



**APPLICATOR'S MANUAL
FOR**



**DEGESCH FUMI-CEL®
and FUMI-STRIP®**

FOR CONTROL OF PESTS IN STORED GRAIN, PROCESSED FOODS,
FEEDS AND NON-FOOD COMMODITIES, INCLUDING TOBACCO

READ THE ENTIRE LABEL, APPLICATOR'S MANUAL AND GUIDANCE FOR
PREPARATION OF A FUMIGATION MANAGEMENT PLAN BEFORE USING.

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

RESTRICTED

DANGER



POISON

KEEP OUT OF REACH OF CHILDREN

GUARANTEE: Magnesium Phosphide 56%

REGISTRATION NO. 26188 PEST CONTROL PRODUCTS ACT

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THIS PRODUCT IS ACCOMPANIED BY AN APPROVED LABEL AND APPLICATOR'S MANUAL. READ AND UNDERSTAND THE ENTIRE LABEL AND APPLICATOR'S MANUAL. ALL PARTS OF THE LABEL AND MANUAL ARE EQUALLY IMPORTANT FOR SAFE AND EFFECTIVE USE OF THIS PRODUCT. CALL THE MANUFACTURER IF YOU HAVE ANY QUESTIONS OR DO NOT UNDERSTAND ANY PART OF THIS LABEL OR APPLICATOR'S MANUAL.

REFER TO THE APPLICATOR'S MANUAL FOR DETAILED PRECAUTIONS, RECOMMENDATIONS AND DIRECTIONS FOR USE.

HYDROGEN PHOSPHIDE-AIR MIXTURES AT CONCENTRATIONS ABOVE THE LOWER FLAMMABLE LIMIT MAY IGNITE SPONTANEOUSLY. IGNITION OF HIGH CONCENTRATIONS OF HYDROGEN PHOSPHIDE CAN PRODUCE A VERY ENERGETIC REACTION. EXPLOSIONS CAN OCCUR UNDER THESE CONDITIONS AND MAY CAUSE SEVERE PERSONAL INJURY. **NEVER ALLOW THE BUILD-UP OF HYDROGEN PHOSPHIDE TO EXCEED EXPLOSIVE CONDITIONS.** DO NOT CONFINE SPENT OR PARTIALLY SPENT DUST FROM METAL PHOSPHIDE FUMIGANTS, AS THE SLOW RELEASE OF HYDROGEN PHOSPHIDE FROM THIS MATERIAL MAY RESULT IN THE FORMATION OF AN EXPLOSIVE ATMOSPHERE.

NOTICE TO USER: This pest control product is to be used only in accordance with the directions on the label. It is an offence under the *Pest Control Products Act* to use this product in a way that is inconsistent with the directions on the label. The user assumes the risk to persons or property that arises from any such use of this product.

NATURE OF RESTRICTIONS: This product is for retail sale to and use only by appropriately provincially licensed persons for those uses covered by the applicator's certification or persons trained in accordance with the Applicator's Manual working under the direct supervision and in the physical presence of the certified applicator. Consult local pesticide regulatory authorities about use permits which may be required.

This product must be stored away from lodging for humans, animal quarters and normal work areas to avoid inadvertent exposure. This product is accompanied by an approved label, an Applicator's Manual and Guidance for Preparation of a Fumigation Management Plan. **READ AND UNDERSTAND THE ENTIRE LABELLING.**

RESTRICTED USES: For the treatment of space, grain pests in stored barley, cocoa beans, coffee beans, corn, cotton seeds, dates, dried peas, lentils, millet, nuts in shells, oats, peanuts, popcorn, rice, rye, sorghum, soybeans, sunflower seeds, triticale, wheat, all processed food and feeds. FumiCel® may also be used to fumigate bagged, packaged or treated cereal, grass, sorghum or small legume seeds destined for planting use only. Even distribution throughout the commodity is essential for good results. Refer to the Applicator's Manual for detailed Precautions, Recommendations and Directions for Use.

The time of required exposure is as follows:

Below 5°C	Do not fumigate
At 5-12°C	4 days are required
At 13-15°C	3 days are required
At 16-20°C	2 days are required

A 48-hour post-fumigation aeration period for the raw agricultural commodity (RAC) is required to ensure that phosphine residues fall within the maximum residue limit (MRL). For tobacco, aeration on hogsheads should be not less than three days; on any other type of storage, two days. Under no conditions shall food, feed and/or raw agricultural commodities which may be used directly as foods come into contact with aluminum or magnesium phosphide.

Phosphine gas may be hazardous to birds nesting on or near warehouses. Carefully inspect the outside of the structure prior to application of the fumigant to ensure the absence of nesting birds.

This product is not to be used for vacuum fumigations.

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

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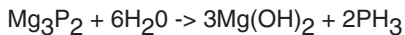
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1. INTRODUCTION

DEGESCH **FUMI-CEL®** plates and **FUMI-STRIP®** fumigants are used to protect stored commodities from damage by pests. Fumigation of stored commodities with these products in the manner prescribed on the label does not contaminate the marketed commodity.

DEGESCH metal phosphide fumigants are acted upon by atmospheric moisture to produce hydrogen phosphide (phosphine, PH₃) gas. The **FUMI-CEL®** plates and **FUMI-STRIP®** contain magnesium phosphide Mg₃P₂ as their active ingredient and will liberate hydrogen phosphide via the following chemical reaction:



Hydrogen phosphide gas is highly toxic to insects, burrowing pests, humans and other forms of animal life. In addition to its toxic properties, the gas will corrode certain metals and may ignite spontaneously in air at concentrations above its lower flammable limit of 1.8% (v/v). These hazards will be described in greater detail later on in this Applicator's Manual for DEGESCH **FUMI-CEL®** plates and **FUMI-STRIP®**.

The FUMI-CEL® Plates and FUMI-STRIP® will liberate only hydrogen phosphide gas. The Plates and Strips do not liberate ammonia and carbon dioxide since they contain no ammonium carbamate as do MAGTOXIN® and PHOS-TOXIN® products.

The **FUMI-CEL®** plates and **FUMI-STRIP®** have a polyethylene matrix which is impregnated with magnesium phosphide along with some inert ingredients. The plate measures about 17 cm by 28 cm and is 4 mm in. thickness (6-3/4 by 11 inches and is 5/32 inches in thickness). The **FUMI-STRIP®** is formed by attaching together, end to end, 20 of the **FUMI-CEL®** plates. The Strip measures 5.6 metres (18 feet 4 inches) in length and will liberate 660g (20 x 33g) of hydrogen phosphide gas. Strips and plates are packaged individually in gas-tight aluminum foil pouches. These pouches are **not** re-sealable. The pouches are in turn packed in a removable head drum, 120 plates or 6 strips, with a net weight of 14.04 kg and will evolve a total of 3960g of hydrogen phosphide gas.

Upon exposure to air, **FUMI-CEL®** plates and **FUMI-STRIP®** begin to react with atmospheric moisture to produce small quantities of hydrogen phosphide gas. This reaction starts slowly, gradually accelerates and then tapers off again as the magnesium phosphide is spent. Strips and plates react at about the same rate. Their rates of decomposition will vary depending upon moisture and temperature conditions. For example, when moisture and temperature are high, decomposition may be complete in less than 2 days. However, at lower ambient temperatures and humidity levels, decomposition may require 4 days or more.

FUMI-CEL® plates, and **FUMI-STRIP®** are much more reactive than **PHOSTOXIN** which contains aluminum phosphide as its active ingredient. Therefore, these products are better suited for fumigations conducted under cooler and drier conditions.

The **FUMI-CEL®** plates and **FUMI-STRIP®** remain intact after fumigation and retain all of the spent material. Plates and Strips must be retrieved for disposal at the end of the fumigation period. If properly exposed, the spent plates and strips will contain virtually no unreacted magnesium phosphide and may be disposed of without hazard. While not considered a hazardous waste, partially spent Plates and Strips will require special care. Precautions and instructions for further deactivation and disposal will be given later in this manual.

DEGESCH **FUMI-CEL®** plates and **FUMI-STRIP®** are supplied in gas-tight containers and their shelf life is unlimited as long as the packaging remains intact. Once pouches are opened for fumigation, the plates and Strips must be used following label instructions or deactivated for disposal. Storage and handling instructions will be given in detail later in the Applicator's Manual.

A summary of safety recommendations is outlined below:

SAFETY RECOMMENDATIONS SUMMARY

1. Carefully read the label and follow instructions within the Applicator's Manual explicitly.
2. Never fumigate alone from inside the storage structure. At least two persons, a certified applicator and trained person, or two trained persons under the direct supervision of the certified applicator must be present during fumigation of structures when entry into the structure for application of the fumigant is required.
3. At least two persons, a certified applicator and trained person, or two trained persons under the direct supervision of a certified applicator, must be present and must wear the proper safety equipment when a structure that is under fumigation is to be entered. Observe all provincial pesticide legislation requirements.
4. The certified applicator must maintain visual and/or voice contact with all fumigation workers during the application of the fumigants.
5. It is not necessary to wear gloves of other protective clothing when handling **FUMI-CEL®** plates and **FUMI-STRIP®**. However, wear dry gloves of cotton or other materials if contact with metal phosphide dust is likely. Wash hands thoroughly after handling metal phosphide materials.
6. Never open pouches in a flammable atmosphere. It is preferable to open them in open air, near a fan or other appropriate ventilation which will rapidly exhaust contaminated air.
7. Exposure to hydrogen phosphide must never exceed 0.1 ppm.
8. Piling of **FUMI-CEL®** plates and **FUMI-STRIP®** or the addition of liquid to the product is prohibited.
9. Dispose of empty containers and spent plates and strips in a manner consistent with the label instructions.
10. Post warning placards on fumigated areas as per instructions in Section 8.
11. Prior to fumigation, notify appropriate company employees.
12. Hydrogen phosphide fumigants are **not** to be used for vacuum fumigations.
13. Fumigated areas must be aerated to 0.1 ppm hydrogen phosphide or less prior to re-entry by unprotected workers.
14. Finished foods and feeds which have been fumigated with magnesium phosphide must be aerated for 48 hours prior to offering to the end consumer.

15. Transport of incompletely aerated commodities to a new site is permissible by rail or ship only, and the new storage site must be placarded if its concentration in phosphine is above 0.1 ppm. Trucks, vans, trailers and similar transport vehicles cannot be moved over public roads or highways until they are aerated and the warning placards removed. If workers must handle incompletely aerated commodity, they are to wear appropriate respiratory protection (see Respiratory Protection section).
16. Keep pouches of **FUMI-CEL®** plates and **FUMI-STRIP®** closed except while removing product for application.
17. Phosphine will corrode copper and precious metals at high concentrations or humidities. Protection or removal of wiring, sensitive equipment or precious metals is recommended under these conditions.
18. **FUMI-CEL®** plates and **FUMI-STRIP®** may be used for the fumigation of packaged goods, processed foods and other commodities where direct contact with metal phosphide fumigant or its reacted residue is illegal or not desired. Under no circumstances shall any processed food, feed or bagged commodity come into direct contact with metal phosphide fumigants or a raw agricultural commodity that will be used directly as a food without further processing.
19. Do not use magnesium phosphide containers of any purpose other than recycling or reconditioning.
20. Pre-exposure screening of employees to detect impaired pulmonary function if recommended. Any employees developing this condition should be referred for medical examination.
21. Theft of product: Immediately report to the local police department thefts of metal phosphide fumigants.
22. Registrant must be informed of any incident involving the use of this product.

2. **FIRST AID**

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

FIRST AID RESPONDER PROTECTION: Phosphine gas is a highly toxic systemic poison and a severe respiratory tract irritant. Persons exposed to solid phosphides, which react with moisture to produce phosphine gas, can pose risks to others if phosphides are on clothes, skin, or hair. First Aid responders should protect themselves through the use of appropriate personal protective equipment before attempting to rescue or care for a person who has been exposed to a phosphine-releasing product, and/or if entering a zone with potentially unsafe phosphine levels. A NIOSH/MSHA approved self-contained breathing apparatus (SCBA) operated in a positive pressure mode is recommended in response situations that involve exposure to potentially unsafe or unknown levels of phosphine (see the PRECAUTIONS section of product label or applicator's manual for further guidance regarding personal protective equipment).

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

IF SWALLOWED: Call a poison control centre or doctor immediately for treatment advice. **DO NOT DRINK WATER.** Do not administer anything by mouth or make the person vomit. It is likely that this exposure will lead to spontaneous vomiting.

IF ON SKIN OR CLOTHING: Brush or shake material off clothes and shoes in a well ventilated area. Allow clothes to aerate in a ventilated area prior to laundering. Do not leave contaminated clothing in occupied and/or confined areas such as automobiles, vans, motel rooms, etc. Wash contaminated skin thoroughly with soap and water for 15-20 minutes. Call a poison control centre or doctor for further treatment advice.

IF IN EYES: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control centre or doctor for treatment advice.

HOT LINE NUMBER

Have the product container label or Applicator's Manual with you when calling a poison control centre, doctor, or when going for treatment. **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 or, GARDEX CHEMICALS, LTD. 416-675-1638. For all other chemical emergencies, please contact CHEMTREC – 1-800-424-9300 or Canadian Transport Emergency Centre (CANUTEC) 613-996-6666.

3. TOXICOLOGICAL INFORMATION

Magnesium phosphide Fumi-Cel® plates or Fumi-Strips® will react with moisture from the air, acids and many other liquids to release hydrogen phosphide (phosphine, PH₃) gas. Mild exposure by inhalation causes malaise (indefinite feeling of sickness), ringing in the ears, fatigue, nausea and pressure in the chest which is relieved by removal to fresh air. Moderate poisoning causes weakness, vomiting, pain just above the stomach, chest pain, diarrhea and dyspnea (difficulty in breathing). Symptoms of severe poisoning may occur within a few hours to several days resulting in pulmonary edema (fluid in lungs) and may lead to dizziness, cyanosis (blue or purple skin colour), unconsciousness, and death.

In sufficient quantity, phosphine affects the liver, kidneys, lungs, nervous system and circulatory system. Inhalation can cause lung edema (fluid in lungs) and hyperaemia (excess of blood in a body part), small perivascular brain hemorrhages and brain edema (fluid in brain). Metal phosphide fumigants are poisonous if swallowed. Ingestion can

cause lung and brain symptoms, but damage to the viscera (body cavity organs) is more common. Phosphine poisoning may result in (1) pulmonary edema, (2) liver elevated serum GOT, LDH and alkaline phosphatase, reduced prothrombin, hemorrhage and jaundice (yellow skin colour) and (3) kidney hematuria (blood in urine) and anuria (abnormal or lack of urination). Pathology is characteristic of hypoxia (oxygen deficiency in body tissue). Frequent exposure to concentrations above permissible levels over a period of days or weeks may cause poisoning. Treatment is symptomatic.

The following measures are suggested for use by the physician in accordance with his/her own judgement:

In its milder forms, symptoms of poisoning may take some time (up to 24 hours) to make their appearance, and the following is suggested.

1. Give complete rest for 1-2 days, during which the patient must be kept quiet and warm.
2. Should patient suffer from vomiting or increased blood sugar, appropriate solutions should be administered.

Treatment with oxygen breathing equipment is recommended as is the administration of cardiac and circulatory stimulants.

In cases of severe poisoning (intensive Care Unit recommended):

1. Where pulmonary edema is observed, steroid therapy should be considered and close medical supervision is recommended. Blood transfusions may be necessary.
2. In case of manifest pulmonary edema, venesection should be performed under vein pressure control. Heart glycosides (I.V.) (in case of haemoconcentration, venesection may result in shock). On progressive edema of the lungs: immediate intubation with a constant removal of edema fluid and oxygen over-pressure respiration, as well as any measures required for shock treatment. In case of kidney failure, extracorporeal haemodialysis is necessary. There is no specific antidote known for this poisoning.
3. Mention should be made of suicidal attempts by taking solid phosphide by mouth. After swallowing: emptying of the stomach by vomiting, flushing of the stomach with diluted potassium permanganate solution or a solution of magnesium peroxide until flushing liquid ceases to smell of carbide. Thereafter, apply medicinal charcoal.

4. PRECAUTIONS

- 4.1 Hazardous to Humans and Domestic Animals and Nesting Birds – KEEP OUT OF REACH OF CHILDREN**

If this pest control product is to be used on a commodity that may be exported to the U.S. and you require information on acceptable residue levels in the U.S., visit CropLife Canada's web site at www.croplife.ca

DANGER: Magnesium phosphide from DEGESCH **FUMI-CEL®** plates, and **FUMI-STRIP®** may be fatal if swallowed. Do not get dust in the eyes, on skin or on clothing. Do not eat, drink or smoke while handling magnesium phosphide fumigants. If a sealed pouch is opened, or if the material comes into contact with moisture, water or acids, these products will release hydrogen phosphide (phosphine, PH_3) which is an extremely toxic gas. The **FUMI-CEL®** plates and **FUMI-STRIP®** do not liberate ammonia and carbon dioxide since they contain no ammonium carbamate. If a garlic odour is detected, refer to the Industrial Hygiene Monitoring section 6 of the Applicator's Manual for appropriate monitoring procedures. Pure hydrogen phosphide gas is odourless; the garlic odour is due to a contaminant. Since the odour of hydrogen phosphide may not be detected under some circumstances, the absence of a garlic odour does not mean that dangerous levels of hydrogen phosphide gas are absent. Observe proper reentry procedures specified elsewhere on the label and Applicator's Manual to prevent overexposure. In situations where ventilation of buildings is required following fumigation (e.g. warehouses), phosphine gas may pose a potential hazard to small birds (e.g. swallows) nesting on or near those structures. Therefore, carefully inspect the outside of the structure prior to application of the fumigant to ensure the absence of nesting birds.

4.2 Physical and Chemical Hazards

Magnesium phosphide in **FUMI-CEL®** plates and **FUMI-STRIP®** will release hydrogen phosphide if exposed to moisture from the air or if it comes into contact with water, acids and many other liquids. Magnesium phosphide is considerably more reactive than is aluminum phosphide and will liberate gas more rapidly. This is particularly true in the presence of liquid water and at higher temperatures. Since hydrogen phosphide may ignite spontaneously at levels above its lower flammable limit of 1.8% (v/v), it is important not to exceed this concentration. Ignition of high concentrations of hydrogen phosphide can produce a very energetic reaction. Explosions can occur under these conditions and may cause severe personal injury. Never allow the buildup of hydrogen phosphide to exceed explosive concentrations. Do not confine spent or partially spent metal phosphide fumigants as the slow release of hydrogen phosphide from this material may result in formation of an explosive atmosphere. Piling of **FUMI-CEL®** plates and **FUMI-STRIP®** or the addition of liquid to the product is prohibited. This may cause a temperature increase, increase the rate of gas production and confine the gas so that ignition could occur.

It is preferable to open containers of magnesium phosphide products in open air as under certain conditions, they may flash upon opening. Containers may also be opened near a fan or other appropriate ventilation which will rapidly exhaust contaminated air. When opening pouches of **FUMI-CEL®**

plates or **FUMI-STRIP®**, point the pouch away from the face and body and cut open the far end. Although the chances for a flash are very remote, never open pouches containers of metal phosphide fumigants in a flammable atmosphere. These precautions will also reduce the fumigator's exposure to hydrogen phosphide.

Pure phosphine (hydrogen phosphide) gas is practically insoluble in water, fats and oils, and is stable at normal fumigation temperatures. However, phosphine will corrode copper and precious metals at high concentrations or humidities. Protection or removal of wiring, sensitive equipment or precious metals is recommended under these conditions. 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 electrical equipment should be protected or removed before fumigation. Hydrogen phosphide will also react with certain metallic salts and, therefore, sensitive items such as photographic film, some inorganic pigments, etc., should not be exposed.

4.3 **Environmental Hazards**

DO NOT contaminate irrigation or drinking water supplies or aquatic habitats such as lakes, rivers, sloughs, ponds, prairie potholes, creeks, marshes, streams, reservoirs and wetlands by cleaning or equipment or disposal of wastes.

5. **PROTECTIVE CLOTHING**

Wear dry gloves of cotton or other breathable material if contact with dust from **FUMI-CEL®** plates **OR FUMI-STRIPS®** is likely. Wear a loose fitting long sleeve shirt, long pants, shoes and socks. After fumigation activities, remove all protective clothing, aerate in a well ventilated area, then wash thoroughly, separately, before re-use.

If magnesium phosphide dust becomes trapped inside clothing, remove clothing, wash hands and exposed skin thoroughly, shower and change into clean clothing.

If application of fumigant is performed from within the structure to be fumigated, approved respiratory protection against phosphine must be worn during fumigation, by all personnel in the structure (see below).

6. **RESPIRATORY PROTECTION**

6.1 **When Respiratory Protection Must Be Worn**

NIOSH/MSHA approved respiratory protection must be worn if worker exposure limits cannot be met through engineering controls (such as forced air ventilation) and/or appropriate worker practices. For example, if application of the fumigant is performed from within the structure to be fumigated, approved respiratory protection is required to be worn by all personnel inside the structure. Respiratory protection is also required to be worn upon reentry into a partially aerated structure, (e.g. upon initiation of aeration or after

eration when testing for re-entry), and when attending to spills and leaks. When required, gas concentration measurements for safety purposes may be made using low level detector tubes*. See the section on Applicator and Worker Exposure for monitoring requirements.

The respiratory protection must fit properly, any obstruction to a proper fit should be removed (e.g. beard, long sideburns).

*Information on hydrogen phosphide (phosphine, PH_3) detector tubes may be obtained from your distributor.

6.2 **Permissible Gas Concentration Ranges for Respiratory Protection Devices**

A NIOSH/MSHA approved, air-purifying full-face gas mask with a chin style mounted canister approved for phosphine OR a NIOSH/MSHA approved supplied-air respirator with a full face piece must be used at levels up to 5 ppm. Above this level or in situations where the hydrogen phosphide concentration is unknown, a NIOSH/MSHA approved, self-contained breathing apparatus (SCBA) or its equivalent must be worn and operated in a positive pressure mode. Observe provincial pesticide regulations.

6.3 **Requirements for Availability of Respiratory Protection for outside applications**

Respiratory protection must also be available for applications from outside the area to be fumigated, or outdoor applications even if exposures above the permitted exposure limits are not expected. Observe Provincial pesticide regulations.

7. **APPLICATOR AND WORKER EXPOSURE**

7.1 **Hydrogen Phosphide Exposure Limits**

Exposure to hydrogen phosphide gas must never exceed 0.1 ppm for applicators and workers during application. Application is defined as the time period covering the opening of the first container, applying the appropriate dosage of fumigant and closing up the site to be fumigated. All persons in the treated site and in adjacent indoor areas are covered by this exposure standard. Periodic gas measurements should be made in the worker's breathing zone using phosphine detector tubes or another suitable detector, unless they are protected by a NIOSH/MSHA approved supplied air respirator operated in a positive pressure mode.

7.2 **Application of Fumigant**

Depending upon temperature and humidity, DEGESCH **FUMI-CEL®** plates and **FUMI-STRIP®** will release hydrogen phosphide gas slowly upon exposure to moisture from the air. If the fumigator's exposure exceeds 0.1 ppm, approved respiratory protection must be worn. If **FUMI-CEL®** plates and **FUMI-STRIP®** is to be applied from within the structure to be fumigated, approved respiratory protection must be worn by all personnel inside the struc-

ture. When required, gas concentration measurements for safety purposes may be made using low level detector tubes. See the information on Industrial Hygiene Monitoring in Section 6.6 of this Applicator's Manual.

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

7.3 **Leakage from Fumigated Sites**

Hydrogen phosphide 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 should be examined to ensure that significant leakage has not occurred. Sealing of the fumigated site and/or air flow in the occupied areas must be sufficient to meet exposure standards.

7.4 **Aeration and Reentry**

If the area is to be entered after fumigation, it must be aerated until the level of hydrogen phosphide gas is 0.1 ppm or below. The area 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 hydrogen phosphide. Do not allow reentry into treated areas by any person before this time unless protected by an approved respirator. A NIOSH/MSHA approved self-contained breathing apparatus with a positive pressure mode must be worn during testing of the phosphine level and during initiation of aeration, if re-entry of the fumigated structure is necessary.

7.5 **Handling Unaerated Commodities**

Exposure to hydrogen phosphide must never exceed 0.1 during moving, storage or processing of incompletely aerated commodities.

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

7.6 **Industrial Hygiene Monitoring**

Periodic gas measurements should be made in the worker's breathing zone using phosphine detector tubes or another suitable detector, unless they are protected by a NIOSH/MSHA approved supplied air respirator operated in a positive pressure mode.

It is recommended that hydrogen phosphide exposures be documented in an operations log or manual for each site and operation where exposures may occur. The purpose of this monitoring is to prevent excessive exposures, to verify whether the appropriate respiratory protection is being worn

during fumigation within a structure and whether respiratory protection is required upon re-entry after aeration. This monitoring is mandatory although, once exposures have been adequately characterized, subsequent monitoring is not routinely required. However, spot checks should be made occasionally, especially if conditions change significantly or if an unexpected garlic odour is detected. Gas measurements should be made in the worker's breathing zone. Monitoring is not required for outdoor operations.

There are a number of devices on the market for measurement of hydrogen phosphide gas levels for industrial hygiene purposes. One of these is the hydrogen phosphide detector tube used in conjunction with the appropriate hand-operated air sampling pump. These devices are reliable, simple to use, do not require extensive training and are relatively rapid, inexpensive and accurate. Low level detector tubes are available which can detect 0.1 ppm and are suitable for industrial hygiene monitoring. Information on hydrogen phosphide (phosphine, PH₃) detector tubes may be obtained from your distributor.

8. PLACARDING OF FUMIGATED AREAS

The applicator must placard or post all entrances to the structures under fumigation with placards at least 35cm long and 25cm wide that are made of substantial material that can be expected to withstand adverse weather conditions bearing the following information:

1. The signal word DANGER in letters at least 7 cm high and the SKULL AND CROSSBONES symbol in red.
2. The statement "Area and/or commodity under fumigation, DO NOT ENTER".
3. The statement, "This sign may only be removed after fumigated area/commodity is completely aerated (contains 0.1 ppm or less of hydrogen phosphide gas). Transport of incompletely aerated commodities is permissible by rail or ship only and the new storage site must be placarded if its concentration is above 0.1 ppm. If workers must handle incompletely aerated commodity, or reenter incompletely aerated area, appropriate respiratory protection must be worn".
4. The date and time fumigation begins and date and time which aeration can begin.
5. Name of fumigant used.
6. Name, address and telephone number of the licenced applicator.
7. Placards must bear a 24-hour emergency response telephone number.

All entrances to the fumigated and deactivation areas must be placarded. Where possible, placards should be placed in advance of the fumigation to keep unauthorized persons away.

For railroad hopper cars, placards must be placed on both sides of the car near the ladders and next to the top hatches into which the fumigant is introduced.

Do not remove placards until the treated commodity is aerated down to 0.1 ppm hydrogen phosphide or less. To determine whether aeration is complete, each fumigated

site or vehicle must be monitored and shown to contain 0.1 ppm or less hydrogen phosphide gas in the air space around and, if feasible, in the mass of the commodity.

It is recommended that the persons responsible for removing placards be familiar with the physical, chemical and toxicological properties of hydrogen phosphide. They should also be knowledgeable in making gas concentration measurements, exposure limits and symptoms and first aid treatment for hydrogen phosphide poisoning.

9. FUMIGATION MANAGEMENT PLAN

The certified applicator is responsible for working with the owners and/or responsible employees of the site to be fumigated to develop and follow a Fumigation Management Plan (FMP). 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. Inspect the site to determine its suitability for fumigation.
2. When sealing is required, consult previous records for any changes to the structure, seal leaks, and monitor any occupied adjacent buildings to ensure safety.
3. Prior to each fumigation, review any existing FMP, MSDS, Applicator's Manual and other relevant safety procedures with company officials and appropriate employees.
4. 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.
5. 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.
6. Consult with company officials to develop procedures for local authorities to notify nearby residents in the event of an emergency.
7. Confirm the placement of placards to secure entrance into any structure under fumigation.
8. Confirm the required safety equipment is in place and the necessary manpower is available to complete a safe and effective fumigation.
9. notification must be provided to the receiver of a vehicle that is fumigated in transit (i.e., fumigation in transit is permitted by rail or ship only).

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 should 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 and the Applicator's Manual and follow its directions carefully. If the applicator has any questions about the development of a FMP, contact the supplier for further assistance.

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

GUIDANCE FOR PREPARATION OF A FUMIGATION MANAGEMENT PLAN

Purpose

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

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

Before any fumigation begins, carefully read and review the 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 site. Preparation is the key to any successful fumigation. If you do not find specific instructions for the type of fumigation that you are to perform listed in this Guidance Document, you will want to construct a similar set of procedures using this document as your guide or contact Degesch America, Inc. for assistance. Finally, before any fumigation begins, you must be familiar with and comply with all applicable federal, provincial and municipal laws and regulations. The success of the fumigation is not only dependent on your ability to do your job but also upon carefully following all rules, regulations and procedures required by governmental agencies.

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 site.

A. PRELIMINARY PLANNING AND PREPARATION

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

2. Determine the type of fumigation. For example:
 - a. Space: tarp, mill, warehouse, food processing plant,

- b. Vehicle: railcar, truck, van, container
 - c. Commodity: raw agricultural or processed foods or non-food
 - d. Type of storage: vertical silo, farm storage, flat storage, etc.
 - e. Vessels: ship or barge. In addition to the Applicator's Manual, read the Cargo, Fumigation and Tackle Regulations under the *Canada Shipping Act, 2001*.
3. Fully acquaint yourself with the site and commodity to be fumigated, including:
- a. The general structure layout, construction (materials, design, age, maintenance), of the structure, fire or combustibility hazards, connecting structures and escape routes, above and below ground, and other unique hazards or structural characteristics. Prepare, with the owner/operator/person in charge, a drawing or sketch of structure to be fumigated, delineating features, hazards, and other structural characteristics.
 - b. The number and identification of persons who routinely enter the area to be fumigated (i.e. employees, visitors, customers, etc.)
 - c. The specific commodity to be fumigated, its mode of storage, and its condition.
 - d. The previous treatment history of the commodity, if available.
 - e. Accessibility of utility service connections
 - f. Nearest telephone or other means of communication. Mark the location of these items on the drawing/sketch.
 - g. Emergency shut-off stations for electricity, water and gas. Mark the location of these items on the drawing/sketch.
 - h. Current emergency telephone numbers of local health, fire, police, hospital and physician responders.
 - i. Name and phone number (both day and night) of appropriate company officials.
 - j. Check, mark and prepare the points of fumigant application locations if the job involves entry into the structure for fumigation.
 - k. Review labeling and Applicator's Manual
 - l. Location of command centre
 - m. Exposure time considerations:
 - 1. Product (tablet and pellets and sachet) to be used
 - 2. Minimum fumigation period, as defined and described by the label use directions.
 - 3. Down time required to be available
 - 4. Aeration requirements
 - 5. Cleanup requirements, including dry or wet deactivation methods, equipment, and personnel needs, if necessary.
 - 6. Measured and recorded commodity temperature and moisture
 - n. Determination of dosage:
 - 1. Cubic footage or other appropriate space/location calculations
 - 2. Structure sealing capability and methods

3. Label recommendations
 4. Temperature, humidity, wind
 5. Commodity/space volume
 6. Past history of fumigation of structure
 7. Exposure time
 8. Amount of fumigant used
 9. Actual concentration achieved
- o. to other on-site and neighbouring off-site structures, recreational areas or areas where bystanders may be exposed.
 - p. Site of aeration vent(s) to be opened to aerate structure.

B. PERSONNEL

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

C. MONITORING

1. Safety
 - a. Scheduled ambient air monitoring of phosphine concentrations must be conducted, downwind, along the fumigation boundary to prevent worker and bystander exposure to concentrations of hydrogen phosphide ≥ 0.1 ppm*** and to determine where exposures may occur. It may be necessary to monitor gas levels in other areas as well. Document where monitoring will occur.
 - b. Monitor (and record) the wind direction and adjust the phosphine monitoring if wind direction changes over the fumigation/aeration period.
 - c. Keep a log or manual of monitoring records for each fumigation site. This log must, at a minimum, contain the timing, number of readings taken and level of concentrations found in each location.

- d. When monitoring, document any phosphine level even if it is present below the limit of detection.
- e. Outdoor air monitoring must be conducted during fumigation and aeration and corrective action must be taken if gas levels exceed the allowed levels in an area where bystanders and/or nearby residents or domestic animals may be located. Monitor gas levels at the fumigation boundary (downwind locations) continuously for one hour, commencing six hours after the introduction of phosphine gas, followed by once every six hours to the beginning of aeration. During aeration, monitor gas levels continuously until the structure is ready for re-entry.

*****NOTE: An evacuation action is necessary when phosphine levels exceed 0.1 ppm.** To determine phosphine levels, a properly calibrated digital portable gas monitoring unit is needed with alarm capability for the STEL and TWA. (e.g., Draeger Mini Warn, Draeger Micro Pac Plus, Draeger, Pac III, Draeger Multi Warn, Porta Sens or similar equipment).

2. Efficacy

- a. Phosphine readings should be taken from within the fumigated structure to insure proper gas concentrations, along with temperature and relative humidity readings. Readings must be taken immediately after introduction of the product, six hours after the introduction of the product followed by a reading every twelve hours during the fumigation period. Finally, phosphine readings should be taken every thirty minutes until aeration is complete.
- b. All phosphine, temperature and relative humidity readings should be documented.

D. NOTIFICATION

1. Confirm all the appropriate local authorities (fire departments, police departments, etc.) have been notified as per label instructions, local ordinances, or instructions of the client.
2. Prepare written procedure (“Emergency Response Plan”), which contains explicit instructions, names, and telephone numbers so as to be able to notify local authorities if phosphine levels are exceeded in an area that could be dangerous to bystanders and/or domestic animals. Elaborate in this section the key elements of an Emergency Response Plan including reference to evacuation procedures, etc.
3. Confirm that the receiver of in-transit vehicles under fumigation have been notified and are trained according to Section 10.6.1 of this Applicator’s Manual.

E. SEALING PROCEDURES

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

1. Plan carefully and apply the product 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.
3. Apply fumigant from the outside when and where appropriate.
4. Provide watchmen when the possibility of entry into the fumigation site by unauthorized person cannot otherwise be assured (e.g., by secondary locks, barricades, etc.).
5. When entering structures, always follow applicable provincial legislation for confined spaces.
6. Document that the receiver of vehicles/containers fumigated in-transit has been notified.
7. Turn off any electric lights in the fumigated area of the structure, as well as all non-essential electrical motors.

G. POST-APPLICATION OPERATIONS

1. Provide watchmen when you cannot secure the fumigation site from entry (e.g., by secondary locks, barricades, etc.) by unauthorized persons during the aeration process.
2. Ventilate and aerate in accordance with structural limitations and nearby occupied areas so as to minimize bystander exposure.
3. Turn on ventilating or aeration fans where appropriate.

4. Determine gas concentration in the fumigated environment from outside if possible. Use a sufficiently sensitive gas detector before re-entry into a fumigated structure to determine fumigant concentration.
5. During aeration, monitor gas levels continuously until the structure is ready for re-entry.
6. Keep written records of monitoring to document completion of aeration.
7. Consider temperature when aerating.
8. Ensure that aeration is complete before moving a treated vehicle onto public roads.
9. Remove warning placards when aeration is complete and the fumigated space has been cleared for re-entry using a detection device of sufficient sensitivity.
10. Inform business/client that employees/other persons may return to work or otherwise be allowed to re-enter the aerated structure.

10. DIRECTIONS FOR USE

10.1 General

- 10.1.1 The use of DEGESCH **FUMI-CEL®** plates and **FUMI-STRIP®** is restricted due to the acute inhalation toxicity of hydrogen phosphide (phosphine, PH_3) gas. These products are for retail sale to and use only by provincially licenced applicators for those uses covered by the applicator's certification or worker's trained in accordance with the Applicator's Manual working under the direct supervision and in the physical presence of the provincially licenced applicator. Physical presence means on site or on the premises. Read and follow the label and the Applicator's Manual which contains complete instructions for the safe use of this pesticide.
- 10.1.2 Magnesium phosphide is a highly hazardous materials and should be used only by individuals trained in their proper use. Before using, read and follow all label precautions and directions.

Additional copies of this Manual are available from:

DEGESCH America, Inc.
153 Triangle Drive
P. O. Box 116
Weyers Cave, VA 24486
Telephone: 540-234-9281/1-800-330-2525
Fax: 540-234-8225
Internet: www.degeschamerica.com
E-Mail: degesch@degeschamerica.com

Gardex Chemicals Ltd.
7 Meridian Road
Etobicoke, Ontario M9W 4Z6
Tel. 416-675-1638

10.1.3 Persons working with magnesium phosphide should be knowledgeable of the hazards of these products and trained in the use of required respiratory equipment and detector devices, emergency procedures, and use of these fumigants.

10.1.4 At least two persons, a certified applicator and trained person, or two trained persons under the direct supervision of the certified applicator must be present during fumigation of structures when entry into the structure for application of the fumigant is required.

At least two persons, a certified applicator and trained person, or two trained persons under the direct supervision of a certified applicator, must be present and must wear the proper safety equipment when a structure that is under fumigation is to be entered.

The certified applicator must maintain visual and/or voice contact with all fumigation workers during the application of the fumigants.

Large scale (permit) fumigations may require the posting of guards to prevent entry into the area under fumigation. Refer to Provincial pesticide regulations.

10.1.4 Shipholds, barges, containers on ships, railroad cars and containers shipped piggyback by rail may be fumigated in-transit. Aeration of railcars, railroad boxcars or shipping containers is prohibited en route.

Trucks, vans, trailers and similar transport vehicles cannot be moved over public roads or highways until they are aerated and the warning placards removed.

10.1.5 Do not fumigate commodities with Plates or Strips when commodity temperature is below 5°C (40°F).

10.1.6 The site to be fumigated must first be inspected to determine if it can be made sufficiently gas tight. Then a plan should be developed to provide for safe and efficient application of the fumigant to include

emergency procedures, etc., where required, and to decide how monitoring should be conducted to prevent excessive exposures.

- 10.1.7 Hydrogen phosphide gas may flash at concentrations above its flammable limit of 1.8% (v/v). Therefore, always open pouches of metal phosphide fumigants in open air and never in a flammable atmosphere. This precaution will not only prevent harm in the unlikely event of a flash but will reduce the applicator's exposure to hydrogen phosphide gas.

Contact with liquids is prohibited when applying **FUMI-CEL®** plates and **FUMI-STRIP®** treatment of bulk commodities or space. Liquids in contact with unreacted magnesium phosphide will greatly accelerate the production of hydrogen phosphide gas which would result in a toxic and/or fire hazard.

- 10.1.8 Piling of **FUMI-CEL** plates, **FUMI-STRIP®**, dust from their fragmentation or the addition of liquid is prohibited. Liquid may speed up the reaction, cause a temperature increase and confine the gas so that ignition could occur.
- 10.1.9 As much as is possible, protect unused Plates and Strips from excessive exposure to atmospheric moisture during application.
- 10.1.10 Hydrogen phosphide gas may react with certain metals and their salts to produce corrosion. This gas is corrosive to copper, copper alloys and precious metals such as silver and gold. Sensitive equipment and items containing these elements should be removed or protected prior to fumigation with **FUMI-CEL®** plates or **FUMI-STRIP®**.
- 10.1.11 Under no circumstances shall any processed food, feed or bagged commodity come into direct contact with **FUMI-CEL** plates, **FUMI-STRIP®** or residual dust, or a raw agricultural commodity that will be used directly as a food without further processing.
- 10.1.12 IF **FUMI-CEL/FUMI-STRIP** IS TO BE APPLIED FROM WITHIN THE STRUCTURE TO BE FUMIGATED, APPROPRIATE RESPIRATORY PROTECTION MUST BE WORN BY ALL PERSONNEL IN THE STRUCTURE. A NIOSH/MSHA approved, air-purifying full-face gas mask with a chin style mounted canister approved for phosphine OR a NIOSH/MSHA approved supplied-air respirator with a full-face piece must be used at levels up to 5 ppm. Above this level or in situations where the hydrogen phosphide concentration is unknown, a NIOSH/MSHA approved, self-contained breathing apparatus (SCBA) or its equivalent, operated in a positive pressure mode, must be used. Respiratory protection need not be worn but must be available for outdoor applications, even if exposure above the allowable limit is not expected.

- 10.1.13 Notify appropriate company employees prior to fumigation. Provide to local officials (fire department, rescue squad, police, etc.) on an annual basis relevant safety information for use in the event of an emergency.
- 10.1.14 It is not necessary to wear gloves or other protective clothing when handling **FUMI-CEL®/FUMI-STRIP®**. However, wear dry gloves of cotton or other breathable material if contact with Fumi-Cel/Fumi-Strip plates or dust is likely. Wash hands thoroughly after using Fumi-Cel/Fumi-Strip.

10.2 Pests Controlled

FUMI-CEL® plates and **FUMI-STRIP®** have been found effective against the following pests and their preadult stages—that is, eggs, larvae and pupae:

almond moth	flat grain beetle	mice
Angoumois grain moth	flour beetle	nematodes
bean weevil	fruit flies (small)	pink bollworm
bees	grain moth	raisin moth
cadelle	grainary weevil	red flour beetle
cereal leaf beetle	greater wax moth	rice weevil
cigarette beetle	hairy fungus beetle	rodents
cockroaches	Hessian fly	rusty grain beetle
confused flour beetle	Indian meal moth	saw-toothed grain beetle
dermestid beetles	Khapra beetle	spider beetles
dried fruit beetle	lesser grain borer	tobacco moth
dried fruit moth	maize weevil	yellow mealworm
drug store beetle	Mediterranean flour moth	wood boring beetles
European grain moth	merchant grain beetle	

Rodent pests may also be controlled using **FUMI-CEL®** plates and **FUMI-STRIP®**. Although it is possible to achieve total control of the listed insect pests, this is frequently not realized in actual practice. Factors contributing to less than 100% control are leaks, poor gas distribution, unfavorable exposure conditions, etc. In addition, some pests are less susceptible to hydrogen phosphide than others. If maximum control is to be attained, extreme care must be taken in sealing, the higher dosages must be used, exposure periods lengthened, proper application procedures followed and temperature and humidity conditions must be favorable.

10.3 Exposure Conditions

The following table may be used as a guide in determining the minimum length of the exposure period at the indicated temperatures:

Temperature

below 5°C (40°F)
5° - 12°C (40° - 53°F)
13° - 15°C (54° - 59°F)
16° - 20°C (60° - 68°F)

FUMI-CEL® & FUMI-STRIP®

Minimum Exposure Periods

Do not fumigate*
4 days (96 hours)
3 days (72 Hours)
2 days (48 Hours)

*if the temperature drops below 5°C during a fumigation, deactivate the **FUMI-CEL®** plates and **FUMI-STRIP®** at the end of the fumigation period, as detailed in the Spill and Leak Procedures (Section 14).

The length of the fumigation must be great enough so as to provide for adequate control of the insect pests which infest the commodity being treated. Additionally, the fumigation period should be long enough to allow for complete reaction of plates and strips with moisture so that little or no unreacted magnesium phosphide remains. This will minimize worker exposures during further storage and/or processing of the treated bulk commodity as well as reduce hazards in the disposal of partially spent magnesium phosphide remains. The proper length of the fumigation period will vary with exposure conditions since, in general, pests are more difficult to control at lower temperatures and the rate of hydrogen phosphide gas production by **FUMI-CEL®** plates and **FUMI-STRIP®** is lower at lower temperatures and humidities.

It should be noted that there is little to be gained by extending the exposure period if the structure to be fumigated has not been carefully sealed or if the distribution of gas is poor and pests are not subjected to lethal concentrations of hydrogen phosphide. Careful sealing is required to ensure that adequate gas levels are retained and proper application procedures must be followed to provide satisfactory distribution of hydrogen phosphide gas. Some structures can only be treated when completely tarped while others cannot be properly sealed by any means and should not be fumigated. Exposure times must be lengthened to allow for penetration of gas throughout the commodity when fumigant is not uniformly added to the commodity mass, for example, by surface application or shallow probing. This is particularly important in the fumigation of bulk commodity contained in large storages.

Remember, exposure periods recommended in the table are minimum periods and may not be adequate to control all pests under all conditions nor will they always provide for total reaction of the Plates and Strips, particularly if temperatures and commodity moisture levels or humidity are low during the fumigation. **Since they are more reactive, magnesium phosphide fumigants such as FUMI-CEL® plates, and FUMI-STRIP® are the products of choice under conditions of lower temperatures and/or low humidity.**

10.4 **Commodities Which May be Fumigated with FUMI-CEL® plates and FUMI-STRIP®**

FUMI-CEL® plates and **FUMI-STRIP®** may be used for the fumigation of listed raw agricultural commodities, animal feed and feed ingredients, listed processed

foods, tobacco and certain other nonfood items. Under no circumstances shall any processed food, feed or bagged commodity come into direct contact with **FUMI-CEL® plates**, **FUMI-STRIP®**, residual dust, or a raw agricultural commodity that will be used directly as a food without further processing.

10.4.1 **Raw Agricultural Commodities, Animal Feed and Feed Ingredients**

almonds	filberts	rye
animal feed & feed ingredients	flower seed	sorghum
barley	grass seed	soybeans
Brazil nuts	millet	sunflower seeds
cashews	oats	triticale
cocoa beans	peanuts	vegetable seed
coffee beans	pecans	walnuts
corn	pistachio nuts	wheat
cottonseed	popcorn	
dates	rice	

Raw Agricultural Commodities include all food commodities at farm gate or harvest, i.e. not processed.

10.4.2 **Processed Foods**

The listed processed foods may be fumigated with **FUMI-CEL®** plates and **FUMI-STRIP®**. Under no condition shall any processed food or bagged commodity come in contact with residual dust from plates or strips.

Processed Foods Which May Be Fumigated With FUMI-CEL® plates and FUMI-STRIP®

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 (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 and Figs
 Dried Eggs and Egg Yolk Solids
 Dried Milk, Dried Powdered Milk, Nondairy Creamers, and Nonfat Dried Milk
 Dried or Dehydrated Fruits (apples, dates, figs, peaches, pears, prunes, raisins and sultanas)

Processed Herbs, Spices, Seasonings and Condiments
 Malt
 Processed Nuts (almonds, apricot kernels, Brazil nuts, cashews, filberts, peanuts, pecans, pistachio nuts and walnuts)
 Processed Oats (including oatmeal)
 Rice (brewer's rice grits, enriched and polished, wild rice)
 Soybean Flour and Milled Fractions
 Processed Tea
 Dried and Dehydrated Vegetables (beans, carrots, lentils, peas, potato flour, potato products and spinach)
 Yeast (including primary yeast)

10.4.3 **Nonfood Commodities, Including Tobacco**

The listed nonfood items may be fumigated with **FUMI-CEL®** plates and **FUMI-STRIP®**. Tobacco, psyllium seed and psyllium seed husks intended for drug use and certain other of the nonfood commodities should not be contacted by residual dust from metal phosphide fumigants. Only lots of 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, containers, etc.) prior to shipment. In addition, psyllium seed and husks may be fumigated at other locations only under direct instructions from the pharmaceutical company.

Nonfood Commodities Which May Be Fumigated With FUMI-CEL® Plates and FUMI-STRIP®

Processed or Unprocessed Cotton, Wool and Other Natural Fibers or Cloth, Clothing
 Straw and Hay
 Feathers
 Human Hair, Rubberized Hair, Vulcanized Hair, Mohair
 Leather Products, Animal Hides and Furs
 Tires (for mosquito control)
 Tobacco
 Wood, Cut Trees, Wood Chips and Wood and Bamboo Products
 Paper and Paper Products
 Psyllium Seed and Psyllium Seed Husks intended for drug use
 Dried Plants and Flowers
 Seeds (grass seed, ornamental herbaceous plant seed and vegetable seed)

10.5 **Recommended Dosages**

Hydrogen phosphide is a mobile gas and will penetrate to all parts of the storage structure. Therefore, dosage must be based upon the total volume of the space being treated and not on the amount of commodity it contains. The same number of Plates is required to treat a 10,000 bushel silo whether it is empty or full of grain unless, of course, the surface of the commodity is sealed off by a tarpaulin.

The allowable dosage ranges are one FUMI-CEL® plate (33 g of hydrogen phosphide) per 6.5 to 46 cubic metres and one FUMI-STRIP® (660 g of hydrogen phosphide) per 130 to 934 cubic metres. Note: The maximum dosage for dates, nuts and dried fruits is one FUMI-CEL® plate per 23 cubic metres or one FUMI-STRIP® per 467 cubic metres. These dosages are not to be exceeded. It is important to be aware that a shortened exposure period cannot be fully compensated for with an increased dosage of hydrogen phosphide.

The wide range of dosages listed above is required to handle the variety of fumigation situations encountered in practice. Somewhat higher dosages are usually recommended under cooler, drier conditions or where exposure periods are relatively short. However, the major factor in selection of dosage is the ability of the structure to hold hydrogen phosphide gas during the fumigation. A good illustration of this point is comparison of the low dosages required to treat modern, well-sealed warehouses with the higher range used for poorly constructed buildings that cannot be sealed adequately. In certain other fumigations, proper distribution of lethal concentrations of gas to reach all parts of the structure becomes a very important factor in dose selection. An example where this may occur is in the treatment of grain stored in tall silos. Poor gas distribution frequently results when the fumigant cannot be uniformly added to the grain and it must be treated by surface application.

Although it is permissible to choose from the full range of dosages listed above, the following dosage ranges are recommended for the various types of fumigations:

Recommended Dosages for Various Types of Fumigations

	Volume Range	
	<u>Cubic Metres/ FUMI-CEL®</u>	<u>Cubic Metres/ FUMI-STRIP®</u>
1. Space		
mills, warehouses. etc.	15 - 46	308 - 924
bagged commodities	15 - 31	308 - 616
processed dried fruits and nuts	23 - 46	462 - 924
stored tobacco	23 - 46	462 - 924
2. Bulk Stored Commodities		
vertical storages	15 - 31	308 - 616
tanks	13 - 31	263 - 616
flat storages (loose construction)	6.5 - 18.5	130 - 370
farm bins	6.5 - 13	135 - 263
bunkers & tarped ground storages	11.5 - 31	230 - 616
railcars, containers, trucks	14 - 31	285 - 616
barges	6.3 - 18.5	130 - 370
ship holds	14 - 31	280 - 616

Higher dosages are recommended in structures that are of loose construction and in the fumigation of bulk stored commodities in which diffusion will be slowed and result in poor distribution of hydrogen phosphide gas.

10.6 Application Procedures

Regardless of the type of storage or structure to be treated, there are several important factors common to all application procedures. A number of these points have been covered in other sections of the Applicator's Manual but are listed again in the following for completeness.

1. A plan should be devised for application, aeration and disposal of the fumigant so as to keep to a minimum any exposures to hydrogen phosphide. See the requirements for Industrial Hygiene Monitoring under the Applicator and Worker Exposure section 7 of this Applicator's Manual.
2. **FUMI-CEL®** plates and **FUMI-STRIP®** should be applied so as to provide effective gas concentrations throughout the storage. When this is not possible, exposure times should be lengthened to allow for penetration of gas throughout the storage.
3. The storage structure should be sealed so as to maintain a suitable gas concentration over the time period required for control of the pests.
4. Exposure periods should be long enough to provide for adequate control of the pests and also complete reaction of the fumigant.
5. Remove **FUMI-CEL®** plates and **FUMI-STRIP®** entirely from their pouches for application.
6. Do not subdivide **FUMI-CEL®** plates or **FUMI-STRIP®** for fumigations.
7. Magnesium phosphide is considerably more reactive than aluminum phosphide, therefore, magnesium phosphide fumigants such as **FUMI-CEL®** plates, and **FUMI-STRIP®** are the products of choice for treatments under cooler and drier conditions.
8. Piling of Plates, Strips or the addition of liquid is prohibited
9. Observe the precautionary and safety statements mentioned elsewhere in this manual.
10. Hydrogen phosphide will corrode certain metals, especially at high concentrations and humidities. Protection or removal of wiring, sensitive equipment or precious metals is recommended under these conditions.
11. The fumigant should not be applied to confined spaces where the concentration of hydrogen phosphide may build up to exceed its lower flammable limit.
12. **FOR ALL TYPES OF FUMIGATIONS, IF APPLICATION OF FUMIGANT IS TO BE PERFORMED FROM WITHIN THE STRUCTURE TO BE FUMIGATED, APPROVED RESPIRATORY PROTECTION MUST BE WORN BY ALL PERSONNEL IN THE STRUCTURE. APPROVED RESPIRATORY PROTECTION MUST BE WORN IF RE-ENTRY OF THE TREATED AREA IS NECESSARY BEFORE COMPLETE AERATION (refer to the Respiratory Protection and the Applicator and Worker Exposure sections for approved respiratory protection).**

Listed commodities may be fumigated in bulk, in bags or in packages under gas-proof tarpaulins, in warehouses, silos, bins, flat stores, ships, unmanned barges or in other sealable enclosures where they are stored commercially and which can be made sufficiently gas tight. They may also be fumigated in sealed box or hopper cars and containers or other transport vehicles shipped piggyback by rail (static or rolling). **Do not move trucks, trailers, containers, vans, etc., over public roads or highways until they have been aerated and the warning placards removed.**

The following instructions are intended to provide general guidelines for typical fumigations. These instructions are not intended to cover every type of situation nor are they meant to be restrictive. Other procedures may be used if they are safe, effective and consistent with the properties of magnesium phosphide products.

10.6.1 **Fumigation of Railcars, Containers, Trucks, Vans and Other Transport Vehicles**

Railcars and containers, trucks, vans and other transport vehicles shipped piggyback by rail may be fumigated in-transit. Aeration of railcars, railroad boxcars or shipping containers is prohibited en route

It is not legal to move trucks, trailers, containers, vans, etc., over public roads or highways until they have been aerated and warning placards removed.

Care must be taken to seal all doors, hatches, vents, cracks or other leaks, particularly if the fumigation is to be carried out in-transit. **FUMI-CEL®** plates may be applied to bulk or bagged materials in railcars by placing them in porous, draw-string bags, one Plate per bag. **Caution: Do not put more than one Plate in a single bag. Do not use bags which will confine the gas.** The porous bags containing the Plates may then be suspended from the hatch cover, from a bulkhead or from a nail in the wall of the railcar. Porous bags containing Plates may be placed in contact with the commodity, after they have been suitably anchored, to take advantage of higher commodity temperatures during periods of cooler weather. The temperature of the commodity is frequently higher than ambient air, particularly in in-transit railcar fumigations conducted during winter months. The higher temperatures may be of considerable benefit in deactivating of the Plates. Cloth bags with draw strings are available from DEGESCH America, Inc., or from Gardex Chemicals Ltd.

See Section 8 of this Applicator's Manual for recommendations on placarding. Both doors of box cars should be placarded. Place fumigation warning placards on both sides of hopper cars near the ladders and atop the hatches to which **FUMI-CEL®** plates has been applied. Written notification must be provided to the receiver of railcars, railroad boxcars, shipping containers and other vehi-

cles that are being fumigated in transit. Notification must be made prior to the actual receipt of a fumigated vehicle or container by a consignee. A copy of the applicator's manual must precede or accompany all transportation containers or vehicles. Attach a packet of information for the consignee (available from DEGESCH America, Inc.) if the transport vehicle is to be shipped under fumigation. **The shipper must notify the consignee of commodities shipped under fumigation.**

Consignees Responsibilities

Proper handling of treated railcars, containers and other transport vehicles shipped piggyback by rail at their destination is the responsibility of the consignee. Upon receipt of the railcar, railroad boxcars, shipping containers and other vehicles, a trained person must perform the aeration process. The trained person must be provincially licensed or have other documented authorized training recognized by the province or territory and must be familiar with the properties of hydrogen phosphide fumigants, worker exposure limits, required personal protective equipment, symptoms and first aid treatment for hydrogen phosphide poisoning, and must know how to take gas concentration measurements. A training completion date must be logged and maintained in the employee's safety training record. Upon receipt of a fumigated commodity, it must be documented in writing that the monitoring has been conducted and that aeration has been completed. Unless prior arrangements have been made to return the railcar containing the spent fumigant back to the shipper, consignees must also be familiar with proper procedures for deactivation and disposal of spent fumigant. Un-aerated railcars being returned in this manner must bear fumigation warning placards and must be carefully sealed. If the railcar containing spent fumigant is not being returned to the shipper, the consignee must:

1. aerate the railcar until the level of hydrogen phosphide is 0.1 ppm or below.
2. remove the fumigation placards,
3. remove and properly dispose of the spent fumigant (see Section 13 for instructions on proper disposal),
4. ensure that worker exposure limits have not been exceeded (see sections 5 and 6 for required respiratory protection and exposure limits),
5. transfer commodity from the railcar

10.6.2 Fumigations Under Tarpaulins and in Small Sealable Structures and Enclosures

Use of plastic sheeting or tarpaulins to cover commodities is one of the easiest and least expensive means for providing relatively gas tight enclosures which are very well suited for fumigation. Poly

tarps (4 mil) are penetrated only very slowly by hydrogen phosphide gas, and tight coverings are readily formed from the sheets. The volume of these enclosures may vary widely from a few cubic feet; for example, a fumigation tarpaulin placed over a small stack of bagged commodity to a plastic bunker storage capable of holding 600,000 bushels of grain or more. When possible, conduct tarpaulin fumigations outside. Do not conduct outdoor fumigations in the proximity of wildlife areas.

An enclosure suitable for fumigation may be formed by covering bulk or packaged commodity with poly sheeting (4 ml). The sheets may be taped together to provide a sufficient width of material to ensure that adequate sealing is obtained. If the flooring upon which the commodity rests is of wood or other porous material, it should be repositioned onto poly prior to covering for fumigation. The plastic covering of the pile may be sealed to the floor using sand or water snakes, by shoveling soil or sand onto the ends of the plastic covering or by other suitable procedures. The poly covering should be reinforced by tape or other means around any sharp corners or edges in the stack so as to reduce the risk of tearing. Use plastic sheeting or tarpaulins of at least 4 mil thickness. Thicker poly sheeting is recommended to reduce the potential for loss of fumigant.

FUMI-CEL® plates or **FUMI-STRIP®** may be applied to the tarped stack or bunker storage of bulk commodity through slits in the poly covering. Avoid application of large numbers of Plates or Strips to any one point.

Do not apply in areas where condensation may occur. The slits in the covering should be carefully taped to prevent loss of gas once the dose has been applied. Plates and Strips are recommended for the treatment of bagged commodities and processed foods where direct contact with spent dust is prohibited or not desired.

Distribution of hydrogen phosphide gas is generally not a problem in the treatment of bagged commodities and processed foods. However, fumigation of larger bunker storages containing bulk commodity will require proper application procedures to obtain adequate results.

Place warning placards at conspicuous points on the enclosure.

Excellent results may be attained in the treatment of small enclosures or structures since it is often possible to control the temperature during fumigation and also to make the enclosure virtually gas tight. Take care not to overdose during these fumigations. A single **FUMI-CEL®** plate will treat a space of from 6.5 to 46 cubic metres. A single **FUMI-STRIP®** will treat a volume of from 130 to 925 cubic metres.

10.6.3 Fumigation of Mills, Food Processing Plants and Warehouses

1. Using the label, calculate the length of the fumigation and the dosage of **FUMI-CEL®** plates or **FUMI-STRIP®** to be applied based upon volume of the building, air and/or commodity temperature and the general tightness of the structure.
2. Carefully seal and placard the space to be fumigated.
3. Apply **FUMI-CEL®** plates and/or **FUMI-STRIP®** to the area to be treated. Lean the Plates against walls, columns, pallet or other support which will allow free access of air to both sides of the Plates. **FUMI-STRIP®** are to be opened, accordion style, and stood on end so that the surfaces of each Plate are exposed.
4. Doors leading to the fumigated space should be closed, sealed, locked and placarded with warning signs.
5. The fumigation period usually lasts from 2 to 5 days, depending upon the temperature. Upon completion of the exposure period, windows, doors, vents, etc., should be opened and the fumigated structure allowed to aerate for at least two hours before entering. Do not enter the structure without appropriate respiratory protection until the phosphine concentration is 0.1 ppm or below. When required, gas concentration readings may be taken using low level detector tubes or similar devices to ensure safety of personnel who reenter the treated area. Refer to section 8 on Applicator and Worker Exposure.
6. Collect the spent **FUMI-CEL®** plates and **FUMI-STRIP®** for disposal, with or without further deactivation, following recommendations given under **Disposal Instructions** (section 8).
7. Remove fumigation warning placards from the aerated structure when the hydrogen phosphide concentration is 0.1 ppm or less.

10.6.4 Fumigation of Ships

10.6.4.1 General Information

Important: Shipboard, in-transit ship or shiphold fumigation is also governed by Transport Canada Ship Safety Regulations. Refer to and comply with those Regulations and Ship Safety Bulletins prior to fumigation. In Canada, fumigations must be carried out under the direction of a “Fumigator-in-Charge” as indicated in

these regulations. **No person shall fumigate in-transit or permit in-transit fumigation in a Canadian flag ship.** The decision to fumigate-in-transit on Non-Canadian flag vessels is at the discretion of the master (see Ship Safety Bulletin 13/93).

10.6.4.2 Pre-Voyage Fumigation Procedures

1. Before fumigation is commenced, a notification of intention to fumigate must be given to the nearest Transport Canada Ship safety office (generally, no less than 24 hours in advance). Similarly, a notice must be given for vessels in-transit of Canadian waters and stopping at a Canadian Port. Prior to fumigating a vessel for in-transit cargo fumigation, the master of the vessel or his/her representative, and the fumigator must determine whether the vessel is suitably designed and configured so as 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 will not be allowed to reoccupy the vessel until the vessel has been properly aerated to 0.1 ppm or below 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/her representative, of the requirements: 1) relating to the use of personal respiratory protection equipment*; 2) relating to the use of detection equipment; and 3) 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 and understood by the master of the vessel or his/her representative.

*Personal respiratory protection means a NIOSH/MSHA approved air purifying full face

gas-mask with a chin style mounted canister approved for phosphine OR a NIOSH/MSHA approved supplied-air respirator with a full face piece for phosphine levels up to 5 ppm. A self-contained breathing apparatus (SCBA) must be worn and operated in a positive pressure mode when phosphine levels are above 5 ppm or at unknown concentrations.

3. Seal all openings to the cargo hold or tank and lock or otherwise secure all openings, manways, etc., which might be used to enter the hold. The overspace pressure relief system of each tank aboard tankers must be sealed by closing the appropriate valves and sealing the openings into the overspace with gas-tight materials.
4. Placard all entrances to the treated spaces with fumigation warning signs as described in Section 8 of this Applicator's Manual. A watchman may be posted at the gangway to keep unnecessary persons from boarding.
5. If the fumigation is not completed and the vessel aerated before the manned vessel leaves port, the Fumigator-in-Charge shall ensure that there be on board the vessel during the voyage: 1) at least four NIOSH/MSHA approved self-contained breathing apparatus (SCBA)* and four additional air bottles or combination supplied-air respirators; 2) two gas detection devices (when these devices require re-arming after use, the ship shall be equipped with 10% more spare tubes than are required to conduct the required testing for the duration of the voyage); and 3) a person qualified in their operation. If the fumigated area of the vessel has to be re-entered before complete aeration, approved respiratory protection must be worn.

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

6. During fumigation, the Fumigator-in-Charge shall ensure that a qualified person using gas or vapour detection equipment routinely test spaces adjacent to spaces containing fumigated cargo

and all regularly occupied spaces for fumigant leakage. For fumigation-in-transit, the vessel must remain in port for a minimum of 24 hours, or the Fumigator-in-Charge must sail with the ship and remain on board for a minimum of 24 hours once fumigation has commenced. If leakage of the fumigant is detected, the person in charge of the fumigation shall take action to correct the leakage, or shall inform the master of the vessel, or his/her representative, of the leakage so that corrective action can be taken. At the end of the 24 hours period, final gas readings should be made and a clearance certificate issued.

7. Review with the master, or his/her representative, the precautions and procedures for during the voyage. Clear written instructions must be given to the master of the ship, to the receiver of the cargo, and to the authorities at the discharging port as to how any residues are to be disposed of.

10.6.4.3 **Application Procedures for Bulk Dry Cargo Vessels and Tankers**

1. **FUMI-STRIP®** are recommended for the treatment of ship's holds and tanks. **FUMI-CEL®** plates may also be used if they are secured and marked for easy retrieval.
2. **FUMI-STRIP®** may be applied directly atop the surface of the commodity if they are secured to prevent them from shifting during the voyage. They may also be applied in trenches or inserted edgewise into the commodity.
3. Take care to ensure that the Strips are spread out and are applied at least several feet apart. Do not apply Plates or Strips in areas where contact with water is likely.
4. Immediately after application of the fumigant, close and secure all hatch covers, tank tops, butterworth valves, manways, etc.

10.6.4.4 **Intransit Fumigation of Containers Aboard Ships** In-transit fumigation of containers on ships is also governed by Transport Canada Ship Safety Regulations. Refer to and comply with these regulations prior to fumigation.

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

Application procedures for fumigation of raw commodities or processed foods in containers and other transport vehicles are described in Section 10.6.1.

10.6.4.5 **Precautions and Procedures During Voyage**

1. Using appropriate gas detection equipment, routinely monitor spaces adjacent to areas containing fumigated cargo and all regularly occupied areas for fumigant leakage. If leakage is detected, the area should be evacuated of all personnel, ventilated, and action taken to correct the leakage before allowing the area to be occupied.
2. Do not enter fumigated areas except under emergency conditions. If necessary to enter a fumigated area, appropriate personal protection equipment must be used. Never enter fumigated areas alone. At least two persons wearing the required breathing apparatus should enter and at least one other person, wearing personal protection equipment, should be available to assist in case of an emergency.

10.6.4.6 **Precautions and Procedures During Discharge**

1. If necessary to enter a treated area prior to discharge, test spaces directly above commodity surface for fumigant concentration, using appropriate gas detection and personal safety equipment. Do not allow entry to fumigated areas without personal safety equipment, unless fumigant concentrations are at or below 0.1 ppm., as indicated by a suitable detector.

11. **AERATION OF FUMIGATED COMMODITIES**

11.1 **Foods and Feeds**

Some pesticides are poisonous and may leave toxic residues on the commodities or in the area to which they are applied. Health Canada has established maximum residue limits (MRLs) for pesticides that may remain in/on agricultural commodities. **To guarantee compliance with these MRLs, it is necessary**

to aerate these commodities for 48 hours prior to sale. It is the user's responsibility to ensure that the label directions are followed. The instructions in this Applicator's Manual are based on the best available information, and if followed carefully, should not result in residues exceeding established MRLs.

11.2 **Tobacco**

Tobacco must be aerated for at least three days (72 hours) when fumigated in hogsheads and for at least two days (48 hours) when fumigated in other containers. Tobacco fumigated in containers with plastic liners will probably require longer aeration periods to reach 0.1 ppm.

12. **STORAGE INSTRUCTIONS**

1. Store DEGESCH **FUMI-CEL®** plates and **FUMI-STRIP®** in a dry, well ventilated area away from heat, under lock and key. Post as a pesticide storage area. Do not contaminate water, food or feed by storing pesticides in the same areas used to store these commodities. Observe all provincial guidelines for storage of pesticide.
2. Do not store in buildings where humans or domestic animals reside. Keep out of reach of children.
3. DEGESCH **FUMI-CEL®** plates and **FUMI-STRIP®** are supplied in gas-tight, aluminum foil pouches. These pouches are not re-sealable, and the Plates and Strips must be used immediately or disposed of once they have been opened.
4. The shelf life of the Plates and Strips is virtually unlimited as long as the containers are tightly sealed.

13. **DISPOSAL INSTRUCTIONS**

13.1 **General**

- 13.1.1 Pesticide wastes are toxic. Open dumping is prohibited. Do not discharge this product, or material containing this product, into natural waterways, wetlands (swamps, bogs, marshes, potholes, etc.) or municipal wastewater collection systems. Do not contaminate water, food or feed by disposal. Proper disposal of magnesium phosphide is required to ensure minimal impact on the environment.

Unreacted or partially reacted magnesium phosphide is acutely hazardous. If these wastes cannot be disposed of according to label instructions, contact the Provincial Regulatory Agency or the Manufacturer. See also Section 14 of this manual, Spill and Leak Procedures.

- 13.1.2 Unreacted or partially reacted **FUMI-CEL®** plates or **FUMI-STRIP®** is acutely hazardous. Improper disposal of excess pesticide is a vi-

olation of the Pest Control Products Act. If these wastes cannot be disposed of by use according to label instructions, contact the Provincial Regulatory Agency or the Manufacturer for directions. For specific instructions, see Section 14 of this manual, Spill and Leak Procedures.

- 13.1.3 Some local and provincial waste disposal regulations may vary from the following recommendations. Disposal procedures should be reviewed with appropriate authorities to ensure compliance with local and provincial regulations. Contact your Provincial Pesticide Agency.
- 13.1.4 Dispose of containers in a sanitary landfill or by other procedures approved by provincial and local authorities.
- 13.1.5 If properly exposed during the fumigation period, **FUMI-CEL®** plates and **FUMI-STRIP®** will contain virtually no unreacted magnesium phosphide. This is a nonhazardous waste. However, incompletely exposed Plates and Strips will require special care for disposal.

13.2 **Directions for Disposal of Exposed FUMI-CEL® Plates and FUMI-STRIP®**

- 13.2.1 Confinement of partially spent **FUMI-CEL®** plates or **FUMI-STRIP®**, as in a closed container or plastic bag, may result in a fire hazard. Small amounts of hydrogen phosphide may be given off from unreacted magnesium phosphide, and confinement of the gas may result in a flash.
- 13.2.2 In open areas, Plates and Strips may be disposed of on site by burial.
- 13.2.3 Unreacted or improperly exposed Plates and Strips **must** be further deactivated before disposal at a landfill.
- 13.2.4 Spent Plates and Strips may be collected for disposal in well ventilated containers such as wire baskets (available from Gardex Chemicals Ltd.) or porous cloth bags of burlap, cotton or other suitable material. The Plates and Strips may be loaded directly into open vehicles for transportation to the disposal site or they may be transported in the ventilated containers used for collection. Do not pile the cloth bags together. Do not use this method for partially spent Fumi-Cels or Fumi-Strips.

13.3 **Directions for Deactivation of Partially Spent FUMI-CEL® Plates and FUMI-STRIP®**

- 13.3.1 Partially spent **FUMI-CEL®** plates and **FUMI-STRIP®** must be fur-

ther deactivated prior to ultimate disposal. This is particularly true in cases of incomplete exposure or following a fumigation which has produced large quantities of partially spent material.

Caution: Wear appropriate respiratory protection during wet deactivation of partially spent material. Do not cover the container being used for wet deactivation. This procedure should be performed in the open air and not in the fumigated structure. Placards should be posted and the site secured to prevent unauthorized persons from tampering with deactivating Fumi-Cel plates or Fumi-Strip.

13.3.2 Partially spent Plates and Strips may be deactivated as follows using the “Wet Method.”

13.3.2.1 Water is used for deactivation of Plates and Strips and other magnesium phosphide fumigants by the “Wet Method.” **Detergent solution is not required for magnesium phosphide fumigants.** Fill a drum or other container to be used for wet deactivation with water to within 2 to 5 cm (1 to 2 inches) of the top. Do **not** allow a large headspace above the surface of the water.

13.3.2.2 Magnesium phosphide will react quite rapidly and very vigorously with liquid water. Therefore, small amounts of partially spent material should be tested initially by immersion in water prior to proceeding with large scale wet deactivation. One or two individual Plates or Plates cut off of **FUMI- STRIP®** should be evaluated first to determine their level of activity.

13.3.2.3 In a well ventilated area, out of doors, submerge the entire Plate or Strip in water. The Plates and Strips may float to the surface and, therefore, it is necessary to hold them under water by use of a suitable weight. Caution: Partially spent Plates and Strips may ignite if they are allowed to float to the surface. Active Plates and Strips should be submerged at least 10 to 15 cm to prevent smoking of the liberated hydrogen phosphide gas. Plates and Strips may be placed in wire baskets for immersion in water.

Adhere to provincial ambient air quality criteria standards and monitor downwind gas levels. Ensure that the deactivation area is secure and placarded to prevent public and unauthorized worker access.

13.3.2.4 Reaction of the magnesium phosphide with water is practically complete within about 15 to 30 minutes.

However, Plates and Strips should be totally immersed for at least 6 hours to ensure total hydrolysis.

Caution: Removal of Plates or Strips from water before they are largely deactivated may result in a fire. They may then be taken to an approved site for disposal. Dispose of the water at a sanitary landfill or other approved site or means. Where permissible, the water may be poured out onto the ground.

13.3.3 **Partially Spent Plates and Strips may be Deactivated as Follows Using the “Dry Method”**

13.3.3.1 Extension of the fumigation period is the simplest method for further deactivation of partially spent Plates and Strips prior to ultimate disposal.

13.3.3.2 Alternatively, partially spent materials may be further deactivated by storing the Plates and Strips out of doors, protected from rain and ground water, in locked wire baskets or other similarly ventilated containers. The deactivated Plates and Strips may be taken to an approved site for disposal. Storage of partially spent Plates or Strips in a closed container may result in a fire hazard. Large numbers of partially spent Plates or Strips stored in open containers may ignite if contacted by water.

13.3.3.3 Plates and Strips may also be “dry deactivated” by spreading them out onto the ground in a secure, open outdoor area away from inhabited buildings to be deactivated by atmospheric moisture. Care should be taken to ensure that the Plates or Strips are not carried away by the wind. If desired, they may be weighted down by 20 to 30 cm of sand or soil or by other suitable means. Do not use this procedure during periods of rain or if the soil is wet. After deactivation, the spent Plates and Strips may be gathered for disposal at approved sites.

14. SPILL AND LEAK PROCEDURES

14.1 **General Precautions and Directions**

This product is highly toxic to fish, birds and other forms of wildlife. Do not discharge directly to natural waterways, wetlands (swamps, bogs,

marshes, potholes, etc.) or municipal wastewater collection systems. Do not contaminate water, food or feed by disposal. Proper disposal of magnesium phosphide is required to ensure minimal impact on the environment. Contact the manufacturer and the provincial regulatory agency in case of a spill, and for clean-up of spills.

A spill, other than incidental to application or normal handling, may produce high levels of gas and, therefore, attending personnel must wear a NIOSH/MSHA approved SCBA, operated in a positive pressure mode, or its equivalent when the concentration of hydrogen phosphide gas is unknown. Other NIOSH/MSHA approved respiratory protection may be worn if the concentration is known to be less than 5 ppm (see section 5 and 6 on respiratory protection and exposure limits). Do not use water at any time to clean up a spill of **FUMI-CEL®** plates or **FUMI-STRIP®**. Water in contact with unreacted metal phosphides will greatly accelerate the production of hydrogen phosphide gas which could result in a toxic and/or fire hazard. Wear gloves of cotton or other porous material when handling metal phosphides.

Return all intact aluminum foil pouches of **FUMI-CEL®** plates or **FUMI-STRIP®** to original packaging or other packaging which has been suitably constructed and marked according to T.D.G.A. regulations. Notify consignee and shipper of damaged packaging.

If the foil pouches have been punctured or damaged so as to leak, they may be temporarily repaired with aluminum tape. Transport the damaged pouches, thus sealed, to an area suitable for pesticide storage for inspection. **Caution:** The punctured pouches may flash upon opening at some later time. Further instructions and recommendations may be obtained, if required, from DEGESCH America, Inc. or Gardex Chemicals Ltd.

If foil pouches of **FUMI-CEL®** plates or **FUMI-STRIP®** have been damaged so severely that they cannot be temporarily repaired, these materials may be wet deactivated on site using the procedure described in 14.2. If on-site, wet deactivation is not feasible, the damaged containers should be transported in open vehicles to a suitable area. Wet deactivation may then be carried out as described in 14.2. Alternatively, spillage may be spread out in an open area away from inhabited buildings to be deactivated by atmospheric moisture. Care should be taken to ensure that the Plates or Strips are not carried away by the wind. If desired, they may be weighted down by 20 to 30 cm of sand or soil or by other suitable means. Do not use this procedure during periods of rain or if the soil is wet. After deactivation, the spent Plates and Strips may be gathered for disposal at approved sites.

14.2 **Directions for Deactivation by the Wet Method**

If the contaminated material is not to be held until completely reacted by exposure to atmospheric moisture, deactivate the product by the "Wet Method" as follows:

- 14.2.1 Water is used for the wet deactivation of **FUMI-CEL®** plates and **FUMI-STRIP®** and other magnesium phosphide fumigants. Detergent solution is not required. Fill several drums or other containers to be used for wet deactivation with water to within 2 to 5 cm (1 to 2 inches) of the top. Do **not** allow a large head-space above the surface of the water.

Keep a water supply on hand to top-up drums as necessary. Placards should be posted and the site secured to prevent unauthorized persons from tampering with the drums.

- 14.2.2 Magnesium phosphide reacts very vigorously with water and, therefore, only 1 or 2 unexposed Plates should be wet deactivated at one time. Plates should be cut from **FUMI-STRIP®** rather than attempting deactivation of an entire Strip. Unexposed Plates or Strips will likely ignite if they are allowed to float to the surface of the water. They may be placed into wire baskets or similar containers, weighted and dropped into the water for deactivation. The Plates should be submerged to at least 10 to 15 cm to prevent smoking of the liberated hydrogen phosphide gas.

- 14.2.3 Reaction of magnesium phosphide with water is practically complete within about 15 to 30 minutes. However, the Plates and Strips should be totally immersed for at least 6 hours to ensure total hydrolysis. It is suggested that one or more drums or barrels be set up for the first half hour's immersion, until bubbling has practically ceased, after which the Plates are transferred to a second drum for the remainder of the wet deactivation period.

Caution: Removal of Plates or Strips from water before they are largely deactivated may result in fire. Deactivated Plates and Strips may then be taken to an approved site for disposal. Dispose of the water at a sanitary landfill or other approved site or means. Where permissible, the water may be poured out onto the ground. Do not dispose of deactivation water by direct addition to sanitary or storm sewers.

- 14.2.4 **Caution:** A NIOSH/MSHA approved self-contained breathing apparatus with a full face-piece, operated in positive pressure mode, should be worn during wet deactivation of unexposed **FUMI-CEL** and **FUMI-STRIPS**). Never place metal phosphide products or their dust in a closed container such as a dumpster, sealed drum, plastic bag, etc., as flammable concentrations and a flash of hydrogen phosphide gas are likely to develop. Do not cover the deactivation vessel at any time.

15. **FOR ASSISTANCE, CONTACT:**

DEGESCH America, Inc.
153 Triangle Drive
P. O. Box 116
Weyers Cave, Virginia
24486 USA
Telephone: 540-234-9281/800-330-2525
Fax: 540-234-8225
Internet: www.degeschamerica.com
E-Mail: degesch@degeschamerica.com

OR

Gardex Chemicals Ltd.
7 Meridian Road
Etobicoke, Ontario
M9W 4Z6 Canada
Telephone: 416-675-1638
Fax: 416-798-1647

OR

HOT LINE NUMBER

Have the product container label or Applicator's Manual with you when calling a poison control centre, doctor, or when going for treatment. **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 or, GARDEX CHEMICALS, LTD. 416-675-1638. For all other chemical emergencies, please contact CHEMTREC – 1-800-424-9300 or Canadian Transport Emergency Centre (CANUTEC) 613-996-6666.