RESTRICTED USE PESTICIDE
DUE TO ACUTE INHALATION TOXICITY OF SULFURYL FLUORIDE

For sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification. An applicator certified by the state must be present on site at all times during introduction of fumigant, reentry prior to aeration, and initiation of the aeration procedure.

DOUGLAS PRODUCTS

STATE OF HAWAII
Department of Agriculture
ACCEPTED
LICENSE NO. 7030.4

ProFume®

Gas Fumigant

For control of rodent, insect and other invertebrate pests.

Sites to be fumigated: Non-residential structures, food handling establishments (e.g., pet food facilities, bakeries, food production facilities, mills, warehouses, etc.), stationary transportation vehicles (railcars, shipping containers, trucks, etc., excluding aircraft and passenger railcars), temporary and permanent fumigation chambers, and storage structures.

This product is accompanied by a ProFume Applicator's Manual describing the sites and commodities that can be fumigated, pests controlled, application rates and safety procedures to follow during fumigation. Read the entire container label and ProFume Applicator's Manual before use. The ProFume Applicator's Manual contains important information for the safe and effective use of this product and must be read and in the user's possession during fumigation. If the ProFume Applicator's Manual is lost, contact your ProFume distributor or Douglas Products representative to obtain a replacement copy.

When fumigating, all local, state, and federal rules and regulations regarding use of detection devices, positive-pressure self-contained breathing apparatus, security requirements, and placement of warning signs must be observed.

Active Ingredient	
sulfuryl fluoride	99.8%
Inert Ingredients	0.2%
Total	100.0%

Keep Out of Reach of Children

DANGER POISON
PELIGRO

Si usted no entiende la etiqueta ni el manual de fumigacion del gas fumigante ProFume, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label nor ProFume Applicator's Manual, find someone to explain it to you in detail.)

First Aid

In all cases of overexposure, when symptoms such as nausea, difficulty in breathing, abdominal pain, slowing of movements and speech, or numbness in extremities are exhibited, get medical attention immediately. Take person to a doctor or emergency treatment facility.
If inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible. Call a poison control center or doctor for further treatment advice.
If on skin or clothing: May cause frostbite to unprotected skin upon contact with dispensing equipment when gas is discharged. Immediately apply water to contaminated area of clothing before removing. Once area has thawed, remove contaminated clothing, shoes, and other items covering skin.

Net Contents 125 lb

First Aid (Cont.)

Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.
If in eyes: May cause "cryogenic burn" if exposed. Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Liquid ProFume in the eye may cause damage due to refrigeration or freezing. Call a poison control center or doctor for treatment advice.

Note to Physician: ProFume is a gas that has no warning properties such as odor, color, or eye irritation. Early symptoms of exposure to ProFume are respiratory irritation and central nervous system depression. Excitation may follow. Slowed movement, reduced awareness, and slow or garbled speech may be noted. Prolonged exposure can produce lung irritation, pulmonary edema, nausea, and abdominal pain. Repeated exposure to high concentrations can result in significant lung and kidney damage. Single exposures at high concentrations have resulted in death. Treat symptomatically.

Have the product label or ProFume Applicator's Manual with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-844-845-3129 or 1-352-323-3500 for emergency medical treatment information.

Precautionary Statements

Hazards to Humans and Domestic Animals

Danger • Fatal If Inhaled • Causes Irreversible Eye Damage • Liquid Causes Freeze Burns Of Exposed Skin • May Be Fatal If Swallowed

Do not breathe vapor. Do not get in eyes, on skin, or on clothing. ProFume is odorless and colorless. Exposure to toxic levels may occur without warning or detection by the user.

Personal Protective Equipment for Fumigation

Protective Clothing
Wear splash resistant goggles or full face shield when handling the liquid product during introduction of fumigant or when working around any lines containing fumigant under pressure. Do not wear gloves or rubber boots. Do not reuse clothing or shoes that have become contaminated with liquid ProFume until thoroughly aerated. Wear loose fitting or well-ventilated long-sleeve shirt, long pants, shoes and socks.

Respiratory Protection
If the concentration of ProFume in the fumigated area as measured by a detection device with sufficient sensitivity [Limit of Detection (LOD) ≤ 1 ppm] such as an INTERSCAN gas analyzer [Model GF 1900] or MIRAN vapor analyzer [SapphIRe] does not exceed 1 ppm, no respiratory protection is required. When this concentration is exceeded or when the concentration of ProFume is unknown, all persons in these areas must wear a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA), approval number prefix TC-19C, or combination air-supplied/SCBA respirator such as manufactured by Draeger, Ranger, Survivair, Scott, or MSA. This SCBA must be on site and operational before fumigation. Before using any make or brand of SCBA, learn how to use it correctly. Determine that it is in good working order, has an adequate air supply for the job at hand, fits properly, and provides an adequate seal around the face.

Environmental Hazards

Sulfuryl fluoride is a highly toxic gas. Do not expose non-target organisms. This pesticide is toxic to fish and wildlife.

Physical or Chemical Hazards

Sulfuryl fluoride is a colorless, odorless toxic gas. ProFume cylinders are under pressure and must not be stored near heat or open flame. Exposures to temperatures above 158°F will cause a fusible plug to melt and the contents will be released. Under high heat conditions (temperatures above 752°F), ProFume can decompose into sulfur dioxide (SO_2), hydrofluoric acid (HF), and other decomposition products. Hydrofluoric acid is highly reactive and can corrode or damage many materials including metals, glass, ceramic finishes, fabrics, etc. Extinguish all flames including pilot lights of furnaces, hot water heaters, dryers, gas refrigerators, ranges, ovens, broilers, etc. Turn off or unplug all electrical heating elements such as those in heaters, dryers, etc., that represent a reasonable risk of a heat source that is at or near 752°F. Shut off automatic switch controls for appliances and lighting systems that will be included in the space to be fumigated. Contact your local gas company to determine what procedures should be followed in your area for shutting off natural gas or propane service. Gas service should be shut off at the main service valve. Sulfuryl fluoride can react with strong bases such as some photo developing solutions.

ProFume cylinders must never be transported by aircraft under any circumstance.

Refer to the ProFume Applicator's Manual for additional precautionary information and Directions for Use.

Notice: Read the entire label. Use only according to label directions. **Before using this product, read Warranty Disclaimer, Inherent Risks of Use and Limitation of Remedies elsewhere on the label. If terms are unacceptable, return at once unopened.**

In case of emergency endangering health or the environment involving this product, call 1-844-845-3129 or 1-352-323-3500. If you wish to obtain additional product information, visit our web site at www.douglasproducts.com.

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
Read all Directions for Use carefully before applying.

Storage and Handling

Do not contaminate water, food, or feed by storage.

Cylinder Storage: Storing indoors in occupied areas in buildings is **not** recommended. Store in an adequately dry, cool, well ventilated secured and locked area. Post as a pesticide storage area. All cylinders (full, partially full, or empty) should be stored in an upright (vertical) position with safety caps and protective bonnets securely in place. Secure ProFume cylinders to prevent being knocked over during storage, transport, weighing, and fumigant release. Secure in a manner that does not deface the label. Various state and local authorities may regulate the storage of ProFume. Be certain to check with the appropriate authorities in your area.

If cylinders are stored in an enclosed area without proper ventilation, the area must be tested for leaks using an Interscan or Miran analyzer, or similar device of sufficient sensitivity, so persons entering or working in the general area will not be exposed to concentrations of ProFume >1 ppm. Contact your state and local authorities for additional guidelines.

Transportation of Cylinders: Transport cylinders capped and secured in an upright position. On public roads, transport securely only in an upright position. During transport, special care must be taken to prevent rough handling or mechanical shock such as dropping, bumping, dragging, or sliding. Also, dip tubes can be broken due to sharp blows and shocks if the cylinder is on its side. Never transport unsecured cylinders without preventing their excessive movement. Never suspend or lift cylinders by the valve. Loose cylinders can become airborne and cause significant damage in an accident.

Do not transport cylinders in closed vehicles where the same common airspace is occupied by personnel. Never transport ProFume cylinder by aircraft.

Do not remove valve protection bonnet and safety cap until immediately before use. Replace safety cap and valve protection bonnet when cylinder is not in use.

When cylinder is empty, fully close the valve, and replace the safety cap and protection bonnet before returning to the Profume distributor and subsequent supplier. Only Douglas Products is authorized to refill cylinders. Do not use cylinders for any other purpose.

Leak Procedures: Evacuate immediate area of leak. Use a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air-supplied/SCBA respirator, such as manufactured by Draeger, Ranger, Survivair, Scott, or MSA, for entry into affected areas to correct problem. Move leaking or damaged cylinder outdoors or to an isolated location, observing strict safety precautions. Work upwind if possible. Do not permit entry into leakage area by unprotected persons until concentration of fumigant is determined to be 1 part per million (ppm) or less, as determined by a detection device with sufficient sensitivity such as an INTERSCAN gas analyzer [Model: GF 1900] or MIRAN vapor analyzer [SapphIRe].

Pesticide Disposal: Promptly return all empty cylinders to the supplier of ProFume. All unused or unwanted partially used cylinders must be returned to the supplier of ProFume. Follow proper cylinder handling directions above. Supplier must return all cylinders to The Douglas Products and Packaging Company, Pittsburg, California facility.

Pesticide wastes are toxic. Improper disposal of excess pesticides is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, consult your State Pesticide or Environmental Control Agency or Hazardous Waste office nearest your location.

General Information

Restricted Use Pesticide

Carefully read the container label and ProFume® gas fumigant Applicator's Manual before using this product. Do not use this product without the Fumiguide® Program for ProFume. The ProFume Fumiguide is a computer program available to calculate safe and effective levels of ProFume for fumigating structures and commodities. Never allow untrained individuals to use ProFume.

Prior to fumigation, read the Applicator's Manual carefully. Notify appropriate owners, employees, and/or operators at the facility where the fumigation will occur, and provide relevant safety and health information to local fire and rescue officials for use in the event of an emergency.

Do not connect cylinders to introduction equipment until all fumigation warning signs have been posted and the space to be fumigated is clear of people, non-target animals and secured.

Compressed Gas Hazards

The release of high pressure fumigant can be forceful and there is potential for personal injury. Care must be exercised when fumigating, especially tarped commodities, so that the fumigant is not released too rapidly and "balloons" the tarp off of the restraining sand or water snakes. A fog-out can also occur if the fumigant is released too rapidly, cooling the air temperature below the dew point. This is avoided by following the instructions in the ProFume Applicator's Manual.

The rapid discharge of ProFume through introduction equipment will result in cooling parts of the equipment and the cylinders. Contact with the cooled equipment can cause frostbite.

ProFume is a highly hazardous material and should be used only by individuals knowledgeable of its chemical hazards and trained in the use of required respiratory equipment, detection devices, emergency procedures, and proper use.

Two persons trained in the use of this product, at least one being an applicator certified by the state, must be present on site at all times during introduction of the fumigant, reentry prior to aeration, initiation of the aeration procedure, and when testing for reentry after aeration (if aerated in an enclosed space).

After fumigation, it is essential no occupant reenter the fumigated space until the fumigant has been aerated and the space has been fully tested and cleared for reentry.

Only a detection device of sufficient sensitivity (LOD ≤1 ppm), such as the INTERSCAN gas analyzer [Model GF 1900] or MIRAN vapor analyzer [SapphIRe], can be used to confirm a concentration of ProFume of 1 ppm or less. The Interscan gas analyzer GF 1900 must be calibrated within one month prior to use as a detection device. All other approved detection devices must be calibrated according to manufacturer recommendations. The concentration of ProFume must be monitored throughout the structure in the breathing zone. The structure or enclosure must remain posted for fumigation until cleared for reentry.

Terms and Conditions of Use

If terms of the following Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies are not acceptable, return unopened package at once to the seller for a full refund of purchase price paid. Otherwise, use by the buyer or any other user constitutes acceptance of the terms under Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies.

Warranty Disclaimer

Douglas Products and Packaging Company warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. DOUGLAS PRODUCTS MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label, such as low temperature, etc.), abnormal conditions (such as excessive winds, tornadoes, hurricanes), presence of other materials (poor sanitation, large amounts of infested product), the manner of application, or other factors, all of which are beyond the control of Douglas Products or the seller. All such risks shall be assumed by buyer.

Limitation of Remedies

The exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories, shall be limited to, at Douglas Products' election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used.

Douglas Products shall not be liable for losses or damages resulting from handling or use of this product unless Douglas Products is promptly notified of such loss or damage in writing. In no case shall Douglas Products be liable for consequential or incidental damages or losses.

The terms of the Warranty Disclaimer, Inherent Risks of Use, and this Limitation of Remedies cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Douglas Products or the seller is authorized to vary or exceed the terms of the Warranty Disclaimer or this Limitation of Remedies in any manner.

EPA Reg. No. 1015-79 EPA Est. 1015-CA-001
A-3-LBL-PFXXX-001-20151125

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Douglas Products and Packaging Company •
1550 East Old 210 Hwy • Liberty, MO 64068-9459

EPA-Accepted 11/25/15

MADE IN THE USA

Size: 11" H x 23-1/2" W

Code: A-3-LBL-PFXXX-001-20151125

Product Name: Profume

Spec Type: Label Cylinder

Component Size: 125 lb

Country: US

Colors:

- Process: Black
- PMS: 116 C Yellow
- PMS: 281 C Blue
- PMS: 485 C Red
- PMS: 3435 C Green

RR DONNELLEY

DGT: car

Date: 12/29/15

- ❑ 1st Proof
- ■ 2nd Proof
- ❑ 3rd Proof
- ❑ 4th Proof
- ❑ 5th Proof
- ❑ 6th Proof

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STATE OF HAWAII
Department of Agriculture
ACCEPTED
LICENSE NO. 7030.4

Applicator's Manual for

ProFume®

Gas Fumigant

For control of rodent, insect, and other invertebrate pests.

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Active Ingredient
sulfuryl fluoride.....99.8%
Inert Ingredients.....0.2%
Total 100.0%

Keep Out of Reach of Children

DANGER **POISON**

[Editors note: the word POISON must appear in red]

PELIGRO

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Have the product label or ProFume Applicator's Manual with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-844-845-3129 or 1-352-323-3500 for emergency medical treatment information.

In case of emergency endangering health or the environment involving this product, call 1-844-845-3129 or 1-352-323-3500. If you wish to obtain additional product information, visit our web site at www.douglasproducts.com.

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

EPA Reg. No. 1015-79

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FUMIGATING WITH PROFUME GAS FUMIGANT. . . . . .

INTRODUCTION

ProFume (sulfuryl fluoride) is registered for use exclusively by professional fumigators to control existing infestations of stored product insect pests in non-residential structures, food handling establishments (e.g., pet food facilities, bakeries, food production facilities, mills, warehouses, etc.), stationary transportation vehicles (railcars, shipping containers, trucks, etc., excluding aircraft and passenger railcars), temporary and permanent fumigation chambers, and storage structures.

The purpose and objective of this Applicator's Manual are to:

1. **Supplement and support the container label for ProFume**
2. **Reinforce the safe and effective use of this product.**
3. **Increase the understanding and adoption of Precision Fumigation™ principles and practices.**
4. **Provide guidance in the form of a Fumigation Management Plan (FMP) for preventing accidents and accidental exposure of bystanders.**

Read the entire label and Applicator's Manual before use. The Applicator's Manual is part of the labeling for ProFume and any changes will be made by a label amendment. The Applicator's Manual contains important information for the safe and effective use of this product and must be read and in the user's possession during fumigation. If the Applicator's Manual is lost, contact your ProFume distributor or your Douglas Products representative to obtain a replacement copy.

This Applicator's Manual is not intended to supersede label requirements or state and local regulations. This manual will be periodically revised to reflect additional use patterns or label modifications, and knowledge obtained through continuing research and experience. The Applicator's Manual includes recommendations for using ProFume and describes the safe handling and storage of this product.

Each fumigator using ProFume is responsible for complying with all federal, state, and local regulations or codes regulating the use of this product. The development of this Applicator's Manual included the study and interpretation of many codes and regulations considered relevant to the use of ProFume. However, because regulations and the enforcement of regulations can change, the fumigator should stay informed about state and local regulations in areas where they operate.

State and local government offices, ProFume distributors, or Douglas Products sales representatives responsible for your area can help identify the relevant agencies responsible for regulating fumigation practices in your area.

LEGAL RAMIFICATIONS OF CONDUCTING FUMIGATIONS WITH PROFUME

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

Douglas Products warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. DOUGLAS PRODUCTS MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY. It is impossible to eliminate all risks associated with use of this product. Lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label, such as low temperature, etc.), abnormal conditions (such as excessive winds, tornadoes, hurricanes), presence of other materials (poor sanitation, large amounts of infested product), the manner of application, or other factors, all of which are beyond the control of Douglas Products or the seller.

The exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories), shall be limited to, at Douglas Products' election, one of the following:

(1) Refund of purchase price paid by buyer or user for product bought, or
(2) Replacement of amount of product used.

Douglas Products shall not be liable for losses or damages resulting from handling or use of this product unless Douglas Products is promptly notified of such loss or damage in writing. In no case shall Douglas Products be liable for consequential or incidental damages or losses.

The terms of the Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Douglas Products or the seller is authorized to vary or exceed the terms of this Warranty Disclaimer or Limitation of Remedies in any manner.

PRODUCT INFORMATION 1

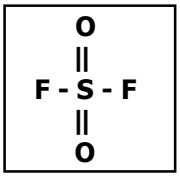
PROFUME IS A RESTRICTED USE PESTICIDE DUE TO ACUTE INHALATION TOXICITY OF SULFURYL FLUORIDE.

ProFume Label: The label is a legal document. Use of the product in any manner inconsistent with the label is illegal.

PHYSICAL PROPERTIES

Sulfuryl fluoride is a colorless, odorless toxic gas. ProFume cylinders are under pressure and must not be stored near excessive heat or open flame. Exposures to temperatures above 158°F will cause a fusible plug to melt and the contents will be released. Sulfuryl fluoride can react with strong bases such as some photo developing solutions.

Structural formula: SO_2F_2



Molecular Weight: 102.07 AMU

Color: None

Odor: None

Active Ingredient per Gallon: 10.8 lb

Specific Gravity: 1.35 at 20°C (68°F)

Vapor Density: 4.3 g/l at 20°C (68°F) air = 1

Vapor Pressure: 15.2 atm at 20°C (68°F)

Boiling Point: –55.2°C (–67°F) at 760 mmHg

Gas Solubility at 25°C (77°F) at 760 mm Hg: In water 0.075% (750 ppm) by weight, only slightly soluble in organic solvents and vegetable oils.

Stability: Stable to temperatures normally encountered in space fumigations. Non-flammable under normal conditions in all atmospheric concentrations. However, heaters and open flames must be extinguished as temperatures over 400°C (752°F) will cause decomposition products to be formed which can be corrosive and etch metal and glass.

Heat of Vaporization: 81.1 BTU/pound at –55°C (–67°F) or 188.1KJ/kg. 1 lb of sulfuryl fluoride = 4.45 moles. 1 lb of ProFume will lower 1000 cu ft of dry air by 2.5°C (4.5°F).

Volume per Pound: 1 lb of gas occupies 3.8 cu ft at 25°C (77°F) and 760 mm Hg. 1 lb of gas per 1000 cu ft of unoccupied space equals approximately 3850 ppm at room temperature and pressure (25°C at 760 mm Hg).

Hydrolysis: Hydrolysis slow in water, but more rapid in basic solutions.

Reactivity: Sulfuryl fluoride is relatively non-reactive as a gas. No malodor or corrosive effects have been detected when the chemical has been used as directed.

Sulfuryl fluoride can react with strong bases such as some photo developing solutions.

COMMODITIES THAT CAN BE FUMIGATED

The raw agricultural and processed food commodities that may be fumigated with ProFume include:

Almond
Barley
Beech nut
Beef, dried
Brazil nut
Butternut
Cashew
Cheese
Chinquapin
Cocoa bean, postharvest
Coconut
Coffee bean, postharvest
Corn
Corn flour
Corn grits
Corn meal
Cotton, seed, postharvest
Date (dried)
Fig (dried)
Filbert
Ginger, roots, postharvest
Ham
Herbs and spices (dried)
Hickory nut
Macadamia nut
Millet
Oat
Other dried fruits (e.g., apricots)
Peanut
Pecan
Pinenut
Pistachio
Popcorn
Prunes (dried)
Raisin
Rice
Rice, bran
Rice, flour
Rice, hulls
Rice, polished
Sorghum
Triticale
Vegetable, legume (dried)
Walnut
Wheat
Wheat, bran
Wheat, flour
Wheat, germ
Wheat milled byproducts
Wheat, shorts
Wild rice

ProFume can be used to fumigate seeds of foods listed above. Additional seed varieties may be fumigated so long as the fumigated seeds will not be part of the food chain for human consumption.

FACILITY FUMIGATIONS

Facility fumigations primarily target pests infesting non-residential structures, food handling establishments, (e.g., pet food facilities, bakeries, food production facilities, mills, warehouses, etc.). For a list of sites than can be fumigated with ProFume and site specific considerations for doing an effective and safe fumigation, see Chapter 10.

Facility Fumigation Restrictions

- Special care should be taken to minimize quantities of processed foods prior to space fumigations. Processed food not practical to remove prior to fumigation may undergo incidental fumigation with ProFume. However, no direct fumigation of processed foods is permitted unless the processed food is specifically listed in the section Commodities That Can Be Fumigated.
- Rice mills cannot be fumigated more than six times per year. Other food handling establishments cannot be fumigated more than three times per year.

PESTS CONTROLLED

The pests for which ProFume is used includes all life stages (egg, larva, pupa and adult) of pests such as Indian meal moth (*Plodia interpunctella*), Mediterranean flour moth (*Ephestia kuehniella*), codling moth (*Cydia*

pomonella), navel orange worm (*Amyelois transitella*), flour beetles (*Tribolium* spp.), saw toothed grain beetle (*Oryzaephilis suranamensis*), warehouse beetle (*Trogoderma variable*), granary weevil (*Sitophilus granarius*), rice weevil (*Sitophilus oryzae*) and rats and mice.

Symptoms in humans from inhalation exposure to ProFume will depend on the concentration and the length of exposure experienced.

ProFume is toxic and must be handled carefully because of the potential hazards it presents. Disregarding the lethal potential of ProFume can result in serious illness, even death.

POISONING SYMPTOMS

ProFume is colorless, odorless and, at low concentrations, non-irritating to mucous membranes. ProFume gives no warning of its presence.

The earliest sign of overexposure to ProFume is central nervous system (CNS) depression. Although dose-response data are not available for effects in humans exposed to ProFume, acute inhalation studies have been conducted on laboratory animals. No signs of CNS depression were observed in rats exposed to 450 ppm for 4 hours, while rats exposed to 750 ppm were lethargic after that time.

Exposure to progressively higher concentrations is expected to result in convulsions, tremors and/or strychnine-like muscular rigidity. Rats exposed to 1000 ppm began to show CNS depression 15 minutes after initiation of exposure, and slight eye irritation was evident after 2 hours. By 3 1/2 hours, the animals were moribund and/or convulsive, and some died shortly after termination of the 4-hour exposure. Rats exposed to 1425 ppm were sedated in 20 minutes, prostrate in 40 minutes, convulsive after 1 to 2 hours and dead in 4 hours.

Humans exposed to high concentrations of ProFume may experience respiratory irritation, nausea, abdominal pain, CNS depression, slowing of movements and speech, and numbness in the extremities. Survival after exposure to high concentrations can occur even following convulsions, if exposure has been brief.

PHYSICIAN INFORMATION

The prediction of possible effects in human beings is based in part on observations made on laboratory animals. On this basis, depending on length of exposure, it is predicted that persons exposed to ProFume will probably show little evidence of intoxication at first unless the concentration was moderate to high (>500 ppm).

Initial effects will probably be depression on the CNS with slow speech and body movement the first signs noted. Convulsions may ensue with respiratory arrest being a terminal event. Assisted respiration may be necessary.

An exposed patient should be removed to fresh air and put at rest. Keep exposed individual at bed rest and under observation for at least 24 hours. Clinical observation should be directed at the pulmonary, hepatic and renal systems. A postmortem finding in a fatality attributed to sulfuryl fluoride was pulmonary edema. Death was attributed to cardio-respiratory failure.

There is no known antidote. Clinical observation is essential. Treatment is based on the clinical judgment of the physician and the individual reaction of the patient.

IN CASE OF EMERGENCY
CALL 1-844-845-3129 or 1-352-323-3500

FIRE FIGHTING

General Information

ProFume is not combustible. However, in temperatures exceeding approximately 400°C (752°F), ProFume will degrade to form hydrogen fluoride (HF) and sulfur dioxide (SO_2). Theoretically, a structure containing ProFume would produce 0.4x the concentration of ProFume in HF per 1000 cu ft.

For temperatures greater than 400°C, each mole (102 gm) of sulfuryl fluoride will degrade to form 2 moles (40 gm) of HF. However, the HF actually produced during fires involving ProFume may be insignificant because ProFume rapidly escapes from structures unless confined.

Cylinders containing ProFume are designed not to explode in high temperatures. A fusible plug in the cylinder valve body melts at 70 to 74 °C (158 to 165°F).

Use of Water: Evolution of hazardous materials during a fire can be minimized by use of water. Water will scrub out part of the HF and SO_2 formed by decomposition of ProFume by the flame. Water also can be used to cool ProFume cylinders and prevent discharge of the product caused by melted fusible plugs. Avoid runoff into waterways if possible. The toxicity of ProFume in water for fish is unknown.

Fire Fighting Protective Clothing

For Structures Under Fumigation: Self-contained breathing apparatus and normal "turn-out" gear should be worn when fighting fires in structures under fumigation with ProFume.

For Fires Involving ProFume Cylinders: A self-contained breathing apparatus (SCBA) and encapsulating protective suits should be worn when fighting fires in atmospheres containing potentially high concentrations of ProFume. Protective suit material should be compatible with exposure to hydrofluoric acid.

WORKER SAFETY

NIOSH or MSHA approved positive-pressure self-contained breathing apparatus (SCBA, not SCUBA) or an air-supplied/SCBA respirator is necessary when entering areas being fumigated where the concentration is unknown or is >1 ppm as measured by a detection device with sufficient sensitivity such as an Interscan or Miran.

Two persons trained in the use of the product, at least one being an applicator certified by the state, must be present on site at all times during the introduction of the fumigant, reentry prior to aeration, initiation of the aeration procedure, when testing for reentry after aeration (if aerated in an enclosed space), and during reentry.

Any unprotected exposure to ProFume >1 ppm should result in a visit to your physician (consult label).

Personal Protection Equipment

The label for ProFume requires the following personal protective equipment:

Appropriate Respiratory Protection: This must be worn when the concentration of ProFume in the breathing zones exceeds 1 ppm or when the concentration is not known.

Prior to introducing fumigant, confirm that SCBAs are available and operational. The respiratory protection must be National Institute of Occupational Safety and Health (NIOSH) or Mine Safety and

Health Administration (MSHA) approved, positive-pressure self-contained breathing apparatus SCBA (not SCUBA) approval number prefix TC-19C or combination air-supplied/SCBA respirator, such as manufactured by Draeger, Survivair, Ranger, Scott, or MSA.

Consult current standards concerning SCBA use and maintenance.

Eye Protection: Wear splash resistant goggles or full face shield when handling the liquid product during introduction of fumigant or when working around any lines containing fumigant under pressure.

Protective Clothing: Do not wear gloves or rubber boots. Do not reuse clothing or shoes that have become contaminated with liquid ProFume until thoroughly aerated. Wear loose fitting or well-ventilated long-sleeve shirt, long pants, shoes and socks.

Preventing Static Electricity
The flow of liquid gas in the introduction hose may be a source of static electricity. To prevent the risk of static sparking, the introduction hose must be properly grounded using acceptable demonstrated methods (e.g., securely attaching a length of copper tubing with adequate fittings to the end of the introduction hose).

When using copper tubing as a ground, attach the copper tubing with a grounding wire to the fan cage frame or to a neutral ground. The copper tubing mounted at the end of the introduction hose must be securely attached to the fan or some other stable object.

Fumigant Introduction Hose and Fittings
- Use hose with minimum burst pressure of 3450 kPa (500 psi) that is compatible with liquid ProFume. Polyethylene or polypropylene hoses have proven satisfactory.
- Use care not to kink or crush the hose. Reinforced hose helps prevent collapse.

Personal Safety
- Always wear eye protection when introducing ProFume or repairing leaks on introduction manifolds or hoses.
- Proper respiratory protection (SCBA) must be on hand in case of required emergency entry into structure.
- Make a security check for personnel, structure preparation and persons in nearby buildings and grounds. Apply proper lock-outs and placarding.

Material Safety
- Use proper fumigant introduction techniques to help prevent corrosion or water stains on interior materials.
- To the extent possible, provide protection for nearby desirable plants.
- Use circuit breakers or fuses for fans.
- To the extent possible, place fans to minimize the risk of damage to equipment.

IN CASE OF EMERGENCY
CALL 1-844-845-3129 or 1-352-323-3500

IN CASE OF ACCIDENTAL EXPOSURE, SEEK MEDICAL ATTENTION

CYLINDER SAFETY AND STORAGE..... 3

ProFume is toxic to most living organisms including humans. It is colorless, odorless, packaged as a liquid gas under pressure, and has no warning properties. **ProFume must only be used by certified professional applicators that have satisfactorily completed the ProFume training program.**

CYLINDER SAFETY

General Cylinder Information

Cylinders containing ProFume must be properly and legibly labeled at all times. If labels become damaged or lost during shipment or use, additional cylinder labels can be obtained from Douglas Products.

ProFume is sold as a compressed liquid gas in a high-pressure cylinder and must be handled, stored and transported with caution. Every cylinder should be inspected upon delivery for damage. If the cylinder is damaged, immediately return the cylinder to the ProFume distributor.

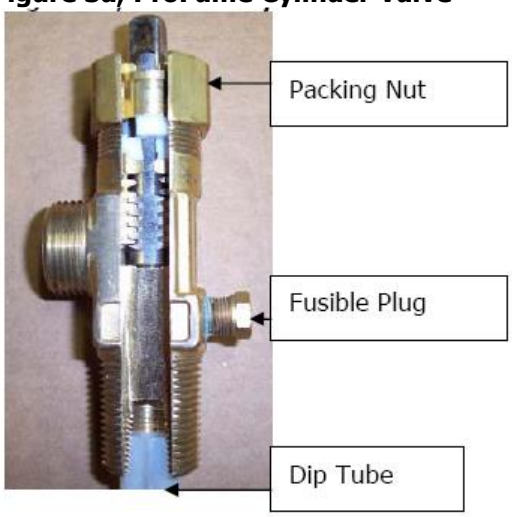
No additional gas is used to pressurize the cylinder. Each full cylinder contains 57 kg (125 lb) of product normally under about 1380-2070 kPa (200 to 300 psi).

ProFume Cylinder Valves

ProFume cylinders are fitted with special valves (see Figure 3a). The cylinder is equipped with both a safety cap and a covering called a "bonnet." The safety cap and bonnet should be securely in place at all times except when gas is to be released from the cylinder. This protects the valve system from being damaged and/or prevents accidental release of the fumigant.

Never hang cylinders by the valves during weighing. Use a proper sling or "hanging" bonnet specifically designed for this purpose. Hanging bonnets have openings on two or more sides that a hook strap or cable can be inserted in to support the cylinder during weighing. Hanging bonnets are available through ProFume distributors.

Figure 3a, ProFume Cylinder Valve



Cylinder Safety

- Avoid manhandling the cylinder when moving or weighing; e.g., use a hoist with a hanging bonnet.
- Protect the valve from damage by always replacing the valve cover and safety bonnet.
- Open valve slowly at first, then completely open it (one full turn) so the valve and the introduction hose do not frost. Use proper size adjustable wrench (25 to 30 cm). Keep wrench attached to valve.

- Bear in mind that frosting of the outside cylinder surface when releasing the last 1.5 to 2 kg of ProFume is likely.
- Close valve completely when fumigant introduction is finished or cylinder is "empty."

CYLINDER STORAGE

Store ProFume cylinders in an adequately dry, cool, well ventilated, secured, and locked area. Post as a pesticide storage area. All cylinders (full, partially full, or empty) should be stored in an upright (vertical) position with safety caps and protective bonnets securely in place. Secure ProFume cylinders to prevent being knocked over during storage, transport, weighing, and fumigant release. Secure in a manner that does not deface the label.

Keep the safety cap and protective bonnet on cylinders except when introducing the fumigant

Various state and local authorities may regulate the storage of ProFume. Be certain to check with the appropriate authorities in your area.

If cylinders are stored in an enclosed area without proper ventilation, the area must be tested for leaks using an Interscan or Miran analyzer or similar device of sufficient sensitivity so persons entering or working in the general area will not be exposed to concentrations of ProFume >1 ppm. Contact your state and local authorities for additional guidelines.

Do not contaminate water, food, or feed by storage.

CYLINDER TRANSPORT

Transport cylinders capped and secured in an upright position. On public roads, transport securely only in an upright position. During transport, special care must be taken to prevent rough handling or mechanical shock such as dropping, bumping, dragging, or sliding. Also, dip tubes can be broken due to sharp blows and shocks if the cylinder is on its side. Never transport unsecured cylinders without preventing their excessive movement. Never suspend or lift cylinders by the valve. Loose cylinders can become airborne and cause significant damage in an accident.

Because of the toxicity of ProFume, cylinders are not to be transported in the same airspace or breathing zone as the driver or other occupants of vehicles, such as in unpartitioned trucks, vans or station wagons.

All Department of Transportation (DOT) regulations must be followed. If you have questions, contact your local DOT.

Always store and transport cylinders in a secure upright position over public roads.

Do not transport ProFume cylinders in the same airspace or breathing zone as the driver or other occupants of vehicles.

Air Transportation

Never transport ProFume cylinders by aircraft.

Empty Cylinders

Handle, store and transport empty cylinders using the same precautions as previously discussed for full cylinders. When the cylinder is empty, fully close the valve and replace the safety cap and protection bonnet before returning to the ProFume distributor and subsequent shipper. Only Douglas Products is authorized to refill cylinders. Do not use cylinders for any other purpose.

REMEMBER TO
CLOSE VALVE COMPLETELY
ON EMPTY CYLINDERS

Cylinder Label Protection

Protect cylinder labels from being damaged to ensure label text can be read. Protection measures should prevent knocking or scraping of the labels. It is recommended that plastic-coated or covered chains be used when securing the cylinder on vehicles.

Leaking Cylinders

If a cylinder is suspected of leaking fumigant, evacuate immediate area of leak. Use a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) approval number prefix TC-19C or combination air-supplied/SCBA respirator, such as manufactured by Draeger, Ranger, Survivair, Scott, or MSA, for entry into affected areas to correct problem. The SCBA must be worn when exposure is >1 ppm.

Move leaking or damaged cylinder outdoors or to an isolated location, observing strict safety precautions. Work upwind if possible. Do not permit entry into leakage area by unprotected persons until concentration of fumigant is determined to be 1 part per million (ppm) or less, as determined by a detection device with sufficient sensitivity such as an INTERSCAN gas analyzer [Model: GF 1900] or MIRAN vapor analyzer [SapphIRe].

Often tightening the packing nut on the top of the valve to 35-40 N.m (25-30 foot pounds) of torque with an adjustable wrench will stop the leak. Never use excessive force to open a stuck or improperly seated valve. See ProFume Valve Stem Adjustment Procedures at the end of this chapter.

Once the cylinder is empty, contact your ProFume distributor for proper return instructions.

IN CASE OF EMERGENCY
CALL 1-844-845-3129 or 1-352-323-3500

ENTERING A STRUCTURE UNDER FUMIGATION

If emergency entry into a structure under fumigation with ProFume is required, the proper respiratory protection (SCBA) must be used.

FROZEN VALVES AND HOSES

If the ProFume cylinder valve is "just cracked" to reduce the rate of release, ProFume will expand from a liquid to a gas within the hose and frosting of the outside of the valve and hose may occur.

Frosting can be avoided by allowing full flow through the valve and lines.

The rate of flow of ProFume should not be controlled by restricting flow through the cylinder valve.

FROZEN CYLINDERS

If a break occurs on the dip tube in the cylinder, ProFume will be discharged in the gas phase when the liquid level falls below the break. As the liquid expands in the cylinder, heat will be taken from the surrounding area and the cylinder will frost or freeze at that point. ProFume will still be discharged, but at a much slower rate. Cylinders showing signs of a broken dip tube (a very rare occurrence) should be painted red on the shoulder of the cylinder, red tagged, and returned to the distributor so that the problem can be corrected before refilling.

CYLINDER RETURN PROCEDURE

One of the more common reasons for returning a cylinder is the perception that the last 1.5 to 2 kg (3 to 5 lb) of gas in the cylinder cannot be released. The final pounds of ProFume in a cylinder generally are in a gaseous state and will not move out of the cylinder as rapidly as when it is a liquid. However, it will move through the introduction hose.

Cylinders that are deemed to be "defective" should be returned using the following procedure.

1. Do not continue to use a cylinder if you believe the valve is defective.
2. Contact your ProFume distributor. The distributor will need information about the cylinder (cylinder number, etc.). Complete a Defective Cylinder Report form. Fax the form to Customer Service at Douglas Products (1-816-781-1043).
3. Distributors should identify defective cylinders by spray painting the top and shoulders of the cylinder with red paint and attaching a completed red tag to the protection bonnet.

Do not mark functional cylinders with paint as this could cause confusion when dysfunctional cylinders are returned for repair.

ProFume Valve Stem Adjustments in the Field

Introduction

When cylinders are filled at the plant, a soap solution is applied to the valve stem (the square shaft area) and valve threads at the top of the cylinder. The cylinder is not released if leaks are present. Each time the valve is opened and closed, the stem works against the packing causing the packing to flow away from the valve stem. Over time this may allow product to escape past the valve stem when the valve is in the open position. This document describes how this situation can be safely corrected in the field.

Hazards & PPE

Operators performing the valve stem adjustment should follow all precautions on the product label section for "Leak Procedures." This may include, but is not limited to, immediate evacuation followed by reentry using positive pressure self-contained breathing apparatus. Move cylinders outdoors or to a ventilated isolated location prior to adjusting the stem. Allow no unprotected persons in the area during the adjustment procedure until fumigant concentration is verified with sufficiently sensitive detection equipment to be below the levels of concern indicated on the product label.

Indications

This procedure is appropriate when a cylinder shows indication of product loss from around the valve stem. Loss may be indicated either by a sufficiently sensitive detection device or hissing/bubbling at the stem when the valve is open. This procedure may not be effective or appropriate for other valve problems.

Training

Only persons appropriately trained for Hazardous Material handling are permitted to perform this task. While operators who transport ProFume are required to receive Hazardous Material training, individuals should check with their employer if they have any questions regarding required training.

Procedure

Listed below are the steps necessary to stop a loss of ProFume from around the valve stem in the field.

Warning: Follow directions in Hazards and PPE section above prior to starting this procedure. Make sure all PPE and sufficiently sensitive detection devices are used.

Step	Action
1	If product loss is detected, immediately close the valve. This will stop ProFume from leaking out of the stem.
2	Secure the cylinder against a stationary object (rack, wall, etc.) to prevent tipping. Using the same wrench you use to remove the cap from the valve exit, tighten the packing nut on top of the valve. Turn the packing nut in a clockwise direction to tighten the packing. **Note:** Do not over tighten this nut. The specification is 34 to 40 N.m (25 to 30 foot pounds) of torque, which is easily reached with a 25 to 30 cm (10 to 12") adjustable wrench.
3	Open the valve. If product is still leaking from around the valve stem, repeat steps 1 and 2. If product loss still persists, close the valve, red tag the cylinder, and return it for credit. The valve will be replaced at the plant.

MONITORING EQUIPMENT

Fumiscope

The Fumiscope is designed to measure the actual concentration of ProFume within the fumigation site to determine accumulated dosage. **The Fumiscope is not sensitive enough to use as a clearing device after the exposure period.** The Fumiscope also is used in conjunction with the ProFume Fumiguide™ for determining actual HLTs.

Fumiscope units are portable and weigh approximately 3.5 kg (8 lb). The Fumiscope uses a mechanism to compare the thermal conductivity of a mixture of ProFume and dry air to that of dry ambient air. This difference is converted into an electric current, which is displayed as oz per 1000 cu ft.

The sample is drawn through the drying tube, the flow rate meter, and subsequently through the thermal conductivity cell by an electric pump.

The **Model D** Fumiscope has a digital readout and indicates 0 to 1000 gm/m^3 or oz per 1000 cu ft. It is normally operated on 110 volt AC, but can be adapted to operate on 220 volts AC or from a 12-volt auto battery.

Older analog models (**EV or E-200**) are still found in the field. The model EV has a range of 0 to 50 oz per 1000 cu ft. The model E-200 has a range of 0 to 100 oz per 1000 cu ft.

Fumiscopes can be purchased through your distributor or from the manufacturer.

Fumiscopes Manufactured by:

Key Chemical and Equipment Co., Inc.
13195 49th Street N., Unit A
Clearwater, FL 34622
Phone: (813) 572-1159
Fax: (813) 572-4595

Operating Procedure (for Units Using Drierite)

1. Fill drying tube with Drierite (4 to 8 mesh). Tip: Be sure cotton is in place in bottom of tube to prevent dust from being drawn into the pump and cell.
2. Turn on pump and check for leaks by blocking inlet and noting if flow rate drops to "zero." Do the same by blocking the outlet.
3. After warm-up (approximately 10 to 15 minutes depending on the humidity), adjust the flow rate to approximately 1 cu ft per hour (CFH) and "zero" the instrument.
4. Attach sampling hose (usually 6 mm tubing) and readjust the flow rate if necessary to the same rate in Step 3.
5. Wait at least 3 minutes for a monitoring line of 100 feet or less for the sample to reach the Fumiscope or similar device and the reading to stabilize before recording the concentration.
6. Disconnect the tubing and adjust the flow rate to the original setting and check to be sure the unit returns to "zero" - if not, reset it to "zero." Zero drift may occur during the first few minutes of operation.
7. Change Drierite when approximately 3/4 of the material has changed from blue to pink. (Spent Drierite may be regenerated by placing in a shallow pan and heating in an oven to 150 to 200 C for 20 to 30 minutes then return it to the bottle while still slightly warm.)

Monitoring Line Purge Pump

Because most fumigations will result in the use of multiple monitoring lines that are several hundred feet long, the use of a vacuum purge pump is recommended. Because the pump within the Fumiscope or

similar device is not high volume, getting accurate samples from locations several hundred feet away in a timely manner can be a problem.

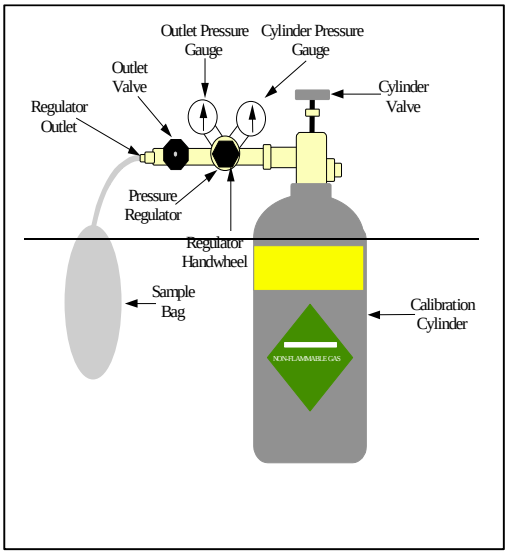
The use of a vacuum pump ensures timely, accurate samples from all areas within the structure. The use of this system greatly reduces the time needed to monitor all locations within the structure.

Fumiscope Calibration Procedure

Small sample cylinders containing known concentrations of ProFume are available for calibration purposes. Specially designed plastic sample bags are used to transfer and inject the gas/air mixture to the Fumiscope. The instrument can then be adjusted to accurately measure the known concentration. This method is ideally suited for quick, easy and reliable calibration of the Fumiscope and confirmation of accuracy in the field.

Sample cylinders and bags are available from:
Scott-Marrin, Inc.
6531 Box Springs Blvd.
Riverside, CA 92507-0725
Phone: (909) 653-6780

Calibrating the Fumiscope



The procedure for testing the calibration of the Fumiscope is as follows:

1. Warm up and "zero" Fumiscope.
2. Attach regulator to calibration cylinder and tighten with a wrench (note - left-hand thread).
3. Close outlet valve and back out regulator knob (turn to left).
4. Open cylinder valve approximately 1/2 turn.
5. Turn regulator valve clockwise until outlet pressure gauge reads 20 to 35 kPa (3 to 5 psi).
6. Attach sample bag to regulator outlet and slowly open outlet valve to fill bag approx. 90% full. Do not overfill as bag will burst.
7. Disconnect sample bag from regulator and connect to Fumiscope inlet.
8. Read Fumiscope meter for concentration of calibration standard. If the concentration on the meter is more than 5% different from the actual concentration, remove the bag, re-zero the Fumiscope and repeat measurements.

If the calibration check indicates a need for adjustment, remove the four phillips screws in the faceplate of the Fumiscope.

1. Wait 2 to 3 minutes and then adjust the meter to the gas concentration with the appropriate "pot" (blue disks).
2. Remove the bag and allow the meter to return to zero. If it does not return to zero, re-zero it and re-calibrate.

Model E-V and **E-200** have two adjustment "pots" along the top of the circuit board. The disk on the left (when facing front of panel) adjusts the scale for ProFume. These two pots are interacting. The methyl bromide (MeBr) scale must be adjusted first if the instrument is to be calibrated for both gases. If a calibration is desired for ProFume only, the MeBr pot should not be touched and only the pot for ProFume is adjusted. Some also have a zero adjust lower on the board (adjust this first if it needs adjustment).

Model D has three pots on the top edge of the board. The outer pot is the zero adjust, the center is for ProFume, and the inner is for MeBr. The MeBr scale must be adjusted first if the instrument is to be calibrated for both gases. Some instruments have another zero adjust lower on the board near the pump (adjust this first if the zero needs adjustment).

An alternate procedure can be used to calibrate the Fumiscope. This procedure is based on comparing the concentration readings of the instrument to be calibrated with a standard instrument and adjusting the one to be calibrated to indicate exactly the same concentration as the standard.

Factors Affecting Measurement

1. Warm-up - Allow the instrument to warm up until the readout stabilizes (usually 10 to 15 minutes depending on the humidity).
2. Zero - Frequently re-align meter to zero.
3. Flow rate - Keep flow rate at 1 cu ft/hour. Check flow rate for each sample.
4. To save time, charge sampling hoses with a hand squeeze bulb or vacuum pump before connecting them to Fumiscope.
5. Monitoring line - For accurate readings do not draw samples through fumigant introduction hose, which could cause erroneously high readings.
6. Other gases - Fumiscope will detect other gases and vapors, including paints, varnishes, propane and natural gas, sewer gases and auto exhaust.
7. Temperature - Avoid rapid changes in temperature. Avoid moving the instrument from shade to sun or from a hot car to cool shade.
8. Moisture - Water can cause the TC cell to rust. Check sampling tube for condensation. Keep units with digital meters in air-conditioned environments when not in use to prevent moisture from getting into the meter. Use fresh and adequate drying medium such as Drierite.
9. Interference - Flickering fluorescent light ballasts will interfere with Fumiscope measurements. Use extension cords with grounds.
10. Static electricity - In analog meters, replace broken glass on meter with glass, not plastic, to avoid effects of static electricity.
11. Dust from Drierite - Dust can damage the pump and TC cell. Regularly replace cotton in bottom of drying tube. Clean inside of drying tube with glass window cleaner when dusty.

For Fumiscope repair procedure, contact the manufacturer

CLEARANCE TESTING EQUIPMENT

Interscan Gas Analyzer

Model GF1900 is a continuous, direct-reading instrument designed to monitor low concentrations of ProFume for clearing for reentry and leak detection. **(Note: Exposure to levels above 50 ppm can shorten the life of the sensor and/or furnace or cause the unit to fail.)** An integral pump draws the air sample through a pyrolyzer (furnace) where the ProFume is converted to SO_2 which then passes through an SO_2 sensor. The sensor output is registered on a direct reading dial as ppm of ProFume. The unit is lightweight and battery or AC powered for easy portability.

The INTERSCAN must be calibrated within 1 month prior to use as a clearance device. All other detection devices must be calibrated according to manufacturer recommendations.

Specifications

Measuring Range:	0 to 50 ppm sulfuryl fluoride
Accuracy:	±2% of full scale
Warm-up Time:	Approx. 10 minutes
Weight:	8 3/4 lb. (4 kg)
Power:	24 volt DC. Two 12-volt, rechargeable batteries in a leather case or AC power supply with 15 meter cable on output side.
Operation Time:	The battery pack can operate the instrument for up to 70 minutes before recharging (recharge overnight).
Manufactured By:	Interscan Corporation 21700 Nordhoff St. P.O. Box 2496 Chatsworth, CA 91311 (818) 882-2331 or (800) 458-6153

Analyzers can be purchased through your ProFume distributor.

Operation

1. Turn the function knob to the "off" position and connect a power supply or battery pack. Be certain to screw the connector all the way down.
2. Turn the function knob to the "on" position. The "on" light should appear and the pump will start.
3. If the analyzer is being powered by an AC unit, disregard the Lo Bat. light, which in some analyzers stays on, while in others, flickers on and off. If using a battery pack as a power supply, turn the function knob to the Bat. Test position. The needle should move to the right of the Lo Bat. position on the meter (40 ppm). If this is not the case, or if the Lo Bat. light is on, do not attempt to use. The battery needs charging.
4. If power supply is OK, turn the function knob to the "on" position and allow the unit to warm up. After the "ready" light comes on, adjust the meter to 20 ppm in ambient air using the zero knob. Observe the needle for about 2 minutes and look for any drifting of the pointer. If it has drifted more than 3 ppm to either side, repeat the procedure until the needle has stabilized. In some cases, the unit will have to purge between 30 and 60 minutes before it stabilizes.
5. Adjust the meter to read "zero" using the zero knob.
6. When using the battery pack, the Lo Bat. indicator will light when there is about 10 minutes of operating time left. After the light is on, turn the control knob to Bat. Test to see if the meter is on or to the left of the "bat" line. If the meter is to the right, turn back to "on" and continue. Check battery condition every few minutes. When the meter shows "Lo Bat" turn the knob to off and discontinue use.
7. Recharge batteries overnight.

Calibration Procedure

Small sample cylinders containing known concentrations of ProFume are available for calibration purposes. Specially designed plastic sample bags are used to introduce the gas/air mixture to the Interscan. The instrument can then be adjusted to accurately measure the known concentration. This method is ideally suited for quick, easy and reliable calibration of the Interscan, as well as confirmation of accuracy in the field.

Sample cylinders and bags are available from:

Scott-Marrin, Inc.
6531 Box Springs Blvd.
Riverside, CA 92507-0725
Phone: (909) 653-6780

1. Warm up and "zero" analyzer.
2. Attach regulator to calibration cylinder and tighten with a wrench (**note** - left hand thread).
3. Close outlet valve and back out regulator handwheel (turn to left).
4. Open cylinder valve approximately 1/2 turn.
5. Turn regulator valve clockwise until outlet pressure gauge reads 20 to 35 kPa (3 to 5 psi).
6. Close cylinder valve and open regulator valve to bleed regulator.
7. Attach sample bag to regulator outlet and slowly open outlet valve to fill bag approx. 90% full (do not overfill as bag will burst).
8. Disconnect sample bag from regulator and connect to analyzer.
9. Wait 2 to 3 minutes and then adjust the meter to the gas concentration with the SPAN adjust.
10. Remove the bag and allow the meter to return to zero. If it does not return to zero, re-zero it and re-calibrate.

Pyrolzer (Furnace)

- Average lifespan - 3 to 4 years, depending upon the frequency and conditions of use.
- Reasons for malfunction - the pyrolyzer contains a porcelain furnace that can crack with age or mishandling. It is most susceptible to damage when it is hot. Avoid dropping the Interscan and transport/store them in shock-resistant containers.
- Diagnosing malfunctions - A pyrolyzer that will not heat up may be cracked or damaged. Furnaces can also be checked by using a voltmeter or testing for air leaks. Leaks are checked by opening the unit, turning the unit on, and briefly blocking the air intake on the SO_2 sensor. If the pump stops, there are no leaks.

SO_2 Sensor

- Average lifespan - 3 to 4 years (whether used or not).
- Diagnosing malfunctions - A slow response time, erratic readings, or inability to calibrate the Interscan indicates the sensor may need replacement. Dysfunctional sensors can also leak electrolyte solution.

Battery Pack

- Reasons for malfunction - Excessive discharging of batteries after the "Low Battery" light is on.
- Battery charger - Turn battery charger off before connecting or disconnecting the batteries from the charger to avoid potential damage to the charger circuit board. A delay in the illumination of the charge light (for up to 5 minutes) once batteries are connected may be due to excessive discharging of the batteries during use.

Power Supply

- Reasons for malfunction - The cord connecting the AC power supply to the Interscan can become worn (turn brown or become frayed) through use and require replacement. Fumigators have incorrectly installed new cords, resulting in the destruction of the circuit board of the Interscan. The color-coding for the wiring of the power supply is the reverse of that for the battery pack, and the positive and negative ports of the canon plug are not identified.

Repair Instructions

Return the analyzer to the manufacturer, or:
Key Chemical and Equipment Co. Inc.
13195 49th Street N., Unit A
Clearwater, FL 34622
Phone: (813) 572-1159
Fax: (813) 572-4595

Miran Gas Analyzer

The **Miran 101** is an older model designed to measure a single gas or vapor.

The **Miran 203** is a single beam infrared gas analyzer with interchangeable filters and two fixed path lengths. Factory calibrated gas calibration sets, which can be interchanged in about 1 minute, allow you to monitor other gases.

The **Miran SapphIRe** is a newer model infrared gas analyzer that allows monitoring of other multiple gases.

Units are portable and designed to operate on 120-volt AC or on 7.2-volt rechargeable batteries. They are suitable for measuring low levels when clearing for reentry and for leak detection.

Specifications

Weight:	Model 101 – 8 kg (18 lb)
	Model 203 – 9 kg (20 lb)
	SapphIRe – 9 kg (20 lb)
Range:	Dual scale 0 to 15 ppm and 0 to 150 ppm
Operating Time:	4 hours on batteries (rechargeable overnight)
Accuracy:	± 5% of reading

Manufactured by:
Thermo Environmental Instruments
8 West Forge Parkway
Franklin, MA 02038
Phone: (508) 520-0430

Operation
1. Turn on analyzer and allow to warm up for approximately 30 minutes.
2. "Zero" analyzer and take readings.

Calibration
The analyzers are factory calibrated and usually do not require frequent re-calibration. They should be checked either by the electronic method or by the closed loop method described below and sent to Foxboro or their representative when re-calibration is indicated.

Performance Verification Procedure for Miran 101 and 203 Analyzers

1. Turn on analyzer and allow it to warm up for 15 minutes.
2. Zero instrument and attach Tygon tubing loop.
3. Connect needle valve and tubing to ProFume cylinder.
4. Place end of 4.7 mm" Tygon tubing in container of water.
5. Turn on cylinder valve and use needle valve to adjust the flow of ProFume so there is a slow stream of bubbles in the water. This step should be done under an exhaust hood or outdoors downwind of the Miran.
6. Using a gas tight syringe, withdraw ProFume (13 microliters (µl) = 5 ppm[†]) from the tubing on the ProFume cylinder and inject it into the tubing loop on the Miran.
7. Repeat Step 6 twice and record results after each injection.

[†] Volume of 101 and 203 cell is 2.5 liters.
Volume of 24" of 1/2" tubing is 0.08 liters.
µl of gas injected ÷2.6L (cell + tubing) = ppm. Therefore, 13 ÷ 2.6 = 5 ppm.

Miran SapphIRe Analyzer Performance Verification Procedure

1. Turn on the machine and let it warm up for 30 minutes.
2. From main menu, select 4 = Config/Setup. From the setup menu select 1 = Calibration. From the calibration menu select 3 = Performance Verification.
3. Grasp the capillary tubing end of the sampling line and slowly push it into the nozzle opening on the gas tank.
4. Zero analyzer and confirm stable zero.
5. Attach tubing sleeve to inlet tube of analyzer. Activate trigger valve and watch gas readings climb.
6. After 3 to 4 minutes readings should stabilize. Record readings.

7. Remove the tubing and reattach the zero filter.

8. Restart pump by selecting Option 2 from the control menu. Continue until reading is substantially zero.
9. Remove the capillary tubing from the tank trigger nozzle and check results against challenge gas concentration.

Repair Procedure
Contact ThermoEnvironmental Instruments or their representative.

OTHER UNITS

The listed detection and monitoring equipment in this label is not intended to be all inclusive. As new technology is developed, new devices may be evaluated by Douglas Products to detect ProFume. Contact your nearest representative from Douglas Products for the latest information on sufficiently sensitive detection devices.

Note: Prior to using these instruments to clear a structure for reoccupancy, meters must be "zeroed." This should be done according to the manufacturer's directions, away from the fumigation site and in an atmosphere that contains no ProFume. Manufacturer's instructions also include information regarding appropriate and necessary calibration and maintenance. Manufacturer's recommendations must be followed to ensure proper operation of these instruments. Please refer to the manufacturer for the latest recommendations and instructions for any equipment for use with ProFume.

FUMIGATION PREPARATION..... 5

Prior to fumigation, read the Applicator's Manual carefully. Notify appropriate owners, employees, and/or operators at the facility where the fumigation will occur and provide relevant safety and health information to local fire and rescue officials for use in the event of an emergency.

Best practice is to notify local police, fire department and emergency responders of impending start and finish times for the fumigation.

Property Owner/Customer Checklist: The owners of buildings to be fumigated need to be informed of circumstances and conditions associated with the fumigation process and of their involvement in preparation, vacancy and re-occupancy. Some states require the fumigator to provide the customer with a list of preparations required for the fumigation. The customer may also be required to acknowledge in writing certain liabilities.

The responsibility for proper fumigation procedures lies with the certified fumigator regardless of who does the work.

OCCUPANTS/CUSTOMERS NEED TO KNOW:

1. Qualifications of the certified applicator who will be doing the fumigation.
2. Their specific role in preparation for fumigation - what to prepare, turn off, remove, etc.
3. What the fumigation process (introduction, exposure, aeration and clearance) entails so that there can be absolutely *no* entry by unauthorized personnel into the structure until it is certified clear for reentry by the fumigator.
4. The specific times to leave the structure and when re-occupancy may occur.
5. That the fumigator often requires that the property owners surrender keys to the structure to be fumigated. The fumigator should have access to all areas of the fumigation site during the whole period that the site is under their control.
6. ProFume has no residual effectiveness and so does not control future infestations of pests.
7. To reveal to the fumigator known or potential connections to adjacent/other buildings.

WHAT TO REMOVE PRIOR TO FUMIGATION

Remove from the structure to be fumigated all persons, non-target animals, and desirable growing plants. All drugs (including tobacco products) and medicinals (including those items in refrigerators and freezers) need to be removed prior to fumigation.

FLAMES OR HEATING ELEMENTS

ProFume is a very stable compound that is relatively non-reactive and non-flammable. However, under high heat conditions present in gas flames or glowing electric elements, ProFume can decompose into sulfur dioxide SO_2, hydrofluoric acid HF, and other decomposition products. Hydrofluoric acid is highly reactive and can corrode or damage many materials including metals, glass, ceramic finishes, fabrics, etc. Therefore, extinguish all flames including pilot lights of furnaces, hot water heaters, dryers, gas refrigerators, ranges, ovens, broilers, etc. Turn off or unplug all electrical heating elements such as those in heaters, dryers, etc. Shut off automatic switch controls for appliances and lighting systems that will be included in the space to be fumigated.

Contact your local gas company to determine what procedures should be followed in your area for shutting off natural gas or propane service. Gas service should be shut off at the main service valve. When a single gas meter serves more than 1 structure, gas service to all sources may be interrupted. The gas lines should be cleared. Fumigation companies may request that customers have the local gas

company turn off the gas prior to fumigation. The local gas company will always need to turn gas service on after it has been turned off to determine that the gas flow rate and pressure are appropriate.

Before fumigating, ALL pilot lights must be turned off. The heat of gas flames, pilot light flames, or the glowing wires or hot surfaces of electric heaters can cause ProFume to break down to form a corrosive material. Make sure the gas flames and pilot flames of furnaces, gas refrigerators and kitchen ranges are extinguished and that glowing electric heaters that represent a reasonable risk of a heat source that is at or near 752°F are turned off.

Chlorine Gas: Damage to metals can also occur from the inclusion of chlorine gas for bleaching or chlorination processes. Ensure this equipment is turned off with no leaks or excluded from the fumigation.

CHECKING FOR CONNECTED AREAS

Prior to fumigation, the certified applicator is required to check for connected areas. A connected area is defined as any area connected with the space to be fumigated by construction elements (e.g., pipes, conduits, ducts, etc.) that may allow the passage of fumigant between the spaces.

Any connected areas must be vacated during the fumigation process unless it is isolated from the space to be fumigated by methods that will prevent passage of the fumigant from the space to be fumigated into the connected area. When it is necessary to vacate areas that have been isolated, that area shall be considered as a fumigated space, and all applicable rules, regulations and label instructions apply such as preparation, placarding, securing, and aeration.

ProFume concentrations in the breathing zones must be continually measured during the fumigation of a structure in any occupied isolated connected structures to verify ProFume concentrations are <1 ppm to confirm that individuals in the isolated areas are not exposed to unacceptable levels of ProFume. Use only a detection device of sufficient sensitivity such as the INTERSCAN gas analyzer [Model GF 1900] or MIRAN vapor analyzer [SapphIRe] to confirm a concentration of ProFume $\leq$1 ppm. If ProFume concentrations exceed 1 ppm then the sealing of the isolated space from the fumigated area is probably not working and the immediate space must be evacuated unless the ProFume concentration is continuously monitored to prevent exposure >1 ppm. SCBA must be worn by the applicator if the concentration exceeds 1 ppm. **Note:** All connected/adjoining areas must be vacated if required by state or local laws or regulations.

DISTRIBUTION/AERATION FAN USE AND PLACEMENT

Purpose of Fans

There are three purposes for fans in a structural fumigation:
1. Fumigant introduction
2. Equilibrium and circulation
3. Aeration

Positioning Fans

- There is no set pattern established for the positioning or the number of fans to use.
- Fans should be strategically placed in order to mix the fumigant and rapidly reach equilibrium.
- At least one fan for each level of the structure.
- It is good fumigation practice to use more fans in structures that are divided into numerous smaller compartments or rooms.

A rule of thumb is to use one fan for each 75,000 ft^3 and at least one fan for each area or level of the fumigation.

In structures frequently used or dedicated to fumigation, air circulation equipment and fans can be built into the structure. Examples of some systems include air-handling systems that provide for the fumigant introduction, continuous circulation, and also aid in the quick, effective aeration of the structure.

Reaching Equilibrium

When liquid ProFume is released from the introduction hose, it extracts a substantial amount of heat from the surrounding air as it expands to form a gas. A pound of liquid ProFume changing to the gas phase will drop the temperature of 1000 cu ft of dry air 4.5°F (28.3 m^3 of air 2.5 °C).

The chilling causes the formation of a cloud of condensed water (fog) that must be dissipated before it collects on a surface. The rate of dissipation depends upon the release rate, atmospheric conditions, and mixing rate. The fan capacity, quantity, and placement determine the mixing rate. The chilled ProFume gas is much denser than the surrounding air and can settle to the bottom of the fumigation space unless mechanically mixed with the surrounding air.

All gases tend to move from an area of high concentration to low concentration and will eventually come to equilibrium in a confined space. ProFume will do the same when it is introduced into a fumigation space, regardless of the fact that molecules of ProFume are heavier than air molecules. However, the rate of passive diffusion may be too slow to achieve equilibrium within a practical period. Thus, mechanical mixing by fans is essential.

High capacity fans are needed when introducing ProFume into a space to prevent stratification, to aid in proper dispersion, and to assist temperature distribution.

Continuous Circulation with Fans

A significant benefit of continuous circulation is the movement of ProFume from areas of high concentration to areas of lower concentration. This continuous circulation maintains a more equal concentration within the fumigation space and helps ensure that ProFume will penetrate all areas where infestation may exist.

It is next to impossible to seal a structure so that there are no leaks. Unless there are abnormally large leaks, continuous circulation during the entire exposure period will not appreciably affect the loss rate for ProFume. Obviously, the air stream should not flow directly against "leaky" areas because excessive fumigant loss can occur.

Preparing for Aeration

When first preparing the fumigation, plan ahead for the aeration period and take steps to aid aeration by strategic placement of fans and other aeration tools. Just as fans are useful in achieving equilibrium of fumigants, they are excellent aids in attaining rapid aeration and are essential where cross ventilation is poor. Have a detailed plan in place for safe, effective aeration of the structure. Be sure to consult local regulations for more restrictive aeration procedures.

MONITORING HOSES

Arrangements should be made to place sampling hoses in the structure prior to fumigant introduction. Semi-rigid vinyl hoses (3 to 6 mm or 1/8 to 1/2" ID) should be placed to allow sample representative concentrations with a Fumiscope or similar device. Monitoring hoses larger than 6 mm ID may take a longer time to pull the sample from the fumigated space to the monitoring device because of the larger volume of air needed to be moved.

Ideally, monitoring lines should be placed on all levels of the fumigated structure. If the structure is compartmentalized into separate rooms or other sub-units, place lines in areas representative of the different units.

SEALING THE STRUCTURE

No two fumigations are exactly alike. Each job requires the fumigator to establish and maintain an effective fumigation environment. The fumigation must be conducted in a manner that will effectively control the pests without causing undue risk to people or property.

The fumigator must conform to the label for ProFume and the Applicator's Manual, as well as to federal, state and local regulations. When in doubt, a fumigator should seek assistance from suppliers, regulators, Douglas Products representatives, or other educational sources.

The quality of the seal has a huge influence on the effectiveness of the fumigation. Increasing the seal of the fumigation site is one of the most effective ways to ensure a quality fumigation and reduce the total amount of fumigant needed.

There are several approaches to the challenges of confining the fumigant. The fumigator needs to make field judgments how to best seal a space. Pay special attention to drains, vents, conduits, wiring, electrical junction boxes, floor cracks, wall/floor or wall/ceiling joints, and damage to outside walls from equipment.

When sealing, keep in mind a few basic thoughts:

1. Identify and address key leakage areas. Careful inspection of the structure will help identify leaky areas. Be sure to carefully seal protruding equipment on the top floors and roofs. Building eaves also can be very leaky.
2. To the extent necessary and possible, close off all connected structures and install an "air break" to stop gas moving to connected structures.

Tape and Seal

For fumigation structures that can be appropriately sealed with materials such as plastic or tape, seal adequately around doors, windows, vents, and other openings. When necessary to minimize escape of fumigant through the soil and to avoid injury to nearby plants, wet soil (if not sufficiently moist) around the structure to act as a barrier for the fumigant. Often, structures are too large to be completely tarped for fumigant confinement. The most common practices are to use polyethylene sheeting, non-porous panels, fumigation tape, spray adhesives, foams and insulation materials to seal the structure for fumigation. These techniques are usually used around doors, windows, roof eaves, loading docks, pipes, augers, conveyers, vents, etc. If properly used, these materials can do an ample job of confining the fumigant within the structure.

Stucco or masonry block buildings may be sealed by taping laminated paper or plastic film over outside doorways, windows and vents. This sealing method is recommended for structures in which any wooden section, including roofing, is exposed to the outside.

However, even with an excellent job of tape and seal around windows, doors, etc., if the building walls, roof, or basement have holes that are not sealed, the structure may not hold fumigant satisfactorily. Always monitor with a Fumiscope or similar device when necessary.

Foam Sealing

The use of expandable spray foams have been effectively used to help seal structures. Expandable foam is economical and can be used for both permanent and temporary seals. Refer to the foam product directions for proper use and compatibility issues.

Tarping

Good sealing is necessary for an effective fumigation. Tarpaulins (tarps) can be used in the sealing process with tapes/adhesives to help seal leaky areas or to envelop the entire area to be fumigated. This

method is effective on almost any size or type of space/site. The ability of a tarp to contain a gas depends on the condition of the tarp, the material of construction and its thickness.

One of the most critical operations in tarping a space is achieving a tight seal at the ground where protrusions, debris or rough-textured soil or concrete may provide an opening for gas to escape. The edges of the cover that contact the floor or soil must be sealed by techniques such as taping the tarp to the floor or placing sand or water snakes over the edges of the tarp. Sand or water snakes may be used effectively if the ground surface is very smooth. One method of improving the seal with a sand or water snake is to run a trough of water on the tarps along with the snakes. Vinyl/nylon snake covers do not deteriorate readily. To minimize escape of fumigant through the soil and to avoid injury to nearby plants, wet soil (if not sufficiently moist) around the structure to act as a barrier for the fumigant. When possible avoid walking on tarped, fumigated material to maintain seal during the exposure period. To achieve an adequate ground seal, allow at least 2 feet of tarp to clear the ground snakes. This will accommodate movement of the tarps from wind movement.

Tarp Material
Plastic tarps are semi-permeable membranes that permit different fumigants to pass through them at different rates. The passage of ProFume through most plastic sheeting of sufficient thickness is very slow (see Table 5a).

Use only tarps made of materials that will adequately confine ProFume for the required time. Tarps are sold in many sizes. Experience has shown that the following have proven satisfactory:

1. 4 to 6 mil polyethylene for "single use" tarps
2. Laminated (several layers) polyethylene
3. Vinyl coated nylon
4. Neoprene coated nylon
5. PVC (polyvinyl chloride) coated nylon

Thickness
As a minimum, 4 to 6 mil (160 to 240 microns) thickness of the above materials adequately confines ProFume. A tarp of 100 microns is equivalent to a 400-gauge material. Polyethylene tarps less than 4 mil (160 microns) are not of an adequate thickness to confine ProFume because they do not possess the strength and weight needed for the handling, wind resistance and abrasion encountered in most fumigations.

Table 5a
Percent permeation loss and adsorption
of 8 oz/1000 ft^3 sulfuryl fluoride after 24 hours from 11 oz glass bell jar with lid made of tarp materials.

	Percent permeation loss	Percent adsorption[a]
Tarp material	**Sulfuryl fluoride**	**Sulfuryl fluoride**
Polyethylene 4-mil	**0.0**	**1.3**
Tarp A, 10.3 oz/yd^2	**3.3**	**6.1**
Tarp B, 7.2 oz/yd^2	**5.5**	**3.1**
Tarp C, 9.6 oz/yd^2	**0.2**	**3.3**
Used tarp	**100.0**	**8.8**

[a] Values reflect subtraction of fumigant loss due to glass container adsorption (2.2% for sulfuryl fluoride). (n=4)

Source: Scheffrahn, R.H. and E.M. Thoms (1993) "Penetration of Sulfuryl Fluoride and Methyl Bromide Through Substrates During Fumigation." DOWN TO EARTH 48 (1) pp. 15-19.

PLACARDING AND SECURING FUMIGATED AREAS

Placarding of Fumigated Areas

ProFume is a toxic gas without a warning agent.

All entrances and all sides of the fumigated environment and any connected area not monitored must have warning signs. Do not connect cylinders to introduction equipment until all fumigation warning signs have been posted, the space to be fumigated is clear of people and non-target animals, and it is secured. Warning signs must be of weather-resistant material and should be securely affixed to the structure. Do not allow entry by unprotected persons into fumigated area until the signs are removed. Signs must remain legible during the entire posting period. Warning signs should be placed in advance of the fumigation in order to keep unauthorized persons away. The warning signs must be printed, in English and Spanish, with:

- The signal word DANGER/PELIGRO and the SKULL and CROSSBONES symbol in red.
- The statement, "Area under fumigation, DO NOT ENTER/NO ENTRE" both in English and Spanish.
- The date and time of fumigation.
- Name and EPA Reg. No. of the fumigant used.
- Name, address, and a 24-hour telephone number (including weekends) of the fumigation company and certified applicator to allow prompt communication with the fumigation company in case of emergency.

Transfer of incompletely aerated commodity to a new storage site within a facility is permissible. However, the new storage site must have placarding and security similar to the fumigation site if breathing zones around the commodity contain $\geq$1 ppm of ProFume. Workers who handle incompletely aerated commodity must be informed and appropriate measures must be taken (ventilation and wearing of SCBA) to prevent any exposure >1 ppm.

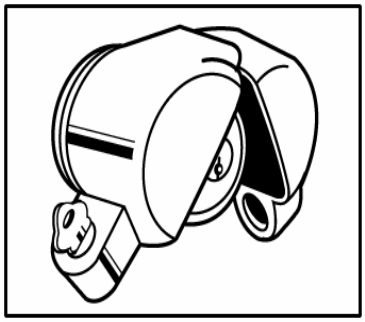
Only a state certified applicator may authorize removal of warning signs. The warning signs may be removed only when the concentration of ProFume within the breathing zones of the fumigated area is $\leq$1 ppm. Before introducing the fumigant, verify that all required safety equipment is available and in good working order.

Securing Structures

In order to secure against unauthorized entry during the fumigation exposure period, a locking device or barricade must be used on all exterior doors or doorways. A locking device or barricade must be effective in preventing entry of any exterior door or doorway using normal opening or entering processes by anyone other than the certified applicator in charge of the fumigation or persons in his/her on-site direct supervision. Consult state and local regulations for any supplementary instructions and local restrictions on securing against entry.

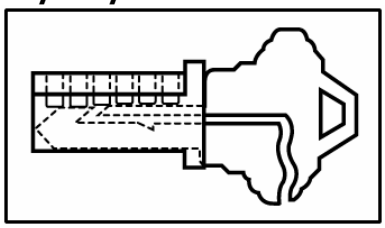
Several additional security options to consider might include:

Clam Shell Locks



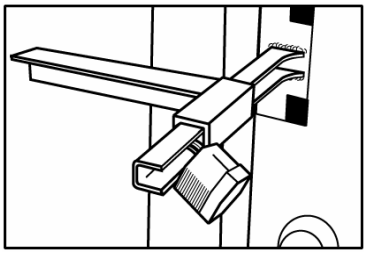
Clam shell locks are designed to prevent use of the door or occupant's keys to unlock entrance doors.

Key-Way Locks



Key-way locks are designed to prevent use of the occupant's keys to unlock entrance doors. These function by inserting a two-part locking key into the door keyhole and removing only half of the key. The other half of the locking key remaining in the door prevents insertion of the occupant's key.

J-SAFE Locks



J-SAFE lock or chains can also be used on certain structures.

Guards

Guards may be considered in some circumstances and may be required in some locations. Consult local regulations.

Best practice is to notify local police, fire department and emergency responders of impending start and finish times for the fumigation.

Railcars, Trailers or Ships

Railcars, trailers or ships must be secured against unauthorized entry during the fumigation exposure period.

PROFUME INTRODUCTION AND DISTRIBUTION..... 6

CHOOSING PROFUME INTRODUCTION SITES

The specific site(s) of release of ProFume is (are) very important to the success of the fumigation. ProFume should be introduced in a manner to achieve rapid equilibrium, avoid excessive loss, prevent fog-out, and ensure safety to personnel and materials.

Site selection should be made using good judgment. Ask, "If ProFume was introduced in this location, how and when will it get to the most remote locations in the commodity or structure?" The size and configuration of the space and the adequacy of the circulation typically dictate the number of release sites for ProFume. Therefore, for many applications, it is often appropriate to use multiple introduction sites to rapidly attain equilibrium.

In structures that are frequently used for fumigation, permanent introduction systems can be built into the structure to ensure safe, effective and adequate fumigant introduction. Be sure to inspect all components of introduction systems prior to each use.

The proper introduction of ProFume (release from the cylinder) is essential to the success, safety and economy of a fumigation. It is imperative that the fumigator understands the principles involved and the conditions that exist for introducing the fumigant on each job.

Outlined below are points that are considered when introducing ProFume:

1. The introduction methods used will practically achieve the target dosage (sufficient ounce-hours for the working temperature to control the target pest).
2. ProFume must be introduced in a manner that is safe to personnel and property inside and outside of the fumigation space.
3. The goal is to reach ProFume concentration equilibrium throughout the fumigated space as quickly as is safe and practical.

Prior to release of ProFume, make sure a thorough check of the structure and surroundings is conducted and all safety precautions have been taken.

Do not apply for insect control when temperature at the site of the pest is below 40ºF. This temperature may be measured wherever the infestation may be. This restriction does not apply when fumigating for rodents. To prevent damage, do not apply liquid fumigant directly to any surface within the fumigation area.

ProFume is packaged as a liquid under pressure and requires a heat source for conversion of the liquid to a gas during introduction. The heat source can be the air around the introduction site or mechanical heat exchanging systems.

The introduction system must:

- Prevent breakdown or contamination of ProFume
- Confine ProFume until it is released into the fumigation area
- Prevent liquid sulfuryl fluoride from contacting surfaces which could be damaged or the commodity within the fumigation area
- Prevent a fog-out in the fumigation area. A fog-out is substantial condensation of moisture inside a fumigated structure that is caused by the air temperature dropping below the dew point.

Damage to materials can occur if the rate of ProFume release exceeds fan capacity. Use electric fan(s) to facilitate forced distribution and aeration of other dead air spaces and rapid dispersion of the gas.

ProFume must be introduced from the cylinder through a suitable leak-proof delivery system (hoses, connectors, gauges, solenoids, etc.) with a minimum burst pressure of 500 psi. It is recommended to:

- Release the fumigant into a large open space.
- Direct the fumigant into the blast of air from a fan(s) having a capacity of at least 1000 cu ft per minute per pound of ProFume released per minute.
- Introduce no more than 4 cylinders per introduction site.
- Have one introduction site per every 75,000 cu ft.

SELECTION AND USE OF EQUIPMENT FOR FUMIGANT INTRODUCTION

Weighing the Fumigant

Either platform or hanging scales can be used to weigh the ProFume cylinder during fumigant introduction. If hanging scales are used, hanging bonnets or cylinder slings must be used to hang the cylinder from the scale. Consult the ProFume distributor or Douglas Products for a source of hanging bonnets. Scales should be routinely calibrated to assure correct readings. Refer to the scale manufacturer for calibration and maintenance details.

The cylinder should never be suspended by the valve!

Hoses
Release the fumigant through a suitable leak-proof hose with a minimum burst pressure of 3450 kPa (500 psi). The hose should be flexible, kink resistant, durable and compatible with liquid ProFume. Prior to use, confirm with distributor or manufacturer that the introduction hose meets the above requirements.

The ProFume introduction rate is mostly controlled by the inside diameter and the length (resistance) of the fumigant introduction hose. Flow rates can be easily calculated using the ProFume Fumiguide.

Protective Sheeting
Protective sheeting, such as polyethylene plastic, can be placed under the hose and fan to further protect floors and other materials during application from potential moisture condensation.

Securing Introduction Hose
A widely used method is to securely attach the introduction hose to a tarp clamp and then use the tarp clamp to attach the hose to the fan cage. The fan cage is angled upward at about 45°. Another option is to attach the fumigant introduction hose to a solid heavy object in front of a fan angled upward at 45°. If the introduction hoses are part of a permanent introduction system, be sure to inspect the hoses prior to each use to ensure they are securely mounted and still in required working order.

Fog-Outs

A cloud of fine droplets suspended in air near the ground is called fog. It is very important when introducing ProFume to prevent excessive fog and dew formation. Releasing ProFume will cause some condensation near the release point - slow release rate and low humidity will cause less and a fast release rate and high humidity will cause more. After the condensation forms, it will evaporate at a rate that is dependent on the relative humidity, the temperature of the fumigation atmosphere, and the air mixing rate controlled by the introduction fans. Condensation forming on the photoelectric eye of a smoke detector or motion detector can cause the alarm to activate. It is very important to use proper fans to help mix the heat of the building and fumigation atmosphere to evaporate the condensation. Liquid water absorbs the very small amount of impurities in ProFume and can result in corrosion.

Fog-Out Prevention
There are several options to reduce the incidence of moisture condensation when fumigating air-conditioned structures in hot, humid weather:

1. Let structure warm a day or two before fumigation to equalize inside and outside temperature and stabilize the Relative Humidity (RH).
2. Reduce the introduction rate with a smaller diameter hose, longer hose, or pulsed (interrupted) introduction.
3. Reduce the amount of ProFume introduced into one area by using multiple introduction sites. This would be most important in high-dosage fumigations.
4. Use multiple fans or larger fans to hasten the mixing of air and heat exchange.
5. Monitor the fumigation or extend the exposure period to reduce the overall fumigant requirements, if practical.
6. When necessary, use a combination of several of these techniques to reduce the release rate and relative humidity, and increase the heat exchange of the structure to the fumigation atmosphere. The ProFume Fumiguide takes into consideration fan capacity to recommend the fumigant introduction rate.
7. Do not tarp or seal a space that is excessively wet.

Fumigated Space Leak Detection and Mitigation

During release of ProFume, the fumigator must monitor around the perimeter of the fumigation area (especially downwind) with a leak detector with sufficient sensitivity to ensure a good seal so that ProFume concentrations are kept within acceptable levels ($\leq$1 ppm) outside of the fumigation area. An SCBA must be readily available during the fumigant introduction period in case of leaks.

Detectors such as TIF 5750 and XP-1 manufactured by TIF Instruments, Inc., Miami, Florida, can detect ProFume concentrations over 50 ppm. These devices can only be used to check cylinders for significant leaks. A device capable of measuring to 1 ppm of ProFume must be used for all other tasks.

If ProFume is detected >1 ppm, then clear the area of all personnel. Only persons wearing a self-contained breathing apparatus (SCBA) with full facemask and operating in pressure demand mode or its equivalent are permitted in the area to address the leak. Only after ProFume levels are $\leq$1 ppm are unprotected personnel permitted in the area.

Large leaks must be minimized as quickly as possible to help avoid risk of exposure to bystanders and/or occupants of nearby structures and to minimize loss of fumigant. This involves walking around the structure or fumigated area with a monitoring device to determine if excessive amounts of fumigant are escaping. Proper respiratory protection must be worn when sealing leaks. Seal leaks from the exterior of the structure whenever possible. If it is necessary to seal a leak from the interior of the structure, the applicator must follow all proper reentry procedures.

Reentry Procedures

If reentry into a fumigated area is necessary after introduction of the fumigant, but before complete aeration, to troubleshoot distribution of the fumigant or repair leaks, follow the reentry procedures specified in Chapter 8.

CALCULATING DOSAGE

Establishing the Required Dosage

The fumigator is challenged with the task of distributing and maintaining a concentration of fumigant over the fumigation period to achieve the target dosage. Because of the multitude of factors, no two fumigations are identical. To specify a single dosage rate for all conditions would seldom be correct — usually it would be either excessive or insufficient for expected pest control.

ProFume Fumiguide

The ProFume Fumiguide is used for all fumigations using ProFume. See directions for details and specific use. Do not use this product without the ProFume Fumiguide. The ProFume Fumiguide is part of the labeling for this product and must be used to calculate the dosage. The ProFume Fumiguide program may be modified and updated from time to time; please contact your Douglas Products representative for current information.

Precision Fumigation Defined

Precision Fumigation is not a new concept; however, most fumigators have lacked the tools to consistently plan and conduct precision fumigations. **Precision Fumigation can be defined as "Optimizing fumigant use to maximize efficiency and minimize risk."**

Precision Fumigation Concepts

ProFume use allows fumigators to use their skills, knowledge, and experience to create and implement successful, flexible fumigations. Precision Fumigation methods:

- Allow fumigation when/how necessary
- Capitalize on enhanced sealing methods
- Maximize exposure time
- Utilize temperature modification

Fumigant Dosage

All fumigants utilize some form of the dosage relationship which is often referred to as the "CT Concept":

Dosage = Concentration (C) X Time (T)
or
D = C x T (CT)

Therefore, the dosage required to kill the target pest(s) is accumulated over a period of time and is measured in ounce-hours or gram-hours.

CT = oz-h/1000 cu ft

The concentration in oz/1000 cu ft of fumigant multiplied by the exposure time in hours

The maximum target concentration in the ProFume Fumiguide is 128 oz/1000 cu ft.

The maximum target dosage for all normal atmospheric pressure (NAP) fumigations is 1500 CT (1500 oz-h/1000 cu ft).

For vacuum chamber fumigations, the maximum target concentration is 128 oz/1000 cu ft,
and the maximum target dosage is 200 CT (200 oz-h/1000 cu ft).

ProFume Concentration Units
1 oz/1000 cu ft = 240 ppm

FUMIGANT DOSAGE FACTORS

The proper dosage for efficacy and the total amount of ProFume needed for a fumigation is determined by four interrelated factors:

1. Pest species and life stages
2. Temperature at the site of infestation
3. Exposure time
4. Half-Loss Time (HLT)

Pest Factor

ProFume is effective on all key stored product insect pest species and can control all life stages of insects. However, different pest species and life stages require different dosages for effective control. Adult, larval, and pupal stages are controlled with relatively low dosages of ProFume, while the egg stage requires higher dosages.

Several rodent pests such as rats and mice may infest commodities and sites, and damage materials within facilities. The temperature restriction of 40°F for insect fumigation does not apply to rodents because they are warm blooded. The target dosage for rodents is 36 oz-h/1000 cu ft.

Temperature Factor

Temperature is an important factor for successful fumigation. Insects are cold-blooded, so increasing temperature increases insect metabolism. Increasing insect metabolism greatly improves the efficacy of ProFume. Increasing temperature can decrease exposure time and/or gas needed. Relatively large changes in temperature are generally not required. Achieving temperatures of 25 to 30°C (78 to 86°F), for example, can have a very positive effect on fumigation efficacy and efficiency.

Fumigators can use the following methods for increasing temperature of the fumigated space. Permanent/built-in systems utilizing hot water, steam, electric, fossil, solar heat sources. Temporary/leased units operating on propane or natural gas, electric, or other fuels can be used. Fans, heater fans and other electrical equipment should be grounded and have a good protective fusable or breaker system. Planning fumigations during the warmer seasons or even during the warmer periods of the day can positively affect temperature factor.

Do not apply ProFume for <u>insect</u> control when the temperature of the site of the pests is below 40°F.

The measured minimum temperature at the site of the insect pest should be used for dosage calculations.

For rodents, temperature does not affect dosage because they are warm blooded.

Time Factor (T)

The time factor is a key component of C x T = Dosage formula. The exposure time is defined as the number of hours the target insect is exposed to the fumigant. If the structure has good gas confinement, increasing the exposure period is one of the most cost effective practices available to the fumigator. Doubling exposure time in a well-sealed structure can decrease gas needed by up to 50%. The fumigator should work with the customer to plan and optimize exposure time to minimize the fumigant needed.

Increase time = Decrease gas needed
Decrease time = Increase gas needed

Half Loss Time (HLT)

HLT is the measurement of how well a fumigated space or area holds fumigant from loss. HLT is defined as the time in hours during which 50% of the initial concentration of fumigant is lost. Research has shown fumigant retention is often extremely variable between and even among areas within a structure. Results from numerous measurements for ProFume indicate the main influencing factors are:

1. Condition of seal (wall construction, number and size of leaks, etc.).
2. Type of underseal (slab, soil, wood).
3. Volume of structure (ratio of surface area to volume).
4. Wind velocity.
5. Number of windows and doors and other openings such as pipes, vents, racks, etc.

If the HLT >20 hours for structures, the seal is considered very good. The HLT is calculated by actively monitoring the fumigation with a Fumiscope or similar device over a period of time and determining the specific loss of gas in that time period. To get a reasonably accurate picture of the HLT in a large structure, monitoring points should be established throughout the building. This ensures that each area or compartment of the structure will achieve the required dosage. The ProFume Fumiguide will calculate an HLT by area using the collected monitoring data.

Under conditions of rapid fumigant loss (low HLT), only the initial hours of exposure significantly accumulate dosage. If the HLT is significantly shorter than expected (fumigant leaking drastically faster than planned), to achieve the required dosage, the fumigator must take additional steps. These steps include, but are not limited to, stopping the addition of fumigant and addressing the leak (following reentry procedures if there is a need to reenter or wearing SCBA if working from outside), before increasing the ProFume gas concentration, increasing the time of exposure, or utilizing a combination of the two methods.

Best practice is to use monitoring data, from previous fumigations for this or similar sites and conditions to estimate the HLT, and then monitor to confirm the true HLT. When a reasonable estimate of HLT is not available prior to the initiation of exposure, the following Precision Fumigation method should be used. Introduce part of the calculated dosage of ProFume, monitoring to determine the actual HLT, and then introduce additional ProFume and/or increase exposure time to achieve the target dosage.

USING THE PROFUME FUMIGUIDE PROGRAM

The ProFume Fumiguide is a computer-based program that requires entry of key information to determine the dosage and amount of ProFume to be used. Before the ProFume Fumiguide Program can be used, contact your Douglas Products representative for how to activate the computer program for calculating dosage. The ProFume Fumiguide Program may be modified and updated from time to time; please contact your Douglas Products representative for more information.

The ProFume Fumiguide has been developed to allow fumigators to calculate the correct dosage over a broad range of pest species, life stages, temperatures, and exposure times. The ProFume Fumiguide determines the necessary dosage (gram-hours or ounce-hours), converts this to pounds of ProFume per 1000 cubic feet (or cubic meter) based on volume of fumigated space for all target pests referenced in this Manual. The program also can calculate the necessary adjustments to the exposure period or pounds of ProFume required to reach the target dosage based on fumigation monitoring data.

The maximum target <u>concentration</u> in the ProFume Fumiguide is 128 oz/1000 cu ft.

The maximum target <u>dosage</u> for NAP fumigation in the ProFume Fumiguide is 1500 CT (oz-h/1000 cu ft).

ProFume Fumiguide Temperature Range

This Manual states that the lower fumigation temperature limit is 40°F for insects. At present, however, the ProFume Fumiguide calculates specific dosages for temperatures between 68°F (20°C) and 86°F (30°C).

The ProFume Fumiguide allows the user to input temperatures higher than 86°F, but will calculate the dosage based on 86°F. Since the efficacy of ProFume increases with temperature, the ProFume Fumiguide dosages for temperatures higher than 86°F are conservative.

The ProFume Fumiguide allows the user to input temperatures below 68°F, but will calculate the dosage based on 68°F and provide a warning message that insect control may be less than optimal due to the cooler temperature and decreased insect metabolism. Following the fumigation, monitoring the pest population is recommended to assess control.

ProFume Fumiguide Exposure Time Range

The ProFume Fumiguide allows the user to input exposure times between 1 and 168 hours. Short exposures of a few hours are best suited for vacuum fumigations, while exposure periods of several days can be appropriate for reasonably sealed structures. Fumigations will commonly be 24 hours due to the need to limit shutdown time, but extending the exposure time can decrease the amount of fumigant necessary. Use the ProFume Fumiguide to determine the most appropriate exposure time to meet both the customer's and fumigator's needs.

ProFume Fumiguide HLT Range

The ProFume Fumiguide accepts HLTs from 1 to 1000 hours. The fumigator estimates this value prior to the fumigation preferably based on results of monitoring previous fumigations of this structure, or of fumigations conducted under similar conditions. HLTs of greater than 50 hours are normally achieved only in chambers and other tightly sealed silos. Change HLTs in the ProFume Fumiguide to see the impact of HLT on the amount of fumigant needed for a fumigation.

ProFume Fumiguide Area Volume Range

The ProFume Fumiguide calculates fumigant dosages for structures ranging in volume from 35 to 10,000,000 cu ft. Errors in measuring the volume can lead to underdosing and not achieving the target dosage, or using more fumigant than is needed to achieve the target dosage.

ProFume Fumiguide Ranges

Temperature	68 to 86°F
HLT	1 to 1000 hours
Exposure Time	1 to 168 hours
Volume	35 to 10,000,000 cu ft
Dosage	"Low" or "High"
Fumigation Type	"Space" or "Commodity"
Pressure Type	"Normal Atmospheric" or "Vacuum"

Limits

Dosage (CT)	1500 oz-h/1000 cu ft (NAP)
	200 oz-h/1000 cu ft (vacuum)
Concentration	128 oz/1000 cu ft

ProFume Fumiguide Example

Input

Species	Red Flour Beetle
Temperature	86ºF
HLT	15 hours
Exposure Time	24 hours
Volume	800,000 cu ft
Dosage	Low
Fumigation Type	Space
Pressure Type	Normal Atmospheric

Output

Dosage (CT)	338 oz-h/1000 cu ft
Concentration	23.3 oz/1000 cu ft
Quantity	1164 lb

Steps of Operation

Preparation prior to fumigant release:

1. Determine pest species and life stages to be controlled.
2. Measure temperature at pest location with a thermometer. (ProFume Fumiguide operates in both English (ºF) and metric (ºC) units.)
3. Calculate volume of fumigation space.
4. Determine the targeted exposure period.
5. Estimate the HLT based on previous experience or estimation.
6. In the ProFume Fumiguide, calculate dosage of ProFume in oz per 1000 cu ft (or gm/m^3) and get lb (or kg) of ProFume needed for the job.

Sequential Fumigations

Sequential fumigations are an alternative dosage strategy that may be used to control insect infestations. Fumigate once at the low dosage, which is sufficient for control of the post-embryonic (larva, pupa, adult) stages, plus a significant portion of the eggs. If there are any surviving insect eggs, then after they have hatched, but prior to their maturation and deposition of new eggs, fumigate a second time, again at the low dosage. When sequential fumigations are done, do not exceed the maximum cumulative target dosage of 1500 CT (1500 oz-h/1000 cu ft) for the target commodity.

Using the ProFume Fumiguide When Monitoring

During the exposure period, the concentration of ProFume can be measured by a Fumiscope or similar device. After the fumigant concentration has reached equilibrium, measurements taken over an interval of time will give the actual loss rate from which the HLT can be determined. Use of the ProFume Fumiguide during monitored fumigations has shown that significant quantities of ProFume can be saved compared to unmonitored fumigations and better control achieved. Refer to the ProFume Fumiguide help file for specific directions on how to use this program.

The ProFume Fumiguide is designed to determine actual HLT based on measurements of ProFume concentrations during fumigation.

Monitoring to Determine Status and Updated Dosing Recommendations

1. Measure (with a gas measuring instrument such as a Fumiscope or similar device) concentration of ProFume oz/1000 cu ft (gm/m^3).
2. After one or more hours, take a second measurement of concentration of ProFume. Accuracy of HLT increases as time between monitoring intervals is increased.
3. The ProFume Fumiguide will calculate the actual measured HLT.
4. If the HLT is shorter than estimated (more rapid loss of fumigant), then either more ProFume needs to be added to finish on time or the exposure time may be extended if sufficient ProFume is present. The ProFume Fumiguide will provide these time and "add gas" recommendations.

MONITORING PROFUME GAS FUMIGANT 7

Monitoring discussed within this chapter refers to measuring accumulated dosage and does not refer to required monitoring for worker and bystander exposure.

Monitoring fumigant concentration at key places in the fumigated environment is recommended because it can provide important information to the fumigator regarding the placement of fumigant introduction sites that will assist in the efficiency and success of future fumigations. Thus, in addition to helping maximize efficiency of a large fumigation, monitoring fumigant concentration can serve as a learning experience for the fumigator. For instance, if equilibrium is not achieved quickly, the fumigator can consider placing additional introduction sites or fans in the next fumigation.

Measurement of the accumulated ProFume concentration while the fumigation is in progress becomes increasingly valuable as the structure size, complexity, and the repercussions of poor pest control increase.

The objective of monitoring fumigant concentration are:

1. To allow the ProFume Fumiguide to determine the optimal amount of ProFume needed to control the target pests under the actual fumigation conditions.
2. To allow the ProFume Fumiguide to calculate CT (dosage) needed and achieved to ensure a successful fumigation.
3. To allow the ProFume Fumiguide to calculate the actual HLT vs. just estimating the HLT.
4. To create a reasonable history of Fumiguide file records so that enhanced Precision Fumigation techniques can be built upon in subsequent fumigations.

SPECIFIC GUIDELINES FOR MONITORING A TYPICAL FUMIGATION

ProFume should be circulated so as to reach equilibrium rapidly, ideally within an hour of introduction. The time for HLT determination starts only after equilibrium of ProFume has been established.

1. Monitor ProFume in spaces most representative of the atmosphere in which insects will be located within the structure. In larger jobs, more sampling points may be necessary.
2. In structures with partitions or poor air circulation, samples should be taken from the separate sections, such as each floor of multiple story structures or each room in a partitioned building.
3. Measurements should be as dependable and accurate as possible, especially when low concentrations are involved.
4. The time required between measurements to determine the HLT will depend on the estimated HLT or past history of the structure.

Monitoring Hoses

Arrangements should be made to place sampling hoses in the structure prior to fumigant introduction. Semi-rigid vinyl hoses (3 to 6 mm or 1/8" to 1/2" ID) should be placed so as to sample representative concentrations with a Fumiscope or similar device. Monitoring hoses larger than 6 mm ID may take a longer time to pull the sample from the fumigated space to the monitoring device because of the larger volume of air needed to be moved.

Adequate tubing must be connected to the Fumiscope or similar device to direct all of the ProFume exhausted from the unit back into the enclosure or structure to prevent exposure to the fumigant.

AERATION, CLEARING, AND REENTRY 8

Two persons trained in the use of this product, at least one being an applicator certified by the state, must be present on site at all times during introduction of the fumigant, reentry prior to aeration, initiation of the aeration procedure, when testing for reentry after aeration (if aerated in an enclosed space) and during reentry.

After fumigation, it is essential no occupant reenter the structure until the fumigant has been aerated and the space has been fully tested and cleared for reentry.

One of the features of ProFume for structural fumigation is its capacity to rapidly diffuse into the sites of the pests. Then, when the confinement seals are removed, aeration is also typically rapid. Fans are excellent aids in attaining quick aeration and are essential where cross ventilation is poor. The "opening" of a fumigation should be carried out with care to minimize crew and bystander exposure to ProFume.

Prior to aeration, fumigators need to take into account the proximity to bystanders, location of other structures, wind speed and direction.

AERATION – RECOMMENDED PRACTICES

Successful, timely, and safe aerations following fumigations must be planned. The following five recommended practices always should be factored into the fumigation prior to fumigant introduction:

Minimize concentrations at end of exposure period: The lower the concentration of fumigant at the end of the exposure period, the easier and more timely the aeration process will be. By using Precision Fumigation techniques, the fumigator can minimize the amount of fumigant introduced, maximize its efficiency, and maximize the accumulated dosage (CT).

Aerate at the highest point practical: By aerating at the highest point on the structure, the highest concentrations of fumigant are directed away from workers and bystanders and are allowed to quickly dilute to levels <1 ppm.

Direct aeration gases upward: Aeration in an upward manner also directs fumigant away from workers and bystanders and, by using additional fans, acts to further dilute the fumigant to safe levels. In many cases, a permanent exhaust system that forcefully directs the air column upward or emits it through a stack would aid in the efficiency and safety of the aeration process.

Control the exhaust rate: The exhaust rate during the aeration process should be controlled to ensure large volumes of fumigant laden air have time to disperse, thus minimizing the risk of bystander exposure to concentrations >1 ppm. Many structures have air handling systems that can easily achieve a total air exchange within the facility in a very short period of time.

Monitor to ensure worker and bystander exposure levels are not exceeded: The perimeter of the fumigation area, especially downwind, must be monitored to ensure that ProFume concentrations are kept within acceptable levels outside the fumigation area.

FACTORS INFLUENCING AERATION TIME

Five factors affect the time needed for aeration:

1. Rate of air exchange
2. Fumigant concentration
3. Sorbtion/desorbtion and diffusion rate
4. Temperature
5. Interior layout of the structure

Rate of Air Exchange

The most important factor in aeration is the rate of air exchange in a structure. The air exchange rate will be influenced by openings in the external walls (windows, vents, door, etc.), wind velocity, size and arrangement of the structure. The most effective, practical method to increase the rate of aeration is to increase cross ventilation by opening doors and windows. Fans are also useful for this purpose as a means of establishing a directed airflow through the structure in which fresh air is introduced and air inside the structure is exhausted/ventilated as efficiently as possible.

Terminal Fumigant Concentration

The amount of fumigant left in a structure at the end of the fumigation period can vary greatly. All other factors being equal, the greater the terminal concentration, the longer the time required to complete aeration. Thus, good planning and monitoring to ensure only the necessary amount of ProFume is introduced can decrease the aeration period.

Load Factor — Sorption, Desorption and Diffusion

The "load factor" can be expressed as the amount of materials fumigated that will adsorb or absorb the fumigant. ProFume has relatively low sorbtive characteristics, meaning it has a low potential to stick to or react with fumigated materials.

The sorption that does occur, however, can affect aeration in some situations. Desorbing fumigant can slow the time to reach safe reentry levels of $\leq$1 ppm in the breathing zones. Often, the greatest amount of ProFume to be desorbed is associated with the commodities.

The sorption/desorption phenomenon is a function of fumigant concentration and temperature — the higher the concentration throughout the fumigation, the greater the driving force for sorption and, therefore, the higher the quantity to be desorbed. As with sorption, desorption initially occurs very rapidly. Most of the fumigant will desorb during the initial part of the aeration period in response to the immediate lowered concentration inside the structure when seal is broken.

Temperature

Temperature has a direct effect on the clearance rate of a fumigant. The higher the temperature, the faster the rate of gas diffusion and desorption.

HANDLING UNAERATED COMMODITIES

Transfer of an unaerated commodity to a new storage site within a facility prior to complete aeration is permissible; however, transfer of unaerated containers or truck trailers over public roads is prohibited. Also, railcars cannot be moved off site until aerated.

While handling unaerated commodities, people must not be exposed to ProFume in excess of permitted exposure levels.

Transfer of incompletely aerated commodity via bulk handling equipment such as augers, drag conveyors and conveyor belts to a new site is permissible. However, the new storage must have proper placarding and adequate security if it contains >1 ppm of ProFume. Workers who handle incompletely aerated commodity must be informed and appropriate safety measures must be taken (i.e., ventilation and respiratory protection) to prevent exposures from exceeding 1 ppm.

CLEARANCE AND REENTRY

Reentry Procedures

Before aeration, if reentry into an area under fumigation is required for any reason, the following procedures must be strictly adhered to:

1. **Before reentry, measure the concentration of ProFume using a sufficiently sensitive device to adequately prepare for worker safety.**
2. **A minimum of two persons, one an applicator certified by the state and others being trained in the use of this product, must be present on site to reenter an area under fumigation for initiating aeration or trouble shooting and testing for concentration of the fumigant after aeration before releasing for reoccupation.**
3. **The person before entering must be wearing a self-contained breathing apparatus (SCBA) with full facemask and operating in pressure demand mode or its equivalent.**
4. **Other appropriate worker protective equipment must be worn by all workers at the site depending upon the site and the type of work being done.**
5. **Notify authorities, emergency personnel and other required personnel if reentry is done under emergency conditions (see Chapter 9, FMP).**

No one shall be in fumigated areas if the level of ProFume is >1 ppm in the breathing zones unless wearing a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air supplied/SCBA respirator, such as manufactured by Draeger, Ranger, Survivair, Scott, or MSA. Only a detection device of sufficient sensitivity, such as the INTERSCAN gas analyzer [Model GF 1900] or MIRAN vapor analyzer [SapphIRe], can be used to confirm a concentration of ProFume of $\leq$1 ppm.

Reoccupancy

Do not allow reoccupancy of any fumigated area until the aeration and clearing process is complete according to directions and ProFume levels do not exceed 1 ppm as determined by the use of a detection device with sufficient sensitivity.

Following the aeration period, the fumigator must test the breathing spaces in the space or structure to make certain that the concentration of ProFume is $\leq$1 ppm before allowing re-occupation of the structure.

Follow all federal, state, and local requirements for reoccupancy.

PROFUME FUMIGATION MANAGEMENT PLAN (FMP)..... 9

The certified applicator is responsible for working with the owners and/or responsible employees of the site to be fumigated to develop an FMP. The FMP is intended to ensure a safe and effective fumigation. Critical components of a ProFume fumigation include the ProFume Fumiguide Program and the documentation it creates and the Precision Fumigation™ Techniques. The FMP must address characterization of the site and appropriate monitoring and notification requirements consistent with, but not limited to, the following:

1. Inspect the site to determine its suitability for fumigation.

2. When sealing is required, consult previous records for any changes to the structure, potential leaks and monitoring of occupied and adjacent buildings.

3. Consult with company officials (whose area or commodity is fumigated) and appropriate employees, prior to each fumigation, for any existing FMPs, MSDS, Applicator's Manual and other relevant safety procedures.

4. Consult company officials in the development of procedures and appropriate safety measures for nearby workers and public personnel who will be in and around the area during fumigation and aeration.

5. Consult with company officials to develop an appropriate exterior monitoring plan that will confirm that nearby workers and bystanders are not exposed to levels above the allowed limits during application, fumigation and aeration. This plan must also demonstrate that nearby residents will not be exposed to concentrations above the allowable limits.

6. Consult with company officials to develop procedures for local authorities to notify nearby residents in the event of an emergency.

7. Confirm the placement of warning placards around the fumigation site as described in this Manual.

8. Confirm the required safety equipment (including that required for entry into an area under fumigation) is in place and the necessary manpower is available to complete a safe, effective fumigation.

GUIDANCE FOR PREPARATION OF AN FMP

An FMP is an organized, documented description of the steps involved to help ensure a safe, legal, and effective fumigation. The Fumiguide supports the creation of documentation needed to satisfy a ProFume FMP. The Fumiguide and the FMP will assist you and others in complying with pesticide product label requirements. The guidance that follows is designed to help assist you in addressing all the necessary factors involved in preparing for and fumigating a site. This guidance is intended to help you organize any fumigation that you might perform **prior to actual treatment**. It is meant to be somewhat prescriptive, yet flexible enough to allow the experience and expertise of the fumigator to make changes based on circumstances which may exist in the field. Precision Fumigation techniques support this flexible and adaptive approach. By following a step-by-step procedure, yet allowing for flexibility, safe and effective fumigation can be performed. Before any fumigation begins, carefully read and review the label and the Applicator's Manual. This information must be given to the appropriate company officials (supervisors, foreman, safety officer, etc.) in charge of the site. Preparation is the key to any successful fumigation. If you do not find specific instructions for the type of fumigation that you are to perform listed in this guidance document, you will want to construct a similar set of procedures using this document as your guide or contact Douglas Products for assistance and/or additional resources. Finally, before any fumigation begins you must be familiar with and comply with all applicable federal, state and local laws. The success and future of fumigation are not only dependent on your

ability to do your job, but also by carefully following all rules, regulations, and procedures required by governmental agencies.

Checklist Guide for an FMP

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

A. Preliminary Planning and Preparation

1. Determine the purpose of the fumigation and record in the Fumiguide.
   a. Control of insect infestation
   b. Control of rodent infestation
   c. Plant pest quarantine
2. Determine the type of fumigation and record in Fumiguide. For example
   a. Space: tarp, mill, warehouse, food plant, railcar or ship (when fumigating vessels such as ships read the U.S. Coast Guard Regulations 46 CFR 147A, in addition to the Applicator's Manual)
   b. Commodity: raw agricultural or processed foods
3. Fully acquaint yourself with the site and commodity to be fumigated, and record the following in the Fumiguide when necessary
   a. In conjunction with the owner/operator/person in charge, take note of the general structure layout, structure construction (materials, design, age, maintenance), fire or combustibility hazards, connecting structures, other significant fumigant escape routes, and other unique hazards or structure characteristics.
   b. The number and identification of persons who will routinely enter the proximate area fumigated (i.e., employees, visitors, customer, etc.)
   c. The specific commodity to be fumigated
   d. The previous treatment history of the commodity, if available
   e. Accessibility of utility service connections.
   f. Nearest telephone or other means of communication, and note the location of these items
   g. Emergency shut-off stations for electricity water and gas. Note the location of these items
   h. Location and number of fans, introduction sites, and monitoring lines
   i. Current emergency telephone numbers of local health, fire, police, hospital and physician responders.
   j. Name and phone number (both day and night) of appropriate company officials.
   k. Location of command center
   l. Review labeling, including the Applicator's Manual
   m. Location of cylinders
   n. Cylinder temperature or pressure
   o. Introduction line: length, inside diameter, and burst pressure
   p. Fan capacity (i.e., cu ft/min)
   q. Record and calculate dosage in the Fumiguide
      (1) Cubic footage or other appropriate space/location calculations
      (2) Estimated HLT
      (3) Temperature
      (4) Exposure time
      (5) Target pest
      (6) Whether the low, high, or user-defined CT was used and the resultant CT target value
      (7) Initial, additional and total amount of fumigant used
      (8) Time of introduction and, if any, times of introduction of add gas applied
      (9) Actual CT achieved

B. Personnel

1. Confirm that all relevant personnel in and around the structure to be fumigated have been notified prior to application of the fumigant. Consider using a checklist that each employee initials indicating they have been notified.
2. Instruct all relevant fumigation personnel to read the Applicator's Manual about the hazards that may be encountered and about the selection of personal protection devices, including sufficiently sensitive detection equipment.

3. Confirm that all personnel are aware of and know how to proceed in case of an emergency situation.
4. Instruct all relevant personnel on how to report any accident and/or incidents related to fumigant exposure. Provide a telephone number for emergency response reporting.
5. Instruct all personnel to report to proper authorities any theft of fumigant and/or equipment related to fumigation.
6. Establish a meeting area for all personnel in case of emergency.

C. Monitoring

1. Safety
   a. Monitoring of ProFume conditions must be conducted in areas to prevent excessive exposure and bystander exposure.
   b. Keep a log or manual of monitoring records for each fumigation site. This log must at a minimum contain the timing, number of readings taken, location, and level of concentrations found.
   c. When monitoring, document even if there is no ProFume present above the safe levels. In such cases, subsequent monitoring is not routinely required. However, spot checks must be made occasionally, especially if conditions significantly change.
   d. Monitoring must be conducted during aeration and corrective action taken if gas levels exceed the allowed levels in an area where bystanders and/or nearby residents or domestic animals may be exposed.
2. Efficacy
   a. ProFume readings should be taken from within the fumigated structure to insure proper gas concentrations. The Fumiguide's analysis of these readings must be used as a basis for any decisions to add gas and the determination of subsequent amounts needed.
   b. All ProFume readings must be recorded in the Fumiguide.
   c. Readings should be of sufficient nature to reasonably determine HLT and, thus, identify whether any significant unforeseen leaks are occurring.

D. Notification

1. Confirm the appropriate local authorities (fire departments, police departments, etc.) have been notified as per label instructions, local ordinances, or instructions of the client.
2. Prepare written procedure ("Emergency Response Plan") that contains explicit instructions, names, and telephone numbers so as to be able to notify local authorities if ProFume levels are exceeded in an area that could be dangerous to bystanders and/or domestic animals.

E. Sealing Procedures

1. Sealing must be adequate to control the pests. Care should be taken to ensure that sealing materials will remain adequately intact until the fumigation is complete.
2. If the site has been fumigated before, review the previous FMP and/or Fumiguide files for previous sealing and HLT information.
3. Make sure that construction/remodeling has not changed the building in a manner that will materially effect the fumigation.
4. Warning placards must be placed on all entrances and all sides of the fumigation site.

F. Application Procedures and Fumigation Period

1. Plan carefully and apply the product in accordance with the label requirements.
2. Two persons trained in the use of the product, at least one being an applicator certified by the state, must be present on site at all times during the introduction of the fumigant, reentry prior to aeration, initiation of the aeration procedure, when testing for reentry after aeration (if aerated in an enclosed space) and during reentry.
3. Apply fumigant from the outside when and where appropriate.
4. Provide watchmen when entry into the fumigation site by unauthorized persons cannot otherwise be assured (e.g., by secondary locks, barricades, etc.).
5. When entering structures, always follow OSHA rules for confined spaces.
6. Keep the flexibility and record keeping function of the Fumiguide in mind - it will provide a basis for improved understanding and thus safer fumigation application in the future.

a. If the Fumiguide calculated CT is achieved early, the fumigation can be ended early.
b. If additional time is necessary, use the Fumiguide to calculate how much time is needed.
c. If it is necessary to add gas, use the Fumiguide to calculate how much additional gas is required.

G. Post-Application Operations

1. Provide watchmen when you cannot otherwise secure the fumigation site from entry (e.g., by secondary locks, barricades, etc.) by unauthorized persons during the aeration process.
2. Determine gas concentration in the fumigated environment from outside if possible. Use a sufficiently sensitive gas detector before reentry into a fumigated structure to determine fumigant concentration.
3. Turn on ventilating or aerating fans where appropriate.
4. Ventilate and aerate in accordance with structural limitations and nearby occupied areas so as to minimize bystander exposure.
5. Consider temperature when aerating.
6. Determine gas concentration in the surrounding area if required.
7. Remove warning placards when aeration is complete and the fumigated space has been cleared for reentry using a detection device of sufficient sensitivity.
8. Inform business/client that employees/other persons may return to work or otherwise be allowed to reenter the aerated structure.
9. Keep records of monitoring of gas concentration inside (efficacy readings) and outside (safety readings) the fumigation environment to document completion of aeration.

KEY CONSIDERATIONS FOR FUMIGATING STORAGE FACILITIES, TRANSPORT VEHICLES AND PROCESSING PLANTS

Follow all local, state and federal regulations covering the fumigation of vehicles and processing plants.

Stationary vs. In-Transit

Empty and loaded containers, trucks, railcars, surface ships, and other transport vehicles or vessels may be fumigated in essentially the same way as other storage facilities. However, in-transit fumigation (including aeration) of any vehicle is prohibited on public roads or waterways. Nevertheless, stationary vehicles under fumigation may be moved within the confines of the fumigation site if necessary. Special care must be given while moving a stationary vehicle or vessel under fumigation so as to prevent exposure to bystanders or workers to levels of ProFume $\geq$1 ppm. Vehicles and vessels successfully moved must have proper placarding and adequate security. Workers who handle incompletely aerated commodity must be informed and appropriate safety measures must be taken (i.e., ventilation and respiratory protection) to prevent exposures from exceeding 1 ppm. Moving vehicles while under fumigation on the fumigation site may result in loss of fumigant and, therefore, potentially less effective fumigation.

Selection of Fumigation Location

The size and configuration of the space and the adequacy of the circulation will dictate the placement and number of release sites for ProFume in a stationary vehicle or vessel. Careful planning must be made for fumigant introduction in railcars, shipping containers, and trailers. Prevent liquid ProFume from contacting any part of the vehicle or contents as it can damage paint or tarnish metals. Railcars, shipping containers, and trailers must be placed in a location appropriate for conducting fumigation. The location should be away from other work areas in a secured place.

Sealing the Vehicle or Vessel

Stationary vehicles should be prepared and sealed following general fumigation using tarpaulin and tape.

Seal vessels using tarping, taping, and other methods specific for ships to confine ProFume to the fumigation area.

Securing the Vehicle or Vessel

After the fumigation site has been selected, railcars and trailers should be moved into position and secured by setting the brakes and blocking the wheels so that the vehicle will not move during the fumigation and aeration periods.

When fumigating vessels, place warning signs at all entrances and secure the fumigated space. Only certified applicator and trained workers involved in the fumigation, wearing appropriate personal protective equipment, may be at the site during fumigation and aeration.

Follow label instructions for securing entrances and posting warning signs on fumigated spaces and structures.

Fumigation of Surface Ships and Vessels in Port

Because of its physical properties, ProFume is ideally suited to control pest infestations in surface ships. Its high volatility allows the gas to penetrate into all areas of the vessel very quickly, control the pest, and aerate rapidly. However, due to its lack of warning properties and high inhalation toxicity, ProFume

must not be used to fumigate ships or other vessels while they are in use. People and desirable plants or pets must not remain on board during the fumigation.

Surface ships and barges may be fumigated with ProFume, but all aeration procedures must be completed before these vessels are allowed to sail. The vessel must not be moved during the fumigation and aeration periods. If reentry is necessary before aeration is completed, strictly follow reentry procedures (see Chapter 8). Only those persons involved in the fumigation may be at the fumigation site, including during the aeration process. **Note:** Submarines and other below-the-surface ships must not be treated with ProFume.

Except for those persons involved in the fumigation, no people, desirable plants, or pets may be on board during fumigation. The professional fumigator and the ship's captain (or owner) shall follow all applicable regulations including those listed in the Coast Guard, DOT, Title 46, Shipping, section Parts 147A.1-147A.43. Since the codes listed are for fumigants in general, do not use procedures that are not permissible for ProFume as directed by label instructions and regulations.

If conditions of high relative humidity exist in the vessel during fumigation, great care should be exercised to use the proper sized fan and shooting hose to avoid overshooting the fan capacity, thereby causing a "fog out" in the vessel and possibly tarnishing and staining.

Vehicle (Trailers, Containers, Railcars, etc.) Aeration

Aerate the vehicle using active ventilation methods. To help ensure workers and bystanders are not exposed to concentrations that exceed exposure levels for reentry, to the extent possible, control the ventilation process using the recommended practices procedures described in this Manual (Chapter 7), monitor concentrations of ProFume around the fumigated ship and/or prohibit entry into the area in question. At the end of the aeration time when the vehicle has been cleared for reentry, the warning signs should be removed, the chocks removed from the wheels, and the vehicle put back into service. In-transit fumigation and aeration of railcars and other transportation vehicles are not permitted.

Surface Ship Aeration

Only those persons involved in the fumigation may be at the present fumigation site until the site is cleared for reoccupancy. In-transit aeration of ships is not permitted. Ships must be aerated and cleared for reentry prior to being reoccupied. Aerate the ship using active ventilation methods to ventilate the bulk of the fumigant from the ship. To help ensure workers and bystanders are not exposed to concentrations that exceed exposure levels for reentry, to the extent possible, control the ventilation process using the recommended practices procedures in this Manual (Chapter 7), monitor concentrations of ProFume around the fumigated ship, and/or prohibit entry into the area in question.

PREPARATION FOR CHAMBER OR STACK FUMIGATION

Safety precautions and ProFume fumigation procedures vary by whether the chamber or stack is outside or within another structure.

Before any chamber or stack is fumigated, it is appropriate to:

1. Determine the correct dosage (concentration x time = ounce-hours) to control the designated pest under the specific treatment conditions.
2. Confirm that the chamber or stack and any accessory equipment perform as intended.
3. Determine that ProFume will be confined within the chamber or stack by making a test run and monitoring for leaks with appropriate equipment. Pressure testing can also indicate the gas confinement capabilities of the chamber.
4. Have on hand proper respiratory protection equipment (SCBA) and personnel trained in how to properly use it.

5. Train personnel in the proper handling of the ProFume cylinders.
6. Educate personnel in first aid procedures to be followed should an accident occur and personnel be exposed to ProFume.
7. Notify other appropriate individuals that ProFume fumigations will be taking place: Company employees other than those performing the fumigations such as security patrols, janitors, etc., police and fire department personnel and others required by local, state and federal laws.

Chambers and Stacks Within Structures

Permanent Chambers
Fumigations with ProFume may be conducted in permanent fumigation chambers enclosed within a larger structure. A permanent chamber is defined as a durable hard-walled structure engineered specifically for fumigation that effectively confines ProFume.

Monitor indoor areas around the permanent fumigation chamber for concentrations of ProFume during the fumigation, especially during introduction. No one is permitted to be in an area where the concentration is >1 ppm without proper respiratory protection (SCBA). It is advisable to position the chamber away from work areas.

Loading: Chambers and stacks should be loaded so that adequate air movement can occur around commodities to allow even distribution of the gas.

Circulation Fan(s): A shooting fan/circulation fan is recommended when introducing ProFume. A small circulating fan inside the chamber will provide a gentle movement of air adequate to achieve even gas distribution throughout the chamber. However, if a large open space is not available, or if use of an introduction fan is dangerous or impractical, an introduction/circulation fan is not required. If a fan is not used, ensure introduction will not result in a fog-out within the fumigation chamber. Slow introduction rates (1 to 4 lb per minute) are recommended to prevent excessive cooling of air near the introduction site. Do not apply liquid fumigant directly onto food commodities. Another recommendation is to increase the number of introduction sites.

Without circulation fans, reaching equilibrium will be delayed or may not be achieved. Thus, insect control may not be achieved throughout the chamber and aeration will be slowed since ventilation will be lessened.

Testing Seal Effectiveness: Fittings for conducting pressure tests and for monitoring lines during fumigation should be incorporated in the chamber.

Vacuum Chambers
Vacuum fumigations often require a lower use rate than normal atmospheric fumigations. Do not exceed 200 oz-h/1000 cu ft.

Vacuum fumigations can be conducted in vacuum chambers located within an enclosed structure without considering the entire structure as being under fumigation.

Placarding: Post warning signs at all entrances to the vacuum chamber.

Introduction: ProFume should be released from outside the building. If ProFume is released into the vacuum chamber from within the enclosing structure, then the occupied area must be monitored to ensure the ProFume concentration does not exceed 1 ppm.

Worker Exposure Monitoring: The area surrounding the vacuum chamber should be frequently monitored for ProFume concentrations to ensure that occupants and workers are not exposed above 1 ppm. Special care should be taken to monitor during introduction to ensure that the introduction lines and cylinder connections are not leaking.

If any leak resulting in detectable levels >1ppm is encountered during application, immediately clear the area of all personnel not wearing an SCBA. Only persons who are wearing an SCBA are permitted in the area to address the leak. Only after the level of ProFume has dropped $\leq$1 ppm are unprotected personnel permitted to enter the area.

Aeration: Aerate the vacuum chamber following instructions above for vacuum chamber fumigations outside structures.

If reentry is necessary before aeration is completed, strictly follow reentry procedures (see Chapter 8).

Tarped-Stacks
ProFume may be used to fumigate stacked commodities by covering the commodity with highly fumigant-resistant tarpaulins and then sealing them to the subsurface to create a temporary fumigation chamber (tarped-stack).

All personnel not trained or not involved in the fumigation must be vacated from the immediate area in which the tarped-stack fumigation is occurring until the fumigation is completed and the immediate area has been cleared for reentry.

The indoor areas around the tarped stack must be monitored for concentrations of ProFume when fumigation workers, without proper respiratory protection (SCBA), are present within the structure. Perform air monitoring by utilizing a detection device with sufficient sensitivity such as an INTERSCAN gas analyzer [Model GF 1900] or MIRAN vapor analyzer [SapphIRe] to ensure that workers are not exposed to concentrations of ProFume exceeding 1 ppm. No one is permitted to be in an area where the concentration is >1 ppm without proper respiratory protection (SCBA).

Placarding: Post warning signs to all sides of the structure that encloses the stack. For a tarped-stack, post all sides of the stack as well as all entrances and sides of the building.

Occupancy: All personnel not trained or involved in execution of the fumigation are not permitted within the immediate area of the tarped stack during the fumigation.

Securing the Enclosing Structure: When the fumigation workers are not present at the fumigation site, the enclosing structure must be secured from entry by anyone other than the certified fumigator or persons under his/her direct supervision.

Worker Exposure Monitoring: Workers and bystanders should not be exposed above 1 ppm ProFume. When fumigation workers are present within the enclosing structure during the fumigation, frequently monitor with a detection device of sufficient sensitivity to measure at the 1 ppm level. Immediately vacate the area, or use proper respiratory protection (SCBA), if the concentration of ProFume exceeds 1 ppm. Utilize ventilation procedures to reduce ProFume below 1 ppm prior to allowing reentry without an SCBA.

Introduction: ProFume should be released from outside the building. If ProFume is released into the tarped-stack from within the enclosing structure, then the occupied area must be monitored to ensure the ProFume concentration does not exceed 1 ppm.

If any leak resulting in detectable levels >1ppm is encountered during application, immediately clear the area of all personnel not wearing an SCBA. Only persons who are wearing an SCBA are permitted in the area to address the leak. Only after the level of ProFume has dropped below 1 ppm are unprotected personnel permitted to enter the area.

Aeration: Aeration should be designed to exhaust fumigant from the enclosing structure to ensure that workers and bystanders are not exposed to levels above 1 ppm.

Chambers/Stacks Outside of Structures

Atmospheric Pressure Chambers

Design and Construction: A suitable atmospheric fumigation chamber consists of a sufficiently gas-tight room with an appropriate door. An application system, exhaust blower and a small fan for even gas distribution are recommended.

Placarding: The applicator must post all entrances and all sides of the chamber (if accessible) to be fumigated with warning signs.

Introducing Fumigant: Release ProFume from the cylinder placed outside the chamber through an introduction system (introduction lines, connectors, etc.) with a minimum 500 psi burst pressure rating. A small fan should be used to distribute the gas uniformly within the chamber. Monitoring gas concentrations within the chamber can confirm the distribution of gas within the chamber.

Dosage Monitoring: Monitoring gas concentrations within the chamber during the exposure period with a Fumiscope or similar device is recommended to confirm HLT, describe gas distribution throughout the chamber, and ensure the target dosage is achieved. Recommended monitoring site locations include one at high, medium, and low heights and in the front, middle and back of the chamber.

Exhaust Fan(s): The size of the exhaust blower will depend on the size of the fumigation chamber and the aeration time requirements. Generally, a fan capable of changing the air in the chamber in 5 to 10 minutes is recommended. The chamber must exhaust ProFume outside the building and away from adjoining buildings or work areas. Consult your state agency for emission control requirements.

Vacuum Chambers
Vacuum chambers require special designs which take into account the vacuum pressure exerted on the materials of construction. For this reason, it is recommended that trained engineers be consulted before constructing a vacuum chamber. Follow all directions given by the manufacturer or design engineer.

Vacuum fumigations often require a lower use rate than normal atmospheric fumigations. Do not exceed 200 oz-h/1000 cu ft.

Specially built steel chambers for vacuum fumigations provide the fastest and most effective fumigation. After the commodity is placed in the chamber, pumps evacuate air. ProFume is introduced and rapidly penetrates all space previously occupied by air. A lethal dosage of ProFume results when the proper concentration is maintained for the required fumigation period. With the sustained concentration (no leakage) and a vacuum of 25 to 27 inches Hg, the time of exposure and the dosage may be reduced for some insects and life stages.

Placarding: The applicator must post all entrances and all sides of the chamber (if accessible) to be fumigated with warning signs.

Drawing a Vacuum: A vacuum of 25 to 27 inches of mercury is commonly drawn for vacuum fumigations. Check to ensure that the vacuum is maintained according to plan. Unplanned vacuum release indicates leakage. Note that some vacuum fumigations are planned to allow release of the vacuum during exposure with the objective of improving penetration of the commodity as air enters the chamber.

Introducing Fumigant: Because of the special design of vacuum chambers, it is recommended that the manufacturer or design engineer's operation procedure be followed. Release ProFume from the cylinder placed outside the chamber through an introduction system (introduction lines, connectors, etc.) with a minimum 500 psi burst pressure rating. A small fan can be used to distribute the gas uniformly in the chamber if the vacuum is to be maintained throughout the exposure period.

Dosage Monitoring: The Fumiscope or similar device <u>cannot</u> be used to measure ProFume during a vacuum fumigation unless the vacuum is released. If the vacuum is maintained, and thus no gas is leaking from chamber, the achieved dosage (CT) can be calculated by using the simple Concentration x Time formula.

Aeration Procedures: At the end of the exposure, release the vacuum, ensuring any exhaust does not expose workers or bystanders above the permissible exposure limit. It is recommended to purge the chamber of air/fumigant 2 times by pulling a partial vacuum prior to checking the gas concentration for reentry purposes. Aeration of ProFume is very rapid, but desorption can occur for a longer period of time.

Manage the aeration process (location, exhaust rate and direction) to ensure that workers and bystanders are not exposed to levels >1 ppm.

Always check for the concentration of ProFume with a suitable detector before entering the chamber without proper respiratory protection (SCBA). Keep the exhaust fans running during the aeration period and also while unloading the chamber. Remove the warning signs when aeration has been completed and it has been determined that the area is safe to enter.

Tarped-Stacks
Fumigations may be conducted in temporary chambers created using tarpaulins or other gas impermeable sheeting as the "walls" to hold in the fumigant. These are sometimes called "stack fumigations." The following instructions pertain to fumigation of tarped-stacks located outside other structures.

The items should be placed on a sufficiently airtight foundation, such as another tarp or on concrete, and covered with a fumigation tarp to ensure a tight seal. The tarp over the items should be supported so as to create a gas expansion dome. The edge of the tarp on the foundation must be sealed either by weighting the edges with sand or water "snakes" or equivalent.

Tarp fumigations should be conducted out of doors or in a building that will not be occupied during fumigation and aeration periods.

Placarding: All entrances and all sides of the fumigated environment and any connected area not monitored must have warning signs.

Dosage Monitoring: Monitoring gas concentrations within the tarped-stack during the exposure period with a Fumiscope or similar device is recommended to confirm HLT, describe gas distribution throughout the stack, and ensure the target dosage is achieved. Recommended monitoring site locations include one at high, medium, and low heights and in the front, middle and back of the stack.

Aeration: Best practices for aeration of tarped-stacks involves setting up a chimney system that will ventilate from the highest point of the stack in an upward direction at a rate that will not lead to workers or bystanders being exposed to levels >1 ppm.

STORED BULK COMMODITY FUMIGATION (e.g., SILOS, etc.)

In many commodity storage situations, the amount of open space for introducing ProFume is limited compared to the total volume of the structure. It may not be possible to use shooting fans and release methods that are recommended for space fumigations.

Because of limited free air volume and lower air movement, fumigators can best adjust by slowing the introduction rate by using smaller diameter shooting hoses and/or extending the hose length.

If the fumigant is released directly into the headspace of a storage structure, care should be taken to avoid contact of liquid fumigant and the commodity. Sufficient air circulation should be provided to prevent moisture condensation in the introduction area.

It is strongly recommended that recirculation systems (portable or built-in) be used to rapidly and evenly distribute ProFume throughout the space being treated. Existing aeration blowers that are vented to the outside should not be used.

Procedures for Fumigating Bulk Commodities

1. Follow instructions in this Manual regarding sealing, securing, placarding, and aeration/clearing.
2. Seal and secure the storage structure.
3. Determine the ProFume target dosage and quantity of fumigant needed using the ProFume Fumiguide.
4. Make adjustments to the dosage based on the fumigant monitoring results and ProFume Fumiguide recommendations for achieving target dosages.
5. Determine where the fumigant will be released.
6. Best practice is to introduce fumigant directly into the air stream of a recirculation system. This may either be inside the storage structure or directly into the ducting of the system. If the fumigant is released into the recirculation system, it should be down stream of the fan itself.
7. In almost all cases fumigant introduction rates should be slower than for space fumigations of similar volumes to provide time for the fumigant to penetrate the grain mass and not establish high fumigant concentrations in the introduction space.
8. In the event that a recirculation system is not available, the fumigant should be released into the headspace above the commodity. Care should be taken to prevent contact of liquid fumigant with the commodity.
9. Air circulation should be started prior to fumigant introduction and continued during introduction to aid in ProFume penetration into the commodity mass. High concentrations in the introduction space can result in excessive fumigant loss via leakage before the fumigant penetrates evenly into commodity mass.
10. After introducing the initial amount of fumigant to reach the targeted dosage, gas concentrations should be monitored periodically. Any adjustments in terms of amount of fumigant or exposure time should be made based on the ProFume Fumiguide status recommendations.

Bulk Commodity Aeration

1. Prior to the initiation of fumigation procedures, equipment should be put in place for a safe aeration.
2. The fumigant laden air should be vented from the highest practical point of the storage structure slow enough to not exceed exposure limits.
3. If available, aeration blowers can be used to rapidly exhaust remaining fumigant so long as these do not vent in areas where workers or bystanders might be affected.
4. SCBA equipment must be worn if workers must enter the fumigated space to initiate aeration or levels in the breathing zone exceed 1 ppm.
5. The storage facility should be finally aerated to $\leq$1 ppm.
6. The area or site must be monitored to ensure that liberation of fumigant from the treated commodity does not result in the development of unacceptable levels of ProFume. Do not allow reentry into treated areas by any person before this time without proper respiratory protection.
7. Actively aerate commodity a minimum of 24 hours prior to offering to consumers.

Mills and Food Processing Facilities

For mills and food processing facilities, special consideration should be given to help ensure workers and bystanders are not exposed to concentrations that exceed exposure levels for reentry. To the extent possible, control the ventilation process using the recommended procedures described in this Manual (Chapter 7), monitor concentrations of ProFume around the fumigated site, and/or prohibit entry into the area in question. Precautions to help protect accidental bystander exposure to ProFume in excess of 1 ppm can be of particular importance because of the sometimes proximate location of residential structures and bystanders that can occasionally occur around mills and food processing facilities. Special care should be taken to minimize quantities of processed foods prior to space fumigations. Processed food not practical to remove prior to fumigation may undergo incidental fumigation with ProFume. However, no direct fumigation of processed foods is permitted unless the processed food is specifically listed in the section Commodities That Can Be Fumigated.

ProFume in the gaseous phase is a very slightly reactive chemical compared to other fumigants such as methyl bromide, hydrocyanic acid (HCN), or acrylonitrile.

CYLINDERS

Valve Problems

ProFume cylinders are fitted with special valves that are appropriate for use with ProFume. These valves can be damaged if the wrong size wrench is used. A 25 to 30 cm adjustable wrench should be used to open or close these valves.

Stuck Valve — Never use excessive force to open a stuck valve. If a valve will not open using normal force, return the cylinder to your ProFume distributor.

Leaking Valve — Make sure the valve is completely shut off; however, do not use excessive force. Reopening and then closing can usually properly seal the valve and stop the leak. If the valve continues to leak, often tightening the packing nut on the top of the valve to 25 to 30 foot pounds of torque with an adjustable wrench will stop the leak.

If the valve still leaks, move the cylinder to an isolated, secured area and allow the cylinder to continue to vent to the air. Be sure to keep people away from the area. When all the gas has escaped, replace the bonnet and identify faulty cylinders by painting the cylinder shoulders red and tagging the cylinder describing the problem in detail. Return the cylinder to your ProFume distributor so it may be sent to Douglas Products for repairs.

Dip Tubes

A broken dip tube rarely is the reason liquid ProFume cannot be moved out of the cylinder when the valve is wide open. Sharp blows to the cylinder, rough handling, or dropping the cylinder can break off the dip tube from the bottom of the valve. If the dip tube is broken, ProFume will be released from the cylinder, but at a much slower rate. Either introduce the ProFume slowly or replace the bonnet and call your distributor for instructions on cylinder return procedures.

Leaking Cylinders

Leaking may occur if cylinders receive rough handling. Abrasion on the side of the cylinder may produce pinholes in the metal.

Always identify faulty cylinders, valves, and dip tube by painting the cylinder shoulders red. Attach red tag describing the problem in detail. Return cylinders to your distributor.

CORROSION OF METALS

ProFume is not known to cause any corrosion when it is in the vapor (gaseous) phase under normal temperatures. Every batch of ProFume is tested for metal corrosion before being released for sale.

Metal surfaces of copper, silver, steel, stainless steel, brass, aluminum, etc., may become corroded or rusted if ProFume is released *incorrectly*. If ProFume is introduced too rapidly, the temperature of the air will drop below the dew point resulting in the formation of condensation.

Condensation generally occurs in or near the area of ProFume introduction. Minute quantities of acids (by-products of the manufacturing process) are soluble in water condensation and can etch metal surfaces. The fumigant introduction rate should not exceed the fan capacity (1 kg ProFume per 60

m^3/minute of fan capacity) to thoroughly mix the colder air when ProFume is introduced into the warmer air in the structure.

Metal tarnishing/corrosion can also occur if heat sources are left on during fumigation. ProFume is decomposed by heat from flames such as pilot lights in furnaces, stoves, dryers, or refrigerators and such glowing heat sources as electric heaters. Heat sources above 400°C (752°F) decompose ProFume to corrosive materials (mainly HF). Therefore, it is imperative that pilot lights and other heat sources which pose this risk be eliminated or turned off during fumigations.

Damage to metals can also occur from the inclusion in the fumigated space of chlorine generators. These pieces of equipment should either be turned off or excluded from the fumigation.

Damage to metals can usually be corrected by cleaning the metal items with a good metal cleanser or polish. The corrosion or rust is usually only on the surface.

GLASS ETCHING

ProFume in the gaseous phase is not known to cause etching of glass. HF, the decomposition product of ProFume, may react with ceramic material such as window glass, china, glazed tile, etc., creating a condition referred to as "etching" or "frosting." Therefore, it is *imperative* that all heat sources which produce temperatures at or near 752°F and pilot lights be turned off during fumigation. Fog-outs can also cause etching of glass and ceramic tile. Each batch of ProFume is also tested for glass etching before it leaves the production plant.

RUN STAINS

ProFume in the gaseous phase is not known to cause staining of fabrics, walls, paintings, etc. Staining, however, can be caused by the presence of liquid water (dew or fog) caused by exceeding the capacity of the fan to mix cold air when ProFume is introduced with the air in the structure. A condition can occur when condensation forms on the interior and/or exterior surfaces of the structures and a "sticky" light to dark brown liquid (from grease, dirt, and smoke) runs down wall surfaces. This may have the appearance in color and consistency of cola. Spots also may form on the bottom side of horizontal surfaces. Most stains can be removed by washing.

Condensation forming and running down vertical surfaces can occur even without the introduction of ProFume. A structure that is air conditioned to a much lower temperature than the air temperature and then opened to introduce hot humid outside air will form condensation on cold surfaces such as heavy brass. This condition can be avoided by either warming the structure slowly prior to sealing or waiting until all seals are in place before opening windows and doors to avoid introducing outside air.

STAINING

ProFume in the vapor phase does not cause staining or discoloration of fabric or other materials normally found in a structure under fumigation. Fabric staining or color changes can occur when a high heat source (i.e., pilot light) converts ProFume to SO_2 and other corrosive materials. Many fabric dyes are acid or base indicators and will change color in the presence of acids or bases.

For staining caused by frosting of the fumigant introduction hose, see Fumigant Introduction Hose Freezing, below.

FUMIGANT INTRODUCTION HOSE FREEZING

When ProFume is introduced according to label directions, the introduction hose will not freeze and the liquid will change to a gas at the end of the hose. The use of the proper size fumigant introduction hose is important. Initially, slowly open the valve a quarter to one-half turn to begin the flow of liquid ProFume. Then, open valve to one full turn or full flow through the hose. If the liquid changes to a gas

within the hose, frost will collect along the length of the hose and water damage can occur to floors, furniture, etc., where the hose rests. Also, ProFume may change from a liquid to a gas in a hose with kinks. This can cause freeze damage from either frost accumulating on the outside of the hose, or the hose becoming brittle, breaking and splashing liquid ProFume on surfaces. Replace kinked or damaged hoses. Use mesh-reinforced, flexible hosing of proper specifications to avoid this problem.

During release of ProFume from the cylinder, some chilling of the valves, cylinder, and fumigant introduction hoses can occur under normal circumstances. Valves can freeze if ProFume is allowed to change from a liquid to a gas within the valve area. Valve freezing is usually caused by using an improper fumigant introduction hose connector.

Carpeting and floors can be damaged if cylinders, fans and hoses are allowed to rest upon them. When this could pose a problem, plastic or other protective material should be placed under the fumigant introduction hoses and fans.

PLANT AND TURF DAMAGE

ProFume is quite toxic to most plants and they should be protected from the fumigant; however, plants should not be used as an indicator of the success or failure of a fumigation. Plants should be removed from inside the fumigation site. Structural foundation plantings of ornamental shrubs and trees can be protected to a certain degree from the gas by wetting the soil, thereby sealing off the gas from the plant root system. Water is an excellent barrier and ProFume will not readily move through moist soil.

Certain plants have been found to be more sensitive to ProFume than others. These include junipers, some dwarf palms, springeri fern, orchids, and Lily grasses (*Liriope* spp. and *Ophiopogon* spp.), which are commonly used as border plantings. Special attention should be given to these plants during fumigation and the initiation of aeration to reduce the exposure to ProFume. Plants that have been moved should be placed in a similar environment to that where they were being grown — same temperature, light, humidity, etc.

ODOR PROBLEMS

Odors can also be caused by the decomposition of dead animals. Occasionally animals such as rats or mice are trapped inside the fumigation site and killed during the fumigation. Many times they die in inaccessible areas within the structure and cannot be easily removed.

POOR CONTROL OF PESTS

Poor control of the target pest is caused by not generating the target CT (Concentration x Time) for the temperature to kill the pest. Accumulation of target CT does not begin until the fumigant is uniformly mixed throughout the site (reached equilibrium). Many factors may contribute to insufficient CT accumulation.

1. Confinement of fumigant, primarily ground seal or tarps, is worse than estimated.
2. Inaccurate monitoring device.
3. Too short an exposure period (insufficient CT).
4. Using the wrong dosage (insufficient oz/hrs).
5. Not using adequate fans to distribute the gas properly within the site.
6. Not accurately determining the temperature of the pest site.
7. Error in calculating volume to be fumigated.
8. High winds which can cause excessive loss of gas.
9. Target pest excluded from exposure to fumigant by some gas inhibiting barrier.

Latent Mortality

Sometimes live insects may be found immediately after fumigation. Under optimum or favorable conditions, the target pest will be dead or obviously dying by the end of the fumigation period. Researchers have evaluated eventual mortality of several stages of key postharvest pests following exposure to ProFume. Latent mortality in insects occurs for exposures very near mortality threshold levels. Within a species, the latent mortality period for the egg stage is generally longer and more variable than other life stages.

Non-Target Organisms

Signs of activity of live non-target organisms (organisms which are not specific targets of the fumigation) found within the fumigated space does not mean the fumigation failed to control the target pests.

Consider the following:

- Lethal dosage requirements vary for different organisms and may be higher for non-target organisms than for the target pest.
- The organism may have received a toxic dosage and will eventually die (latent mortality).
- The non-target organism may have entered the structure during the aeration period.

Therefore, judgment of the success or failure of the fumigation should not be made on the presence of live organisms immediately following the fumigation.

PLASTICS

Liquid ProFume can be a solvent of some plastic materials. ProFume should not be introduced directly onto plastic surfaces, such as windows, as liquid droplets may discolor or etch the material.

MISCELLANEOUS

White Powder Left as Residue: A white powder substance found on windows, tile, glass, lamps, etc., indicates that a source of heat (pilot lights, etc.) was left on during the fumigation.

APPENDIX..... 12

ENGLISH-METRIC CONVERSION TABLES

Temperature
(°C x 1.8) + 32 = °F
(°F – 32) ÷ 1.8 = °C

°F	°C
104	40
102	39
100	38
98	37
96	36
94	35
92	34
90	33
88	32
86	31
84	30
82	29
80	28
78	27
76	26
74	25
72	24
70	23
68	22
66	21
64	20
62	19
60	18
58	17
56	16
54	15
52	14
50	13
48	12
46	11
44	10
42	9
40	8
38	7
36	6
34	5
32	4
	3
	2
	1
	0

Volume
1 ft^3 = 0.0283 m^3
1 m^3 = 35.31 ft^3

m^3	ft^3
1	35.3
10	353
25	706
50	1,765
75	2,647
100	3,530
200	7,060
300	10,590
400	14,120
500	17,650
600	21,180
700	24,710
800	28,240
900	31,770
1,000	35,300
1,500	52,950
2,000	70,600
3,000	105,900
4,000	141,200
5,000	176,500
6,000	211,800
7,000	247,100
8,000	282,400
9,000	317,700
10,000	353,000
20,000	706,000
30,000	1,057,000
40,000	1,412,000
50,000	1,765,000
100,000	3,530,000

DOSAGE

oz-hr/1000 ft^3 ≈ gm-hr/m^3

Wind Speed
1.609 kph = 1 mph
0.621 = 1 kph

kmph	mph
50	31
48	30
46	29
44	28
42	27
40	26
38	25
36	24
34	23
32	22
30	21
28	20
26	19
24	18
22	17
20	16
18	15
16	14
14	13
12	12
10	11
8	10
6	9
4	8
2	7
0	6
	5
	4
	3
	2
	1
	0

PRESSURE

1 PSI ≈ 6.9 Kpa ≈ 0.689 bar

1 bar ≈ 100 Kpa ≈ 14.50 PSI

GLOSSARY TERMS USED IN FUMIGATION

ACTIVE AERATION: Aeration that is not passive. Any increased aeration as a result of human intervention or process.

ACTIVE INGREDIENT: Components of a pesticide that control the target pest and is responsible for the pesticidal effect.

ACUTE INHALATION TOXICITY: Immediate poisoning from a single elevated inhalation exposure to a substance; causes injury or death from a single exposure.

ACUTE ORAL TOXICITY: Immediate poisoning from a single oral elevated ingestion exposure to a substance; causes injury or death from a single exposure.

ACUTE TOXICITY: A rapid response, often within minutes or hours, to a single exposure or dose of a chemical.

ADSORBTION/ABSORBTION = SORPTION: The action of a material in holding a gas or substance. The opposite of desorption.

AERATE: Exchange fumigant-laden air with fresh air until the concentration of fumigant has reached the permitted entry level.

AERATION: The final step of a fumigation that involves proper ventilation and clearance of ProFume from the structure.

AMERICAN CONFERENCE FOR GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH): The professional organization of governmental industrial hygienists which establishes annual recommended guideline threshold limit values (TLVs) for lifetime noise, radiation and chemical occupational exposures for eight hours per day, 40 hours per week.

ANTIDOTE: A remedy that counteracts the effects of a poison.

ARTHROPOD: Any segmented invertebrate of the phylum Arthropoda, having jointed legs.

ATMOSPHERE: A mass or body of gases that are present in a region or place.

AXIAL FLOW FAN: A fan in which the air flows through the impeller and casing is primarily axial. The impeller is contained within a cylinder housing (AMCA Publication 211).

BOILING POINT (BP): The temperature at which a liquid converts from liquid phase into a gas (the temperature at which the vapor pressure in a liquid equals the external pressure).

BONNET: The cap that covers the valve and safety cap on the fumigant cylinder to protect the valving system from damage and prevent accidental release of the fumigant.

CARCINOGENICITY: Possessing the power, ability or tendency to produce or incite cancer in a living tissue.

CENTRAL NERVOUS SYSTEM (CNS) DEPRESSION: An alteration of level of consciousness that proceeds other changes in vital and neurologic signs.

CERTIFIED APPLICATOR: Member of a fumigation crew who has successfully completed the proper training and is approved by the State and the manufacturer to release the fumigant.

CIRCULATION: Mechanically stir or circulate the fumigation atmosphere.

CLAMPS: Devices used to attach tarps together and hold them in place during a fumigation.

CLEARING: The procedure following the aeration period when the fumigator tests the breathing space in the structure with sensitive equipment to make certain the concentration of ProFume is 1 ppm or less before allowing re-occupancy.

CONCENTRATION: Amount of fumigant per unit area within the fumigated space during exposure period. Usually measured in ounces per 1000 cubic feet or grams per cubic meter.

CONDENSATION: The change of a vapor or gas into a liquid.

CUBIC FEET PER MINUTE (CFM): Often used as a rating system for the amount of air a fan can move.

CYLINDER SLING: A type of holster or suspension ring used to suspend a fumigant cylinder.

DESORPTION: The liberation or removal of a fumigant substance from other substances.

DEW POINT: The temperature at which water will condense from air (the temperature at which dew forms).

DEW POINT DEPRESSION: The number of degrees the temperature must be lowered for dew (water condensation form air) to form.

DIP TUBE: A PVC tube that extends from the bottom of the cylinder to the valve on the top that releases liquid ProFume.

DISPERSE: Distribute the fumigant throughout the fumigation site.

DIFFUSION: The spontaneous process whereby a fumigant moves from an area of high concentration toward an area of lower concentration.

DOSAGE: The number of ounce-hours (gram-hours) accumulated during the exposure period. Target dosage is the ounce-hours targeted during the planning phase.

DOSE: The amount of fumigant introduced into the fumigation space — oz/1000 cubic feet (gm/cubic meter). Often confused with dosage.

DRIERITE: The hygroscopic material used in the Fumiscope unit to remove moisture from the air. Drierite in good condition is normally blue in color.

EQUILIBRIUM: The state when all the sulfuryl fluoride molecules are at equal concentrations from each other in a confined area.

EXPOSURE TIME: The amount of time a fumigant is confined in a structure to kill the target pest.

°F/°C: Working temperature. Usually the temperature of the closest spots insect pests are located. Usually expressed in degrees Fahrenheit or Celsius. In the case of chamber fumigations, the internal temperature of the commodities to be fumigated (i.e., site of pest).

FACE SHIELD: One of two pieces of safety equipment permitted to protect the eyes required when releasing the fumigant (see goggles).

FLASH POINT: The temperature at which vapor explodes.

FLUOROSIS: A mottling or blackening of the teeth caused by an overexposure to fluorine.

FOG: Very fine droplets of liquid moisture in air.

FOG-OUT: The condensation of moisture inside a fumigated structure which is caused by a large drop in air temperature. Methods to prevent a fog-out include: (1) using the proper inside diameter and length of the introduction hose, and (2) using appropriate fans with sufficient velocity to effectively mix the warmer air inside the structure with the colder ProFume gas.

FUMIGANT INTRODUCTION: Release of the fumigant from its containers into the fumigation space.

FUMISCOPE: A thermal conductivity analyzer used to monitor the concentration of ProFume during a fumigation. Measures in ounces per 1000 cubic feet or gm per cubic meter. The Fumiscope is not for monitoring for human exposure.

GAS: Matter in vapor state. That fluid form of matter which is compressible with limits and, which owing to the relatively free movement of its molecules, diffuses readily in other like forms of matter and is capable of indefinite expansion in all directions.

GOGGLES: One of two pieces of approved safety equipment to protect the eyes required when releasing the fumigant (see face shield).

GROUND SEAL: The sealing of tarps to the ground to prevent fumigant loss during a fumigation.

HALF-LOSS TIME (HLT): The relative measure of how well a structure holds fumigant. Actual time required to lose one-half of the fumigant concentration, measured in hours. The fumigant loss rate depends on the building construction, sealing practices, wind, and fumigant distribution influences. The *actual* HLT can be established only by measuring the fumigant concentration during the exposure period with a gas measuring instrument and using the ProFume Fumiguide program.

HANGING BONNET: A type of cap or ring used to suspend the fumigant cylinder.

HEAT OF VAPORIZATION: The amount of heat necessary to change a liquid state to a gaseous state. This is usually measured in British Thermal Units (BTUs).

HEPATIC: Pertaining to the liver.

HOURS EXPOSURE (HE): The number of hours the site is exposed to the fumigant.

HYDROFLUORIC ACID: A highly reactive chemical which can corrode or damage many household effects. ProFume can decompose into hydrofluoric acid and sulfur dioxide if exposed to high heat conditions present in gas, flames or glowing electric elements.

HYDROGEN FLUORIDE: A colorless liquid made by the action of sulfuric acid on calcium fluoride. The compound is an extremely strong fluorinating agent, which attacks glass.

HYDROLYSIS: A chemical reaction that causes chemical breakdown in the presence of water.

INSIDE DIAMETER (ID): The measurement of the interior width of the fumigant introduction and monitoring hoses.

INERT INGREDIENT: Other non-pesticidal or formulating ingredients in a pesticide formulation.

INTERSCAN GAS ANALYZER: A portable analyzer designed to measure low concentrations of ProFume for worker and bystander exposure and final clearing. The Interscan provides immediate and continuous readings of gas concentrations from 1 to 50 ppm.

LATENT HEAT OF VAPORIZATION: The number of calories per mole of substance needed to change a liquid at its boiling point to a gas. For ProFume, this is 4600 cal/mole. When liquid fumigants under

pressure are released, available heat is "pulled" from the immediate surroundings as the liquid changes to a gas.

LATENT MORTALITY: The delayed kill of an organism receiving a toxic dose.

LEAK DETECTOR: Device used to detect leaks in the structure or seal during a fumigation. An example would be a TIF 5750 or XP-1 detector models.

LOAD FACTOR: The amount of material within the fumigated space. Sometimes fumigant is sorbed by materials and made unavailable for insect control.

MAXIMUM CONCENTRATION: The greatest concentration of chemical that can or is permitted to exist as a gas in a given space. The higher the maximum concentration of the fumigant, the more that can be applied in a given space.

MIRAN SapphIRe (mobile infrared analyzer): A type of clearance device used to clear a structure for re-occupancy after a fumigation. Uses infrared technology to measure down to ppm.

MOLECULAR WEIGHT: The sum of the weights of the constituent atoms of a molecule. For ProFume it is 102.07.

MONITORED FUMIGATION: Repeated observations of a fumigation during the exposure period to determine the concentration of gas at a specific location, detect gas loss over time, ensure the appropriate amount of fumigant and the exposure time, and/or to reduce potential problems or expenses.

MINE SAFETY AND HEALTH ADMINISTRATION (MSHA): This government agency is responsible for approving respiratory protection devices used in the workplace.

MUTAGENICITY: Possessing the power, ability or tendency to produce genetic changes or mutations.

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH): The U.S. government agency responsible for research regarding occupational safety and health issues in the workplace. They also approve appropriate safety equipment, such as hard hats, respirators, eye protection, etc.

NON-FLAMMABLE: Not flammable or readily ignitable.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA): Federal agency that regulates worker health and safety procedures and practices.

ODOR POTENTIAL: The possibility of malodor being generated due to the fumigant having been in contact with certain materials.

OUNCE-HOURS (OH) OR GRAM-HOURS: Dosage = concentration X hours exposure.

OVICIDAL: Possessing the ability to kill the egg stage of an insect.

PARTIAL PRESSURE (DALTON'S LAW): In any mixture of gases the total pressure is equal to the sum of the partial pressures each gas would exert were it present alone in the volume occupied by the mixture. The total pressure P is equal to the sum of the partial pressures of the individual gases.

PARTS PER MILLION (PPM): A measure of the concentration of a substance, e.g., 10 ppm = 10 drops of water in a million drops.

PERMISSIBLE EXPOSURE LIMIT (PEL): The eight-hour time weighted average acceptable inhalation exposure limit for any regulated substance in the workplace. This exposure limit is enforced by OSHA and is the law.

PENETRATION: The passage of fumigant into or through an object, such as flour, commodities, wood, tarps, soil, etc.

POSTEMBRYONIC: The larval, pupal and adult stages of insects.

POUNDS PER SQUARE INCH ABSOLUTE (PSIA): A measure of atmospheric pressure. PSIG is pounds per square inch as measured by gauge.

PULMONARY: Pertaining to, or affecting, the lungs.

PULMONARY EDEMA: The presence of abnormally large amounts of fluids in the intercellular spaces of the lungs.

REACTIVITY: The ability of the fumigant to react with (combine with or change) other compounds in which it comes into contact.

RELATIVE HUMIDITY: The ratio of the amount of water present in the air relative to the amount it could hold at 100% saturation; usually expressed in percent.

RELEASE OF FUMIGANT: The actual introduction of fumigant into the fumigation space or site.

RENAL: Relating to the kidneys.

REVOLUTIONS PER MINUTE (RPM): A measure of fan speed.

RODENTS: Any animal from the order Rodentia, such as mice and rats.

SAFETY CAP: A covering that protects the cylinder valve from damage or accidental release of the fumigant.

SAND SNAKES: Sand- or water-filled tubes made of material used to seal tarps to the ground to minimize release of the fumigant.

SCBA - POSITIVE PRESSURE: Self-contained breathing apparatus that maintains a slightly positive pressure of air inside the face piece at all times.

SECONDARY LOCKS: Securing mechanisms used during fumigation to prevent inadvertent or illegal entry to a structure under fumigation.

SHORT-TERM EXPOSURE LIMIT (STEL): The time-weighted average exposure limit for a particular compound, which should not be exceeded at any time during a work day, even if the eight hour time-weighted average is within the threshold limit value (TLV). Exposures to this level of a compound should not be longer than 15 minutes and should not occur more than four times per day. There should be 60 minutes between exposures in this range.

SOLUBILITY: The capability of being dissolved in a solvent such as water.

SORPTION: The uptake of gaseous fumigant resulting from the attraction and retention by liquid and solid materials present. If great enough, there is a gradual reduction of fumigant available to kill the target pest. Sorption may also negatively affect the penetrability of the gas.

SPECIFIC GRAVITY: The ratio of the weight of a body to that of an equal volume of some standard substance — water in the case of solids and liquids, air in the case of gases. The ratio of the mass of a **liquid** to the mass of an equal volume of water at 4°C, water = 1.

SUBCHRONIC ORAL TOXICITY: The oral toxicity of a material determined for an exposure period between an acute (24 hours) and chronic (weeks to months) in length.

SULFURYL FLUORIDE: The active ingredient of ProFume, which is non-flammable, non-corrosive and does not cause undesirable odors, is a gas at temperatures above -55°C (-67°F).

TARPAULIN: Semi-permeable membranes used during fumigation to confine the fumigant in a specific area during the exposure period.

TEMPERATURE (°C OR °F): The pesticidal activity of a fumigant varies with temperature. The dosage requirements for ProFume are based on the mean temperature of the coldest potential pest infested site in the structure. This temperature is nearly always represented by that of the subarea soil or slab. A probe or surface thermometer can be used to measure temperature. It is very important to accumulate the proper ounce-hours for the temperature that exists.

TERATOGENIC: The potential for an effect to cause congenital abnormality.

TERATOLOGY: The division of embryology and pathology that deals with abnormal development and congenital malformations.

THRESHOLD LIMIT VALUE (TLV): The time-weighted average concentration for a normal eight-hour day and 40-hour work week to which nearly all workers may be repeatedly exposed day-to-day without adverse effects.

VACUUM CHAMBER: Specially built steel chamber used for fumigation. After the material to be fumigated is placed in the chamber, air is evacuated by pumps. The fumigant is then admitted and rapidly fills all the air space previously occupied by air.

VALVE STEM: Opening at the top of the cylinder through which the fumigant is released.

VAPOR CORROSIVENESS: The tendency of the gas to corrode materials. When properly introduced, ProFume is not corrosive.

VAPOR DENSITY: The weight ratio of a gas to air.

VAPOR PRESSURE: The pressure exerted by a gas that is in equilibrium with its solid or liquid state. The higher the vapor pressure, the more easily and rapidly a fumigant will diffuse and penetrate to reach a gas-air equilibrium and the more rapidly it will aerate and desorb.

WATER SOLUBILITY: The ability of the fumigant to dissolve in water. The less soluble in water, the less that compound is attracted to and adsorbed on the surface of materials. It is also important when considering penetration of the fumigant into soil moisture.

WATER VAPOR: Water in the gaseous state.