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Systems Integration Group, Inc.

PM04

40285-8

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

For retail sale to and use only by certified applicators 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. Physical presence means on site or on the premises. Read and follow the label and the DEGESCH America, Inc., Applicator's Manual which contains complete instructions for the safe use of this pesticide.

APPLICATOR'S MANUAL



ACCEPTED
JAN 25 1999
 Under the Federal Insecticide,
 Fungicide, and Rodenticide Act,
 as amended, for the pesticide
 registered under
 EPA Reg. No. 40285-8

FUMI-CEL® AND FUMI-STRIP®

USA-Patent No. 5,015,475

FOR USE AGAINST INSECTS WHICH INFEST STORED COMMODITIES

Active Ingredient: Magnesium Phosphide.....56%
 Other Ingredients44%



KEEP OUT OF REACH OF CHILDREN



DANGER-POISON-PELIGRO

PRECAUCION AL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta se le haya sido explicada ampliamente.

(TO THE USER: If you cannot read English, do not use this product until the label has been fully explained to you.)

STATEMENT OF PRACTICAL TREATMENT

Symptoms of overexposure are headache, dizziness, nausea, difficult breathing, vomiting, and diarrhea. In all cases of overexposure get medical attention immediately. Take victim to a doctor or emergency treatment facility.

If the gas or dust from magnesium phosphide is inhaled:

Get exposed person to fresh air. Keep warm and make sure person can breathe freely. If breathing has stopped, give artificial respiration by mouth-to-mouth or other means of resuscitation. Do not give anything by mouth to an unconscious person.

If magnesium phosphide pellets, tablets or powder are swallowed:

Drink or administer one or two glasses of water and induce vomiting by touching back of throat with finger, or if available, syrup of ipecac. Do not give anything by mouth if victim is unconscious or not alert.

If powder or granules of magnesium phosphide get 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.

If dust from pellets or tablets gets in eyes:

Flush with plenty of water. Get medical attention.

DEGESCH AMERICA, INC.

Weyers Cave, Virginia 24486 USA - Telephone (540) 234-9281

EPA Est. No. 33982-WG-1

EPA Reg. No. 40285-8

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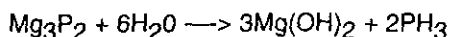
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1. INTRODUCTION

DEGESCH **FUMI-CEL**® and **FUMI-STRIP**® fumigants are used to protect stored commodities from damage by insects. Fumigation of stored products with these products in the manner prescribed in the labeling 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** 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 **PHOSTOXIN**® 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 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 18 feet 4 inches in length and will liberate 660g (20 x 33) of hydrogen phosphide gas. Strips and Plates are packaged individually in gas-tight aluminum foil pouches. These pouches are not resealable. 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.

Upon exposure to air, **FUMI-CEL** 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**, **FUMI-STRIP**, **MAGTOXIN** and other magnesium phosphide products 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** 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** 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 labeling and follow instructions explicitly.
2. Never fumigate alone from inside the storage structure.
3. Person supervising must be a certified fumigator and personnel assisting must be trained in the use of Plates or Strips. Never allow uninstructed personnel to handle metal phosphide fumigants.
4. Approved respiratory protection must be available for the fumigation of structures from within.
5. It is not necessary to wear gloves or other protective clothing when handling Plates or Strips. However, wear dry gloves of cotton or other materials if contact with metal phosphide tablets, pellets or dust is likely. Wash hands thoroughly after handling metal phosphide materials.
6. Open fumigant pouches in open air only. Never open in a flammable atmosphere.

7. Do not allow Strips or Plates to contact liquid water or to pile up.
8. Dispose of empty containers and spent Plates and Strips in a proper manner consistent with the label instructions.
9. Post warning placards on fumigated areas.
10. Prior to fumigation, notify appropriate company employees. 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. It is recommended that they be notified prior to each fumigation.
11. Hydrogen phosphide fumigants are not to be used for vacuum fumigations.
12. Exposures to hydrogen phosphide must not exceed the eight hour TWA of 0.3 ppm during application, or a ceiling concentration of 0.3 ppm after application is completed.
13. Fumigated areas must be aerated to 0.3 ppm hydrogen phosphide or less prior to reentry by unprotected workers.
14. Finished foods and feeds which have been fumigated with **FUMI-CEL** or **FUMI-STRIP** must be aerated for 48 hours prior to offering to the end consumer.
15. Transfer of a treated commodity to another site without complete aeration is permissible provided that the new storage site is placarded if its concentration is above 0.3 ppm.
16. Do not open pouches until just prior to application of the Plates or Strips.
17. Protect materials containing metals such as copper, silver, gold and their alloys and salts from corrosive exposure to hydrogen phosphide.
18. **FUMI-CEL** 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.
19. Do not use metal phosphide fumigant containers for any purpose other than recycling or reconditioning.
20. OSHA recommends preexposure screening of employees to detect impaired pulmonary function. They recommend that any employees developing this condition be transferred for medical examination.

2. PRECAUTIONARY STATEMENTS

2.1 Hazards to Humans and Domestic Animals

DANGER: Magnesium phosphide from **DEGESCH FUMI-CEL**, **FUMI-STRIP** or dust may be fatal if swallowed. Do not get in eyes, on skin or on clothing. Do not eat, drink or smoke while handling magnesium phosphide fumigants. If a sealed container is opened, or if the material comes into contact with moisture, water or acids, these products will release hydrogen phosphide (phosphine, PH₃) which is an extremely toxic gas. If a garlic odor is detected, refer to the Industrial Hygiene Monitoring section 8.6 of the Applicator's Manual for appropriate monitoring procedures. Pure hydrogen phosphide gas is odorless; the garlic odor is due to a contaminant. Since the odor of hydrogen phosphide may not be detected under some circumstances, the absence of a garlic odor does not mean that dangerous levels of hydrogen phosphide gas are absent. Observe proper reentry procedures specified elsewhere in the labeling to prevent overexposure.

2.2 Statement of Practical Treatment

Symptoms of overexposure are headache, dizziness, nausea, difficult breathing, vomiting, and diarrhea. In all cases of overexposure get medical attention immediately. Take victim to a doctor or emergency treatment facility.

If the gas or dust from magnesium phosphide is inhaled:

Get exposed person to fresh air. Keep warm and make sure person can breathe freely. If breathing has stopped, give artificial respiration by mouth-to-mouth or other means of resuscitation. Do not give anything by mouth to an unconscious person.

If magnesium phosphide is swallowed:

Drink or administer one or two glasses of water and induce vomiting by touching back of throat with finger, or if available, syrup of ipecac. Do not give anything by mouth if victim is unconscious or not alert.

If powder or granules of magnesium phosphide get 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.

If dust from pellets or tablets gets in eyes:

Flush with plenty of water. Get medical attention.

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2.3 Note to Physician (we recommend that this section be given to the attending physician)

Magnesium phosphide Plates, Strips, tablets, pellets or dust react with moisture from the air, acids and many other liquids to release hydrogen phosphide (phosphine, PH_3) 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 color), unconsciousness, and death.

In sufficient quantity, phosphine affects the liver, kidneys, lungs, nervous system and circulatory system. Inhalation can cause lung edema (fluid in lungs) and hyperemia (excess of blood in a body part), small perivascular brain hemorrhages and brain edema (fluid in brain). 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 color) 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 own judgment: 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 hemoconcentration, 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 hemodialysis is necessary. There is no specific antidote known for this poisoning.
3. Mention should be made here 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.

2.4 Physical and Chemical Hazards

Magnesium phosphide-based fumigants such as Plates, Strips, Prepac Spot Fumigant and partially spent materials 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. Magnesium phosphide fumigants should not be stacked or piled up or contacted with liquid water. 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 or FUMI-STRIP, point the pouch away from the face and body and tear or cut open the far end. Although the chances for a flash are very remote, never open con-

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tainers 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, it may react with certain metals and cause corrosion, especially at higher temperatures and relative humidities. Metals such as copper, brass and other copper alloys, and precious metals such as gold and silver are susceptible to corrosion by phosphine. 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.

3. DIRECTIONS FOR USE

3.1 General

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

3.1.1 **DEGESCH FUMI-CEL** and **FUMI-STRIP** are Restricted Use Pesticides due to the acute inhalation toxicity of hydrogen phosphide (phosphine, PH₃) gas. These products are for retail sale to and use only by certified applicators 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. Physical presence means on site or on the premises. Read and follow the label and the DEGESCH America, Inc., Applicator's Manual which contains complete instructions for the safe use of this pesticide.

3.1.2 **FUMI-CEL** and **FUMI-STRIP** are 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.
P. O. Box 116
Weyers Cave, VA 24486
(540) 234-9281
Internet address: <http://www.degeschamerica.com>

Persons working with **FUMI-CEL** and **FUMI-STRIP** 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.

3.1.3 At least two persons trained in the use of **FUMI-CEL/FUMI-STRIP** must be present during fumigation of structures if entry into the structure is required for application of the fumigant. Two trained persons must also be present during reentry into fumigated or partially aerated structures. Only one trained person is required to be present when Plates or Strips are applied from outside the area to be treated.

3.1.4 Shipholds, barges, containers on ships, railroad cars and containers shipped piggyback by rail may be fumigated in-transit. However, trucks, vans, trailers and similar transport vehicles cannot be moved over public roads or highways until they are aerated and the warning placards removed.

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

3.1.6 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.

3.1.7 It is not necessary to wear gloves or other protective clothing when handling **FUMI-CEL** or **FUMI-STRIP**. However, wear dry gloves of cotton or other material while handling **PHOSTOXIN** or **MAGTOXIN** tablets or pellets. Wash hands thoroughly after use.

- 3.1.8 Hydrogen phosphide gas may flash at concentrations above its flammable limit of 1.8% (V/V). Therefore, always open containers 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.
- 3.1.9 Piling of **FUMI-CEL, FUMI-STRIP**, dust from their fragmentation or addition of liquid water may speed up the reaction, cause a temperature increase and confine the gas so that ignition could occur.
- 3.1.10 As much as is possible, protect unused Plates and Strips from excessive exposure to atmospheric moisture during application.
- 3.1.11 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 or FUMI-STRIP.
- 3.1.12 Do not allow residual dust from **FUMI-CEL, FUMI-STRIP** or other metal phosphide fumigants to come into contact with processed foods or commodity packages intended for retailers.
- 3.1.13 Respiratory protection approved for the concentration to which the fumigator will be exposed must be available if metal phosphide fumigant is to be applied from within the structure to be fumigated. Respiratory protection need not be available for uses such as outdoor application, if exposures above the allowable limits will not be encountered.

A NIOSH/MSHA approved, full-face gas mask - hydrogen phosphide canister combination may be used at levels up to 15 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 used.
- 3.1.14 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.

3.2 Efficacy

FUMI-CEL and FUMI-STRIP have been found effective against the following insects and their preadult stages - that is, eggs, larvae and pupae:

almond moth	European grain moth	Mediterranean flour moth
Angoumois grain moth	flat grain beetle	pink bollworm
bean weevil	fruit flies	raisin moth
bees	granary weevil	red flour beetle
cadelle	greater wax moth	rice weevil
cereal leaf beetle	hairy fungus beetle	rusty grain beetle
cigarette beetle	Hessian fly	saw-toothed grain beetle
confused flour beetle	Indian meal moth	spider beetles
dermestid beetles	Khapra beetle	tobacco moth
dried fruit beetle	lesser grain borer	yellow meal worm
dried fruit moth	maize weevil	

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 insects 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.

3.3 Exposure Conditions

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

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Temperature

FUMI-CEL & FUMI-STRIP
Minimum Exposure Periods

below 40°F (5°C)
40° - 53°F (5-12°C)
54° - 68°F (12-20°C)
above 68°F (20°C)

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

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 *more or less 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 products remaining after space fumigations. The proper length of the fumigation period will vary with exposure conditions since, in general, insects are more difficult to control at lower temperatures and the rate of hydrogen phosphide gas production by **FUMI-CEL** 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 insects 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 stored products 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**, **FUMI-STRIP** and **MAGTOXIN** are the products of choice under conditions of lower temperatures and/or low humidity.

3.4 **Commodities Which May be Fumigated with FUMI-CEL and FUMI-STRIP**

FUMI-CEL and **FUMI-STRIP** may be used for the fumigation of listed raw agricultural commodities, animal feed and feed ingredients, processed foods, tobacco and certain other nonfood items.

3.4.1 **Raw Agricultural Commodities, Animal Feed and Feed Ingredients Which May Be Fumigated with FUMI-CEL and FUMI-STRIP**

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	

3.4.2 **Processed Foods**

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

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3.4.2 Processed Foods

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

ACCEPTED
JAN 25 1999
Under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, for the pesticide registered under EPA Reg. No. 40285-8
Noodles, pasta,

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

- Processed Candy and Sugar
- Cereal Flours and Bakery Mixes
- Cereal Foods (including cookies, crackers, macaroni, pretzels, snack foods and spaghetti)
- Processed Cereals (including milled fractions and packaged cereals)
- Cheese and Cheese By-products
- Chocolate and Chocolate Products (such as assorted chocolate, chocolate liquor, cocoa, cocoa powder, dark chocolate coating and milk chocolate)
- Processed Coffee
- Corn Grits
- Cured, Dried and Processed Meat Products and Dried Fish
- Dates and Figs
- Dried Eggs and Egg Yolk Solids
- Dried Milk, Dried Powdered Milk, Nondairy Creamers, and Nonfat Dried Milk
- Dried or Dehydrated Fruits (such as apples, dates, figs, peaches, pears, prunes, raisins, citrus and sultanas)
- Processed Herbs, Spices, Seasonings and Condiments
- Malt
- Processed Nuts (such as almonds, apricot kernels, Brazil nuts, cashews, filberts, macadamia nuts, 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 (such as beans, carrots, lentils, peas, potato flour, potato products and spinach)
- Yeast (including primary yeast)
- Other processed foods

3.4.3 Nonfood Commodities, Including Tobacco

The listed nonfood items may be fumigated with FUMI-CEL 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 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
- Dried Plants and Flowers
- Seeds (grass seed, ornamental herbaceous plant seed and vegetable seed)
- Other nonfood commodities

Processed Foods Which May Be Fumigated With FUMI-CEL 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)

3.4.3 Nonfood Commodities, Including Tobacco

The listed nonfood items may be fumigated with **FUMI-CEL** 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 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
- Dried Plants and Flowers
- Seeds (grass seed, ornamental herbaceous plant seed and vegetable seed)

3.5 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 (33 g of hydrogen phosphide) per 230 to 1650 cubic feet and one FUMI-STRIP (660 g of hydrogen phosphide) per 4600-33,000 cubic feet. Note: The maximum dosage for dates, nuts and dried fruits is one FUMI-CEL per 825 cubic feet or one FUMI-STRIP per 16,500 cubic feet. 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 Feet/FUMI-CEL</u>	<u>Cubic Feet/FUMI-STRIP</u>
1.	Space		
	mills, warehouses, etc.	550 - 1650	11,000 - 33,000
	bagged commodities	550 - 1100	11,000 - 22,000
	processed dried fruits and nuts	825 - 1650	16,500 - 33,000
	stored tobacco	825 - 1650	16,500 - 33,000
2.	Bulk Stored Commodities		
	vertical storages	550 - 1100	11,000 - 22,000
	tanks	470 - 1100	9,400 - 22,000
	flat storages (loose construction)	230 - 660	4,600 - 13,200
	farm bins	230 - 470	4,800 - 9,400
	bunkers & tarped ground storages	410 - 1100	8,200 - 22,000
	railcars	510 - 1100	10,200 - 22,000
	barges	230 - 660	4,600 - 13,200
	ship holds	500 - 1100	10,000 - 22,000

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.

3.6 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 8 of this Applicator's Manual.
2. **FUMI-CEL** 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 insect pests.
4. Ideally, exposure periods should be long enough to provide for adequate control of insect pests and also more or less completely react the fumigant.

5. Remove **FUMI-CEL** and **FUMI-STRIP** entirely from their pouches for application.
6. Do not subdivide **FUMI-CEL** or **FUMI-STRIP** for fumigations.
7. Magnesium phosphide is considerably more reactive than aluminum phosphide, therefore, magnesium phosphide fumigants such as **FUMI-CEL**, **FUMI-STRIP** and **MAGTOXIN** are the products of choice for treatments under cooler and drier conditions.
8. Since magnesium phosphide is more reactive, care should be taken to prevent contact with water, piling up of Plates or Strips and allowing the gas to build up to flammable levels.
9. Observe the precautionary and safety statements mentioned elsewhere in this manual.

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.

3.6.1 **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. However, it is not legal to move trucks, trailers, containers, vans, etc., over public roads or highways until they have been aerated.

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 your supplier of DEGESCH products.

See Section 6 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** has been applied. Attach a packet of information for the consignee (available from DEGESCH America, Inc.) if the transport vehicle is to be shipped under fumigation. **Notify the consignee.**

Consignee Responsibilities

Proper handling of treated railcars at their destination is the responsibility of the consignee. The consignee must be familiar with the properties of hydrogen phosphide fumigants, worker exposure limits and symptoms and first aid treatment for hydrogen phosphide poisonings and must know how to make gas concentration measurements. 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. **Unaerated 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 and verify that it contains no more than 0.3 ppm hydrogen phosphide.
2. remove the fumigation warning placards,
3. remove and properly dispose of the spent fumigant,
4. ensure that worker exposure limits have not been exceeded,
5. transfer the fumigated commodity from the railcar, with or without prior aeration and
6. placard the new storage if it contains more than 0.3 ppm hydrogen phosphide.

3.6.2 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 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.

An enclosure suitable for fumigation may be formed by covering bulk or packaged commodity with poly sheeting. 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. Thinner poly, about 2 mil, is suitable for most indoor tarp fumigations and for sealing of windows, doors and other openings in structures. However, 4 mil poly or thicker is more suitable for outdoor applications where wind or other mechanical stresses are likely to be encountered.

FUMI-CEL 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** will treat a space of from 230 to 1650 cubic feet. A single **FUMI-STRIP** will treat a volume of from 4600 to 33,000 cubic feet.

3.6.3 Fumigation of Mills, Food Processing Plants and Warehouses

1. Using the label, calculate the length of the fumigation and the dosage of **FUMI-CEL** 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** 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. 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** and **FUMI-STRIP** for disposal, with or without further deactivation, following recommendations given under **Disposal Instructions**, section 10.
7. Remove fumigation warning placards from the aerated structure when the hydrogen phosphide concentration is 0.3 ppm or less.

3.6.4 **Fumigation of Ships**

3.6.4.1 **General Information**

1. Important - shipboard, in-transit ship or ship hold fumigation is also governed by U.S. Coast Guard Regulation 46 CFR 147A. Refer to this regulation prior to fumigation.
2. DEGESCH **FUMI-CEL** and **FUMI-STRIP** are classified by EPA as restricted use pesticides due to the acute inhalation toxicity of hydrogen phosphide (phosphine, PH₃) gas. This product is for retail sale to and use only by certified applicators 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. Physical presence means on site or on the premises. Read and follow the label and the DEGESCH America, Inc., Applicator's Manual which contains complete instructions for the safe use of this pesticide.

3.6.4.2 **Pre-Voyage Fumigation Procedures**

1. Prior to fumigating a vessel for in-transit cargo fumigation, the master of the vessel, or his 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 and a determination has been made by the master of the vessel and the fumigator that the vessel is safe for occupancy.
2. The person responsible for the fumigation must notify the master of the vessel, or his representative, of the requirements relating to personal protection equipment*, detection equipment and that a person qualified in the use of this equipment must accompany the vessel with cargo under fumigation. Emergency procedures, cargo ventilation, periodic monitoring and inspections, and first aid measures must be discussed with and understood by the master of the vessel or his representative.

*Personal protection equipment means a NIOSH/MSHA approved respirator or gas mask fitted with an approved canister for phosphine. The canister is approved for use up to 15 ppm. SCBA or its equivalent must be used above 15 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.
5. If the fumigation is not completed and the vessel aerated before the manned vessel leaves port, the person in charge of the vessel shall ensure that at least two units of personal protection equipment and one gas or vapor detection device, and a person qualified in their operation be on board the vessel during the voyage.
6. During the fumigation or until a manned vessel leaves port or the cargo is aerated, the person in charge of the fumigation shall ensure that a qualified person using gas or vapor detection equipment tests spaces adjacent to spaces containing fumigated cargo and all regularly occupied spaces for fumigant leakage. If leakage of the fumigant is detected, the person in charge of the fumigation shall take action to correct the leakage, or shall inform the master of the vessel, or his representative, of the leakage so that corrective action can be taken.
7. Review with the master, or his representative, the precautions and procedures for during the voyage.

3.6.4.3 **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 liquid water is likely.
- 4. Immediately after application of the fumigant, close and secure all hatch covers, tank tops, butterworth valves, manways, etc.

3.6.4.4 Intransit Fumigation of Transport Units (Containers) Aboard Ships

Intransit fumigation of transport units on ships is also governed by D.O.T. RSPA 49 CFR 176.76 (i) transport vehicles, freight containers, and portable tanks containing hazardous materials and International Maritime Dangerous Goods Code P9025-1 Amdt. 27-94. This permit which must be obtained prior to the fumigation is available from:

Commandant
U. S. Coast Guard
Hazardous Materials Standards Div.
GMSO-3
Washington, DC 20593-0001

Application procedures for fumigation of raw commodities or processed foods in containers and other transport vehicles are described in Section 3.6.1.

3.6.4.5 Precautions and Procedures During Voyage

- 1. Using appropriate gas detection equipment, monitor spaces adjacent to areas containing fumigated cargo and all regularly occupied areas for fumigant leakage. If leakage is detected, the area 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 one other person, wearing personal protection equipment, should be available to assist in case of an emergency.

3.6.4.6 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 safe levels, as indicated by a suitable detector.

3.6.5 Fumigation of Barges

Barge fumigations are also regulated by U. S. Coast Guard Regulation 46 CFR 147A as modified by U. S. Coast Guard Special Permit 2-75. This permit which must be obtained prior to the fumigation is available from:

Commandant
U. S. Coast Guard
Hazardous Materials Standards Div.
GMSO-3
Washington, DC 20593-0001

Leaks are a common cause of failures in the treatment of commodities aboard barges. Carefully inspect all hatch covers prior to application of **FUMI-CEL** or **FUMI-STRIP** and seal, if necessary. Notify consignee if the barge is to be fumigated in-transit.

4. PROTECTIVE CLOTHING

It is not necessary to wear gloves or other protective clothing when handling DEGESCH **FUMI-CEL** or **FUMI-STRIP**. However, wear dry gloves of cotton or other material if contact with metal phosphide tablets, pellets or dust is likely. Wash hands thoroughly after handling magnesium phosphide products. Aerate used gloves and other contaminated clothing in a well ventilated area prior to laundering.

5. RESPIRATORY PROTECTION

5.1 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. Respiratory protection is required if exposure is likely to exceed the eight hour TWA of 0.3 ppm during application, or a 0.3 ppm ceiling at any time afterwards. For example, respiratory protection is required to be worn upon reentry into a partially aerated structure if the hydrogen phosphide concentration is above 0.3 ppm. 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. Information on hydrogen phosphide (phosphine, PH₃) detector tubes may be obtained from DEGESCH America, Inc., or your DEGESCH distributor.

5.2 Permissible Gas Concentration Ranges for Respiratory Protection Devices

A NIOSH/MSHA approved, full-face gas mask - hydrogen phosphide canister combination may be used at levels up to 15 ppm or to escape from levels up to 1500 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 used. The NIOSH/OSHA Pocket Guide, 8-85, DHEW/NIOSH 78-210, lists these and other types of approved respirators and the concentration limits at which they may be used.

5.3 Requirements for Availability of Respiratory Protection

If metal phosphide products are to be applied from within the structure to be fumigated, an approved full-face gas mask - phosphine canister combination or self-contained breathing apparatus (SCBA) or its equivalent must be available at the site of application in case it is needed. In addition, SCBA or its equivalent must be available locally, for example, at fire station or rescue squad if it is not available at the fumigation site.

Respiratory protection need not be available for applications from outside the area to be fumigated such as addition of tablets or pellets to automatic dispensing devices, outdoor applications, etc., if exposures above the permitted exposure limits will not be encountered.

If monitoring equipment is not available on a farm and application of fumigant cannot be made from outside the structure, an approved canister respirator must be worn during application from within the structure being treated.

6. PLACARDING OF FUMIGATED AREAS

The applicator must placard or post all entrances to the structures under fumigation with signs bearing, in English and Spanish.

1. The signal word DANGER/PELIGRO and the SKULL AND CROSSBONES symbol in red.
2. The statement "Area and/or commodity under fumigation, DO NOT ENTER/NO ENTRE".
3. The statement, "This sign may only be removed after the commodity is completely aerated (contains 0.3 ppm or less of hydrogen phosphide gas). If incompletely aerated commodity is transferred to a new site, the new site must also be placarded if it contains more than 0.3 ppm. Workers must not be exposed to more than 0.3 ppm hydrogen phosphide."

- 4. The date and time fumigation begins and is completed.
- 5. Name of fumigant used.
- 6. Name, address and telephone number of the applicator.

All entrances to a fumigated area 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 0.3 ppm hydrogen phosphide or less. To determine whether aeration is complete, each fumigated site or vehicle must be monitored and shown to contain 0.3 ppm or less hydrogen phosphide gas in the air space around and, if feasible, in the mass of the commodity. Transfer of incompletely aerated commodity to a new site is permissible. However, the new storage must be placarded if it contains more than 0.3 ppm hydrogen phosphide. No placarding is required if aeration occurs during transfer. Workers who handle incompletely aerated commodity must be informed and appropriate measures taken (i.e., ventilation or respiratory protection) to prevent exposures from exceeding 0.3 ppm hydrogen phosphide.

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.

7. AERATION OF FUMIGATED COMMODITIES

7.1 Foods and Feeds

Tolerances for hydrogen phosphide residues have been established at 0.1 ppm for animal feeds and 0.01 ppm for finished foods. To guarantee compliance with these tolerances, it is necessary to aerate these commodities for 48 hours prior to offering them to the end consumer. As an alternative to this aeration period, each container of the treated commodity may be analyzed for residues using accepted analytical methods.

7.2 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 0.3 ppm.

8. APPLICATOR AND WORKER EXPOSURE

8.1 Hydrogen Phosphide Exposure Limits

Exposure to hydrogen phosphide gas may not exceed 0.3 ppm, measured as an eight hour time-weighted average (TWA), 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.

After application, exposure for any person may not exceed a 0.3 ppm ceiling for hydrogen phosphide. Such exposures may occur if the commodity or space under fumigation leaks, when treated commodity is transferred or handled, if an unaerated or partially aerated space is entered, etc.

8.2 Application of Fumigant

Depending upon temperature and humidity, DEGESCH **FUMI-CEL** and **FUMI-STRIP** release hydrogen phosphide gas slowly upon exposure to moisture from the air. This release rate is considerably more rapid than with **PHOSTOXIN**. However, since the Plates and Strips are so easy and rapid to apply, in most cases, this release is slow enough to permit applicators to deposit fumigant in the desired areas and then vacate the premises without significant exposure to the gas. If the fumigator's exposure exceeds the eight hour TWA of 0.3 ppm, approved respiratory protection must be worn. When required, gas concentration measurements for

safety purposes may be made using low level detector tubes. See the write-up below on Industrial Hygiene Monitoring. Information on hydrogen phosphide (phosphine, PH₃) detector tubes may be obtained from DEGESCH America, Inc., or your DEGESCH distributor.

It is often advisable to wear respiratory protection during application of fumigant under hot and humid conditions, particularly when considerable time must be spent inside the structure being treated.

8.3 **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.

8.4 **Aeration and Reentry**

If the area is to be entered after fumigation, it must be aerated until the level of hydrogen phosphide gas is 0.3 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.

8.5 **Handling Un aerated Commodities**

Workers must not be exposed to hydrogen phosphide in excess of 0.3 ppm during moving, storage or processing of incompletely aerated commodities.

8.6 **Industrial Hygiene Monitoring**

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 and to determine when and where respiratory protection is required. 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 odor is detected. Gas measurements should be made in the worker's breathing zone. Monitoring is not required for outdoor operations.

If monitoring shows that workers are exposed to concentrations in excess of the permitted limits, then engineering controls (such as forced air ventilation) and/or appropriate work practices should be used, where possible, to reduce exposure to within permitted limits.

There are a number of devices on the market for the 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, portable, 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.

9. STORAGE INSTRUCTIONS

1. Store DEGESCH **FUMI-CEL** 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.
2. Do not store in buildings where humans or domestic animals reside. Keep out of reach of children.
3. DEGESCH **FUMI-CEL** and **FUMI-STRIP** are supplied in gas-tight, aluminum foil pouches. These pouches are not resealable, 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.

10. DISPOSAL INSTRUCTIONS

10.1 General

- 10.1.1 Do not contaminate water, food or feed by storage or disposal
- 10.1.2 Unreacted or partially reacted **FUMI-CEL** or **FUMI-STRIP** is acutely hazardous. Improper disposal of excess pesticide is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance. For specific instructions, see Section 11 of this manual, Spill and Leak Procedures.
- 10.1.3 Some local and state waste disposal regulations may vary from the following recommendations. Disposal procedures should be reviewed with appropriate authorities to ensure compliance with local regulations. Contact your state Pesticide or Environmental Control Agency or Hazardous Waste Specialist at the nearest EPA Regional Office for guidance.
- 10.1.4 Dispose of containers in a sanitary landfill or by other procedures approved by state and local authorities.
- 10.1.5 If properly exposed during the fumigation period, **FUMI-CEL** and **FUMI-STRIP** will contain virtually no unreacted magnesium phosphide. This will be a nonhazardous waste. However, incompletely exposed Plates and Strips will require special care for disposal.

10.2 Directions for Disposal of Exposed **FUMI-CEL** and **FUMI-STRIP**

- 10.2.1 Confinement of partially spent **FUMI-CEL** 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.
- 10.2.2 In open areas, Plates and Strips may be disposed of on site by burial.
- 10.2.3 *Unreacted or improperly exposed Plates and Strips must be further deactivated before disposal at a landfill.*
- 10.2.4 Spent Plates and Strips may be collected for disposal in well ventilated containers such as wire baskets (available from DEGESCH America, Inc.) 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.

10.3 Directions for Deactivation of Partially Spent **FUMI-CEL** and **FUMI-STRIP**

- 10.3.1 Partially spent **FUMI-CEL** Plates and **FUMI-STRIP** must be further 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.
- 10.3.2 Partially spent Plates and Strips may be deactivated as follows using the "Wet Method."
 - 10.3.2.1 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 an inch or two of the top. Do not allow a large headspace above the surface of the water.
 - 10.3.2.2 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.
 - 10.3.2.3 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 4 to 6 inches to prevent smoking of the liberated hydrogen phosphide gas. Plates and Strips may be placed in wire baskets for immersion in water.

- 10.3.2.4 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 or it may be poured into a storm sewer.
- 10.3.2.5 **Caution: Wear appropriate respiratory protection during wet deactivation of partially spent material. Do not cover the container being used for wet deactivation. Do not dispose of dust in a toilet.**
- 10.3.3 Partially Spent Plates and Strips may be Deactivated as Follows Using the "Dry Method"
- 10.3.3.1 Extension of the fumigation period is the simplest method for further deactivation of partially spent Plates and Strips prior to ultimate disposal.
- 10.3.3.2 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. As time permits, or when the container is full, 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 liquid water.
- 10.3.3.3 Plates and Strips may also be "dry deactivated" by spreading them out onto the ground in a secure, 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 several inches 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.

11. SPILL AND LEAK PROCEDURES

11.1 General Precautions and Directions

A spill, other than incidental to application or normal handling, may produce high levels of gas and, therefore, attending personnel must wear SCBA 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. Do not use water at any time to clean up a spill of **FUMI-CEL** 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 material when handling metal phosphides.

Return all intact aluminum foil pouches of **FUMI-CEL** or **FUMI-STRIP** to original packaging or other packaging which has been suitably constructed and marked according to DOT 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.

If foil pouches of **FUMI-CEL** 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 11.2. 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 11.2. 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 several inches 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.

11.2 **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:

- 11.2.1 Water is used for the wet deactivation of **FUMI-CEL** 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 an inch of the top. Do not allow a large headspace above the surface of the water.
- 11.2.2 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 4 to 6 inches to prevent smoking of the liberated hydrogen phosphide gas.
- 11.2.3 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 or it may be poured into a storm sewer.
- 11.2.4 **Caution:** Respiratory protection is required during wet deactivation of unexposed **FUMI-CEL** and **FUMI-STRIP**. 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.
- 11.2.5 The EPA has determined that proper disposal of magnesium phosphide will cause no unreasonable adverse effects to the environment.