



U.S. ENVIRONMENTAL PROTECTION AGENCY

Office of Pesticide Programs  
Registration Division (7505T)  
1200 Pennsylvania Ave., N.W.  
Washington, D.C. 20460

EPA Reg. Number:

40285-22

Date of Issuance:

12/27/23

NOTICE OF PESTICIDE:

Registration  
 Reregistration  
(under FIFRA, as amended)

Term of Issuance:

Unconditional

Name of Pesticide Product:

U-Phos® Phosphine Fumigant

Name and Address of Registrant (include ZIP Code):

Anna Armstrong  
Senior Regulatory Specialist, Agent for  
Degesch America, Inc.  
153 Triangle Drive  
Weyers Cave, VA 24486

Note: Changes in labeling differing in substance from that accepted in connection with this registration must be submitted to and accepted by the Registration Division prior to use of the label in commerce. In any correspondence on this product always refer to the above EPA registration number.

On the basis of information furnished by the registrant, the above named pesticide is hereby registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

Registration is in no way to be construed as an endorsement or recommendation of this product by the Agency. In order to protect health and the environment, the Administrator, on his motion, may at any time suspend or cancel the registration of a pesticide in accordance with the Act. The acceptance of any name in connection with the registration of a product under this Act is not to be construed as giving the registrant a right to exclusive use of the name or to its use if it has been covered by others.

This product is unconditionally registered in accordance with FIFRA section 3(c)(5) provided that you:

1. Submit and/or cite all data required for registration/reregistration/registration review of your product when the Agency requires all registrants of similar products to submit such data.

*Continues page 2*

Signature of Approving Official:

Venus Eagle, Product Manager 01  
Invertebrate & Vertebrate Branch 3  
Registration Division (7505T)

Date:

12/27/23

2. Make the following label changes before you release the product for shipment:
  - Revise the EPA Registration Number to read, “EPA Reg. No. 40285-22.”
3. Submit one copy of the final printed label for the record before you release the product for shipment.

Should you wish to add/retain a reference to the company’s website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by the Agency. If the website is false or misleading, the product would be misbranded and unlawful to sell or distribute under FIFRA section 12(a)(1)(E). 40 CFR 156.10(a)(5) lists examples of statements EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product’s label, claims made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the Agency find or if it is brought to our attention that a website contains false or misleading statements or claims substantially differing from the EPA approved registration, the website will be referred to the EPA’s Office of Enforcement and Compliance.

If these conditions are not complied with, the registration will be subject to cancellation in accordance with FIFRA section 6. Your release for shipment of the product constitutes acceptance of these conditions. A stamped copy of the label is enclosed for your records.

The record for this product currently contains the following CSF(s):

- Basic CSF dated 04/24/2023

If you have any questions, please contact Ralph Narain at 202-566-2853 or at [Narain.Ralph@epa.gov](mailto:Narain.Ralph@epa.gov).

Enclosure: Stamped label

**RESTRICTED USE PESTICIDE**

**DUE TO HIGH ACUTE INHALATION TOXICITY OF PHOSPHINE GAS**

FOR RETAIL SALE TO DEALERS AND CERTIFIED APPLICATORS ONLY. FOR USE BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION, AND ONLY FOR THOSE USES COVERED BY THE CERTIFIED APPLICATOR'S CERTIFICATION. REFER TO THE DIRECTIONS IN THE APPLICATOR'S MANUAL FOR REQUIREMENTS OF THE PHYSICAL PRESENCE OF A CERTIFIED APPLICATOR.

**PHOSPHINE | GROUP 24A | INSECTICIDE**

THE COMPLETE LABEL FOR THIS PRODUCT CONSISTS OF THE CONTAINER LABEL AND APPLICATOR'S MANUAL WHICH MUST ACCOMPANY THE PRODUCT. THEREFORE, EVERY CYLINDER MUST HAVE AN APPLICATOR'S MANUAL DATED [Insert EPA Stamped Date] TO ACCOMPANY IT. READ AND UNDERSTAND THE ENTIRE CONTAINER LABEL AND APPLICATOR'S MANUAL. REFER TO THE APPLICATOR'S MANUAL FOR DIRECTIONS FOR USE, PRECAUTIONS AND RESTRICTIONS.

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

CONSULT WITH YOUR STATE LEAD PESTICIDE REGULATORY AGENCY TO DETERMINE REGULATORY STATUS, REQUIREMENTS, AND RESTRICTIONS FOR FUMIGATION USE IN THAT STATE. CALL DEGESCH AMERICA, INC. IF YOU HAVE ANY QUESTIONS OR DO NOT UNDERSTAND ANY PART OF THIS LABEL.

**U-PHOS® Phosphine Fumigant**

Pure phosphine gas for on-site blending with registered or food grade carbon dioxide or forced air to produce a nonflammable fumigant gas for use in controlling pests in enclosed empty spaces and enclosed spaces (including temperature-controlled spaces such as cold storage chambers, transport containers and other suitable fumigation spaces) containing listed raw agricultural commodities, processed foods, stored tobacco, animal feeds, and nonfood products. Not for use on barges. Not for burrow treatment. For details refer to the U-Phos® Phosphine Fumigant Application Manual.

**ACTIVE INGREDIENT:** PHOSPHINE GAS (PH<sub>3</sub>) ..... 99.35%  
**INERT INGREDIENTS:** ..... 0.65%  
**Total:**..... 100.00%



**KEEP OUT OF REACH OF CHILDREN  
 DANGER - POISON - PELIGRO**



SEE SIDE PANEL OF LABEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

**PELIGRO AL USUARIO: Si usted no ingles, no use este producto hasta que la etiqueta se le haya sido explicado ampliamente. (TO THE USER: If you cannot read English, do not use this product until the label has been fully explained to you.)**

**THE USE OF THIS PRODUCT IS STRICTLY PROHIBITED ON SINGLE AND MULTI-FAMILY RESIDENTIAL PROPERTIES AND NURSING HOMES, SCHOOLS, DAYCARE FACILITIES AND HOSPITALS.**

<b>FIRST AID</b>	
<b>If Inhaled:</b>	<ul style="list-style-type: none"> <li>• Move person to fresh air.</li> <li>• If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible.</li> <li>• Call a poison control center or doctor for further treatment advice.</li> </ul>
<b>If on Skin:</b>	<ul style="list-style-type: none"> <li>• May cause frostbite to unprotected skin upon contact with dispensing equipment while gas is discharged rapidly.</li> <li>• Take off contaminated clothing and allow clothes to aerate in ventilated room prior to laundering.</li> <li>• Call a poison control center or doctor for treatment advice.</li> </ul>
<b>If in Eyes:</b>	<ul style="list-style-type: none"> <li>• Hold eye open and rinse slowly and gently with cool water for 15-20 minutes in case of freezing or cryogenic "burns". Do not rinse eyes with hot or even tepid water.</li> <li>• Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.</li> <li>• Call a poison control center or doctor for further treatment advice.</li> <li>• Never introduce oil or ointment into eyes without medical advice.</li> </ul>
<b>NOTES TO PHYSICIAN</b>	
Symptoms of exposure to this product are headache, dizziness, nausea, difficult breathing, vomiting, and diarrhea. In all cases of overexposure get medical attention immediately. Take victim to a doctor, hospital or emergency treatment facility. Refer to the <b>PRECAUTIONARY STATEMENTS</b> (Note to EPA reviewer: the page number for the Precautionary Statements section will be added here on the market label.) for the complete and detailed Notes to Physician pertaining to the treatment of exposure to phosphine fumigants.	
<b>HOTLINE NUMBER</b>	
Have the Applicator's Manual with you when calling a poison control center or doctor, or when going for treatment. <b>CONTACT 1-800-308-4856 FOR ASSISTANCE WITH HUMAN OR ANIMAL MEDICAL EMERGENCIES.</b> You may also contact DEGESCH AMERICA, INC. 540-234-9281/1-800-330-2525 or CHEMTREC 1-800-424-9300.	

**Manufactured for:**

DEGESCH AMERICA, INC.  
 P. O. Box 116 - 153 Triangle Drive  
 Weyers Cave, VA 24486 USA  
 Telephone: (540) 234-9281/1-800-330-2525  
 Internet: [www.degeschamerica.com](http://www.degeschamerica.com)  
 E-mail: [degesch@degeschamerica.com](mailto:degesch@degeschamerica.com)

EPA Est. No. \_\_\_\_\_ EPA Reg. No. 40285-EE  
 Net Contents: \_\_\_\_\_ lbs. (\_\_\_\_\_ kg)  
 Batch No. \_\_\_\_\_

**ACCEPTED**

**12/27/2023**

Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No. 40285-22

CALL DEGESCH AMERICA, INC. (Tel: 540-234-9281/1-800-330-2525) IF YOU HAVE ANY QUESTIONS OR DO NOT UNDERSTAND ANY PART OF THE LABEL OR APPLICATOR'S MANUAL. IF THE PRODUCT CONTAINER LABEL OR APPLICATOR'S MANUAL ARE LOST, CONTACT DEGESCH AMERICA, INC. TO OBTAIN A REPLACEMENT COPY.

## **PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS**

### **DANGER/PELIGRO – POISON**

Fatal if inhaled. The liquid may cause burns. Keep animals, children and unauthorized persons away from area under treatment, until area is shown to be free from phosphine gas, as indicated by a gas-measuring device. Working in an area with undetermined concentrations requires a self-contained breathing apparatus (SCBA) with full face-piece operated in a pressure-demand mode. Do not get in eyes, in nose, on skin or on clothing. Do not breathe vapor. Do not eat, drink or smoke while handling U-PHOS® Phosphine Fumigant. Phosphine gas may deaden the sense of smell. Do not depend solely on the odor to detect U-PHOS® Phosphine Fumigant. Observe proper application, aeration, re-entry and dosing procedures specified in the Applicator's Manual to prevent overexposure.

#### **NOTE TO PHYSICIAN – THIS IS PHOSPHINE**

Mild exposure by inhalation of U-PHOS® Phosphine Fumigant causes malaise (indefinite feeling of sickness), ringing of ears, fatigue, nausea and pressure in chest, which are relieved by removal to fresh air. Moderate poisoning causes weakness, vomiting, epigastric pain (pain just above the stomach), chest pain, diarrhea and dyspnea (difficulty in breathing). Symptoms of severe poisoning may occur within a few hours or up to several days, resulting in pulmonary edema (fluid in lungs) and may lead to dizziness, cyanosis (blue or purple skin color), unconsciousness and death.

In sufficient quantity it affects the liver, kidneys, lungs, nervous system, and circulatory system. Inhalation can cause lung edema (fluid in lungs) and hyperemia (excess of blood in a body part), small perivascular brain hemorrhages and brain edema (fluid in brain). Poisoning may result in (1) pulmonary edema, elevated MB-creatinine phosphokinase fraction of cardiac enzymes, cardiac dysrhythmia, (2) elevated serum GOT, LDH and alkaline phosphatase, reduced prothrombin, hemorrhage and jaundice (yellow skin color) and (3) hematuria (blood in urine) and anuria (abnormal or lack of urination). Pathology is characteristic of hypoxia (oxygen deficiency in body tissue). Frequent exposure over a period of days or weeks may cause poisoning. 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), the following is suggested: Complete rest 1-2 days during which the patient must be kept quiet and warm. If the patient suffers from vomiting or increased blood sugar, appropriate solutions must be administered. Treatment with oxygen is recommended, as is the administration of cardiac and circulatory stimulants.
4. In cases of severe poisoning (intensive care unit is recommended): Where pulmonary edema is observed, steroid therapy must be considered and close medical supervision is recommended. Blood transfusions may be necessary. In case of manifest pulmonary edema, venesection must be performed under vein pressure control. Heart glycosides (I.V.) can be used in case of hemoconcentration. Venesection may result in shock. In the case of progressive edema of the lungs, immediately intubate and remove edema fluid and administer oxygen over-pressure respiration, as well as any measures required for shock treatment. In case of kidney failure, extracorporeal hemodialysis is necessary. There is no specific antidote known for this poisoning.

#### **ENVIRONMENTAL HAZARDS**

This product is highly toxic to fish and wildlife. Non-target organisms exposed to phosphine gas will be killed.

#### **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. Phosphine must be blended with carbon dioxide (CO<sub>2</sub>) or forced air before using as a fumigant. Ignition of high concentration of phosphine can produce an explosive 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 130°F may cause bursting. Do not drop the container.**

Never open cylinder in confined space without a self-contained breathing apparatus (SCBA) with full face-piece and operated in a pressure-demand mode. Never enter a space under fumigation with U-PHOS® Phosphine Fumigant without first checking the gas concentration levels and wearing the appropriate breathing apparatus (refer to PPE in Section V.E. in the applicator's manual). 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 must 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., must not be exposed. Under high vacuum conditions, phosphine gas blended with forced air may cause an explosive hazard. Do not apply U-PHOS® Phosphine Fumigant in vacuum chambers.

## **DIRECTIONS FOR USE**

### **RESTRICTED USE PESTICIDE**

**It is a violation of federal law to use this product in a manner inconsistent with its labeling.** U-PHOS® Phosphine Fumigant is a hazardous material and may be used only by Certified Applicators or persons under their direct supervision. This product is for use against insects and rodents that infest stored commodities, including fresh, processed and non-food commodities in cold storage, and insects and nematodes that infest wood and wood products. Refer to the Applicator's Manual for directions for use (e.g., pest controlled, specific commodities), precautions and restrictions.

**U-PHOS® Phosphine Fumigant is pure phosphine gas for use as a fumigant after on-site blending with forced air or with registered or food grade carbon dioxide for the production of non-flammable phosphine fumigant gas.**

## **STORAGE AND DISPOSAL**

### **STORAGE INSTRUCTIONS:**

**PESTICIDE STORAGE:** Store in dry, cool, well-ventilated area under lock and key. Post as a pesticide storage area. Store cylinders upright (vertical) position to a rack or wall to prevent tipping with safety caps and protective bonnets securely in place. Do not store cylinders in areas where temperature may exceed 125 °F (51.7 °C).

**INDOOR STORAGE:** Indoor storage in a separate building with no other occupancy is suitable. If cylinders are stored in an enclosed area without proper ventilation, the area must be tested for leaks. An approved low range phosphine monitor can be used to ensure that phosphine levels are below the TLV of 0.3 ppm before entry into the storage.

Storing indoors in occupied areas in buildings is prohibited. If the storage area is in an occupied building, the storage area must have either 1) a forced air ventilation system that meets required local ordinances for the storage of hazardous materials and operates continuously; or 2) be equipped with a permanently mounted and properly maintained and functioning phosphine monitoring system designed to alert occupants of the building if phosphine in the air of the storage area is greater than Threshold Limit Value (TLV) of 0.3 ppm.

**OUTDOOR STORAGE:** It is recommended that U-PHOS® Phosphine Fumigant cylinders be stored outdoors on a firm and level surface that is well drained. Store away from heat and building ventilation intakes.

### **SECURING CYLINDERS**

Cylinders (filled or empty) 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.

### **CONTAINER HANDLING (CYLINDER):**

Cylinders must not be subjected to rough handling or mechanical shock such as dropping, bumping, dragging, or sliding beyond that which would normally occur when moving cylinders. Do not transport any cylinders in closed vehicles where they occupy the same common airspace as personnel. Transport securely only in an upright position. Do not remove valve protection bonnet and safety cap until immediately before use. Replace safety cap and valve protection bonnet when cylinder is not in use.

Refillable container. Return all, U-PHOS® Phosphine Fumigant cylinders to Degesch America, Inc. or an authorized distributor or their designated point of return. Regardless of the quantity of material remaining in the cylinder. **DO NOT** use cylinders for any other purpose.

### **LEAK PROCEDURES:**

Evacuate immediate area of leak. Use a NIOSH approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air-supplied/SCBA respirator, such as manufactured by Draeger, Ranger, Survivair, Scott, or MSA, for entry into affected areas to correct problem. Move leaking or damaged cylinder outdoors or to an isolated location, observing strict safety precautions. Work upwind if possible. Do not permit entry into leakage area by unprotected persons until concentration of phosphine fumigant is determined to be 3 parts per million (ppm) or less, as determined by a detection device with sufficient sensitivity. If burning, and there is no risk to surroundings, let the fire burn itself out.

### **WHO TO CALL:**

For emergencies involving spill, leak, fire, exposure or accident call CHEMTREC: 1-800-424-9300. **CONTACT 1-800-308-4856 FOR ASSISTANCE WITH HUMAN OR ANIMAL MEDICAL EMERGENCIES.** You may also contact DEGESCH AMERICA, INC. – (540) 234-9281/1-800-330-2525.

### **EMERGENCY RESPONDERS**

**Use Guide 119 from the Emergency Response Guidebook for First Responders)**

All emergency responses must be made in level B protection, which includes neoprene, butyl rubber or PVC gloves, Seranex coated Tyvek suit, rubber boots and an air-supplied respirator. Refer to the Applicator's Manual for more detailed recommendations for handling, storage, spill and leak procedures.

### **PESTICIDE DISPOSAL:**

Return all unused, unwanted or partially used U-PHOS® Phosphine Fumigant cylinders to Degesch America, Inc. or an authorized distributor or their designated point of return. Follow proper **CONTAINER HANDLING** directions above. Pesticide wastes may be hazardous. Improper disposal of excess pesticide is a violation of Federal law. Consult your State Pesticide or Environmental Control Agency, or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.

**NO WARRANTIES:** To the extent consistent with applicable law (i) THE MANUFACTURER AND SELLER DISCLAIM ALL EXPRESS OR IMPLIED WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE; and (ii) in no case shall the Manufacturer or Seller be liable for special, incidental, or consequential damages resulting from the use, handling, storage, or disposal of this product.



**RESTRICTED USE PESTICIDE**

**DUE TO HIGH ACUTE INHALATION TOXICITY OF PHOSPHINE GAS**

**FOR RETAIL SALE TO DEALERS AND CERTIFIED APPLICATORS ONLY. FOR USE BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION, AND ONLY FOR THOSE USES COVERED BY THE CERTIFIED APPLICATOR'S CERTIFICATION. REFER TO THE DIRECTIONS IN THE APPLICATOR'S MANUAL FOR REQUIREMENTS OF THE PHYSICAL PRESENCE OF A CERTIFIED APPLICATOR.**

**THE COMPLETE LABEL FOR THIS PRODUCT CONSISTS OF THE CONTAINER LABEL AND APPLICATOR'S MANUAL WHICH MUST ACCOMPANY THE PRODUCT. THEREFORE, EVERY CYLINDER MUST HAVE AN APPLICATOR'S MANUAL DATED {Note to EPA reviewer: the EPA stamped approval date, which includes the approval of the Applicator's Manual, will be included here in the final printed labeling} TO ACCOMPANY IT. READ AND UNDERSTAND THE ENTIRE CONTAINER LABEL AND APPLICATOR'S MANUAL.**

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

**CONSULT WITH YOUR STATE LEAD PESTICIDE REGULATORY AGENCY TO DETERMINE REGULATORY STATUS, REQUIREMENTS, AND RESTRICTIONS FOR FUMIGATION USE IN THAT STATE. CALL DEGESCH AMERICA, INC. at (540) 234-9281/1-800-330-2525 IF YOU HAVE ANY QUESTIONS OR DO NOT UNDERSTAND ANY PART OF THIS LABEL.**

**APPLICATOR'S MANUAL**

FOR

**U-PHOS® Phosphine Fumigant**

Pure phosphine gas for use after blending with carbon dioxide or forced air in controlling pests in enclosed empty spaces and enclosed spaces, (including temperature-controlled spaces such as cold storage chambers), transport containers and other suitable fumigation spaces containing listed raw agricultural commodities, processed foods, stored tobacco, animal feeds, and non-food products. Not for use on barges. This product is the technical grade active ingredient phosphine and is intended for on-site blending with registered or food grade carbon dioxide for the production of a non-flammable fumigant gas. With special equipment, U-PHOS® Phosphine Fumigant may also be blended directly with forced air to a concentration that will be below 55% of the lower flammability limit (LFL) for phosphine. Never use the technical grade phosphine alone for fumigating structures or commodities because of danger of explosion and fire. Refer to the Applicator's Manual for a list of commodities and pests controlled and for Directions for Use.

<b>ACTIVE INGREDIENT:</b> PHOSPHINE GAS.....	99.35%
<b>INERT INGREDIENTS:</b> .....	0.65%
<b>Total:</b> .....	<b>100.00%</b>



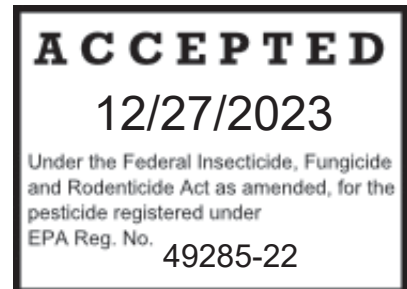
**KEEP OUT OF REACH OF CHILDREN  
DANGER - POISON - PELIGRO**



**Si Usted no entiende la etiqueta, busque a alguien para que se la explique a Usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)**

**Manufactured for:**

DEGESCH AMERICA, Inc.  
P. O. Box 116 - 153 Triangle Drive  
Weyers Cave, VA 24486 USA  
Telephone: (540) 234-9281/1-800-330-2525  
Internet: [www.degeschamerica.com](http://www.degeschamerica.com)  
E-mail: [degesch@degeschamerica.com](mailto:degesch@degeschamerica.com)  
EPA Est. No. \_\_\_\_\_  
EPA Reg. No. 40285-EE  
Contents: \_\_\_\_\_ lbs. (\_\_\_\_ kg)



**THE USE OF THIS PRODUCT IS STRICTLY PROHIBITED ON SINGLE AND MULTI-FAMILY RESIDENTIAL PROPERTIES AND NURSING HOMES, SCHOOLS, DAYCARE FACILITIES AND HOSPITALS.**

<b>FIRST AID</b>	
<b>If Inhaled:</b>	<ul style="list-style-type: none"><li>• Move person to fresh air.</li><li>• If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible.</li><li>• Call a poison control center or doctor for further treatment advice.</li></ul>
<b>If on Skin:</b>	<ul style="list-style-type: none"><li>• May cause frostbite to unprotected skin upon contact with dispensing equipment while gas is discharged rapidly.</li><li>• Take off contaminated clothing and allow clothes to aerate in ventilated room prior to laundering.</li><li>• Call a poison control center or doctor for treatment advice.</li></ul>
<b>If in Eyes:</b>	<ul style="list-style-type: none"><li>• Hold eye open and rinse slowly and gently with cool water for 15-20 minutes in case of freezing or cryogenic "burns". Do not rinse eyes with hot or even tepid water.</li><li>• Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.</li><li>• Call a poison control center or doctor for further treatment advice.</li><li>• Never introduce oil or ointment into eyes without medical advice.</li></ul>
<b>NOTES TO PHYSICIAN</b> Symptoms of exposure to this product are headache, dizziness, nausea, difficult breathing, vomiting, and diarrhea. In all cases of overexposure get medical attention immediately. Take victim to a doctor, hospital or emergency treatment facility. Refer to the <b>PRECAUTIONARY STATEMENTS</b> for the complete and detailed Notes to Physician pertaining to the treatment of exposure to phosphine fumigants.	
<b>HOTLINE NUMBER</b> Have the Applicator's Manual with you when calling a poison control center or doctor, or when going for treatment. <b>CONTACT 1-800-308-4856 FOR ASSISTANCE WITH HUMAN OR ANIMAL MEDICAL EMERGENCIES.</b> You may also contact DEGESCH AMERICA, INC. 540-234-9281/1-800-330-2525 or CHEMTREC 1-800-424-9300.	

**NO WARRANTIES**

TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, THE MANUFACTURER AND SELLER DISCLAIM ALL EXPRESS OR IMPLIED WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.

**EXCLUSION OF SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGE**

To the extent permitted by applicable law, in no case shall the Manufacturer or Seller be liable for any special, incidental, or consequential damages resulting from the use, handling, storage, or disposal of this product.

**LIMITATION OF REMEDY**

To the extent consistent with applicable law, the exclusive remedy for any claims, losses, injuries, or damages (including claims based on breach of warranty, breach of contract, and negligence) arising from the use, handling, storage, or disposal of the product shall be either the purchase price of the product, or at the election of the Manufacturer or Seller, replacement of the product.

{Note to EPA Reviewer: where the state allows, the following paragraph will be included.}

**GOVERNING LAW**

To the extent consistent with applicable law, this Applicator's Manual shall be interpreted and enforced in accordance with the laws of Delaware, without regard to any conflicts of law provisions or principles thereof to the contrary. In all court proceedings brought in connection with this Applicator's Manual, the parties consent to exclusive personal jurisdiction by, and venue in, any state or federal court located in or about Augusta County, Virginia. If any provision of this Applicator's Manual is determined to be invalid or unenforceable as written, the remaining provisions shall be interpreted as if such invalid or unenforceable provisions were not included herein.

**CONDITIONS OF SALE**

To the extent consistent with applicable law, the Manufacturer and Seller offer, and the Buyer accepts, this product subject to the foregoing terms. These terms may not be modified except by written agreement signed by an authorized representative of the Manufacturer. **IF THESE TERMS ARE UNACCEPTABLE, RETURN THE UNOPENED PRODUCT IMMEDIATELY FOR A REFUND OF THE PURCHASE PRICE.**

{Note to EPA Reviewer: Page numbers will be included according to final print.}

**TABLE OF CONTENTS**

<b>SECTION</b>	<b>DESCRIPTION</b>	<b>PAGE NUMBER</b>
Front Cover	Restriction and First Aid Statements	
Inside Cover	Warrant and Disclaimer Statements	
<b>I.</b>	<b>PRECAUTIONARY STATEMENTS</b>	
A.	HAZARDS TO HUMANS AND DOMESTIC ANIMALS	
B.	NOTE TO PHYSICIAN	
C.	ENVIRONMENTAL HAZARDS	
D.	PHYSICAL AND CHEMICAL HAZARDS	
<b>II.</b>	<b>INTRODUCTION</b>	
A.	PRODUCT DESCRIPTION	
B.	PRODUCT PACKAGING	
1.	Packaging	
2.	Blending Equipment for U-PHOS® Phosphine Fumigant and Carbon Dioxide	
3.	Blending Equipment for U-PHOS® Phosphine Fumigant and Forced Air	
C.	PHOSPHINE, AIR AND CARBON DIOXIDE	
1.	PHOSPHINE	
2.	FORCED AIR	
3.	CARBON DIOXIDE	
<b>III.</b>	<b>SAFETY REQUIREMENTS</b>	
A.	GENERAL	
B.	SECURING CYLINDERS	
C.	POISON GAS HAZARDS - LEAK DETECTION AND REPAIR	
1.	Blending Equipment	
2.	Storage Structures	
D.	COMPRESSED GAS HAZARDS	
1.	Gas Discharge	
2.	Temperature	
3.	Residual Pressure	
4.	Liquid Expansion	
<b>IV.</b>	<b>DIRECTIONS FOR USE</b>	
A.	GENERAL	
B.	PESTS CONTROLLED	
C.	USE PATTERN	
1.	Pests	
2.	Type of Fumigation	
3.	Use Sites	
D.	DOSAGE GUIDE	
E.	EXPOSURE GUIDELINES	
F.	SEALING	
G.	FUMIGATION MANAGEMENT PLANS	
H.	APPLICATION PROCEDURES	
1.	General Statement	
2.	Equipment Specification and Use	
3.	Application to Bulk Commodities	
4.	Application to Space Fumigations	
5.	Application to Tarpaulin Fumigations	
6.	Application to Transport Containers and Trailers	
7.	Application to Ships (not for use on barges)	
<b>V.</b>	<b>PERSONAL PROTECTIVE EQUIPMENT (PPE)</b>	
A.	GLOVES	
B.	SAFETY GLASSES	
C.	SAFETY SHOES	



- D. HAND TRUCKS.....
- E. RESPIRATORS.....
- F. NOTIFICATION REQUIREMENTS.....
  
- VI. PLACARDING OF FUMIGATED AREAS.....**
  
- VII. GAS DETECTION EQUIPMENT.....**
  
- VIII. AERATION OF FUMIGATED COMMODITIES.....**
  - A. FOODS AND FEEDS.....
  - B. NON-FOOD COMMODITIES.....
  - C. TOBACCO.....
  
- IX. APPLICATOR AND WORKER EXPOSURE.....**
  - A. PHOSPHINE EXPOSURE LIMITS.....
  - B. CARBON DIOXIDE EXPOSURE LIMITS (IF USED).....
  - C. APPLICATION OF FUMIGANT.....
  - D. LEAKAGE FROM FUMIGATED SITES.....
  - E. AERATION AND REENTRY.....
  - F. HANDLING UNAERATED COMMODITIES.....
  - G. INDUSTRIAL HYGIENE MONITORING.....
  - H. ENGINEERING CONTROLS AND WORK PRACTICES.....
  
- X. SAFE HANDLING OF COMPRESSED GASES IN CONTAINERS.....**
  
- XI. STORAGE OF CYLINDERS.....**
  - A. GENERAL.....
  - B. EMERGENCY RESPONSE PLAN.....
  - C. INDOOR STORAGE.....
  - D. OUTDOOR STORAGE.....
  - E. TEMPERATURE LIMITATIONS.....
  - F. SECURING CYLINDERS.....
  - G. LABELLING OF STORAGE.....
  
- XII. TRANSPORT.....**
  - A. GENERAL.....
  - B. TRANSPORT DESIGNATIONS.....
  - C. TRANSPORT REQUIREMENTS.....
    - 1. Package Preparation.....
    - 2. Cylinder Contents.....
    - 3. Documents.....
    - 4. Vehicle Loading.....
    - 5. Vehicle Markings.....
    - 6. Use of Common Carriers.....
    - 7. Driver Qualifications.....
  
- XIII. DISPOSAL.....**
  
- XIV. SPILL AND LEAK PROCEDURES.....**
  - A. GENERAL.....
  - B. WHAT TO DO.....
  - C. WHO TO CALL.....
  - D. EMERGENCY RESPONDERS.....

## **I. PRECAUTIONARY STATEMENTS**

### **A. HAZARDS TO HUMANS AND DOMESTIC ANIMALS**

#### **KEEP OUT OF REACH OF CHILDREN DANGER-POISON & PYROPHORIC**

Fatal if inhaled. The liquid may cause burns. Use in well-ventilated areas. Keep animals, children and unauthorized persons away from area under treatment until area is shown to be free from phosphine gas, as indicated by a gas-measuring device. Where the concentration of phosphine gas is unknown, a NIOSH approved self-contained breathing apparatus (SCBA) with full face piece and operated in pressure-demand mode must be used. See respirator requirements in Section V.E.

Do not get in eyes, in nose, on skin or on clothing. Do not breathe vapor. Do not eat, drink, or smoke while handling U-PHOS® Phosphine Fumigant. Phosphine gas may deaden the sense of smell. Do not depend solely on the odor to detect U-PHOS® Phosphine Fumigant. Observe proper application, aeration, and reentry procedures specified in the Applicator's Manual (IX. APPLICATOR AND WORKER EXPOSURE) to prevent overexposure.

#### **EXPOSURE TO CONCENTRATIONS ABOVE PERMISSIBLE LEVELS MAY CAUSE POISONING OR DEATH.**

### **B. NOTE TO PHYSICIAN**

Mild exposure by inhalation causes malaise (indefinite feeling of sickness), ringing of ears, fatigue, nausea and pressure in the chest, which is relieved by removal to fresh air. Moderate poisoning causes weakness, vomiting, epigastric pain (pain just above the stomach), chest pain, diarrhea and dyspnea (difficulty in breathing). Symptoms of severe poisoning may occur within a few hours or up to several days, resulting in pulmonary edema (fluid in lungs) and may lead to dizziness, cyanosis (blue or purple skin color), unconsciousness and death.

In sufficient quantity, phosphine affects the liver, kidneys, lungs, nervous system, and circulatory system. Inhalation can cause lung edema (fluid in lungs) and hyperemia (excess of blood in a body part), small perivascular brain hemorrhages and brain edema (fluid in brain). Phosphine poisoning may result in (1) pulmonary edema, elevated MB-creatinine phosphokinase fraction of cardiac enzymes, cardiac dysrhythmia, (2) elevated serum GOT, LDH and alkaline phosphatase, reduced prothrombin, hemorrhage and jaundice (yellow skin color) and (3) hematuria (blood in urine) and anuria (abnormal or lack of urination). Pathology is characteristic of hypoxia (oxygen deficiency in body tissue). Frequent exposure over a period of days or weeks may cause poisoning. Treatment is symptomatic.

The following measures are suggested for use by the physicians 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 make their appearance), the following is suggested:
  - a. Complete rest for 1-2 days during which the patient must be kept quiet and warm.
  - b. Should the patient suffer from vomiting or increased blood sugar, appropriate solutions must be administered. Treatment with oxygen is recommended, as is the administration of cardiac and circulatory stimulants.
4. In case of severe poisoning (intensive care unit recommended):
  - a. Where pulmonary edema is observed, steroid therapy must be considered and close medical supervision is recommended. Blood transfusions may be necessary.
  - b. In case of manifest pulmonary edema, venesection should be performed under vein pressure control. Heart glycosides (I.V.) can be used in case of hemoconcentration. Venesection may result in shock.
  - c. In case of progressive edema of lungs, immediately intubate and remove edema fluid and administer oxygen over-pressure respiration, as well as any measures required for shock treatment.
  - d. In case of kidney failure, extracorporeal hemodialysis is necessary. There is no specific antidote known for this poisoning.

### **C. ENVIRONMENTAL HAZARDS**

Phosphine gas is highly toxic to fish and wildlife. Non-target organisms exposed to phosphine gas will be killed.

### **D. PHYSICAL AND CHEMICAL HAZARDS**

Never allow the buildup of phosphine to exceed explosive concentrations. Phosphine may ignite spontaneously at levels above its Lower Flammability Limit (LFL) of 1.8% v/v (18,000 ppm) in air. It is important not to exceed this concentration. U-PHOS® Phosphine Fumigant must be blended with carbon dioxide (CO<sub>2</sub>) or forced air on site using special equipment either specific for carbon dioxide or specific for forced air, to produce a non-flammable mixture. When phosphine is blended with carbon dioxide, the LFL is raised to 3% v/v (30,000 ppm). When U-PHOS® Phosphine Fumigant is blended directly with forced air, the concentration of phosphine in the air mixture must be below 10,000 ppm (1% v/v) which is 55% of the LFL.

Ignition of high concentrations 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 flammable concentrations.** Degesch-approved U-PHOS® Phosphine Fumigant/Air blending equipment has been designed to safely blend phosphine in air.

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

Never open cylinder in a confined space without an SCBA (see PPE Section V.E.) with full face piece operated in pressure-demand mode. Never enter a space under fumigation with U-PHOS® Phosphine Fumigant without first checking the gas concentration levels and wearing the appropriate breathing apparatus. 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 must 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., must not be exposed. Do not introduce phosphine-CO<sub>2</sub> or phosphine-air mixtures into vacuum chambers.

## **II. INTRODUCTION**

### **A. PRODUCT DESCRIPTION**

U-PHOS® Phosphine Fumigant is a cylinderized source of phosphine gas and is packaged in high-pressure gas cylinders. U-PHOS® Phosphine Fumigant cylinders contain 99.35% wt. phosphine as liquefied gas under pressure. Phosphine is pyrophoric and will spontaneously ignite in air. With the use of proper equipment, U-PHOS® Phosphine Fumigant can be safely blended with carbon dioxide to less than 3% v/v (30,000 ppm of phosphine) or forced air (10,000 ppm of phosphine) to eliminate the flammability hazard.

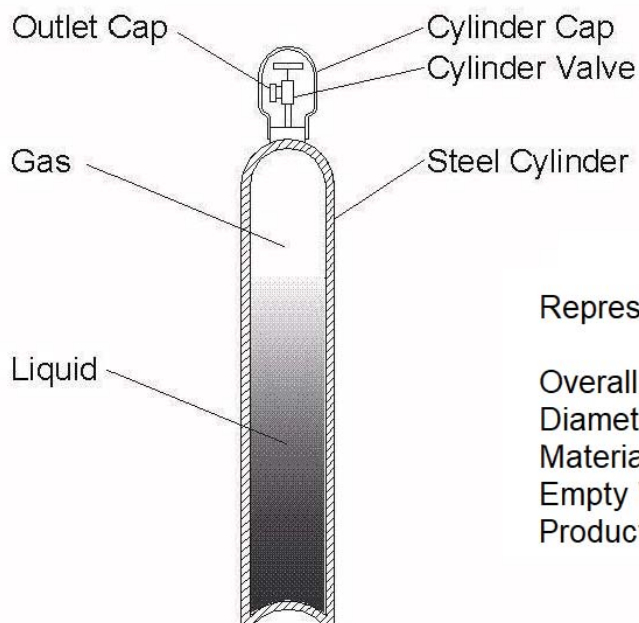
Phosphine, under sufficient pressure, can exist in a liquid state. It is this “liquefied gas” that is stored in the cylinder. The product is dispensed as a gas from the cylinder and blended with carbon dioxide or forced air. The on-site blending of U-PHOS® Phosphine Fumigant and CO<sub>2</sub> or forced air greatly reduces the number of cylinders that are required. 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.

### **B. PRODUCT PACKAGING**

#### **1. Packaging**

U-PHOS® Phosphine Fumigant is packaged in a steel compressed gas cylinder, designed, manufactured, maintained and filled in compliance with regulations established by the United States Department of Transportation (DOT).

**Diagram of Representative Cylinder****Representative Package**

Overall Height	60 inches (1.52 m)
Diameter	9.25 inches (23.5 cm)
Material	Steel
Empty Weight	136 pounds (61.7 kg)
Product Weight	37.5 pounds (17.0 kg)

The product flows to the blending equipment through the cylinder outlet valve. As gas is withdrawn from the cylinder, some of the product vaporizes to fill the remaining space in the cylinder. Through this vaporization, the cylinder pressure is maintained.

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 DEGESCH provided (or approved) blending equipment to the cylinder valve outlet to dispense U-PHOS® Phosphine Fumigant gas the time of fumigation. Use of any other blending 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 U-PHOS® Phosphine Fumigant is a poisonous gas, Hazard Class A, DOT 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 a U-PHOS® Phosphine Fumigant gas cylinder without the valve outlet cap and the cylinder cap securely in place.

U-PHOS® Phosphine Fumigant gas cylinders can only be refilled through authorized distributors. They can be filled countless times within a five-year period. Every five years, however, the cylinder is required by law to be tested by a qualified facility.

**2. Blending Equipment for U-PHOS® Phosphine Fumigant and Carbon Dioxide**

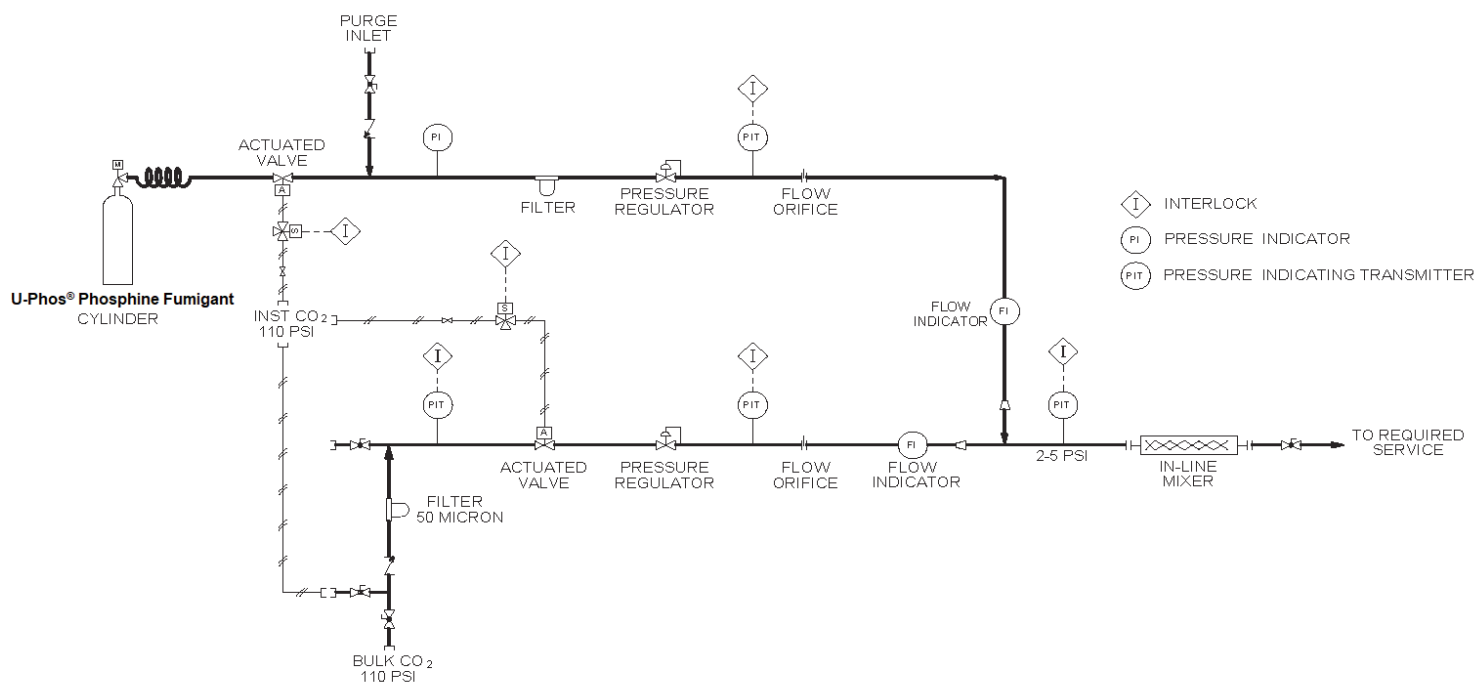
Phosphine gas (U-PHOS® Phosphine Fumigant) from high pressure cylinders flows into the blender unit where it combines with carbon dioxide gas sourced from bulk storage, mobile bulk truck, semi-bulk or cylinders. Various models of on-site blending equipment have been designed, built and tested. All of the designs have incorporated engineering safeguards to ensure that the blended product is a non-flammable mixture.

One design (see diagram below) uses a pressure regulator and flow control orifice on both the U-PHOS® Phosphine Fumigant and CO<sub>2</sub> gases to control the flow rate and properly blend U-PHOS® Phosphine Fumigant with carbon dioxide. The size of each orifice is engineered for a specific fixed flow rate and therefore, the blending rate cannot be adjusted. By controlling the pressure drop across the orifice plates, the phosphine concentration can be controlled around 2.5% v/v.

A more sophisticated design uses mass meters, control valves and the electronics to allow an adjustable blending rate while maintaining the proper blend of Phosphine. Engineering controls have been designed into the blending units that will prevent the phosphine concentration from going outside the range of 2.0 - 2.9% vol. (1.6 - 2.2% wt.). Mass meters are employed in the design, therefore, the concentration can be precisely controlled to 2.5% v/v (1.9% wt.).

Blending equipment is intended for use at large facilities that have on-site CO<sub>2</sub> bulk storage and vaporizing equipment, or at facilities where it is feasible to bring in bulk CO<sub>2</sub> and vaporizing equipment for the fumigation. The blending equipment is designed for use only with carbon dioxide gas, therefore, a bulk supply of liquid CO<sub>2</sub> must be equipped with suitable vaporizing equipment. Contact DEGESCH AMERICA, INC., Telephone: 540-234-9281/1-800-330-2525 for blending equipment design specifications and recommendations.

### Diagram of a Representative Type of U-PHOS® Phosphine Fumigant and Carbon Dioxide Blending Equipment



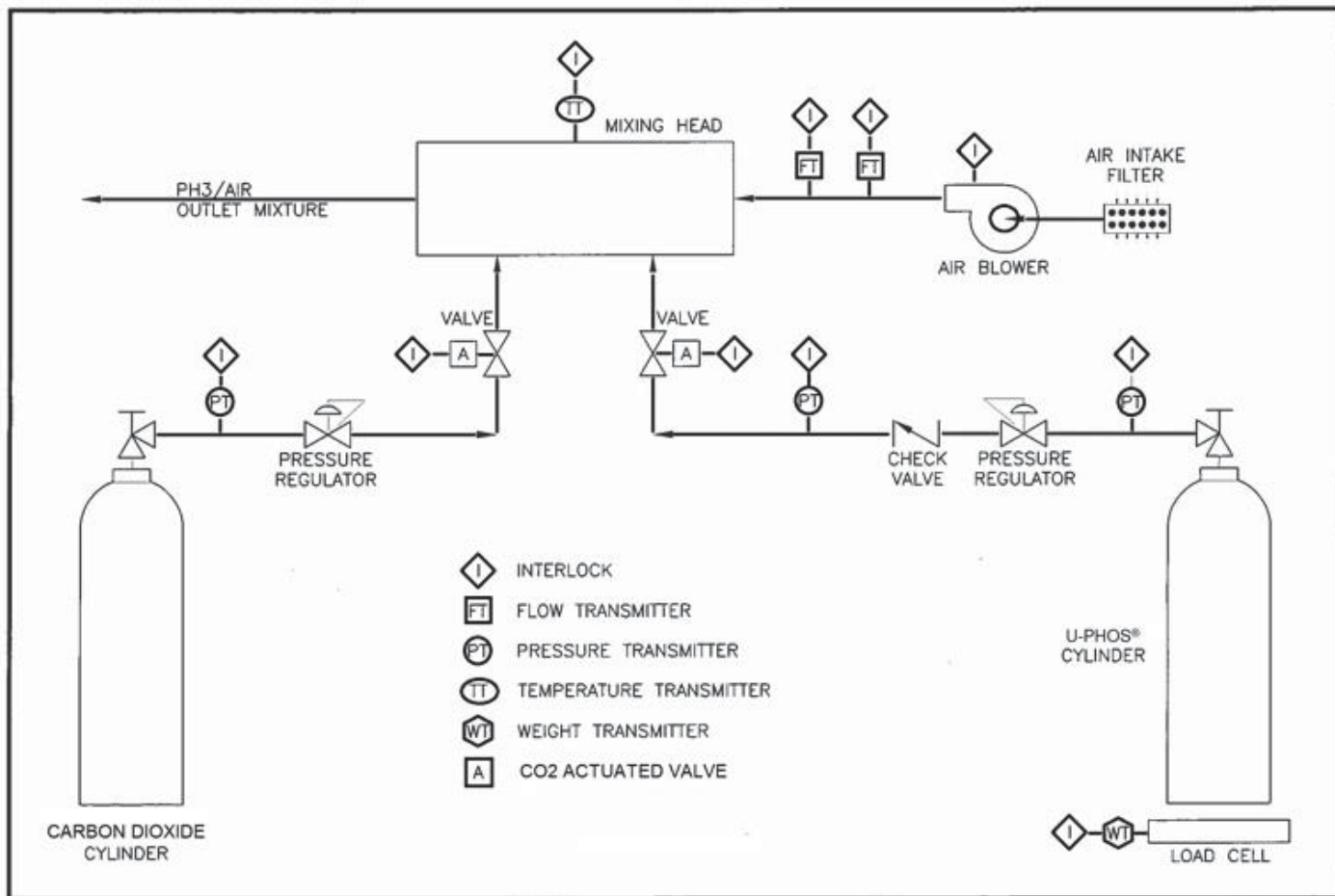
### 3. Blending Equipment for U-PHOS® Phosphine Fumigant and Forced Air

Phosphine gas (U-PHOS® Phosphine Fumigant) can ignite spontaneously in air if the concentration is greater than 1.8% v/v (18,000 ppm). With specialized equipment, pure phosphine can be safely blended with a forced air stream to ensure the final concentration does not exceed 10,000 ppm (55% of the Lower Flammability Limit of 18,000 ppm). The equipment has incorporated engineering safeguards to ensure this concentration is never exceeded.

Various models of phosphine/forced air blending equipment have been designed, built, and tested. One design (see diagram below) uses inert gas (nitrogen or CO<sub>2</sub>) to pre-purge the phosphine lines and equipment. Once purged, phosphine flows through a pressure regulator and flow controller to the mixing point. Here phosphine is safely blended into the forced air stream. The forced air can be supplied by various types of fans, blowers or compressors. The flow of air is measured and the flow of phosphine will stop if the air flow is insufficient. Post purging of the phosphine lines and equipment is also automatic if the phosphine flow is stopped for any reason.



### Diagram of a Representative Type of U-PHOS® Phosphine Fumigant and Forced Air Blending Equipment



## C. PHOSPHINE, AIR AND CARBON DIOXIDE

### 1. PHOSPHINE

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

Phosphine may ignite spontaneously at levels above its LFL of 1.8% v/v (18,000 ppm) in air. 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.

For worker safety, monitoring for phosphine is required and suitable breathing apparatus must be used when working in a phosphine environment that exceeds permitted exposure levels. Sometimes phosphine may have an odor due to the presence of impurities in the product; however, this odor cannot always be relied upon as an adequate indicator of phosphine exposure.

U-PHOS® Phosphine Fumigant *does not have an expiration date*. Contact DEGESCH AMERICA, INC. Telephone: 540-234-9281/1-800-330-2525 for any questions.

### 2. FORCED AIR

U-PHOS® Phosphine Fumigant may be blended with ambient forced air. Degesch America, Inc. supplied (or approved) blending equipment is necessary to ensure phosphine is safely blended with



forced air and will not exceed 55% of the LFL.

### 3. CARBON DIOXIDE

Any registered or food grade source of carbon dioxide may be used with U-PHOS® Phosphine Fumigant. Carbon dioxide is a colorless, non-flammable gas, which, at high concentrations or prolonged exposure, is toxic. For worker safety, the monitoring for carbon dioxide gas is required and suitable breathing apparatus used. Carbon dioxide gas is an asphyxiant. Concentrations of 10% or more can produce unconsciousness or death in 1 minutes or less.

U-PHOS® Phosphine Fumigant can be blended only with registered or food grade carbon dioxide products. Degesch America, Inc. supplied (or approved) blending equipment is necessary to ensure phosphine is safely blended with carbon dioxide. Follow all label directions for the most restrictive of label limitations and precautions. Consult the carbon dioxide product label for appropriate use, storage and disposal instructions and restrictions.

**Never allow the buildup of phosphine to exceed explosive concentrations.** When phosphine is blended with carbon dioxide the LFL is raised to 3% v/v.

## III. SAFETY REQUIREMENTS

***U-PHOS® Phosphine Fumigant is a restricted use product for retail sale and use only by certified applicators and people under their direct supervision.***

### A. GENERAL

1. Carefully read the container label and Applicator's Manual and follow instructions explicitly.
2. Never work alone when applying fumigant from within the storage structure (if re-entry is required) or when aerating commodities after the fumigation is over.
3. Never allow untrained personnel to handle U-PHOS® Phosphine Fumigant.
4. The use of respiratory protection may be required as described in Section V.E. of this manual.
5. Post U-PHOS® Phosphine Fumigant fumigation placards on fumigated areas, including all entrances/exits. See Section VI for specific wording that must appear on these placards. Ensure that no personnel are inside any of the structures to be fumigated prior to initiating fumigation.
6. Notify appropriate owners, employees, and/or operators at the facility each time prior to initiating fumigation and provide relevant safety, health, and environmental information to local fire and rescue officials annually for use in the event of an emergency.
7. Workers exposure to phosphine must not exceed the 8-hour Time-Weighted Average (TWA) of 0.3 ppm during application or a maximum concentration of 0.3 ppm after application is completed. This includes re-entry into a structure.
8. Workers 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.
9. Workers required to use SCBA must be assessed for impaired pulmonary function prior to initial use and at least annually thereafter. Any employees found to have impaired pulmonary function must be referred for medical attention.
10. Protect or remove materials containing metals such as copper, silver, gold and their alloys and salts from corrosive exposure to phosphine.
11. Do not connect cylinders to blending equipment until all fumigation notice placards have been posted and the space to be fumigated is clear and secured.
12. Wear protective clothing as described in Section V. Respiratory protection requirements are also discussed in Section V.
13. The perimeter of the fumigation area, especially downwind, must be monitored to ensure that phosphine and carbon dioxide concentrations are kept within acceptable levels outside the fumigation area. Large leaks must be repaired to minimize loss of fumigant and reduce risk of exposure to bystanders and/or occupants of nearby buildings.
14. Special instructions are provided in Section IV.H.8 to establish buffer zones during fumigation and aeration of cold storage fumigations to ensure worker and bystander safety during rapid aeration of chambers containing fresh commodities.

### 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 U-PHOS® Phosphine Fumigant is a poisonous gas, care must be taken to avoid exposure to levels above 0.3 ppm phosphine. Appropriate procedures must be followed to detect and repair leaks in blending equipment and structures. These are discussed below. Also, see Section XIV. of this manual, “SPILL AND LEAK PROCEDURES”.

### **1. Blending Equipment**

Use only DEGESCH provided (or approved) blending equipment, use of any other blending equipment is prohibited. Although the blending equipment is designed to contain the gas, small leaks can occur. A phosphine detector must be used from the beginning until the end of each application to check the integrity of the equipment and any leaks must be corrected immediately. Carbon dioxide or nitrogen must be used to pressurize and leak-check equipment with soap solution prior to use in the field.

**If any leak is encountered while using U-PHOS® Phosphine Fumigant clear the immediate area of all personnel.**

Where the concentration of phosphine is unknown, only persons who are wearing a NIOSH-approved self-contained breathing apparatus (SCBA) with full face piece and operated in pressure-demand mode or its equivalent are permitted in the area to address the leak. 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 has dropped below the eight-hour TWA of 0.3 ppm or the Short Term Exposure Level (STEL) of 1 ppm for 15 minutes, or the carbon dioxide concentration is less than the TWA of 5,000 ppm or the STEL of 30,000 ppm, are unprotected personnel permitted to enter.

If a cylinder leak is detected, refer to equipment troubleshooting in Section IV. H.2.e. (Directions for Use (IV)-Application Procedures (H)-Equipment Specification and Use (2-Troubleshooting (e)-Leak in cylinder valve outlet) of this manual for guidance on troubleshooting. Further troubleshooting assistance for a particular piece of blending equipment is addressed in the respective equipment manual.

### **2. Storage Structures**

To reduce the potential for leakage, careful attention must 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 fumigation area, especially downwind and in adjacent or nearby buildings, must be monitored to ensure that phosphine and carbon dioxide (if applicable) concentrations are kept within acceptable levels outside the fumigation area. This involves walking around the structure with a personal monitoring device to determine whether excessive amounts of fumigant are escaping.

If a high level of phosphine is detected outside the fumigation area, the addition of fumigant must be stopped. Large leaks must be repaired to minimize loss of fumigant and prevent exposure to bystanders and/or occupants of nearby buildings. Appropriate personal protective equipment must be worn when sealing leaks. 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 (for details, see IV.A.2. and 3. under Directions for Use and IX.E. under Aeration and Re-Entry) including wearing a NIOSH-approved respirator operated in pressure-demand mode (refer to PPE Section V.E.).

## **D. COMPRESSED GAS HAZARDS**

U-PHOS® Phosphine Fumigant cylinders and blending equipment can achieve pressures of over 1000 pounds per square inch. 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 a 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 U-PHOS® Phosphine Fumigant through blending 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 if touched by unprotected skin. 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 boiling to maintain the pressure in the gas space of the cylinder.

When the cylinder is allowed to warm, the pressure in the cylinder may 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 blending equipment.

Prior to the dismantling of U-PHOS® Phosphine Fumigant blending equipment at the conclusion of fumigation, all residual gas in the equipment must be vented to atmospheric pressure. 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 and purged.

## 4. Liquid Expansion

U-PHOS® Phosphine Fumigant blending equipment is only designed to blend gas. Never invert the cylinder or lay the cylinder down when dispensing the gas. This may result in liquid product flowing into the blending equipment. Always ensure the cylinder is secured in an upright position.

# IV. DIRECTIONS FOR USE

## A. GENERAL

1. It is a violation of federal law to use this product in a manner inconsistent with its labeling. U-PHOS® Phosphine Fumigant is a Restricted Use Pesticide due to the acute inhalation toxicity of phosphine, PH<sub>3</sub> gas. For retail sale to and use by Certified Applicators only. For use by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification. Refer to directions in this applicator's manual for requirements of the physical presence of a Certified Applicator. Before using, read and follow the label precautions, restrictions and directions on the label, which includes the container label and the U-PHOS® Phosphine Fumigant Applicator's Manual. Additional copies of this manual are available from: DEGESCH AMERICA, INC., Telephone: 540-234-9281/1-800-330-2525.
2. Requirements for Certified Applicator to be present and responsible for all workers:
  - a. A Certified Applicator must be physically present, responsible for, and maintain visual and/or voice contact with all fumigation workers during the application of the fumigant. Once the application is complete and the structure has been made secure the certified applicator does not need to be physically present on the site.
  - b. A Certified Applicator must be physically present, responsible for, and maintain visual and/or voice contact with all fumigation workers during the initial opening of the fumigation structure for aeration. Once the aeration process is secured and monitoring has been established that aeration can be completed safely the certified applicator does not need to be physically present and trained person(s) can complete the process and remove the placards.
  - c. Persons with documented training in the handling of phosphine products must be responsible for receiving, aerating and removal of placards from vehicles, transport containers and trailers that have been fumigated in-transit.
3. Requirements for Re-entry Following Fumigation:

If the structure is to be entered after fumigation, it must be aerated until the level of phosphine gas is 0.3 ppm or below. The structure or site must be monitored to ensure that liberation of gas from the treated commodity does not result in the development of unacceptable levels (i.e., over industrial hygiene levels of phosphine). Do not allow re-entry into treated structures by any person before the level of phosphine reaches 0.3 ppm or below unless protected by an approved respirator (refer to PPE Section V.E.).

4. Preparation and Notification Requirements for Fumigation Sites:  
Prior to applying this product, the storage structure must be inspected to determine if it can be made sufficiently gas tight. The storage structure must be sealed so as to maintain a suitable gas concentration over the time period required for control of insects. Personal exposure monitoring must be conducted by use of personal electronic monitors or low level detection tubes, as appropriate. 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. For additional information consult the manufacturer and training manual about safe and effective use of U-PHOS® Phosphine Fumigant. Contact DEGESCH AMERICA, INC., Telephone: 540-234-9281/1-800-330-2525.
5. Do not apply U-PHOS® Phosphine Fumigant in vacuum chambers.
6. Protect or remove copper, silver, gold and their alloys from corrosive exposure to phosphine.

**B. PESTS CONTROLLED**

Complete control of listed pests may not always be achieved. Factors contributing to less than 100% control include gas leakage, poor gas distribution, unfavorable exposure conditions, etc. Improperly sealed structures may allow pests (especially rodents and other vertebrates) to escape. In addition, some insects are less susceptible to phosphine than others. To maximize control, extreme care must be observed in sealing, higher dosages up to the maximum labeled dose must be used, exposure periods must be lengthened, proper application procedures must be followed, and temperature and humidity must be favorable.

**C. USE PATTERN**

**1. Pests**

U-PHOS® Phosphine Fumigant will control the following pests:

**a. Insects, specifically**

Almond Moth	Bees	Light Brown Apple Moth
Asian Citrus Psyllid	Angoumois Grain Moth	Brown Marmorated Stink Bug
Cadelle	Bean Weevil	Carob Moth
Carpet Beetle**	California Red Scale	Cigarette Beetle
Codling Moth	Cereal Leaf Beetle	Dermeid Beetle
Dried Fruit Beetle	Confused Flour Beetle	Eulia
European Grain Moth	Dried Fruit Moth	Flat Grain Beetle
Fruit Flies (e.g., Mediterranean, Oriental, Melon, Caribbean, Spotted Wing, Western Cherry)	European Grapevine Moth	Fuller Rose Beetle
Fruit Tree Weevil	Granary Weevil	Grape Mealybug
Greater Wax Moth	Hairy Fungus Beetle	Hessian Fly
Khapra Beetle	Indian Meal Moth	Leafminer
Lesser Grain Borer	Maize Weevil	Mealybugs
Mediterranean Flour Moth	Mites (California, Citrus, Pacific, Spider, False Chilean)	Navel Orangeworm
Pea Weevil	Pink Bollworm	Raisin Moth
Red Flour Beetle	Rice Weevil	Rusty Grain Beetle
Saw-toothed Grain Beetle	Spider Beetles	Thrips (e.g., Western flower)
Tobacco Moth	Warehouse Beetle**	Yellow Meal Worm
**Non-residential use sites such as warehouses, bulk storages, flour/feed mills, Processing plants.		

**b. Rodents and other vertebrate pests. Not for use in burrows.**

**c. Wood pests (specifically the pine wood nematode and other wood-infesting nematodes and beetles)**

Non-residential use only. For use on wood, cut trees, wood chips and wood and bamboo products stored in bins, flat storage bunkers, mills, warehouses, stacked under tarpaulin and in containers or ship holds.

**2. Type of Fumigation**

- a. Space:** tarp, mill, warehouse, food plant, packaging facility, temperature-controlled storage

structures suitable for fumigation.

**b. Transport Vehicle:** railcar, truck, van, container, refrigerated container for railcars or trucks.

**c. Storage:** vertical silo, farm storage, flat storage, cold temperature storage spaces.

**d. Vessels or ships (not for use on barges) refrigerated containers.**

### 3. Use Sites

The following can be fumigated with U-PHOS® Phosphine Fumigant:

#### a. Terrestrial food and feed crop use:

##### Fresh Commodities:

- |                               |   |                |
|-------------------------------|---|----------------|
| ○ Alfalfa                     | ○ Kumquat                                       | ○ Pepper       |
| ○ Avocado                     | ○ Legume Vegetables (Succulent, except Soybean) | ○ Persimmon    |
| ○ Banana (includes Plantains) | ○ Lemon   | ○ Pimento      |
| ○ Cabbage (Chinese)           | ○ Lettuce                                       | ○ Salsify Tops |
| ○ Citrus Citron               | ○ Lime  | ○ Sweet Potato |
| ○ Dill                        | ○ Mango   | ○ Tangelo      |
| ○ Eggplant                    | ○ Okra  | ○ Tangerine    |
| ○ Endive                      | ○ Orange  | ○ Tomato       |
| ○ Grapefruit                  | ○ Papaya  |                |

##### Other Raw Commodities:

- |                |                             |                   |
|----------------|-----------------------------|-------------------|
| ○ Almonds      | ○ Flower Seed               | ○ Rye             |
| ○ Barley       | ○ Grass Seed                | ○ Safflower Seed  |
| ○ Brazil Nuts  | ○ Legume Vegetables (Dried) | ○ Sesame Seeds    |
| ○ Cashews      | ○ Millet                    | ○ Sorghum         |
| ○ Cocoa Beans  | ○ Oats                      | ○ Soybeans        |
| ○ Coffee Beans | ○ Peanuts                   | ○ Sunflower Seeds |
| ○ Corn         | ○ Pecans                    | ○ Triticale       |
| ○ Cottonseed   | ○ Pistachio Nuts            | ○ Vegetable Seeds |
| ○ Dates        | ○ Popcorn                   | ○ Walnuts         |
| ○ Filberts     | ○ Rice                      | ○ Wheat           |

#### b. Processed foods and food crop use:

Processed foods that may be fumigated with U-PHOS® Phosphine Fumigant:

- 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 citrus, 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)
- 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)
- Wild rice

#### c. Animal Feed and Feed Ingredients

All animal feed and feed ingredients.



**d. Fumigation under cold storage for fresh commodities and processed foods:**

- Refer to the commodities listed under sections 2a and 2b listed above.

**e. Terrestrial non-food crop use:**

- Tobacco
- Fresh or dried plants and flowers (non-food)
- Bulbs, tubers, corms and rhizomes (ornamentals, non-food use)
- Seeds (grass seeds and ornamental herbaceous plant seeds)

**f. Terrestrial non-food indoor for fumigation of non-food commodities:****Commodities:**

- Animal hides; leather products
- Processed or unprocessed cotton, wool, or other natural fibers, cloth or clothing
- Feathers, furs, human hair, rubberized hair, vulcanized hair, mohair
- Wood, cut trees, wood chips and wood and bamboo products
- Dunnage
- Tires
- Paper and paper products
- Non-food flour (used in non-food coatings, sizings, etc.)
- Non-food starch (used in non-food coatings, sizings, etc.)
- Straw or hay
- Psyllium seed and psyllium seed husks\*\*

**g. Terrestrial non-food commodities kept refrigerated or in cold storage:**

- Refer to the commodities listed under sections **f** and **g** listed above.

\*\*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****1. AMBIENT TEMPERATURE FUMIGATIONS**

ALLOWABLE PHOSPHINE DOSAGES FOR U-PHOS® PHOSPHINE FUMIGANT<sup>1,2</sup> FOR COMMODITIES LISTED IN IV.C.2.a.ii AND IV.c.2.b, c and d.

Temperature	Phosphine Concentration Maintained (ppm)/1,000 cubic feet		
	Minimum	Maximum	Minimum Duration
Below 32°F (0°C)	Do not fumigate		
32-39°F (0-4°C)	200 ppm	3,625 ppm	6 days
40-53°F (5-12°C)	200 ppm	3,625 ppm	4 days <sup>3</sup>
54-59°F (12-15°C)	200 ppm	3,625 ppm	3 days
60-79°F (16-25°C)	200 ppm	3,625 ppm	2 days
80°F & Above (≥26° C)	500 ppm	3,625 ppm	24 - 36 hours

**Restriction:** After introduction and stabilization, the maximum concentration of phosphine maintained during fumigation must not exceed 2,500 ppm for fresh commodities, or 3,625 ppm for all other commodities.

<sup>1</sup>For other calculations, refer to Section IV.H.2.d.

<sup>2</sup>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. For best results, fumigate with a dose of 750 – 1,000 ppm phosphine for 10 days. Higher concentrations within the dosage range are recommended to counter the solubility of phosphine in water or moisture present in the wood or wood product. If fumigating for quarantine purposes, check with the receiving country concerning accepted fumigation methods for the specific product being fumigated.

<sup>3</sup>U-PHOS® Phosphine Fumigant can be used on cocoa beans to control all stages of those moth species (including Indian Meal Moth) that commonly infest cocoa beans in a 24-hour exposure time with 500 – 1,000 ppm phosphine at a temperature of 40°F or higher.



Rodents and other vertebrate pests in storages may be controlled with short-term fumigations within 1 to 4 hours with low levels of phosphine (200 ppm) after achieving distribution of phosphine throughout the structure. *Not for use in burrows.*

Although it is permissible to use the maximum allowable dosage of 3,625 ppm for food/feed and non-food commodities (excluding fresh commodities), the following table lists a range of dosages that can be used as a guideline for various types of fumigations.

Commodity	Phosphine Dosage Range
Food/Feed Commodities in bulk storage	500 – 3,625 ppm
Packaged Commodities	500 – 2,250 ppm
Stored Tobacco	200 – 1,250 ppm
Non-food products	500 – 2,250 ppm
Nuts, dates or dried fruit in bulk or storage boxes	250 – 1,000 ppm
Space fumigations	200 – 1,500 ppm

Use higher rates (not to exceed the maximum dosage rate of 3,625 ppm) under conditions of severe infestation, lower temperature and other application variables.

## 2. FUMIGATION UNDER COLD STORAGE

ALLOW PHOSPHINE DOSAGE FOR U-PHOS® PHOSPHINE FUMIGANT FOR FRESH COMODITIES LISTED IN SECTION IV.C.2.a i AND PROCESSED FOODS AND NON-FOOD COMMODITIES LISTED IN IV.C.2.b and d KEPT REFRIGERATED OR IN COLD STORAGE

Temperature	Phosphine Concentration Maintained/1,000 Cubic Feet of Area	Duration
28°F - 43°F (-2°C to 6°C)	1,000 – 2,500 ppm <sup>1</sup>	24-72 hours
>43°F (≥6°C)	750 – 2,500 ppm <sup>1</sup>	24-48 hours

<sup>1</sup>For control of False Chilean Mites in cold storage, fumigate with >300 ppm at 28°F to 43°F (-2° to 6°C) for >9 days.

Specific directions for cold storage fumigations are provided in Section IV.H.8.

## E. DOSAGE INFORMATION

Do not exceed the maximum allowable rate. Use the “Allowable Dosages” table to determine 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, center of grain mass, etc.). The applicator must measure the temperature in the space or the stored commodity next to the pest insect and use the maximum dosage table in Section III.D.1. for ambient temperature fumigations or Section III.D.2 for cold storage fumigations to determine the minimum duration of exposure needed. For example, if the commodity temperature for a cold storage fumigation is greater than 43°F (>6°C) then a dose of 750 – 2,500 ppm must be maintained for 24-48 hours.

Some insect species and life stages are harder to kill than others. It is important that target pest(s) are known and understood. For example, eggs of certain pests or overwintering dormant larva may be more difficult to kill than an active larva or other life stages of the same species. For ambient fumigations, use of the maximum duration and concentration of phosphine is recommended when possible. A dosage of up to 3,625 ppm phosphine can be used when necessary (excluding use on fresh commodities) to prevent or control tolerant or resistant insect strains and reduce future potential for resistance. Insects, in general, are more difficult to control at lower temperatures because of factors such as slower respiration and slower diffusion of the fumigant into the space and commodity.

Short treatment times are effective at high temperatures (80°F and above). At these higher temperatures a treatment time of one day is sufficient to kill most storage pests, however, two days may be needed to destroy 100% of the eggs of some storage pests (e.g., *Amyelois transitella*, *Tribolium* spp., and *Trogoderma variabile*). Knowing the pest and life stage to control is critical to determining the dose and treatment needed.

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 60 degrees F) due to the lower activity and respiration levels of insects.

For both ambient and cold storage fumigations, fumigators also must be aware that different types of packaging will influence the penetration rate of the gas. Selection of appropriate exposure times must be considered accordingly.

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

When used for quarantine/regulatory purposes of listed commodities, consult the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) Plant Protection and Quarantine (PPQ) Treatment Manual for more detailed guidance and information on treatment conditions, dosage rates, treatment periods, monitoring requirements, etc. Additional requirements may be imposed by the USDA/APHIS Manual, official government correspondence or documents, or the supervising regulatory agent at the fumigation.

## **F. SEALING**

Good sealing is necessary for an effective fumigation. Turn off all ventilation, supply air, and any other air moving systems which could negatively affect the fumigation. Thoroughly inspect the fumigation chamber/structure 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 fumigated structure and will decrease the chance of unwanted exposure outside of the fumigated structure.

As with all fumigations, perimeter monitoring for leaks and potential exposures is required. If phosphine above 0.3 ppm is found in an area where exposure to workers or bystanders may occur, 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 a NIOSH-approved respirator operated in pressure-demand mode (refer to PPE Section V.E.), 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 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.

Phosphine gas is highly mobile and given enough time may penetrate seemingly gas-tight materials such as concrete and cinder block. Therefore, adjacent enclosed areas likely to be occupied must be examined to ensure that significant leakage has not occurred. Sealing of the fumigated site and/or airflow in the occupied areas must be sufficient to bring down the phosphine concentration to a safe level of 0.3 ppm or below.

**DO NOT FUMIGATE A STRUCTURE THAT CANNOT BE SEALED SUFFICIENTLY GAS TIGHT.**

## **G. REQUIRED WRITTEN FUMIGATION MANAGEMENT PLAN**

The certified applicator is responsible for working with the owners and/or responsible employees of the structure and/or area to be fumigated to develop and follow a written Fumigation Management Plan (FMP). State, county and local authorities may also have specific requirements. The FMP must be written **PRIOR TO EVERY TREATMENT**. The FMP is intended to ensure a safe and effective fumigation. The FMP must address characterization of the site, and include appropriate monitoring and notification requirements, consistent with, but not limited to, the following:

1. The use of this product is strictly prohibited on single and multi-family residential properties, nursing homes, schools, day-care facilities and hospitals.
2. Inspect the structure and/or area to determine its suitability for fumigation.
3. When sealing is required, consult previous records for any changes to the structure, seal leaks, and monitor any occupied adjacent buildings to ensure safety.
4. Prior to each fumigation, review any existing FMP, SDS, Applicator's 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 develop an appropriate monitoring plan that will confirm that nearby workers and bystanders are not exposed to levels above the allowed limits during application, fumigation and aeration. This plan must also 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 or access into any area under fumigation.
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.

These factors **must** be considered in putting a FMP together. It is important to note that some plans will be more comprehensive than others. All plans must reflect the experience and expertise of the applicator and circumstances at and around the structure and/or area.

In addition to the plan, the applicator must read the entire label, which includes the container label and the Applicator's Manual and follow their directions carefully, and abide by all restrictions. If the applicator has any questions about the development of a FMP contact DEGESCH AMERICA, INC., Telephone: 540-234-9281/1-800-330-2525 for further assistance.

The FMP and related documentation, including monitoring records, must be on-site and available for review during the fumigation and must be maintained for a minimum of 2 years.

### **STEPS 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.

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 that 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 entire label, which includes the container label and the Applicator's Manual. This information must also be given to the appropriate company officials (supervisors, foreman, safety officer, etc.) in charge of the structure and/or area. 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 must construct a similar set of procedures using this document as your guide or contact DEGESCH AMERICA, INC. for assistance. Finally, before any fumigation begins you must be familiar with and comply with all applicable Federal, State, and local 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.

### **A CHECKLIST GUIDE FOR A FUMIGATION MANAGEMENT PLAN**

This checklist is provided to help you take into 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 plan. Each item must be considered, however, it is understood that each fumigation is different and not all items will be necessary for each fumigation structure.

#### **A. PRELIMINARY PLANNING AND PREPARATION**

1. Determine the purpose of the fumigation;
  - a. Elimination of insect infestation.
  - b. Elimination of rodent/vertebrate pests.
  - c. Plant pest quarantine.
2. Determine the type of fumigation, for example;
  - a. Space; tarp, mill, warehouse, food plant, packaging facility, temperature-controlled storage structures suitable for fumigation.

- b. Transport Vehicle; railcar, truck, van, container, refrigerated container for railcars or trucks
  - c. Commodity; raw agricultural commodities, processed foods, perishable processed foods, non-food.
  - d. Type of storage; vertical silo, farm storage, flat storage, cold temperature storage spaces.
  - e. Vessels or ships (not for use on barges), refrigerated containers. In addition to the Applicator's Manual, read the US Coast Guard Regulations 46CFR 147A.
3. Fully acquaint yourself with the structure 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. Draw or have a drawing or sketch of structure to be fumigated, delineating features, hazards, and other structural issues.
  - 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, and 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 fumigation application.
  - k. Review the entire label, which includes both the container label and Applicator's Manual.
  - l. 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 (follow special requirements for aeration following cold storage fumigations).
    5. Measured and recorded commodity temperature.
  - m. Determination of dosage.
    1. Cubic footage or other appropriate space/location calculations.
    2. Structure sealing capability and methods.
    3. Maximum allowable dosage rates.
    4. Temperature humidity and wind.
    5. Commodity/space volume.
    6. Past history of fumigation of structure.
    7. Exposure time.

## **B. PERSONNEL**

1. Confirm in writing that all personnel in and around the structure 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 Applicator's Manual. Fumigation personnel must be trained in the proper method of application, the hazards that may be encountered, and the selection of personal protection devices, including detection equipment. Confirm that all applicators have been trained in the use of U-PHOS® Phosphine Fumigant and have received the required refresher training every two years.
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/or 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 emergency.

## **C. MONITORING**

### **1. Perimeter Safety**

- a. Monitoring of phosphine concentrations must be conducted in enclosed areas to prevent excessive exposure and to determine where exposure may occur. Document where monitoring will occur.
- b. Keep a log or manual of monitoring records for each fumigation site. This log must, at a minimum, contain the timing, number of readings taken and level of concentrations found in



each location.

- c. When monitoring, document even if there is no phosphine present above the safe levels. In such cases, subsequent monitoring is not routinely required. However, spot checks must be made, especially if conditions significantly change.
- d. Monitoring must be conducted during aeration and corrective action taken if gas levels exceed the allowed levels in an area where bystanders and/or nearby residents may be exposed.
- e. Buffer zones are required during cold storage fumigations unless the fumigation chamber/structure has been leak tested and found to be gas tight (See F. below, "APPLICATION PROCEDURES & FUMIGATION PERIOD"). Buffer zones must be established during aeration of chambers fumigated under cold storage conditions (see Section G. below, "POST-APPLICATION OPERATIONS", and Section VIII. A. Special instructions for Aeration after Cold Storage Fumigations for buffer zone requirements). Entry into buffer zone areas requires periodic monitoring and the use of SCBA respirators as set forth in Section V.E. RESPIRATORS and the USDA Treatment Manual.

## **2. Efficacy**

- a. Gas readings must be taken from within the fumigated structure to ensure proper gas concentrations. This can be safely achieved from outside the structure through the use of sample lines.
- b. All phosphine readings must be documented.

## **D. NOTIFICATION**

1. Confirm that all appropriate local authorities (fire departments, police departments, etc.) have been notified as per label instructions, local ordinances if applicable, 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.
3. Confirm that the receivers of vehicles and containers under in-transit fumigation have been notified and that trained workers will be available on site (IV.H.6.c. under DIRECTIONS FOR USE).

## **E. SEALING PROCEDURES**

1. Sealing must be adequate to control pests. Care must be taken to ensure that sealing materials will remain intact until the fumigation is complete.
2. If the structure has been fumigated before, review the previous FMP for previous sealing information.
3. Make sure that construction/remodeling has not changed the building in a manner that will affect the fumigation.
4. Warning placards must be placed on every possible entrance to the fumigation site.

## **F. APPLICATION PROCEDURES & FUMIGATION PERIOD**

1. Plan carefully and apply all fumigants in accordance with the label requirements.
2. When entering into the area under fumigation, always work with two or more people under the direct supervision of a certified applicator wearing appropriate respirators (refer to PPE Section V.E.).
3. Apply fumigant from the outside of the fumigation space.
4. Provide watchmen when a fumigation site cannot otherwise be made secure from entry by unauthorized persons.
5. When entering structures, always follow OSHA rules for confined spaces.
6. Document that the receiver of vehicles fumigated in-transit has been notified and is trained to receive commodity under fumigation.
7. Turn off any electric lights in the fumigated area of the structure, as well as all non-essential electrical motors.
8. For cold storage fumigations, a 30-foot buffer zone must be established from the outside edge of the structure being fumigated unless the structure has been pressure tested and found to be gas tight per USDA testing protocols (see the USDA Treatment Manual, available from the Animal and Plant Health Inspection Service (APHIS) web site (<http://www.aphis.usda.gov>)).

## **G. POST-APPLICATION OPERATIONS**

### **For Ambient Fumigations:**

1. Provide watchmen when you cannot secure the fumigation site from entry by unauthorized persons during the aeration process.
2. Ventilate and aerate in accordance with structural limitations.
3. Turn on ventilating or aerating fans where appropriate.

4. Use a suitable gas detector before re-entry into a fumigated structure to determine fumigant concentration.
5. Keep written records of monitoring to document completion of aeration.
6. Consider temperature when aerating.
7. Ensure aeration is complete before moving a treated vehicle onto public roads.
8. Remove warning placards when aeration is complete.
9. Inform business/client that employees/other persons may return to work or otherwise be allowed to re-enter the aerated structure.

**For Cold Storage Fumigations:**

1. Provide watchmen when you cannot secure the fumigation site from entry by unauthorized persons during the aeration process.
2. Ventilate and aerate in accordance with structural limitations.
3. Turn on ventilating or aerating fans where appropriate.

To ensure bystander safety during rapid aeration of chambers containing fresh commodities fumigated under cold storage conditions, the following buffer zones must be maintained:

The required buffer zones vary based upon the volumes treated;

- 200 foot buffer for all aeration methods and fumigations  $\leq 100,000$  cubic feet.
- 350 foot buffer for all aeration methods and fumigations  $\leq 500,000$  cubic feet.
- 500 foot buffer for all aeration methods and fumigations  $> 500,000$  cubic feet.

During the first 10 minutes of aeration, no one is permitted within the buffer zone surrounding the exhaust duct outlet. If the exhaust duct is not used for aeration, the buffer zone distances must be measured from the perimeter of the fumigated structure. In either scenario, no one is permitted within the buffer zone until the structure has aerated for 10 minutes and monitoring indicates that the level of phosphine gas is 0.3 ppm or below. For personal safety, gas levels should occasionally be monitored at greater distances, especially downwind to ensure this buffer zone is adequate.

Everyone within the aeration buffer zone must be made aware that a release of fumigant gas is about to take place. If personnel involved with the fumigation choose to remain in the area, they must wear the minimum respiratory protection specified in Section V.E. Anyone not involved with the fumigation must evacuate and remain beyond the buffer zone. If people cannot be restricted from the buffer zone during regular work hours, aeration must be done during another time of the day. When securing the duct outlet area, consider the direction of the wind and face the duct outlet toward an open area, and away from people. Always point the duct outlet upward to aid in dispersing the exhausted gas.

4. Use a suitable gas detector before re-entry into a fumigated structure to determine fumigant concentration.
5. Keep written records of monitoring to document completion of aeration.
6. Consider temperature when aerating.
7. Ensure aeration is complete before moving a treated vehicle onto public roads.
8. Remove warning placards when aeration is complete.
9. Inform business/client that employees/other persons may return to work or otherwise be allowed to re-enter the aerated structure.

**H. APPLICATION PROCEDURES**

**1. General Statement**

A Fumigation Management Plan (FMP) (see Section IV.G. above) must be written PRIOR to all applications. A FMP must be prepared for all structures and containers to cover application, exposure period and aeration before fumigation is started in order to prevent human and animal exposure to phosphine and to help assure adequate control of insect pests.

The following instructions are intended to provide general guidelines for typical fumigation. There are a number of critical factors involved in the design of blending equipment. As such, blending equipment must meet both high-pressure standards and chemical compatibility requirements. Improper or inappropriate use of blending equipment may result in severe injury or death. Application inconsistent with the labeling and Applicator's Manual is a violation of Federal Law. Buyer assumes all risk if the product is used contrary to label or the Applicator's Manual instructions.



## 2. Equipment Specification and Use

### a. General

The equipment used to blend U-PHOS® Phosphine Fumigant on site with CO<sub>2</sub> or forced air provides a means of containing the gas during the application and controlling the release of the product into the space to be fumigated. The development of suitable blending equipment is an ongoing process, based on the needs of the users and available technology. Only equipment designed or approved by DEGESCH AMERICA, INC. may be used.

The design of blending equipment must account for a number of technical issues, including pressure rating, material compatibility, temperature limitations, operator safety, and controlling the phosphine concentration between 2.0 – 2.9% v/v when blended with CO<sub>2</sub> or less than 10,000 ppm (55% of the LFL) when blended with forced air. For this reason, only appropriate equipment must be used in the blending of U-PHOS® Phosphine Fumigant. Only persons trained in the proper use of U-PHOS® Phosphine Fumigant and the blending equipment (specific to blending with forced air or CO<sub>2</sub>) shall be permitted to use U-PHOS® Phosphine Fumigant for fumigation.

The instruction materials provided with the blending equipment must be consulted for its 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. This is not an approved dispensing method and must never be used with U-PHOS® Phosphine Fumigant. U-PHOS® Phosphine Fumigant is pyrophoric and will spontaneously ignite in the air. The cylinder containing U-PHOS® Phosphine Fumigant must be placed outside the fumigation area and properly blended with carbon dioxide or using specialized equipment with forced air, to eliminate the flammability hazard.

### c. Approved Blending Methods

U-PHOS® Phosphine Fumigant and approved blending equipment is generally used for large fumigations. Some facilities may have bulk carbon dioxide storage tanks on site.

The approved CO<sub>2</sub> blending equipment has incorporated required safety features to properly blend phosphine and carbon dioxide into a non-flammable mixture with a phosphine concentration between 2.0 – 2.9% vol.

The approved Force Air blending equipment has incorporated required safety features to properly blend phosphine and forced air to ensure the concentration of phosphine does not exceed 55% of the LFL (10,000 ppm).

### d. Calculating the Amount of U-PHOS® Phosphine Fumigant Required

The amount of U-PHOS® Phosphine Fumigant and CO<sub>2</sub> required to perform a fumigation will depend on (i) 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 of the infestation site, (v) duration of fumigation, (vi) use of any re-circulation or temperature control devices and (vii) whether or not it is a stationary or in-transit fumigation. An initial dose of U-PHOS® Phosphine Fumigant and CO<sub>2</sub>/forced air is used to establish a pesticidal atmosphere in the fumigation space, and through active monitoring of the phosphine concentrations, additional U-PHOS® Phosphine Fumigant and CO<sub>2</sub>/forced air 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. When blending U-PHOS® Phosphine Fumigant with CO<sub>2</sub> and forced air, it is sometimes easier to speak in terms of the amount of phosphine that is required rather than the amount of blended gas required. The maximum concentration of U-PHOS® Phosphine Fumigant used per fumigation must not exceed 3,625 ppm of phosphine for ambient temperature fumigations or 2,500 ppm for cold storage fumigations.

**One gram of phosphine (PH<sub>3</sub>) will produce a concentration of 25 parts per million (ppm) in a volume of 1,000 cubic feet (ft.<sup>3</sup>). This is the fundamental conversion used when calculating the amount of U-PHOS® Phosphine Fumigant needed to dose a space.**

$$1 \text{ gram PH}_3 = 25 \text{ ppm PH}_3/1,000 \text{ ft.}^3$$

$$1 \text{ pound of U-PHOS® Phosphine Fumigant} = 454 \text{ grams PH}_3$$

To calculate the total amount of U-PHOS® Phosphine Fumigant required to dose a space:

$$\text{grams of PH}_3 = (\text{Target Conc.} \times \text{Volume}) / 25,000$$

“Target” is the Phosphine concentration to be achieved in parts per million (ppm)

“Volume” is the empty volume of the space to be fumigated in cubic feet (ft.<sup>3</sup>)

To calculate the amount of Phosphine or U-PHOS® Phosphine Fumigant to be added to a space to reestablish the Target concentration:

$$\text{grams of PH}_3 = (\text{Target Conc.} - \text{Actual}) \times \text{Volume} / 25,000$$

“Actual” is the measured phosphine concentration in parts per million (ppm)

“Target” is the phosphine concentration to be achieved in parts per million (ppm)

“Volume” is the empty volume of the space to be fumigated in cubic feet (ft.<sup>3</sup>)

### 1. Blending with CO<sub>2</sub>

Manuals for approved blending equipment are available from authorized U-PHOS® Phosphine Fumigant Distributors.

As a general rule, 200 ppm of PH<sub>3</sub> from U-PHOS® Phosphine Fumigant when blended with carbon dioxide will produce 8,000 ppm of carbon dioxide in the fumigation space.

Once the amount of phosphine has been determined, the appropriate amount of carbon dioxide required can be calculated. The lower explosion limit for a blend of phosphine in CO<sub>2</sub> is 3% vol. phosphine or 2.3% wt. The blending equipment is designed to produce a blend of 2.5% vol. (1.9% wt.) phosphine in carbon dioxide. Engineering controls have been designed into the blending equipment that will prevent the phosphine concentration from going outside the range of 2.0 – 2.9% vol. (1.6 – 2.2% wt.). It is recommended, as shown in the formula below, that twice this amount of carbon dioxide be available to ensure that an adequate supply is available for initial dose, redosing, and equipment purging.

$$\text{lb. CO}_2 \text{ required} = \frac{\text{gms PH}_3 \text{ required}}{454 \text{ gms/lb.}} \times \frac{2}{0.019}$$

### 2. Blending with Forced Air

Manuals for approved blending equipment are available from authorized U-PHOS® Phosphine Fumigant distributors.

When blending with forced air only the amount of phosphine needs to be calculated. It is sometimes desirable to source the air supply from inside the fumigation space thereby establishing a closed circulation system. In this way a positive pressure will not develop within the fumigation space. If recirculation is not used the displacement of air from the fumigation space will occur and perimeter monitoring for phosphine must be performed. The blending equipment provided with U-PHOS® Phosphine Fumigant dispenses approximately 20 grams of phosphine per minute and an air flow of 50 standard cubic feet per minute (SCFM). The air blending equipment is controlled by programmable sequence controllers that automatically shut down the dispensing of phosphine if the minimum air flow is not maintained.

### 3. General

When adding U-PHOS® Phosphine Fumigant 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 target concentration is achieved before the calculated amount of U-PHOS® Phosphine Fumigant has been added, close the phosphine cylinder to stop the blending of U-PHOS® Phosphine Fumigant with CO<sub>2</sub> or forced air and the calculations must be checked. It is

possible that a localized higher concentration has been detected and the gas requires more time to evenly disperse.

The phosphine in a full cylinder of U-PHOS® Phosphine Fumigant weighs 37.5 lbs. (17 kg). When a partial cylinder is required, a scale can be used to check how much U-PHOS® Phosphine Fumigant 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. The scale must have a maximum capacity for at least 200 lbs. (90.7 kg) to accommodate the cylinder weight. It must also have an accuracy of ±10% of the phosphine dosage.

Quantifying the amount of the CO<sub>2</sub> or forced air used based on cylinder weight is unnecessary because the blending equipment automatically dispenses the proper amount as the phosphine is introduced.

**e. Troubleshooting**

This section is provided to assist in addressing problems that may be encountered while using U-PHOS® Phosphine Fumigant cylinders. In the event of a potential leak in the structure, refer to Section IV.F. SEALING. When troubleshooting leaking cylinders, SCBA is required when levels of phosphine are unknown, or known to exceed the short-term exposure limit (STEL; 1 ppm for 15 minutes for phosphine). Troubleshooting assistance for a particular piece of blending equipment is addressed in the respective equipment manual which is available from the authorized U-PHOS® Phosphine Fumigant distributor. Questions for problems other than those listed below, must be directed to the authorized U-PHOS® Phosphine Fumigant distributor.

1. Condensation is forming on the outside of the cylinder.  
This is normal. As the fumigant is removed from the cylinder, the liquefied phosphine 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. The liquid phosphine that remains in the cylinder must vaporize in order to be released. If the withdrawal 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 XIV: SPILL AND LEAK PROCEDURES.
  - a) There is a leak at the cylinder valve outlet.
    - i. If the cylinder is attached to the blending 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 blending equipment to vent the remaining fumigant in the line. Purge the equipment, then 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. Install the valve outlet plug and attach a tag to the cylinder conspicuously indicating “Bad Valve Outlet” and return it.
    - ii. If the cylinder is not attached to the blending equipment:  
Check to see if the cylinder valve is fully closed. If it is fully closed and the leak continues, the cylinder must be moved to a well-ventilated area, away from personnel. Refer to Spill and Leak Procedures, Section XIV.
  - b) The leak is not at the cylinder valve outlet. Assistance is required. Refer to Spill and Leak Procedures, Section XIV.
4. Phosphine gas is not dispensing from cylinder.  
Check to see if the cylinder is empty. 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 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. Consult the blending equipment instructions

for troubleshooting assistance.

5. Loss of CO<sub>2</sub> Supply

The blending equipment is designed to automatically shut down the flow of phosphine gas if the carbon dioxide supply pressure is lost or is insufficient. Close the phosphine cylinder discharge valve and discontinue operating the blending equipment until problems with the CO<sub>2</sub> supply are resolved. Contact the CO<sub>2</sub> equipment supplier for help in troubleshooting supply problems.

6. Loss of Dilution Air

The blending equipment is designed to automatically shut down if the dilution forced air flow is lost or is insufficient. Close the phosphine cylinder discharge valve and discontinue operating the blending equipment until problems with the air supply are resolved.

**3. Application to Bulk Commodities**

**a. General**

U-PHOS® Phosphine Fumigant 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 storages, 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. Develop an appropriate Fumigation Management Plan**

Refer to Section IV.G. Fumigation Management Plan.

**c. Procedure for Fumigating Bulk Commodities**

1. Calculate the empty volume space to be treated.
2. Determine the target phosphine concentration and the duration of the fumigation based on area fumigated, commodity type and packaging, the insect pest(s) involved, and the commodity temperature. For details, refer to Section IV.D. (Directions for Use-Dosage Guide) in this manual.
3. Calculate how much fumigant (phosphine and CO<sub>2</sub> [if used]) will be required. If forced air is used for dilution with U-PHOS® Phosphine Fumigant, check the blending unit for its adequacy for the space to be treated.
4. Determine where the fumigant will be dispensed into the space, and plan for and install required equipment.
5. Gas monitoring must be performed from outside the fumigated structure. Polyethylene tubing is used for remote monitoring. This tubing can be run from each area of the fumigation to an outside location where gas samples can be taken safely. At least one monitoring line must be run in each fumigated structure. In the event of multi-floored structures or compartmentalized buildings, monitoring must be performed in all major areas of the fumigated structure. Fans can be used to help distribute gas into smaller areas and the outer reaches of these structures.
6. Isolate and seal all openings to other storage and spaces that are not intended for fumigation.
7. 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.
8. Ensure that all personnel, animals, and damageable goods are clear of the space to be treated and post fumigation placards on all points of access and any unloading penetrations.
9. Lock all entrances to the space.
10. Verify that all required safety equipment is available and in good working order.
11. Notify all personnel in nearby buildings at the facility that fumigant release is about to commence.
12. Connect the U-PHOS® Phosphine Fumigant cylinders to the CO<sub>2</sub> or forced air blending equipment.
13. Purge and leak test the blending equipment.
14. Dispense the initial dose of blended U-PHOS® Phosphine Fumigant.
15. Periodically monitor the phosphine concentrations within the space, using suitable gas detection equipment, to ensure that the minimum concentrations are being maintained. Additional blended U-PHOS® Phosphine Fumigant can be added as required to ensure that the target phosphine concentrations are reached and maintained during the fumigation period.
16. During and immediately after dispensing of U-PHOS® Phosphine Fumigant, perimeter monitoring for phosphine concentrations must be conducted to identify possible leak points. Seal any leak points found.
17. Blend and dispense additional fumigant as required to maintain the target phosphine concentrations. At any time, the dosage of phosphine must not exceed the recommended application rate.
18. When no further fumigant is required, close all cylinder valves and isolate the CO<sub>2</sub> source if used. Depressurize and purge the blending equipment and disconnect all U-PHOS® Phosphine Fumigant cylinders and CO<sub>2</sub> source if used. Ensure that the valve discharge cap is securely installed and



- replace the cylinder cap.
19. Before leaving the fumigation site, re-check barricades and placards at all entrances/exits into the fumigation space and/or area under fumigation to prevent entry by unauthorized people and animals during fumigation.
  20. When the fumigation is complete, unseal the space and aerate (see VIII. AERATION OF FUMIGATED COMMODITIES and IX.E. AERATION AND RE-ENTRY). Use suitable gas detection equipment to check both the carbon dioxide (if used) and phosphine concentrations before allowing entry into the space. Use appropriate breathing apparatus (refer to PPE Section V.E.) and entry procedures to avoid undue worker exposure.

**Additional Considerations for Fumigating Large Quantities of Bulk Commodities:**

1. Dispensing and monitoring lines must be installed with loading, unloading and other operations in mind. If frequent fumigations are expected, permanently mounted lines must be secured within the space. If temporary lines are to be used, they must 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 must 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 the 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 fumigant. Small commercial blowers can be used to recirculate the atmosphere within the space being treated. Dispense blended U-PHOS® Phosphine Fumigant into the discharge of recirculation blowers. Do not run blowers continuously, but long enough to ensure good fumigant distribution and each time fumigant is added.
4. For large storage facilities, multiple dispensing points must be considered to assist in the distribution of the fumigant.

**4. Application to Space Fumigations**

**a. General**

U-PHOS® Phosphine Fumigant can be used to fumigate any type of space (empty or full) where listed commodities are stored or processed, except barges. These include, but are not limited to mills, warehouses, processing facilities, packaging plants 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.

Blended U-PHOS® Phosphine Fumigant dispensing lines shall not be placed in or attached to commodity packages containing processed food.

**b. Develop and follow an appropriate Fumigation Management Plan**

Refer to Section IV.G. Fumigation Management Plans.

**c. Procedure for Fumigating Spaces**

1. Calculate the empty volume of the space to be treated.
2. Determine the target phosphine concentration and the duration of the fumigation. This must be based on the target pests and the temperature of the space or commodity.
3. Calculate how much U-PHOS® Phosphine Fumigant and CO<sub>2</sub> will be required. The CO<sub>2</sub> and air concentration in the blended mixture will be automatically controlled by the blending equipment to ensure the mixture is non-flammable.
4. Determine where the fumigant will be dispensed into the space, and plan for and install required components. Dispensing points must not be located in or attached to processed food commodity packages. Direct the discharge toward the center of the space being treated and away from any equipment present in the fumigation space, if possible.
5. If required, determine the number and location of circulating fans. Low speed fans must be placed on the floor and angled upwards. A means of turning the fans off from outside the treated space must be provided.
6. Determine where the fumigant concentrations will be measured (if used) and plan for and install required gas sampling lines.
7. Identify one access door and lock all other entrances. Lock all ground level and other accessible windows, if possible.
8. 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 fumigant dispensing



and monitoring. Isolate and seal all connections to other spaces that are not intended for fumigation.

9. Remove from the space, or protect sensitive equipment, material and food.
10. Ensure that all personnel, animals and damageable goods are clear of the space to be treated and post fumigation placards on 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.
11. Close, lock, seal, and placard the access door.
12. Verify that all required safety equipment is available and in good working order.
13. Notify all personnel that fumigant release is about to commence.
14. Connect the U-PHOS® Phosphine Fumigant cylinders and forced air or CO<sub>2</sub> source to the blending equipment.
15. Purge and leak test the blending equipment.
16. Dispense the initial dose of blended U-PHOS® Phosphine Fumigant.
17. Periodically monitor the phosphine concentrations within the space, using suitable gas detection equipment, to ensure that the minimum concentrations are being maintained.
18. Blend and dispense additional fumigant as required to maintain the target phosphine concentrations.
19. When no further fumigant is required, close all cylinder valves. Depressurize and purge the blending equipment and disconnect all U-PHOS® Phosphine Fumigant cylinders and forced air/CO<sub>2</sub> source. Ensure that the valve discharge cap is securely installed and replace the cylinder cap.
20. Before leaving the fumigation site, recheck barricades and placards at all entries into the fumigation space and/or fumigated area to prevent entry by unauthorized personnel during fumigation.
21. When the fumigation is complete, unseal the space and aerate (see VIII. AERATION OF FUMIGATED COMMODITIES and IX.E. AERATION AND RE-ENTRY). Use suitable gas detection equipment to check both the carbon dioxide and phosphine concentrations before allowing entry into the space. Use appropriate breathing apparatus and entry procedures to avoid undue worker exposure.
22. Remove all dispensing and gas monitoring lines.
23. Workers must 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 0.3 ppm.

## **5. Application to Tarpaulin Fumigations**

### **a. General**

U-PHOS® Phosphine Fumigant 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.

Blended U-PHOS® Phosphine Fumigant dispensing lines shall not be placed in or attached to commodity packages containing processed food.

### **b. Develop and follow an appropriate Fumigation Management Plan**

Refer to Section IV.G. Fumigation Management Plans.

### **c. Procedure for Tarpaulin Fumigations**

1. 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 empty space contained within the tarp.
2. Determine the target phosphine concentration and the duration of the fumigation. This must be based on the target pests and the temperature of the material being treated.
3. Calculate how much phosphine will be required, based on the volume calculation.
4. Determine where the fumigant will be dispensed into the space, and plan for and install required components. Dispensing points must not be located in or attached to commodity packages or within containers.
5. 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 inaccurate readings.
6. Cover the material with plastic sheeting using tape, glue or clamps to join individual sheets. If the flooring on which the material is placed is wood or other porous material, it must be covered first

with plastic sheeting. 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 must be a minimum of 2-mil thickness for indoor applications, however, 4 mil is preferred and is more suitable for outdoor use. Ensure that tarp penetrations for dispensing and monitoring are well sealed.

7. Placard the tarped material.
8. Verify that all required safety equipment is available and in good working order.
9. Notify all personnel that fumigant release is about to commence. For the case of indoor tarp fumigations, the area surrounding the material being treated must be monitored for phosphine and carbon dioxide (if used) concentrations to ensure that workers are not unduly exposed. It is required that all personnel not trained or involved in execution of the fumigation be restricted from entering the area, until the work is complete. Workers under a continuous roof, connected buildings or those working near an adjacent outside wall must be vacated.
10. Connect the U-PHOS® Phosphine Fumigant cylinders to the blending equipment.
11. Purge and leak test the blending equipment.
12. Dispense the initial dose of blended U-PHOS® Phosphine Fumigant.
13. Periodically monitor the phosphine concentrations within the space, using suitable gas detection equipment, to ensure that the minimum concentrations are being maintained for the required time.
14. Dispense additional fumigant as required to maintain the target phosphine concentrations.
15. When no further fumigant is required, close all cylinder valves. Depressurize and purge the blending equipment and disconnect all U-PHOS® Phosphine Fumigant gas cylinders. Ensure that the valve discharge cap is securely installed and replace the cylinder cap.
16. Before leaving the fumigation site, recheck barricades and placards at all entries into the fumigation space and/or fumigated area to prevent entry by unauthorized personnel during fumigation.
17. When the fumigation is complete, remove the tarp and aerate as appropriate using precautions to prevent exposure to workers (see VIII. AERATION OF FUMIGATED COMMODITIES and IX.E. AERATION AND RE-ENTRY).

**Additional Considerations:**

1. Do not walk on tarped material once it has been sealed and fumigant has been dispensed.
2. Placard each access to the area where treatment is occurring.
3. Seal off doors, windows and other connections to adjacent areas that may be occupied and placard on the occupied side.

**6. Application to Transport Containers and Trailers**

**a. General**

Railcars and containers, trucks, vans and other transport vehicles shipped piggyback by rail may be fumigated in-transit, however, aeration en-route is prohibited. It is not legal to move trucks, trailers, containers, vans, etc. over public roads or highways until they have been aerated and the warning placards removed. Notify the consignee if the commodity is to be shipped under fumigation. If the consignee is unfamiliar with proper handling of fumigated rail cars and containers fumigated in-transit, they must be provided with the necessary information. See Section VI and VIII of this manual for recommendations concerning placarding, commodity aeration, and training of persons authorized to remove placarding.

Containers, trucks, and other transport vehicles loaded with bulk commodities, when stationary, to which U-PHOS® Phosphine Fumigant may be added are treated in essentially the same way as any other storage facility. However, when transport vehicles are fumigated in-transit they require special handling, which is described below.

Blended U-PHOS® Phosphine Fumigant dispensing lines shall not be placed in or attached to commodity packages containing processed food.

Trailers and containers require small amounts of fumigant.

**b. Procedure for Stationery Container and Trailer Fumigation**

1. Develop and follow an appropriate Fumigation Management Plan (Refer to Section IV.G.)
2. Determine the empty volume of the trailer or container.
3. Determine the target phosphine concentration and exposure time. This must be based on the target pests, the commodity temperature, and the commodity stored in the container.
4. Calculate how much fumigant (phosphine) and CO<sub>2</sub> (if used) will be required.

5. Inspect all sidewalls, roof, floor, and doors for cracks, holes or defects. Seal all openings with tape or caulk. Particular attention must be paid to any drain holes in the floor.
6. Install the 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. Affix fumigation placards to all sides of the container or trailer.
9. Verify that all required safety equipment is available and in good working condition.
10. Notify all personnel that fumigation release is about to commence. When trailers attached to tractors and trucks are fumigated, drivers must not be allowed to enter the vehicle until fumigation has ended and the truck is aerated.
11. Purge and leak test the blending equipment.
12. Blend and dispense the predetermined quantity of U-PHOS® Phosphine Fumigant into the container or trailer.
13. Before leaving the fumigation site, recheck barricades and placards at all doors into the fumigation space and/or fumigated area to prevent entry by unauthorized personnel while fumigation is in progress.
14. When the fumigation is complete, aerate as appropriate using precautions to prevent exposure to workers (See Section VIII. Aeration of Fumigated Commodities and IX.E. Aeration and Re-Entry). Adequate monitoring and aeration must be performed to reduce any residual phosphine levels to below 0.3 ppm.

**c. Procedure for In-Transit Container and Trailer Fumigation**

Develop and follow an appropriate Fumigation Management Plan (Refer to Section IV.G.)

A Certified Applicator or trained person under his direct supervision must be responsible for adding fumigant and sealing and placarding the container or trailer for transport. The shipper and/or the fumigator must provide written notification to the receiver of the railcar, railroad boxcars, shipping containers and other vehicles that have been fumigated in-transit. A Certified Applicator or trained person under his direct supervision is responsible for ensuring that a copy of the label and Applicator's Manual precedes or accompanies all transportation containers or vehicles that are fumigated in-transit. If the Applicator's Manual is sent with the transport vehicle it must be placed securely on the outside of the vehicle. Proper handling at their destination is the responsibility of the consignee. Upon receipt of the railcar, railroad boxcars, shipping containers and other vehicles fumigated in-transit, a Certified Applicator and/or persons with documented authorized training must supervise the aeration process and removal of the placards.

**TRAINING REQUIREMENTS FOR RECEIPT OF VEHICLES OR SHIPPING CONTAINERS FUMIGATED IN-TRANSIT**

The trained person(s) must be trained by a Certified Applicator following the EPA accepted product Applicator's Manual or by other training which is accepted by local or state authorities. The worker training must take place before the in-transit (fumigated) containers arrive and the training must include related instructional materials in addition to the Applicator's Manual. When training has been completed and the employee demonstrates safety knowledge proficiency, the training date must be logged and maintained in the employee's safety training record for a minimum of three years. Refresher training must be done on an annual basis.

This training must cover the following items, each of which may be found in this manual.

1. How to aerate the vehicle and verify that it contains no more than 0.3 ppm phosphine

**OR**

2. How to transfer the commodity under fumigation to another storage area without prior aeration, to ensure that safety limits for workers and people in neighboring areas are not being exceeded during transfer and to placard the new storage area until aeration.
3. How to determine when respiratory protection must be worn (refer to PPE Section V.E.).
4. How to protect workers and nearby persons from exposure to levels above the 8-hour time weighted average (TWA) of 0.3 ppm or the 15-minute TWA short-term exposure limit (STEL) of 1.0 ppm phosphine.
5. Proper removal of placards from the vehicle or shipping container.

**7. Application to Ships (not for use on barges)**

**a. General**

1. Develop and follow an appropriate Fumigation Management Plan (Refer to Section IV.G.).
2. Important – shipboard in-transit ship or ship hold fumigation is also governed by U.S. Coast Guard Regulation 46 CFR 147A. *Interim regulations for shipboard fumigation.* Refer to this regulation prior to fumigation. For further information contact:  
Commandant  
U.S. Coast Guard  
Hazardous Materials Standards Division  
GMSO-3  
Washington, DC 20593-0001
3. 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.H.3.b), spaces (see IV.H.4.b), or containers (see IV.H.6.b), as appropriate. Special instructions are also provided below (paragraph d) for handling in-transit fumigation of containers and ships. Gas circulation assistance may be needed to ensure complete penetration with U-PHOS® Phosphine Fumigant for bulk commodity fumigations. Suggestions are provided under “Additional Considerations” in Section IV.H.3.b, “Application to Bulk Commodities”.

**b. Pre-Voyage Fumigation Procedures for In-Transit Fumigation**

1. Prior to fumigating a vessel for in-transit cargo fumigation, the master of the vessel, or his representative, and the fumigator 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 must not be allowed to reoccupy the vessel until it has been properly aerated to below 0.3 ppm phosphine and a determination has been made by the master of the vessel and the fumigator that the vessel is safe for occupancy.
2. The person responsible for the fumigation must notify the master of the vessel or his representative of the requirements relating to personal protection equipment\*\* and detection equipment, and that a person qualified in the use of this equipment must accompany the vessel with cargo under fumigation. Emergency procedures, cargo ventilation, periodic monitoring and inspections, and first aid measures must be discussed with the master of the vessel or his representative.  
\*\*Personal protection equipment means a NIOSH approved air purifying full face gas-mask with a chin style mounted canister approved for phosphine, OR a NIOSH approved supplied-air respirator with a full-face piece for phosphine up to 15 ppm. Although respiratory protection is not required for CO<sub>2</sub> exposure up to 5,000 ppm, a canister respirator will not provide protection from CO<sub>2</sub> at any concentration. A self-contained breathing apparatus (SCBA) must be worn and operated in a positive pressure mode when phosphine levels are above 15 ppm or at unknown concentrations (refer to PPE Section V.E.).
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.
5. If the fumigation is not completed and the vessel aerated before the manned vessel leaves port, the person in charge of the vessel shall ensure that at least two units of personal protection equipment and one gas or vapor detection device, and a person qualified in their operation be on board the vessel during the voyage. **The U-PHOS® Phosphine Fumigant cylinders and the CO<sub>2</sub> source (if used) must be disconnected and removed from the vessel before it leaves port.**
6. During the fumigation or until a manned vessel leaves port or the cargo is aerated, the person in charge of the fumigation shall ensure that a qualified person using gas or vapor detection equipment tests spaces adjacent to spaces containing fumigated cargo and all regularly occupied spaces for fumigation leakage. If leakage of the fumigant is detected, the person 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.
7. The person in charge of the fumigation shall review with the master, 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.

1. If the fumigation is not completed and the vessel aerated before the manned vessel leaves port, the person in charge of the vessel shall ensure that at least two units of personal protection equipment and one gas or vapor detection device, and a person qualified in their operation be on board the vessel during the voyage. **The U-PHOS® Phosphine Fumigant cylinders and the CO<sub>2</sub> source (if used) must be disconnected and removed from the vessel before it leaves port.**
2. During the fumigation or until a manned vessel leaves port or the cargo is aerated, the person in charge of the fumigation shall ensure that a qualified person using gas or vapor detection equipment tests spaces adjacent to spaces containing fumigated cargo and all regularly occupied spaces for fumigant leakage. If leakage of the fumigant is detected, the person 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.

**d. In-transit Fumigation of Containers Aboard Ships**

In-transit fumigation of transport units on ships is also governed by the U.S. Department of Transportation (DOT). RSPA 49 CFR 176.76(h) transport vehicles, freight containers, and portable tanks containing hazardous materials and International Maritime Dangerous Goods Code P9025-1 Amdt. 30-00.

1. If the fumigation is not completed and the vessel aerated before the manned vessel leaves port, the person in charge of the vessel shall ensure that at least two units of personal protection equipment and one gas or vapor detection device, and a person qualified in their operation be on board the vessel during the voyage. **The U-PHOS® Phosphine Fumigant cylinders and the CO<sub>2</sub> source (if used) must be disconnected and removed from the vessel before it leaves port.**
2. During the fumigation or until a manned vessel leaves port or the cargo is aerated, the person in charge of the fumigation shall ensure that a qualified person using gas or vapor detection equipment tests spaces adjacent to spaces containing fumigated cargo and all regularly occupied spaces for fumigant leakage. If leakage of the fumigant is detected, the person 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.

**e. Precautions and Procedures During Voyage**

1. 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 must be evacuated of all personnel, ventilated, and action taken to correct the leakage before allowing the area to be occupied.
2. Do not enter fumigated areas except in an emergency. If necessary to enter a fumigated area, appropriate personal protection equipment must be used. Never enter fumigated areas alone. At least one other person, who is also wearing personal protection equipment, must be available to assist in case of an emergency.

**f. Precautions and Procedures During Discharge**

If necessary to enter holds prior to discharge, test spaces directly above the cargo surface for fumigant concentration using appropriate gas detection and personal safety equipment. Do not allow entry to fumigated areas without personal safety equipment, unless phosphine concentrations are less than 0.3 ppm, as indicated by a suitable detector.

**8. APPLICATIONS TO PERISHABLE COMMODITIES IN COLD STORAGE**

**a. General**

U-PHOS® Phosphine Fumigant can be used to fumigate fresh commodities under cold storage conditions. 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. Develop and follow an appropriate Fumigation Management Plan (Refer to Section IV.G.)**

The Fumigation Management Plan must be written PRIOR to fumigation. Following the instructions provided in Section IV.G of this manual will ensure that the applicator has become acquainted with the structure and commodity to be fumigated, has notified personnel and potential bystanders in and around the area to be fumigated, and has established the monitoring necessary to ensure perimeter safety during fumigation and aeration.



The main difference between fumigation of fresh commodities in cold storage and other raw or processed commodities is the reduced amount of time for fumigation and aeration that is necessary to preserve the quality of the fresh commodities. Typical fumigation sites for fresh commodities include cooling chambers, controlled atmosphere chambers or reefer containers specially adapted for fumigations. Other sites may be used provided that they are gas-tight and meet the quality assurance needs of the commodity to be fumigated. The chamber design typically will reflect what is needed to maintain the quality of the particular fresh commodity that is being fumigated. For example, fumigation and aeration must be completed as rapidly as feasible when highly perishable commodities are treated. To accomplish this, it may be necessary to release the gas near the fans of the cooling system in order to distribute the phosphine in the chamber rapidly and safely. For aeration, extraction fans are available with the capacity to perform 20-30 air changes or more in the chamber per hour. Under these conditions it is possible to ventilate a chamber from over 1,000 ppm to less than 0.3 ppm in about 90 minutes.

Another potential difference between fumigation under cold storage conditions and ambient temperatures is that temperature differences could occur during the fumigation process that result in pressure increases or vacuum formation. When this is the case, a pressure monitoring device (e.g., U-manometer) can be installed on the chamber to monitor the pressure during the fumigation process, and/or a pressure relief system such as flappers or water traps can be installed.

For advice concerning cold storage fumigations and the development of a Fumigation Management Plan, contact DEGESCH AMERICA, INC., Telephone: 540-234-9281; Fax: 540-234-8225 for further assistance.

**c. Cold storage buffer zone requirements for fumigation and aeration.**

For cold storage fumigations, a 30-foot buffer zone must be established from the outside edge of the structure being fumigated unless the structure has been pressure tested and found to be gas tight per USDA testing protocols (see USDA Treatment Manual, available from the Animal and Plant Health Inspection Service (APHIS) web site (<http://www.aphis.usda.gov>)).

During aeration, follow the special instructions for aeration after cold storage fumigations found in Section VIII.A. To ensure bystander safety during rapid aeration of chambers containing fresh commodities fumigated under cold storage conditions, the following buffer zones must be maintained:

The required buffer zones vary based upon the volumes treated;

- 200 foot buffer for all aeration methods and fumigations  $\leq 100,000$  cubic feet.
- 350 foot buffer for all aeration methods and fumigations  $\leq 500,000$  cubic feet.
- 500 foot buffer for all aeration methods and fumigations  $> 500,000$  cubic feet.

During the first 10 minutes of aeration, no one is permitted within the buffer zone surrounding the exhaust duct outlet. If the exhaust duct is not used for aeration, the buffer zone distances must be measured from the perimeter of the fumigated structure. In either scenario, no one is permitted within the buffer zone until the structure has aerated for 10 minutes and monitoring indicates that the level of phosphine gas is 0.3 ppm or below. For personal safety, gas levels should occasionally be monitored at greater distances, especially downwind to ensure this buffer zone is adequate.

Everyone within the aeration buffer zone must be made aware that a release of fumigant gas is about to take place. If personnel involved with the fumigation choose to remain in the area, they must wear the minimum respiratory protection specified in Section V.E. Anyone not involved with the fumigation must evacuate and remain beyond the buffer zone. If people cannot be restricted from the buffer zone during regular work hours, aeration must be done during another time of day. When securing the duct outlet area, consider the direction of the wind and face the duct outlet toward an open area, and away from people. Always point the duct outlet upward to aid in dispersing the exhausted gas.

Entry into buffer zone areas requires periodic monitoring and the use of SCBA respirators as set forth in Section V.E. RESPIRATORS and the USDA Treatment Manual.

- d. For complete control of most pests,** treat at a concentration of 1,000 – 2,500 ppm phosphine for 24-72 hours at approximately 28°F to 43°F (-2°C to 6°C) during the fumigation. When the commodity temperature is  $> 43^\circ\text{F}$  ( $> 6^\circ\text{C}$ ) treat at a concentration of 750 – 2,500 ppm for 24 to 48 hours. If survivors are found, follow with continued cold treatment for up to 10 days at 32°F (0°C).

**e. Procedure for fumigating cold storage chambers, including fumigation chambers, warehouses, transport containers for railcars, trucks and ships and other suitable structures:**

1. Calculate the empty volume of the space to be treated.
2. Calculate how much U-PHOS® Phosphine Fumigant will be required.
3. Determine where the fumigant will be dispensed into the space, and plan for and install required components.
4. Determine where fumigation concentrations will be measured (if used) and plan for and install required gas sampling lines.
5. Identify one access door and lock all others. Lock all ground level and other accessible windows if possible.
6. Except for the access door, seal all openings including cracks, windows, doors, vents, eaves, ventilation fan 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 to be fumigated.
7. Remove from the space, or protect sensitive equipment.
8. Ensure that all personnel, animals and damageable goods are clear of the space to be treated and post fumigation placards on and lock all points of access. Comply with the buffer zone requirements set forth in Section IV.H.8.c (above).
9. Close, lock, seal and placard the access door. Prevent gas loss by sealing with tape, caulk or polyethylene sheeting or by using special designed permanent door seal and closure systems. Affix fumigation placards to all sides and at all openings of the fumigated space.
10. Verify that all required safety equipment is available and in good working order.
11. Notify all personnel that fumigant release is about to commence.
12. Connect the U-PHOS® Phosphine Fumigant cylinders to the dispensing equipment. Follow directions provided by the manufacturer of the equipment.
13. Dispense the initial dose of U-PHOS® Phosphine Fumigant. Because it is not dependent on environmental conditions such as temperature and humidity, U-PHOS® Phosphine Fumigant release is instantaneous. Low level phosphine monitoring for personal exposure should begin at the time gas is released from the dispensing equipment. If leakage causes the fumigator's exposure to exceed the 8-hour TWA of 0.3 ppm of phosphine, approved respiratory protection such as SCBA must be worn. Gas concentration measurements for safety purposes must be made using suitable low-level detection equipment. See Section IX.G. "Industrial Hygiene Monitoring" for more information. The STEL is 1.0 ppm phosphine for 15 minutes. Conduct permitted monitoring during the release of fumigant to ensure that phosphine levels do not exceed exposure limits around the fumigation structure where workers or bystanders have access.
14. Periodically monitor the phosphine concentrations within the space, using suitable gas detection equipment, to ensure that minimum concentrations are being maintained.
15. Dispense additional fumigant as required to maintain the desired phosphine concentrations.
16. When no further fumigant is required, close all cylinder valves. Depressurize the dispensing equipment and disconnect all U-PHOS® Phosphine Fumigant cylinders in accordance with equipment operating instructions. Ensure that the valve discharge cap is securely installed and replace the cylinder cap.
17. Before leaving the fumigation site, recheck barricades and placards at all entries into the fumigation space to prevent entry by unauthorized personnel during fumigation.
18. When the fumigation is complete, unseal the space and aerate as appropriate using precautions to prevent exposure to workers. Comply with the buffer zone requirements set forth in Section IV.H.8.c (above), Section VIII. AERATION OF FUMIGATED COMMODITIES with attention to the SPECIAL INSTRUCTIONS FOR AERATION AFTER COLD STORAGE FUMIGATION and IX.E. AERATION AND RE-ENTRY). Phosphine concentrations must be monitored continuously during aeration to ensure no worker exposure occurs.
19. Remove all dispensing and gas monitoring lines.
20. Workers should be aware that some residual gas may be entrapped within the fumigated commodity container (i.e., bagged and/or boxed commodities). Adequate monitoring and aeration must be performed to reduce any residual phosphine levels to below 0.3 ppm.

## **V. PERSONAL PROTECTIVE EQUIPMENT (PPE)**

### **A. GLOVES**

Wear leather work gloves or leather faced cotton gloves when connecting to or disconnecting U-PHOS®

Phosphine Fumigant cylinders from the blending equipment.

**B. SAFETY GLASSES**

When working with pressurized equipment, safety glasses must be worn.

**C. SAFETY SHOES**

It is recommended that steel-toed safety shoes be worn by anyone handling compressed gas cylinders.

**D. HAND TRUCKS**

Hand trucks are the recommended means of moving individual U-PHOS® Phosphine Fumigant cylinders about the fumigation site. The hand truck must be designed specifically for compressed gas cylinders and equipped with a suitable chain or strap to ensure the cylinder remains in place. Never move a U-PHOS® Phosphine Fumigant cylinder without valve cap and cylinder cap in place.

**E. RESPIRATORS**

**1. When Respiratory Protection Must Be Worn**

NIOSH approved self-contained breathing apparatus (SCBA) with full facepiece and operated in pressure-demand mode must be worn when concentrations are unknown.

**2. Permissible Gas Concentration Ranges For Respiratory Protection Devices**

A NIOSH approved, full-face gas mask phosphine canister may be used at levels up to 15 ppm. Respiratory protection (SCBA) must be worn if the concentration of phosphine is unknown or known to exceed the STELs for phosphine (1 ppm for 15 minutes) and/or carbon dioxide (30,000 ppm for 15 minutes).

Full face canister respirators shall not be used in phosphine concentrations above 15 ppm phosphine because of the presence of carbon dioxide. Although respiratory protection is not required for CO<sub>2</sub> exposure up to 5,000 ppm, a canister respirator will not provide protection for CO<sub>2</sub> at any concentration.

**3. Requirements for Availability of Respiratory Protection**

Respiratory protection must be available at the site of application in case it is needed when fumigating with U-PHOS® Phosphine Fumigant. At least two self-contained breathing apparatus (SCBA) with full facepiece and operated in pressure-demand mode must be available at the site of application. See the following table for the required minimum respiratory protection needed for different phosphine concentrations.

**NIOSH-RECOMMENDED RESPIRATORY PROTECTION FOR WORKERS EXPOSED TO PHOSPHINE GAS:**

CONDITION (Phosphine gas, ppm)	MINIMUM RESPIRATORY PROTECTION
0.3 – 3	Supplied-air respirator (SARs)
7.5 or less	Supplied-air respirator operated in a continuous-flow mode
15 or less	Self-contained breathing apparatus (SCBA) with full facepiece or supplied-air respirator with a full facepiece, or air-purifying full-facepiece respirator (gas mask) with a chin-style front- or back-mounted canister
50 or less	Supplied-air respirator equipped with a full facepiece and operated in pressure-demand mode or SCBA with a full facepiece and operated in a pressure-demand mode
More than 50 ppm	Do not enter until the phosphine level is 50 ppm or less

**F. NOTIFICATION REQUIREMENTS**

**1. Authorities and on-site workers:**

On an annual basis, prior to a fumigation, or more frequently if required by the Fumigation Management Plan, provide and review with local emergency committee officials (as defined by Emergency Planning and Community Right-to-Know Act (EPCRA) Section 301(c), the MSDS, Applicator’s Manual, and other relevant safety information, if available, for use in the event of an emergency.

**2. Incidents involving these products:**

Registrants must be informed of any incident involving the use of this product. Please call DEGESCH

AMERICA, INC., 540-234-9281/1-800-330-2525 so the registrant can report all incidents as per requirements of OSHA CFR 29.

## **VI. PLACARDING OF FUMIGATED AREAS**

The applicator must placard or post all entrances to the fumigated area or transport containers fumigated in-transit with signs in English and Spanish bearing:

1. The signal word “**DANGER/PELIGRO**” and the **SKULL** and **CROSSBONES** symbol in red.
2. The statement, “Area and/or commodity under fumigation. DO NOT ENTER/NO ENTRE”.
3. The statement, “This sign may only be removed after the commodity is completely aerated (contains 0.3 ppm or less phosphine gas and 5,000 ppm or less carbon dioxide). If incompletely aerated commodity is transferred to a new site, the new site must also be placarded and workers and nearby personnel must not be exposed to more than 0.3 ppm phosphine or 5,000 ppm carbon dioxide.”
4. The date and time fumigation began and expected completion date.
5. Trade name and EPA Registration number of fumigant used.
6. Name, address, and telephone number of the applicator.
7. All entrances to a fumigated area must be placarded. Placards must be placed in advance of the fumigation in order to keep unauthorized persons away. Do not remove a placard until the treated commodity is aerated down to 0.3 ppm or less of phosphine and 5,000 ppm or less of carbon dioxide (if used). To determine whether aeration is complete, each fumigated site or vehicle must be monitored and shown to contain 0.3 ppm or less phosphine gas and 5,000 ppm or less of carbon dioxide (if used) in the air space around and, when feasible, in the mass of the commodity. 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.
8. A Certified Applicator or person under his direct supervision must put placards in place after determining how many are required at the container or fumigation site and where they must be placed. An exception is when a trained worker receives raw agricultural commodities under in-transit fumigation and the commodity is transferred to another container before the contents are aerated. In this case, placarding is the responsibility of the trained worker.
9. Placards can only be removed by workers under the direct supervision of a certified applicator when the structure/container/vehicle is no longer under fumigation and aeration is complete. The person responsible for removing the placards is required to be familiar with the physical, chemical and toxicological properties of phosphine and carbon dioxide. They must also be knowledgeable in how to take gas readings, exposure limits, symptoms, and first aid treatment for phosphine and carbon dioxide poisoning.

## **VII. GAS DETECTION EQUIPMENT**

At all times there must be more than one each of phosphine and CO<sub>2</sub> (if used) detection equipment capable of measuring at least <0.3 ppm for phosphine and <5,000 ppm for CO<sub>2</sub> present at the stationary and in-transit fumigation and aeration sites. They must be periodically checked for accuracy. There are a number of devices on the market for the measurement of phosphine gas as well as carbon dioxide levels for industrial hygiene purposes. 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 must be used in full compliance with manufacturers’ recommendations.

## **VIII. AERATION OF FUMIGATED COMMODITIES**

### **A. FOODS AND FEEDS**

Tolerances for phosphine residues have been established at 0.1 ppm for animal feeds, grains, nuts, and dates; 0.01 ppm for processed foods, dry legumes, fresh fruits and vegetables. To guarantee compliance with these tolerances, it is necessary to aerate commodities for a minimum of 48 hours prior to offering them to the end-consumer. A shorter holding period may be permitted if the airborne phosphine concentration is found to be less than 0.1 ppm. Commodities may be analyzed before release to consumers to ensure that phosphine levels do not exceed tolerances. Fresh commodities fumigated under cold storage conditions must be aerated to 0.3 ppm very rapidly (one to two hours) in order to preserve quality – see the special instructions below.



### **SPECIAL INSTRUCTIONS FOR AERATION AFTER COLD STORAGE FUMIGATIONS:**

Cold storage chambers must be aerated rapidly in order to preserve the quality of the stored commodity. In order to aerate while keeping the commodity cold, use large fans and/or exhaust systems capable of replacing the air in the chamber with fresh air in about one to two hours. The aerated chamber must be tested and found to have airborne phosphine concentrations less than the TLV of 0.3 ppm before aeration is considered complete. Phosphine concentrations must be monitored continuously during aeration to ensure no worker exposure occurs. When aeration is complete, turn off the aeration fans, seal the door(s) and bring the temperature back down to the required cold storage temperature. If survivors are found following treatment, treated fruit must be kept in cold storage for up to 10 days following treatment.

To ensure bystander safety during rapid aeration of chambers containing fresh commodities fumigated under cold storage conditions, the following buffer zones must be maintained:

The required buffer zones vary based upon the volumes treated;

- 200 foot buffer for all aeration methods and fumigations  $\leq$ 100,000 cubic feet.
- 350 foot buffer for all aeration methods and fumigations  $\leq$ 500,000 cubic feet.
- 500 foot buffer for all aeration methods and fumigations  $>$ 500,000 cubic feet.

During the first 10 minutes of aeration, no one is permitted within the buffer zone surrounding the exhaust duct outlet. If the exhaust duct is not used for aeration, the buffer zone distances must be measured from the perimeter of the fumigated structure. In either scenario, no one is permitted within the buffer zone until the structure has aerated for 10 minutes and monitoring indicates that the level of phosphine gas is 0.3 ppm or below. For personal safety, gas levels should occasionally be monitored at greater distances, especially downwind to ensure this buffer zone is adequate.

Everyone within the aeration buffer zone must be made aware that a release of fumigant gas is about to take place. If personnel involved with the fumigation choose to remain in the area, they must wear minimum respiratory protection specified in Section V.E. Anyone not involved with the fumigation must evacuate and remain beyond the buffer zone. If people cannot be restricted from the buffer zone during regular work hours, aeration must be done during another time of day. When securing the duct outlet area, consider the direction of the wind and face the duct outlet toward an open area, and away from people. Always point the duct outlet upward to aid in dispersing the exhausted gas.

### **B. NON-FOOD COMMODITIES**

Aerate all non-food commodities to less than 0.3 ppm of phosphine. Continue to monitor densely packed commodities carefully.

### **C. TOBACCO**

Tobacco must be aerated to less than 0.3 ppm phosphine. When plastic liners are used, longer aeration periods will probably be required to aerate the commodity down to less than 0.3 ppm. A minimum aeration period of 48 hours is required.

## **IX. APPLICATOR AND WORKER EXPOSURE**

### **A. PHOSPHINE EXPOSURE LIMITS**

Exposure to phosphine must not exceed the 8-hour TWA of 0.3 ppm for applicators and workers during application. All persons in the treated site and in adjacent indoor areas are covered by this exposure standard. Such exposures might occur because of leakage into enclosed areas from fumigation sites or during transfer of unaerated commodity. The short-term exposure limit (STEL) is 1.0 ppm phosphine for 15 minutes.

### **B. CARBON DIOXIDE EXPOSURE LIMITS (IF USED)**

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. All persons in the treated site and in adjacent indoor areas are covered by this exposure standard. After application is completed, worker or applicator exposure must not exceed 5,000 ppm maximum concentration. Such exposures might occur because of leakage into enclosed areas from fumigation sites during transfer of unaerated commodity. An SCBA is required for any carbon dioxide concentrations exceeding the TLV or TWA.

### **C. APPLICATION OF FUMIGANT**

Because the release of U-PHOS® Phosphine Fumigant is not dependent on environmental conditions such as



temperature and humidity, phosphine release is instantaneous. This instantaneous release can expose the fumigator to immediate high levels of phosphine. If the fumigator's exposure exceeds the 8-hour TWA of 0.3 ppm of phosphine and the TLV of 5,000 ppm (0.5% by volume) of carbon dioxide (if used), approved respiratory protection such as an SCBA must be worn. Gas concentration measurements for safety purposes must be made using suitable low-level detection equipment (refer to PPE Section V.E.). See the "Industrial Hygiene Monitoring" section below. The STEL for phosphine is 1.0 ppm for 15 minutes. 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, adjacent, enclosed areas likely to be occupied must be monitored to ensure that significant leakage has not occurred. Sealing of the fumigated structure must be done to reduce exposure.

#### **E. AERATION AND RE-ENTRY**

If the structure is to be entered after fumigation, it must be aerated until the level of phosphine gas is 0.3 ppm or below and the level of carbon dioxide (if used) is 5,000 ppm (or 0.5% by volume) or below. The structure or site must be monitored to ensure that liberation of gas from the treated commodity does not result in the development of unacceptable levels of phosphine and carbon dioxide. Do not allow re-entry into treated structures by any person before this time unless protected by an approved respirator (refer to PPE Section V.E.).

#### **F. HANDLING UNAERATED COMMODITIES**

With the exception of commodities fumigated in cold storage, transfer of a treated commodity prior to complete aeration (including in-transit) is permissible. In the process, workers, people and animals in neighboring areas must not be exposed to phosphine and/or carbon dioxide in excess of the permitted exposure limits. 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 0.3 ppm phosphine or, when blending with CO<sub>2</sub>, 5,000 ppm of carbon dioxide. Workers who handle incompletely aerated commodity must be informed and appropriate measures must be taken (i.e., ventilation or respiratory protection (refer to PPE Section V.E.)) to prevent exposures from exceeding the exposure limits for phosphine and carbon dioxide. The transfer of unaerated containers or truck trailers over public roads is prohibited.

Fresh commodities fumigated in cold storage must be completely aerated before being handled.

#### **G. INDUSTRIAL HYGIENE MONITORING**

At each site and operation, monitor phosphine and carbon dioxide (if used) concentrations in all indoor and neighboring areas to which fumigators, other workers, and bystanders 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 (refer to PPE Section V.E.). After gas concentrations have been adequately characterized for various locations, spot-check those areas to determine whether conditions have significantly changed or if an unexpected garlic-like odor is present. Record all monitoring data in an operation log or manual.

#### **H. ENGINEERING CONTROLS AND WORK PRACTICES**

If initial monitoring shows that workers are exposed to concentrations in excess of the permitted exposure limits, then engineering controls (such as forced air ventilation) and/or appropriate work practices must be used (such as using personal exposure monitors) where possible to reduce exposure to below permitted limits. In any case, PPE must be worn if phosphine and/or carbon dioxide (if used) exposure limits are exceeded.

#### **X. 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. The user must read all of the following information contained in the 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, obstruct, remove or repair any part of the cylinder or the container valve or the valve protection device. Maintenance of the container shall be performed only by

- trained personnel under the direction of the container owner or an authorized representative.
3. The prescribed stamped marking 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 125°F (51.7°C).
  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.
  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 inspections and maintenance procedures should be provided by the supplier of 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 re-entry can be ensured.
  18. 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.

## **XI. STORAGE OF CYLINDERS**

### **A. GENERAL**

The first consideration when planning a storage area for U-PHOS® Phosphine Fumigant cylinders is the safety needs of the local authorities. It is important that emergency response professionals are aware of all hazardous materials stored in their jurisdiction. They must 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 must be developed for the site. This plan must define procedures and outline responsibilities in addressing emergency situations involving U-PHOS® Phosphine Fumigant. All site personnel must be trained in the plan and it must 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. Add security (locks) for the building. It is recommended that the building be made of non-combustible construction (1 hour fire rating), adequately ventilated and equipped with a continuous phosphine monitoring and alarm system that is activated at the TLV of 0.3 ppm. Operating personnel must not enter a building when the alarm is activated, without wearing a SCBA with full facepiece and operated in pressure-demand mode. Alternatively, an approved low range phosphine monitor can be used to ensure that phosphine levels are below the TLV of 0.3 ppm before entry into the storage. In some jurisdictions, the indoor storage of toxic gases is prohibited.

## **D. OUTDOOR STORAGE**

It is recommended that both full and used U-PHOS® Phosphine Fumigant cylinders be stored outdoors in a dedicated and properly designed and labeled 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**

U-PHOS® Phosphine Fumigant cylinders must not be stored where the temperature will exceed 125°F (51.7°C). Low temperatures will not affect U-PHOS® Phosphine Fumigant.

## **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. LABELING OF STORAGE**

The labeling of the U-PHOS® Phosphine Fumigant cylinders storage area must take into account the needs of a variety of organizations. These must include, but not be limited to corporate policy, insurance carrier, Occupational Safety and Health Administration (OSHA), Right-to-Know and local emergency response professionals. As a minimum, it is suggested that the storage be clearly marked with the following signs:

1. Danger, Poison (with skull and crossbones) placard
2. Flammable placard
3. Authorized Personnel Only
4. 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 U-PHOS® Phosphine Fumigant:

<b>Category</b>	<b>Degree of Hazard</b>
Health	4
Flammability	4
Reactivity	2

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 must be consulted for guidance on the selection and placement of such signs.

## XII. TRANSPORT

### A. GENERAL

U-PHOS® Phosphine Fumigant is classified as a poison gas and flammable gas by the United States Department of Transportation (DOT) and it shall only be transported in accordance with DOT regulations. All persons involved in the transport of or the preparation of cylinders for transport must be trained in and familiar with the specifications of 49 CFR (Code of Federal Regulations).

### B. TRANSPORT DESIGNATIONS

The following transport designations apply to U-PHOS® Phosphine Fumigant:

<b>Proper Shipping Name:</b>	Phosphine
<b>Hazard Class:</b>	2.3
<b>Subsidiary Class</b>	2.1
<b>Identification Number:</b>	UN 2199
<b>Shipping Label:</b>	Poison Gas Flammable Gas
<b>Additional Description:</b>	Poison Inhalation Hazard, Zone A

### C. TRANSPORT REQUIREMENTS

#### 1. Package Preparation

U-PHOS® Phosphine Fumigant cylinders shall not be transported unless:

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

#### 2. Cylinder Contents

Used U-PHOS® Phosphine Fumigant 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 U-PHOS® Phosphine Fumigant cylinders.

#### 3. Documents

Proper documentation is required by law for the transport of any hazardous material. The documentation accompanying the shipment of phosphine (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 must be trained in their preparation.

#### 4. Vehicle Loading

U-PHOS® Phosphine Fumigant cylinders shall only be loaded into unoccupied spaces of vehicles. All cylinders shall be secured from movement during transport.

#### 5. Vehicle Markings

Vehicles transporting U-PHOS® Phosphine Fumigant shall be placarded in accordance with Table I of 172.504 of 49 CFR. Consideration must be made for other hazardous materials that are concurrently being transported. Proper placarding must take into account all hazardous materials on board.

#### 6. Use of Common Carriers

Shipment of U-PHOS® Phosphine Fumigant cylinders by common carrier is permitted, provided the carrier meets certain criteria. Contact an authorized U-PHOS® Phosphine Fumigant distributor or DEGESCH AMERICA, INC. 540-234-9281/1-800-330-2525 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.

### **XIII. DISPOSAL**

Container handling: Refillable container. Refill this container with phosphine only. Do not reuse this container for any other purpose.

Once used, U-PHOS® Phosphine Fumigant 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 package. Disposal of the cylinder contents is prohibited. If the cylinder is partially full do not release the remaining gases; just return the cylinder to an authorized distributor.

### **XIV. SPILL AND LEAK PROCEDURES**

#### **A. GENERAL**

All releases can produce high levels of toxic phosphine gas and, therefore, attending personnel must wear a SCBA with full facepiece and operated in a pressure demand mode when the concentration of phosphine gas is unknown. If the concentration is known, other NIOSH approved respiratory protection must be worn (refer to PPE section V.E.).

This material is spontaneously flammable in air and may form an explosive mixture in air. In case of fire, stop flow of gas if it can be done without risk. Use water spray, alcohol foam, carbon dioxide or dry chemical to extinguish fires. Use water to keep cylinders cool.

#### **B. WHAT TO DO**

In the event of an accidental release, evacuate the area immediately and call for expert assistance. 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. If burning, and there is no risk to surroundings, let the fire burn itself out.

#### **C. WHO TO CALL**

DEGESCH AMERICA, INC. operates a 24-hour Emergency Response and Incident Management System (ERIM). For emergencies involving spills, call CHEMTREC: 1-800-424-9300. For emergencies involving leak, fire or exposure, call 911 or local Fire and Rescue or DEGESCH AMERICA, INC. Emergency Phone No. 1-800-424-9300. Outside the US or Canada call 540-234-9281.

#### **D. EMERGENCY RESPONDERS (Use Guide 119 from the Emergency Response Guidebook for First Responders)**

All emergency responses must be made in level B protection, which includes neoprene, butyl rubber or PVC, gloves; Seranex coated Tyvek suit, rubber boots and an air-supplied respirator (refer to PPE Section V.E.).