(Container)

DOUGLAS PRODUCTS

ProFume™ Gas Fumigant

RESTRICTED

For control of the following stored product pests: Almond moth, cowpea weevil, dried bean weevil, drugstore beetle, flour beetles, granary weevil, hide beetle, Indian meal moths, Mediterranean flour moths, rice weevil, rusty grain beetle, saw-toothed grain beetles and warehouse beetles.

Fumigation sites: Cereal grain mills, associated storage facilities and food processing plants. FUMIGATION OF LISTED COMMODITIES IS PERMISSIBLE.

When fumigating, all provincial and federal rules and regulations regarding use of detection devices, positive-pressure self-contained breathing apparatus, security requirements, and placement of warning signs and other requirements under the ProFume Gas Fumigant fumigation site specific management plan must be observed.

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

READ THE LABEL, BOOKLET AND MANUAL BEFORE USING
READ THE ENTIRE LABEL, APPLICATOR'S MANUAL AND GUIDANCE FOR PREPARATION OF A FUMIGATION MANAGEMENT PLAN BEFORE USING
KEEP OUT OF REACH OF CHILDREN AND PREVENT ACCESS BY UNAUTHORIZED PERSONNEL

GUARANTEE: sulfuryl fluoride.....99.8%
PRESSURIZED PRODUCT INSECTICIDE

REGISTRATION NO. 28241 PEST CONTROL PRODUCTS ACT

LIQUID IS CORROSIVE TO EYES AND SKIN

Extremely Hazardous Liquid And Vapour Under Pressure
Inhalation Of Vapours May Be Fatal
Liquid May Cause Freeze Burns Of Exposed Skin

NET CONTENTS: 57 kg

Douglas Products and Packaging Company
1550 East Old 210 Highway
Liberty, MO 64068-9459
1-800-223-3684

PRECAUTIONS

KEEP OUT OF REACH OF CHILDREN AND PREVENT ACCES BY UNAUTHORIZED PERSONNEL
Extremely Hazardous Liquid And Vapour Under Pressure. Inhalation Of Vapours May Be Fatal.
Liquid May Cause Freeze Burns Of Exposed Skin

Do not get in eyes, on skin, or on clothing. ProFume Gas Fumigant is odourless. Exposure to toxic levels may occur without warning or detection by the user.

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

Personal Protective Equipment for Fumigation
Protective Clothing
A long-sleeved shirt and long-pants are required. Do not wear gloves or rubber boots. Do not reuse clothing or shoes that have become contaminated with liquid ProFume Gas Fumigant until thoroughly aerated and cleaned.

Respiratory Protection
If the concentration of ProFume Gas Fumigant in the fumigated area (as measured by an approved detection device with sufficient sensitivity such as INTERSCAN, Spectros ExplorIR, MIRAN gas analyzer (SapphIRe), or CLIRcheck does not exceed 1 ppm in the breathing zones, no respiratory protection is required. When this concentration is exceeded, all persons in the exposure area must wear NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air-supplied/SCBA respirator such as manufactured by Ranger, Draeger, Survivair, Scott or MSA. Before using any make or brand of SCBA, learn how to use it correctly. Determine that it has an adequate air supply for the job at hand, that it fits properly, provides an adequate seal around the face, and that it is in good working order.

All users are advised to contact Call 1-844-845-3129 or 1-352-323-3500 for medical information and the clean-up of spills. DO NOT attempt to clean up a major spill. DO NOT attempt to clean up any spill if you do not have the proper protective equipment.

For transportation emergencies, call 1-844-845-3129 or 1-352-323-3500.

FIRST AID
Take container, label or product name and Pest Control Product Registration Number with you when seeking medical attention.
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. Consult a physician or contact a poison control centre immediately.
If inhaled: Move person to fresh air. If person is not breathing, contact emergency personnel immediately, then give artificial respiration, preferably mouth-to-mouth if possible. Consult a physician or contact a poison control centre for further treatment advice.
If on skin or clothing: Immediately apply water to contaminated area of clothing before removing. Once area has thawed, remove contaminated clothing, shoes, and other items covering skin. Rinse skin immediately with plenty of water for 15-20 minutes. Consult a physician or contact a poison control centre immediately.
If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Liquid ProFume Gas Fumigant in the eye may cause damage due to refrigeration or freezing. Consult a physician or contact a poison control centre immediately.

TOXICOLOGICAL INFORMATION
No specific antidote. Employ supportive care. Treatment should be based on judgment of the physician in response to reactions of the patient.

ProFume Gas Fumigant is a gas that has no warning properties such as odour or eye irritation. Early symptoms of exposure to ProFume Gas Fumigant 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.

AGRICULTURAL CHEMICAL
Do not ship or store with food, feeds, drugs or clothing.

ENVIRONMENTAL HAZARDS
DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes. TOXIC to birds and mammals. Carefully inspect the outside and inside of the structure prior to application of the fumigant to ensure the absence of birds and mammals. Avoid application if birds or mammals are present.

STORAGE
Store in dry, cool, well ventilated area under lock and key. Post as a pesticide storage area. Store cylinders upright; secured to a rack or wall to prevent tipping. Cylinders should not be subjected to rough handling or mechanical shock such as dropping, bumping, dragging, or sliding. It is recommended to transport cylinders using hand truck or fork truck to which the cylinder can be firmly secured. Do not transport cylinders in closed vehicles where the same common airspace is occupied by personnel. When on public roads, transport securely only in an upright position.

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

When cylinder is empty, close valve, screw safety cap onto valve outlet, and replace protection bonnet before returning to supplier. Only the registrant is authorized to refill cylinders. Do not use cylinder for any other purpose. Follow registrant's instructions for return of empty or partially empty cylinders. ProFume Gas Fumigant cylinders must never be transported by aircraft.

Leak Procedures: Evacuate to a distance where the concentration of sulfuryl fluoride is below 1 ppm. 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 Ranger, Draeger, 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 [Model: GF 1900], MIRAN gas analyzer [SapphIRe], or Spectros ExplorIR.

DISPOSAL
Disposal of Container: For disposal, this container may be returned to the point of purchase (distributor/dealer). It must be refilled by the distributor/dealer with the same product. Do not reuse this container for any other purpose. See Storage for proper handling directions.

Disposal of Product: All unused product must be returned to the point of purchase (distributor/dealer).

For information on disposal of unused, unwanted product, contact the manufacturer or the provincial regulatory agency. Contact the manufacturer and the provincial regulatory agency in case of a spill, and for clean-up of spills.

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

(Booklet)

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ProFume™
Gas Fumigant

RESTRICTED

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NATURE OF RESTRICTION; Exposure to this product may be hazardous to your health. Care must be taken when handling to minimize exposure. Follow all label directions and precautions carefully. FOR USE ONLY BY PEST CONTROL OPERATORS MEETING APPLICABLE PROVINCIAL/TERRITORIAL LICENSING/CERTIFICATION REQUIREMENTS, AND WHO ARE TRAINED BY DOUGLAS PRODUCTS IN THE USE OF THIS PRODUCT. This product is accompanied by an approved label, an Applicator's Manual and Guidance for Preparation of a Fumigation Management Plan. **READ AND UNDERSTAND THE ENTIRE LABELLING.**

RESTRICTED USES

GENERAL INFORMATION
Before using, carefully read and understand all label precautions and directions. ProFume Gas Fumigant 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.

GENERAL USE PRECAUTIONS
When used for fumigation of enclosed spaces, two persons trained in the use of ProFume Gas Fumigant, at least one meeting applicable provincial/territorial licensing/certification requirements, must be present at all times during introduction of fumigant, reentry prior to aeration, and initiation of the aeration procedure. Two persons need not be present while monitoring from outside of the fumigated structure.

No one shall be in fumigated structures if the level of ProFume Gas Fumigant is above 1 ppm 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 Ranger, Survivair, Scott, or MSA. **Note: When in the fumigated area during the aeration procedure, approved respiratory protection must be worn until concentration of ProFume Gas Fumigant is confirmed not to exceed 1 ppm with an approved detection device.**

Only an approved detection device of sufficient sensitivity, such as the INTERSCAN (Model GF 1900) or MIRAN gas analyzer (SapphIRe), can be used to confirm a concentration of ProFume Gas Fumigant of 1 ppm or less. The Interscan 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 Gas Fumigant must be monitored in breathing zones. The structure or enclosure must remain posted for fumigation until cleared for reentry.

Fumigations performed by any individual fumigation worker or crew member must be separated by a 2-week interval.

Scheduled ambient air monitoring of ProFume Gas Fumigant must be conducted up to 25 m from the fumigated structure to prevent worker and bystander exposure to sustained concentrations of ProFume Gas Fumigant in excess of 1 ppm during the introduction, fumigation, and aeration phases. Air concentrations should be measured at several locations, especially downwind from the fumigated structure, noting the wind direction, and in the direction of neighbouring off-site structures, recreational areas, or areas where bystanders may be exposed.

NOTE: Air concentrations of sulfuryl fluoride are transient in nature and will decline rapidly. An evacuation action is necessary when sustained sulfuryl fluoride levels exceed 1 ppm for one hour (with no more than 5 ppm allowable for a 30 minute time frame). Air monitoring must use a detection device with sufficient sensitivity such as an Interscan, SF-ExplorIR, Miran, or

CLIRcheck. During introduction of ProFume Gas Fumigant, measure air samples outside of the facility every 30 to 60
minutes, or as needed, to ensure that sulfuryl fluoride levels do not exceed 5 ppm for more than 30 minutes, and 1 ppm for more than 60 minutes. Measure air samples outside of the facility at least once during fumigation. Measure air samples outside of the facility every 60 minutes, for a minimum of 3 hours, during the initiation of aeration.

DIRECTIONS FOR USE
READ ALL DIRECTIONS CAREFULLY BEFORE APPLYING.
Read the Profume Gas Fumigant Manual prior to completing fumigations for further Directions for Use.

Preparation for Fumigation
All persons, non-target animals, and growing plants must be removed from the space to be fumigated. When monitoring, place gas sampling lines at representative areas within the fumigated space. Use re-circulation fans as appropriate to rapidly disperse fumigant throughout the structure or enclosure.

Note: All flames, including pilot lights, must be extinguished. All electrical heating elements must be turned off or unplugged.

A structure may only be fumigated twice in one year. This product may only be used from April until October. The second structural fumigation must occur at least 15 days after the first fumigation.

Connected Areas
A connected area is defined as any area connected with the space to be fumigated by construction elements that may allow passage of fumigant between the spaces. Any connected area must be vacated during the fumigation process.

ProFume Gas Fumigant concentration levels must be measured in any connected space or structure during the fumigation. Use only an approved detection device of sufficient sensitivity, such as the INTERSCAN (Model GF 1900) or MIRAN gas analyzer (SapphIRe), to confirm a concentration of ProFume Gas Fumigant of 1 ppm or less. **Note:** Connected areas must be vacated and that area shall be considered as a fumigated space, and all applicable rules, regulations and label instructions apply, such as preparation, posting, securing, and aeration.

Posting of Fumigated Areas
The applicator must post all entrances and all sides of the structure or enclosure to be fumigated with warning signs bearing the statements:

- The signal word DANGER and the SKULL and CROSSBONES symbol in red
- The statement, "Area under fumigation, DO NOT ENTER."
- This sign may only be removed after the structure is aerated to less than a concentration of 1 ppm of fumigant.
- The date and time fumigation began and fumigation is completed.
- Name of fumigant used.
- Name, address, and telephone number of the fumigation company and licensed/certified applicator.

Post warning signs at all entrances to a fumigated area and all sides of the structure to be fumigated. Warning signs should be placed in advance of the fumigation in order to keep unauthorized persons away. Do not remove a warning sign until the treated structure is aerated down to a fumigant concentration of 1 ppm.

Only a licensed/certified applicator may authorize removal of warning signs. The warning signs may be removed only when the concentration of ProFume Gas Fumigant within the treated area is below exposure standards for reentry.

Sealing Instructions

Taped and Other Spot Sealing
For fumigation enclosures that can be adequately sealed with plastic, paper, or tape, seal adequately around doors, windows, vents, and other openings. To minimize escape of gas 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 gas.

Securing Structure Entrances
Seal and placard all exterior doors or doorways with warning signs. To secure the structure against unauthorized entry during the fumigation exposure period, use a locking device or barricade on all exterior doors or doorways. Consult provincial regulations for any supplementary instructions and local restrictions on securing against entry.

INTRODUCING THE FUMIGANT
Do not apply when temperature is below 4.4ºC. To prevent damage, do not apply liquid fumigant directly to any surface within the fumigation area.

ProFume Gas Fumigant 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. Consult the ProFume Gas Fumigant Fumigation Manual and ProFume Gas Fumigant Fumiguide for fumigant introduction options, instructions, and safety precautions. The introduction system must:

- prevent breakdown or contamination of ProFume Gas Fumigant
- confine ProFume Gas Fumigant until it is released into the fumigation area
- prevent liquid sulfuryl fluoride from contacting surfaces within the fumigation area
- prevent a fog-out in the fumigation area. A fog-out is condensation of moisture inside a fumigated structure that is caused by a large drop in air temperature.

ProFume Gas Fumigant must be introduced from the cylinder through a suitable leak-proof tube with a minimum burst pressure of 3450 kPa (500 psi). Release of the fumigant into a large open space is recommended.

Dosage and Exposure Time
The target dosage is the product of fumigant Concentration x Exposure Time (CT). However, the impact of concentration and time on control of the target pest varies and, thus, is more accurately represented by C^nT. The ProFume Gas Fumigant Fumiguide calculator uses specific C^nT formulas based on the pest, life stage, temperature, and exposure period to determine target dosages for specific fumigation scenarios. The maximum target dosage in the Fumiguide is 1500 CT with a maximum target concentration of 128 g/m^3.

The target dosage can thus be calculated by inputting into the ProFume Gas Fumigant Fumiguide the target pest, low or high dosage target, temperature, and exposure time. Then, to calculate the amount of fumigant to be introduced, input the estimated fumigant loss rate measured as half-loss time (HLT) and volume of the area to be fumigated. Based on the calculated target dosage, exposure time, HLT, and volume of the area to be fumigated, the ProFume Gas Fumigant Fumiguide will calculate the amount of ProFume Gas Fumigant to be initially introduced.

Monitoring concentrations of ProFume Gas Fumigant within the fumigated area is required for fumigation accuracy. When monitoring, take gas concentration readings from the exposure area with an approved monitoring device such as a Fumiscope (Model D). Input these monitoring results into the ProFume Gas Fumigant Fumiguide that will calculate the actual HLT. The ProFume Gas Fumigant Fumiguide will then

calculate any additional amount of fumigant and/or increase in exposure time necessary to achieve the target dosage. Add any necessary fumigant or extend fumigant exposure time to achieve the targeted dosage.

Commodities that can be fumigated

The raw agricultural and processed food commodities that may by fumigated with ProFume Gas Fumigant include:

Barley (bran, flour, grain, pearled)
Beef (dried)
Cocoa bean
Coconut (dried)
Coffee bean
Corn (grain, flour, grits and meal)
Eggs (dried)
Ham
Milk, powdered
Oat (grain, flour, rolled)
Popcorn
Rice (grain, bran, hulls, polished)
Sorghum (grain)
Triticale (grain)
Wheat (bran, flour, germ, milled byproducts, shorts)
Wild rice

For a list of sites that can be fumigated with ProFume Gas Fumigant and site specific considerations for doing an effective and safe fumigation, see Chapter 10 of the manual.

Fumigation Restrictions

1. For normal atmospheric pressure (NAP) fumigations, do not exceed a maximum cumulative dosage of 1500 CT (g x hr/m^3).
2. For vacuum fumigations, do not exceed a maximum cumulative dosage of 200 CT.
3. When fumigating storage tanks, silos, etc. containing bulk flour, empty or draw down flour to less than 1 m (3 feet) deep. To prevent excessive residues in flour, minimize quantities of flour in the processing plant, structure or enclosure prior to fumigation.
4. ProFume Gas Fumigant is sold along with a dosage calculator called a Fumiguide (Chapter 5 of this manual). The Fumiguide must be used to calculate the initial dosage required for treatment and for any additional quantities needed during the fumigation to improve efficacy and/or to rectify loss due to leakage.
5. 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 Gas Fumigant. However, no direct fumigation of processed foods is permitted unless the processed food is specifically listed in the section, "Commodities that can be Fumigated".
6. Fumigation is not permitted when food grade oil is present.

Efficacy

ProFume Gas Fumigant may be used to control infestations of insect pests of food, feed, commodities and the structures where these are stored or processed. Total insect control is possible under optimum environmental and fumigation conditions. However, for some less susceptible insects, egg stage tolerance combined with cool temperatures may limit the potential for total control of the infestation. Maximum control is achieved by using precision fumigation techniques (excellent gas distribution and confinement, long exposures, sealed structures, high temperatures, etc.).

Aeration and Reentry

Aeration
Aerate the enclosure or structure using passive or active ventilation methods. To ensure workers and bystanders are not exposed to concentrations that exceed exposure standards for reentry, control the ventilation process, monitor concentrations of ProFume Gas Fumigant around the fumigated enclosure or structure, or prohibit entry into the area.

Prior to offering to customers, actively aerate food commodities for a minimum of 24 hours commencing once the mill has been cleared for worker reentry. When plastic liners are used for commodity packaging, longer aeration periods are required to aerate the commodity.

Reentry
No one shall be in fumigated structures if the level of ProFume Gas Fumigant is above 1 ppm 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 Ranger, Survivair, Scott, or MSA. **Note:** When in the fumigated area during the aeration procedure, approved respiratory protection must be worn until concentration of ProFume Gas Fumigant is confirmed not to exceed 1 ppm with an approved monitoring device.

Only an approved detection device of sufficient sensitivity, such as the INTERSCAN (Model GF 1900) or MIRAN gas analyzer (SapphIRe), can be used to confirm a concentration of ProFume Gas Fumigant of 1 ppm or less. The Interscan Model 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 Gas Fumigant must be monitored in breathing zones. The structure or enclosure must remain posted for fumigation until cleared for reentry.

Reentry Procedure
Measure the concentration of ProFume Gas Fumigant in the structure or enclosure. When concentrations are below 1 ppm, the structure or enclosure is cleared for immediate reentry.

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If inhaled: Move person to fresh air. If person is not breathing, contact emergency personnel immediately, then give artificial respiration, preferably mouth-to-mouth if possible. Consult a physician or contact a poison control centre for further treatment advice.

If on skin or clothing: Immediately apply water to contaminated area of clothing before removing. Once area has thawed, remove contaminated clothing, shoes, and other items covering skin. Rinse skin immediately with plenty of water for 15-20 minutes. Consult a physician or contact a poison control centre immediately.

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IMPORTANT NOTICE

Always read and follow all product label directions.

TABLE OF CONTENTS

FUMIGATING WITH PROFUME GAS FUMIGANT

INTRODUCTION

ProFume™ Gas Fumigant, (sulfuryl fluoride) is registered to be used exclusively by professional fumigators to control existing infestations of stored product pests in cereal grain mills, associated storage facilities and food processing plants.

The purpose and objective of this technical manual are to:

1. **Supplement and support the label for ProFume Gas Fumigant.**
2. **Reinforce the safe and effective use of this product.**
3. **Increase the understanding and adoption of Precision Fumigation™ principles and practices.**

Read the entire label, booklet and Fumigation Manual before use. The ProFume Gas Fumigant Fumigation 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 Fumigation Manual is lost, contact your ProFume Gas Fumigant distributor or your Douglas Products representative to obtain a replacement copy.

The ProFume Gas Fumigant Manual has been prepared as a part of the continuing Product Stewardship Program for ProFume Gas Fumigant provided by Douglas Products. The manual includes instructions for using ProFume Gas Fumigant and describes the safe handling and storage of this product.

Each fumigator using ProFume Gas Fumigant is responsible for complying with all federal, provincial, and local regulations or codes regulating the use of this product. The development of this guide included the study and interpretation of many codes and regulations considered relevant to the use of ProFume Gas Fumigant. However, because regulations and the enforcement of regulations can change, the fumigator will need to stay informed about provincial and local regulations in areas where they operate.

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

COMMITTED TO STEWARDSHIP

Douglas Products is committed to exercising responsible care for the manufacturing, distribution, handling, and use of its products by distributors, dealers, and customers.

In addition to safe production, stewardship means Douglas Products has a continuous concern for the proper use and ultimate disposal of our products. This includes assessing the environmental impact of products and taking appropriate steps to protect employee and public health and the environment as a whole.

BE GOOD PRODUCT STEWARDS

All handlers and applicators of ProFume Gas Fumigant should be good product stewards by following all the label and manual directions and all applicable federal, provincial, and local regulations.

ProFume Gas Fumigant Users Should
Be Good Stewards...
GOOD STEWARDSHIP = GOOD BUSINESS!

Chapter 1 PRODUCT INFORMATION

ProFume™ Gas Fumigant is a product developed by Douglas Products to control existing infestations of stored product insect pests in cereal grain mills, associated storage facilities and food processing plants. Fumigation of commodities including raw agricultural commodities, processed foods, animal feed and feed ingredients is permissible.

PROFUME GAS FUMIGANT IS A RESTRICTED USE PESTICIDE.

Pests Controlled:

Due to its toxic and penetrating qualities, ProFume Gas Fumigant is excellent for controlling a broad spectrum of insect pests. The pests for which ProFume Gas Fumigant is commonly used include Indian Meal Moth (*Plodia interpunctella*), Mediterranean Flour Moth (*Ephestia kuehniella*), Flour Beetles (*Tribolium* spp.), Saw-toothed grain beetle (*Oryzaephilis suranamensis*), warehouse beetle (*Trogoderma variable*), granary weevil (*Sitophilus granarius*), rice weevil, (*Sitophilus oryzae*), cowpea weevil (*Callosobruchus maculatus*), dried bean weevil (*Acanthoscelides obtectus*), hide beetle (*Dermestes maculatus*), drugstore beetle (*Stegobium paniceum*), rusty grain beetle (*Cryptolestes ferruginceus*), and almond moth (*Ephestia cautella*).

For further information on fumigation practices to control these pests, consult the product label, booklet and Chapter 2 of this manual.

Commodities that can be fumigated

The raw agricultural and processed food commodities that may by fumigated with ProFume Gas Fumigant include:
Barley (bran, flour, grain, pearled)
Beef (dried)
Cocoa bean
Coconut (dried)
Coffee bean
Corn (grain, flour, grits and meal)
Eggs (dried)
Ham
Milk, powdered
Oat (grain, flour, rolled)
Popcorn
Rice (grain, bran, hulls, polished)
Sorghum (grain)
Triticale (grain)
Wheat (bran, flour, germ, milled byproducts, shorts)
Wild rice

For a list of sites that can be fumigated with ProFume Gas Fumigant and site specific considerations for doing an effective and safe fumigation, see Chapter 7 of this manual.

Fumigation Restrictions

1. For normal atmospheric pressure (NAP) fumigations, do not exceed a maximum cumulative dosage of 1500 CT (g x hr/m^3).
2. For vacuum fumigations, do not exceed a maximum cumulative dosage of 200 CT.
3. When fumigating storage tanks, silos, etc. containing bulk flour, empty or draw down flour to less than 3 feet (~1 m) deep. To prevent excessive residues in flour, minimize quantities of flour in the processing plant, structure or enclosure prior to fumigation.
4. ProFume Gas Fumigant is sold along with a dosage calculator called a Fumiguide (Chapter 6 of this manual). The Fumiguide must be used to calculate the initial dosage required for treatment and for any additional quantities needed during the fumigation to improve efficacy and/or to rectify loss due to leakage.
5. 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 Gas Fumigant. However, no direct fumigation of processed foods is permitted unless the processed food is specifically listed in the section, "Commodities that can be Fumigated".
6. **Fumigation is not permitted when food grade oil is present.**

ProFume Gas Fumigant Label The label is a legal document. Use of the product in any manner inconsistent with the label is illegal. Labels are periodically revised and available through Douglas Products or your authorized ProFume Gas Fumigant distributor.

COMPOSITION

ProFume Gas Fumigant is an inorganic chemical and is composed of (by weight):
Active Ingredient: Sulfuryl fluoride 99.8%.

Sulfuryl fluoride is an odourless gas.

PRECAUTIONARY STATEMENTS

KEEP OUT OF REACH OF CHILDREN AND PREVENT ACCESS BY UNAUTHORIZED PERSONNEL

Extremely Hazardous Liquid And Vapour Under Pressure. Inhalation Of Vapours May Be Fatal. Liquid May Cause Freeze Burns Of Exposed Skin.

Do not get in eyes, on skin, or on clothing. ProFume Gas Fumigant is odourless. Exposure to toxic levels may occur without warning or detection by the user.

Fumigations performed by any individual fumigation worker or crew member must be separated by a 2-week interval.

Personal Protective Equipment for Fumigation

Protective Clothing

A long-sleeved shirt and long-pants are required. Do not wear gloves or rubber boots. Do not reuse clothing or shoes that have become contaminated with liquid ProFume Gas Fumigant until thoroughly aerated and cleaned.

Respiratory Protection

If the concentration of ProFume Gas Fumigant in the fumigated area (as measured by an approved detection device with sufficient sensitivity such as INTERSCAN, SF-ExplorIR, MIRAN, or CLIRcheck gas analyzer (SapphIRe) does not exceed 1 ppm in the breathing zones, no respiratory protection is required. When this concentration is exceeded, all persons in the exposure area must wear NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air-supplied/SCBA respirator such as manufactured by Ranger, Draeger, Survivair, Scott or MSA. Before using any make or brand of SCBA, learn how to use it correctly. Determine that it has an adequate air supply for the job at hand, that it fits properly, provides an adequate seal around the face, and that it is in good working order.

Respiratory protection (positive pressure Self Contained Breathing Apparatus (SCBA, not SCUBA) is required when entering a structure being fumigated where the concentration that exceeds 1 ppm or the concentration is unknown (See Chapter 4 Worker Safety).

For transportation emergencies, call 1-844-845-3129 or 1-352-323-3500.

Chapter 2 : FUMIGATION MANAGEMENT PLAN

PROFUME® GAS FUMIGANT PRODUCT STEWARDSHIP PLAN

Overview: Douglas Products Sulfuryl Fluoride Exposure Management Program

Sulfuryl fluoride products have been used for over 55 years in the United States. Sulfuryl fluoride successfully completed the federal reregistration process in the United States (as Vikane®) and received a comprehensive registration as ProFume Gas Fumigant from USEPA in 2004 (amended in 2005). The conditions of product use, including both regulatory requirements and a comprehensive Douglas Products Product Stewardship Program provide for the safe use of these products. The proposed product stewardship plan for use of ProFume Gas Fumigant in Canada is similar to the product stewardship plan currently being used in the United States.

Bystander exposure and risk potential are managed through a series of mandatory procedural and engineering control requirements which ensure and maintain a safe use environment for these products.

Douglas Products ProFume Gas Fumigant authorization requirements

Douglas Products requires all end users to successfully complete the following before becoming authorized by Douglas Products to use this product:

1. Complete one day classroom training which reviews the fumigant characteristics, stewardship, and label, as well as how to plan, introduce, monitor and safely aerate a ProFume Gas Fumigant fumigation. All participants must pass the Douglas Products administered written exam.
2. Complete one day academy training which reviews the label, sealing, and introduction, monitoring and safety equipment in a “hands on” setting. All participants must pass the Douglas Products administered written exam.
3. All end users must sign Douglas Products stewardship agreement.
4. All end users must identify a chief stewardship officer for ProFume Gas Fumigant.
5. All end users, after satisfying requirements 1 through 4, must successfully and independently plan and implement a ProFume Gas Fumigant fumigation with a Douglas Products representative present before becoming Douglas Products approved to independently use the product
6. All end users must complete an annual stewardship program.

PROFUME FUMIGATION MANAGEMENT PLAN (FMP)

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 Gas Fumigant FMP. The Fumiguide and the FMP will assist you and others

in complying with pesticide product label requirements. The guidance that follows 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, which are supported by the Fumiguide, and are defined as an "optimizing fumigant use to maximize efficiency and minimize risk" aid.

Before any fumigation begins, carefully read and review the label. This information must be given to the appropriate company officials (supervisors, foreman, safety officer, etc.) in charge of the site. If you do not find specific instructions for the type of fumigation that you are to perform listed in this guidance document, you should 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, provincial and local laws. 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 Gas Fumigant fumigation include the ProFume Gas Fumigant Fumiguide Program and the documentation it creates and the Precision Fumigation™ Techniques.

The FMP must address characterization of the site and include appropriate monitoring and notification requirements, consistent with, but not limited to, the following:

1. Inspect the site to determine its suitability for fumigation.
2. When sealing is required, consult previous records for any changes to the structure, 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 may 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 workers and bystanders are not exposed to levels above safe levels during application, fumigation and aeration. This plan must also demonstrate that nearby residents will not be exposed to concentrations above safe levels in neighbouring off-site structures, recreational areas, etc.

   NOTE: Air concentrations of sulfuryl fluoride are transient in nature and will decline rapidly. An evacuation action is necessary when sustained sulfuryl fluoride levels exceed 1 ppm for one hour (with no more than 5 ppm allowable for a 30 minute time frame). Air monitoring must use a detection device with sufficient sensitivity such as an Interscan, SF-ExplorIR, Miran, or CLIRcheck. During introduction of ProFume Gas Fumigant, measure air samples outside of the facility every 30 to 60 minutes, or as needed, to ensure that sulfuryl fluoride levels do not exceed 5 ppm for more than 30 minutes, and 1 ppm for more than 60 minutes. Measure air

samples outside of the facility at least once during fumigation. Measure air samples outside of the facility every 60 minutes, for a minimum of 3 hours, during the initiation of aeration.

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
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.
9. Develop a detailed plan for mitigating risk if ambient air monitoring demonstrates gas levels at or above1 ppm. For example, an aeration procedure demonstrating how aeration time can be extended and how aeration can be quickly stopped if needed.
10. Compile a final report including the target pest, fumigation and aeration procedures, amount of fumigant used, meteorological conditions, all indoor and outdoor air concentrations measured during the fumigation and aeration period. The Fumiguide can be used to capture this data and satisfy this requirement.

A 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, or food plant
    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 labelling.
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 Half-Loss Time (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.
r. Distance to other on-site and neighbouring off-site structures, recreational areas or areas where bystanders may be exposed.
s. Indoor air monitoring locations.
t. Site of aeration vent to be opened to aerate structure.

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. Scheduled ambient air monitoring of ProFume Gas Fumigant conditions must be conducted in areas to prevent worker and bystander exposure to concentrations of ProFume Gas Fumigant ≥1 ppm.

NOTE: Air concentrations of sulfuryl fluoride are transient in nature and will decline rapidly. An evacuation action is necessary when sustained sulfuryl fluoride levels exceed 1 ppm for one hour (with no more than 5 ppm allowable for a 30 minute time frame). Air monitoring must use a detection device with sufficient sensitivity such as an Interscan, SF-ExplorIR, Miran, or CLIRcheck. During introduction of ProFume Gas Fumigant, measure air samples outside of the facility every 30 to 60 minutes, or as needed, to ensure that sulfuryl fluoride levels do not exceed 5 ppm for more than 30 minutes, and 1 ppm for more than 60 minutes. Measure air samples outside of the facility at least once during fumigation. Measure air samples outside of the facility every 60 minutes, for a minimum of 3 hours, during the initiation of aeration.

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 Gas Fumigant present above the safe levels.
d. Monitoring must be conducted during fumigation and 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 located.

2. Efficacy

a. ProFume Gas Fumigant 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 Gas Fumigant 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 Gas Fumigant levels are exceeded in an area that could be dangerous to bystanders and/or domestic animals. Elaborate in this section the key elements of an Emergency Response Plan including reference to evacuation procedures, etc.

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/remodelling has not changed the building in a manner that will materially affect 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 province, must be present on site at all times during the introduction of the fumigant, re-entry prior to aeration, initiation of the aeration procedure, when testing for re-entry after aeration (if aerated in an enclosed space) and during re-entry.
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 applicable provincial legislation 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 re-entry 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 re-entry using a detection device of sufficient sensitivity.
8. Inform business/client that employees/other persons may return to work or otherwise be allowed to re-enter 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.

SITE SPECIFIC CONSIDERATIONS

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 safe levels. Monitor concentrations of ProFume Gas Fumigant around the fumigated site as outlined previously. In addition, ensure that the following points are taken in to consideration:

Placarding: Post warning signs at 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 mill or food processing facility during the fumigation.

Securing the Enclosing Structure: The enclosing structure must be secured to prevent entry by anyone other than the certified fumigator or persons under his/her direct supervision at all times.

The certified applicator is responsible for working with the owners and/or responsible employees of the site to be fumigated to develop and follow a Fumigation Management Plan (FMP). The FMP is intended to ensure a safe and effective fumigation. The FMP must address characterization of the site, and include appropriate monitoring and notification requirements, consistent with, but not limited to, the following:

1. Inspect the site to determine its suitability for fumigation.
2. When sealing is required, consult previous records for any changes to the structure, seal leaks, and monitor any occupied adjacent buildings to ensure safety.
3. Prior to each fumigation, review any existing FMP, MSDS, Applicator's Manual and other relevant safety procedures with company officials and appropriate employees.
4. Consult company officials in the development of procedures and appropriate safety measures for nearby workers that will be in and around the area during application and aeration.
5. Consult with company officials to develop an appropriate monitoring plan that will confirm that nearby workers and bystanders are not exposed to levels above the allowed limits during application, fumigation and aeration. This plan must also demonstrate that nearby residents will not be exposed to concentrations above the allowable limits.
6. Consult with company officials to develop procedures for local authorities to notify nearby residents in the event of an emergency.
7. Confirm the placement of placards to secure entrance into any structure under fumigation.
8. Confirm the required safety equipment is in place and the necessary manpower is available to complete a safe and effective fumigation.

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

In addition to the plan, the applicator must read the entire label and the Applicator's Manual and follow its directions carefully. If the applicator has any questions about the development of a FMP, contact the supplier for further assistance.

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

Chapter 3 : CYLINDER STORAGE AND USE

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

CYLINDER SAFETY

General Cylinder Information

Cylinders containing ProFume Gas Fumigant 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.

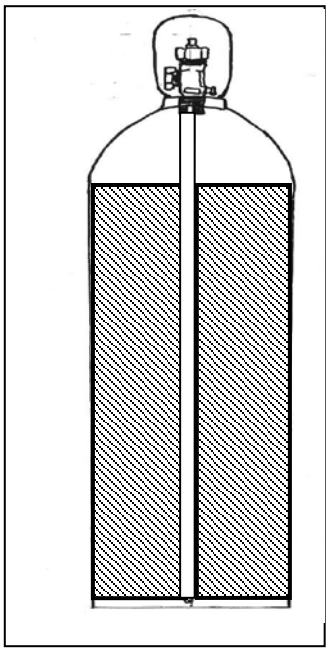
ProFume Gas Fumigant is sold as a compressed liquid gas in a high-pressure cylinder and must be handled, stored and transported with caution. Every cylinder should be inspected upon delivery for damage. If the cylinder is damaged, immediately return the cylinder to the ProFume Gas Fumigant distributor. No additional gas is used to pressurize the cylinder. Each full cylinder contains 57 kg (125 lbs) of product normally under about 1380-2070 kPa (200-300 psi). Table 2a below shows range of cylinder pressures at various temperatures.

TABLE 2a ProFume Gas Fumigant Cylinder Pressure At Various Temperatures

Temperature		Pressure	
°F	°C	kPa	(PSIA)[1]
0	-17.8	490	71
10	-12.2	594	86
20	-6.7	710	103
30	-1.1	849	123
40	4.4	1000	145
50	10.0	1173	170
60	15.6	1366	198
70	21.1	1580	229
80	26.7	1822	264
90	32.2	2090	303
100	37.8	2386	346
110	43.3	2712	393
120	48.9	3072	445
130	54.4	3469	502
140	60.0	3906	566
150	65.6	4389	636

ProFume Gas Fumigant is present in each cylinder in both the gas and liquid phases. The product comes out of the tank through the riser or dip tube as a liquid. However, the last 1.5-2.0 kg (3-5 lbs) of ProFume Gas Fumigant will be released as gas or a combination of gas and liquid. ProFume Gas Fumigant introduction in the gas phase often takes longer to move through the hose (see Figure 2a for cylinder diagram).

Figure 2a ProFume Gas Fumigant Cylinder Diagram



ProFume Gas Fumigant cylinders are equipped with a 2.6 cm (1.030") right-hand thread, 14 threads per 2.54 cm (14 threads per inch), straight thread fitting. This is comparable to a 1.9 cm (¾") NPTS pipefitting thread (pipefitting is not the same as a hose fitting). A gasket supplied with each cylinder must be used at the valve connection to prevent fumigant leakage.

Cylinder Storage

Store ProFume Gas Fumigant cylinders in a dry, cool, well ventilated, secure, 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 Gas Fumigant cylinders to prevent being knocked over during storage, transport, weighing, and fumigant release. Secure in a manner which does not deface the label.

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

Various provincial and local authorities may regulate storage of ProFume Gas Fumigant. 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 SF-ExplorIR, or CLIRcheck so persons entering or working in the general area will not be exposed to concentrations of sulfuryl fluoride over 1 ppm (see Chapter 9, Clearance Testing). Contact your provincial and local authorities for additional guidelines.

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

Cylinder Transport

Always transport cylinders capped and secured in an upright position. Never transport cylinders unsecured. Loose cylinders can become airborne and cause significant damage in an accident. Because of ProFume Gas Fumigant's toxicity, 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. Cylinders may be secured and transported horizontally on the job site; cylinders may never be transported horizontally on public roads.

All Transport Canada – Transportation of Dangerous Goods (TDG) regulations must be followed. If you have questions, contact your local Transport Canada Office.

Always store and transport cylinders in a secure upright position.

ProFume Gas Fumigant cylinders are not to be transported in the same airspace or breathing zone as the driver or other occupants of vehicles

Air Transportation

PROFUME GAS FUMIGANT CYLINDERS MUST NEVER BE TRANSPORTED BY AIRCRAFT UNDER ANY CIRCUMSTANCE

ProFume Gas Fumigant Cylinder Valves

ProFume Gas Fumigant cylinders are fitted with special valves (see Fig 2b). 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 Gas Fumigant distributors.

Figure 2b
ProFume Gas Fumigant Cylinder Valve

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 Gas Fumigant 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 cylinders on vehicles.

Leaking Cylinders

If a cylinder is suspected of leaking fumigant, evacuate immediate area. Do not continue to use a cylinder if you believe the valve is defective. Use a NIOSH or MSHA approved positive-pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air-supplied/SCBA respirator for entry into affected areas to correct the leak.

Move leaking or damaged cylinder outdoors or to an isolated location, observing strict safety precautions. Work upwind if possible.

Do not allow entry into the leakage area until the concentration of the fumigant is determined to be 1 ppm or less, as determined by a detection device with sufficient sensitivity (see Chapter 9, Clearance Testing).

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 sealed valve. See ProFume Gas Fumigant Valve Stem Adjustment Procedures at the end of this chapter.

Once the cylinder is empty, contact your ProFume Gas Fumigant distributor or Douglas Products representative for proper return instructions.

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

Cylinder Return Procedure

One of the more common reasons for returning a cylinder is the perception that the last 1.5-2.0 kg (3 to 5 lbs) of gas in the cylinder cannot be released. The final kilograms of ProFume Gas Fumigant 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.

1. To return cylinders contact your ProFume Gas Fumigant distributor or your Dow AgroScience representative for return instructions.

2. If a cylinder is defective, distributors should identify defective cylinders by spray painting the top and shoulders of the cylinder with red paint and attach a completed red tag to the protection bonnet.

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

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 Gas Fumigant is required, the proper respiratory protection (SCBA) must be used. See Chapter 4 for respiratory protection instructions in emergencies.

ProFume Gas Fumigant 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 re-entry 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 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 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.
Procedure	Listed below are the steps necessary to stop a loss of ProFume Gas Fumigant 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 detection devices are used.

Step	Action
1	If product loss is detected, immediately close the valve. This will stop ProFume Gas Fumigant 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 34-40 N.m (25-30 foot pounds) of torque, which is easily reached with a 25-30 cm (10-12”) 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.

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

POISONING SYMPTOMS

ProFume Gas Fumigant is colourless, odourless and, at low concentrations, non-irritating to mucous membranes. ProFume Gas Fumigant gives no warning of its presence.

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

Humans exposed to high concentrations of ProFume Gas Fumigant 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.

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 greater than 1 ppm as measured by a detection device with sufficient sensitivity such as an Interscan or SF-ExplorIR, or CLIRcheck.

It is highly recommended that a 24-hour telephone number (including weekends) is on the warning signs to allow for prompt communication with a fumigation company representative in case of emergency.

IN CASE OF OVER EXPOSURE,
SEEK MEDICAL ATTENTION

FIRST AID

Take container, label or product name and Pest Control Product Registration Number with you when seeking medical attention.

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. Consult a physician or contact a poison control centre immediately.

If inhaled: Move person to fresh air. If person is not breathing, contact emergency personnel immediately, then give artificial respiration, preferably mouth-to-mouth, if possible. Consult a physician or contact a poison control centre for further treatment advice.

If on skin or clothing: Immediately apply water to contaminated area of clothing before removing. Once area has thawed, remove contaminated clothing, shoes, and other items covering skin. Rinse skin immediately with plenty of water for 15-20 minutes. Consult a physician or contact a poison control centre immediately.

If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Liquid ProFume Gas Fumigant in the eye may cause damage due to refrigeration or freezing. Consult a physician or contact a poison control centre immediately.

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 Gas Fumigant 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 central nervous system 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 on 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 Gas Fumigant is not combustible. However, in temperatures exceeding approximately 400°C (752°F), ProFume Gas Fumigant will degrade to form hydrogen fluoride (HF) and sulfur dioxide. Theoretically, a structure containing ProFume Gas Fumigant would produce 0.4x the concentration of ProFume Gas Fumigant in the form of HF per 28.3 cubic metres (per 1000 cubic feet).

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

Cylinders containing ProFume Gas Fumigant are designed not to explode in high temperatures. A fusible plug in the cylinder valve body melts at 70-74 °C (158-165°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 sulfur dioxide (SO_2) formed by decomposition of ProFume Gas Fumigant by the flame. Water also can be used to cool ProFume Gas Fumigant cylinders and prevent discharge of the product caused by melted fusible plugs. Avoid runoff into waterways if possible. The toxicity of ProFume Gas Fumigant in water for fish is unknown.

Fire Fighting Protective Clothing

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

For Fires Involving ProFume Gas Fumigant 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 Gas Fumigant. Protective suit material should be compatible with exposure to hydrofluoric acid.

Chapter 5 : PREPARATION, SEALING, AND SECURING

In addition to the technical knowledge required for fumigation, the fumigator must at all times be guided by a good sense of safety and judgment. No two fumigation jobs are exactly alike. Each job requires the fumigator to establish and maintain an effective fumigation space. 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 ProFume Gas Fumigant label and ProFume Gas Fumigant Manual, as well as to federal, provincial and local regulations. When in doubt, a fumigator should seek assistance from suppliers, regulators, Douglas Products representatives, or other educational sources.

WORKER SAFETY

Government authorities regulate worker safety at the job site and some agencies mandate that the employer must have written safety procedures including standard operating procedures and emergency procedures. Agencies may give special attention to the following areas: self-contained breathing apparatus (SCBA) use and maintenance, working in confined spaces, man-lifts, using ladders, working on roofs/bins, and lifting heavy objects.

Any unprotected overexposure to ProFume Gas Fumigant should result in a visit to your physician (consult label).

Personal Protection Equipment

The ProFume Gas Fumigant label will require the following personal protective equipment:

Respiratory Protection: Fumigators must have available a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) with a full face mask or combination air-supplied/SCBA respirator such as manufactured by Ranger, Survivair, Scott, or MSA with a full face mask. Before using any make or brand of SCBA, learn how to use it correctly. Determine that it has an adequate air supply for the job at hand, that it fits properly, providing an adequate seal around the face, and that it is in good working order.

Consult current standards concerning

SCBA use and maintenance.

Eye Protection: Liquid ProFume Gas Fumigant can freeze the eye tissue. Eye protection also helps prevent physical injury if the hose disconnects.

Protective Clothing: A long-sleeved shirt and long pants are required. Skin contact with gaseous ProFume Gas Fumigant is not considered a problem. However contact with liquid ProFume Gas Fumigant can cause freeze damage.

Do not wear gloves or rubber boots when introducing ProFume Gas Fumigant, as these items of protective clothing can confine the liquid against the skin that may cause freeze damage.

PROPERTY OWNER AND CUSTOMER INFORMATION

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.

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.

Occupants/Customers need to know:

1. Their specific role in preparation for fumigation; what to prepare, turn off, remove, etc.

2. 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.

3. The specific times to leave the structure and when re-occupancy may occur.

4. 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.

5. ProFume Gas Fumigant has no residual effectiveness and so does not control future infestations of pests.

6. To reveal to fumigator known or potential connections to adjacent/other buildings.

Misapplication of ProFume Gas Fumigant and/or moisture condensation from introduction may cause damage to certain materials. The risk of condensation increases under conditions of high relative humidity and where high dosages of ProFume Gas Fumigant are required. Proper fumigant release techniques to avoid misapplication and condensation are described on the ProFume Gas Fumigant label, booklet and Chapter 7 of this manual.

WHAT TO REMOVE PRIOR TO FUMIGATION

Remove from the structure to be fumigated all persons, non-target animals, and growing plants including seeds for planting. Remove all drugs, and medicines. If the customer is concerned about a particular item prior to the fumigation, removal is the best approach.

FLAMES OR HEATING ELEMENTS

ProFume Gas Fumigant (sulfuryl fluoride) 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 Gas Fumigant 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.

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 Gas Fumigant 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 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 and 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 Gas Fumigant concentrations in the breathing zones must be continually measured during the fumigation of a structure in any occupied isolated connected structures to verify ProFume Gas Fumigant concentrations are <1 ppm to confirm that individuals in the isolated areas are not exposed to unacceptable levels of ProFume Gas Fumigant. Use only a detection device of sufficient sensitivity such as the INTERSCAN gas analyzer [Model GF 1900 or equivalent] or SF-ExplorIR, or CLIRcheck to confirm a concentration of ProFume $\leq$1 ppm. **Note:** All connected/adjoining areas must be vacated if required by federal, provincial or local laws or regulations.

A connected area is defined as any area connected with the space to be fumigated by construction elements (e.g. pipes, conduits, ducts, etc.) which may allow the passage of fumigant between the spaces.

Follow all local, provincial and federal regulations.

CHOOSING PROFUME GAS FUMIGANT INTRODUCTION SITES

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

During site selection ask, "If ProFume Gas Fumigant was introduced in this location, how and when will it get to the most remote locations in the structure?" For most 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.

Key Considerations for Site Selection for Space Fumigations

1. Largest open space.

2. At least one introduction location on each floor of a multi-story structure.

3. Proximity of materials or equipment that may be damaged by fumigant introduction.

4. Recommend at least one introduction site per 2,100 cubic metres (75,000 cubic feet) of fumigated space.

The size and configuration of the space and the adequacy of the circulation will dictate the number of release sites for ProFume Gas Fumigant. As a rule of thumb, there should be sufficient circulation to establish fumigant equilibrium in about 2 hours following fumigant introduction in most situations.

Experience with ProFume Gas Fumigant, measurements discussed in Chapter 6, and data from past monitoring of the fumigation site will help the fumigator judge the amount of circulation needed.

Successful introduction can usually be accomplished by directing the flow into the air stream of a fan that has the capacity of 60 m^3/min (1m^3/second) for each Kg of ProFume Gas Fumigant introduced per minute.

DISTRIBUTION/AERATION FAN USE AND PLACEMENT

Purpose of Fans: There are three purposes for fans in a structural fumigation:

1. **Fumigant Introduction**

2. **Circulation and Equilibrium**

3. **Aeration**

Fans ensure that the fumigant equilibrium is achieved in a timely manner and aid in the ventilation and aeration process.

In most instances, the ProFume Gas Fumigant label requires fan use during fumigant introduction.

Positioning Fans

→ There is no set pattern established for the positioning or the number of fans to use.
→ Fans should be placed to mix the fumigant to 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 2100 m^3 (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.

Continuous Circulation With Fans

A significant benefit of continuous circulation is the movement of ProFume Gas Fumigant 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 Gas Fumigant 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 Gas Fumigant. Obviously, the air stream should not flow directly against "leaky" areas because excessive fumigant loss can occur.

INTRODUCTION MANIFOLDS AND HOSES

ProFume Gas Fumigant must be released only through manifolds and suitable leak-proof hoses with a minimum burst pressure of 35 Bars (35 kg/cm^2, 500 lbs/in^2). The hose should be flexible, kink resistant, and be durable.

The ProFume Gas Fumigant introduction rate is mostly controlled by the inside diameter and the length (resistance) of the fumigant introduction hose. See Chapter 6 or the ProFume Gas Fumigant Fumiguide Program.

Protective Sheeting: Polyethylene plastic should be placed under the hose and fan and secured to further protect floors and other materials during application**.**

MONITORING HOSES

Plans for placement of sampling hoses in the structure should be made prior to fumigant introduction. Clear vinyl hoses (3 or 6 mm (1/8-1/4") interior diameter (ID)) should be placed to allow representative sampling of fumigant concentrations. 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.

The Fumiscope or other appropriate equipment is used to measure ProFume Gas Fumigant concentrations during exposure. Confirm that electricity is available to correctly operate monitoring equipment during the fumigation.

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 label and local regulations for more restrictive aeration procedures.

SEALING THE STRUCTURE

The quality of the seal has a significant 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 two basic thoughts:

1. Identify and seal key leakage areas. Careful inspection of the facility/chamber 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. Ensure you close off all connected structures and install an “air break” to stop gas moving to connected structures.

The fumigator must be guided by the principle of rapidly achieving and maintaining equilibrium for a sufficient period to accumulate the dosage needed to control the target pest.

Tape and Seal

Often, mills, warehouses, processing facilities, and storage bins contained therein are too large to be completely tarped for fumigant confinement. The most common practice is 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, etc. If properly used, these materials can do a very adequate job of confining the fumigant within the structure.

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 will not hold fumigant satisfactorily.

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. Always monitor with a Fumiscope when using these methods.

Taping the cracks at windows, doors and other small openings helps seal buildings. Vents should be sealed around the edges. Always monitor with a Fumiscope to confirm the effectiveness of fumigant confinement and to calculate the actual HLT.

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

Tarpaulins (tarps) can be used in the sealing process, used with tapes/adhesives to help seal leaky areas.

If extremely leaky parts or entire structures exist it may be preferable to cover the space/structure with a tarpaulin that envelops all areas susceptible to pest infestation. 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.

The question naturally arises: "If ProFume Gas Fumigant penetrates wood so well, how well can it be confined for fumigation?" Surprisingly, the relative ease of confinement is characteristic of the product and one of its major advantages.

Tarp Material

Plastic tarps are semi-permeable membranes, which permit different fumigants to pass through them at different rates. The passage of ProFume Gas Fumigant through plastic sheeting is very slow (see Table 4a).

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

1. Four-six 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 (160-240 microns) thickness of the above materials is able to adequately confine ProFume Gas Fumigant. 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 Gas Fumigant because they do not possess the strength and weight needed for the handling, wind resistance and abrasion encountered in most fumigations.

Before tarping, open all interior openings/vents prior to fumigation, as well as interior doors, access panels, etc. (always comply with local regulations concerning barriers to entry into the structure during the exposure period.)

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. 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 achieve an adequate ground seal, allow at least 61 cm (2 ft) of tarp to clear the ground snakes. This will accommodate movement of the tarps from wind movement.

Table 4a
Percent permeation loss and adsorption of 8 g/m^3 sulfuryl fluoride, after 24 hrs from 325 ml glass bell jar with lid made of tarp materials.

	Percent permeation loss	Percent adsorption[a]
Tarp material	Sulfuryl fluoride	Sulfuryl fluoride
Used tarp	100	8.8
Tarp A, 350 g/m²	3.3	6.1
Polyethylene 100 microns	0.0	1.3

[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.

Preventing Condensation

To reduce the risks of moisture condensation, the following precautions should be observed:

1. Do not tarp or seal a space that is wet.

2. Pay special attention to air circulation in cold weather. Low outside temperatures can induce moisture condensation on uninsulated surfaces such as windowpanes, skylights, machinery, or ducting. To help prevent condensation, fans should be used to maintain temperature equilibrium throughout the structure during the exposure period.

3. Cold temperatures in warm weather may also warrant special attention. An air conditioned structure that is much cooler than the outside air temperature and then opened to introduce hot humid outside air, will form condensation on cold surfaces, such as heavy brass (an example would be the fogging of sunglasses when exiting an air conditioned car in the summer). This condition can be avoided by warming the structure slowly prior to sealing and before opening windows and doors to avoid introducing outside air.

POSTING AND SECURING FUMIGATED AREAS

ProFume Gas Fumigant is a toxic gas without a warning agent. The ProFume Gas Fumigant label requires that the structure be posted with specific warning signs on all entrances and all sides during the exposure and aeration periods until the building is cleared for reentry by the fumigator.

Warning signs should be of weather-resistant material and should be securely affixed to the structure. The warning logo on the sign should be visible from any approach to the structure.

Only a certified applicator may authorize removal of the warning signs, and only when the concentration of ProFume Gas Fumigant at the treated site is 1 ppm or less. The label states the signs must bear in English and French:

1. The signal word DANGER and the SKULL and CROSSBONES symbol in red.

2. The statement “Area under fumigation, DO NOT ENTER”.

3. The date and time of fumigation.

4. Name, business address and telephone number of the fumigation company and licensed/certified applicator.

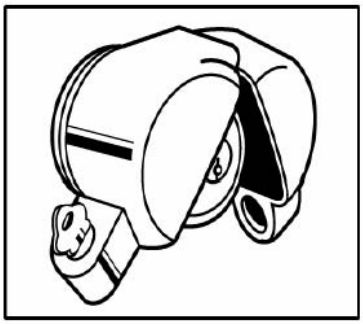
It is highly recommended that a 24-hour telephone number (including weekends) is written on the warning signs to allow for prompt communication with a fumigator in case of emergency.

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 licensed applicator in charge of the fumigation or persons in his/her on-site direct supervision. Consult provincial and local regulations for any supplementary instructions and local restrictions on securing against entry.

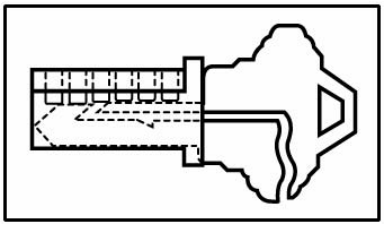
Several additional security options to consider might include:

• Clam Shell Locks



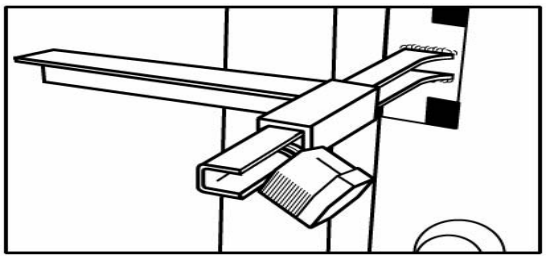
Clam Shell locks are designed to prevent use of the door or occupant's keys to unlock entrance doors.

• Key-way Locks



Keyway 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 also be considered for 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.

Chapter 6 : DOSAGE OF PROFUME GAS FUMIGANT

Establishing the Required Dosage

The fumigator is challenged with the task of distributing and maintaining a concentration of fumigant over enough time to achieve the target dosage. Because of the multitude of variations, there are no two identical fumigations nor are any of them truly gas tight. 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.

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 Gas Fumigant use is not complicated and allows pest managers the ability to use their skills, knowledge, and experience to create and implement successful, flexible IPM programs. 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
CT = C x T

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

CT in (g-h/m^3) =
The concentration in g/m^3 of fumigant multiplied by the exposure time in hours (h).

The Maximum Target Concentration In The ProFume Gas Fumigant Fumiguide Is 3.629 kg per MCF

The Maximum Target Dosage In The Fumiguide Is 1500 CT.

Fumigant Dosage Key Factors

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

1. Pest Species and Life Stages
2. Temperature at Site of Pest
3. Exposure Time
4. Half-Loss Time (HLT) or Quality of Seal

Pest Factor

ProFume Gas Fumigant is effective on all key stored product insect pest (SPIP) 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 Gas Fumigant, while the egg stage requires higher dosages.

Pest Monitoring

To achieve maximum pest population management and control, the facility/commodity should be routinely monitored and data collected to define the actual pest spectrum and levels of infestation present. Successful pest management professionals also use knowledge of pest biology, behavior, and the understanding of pest population dynamics to make control decisions and develop integrated control plans. Understanding the customer-defined level of control is very important when developing an integrated control program.

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 Gas Fumigant. Increasing temperature can decrease exposure time and/or gas needed. Large changes in temperature are not required. Achieving temperatures of 25-30 °C (78-86°F), for example, can have a very positive effect on fumigation efficacy and efficiency.

Do not apply ProFume Gas Fumigant for insect control when the temperature of the site of the pests is below 4°C (40°F).

Temperature Control

It is possible to substantially reduce the amount of ProFume Gas Fumigant needed by raising the temperature within the structure.

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.

Dosage requirements for a particular structure should be based on the mean temperature at the coldest site that could harbour the pest. The measured minimum temperature at the site of the pest should be used for dosage calculations.

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 insects 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.

Increased time = Decrease gas needed
Decreased time = Increase gas needed

Doubling exposure time in a well-sealed structure can decrease gas needed by up to 50%. Work with the customers to plan and optimize exposure time to minimize the fumigant needed. The case study in Table 6a shows how exposure time and HLT affect the amount of ProFume Gas Fumigant needed:

Half Loss Time (HLT)

Half-Loss Time (HLT) is the measurement of how well a fumigated space or area holds fumigant. HLT is defined as the time in hours that 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.

**The higher the HLT value,
the better the fumigant confinement.**

If the HLT > 20 hours for processing facilities or warehouses the seal is very good. The HLT is calculated by actively monitoring the fumigation with a Fumiscope over a period of time and determining the specific loss of gas in that time period. To get an 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 Fumiguide™ Program for ProFume Gas Fumigant will calculate a HLT by area using the collected monitoring data.

Under conditions of rapid fumigant loss (low HLT), only the initial hours of exposure are significant to the accumulated dosage. If the HLT is shorter than expected (fumigant leaking faster than planned), to achieve the required dosage, the fumigator must either increase the ProFume Gas Fumigant gas concentration, increase the time of exposure, or utilize a combination of the two methods.

Fumigators can utilize better sealing techniques to increase HLT substantially. See Chapter 5 for more information.

Table 6a Dosage Case Studies

	HLT = 20	HLT = 10
Exposure Time	**Fumigant Needed***	**Fumigant Needed**
48 hrs	**1.0X**	**1.8X**
36 hrs	**1.2X**	**1.9X**
24 hrs	**1.5X**	**2.1X**
18 hrs	**1.9X**	**2.4X**

- A HLT of 20 with 48 hr exposure is considered the benchmark. Other values are multiplicative of the 1X benchmark.

**Doubling exposure time
with good HLT decreased
fumigant used by 33-58%**

DOSAGE CALCULATIONS

The ProFume Gas Fumigant Fumiguide is a computer-based program that requires entry of key information to determine the dosage and amount of ProFume Gas Fumigant to be used.

The ProFume Gas Fumigant 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 Fumiguide also coordinates the necessary adjustments based on fumigant monitoring results and changing conditions to obtain the proper dosage for the job for exposure periods from 2-168 hours.

Fumigant Loss Rate Contributing Factors

No method presently exists for accurately predicting the loss rate of fumigant. Conditions affecting the fumigant confinement will differ for each job.

Results from numerous measurements for ProFume Gas Fumigant indicate the main influencing factors to be structural design/features such as concrete, wood, windows, etc.:

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.

Experienced fumigators probably are familiar with the physical features of the structure that provide opportunities for improving the seal and increasing HLT.

THE PROFUME FUMIGUIDE PROGRAM

Using the ProFume Gas Fumigant Fumiguide Program

Douglas Products has the ProFume Gas Fumigant Fumiguide program for analyzing factors that affect fumigant confinement and efficacy to calculate the required dosage of ProFume Gas Fumigant.

The ProFume Gas Fumigant Fumiguide determines the necessary dosage (gram-hours or ounce-hours), converts this to grams or pounds of ProFume Gas Fumigant per 1000 cubic metre (or cubic feet) based on volume of fumigated space for all target pests referenced on the ProFume Gas Fumigant label. The program can also calculate the necessary adjustments to the exposure period or the amount (kilograms or pounds) of ProFume Gas Fumigant required to reach the target dosage based on fumigation monitoring data.

The ProFume Gas Fumigant Fumiguide program also calculates the maximum recommended rate (kilograms or pounds/minute) of fumigant introduction based on fan capacity and relative humidity.

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

The Fumiguide program enables Precision Fumigation and supports fumigating under a wide range of conditions, including exposure periods of 2-168 hours. Use of the ProFume Gas Fumigant Fumiguide program during monitored fumigations has shown that significant quantities of ProFume Gas Fumigant gas can be saved and better control achieved. Refer to the ProFume Gas Fumigant Fumiguide instruction booklet or help file for specific directions on how to use this program.

Using the ProFume Gas Fumigant Fumiguide Program When Monitoring

During the exposure period, the concentration of ProFume Gas Fumigant can be measured by a gas-measuring instrument such as the Fumiscope. After the fumigant concentration has reached equilibrium, measurements taken over an interval of time will give the actual loss rate from which the half-loss time (HLT) can be determined.

Using the actual HLT and in case of a grams-hour deficiency between the targeted and predicted dosages, the required amount of additional fumigant or exposure is readily calculated by the ProFume Gas Fumigant Fumiguide.

MAKE SURE TO ACCUMULATE THE REQUIRED GRAMS-HOURS FOR THE TEMPERATURE AND TARGET PEST!

Suggested Steps of Operation

Preparation Prior to Fumigant Release:

1. Determine pest species and life stages to be controlled. Consult the ProFume Gas Fumigant label or Chapter 1 of this manual for a list of pests controlled.

2. Measure temperature (°C) of pest location with a thermometer.

3. Calculate volume of fumigation space.

4. Determine the targeted exposure period.

5. In the ProFume Gas Fumigant Fumiguide program, calculate dosage of ProFume Gas Fumigant mass (g) of ProFume Gas Fumigant per cubic metre (or ounces of ProFume Gas Fumigant per 1000 cubic feet) and get kg (or pounds) of ProFume Gas Fumigant needed for the job.

Monitoring to Determine Status and Updated Dosing Recommendations:

1. Measure (with a gas measuring instrument such as a Fumiscope) concentration of ProFume Gas Fumigant g/m^3 (ounces/1000 cubic feet) (see Chapter 8, Monitoring Information).

2. After one or more hours, take a second measurement of concentration of ProFume Gas Fumigant. Accuracy of HLT increases as time between monitoring intervals is increased.

3. The ProFume Gas Fumigant Fumiguide program will calculate the actual measured HLT.

4. If the HLT is shorter than estimated (more rapid loss of fumigant), then either more ProFume Gas Fumigant needs to be added to finish on time or the exposure time may be extended if sufficient ProFume Gas Fumigant is present.

TEMPERATURE VARIATIONS AND ECONOMICS

Temperature has a major influence on the dosage requirements for successful fumigation with ProFume Gas Fumigant and is factored into dosage calculations. The economics of dosage are important, especially where temperature variations are pronounced.

Dosage requirements can vary based on changing seasonal temperature conditions.

Chapter 7 : PROFUME GAS FUMIGANT INTRODUCTION AND DISTRIBUTION

The proper introduction of ProFume Gas Fumigant (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 need to be considered when introducing ProFume Gas Fumigant:

1. The introduction methods used will practically achieve the target dosage (sufficient gram-hours for the working temperature to control the target pest).

2. ProFume Gas Fumigant should 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 Gas Fumigant concentration equilibrium throughout the fumigated space as quickly as is safe and practical.

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

Fumigant monitoring is conducted so that the optimal amount of ProFume Gas Fumigant is introduced based on the measured half-loss time. When an accurate estimate of HLT is not available prior to the initiation of exposure, the following Precision Fumigation method should be used. Initially introduce part (i.e., one-half) of the calculated dosage of ProFume Gas Fumigant, monitoring to determine the actual half-loss time, and then introducing additional ProFume Gas Fumigant and/or increase pest exposure time to achieve the target dosage.

CHOOSING PROFUME GAS FUMIGANT INTRODUCTION SITES

The specific site(s) of release of ProFume Gas Fumigant is (are) very important to the success of the fumigation. ProFume Gas Fumigant 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 Gas Fumigant was introduced in this location, how and when will it get to the most remote locations in the structure?” 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.

Key Considerations for Site Selection for Space Fumigations

1. Large, open spaces.

2. At least one introduction location on each floor of a multi-story structure.

3. Proximity of materials or equipment that may be damaged by fumigant introduction. Do not direct the stream of ProFume Gas Fumigant directly onto any materials.

4. Recommend at least one introduction site per 2,100 cubic metres (75,000 cubic feet) of fumigated space.

The size and configuration of the space and the adequacy of the circulation will dictate the number of release sites for ProFume Gas Fumigant. As a rule of thumb, there should be sufficient circulation to establish fumigant equilibrium in about 2 hours following introduction in most situations.

THE FUMIGATION ATMOSPHERE

The air or atmosphere in which we fumigate has properties that are not always readily evident but should be understood as they relate to site fumigation.

Weight of Air: Air has weight which changes with temperature: the colder the temperature, the heavier the air; the hotter the temperature, the lighter the air. Therefore, cold air will settle to the lowest point, whereas warm air rises to the highest point in the structure being fumigated. Once these different parcels of air are thoroughly mixed they will not tend to separate or stratify. This is an important concept that must be understood as it relates to use of fumigant.

Water Vapour: The concentration of water vapour in the atmosphere varies with temperature. The warmer the air, the more water vapour it can hold. The capacity in air is shown in Table 4b.

Table 4b Water Vapour in Air at Saturation[1]

Temp °C	Temp °F	Lb H_2O/MCF	g H_2O/m^3
4.5	40	0.5	38.9
15.5	60	1.0	77.7
26.7	80	1.9	147.7
37.8	100	3.5	272.1

[1] Approximate at standard conditions.

The weight of water in a cubic metre (3.28 cubic feet) of saturated air at 27 °C (80°F) is 147.7 g. Air chilled to 15.5 ° C (60°F) can only hold 77.7 g, thus 70 g will condense out as visible water (fog, rain or dew).

Relative Humidity (RH) is the amount of water in air relative to the amount it can hold at saturation (100%) at a given temperature. Thus, if air contains 100 g and could hold 200 g at saturation, the relative humidity would be 50 percent. A psychrometre (dry and wet bulb thermometer) or a humidity gauge can measure RH.

The **Dew Point** is the temperature at which water vapour condenses from air. The **Dew Point Depression** is the number of degrees in temperature that the air must be chilled to reach the dew point.

Water evaporates into and condenses out of the atmosphere, a function that is largely dependent upon temperature, concentration and vapour pressure. ProFume Gas Fumigant use in fumigation involves, and is influenced by, some of these basic principles as it interacts with atmospheric gases.

PROFUME GAS FUMIGANT RELEASE

Two persons trained in the use of ProFume Gas Fumigant, with at least one meeting applicable provincial/territorial licensing/certification requirements must be present at all times during the introduction of ProFume Gas Fumigant and any re-entry prior to aeration.

Worker Safety

Government authorities regulate worker safety at the job site and some agencies mandate that the employer must have written safety procedures including standard operating procedures and emergency procedures. Agencies may give special attention to the following areas: self-contained breathing apparatus (SCBA) use and maintenance, working in confined spaces, man-lifts, using ladders, working on roofs/bins, and lifting heavy objects.

Any unprotected exposure to ProFume Gas Fumigant should result in a visit to your physician (consult label, booklet and manual).

Personal Protection Equipment

The ProFume Gas Fumigant label requires the following personal protective equipment:

Respiratory Protection:

If the concentration of ProFume Gas Fumigant in fumigated areas (as measured by an approved detection device with sufficient sensitivity such as the INTERSCAN or SF-ExplorIR, or CLIRcheck does not exceed 1 ppm in the breathing zones, no respiratory protection is required. Otherwise, all persons must wear a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) with a full face mask or combination air-supplied/SCBA respirator such as manufactured by Ranger, Survivair, Scott, or MSA with a full face mask. Workers performing aeration activities inside the structure must wear approved respiratory protection until the concentration of ProFume Gas Fumigant is confirmed not to exceed 1 ppm with an approved monitoring device.

Consult current standards concerning SCBA use and maintenance.

Eye Protection: Liquid ProFume Gas Fumigant can freeze the eye tissue. Eye protection also helps prevent physical injury if the hose disconnects. There is a potential for the fumigant introduction hose to burst, leak or detach from the cylinder.

Protective Clothing: A long-sleeved shirt and long pants are required. Do not wear gloves or rubber boots when introducing ProFume Gas Fumigant, as these items of protective clothing can confine the liquid against the skin and may cause freeze damage. Skin contact with gaseous ProFume Gas Fumigant is not considered a problem. However, contact with liquid ProFume Gas Fumigant can cause freeze damage.

Do not wear gloves or rubber boots that could Trap liquid fumigant against the skin

Using the Cylinder

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 has been secured.

ProFume Gas Fumigant is supplied in a cylinder equipped with a dip tube that extends from the bottom of the tank to a valve on the top (see Chapter 3 for illustration). This valve is opened to permit a free flow of the liquid, which vaporizes as it escapes from the release hose.

The last one to two kg of ProFume Gas Fumigant in the cylinder will turn to gas before moving through the hose and the flow rate is markedly reduced (see Chapter 3 for more details).

During this phase, the cylinder and hose can become frosted or iced. Care should be taken to keep this melting frost from dripping onto surfaces that can be damaged by cold temperatures or water.

Initially, the valve should be opened slightly (using an adjustable wrench works well) until flow has begun. Then open the valve about one full turn, which should give full flow through the fumigant introductions hose. When finished, close the valve tightly with the wrench. A clearance detector or leak detector (see Chapter 8) may be used to test connections for a tight seal.

Weighing The Fumigant

Either platform or hanging scales can be used to weigh the ProFume Gas Fumigant 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 Gas Fumigant distributor or Douglas Products for a source of hanging bonnets.

The cylinder should never be suspended by the valve!

Scales should be routinely calibrated to assure correct readings. Refer to the scale manufacturer for calibration and maintenance details.

Selection and Use of Equipment for Fumigant Introduction

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, and durable and be compatible with liquid sulfuryl fluoride.

The ProFume Gas Fumigant 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 Fumiguide Program for ProFume Gas Fumigant.

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, properly attach a length of copper tubing (rated for 3450 kPa (500 psi)) with approved fittings (compression fittings can be functional) to the end of the introduction hose.

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.

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 successful option is to attach the fumigant introduction hose to a solid heavy object in front of a fan angled upward at 45°.

The ProFume Gas Fumigant label requires proper fan use, during fumigant introduction.

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 are still in required working order.

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.

Change of State

When ProFume Gas Fumigant evaporates, it cools the air because it takes heat to change state from a liquid to a gas. This phenomenon is easily recognized as the action of an evaporative cooler, such as a perspiring person.

Frozen Valves and Hoses

If the ProFume Gas Fumigant cylinder valve is barely opened, to reduce the rate of release, ProFume Gas Fumigant 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 Gas Fumigant should only be controlled by the inside diameter (ID) and length of hose and not by restricting flow through the cylinder valve.

Frozen Cylinders

If a break occurs on the dip tube in the cylinder, ProFume Gas Fumigant 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 Gas Fumigant 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 (see Chapter 3 for the Cylinder Return Procedure).

Fog-outs

ProFume Gas Fumigant will also take the heat needed for vapourization from nearby objects. If the temperature of the object reaches the dew point of the surrounding air, (see Chapter 5) water can condense on it. The liquid water that condenses on an object chilled to or below the dew point is called dew, like dew on glass containers of chilled drinks.

A cloud of fine droplets suspended in air near the ground is called fog. It is very important when introducing ProFume Gas Fumigant that fog and dew formation be prevented. Liquid water absorbs the very small amount of impurities in ProFume Gas Fumigant and can result in corrosion (see Chapter 11 in this manual on Troubleshooting).

If the temperature in the fumigation area drops below the dew point, water will condense out and fog-outs can occur.

Condensation forming on the photoelectric eye of a smoke detector or motion detector can cause the alarm to activate.

Releasing ProFume Gas Fumigant will cause some condensation near the release point; slow release rate and low humidity will cause less; 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.

It is very important to use proper fans to help mix the heat of the building and fumigation atmosphere to evaporate the condensation. Consult the label for complete instructions on introducing ProFume Gas Fumigant.

Fog-out Prevention: There are several potential 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 Gas Fumigant 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 Gas Fumigant Fumiguide takes into consideration fan capacity to recommend the fumigant introduction rate.

PRECAUTIONS WHEN INTRODUCING PROFUME GAS FUMIGANT

Leak Detection and Repair

During release of ProFume Gas Fumigant, the fumigator must monitor around the perimeter of the fumigation area (especially downwind) with an approved detection device to ensure a good seal and that sulfuryl fluoride concentrations are kept within acceptable levels (<1 ppm) outside of the fumigation area. A SCBA should be readily available during the fumigant introduction period in case of leaks.

If a sustained high concentration of ProFume Gas Fumigant is detected outside the fumigation area during fumigant introduction, stop introducing the fumigant.

If any leak is encountered while using ProFume Gas Fumigant, 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 (i.e. cylinder contains pressurized air delivered “on demand” to the face piece) are permitted in the area to address the leak. Only after sulfuryl fluoride levels are < 1 ppm within the fumigated structure are unprotected personnel permitted in the area. Large leaks from structures being fumigated must be repaired immediately to minimize loss of fumigant and to reduce risk of exposure to bystanders and/or occupants of nearby structures. This involves walking around the structure or fumigated area with a monitoring device to determine if excessive amounts of fumigant are escaping. Proper PPE 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 procedures (SCBA).

Reaching Equilibrium

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

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 the mixing rate. The fan capacity, quantity, and placement determine the mixing rate. The chilled ProFume Gas Fumigant 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 Gas Fumigant will do the same when it is introduced into a fumigation space, regardless of the fact that molecules of ProFume Gas Fumigant 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 Gas Fumigant into a space to prevent stratification, to aid in proper dispersion and to assist temperature distribution.

Safety

There are several safety concerns that arise when introducing ProFume Gas Fumigant. They are covered in more detail in Chapter 3, but are also outlined here.

Cylinder Safety

- Avoid "man-handling" the cylinder for moving or weighing — use a hoist with a hanging bonnet.
- Protect the valve from damage; always replace valve cover and safety bonnet.
- Open valve slowly at first, then to open position (one full turn) so valve and the introduction hose do not frost. Use proper size adjustable wrench (25-30 cm). Keep wrench attached to valve.
- Prepare for frosting of the outside cylinder surface when releasing the last 1.5 to 2.0 kg of ProFume Gas Fumigant.
- Close valve completely when fumigant introduction is finished or cylinder is "empty."

Fumigant Introduction Hose & Fittings

- Use hose with minimum burst pressure of 3450 kPa (500 psi) compatible with liquid Sulfuryl fluoride. Polyethylene or polypropylene hoses have proven satisfactory.

- Use care not to kink or crush the hose. Reinforced hose helps prevent collapse.

Personal Safety

Respiratory Protection

- Proper respiratory equipment must be on hand including NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) with a full face mask or combination air-supplied/SCBA respirator such as manufactured by Ranger, Survivair, Scott, or MSA with a full face mask. Before using any make or brand of SCBA, learn how to use it correctly. Determine that it has an adequate air supply for the job at hand, that it fits properly, providing an adequate seal around the face, and that it is in good working order.

- Fumigations performed by any individual fumigation worker or crew member must be separated by a 2-week interval.

- Scheduled ambient air monitoring of ProFume Gas Fumigant must be conducted up to 25 m from the fumigated structure to prevent worker and bystander exposure to sustained concentrations of ProFume Gas Fumigant in excess of 1 ppm during the introduction, fumigation, and aeration phases.

- Make a security check for personnel, structure preparation and potentially involved non-targets. Apply proper lock-outs and tagging (Chapter 5).

Material Safety

- Use proper fumigant introduction techniques to prevent corrosion or water stains on interior materials.
- Provide protection for nearby plants.
- Use circuit breakers or fuses for fans.
- Place fans so they cannot cause damage to equipment.

PROFUME GAS FUMIGANT INTRODUCTION SUMMARY

The following factors need to be used in making judgments for ProFume Gas Fumigant introduction and distribution:

1. **The structure**
   - a. Size and volume
   - b. Space layout: open or compartmentalized; single or multi-story, etc.
   - c. Type of seal — structure and materials
   - d. HLT-sealing
   - e. Working temperature
   - f. Relative humidity (interior)
   - g. Equipment and Materials present
   - h. Others

2. **Pest Complex**
   - a. Species
   - b. Life stage

3. **Fumigation Atmosphere**
   - a. Temperature
   - b. Humidity
   - c. Air Circulation Pattern

4. **ProFume Gas Fumigant Dosage**
   - a. Dosage for target pests
   - b. Amount (kg or lb) ProFume Gas Fumigant for fumigation

5. **Fans**
   - a. Capacity
   - b. Number
   - c. Air stream direction
   - d. On/Off switches
   - e. Safety circuits/breakers
   - f. Aeration needs

6. **Fumigant introduction sites and hoses**
   - a. Number and location of fumigant release locations
   - b. $\geq$3450 kPa (500 PSI) burst strength
   - c. Size (ID) of hose
   - d. Length of hose
   - e. Placement and direction of outlet

7. **Fumigant introduction**
   - a. Duration of introduction
   - b. Release method— all at once or periodic "bursts"

Fumigant Introduction Checklist

- Responsibilities of fumigators onsite
- Number and location of fumigant release points (document on graph)
- Fan capacity (cubic metres/minute)
- Hose diameter
- Hose length
- Calculate actual and permitted introduction rates. Ensure actual rate does not exceed permitted rate.
- Protective sheeting under fumigant release points and hose (as needed)
- Amount of ProFume Gas Fumigant to be released
- Time of introduction
- Planned duration of introduction
- Fumigant Top-up options

Chapter 8 : MONITORING PROFUME GAS FUMIGANT

Measurement of the accumulated dosage (g-h/m^3 or oz-h/MCF) of a fumigant becomes increasingly valuable as the structure size, complexity, and the repercussions of poor pest control increase. **The objectives of monitoring fumigant concentration are:**

1. **To allow the ProFume Gas Fumigant Fumiguide to determine the optimal amount of ProFume Gas Fumigant to be introduced for controlling the target pests under the actual fumigation conditions.**

2. **To allow the ProFume Gas Fumigant Fumiguide to calculate CT (dosage) achieved to ensure a successful fumigation.**

3. **To allow the ProFume Gas Fumigant Fumiguide to calculate the actual HLT vs. just estimating the HLT.**

4. **To develop records and experience to be able to use enhanced Precision Fumigation™ techniques in following fumigations.**

Monitoring fumigant concentration 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.

Specific guidelines for monitoring the typical fumigation:

ProFume Gas Fumigant 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 Gas Fumigant has been established.

1. Monitor ProFume Gas Fumigant 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 dependable and accurate, especially when low concentrations are involved, (see following chapters on instrumentation).

4. The time required between measurements to determine the HLT will depend on the estimated HLT or past history of the structure. Usually two to four hours will be sufficient, but in the case of very large structures or excellent half-loss times, more time may be required.

Monitoring allows the correct amount of ProFume Gas Fumigant to be introduced and calculates dosage corrections necessary to ensure a successful fumigation.

EQUIPMENT

ProFume Gas Fumigant Fumiguide Program

The ProFume Gas Fumigant Fumiguide is used for all fumigations. See directions for details and specific use.

Monitoring Hoses

Arrangements should be made to place sampling hoses in the structure prior to fumigant introduction. Semi-rigid vinyl hoses (3 - 6 mm or 1/8" – 1/2" ID) should be placed so as to sample representative concentrations with a Fumiscope or other appropriate equipment. 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, be sure to place lines in areas representative of the different units. For more detailed information on monitoring hose use and placement, see Chapter 5.

Fumiscope

The Fumiscope is designed to measure the actual concentration of ProFume Gas Fumigant 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 is also used in conjunction with the ProFume Gas Fumigant Fumiguide program for determining actual half-loss times.

Fumiscope units are portable and weigh approximately 3.5 kg (8 lbs). The Fumiscope uses a mechanism to compare the thermal conductivity of a mixture of ProFume Gas Fumigant and dry air to that of dry ambient air. This difference is converted into an electric current, which is displayed as g/m^3 or ounces/1,000 ft^3.

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

The **Model D** Fumiscope has a digital readout and indicates 0-1,000 g/m^3 or ounces per 1,000 cubic feet. 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 0-50 g/m^3 or ounces/1,000 ft^3. The model E-200 has a range of 0-100 g/m^3 or ounces/1,000 ft^3. 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 H
Clearwater, FL 33762
Phone: (727) 572-1159
Fax: (727) 572-4595

Operating Procedure (for units using Drierite)

1. Fill drying tube with Drierite (4-8 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 10-15 minutes depending on the humidity), adjust the flow rate to approximately 0.28 cubic metres (1 cubic feet) 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 30.48 metres (100 feet) or less for the sample to reach the Fumiscope 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 150-200° C for 20-30 minutes then returning 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 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.

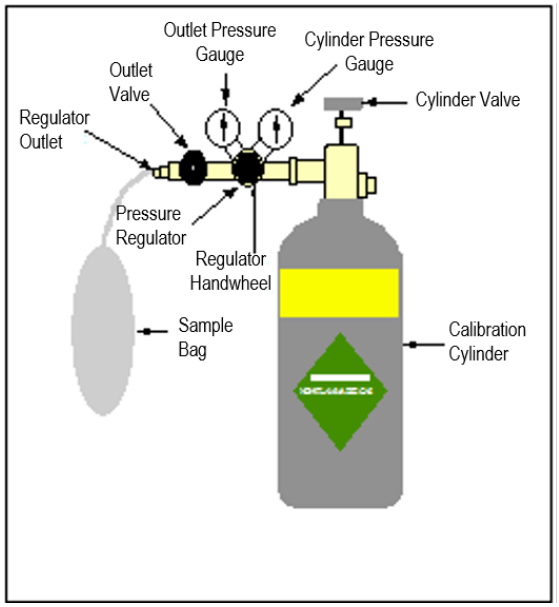
Fumiscope Calibration Procedure

Small sample cylinders containing known concentrations of ProFume Gas Fumigant 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: (521) 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 20-35 kPa (3-5 psi).

6 Attach sample bag to regulator outlet and slowly open outlet valve to fill bag approximately 90% full. Do not overfill as bag will burst.

7 Disconnect sample bag from regulator and connect to Fumiscope inlet.

8 Read Fumiscope metre for concentration of calibration standard. If the concentration on the metre is more than 5-percent 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 2-3 minutes and then adjust the metre to the gas concentration with the appropriate “pot” (blue disks).

2. Remove the bag and allow the metre 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 Gas Fumigant. 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 Gas Fumigant only, the MeBr pot should not be touched and only the pot for ProFume Gas Fumigant 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 centre is for ProFume Gas Fumigant, 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 10-15 minutes - depending on the humidity).

2. Zero - Frequently re-align metre to zero.

3. Flow rate - Keep flow rate at 0.28 cubic metres/hour (1 cubic foot/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 metres in air-conditioned environments when not in use to prevent moisture from getting into the metre. 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 metres, replace broken glass on metre 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

MONITORING SCENARIOS

Monitoring should be conducted in a manner so that the optimal amount of ProFume Gas Fumigant required is introduced based on the measured half-loss time to ensure the targeted dosage (CT) is achieved.

A typical scenario of key steps in the precision fumigation process is outlined below:

1. Input all information and variables into the ProFume Gas Fumigant Fumiguide.

2. From information provided by the ProFume Gas Fumigant Fumiguide, safely introduce part (i.e., one-half) of the calculated amount of ProFume Gas Fumigant into the fumigation space.

3. After a period of about one-hour, begin monitoring to determine when maximum concentration occurs. This is normally the time when the exposure period begins.

4. Continue to monitor at practical time intervals (initially 2-4 hours, longer thereafter) to determine the actual half-loss time over the exposure period for the structure or sub-areas.

5. Using the information calculated by the ProFume Gas Fumigant Fumiguide, either introduce additional ProFume Gas Fumigant to achieve sufficient grams-hours in the time remaining for the fumigation and/or extend exposure time and add appropriate amount of fumigant. Attempt to add fumigant early in the exposure period to get maximum efficiency in CT accumulation.

Chapter 9 : AERATION, CLEARING, AND REENTRY

One of the outstanding features of ProFume Gas Fumigant 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 rapid. 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.

When first preparing the fumigation, plan ahead for the aeration period and take steps to aid aeration by strategic placement of fans and by placing seams away from outdoor plants. Open operable internal doors, access panels, and storage bins to facilitate aeration.

After fumigation, it is essential no occupant re-enter the structure, warehouse, chamber, connected structures, or other fumigation sites until the fumigant has been aerated and the site has been fully tested and cleared for reentry.

AERATION – Best Practices

Successful, timely and safe aerations following fumigations must be planned. The following five best practices always should be planned 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, maximizing 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 below 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 help 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 needs to be controlled to ensure large volumes of fumigant laden air have time to disperse and do not exceed 1 ppm. Many mills, food processing facilities, and storage facilities have air handling systems that can easily achieve a total air exchange within the facility in a very short period of time.

However, if large volumes of air are exhausted from the facility too quickly, levels of sulfuryl fluoride may exceed the exposure level of 1 ppm. Prior to using quick aeration procedures, fumigators need to take into account the proximity to bystanders, location of other structures, wind speed and direction.

Monitor to ensure worker and bystander exposure levels are not exceeded:

As outlined on the ProFume Gas Fumigant label, this product can only be used in conjunction with a detailed fumigation management plan. When fumigating, all provincial and federal rules and regulations regarding use of detection devices, positive pressure self contained breathing apparatus, security requirements, and placement of warning signs and other requirements under the ProFume Gas Fumigant fumigation site specific management plan must be observed.

FACTORS INFLUENCING AERATION TIME

Four factors affect the time needed for aeration:

1. Rate of Air Exchange

2. Fumigant Concentration

3. Sorption/Desorption and Diffusion Rate

4. Temperature

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 Gas Fumigant 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 Gas Fumigant has relatively low sorptive 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 1 ppm or less.

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.

SAFETY CONSIDERATIONS AT AERATION

Two persons trained in the use of ProFume Gas Fumigant, at least one meeting applicable provincial/territorial licensing/certification requirements, must be present at the time of the initiation of aeration. The “opening” of a fumigation should be carried out to minimized ProFume Gas Fumigant exposures for the opening crew and bystanders.

Workers performing aeration activities must wear a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) with a full face mask or combination air supplied/SCBA respirator such as manufactured by Ranger, Survivair, Scott, or MSA with a full face mask.

USE-SPECIFIC AERATION INITIATION PROCEDURES

Space Aeration

Aerate the enclosure or structure using passive or active ventilation methods. To ensure workers and bystanders are not exposed to concentrations that exceed exposure standards for reentry, control the ventilation process, monitor concentrations of ProFume Gas Fumigant around the fumigated enclosure or structure, or prohibit entry into the area. Use fans and aeration exhaust stacks to ventilate the bulk of the fumigant from the structure’s roof eave or higher.

Bulk Commodity Aeration

Prior to offering to consumers, actively aerate food commodities for a minimum of 24 hours commencing once the mill has been cleared for worker reentry. When plastic liners are used for commodity packaging, longer aeration periods are required to aerate the commodity.

Aerate the storage facility using active ventilation methods. To ensure workers and bystanders are not exposed to concentrations that exceed exposure levels for reentry, control the ventilation process using the "Best Practices" procedures within the Chapter, monitor concentrations around the fumigated storage facility or prohibit entry into the area.

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 Gas Fumigant. Do not allow reentry into treated areas by any person before this time without proper respiratory protection.

CLEARANCE AND REENTRY

General Procedures

"Two persons trained in the use of ProFume Gas Fumigant, at least one meeting applicable provincial/territorial licensing/certification requirements, must be present during the initiation of aeration."

No one shall be in the fumigated structures if the level of ProFume Gas Fumigant is above 1 ppm 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 Ranger, Survivair, Scott, or MSA.

Note: When in the fumigated area during the aeration procedure, approved respiratory protection must be worn until concentration of ProFume Gas Fumigant is confirmed not to exceed 1 ppm with an approved monitoring device.

Re-occupancy

Do not allow re-occupancy of any fumigated site until the aeration and clearing process is complete according to label directions and sulfuryl fluoride 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 Gas Fumigant is 1 ppm or less before allowing re-occupation of the structure.

Follow all federal, provincial, and local requirements for re-occupancy.

CLEARANCE TESTING EQUIPMENT

Only an approved detection device of sufficient sensitivity, such as the INTERSCAN or SF-ExplorIR, or CLIRcheck, can be used to confirm a concentration of ProFume Gas Fumigant of 1 ppm or less. The Interscan must be calibrated within one month prior to use as a clearance device. All other approved detection devices must be calibrated according to manufacturer recommendations. The concentration of ProFume Gas Fumigant must be monitored in breathing zones. The structure or enclosure must remain posted for fumigation until cleared for reentry.

Interscan Gas Analyzer

Model GF1900 is a continuous, direct-reading instrument designed to monitor low concentrations of sulfuryl fluoride for clearing for re-entry and leak detection. **(Caution: 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 sulfuryl fluoride is converted to sulfur dioxide (SO^2) which then passes through an SO^2 sensor. The sensor output is registered on a direct reading dial as ppm of sulfuryl fluoride. The unit is lightweight and battery or AC powered for easy portability. Contact the manufacturer at Interscan Corporation, 4590 Ish Drive #110, Simi Valley, CA 93063. Phone: (800) 458-6153 for specifications, operation, calibration procedures, and repair instructions.

SF-ExplorIR

SF-ExplorIR is a continuous, direct-reading instrument designed to monitor low concentrations of sulfuryl fluoride for clearing re-entry and leak detection. Contact the manufacturer at http://www.spectroinstruments.com, for specifications, operations, calibration procedure and repair instructions.

Other Units

As new technology is developed, new devices may be developed to detect ProFume Gas Fumigant. Contact your nearest representative from Douglas Products for the latest information on detection devices.

Note: Prior to using these instruments to clear a structure for re-occupancy, metres 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 Gas Fumigant. 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.

Chapter 10 : SITE SPECIFIC CONSIDERATIONS

PREPARATION FOR CHAMBER OR STACK FUMIGATION

Safety precautions and ProFume Gas Fumigant 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 = gram-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 Gas Fumigant 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 Gas Fumigant cylinders.
6. Educate personnel in first aid procedures to be followed should an accident occur and personnel be exposed to ProFume Gas Fumigant.
7. Notify other appropriate individuals that ProFume Gas Fumigant 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, provincial, and federal laws.

Chambers and Stacks Within Structures

Permanent Chambers

Fumigations with ProFume Gas Fumigant 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 Gas Fumigant.

Monitor indoor areas around the permanent fumigation chamber for concentrations of ProFume Gas Fumigant 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 round commodities to allow even distribution of the gas.

Circulation Fan(s):

A shooting fan/circulation fan is recommended when introducing ProFume Gas Fumigant. 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 (0.45 to 1.81 kg (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 CT (g x hr/m3).

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

Worker Exposure Monitoring:

The area surrounding the vacuum chamber should be frequently monitored for ProFume Gas Fumigant 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 Gas Fumigant has dropped <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 9).

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 Gas Fumigant 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 Gas Fumigant outside the building and away from adjoining buildings or work areas. Consult applicable federal, provincial and municipal laws and regulations 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 mg x hr/L.

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 Gas Fumigant is introduced and rapidly penetrates all space previously occupied by air. A lethal dosage of ProFume Gas Fumigant results when the proper concentration is maintained for the required fumigation period. With the sustained concentration (no leakage) and a vacuum of

63.5 to 68.6 mmHg, 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 63.5 to 68.6 mmHg 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 Gas Fumigant 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 cannot be used to measure ProFume Gas Fumigant 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 Gas Fumigant 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 Gas Fumigant 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.

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

In many commodity storage situations, the amount of open space for introducing ProFume Gas Fumigant 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 Gas Fumigant 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 Gas Fumigant target dosage and quantity of fumigant needed using the ProFume Gas Fumigant Fumiguide.
4. Make adjustments to the dosage based on the fumigant monitoring results and ProFume Gas Fumigant 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 downstream 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 Gas Fumigant 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 Gas Fumigant 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 by workers during fumigant introduction, fumigation and aeration until the fumigant has been aerated to a concentration below1 ppm in the treated structure/area.
5. The storage facility should be finally aerated to <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 Gas Fumigant. Do not allow reentry into treated areas by any person before this time without proper respiratory protection.
7. Prior to offering to consumers, actively aerate food commodity a minimum of 24 hours commencing once the mill has been cleared for worker reentry.

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 Gas Fumigant 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 Gas Fumigant. However, no direct fumigation of processed foods is permitted unless the processed food is specifically listed in the chapter Commodities That Can Be Fumigated.

Chapter 11 : TROUBLESHOOTING

ProFume Gas Fumigant 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 Gas Fumigant cylinders are fitted with special valves that are appropriate for use with sulfuryl fluoride. These valves can be damaged if wrong size wrench is used. A 25-30 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 Gas Fumigant 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 34-40 Nm of torque with an adjustable wrench will stop the leak. (See ProFume Valve Stem Adjustment Procedures at the end of Chapter 3)

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 cylinders to your ProFume Gas Fumigant distributor so it may be sent to Douglas Products for repairs (see Chapter 3 for Cylinder Return Procedure).

Dip Tubes

A broken dip tube rarely is the reason liquid ProFume Gas Fumigant cannot be moved out of the cylinder when the valve is wide open. Sharp blows to the cylinder, rough handling, or dropping of the cylinder can break off the dip tube from the bottom of the valve (see Chapter 3). If the dip tube is broken, ProFume Gas Fumigant will be released from the cylinder, but at a much slower rate. Either introduce the ProFume Gas Fumigant slowly or replace the bonnet and call your distributor for instructions on cylinder return procedures (see Chapter 3 for 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 Gas Fumigant is not known to cause any corrosion when it is in the vapour (gaseous) phase under normal temperatures. Every batch of ProFume Gas Fumigant 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 Gas Fumigant is released incorrectly. If ProFume Gas Fumigant 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 Gas Fumigant 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 (one kg ProFume Gas Fumigant per 60 m^3/minute of fan capacity) to thoroughly mix the colder air where ProFume Gas Fumigant is introduced into the warmer air in the structure (see Chapters 5, 6 and 8).

Metal tarnishing/corrosion can also occur if heat sources are left on during fumigation. ProFume Gas Fumigant 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 Gas Fumigant to corrosive materials (mainly HF, hydrofluoric acid). Therefore, it is imperative that pilot lights and other heat sources 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 Gas Fumigant in the gaseous phase is not known to cause etching of glass. HF (hydrofluoric acid), the decomposition product of ProFume Gas Fumigant (as described under the chapter on corrosion), 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 and pilot lights be turned off during fumigation. Fog-outs can also cause etching of glass and ceramic tile. Each batch of ProFume Gas Fumigant is also tested before it leaves the production plant.

RUN STAINS

ProFume Gas Fumigant 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 where ProFume Gas Fumigant is introduced with the air in the structure (see Chapter 7). 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 colour 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 Gas Fumigant. 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 Gas Fumigant in the vapour phase does not cause staining or discolouration of fabric or other materials normally found in a structure under fumigation. Fabric staining or colour changes can occur when a high heat source (i.e., pilot light) converts sulfuryl fluoride to the acid, HF (hydrofluoric acid), sulfur dioxide 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 Gas Fumigant 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 (see Chapter 7). Initially, slowly open the valve a quarter to one half turn to begin the flow of liquid ProFume Gas Fumigant. 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 Gas Fumigant 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 Gas Fumigant on surfaces. Replace kinked or damaged hoses. Use mesh-reinforced, flexible hosing of proper specifications to avoid this problem.

During ProFume Gas Fumigant release from the cylinder, some chilling of the valves, cylinder, and fumigant introduction hoses can occur under normal circumstances. Valves can freeze if ProFume Gas Fumigant 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 Gas Fumigant 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 (see Chapter 5). 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 Gas Fumigant will not readily move through moist soil.

Certain plants have been found to be more sensitive to ProFume Gas Fumigant 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 which they are used to — same temperature, light, humidity, etc.

ODOUR PROBLEMS

Odours 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 Gram x H).

5. Not using adequate fans to distribute the gas properly within the site.

6. Not accurately determining the temperature of the site of pest.

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.

PLASTICS

Liquid ProFume is a good solvent of some plastic materials. ProFume Gas Fumigant should not be introduced directly onto plastic surfaces such as windows, as liquid droplets may discolour or etch the material.

Plastic fittings (connections) are not recommended for use with ProFume Gas Fumigant. Certain nylon fittings have been damaged by the liquid dissolving the plasticizers in the plastic that resulted in the formation of a white powder in the hose. No information is available on other types of plastic connectors; therefore, only metal connections are recommended.

MISCELLANEOUS

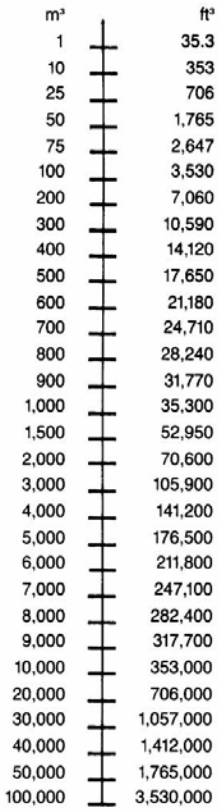
White Powder Left as Residue:

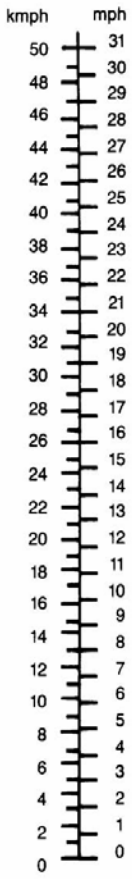
A white powder substance found on windows, tile, glass, lamps, etc. indicates that a source of heat (pilot lights, etc.) was left on during the fumigation.

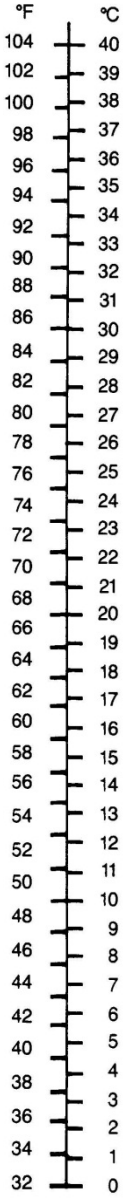
Chapter 12 : APPENDIX

ENGLISH-METRIC CONVERSION TABLES

Volume	Wind Speed	Temperature
1 ft^3 = 0.0283 m^3 1 m^3 = 35.31 ft^3	1.609 kph = 1 mph 0.621 mph = 1 kph	(C x 1.8) + 32 = °F (°F – 32) ÷ 1.8 = °C







DOSAGE ≈ g-hr/m^3 oz-hr/1000ft^3	PRESSURE 1 PSI ≈ 6.9 Kpa ≈ 0.68 bar 1 bar ≈ 100 Kpa ≈ 14.50 PSI