19713-596 9/25/2009 1 of 39

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

Luz Chan
Drexel Chemical Company
P.O. Box 13327
Memphis, TN 38113-0327

SEP 25 2009

Dear Ms. Chan:

Subject: Labeling Amendment; Revised Placard Verbiage
Master Fume
EPA Registration No. 19713-596
Submission Date: September 1, 2009 (originally submitted as notification)

The labeling referred to above, submitted in connection with registration under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, is acceptable. A stamped copy is enclosed for your records. Please submit one (1) final printed copy for the above mentioned label before releasing the product for shipment. If you have any questions regarding this label, please contact me at (703) 306-0415.

Sincerely yours,

Kable Bo Davis
Entomologist
Insecticide-Rodenticide Branch
Registration Division (7505P)

20f39

RESTRICTED USE PESTICIDE

(Due to Acute Inhalation Toxicity of Sulfuryl Fluoride)

FOR SALE TO AND USE ONLY BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION AND ONLY FOR THOSE USES COVERED BY THE CERTIFIED APPLICATOR'S CERTIFICATION. AN APPLICATOR CERTIFIED BY THE STATE AND ONE TRAINED PERSON MUST BE PRESENT ON SITE AT ALL TIMES DURING INTRODUCTION OF FUMIGANT, REENTRY PRIOR TO AERATION, AND INITIATION OF THE AERATION PROCEDURE.

ACCEPTED

SEP 25 2009

Under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, for the pesticide registered under EPA Reg. No. 19713-596

Drexel

MASTER FUME™

Specialty Gas Fumigant

For control of existing infestations of insects and related pests such as (or including) Bedbugs, the larvae and adults of Carpet beetles (except egg stage), Clothes moths, Cockroaches (American, Brown-banded, Oriental cockroaches), Death watch beetles, Drywood termites, Formosan termites, Old house borers, Powder post beetles, Rodents (rats, mice).

For use in dwellings (including mobile homes), Buildings, Construction Materials, Furnishings (household effects), Shipping containers and Vehicles including automobiles, buses, passenger rail cars, recreational vehicles (but not including aircraft), and surface ships.

ACTIVE INGREDIENT:

Sulfuryl fluoride	99.8%
OTHER INGREDIENTS:	0.2%
TOTAL:	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER PELIGRO

POISON VENENO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle.
(If you do not understand the label, find someone to explain it to you in detail.)

See FIRST AID Below

EPA Reg. No. 19713-596

EPA Est. No. 19713-XX-XXX **Net Content:** _____

FIRST AID

IF INHALED:
- Get exposed person to fresh air.
- Keep warm and at rest.
- Make sure person can breathe freely.
- If breathing has stopped, give artificial respiration.
- Do not put anything in the mouth of an unconscious person.
- Call a poison control center or doctor for further treatment advice.

IF LIQUID IS 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.
- Wash contaminated skin area thoroughly or shower.
- Call a poison control center or doctor for treatment advice.

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

In all cases of overexposure, such as nausea, difficulty in breathing, abdominal pain, slowing of movements and speech, numbness in extremities, get medical attention immediately. Take person to a doctor or emergency treatment facility. Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For information on this pesticide product (including health concerns, medical emergencies or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.

Note to Physician: This product is a gas which has no warning properties such as odor or eye irritation. (However, chloropicrin is used as a warning agent and is a known lachrymator). Early symptoms of exposure to this product are respiratory irritation and central nervous system depression.

(Continued)

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 of this product can result in significant lung and kidney damage. Single exposures at high concentrations have resulted in death. Treat symptomatically. The liquid form of this product in the eye may cause damage due to refrigeration or freezing.

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

DANGER: Fatal if inhaled. May be fatal if swallowed. Extremely hazardous liquid and vapor under pressure. Liquid may cause freeze burns of exposed skin.

Do not get in eyes, on skin, or on clothing. This product is an odorless gas fumigant. Exposure to toxic levels may occur without warning or detection by the user.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Protective Clothing

Wear splash-resistant goggles (goggles designed and made of material that allows no measurable movement of the liquid pesticide being used to pass through them during use) or full face shield for eye protection during introduction of the fumigant. Do not wear gloves or rubber boots. Do not reuse clothing or shoes that have become contaminated with this product until thoroughly aerated and cleaned.

Respiratory Protection

If the concentration of this product in the breathing zone of the fumigated area (as measured by a detector device with sufficient sensitivity such as an INTERSCAN, MIRAN or SF-ExplorIR™ gas analyzer) does not exceed 1 ppm (4 mg/cubic meter), no respiratory protection is required. (A breathing zone is defined as the area within a structure where individuals typically stand, sit or lie down.) When this concentration is exceeded, all persons in the exposed area must wear a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air-supplied/SCBA respirator such as manufactured by Draeger, Ranger, Survivair, Scott, or MSA. 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. For more detailed information on the source and use of air monitoring devices and respirators, consult the Structural Fumigation Manual of this product.

Notice: Read the entire label. Use only according to label directions. Before buying or using this product, read "Warranty-Conditions of Sale".

In case of emergency endangering health or the environment involving this product, call 1-877-208-2593. If you wish to obtain additional product information call Drexel Chemical Company at (901) 774-4370.

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

INFORMATION

APPLICATION PERSONNEL MUST PARTICIPATE IN DREXEL CHEMICAL'S SULFURYL FLUORIDE TRAINING AND STEWARDSHIP PROGRAM, MASTER TRAIN.

The Manual is part of the labeling for this product.

Read the label before using this product. Follow all label precautions and directions. Prior to the parties entering into a fumigation agreement, the Fact Sheet for this product must be provided to an adult occupant of the structure to be fumigated. This product is a highly hazardous material. Only individuals knowledgeable of the hazards of this chemical and trained in the use of required respiratory equipment, detector devices, emergency procedures, and in the proper use of this fumigant should use this product.

DIRECTIONS FOR USE

RESTRICTED USE PESTICIDE

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

When fumigating, observe local, state and federal rules and regulations including the use of the warning agent, chloropicrin, clearing devices, positive-pressure self-contained breathing apparatus, security requirements, and placement of warning signs.

USE PRECAUTIONS

When used for fumigation of enclosed spaces, such as boxcars, chambers, houses and other structures, ships, and other transport vehicles, trucks, warehouses, vans, vaults, two persons trained in the use of this product must be present at all times during introduction of fumigant, reentry prior to aeration, and during the initiation of the initial aeration procedure when exposure within the breathing zones exceeds 1 ppm. At least one person must be an applicator that is licensed/certified by the state. Two persons, however, need not be present if monitoring is conducted remotely (outside the area being fumigated) and no one enters the fumigated structure.

Do not apply when temperature at site of pest activity is below 40°F if fumigation is intended for control of insect pests. The temperature should be measured at the coolest site of pest activity. The coolest site may be at the slab foundation, sub-floor soil, or other areas. This restriction does not apply when this product is used to control rodents.

When fumigating connected structure or structures attached by means physically capable of transmitting gas, all attached units will be regarded as fumigated space. Therefore, all units will be vacated, items that must be bagged or removed will be handled accordingly, and all entrances will be posted and secondarily locked.

Chloropicrin must be used according to the label requirements in the fumigated space(s).

PREPARATION FOR FUMIGATION

Chamber Fumigation

Use a tightly sealed chamber with adequate circulation for chamber fumigation.

Construction Materials, Furnishings (Household effects), Shipping containers and Vehicles

Fumigation

Follow preparations as appropriate for chamber, taped fumigation, or tarpaulin fumigation to assure good confinement of the gas for the recommended period of exposure.

Structural Fumigation

Remove from the structure to be fumigated all persons, domestic animals, pets, and desirable growing plants. Remove fish tank containing live fish, or remove the fish, or develop a plan for preparing the tank for fumigation. If necessary, exclude water in the tank and biological filters, if present, from the fumigated space by sealing with gas resistant tarps or sheeting. If water aeration is required during the fumigation, provide fresh air from outside the fumigated space for the tank aerator. Remove mattresses (except waterbeds) and pillows completely enveloped in water proof covers or remove covers (or open seal of waterproof covers). Food, feed, drugs, tobacco products, and medicinals (including those items in refrigerators and freezers) can remain in the structure if they are unopened plastic soda and water bottles, unopened glass or metal bottles, cans, or jars with the original manufacturer's air-tight seal intact. Food, feed, drugs, tobacco products, and medicinals (including those items in refrigerators and freezers) not in glass or metal bottles, cans, or jars, or plastic water and soda bottles with the original manufacturer's air-tight seal intact, need to be removed from the fumigation site, or double bagged in Master Fume bags, Nylofume® bags or Fumiguard bags, which are available from distributors of these products.

Open operable internal doors, internal openings to attics and sub areas, storage chests, cabinets, drawers, closets, and appliances (such as washers, dishwashers, dryers, microwave or conventional ovens, etc.). Using electric fan(s) will help provide for forced distribution and aeration of basements and other dead air spaces to facilitate rapid dispersion of gas. Refrigerator and freezer doors may be left open if the units are turned off or disconnected and all food items have been removed. If the applicator chooses to leave sealed food items in closed refrigerators and freezers during the fumigation, the appliances should be opened when clearing the structure until the concentration of this product in them is 1 ppm or less.

Use Precautions: Extinguish all flames, including pilot lights of water heaters, gas refrigerators, ranges, ovens, broilers, dryers, gas fireplaces, etc. Turn off or unplug all electrical heating elements such as those in heaters, pianos, organs, etc. Shut off automatic switch controls for appliances and lighting systems which will be included in the space to be fumigated.

Multi-Unit Structures: When fumigating a single unit/room within a larger structure (such as townhouses, apartments, condominiums), all units of the entire structure must be prepared as a fumigated structure, and all applicable rules, regulations and label instructions apply, such as occupant notification, structure preparation, posting, securing and aeration. An adult occupant of each currently-occupied unit must be provided with the Fact Sheet for this product. Ensure that all exterior doors providing access to individual units are secured with secondary locks (see Securing Structure Entrances) so that only the state licensed applicator in charge can gain access. Chloropicrin need only be used in the fumigated space where Master Fume is introduced. During Step(3) of Aeration Procedure 1 or 2, check all units within the fumigated structure for concentration of this product with an approved clearance device. If the concentrations of this product is greater than 1 ppm in the breathing zone in a unit, ventilate the unit with operable doors and windows open until concentrations in the breathing zones in all units is 1 ppm or less. A breathing zone is defined as the area in a structure where individu[als] typically sit, stand or lie down.

Connected Structures: A connected structure is defined as any structure connected with the structure to be fumigated by construction elements (e.g., pipes, conduits, ducts, etc.) which may allow passage of fumigant between the structures. If state rules and regulations do not describe or permit a process to isolate and seal a connected structure to prevent passage of fumigant from the fumigated structure, then the connected structure must be vacated during the fumigation. When it is necessary to vacate any connected structure, that structure shall be considered as a fumigated structure and all applicable rules, regulations and label instructions apply, such as occupant notification, structure preparation, posting, securing, and aeration. Chloropicrin need only be used in structures where Master Fume is introduced. Concentration levels of this product must be measured in the breathing zones (see Aeration and Reentry) in any connected space or structure to confirm concentrations are 1 ppm or less before structure can be reoccupied. A breathing zone is defined as the area within a structure where individuals typically stand, sit or lie down.

Surface Ships in Port Fumigation

Surface ships in size up to and including large ocean-going ships may be fumigated with this product to control the various pests listed. The professional fumigator and the ship's captain (or owner) shall follow all applicable regulations including those listed in the Coast Guard, Department of Transportation, Title 46, Shipping Section, Parts 147A.1-147A.43. No people, plants, or pets may be on-board during fumigation except for those persons involved in fumigation.

The person responsible for the fumigation must notify the master of the vessel, or his representative, of the requirements relating to personal protection equipment and detection equipment. Emergency procedures, cargo ventilation, periodic monitoring and inspections, and first aid measures must be discussed with and understood by the master of the vessel or his representative.

If leakage of the fumigant is detected, the person in charge of the fumigation shall take action to correct the leakage, or shall inform the master of the vessel, or his representative, of the leakage so that corrective action can be taken.

Food, feed, drugs, tobacco products and medicinals shall not be exposed to the chemical. If not removed from the vessel, they shall be protected from exposure. The vessel must not be moved during fumigation and aeration periods. If reentry is necessary before aeration is completed, positive pressure self-contained respiratory protection must be worn.

Tarpaulin Fumigation

Open operable windows as permitted by local and state regulations. When tarping, use a highly resistant material such as a vinyl coated nylon, or polyethylene sheeting of at least 4 mil thickness. Seal all seams. Seal the bottom edges of the cover to the ground using materials (such as soil, sand, or weighted "snakes"). If needed wet soil outward from foundation to the cover if soil is not sufficiently moist to act as a barrier for the gas to minimize escape of gas through the soil and to avoid injury to nearby plants.

Taped Fumigation

For fumigation sites that can be sealed with plastic or tape, seal adequately around doors, windows, vents, and other openings.

Warning Agent

Chloropicrin is a warning agent introduced into the structure during fumigation. It causes smarting of the eyes, tears, and discomfort, and has a very disagreeable pungent odor at very low concentrations. Chloropicrin must be used by a person certified to apply this fumigant or under their supervision.

In order to avoid direct exposure to the fumigant being released, chloropicrin must be released within the structure at least **5 to 10 minutes prior to introduction of the** fumigant. Place a handful of wicking agent, (e.g., cotton) in a chloropicrin evaporation container. Do not use chloropicrin evaporation containers or application equipment made of magnesium, aluminum, or their alloys, as chloropicrin may be severely corrosive to such metals. To enhance the distribution of chloropicrin throughout the structure, place the chloropicrin evaporation container in the air stream of a fan. Pour chloropicrin over the wicking agent. When adding chloropicrin to evaporation containers, dispense no more than 3 fluid ounces per container. Use 1 fluid oz. per 10,000 to 15,000 cubic feet - (30 ml per 283 to 425 cubic meters) of space to be fumigated or follow dosage rate calculated by the electronic Master Fume Calculator system. Establish at least one chloropicrin introduction site for each 45,000 cubic feet of space to be fumigated. Removal of all chloropicrin evaporation containers from the fumigated space during the initial phase of aeration will aid in the dissipation of the warning agent from the structure.

Chloropicrin need not be used when fumigating railcars; however, a thorough walk-through inspection must be performed of each railcar with doors being immediately locked upon leaving each car, and a guard must be posted during fumigant introduction, exposure period, and aeration.

Fumigators must observe the precautionary statements and safety recommendations appearing on the Chloropicrin label.

PREFUMIGATION CHECK

Check for potential leaks.

SECURING STRUCTURE ENTRANCES

To secure the structure against unauthorized entry during the fumigation exposure period and Step 2 of Aeration Procedure 1 or 2, use a locking device or barricade on all exterior door or doorways. A locking device, such as a secondary lock, or barricade must be demonstratively effective in preventing an exterior door or doorway from being opened from the exterior using normal opening or entering processes by anyone other than the certified applicator in charge of the fumigation or persons in his/her on-site direct supervision. Consult state and local regulations for any supplementary instructions and restrictions on secondary locks.

DOSE AND TIME OF EXPOSURE

To control drywood termites and non-egg s[tages] of other insect and related structural and household pests, Drexel Chemical's Master Fume Calculator is to be used for the coordination of fumigant rates with soil or slab temperature, exposure period, and fumigant loss rate measured as half-loss-time (HLT).

When control of the egg stage is desired or when fumigating for Formosan termites, use the following multiple factor of the drywood termite dosage as determined by Drexel Chemical's Master Fume Calculator for pests listed in the following table:

Pest	Dosage Factor (as a multiple of drywood termite dosage)
Rodents[1]	0.5X
Carpet Beetles[2] and Cockroaches[2]	1X
Furniture Carpet Beetles[2] and Bedbugs	3X
Old House Borers and Formosan Termites	4X
Clothes Moths	6X
Powder Post Beetles and Death Watch Beetles	10X

[1]To determine the proper dose for rodent control, use 80°F as the calculating temperature. Unlike insects, rodents are warm blooded and do not require increased dosages at lower temperatures.
[2]More than one fumigation may be needed to control the infestation after egg hatch.

These dosages apply to dwellings, buildings, construction materials, furnishings, and vehicles.

To control rodents, use sufficient gas to accumulate at least 36 ounce-hours following equilibrium, regardless of ambient air temperature. Refer to the Structural Fumigation Manual of this product.

Drexel Chemical's Master Fume Calculator is a program that requires entry of key information to determine the dosage and amount of this product to be used. Consult the Structural Fumigation Manual of this product for more details. Before Drexel Chemical's Master Fume Calculator program can be used, contact your Drexel Chemical Company representative for how to activate the program for calculating dosage. Drexel Chemical's Master Fume Calculator program may be modified and updated from time to time; please contact your Drexel Chemical Company representative for more information.

RELEASING THE FUMIGANT

Release the fumigant from outside of the fumigated space. The release point(s) should be into a large open space(s) in the fumigation site(s). Release the fumigant through a suitable leak-proof tube with a minimum burst pressure of 500 psi. Direct the fumigant into the blast of air from a fan(s) having a capacity of at least 1000 cubic feet per minute (cfm) for each pound of this product released per minute. Damage to household materials can occur if insufficient fan capacity is used for releasing the rate of this product. It is recommended that protective sheeting, such as polyethylene plastic under the shooting stand, shooting hose, and shooting fan can be used to further protect floors during application.

Use Precautions: Do not apply fumigant directly to any surface to prevent damage.

POSTING OF FUMIGATED AREAS

The applicator must post all entrances to the fumigated areas with signs bearing in English and Spanish.

1. The signal word DANGER/PELIGRO and the SKULL and CROSSBONES symbol.
2. The statement, "Area under fumigation, DO NOT ENTER/NO ENTRE".
3. The date of fumigation.
4. Name of fumigant used.
5. Name, address, and telephone number of the applicator.

Only a certified applicator may authorize removal of placards, and only when the concentration of this product in the breathing zone of the treated site is 1 ppm or less. A breathing zone is defined as the area within a structure where individuals typically stand, sit or lie down.

AERATION AND REENTRY

No one should be allowed in treated areas if the level of this product exceeds 1 ppm in the breathing zone. A breathing zone is defined as the area within a structure where individuals typically stand, sit or lie down. **Note: During the initial one hour aeration procedure, approved respiratory protection must be worn until the concentration of this product is confirmed not to exceed 1 ppm with an approved detection device.** Since the INTERSCAN, MIRAN or SF-ExplorIR gas analyzers give immediate readings, respiratory protection is not required when clearing with these instruments after having completed the initial 1 hour aeration procedure. If a reading indicates levels above 1 ppm, leave the affected area immediately.

Only an approved detection device of sufficient sensitivity, such as the INTERSCAN, MIRAN or SF-ExplorIR, can be used to confirm a concentration of 1 ppm or less of this product. The INTERSCAN must be calibrated according to manufacturer recommendations 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 this product must be monitored in breathing zones. Structure must remain posted for fumigation until cleared for reentry.

Open all operable doors and windows including doors between the attached garage and structure. Open all operable attic doors and accesses and direct the air flow of a fan into the attic. If the structure has a central air handling system, the fan (or blower) should be activated for each unit if operational. As an alternative, a fan may be placed in front of a sy[stem] [out]let to blow air into central heating or cooling ducts. Select the appropriate p[roce]dure based on the fumigation rate:

All structures fumigated at 16 oz/MCF or less may be aerated using Aeration Procedure 1 or 2.

All structures fumigated at concentrations greater than 16 oz/MCF must be aerated using Aeration Procedure 2.

Aeration Procedure 1

These steps must be completed in succession.

Step 1: Aerate structure with all operable windows and doors open, aided by the use of 1 or more fans, for a minimum of 1 hour. Total fan capacity using one or more fans shall be capable of displacing a total of 5,000 cfm.

Step 2: Secure structure and do not allow reentry for a minimum of 6 hours from the start of aeration (first opening of the seal). During this time, structures must remain posted.

Step 3: After the minimum 6 hour waiting period, measure the concentration of this product in breathing zones of each room. If the concentration of this product is above 1 ppm, ventilate structure with operable doors and windows open. Structure may be reoccupied when concentration of this product is 1 ppm or less in the breathing zones.

Aeration Procedure 2

These steps must be completed in successsion.

Step 1: Aerate structure with all operable windows and doors open, aided by the use of 1 or more fans, for a minimum of 1 hour. Total fan capacity, using one or more fans shall be capable of displacing a total of 5,000 cfm.

Step 2: Secure the structure and do not allow reentry for a minimum of 8 hours from the start of aeration (first opening of the seal). During this time, the structure must remain posted.

Step 3: After the minimum 8 hour waiting period, measure the concentrations of this product in breathing zones of each room. If the concentration of this product is above 1 ppm, ventilate structure with operable doors and windows open. Structure may be reoccupied when the concentration of this product is 1 ppm or less in the breathing zones.

For more detailed information on the source and use of air monitoring devices or respirators, consult the Structural Fumigation Manual of this product. Do not reoccupy fumigation site, i.e. building, ship, vehicle or chamber, or move vehicle until aeration is complete. Warning signs must remain posted until aeration is determined to be complete and it is safe for reentry.

STORAGE AND DISPOSAL

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

PESTICIDE STORAGE AND HANDLING: Store in dry, cool, well ventilated area under lock and key. Post as a pesticide storage area. If the storage area is in an occupied building, the storage area must have either 1) a forced air ventilation system that meets required local ordinances for the storage of hazardous materials and operates continuously; or 2) be equipped with a permanently mounted and properly maintained and functioning sulfuryl fluoride monitoring device designed to alert occupants of the building if sulfuryl fluoride in the air of the storage area is greater than 1 ppm. 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. Do not transport any cylinders in closed vehicles where they occupy the same common airspace as personnel. 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.

Leak Procedures: Evacuate immediate area of leak. Use a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air-supplied/SCBA respirator, such as manufactured by Ranger, Survivair, Scott, or MSA, for entry into affected areas to correct problem. Move leaking or damaged cylinder outdoors or to an isolated location, observing strict safety precautions. Work upwind if possible.

Do not permit entry into leakage area by unprotected persons until concentration of fumigant in the breathing zone is determined to be 1 ppm or less, as determined by a detection device with sufficient sensitivity such as an INTERSCAN, MIRAN or SF-ExplorIR gas analyzer. For more detailed information on the source and use of air monitoring devices or respirators, consult the Structural Fumigation Manual of this product.

CYLINDER AND PRODUCT DISPOSAL: Promptly return all empty cylinders to your distributor of this product. Follow proper cylinder handling directions above. Pesticide wastes are toxic. Improper disposal of excess pesticide is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, consult your State Pesticide or Environmental Control Agency, or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.

WARRANTY DISCLAIMER

Drexel Chemical Company warrants that this product conforms to the chemical description on the label and based upon tests is believed reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. To the extent consistent with applicable law, Drexel Chemical Company makes no other express or implied warranty of merchantability or fitness for a particular purpose or any other express or implied warranty.

Use Risk

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label, such as unfavorable weather, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of Drexel Chemical Company or the seller. To the extent consistent with applicable law, all such risks shall be assumed by buyer.

Limitation of Remedies

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

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

To the extent consistent with applicable law, in no case shall Drexel Chemical Company or the seller be liable for consequential, special or indirect damages or losses from the use, handling, or storage of this product.

The terms of the "Warranty Disclaimer" above and this "Limitation of Remedies" cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Drexel Chemical Company or the seller is authorized to vary or exceed the terms of the "Warranty Disclaimer" or this "Limitation of Remedies" in any manner.

Manufactured By:
Drexel Chemical Company
P.O. BOX 13327, MEMPHIS, TN 38113-0327
SINCE 1972

RESTRICTED USE PESTICIDE

(Due To Acute Inhalation Toxicity Of Sulfuryl Fluoride)

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

MANUAL FOR STRUCTURAL FUMIGATION

Drexel

MASTER FUME™

Specialty Gas Fumigant

For control of existing infestations of insects and related pests such as (or including) Bedbugs, the larvae and adults of Carpet beetles (except egg stage), Clothes moths, Cockroaches (American, Brown-banded, Oriental cockroaches), Death watch beetles, Drywood termites, Formosan termites, Old house borers, Powder post beetles, Rodents (rats, mice).

For use in dwellings (including mobile homes), Buildings, Construction Materials, Furnishings (household effects), Shipping containers, and Vehicles including automobiles, buses, passenger rail cars, recreational vehicles (but not including aircraft) and surface ships.

ACTIVE INGREDIENT:	
Sulfuryl fluoride	99.8%
OTHER INGREDIENTS:	0.2%
TOTAL:	100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER PELIGRO

POISON VENENO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

See FIRST AID Below

EPA Reg. No. 19713-596

FIRST AID

IF INHALED:
- Get exposed person to fresh air.
- Keep warm and at rest.
- Make sure person can breathe freely.
- If breathing has stopped give artificial respiration.
- Do not put anything in the mouth of an unconscious person.
- Call a poison control center or doctor for further treatment advice.

IF LIQUID IS 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.
- Wash contaminated skin area thoroughly or shower.
- Call a poison control center or doctor for treatment advice.

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

In all cases of overexposure, such as nausea, difficulty in breathing, abdominal pain, slowing of movements and speech, numbness in extremities, get medical attention immediately. Take person to a doctor or emergency treatment facility. Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For information on this pesticide product (including health concerns, medical emergencies or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.

Note to Physician: This product is a gas which has no warning properties such as odor or eye irritation. (However, chloropicrin is used as a warning agent and is a known lachrymator). Early symptoms of exposure to this product 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

(Continued)

(Continued)

concentrations of this product can result in significant lung and kidney damage. Single exposures at high concentrations have resulted in death. Treat symptomatically. The liquid form of this product in the eye may cause damage due to refrigeration or freezing.

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

DANGER: Fatal if inhaled. May be fatal if swallowed. Extremely hazardous liquid and vapor under pressure. Liquid may cause freeze burns of exposed skin. Do not get in eyes, on skin, or on clothing. This product is an odorless gas fumigant. Exposure to toxic levels may occur without warning or detection by the user.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Protective Clothing

Wear splash-resistant goggles (goggles designed and made of material that allows no measurable movement of the liquid pesticide being used to pass through them during use) or full face shield for eye protection during introduction of the fumigant. Do not wear gloves or rubber boots. Do not reuse clothing or shoes that have become contaminated with this product until thoroughly aerated and cleaned.

Respiratory Protection

If the concentration of this product in the breathing zone of the fumigated area (as measured by a detector device with sufficient sensitivity such as an INTERSCAN, MIRAN or SF-ExplorIR™ gas analyzer) does not exceed 1 ppm (4 mg/cubic meter), no respiratory protection is required. [A breathing zone is defined as the area within a structure where individuals typically stand, sit or lie down.] When this concentration is exceeded, all persons in the exposed area must wear a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air-supplied/SCBA respirator such as manufactured by Draeger, Ranger, Survivair, Scott or MSA. 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.

Notice: Read the entire label. Use only according to label directions. Before buying or using this product, read *"WARRANTY DISCLAIMER"*.

In case of emergency, endangering health or the environment involving this product, call 1-877-208-2593. If you wish to obtain additional product information call Drexel Chemical Company at (901) 774-4370.

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

INFORMATION

APPLICATION PERSONNEL MUST PARTICIPATE IN DREXEL CHEMICAL'S SULFURYL FLUORIDE TRAINING AND STEWARDSHIP PROGRAM, MASTER TRAIN.

This manual is part of the labeling for this product. This manual was written to expand on information contained in the product label and is not intended to supersede the container label, State or Local requirements. All information contained in this manual are to help better stewardship the use of this product.

Read the label before using this product. Follow all label precautions and directions. Prior to the parties entering into a fumigation agreement, the Fact Sheet for this product must be provided to an adult occupant of the structure to be fumigated.

TABLE OF CONTENTS

This product is a highly hazardous material. Only individuals knowledgeable of the hazards of this chemical and trained in the use of required respiratory equipment, detector devices, emergency procedures and in the proper use of this fumigant should use this product.
Two persons trained in the use of this product must be present on site at all times during introduction of the fumigant, reentry prior to aeration, initiation of the aeration procedure and when testing for reentry after aeration (if aerated in an enclosed space) with at least one person being an applicator certified by the state. It is essential that no occupant reenter the fumigated space after fumigation until the fumigant has been aerated and the space has been fully tested and cleared for reentry.
See Chapter 4 for detection device.

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

PHYSICAL OR CHEMICAL HAZARDS
Sulfuryl fluoride is a colorless, odorless toxic gas. Cylinders of this product are under pressure and must not be stored near heat or open flame.
Exposures to temperatures above 158°F will cause a fusible plug to melt and the contents will be released. Under high heat conditions (temperatures above 752°F), this product can decompose into sulfur dioxide (SO_2), hydrofluoric acid (HF), and other decomposition products. Hydrofluoric acid is highly reactive and can corrode or damage many materials including metals, glass, ceramic finishes, fabrics, etc. Extinguish all flames including pilot lights of furnaces, hot water heaters, dryers, gas refrigerators, ranges, ovens, broilers, etc. Turn off or unplug all electrical heating elements such as those in heaters, dryers, etc., that represent a reasonable risk of a heat source that is at or near 752°F. Shut off automatic switch controls for appliances and lighting systems that will be included in the space to be fumigated. Contact your local gas company to determine what procedures should be followed in your area for shutting off natural gas or propane service. Gas service should be shut off at the main service valve. Sulfuryl fluoride can react with strong bases such as some photo developing solutions.
Notice: Read the entire label. Use only according to label directions. Before using this product, read Warranty Disclaimer, Use Risk and Limitation of Remedies elsewhere on the label. If terms are unacceptable, return at once unopened. In case of emergency, endangering health or the environment involving this product, call 1-800-424-9300. If you wish to obtain additional product information, call Drexel Chemical Company at (901) 774-4370.

FUMIGATING WITH THIS PRODUCT

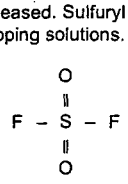
PRODUCT INFORMATION
MASTER FUME contains the active ingredient, sulfuryl fluoride, and is registered for use only by professional fumigators to control pests in construction materials and furnishings, fumigation chambers, structures, and vehicles including rail cars and cargo containers (except aircraft and subsurface vessels).

MASTER FUME IS A RESTRICTED USE PESTICIDE DUE TO ACUTE INHALATION TOXICITY OF SULFURYL FLUORIDE.
APPLICATION PERSONNEL MUST PARTICIPATE IN DREXEL CHEMICAL'S SULFURYL FLUORIDE TRAINING AND STEWARDSHIP PROGRAM, MASTER TRAIN.
Carefully read the container label and this manual before using this product. Do not use this product without Drexel Chemical's Master Fume Calculator program. Drexel Chemical's Master Fume Calculator is a program available to calculate safe and effective levels of this product for fumigating structures and commodities. Never allow untrained individuals to use this product.

COMPRESSED GAS HAZARDS
The release of high pressure fumigant can be forceful and there is potential for personal injury. A "fog-out" can also occur if the fumigant is released too rapidly, cooling the air temperature below the dew point. See Chapter 6 for prevention of "fog-out".

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

Structural formula: SO_2F_2



Molecular Weight:	102.07 AMU
Color:	None
Odor:	None
Active Ingredient:	10.8 lbs. sulfuryl fluoride per gallon of product
Specific Gravity:	1.35 at 20°C (68°F)
Vapor Density:	4.3 g/L at 20°C (68°F) air = 1
Vapor Pressure:	15.2 atm at 20°C (68°F)
Boiling Point:	-55.2°C (-67°F) at 760 mm Hg

GAS SOLUBILITY at Pressure = 1 ATM: 25°C (77°F) and in water 0.075% (750 ppm) by weight, only slightly soluble in organic solvents and vegetable oils.

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

HEAT OF VAPORIZATION: 81.1 BTU per pound at -55°C (-67°F) or 4,600 cal./mol. 1 pound of sulfuryl fluoride = 4.45 moles. 1 pound of this product will lower 1000 cubic foot of dry air by 2.5°C (4.5°F).

VOLUME PER POUND: 1 pound of gas occupies 3.8 cubic foot at 25°C (77°F) and 760 mm Hg. 1 pound of gas per 1000 cubic foot of unoccupied space equals approximately 3850 ppm at room temperature and pressure (25°C at 760 mm Hg).

HYDROLYSIS: Slow in water; Rapid in basic solutions.

REACTIVITY: Sulfuryl fluoride is relatively non-reactive as a gas. No malodor or corrosive effects have been detected when the chemical has been used as directed. Sulfuryl fluoride can react with strong bases such as some photo developing solutions.

DIRECTIONS FOR USE

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

When fumigating, all local, state and federal rules and regulations regarding use of detection devices, positive-pressure self-contained breathing apparatus, security requirements, warning agent, and placement of warning signs must be observed.
Read carefully all Directions for Use before using this product.

Chapter 1

PESTS CONTROLLED

Uses

This product is used for the control of existing infestations of insects and related pests such as (or including) Bedbugs, the larvae and adults of Carpet beetles (except egg stage), Clothes moths, Cockroaches (American, Brown-banded, Oriental cockroaches), Death watch beetles, Drywood termites, Formosan termites, Old house borers, Powder post beetles, Rodents (rats, mice). It is also for use in dwellings (including mobile homes), Buildings, Construction Materials, Furnishings (household effects), Shipping containers, and Vehicles including automobiles, buses, passenger rail cars, recreational vehicles (but not including aircraft) and surface ships.

Biological Activity of This Product
The toxicity of fumigants, including this product, is mainly determined by the uptake of the fumigant by the target pest during the time of exposure. Eggs of arthropods are less susceptible to this product as compared to its post-embryonic stages. Poor ovicidal activity of this product is mainly due to its lack of penetration through and binding to the eggshell and membranes.

For social insects such as ants and termites, control of the egg stage is not necessary when workers are eradicated as eggs will not survive in the absence of care workers. For ants and termites, dosage lethal to workers will also kill winged reproductives, called swarmers.

Toxicity of this product to the post-embryonic stages of arthropods is dependent on its intrinsic metabolism and respiration rates. The faster the locomotion is, the more susceptible the arthropod is to this product. For example, adult cockroaches, flies, ants, and fleas are very susceptible to this product with 95 to 99% mortality at less than half the drywood termite dosage compared to adult ticks and spiders which require two-fold the drywood termite dosage for 99% mortality.

Post-embryonic stages of carpenter ants and subterranean termites are susceptible to the same dosage of this product. Their nests, however, which contain reproductives and brood are usually hidden outside of the fumigation zone. Thus, the colony is able to survive and reinvade the structures. For this reason, fumigation should be conducted only when colonies are above ground and in the structure to be fumigated, and are inaccessible for localized treatments. For example, Formosan subterranean termites often make aerial nests and galleries that allow colonies to exist without ground contact. Fumigation using this product is sometimes necessary.

Higher dosage of this product is required to kill many non-social insects. Dermestid beetles and some species of cockroaches require two fumigations as the maximum application rate of this product which is 10-fold the drywood termite dosage is not sufficient to kill egg stage. The second fumigation is conducted after eggs surviving the first fumigation have hatched and before reaching adulthood.

The German cockroach is an exception to other non-social insects because the embryos in the egg case depends on the female for survival. German cockroach females carry their egg case for about 30 days. If females die prematurely before eggs are deposited for hatching, embryos desiccate. Therefore, most em-

bryos in the egg case of the German cockroach can be controlled by this product at the dosage for drywood termite.

On the other hand, American, brown-banded, and Oriental female cockroaches deposit their egg cases after carrying them for one or two days only. Killing the adult does not have any effect on the survival of the eggs. Higher dosages of this product are needed to penetrate the thick, protective covering to kill the developing embryos.

Rodents, unlike insects, are warm blooded animals and do not require increased dosages at lower temperatures. Use 80°F as the calculating temperature for proper dose determination. The dose rate will be half of the rate for drywood termite control. For a successful rodent fumigation, the fumigator, however, should use sufficient gas to accumulate at least 36 ounce-hours of exposure.

The following table lists the rates to be used for complete ovicidal activity:

Pest	Dosage to be Used as Multiple of Drywood Termite Rate
Rodents	0.5X
Carpet beetles*	1X
Cockroaches*	1X
Furniture carpet beetles*	3X
Bed Bugs	3X
Old house borers	4X
Formosan termites	4X
Clothes moths	6X
Powder post beetles	10X
Death watch beetles	10X
*To control infestation after the eggs hatch, more than one fumigation may be needed	

Latent Mortality

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

Delayed mortality (latent mortality) in insects occurs for exposures very near mortality threshold levels. Generally, within a species, the latent mortality period for the egg stage is longer and more variable compared to other life stages.

Signs of activity or live non-target organisms after fumigation do not mean failure because:

1. Different organisms vary in their lethal dose requirements and may be higher for non-target organisms than for the targeted pest.
2. The organism may have received the toxic dose and will eventually die (delayed mortality).
3. Newly hatched larvae of the non-target organism may appear from eggs not killed by the fumigant.
4. The non-target organism may have entered the structure during the aeration period.
5. Frass pellets or powder may continue to fall out of damaged woods for weeks or months following fumigation.

Mortality of arthropods following exposure to sulfuryl fluoride gas fumigant is presented in the following table:

Lethal accumulated dosages (LAD 99) (oz.-h/1000 cu. ft.) of Sulfuryl fluoride for various arthropod species

Pest		Hours of Exposure	Temp (°F)	Life Stage			
Scientific Name	Common Name			Egg	Larve/ nymph	Pupa	Adult
Ants							
Camponotus floridanus	Carpenter ant	8	81	–	–	–	18 (5)
Camponotus modoc	Carpenter ant	8	61	–	–	–	48 (8)
Camponotus vicinus	Carpenter ant	8	61	–	–	–	35 (8)
Bed bugs							
Cimex lectularius	Bed bug	16	80	64[a] (14)	64[a] (14)	–	64[a] (14)
Cockroaches							
Blattella germanica	German cockroach	16	80	–	–	–	19[c] (3)
		4	70	64[a] (13)	–	–	16 (2)
		8	81	–	17[f] (9)	–	–
Periplaneta americana	American cockroach	16	80	413[c] (14)	–	–	9[c] (7)
		8	81	>402[d] (14)	–	–	–
Supella longipalpa	Brown-banded cockroach	16	80	>256[d] (14)	64[a] (14)	–	64[a] (14)
Dermestid beetles							
Anthrenus flavipes	Furniture carpet beetle	22	80	854 (18)	156 (8)	–	78 (6)
Attagenus unicolor	Black carpet beetle	16	80	1213[c]	38[c] (14)	–	–
		22	80	1694 (18)	68 (2)	–	44 (4)
Dermestes maculatus	Hide beetle	22	80	769 (5)	28 (6)	–	29 (3)
Trogoderma granarium	Khapra beetle	8	70	>499[d]	80[c]	128	–

(Continued)

Lethal accumulated dosages (LAD 99) (oz.-hrs./1000 cu. ft.) of Sulfuryl fluoride for various arthropod species

Pest		Hours of Exposure	Temp (°F)	Life Stage			
Scientific Name	Common Name			Egg	Larve/ nymph	Pupa	Adult
Fleas & Flies							
Ctenocephalides felis	Cat flea	20	72	–	–	24[c]	–
Musca domestica	House fly	16	80	–	–	22[c]	15[c] (0)
Grain beetles							
Oryzaephilus surinamensis	Saw-toothed grain beetle	16	80	–	–	–	14[c] (7)
Rhyzopertha dominica	Lesser grain borer	16	80	219[c] (14)	–	21[c] (14)	10[c] (14)
Sitophilus granarius	Granary weevil	5	77	–	–	–	18 (7)
		16	80	794[c] (14)	14[c] (14)	14[c] (14)	15[c] (14)
Tenebroides mauritanicus	Cadelle	5	77	–	82 (7)	–	–
Tribolium confusum	Confused flour beetle	5	77	–	–	–	55 (7)
		16	80	1125[c] (14)	–	–	55[c] (14)
		24	80	1517[c]	–	–	–
Moths							
Anagasta kuehniella	Mediterranean flour moth	16	80	–	42[c] (14)	–	34[c] (3)
Ephestia elutella	Tobacco moth	16	80	768[a] (14)	64[a] (14)	–	–
Sitotroga cerealella	Angoumois grain moth	16	80	87[c] (14)	24[c] (14)	–	21[c] (3)
Spodoptera eridania	Southern armyworm	16	80	363[c]	–	–	–
Tineola bisselliella	Webbing clothes moth	10	80	280[a] (14)	70[c] (14)	–	–
Termites							
Coptotermes formosanus	Formosan subterranean termite	22	81	–	–	–	39 (5)
		4-20	81	–	–	–	48[a] (3)
		24	86	–	–	–	132[a] (0)
Cryptotermes cavifrons	–	22	81	–	–	–	37 (5)
		4-20	81	–	–	–	48[a] (3)
Incisitermes minor	Western drywood termite	22	81	–	–	–	51 (5)
		24	80	–	–	–	47 (5-14)
Incisitermes schwarzi	–	4-20	81	–	–	–	48[a] (3)
Incisitermes snyderi	–	22	81	–	–	–	46 (5)
Kalotermes approximatus	–	22	81	–	–	–	44 (5)
Neotermes jouteli	–	22	81	–	–	–	36 (5)
Prorhinotermes simplex	–	22	81	–	–	–	42 (5)
Reticulitermes flavipes	Eastern subterranean termite	22	81	–	–	–	20 (5)
Reticulitermes tibialis	–	22	81	–	–	–	30 (5)
Zootermopsis angusticollis	Western dampwood termite	22	81	–	–	–	35 (5)
Ticks and Spiders							
Lactrodectus hesperus	Black widow spiders	20	81	300[a]	–	–	82 (4)
Loxosceles reclusa	Brown recluse spider	20	81	–	–	–	77 (7)
Rhipicephalus sanguineus	Brown dog tick	16	72	–	–	–	186[a] (2)[b]
		8	81	–	–	–	108
Wood-boring beetles							
Euvrilletta peltata	–	18	72	470[e,h]	–	–	–
Hemicoelus gibbicollis	–	20	72	>500[d]	87[a]	–	–
Lasioderma serricorne	Cigarette beetle	16	80	–	–	–	15[c] (14)
		22	80	712 (10)	56 (3)	–	35 (3)
Lyctus brunneus	–	6.5	72	289[e,g]	–	–	–
Lyctus planicollis	Southern lyctus beetle	16	79	5[f,g]	–	–	–

[a] Lowest LAD (oz.-hrs./1,000 ft³ is equivalent to mg-h/h and g-h/m³) tested resulting in 100% mortality of life stage.
[b] Number in parentheses is days after fumigation at which mortality was assessed.
[c] LAD_{95}
[d] Highest concentration tested; emergence from some eggs/egg cases observed.
[e] LAD_{90}
[f] Ninth-generation selection of survivors from exposure to sulfuryl fluoride.
[g] >2-day-old eggs.
[h] >4-day-old eggs.

Source: E.M. Thomas and Scheffrahn, R.H. (1994) "Control of Pests by Fumigation with Vikane Gas Fumigant." DOWN TO EARTH™ 49 (2).

Chapter 2

SAFETY

This product is colorless, odorless and non-irritating to mucous membranes at low concentrations. This product gives no warning of its presence.
This product is toxic and must be handled carefully. Ignoring the potential hazards of this product can result in serious illness or even death.

SYMPTOMS OF POISONING

Symptoms in humans from inhalation exposure to this product will depend on the concentration and the length of exposure experienced.
The earliest sign of overexposure to this product is central nervous system (CNS) depression.

Exposure to progressively higher concentrations is expected to result in convulsions, tremors and/or strychnine-like muscular rigidity.
Humans exposed to high concentrations of this product 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.

FIRST AID

Refer to the *"FIRST AID"* section on page 1 of this manual or container label.

In all cases of overexposure, such as nausea, difficulty in breathing, abdominal pain, slowing of movements and speech, numbness in extremities, get medical attention immediately. Take person to a doctor or emergency treatment facility. Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For information on this pesticide product (including health concerns, medical emergencies or pesticide incidents), call the National Pesticide Information Center at 1-800-858-7378.

NOTES TO PHYSICIAN

Depending on the length of exposure, it is predicted that persons exposed to this product will probably show little evidence of intoxication at first unless the concentration was moderate to high (more than 500 ppm).

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

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

Also see *"FIRST AID"* section on page 1 of this manual for additional notes to physician.

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 1-877-208-2593.

IN CASE OF ACCIDENTAL EXPOSURE,
SEEK MEDICAL ATTENTION

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Protective Clothing
Wear splash-resistant goggles or full face shield for eye protection during introduction of the fumigant. Do not wear gloves or rubber boots. Do not reuse clothing or shoes that have become contaminated with this product until thoroughly aerated and cleaned.

Respiratory Protection
If the concentration of this product in the breathing zone of the fumigated area (as measured by a detector device with sufficient sensitivity such as an INTERSCAN, MIRAN or SF-ExplorIR™ gas analyzer) does not exceed 1 ppm (4 mg/cubic meter), no respiratory protection is required. [A breathing zone is defined as the area within a structure where individuals typically stand, sit or lie down.] When this concentration is exceeded, all persons in the exposed area must wear a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air-supplied/SCBA respirator such as manufactured by Draeger, Ranger, Survivair, Scott, or MSA. 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.

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

FUMIGANT INTRODUCTION HOSE AND FITTINGS

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

PERSONAL SAFETY

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

MATERIAL SAFETY

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

Chapter 3

CYLINDER

Cylinder Safety
This product is toxic to most living organisms including humans. It is colorless, odorless, packaged as a liquid gas under pressure and has no warning properties. This product is only for sale to, and for use by, certified applicators or persons under their direct supervision and only for those uses covered by the certified applicator's certification. An applicator certified by the state must be present on site at all times during introduction of fumigant, reentry prior to aeration and initiation of the aeration procedure.

Cylinder Information
Cylinders containing this product must be properly and legibly labeled at all times. If labels become damaged or lost during shipment or use, replacement cylinder labels can be obtained from Drexel Chemical Company.

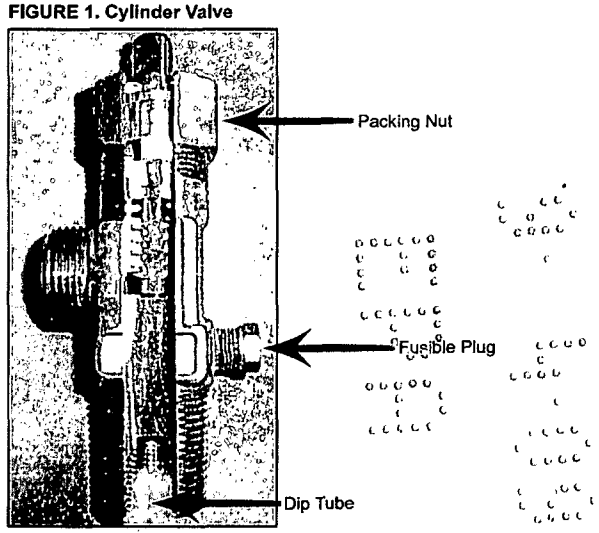
This product is sold as a compressed liquid gas in a high-pressure cylinder and must be handled, stored and transported with precaution. Inspect every cylinder upon delivery for damage. If the cylinder is damaged, immediately return the cylinder to the distributor of this product.

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

Cylinder Valves
Cylinders of this product are fitted with special valves (see Figure 1). The cylinder is equipped with both a safety cap and a covering called a "bonnet." The safety cap and bonnet must 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 your distributors.

FIGURE 1. Cylinder Valve



Cylinder Handling

- Avoid manhandling the cylinder when moving or weighing; e.g., use a hoist with a hanging bonnet.

- Protect the valve from damage by alw[illegible]eplacing the valve cover and safety bonnet.
- Open valve slowly at first, then completely open it (one full turn) so the valve and the introduction hose do not frost. Use proper size adjustable wrench (25 to 30 cm). Keep wrench attached to valve while valve is open.
- Bear in mind that frosting of the outside cylinder surface when releasing the last 3 to 5 pounds of this product is likely.
- Close valve completely when fumigant introduction is finished or cylinder is "empty."

SEE STORAGE AND DISPOSAL SECTION AT THE END OF THIS MANUAL FOR STORAGE AND DISPOSAL OF THIS PRODUCT.

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

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

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

Often tightening the packing nut on the top of the valve to 35 to 40 N.m (25 to 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 valve stem adjustment procedures at the end of this chapter.
Once the cylinder is empty, contact your distributor for proper return instructions.

Entering a Structure Under Fumigation
If emergency entry into a structure under fumigation with this product is required, the proper respiratory protection (SCBA) must be used.

Frozen Valves and Hoses
If the cylinder valve is "just cracked" to reduce the rate of release, this product 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 this product should not be controlled by restricting flow through the cylinder valve.

Frozen Cylinders
If a break occurs on the dip tube in the cylinder, this product 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. This product 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.

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 your distributor and subsequent shipper. Only Drexel Chemical Company is authorized to refill cylinders. Do not use cylinders of this product for any other purpose.

REMEMBER TO CLOSE VALVE COMPLETELY ON EMPTY CYLINDERS.

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

Cylinders that are deemed to be "defective" should be returned using the following procedure.
1. Do not continue to use a cylinder if you believe the valve is defective.
2. Contact your distributor. The distributor will need information about the cylinder (cylinder number, etc.). Complete a Defective Cylinder Report form. Fax the form to Customer Service at Drexel Chemical Company (901-774-4666).
3. Distributors should identify defective cylinders by spray painting the top and shoulders of the cyli[illegible]with red paint and attaching a completed red tag to the protection bonne[illegible]e: Do not mark functional cylinders with paint as this could cause confusion when dysfunctional cylinders are returned for repair.

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

Do not transport cylinders in closed vehicles where the same common airspace is occupied by personnel. Never transport cylinders by aircraft under any circumstance.

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.

All Department of Transportation (DOT) regulations must be followed.
Contact your local DOT if you have questions.

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

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

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

Procedure
To stop a loss of this product from around the valve stem in the field, follow the following steps.

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

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

Chapter 4

EQUIPMENT

MONITORING EQUIPMENT: FUMISCOPE
The Fumiscope is designed to measure the actual concentration of this product within the fumigation site to determine accumulated dosage. The Fumiscope is not sensitive enough to use as a clearing device after the exposure period. The Fumiscope also is used in conjunction with Drexel Chemical's Master Fume Calculator for determining actual HLTs.

Fumiscope units are portable and weigh approximately 3.5 kg (8 pounds). The Fumiscope uses a mechanism to compare the thermal conductivity of a mixture

of this product and dry air to that of dry ambient air. This difference is converted into an electric current, which is displayed as ounce per 1000 cubic foot.

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

The Model D Fumiscope has a digital readout and indicates 0 to 1000 gram per cubic meter or ounce per 1000 cubic foot. It is normally operated on 110 volt AC, but can be adapted to operate on 220 volts AC or from a 12-volt auto battery.

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

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

Fumiscopes Manufactured by:
Key Chemical and Equipment Co., Inc.
13195 49th Street N., Unit A
Clearwater, FL 34622
Phone: (727) 572-1159
Fax: (727) 572-4595

Operating Procedure (for Units Using Drierite)

1. Fill drying tube with Drierite (4 to 8 mesh). Tip: Be sure cotton is in place in bottom of tube to prevent dust from being drawn into the pump and cell.
2. Turn on pump and check for leaks by blocking inlet and noting if flow rate drops to "zero." Do the same by blocking the outlet.
3. After warm-up (approximately 10 to 15 minutes depending on the humidity), adjust the flow rate to approximately 1 cubic foot per hour (CFH) and "zero" the instrument.
4. Attach sampling hose (usually 6 mm tubing) and readjust the flow rate if necessary to the same rate in Step 3.
5. Wait at least 3 minutes for a monitoring line of 100 feet or less for the sample to reach the Fumiscope or similar device and the reading to stabilize before recording the concentration.
6. Disconnect the tubing and adjust the flow rate to the original setting and check to be sure the unit returns to "zero" - if not, reset it to "zero." Zero drift may occur during the first few minutes of operation.
7. Change Drierite when approximately 3/4 of the material has changed from blue to pink. (Spent Drierite may be regenerated by placing in a shallow pan and heating in an oven 300 to 400°F for 20 to 30 minutes then return it to the bottle while still slightly warm.)

Monitoring Line Purge Pump

Because most fumigations monitored using Fumiscope will result in the use of multiple monitoring lines that are several hundred feet long, the use of a vacuum purge pump is recommended. Because the pump within the Fumiscope or similar device is not high volume, getting accurate samples from locations several hundred feet away in a timely manner can be a problem.
The use of a vacuum pump ensures timely, accurate samples from all areas within the structure. The use of this system greatly reduces the time needed to monitor all locations within the structure.

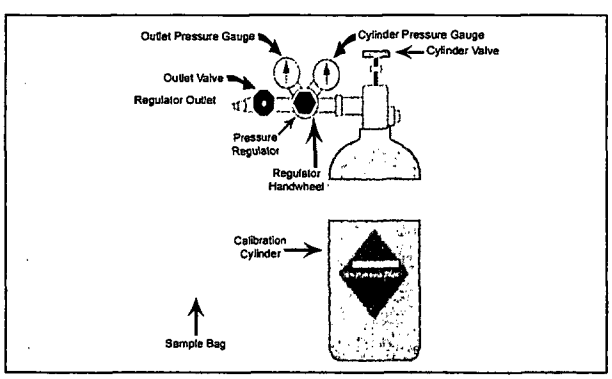
Fumiscope Calibration Procedure

Small sample cylinders containing known concentrations of this product 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: (951) 653-6780

Calibrating the Fumiscope



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

1. Warm up and "zero" the 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 one-half turn.
5. Turn regulator valve clockwise until outlet pressure gauge reads 20 to 35 kPa (3 to 5 psi).
6. Attach sample bag to regulator outlet and slowly open outlet valve to fill bag approximately 90% full. Do not overfill as bag will burst.
7. Disconnect sample bag from regulator and connect to Fumiscope inlet.
8. Read Fumiscope meter for concentration of calibration standard. If the concentration on the meter is more than 5% different from the actual concentration, remove the bag, re-zero the Fumiscope and repeat measurements.

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

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

Model E-V and E-200 have two adjustment "pots" along the top of the circuit board. The disk on the left (when facing front of panel) adjusts the scale for this product. 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 this product only, the MeBr pot should not be touched and only the pot for this product is adjusted. Some also have a zero adjust lower on the board (adjust this first if it needs adjustment).

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

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

Factors Affecting Measurement

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

Note: Contact the manufacturer for Fumiscope repair procedures.

CLEARANCE TESTING EQUIPMENT

A. INTERSCAN GAS ANALYZER

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

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

Specifications

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

Analyzers can be purchased through your distributor of this product.

Operation

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

Calibration Procedure

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

Sample cylinders and bags are available from:

Scott-Marrin, Inc.
6531 Box Springs Blvd.
Riverside, CA 92507-0725
Phone: (951) 653-6780

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

Pyrolyzer (Furnace)

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

SO_2 Sensor

- Average lifespan is 2 years (whether used or not).
- Diagnosing malfunctions - A slow response time, erratic readings, or inability to calibrate the Interscan indicates the sensor may need replacement. Dysfunctional sensors can also leak electrolyte solution.

Battery Pack

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

Power Supply

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

Repair Instructions

Return the analyzer to the manufacturer, or:

Key Chemical and Equipment Co. Inc.
13195 49th Street N., Unit A
Clearwater, FL 34622
Phone: (727) 572-1159
Fax: (727) 572-4595

B. MIRAN GAS ANALYZER

The Miran 101 is an older model designed to measure a single gas or vapor. The Miran 203 is a single beam infrared gas analyzer with interchangeable filters and two fixed path lengths. Factory calibrated gas calibration sets, which can be interchanged in about 1 minute, allow you to monitor other gases.
The Miran SapphIRe is a newer model infrared gas analyzer that allows monitoring of other multiple gases.

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

Specifications

Weight:	Model 101 — 8 kg (18 lb) Model 203 — 9 kg (20 lb) SapphIRe — 9 kg (20 lb)
Range:	Dual scale 0 to 15 ppm and 0 to 150 ppm
Operating Time:	4 hours on batteries (rechargeable overnight)
Accuracy:	± 5% of reading
Manufactured by:	Thermo Environmental Instruments 8 West Forge Parkway Franklin, MA 02038 Phone: (508) 520-0430 www.thermo.com/AQI

Operation

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

Calibration

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

Performance Verification Procedure for Miran 101 and 203 Analyzers

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

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

MIRAN SapphIRe Analyzer Performance Verification Procedure

1. Turn on the machine and let it warm up for 30 minutes.
2. From main menu, select 4 = Config/Setup. From the setup menu select 1 = Calibration. From the calibration menu select 3 = Performance Verification.
3. Grasp the capillary tubing end of the sampling line and slowly push it into the nozzle opening on the gas tank.
4. Zero analyzer and confirm stable zero.

5. Attach tubing sleeve to inlet tube of analyz Activate trigger valve and watch gas readings climb.
6. After 3 to 4 minutes readings should stabilize. Record readings.
7. Remove the tubing and reattach the zero filter.
8. Restart pump by selecting Option 2 from the control menu. Continue until reading is substantially zero.
9. Remove the capillary tubing from the tank trigger nozzle and check results against challenge gas concentration.

Note: Contact Thermo Environmental Instruments or their representative for repair procedures.

C. SF-EXPLORIR GAS MONITOR

The SF-ExplorIR is a portable monitor weighing less than 9 pounds that uses non-dispersive infrared (NDIR) technology to detect low level concentrations of sulfuryl fluoride and confirms clearance for reentry after fumigation. The unique infrared "fingerprint" of sulfuryl fluoride distinguishes it from all gases and eliminates any false readings.

SF-ExplorIR features direct measurement of sulfuryl fluoride at 0 to 5 ppm detection for clearance (full measuring range is 0 to 100 ppm) and operates on an integrated 8-hour lithium rechargeable battery with power meter.

Specifications

Product Type	:	Portable sulfuryl fluoride (Master Fume) gas monitor
Measuring Range	:	0 to 100 ppm (parts per million)
Warm-up Time	:	15 minutes
Operating Time	:	30 minutes before the purge-air bag needs refilling
Detector Type	:	Non-dispersive infrared (NDIR)
Sensitivity	:	300 ppb (parts per billion)
Response Time	:	90% of response within 5 seconds; 100% in 7 seconds
Temperature Drift	:	1.5 ppm per °C between purge cycles
System Noise	:	Less than 40dB(A) at 10 ft (3 m)
Operating Temperature	:	32 to 122°F (0 to 50°C)
Ambient Humidity	:	5 to 90% RH (non-condensing)
Altitude Limit	:	6,562 ft (2,000 m)
Power	:	DC power pack, provides at least 8 hours of operation
Power Consumption	:	15 watts
Front Panel	:	3 indicator lights 1) Alarm light – Red light flashes when detected gas level reaches the factory set alarm level of 5 ppm 2) System fault – Yellow light flashes when there is fault in the system 3) Monitor on – Green light flashes during warm-up and then steadily glows during normal operation
Audible Alarm	:	Internal audible alarm activated when the 5 ppm gas-alarm factory set level occurs
Dimensions	:	8D x 19L x 5W inches (203 x 483 x 127 mm)
Weight	:	Less than 9 lbs (4 kg) including battery
Valid Calibration Period	:	6 months
Warranty	:	1 Year from date of shipment (extended warranty available)

Operation

1. Turn ON by pressing red button in front of handle.
2. Wait for warm-up period to elapse (15 minutes – 900 second countdown)
3. Press ENTER button to fill the purge-air bag with clean, fresh air that is of the same temperature and humidity as the area being checked for gas. DO NOT fill the purge-air bag in an area that is contaminated with sulfuryl fluoride gas.
4. After the purge-air bag has been filled, the monitor will automatically start taking measurements in the area being sampled. The results of those measurements are displayed on the front panel display.

USE PRECAUTION: Operate the monitor in its horizontal position (handle facing upwards). Tilting the monitor to a vertical position while in operation may cause inaccurate measurements to occur.

NOTE: Contact Spectros Instruments, Inc. or their representatives for repair and assistance.

Calibration

SF-ExplorIR is factory calibrated and does not require monthly calibrations.

Only Spectros Instruments, Inc. or their authorized agents can perform the required 6 month calibration service to assure proper performance of SF-ExplorIR.

D. OTHER UNITS

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

Note: Prior to using the instruments to clear a structure for reoccupancy, meters must be "zeroed." This should be done according to the manufacturer's directions, away from the fumigation site and in an atmosphere that does not contain this product. Manufacturer's instructions also include information regarding appropriate and necessary calibration and maintenance. Manufacturer's recommendations must be followed to ensure proper operation of these instruments. Please refer to the manufacturer for the latest recommendations and instructions for any equipment used with this product.

Chapter 5

BASICS OF STRUCTURAL FUMIGATION

FACTS ABOUT STRUCTURAL PESTS

Termites

The three important types of termites found in the United States are – **drywood, subterranean and dampwood termites.** They are most easily identified on the basis of their habits and where they live. Drywood termites are a problem chiefly in the warm, moist coastal regions. They live inside of wood and do not require contact with the soil. Subterranean termites, on the other hand, generally live underground, and, with rare exceptions, must maintain contact with the soil. Dampwood termites are larger insects than either the drywood or the subterranean termite, but is of less economic importance than the other two. Dampwood termites typically infest posts, forest trash, dead trees and wooden structural members in soil or areas with sufficient exposure to water.

Wood Borers

Death watch beetles *(Xestoblum spp.)* are members of the family Anobiidae. They feed on hardwoods and softwoods, and are usually associated with some fungal decay. Their total life cycle is from four to five years.

Old house borers belong to the family Cerambycidae, which is called "long horn beetles." *(Hylotrupes spp.)* They mainly infest sapwood of pine and spruce, but occasionally have been seen in hemlock, Douglas fir and other true firs. They are usually seen near the surface of wood in the sapwood and generally do not infest the heartwood. These beetles have a wide geographic distribution. Development from egg to adult can require up to 10 years in temperate zones.

Powderpost beetles *(Lyctus spp.)* are members of the family Lyctidae. Lyctids are mainly found infesting the sapwood of hardwoods (i.e., oak and ash). They digest starches and sugars, but not cellulose. Their growth is relatively slow as they average only two generations a year, however, they can do extensive damage before their presence is known.

See the label and Chapter 1, of this manual, to control these pests.

Fabric Pests

Clothes moths are widely distributed, persistent pests in structures. They are noted for the damage caused to woolens and are normally controlled by localized treatments. Where severe infestations occur, or local control measures are insufficient, this product, at six times the drywood termite dosage, will give control of all life stages.

Black carpet beetles are common pests of carpets, woolen garments, skins, furs and museum specimens, including bones. Their life cycle is usually completed in 12 months. Because of the excessively high dosage requirements to control the eggs, the termite rate will control only the post-embryonic forms. Two fumigations are recommended to control all life stages. These should be spaced 2 to 6 weeks apart in order to control newly hatched beetles. Check with local experts to determine the duration of each stage in the life cycle.

Health-Related Pests

Cockroaches:

German cockroaches are considered by many in the pest control profession, to be the "Number One" domestic pest. All stages of this roach are controlled by this product at drywood termite dosages because the female carries the egg case during the incubation period and the embryos are dependent on the female for survival.

Brown-banded and Oriental cockroach females, on the other hand, deposit the egg case shortly after it is formed, thus, the embryos are not dependent on the female for survival. The egg case is vulnerable to this product only at high dosages, while nymphs and adults of these cockroaches are controlled at termite dosages.

Bed bugs are occasional parasites of humans. They are usually hidden in the seams and folds of mattresses. They are controlled at 3 times the drywood termite dosage.

Rats and mice (rodents) are always unwanted in any structure. They are easily controlled with this product using one-half the calculated drywood rate (1/2X). However, regardless of the ambient temperature, the fumigator should use sufficient gas to accumulate at least 36 ounce-hours of exposure for a successful fumigation.

For additional information on these and other pests, see Chapter 1 of this manual.

PENETRATION AND CONFINEMENT OF THIS PRODUCT

The objective of a structural fumigation is to cc enough fumigant for sufficient time to control the pest. There are, however, interactions to consider regarding the confinement characteristics of this product and its ability to penetrate the site or chambers of the drywood termite or other pest.

Wood Penetration

Fumigants differ in their ability to penetrate wood. Their performance depends upon certain characteristics and conditions of the fumigant and of the wood to be fumigated.

Wood Characteristics

These conditions must be taken into consideration when fumigating:

1. Tree species (chemical makeup)
2. Density
3. Porosity (number and arrangement of pores)
4. Moisture content
5. Sorption qualities (affinity for fumigant)

Penetration of this product, through different one inch thick wood plugs, is described in the following table.

Concentration of Sulfuryl fluoride inside wood-PVC voids exposed to 16 ozs./1,000 sq. ft. of fumigant for 20 hours inside a chamber

Wood	Exposure Condition	Gas Concentration (oz./1,000 sq. ft.)[a]	Dosage (oz.-hrs./ 1,000 sq. ft.)[b]
Pine A	End grain	16.15[a]	296
Pine B		14.08[b]	171
Mahogany		8.72[cd]	89.7
W. hemlock		6.97[d]	69.7
Red oak		2.50[e]	24.2
Douglas-fir		2.95[e]	27.9
Pine B	Hydrated	3.12[e]	29.8
Pine B	Paint 2x	6.84[d]	74.8
Mahogany	Paint 2x	6.49[d]	65.7
Mahogany	Paint 3x	3.61[e]	36.0

[a] Means (n=4) in columns followed by the same letter are not significantly different at P=0.05. Student-Newman-Keuls test (6).
[b] Mean dosage (concentration x time). Maximum theoretical accumulated dosage inside PVC cups is 296 oz.-hrs/1,000 sq. ft.
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.

The low affinity for wood also provides this product the further advantage of rapid desorption of the fumigant and quick aeration of a building when the seals are removed.

It may be difficult, however, for this product to penetrate wood that is wet, because the air passages are blocked by the water and by the swelling it causes.

Painted surfaces or plastic covered panels are not readily penetrated by this product or other fumigants. These surfaces form a barrier much like a plastic tarp and should be considered in assessing the ability of this product to penetrate into wall voids or other covered spaces.

Confinement of This Product by Tarps

The question naturally arises: "If this product 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.

Plastic tarps are semi-permeable membranes, which permit different fumigants to pass through them at different rates. The passage of this product through plastic sheeting is very slow, as shown in the following table.

Percent permeation loss and adsorption of 8 oz./1,000 sq. ft. sulfuryl fluoride after 24 hrs. from 11-oz. glass bell jar with lid made of tarp materials

Tarp material	Percent Permeation loss	Percent adsorption[a]
	Sulfuryl fluoride	Sulfuryl fluoride
Used tarp	100.0	8.8
Tarp A, 10.3 oz./yd²	3.3	6.1
Tarp B, 7.2 oz./yd²	5.5	3.1
Tarp C, 9.6 oz./yd²	0.2	3.3
4-mil polyethylene	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.

Loss to Soil

The loss of this product to the soil is dependent on soil type and moisture. The Master Fume Calculator takes soil type into consideration when estimating the half loss time. Soil water reduces penetration of this product due to its low water solubility.

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 fumigation.
All matter exists in three phases: SOLID, LIQUID and GAS (VAPORS). The best known example is water, which appears as solid ice, liquid water and water vapor (gas).

The air atmosphere includ ater in all three phases, i.e.:

1. Ice crystals, such as in cirrus clouds or as snow, hail or sleet;
2. Water droplets as clouds, fog or rain;
3. Water vapor that we cannot see but can feel, such as humidity in dry air.

Air is largely composed of 78% nitrogen and 21% oxygen. Excluding water, all other gases equal only about one percent. These include carbon dioxide, argon, neon, krypton and others in minute amounts. There are many contaminants in the atmosphere such as dust, volcanic ash, smog, etc., with which fumigations are not normally involved. These contribute only a very small fraction of one percent of the total air.

The amount of water in the atmosphere is variable. The warmer the air, the more water air can hold. This feature is very important as it relates to the use of this product.

The vast majority of structural fumigations occur close to sea level. Thus, our calculations are based on atmospheric pressures of 760 millimeters of mercury (mm Hg) and 20°C (68°F), which are known as "Standard Conditions."

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.

This relative density of air becomes apparent when a refrigerator or freezer door is opened and the cold dense air flows out onto the floor. Conversely, a hot air balloon rises because the contained heated air is lighter than the surrounding air. Once these different parcels of air are thoroughly mixed with the surrounding air, however, they will not tend to separate or stratify. This is an important feature we must understand as it relates to use of fumigants.

The weight is also noticeable when air is moving (wind) or we are moving through it. The ability to quickly disperse a fumigant depends on the air movement we create with fans.

Water Vapor

The concentration of water vapor in the atmosphere will vary with temperature. The warmer the air, the more water vapor it can hold.

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 0.7 pounds and could hold 1.4 pounds at saturation, the relative humidity would be 50 percent. It can be measured by a dry or wet bulb thermometer or a humidity gauge.

The Dew Point is the temperature at which water 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. This amount varies slightly from different air temperatures. The dew point and dew point depression are shown in the following graph for relative humidity levels when the ambient (existing) air temperature is 50°F, 68°F or 86°F.

For practical purposes, the gases of the air, except for water, are, and tend to remain, evenly distributed throughout the atmosphere. Water evaporates into and condenses out of the atmosphere, a function that is largely dependent upon temperature, concentration and vapor pressure. This process becomes a large part of the weather of the world. The use of this product in structural fumigation involves, and is influenced by, some of these basic principles as it interacts with the gases of the air atmosphere.

Example: If the air temperature in a structure is 68°F and the relative humidity is 50 percent, how many degrees can the air temperature be lowered before condensation occurs?

Answer: See the graph on following page. Condensation or possibly a "fog out" is likely to occur if the air temperature is lowered by approximately 9°F or more.

Note: 1.0 pound of this product will lower the temperature of 1,000 cu.ft. of air (4.5°F).

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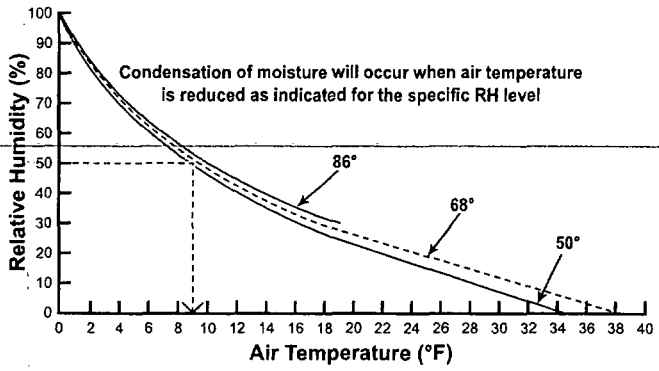
In practical use situations, the fumigator can use the information in the graph below to plan the job (fan size, fan location, fumigant introduction rate, etc.) so that gas is introduced into the structure in a manner that avoids "fog out" situations. See Chapter 6 of this manual for additional information.



SEASONAL VARIATIONS – ECONOMICS

Temperature has a major influence on the dose/dosage requirements for successful fumigation with this product and certainly needs to be factored into these calculations. The economics of dosage are important, especially where seasonal variations are pronounced such as in California and to a lesser extent in Florida and Hawaii. The following example illustrates this need:

Effect of Temperature on the Required Equilibrium Concentration of this Product for a Measured 12 Hour HLT and 20 Hours Exposure						
Temp of slab or soil (°F)*	55	60	65	70	75	80
This product per 1,000 cu. ft.	16	12	9.5	8	7	6
*Temperature at coldest point of infestation.						

These dosage requirements can vary based on changing seasonal temperature conditions.

In winter, higher dosages are required. However, larger majorities of fumigations take place in the warmer periods when minimal dosages are adequate. The fumigator should understand these variations and figure them into the economy of his practices.

PREPARATIONS FOR FUMIGATION

The fumigator must conform to the fumigant label as well as to federal, state and local regulations. As an additional suggested guide, the fumigator has a compilation of GOOD PRACTICES published by the National Pest Management Association (NPMA). When in doubt, a fumigator should seek assistance from suppliers, regulators or other educational sources.

Prior to the parties entering into a fumigation agreement, the Fact Sheet for **MASTER FUME** gas fumigant must be provided to an adult occupant of the structure to be fumigated. This Fact Sheet is required by the label for this product, and should not be confused with the customer checklist required by some state regulations.

OCCUPANTS/CUSTOMERS NEED TO KNOW:

1. Their specific role in preparation for fumigation - what to prepare, what to protect, 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. Potential problems like:
   I) Damage to plants too near the house for proper tarping or plants included within the fumigation space.
   II) Damage to highly sensitive plants.
   III) Damage to old or otherwise fragile roofs (especially tile), TV antennas, fences, etc.
   IV) Excellent efficacy of the fumigation, but lack of residual effectiveness to control future infestations of pests.

Occasionally items of social value or of a peculiar nature may best be removed or protected because of the uniqueness of the risk. High-priced pictures, electronic equipment, chemical supplies, etc. are some examples. Although this product is a high-purity material and its gas phase has not been known to have caused adverse effects, there are certain risks from misapplication by the fumigator and moisture condensation when introducing this product. Risk of condensation increases under conditions of high relative humidity and where high dosages of this product are required. To avoid this application and condensation, follow instructions on this label. A good rule of thumb is "when in doubt, take it out." If the customer is unduly concerned about a particular item before fumigation, removal is the best approach.

WHAT TO REMOVE PRIOR TO FUMIGATION

Remove from the structure all persons, domestic animals, pets and desirable growing plants. Remove fish tank containing live fish, or remove the fish, or develop a plan for preparing the tank for fumigation. If necessary, exclude water in the tank and biological filters, if present, from the fumigated space by sealing with gas resistant tarps or sheeting. If water aeration is required during the fumigation, provide fresh air from outside the fumigated space for the tank aerator. Remove mattresses (except waterbeds) and pillows completely enveloped in waterproof covers or remove covers (or open seal of waterproof covers). Food, feed, drugs, tobacco product, and medicinals (including those items in refrigerators and freezers) can remain in the structure if they are unopened in plastic and water bottles, unopened glass or metal bottles, cans or jars with the original manufacturer's air-tight seal intact. Food, feed, drugs, tobacco products, and medicinals (including those items in refrigerators and freezers) not in glass or metal bottles, cans, or jars, or plastic water and soda bottles with the original manufacturer's air-tight seal intact, need to be removed from the fumigation site, or double bagged in Master Fume bags, Nylofume® bags or Fumiguard bags, which are available from distributors of these products.

FLAMES OR HEATING ELEMENTS

This product is a very stable compound that is relatively non-reactive and non-flammable. Under high heat conditions present in gas flames or glowing electric elements, however, this product can decompose into sulfur dioxide SO_2, hydrofluoric acid HF, and other decomposition products. Hydrofluoric acid is highly reactive and can corrode or damage many materials including metals, glass, ceramic finishes, fabrics, etc. Extinguish all flames, including pilot lights of water heaters, gas refrigerators, ranges, ovens, broilers, dryers, gas fireplaces, etc. Turn off or unplug all electrical heating elements such as those in heaters, pianos, organs, 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. The gas lines should be cleared. Fumigation companies may request that customers have the local gas company turn off the gas prior to fumigation. The local gas company will always need to turn gas service on after it has been turned off to determine that the gas flow rate and pressure are appropriate.

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.

PROTECTING PLANTS AND SHRUBS

Sensitive plants growing near the fumigation job can be injured if they are exposed long enough to sufficient concentrations of this product. This can be due to excessive leakage of fumigant from the soil-tarp seal without sufficient wind to disperse the fumigant. Also, this product can escape through dry soil at the ground seal. Usually, the soil at the foundation is the driest in the yard because of protection from the roof overhang. These can be improved by asking the homeowner to water the area next to the building on the day before tenting. They should also cut back plants to clear the area to place tents and ground snakes (at least 18 inches), and rake away the mulch or debris next to the foundation (at least 12 inches).

It is the responsibility of the fumigator to ensure that the ground seal is established prior to releasing the product into the structure. The fumigator must give special attention to the ground seal and can use a leak detector of sufficient sensitivity, such as a TIF 5750 leak detector manufactured by TIF Instruments, Inc., Miami, Florida that can detect this product to about 50 ppm. Sensitive plants could potentially be injured by this product during aeration when there is insufficient air movement to quickly dissipate the fumigant. The risks of plant injury would be increased when there are high concentrations of fumigant remaining at the end of the exposure period resulting from good confinement (often in slab type construction) and/or high dosages used. The fumigator should open seams initially in areas such as driveway or patio or plan to use the TRAP aeration method (direct discharge) that will not allow exposure to plants. Junipers, monkey grass, springeri fern, lily grasses and orchids appear to be especially sensitive to this product and their protection may require special attention.

Indoor or sheltered plants should be moved to conditions similar to their usual growing habitat (e.g., light conditions, temperature, humidity, etc.) to avoid risk of injury.

(See also Chapter 11 on troubleshooting.)

Wetting the Soil

Prior to the tarping time (generally the day before the fumigation), some fumigators require that the occupants or owners wet the soil for the tarp seal. Often, this can accomplish the necessary "sealing" of the soil and, if done properly, will not cause puddling or muddy conditions at tarping time. The sub-area of crawl space structures should not be watered or treated for subterranean termites immediately prior to a fumigation. Wet sub-area should be allowed to dry before fumigation. Enclosing the structure in a tarp can cause the moisture to be confined and accumulate within the structure during the fumigation period, leaving condensation and/or an odor problem.

FUMIGATOR'S CHECKLIST
Even though some duties are assigned to othe[illegible]e fumigator is responsible for all aspects of conduct of a fumigation. Preparations must be carried out properly before the actual fumigation can proceed.

The following checklist can help a fumigator prevent exclusions. This checklist is just an example but may not be complete:

PREPARATION:

CONFER WITH OCCUPANTS / PROPERTY OWNERS –

Protect or remove by occupants (PO) or fumigator (F) (circle which):

PO F Food
PO F High value items
PO F Medicinals
PO F People
PO F Personal items
PO F Pets
PO F Plants
PO F Waterproof mattress covers
PO F Wet soil at seal

IDENTIFY LIABILITIES – *POTENTIAL PROBLEMS:*

☐ Antenna
☐ High Value Items
☐ Roof
☐ Surrounding Plants
☐ _____
☐ _____

OCCUPANCY – *SINGLE OR MULTI-UNITS:*

☐ Contact: _____
☐ Keys _____
☐ Time In: _____
☐ Time Out: _____
☐ _____
☐ _____

AUTHORITIES NOTIFIED:

☐ Fire
☐ Guard
☐ Police
☐ Regulatory
☐ Utility
☐ _____

SOURCES OF HEAT OFF

☐ Automatic equipment
☐ Electric heaters
☐ Electric pianos/organs
☐ Gas refrigerators
☐ Pilot lights
☐ Space heaters
☐ Stove
☐ Water heater
☐ _____
☐ _____

PLAN FOR FUMIGANT INTRODUCTION:

FANS (WITH FUSES/GROUND WIRE):

☐ Capacity
☐ Cords
☐ Number
☐ Position
☐ Power Source
☐ Switches
☐ _____
☐ _____

FUMIGANT INTRODUCTION HOSE:

☐ Direction
☐ Entry
☐ Rate
☐ Security
☐ Site
☐ Special Needs
Size_____ID

PLAN FOR FUMIGANT EXPOSURE PERIOD:

☐ Monitoring hoses placed.

☐ Open interior drawers, microwaves, ovens, dishwashers, doors, cabinets, attic crawl, etc.

☐ Verify food and medicinal preparatio in accordance with the label directions.

☐ Windows open with locked screens on tarp jobs.

☐ Exterior doors se[illegible] *Conform to codes).*

☐ Tarps, Seals – *Proper and secure.*

☐ Non-target areas secure.

☐ Exterior plants and pets

☐ Neighbors

☐ Spectators – *especially children*

☐ Warning signs attached.

☐ Post and inform guard where required.

☐ Cubage calculated (Mcf): _____

☐ Dosage calculated (oz/Mcf): _____

☐ Soil or Slab °F_____

☐ HLT estimate _____

☐ Hours Exposure _____

☐ Wind Velocity _____

☐ Humidity _____

☐ Cylinder of fumigant secured for measurements.

☐ Safety equipment on hand (SCBA and safety goggles, etc.).

☐ Crew Check – *Final clearance of building personnel and equipment.*

☐ Introduce Warning Agent – Use 1 oz of chloropicrin/10-15 Mcf.

☐ Close and lock last entry.

☐ Start fans.

☐ Wait 5 to 10 minutes for chloropicrin distribution.

☐ Introduce Master Fume gas fumigant.

☐ Check for leaks.

OPENING, AERATION AND CLEARANCE:

TAPE/SEAL FUMIGATION:

☐ Open doors – Start fans.

☐ Remove interior seals – Open windows (wear respiratory protection).

TARP/FUMIGATION:

☐ Remove bottom seal.

☐ Open tarps – Downwind side first, then upwind side.

☐ Move warning signs from tarp to structure.

☐ Start fans.

☐ Reactivate utilities.

☐ Test for clearance of Master Fume gas fumigant with suitable equipment.

☐ Remove warning signs when site is cleared for re-occupancy.

☐ Post fumigation notices where required.

☐ Return building keys to occupant/owner.

DISTRIBUTION/AERATION FAN
(Also see Chapter 6 on Fumigant Introduction)

Distribution
It is recommended that this product be introduced into a structure in such a way that it reaches equilibrium rapidly. The exposure period does not begin until equilibrium has been reached. Rapid mixing of fumigant with the atmosphere of the structure also helps prevent formation of pockets of chilled air, which can produce fogging, especially if the atmospheric humidity is high. The introduction of this product must be directed into the air stream of the fan for best distribution.

A fan or combination of fans must have a capacity of at least 1,000 cfm for each pound of this product released per minute. Never use an unsafe fan in a fumigation and remember to carry adapters with you to accomodate a 3-prong plug.

Pay special attention to air circulation in cold weather. Low outside temperatures can induce moisture condensation on uninsulated surfaces such as exposed-beam ceilings, skylights or windowpanes. Fans should be used to maintain heat equilibrium throughout the structure during the exposure period to prevent condensation. During fumigation, furnaces and other sources of heat must always be turned off.

Multiple Release Sites
The number of release sites of this product will be dictated by the size and configuration of the structure and the adequacy of the circulation. As a rule of thumb, there should be sufficient circulation to establish fumigant equilibrium within an hour. Experience with the product and with the measurements discussed elsewhere in Chapter 6 will help the fumigator judge the amount of circulation required (see Chapter 6 on Fumigant Introduction).

Continuous Circulation
In addition to effective initial distribution of the fumigant, equilibrium of the gas is essential for making sure that the fumigant released into the structure will reach all areas in the structure where infestation may exist.

Fans can be used to maintain air/gas circulation, although it has been demonstrated not to be necessary during the course of a normal fumigation with this product. Care should be taken to ensure fans are in good operating condition and secure to avoid accidents if they are to remain on for the entire fumigation.

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 this product. Obviously the air stream should not be directed against "leaky" tarps because excessive gas loss could occur.

Electricity is needed to operate fans during fumigation introduction and aeration. If electricity is not available on the property to be fumigated, the applicator must make alternate arrangements, such as having a generator or securing power from a neighbor.

MONITORING HOSES
(See Chapter 7 for information on monitoring this product.)

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

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

The fumigator must conform to the label and this manual for use of this product, as well as to federal, state and local regulations. When in doubt, a fumigator should seek the assistance from suppliers, regulators, Drexel Chemical Company representatives or other educational sources.

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

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

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

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

Stucco or masonry block buildings may be sealed by taping plastic film over outside doorways, windows and vents. With this method, as with tape, partitions may interfere with fumigant distribution. When tape is used for sealing, particularly if a subsection is involved, a re-circulation fan is required, unless proper amounts of fumigant are introduced separately into each compartment to assure an adequate concentration of gas. Neither sealing method is recommended for houses in which any wooden section, including roofing, is exposed to the outside. Always monitor with a Fumiscope or similar device when necessary.

Tarping
Good sealing is necessary for effective fumigation. Tarpaulins (tarps) can be used in the sealing process with tapes/adhesives to help seal leaky areas or to envelop the entire area to be fumigated. This method is effective on almost any size or type of space/site. The ability of a tarp to contain a gas depends on the condition of the tarp, the material of construction and its thickness.

It is recommended to open windows before tarping to aid in the distribution of the fumigant between the tarps and the structure. Attic and subsection vents should also be opened during fumigation, as well as interior doors, cupboards, drawers, washers, dryers and ovens. (Always comply with local regulations concerning barriers to entry into the structure during the exposure period.)

One of the most critical operations is achieving a tight seal in tarping a structure at the ground where protrusions, debris or rough-textured soil or concrete may provide an opening for gas to escape. If the ground surface is very smooth, sand or water snakes may be used effectively. One method of improving the seal with a sand or water snake is to run a trough of water on tarps along with the snakes. Vinyl/nylon snake covers do not deteriorate readily.

To improve tarp seal, uneven or rough-textured soil surface should be evened with soil or wet sand. Grass, mulch or rocky surfaces make poor seals.

Soak the surface with water, if possible, at the ground seal or, preferably, have the homeowner soak the soil in the morning prior to releasing the fumigant. Loose sand can be packed on the lower edge of the tarp, to improve the seal. Ramping with sand or soil is also very effective for sealing around steps and ridges. (See Chapter 4 for information on instrumentation for detecting leaks.)

The faster the gas reaches equilibrium within the building, the less the loss rate at the ground seal. Allow at least two feet of tarp to clear the ground snakes to achieve an adequate ground seal. This will accommodate movement of the tarps due to wind movement.

Tarp Material
Plastic tarps are semi-permeable membranes that permit different fumigants to pass through them at different rates. The passage of this product through most plastic sheeting of sufficient thickness is very slow.

Use only tarps made of materials that will adequately confine this product for the required time. Tarps are sold in many sizes. Experience has shown that the following have proven satisfactory:
1. 4 to 6 mil polyethylene for "single use" tarps
2. Laminated (several layers) polyethylene
3. Vinyl coated nylon
4. Neoprene coated nylon
5. PVC (polyvinyl chloride) coated nylon

Thickness
As a minimum, 4 to 6 mil (160 to 240 microns) thickness of the above materials adequately confines this product. 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 this product because they do not possess the strength and weight needed for the handling, wind resistance and abrasion encountered in most fumigations.

Since all fumigants escape readily through any opening, tarps should be kept in good repair. Rotate tarps on a regular basis to ensure that poor tarps are discarded and new tarps are purchased. It is a good idea to mark new tarps with the purchase date. Patching rips or holes in the field should be kept at a minimum. Where tarps join, the edges should also be tightly rolled and appropriately clamped because loose folds waste fumigant. Obviously, more clamps will be needed on windy days.

Preventing Condensation
Observe the following precautions to reduce the risks of moisture condensation:
1. When a structure is wet, do not tarp or seal. It is especially important to make sure that wooden shingles are dry before sealing.
2. Do not tarp a structure immediately after subsection soil is treated with insecticides. First, allow the treatment to dry.
3. Low outside temperatures can induce moisture condensation on uninsulated surfaces such as exposed-beam ceilings, skylights or windowpanes. Fans

should be used to maintain temperature equilibrium throughout the structure during exposure period, to help prevent condensation.

4. Cold temperatures in warm weather may also warrant special attention. A structure that is air conditioned to a much lower temperature 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 either warming the structure slowly prior to tenting or waiting until all tents are in place before opening windows and doors to avoid introducing outside air.

See the label and Chapter 9 of this manual for additional instructions on tarped chamber and vehicle fumigations, respectively.

PLACARDING, USE OF CHLOROPICRIN AND SECURING FUMIGATED AREAS

PLACARDING OF FUMIGATED AREAS AND USE OF CHLOROPICRIN

This product is a toxic gas without a warning agent.

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

1. The signal word DANGER/PELIGRO and the SKULL and CROSSBONES symbol.
2. The statement, "Area under fumigation, DO NOT ENTER/NO ENTRE".
3. The date of fumigation.
4. Name of fumigant used.
5. Name, address, and telephone number of the applicator.

Also required by label is the proper use of the warning agent, chloropicrin. This is an essential part of security against improper entry (see Chapter 6 for proper chloropicrin placement and rates).

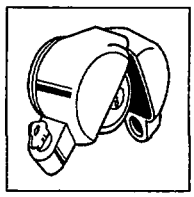
Tarped structures must have proper circulation and exposure to the fumigant.

Windows that have locked screens are not considered normal entries and should be opened for the fumigation. However, the risk of illegal entry should be considered in the plans for securing valuables during the fumigation.

SECURING STRUCTURES

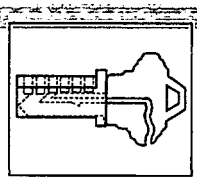
In order to secure against unauthorized entry during the fumigation exposure period, a locking device or barricade must be used on all exterior doors or doorways. A locking device, such as a secondary lock, or barricade must be demonstratively effective in preventing an exterior door or doorway from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

Several additional security items to consider might include:

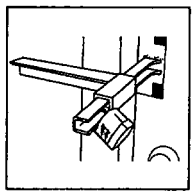


1. Locks

a) **CLAM SHELL LOCKS**
CLAM SHELL LOCKS are designed to prevent use of the door or occupant's keys to unlock entrance doors.



b) **KEY-WAY LOCKS**
KEY-WAY LOCKS are designed to prevent use of the occupant's keys to unlock entrance doors. These function by inserting a two-part locking key into the door keyhole and removing only half of the key. The other half of the locking key remaining in the door prevent insertion of the occupant's key.



c) **J-SAFE LOCKS**
J-SAFE LOCKS or chains can also be used on certain structures.

d) **CHAINS**
CHAINS can also be used on certain structures. Pins and staples in keyways are not recommended unless they are the only option and can only be removed with a special tool.

2. Guards
Guards may be considered in some circumstances and may be required in some locations. Consult local regulations.
3. Barricades
4. Caution tape similar to that used on construction sites.
5. If a fence encircles the fumigated structure, posting no trespassing signs on gateways/entrances.

Chapter 6

DOSAGE, CHLOROPICRIN WARNING AGENT, INTRODUCTION OF FUMIGANT

CALCULATING DOSAGE

Establishing the Required Dosage

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

Drexel Chemical's Master Fume Calculator

Drexel Chemical's Master Fume Calculator program is used for all fumigations using this product. See directions for details and specific use. Do not use this product without the Drexel Chemical's Master Fume Calculator. Drexel Chemical's Master Fume Calculator must be used to calculate the dosage. Drexel Chemical's Master Fume Calculator program may be modified and updated from time to time; please contact your Drexel Chemical Company representative for current information.

Precision Fumigation Defined

Precision Fumigation is not a new concept; however, most fumigators 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

Use of this product allows fumigators to use their skills, knowledge, and experience to create and implement successful, flexible fumigations.

Precision Fumigation methods: a) allow fumigation when/how necessary, b) capitalize on enhanced sealing methods, c) maximize exposure time, and d) utilize temperature modification.

Fumigant Dosage

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

Dosage = Concentration (C) X Time (T)

or

D = C x T (CT)

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

CT = oz.-hr./1000 cu. ft.

The concentration in ounce per 1000 cubic foot of fumigant multiplied by the exposure time in hours.

The maximum target concentration in Drexel Chemical's Master Fume Calculator is 128 ounces per 1000 cubic foot.

The maximum target dosage for all normal atmospheric pressure (NAP) fumigations is 1500 CT (1500 ounces-hours per 1000 cubic foot).

For vacuum chamber fumigations, the maximum target concentration is 128 ounces per 1000 cubic foot, and the maximum target dosage is 200 CT (200 ounce-hours per 1000 cubic foot).

Concentration Units of this product
1 ounce per 1000 cubic foot = 240 ppm

FACTORS AFFECTING FUMIGANT DOSAGE

The following four interrelated factors greatly influence all structural fumigants:
1. Initial fumigant concentration
2. Loss rate of fumigant
3. Temperature at site of pest
4. Exposure period

A change in any factor will require a compensating change in one or more of the others for equivalent performance.

Initial Fumigant Concentration

Several HLT curves show different rates of dosage accumulation related to exposure time. The curves are plotted for one ounce of fumigant to furnish coordinates as unit ounce-hours. To determine the total ounce-hours (OH) accumulated, multiply the respective ounce-hour coordinate by the number of ounces of fumigant used.

Under conditions of rapid fumigant loss (short HLT) it is obvious that only the initial hours of exposure are of any significance for the accumulation of dosage.

Contributing Factors to Fumigant Loss Rate

Currently, there is no method for accurately predetermining the loss rate of fumigant from a structure. For each job, the conditions affecting the fumigant confinement will differ. From numerous measurements of this product, it indicates that the main influencing factors are:
1. Condition of tarpaulin or cover.
2. Seal condition (where tarp joins soil, steps, wires, fences, etc.)
3. Underseal type (slab or soil).
4. Volume of structure (ratio of surface area to volume).
5. Velocity of wind.

The following table assigns series of values for tarp and seal expressing their estimated conditions. Although these values are necessarily subjective, they have proven useful when associated with the practices and terminology of professional fumigators.

ESTIMATION OF HALF-LOSS TIME (HLT)

Influence	Estimated	Factor	Start with the basic HLT of 12 hours, then multiply products by successive factors-example
Tarp or Stucco Conditions	Excellent Good Medium Fair Poor	1.0 0.9* 0.8 0.7 0.6	0.9 x 12 = 10.8 hours
Seal Tarps Tape At Soil	Excellent Good Medium Fair Poor	1.0 0.9 0.8† 0.7 0.6	0.8 x 10.8 = 8.64 hours
Soil	Slab Clay Loam Sandy Loam Sand	3.0 2.0 1.0† 0.5 0.25	1.0 x 8.64 = 8.64 hours
Volume (1,000 cu.ft.)	1 3 8 16 27 45 65 90 125 400 1,000	0.4 0.6 0.8 1.0 1.2† 1.4 1.6 1.8 2.0 3.0 4.0	1.2 x 8.64 = 10.4 hours
Wind (mph)	0 1-2 3-5 6-9 10-14 15-20 20-	Tarped 1.0 0.9 0.8 0.7* 0.6 0.5 0.4	Sealed Masonry 1.00 0.95 0.90 0.85 0.80 0.75 0.70	0.7 x 10.4 = 7.3 hours

The loss rate factors can be worked out easily on the Master Fume Calculator to give the HLT (half-loss time) estimation.

MEASURING THE STRUCTURE

Consult on how to measure building to be fumigated with this product. Contact Drexel Chemical Company or your local distributor for this product.

The rate of fumigant loss is expressed as half-loss time (HLT), the time required for half the fumigant to be lost. An example is shown in the following table.

HALF-LOSS TIME (HLT) OF SIX HOURS

HLT	TIME ELAPSED (HRS)	CONCENTRATION OF FUMIGANT (OUNCE/1,000 CU.FT.)
(HLT = 6 hours) One-half of remaining fumigant is lost every 6 hours	0	16
	6	8
	12	4
	18	2
	24	1

Examples of the required dosage of this product are shown in the following table for various loss rates of the fumigant for a temperature of 70°F and a 20-hour exposure period.

Required Rate of this Product for Drywood Termite Control at 70°F and 20 Hours of Exposure for Various Measured Half-Loss Time (HLT)

HLT	2	4	8	12	16	20	24
This Product in ounces/1,000 cu.ft.	32	17	10	8	7	6.5	6

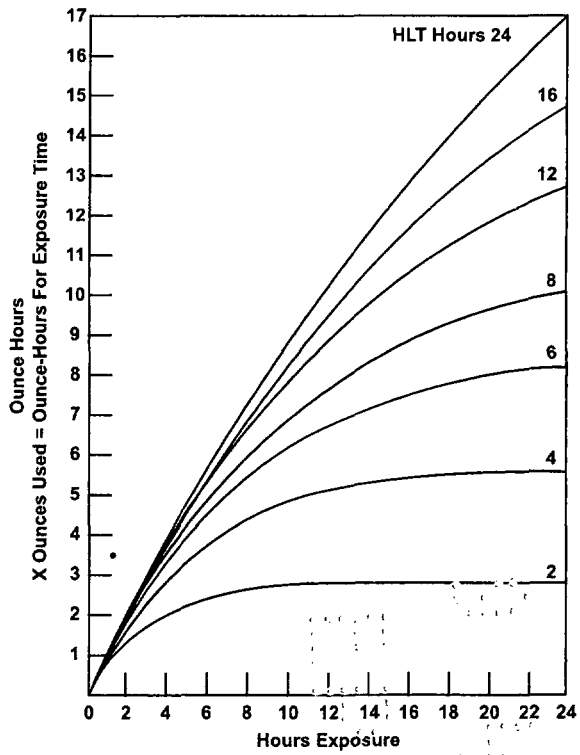
The experienced fumigator probably is familiar with the physical features of the terrain that will assist in making judgments of HLT calculations.

For a crawl space structure on sand, the HLT estimation would be 3 hours, requiring 43 pounds of this product. If, however, a shallow water table is known to exist, extend the volume to include the extra space and estimate the new HLT on the basis of perhaps a foam underseal. The new HLT would then be 12 hours, requiring only 13 pounds of this product for the structure. If uncertain about how the terrain may affect the HLT, it is best to monitor with a Fumiscope.

TEMPERATURE AT SITE OF PEST (i.e. Termite)

The pesticidal activity of a fumigant varies with the temperature, thus the dosage requirements for a particular structure must be based on the mean temperature at the coldest site that could harbor the pest. Numerous temperature measurements have been made of various structural components and atmospheric conditions of homes under fumigation. These have shown that a thermometer reading of the concrete slab or sub-section soil 2 to 3 inches below the surface will reliably represent the temperature of the coldest site that could harbor the target pest. The measurement can be made in the shade on the slab with a surface thermometer just before the fumigation.

Accumulation of Fumigant Dosage (OH) Related to Half-Loss Time (HLT) when Initial Concentration is 1 oz./Mcf.



As determined in other similar measurements, the warming influence caused by the weather is usually greatest in the attic and least in the soil; consequently, the temperatures of the mud sill and pier-post pad are usually the coldest and the most critical encountered in the entire structure.

The range of temperature in the following table represents mean seasonal temperatures in Florida and Southern California, where drywood termites are most prevalent.

Equilibrium Concentration of this product required for Drywood Termite Control for a Measured 12-hour HLT and 20 Hours of Exposure						
Temp. of slab or soil, (°F)	55	60	65	70	75	80
This Product (ozs./1,000 cu.ft.)	16	12	9.5	8	7	6

TEMPERATURE CONTROL

It is difficult to save a substantial amount of this product during winter fumigation by raising temperatures in the structure. There are no specific recommendations for heating the structure. However, if an elevated temperature is confirmed with a thermometer, it can be used in calculations with the Master Fume Calculator program.

Fans, heater-fans and other electrical equipment should be grounded and have a good protective fusing system. The surface temperature of heating equipment should not exceed 752°F (400°C).

The following conditions will have to be met, in any case:

1. During fumigation period, glowing heat surfaces or open flames must never be used.
2. The temperature should still be measured at the coldest potential pest site, such as the pier pad, mud sill or north wall ("shaded"). Usually, the temperature of the soil at a depth of 3 inches is representative of the coldest area.
3. For dosage calculations, the measured minimum temperature should be used.

USING DREXEL CHEMICAL'S MASTER FUME CALCULATOR PROGRAM

Drexel Chemical's Master Fume Calculator is a program that requires entry of key information to determine the dosage and amount of this product to be used. The calculations takes into consideration a broad range of pest species life stages and varying conditions of individual fumigation.

The program determines the dosage for monitored and non-monitored fumigations of exposure periods from 2 to 72 hours. The program will calculate the estimated half-loss time, dosage of product per 1,000 cu. ft., the pounds of the fumigant required, ounce-hours required and the maximum shoot rate per minute, and the amount of chloropicrin required.

(Refer to the table on page 3 of this manual for lethal accumulated dosages of this product for various pests.)

Drexel Chemical's Master Fume Calculator program information requires that the dosage range is from 0.5X to 10X the dosage for drywood termites, dependent on the target pest.

The tarp condition and seal inputs are: Excellent, Good, Medium, Fair or Poor. This input would be in relation to age and condition of the tarps used and how well a ground seal could be achieved.

Input Info

Dosage	:	1 – 10
Tarp condition	:	Excellent – Poor
Seal condition	:	Excellent – Poor
Wind (mph)	:	0 – 25
Volume (mcf)	:	1 – 5000
Underseal	:	Slab, clay, loam, sandy loam, sand
Temperature (°F)	:	40 – 100
Hours exposure	:	2 – 92
% Relative humidity	:	10 – 95
Amps per fan	:	1 – 10
Pic rate	:	10 or 15
Monitor job	:	No or Yes

Output Received

Estimated half-loss time
Dosage as ounce per 1,000
Gas required as pounds
Ounce-hour required
Maximum shoot rate as pounds per minute
Ounces of Pic needed

Using Drexel Chemical's Master Fume Calculator When Monitoring

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

Drexel Chemical's Master Fume Calculator is designed to determine actual HLT based on measurements of concentrations of this product during fumigation.

Monitoring to Determine Gas and Updated Dosing Recommendations

1. Measure (with a gas monitoring instrument such as a Fumiscope or similar device) concentration of this product ounce per 1000 cubic foot (gm/m3).
2. After one or more hours, take a second measurement of concentration of this product. Accuracy of HLT increases as time between monitoring intervals is increased.
3. Drexel Chemical's Master Fume Calculator will calculate the actual measured HLT.
4. If the HLT is shorter than estimated (more rapid loss of fumigant), then either more of this product needs to be added to finish on time or the exposure time may be extended if sufficient product is present. Drexel Chemical's Master Fume Calculator will provide the time and "add gas" recommendations.

CHLOROPICRIN WARNING AGENT

Because this product is odorless, protective chloropicrin warning agent must be released within the structure or site before the fumigation begins. This is precaution to assure that the space to be fumigated remains free of people.

Introduction of Chloropicrin

Studies have shown that when chloropicrin is applied according to label directions, it will reach warning concentration by the time the fumigant is introduced and will maintain a warning concentration throughout a 22 to 24 hour fumigation period. In order for chloropicrin to perform effectively, it must be applied:

- In a container with fresh wicking material.
- In the air stream of a fan.
- At a rate of 1 fl. oz. per 10,000 to 15,000 cubic feet or follow dosage rate calculated by the electronic Master Fume Calculator system.
- Do not fill chloropicrin pan or any pan with more than 3 fl. ozs. of chloropicrin.
- Wait 5 to 10 minutes before introducing Master Fume.

Also, it is suggested that introduction of chloropicrin should be:

- At least one on each floor of a multi-story structure.
- At each fumigant introduction site.
- The most effective placement of chloropicrin is about 1 foot behind the fan with the fan positioned upward at a 45-degree angle.

To avoid problems with desorption of chloropicrin, a fumigator may disqualify areas with many furnishings on which chloropicrin can absorb.

It is important to not over-apply the chloropicrin in any area of the structure, such as the lowest floor. Reaching a high localized concentration of chloropicrin will only lead to aeration difficulties due to the absorption potential of chloropicrin. The goal of the fumigator should be to rapidly attain distribution with chloropicrin, just as with the fumigant.

Use Precautions for Chloropicrin

1. Although chloropicrin is an excellent warning agent, it must not, however, be relied upon as a deterrent to entry during the entire exposure period if the confinement conditions are poor or if the exposure period exceeds 22 to 24 hours.
2. The amount of chloropicrin MUST be accurately measured. Less than the required amount will not give sufficient warning; too much can be difficult to aerate.
3. Store and transport chloropicrin and measuring container in a gas-tight case outside of the driver's space. Refer to the local Department of Transportation for further instructions on transporting chloropicrin.
4. Chloropicrin must be thoroughly aired from a structure before re-occupancy, as even very small amounts can be irritating to the eyes. Prior to reoccupancy, it may be helpful to operate the structure's air-handling systems to aerate chloropicrin from the ducts.
5. Chloropicrin is persistent when adsorbed on wood or concrete. DO NOT use in fumigant introduction hose for this product or pour on concrete or soil.
6. Chloropicrin is an organic molecule with a very high boiling point and low vapor pressure relative to this product. These characteristics contribute to its tendencies toward sorption and slow desorption, and require specific procedures for chloropicrin introduction.

The following sequence, for each chloropicrin introduction site, is recommended after preparing the structure for fumigation:

1. Accumulate the appropriate quantities of chloropicrin. To assist with accurate measurement of chloropicrin, measuring devices with resealable/recloseable caps are available (SCC Products, Anaheim, CA. Phone 714-761-3292). The advantage of using these devices is that chloropicrin can be measured outside the structure so only the amount of chloropicrin needed during the fumigation is carried into the structure.
2. Make sure that wicking material, such as a handful of cotton, is present in each container.
3. To distribute the chloropicrin, place the container in front of or behind fan with adequate cfm rating.
4. Pour chloropicrin over the absorbent material. The measuring container and cap may be left near the container and residue allowed to evaporate.
5. Leave the area immediately if protective respiratory equipment is not being used. Adequate respiratory protection should be used when more than one introduction site is present.
6. Seal the last entrance after application of chloropicrin.
7. If not already started, start the fan(s).

NOTE: Chloropicrin is a warning agent that causes smarting of the eyes, tears and discomfort. It has a very disagreeable pungent odor at very low concentrations. Chloropicrin must be used by a person certified to apply MASTER FUME or under their supervision. Fumigators must observe the precautionary statements and safety recommendations appearing on the label of this product.

Measuring Chloropicrin Concentrations
Concentrations of chloropicrin can be measured using Draeger sensor tubes 8103421 designed for determining chloropicrin concentrations. For additional information, contact your distributor or Draeger representative.

MODE OF OPERATION
Tube consists of a pre-tube and an indicating tube. The pre-tube contains a white oxidation layer, the indicating tube a light-grey layer and a white indicating layer. For measurement, both tubes are connected by the rubber tubing supplied.

When air or gas samples are sucked through the combined tube, the indicating layer changes color to yellow in the presence of carbon tetrachloride.

AMBIENT CONDITIONS
- Temperature: 59°F to 86°F (15°C to 30°C)
- Humidity: 3 to 15 mg/L (corresponds to 50% r.h. at 86°F [30°C])
- Atmospheric pressure: for correction of the reading, multiply by factor F.

$$F = \frac{1013}{\text{Actual atmospheric pressure (hPa)}}$$

PREREQUISITES
The tubes may only be used in conjuction with the following Draeger Pumps: Model 21/31, Accuro, Accuro 2000 or Quanitmeter 1000. Using other pumps may result in considerable measurement errors.

Observe the Instructions for Use of the pump.

Check the pump for leaks with an unopened tube before each series of measurements.

The measured value applies only to the place and date of measurement.

MEASUREMENT AND EVALUATION
1. Break off the tips of both tubes in the tube opener.
2. Connect them using the rubber tubing supplied.
3. Insert the combined tubes tightly in the pump. Arrows point towards the pump. Measuring range: 1 to 15 ppm (5 strokes, scale n=5)
4. Suck air or gas sample through the tube. Measuring period is approximately six minutes.
5. Read the entire length of the yellow discoloration.
   - Multiply the value by factor F for correction of the atmospheric pressure. Enter the result in the measurement record. Relative standard deviation ± 15% to 20%.
   - Observe possible cross sensitivities.
   - Flush the pump with air after operation.

DISPOSAL
See label for directions. For disposal, observe safety recommendation S 2-26-28. 1-36/37-44. Keep out of reach of unauthorized persons. Contents are corrosive.

Avoid contact with skin.

Note: Chloropicrin detection tubes have a limited shelf life.

INTRODUCTION OF FUMIGANT
The proper introduction of this product (release from the cylinder) is essential to the success, safety and economy of a fumigation. The fumigator must understand the principles involved as well as the conditions that exist for introducing the fumigant on each job. No two jobs are alike.

Many of the problems listed in the "Troubleshooting" section (see Chapter 11) are results of improper introduction of this product.

USING THE CYLINDER
This product is supplied in cylinders equipped with tubes that extend from the bottom of the tank to a valve on the top. To release the fumigant, this valve is opened to permit a free flow of the liquid, which vaporizes as it escapes from the release hose.

The last 3 to 5 pounds of fumigant in the cylinder will turn to gas before moving through the hose and the rate of flow is thus markedly reduced. During this phase, the cylinder and hose will often become frosted or iced. Care should be taken to keep this melting frost from dripping onto household furnishings.

The valve should be turned fully open. Initially, the valve should be opened slightly until flow has begun and then opened about one full turn, which should give full flow through the 1/8" fumigant introduction hose. When finished, close the valve tightly using a wrench with a handle of 10 inches to 20 inches in length. A clearance detector or leak detector may be used to test for a tight seal at the connections.

Also refer to Chapter 3 of this manual for additional information on cylinder.

WEIGHING THE FUMIGANT
Either platform or hanging scales can be used to weigh the cylinder containing this product during introduction of the fumigant. In the event that hanging scales are used, modified bonnets or cylinder slings should be used to hang the cylinder from the scale.

The cylinder should never be suspended by the valve!

See Chapter 3 of this Manual for additional information.

Consult Drexel Chemical Company or your MASTER FUME distributor for a source of supply.

The scale should be routinely calibrated, regardless of its type, to assure continued correct readings. Refer to the scale manufacturer for further details.

RELEASING THIS PRODUCT

Worker Safety
When releasing this product from the cylinder, the operator must wear face shield or goggles. Since there is a potential for the fumigant introduction hose to detach from the cylinder, all onlookers should remain at a safe distance from the release site. See Chapter 3 of this Manual for more information.

Preventing Damage to Property
The minutely small quantity of impurities in this product are of no consequence when it is correctly introduced and maintained in the gas phase. These impurities can cause damage and accelerate corrosion if a fogout occurs during fumigant introduction, resulting in condensation on susceptible objects; i.e., metals, tile, glass, fabrics, etc.

Reaching Equilibrium
When this product is released as a liquid from the fumigant introduction hose, it becomes very cold as it expands to form a gas and chills the surrounding air as the two mix.

This chilling causes formation of a fog that must be dissipated. The rate of dissipation depends upon the rate of release, atmospheric conditions and the mixing rate (which is determined by fan number, type and placement). Because it is chilled, this product in air is much more dense than the surrounding air and will rapidly settle to the bottom of the fumigation space unless mechanically agitated.

All gases tend to move from an area of high concentration to low concentration and will, therefore, come to equilibrium in a confined space. This product will do the same when it is introduced into a fumigation space, regardless of the fact that molecules of this product are heavier than air molecules. In spite of the high vapor pressure of this product, the rate of passive diffusion may be too slow for this to occur within the practical time of a fumigation. Thus, good mechanical distribution, such as the fans, is essential.

Substantial fans are needed when introducing this product for the following reasons:
1. Prevent stratification.
2. To aid proper dispersion.
3. To assist temperature distribution.

FUMIGANT INTRODUCTION – SELECTION AND USE OF EQUIPMENT

Safety Equipment
Wear goggles or full face shield for eye protection during introduction of the fumigant. Do not wear gloves or rubber boots. Do not reuse clothing or shoes that have become contaminated with liquid of this product until thoroughly aerated and cleaned.

Hoses
Release the fumigant through a suitable leak-proof hose with a minimum burst pressure of 500 pounds per square inch (psi). In addition, the dimensions of the fumigant introduction hose can have a large influence on the efficacy and material safety of this product.

The introduction rate of this product is controlled largely by the inside resistance of the fumigant introduction hose. The effects of the inside diameter size on the flow rate of this product and the effect of hose length on the introduction site are shown in the following tables.

EFFECT OF INSIDE DIAMETER SIZE ON FLOW RATE OF THIS PRODUCT THROUGH A 25 FT. HOSE OF POLYETHYLENE AT 65°F	
TUBE INSIDE DIAMETER (ID)	LBS. OF THIS PRODUCT PER MINUTE
1/8	4
1/4	20
1/2	45

EFFECT OF HOSE LENGTH (1/8" ID) ON THE FLOW RATE OF THIS PRODUCT	
LENGTH (FEET)	LBS. OF THIS PRODUCT PER MINUTE
25	4.0
50	2.8
100	2.0*
*Where fumigant introduction rates lower than 2 lbs./min. are needed, a longer hose can be used, (e.g. 200 ft.).	

FIELD WORKSHEET FOR MASTER FUME CALCULATOR

NAME _____ UNDERSEAL _____

ADDRESS _____ TOTAL POUNDS REQUIRED _____

DATE _____ TEMPERATURE (F) _____

PHONE NUMBER _____ OZ.-HRS. REQUIRED _____

INTRODUCTION TIME _____ HOURS EXPOSURE _____

PEST _____ MAX. SHOOTING RATE _____

DOSAGE FACTOR _____ CHLOROPICRIN _____

RELATIVE HUMIDITY (%) _____

TARP CONDITION _____

SHOOTING FAN AMPS _____

SEAL CONDITION _____

MONITORING INFORMATION OZ./MCF

Time	Location				Average
	1	2	3	4	

MONITOR JOB (YES/NO) _____ FIRST READING (EQUILIBRIUM) _____

WIND (MPH) _____ SECOND READING _____

ESTIMATED HLT _____ HOURS BETWEEN READINGS _____

VOLUME (MCF) _____ ACTUAL HLT _____

DOSAGE (OZ/MCF) _____ CORRECTION INFORMATION _____

Fumigant Introduction Stand
A raised fumigant introduction stand can be constructed of PVC pipe and the base weighted with rebar. Attaching the hose to customer furnishings is not recommended because these items may be damaged if contacted by tape or liquid of this product.

Another widely used solution is to securely tape the introduction hose to a tarp clamp, and then use the tarp clamp to attach the hose to the fan cage. In this case, the fan cage is angled 45° upward. Also, successful introduction of fumigant has been obtained by attaching the introduction hose to a coiled sand snake in front of an up-angled fan at 45°.

It is recommended to always leave the introduction hose in place during the exposure period, rather than attempt to pull the hose out following introduction. Pulling the hose out can result in significant damage to furnishings or the structure.

Protective Sheeting
It is recommended that protective sheeting, such as polyethylene plastic under the stand, hose and fan, be used to further protect floors and floor coverings during application. All of the options outlined above, for fumigant introduction, offer the flexibility to incorporate protective sheeting in critical areas.

Chloropicrin Introduction
Chloropicrin must be used within the structure at least 5 to 10 minutes prior to the introduction of the fumigant. Place a handful of cotton in a container and set the container in the air stream of a fan. Use 1 fl. oz. per 10,000 to 15,000 cubic feet of space to be fumigated. (See section on Chloropicrin in this Chapter for additional information).

Fumigant Introduction Site
The specific site of release of this product is very important to the success of the fumigation. Introduce this product in a manner to achieve rapid equilibrium, avoid excessive loss due to stratification and ensure safety to personnel and materials. Usually this can be accomplished by directing the flow into the air stream of a fan that has the capacity of 1,000 cfm for every pound of this product introduced per minute.

Considerations for Site Selection
1. Largest space.
2. At least one location at each floor of a multistory structure.
3. Proximity of furnishings that might be damaged by introduction.
4. Since it is suggested that chloropicrin be applied at each introduction site for this product, consideration should be given to the furnishings in each site. If the furnishings in a given area are such that chloropicrin desorption may be a problem (overstuffed furniture, many boxes, pillows, excessive clutter, etc.) the fumigator may want to disqualify the said area as a potential chloropicrin application site.
5. Number of sites: Studies support a fumigant introduction site for each 20 to 40 Mcf in a single-family dwelling. For site selection in large or multi-unit structures, see Section on "Fumigation of Large or Multi-Unit Structures" in Chapter 10.

Site selection is made using common sense. Ask, "If this product was introduced in this location, how and when will it get to the most remote locations in the structure?" It may be necessary to use multiple introduction sites to rapidly attain equilibrium. As a rule, it is not necessary from an efficacy standpoint to introduce fumigant directly into the attic space. With proper site selection and fan placement, this product will reach equilibrium throughout the structure and will not stratify in the lower reaches of the building.

Purpose and Choice of Fans
There are three purposes for fans in a structural fumigation: 1) fumigant control, 2) circulation, and 3) aeration. Common high velocity axial fans used in the fumigation business are Patton, Lakewood and Dayton. These fans are usually the most practical and are the most often used due to their relatively low cost. Fans ensure that the fumigant equilibrium is achieved in a timely manner, and aid in the ventilation and aeration process. In all cases, the fan selection is important. Axial flow fans with the propeller-type blades are suggested because they move high volumes of air per minute.

When selecting a fan, check the manufacturer's specifications and ensure that the fan is OSHA approved, grounded, contains a thermal shut off switch, meets or exceeds the cfm needed and has a shield for protection. Similar to other fumigation equipment items, fans will wear and need to be replaced. Never use an unsafe fan in a fumigation and remember to carry adapters with you to accommodate a 3-prong plug. Generators should be provided to run the fans if the fumigation site is not equipped with electricity.

Fan Capacity
The specifications for fans are numerous, e.g., number of blades, speed (rpm), watts, amps, shrouds, blade size and most importantly blade shape. These features affect the amount of air the fan can move, which is usually reported as cubic feet per minute (cfm). It is extremely important that you confirm the cfm rating of the fan by checking the manufacturer's rating. For example, an 18 inch, 2.6 amp, 200-watt fan could have a different cfm rating based on whether it has a tear drop or flat blade design. A 20 inch non-industrial fan will not move as much as an 18 inch industrial fan due to the blade design. The cfm ratings are set by the manufacturer utilizing a gauge or meter in front of the circulating fan.

For example, when introducing this product through a one-eighth inch (1/8 inch) diameter (ID) hose, 25 feet in length, the release rate will be roughly 4 pounds per minute. That rate of release of this product, according to the label, would require a 4,000 cfm capacity fan.

Take note that there may be significant variation in cfm ratings among fan manufacturers and fan models. Contact the fan manufacturer for specifications.

Positioning Fans
There is no set pattern established for the positioning or the number of fans to use. A rule of thumb has been to use one fan for each 20 Mcf and at least one fan for each floor of the structure, including sub-areas (basements) and open attics, if accessible. Fans should be positioned in such a way that the fumigant will be mixed rapidly to reach equilibrium.

It is good fumigation practice to use more fans in structures that are divided into numerous smaller compartments or rooms. (See Chapter 10 on Compartmentalization).

Distribution and Aeration
It is recommended that this product be introduced into a structure in such a way that it reaches equilibrium rapidly, since the exposure period does not begin until equilibrium has been reached. The number of fans will accumulate the calculated hours of exposure by reading equilibrium in the estimated time (usually one hour in an average house). The fumigant introduction fan(s) will mix the warm air of the structure with the cool air during introduction of this product and act as a "heat exchanger".

For best distribution, the introduction of this product should be directed into the air stream of the fan. If you elect to shoot with the air stream, choose a large open space and tilt the fan to a 45° angle or greater. The fan must have a capacity of at least 1,000 cfm for each pound of this product released per minute.

As noted in Chapter 8, fans are equally important during the aeration process of the fumigation. Depending on the size, compartmentalization, actual HLT and terminal concentration, fan placement will be critical during active ventilation. Often, the fans will need to be repositioned for aeration. The best use of the aeration fan(s) is to position them so airflow is moving in one direction. Position fans for fresh air intake in openings on one side of the structure and fans for exhausting fumigant in openings on the opposite side of the structure.

Sites of Multiple Release
The number of release sites for this product will be dictated by the size and configuration of the structure and the adequacy of the circulation. As a rule of thumb, to establish fumigant equilibrium within an hour, there should be sufficient circulation. Experience with the product and with the measurement discussed elsewhere in this Chapter will help the fumigator judge the amount of circulation required.

CONTINUOUS CIRCULATION
In addition to effective initial distribution of the fumigant, equilibrium of the gas is essential for making sure that the fumigant released into the structure will reach all areas in the structure where infestation may exist.

Ensure fans are in good operating condition and secure to avoid accidents if they are to remain on for the entire fumigation. After this product reaches equilibrium, introduction fans can be turned off remotely. Often, fans are left on during the fumigation to assist with ventilation of the fumigant during aeration.

All fumigants leak. The ground seal and tarp condition play a role in confinement. Unless there are abnormally large leaks, continuous circulation during the entire exposure period will not appreciably affect the loss rate for this product. The air stream should not flow directly against "leaky" tarps because excessive gas loss could occur.

Electricity is needed to operate fans during fumigation introduction and aeration. If electricity is not available on the property to be fumigated, the applicator must make alternate arrangements, such as having a generator or securing power from a neighbor.

Use of Industrial High Velocity TurboFlow Fan for Introduction of this Product (i.e. King of Fans)

Background
The King of Fans TurboFan was specially designed for fumigant introduction, circulation and aeration during structural fumigations. This TurboFlow fan was developed to meet industry needs for a more durable fan able to withstand tough conditions and demanding long-term use encountered in structural fumigations.

The TurboFlow fan for this product utilizes two important physical attributes, which maximize fumigant mixing by maintaining and extending maximum high velocity airflow: 1) a unique shrouded fan housing, and 2) a large commercial industrial sealed motor.

Best Practices
1. Ensure that the fan is in good working order.
2. Determine the best position and angle for the fan (i.e. about 45°) then carefully tighten the side knobs to secure the shroud at that angle.
3. Extend the tube holder carefully until it is perpendicular to the fan face.
4. Holding the tube between your thumb and forefinger, measure the appropriate

amount of introduction tubing needed so the approximately one-half to three-fourths inches of the hose will extend from holder perpendicular to the face of the fan.
5. After the length of introduction tubing needed has been determined, thread the tubing through the rim guide, then proceed through the lower hole of the holder that best matches the tubing diameter.
6. Loop the tubing back carefully through the higher matching hole of the holder leaving a tube end of a one-half to three-fourths inch. Leaving a one-half to three-fourths inch loop in the tube between steps 5 and 6 provides the best result. MAKE SURE THAT TUBE IS NOT KINKED!
7. Once the tubing is in place, adjust the tube and holder easily until the tube is projecting outward and is perpendicular to the fan face.
8. For applications of this product, place the chloropicrin pan 1 foot directly behind the fan.

Ordering Information
Contact your local fumigation/pest control product distributor of the TurboFlow fan for orders or questions.

CONTACT:
King of Fans, Inc.
1951 N.W. 22 Street
Fort Lauderdale, FL 33311
Krockenbach@kingoffans.com
(800) 330-3267 Toll Free
(954) 484-7602 Fax
Go to www.kingoffans.com for updates and additional ordering information.

Change of State
When water evaporates, it cools the air because it takes heat to change state from a liquid to a gas.

The following situations can be encountered when introducing this product. Below are suggestions on how to avoid them:

Frozen Valves and Hoses
When liquid of this product is released from the confinement of the cylinder, it quickly expands into a gas because it boils at -55°C (-67°F). Like evaporating water, it absorbs heat from the surrounding material. The amount of heat needed from the air to evaporate one pound of this product is 20,460 calories. The loss of this amount of heat will chill 1,000 cubic feet of sea-level air about 4.5°F for every pound of this product released.

If the valve is "just cracked", to reduce the rate of release, this product will expand from a liquid to a gas in the hose. When this happens, a chilling and consequent frosting of the outside of the valve and hose occurs. This is avoided by allowing full flow through the valve. The rate of flow of this product should be controlled by the inside diameter (ID) and length of hose, and not by restricting flow through the valve.

Frozen Cylinders
If there is a break in the dip tube in the cylinder, the gas phase of this product will be discharged when the liquid level falls below that point. 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. This product will be discharged at a slower rate because it is in the gaseous phase. Cylinders showing signs of a broken dip tube (which is a rare occurrence) should be red tagged and returned to the distributor so that the problem can be corrected before refilling.

Liquid Phase of this Product Splattering Out of Introduction Hose
If this product is allowed to expand in the fumigant introduction hose, this chilling can be sufficient to prevent full vaporization of this product so that "super cold" liquid phase of this product is splattered out of the hose. This can cause moisture stains, corrosion or other damage to objects it strikes (see Chapter 11 on Troubleshooting).

"Fog Outs"
This product will also take the heat needed for vaporization from nearby objects. If the drop in temperature of the object reaches the dew point of the surrounding air, water can condense on it. The liquid water that condenses on an object chilled to or below the dew point is called dew, similar to 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 that the fog be controlled and dew formation be eliminated when introducing this product because liquid water absorbs the very small amount of impurities in this product which can accelerate corrosion or stains (see Chapter 11 on Troubleshooting).

Also, condensation forming on the photoelectric eye of a smoke detector can cause the smoke detector alarm to activate.

Releasing this product will cause some fog. A slow release and low humidity will cause less; a fast release and high humidity will cause more. After the fog forms, it will evaporate at a rate dependent on the relative humidity and temperature of the fumigation atmosphere. Thus, 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 labels for complete instructions on introducing this product.

Prevention of "Fog Out"
The following are potential techniques 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. Run air conditioner during wrapping of structure until the seal is complete. Do not open windows and tarp air conditioning compressor unit until the entire structure has been tarped. This will minimize condensation from occurring when warm moisture-laden air contacts cooled interior surfaces.
3. Reduce the introduction rate with a smaller diameter hose, longer hose or pulsed (interrupted) introduction.
4. Reduce the amount of this product introduced into one area by using multiple introduction sites. This is equally important for beetle and other high-dose fumigations.
5. To hasten heat exchange, use multiple fans or larger fans.
6. Monitor fumigation to reduce the overall fumigant requirements or extend, if practical, the exposure period.
7. Use a combination of several of these techniques to reduce the release rate and relative humidity, for difficult situations, and increase the heat exchange of the structure to the fumigation atmosphere. The Master Fume Calculator program takes into consideration relative humidity and fan capacity in amps to recommend the introduction rate of the fumigant.

USE PRECAUTIONS WHEN INTRODUCING THIS PRODUCT
Safety Concerns
There are several safety concerns that arise when introducing this product. Please refer to Chapters 2 and 3 of this manual for details.

FUMIGANT INTRODUCTION SUMMARY
The method of introducing this product has a very important influence on the efficacy as well as the profitability of the project.

Below are points that need to be considered when introducing this product:
1. The methods used in the introduction of this product will agree with the need to develop a dose of sufficient ounce-hours for the working temperature to control the target pest throughout the structure.
2. This product should be introduced in a manner so as to be safe to personnel and property inside and outside of the fumigation space.
3. Equilibrium should be reached within an hour after this product is introduced in the building.

The following subjects need to be used in making judgments for introducing this product:
1. Structure
   a. Size
   b. Configuration – open or compartmentalized; single or multi-story, etc.
   c. Number and location of release sites for fumigant
   d. Seal – type of structure and soil
   e. Pest – dosage requirements
   f. Half-Loss Time (HLT)
   g. Working temperature
   h. Relative humidity (interior)
   i. Air-conditioning
   j. Others
2. Weather
   a. Humidity
   b. Temperature
   c. Wind
3. This product
   a. Dosage for required ounce-hour (OH) for pest
   b. Pounds of this product for structure
   c. Pressure of release
4. Fans
   a. Capacity
   b. Number
   c. Direction of air stream
   d. On/off
   e. Aeration needs
5. Fumigant introduction hose
   a. Size (ID) of hose
   b. Length of hose
   c. Placement and direction of outlet
6. Introduction of Fumigant
   a. Time of introduction
   b. Release – all at once or periodic "bursts"

Fumigant Introduction Checklist
Number of fumigant release points (document c ph)
- Fan amps
- Hose diameter
- Hose length
- Protective sheeting under fumigant release points
- Pounds of this product released
- Time of introduction

ENTERING A STRUCTURE UNDER FUMIGATION
If emergency entry into a structure under fumigation with this product is required, proper respiratory protection, Self Contained Breathing Apparatus (SCBA), must be used. See Precautionary Statements (Personal Protective Equipment) section of the label of this product.

FIRE FIGHTING

Information
This product is not combustible. However, in temperatures exceeding approximately 400°C (752°F), this product will degrade to form hydrogen fluoride (HF) and sulfur dioxide. Theoretically, the number of ounces of HF/1,000 cubic feet produced during a fire in a structure containing this product would equal 0.4x number of ounces of this product per 1,000 cubic feet {in temperatures exceeding approximately 752°F, each mole (102 gm) of sulfuryl fluoride will degrade to form 2 moles (40 gm) of hydrogen fluoride (HF)}. Nonetheless, amounts of HF actually produced during fires involving this product may be insignificant because this product rapidly diffuses from structures.

Chloropicrin Warning Agent
Chloropicrin is used to aid in vacating a structure. Five to 10 minutes prior to introducing this product, chloropicrin is poured over cotton in a container placed in the air stream of a fan. Chloropicrin is a non-combustible liquid and is not soluble in water. At temperatures exceeding 233°F (112°C), chloropicrin will degrade to form hydrochloric acid, phosgene and oxides of nitrogen such as NO_2 and NO. The concentration of chloropicrin used during fumigation with this product is 1 fl. oz. per 10,000 – 15,000 cubic feet, which equals 17 to 26 ppm. Due to the small amount of chloropicrin present during fumigations, the amount of decomposition products of chloropicrin formed during a fire would be insignificant.

Cylinders of this Product
This product is packaged as a gas under pressure in cylinders. Cylinders contain both gas and liquid. Cylinders containing this product are designed not to explode in high temperatures. A fusible plug in the cylinder valve body melts at 158° to 165°F (70°C to 73.8°C) releasing the contents of the cylinder.

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

Protective Clothing
Self-contained breathing apparatus (SCBA) and normal "turn-out" gear should be worn when fighting fires in structures under fumigation with this product.

For fires involving cylinders of this product
When fighting fires in atmospheres containing potentially high concentrations of this product, self-contained breathing apparatus (SCBA) and encapsulating protective suits should be worn. Protective suit material must be compatible with exposure to hydrofluoric acid.

Chapter 7

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

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

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

Specific guidelines for monitoring a typical fumigation:
This product 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 this product has been established.

1. Monitor this product in es most representative of the atmosphere in which insects will be d 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 living space, sub-section, attic, each floor of multiple story structures or each unit in a partitioned building such as apartments.
3. Measurements should be as dependable and accurate as possible, especially when low concentrations are involved.
4. The time required between measurements to determine the HLT will depend on the estimated HLT or past history of the structure.

Two to 4 hours will usually be sufficient, but more time may be required in the case of very large structures or excellent half-loss times.

EQUIPMENT

Master Fume Calculator Program
Master Fume Calculator program can be used for both non-monitored and monitored fumigations. Master Fume Calculator may also be used for monitored fumigations.

Monitoring Hoses
Arrangements should be made to place sampling hoses in the structure prior to fumigant introduction. Clear vinyl hoses (1/4" to 3/8" ID) should be placed so as to sample representative concentrations with a Fumiscope or similar device.

Monitoring lines should be placed on the fumigated structure at all levels including sub-floorings, attics, if accessible. At least one-half of the lines should be placed in areas/rooms away from the point of fumigant introduction. Place lines in areas representative of the different units, if the structure is compartmentalized into separate towers, wings or other sub-units.

Determination of the time for HLT only begins after equilibrium of the gas fumigant has been established. It is usually desirable, after this time, to draw samples from the main reservoir (living section) as well as the sub-area and attic crawl sections. A single sampling site can be considered if a very good distribution method is used.

Monitoring Hoses – Placement And Use
Below are recommendations on placement and use of monitoring hoses:
1. Label exterior end of the hose with sample location before running the hose outside the structure, when using more than one monitoring hose.
2. Secure the window when running the hose through an open window to avoid closing and constricting the monitoring hose accidentally during fumigation. When fumigation fans are turned on, secure interior doors so they do not close or they may constrict the monitoring hose as well as prevent rapid equilibrium.
3. Sampling hoses are generally placed to sample at 3 to 4 feet above the floor (mid-level). Secure the ends of the sampling hoses in a way such that the sample hoses are not constricted and the objects will not be damaged.
4. Monitoring hoses should be checked for airflow using the Fumiscope or vacuum pump after placement. Confirm that the electricity is available to operate the monitoring equipment during fumigation.
5. To prevent moisture from collecting within the hose, use tape or plugs to cap the ends of the hoses when not in use. To prevent unauthorized persons from tampering with the hoses, it is advisable to roll up the hose and place it in an inconspicuous area when not in use.

Fumiscope
Refer to Chapter 4 of this Manual regarding Fumiscope monitoring equipment for operating, calibration and repair procedures.

MONITORING A LARGE FUMIGATION
Place monitoring lines on all levels of the fumigated structure, including attics and sub-areas, if accessible. At least half the lines should be placed in rooms/areas distant from fumigant introduction points. If the structure is compartmentalized into separate towers, wings or other sub-units, place lines in areas representative of different sub-units.

Monitoring can be conducted, if time permits, in a manner so that the exact amount of this product required is introduced based on the measured half-loss time (HLT). This type of precision fumigation is conducted by initially introducing a portion of the calculated dosage of this product, monitoring to determine the actual HLT, and then adding this product to achieve sufficient ounce-hours in the time remaining for the fumigation.

Constructing a manifold can significantly speed the process of taking concentration readings, so with the use of auxiliary air pumps to purge multiple monitoring lines.

Note: For additional information regarding large or otherwise special fumigations, see Chapter 10 on "Fumigation of Large or Multi-Unit Structures".

MONITORING SCENARIOS

Following are descriptions of scenarios in whic[illegible] Master Fume Calculator program and Fumiscope are used to monitor fumigant dosage and determine what action is required, if any, to ensure a successful fumigation.

Scenario 1

VERIFY REQUIRED OUNCE-HOURS (OH) ACHIEVED

In a drywood termite fumigation, the conditions are as follows:

DOSAGE	1X
TARP	GOOD
SEAL	MEDIUM
WIND	5 MPH
VOLUME	30 MCF
UNDERSEAL	SLAB
TEMPERATURE	70°F (21.1°C)
HOURS EXPOSURE	20 HRS.

Using a non-monitored dose calculation, you arrive at an estimated HLT of 24.8 hours and a dosage of 8.5 oz./mcf, or a total of 15.9 pounds. The required oz.–hrs. are 97.7 for that temperature.

A good use of monitoring in this situation would be to take an equilibrium concentration and one fumigant concentration measurement just prior to breaking the seal (a terminal concentration). In this way, you could be certain you accumulated adequate oz.–hrs.

FIRST READING	9 OZ./MCF
SECOND READING	4 OZ./MCF
TIME BETWEEN READINGS	19 HRS.
ACTUAL HLT	16.2 HRS.
ACTION REQUIRED	NONE: JOB IS ACCOMPLISHED

In this case, you introduced the non-monitored dosage but entered the job in the Master Fume Calculator as monitored. That way, you were able to enter the equilibrium and terminal fumigant concentrations and determine that although the HLT was shorter than estimated, the appropriate oz.–hrs. had been accumulated and the job was accomplished on schedule.

Scenario 2

ADDITIONAL FUMIGANT REQUIRED

In a drywood termite fumigation, your conditions are as follows:

DOSAGE	1X
TARP	GOOD
SEAL	MEDIUM
WIND	10 MPH
VOLUME	30 MCF
UNDERSEAL	CLAY
TEMPERATURE	70°F (21.1°C)
HOURS EXPOSURE	20 HRS.

This time you introduced the monitored dosage, giving you an estimated HLT of 2.1 hours and the dosage of 32.5 oz./mcf, or 61 pounds. You measure the fumigant concentration at equilibrium (1 hour after introduction) and again 2 hours later to measure actual HLT. You placed two monitoring hoses in two different areas of the structure to double-check that equilibrium was achieved and maintained.

FIRST READING	11 OZ/MCF
SECOND READING	10 OZ/MCF
TIME BETWEEN READINGS	2 HRS.
ACTUAL HLT	14.5 HRS.
INITIAL HOURS EXPOSURE	6 HRS.
HOURS REMAINING	8 HRS.
OZ/MCF REMAINING	2 OZ/MCF

Your HLT in this case was significantly shorter than what was estimated, and the program responds by advising you to add fumigant in order to achieve control in the time allowed.

Scenario 3a

FUNCTION 2 – NON-MONITORED

An advanced function of the Master Fume Calculator program allows you to compensate in the case of a "blow-open" in which you have complete, or almost complete, loss of fumigant during the exposure period. This function asks you for the number of hours exposure before the blow-open, the number of hours exposure desired to finish the job and, for monitored jobs, the concentration remaining in the structure at the time the situation has been corrected (i.e. the tarps closed and sealed).

Function 2 on the Master Fume Calculator program can be used for both monitored and non-monitored jobs. The first scenario involved a non-monitored job in which the conditions are as follows:

DOSAGE	1X
TARP	GOOD
SEAL	MEDIUM
WIND	5 MPH
VOLUME	30 MCF
UNDERSEAL	SAND
TEMPERATURE	70°F (21.1°C)
HOURS EXPOSURE	20 HRS.

In this case, the program provides an estimated HLT of 13.9 hours and a dosage of 10.3 oz./mcf or 19.3 pounds. Let us say, though, that your tarps blew open 6 hours into the exposure period. After re-sealing the tarps, you have 8 hours to finish the job. To use Function 2, you must re-enter the job in the program. Immediately after the prograr[illegible]ponds with the dosage information, press the FUNCT (function) button, f[illegible]ed by 2. When you enter the appropriate information, the program responds by advising you to add 21.9 pounds of fumigant to complete the job within the next 8 hours.

Scenario 3b

FUNCTION 2 – MONITORED

In the previous example the program's response is based on the assumption that the estimated HLT was accurate. If you had monitored the job, you would have verified the HLT. In addition, following re-sealing the job, you would measure the remaining fumigant. After entering the first and second readings and determining the actual HLT of additional hours required and hours remaining, press FUNCT followed by 2 and enter the appropriate information.

FIRST READING	40 OZ/MCF
SECOND READING	12 OZ/MCF
TIME BETWEEN READINGS	2 HRS.
ACTUAL HLT	1.2 HRS.
ACTION REQUIRED	ADD 32.1 LBS.

The program responds that 7.6 pounds of fumigant are needed to accomplish the job within the 8 hours remaining.

Chapter 8

AERATION AND REENTRY

AERATION

It is essential that no occupant reenter the structure after fumigation until the fumigant has been aerated and the space has been fully tested and cleared for reentry.

One of the features of this product for structural fumigation is its capacity to rapidly diffuse into the sites of the pests. Then, when the confinement seals are removed, aeration is also typically rapid. Fans are excellent aids in attaining quick aeration and are essential where cross ventilation is poor.

Plan ahead for the aeration period. Take steps to aid in aeration by placement of fans strategically and by placing seams away from outdoor plants. To facilitate aeration, open operable internal doors, internal openings to attics and subareas, storage chests, cabinets, drawers, closets and appliance such as washing machines, dryers, dishwashers, ovens and other enclosed areas. Refrigerator and freezer doors may be left open if the units are turned off, but if they remain closed for the fumigation, they will need to be opened during clearing.

FACTORS INFLUENCING AERATION TIME

FOUR FACTORS AFFECT THE TIME NEEDED FOR AERATION:

1. Rate of air exchange
2. Terminal fumigant concentration
3. Load factor – 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. Terminal concentration of 2 to 8 ounces per 1,000 cubic feet (500 to 2,000 ppm) are most common after the customary exposure period of 20 to 24 hours for drywood termite fumigation. However, it can be as high as 32 ounces per 1,000 cubic feet (8,000 ppm) or more for short exposures or when fumigating for beetles at elevated rates. 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 this product 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. This product 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 in the breathing zones. Often, the greatest amount of this product to be desorbed is associated with the commodities.

The sorption/desorption phenomenon is a function of fumigant concentration and temperature – the higher the concentration throughout the fumigation, the greater the driving force for sorption, thus, 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 tents are opened.

Temperature
Temperature has a direct effect on the clearar[illegible]e of a fumigant. The higher the temperature, the faster the rate of gas diffusion and desorption.

PROCEDURES FOR AERATION
Procedures available to the fumigator for aeration may vary depending on the State. Refer to the label registered in the State or contact your Drexel representative for further information.

Aeration Procedure 1
These steps must be completed in succession.

Step 1: Aerate structure with all operable windows and doors open, aided by the use of 1 or more fans, for a minimum of 1 hour. Total fan capacity, using one or more fans, shall be capable of displacing a total of 5,000 cfm.

Step 2: Secure structure and do not allow reentry for a minimum of 6 hours from the start of aeration (first opening of the seal). During this time, structures must remain posted.

Step 3: After the minimum 6 hour waiting period, measure the concentration of this product in breathing zones of each room. If the concentration of this product is above 1 ppm, ventilate structure with operable doors and windows open. Structure may be reoccupied when concentration of this product is 1 ppm or less in the breathing zones.

Aeration Procedure 2
These steps must be completed in succession.

Step 1: Aerate structure with all operable windows and doors open, aided by the use of 1 or more fans, for a minimum of 1 hour. Total fan capacity, using one or more fans, shall be capable of displacing a total of 5,000 cfm.

Step 2: Secure the structure and do not allow reentry for a minimum of 8 hours from the start of aeration (first opening of the seal). During this time, the structure must remain posted.

Step 3: After the minimum 8 hour waiting period, measure the concentrations of this product in breathing zones of each room. If the concentration of this product is above 1 ppm, ventilate structure with operable doors and windows open. Structure may be reoccupied when the concentration of this product is 1 ppm or less in the breathing zones.

When using Procedures 1 and 2, at least a full hour of active ventilation is required prior to resecuring the structure for extended aeration.

To confirm a fumigant concentration of 1 ppm or below in the breathing zone, the structure must be tested with an approved device such as Interscan gas analyzer, Miran or SF-ExplorIR specific vapor analyzer at the end of the aeration period. Further aeration and retesting are required if the concentration is found to be more than 1 ppm in the breathing zone.

Use Precaution: The structure is considered under fumigation until final clearance is obtained. During this time, appropriate precautions are still needed.

SAFETY CONSIDERATIONS AT AERATION
At the time of the start of aeration, two trained persons in the use of this gas fumigant must be present. The "opening" of a fumigation should be carried out in such a way that there will be minimal exposure of the crew, neighbors and non-target areas to the fumigant.

The following are suggested to prevent non-target exposure, in general:

The downwind side of the tarps or buildings must be first opened, then, only the upwind side.

Use proper respiratory equipment described in the "Personal Protective Equipment (PPE)" section of this product label if entry into the fumigated area is necessary prior to the initial full hour aeration procedure is completed or when the fumigant concentrations are not known. Proper respiratory equipment must be worn until detection devices have confirmed that aeration has reduced the fumigant concentration to 1 ppm or less in the breathing zone.

Do not work (e.g. fold tarps, etc.) downwind next to a fumigation until the fumigant concentration reaches 1 ppm or below in the breathing zone.

To reduce exposure of plants and non-target areas, start slowly the aeration when opening fumigations. Initially open seams over driveways and/or other open areas, if possible, to prevent damage to the plant. When aerating high concentrations (e.g. fumigation for beetles), let the bulk of the fumigant escape first through opened seams from the tent before continuing to work around the structure.

Entrances of fumigated structures must remain posted with warning signs until the level of the fumigant in the breathing zone of the treated areas is found to be 1 ppm or below as determined by a detection device of sufficient sensitivity such as Interscan, Miran or SF-ExplorIR gas analyzer. This includes the time allowed for extended aeration. Removal of the warning signs may only be authorized by a certified applicator, and only when the concentration of this product in the breathing zone of the treated site is 1 ppm or less. Consult your local authorities regarding documentation pertaining to notices on posting clearance.

CLAMPS, TARPS AND/C[illegible]APE REMOVAL
Below are the recommen[illegible]teps for opening of the seal.

Tarp Seal:
1. Open seam at downwind by removing the clamps and folding back the tarps.
2. Open seam upwind in a similar way.
3. Remove weights and clamps.
4. Drop the tents. It has been shown that peeling tarps off the structure, keeping tarp between the worker and the building reduce exposure of the worker to confined fumigant.
5. To facilitate aeration, turn on fans and reposition, if necessary. Respiratory protection is necessary if entering the structure to turn on and/or to reposition fans when fumigant concentration is unknown or has not been confirmed by detection devices to be 1 ppm or less.
6. Aerate and verify concentration of the fumigant following the procedures found on the product label.

Tape and Seal:
1. Remove exterior tape and seals from doors and windows. Where possible, open structure from the outside.
2. Wear proper respiratory protection, then, only enter the structure to open remaining doors and windows.
3. Turn on the fans and reposition, if necessary.
4. Aerate and verify concentration of the fumigant following the procedures found on the product label.

CHLOROPICRIN – COMMON COMPLAINTS
Complaints of chloropicrin are more common on same day clears.

During the winter months, fumigators most likely will find chloropicrin in the building at the end of aeration. The cold, wet weather in the winter months make it more difficult to aerate chloropicrin from a building.

Complaints of chloropicrin are common especially in houses or garages cluttered with goods such as those filled with boxes and small rooms with lots of furniture.

Complaints of chloropicrin are common especially with modern office buildings that lack windows that open. Placing fans in the corners of these buildings and running ducts towards an entrance can be helpful.

Complaints of chloropicrin also occur in areas that are enclosed which are difficult to aerate such as bank vaults, small utility rooms and houses that are tightly constructed with dead air space.

CLEARING THE STRUCTURE
It is important that after fumigation, no occupant reenter the home, vehicle or other fumigation site until the fumigant has been aerated and the site has been tested for fumigant clearance.

The fumigator must test the breathing zones in the structure, following aeration period, to make certain that the concentration of this product is 1 ppm or below in the breathing zones before allowing reoccupation of the structure.

DETECTION OF FUMIGANT
If the level of sulfuryl fluoride is unknown or is above 1 ppm, no one is allowed to enter the treated area unless provided with the NIOSH or MSHA approved respiratory protection device (see Personal Protective Equipment (PPE) section of this product label).

Before occupants re-enter the site, it must be "cleared", indicating that the fumigant has been reduced to a level of 1 ppm or below and maintained at or below that level in the breathing zone. It is the responsibility of the licensed fumigator to measure the concentration of this product using a detector with sufficient sensitivity such as the ones described below.

Aeration is not considered complete until the level of sulfuryl fluoride has been determined to be no more than 1 ppm in the breathing zone with an appropriate detection device. Warning signs must remain posted on the structure at each entrance until aeration is determined to be complete.

CLEARANCE TESTING
Please refer to Chapter 4 of this Manual under the section "Clearance Testing Equipment".

Chapter 9

CHAMBER FUMIGATIONS
Maximum results with a minimum amount of fumigant can best be achieved by chamber fumigation. Precise control over the fumigation of a wide variety of pests can be accomplished in chambers especially constructed for this purpose. Fumigation in either vacuum or atmospheric chambers cuts fumigant costs, since it eliminates the necessity to disperse the fumigant in large empty areas of storage buildings.

This product has excellent penetrating power and also aerates rapidly when the exposure time is completed. Long waiting periods are eliminated before fumigated materials may be safely handled. Also, this product is odorless and colorless, making it an ideal fumigant for chambers.

REQUIREMENTS FOR EQUIPMENT

The requirements for equipment to be used with this product are similar to those used with methyl bromide.

Atmospheric Chambers

A suitable chamber can be constructed for low cost fumigation. The chamber consists of a gas-tight room with an appropriate door and a minimum of equipment. For even gas distribution, an applicator, exhaust blower and a small fan are required. If the chamber is to be used where low temperatures are encountered, it should be equipped with some means of heating to maintain a temperature of at least a 60°F (16°C) during fumigation. Do not use open flames or hot elements (752°F plus) as they will cause the sulfuryl fluoride gas to decompose. Certain well-built truck bodies have been successfully converted to efficient atmospheric chambers. Temporary tarp chambers may also be used. In addition, B & G Equipment Company of Plumbsteadville, Pennsylvania is currently marketing a mini-fumigation bubble developed by Rentokil that may be useful for fumigating small items.

Construction of a typical atmospheric chamber needs to be altered to fit the conditions under which the fumigation chamber is to be used. If the chamber is to be loaded with large, heavy packages, it may be advisable to add a protective sheeting behind the inside lining. Making it gas-tight is the primary consideration in the construction of the atmospheric chamber. Sheet metal or other material impervious to sulfuryl fluoride is suggested. All joints must be sealed.

It is advisable to position the chamber away from work areas. Locating the chamber outside or in a separate building, which is dedicated to fumigations, is the ideal situation. DO NOT locate chamber in an occupied building.

Two openings are provided in the construction of the chamber: the large loading door and the small vent door. The vent door is hinged at the back and provided with a counterweight on the front edge. A rubber strip seal is used around the edge. The door is closed by a light cable and pulleys and is held in place by clamps to provide a final seal.

A vault door hinged at the top may be used for the main opening which is less apt to sag. If provided with proper counter weight, it is easy to use and is out of the way when the vault is being loaded. Plywood and light lumber tongue-and-groove lumber, and sheet metal are suggested materials for the vault doors. The entire edge of the door must be provided with a rubber strip seal. No special fresh air inlets are needed when a door of this type is used since the entrance of fresh air to the floor of the vault is easily accomplished by slightly opening the door.

If a door hinged at the side is preferred, refrigerator hinges and clamps are recommended. A fresh air inlet in the front of the chamber to the side of the door and near the floor is recommended for side opening doors. This type of door must similarly be sealed with rubber stripping.

A small circulating fan inside the chamber can provide a gentle movement of air adequate to secure even gas distribution throughout the chamber.

The size of the exhaust blower will depend on the size of the fumigation chamber, aeration time requirements and the type of material being fumigated. A fan capable of changing the air in the chamber in 5 to 10 minutes is sufficient. Local representatives of the various blower manufacturers can be of assistance in determining the size required. The chamber exhaust must be via a stack, which carries the unused fumigant outside the building and away from adjoining buildings or work areas. Consult your state agency for emission control requirements.

Where heat is required, steam pipes or temperature electric strip heaters are recommended. The maximum temperature limit of the heat source is 752°F (400°C). DO NOT use open flame or high temperature electrical heaters, as this may result in converting sulfuryl fluoride to hydrofluoric acid, which may damage commodities and equipment.

A thermometer should be installed to register chamber temperature. Take note that it is the temperature of the commodity being fumigated that is important. Before starting fumigation, sufficient time should always be allowed for the chamber load to warm up to the desired temperature. This ensures that the pests are active and will rapidly assimilate lethal concentrations of the chemical.

During fumigation, fittings for conducting pressure tests and for monitoring lines should be incorporated in the chamber.

Vacuum Chambers

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

Vacuum fumigations often require a lower use rate than normal atmospheric fumigations. Do not exceed 200 oz.-hrs./1000 cubic foot.

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. This product is introduced and rapidly penetrates all space previously occupied by air. A lethal dosage of this product results when the proper concentration is maintained for the required fumigation period. With the sustained concentration (no leakage) and a vacuum of 25 to 27 inches Hg, the time of exposure and the dosage may be reduced.

PREPARATIONS FOR CHAMBER FUMIGATION

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

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

1. Determine the correct dosage (concentration x time = ounce-hours) to control the designated pest under the specific treatment conditions.
2. Confirm that the chamber or stack and any accessory equipment perform as intended.
3. Determine that this product 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 cylinders.
6. Educate personnel in first aid procedures to be followed should an accident occur and personnel be exposed to this product.
7. Inform company physician about this product so she/he may have knowledge about this product and first aid procedures.
8. Notify other appropriate individuals that fumigations of this product will be taking place: Company employees other than those performing the fumigations such as security patrols, janitors, etc., police and fire department personnel and others required by local, state and federal laws.

Load chambers in a way to allow for adequate air movement around commodities, and even distribution of the gas.

FUMIGANT INTRODUCTION

Atmospheric Chambers

Atmospheric fumigation chambers are easy to operate. Close the trap door to the exhaust fan after loading the chamber. Turn on the circulating fan and close, tightly, the front door. Place warning signs to alert people that fumigation with this product is in process. Introduce the required dosage of this product and check with a monitoring device to determine that no leakage is occurring during fumigation (see Chapters 7 and 8). It is recommended that the manufacturer or design engineer's operation procedure be followed due to the special design of vacuum chambers.

Respiratory protection is required for all personnel in immediate area if, for any reason, the chamber must be opened before aeration is complete or a leak occurs.

Vacuum Chambers

It is recommended that the manufacturer or design engineer's operation procedures be followed due to the special design of vacuum chambers.

Respiratory protection for all personnel in immediate area is required if, for any reason, the chamber must be opened before aeration is complete or leak occurs.

AERATION OF CHAMBER

Atmospheric Chamber

Open the trap door to the exhaust vent. Turn on the exhaust blower and open the front door 1 to 2 inches to permit the entrance of fresh air. If the door is hinged at the side, open the fresh air inlet provided. Aeration of this product is very rapid, usually less than 30 minutes. Desorption, however, can occur for a longer period of time. Always check for the presence of sulfuryl fluoride with a suitable detector (Chapter 4) before entering the chamber without proper respiratory protection (SCBA).

Vacuum Chamber

Follow the directions provided by the manufacturer or design engineer.

CLEARING AND RE-ENTRY

This product aerates rapidly. The fumigator, however, must always check with a gas detector to determine the concentration of gas in the chamber before re-entry. Unless the sulfuryl fluoride concentration is 1 ppm or below, DO NOT re-enter without respiratory protection. Keep the exhaust fans running during the aeration period and also while unloading the chamber. Remove the warning signs only when aeration has been completed and the area has been determined safe to enter (see Chapter 8).

TARPS AS CHAMBERS

Tarp can act as a chamber when fumigating items. Items should be placed on an airtight foundation, such as another tarp or on concrete, and covered with a fumigation tarp so as to ensure a tight seal. The tarp over the items should be supported to create about 2 feet gas expansion dome above items and allow at least 1 foot of space around the sides for the gas to diffuse. The edge of the tarp must be sealed by placing weights at edges with sand or water "snakes" or equivalent.

This product will be released from the cylinder positioned near the site through copper, polyethylene, impolene, saran or other suitable hose through a proper size nozzle. This will prevent the liquid from splashing on the items or tarp and will allow complete volatilization of the liquid. The hose should be secured to prevent movement. Use one fan of at least 2 amp capacity for each 5,000 cubic feet to distribute the gas uniformly under the tarp.

Conduct tarp fumigations out-of-doors or in a building that will not be occupied during fumigation and aeration periods. If it is to be conducted in a building used for purpose other than fumigation, the requirements for structural fumigation should be followed (e.g. removal of people, food, pets and plants, use of warning agents, posting of warning signs, etc.). Procedures for structural fumigation must be followed.

If the fumigation chamber is in a structure or enclosure that requires the gas to be released from inside that structure or enclosure, then it is a must that the applicator and other persons in the area wear proper respiratory protection. A positive-pressure, self-contained breathing apparatus (SCBA, not SCUBA; Section 2) or air-supplied/SCBA respirator must be used. Also, an additional person trained in the use of the product must be present.

Dosage is calculated using the Master Fume Calculator program. Please note that the HLT of fumigations in which tarps act as chambers are difficult to estimate, thus, should be monitored using a Fumiscope.

Prior to releasing the fumigant, post warning signs on the tarps as specified in Chapter 5.

If the tarpaulin fumigation is inside a building, the building must be locked and posted outside at all entry points with warning signs to prevent unauthorized personnel from entering the building during fumigation and aeration period.

When the fumigation period is over, open the tarp by pulling back slightly. Leave for at least 30 minutes to allow the fumigated material to air out before removing the cover. If this is done in an enclosure/structure, then proper respiratory protection must be used as with introducing the gas. Fan(s) is recommended to hasten the aeration, especially when fumigation is done in an enclosure.

DO NOT enter the fumigation site during fumigation or aeration period without proper respiratory protection. DO NOT move the items until the area has been cleared to 1 ppm or below using a suitable detection device (Chapter 4) and warning signs have been removed.

CONSTRUCTION MATERIALS AND FURNISHINGS
Household furnishings and construction materials can remain in a structure being fumigated (see Chapter 5), or they may be fumigated separately in chambers or under tarps.

Construction Materials
Items, such as lumber, logs, burlap and other construction materials, occasionally become infested with pests during storage, particularly if the items are stored unprotected outside before they are used. This product will control existing infestations of many pests when applied properly. However, it has no residual effect and cannot protect the treated items from reinvasion by additional pests. Treatment with residual pesticide is, therefore, recommended if materials will continue to be stored in areas with potential pest infestations.

Household Furnishings
There are instances that one or few items within a structure or location become infested with pests and require treatment. These items may be removed from their location, treated in a chamber or under tarps and then returned, rather than fumigating the entire structure. Again, it should be pointed out that this product lacks residual control, thus, will not prevent reinfestation. A residual pesticide is needed. If the infestation is also present in parts of the permanent structure, fumigation of the entire structure should be considered (see Chapter 5).

Treatment
The same safety practices, general principles of maintaining the required ounce-hours at the pest site, proper preparation, introduction or fumigant, posting, aeration and clearing practices must be followed as previously described in this manual. Contact Drexel Chemical Company for further information.

VEHICLES
This product is not registered for the treatment of aircraft or underwater craft. Numerous pests find their way into various kinds of vehicles by natural means or by humans. Common are bed bugs, carpet beetles, cockroaches, mice, rats and wood-boring insects. This product can provide excellent control of existing infestations without harmful effects to the vehicles themselves.

AUTOMOBILES, BUSES, RAILROAD CARS AND RECREATIONAL VEHICLES (INCLUDING CAMPERS AND TRAILERS)

These vehicles should be treated as small structures (Chapter 5) with the following exceptions or comments.

Selection of Fumigation Location
Vehicle must be placed in an appropriate location, away from other work areas in a secured place, for conducting a fumigation. If they are placed in a building or a fumigation chamber, follow the correct procedures (See Chapters 4, 5 and 10).

Securing the Vehicles
The vehicle must be secured to prevent entry by unauthorized persons using normal means during the fumigation. Set the brakes and block the wheels so that the vehicle will not move during fumigation and aeration periods. **Note:** DO NOT move a vehicle while it is under fumigation as the gas may be lost resulting in a poor fumigation job, and, most importantly, may expose unsuspecting individuals to the hazardous vapors.

Sealing the Vehicles
If vehicle is not placed in an enclosure like a building or chamber, they may be either sealed by tarps or taped if they are of a type of construction that lends itself to adequate containment of the fumigant.

Removal of Certain Items, Calculating the Dosage, Chloropicrin Warning Agent, Introduction of the Fumigant, Posting, Events During Fumigation, Aeration and Clearing

All the above subjects are discussed in this manual. Refer to the respective Chapters in this manual and follow instructions. When the vehicle has been cleared for re-entry, at the end of the aeration time, warning signs can be removed and the vehicle can be put back into service.

Use Precaution: The liquid phase of the fumigant should not be allowed to contact any part of the vehicle, as it can damage paint, corrode or tarnish metals and stain fabrics.

Note: Follow all local, state and federal regulations covering fumigation of vehicles.

SURFACE SHIPS
Below-the-surface ships, such as submarines, must not be fumigated with this product.

Rodents and insect pests may be brought aboard the vessel unknowingly in cargo or ship furnishings or may enter by their own means.

Maintenance and Sanitation
Fumigation is one means of ridding ships of pest infestations. However, because it lacks residual effects, to prevent reinfestation, it is imperative that "good housekeeping" be maintained. All parts of the ship should be kept in a good state of repair to prevent infestations. Good housekeeping is also an important means of reducing, if not, in some cases, eliminating, certain pest problems.

Control of Infestation
Localized problems can be handled by a chemical pesticide with residual activity. In the case of wood-destroying insects, infested wood can be replaced with new wood. Fumigants have the advantage of being able to move into all corners of the vessel to control known infestations as well as into pest sites that may be unknown or inaccessible to the persons responsible for the vessel.

Because of its physical properties, this product is ideally suited to control pest infestations in surface ships. Its high volatility allows the gas to penetrate all areas of the vessel rapidly, control the pest, and aerate rapidly.

Due to its lack of warning properties and high inhalation toxicity, this product must not be used to fumigate boats or other vessels while in use. People, pets or plants must not remain on board during the fumigation. Small pleasure craft may either be removed from the water and fumigated in an appropriate site or fumigated in the water. Large ocean-going vessels, however, can be fumigated at the dockside.

As with all fumigations with this product, ship fumigations must be conducted properly to ensure not only control of the pests involved but also that the fumigation be done without any harm to people or materials.

Follow all local, state and federal requirements for ship fumigation, including those required by the Coast Guard, Department of Transportation, Title 46, Shipping Section, Parts 147A.1-147A.43. Since the codes listed are for fumigants in general, do not use procedures that are not permissible for this product as directed by label instructions and regulations.

Read and follow the label and this manual for this product.

Procedures for Fumigation

SMALL PLEASURE CRAFT
These may be removed from the water to an appropriate fumigation site or left in the water and fumigated in position.

Fumigation out of the water – Small craft, such as canoes or speedboats, should be moved to a safe area in which to conduct the fumigation. If feasible, it may be placed in a fumigation chamber for treatment (see Chapter 9), or it can be treated by tarp fumigation, similar to that conducted for household effects (see Chapters 5 and 9).

Larger pleasure craft, such as cabin cruisers or sailboats having more than one enclosed compartment, must be treated as structures requiring proper sealing, use of warning agent, adequate gas distribution, warning signs, etc. (see Chapter 5). Boats tarped and fumigated out of water should be monitored with a Fumiscope unit during the fumigation, since half-loss-time (HLT) is difficult to estimate.

Follow all label requirements for fumigation aeration and reentry.

Fumigation in the water – Small pleasure craft may be left in the water at dockside during fumigation. Tarps should be dropped over the vessel and should extend below the water surface so the water can act as a barrier for the fumigant.

Since conditions of high relative humidity may ex[illegible]he vessel during fumigation, observe use precautions when using proper [illegible]fan and shooting hose to avoid overshooting the fan and "fogging out" the vessel causing corrosion and staining.

Follow proper fumigation procedures as noted on the label. DO NOT re-occupy or move the vessel after the fumigation until vessel is properly cleared, as noted on the label.

LARGE VESSELS

Large vessels, such as houseboats, freighters and cruise ships, can be fumigated with this product at the dockside and when not underway. All people, pets and plants must be removed from the vessel during fumigation. Food, feeds, drugs, tobacco products, and medicinals not in highly resistant containers must be removed or protected by sealing in glass, metal or double bagged. The infested vessel shall be treated as if it were a building or structure and be fumigated accordingly by following the requirements stated in Chapter 5 for tape or tarp jobs. The water will act as an excellent underseal. Therefore, when using the Master Fume Calculator program to estimate Half-loss-time (HLT) and the amount of this product to release, use the slab rating for ground seal. If pest damage is occurring on deck, the entire vessel must be tarped. If infestation is interior and below decks, it can be taped, and an adequate seal can be made to confine the gas.

It is strongly suggested to monitor the job using a Fumiscope due to uncertainties in estimating HLT for tape and seal fumigations.

If only localized pest damages are present (i.e., one deck or one or two holds), the affected areas may be treated by compartmentalization. However, because of common air ducts, even though only a part of the vessel is to be treated, all people and pets must be removed from the entire ship during fumigation. Edible items must also be removed or protected on the vessel.

If entry is to be made into the vessel during the fumigation or aeration periods, a self-contained breathing apparatus must be worn.

Fumigation must be carried out by a person certified to use this product. The fumigator and the captain or owner of the ship must follow the requirements listed on the label of this product, as well as local and state requirements.

Chapter 10

SPECIAL FUMIGATION JOBS

It is necessary to conduct, occasionally, fumigations that are of a special nature. Below are the types of special fumigations.

FUMIGATIONS OF LARGE OR MULTI-UNIT STRUCTURES

Fumigations involving structures over 100,000 cubic feet often require special considerations because of considerable costs involved. Failure to achieve desired control results in a significant financial loss to a company if they have to refumigate to achieve pest control. The following are important considerations for large jobs.

Planning

Extensive planning is generally required to fumigate large or multi-use structures. Sufficient time and manpower must be allocated for planning, as well as actual fumigation. One employee should be designated as the coordinator to oversee the entire process.

If available, obtain a floor plan of the structure to be fumigated. Prior to fumigation, if the structure has designated maintenance personnel, conduct a walk-through inspection with them. The following should be reviewed during the inspection:

1. Roof condition and drainage -- When tarping flat roofs with parapet walls, drainage may have to be provided in case of rain during the fumigation. The weight of accumulating water can severely damage roofs. Drainage can be provided by running PVC pipe through the scuppers in the parapet walls, aligning tarp seams with the scuppers and sealing the tarps around the PVC pipe on both sides of the parapet wall. Water can then drain from the roof via the PVC pipes, while the structure remains sealed for the fumigation.
2. Plumbing – Location of all floor drains (A significant amount of gas can be lost if the sewer trap is dried out).
3. Location of walkways, pipes or conduits leading from building to be fumigated to adjacent structures.
4. Alarm system, if present.
5. Presence of attics and sub-areas and access openings to these areas, if present.
6. Air handling system – Determine how to activate the system following fumigation to enhance the aeration process.
7. Location of suspended ceilings.
8. Locked vaults or other security areas.
9. Presence of gas pilot lights or glowing heat elements.
10. Location of all areas where food and medicinals are stored. This would include concession machines, emergency and first aid kits and items in storage lockers or desks.
11. Location of items sensitive to increase heat and humidity when air conditioning is turned off (i.e., laboratory chemicals and analytical equipment, mainframe computers, etc.).
12. Presence of any unusual structural features or contents.

Make arrangements for th[illegible]ntenance personnel to be available by phone, at least during fumigation fo[illegible]ultation or in case of emergency.

Preparation

Likewise, large jobs often involve special preparation. Provide written instructions outlining their responsibilities for preparation to the customer.

These instructions may be modified to address conditions specific to the fumigation site (i.e., laboratory, museum, office, school, etc.). Negotiate for the fumigation contract to allow the fumigator to postpone the fumigation without penalty due to inclement weather. Without this contractual allowance, the fumigator may be required by the customer to conduct fumigation in unsuitable weather or forfeit part of the payment to compensate the customer preparing the structure a second time.

Prior to the fumigation, prepare a detailed graph of the structure with fumigant and warning agent introduction sites, fan locations and monitoring sites noted. This will help determine the number of fans and length of fumigant introduction and monitoring hoses needed for the fumigation. An outline of fumigation, aeration and clearing plans and expected timing of events will also prove helpful.

For multi-unit structures, communication with occupants is particularly important. Provide each occupant with a homeowner checklist and other relevant information regarding proper preparation of his or her unit.

Consider each unit an individual structure. Each and every unit must be checked, when conducting a walk-through prior to release of the warning agent, to ensure that the unit has been properly prepared and that people, pets and plants are not present.

Conserving Fumigant

Large jobs can require significant quantities of fumigant. The fumigator should determine options to conserve fumigant while obtaining the ounce-hours required to kill the target pests. The following options can be considered:

1. Monitor the fumigation using a Fumiscope (see Chapter 7). Monitoring lines should be placed on all levels of the fumigated structure, including attics and sub-flooring, if accessible. At least half the lines should be placed in rooms/areas distant from fumigant introduction points. Place lines in areas representative of different sub-units if the structure is compartmentalized into separate towers, wings or other sub-units. If time permits, conduct monitoring in a manner so that the exact amount of this product required for fumigation is introduced based on the measured HLT. This type of precision fumigation is conducted by initially introducing part (i.e., one-half) of the calculated dosage of this product, monitoring to determine the actual HLT, and then introducing additional product to achieve sufficient ounce-hours (OH) in the time remaining for the fumigation.

   Construct a manifold to significantly speed the process of taking concentration readings, as can the use of auxiliary air pumps to purge multiple monitoring lines.

   Monitoring the concentration of the fumigant can provide important information regarding the placement of fumigant/warning agent introduction sites, which 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 example, if equilibrium is not achieved quickly, the fumigator can consider placing additional introduction sites or fans in the next large or multi-unit structure to be fumigated.

2. Extend the fumigation period.

   Large jobs generally have good fumigant confinement due to the large volume to surface area ratio. Extending the hours of fumigant exposure would reduce the concentration of fumigant required.

3. Conduct the fumigation during the time of year when temperatures are warmest.

   Increasing the temperature can significantly decrease the OH required to control the target pests. Fumigating at the warmest time of the year can help conserve fumigant and reduce the chemical cost for the fumigation.

   By fumigating during the warmer times of the year and increasing exposure time, less fumigant is required. The result is a more economical job.

4. Determine the best method (tarp, tape and seal, or a combination) to seal the structure.

5. If tarping the structure, determine the best way to improve the ground seal.

   For crawl space construction, consider covering crawl space, if accessible, with polyethylene or tarps prior to fumigation. Consider all available methods (sand, water, polyethylene) for improving the ground seal around the exterior perimeter foundation.

Equipment

Compared to standard jobs, large jobs require more equipment. Arrange in advance the availability of sufficient equipment such as additional fans, tarps,

chloropicrin pans, extension cords, power s etc. To obtain more of the standard fumigation equipment for a large job, r more of the following can be done:

1. Purchase new equipment.
2. In a multi-branch company, pool equipment from fumigation branches. Be sure to label or mark the source of the equipment. One exception would be clamps, and they can be weighed before and after use to ensure proper redistribution after the fumigation.
3. Borrow or rent equipment from other fumigation companies (again, label or mark equipment).
4. Subcontract other fumigation companies to assist with the job.

Large jobs may require specialized equipment, such as cranes, lifts, C-clamps and ropes for tarping, voice-activated radio headsets, manifolds for fumigant introduction, manifolds and vacuum pumps for monitoring and remote-controlled fans. When renting or purchasing specialized equipment, ensure that the equipment is in good operating condition and that you fully understand how to use it.

The Fumigation Crew

More labor and time for sealing and preparation may be required for large jobs. If pooling employees from multiple fumigation branches, or subcontracting other fumigation companies, have each pre-established fumigation crew remain together as a team. Each team should know how to work together efficiently based on their previous experience. Each team should be assigned specific tasks.

Arrangements should be made to ensure communication on the job. "Walkie-talkies" have been used for this purpose with success.

Determine if arrangements for food, portable rest rooms, lodging and transportation should be made for employees. For example, catering food to the work site can save the time employees would spend traveling to food service facilities and waiting for service.

Aerating Large or Multi-Unit Structures

Extra consideration should be given to aeration of the large or multi-unit structure that has been fumigated, and adequate time should be allowed for ventilation of all units within the structure.

If the chloropicrin warning agent is properly applied at each fumigant introduction site, on at least each story away from highly adsorptive furnishings, aerating it from the building should not be a problem. Difficulties in aerating chloropicrin from structures can frequently be traced to overloading the warning agent on the lower floors and/or not using proper pans and wicking (see Chapter 6).

Chloropicrin tends to adsorb onto furnishings. Overloading the application at any point in the structure creates conditions conducive to adsorption. Under application can create a potentially hazardous condition if an insufficient quantity is available to act as a warning agent. Great care should be taken to ensure the proper application of the correct amount of chloropicrin.

Safety Considerations

If the fumigated property is in a public access area (one building in a multi-building complex), make arrangements for security guards, barricades, warning tape, etc. to limit pedestrian traffic near the fumigated structure. Limiting public access can be very important during the aeration process, depending on how fumigant will be ventilated from the structure.

SEPARATION DISTANCE

Sometimes fumigated structures are located in very close proximity to structures that will be occupied during the fumigation. If the occupied structure has openings, such as windows and air-intake vents, in close proximity to the fumigated structure, fumigant leakage into the occupied structure may be a concern. Some States have procedures required by state law that the fumigator must follow to ensure public safety in these circumstance. In the absence of state guidelines, the fumigator should consider the following procedures:

Procedure 1. Prepare units in non-fumigated structures which are adjacent to the fumigated structure as if they were going to be fumigated; i.e., vacate occupants, turn off heating elements and flames, remove plants, and prepare food and other food, feed, drugs, tobacco products, and medicinals. These units should be tested for clearance following fumigation.

Vacating and preparing adjacent units in the non-fumigated structure may not be possible. The fumigator can follow Procedure 2 as an alternative.

Procedure 2. Close windows and air intake vents on the side of the non-fumigated structure adjacent to the fumigated structure. Provide fresh air circulation in the non-fumigated units.

Periodically test the non-fumigated units throughout the fumigation, using an Interscan or instrument of similar sensitivity, to detect leakage of this product. The fumigator should be prepared to terminate fumigation if leakage in the non-fumigated structure cannot be prevented or minimized to 1 ppm or below.

Procedure 3. If access to the non-fumigated structure is not possible, the fumigator could periodically test the airspace between the fumigated structure and non-fumigated structure throughout the fumigation using an Interscan device or instrument of similar sensitivity. The fumigator should be prepared to terminate fumigation if concentr of this product cannot be maintained at 1 ppm or below in the airspace cting the non-fumigated units.

If the space between the fumigated and non-fumigated structure is not wide enough to permit passage for the fumigator to conduct air testing and the above Procedures 1 and 2 are not possible, the fumigator should consider other options for pest control.

COMPARTMENTALIZATION

Fumigation of a 150,000 cubic foot open warehouse is very different from fumigation of a 150,000 cubic foot apartment building. Available methods involving the use of the Master Fume Calculator make it possible to segment structures into compartments and handle each in accordance with its needs.

Multiple Release Sites

In highly compartmentalized structures, additional fumigant/warning agent introduction sites will be necessary, as will the use of additional fans to achieve rapid equilibrium (see Chapter 6 for a detailed discussion of fumigant introduction). When performing fumigation in this type of structure, achieving equilibrium of both the fumigant and chloropicrin warning agent in one hour is an important goal. Multiple release sites offer flexibility to the fumigator to compensate for differential fumigant loss by enabling the fumigator to introduce more fumigant only in areas requiring it.

Construction of a manifold for introducing fumigant to multiple release sites may speed the process considerably.

Introduction of chloropicrin warning agent at each fumigant release site and at least on each floor of a multi-unit structure is necessary to ensure the presence of chloropicrin consistently throughout the fumigation period. The process of chloropicrin introduction then, is more complex in a large or multi-unit structure and requires coordination of applicator(s) and possibly the use of respiratory protection (see Chapter 6 for details on chloropicrin use). The use of multiple release sites for the warning agent will assist in aerating chloropicrin from the structure once the fumigation is complete.

In addition, because of the large variables involved in compartmentalization, measurements with the Fumiscope unit should be made to determine the half-loss-time (HLT) so that corrections can be made if needed. Use of the Master Fume Calculator and Fumiscope are discussed in detail in Chapters 6 and 7.

Fumigation of Sub-units

Sub-units, such as a single apartment, condominium, store or room in a multi-unit structure can be fumigated and not cause a hazard to humans if, in addition to good fumigation practices listed in Chapter 4, the following points are followed:

1. The extent of the multi-unit structure containing the sub-unit(s) to be fumigated must be determined. The entire multi-unit structure must be vacated during the fumigation and aeration periods. Fumigant can leak through undetectable voids, including pipe chases, eaves, attics, sub-flooring and walls, to areas within multi-unit structures distant from fumigated areas.
2. The unit(s) to be fumigated must be sealed off from other areas. The non-fumigated units should be prepared as if they were going to be fumigated; i.e., turn off heating elements and flames, remove plants, prepare food and other food, feed, drugs, tobacco products, and medicinals as described in Chapter 5. This is necessary in case the fumigant leaks into non-fumigated units. If it is not possible to prepare the non-fumigated units for fumigant leakage, then the fumigator must be prepared to do the following:
   a. If possible, provide fresh air circulation in non-fumigated units.
   b. Regularly test non-fumigated units with an Interscan or instrument of similar sensitivity throughout the fumigation for leakage of this product.
   c. Be prepared to terminate the fumigation if concentrations of this product cannot be maintained at 1 ppm or below in non-fumigated units.
3. Following equilibrium, non-fumigated units within the structure should be tested with an Interscan or instrument of similar sensitivity to detect leakage of this product and the sealing of the fumigated areas should be rechecked to determine where fumigant leakage is occurring. Additional sealing may be necessary.
4. The entire multi-unit structure should be posted with warning signs. All units, fumigated and non-fumigated, within the multi-unit structure must be tested for fumigant clearance prior to re-entry of occupant.

TIDAL AREAS

Generally, high water table will not cause fumigation problems if the water table is stationary during the fumigation period. However, if the structure is on or near the coast, high and low tides can be involved. Experience has shown that changing of tide from high to low over the fumigation period can result in increased fumigant loss as the water moves out. This usually ends in a fumigation failure if it occurs before the pest has been exposed to the proper ounce-hours (OH) of this product.

The fumigator should be aware of this potential problem and become familiar with the high water table locations and tidal schedules for the area. In some cases, it may be necessary to seal the crawl space to prevent the loss of fumigant through the undersoil. Tarping the soil surface beneath the structure might be necessary. These fumigations should be monitored.

HIGH VALUE ITEMS

Great care should be exercised when fumigating high value items such as art ob-

jects found in museums, special furnishings -mainframe computers or specialized analytical equipment. History has sho[illegible]at when this product is used according to label directions, no damage resu[illegible] if high value items do not require fumigation, they should be removed from the site or sealed in fumigation tarps. Note that due to the high vapor pressure of this product, it can be very difficult to prevent the fumigant from contacting objects by tarping the objects or sealing the rooms in which the objects are found.

To avoid the risk of damage, remove expensive, sophisticated items prior to fumigation, if possible. Determining the cause of damage to items can be difficult or impossible after a fumigation if a customer claims that the fumigation caused the damage. Follow the correct fumigation procedures or damage may result.

HIGH DOSAGE FUMIGATIONS

Powderpost Beetle Fumigation
Fumigating for powderpost beetles requires a modification of your normal drywood termite practices in order to be most economical. The main stage is the larval stage which does the damage and, depending on the species and conditions, lives from about 8 months to 6 or 7 years. Adult, pupae and egg stages are very short lived, only lasting 2 to 3 weeks. Adults, pupae and larvae are relatively easy to control but the egg stage requires a higher dosage (10x) than drywood termites. Therefore, it is important to know what species and life stages are present.

The 10x dosage means you need to accumulate ten times the ounce-hours (OH) necessary to control drywood termites to control the egg stage of the beetles. The most economical way to do this is to extend the exposure time beyond the normal 10 to 24 hours, improve the half-loss time (HLT) and fumigate when the temperature is the warmest. It is also recommended that you monitor all beetle jobs with a Fumiscope to determine the actual HLT (this will allow a 25 percent reduction in the required dosage).

In order to benefit from extended exposure time, you must have a good HLT. If the house has a crawlspace with a loam or sandy loam soil, it will pay to put down a polyethylene vapor barrier to reduce the gas loss through the soil. Generally, this will allow you to calculate the underseal as a "clay" or "slab". Use only tarps in good to excellent condition and spend extra time in preparation to assure a good ground seal. The following table demonstrates the increased efficiency by following the above suggestions for a 10x powderpost beetle job.

Crawl Space House						
	Non-Monitored 24 hrs.	Monitored				
		24 hrs.	36 hrs.	48 hrs.	36 hrs.	48 hrs.
					with vapor area in crawl space	
Tarp	Good	Good	Good	Good	Good	Good
Seal	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
Wind (MPH)	5	5	5	5	5	5
Volume (Mcf)	30	30	30	30	30	30
Underseal	Loam	Loam	Loam	Loam	slab*	slab*
Temp (°F)	60	60	60	60	60	60
Hrs. Exp.	24	24	36	48	36	48
HLT (hrs.)	10	10	10	10	31	31
Dosage (oz/Mcf)	162	121	107	101	59	49
Pounds	303	228	200	190	110	92
*If entire crawl space has a good polyethylene vapor barrier, use "clay" or "slab".						

Chapter 11

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

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

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

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

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

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

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

CORROSION OF METALS
This product is not known to cause any corrosion when it is in the vapor (gaseous) phase under normal temperatures. Every batch of this product 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 this product is released incorrectly. If this product 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 introduction of this product. Minute quantities of acids (by-products of the manufacturing process) are soluble in water condensation and can etch metal surfaces. The fumigant introduction rate must not exceed the fan capacity (1 pound of this product per 1,000 cfm) to thoroughly mix the colder air when this product is introduced into the warmer air in the structure.

Metal tarnishing/corrosion can also occur if heat sources are left on during fumigation. This product 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 this product to corrosive materials (mainly HF). Therefore, it is imperative that pilot lights and other heat sources which pose this risk be eliminated or turned off during fumigations.

Damage to metals can also occur from the inclusion in the fumigated space of chlorine generators. These pieces of equipment should either be turned off or excluded from the fumigation.
Damage to metals can usually be corrected by cleaning the metal items with a good metal cleanser or polish. The corrosion or rust is usually only on the surface.

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

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

Condensation forming and running down vertical surfaces can occur even without the introduction of this product. 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
This product in the vapor phase does not cause staining or discoloration of fabric or other materials normally found in a structure under fumigation. Fabric staining or color changes can occur when a high heat source (i.e., pilot light) converts this product to SO_2 and other corrosive materials. Many fabric dyes are acid or base indicators and will change color in the presence of acids or bases.

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

FUMIGANT INTRODUCTION HOSE FREEZING
When this product is introduced according to label directions, the introduction

hose will not freeze and the liquid will change to a gas at the end of the hose. The use of the proper size fumigant introduction hose is important. Initially, slowly open the valve a quarter to one-half turn to begin the liquid flow of this product. 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, this product 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 the liquid form of this product on surfaces. Replace kinked or damaged hoses. Use mesh-reinforced, flexible hosing of proper specifications to avoid this problem.

During release of this product from the cylinder, some chilling of the valves, cylinder, and fumigant introduction hoses can occur under normal circumstances. Valves can freeze if this product 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
This product is quite toxic to most plants and they should be protected from the fumigant; however, plants should not be used as an indicator of the success or failure of a fumigation. Plants should be removed from inside the fumigation site. Structural foundation plantings of ornamental shrubs and trees can be protected to a certain degree from the gas by wetting the soil, thereby sealing off the gas from the plant root system. Water is an excellent barrier and this product will not readily move through moist soil.

Certain plants have been found to be more sensitive to this product 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 this product. Plants that have been moved should be placed in a similar environment to that where they were being grown — same temperature, light, humidity, etc.

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

POOR CONTROL OF PESTS
Poor control of the target pest is caused by not generating the target CT (Concentration x Time) for the temperature to kill the pest. Accumulation of target CT does not begin until the fumigant has reached equilibrium in the site. 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 ounces per hour).
5. Not using adequate fans to distribute the gas properly within the site.
6. Not accurately determining the temperature of the pest site.
7. Error in calculating volume to be fumigated.
8. High winds which can cause excessive loss of gas.
9. Target pest excluded from exposure to fumigant by some gas inhibiting barrier.

LATENT MORTALITY
Sometimes live insects may be found immediately after fumigation. Under optimum or favorable conditions, the target pest will be dead or obviously dying by the end of the fumigation period. Researchers have observed a delay in mortality of 3 to 5 days for termite species and have waited as long as 2 weeks to determine mortality of arthropods. Latent mortality in insects occurs for exposures very near mortality threshold levels. Within a species, the latent mortality period for the egg stage is generally longer and more variable than other life stages.

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

Consider the following:

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

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

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

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

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage and disposal.
PESTICIDE STORAGE AND HANDLING: Store in dry, cool, well ventilated area under lock and key. Post as a pesticide storage area. If the storage area is in an occupied building, the storage area must have either 1) a forced air ventilation system that meets required local ordinances for the storage of hazardous materials and operates continuously; or 2) be equipped with a permanently mounted and properly maintained and functioning sulfuryl fluoride monitoring device designed to alert occupants of the building if sulfuryl fluoride in the air of the storage area is greater than 1 ppm. 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. Do not transport any cylinders in closed vehicles where they occupy the same common airspace as personnel. 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.
Leak Procedures: Evacuate immediate area of leak. Use a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air-supplied/SCBA respirator, such as manufactured by Ranger, Survivair, Scott, or MSA, for entry into affected areas to correct problem. Move leaking or damaged cylinder outdoors or to an isolated location, observing strict safety precautions. Work upwind if possible. Do not permit entry into leakage area by unprotected persons until concentration of fumigant is determined to be 1 ppm or less in the breathing zone, as determined by a detection device with sufficient sensitivity such as an INTERSCAN, MIRAN or SF-ExplorIR gas analyzer.
CYLINDER AND PRODUCT DISPOSAL: Promptly return all empty cylinders to your distributor of this product. Follow proper cylinder handling directions above.
Pesticide wastes are toxic. Improper disposal of excess pesticide is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, consult your State Pesticide or Environmental Control Agency, or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.

WARRANTY DISCLAIMER
Drexel Chemical Company warrants that th. duct conforms to the chemical description on the label and based upon tests is believed reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. To the extent consistent with applicable law, Drexel Chemical Company makes no other expressed or implied warranty of merchantability or fitness for a particular purpose or any other express or implied warranty.

Use Risk
It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label, such as unfavorable weather, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of Drexel Chemical Company or the Seller. To the extent consistent with applicable law, all such risks shall be assumed by Buyer.

Limitation of Remedies
The exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories), shall be limited to, at Drexel Chemical Company's discretion, one of the following:

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

To the extent consistent with applicable law, in no case shall Drexel Chemical Company or the Seller be liable for consequential, special or indirect damages or losses from the use, handling, or storage of this product.

The terms of the "Warranty Disclaimer" above and this "Limitation of Remedies" cannot be varied by any written or verbal statements or agreements. No employee or sales agent of Drexel Chemical Company or the seller is authorized to vary or exceed the terms of the "Warranty Disclaimer" or this "Limitation of Remedies" in any manner.

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SINCE 1972

APPENDIX A
ENGLISH-METRIC CONVERSION TAI

Temperature	Volume	Wind Speed
(°C x 1.8) + 32 = °F	1 ft³ = 0.0283 m³	1.609 kph = 1 mph
(°F - 32) ÷ 1.8 = °C	1 m³ = 35.31 ft³	0.621 = 1 kph

°F	°C	M³	FT³	KMPH	MPH
104	40	1	35.3	50	31
102	39	10	353	48	30
100	38	25	706	46	29
98	37	50	1,765	44	28
96	36	75	2,647	42	27
94	35	100	3530	40	26
92	34	200	7,060	38	25
90	33	300	10,590	36	24
88	32	400	14,120	34	23
86	31	500	17,650	32	22
84	30	600	21,180	30	21
82	29	700	24,710	28	20
80	28	800	28,240	26	19
78	27	900	31,770	24	18
76	26	1,000	35,300	22	17
74	25	1,500	52,950	20	16
72	24	2,000	70,600	18	15
70	23	3,000	105,900	16	14
68	22	4,000	141,200	14	13
66	21	5,000	176,500	12	12
64	20	6,000	211,800	10	11
62	19	7,000	247,100	8	10
60	18	8,000	282,400	6	9
58	17	9,000	317,700	4	8
56	16	10,000	353,000	2	7
54	15	20,000	706,000	0	6
52	14	30,000	1,057,000		5
50	13	40,000	1,412,000		4
48	12	50,000	1,765,000		3
46	11	100,000	3,530,000		2
44	10				1
42	9				0
40	8				
38	7				
36	6				
34	5				
32	4				
	3				
	2				
	1				
	0				

DOSAGE: oz-hr/1000 ft³ ≈ gm-hr/m³
PRESSURE: 1 PSI ≈ 6.9Kpa ≈ 0.689 bar
1 bar ≈ 100 Kpa ≈ 14.50 PSI

APPENDIX B
GLOSSARY TERMS

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

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

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

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

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

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

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

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

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

ANOBIIDAE: A family of bettles which includes furniture and death watch beetles. Anobiids infest all types of seasoned wood, but unlike termites, some anobiids are able to digest the wood without the aid of protozoa.

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

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

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

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

BED BUG *(Cimex lectularius)*: Primarily a human ectoparasite in the order of the Heteroptera and the family Cimicidae, it is also known as "mahogany flat," "chinch," and "red coat." It got its name from its close association with human sleeping beds.

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

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

BREATHING ZONE: The area within a structure where individuals typically stand, sit or lie down.

BROWN-BANDED COCKROACH *(Supella longipalpa)*: One of the smaller domestic cockroaches in the family Blattellidae, they prefer feeding on starchy materials and do not require association with moisture as do German cockroaches. They are frequently transported in furniture and will rapidly spread throughout a building.

CARPENTER ANTS *(Camponotus* spp.*)*: Conspicuous, large, black or dark-bodied ants found in and around homes throughout the United States. Carpenter ants do not use wood for food, but hollow it out for nesting.

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

CELLULOSE: A polysaccharide consisting of repeated glucose units, which is a major component of plant cell walls. Termites help to convert dead wood and other organic materials containing cellulose to humus. Termites harbor one-celled organisms in their digestive tracts, and these organisms convert cellulose into substances the termites can digest.

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

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

CHLOROPICRIN: Most commonly known as 'tear gas,' it is a highly toxic, non-flammable liquid at room temperature which vaporizes slowly and serves as a warning agent for odorless fumigants.

CIRCULATION: Mechanically stir or circulate the fumigation atmosphere.

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

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

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

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

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

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

DEATH WATCH BEETLE: Found throughout the U.S., they attack building timbers in poorly ventilated areas where moisture tends to collect.

DEPARTMENT OF TRANSPORTATION (DOT): Federal agency which regulates the packaging, storage and transportation of hazardous materials.

DERMESTID BEETLES: Family of beetles that cause damage to fabrics. Most common species include the black carpet beetle, varied carpet beetle, common carpet beetle, and furniture carpet beetle. The beetles are extremely small and rarely seen by homeowners.

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

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

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

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

DISPERSE: Distribute the fumigant throughout the fumigation site.

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

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

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

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

DRYWOOD TERMITE: A highly destructive wood-destroying termite in the family Kalotermitidae found in subtropical and tropical regions of the world. They generally live in undecayed wood, which has a very low moisture content. Unlike subterranean termites, they do not need any contact with soil.

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

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

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

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

FLASH POINT: The temperature at which vapor explodes.

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

FOG: Very fine droplets of liquid moisture in air.

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

FORMOSAN SUBTERRANEAN TERMITE (*Coptotermes formosanusi)*: One of the most aggressive and economically important subterranean termite species, they are mainly found in tropical regions.

FRASS: Tiny sand-like fecal pellets excreted by drywood termites which can be an indication of a drywood termite infestation. While their color can vary depending on wood consumed, they will always be elongated oval, less than one millimeter in length, with rounded ends and six concave sides.

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

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

FURNITURE BEETLES: Common group name of beetles in the family Anobiidae. Found primarily in the eastern half of the U.S., they attack not only furniture, but structural timbers as well.

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

GERMAN COCKROACH *(Blattella germanica)*: The most common domestic cockroach species in houses, apartments, restaurant, etc., which hides in cracks and crevices in areas which are dark, humid, warm and close to water and food.

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

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

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

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

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

HEPATIC: Pertaining to the liver.

HOURS EXPOSURE (HE): The number of hours the site is exposed to the fumigant. Exposure periods from 2 to 72 hours are provided by the Master Fume Calculator which coordinates the necessary adjustments to obtain proper dose for the job. The hours of exposure begin only after equilibrium has been reached.

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

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

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

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

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

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

LACHRYMATION: The secretion or discharge of tears from the eye.

LATENT HEAT OF VAPORIZATION: The number of calories per mole of substance needed to change a liquid at its boiling point to a gas. For this product, this is 4600 cal/mole. When liquid fumigants under pressure are released, available heat is "pulled" from the immediate surroundings as the liquid changes to a gas.

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

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

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

LYCTIDAE: The family of Coleoptera commonly referred to as true powderpost beetles.

MASTERFUME BAG: Protective nylon bags available from distributors of Master Fume used to seal and protect food, feed, medicines and tobacco products during fumigation.

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

MCF: 1,000 cubic feet.

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

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

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

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

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

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

NATIONAL PEST MANAGEMENT ASSOCIATION (NPMA): A membership organization which provides educational opportunities and materials for pest control operators throughout the United States.

NON-FLAMMABLE: Not flammable or readily ignitable.

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

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

OLD HOUSE BORER *(Hylotrupes bajulus)*: A re-infesting Cerambycid frequently a pest of newer structures. The larvae hollow out extensive galleries in seasoned softwood.

ORIENTAL COCKROACH *(Blatta orientalis)*: Also referred to as the waterbug, black beetle or shad roach, they are found across the U.S. and feed on rubbish and other decaying matter.

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

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

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

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

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

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

POSTEMBRYONIC: Larval, pupal and adult stages of insects.

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

POWDERPOST BEETLES: The common name for the family of wood-destroying beetles (Coleoptera: *Lyctidae*) whose larvae attack wood and wood products and reduce timbers to a mass of very fine, powder-like material. True powderpost beetle are Lyctid beetles, including *Lyctus brunneus* and *Lyctus plannicolus.*

PULMONARY: Pertaining to, or affecting, the lungs.

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

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

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

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

RENAL: Relating to the kidneys.

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

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

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

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

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

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

SF-ExplorIR: A type of clearance device used to clear a structure for re-occupancy after fumigation. Uses infrared technology to measure sulfuryl fluoride down to ppm level.

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

SOCIAL INSECTS: Category of insects that live within a colony where there is 1) a division of labor between types of individuals (castes), 2) more than one generation is present, and 3) immature stages are cared for.

SOLITARY INSECTS: Category of insects that do not have all three characteristics of social insects.

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

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

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

SQUIRREL CAGE FAN: A fan in which the air flow through the impeller is primarily axil upon entering the impeller and is changed by the impeller blades to an essentially radial flow at the impeller discharge. The impeller is more generally contained in a volute-type housing (AMCA Publication 210).

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

SUBTERRANEAN TERMITES: Social insects in the order Isoptera, family Rhinotermitidae, which generally live underground in self-supporting colonies and require food (cellulose), moisture and soil to survive.

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

SWARMERS: Winged reproductive termite which fly out from established colonies looking for areas to establish new ies.

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

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

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

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

TERMITE: Wood-destroying insect in the order Isoptera generally found in warmer regions which feed on the cellulose in wood to survive.

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

TRAP METHOD: Tarpaulin removal aeration plan developed in California which can be used as a guide to minimize worker exposure during aeration procedures following a fumigation at a typical family residential structure.

UNDERSEAL: The rating of the surface below or under the structure being fumigated. The underseal can vary from a slab (concrete) to sandy soil. This factor is one of the five that will impact the estimated half-loss time for a fumigation.

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

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

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

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

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

WARNING AGENT: A type of 'tear gas' introduced into a structure prior to fumigation to assure the space to be fumigated is and remains free of people.

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

WATER VAPOR: Water in the gaseous state.