakes", shoveling sand or soil onto the ends of the plastic, or by other suitable means. Reinforce by tape or other means, any sharp corners or edges to reduce the risk of tearing the plastic. Plastic sheeting should be a minimum of 2-mil thickness for indoor applications however, 4 or 6 mil is preferred and is more suitable for outdoor use. Ensure that tarp penetrations for dispensing and monitoring are well sealed.

8. A minimum fumigation zone must be established as per Section VII, FUMIGATION ZONE REQUIREMENTS.
9. Post warning placards around the tarped material and the fumigation zone perimeter. Post fumigation warning placards at all usual points of entry and along other likely routes of approach to the fumigated site and fumigation zone (refer to Section X, PLACARDING OF FUMIGATION AREAS).
10. Verify that all required safety equipment is available and in good working order. Appropriate respiratory protection, as outlined in the Application Manual – Section V.E, RESPIRATORS, must be worn when levels of phosphine gas are above 0.1 ppm or are unknown and/or levels of carbon dioxide are above 5,000 ppm or are unknown. **IT IS IMPORTANT TO CONSIDER BOTH PHOSPHINE AND CARBON DIOXIDE CONCENTRATIONS TO DETERMINE THE USE OF APPROPRIATE RESPIRATORY PROTECTION**. To protect workers from phosphine exposure, appropriate respiratory protection is required for all the following operations: delivery/dispensing of the product, attending to spills and leaks, while monitoring phosphine levels during fumigation and aeration periods (i.e. worn at all times when levels of phosphine gas are above 0.1 ppm or are unknown). Entry by unprotected workers is only permitted after the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone.
11. Notify all personnel that fumigant release is about to commence. It is required that all personnel not trained or involved in execution of the fumigation be restricted from entering the fumigated site and fumigation zone, until the work is complete. Workers under a continuous roof, connected buildings or those working near an adjacent outside wall must be vacated.
12. Connect the $ECO_2FUME^{®}$ Fumigant Gas cylinders to the dispensing equipment.
13. Dispense the initial dose of fumigant.
14. Periodically monitor the phosphine concentrations within the site/space, using suitable gas detection equipment, to ensure that the minimum concentrations are being maintained for the required time.
15. Periodically monitor phosphine concentrations at several locations along the zone perimeter (i.e., according to a schedule made by the licensed/certified applicator as per site characteristics and environmental condition). If at any time the person monitoring phosphine levels detects phosphine concentrations greater than 0.1 ppm, the area must immediately be cleared of all individuals who are not wearing respiratory protection as outlined in Section V. E. RESPIRATORS, and the fumigation zone must be extended until the phosphine levels are at or below 0.1 ppm along the perimeter and warning signs relocated to reflect the new fumigation zone perimeter. Refer to the sections on FUMIGATION ZONE REQUIREMENTS (Section VII) and PLACARDING OF FUMIGATION AREAS (Section X) for detailed instructions.
    If concentrations exceed 0.1 ppm, immediately locate and seal the source of the leak, or terminate fumigation until corrected.
16. Dispense additional fumigant as required to maintain the desired phosphine concentrations.
17. When no further fumigant is required, close all cylinder valves. Depressurize the dispensing equipment and disconnect all $ECO_2FUME^{®}$ Fumigant Gas cylinders. Ensure that the valve discharge cap is securely installed and replace the cylinder cap.
18. When the fumigation is complete, remove the tarp and aerate as appropriate using precautions to prevent exposure to workers (see IX.E. AERATION AND REENTRY and XI. MAXIMUM RESIDUE LIMITS OF FUMIGATED COMMODITIES). Ensure the immediate area surrounding the tarpaulin-covered material is free of any birds and wildlife prior to commencing aeration.
19. Appropriate respiratory protection must be worn if entry into the fumigated site and the fumigation zone is required at any point from the beginning of application until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. If entry into the fumigation zone is required at any point, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm, MUST be worn until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. Use low level detector tubes or electronic metering devices to check both the carbon dioxide and phosphine concentrations before allowing entry into the site/space.
20. Remove fumigation warning placards when the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone (See Section X, PLACARDING OF FUMIGATION AREAS).
21. Remove all dispensing and gas monitoring lines.

Additional Considerations:

1. Do not walk on tarped material once it has been sealed and fumigant has been dispensed.
3. Seal off doors, windows and other connections to adjacent areas that may be occupied and placard on the occupied side.

6. APPLICATION TO CONTAINERS AND TRAILERS

a) General

Railcars and containers, trucks, vans and other transport vehicles shipped piggyback by rail may be fumigated in-transit. Aeration of railcars, railroad boxcars or shipping containers is prohibited en route. Transport vehicles, such as trucks, vans and trailers, are prohibited from travel over public roads or highways until completely aerated to a phosphine level at or below 0.1 ppm and the warning placards removed. See appropriate sections of this manual for recommendations on placarding, commodity aeration and training of persons authorized to remove placarding. Containers, trucks, and other transport vehicles loaded with bulk commodities, to which ECO_2FUME® Fumigant Gas may be added are treated in essentially the same way as any other storage facility.

Written notification must be provided to the receiver of railcars, railroad boxcars, shipping containers and other transport vehicles shipped piggyback by rail that are being fumigated in transit. Notification must be made prior to the actual receipt of a fumigated vehicle or container by a consignee. A copy of the Application Manual must precede or accompany all transportation containers or vehicles.

During transport, railcars containing non-aerated bulk commodities must not be located directly adjacent to another railcar containing workers or other individuals, unless it is likely to have a serious impact on train dynamics. Railcars containing fumigated cargo should be placed as far as possible from occupied cars. If prolonged/extended stops are required while en route (e.g. to accommodate use of rest facilities or bunkhouses) fumigation zone requirements around the fumigated cargo must be followed (as outlined under Section VII, FUMIGATION ZONE REQUIREMENTS).

Proper handling of treated railcars, containers and other transport vehicles shipped piggyback by rail, at their destination is the responsibility of the consignee. Upon receipt of the railcar, railroad boxcars, shipping containers and other transport vehicles, a licensed/certified applicator, or a person trained in accordance with the Application Manual working under the direct supervision of a licensed/certified applicator, must perform the aeration process. The applicator must hold an appropriate pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the aeration occurs. Both individuals must be familiar with the properties of phosphine fumigants, worker exposure limit, required personal protective equipment and fumigation zone requirements, symptoms and first aid treatment for phosphine poisoning, and must know how to take phosphine gas concentration measurements. A training completion date must be logged and maintained in the employee's safety training record. Upon receipt of a fumigated commodity, it must be documented in writing that the monitoring has been conducted and that aeration has been completed.

This product is highly toxic to birds, mammals and other forms of wildlife. Do not fumigate containers, trucks, and other transport vehicles in the proximity of wildlife.

ECO_2FUME® Fumigant Gas dispensing lines shall not be placed in or attached to commodity packages containing processed food.

b) Procedure for Container and Trailer Fumigation

1. A Fumigation Management Plan must be written for all fumigations prior to actual treatment.
2. Determine the target phosphine concentration and exposure time desired. This should be based on the target pests and the commodity temperature.
3. Determine the empty volume of the trailer or container.
4. Calculate how much fumigant will be required, and the dispensing time needed. A regulated dispenser on flow restricting nozzles is the recommended means of dispensing the fumigant.
5. Inspect all sidewalls, roof, floor, and doors for cracks, holes or defects. Seal all openings with tape or caulk. Particular attention should be paid to any drain holes in the floor.

6. Install the $ECO_2FUME^{®}$ Fumigant Gas dispensing line and secure it to the door, wall or floor with tape.
7. Close the door and seal with tape, caulk or polyethylene sheeting to prevent gas loss.
8. A fumigation zone must be established as per Section VII, FUMIGATION ZONE REQUIREMENTS.
9. Affix fumigation placards to all sides of the container or trailer and around the fumigation zone perimeter (refer to Section X, PLACARDING OF FUMIGATION AREAS.
10. Verify that all required safety equipment is available and in good working condition. Appropriate respiratory protection, as outlined in the Application Manual – Section V.E, RESPIRATORS, must be worn when levels of phosphine gas are above 0.1 ppm or are unknown and/or levels of carbon dioxide are above 5,000 ppm or are unknown. **IT IS IMPORTANT TO CONSIDER BOTH PHOSPHINE AND CARBON DIOXIDE CONCENTRATIONS TO DETERMINE THE USE OF APPROPRIATE RESPIRATORY PROTECTION**. To protect workers from phosphine exposure, appropriate respiratory protection is required for all the following operations: delivery/dispensing of product, attending to spills and leaks, and while monitoring phosphine levels during fumigation and aeration periods (i.e. worn at all times when levels of phosphine gas are above 0.1 ppm or are unknown). Entry by unprotected workers is only permitted after the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone.
11. Notify all personnel that fumigant release is about to commence. When trailers attached to tractors and trucks are fumigated, drivers should not be allowed to enter the vehicle and the fumigation zone until fumigation has ended and the truck is aerated.
12. Connect the $ECO_2FUME^{®}$ Fumigant Gas cylinders to the dispensing equipment.
13. Dispense the predetermined quantity of $ECO_2FUME^{®}$ Fumigant Gas into the container or trailer.
14. Periodically monitor phosphine gas levels at several locations along the fumigation zone perimeter. If at any time the person monitoring phosphine levels detects phosphine concentrations greater than 0.1 ppm, the area must immediately be cleared of all individuals who are not wearing respiratory protection as outlined in Section V.E. RESPIRATORS, and the fumigation zone must be extended until the phosphine levels are at or below 0.1 ppm along the perimeter and warning signs relocated to reflect the new fumigation zone perimeter. Refer to the sections on FUMIGATION ZONE REQUIREMENTS and PLACARDING OF FUMIGATION AREAS for detailed instructions.
15. Disconnect dispensing lines from dispenser.
16. When no further fumigant is required, close all cylinder valves. Depressurize the dispensing equipment and disconnect all $ECO_2FUME^{®}$ Fumigant Gas cylinders. Ensure that the valve discharge cap is securely installed and replace the cylinder cap.
17. When the fumigation is complete, unseal and aerate as appropriate using precautions to prevent exposure to workers (see IX.E AERATION AND REEENTRY and XI. MAXIMUM RESIDUE LIMITS OF FUMIGATED COMMODITIES).
18. Appropriate respiratory protection must be worn if entry into the fumigated site and the fumigation zone is required at any point from the beginning of application until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. Use low level detector tubes or electronic metering devices to check both the carbon dioxide and phosphine concentrations before allowing entry into the site/space.
19. Remove fumigation warning placards when the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone (See Section X, PLACARDING OF FUMIGATION AREAS).
20. Remove all gas dispensing lines entering the space and seal the penetrations used.

Proper handling of treated railcars, containers and other transport vehicles shipped piggyback by rail, at their destination is the responsibility of the consignee. The consignee must be familiar with the properties of phosphine fumigants, worker exposure limits and symptoms and first aid treatment for phosphine poisoning and must know how to make gas concentration measurements.

Transfer without aeration:

Railcars, shipping containers and other transport vehicles shipped piggyback by rail, containing commodities under fumigation may be transferred to a storage area without prior aeration.

The consignee must:

1. Ensure that worker exposure levels are not exceeded by measuring phosphine levels in the vicinity of the commodity under fumigation. If phosphine levels are above 0.1 ppm, appropriate respiratory protection

must be worn (see Section V.E, RESPIRATORS). If phosphine levels are unknown, appropriate respirator protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm, must be worn.

2. Ensure that the storage area into which the unaerated railcar, container or transport vehicle shipped piggyback is transferred, is placarded if it contains a phosphine level that is above 0.1 ppm or are unknown, and conforms to the fumigation zone requirements as outlined under Section VII, FUMIGATION ZONE REQUIREMENTS.

Transfer with aeration:

The consignee must:

1. Completely aerate the railcar, shipping containers or other transport vehicles shipped piggyback by rail, containing fumigated commodities while conforming to the requirements outlined under Section VII, FUMIGATION ZONE REQUIREMENTS, and Section X, PLACARDING OF FUMIGATION AREAS.
2. With the authorization of the licensed/certified applicator, remove the fumigation warning placard after aeration is completed.
3. Ensure that worker safety limits have not been exceeded by verifying that phosphine levels are at or below 0.1 ppm and carbon dioxide levels are below 5,000 ppm.
4. Transfer the fumigated commodity from the railcar, or shipping containers and other transport vehicles shipped piggyback by rail.

7. APPLICATION TO SHIPS

a) General

Important – shipboard, in-transit ship or ship hold fumigation is governed by Transport Canada Ship Safety Regulations (see Cargo, Fumigation and Tackle Regulations under the *Canada Shipping Act, current to August 5, 2014*). Refer to and comply with those Regulations and Ship Safety Bulletins prior to fumigation. In Canada, fumigations must be carried out under the direction of a "Fumigator-in-Charge" as indicated in these regulations.

No person shall fumigate in-transit or permit in-transit fumigation in a Canadian flagship. The decision to fumigate in-transit on non-Canadian flag vessels is at the discretion of the master (See Ship Safety Bulletin 13/93).

1. $ECO_2FUME^{®}$ Fumigant Gas is classified as a restricted use pesticide due to the acute inhalation toxicity of phosphine gas. This product is for retail sale to, and use only by, individuals holding an appropriate pesticide applicator certificate or licence recognized by the provincial/territorial pesticide regulatory agency where the pesticide application occurs or by persons trained in accordance with the Application Manual working under the direct supervision and in the physical presence of an applicator holding an appropriate pesticide applicator certificate or licence. Physical presence means on site or on the premises. Read and follow the label, the $ECO_2FUME^{®}$ Fumigant Gas Application Manual and Guidance for Preparation of a Fumigation Management Plan that contains complete instructions for the safe use of this pesticide. In facilities that use this product, all employees must complete mandatory annual training as outlined in the Application Manual Section VIII. MANDATORY ANNUAL TRAINING. This training includes information on the hazards of this product, the use of safety equipment (i.e., respiratory protection and personal monitors) and the exposure limit of 0.1 ppm. It is the responsibility of the certified/licensed applicator to inform the owner of the facility or his/her representative of the requirement for mandatory training.

2. In addition to the ship fumigation procedures outlined in the following paragraphs (b, c, d, and e), applicators must follow the general procedures for fumigating bulk commodities (see IV. G. 3. b), spaces (see IV. G. 4. b), or containers (see IV.G. 6. b), as appropriate.

b) Pre-Voyage Fumigation Procedures

1. Before fumigation is commenced, a notification of intention to fumigate must be given to the nearest Transport Canada Ship Safety office (generally no less than 24 hours in advance). Similarly, a notice must be given for vessels in-transit of Canadian waters and stopping at a Canadian Port. Prior to fumigating a vessel for in-transit cargo fumigation, the master of the vessel, or his representative, and the Fumigator-in-

Charge must determine if the vessel is suitably designed and configured to allow for safe occupancy by the ship's crew throughout the duration of the fumigation. If it is determined that the design and configuration of the vessel does not allow for safe occupancy by the ship's crew throughout the duration of the fumigation, then the vessel will not be fumigated unless all crew members are removed from the vessel. The crew members may not be allowed to reoccupy the vessel until it has been properly aerated (to 0.1 ppm phosphine and/or below 5,000 ppm carbon dioxide) and a determination has been made by the master of the vessel that the vessel is safe for occupancy.

2 The Fumigator-in-Charge responsible for the fumigation must notify the master of the vessel or representative of the requirements relating to personal respiratory protection equipment* and detection equipment, and that a trained person, under the direct supervision of the Fumigator-in-Charge, qualified in the use of this equipment must accompany the vessel and cargo under fumigation. Emergency procedures, cargo ventilation, periodic monitoring and inspections, and first aid measures must be discussed with and understood by the master of the vessel or his representative.

*Personal respiratory protection equipment means a NIOSH- approved air-purifying full face piece respirator (gas mask) with a chin-style, front- or back-mounted canister approved for phosphine OR a NIOSH- approved supplied-air respirator (i.e., air-line respirator or self-contained breathing apparatus) with a full face piece for phosphine levels up to 5 ppm. A NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus must be worn when phosphine levels are above 5 ppm or at unknown concentrations. Refer to Section V.E, RESIPIRATORS for detailed information.

3. Seal all openings to the cargo hold or tank and lock or otherwise secure all openings, manways, etc. that might be used to enter the hold. The overspace pressure relief system of each tank aboard tankers must be sealed by closing the appropriate valves and sealing the openings into the overspace with gas-tight materials.

4. Placard all entrances to the treated spaces with fumigation warning signs as described in Section X, PLACARDING OF FUMIGATION AREAS, of this Application Manual. A watchman must be posted at the gangway to keep unnecessary persons from boarding.

5. If the fumigation is not completed and the vessel aerated before the manned vessel leaves port, the Fumigator-in-Charge shall ensure that there be on board the vessel during the voyage: 1) at least four NIOSH-approved self-contained breathing apparatus (SCBA)** with a full face piece operated in a pressure-demand or other positive-pressure mode and four additional filled air bottles; 2) two gas detection devices (when these devices require re-arming after use, the ship shall be equipped with 10% more spare tubes than are required to conduct the required testing for the duration of the voyage); 3) a trained person, under the direct supervision of the Fumigator-in-Charge, qualified in their operation. If the fumigated site of the vessel has to be entered before complete aeration, approved respiratory protection must be worn as outlined in Section V.E, RESPIRATORS.

**the total number of SCBA on board a vessel need not exceed 6, including those already on board for firefighting, etc. and required by other regulations.

6. During the fumigation, or until a manned vessel leaves port or the cargo is aerated, the Fumigator-in-Charge shall ensure that a qualified trained person, under their direct supervision, using gas or vapour detection equipment tests spaces adjacent to spaces containing fumigated cargo and all regularly occupied spaces for fumigant leakage. For fumigation in transit, the vessel must remain alongside for a minimum of 24 hours or the Fumigator-in-Charge must sail with the ship and remain on board for a minimum of 24 hours once fumigation has commenced. If leakage of the fumigant is detected, the Fumigator-in-Charge of the fumigation shall take action to correct the leakage or shall inform the master of the vessel, or his representative, of the leakage so that corrective action can be taken. At the end of the 24 hour period, final gas readings should be made and a clearance certificate issued.

7. The Fumigator-in-Charge of the fumigation shall review with the master of the ship, or his representative, the precautions and procedures to be followed during the voyage.

c) Application Procedures for Bulk Dry Cargo Vessels and Tankers

Immediately after application of the fumigant, close and secure all hatch covers, tank tops, butterworth valves, manways, etc.

d) In-transit Fumigation of Transport Units (Containers) Aboard Ships

In-transit fumigation of transport units on ships is also governed by Transport Canada Ship Safety Regulations (see Cargo, Fumigation and Tackle Regulations under the *Canada Shipping Act, current to August 5, 2014*). Refer to and comply with these regulations prior to fumigation.

No fumigation of containers is to be commenced while the unit is on board a ship. The vessel Master must be notified and correct procedures regarding shipping documents, placarding and transport and stowage of containers under fumigation must be observed.

e) Precautions and Procedures during Voyages

Using appropriate gas detection equipment, monitor spaces adjacent to areas containing fumigated cargo and all regularly occupied areas for fumigant leakage. If leakage is detected, the area should be evacuated of all personnel, ventilated, and action taken to correct the leakage before allowing the area to be occupied.

Do not enter fumigated sites except in an emergency. If necessary to enter a fumigated site, appropriate personal respiratory protection equipment must be used as described in Section V.E, RESPIRATORS. Never enter fumigated sites alone. At least two persons, a licensed/certified applicator and trained person, or two persons trained in accordance with the Application Manual working under the direct supervision of the licenced/certified applicator, wearing the required breathing apparatus should enter, and at least one other person, wearing the required personal respiratory protection equipment should be available to assist in case of an emergency.

f) Precautions and Procedures during Discharge

If necessary to enter fumigated holds prior to discharge, test spaces directly above grain surface for phosphine concentration using appropriate gas detection and personal respiratory protection as described in Section V.E, RESPIRATORS. Do not allow entry to fumigated sites without respiratory protection, unless phosphine concentrations are at or below 0.1 ppm.

V. PERSONAL PROTECTIVE EQUIPMENT (PPE)

A. GLOVES

Leather work gloves or leather faced cotton gloves must be used when connecting to or disconnecting $ECO_2FUME^{®}$ Fumigant Gas cylinders from the dispensing equipment.

B. SAFETY GLASSES

When working with pressurized equipment, safety glasses must be worn. Eye protection must be worn to prevent freezing or cryogenic “burns” to the eyes by rapidly evaporating liquid.

C. CLOTHING AND SAFETY SHOES

Wear a loose fitting long sleeve shirt, long pants, socks and safety shoes (i.e. steel-toed) when handling compressed gas cylinders.

D. HAND TRUCKS

Hand trucks are the recommended means of moving individual $ECO_2FUME^{®}$ Fumigant Gas cylinders about the fumigation site. The hand truck should be designed specifically for compressed gas cylinders and equipped with a suitable chain or strap to ensure the cylinder remains in place. Never move an $ECO_2FUME^{®}$ Fumigant Gas cylinder without valve cap and cylinder cap in place.

E. RESPIRATORS

Appropriate NIOSH-approved respiratory protection must be worn during exposure to concentrations in excess of permitted limits or when concentrations are unknown (see below). Observe all Provincial pesticide legislation requirements. The respiratory protection must fit properly, any obstruction to a proper fit should be removed (e.g., beard, long sideburns).

Entry by unprotected workers into the fumigated site is only permitted after the fumigated site has been aerated and the hydrogen phosphide level is at or below 0.1 ppm in the fumigated site and the fumigation zone. Only if necessary, should workers be present in the fumigation zone. All workers present in the fumigation zone during the fumigation or aeration periods MUST wear appropriate respiratory protection, as outlined below, OR a personal hydrogen phosphide monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm. Each unprotected worker in the fumigation zone must have a personal hydrogen phosphide monitor that is functional for the duration of the work period, must know how to operate the personal hydrogen phosphide monitor and be informed of procedures required if the air levels of hydrogen phosphide gas exceed 0.1 ppm. NIOSH-approved respiratory protection must be worn if worker exposure limits cannot be met through engineering controls (such as forced air ventilation) and/or appropriate worker practices.

Appropriate respiratory protection MUST be worn at all times, when levels of phosphine are above 0.1 ppm and/or levels of carbon dioxide are above 5,000 ppm, which may occur during dispensing of product, while attending to leaks, and while monitoring phosphine levels during the fumigation and aeration periods. If phosphine levels are unknown, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set to 0.1 ppm, must be worn. If carbon dioxide levels are unknown, appropriate respiratory protection must be worn. If a beard or long sideburns interfere with the fit of respiratory protection, they must be shaven.

IT IS IMPORTANT TO CONSIDER BOTH PHOSPHINE AND CARBON DIOXIDE CONCENTRATIONS TO DETERMINE THE USE OF APPROPRIATE RESPIRATORY PROTECTION.

For phosphine levels between 0.1 – 5 ppm, the minimum protection required is a NIOSH-approved air-purifying, full face piece respirator (gas mask) with a chin-style, front- or back-mounted canister approved for phosphine OR a NIOSH-approved supplied-air respirator (i.e., air-line respirator or self-contained breathing apparatus) with a full face piece.

For phosphine levels above 5 ppm or at unknown concentrations, a NIOSH-approved self-contained breathing apparatus with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus must be worn.

For carbon dioxide levels between 5,000 and 30,000 ppm, 1) persons may enter the treated area without respiratory protection for 15 minutes or less; 2) for periods longer than 15 minutes, use either a NIOSH-approved supplied-air respirator (i.e., air-line respirator or self-contained breathing apparatus) with a full face piece.

For carbon dioxide levels over 30,000 ppm or unknown, a NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus must be worn.

For emergency use and/or to escape from conditions which are Immediately Dangerous to Life or Health (IDLH), keep available for use an adequate number of NIOSH-approved self-contained breathing apparatus with a full face piece operated in a pressure-demand or other positive-pressure mode.

Appropriate respiratory equipment is summarized in the table below:

Required Respiratory Equipment:

Phosphine Level (PPM)	Minimum Required Respiratory Equipment
Unknown	Personal phosphine monitor or respiratory equipment required for phosphine levels greater than

	5 ppm.
>0.1 ≤ 5 ppm	NIOSH-approved air-purifying, full face piece respirator (gas mask) with a chin-style, front- or back-mounted canister approved for phosphine OR a NIOSH-approved supplied-air respirator (i.e., air-line respirator or self-contained breathing apparatus) with a full face piece.
>5 ppm	NIOSH-approved self-contained breathing apparatus with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus.
Emergency use or Immediately Dangerous to Life or Health Conditions	NIOSH-approved self-contained breathing apparatus with a full face piece operated in a pressure-demand or other positive-pressure mode.
Carbon Dioxide Level (PPM)	
5,000 – 30,000 ppm	1) persons may enter the treated area without respiratory protection for 15 minutes or less; 2) for periods longer than 15 minutes, use either a NIOSH-approved supplied-air respirator (i.e., air-line respirator or self-contained breathing apparatus) with a full face piece.
Unknown or > 30,000 ppm	NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus must be worn.

When required, gas concentration measurements for safety purposes may be made using low level detector tubes or electronic metering devices. See Section IX. G. INDUSTRIAL HYGIENE MONITORING, for monitoring requirements. Information about phosphine (hydrogen phosphide, PH_3) detector tubes or electronic metering devices may be obtained from your distributor.

VI. GAS DETECTION EQUIPMENT

There are a number of devices on the market for the measurement of phosphine gas as well as carbon dioxide levels. Glass detection tubes used in conjunction with the appropriate hand-operated air sampling pumps are a widely used method. These devices are portable, simple to use, do not require extensive training and are relatively rapid, inexpensive and accurate.

Electronic devices are also available for both low level and high phosphine and carbon dioxide gas readings. The newer low-level electronic units as well as the low-level detector tubes can detect 0.01 ppm of phosphine and are suitable for industrial hygiene monitoring. Such devices should be used in full compliance with manufacturers' recommendations. Information on hydrogen phosphide (phosphine, PH_3) detector tubes or electronic metering devices may be obtained from your distributor.

VII. FUMIGATION ZONE REQUIREMENTS

A. Fumigation Zones

A Fumigation Zone is an area established around the perimeter of the application site (fumigated site) where a phosphine gas releasing fumigant is applied. A fumigation zone must be established according to the distances listed in **Section VII. B Minimum Distance of Fumigation Zone** during the fumigation period (i.e., from the beginning of the fumigant application until the beginning of aeration). During aeration (i.e., from the beginning of aeration until the phosphine level is at or below 0.1 ppm), the fumigation zone is determined by the licensed/certified applicator who MUST be present for the duration of the aeration period.

The following describes the general fumigation zone requirements:

- A fumigation zone must be established according to the distances listed below in Section VII. B., **Minimum Distance of Fumigation Zone.**
- The fumigation zone must be periodically monitored (i.e., according to a schedule made by the licensed/certified applicator as per site characteristics and environmental conditions). If at any point the phosphine level is greater than 0.1 ppm, the provisions in **Section VII. C Extension of Fumigation Zone As A Result of Monitoring** must be followed.
- The fumigation zone must be maintained until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone.
- Individuals must be excluded from the fumigation zone to the extent possible. If entry into the fumigation zone is required at any point from the beginning of application until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone, the provisions in the **Section VII. D Authorized Entry into Fumigation Zones** must be followed.
- Appropriate respiratory protection (as outlined in Section V.E. RESPIRATORS) MUST be worn if entry into the fumigated site is required at any point from the beginning of application until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone.
- Ships and railcars that will be in transit post application are exempt from this requirement. Note: the transport of non-aerated commodities is permitted by rail or ship/barge only. Other transport vehicles such as trucks, vans, and trailers are prohibited from travel over public roads or highways until completely aerated to a phosphine level at or below 0.1 ppm.
- The fumigation zone must extend from the perimeter of the application site equally in all directions.

B. Minimum Distance of Fumigation Zone

During the fumigation period (i.e., from the beginning of the fumigant application until the beginning of aeration) and the aeration period (i.e., from the beginning of aeration until the phosphine level is at or below 0.1 ppm), the following minimum distances for the fumigation zone as outlined in Table VII.1 MUST be adhered to.

Table VII.1: Minimum Distance of Fumigation Zone

SITE	Minimum Distance of Fumigation Zone	
	Fumigation Period	**Aeration Period**
Indoor Application Sites	10 metres OR all workers inside the facility MUST wear a personal phosphine monitor.	Fumigation zone determined by licensed/certified applicator
Vessels	Fumigation zone determined by licensed/certified applicator	
Outdoor Application Sites	Fumigation zone determined by licensed/certified applicator	

Tarpaulins	30 metres OR boundary of the room	
Railcars	30 metres	

Indoor Application Sites: Any fumigation that is taking place within an enclosed structure (except for tarpaulins, see below), such as grain elevators/bins, warehouses, mills, food processing plants, flat houses, upright bins and bunkers. Also includes containers that are fumigated within a structure.

For indoor application sites, provided that all workers within the entire indoor structure are wearing a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm, a minimum fumigation zone of 10 metres does not need to be established. If at any time phosphine levels exceed 0.1 ppm, all individuals who are not wearing respiratory protection as outlined in Section V.E. RESPIRATORS MUST vacate the area until phosphine levels are at or below 0.1 ppm.

Outdoor Application Sites: Any fumigation that is taking place outdoors (except for tarpaulins and railcars, see below), such as silos and containers, outdoor upright bins, and outdoor grain bins.

Tarpaulins: Includes tarpaulin fumigations that are taking place both indoors and outdoors. If the tarpaulin is located indoors in an enclosed room that is less than 30 metres, the fumigation zone is the boundary of the room.

Railcars: Refers to the fumigation of the actual railcar; if a container is being fumigated on the railcar, then the fumigation would be part of the outdoor application sites category.

During the aeration period (i.e., from the beginning of aeration until the phosphine level is at or below 0.1 ppm), the fumigation zone is determined by the licensed/certified applicator who MUST be present for the duration of the aeration period.

C. Extension of Fumigation Zone As A Result of Monitoring

During the fumigation period (i.e., from the beginning of the fumigant application until the beginning of aeration), a supervising fumigant applicator/handler or someone who has been trained by the certified applicator must periodically monitor phosphine levels at several locations along the fumigation zone perimeter (i.e., according to a schedule made by the licensed/certified applicator as per site characteristics and environmental conditions). During the aeration period (i.e., from the beginning of aeration until the phosphine level is at or below 0.1 ppm), the licensed/certified applicator must periodically monitor phosphine levels at several locations along the fumigation zone perimeter (i.e., according to a schedule as per site characteristics and environmental conditions).

If at any time the person monitoring phosphine levels detects concentrations greater than 0.1 ppm, the area must immediately be cleared of all individuals who are not wearing respiratory protection as outlined in Section V.E. RESPIRATORS and the fumigation zone must be extended until the phosphine is at or below 0.1 ppm along the perimeter. If an extension of the fumigation zone is not feasible, appropriate measures must be implemented (e.g. cease the delivery/dispensing of product, sealing of leaks, limiting aeration) until the phosphine level is at or below 0.1 ppm at the fumigation zone perimeter at which time fumigation activities may continue.

D. Authorized Entry into Fumigation Zones

Only if necessary, should authorized pesticide applicators/handlers or workers be present in the fumigation zone. All workers (including authorized pesticide applicators/handlers) in the fumigation zone during fumigation and until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone, MUST wear respiratory protection as outlined in the RESPIRATORY PROTECTION section OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set

at 0.1 ppm. Each unprotected worker in the fumigation zone must know how to operate the personal phosphine monitor and be informed of procedures required if the levels of phosphine gas exceed 0.1 ppm. If at any time phosphine levels exceed 0.1 ppm, all individuals who are not wearing respiratory protection as outlined in Section V.E. RESPIRATORS MUST vacate the area until phosphine levels are at or below 0.1 ppm.

E. Placarding of Fumigation Zones

The fumigation zone must be placarded as outlined in Section X, PLACARDING OF FUMIGATION AREAS.

VIII. MANDATORY ANNUAL TRAINING

A. Responsible Parties

- Certified/Licensed Applicator: Responsible for informing the person in charge of the facility or agricultural establishment, the employer or his/her representative of the requirement for the mandatory training and maintenance of training records, and directing the person in charge of the facility or agricultural establishment, the employer or his/her representative on how to obtain a copy of the product-specific training material from the manufacturer.
- Manufacturer: Responsible for having the product-specific training material readily available upon request.
- The person in charge of the facility or agricultural establishment or the employer or his/her representative is responsible for:
    - Developing site-specific training material.
    - Providing both product-specific and site-specific training to workers.
    - Maintaining training records for their employees/workers for a minimum of two years.

B. Personnel

In facilities or agricultural establishments (i.e., farms) where this product is used, all employees (i.e., all individuals such as workers, contractors, handlers, farmers, and farm workers) who are present in the facility or agricultural establishment during product use, MUST complete mandatory annual training using product-specific training material supplied by the manufacturer, and additional facility-specific information developed by the employer or his/her representative.

C. Mandatory Training Elements

The training material MUST include the following information:

Hazards of Phosphine Gas: Phosphine-releasing products are classified as restricted-class products due to the high acute toxicity of phosphine gas. Signs and symptoms of phosphine exposure are summarized as follows:

Symptoms of mild exposure include:

- Malaise (indefinite feeling of sickness), ringing in the ears, fatigue, nausea, and pressure in the chest.

Symptoms of moderate poisoning include:

- Weakness, vomiting, pain just above the stomach, chest pain, diarrhea, and difficulty breathing.

Symptoms of severe poisoning include:

- Dizziness, blue/purple skin colour, unconsciousness and death.
- High exposure to phosphine may also lead to fluid in the lungs, and effects on the liver, kidneys, lungs, nervous system and circulatory system.
- Note: Symptoms of severe poisoning may appear within a few hours to several days.

The 0.1 ppm Exposure Limit: Information on the 0.1 ppm exposure limit and that it is not a time-weighted average threshold limit value. Workers MUST NOT be exposed to phosphine levels above 0.1 ppm for any duration of time. Frequent exposure to concentrations above permissible levels over a period

of days or weeks may cause poisoning.

How to Use Personal Hydrogen Phosphide (Phosphine) Monitors and Personal Protective Equipment: Information on facility-specific equipment, such as how to calibrate and use personal phosphine monitors, and proper fit-testing of respirators. In addition, information on when respiratory protection should be used must be included.

Procedures when Levels of Phosphine Gas Exceed 0.1 ppm: Facility-specific details on what to do when phosphine levels exceed 0.1 ppm, where workers are to go, who they should contact and where personal protective equipment is located.

IX. APPLICATOR AND WORKER EXPOSURE

A. PHOSPHINE EXPOSURE LIMITS

Exposure to phosphine must not exceed 0.1 ppm. Entry by unprotected workers is only permitted after the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. Only if necessary, should workers be present in the fumigation zone. All workers present in the fumigation zone during the fumigation or aeration periods MUST wear appropriate respiratory protection, as outlined in the Application Manual – Section V.E. RESPIRATORS OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm. Each unprotected worker in the fumigation zone must have a personal phosphine monitor that is functional for the duration of the work period, must know how to operate the personal phosphine monitor and be informed of procedures required if the air levels of phosphine gas exceed 0.1 ppm. All persons in the fumigated site and the fumigation zone are covered by this 0.1 ppm exposure safety limit. Periodic gas measurements must be made in the worker's breathing zone using phosphine detector tubes or electronic metering devices, unless they are protected by a NIOSH-approved self-contained breathing apparatus with full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus.

The level of phosphine gas may be higher at the core of the commodity than the surrounding air. Monitoring is required when unloading or otherwise disturbing a commodity that has been fumigated to ensure that liberation of gas from the treated commodity does not result in unacceptable levels of phosphine.

B. CARBON DIOXIDE EXPOSURE LIMITS

Exposure to carbon dioxide must not exceed the 8-hour TWA of 5,000 ppm or the STEL of 30,000 ppm for applicators and workers during application. Exposure to carbon dioxide must not exceed the TLV of 5,000 ppm for any persons not associated with the application during the fumigation. Fumigated sites must be aerated to a carbon dioxide level below 5,000 ppm prior to entry by unprotected workers. All persons in the fumigated site are covered by this exposure safety limit. A NIOSH-approved supplied-air respirator (i.e. air-line respirator or self-contained breathing apparatus) is required for carbon dioxide concentrations exceeding the TLV or TWA but below the STEL; for carbon dioxide concentrations that exceed the STEL or are unknown, a NIOSH-approved self-contained breathing apparatus with a full face piece operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus is required (See Section V.E, RESPIRATORS).

C. APPLICATION OF FUMIGANT

Because it is not dependent on environmental conditions such as temperature and humidity, $ECO_2FUME^{®}$ Fumigant Gas release is instantaneous. This instantaneous release can expose the fumigator to immediate high levels of fumigant and therefore appropriate respiratory protection, as outlined under Section V.E, RESPIRATORS, must be worn during delivery/dispensing of the product. Appropriate respiratory protection, as outlined under Section V.E. RESPIRATORS MUST be worn at all times when levels of phosphine are above 0.1 ppm. If phosphine levels are unknown, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm MUST be worn. If at any time phosphine levels exceed 0.1 ppm, all individuals who are

not wearing respiratory protection as outlined in Section V.E. RESPIRATORS MUST vacate the area until phosphine levels are at or below 0.1 ppm. If the fumigator's exposure exceeds 0.1 ppm of phosphine or the TLV of 5,000 ppm (0.5% by volume) of carbon dioxide, NIOSH approved respiratory protection described in Section V.E. RESPIRATORS must be worn. Gas concentration measurements for safety purposes must be made using suitable low-level detection equipment or similar devices according to the information in Section IX.G. INDUSTRIAL HYGIENE MONITORING, below. The STEL for carbon dioxide is 30,000 ppm.

D. LEAKAGE FROM FUMIGATED SITES

Phosphine and carbon dioxide are highly mobile and given enough time may penetrate seemingly gas tight materials such as concrete and cinder block. Therefore, ensure that the fumigated site is properly sealed. Adjacent, enclosed areas must be monitored for both phosphine and carbon dioxide to ensure that significant leakage has not occurred. Sealing of the fumigated site, establishment of a fumigation zone, and/or air flow in the occupied areas must be sufficient to meet the 0.1 ppm exposure safety limit.

E. AERATION AND REENTRY

If the fumigated site is to be entered after fumigation, it must be aerated to a phosphine gas level at or below 0.1 ppm and carbon dioxide levels must be below 5,000 ppm (or 0.5% by volume) in the fumigated site and the fumigation zone. Otherwise, appropriate respiratory protection (as outlined in Section V.E, RESPIRATORS) must be worn.

The fumigated site must be periodically monitored (according to a schedule made by the licensed/certified applicator as per site characteristics and environmental conditions) for phosphine and carbon dioxide levels (as well as along the fumigation zone perimeter with respect to phosphine levels) to ensure that liberation of gas from the treated commodity does not result in the development of unacceptable levels of phosphine and carbon dioxide. If at any time the licensed/certified applicator monitoring phosphine levels detects concentrations greater than 0.1 ppm, the area must immediately be cleared of all individuals who are not wearing respiratory protection as outlined in Section V.E. RESPIRATORS, and the fumigation zone must be extended until levels are at or below 0.1 ppm along the perimeter. If an extension of the fumigation zone is not feasible, appropriate measures must be implemented (e.g. sealing of leaks, limiting aeration) until the phosphine level is at or below 0.1 ppm at the fumigation zone perimeter at which time fumigation activities may continue.

Adhere to Provincial ambient air quality criteria standards and monitor downwind gas levels. Ensure that the fumigated site and the fumigation zone are secure and placarded to prevent public and unauthorized worker access.

F. HANDLING UNAERATED COMMODITIES

Transfer and processing of a treated commodity prior to complete aeration is permissible. During this process, if levels exceed 0.1 ppm, appropriate respiratory protection as outlined in Section V.E. RESPIRATORS must be worn. If phosphine levels are unknown, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm must be worn. If workers will be exposed for more than 15 minutes to levels of carbon dioxide that are between 5,000 and 30,000, or if levels of carbon dioxide exceed 30,000 ppm or are unknown, then appropriate respiratory protection as outlined in Section V.E, RESPIRATORS, must be worn. Transfer of incompletely aerated commodity via bulk handling equipment such as augers, drag conveyors and conveyor belts to a new site is permissible; however, the new storage must be placarded if it contains more than 0.1 ppm phosphine or 5,000 ppm of carbon dioxide. Workers who handle incompletely aerated commodities must be informed and trained accordingly on the appropriate measures that must be taken (i.e., ventilation or respiratory protection) to prevent exposures to phosphine and carbon dioxide above their respective exposure limits. This section does not pertain to transferring fumigated containers or vehicles over public roads. The transfer of fumigated containers or truck trailers over public roads is prohibited.

G. INDUSTRIAL HYGIENE MONITORING

At each site and operation under fumigation, monitor airborne phosphine and carbon dioxide concentrations in all areas to which fumigators and other workers have had access during fumigation and aeration. Perform such monitoring in workers' breathing zones. This monitoring is performed to determine when and where respiratory protection is required. When monitoring for phosphine levels, appropriate respiratory protection, OR a personal phosphine monitor with a limit of detection of 0.01 ppm and an alarm set at 0.1 ppm MUST be worn. Periodic gas

measurements in those areas must be taken to determine whether conditions have significantly changed or if an unexpected garlic-like odour is present. Record all monitoring data in an operation log or manual.

There are a number of devices on the market for the measurement of phosphine gas levels for industrial hygiene purposes. One of these is the phosphine detector tube used in conjunction with the appropriate hand-operated air sampling pump. These devices are reliable, portable, simple to use, do not require extensive training and are relatively rapid, inexpensive and accurate. Low level detector tubes or electronic metering devices are available which can detect 0.1 ppm and are suitable for industrial hygiene monitoring. Information on hydrogen phosphide (phosphine, PH_3) detector tubes or electronic metering devices may be obtained from your distributor.

H. ENGINEERING CONTROLS AND WORK PRACTICES

If initial monitoring shows that concentrations of phosphine and/or carbon dioxide are in excess of the permitted exposure limits (i.e. 0.1 ppm and 5,000 ppm respectively), then engineering controls (such as forced air ventilation) and/or appropriate work practices must be implemented (such as using personal exposure monitors) where possible to reduce exposure to below these permitted limits. In any case, appropriate respiratory protection as outlined in Section V.E, RESPIRATORS, must be worn if phosphine and/or carbon dioxide exposure limits are exceeded or are unknown.

X. PLACARDING OF FUMIGATION AREAS

IMPORTANT: Post warning placards around both the application site (fumigated site) and the fumigation zone perimeter before the actual fumigation treatment. Relocating the placards may be required if the fumigation zone needs to be extended at any point during the fumigation or aeration periods.

The licensed/certified applicator must placard or post warning signs at all usual points of entry and along other likely routes of approach where people not under the land operator's control may be in close proximity to the fumigated site and the fumigation zone. Placards should be placed in advance of the fumigation to keep unauthorized persons away. Some examples of points of entry include, but are not limited to, roadways, sidewalks, paths, and bike trails. Some examples of likely routes of approach are the area between a fumigation zone site and a roadway, or the area between a fumigation zone site and a housing development.

Posting of warning signs for the fumigation zone perimeter is required, UNLESS there is a physical barrier (e.g. fence) that prevents access into the fumigation zone. Signage must not be removed until the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone and/or the carbon dioxide level is below 5,000 ppm at the fumigated site. To determine whether aeration is complete, each fumigated site or vehicle must be monitored in the air space around and, when feasible, in the mass of the commodity. Only a licensed/certified applicator can authorize removal of warning signs.

Placards must be at least 35 cm long and 25 cm wide and made of substantial material that can be expected to withstand adverse weather conditions. They must bear the following information:

1. The signal word **"DANGER"** in letters at least 7 cm high and the **SKULL** and **CROSSBONES** symbol in red.
2. The "DO NOT WALK" symbol.
3. The statement, "Area and/or commodity under fumigation, DO NOT ENTER".
4. The statement, "This sign may only be removed after the fumigated site has been aerated and the phosphine level is at or below 0.1 ppm in the fumigated site and the fumigation zone. The fumigated site must be aerated to a carbon dioxide level below 5,000 ppm.
5. The date and time when fumigation begins and the date and time when aeration can begin.
6. Name of fumigant used: ***Eco_2Fume Fumigant Gas, Registration No. 27684***.
7. Contact information (name, address, and telephone number) for the supervising fumigant handler in charge of the fumigation.
8. Placards must bear a 24-hour emergency response telephone number.

For railcar hopper cars, placarding must be placed securely on both sides of the car near the ladders and next to or on the top hatch into which the fumigant is added.

Transport of incompletely aerated commodities to a new site is permissible by rail or ship only, and the new storage site must be placarded if the phosphine concentration is above 0.1 ppm or the carbon dioxide concentration is above 5,000 ppm. Trucks, vans, trailers and similar transport vehicles cannot be moved over public roads or highways until they are aerated and the warning placards removed. If workers must handle incompletely aerated commodity, or enter incompletely aerated areas, or are indoors (e.g., an enclosed elevator head) they are to wear appropriate respiratory protection (refer to Section V.E, RESPIRATORS).

Only a licensed/certified applicator may authorize the removal of warning sings when the structure/container/vehicle is no longer under fumigation and aeration is complete. It is recommended that the trained persons, under the supervision of a licensed/certified applicator, responsible for removing placards be familiar with the physical, chemical and toxicological properties of phosphine. They should also be knowledgeable in making gas concentration measurements, exposure limits and symptoms and first aid treatment for phosphine poisoning.

XI. MAXIMUM RESIDUE LIMITS FOR FUMIGATED COMMODITIES

A. FOODS AND FEEDS

Maximum residue limits for phosphine have been established at 0.1 ppm for animal feeds, grains, nuts, and dates; 0.01 ppm for processed foods, and 0.01 ppm in fresh fruits and vegetables. **To guarantee compliance with these maximum residue limits, it is necessary to aerate these commodities for 48 hours prior to offering them to the end customer.** The licensed/certified applicator is only required to be present until the air concentrations of phosphine gas are at or below the exposure limit of 0.1 ppm.

B. TOBACCO

To guarantee compliance with the default maximum residue limit of 0.1 ppm set for phosphine in tobacco, fumigated tobacco must be aerated to a phosphine level below 0.1 ppm. The minimum aeration period of 48 hours is required. When plastic liners are used, longer aeration periods may be required to aerate the commodity down to the residue limit of 0.1 ppm. The licensed/certified applicator is only required to be present until the air concentrations of phosphine gas are at or below the exposure limit of 0.1 ppm.

XII. SAFE HANDLING OF COMPRESSED GASES IN CONTAINERS

The following are excerpts from the Compressed Gas Association (CGA) Pamphlet P-1 “Safe Handling of Compressed Gases in Containers”. These are provided to assist the user with the more important aspects of cylinder handling. It is recommended that the user be familiar with all aspects of this pamphlet.

1. The user is responsible for the safe use of the container and its contents and for returning the container to the gas manufacturer or distributor in the same safe condition as it was received.

2. The user shall not modify, tamper with, paint, deface, obstruct, remove or repair any part of the cylinder, including the pressure relief device, and the container valve or the valve protection device. Maintenance of the container and its valve or relief device (if required) shall be performed only by trained personnel under the direction of the container owner or an authorized representative.

3. The prescribed stamped markings on the container shall be made and kept in a legible condition. The user shall not add, remove or alter any of these markings.

4. The labels applied by the gas manufacturer to identify the container contents shall not be defaced or removed by the user.

5. Compressed gas containers shall not be exposed to temperature extremes. High temperatures may result in excessive cylinder pressure. Never apply a flame or heat directly to any part of a compressed gas container or allow it to come in contact with an electrically energized system. High temperatures may also damage the physical integrity of the container. If ice or snow accumulates on a container, thaw at room temperature,

or with water at a temperature not exceeding 51.7°C (125°F).

6. Leaking or defective containers shall not be offered for shipment. Consult the gas supplier for advice under these circumstances.

7. Any damage that might impair the safety of the container shall be called to the attention of the gas supplier before returning the container.

8. Where valve outlet caps and /or plugs are provided by the gas supplier, the user shall keep the device on the valve outlet at all times, except when containers are secured and connected to dispensing equipment. Gas-tight valve outlet caps and plugs serve the purpose of containing any residual product and in accordance with the provisions of 49 CFR 173.40 and CSA B340, are mandatory for poison gas containers. The gas-tight valve outlet cap or plug must be checked and tightened securely before return shipment to the gas supplier.

9. The cylinder valve shall be kept closed at all times (charged or empty) except when the cylinder is in use. Do not use tools such as wrenches and hammers in attempting to open or close valves. An exception is when torque wrenches designed for use with container valve hand wheels are acceptable. Contact the gas supplier if the valve is difficult to operate.

10. Users of compressed gas containers shall ensure that they are not rolled in the horizontal position or dragged. A suitable hand truck, forklift truck, cylinder pallet system or similar material-handling device should be used with the container properly secured to the device. Never lift containers by using the container cap or magnets.

11. Caution should be used when handling cylinders to guard against dropping or permitting them to violently strike against each other and other surfaces.

12. The transfer of compressed gases from one cylinder to another should only be performed by the gas supplier or by personnel who are trained and qualified with the proper transfill equipment and written operating procedures, and who are familiar with the precautions necessary to avoid the hazards of the product being transfilled and with the procedures necessary to comply with all government standards and regulations. Detailed written operating instructions including equipment inspection and maintenance procedures should be provided by the supplier or the transfill equipment and rigorously followed.

13. Cylinder valve connections that do not fit shall not be forced.

14. Gas tight connections including piping, regulators and other apparatus shall be kept gas tight to prevent leakage. This can be confirmed by the use of a compatible leak test solution or an appropriate leak detection instrument. DO NOT tighten connections or leaking fittings or attempt other repairs while the system is under pressure.

15. Prior to disconnecting a cylinder from dispensing equipment, the cylinder valve shall be closed and the dispensing equipment relieved of pressure.

16. The transportation of compressed gas cylinders in unsuitable vehicles or in closed-bodied vehicles can present serious safety hazards and should be discouraged. Refer to CGA PS-7, *CGA Position Statement on the Safe Transportation of Cylinders in Vehicles*, for additional guidance. Shipping compartments should be adequately ventilated.

17. An emergency response plan shall be in place wherever compressed gas containers and products are used, handled, stored or disposed of, according to 29 CFR 1910.120. Only trained personnel shall respond to an emergency situation involving a compressed gas container or product. Personnel shall be promptly evacuated from the immediate area in danger and kept up wind at sufficient distance to avoid any inhalation or contact with potentially hazardous products until safe reentry can be ensured.

18. In Canada, CANUTEC, the information center for Transportation Canada (TC), supplies a 24-hour response system for transportation emergencies. Canadian regulations require that when shipping certain gases the shipper file an emergency response plan with TC. In addition, CANUTEC will activate

COMPGEAP Canada when necessary. CANUTEC's phone number for general information is 613-992-4624 and for emergency response is 613996-6666.

19. Before using a gas, read the label and material safety data sheet for information about the material. Exposure to toxic gases shall be kept as low as possible but in no case should concentrations exceed the exposure levels established by the Occupational Safety and Health Administration Canada.

XIII. STORAGE OF CYLINDERS

A. GENERAL

The first consideration when planning a storage area for $ECO_2FUME^{®}$ Fumigant Gas cylinders is the needs of the local authorities. It is important that emergency response professionals are aware of all hazardous materials stored in their jurisdiction. They should be provided with an MSDS and detailed information on the quantities of product stored and the nature and location of the storage area.

B. EMERGENCY RESPONSE PLAN

A clearly defined emergency response plan should be developed for the site. This plan should define procedures and outline responsibilities in addressing emergency situations involving $ECO_2FUME^{®}$ Fumigant Gas. All site personnel should be trained in the plan and it should be practiced periodically.

Proper handling procedures as outlined in this manual must be followed. Storing cylinders with the valve discharge cap securely in place will minimize the potential for leaks. Outside storage of cylinders in a secure, well-ventilated, and preferably covered area is recommended. See Part D. of this section for further information.

C. INDOOR STORAGE

The storage of poison gases in occupied spaces is prohibited. However, indoor storage in a separate building with no other occupancy is suitable. The building should be of non-combustible construction (1 hour fire rating), adequately ventilated and equipped with a continuous phosphine monitoring and alarm system that is activated at 0.1 ppm. Operating personnel must not enter a building, when the alarm is activated, without wearing a NIOSH-approved self-contained breathing apparatus (SCBA) with a full face piece operated in pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus. In some jurisdictions, the indoor storage of toxic gases is prohibited.

D. OUTDOOR STORAGE

It is recommended that both full and used $ECO_2FUME^{®}$ Fumigant Gas cylinders be stored outdoors in a dedicated and properly designed and labelled storage area.

The following are recommended for outdoor storage:

1. A firm and level surface, preferably reinforced concrete, well drained.
2. Chain link fence topped with three strands of barbed wire, with gate and lock.
3. Covered, if snow accumulation is likely to cause handling problems. Non-combustible construction.
4. Shaded, if high temperatures are expected. Non-combustible construction.
5. Protected from vehicle traffic.
6. A means of securing all cylinders.
7. Away from building ventilation intakes.
8. Equipped with a windsock to indicate wind direction.

E. TEMPERATURE LIMITATIONS

$ECO_2FUME^{®}$ Fumigant Gas cylinders should never be stored where the temperature will exceed 51.7°C (125°F). Low temperatures will not affect $ECO_2FUME^{®}$ Fumigant Gas.

F. SECURING CYLINDERS

Cylinders must be stored in an upright position and protected from falling. Protection against falls can include the use of cylinder pallets with straps, walls and securing chains, or pens constructed from steel handrail or like construction.

G. LABELLING OF STORAGE

The labelling of the $ECO_2FUME^{®}$ Fumigant Gas cylinder storage area should take into account the needs of a variety of organizations. These should include, but not be limited to: corporate policy, insurance carrier, Occupational Safety and Health Administration (OSHA), Right to Know and local emergency response professionals. Storage must be clearly marked with the following signs:

1. Danger, Poison (with skull and crossed bones)
2. Authorized Personnel Only
3. NFPA Hazard Identification Symbols

The National Fire Protection Association (NFPA) developed NFPA Hazard Identification Symbols. This standardized symbol system is designed to provide, at a glance, information regarding the health, fire, and reactivity hazards associated with hazardous materials. The following are the hazard categories and degree of hazard for $ECO_2FUME^{®}$ Fumigant Gas:

Category	**Degree of Hazard**
Health	4 (Severe Hazard)
Flammability	0 (No Hazard)**
Reactivity	2 (Moderate)

**although phosphine gas is highly flammable, $ECO_2FUME^{®}$ Fumigant Gas contains 97% carbon dioxide by weight which makes it non-flammable.

Materials to properly label the storage area in compliance with NFPA standards can be purchased through most safety supply companies.

NOTE: When using the NFPA Hazard Identification System, the characteristics of all hazardous materials stored in a particular area must be considered. The local fire protection district should be consulted for guidance on the selection and placement of such signs.

XIV. TRANSPORT

A. GENERAL

$ECO_2FUME^{®}$ Fumigant Gas is classified as a poison gas by Transport Canada and it shall only be transported in accordance with Transport Canada regulations. All persons involved in the transport of or the preparation of cylinders for transport should be trained in and familiar with the regulations.

B. TRANSPORT DESIGNATIONS

The following transport designations apply $ECO_2FUME^{®}$ Fumigant Gas:

Proper Shipping Name	Liquefied gas, toxic N.O.S. (contains phosphine) Inhalation Hazard, Zone A
Hazard Class	2.3
Identification Number	UN 3162
Shipping Label	Poison Gas

C. TRANSPORT REQUIREMENTS

1. Package Preparation

$ECO_2FUME^®$ Fumigant Gas cylinders shall not be transported unless:

- The cylinder valve is fully closed.
- The gas tight outlet cap is secured on the valve outlet.
- The cylinder cap is secured.
- The cylinder has a readable, proper shipping label.

2. Cylinder Contents

Used $ECO_2FUME^®$ Fumigant Gas cylinders can still contain residual gas, and shall be offered for transport and transported as if they are full. Check with your distributor if you have questions about shipping $ECO_2FUME^®$ Fumigant Gas cylinders.

3. Documents

Proper documentation is required by law, for the transport of any hazardous material. The documentation accompanying the shipment of $ECO_2FUME^®$ Fumigant Gas (whether full, partially full, or empty) must include the labeling, a bill of lading, placard, and the MSDS. The documents must clearly identify the quantity and nature of all hazardous materials being transported or offered for transport by a second party. All persons generating such documents should be trained in their preparation.

4. Vehicle Loading

$ECO_2FUME^®$ Fumigant Gas cylinders shall only be loaded into unoccupied spaces of vehicles. All cylinders shall be secured from movement during transport.

5. Vehicle Markings

Vehicles transporting $ECO_2FUME^®$ Fumigant Gas shall be placarded in accordance with Transport Canada regulations for pressurized gases. Consideration should be made for other hazardous materials that are concurrently being transported. Proper placarding should take into account all hazardous materials on board.

6. Use of Common Carriers

Shipment of $ECO_2FUME^®$ Fumigant Gas cylinders by common carrier is permitted, provided the carrier meets certain criteria. Contact an authorized $ECO_2FUME^®$ Fumigant Gas distributor for an approved list of common carriers.

7. Driver Qualifications

Anyone operating a vehicle that is carrying hazardous materials must be in possession of a current Commercial Driver's License (CDL) with Hazardous Material Endorsement.

XV. DISPOSAL

Do not reuse cylinders for any purpose. Once used, $ECO_2FUME^®$ Fumigant Gas cylinders are to be returned only to an authorized distributor or their designated point of return. This applies to all cylinders, regardless of the quantity of material remaining in the cylinder. Disposal of the cylinder contents (mixture of phosphine and carbon dioxide) is prohibited. If the cylinder is partially full do not release the remaining gases; just send the cylinder to authorized distributor.

XVI. SPILL AND LEAK PROCEDURES

A. GENERAL

All releases can produce high levels of toxic phosphine gas, and therefore, attending personnel must wear appropriate respiratory protection and personal protective equipment as specified under EMERGENCY RESPONDER PROTECTION.

IMPORTANT: Emergency responders must be familiar with the "Emergency Response Guidebook", which is maintained by Transport Canada.

B. WHAT TO DO

In the event of an accidental release, evacuate the area immediately. Only trained emergency responders should attempt a response into the leak area. If it is possible to shut off the source of the leak from a remote area, it should be done. Otherwise, evacuate the area and call for assistance. As a reference, small and large spills may require isolation distances between 60 – 400 metres and may also require protective distances between 200 metres and 4.1 kilometres (refer to "Emergency Response Guidebook").

CYTEC operates a 24-hour Emergency Response and Incident Management System (ERIM). For emergencies involving spill, leak, fire, exposure or accident call Canadian Transport Emergency Centre (CANUTEC) 613/996-6666 or CHEMTREC: 1-800/424-9300. Outside the US or Canada call 703/527-3887.

Emergency responders must follow the detailed specifications for phosphine (ID Number 2199, Guide Number 119) in the "Emergency Response Guidebook", which is maintained by Transport Canada (www.tc.gc.ca/eng/canutec/guide-menu-227.htm).

C. EMERGENCY RESPONDER PROTECTION

Wear a NIOSH-approved self-contained breathing apparatus (SCBA) with full face piece and operated in a pressure-demand or other positive-pressure mode OR a NIOSH-approved air-line respirator with a full face piece operated in a pressure-demand or other positive-pressure mode combined with an auxiliary self-contained positive-pressure breathing apparatus when the concentration of phosphine gas is unknown. If the concentration is known, other appropriate respiratory protection must be worn as specified in Section V.E, RESPIRATORS.

All emergency responses should be made wearing personal protective equipment as specified in Section V, PERSONAL PROTECTIVE EQUIPMENT including chemical-resistant gloves (neoprene, butyl rubber or PVC), a Seranex coated Tyvek suit and rubber boots. Note that the chemical protective clothing listed may provide little or no thermal protection. Structural firefighters' protective clothing provides limited protection in fire situations only; it is not effective in spill situations where direct contact with the chemical is possible.