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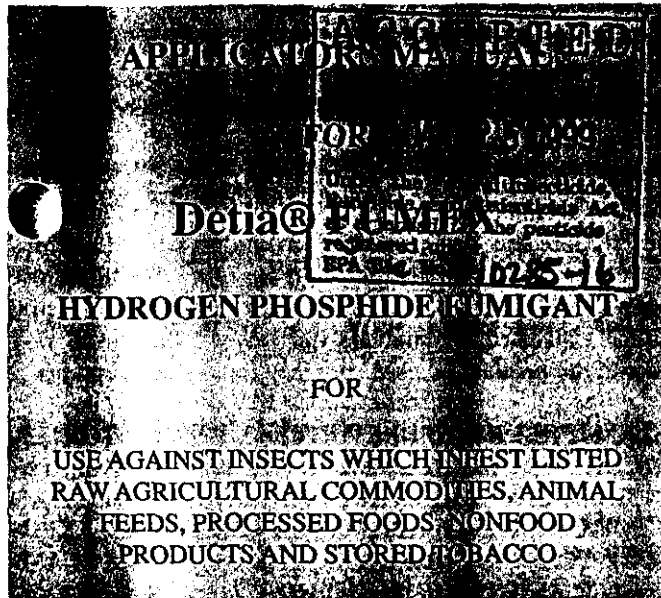
Printed: 13:24:13 Friday, 14 May, 1999 # 9 / 2798

Systems Integration Group, Inc.

3/98

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 this product 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 contain complete instructions for the safe use of this pesticide.



KEEP OUT OF REACH OF CHILDREN
DANGER - POISON - PELIGRO



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

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

Manufactured For:
DEGESCH America, Inc.
P.O. Box 116 • Weyers Cave, VA 24486
Telephone: (540) 234-9281
Fax: (540) 234-8225

EPA Establishment No. 33982-WG-01
EPA Registration No. 40285-16

Form # 23105

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

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

WARRANTY

Seller warrants that the product conforms to its chemical description and when used according to label directions under normal conditions of use, it is reasonably fit for the purpose stated on the label. Seller makes no other warranty, either expressed or implied, and buyer assumes all risk should the product be used contrary to label instructions.

CLASSIFIED BY UNDERWRITERS LABORATORIES, INC., AS TO FIRE HAZARD ONLY WHEN USED SPECIFICALLY AS DIRECTED IN THE LABELING. DETIA® FUMEX IS NONCUMBUSTIBLE ITSELF BUT EXPOSURE TO MOIST AIR OR WATER RELEASES FLAMMABLE AND TOXIC PHOSPHINE GAS. SPONTANEOUS IGNITION MAY RESULT IF CONTACTED BY WATER, ACIDS OR CHEMICALS. (88X5)

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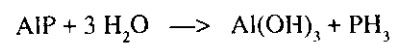
I. INTRODUCTION

A. HISTORY

The history of Detia® pesticides is long, dating back to the mid-1930's. In 1970 Detia® GAS EX-B was introduced into the United States. Detia® Tablets and Detia® Pellets were introduced in 1977 and Detia® FUMEX in 1992. The manufacturer, Detia® Freyberg GMBH, West Germany was the early pioneer in the development of hydrogen phosphide as a fumigant gas.

B. PRODUCT DESCRIPTION

The Detia® FUMEX concept is one that permits the packaging of 57% aluminum phosphide preparation into small, porous bags which become an integral part of the concept. Therefore, the bags should never be torn open during fumigation. Once the bags are removed from the hermetically sealed container, they will begin slowly releasing hydrogen phosphide in the following way:



Warm, humid air accelerates the reaction while cool, dry air has the opposite effect. For example, when relative humidity and temperature to which the bags are exposed are high, decomposition of Detia® may be complete in 3 days. However, at moderate temperatures and low humidities, decomposition may require 7 days or more. This reaction starts slowly, gradually accelerates and then tapers off again as the aluminum phosphide is spent.

Spent Detia® is a gray-white powder composed almost entirely of aluminum hydroxide and other approved inert ingredients. If properly exposed, the spent Detia® will normally contain only a small amount of unreacted aluminum phosphide and may be disposed of without hazard. It is **not** considered a hazardous waste. However, the partially spent residue from incompletely exposed Detia® requires special care. Precautions and instructions for further deactivation and disposal will be given later in this manual.

C. PRODUCT PACKAGING

The bag, in combination with the Detia® FUMEX formulation, permits the controlled release of hydrogen phosphide. The tough, permeable bag used is an integral part of the total concept. The bags contain

34 grams 57% Aluminum Phosphide
43% Other Ingredients

They release over 11 grams of hydrogen phosphide when exposed to moist air.

Bags are packed either 6, 10 or 15 to a container. Detia® FUMEX is also packed as a long fabric strip (bag blanket) which is equivalent to 100 bags and as a short belt (bag belt) which is equivalent to 4 bags. There are 3 or 9 belts per container. Note, neither the bag blanket nor the bag belt have been classified Underwriters Laboratories, Inc.® (UL). The variety of package sizes and types provide for convenience of application in different sizes and types of storages. Other package sizes may also be available.

The bag is especially well suited to fumigation of small spaces and small bulk storages such as rail cars. It may also be added directly to bulk raw agricultural commodities and other indicated commodities as bins are filled. In this instance the bag must be removed when the commodity is pulled from the bin.

The "bag belt" (not classified by UL) consists of 4 bags per belt and is specially designed to be probed into approved bulk commodities.

The "bag blanket" (not classified by UL) contains 100 bags per blanket and is well suited to large scale fumigations such as ship holds, large flat storage bins and large space fumigations.

The "bag blanket" is very quickly applied and retrieved after the fumigation.

The hermetically sealed cans are easily opened with a common strip key or can opener.

The shelf life of Detia® FUMEX is almost unlimited as long as the packaging remains sealed and intact.

D. WHAT IS HYDROGEN PHOSPHIDE?

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

E. SAFETY RECOMMENDATIONS

1. Carefully read the labeling and follow instructions explicitly.
2. Never work alone when applying fumigant from within the storage structure.
3. Never allow uninstructed persons to handle Detia®.
4. Approved respiratory protection must be available for the fumigation of structures from within.
5. It is often desirable to open fumigant containers in open air or near a fan that exhausts outside immediately. Never open in a flammable atmosphere.
6. Do not allow Detia® to contact liquid water or to pile up.
7. Dispose of spent bags in a proper manner consistent with the label instructions.
8. Post "DANGER" signs on fumigated areas.
9. Notify appropriate company employees and provide relevant safety information to local officials annually for use in the event of an emergency.
10. Hydrogen phosphide fumigants are not to be used for vacuum fumigations.
11. Worker exposure to hydrogen phosphide must not exceed the 8 hour TWA of 0.3 ppm during application or a maximum concentration of 0.3 ppm after application is completed. This includes reentry into a structure.
12. Fumigated finished foods and feeds must be aerated 48 hours prior to offering to the end consumer.
13. Transfer of a treated commodity to another site prior to complete aeration is permissible provided the new site is placarded if it contains more than 0.3 ppm.
14. Aerate contaminated clothing in well ventilated area prior to washing.
15. Keep containers sealed and intact until ready to begin applying fumigant.
16. Use all bags from opened containers.
17. OSHA recommends that the exposure screening of employees be conducted to detect impaired pulmonary function. OSHA recommends that any employees developing the above condition be referred for medical attention.

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II. PRECAUTIONARY STATEMENTS

A. HAZARDS TO HUMANS AND DOMESTIC ANIMALS

**Keep Out of Reach of Children
DANGER-POISON**

Aluminum phosphide in Detia® FUMEX can be fatal if swallowed. Do not get in eyes, in nose, on skin or on clothing. Do not eat, drink or smoke while handling aluminum phosphide fumigants. When the container is opened Detia® FUMEX will begin to release hydrogen phosphide (phosphine) which is an extremely toxic gas. Contact with water, acids and some other liquids will accelerate this reaction. If a garlic odor is detected, refer to the section on "Industrial Hygiene Monitoring" on page 40 for appropriate monitoring procedures. Pure hydrogen phosphide gas is odorless; odor is due to a contaminant. Since an odor may not be detected under certain circumstances, the absence of a garlic odor does not mean that hydrogen phosphide gas is absent. Observe proper application, aeration, reentry and disposal procedures specified elsewhere in the labeling to prevent overexposure.

FREQUENT EXPOSURE TO CONCENTRATIONS ABOVE PERMISSIBLE LEVELS OVER A PERIOD OF DAYS OR WEEKS MAY CAUSE POISONING.

B. STATEMENT OF PRACTICAL TREATMENT

Symptoms of overexposure to hydrogen phosphide 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.

1. If gas or dust from Detia® FUMEX is inhaled: 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.
2. If gas or dust from Detia® FUMEX is swallowed: Drink or administer one or two glasses of water and induce vomiting by touching back of throat with finger, or if available, administer syrup of ipecac. Do not give anything by mouth if victim is unconscious or not alert.
3. If the dust from Detia® FUMEX gets on skin or clothing: Brush or shake material off clothes and shoes in well ventilated area. Allow clothes to aerate in a venti-

lated area prior to laundering. Do not leave contaminated clothing in occupied and/or confined area such as automobiles, vans, motel rooms, homes, etc. Wash contaminated skin thoroughly with soap and water.

4. If dust from Detia® FUMEX gets in eyes: Flush with plenty of water. Get medical attention.

C. NOTE TO PHYSICIAN

Aluminum phosphide in Detia® FUMEX reacts with moisture from the air, water, acids and many other liquids to release hydrogen phosphide (phosphine) gas. Mild exposure by inhalation causes malaise (indefinite feeling of sickness), ringing of ears, fatigue, nausea and pressure in chest which are relieved by removal to fresh air. Moderate poisoning causes weakness, vomiting, epigastric pain (pain just above the stomach), chest pain, diarrhea and dyspnea (difficulty in breathing). Symptoms of severe poisoning may occur within a few hours or up to several days, resulting in pulmonary edema (fluid in lungs) and may lead to dizziness, cyanosis (blue or purple skin color), unconsciousness and death.

In sufficient quantity hydrogen phosphide 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. Hydrogen phosphide 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 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:

1. In its milder to moderate forms (symptoms of poisoning may take up to 24 hours to make their appearance), the following is suggested:
 - a. Complete rest 1-2 days during which the patient must be kept quiet and warm.
 - b. If the patient suffers from vomiting or increased blood sugar, appropriate solutions should be administered. Treatment with oxygen is recom-

mended as is the administration of cardiac and circulatory stimulants.

2. In cases of severe poisoning (intensive care unit recommended):
 - a. Where pulmonary edema is observed, steroid therapy should be considered and close medical supervision is recommended. Blood transfusions may be necessary.
 - b. In case of manifest pulmonary edema, venesection should be performed under vein pressure control. Heart glycosides (I.V.) can be used in case of hemoconcentration. Venesection may result in shock. In the case of progressive edema of the lungs, immediately intubate and remove edema fluid and administer oxygen over-pressure respiration, as well as any measures required for shock treatment. In case of kidney failure, extracorporeal hemodialysis is necessary. There is no specific antidote known for this poisoning.
 - c. If the powder from Detia® FUMEX is ingested, induce vomiting. Flush the stomach with a diluted potassium permanganate solution or a solution of magnesium peroxide until flushing liquid ceases to smell of carbide. Thereafter, apply carbomedicinalis.

D. PHYSICAL AND CHEMICAL HAZARDS

Aluminum phosphide in Detia® Fumex and partially spent bags will release hydrogen phosphide if exposed to moisture from the air or if it comes into contact with water, acids and many other liquids. 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 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. Aluminum 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 often desirable to open containers of Detia® FUMEX in open air or near a fan which exhausts *outside immediately*. Never open in a flammable atmosphere because on rare occasions it may flash. When opening, point the container away from the face and body. These precautions will also reduce the applicator's exposure to hydrogen phosphide gas.

Pure hydrogen phosphide gas is practically insoluble in water and oils and is stable at normal fumigation temperatures. However, it may react with certain metals and cause corrosion, especially at higher temperatures and relative humidities. Metals such as copper, brass and other copper alloys, and precious metals such as gold and silver are susceptible to corrosion by hydrogen phosphide. Thus, small electric motors, smoke detectors, brass sprinkler heads, batteries and battery chargers, fork lifts, temperature monitoring systems, switching gears, communication devices, computers, calculators and other electronic or electrical equipment should be protected or removed before fumigation. In most cases all electronic equipment must be removed. Hydrogen phosphide gas will also react with certain metallic salts and therefore, sensitive items such as photographic film, some inorganic pigments, etc., should not be exposed.

III. DIRECTIONS FOR USE

A. GENERAL

1. It is a violation of federal law to use this product in a manner inconsistent with its labeling. Detia® FUMEX is a Restricted Use Pesticide due to the acute inhalation toxicity of 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 this product manual working under the direct supervision and in the physical presence of the certified applicator. Physical presence means on site or on the premises.
2. Detia® is a highly hazardous material and may be used only by individuals trained in its proper use. Before using, read and follow the label precautions and directions on the label and in labeling.

Additional copies of this manual are available from:
DEGESCH America, Inc.
275 Triangle Drive
P. O. Box 116
Weyers Cave, VA 24486
Telephone: (540) 234-9281
Fax: (540) 234-8225

3. At least two trained persons must be present when Detia® FUMEX is applied from within the space being treated or during reentry into a fumigated or partially aerated site. Only one trained person is required when the fumigant is applied from outside the area to be treated.
4. Prior to applying this product, you must inspect the storage structure to determine if it can be made sufficiently gas tight. Decide how personal exposure monitoring should be conducted. Notify appropriate company employees and provide relevant safety information to local officials annually for use in the event of an emergency. Apply this fumigant in an effective and safe manner with appropriate considerations to emergency procedures, etc.
5. Ship holds, barges, containers on ships, railroad cars and containers shipped piggyback by rail may be fumigated in transit. However, fumigated trucks, vans, trailers and similar transport vehicles cannot be moved over public roads or highways until they are aerated.
6. The powder in Detia® FUMEX bags must not come into contact with any processed food with the exception that it can be added directly to **processed brewers rice, malt, and corn grits** used in the manufacture of beer.
7. Protect copper, silver, gold and their alloys from corrosive exposure to hydrogen phosphide.
8. Do not fumigate commodities with this product when commodity temperature or temperature to which the bags are exposed is below 40 degrees F (5 degrees C).

B. EFFICACY

Complete control of listed insect pests is frequently not achieved. Factors contributing to less than 100% control are gas leakage, poor gas distribution, unfavorable exposure conditions, etc. In addition, some insects are less susceptible to hydrogen phosphide than others. To maximize control, extreme care must be observed in sealing, higher dosages must be used, exposure periods must be lengthened, proper applica-

tion procedures must be followed, and temperature and humidity must be favorable.

C. USE PATTERN

1. INSECT PESTS

Detia® FUMEX is registered with the U. S. Environmental Protection Agency as an aid in the control of the following insects:

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

2. COMMODITIES

Detia® FUMEX is registered by EPA for the fumigation of the following commodities.

a. Raw Agricultural Commodities

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

b. Processed Foods

The listed processed foods may be fumigated with Detia®. Under no condition shall any processed food or commodity come in contact with the residual dust from Detia® FUMEX except that Detia may be added directly to processed brewers rice, malt and corn grits for use in the manufacture of beer.

- Processed candy and sugar
- Cereal flours and bakery mixes
- Cereal foods (including cookies, crackers, macaroni, noodles, pasta, pretzels, snack foods and spaghetti)
- Processed cereal grains (including milled fractions and packaged cereals)
- Cheese and cheese by-products
- Chocolate and chocolate products (such as assorted chocolate, chocolate liquor, cocoa, cocoa powder, dark chocolate coating and milk chocolate)
- Processed coffee
- Corn grits
- Cured, dried and processed meat products and dried fish
- Dates
- Dried eggs and egg yolk solids
- Dried milk, dried powdered milk, nondairy creamers, and nonfat dried milk
- Dried or dehydrated fruits (such as apples, dates, figs, peaches, pears, prunes, raisins, citrus and sultanas)
- Dried and dehydrated vegetables (such as beans, carrots, lentils, peas, potato flour, potato products and spinach)
- Figs
- Malt
- Peanuts
- Processed herbs, spices, seasonings and condiments
- Processed nuts (such as almonds, apricot kernels, Brazil nuts, cashews, filberts, macadamia nuts, pecans, pistachio nuts, walnuts and other processed nuts)
- Processed oats (including oatmeal)
- Rice (brewers rice grits, enriched and polished, wild rice)
- Soybean flour and milled fractions
- Processed tea
- Yeast (including primary yeast)
- Other processed foods

c. Animal Feed and Feed Ingredients

d. Nonfood Commodities, Including Tobacco

The listed nonfood items may be fumigated with Detia®. Tobacco, psyllium seed and psyllium seed husks intended or drug use and certain other of the nonfood commodities should not be contacted by tablets, pellets or residual dust. Only lots of psyllium seed and psyllium seed husks destined for shipment to

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

- Animal hide
- Processed or unprocessed cotton, wool and other natural fibers or cloth, clothing
- Feathers
- Furs
- Human hair, rubberized hair, vulcanized hair, mohair
- Leather products
- Tobacco
- Wood, cut trees, wood chips and wood and bamboo products
- Paper and paper products
- Dried plants and flowers
- Psyllium seed and psyllium seed husks
- Seeds (grass seed, ornamental herbaceous plant seed and vegetable seed)
- Straw or hay
- Tires (for mosquito control)
- Other nonfood commodities

D. DOSAGE GUIDE

Since hydrogen phosphide is a mobile gas and will penetrate to all parts of the storage structure, dosage must be based upon the total volume of the space being fumigated and not on the amount of bulk commodity it contains. For example, the same amount of Detia® is required to treat a 30,000 bushel silo whether it is full or not. The following dosage ranges are allowed for bulk and space fumigations.

DOSAGE RANGE: 2 to 13 bags per 1000 cu. ft.

NOTE: The maximum dosage allowed for dates, nuts and dried fruits is 4 bags per 1000 cubic feet.

These dosages should not be exceeded. It is important to realize that shortened exposure period cannot be compensated for with an increased dosage.

The wide dosage ranges listed above are designed to accommodate the variety of fumigation situations that might occur. The major factor in selecting dosage is the capability of the structure to hold

b. Processed Foods

The listed processed foods may be fumigated with Detia®. Under no condition shall any processed food or commodity come in contact with the residual dust from Detia® FUMEX except that Detia® may be added directly to processed brewers rice, malt and corn grits for use in the manufacture of beer.

Processed candy and sugar

Cereal flours and bakery mixes

Cereal foods (including cookies, crackers, macaroni, noodles, pasta, pretzels, snack foods and spaghetti)

Processed cereal grains (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

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)

Dried and dehydrated vegetables (beans, carrots, lentils, peas, potato flour, potato products and spinach)

Figs

Malt

Peanuts

Processed herbs, spices, seasonings and condiments

Processed nuts (almonds, apricot kernels, Brazil nuts, cashews, filberts, pecans, pistachio nuts and walnuts)

Processed oats (including oatmeal)

Rice (brewers rice grits, enriched and polished, wild rice)

Soybean flour and milled fractions

Processed tea

Yeast (including primary yeast)

c. Animal Feed and Feed Ingredients

d. Nonfood Commodities, Including Tobacco

The listed nonfood items may be fumigated with Detia®. Tobacco, psyllium seed and psyllium seed husks intended for drug use and certain other of the nonfood commodities should not be contacted by tablets, pellets or residual dust. 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) prior to shipment. In addition, psyllium seed and husks may be fumigated at other locations only under direct instructions from the pharmaceutical company.

Animal hide

Processed or unprocessed cotton, wool and other natural fibers or cloth, clothing

Feathers

Furs

Human hair, rubberized hair, vulcanized hair, mohair

Leather products

Tobacco

Wood, cut trees, wood chips and wood and bamboo products

Paper and paper products

Dried plants and flowers

Psyllium seed and psyllium seed husks

Seeds (grass seed, ornamental herbaceous plant seed and vegetable seed)

Straw or hay

Tires (for mosquito control)

D. DOSAGE GUIDE

Since hydrogen phosphide is a mobile gas and will penetrate to all parts of the storage structure, dosage must be based upon the total volume of the space being fumigated and not on the amount of bulk commodity it contains. For example, the same amount of Detia® is required to treat a 30,000 bushel silo whether it is full or not. The following dosage ranges are allowed for bulk and space fumigations.

DOSAGE RANGE: 2 to 13 bags per 1000 cu. ft.

NOTE: The maximum dosage allowed for dates, nuts and dried fruits is 4 bags per 1000 cubic feet.

These dosages should not be exceeded. It is important to realize that shortened exposure period cannot be compensated for with an increased dosage.

The wide dosage ranges listed above are designed to accommodate the variety of fumigation situations that might occur. The major factor in selecting dosage is the capability of the structure to hold hydrogen phosphide during the exposure period and thus obtain and sustain lethal concentrations throughout. It is more difficult to obtain penetration of gas throughout the structure in bulk stored commodities. An example of this is the treatment of grain stored in flat storage in which fumigant is probed or surface applied.

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 SEVERAL TYPES OF FUMIGATIONS

<u>TYPE OF FUMIGATION</u>	<u>DOSAGE RANGE</u> <i>(Bags/1000 cu.ft.)</i>
1. SPACE (INCLUDING PACKAGED COMMODITIES)	
A. MILLS, WAREHOUSES, ETC.	2 - 6
B. BAGGED COMMODITIES	3 - 6
C. DRIED FRUITS, NUTS AND DATES	2 - 4
D. STORED TOBACCO	2 - 4
2. BULK STORED COMMODITIES	
A. VERTICAL STORAGE	3 - 5
B. TANKS	4 - 6
C. FLAT STORAGE (LOOSE CONSTRUCTION)	5 - 13
D. FARM BINS	6 - 13
E. HOPPER RAIL CARS	2 - 4
F. BOX RAIL CARS	2 - 6
G. BUNKERS, TARPED GROUND STORAGE	3 - 6
H. BARGES	3 - 7
I. SHIP HOLDS	3 - 6

The upper dosages listed are recommended for bulk stored commodities and in structures that are of loose construction.

E. SEALING

There are many factors affecting a fumigation but most are minor compared to sealing. Proper sealing is necessary to insure effective control of insects and to protect man and other forms of life in adjoining enclosed areas from hydrogen phosphide during the fumigation. Proper sealing must include the closure of all openings except tiny holes or narrow cracks that are very difficult to seal. Maximum results, however, can be achieved if all these are sealed. Polyethylene sheeting and masking or duct tape are adequate sealing materials. Contact DEGESCH America, Inc. for additional information.

EXPOSURE GUIDELINES

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

<u>TEMPERATURE TO WHICH FUMIGANT AND/OR INSECTS ARE EXPOSED</u>	<u>EXPOSURE PERIOD</u>
Below 40°F	Do Not Fumigate
40°F - 49°F	14 days (336 hrs.)
50°F - 59°F	9 days (216 hrs.)
60°F - 77°F	5 days (120 hrs.)
Above 77°F	3 days (72 hrs.)

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. It is necessary to lengthen the fumigation at lower temperatures since insects are more difficult to kill under these conditions. In this regard, the temperature to which the insects are exposed is the critical factor.

There is little to be gained by extending the exposure period if the structure to be fumigated has not been carefully sealed. Careful sealing is required to ensure that adequate gas levels are retained. Proper application procedures must be followed to provide satisfactory distribution of hydrogen phosphide gas particularly in the fumigation of bulk commodity contained in large storages.

When Detia® FUMEX is not uniformly added to a bulk commodity mass (i.e. surface application or shallow probing)

exposure times must be substantially lengthened to allow penetration of gas throughout the commodity. As a "rule of thumb" a minimum of 1 day should be added to the exposure time listed above for each 10 feet the gas must penetrate downward. It is preferable to add 2 days for each 10 feet. Some structures can only be treated when completely tarped.

In addition, the fumigation period should be long enough that the production of hydrogen phosphide has essentially ceased. This will minimize hazards in the disposal of spent aluminum phosphide products remaining. Temperature and humidity to which Detia® FUMEX is exposed are important to this determination since both lower temperatures and/or dry air retard gas release.

Consequently, exposure periods recommended in the table minimum periods and may not be adequate to control stored product pests under all conditions. This is particularly true at lower temperatures (below 60 degrees F). Nor will they always provide for the cessation of the production of hydrogen phosphide when pellets or tablets are exposed to inadequate moisture levels.

If the temperature to which the insects are exposed is warmer than the temperature to which the bags are exposed (i.e. may occur in a winter space fumigation) it may be possible to obtain an effective insect kill before the bags are totally spent. In this event it is permissible to conclude a space fumigation as soon as an effective kill has been achieved. However the bags must be deactivated prior to disposal. See deactivation instructions on page 41 of this manual.

Whenever possible, exposure periods should exceed minimum periods listed above. Remember, the key to effective results lies with correct dosage, long exposure periods, proper application procedures and well sealed enclosures.

G. APPLICATION PROCEDURES

1. GENERAL STATEMENT

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 aluminum phosphide products.

2. APPLICATION PROCEDURES FOR DIRECT ADDITION OF Detia® FUMEX BAGS TO BULK COMMODITIES

- a. Commodities (listed raw agricultural commodities, seeds, wood chips, animal feed and feed ingredients; and processed brewers rice, malt and corn grits used in the manufacture of beer.)
- b. Storage Structures (bins, tanks, silos, granaries, flat storage, bunkers, bulk rail cars, etc.)
- c. Procedures for Vertical Storages (concrete upright bins and other silo type bins that can be quickly transferred)

- (1) Bags may be added to the commodity as the bin is filled, but must be removed as the bin is emptied. Detia® Pellets and Tablets are most suited to this application since they can be automatically added to the commodity and are not removed after the fumigation.
- (2) For best results, all cracks and openings with the exception of fill openings should be closed or sealed prior to fumigating the bin. To this end, vents near the bin top connecting adjacent bins should be sealed prior to the fumigation. Proper respiratory protection must be worn if the bin is entered to seal these openings after the fumigant has been added.
- (3) Determine minimum exposure time based on commodity temperature and moisture. At commodity moistures of below 11.5%, exposure periods should be extended to obtain complete reaction of the fumigant.
- (4) Calculate the number of bags needed and the rate at which they must be added based upon the rate at which the bin will be filled.
- (5) Detia® bags are applied by hand on the headhouse/gallery belt or into the fill opening. Add fumigant in as continuous a manner as possible to the commodity stream.
- (6) Keep an accurate count of bags added since the bags must be removed when the bin is emptied. Bags can be removed by transfer of the commodity through a screen or scalperator.
- (7) Seal the bin deck openings after the application is complete.
- (8) Bins requiring more than 24 hours to fill should not be fumigated by direct addition as

the bin is filled.

- (9) Post "DANGER" placards on all entrances and on the discharge gate.
 - (10) Bins need not be aerated until they are transferred. Workers must not be over exposed during this transfer.
- d. Procedures for Flat Storages (rectangular shaped bins, tanks, farm style bins and other horizontal bins)
- (1) Check the storage for tightness.
 - (2) To the extent practical seal any vents, cracks or sources of leaks.
 - (3) Determine dosage and exposure time. The dosage will depend in large part on a combination of the tightness of the seal, the application procedure and the rain depth. The poorer the seal and the farther the gas must penetrate to reach throughout the bin, the higher the required dosage will be. For good results add the length of time required for the gas to penetrate throughout the bin to the exposure time given on page 17 of this manual. To the extent possible, lengthen the exposure period. As a "rule of thumb" a minimum of 1 day should be added to the exposure time for each 10 feet the gas must penetrate downward. It is preferable to add 2 days for each 10 feet. Exposure periods listed on page 17 of this manual should also be lengthened at commodity moistures below 11.5% to obtain complete reaction of the fumigant.
 - (4) Determine application procedure to be used. This can include shallow probing, uniform addition as the bin is filled, or surface application. Bins requiring more than 24 hours to fill should not be fumigated by addition as the bin is filled since large quantities of gaseous fumigant may escape before the bin is finally sealed.
 - (5) Surface application can be used if the bin can be made sufficiently gas tight to contain the fumigant long enough for it to penetrate throughout. In this instance it is advisable to place 1/4 of the dosage in the floor level aeration ducts. This fumigant must not contact liquid phase water. Surface application can be accomplished using individual bags or

the 15 feet long "bag blanket" (not classified by UL) which contains 100 bags per blanket. It is easier to retrieve the individual bags after the fumigation if they are placed on a strip of kraft paper. Better retention in the commodity mass may be attained by placing the "bag blankets" (not classified by UL) in a shallow trench and covering them with commodity. "Bag blankets" (not classified by UL) are quickly applied and easily retrieved, so they are ideal for large bulk storages. If necessary the "bag blanket" may be subdivided, but do not save a left-over segment for a future fumigation.

- (6) Shallow probing can be accomplished using the "bag belt" (not classified by UL) which contains 4 bags per belt. A "locator" cord should also be attached to the bag belt (not classified by UL) for easy identification and removal of each belt. The belts should be spaced as evenly as possible over the entire surface of the commodity.
- (7) Arrange enough applicators and other workers to complete the job quickly enough to avoid excessive exposure to hydrogen phosphide gas. The production of gas during application can be significantly retarded by conducting fumigations when temperatures in the bin are lowest and other work practices. It is often advisable to wear approved respiratory protection during application of fumigant under hot and humid conditions, particularly when considerable time must be spent inside the structures being treated. Monitoring with a suitable detection device is required to assure that the 0.3 ppm, 8 hour TWA is not exceeded. See "Industrial Hygiene Monitoring" section on page 40 of this manual.
- (8) It is often advisable as an additional sealing measure to cover the commodity with plastic tarps.
- (9) Seal all remaining exits.
- (10) Post "DANGER" placards on and lock all entrances.
- (11) The bin need not be aerated unless reentry is required. Consult safety procedures listed

elsewhere in labeling.

- (12) Remove and dispose of bags prior to emptying bin or during emptying if the bags cannot be retrieved otherwise.
- e. Procedures for Bunkers and Other Outdoor Tarp Fumigations
 - (1) See steps "3", "4", "5", and "6" in section "d" above.
 - (2) When tarps are being spread over ground storage they should be glued, clamped or otherwise sealed together. Sand or water snakes can be used for a ground seal.
 - (3) Surface or shallow probing may be done through slits in the tarp or the tarp can be spread over the commodity after application. Seal slits after application.
 - (4) This is an outdoor application so safety monitoring and respiratory equipment are not required.
 - (5) Post "DANGER" placards.
 - (6) When possible remove bags prior to moving the commodity.

f. Procedures for Farm Storages

- (1) General

Since on farm storage is almost always flat storage, refer to "Procedures for Flat Storage" on page 20 of this manual. The instructions which follow provide additional guidance.
- (2) Sealing

Leakage is the single most important cause of failure in the treatment of farm bins. Since these bins are usually small by comparison they have a higher leakage area in proportion to their capacity. Most wooden granaries are so porous that they cannot be successfully fumigated unless they are completely covered with plastic sheeting or similar tarp. Steel bins are also usually of very loose construction and therefore require much attention to sealing. All vents and aeration ducts must be tightly sealed using 4 mil polyethylene sheeting or its equivalent. The plastic must be sealed directly to the metal with tape or other adhesive. It is not sufficient to "cinch up" the plastic as with a belt. The surface of the grain should be covered with

plastic sheeting after Detia® has been applied. Tarping of the grain surface will greatly reduce leakage. Other sealing techniques are recommended, i.e. closure of all large cracks with caulking, foam insulation or other sealant. Sealing these cracks will greatly reduce the required dosage. Two mil or thicker plastic can be used for tarping the grain surface, however, the plastic used on the outside of the bin should be at least 4 mils. When an entire structure is tarped the plastic must be at least 6 mils thick to prevent excessive tearing during the fumigation.

- (3) Dosage

Unless all the large cracks are sealed as described above, the dosage recommended should be 8-16 bags per 1000 bu. (6-13 bags per 1000 cu. ft.) capacity of the space under the plastic tarp.
- (4) Additional Application Instructions

Probing "bag belts" (not classified by UL) into the grain mass is the recommended method of application. Probe insertions should be scattered evenly over the surface. Place no more than 1/4 of the total dose in floor level aeration ducts. Be sure the inside of the aeration duct is dry before adding the bags. Addition of Detia® to water in an aeration duct can cause a fire. Seal the aeration fan as described above.
- (5) Additional Precautions

Do not fumigate bins that will be entered by humans or animals prior to aeration. Do not fumigate areas which house equipment containing copper or other metals which will be corroded by hydrogen phosphide. This includes electrical and electronic equipment. Place "DANGER" placards on entrances to the bin and near the ladder. See section on "PLACARDING OF FUMIGATED AREAS" on page 37 of this manual. If monitoring equipment is not available, an approved canister respirator must be worn for indoor application. If an approved respirator is not available, application must be done from outside of the site to be fumigated. Also refer to all other precautions given in this manual.

(6) Post-Aeration Treatment

It is good practice to spray the grain surface with an approved insecticide protectant to retard reinfestation and fog the space above the grain to kill existing adult flying insects.

3. APPLICATION PROCEDURES FOR SPACE FUMIGATIONS

a. Procedures for Mills, Warehouses, Food Processing Plants, Chambers, Trucks, Trailers, Containers and other Static Sealable Enclosures

(1) Determine the dosage of bags to be applied based upon the following parameters for space fumigation:

- The volume of the structure
- The air and/or commodity temperature
- The general tightness of the structure to be fumigated.

(2) Determine exposure period based on "Exposure Guidelines" on page 17 of this manual.

(3) Seal all openings except for the door being used to enter and leave. Pay particular attention to openings to connecting or adjacent structures.

(4) Place bags on floor in systematic manner. It is not necessary to distribute the bags evenly over the entire floor. Do not toss bags into inaccessible areas. The "bag blankets" (not classified by UL) (equivalent to 100 bags per 15 foot long blanket) can be easily rolled out on the floor and retrieved. The "bag blanket" (not classified by UL) is well suited to large fumigations. If necessary the bag blanket (not classified by UL) may be subdivided. Do not save a left over segment for a future fumigation. Check to see that they have not piled up and that they are spread out evenly to minimize contact between the individual bags.

(5) Detia® FUMEX bags shall not be placed in or attached to commodity packages containing processed food. If placement of bags on the floor is not convenient they may be attached to a wall or other support. They may also be applied by taping the bags on cardboard with spacing between bags. Tape across the bag ends only. Specially designed discs or boards are available for this purpose from DEGESCH America, Inc. If the Detia® Fumi-

Board or Detia® Fumi-Disc is used, taping is not necessary.

(6) When fumigating multiple story buildings, each floor is considered a separate enclosure. Application should begin with the top floor and end with the ground floor.

(7) Seal all remaining exits.

(8) Placard and lock all entrances.

(9) Aerate the structure upon completion of the exposure period. Standard aeration time and practices should be developed using a low level detection device. Practices will vary widely at different sites but will usually include opening windows, doors, and vents and activating any ventilation equipment. Reentry of an unaerated structure must be done in pairs wearing appropriate respiratory equipment.

(10) Dispose of remaining bags. SEE "STORAGE AND DISPOSAL" on page 40 of this manual. Avoid breathing the dust.

b. Procedures for Space Fumigations Under Tarps

(1) General

Follow the pertinent instructions given immediately above in part "a". Use of plastic sheeting or tarpaulins to provide a fumigation enclosure is one of the easiest and least expensive means for providing relatively gas tight enclosures which are very well suited for fumigation. Plastic 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.

(2) Sealing

An enclosure suitable for fumigation may be formed by covering packaged commodities with plastic sheeting. The sheets may be taped, glued, or clamped 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 plastic sheeting prior to covering for fumigation. The plastic covering of the pile may be sealed to the floor using tape, glue, sand or water snakes, by shoveling soil

or sand onto the ends of the plastic covering or by other suitable procedures. The plastic 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 sheeting, about 2 mils, is suitable for most indoor tarp fumigations. However, 4 mil plastic or thicker is more suitable for outdoor applications where wind or other mechanical stresses are likely to be encountered.

(3) Additional Application Instructions

Bags may be applied under the edge of the tarp or through slits. The bags should be protected from condensation or other source of water. The slits in the covering should be carefully taped to prevent loss of gas once dose has been applied. Bags should not be piled or overlapped. Care should be taken to prevent the plastic tarp from covering the bags in such a way as to prevent contact with moist air or to confine the gas. Refer to other sections for dosage and exposure times.

(4) Additional Precautions

See appropriate precautions if the fumigation is conducted indoors as opposed to outdoors. Indoor fumigation precautions are handled as any other situation where the application is made from outside the area being fumigated. Workers may occupy adjacent indoor areas but they must be protected from overexposure to hydrogen phosphide by adequate sealing, ventilation or as a last resort, respiratory equipment.

Do not walk on stacks during the fumigation. Place "DANGER" placards at conspicuous points on the enclosure.

Follow precautions listed elsewhere in labeling.

(5) Aeration

Precautions must be taken to assure that exposure to hydrogen phosphide in excess of allowed limits does not occur both during the fumigation and aeration.

4. APPLICATION PROCEDURES FOR RAIL CARS, CONTAINERS, TRUCKS AND OTHER SIMILAR VEHICLES

a. General

This section addresses fumigation of transport vehicles whether fumigated static or in transit. Rail cars and containers shipped piggyback by rail may be fumigated in transit, but it is not legal to move trucks, trailers, etc., over public roads or highways until they are aerated. See appropriate sections of this manual for recommendations on placarding, commodity aeration and training of persons authorized to remove placarding.

Railcars, containers, trucks, and other transport vehicles loaded with bulk commodities to which Detia® FUMEX bags may be added are treated in essentially the same way as any other storage facility. Detia® may be added to listed raw agricultural commodities as the vehicle is being filled, the dose may be scattered over the surface after loading has been completed or the "bag belts" (not classified by UL) may be probed below the surface. Surface application is not recommended for in transit fumigation. Carefully seal any vents, cracks or other leaks.

The shipper must provide advance notification to the consignee that treated commodities will be shipped. **Proper handling of the rail cars at their destination is the responsibility of the consignee.** The consignee must be familiar with the physical, chemical and toxicological properties of hydrogen phosphide, worker exposure limits and symptoms and first aid treatment for hydrogen phosphide poisoning, and must be knowledgeable in making gas concentration measurements. Unless prior arrangements have been made to return the aerated railcars containing the spent fumigant back to the shipper, consignees must also know proper procedures for deactivation and disposal of spent fumigant. Unaerated railcars being returned in this manner must bear fumigation warning placards and be carefully sealed. It is the consignee's responsibility to aerate the car unless prior arrangements have been made to return the unaerated car directly to the shipper. Consignees must also ensure that industrial hygiene exposure limits are

not exceeded and that the storage for the treated commodity is placarded if the airspace around the commodity contains more than 0.3 ppm hydrogen phosphide.

Detia® FUMEX bags shall not be placed in or attached to commodity packages containing processed food. If placement of bags on the floor is not convenient or if the vehicle is being fumigated in transit, they may be attached to a wall or other support. They may also be applied by taping the bags on cardboard with spacing between bags. Tape across the bag ends only. Specially designed discs or boards are available for this purpose from DEGESCH America, Inc. If the Detia® Fumi-Board or Detia® Fumi-Disc is used, taping the bags is not necessary. Instructions that follow suggest specific procedures for treatment of cars and containers when direct addition to the commodity is not used.

b. Procedures for Hopper Rail Cars—Round Hatch

- (1) Close and secure all hatch covers except those being utilized for the fumigation.
- (2) Seal all other openings. Pay particular attention to vents.
- (3) Clean the flange lip of hatch (or hatches) being utilized. If the commodity extends into the throat of the hatch, force it away to the extent possible.
- (4) Open cans and insert bags into the pockets of a Detia® Fumi-Disc.
- (5) Place the loaded Fumi-Disc into position, bag side up.
- (6) Secure the Fumi-Disc into place with masking tape.
- (7) Cover the hatch opening with poly sheeting before closing the cover.
- (8) Lower the cover into place and secure. Insert a "DANGER" placard into a clear plastic bag and glue or otherwise affix it securely to the hatch cover.
- (9) Insert "DANGER" placards into clear plastic bags and secure with glue near the ladder on each side of the car. Pre-glued, press on envelopes are available for this purpose.

Correct per insert

c. Procedures for Hopper Rail Cars—Slot Hatch

- (1) Fold the edges of a Fumi-Board to form a

tray. The Fumi-Board is designed to "hang" in the hatch opening.

Correct per insert

- (2) Open containers and insert bags into pockets of Detia® Fumi-Board.
- (3) Place the loaded Fumi-Board into position, bag side up.
- (4) Secure into place with masking tape.
- (5) Cover the entire hatch opening with 4-6 mil poly sheeting.
- (6) Lower the hatch covers.
- (7) Insert a "DANGER" placard into a clear plastic bag and glue or otherwise affix it securely to the hatch cover.
- (8) Insert "DANGER" placards into clear plastic bags and secure with glue near the ladder on each side of the car. Pre-glued, press on envelopes are available for this purpose.

d. Procedures for Boxcars

- (1) Close and secure one of the doors from the inside. Seal all openings and joints. If possible, caulk joints and drape entire doorway with poly film, securing the edges to the inner wall, floor and ceiling with tape or suitable adhesive.
- (2) Inspect the roof, floor and walls for holes and/or cracks. Seal all openings with either masking tape or caulking compound.
- (3) If possible, drape remaining doorway with polyethylene film before door is closed. Secure edges to door jams and floor. Close door and secure. If doorway is draped with poly it may not be necessary to seal the door from the outside. If doorway is not draped, seal all cracks, openings and joints with masking tape and/or caulking compound from the outside.
- (4) Open cans and insert bags into pockets of Detia® Fumi-Disc or Fumi-Board.
- (5) Place the loaded Fumi-Disc or Fumi-Board onto the load, bag side up. Secure it into place with tape.
- (6) Or, nail it to the wall.
- (7) Post "DANGER" placards by inserting into clear plastic bags and gluing them to each door. Pre-glued envelopes are available for this purpose.

e. Procedures for Containers

Procedures for containers are essentially the same as boxcars except their doors tend to be more gas tight and they often have only a rear door which must be sealed after application is completed.

f. Procedures for Receiving Fumigated Rail Cars

(1) General

Persons responsible for receiving rail cars which have been fumigated in transit must be familiar with the pertinent regulations, hazards, safety considerations, aeration and disposal procedures, etc. which apply to practices and situations enumerated in performing this function. The appropriate sections of this Applicator's Manual should be reviewed as part of the training program for persons involved in receiving fumigated rail cars. These persons should be knowledgeable in the following areas:

- (a) health hazards and symptoms of overexposure
- (b) practical treatment for overexposed persons
- (c) physical and chemical hazards
- (d) worker exposure limits
- (e) techniques and requirements for monitoring
- (f) odor of phosphine
- (g) respiratory protection and protective clothing
- (h) aeration and disposal
- (i) placarding

(2) Worker Exposure, Crew Size, Respiratory Protection

Although monitoring for worker exposures, a minimum crew of two persons and the availability of respiratory protection for hydrogen phosphide are not required when receiving rail cars in an out-of-doors location, in no case may the post application worker exposure limit of 0.3 ppm, as a ceiling, be exceeded. Some facilities where rail cars are received may be closed on one or more sides and the distinction between an indoor and outdoor operation is not clear cut. Worker exposure monitoring should be performed initially in these situations where exposure may be excessive.

(3) Responsibilities of Consignees

Unless prior arrangements have been made to return un aerated rail cars containing the spent fumigant back to the shipper, the consignee receiving the fumigated rail car must:

- (a) aerate the rail car and verify that it contains .3 ppm PH3 or less;
 - (b) remove the fumigation warning placards from the rail car; and
 - (c) remove and dispose of the fumigant.
- The consignee must also:
- (d) ensure that the post-application worker exposure limit is not exceeded,
 - (e) transfer the fumigated commodity from the rail car, with or without prior aeration; and
 - (f) placard the new storage if it contains more than 0.3 ppm PH3 in or above the commodity mass.

5. APPLICATION PROCEDURES FOR IN TRANSIT FUMIGATION OF SHIP HOLDS

a. General Information

- (1) Shipboard fumigation is also regulated by the U.S. Coast Guard Regulations 46 CFR 147A.
- (2) The Fumigation Handbook of the U.S. Department of Agriculture, Federal Grain Inspection Service (FGIS) contains additional procedures which must be followed if infested bulk grain is to be fumigated to avoid the designation "infested" by the FGIS, or to obtain a USDA phytosanitary inspection certification. This Fumigation Handbook may also be followed voluntarily.
- (3) This product is toxic to fish. Keep out of lakes, streams and other aquatic environments. Do not contaminate water by cleaning equipment or disposal of wastes.

b. Pre-Voyage Fumigation Procedures and Precautions

- (1) Refer to and comply with the regulations and procedures found in U.S. Coast Guard Regulation, 46 CFR 147A.
- (2) 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/voyage. 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/voyage, then the vessel will not be fumigated unless all crew members are removed from the vessel. The crew members will not be allowed to re-occupy 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.

- (3) The person responsible for the fumigation must notify the master of the vessel or representative of the requirements relating to personal protection equipment*, low range 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.
- (4) Seal all openings to the cargo hold or tank using suitable, water proof, gas tight materials. Lock and/or otherwise secure all openings, manways, etc. used to enter the hold. Post appropriate "DANGER" placards on same.
- (5) On tankers the over-space pressure relief system of each tank must be sealed by (a) closing of appropriate valves and (b) sealing the openings into the over-space with gas tight materials.
- (6) Contact appropriate authorities.

*Personal protection equipment means a respirator or a mask fitted with a canister designed for phosphine gas which is approved by NIOSH/MSHA. A gas mask and canister is approved for use up to 15 ppm. Above 15 ppm or at unknown concentrations, a SCBA or its equivalent must be used.

- (7) If the fumigation is not completed and the vessel aerated before the manned vessel leaves port, the person in charge of the vessel shall insure 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.
- (8) During the fumigation or until a manned vessel leaves port or the cargo is aerated, the person in charge of the fumigation shall insure that a qualified person using gas or vapor detection equipment test spaces adjacent to the fumigated cargo area 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.
- (9) Review with the master, or his representative, the voyage precautions and procedures.

c. Procedures for Bulk Dry Cargo Vessels and Tankers

- (1) Calculate dosage on the basis of cargo hold volume. Dosage is always calculated for total hold volume irrespective of the commodity tonnage in the hold.

Detia® FUMEX...2-6 bags per 1000 cubic feet

- (2) Procedure for Detia® FUMEX "Bag Blanket" (not classified by UL)
 - (a) After a hold has been filled or completed, dig a shallow trench approximately 15 feet long and 2 feet wide for each blanket being used. Maintain at least a two foot separation between trenches and stay in from side walls at least 10 feet.
 - (b) Open "bag blanket" (not classified by UL) containers one at a time; remove the blanket; unroll it until fully extended and position into the trench. Cover with the commodity.
- (3) Procedure for Detia® FUMEX (individual bags) After a hold has been filled or com-

pleted, open containers and distribute bags uniformly onto commodity surface with spacing between each. Do not place bags within 10 feet of side walls. Step on each bag after placement.

- (4) Procedure for Detia® FUMEX "Bag Belt" (not classified (UL) After a hold has been filled or completed, open containers and begin inserting (probing) "bag belts" (not classified by UL) into the commodity mass with spacing between. Do not probe within 10 feet of sidewalls. Attach a "locator" cord to each belt before insertion, leaving the loose end on the commodity surface.
- (5) Observe closing of hatch covers closely. Stop the closing if the cover snags a "bag blanket", individual bag, or "bag belt". Reposition blanket, bag or belt and resume closing.

d. Voyage Precautions and Procedures

- (1) At regular intervals monitor spaces adjacent to areas containing fumigated cargo and all regularly occupied areas for fumigant leakage using appropriate gas detection equipment. Special attention should be given to living quarters, kitchens, storerooms, mess halls, keel ducts, day rooms, the bridge, engine room and any other enclosed spaces occupied or frequented by crew members during a voyage.
- (2) If hydrogen phosphide is detected, evacuate the space or area, locate and seal off the source of the leak wearing appropriate respiratory protection equipment. Ventilate area before allowing occupants to return.
- (3) Do not enter fumigated holds or tanks.
- (4) Do not open, ventilate or aerate the fumigated holds during the voyage.

e. Precautions and Procedures During Discharge

- (1) If necessary to enter holds prior to discharge, test spaces directly above cargo surface for fumigant concentration, using appropriate gas detection and personal protection equipment. Do not allow entry to fumigated areas without personal protection equipment, unless fumigant concentrations are at safe levels, as indicated by a suitable detector.

- (2) It is the responsibility of the consignee to see that the spent fumigant is disposed of properly and that industrial hygiene exposure limits are not exceeded during unloading of the ship or during subsequent transfer and storage of the treated commodity. Safety, aeration and disposal requirements in the United States are given herein as a guide. Consult regulations in the receiving country for local requirements.

f. Personal Protective Equipment and Monitoring

- (1) Fully loaded holds on dry bulk carriers are considered an outdoor fumigation and therefore monitoring and respiratory protection are not required during application.
- (2) NIOSH/MSHA approved respiratory protection must be available at the site in case it is needed during application to tanker holds and in partially filled holds if the hold must be entered for fumigant application. This respiratory protection must consist of a full face gas mask - phosphine canister combination or self-contained breathing apparatus (SCBA) or its equivalent. If a SCBA or its equivalent is not available at the application site, it must be available locally, for example, at a fire station or rescue squad.
- (3) If hydrogen phosphide is detected leaking into crew's quarters, housing or work areas, a minimum of two qualified persons on ship should wear the gas mask and canister described above while aerating the area and locating and sealing the leak.
- (4) Refer to the following sections IV through XI for additional required and recommended practices.

6. APPLICATION PROCEDURES FOR IN TRANSIT FUMIGATION OF CONTAINERS ON SHIPS

- a. When fumigating packaged commodities or bulk commodities to which direct addition of this fumigant is not allowed, refer to section III.G.3.a on page 24 of this manual.
- b. In transit fumigation of containers on ships is regulated by Coast Guard Regulation 46 CFR 147A and the applicator or shipper must obtain and comply with U.S. Coast Guard Special permit No.

52-75. Contact the Coast Guard or DEGESCH America, Inc. for additional information.

- c. Comply with general precautions given in labeling.

7. APPLICATION PROCEDURES FOR FUMIGATION OF BARGES

a. General

Since barge fumigation is a type of flat storage fumigation as well as having similarities in common with a ship, refer to the sections "Procedures for Flat Storage" on page 20 and "APPLICATION PROCEDURES FOR IN TRANSIT FUMIGATION OF SHIP HOLDS" on page 31. Barge fumigation is regulated by the U. S. Coast Guard Regulations 46 CFR 147A as modified by U. S. Coast Guard Special Permit 2-75. The shipper/fumigator must possess this permit prior to fumigating. To obtain this permit contact:

U.S. Coast Guard
Hazardous Materials Branch
Washington, D.C. 20593-0001.

b. Sealing

Special care must be taken in determining whether a barge is suitable for fumigation. Excessive leakage may occur through poorly sealed hold covers.

IV. PROTECTIVE CLOTHING

It is not necessary to wear gloves or other protective clothing. However, wear dry gloves made of cotton or other material if contact with the dust is likely. Wash hands after use.

V. RESPIRATORY PROTECTION

A. WHEN RESPIRATORY PROTECTION MUST BE WORN

NIOSH/MSHA approved respiratory protection must be worn during exposure to concentrations in excess of permitted limits or when concentrations are unknown.

B. 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.

C. REQUIREMENTS FOR AVAILABILITY OF RESPIRATORY PROTECTION

Respiratory protection must be available at the site of application in case it is needed when applying Detia® from within the structure being 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. If SCBA or its equivalent is not available at the application site, it must be available locally, for example, at a fire station or rescue squad. Respiratory protection need not be available for application from outside the area to be fumigated such as hand feeding the bags into the grain stream as it goes into a bin, if exposures above the permitted exposure limit will not be encountered. Respiratory protection need not be available for outdoor applications. If monitoring equipment is not available on a farm and application cannot be done from outside the structure, an approved canister respirator must be worn during application from within the enclosed indoor area.

VI. PLACARDING OF FUMIGATED AREAS

The applicator must placard or post all entrances to the fumigated area with signs bearing:

- A. The signal word "DANGER/PELIGRO" and the SKULL and CROSSBONES symbol in red.
- B. The statement, "Area and/or commodity under fumigation, DO NOT ENTER/NO ENTRE".
- C. The statement "This sign may only be removed after the commodity is completely aerated (contains 0.3 ppm or less phosphine gas). If incompletely aerated commodity is transferred to a new site, the new site must also be placarded and workers must not be exposed to more than 0.3 ppm phosphine."
- D. The date and time fumigation begins and is completed.
- E. Name of fumigant used.
- F. Name, address, 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 in order to keep unauthorized persons away. For railroad hopper cars, placarding must be

placed securely on both sides of the car near the ladders and next to or on the top hatch into which the fumigant is introduced.

Do not remove a placard until the treated commodity is aerated down to 0.3 ppm 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, when 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. Workers who handle incompletely aerated commodity must be informed and appropriate measures must be taken (i.e., ventilation or respiratory protection) to prevent exposures from exceeding the exposure limit for hydrogen phosphide.

It is recommended that the person responsible for removing the placards be familiar with the physical, chemical and toxicological properties of hydrogen phosphide. They should also be knowledgeable in how to take gas readings, exposure limits, symptoms and first aid treatment for hydrogen phosphide poisoning.

VII. GAS DETECTION EQUIPMENT

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.

VIII. AERATION OF FUMIGATED COMMODITIES

A. 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.

B. 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. When plastic

liners are used, longer aeration periods will probably be required to aerate the commodity down to 0.3 ppm.

C. RESIDUE ANALYSES

As an alternative to these aeration periods, each container of a treated commodity may be analyzed for residues using accepted analytical methods. If residues are less than tolerance levels, the commodity may be shipped to the consumer regardless of the above holding periods.

IX. APPLICATOR AND WORKER EXPOSURE

A. HYDROGEN PHOSPHIDE EXPOSURE LIMITS

Exposure to hydrogen phosphide must not exceed the 8 hour TWA of 0.3 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. After application is completed worker or applicator exposure must not exceed 0.3 ppm maximum concentration. Such exposures may occur because of leakage into enclosed areas from fumigation sites, during reentry or during transfer of unaerated commodity.

B. APPLICATION OF FUMIGANT

Depending upon temperature and humidity, Detia® FUMEX releases hydrogen phosphide gas slowly upon exposure to moisture from the air. This release is often 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 8 hour TWA of 0.3 ppm, approved respiratory protection must be worn. Gas concentration measurements for safety purposes must be made using low level detector tubes or other suitable low level detection equipment. See the "Industrial Hygiene Monitoring" section below. Information on hydrogen phosphide (phosphine, PH₃) detector tubes may be obtained from DEGESCH America, Inc. It is often practical to wear approved respiratory protection from start to finish. This is particularly true when performing large space fumigations or when fumigating bulk stored commodities in flat storage buildings.

C. 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 monitored to ensure that significant leakage has not occurred. Sealing of the fumigated site and/or air flow in the occupied areas should be used to reduce exposure.

D. 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.

E. HANDLING UNAERATED COMMODITIES

Transfer and processing of a treated commodity prior to complete aeration is permissible, however, workers must not be exposed to hydrogen phosphide in excess of the permitted exposure limits.

F. INDUSTRIAL HYGIENE MONITORING

It is recommended that hydrogen phosphide exposure be documented in an operation log or manual for each site and operation where exposure may occur. The purpose of monitoring is to prevent excessive exposure 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 significantly change or an unexpected garlic odor is detected. Gas concentration measurements should be taken in the worker's breathing zone. Monitoring is not required outdoors.

G. ENGINEERING CONTROLS AND WORK PRACTICES

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

X. STORAGE

Containers should be stored in a dry, well ventilated area, away from heat and 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. Do not store in buildings where humans or domestic animals reside. Keep out of reach of children. The shelf life of Detia® is virtually unlimited if the containers are unopened.

XI. DISPOSAL

A. DISPOSAL OF UNREACTED OR PARTIALLY REACTED Detia® FUMEX (from spills, leaking cans or other sources)

Unreacted or partially reacted Detia® FUMEX is acutely hazardous. Improper disposal of this product is a violation of federal law. If this product cannot be disposed of by ordinary use or according to the instructions that follow, contact your state pesticide or environmental control agency or the hazardous waste representative at the nearest EPA regional office for guidance. Do not contaminate water by disposal. 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. FOR SPECIFIC INSTRUCTIONS SEE "SPILL AND LEAK PROCEDURES" ON PAGE 43 OF THIS MANUAL.

B. DISPOSAL OF Detia® FUMEX FOLLOWING A SPACE FUMIGATION

1. GENERAL

If properly exposed, the bags remaining after a fumigation will contain a grayish white, spent, nonhazardous waste and will contain only a small amount of unreacted aluminum phosphide. However, residual dust from incompletely exposed bags (See "EXPOSURE GUIDE" on page 17 of this manual.) will require special care. Confinement of partially spent bags, as in a closed container may result in a fire hazard. Small amounts of hydrogen phosphide may be given off from the unreacted aluminum phosphide, and confinement of the gas may result in a flash. UNLESS IT CAN BE DETERMINED WITH CERTAINTY THAT THE BAGS ARE SPENT, THEY MUST BE DEACTIVATED AS DESCRIBED BELOW PRIOR TO DISPOSAL.

2. DEACTIVATION OF Detia® FUMEX

(a) General

The methods below may be used for deactivating used or unused Detia® FUMEX regardless of the extent to which the aluminum phosphide has been consumed in the production of hydrogen phosphide.

(b) Dry Deactivation

Collect bags and place them into a ventilated holding container such as a specially equipped 55 gallon drum, into a wire cage used for other hydrogen phosphide fumigants or other similar devices

which are available from DEGESCH America, Inc. Store the bags in one of these devices until the bags are spent. Unused or partially spent bags can be spread out on the ground in a secure open area away from occupied buildings to be deactivated by atmospheric moisture. Care should be taken so that they are not carried away by the wind. Prior to final disposal, bags may be spread out in a single layer on the ground and covered with several inches of sand until they are spent. Bags that have not been exposed for the minimum times specified in the exposure guide on page 17 should not be covered with sand. Dry deactivation is the recommended procedure for unused or partially spent bags. If in doubt concerning whether the bags are spent, contact DEGESCH America, Inc. Ignition may occur if large numbers of incompletely reacted bags are contacted by liquid water. This can occur in open or perforated storage containers. Therefore, such storage should be out of doors in a relatively isolated area protected from rain.

(c) Wet Deactivation - Method One

Fill an appropriate sized container with water to a few inches from the top. Submerge bags for 36 hours. A metal grid works well to keep bags submerged. Do not cover container. Wear appropriate respiratory protection. This must be done outdoors or in front of an adequate fan that exhausts immediately outside. The water may be disposed of in a storm sewer or by pouring it out on the ground.

(d) Wet Deactivation - Method Two

Fill an appropriate sized metal container 2/3 full with water. For each gallon of water add 1/4 cup of low sudsing detergent or surfactant. Use no less than 1 gallon of water/detergent solution for 60 Detia® FUMEX bags. Open each bag and dump the contents into the container as the water is stirred. Wear appropriate respiratory protection. **DO NOT COVER THE CONTAINER AT ANY TIME.** This must be done outdoors or in front of an adequate fan that exhausts immediately outside.

3. **DISPOSAL PROCEDURES**

In open areas, small amounts (up to 7.0 kg.) of the spent bags may be disposed of on site by burial of

the bags or by opening the bags and spreading the dust over the land surface away from inhabited buildings. Spent bags may also be collected and disposed of at a sanitary landfill, approved pesticide incinerator or other approved sites or by other procedures approved by federal, state and local authorities.

Do not dispose of dust in a toilet.

Dispose of the water/dust slurry (with or without preliminary decanting of excess water) in a sanitary landfill or other suitable burial site approved by local authorities. Where permissible, the slurry may be poured out on the ground. If it is held 36 hours it may be poured into a storm sewer.

Never confine, partially spent bags or slurry in closed containers such as closed drums or plastic bags.

C. DISPOSAL DRUM

In lieu of immediate disposal it may be more practical, particularly in the case of smaller users, to collect reacted or unreacted bags and place them into a specially designed 55-gallon drum or similar device available from DEGESCH America, Inc. The purpose of the drum is to provide a central, known collection point for bags. When full, or at regular intervals, the reacted bags can be transported directly to an approved disposal site. The drum should be located in an open, secured area marked as the collection center for Detia® FUMEX. We recommend the drum also be marked "DANGER, POISONOUS GAS, KEEP AWAY". If the drum is used only for reacted bags "POISONOUS GAS" can be deleted.

D. DISPOSAL OF CONTAINERS

Dispose of containers in a sanitary landfill or by other approved state or local procedures.

XII. SPILL AND LEAK PROCEDURES

A. GENERAL

A spill other than incidental to application or normal handling or punctured containers, can produce high levels of gas, and therefore, attending personnel must wear a SCBA or its equivalent when the concentrations of hydrogen phosphide gas is unknown. If the concentration is known, other NIOSH/MSHA approved respiratory protection can be worn. Wear dry gloves made of cotton or other material when contact with the powdered formulation is likely.

B. DAMAGE TO FIBERBOARD CASE

Check cans. If they are damaged handle as described below. If they are undamaged return them to cardboard cartons or other suitable packaging which complies with DOT regulations.

C. LEAKING FLASK PROCEDURES

If containers have been punctured or damaged causing a leak, the product may be immediately used, the container may be temporarily repaired with aluminum tape, the Detia® may be transferred from the damaged can to a sound metal container which should be sealed and properly labeled as aluminum phosphide, or it may be deactivated and disposed. See page 41 of this manual for deactivation and disposal procedures. Transport the damaged containers to an area suitable for pesticide storage for inspection. Further instructions and recommendations may be obtained, if required, from DEGESCH America, Inc.

Handle empty damaged containers as described under "DISPOSAL OF EMPTY CANS" above.

D. SPILL PROCEDURES

Since the formulation is placed in small, tough bags, a spill will be either bags or a small quantity of powder spilled from a punctured bag. Consequently, spills are not likely to constitute a frequent problem.

Do not flush spillage down drain with water. DO NOT use water at anytime to clean up a spill. Water in contact with unreacted Detia® will rapidly accelerate the production of hydrogen phosphide gas and could cause spontaneous ignition of the gas. If bags have just been spilled and have not been contaminated by other materials, collect the bags and use them or place them into a sound metal container and seal it or deactivate and dispose of them. If possible use immediately.

CAUTION: AN IGNITION MAY OCCUR WHEN THE CONTAINERS ARE OPENED.

If the spill is more than a few minutes old or has been contaminated with water, gather it up and place it into an open top can and deactivate it immediately.

If on-site deactivation is not feasible, these open containers should be transported in open vehicles to a suitable area away from occupied buildings. Wet or dry deactivation may then be carried out. See deactivation instructions on page 41 of this manual.