

2005 *Florida*

FUMIGATION MANUAL

Rudolf H. Scheffrahn, Brian J. Cabrera and William H. Kern, Jr.
Fort Lauderdale Research and Education Center



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New regulations, labeling, and registrations can occur at any time and, when implemented, could make part(s) of the print version of this manual obsolete. Refer to new printed revisions or Web-based documents for current information.

Cover photo

Coconut Creek Government Center. Fumigated by Cobra Termite Control, September 2002. Photo: Smith Aerial Vision, Ft. Lauderdale, FL.

Photographs and illustrations

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In the past, there have been a number of reference publications for those studying to take the Florida examination for certification (Certified Operator or CO) in the fumigation category [482.111 & 482.021(3)] or as a special fumigation identification card holder (SPID) [482.151 & 482.021(25)]. Some publications were expensive, outdated, incomplete, or irrelevant to Florida conditions. The University of Florida published the first structural fumigation manual for Florida in 1982. That manual was conceived by the Florida Pest Control Association Education Committee and was authored by Fred Diehl, Bob Hughes, Phil Koehler (UF), Art Leisure (Dow), Richard Lewis, and Larry McKinney (FPCA Education Committee chairman).

In 2000, T. Wayne Gayle, then FDACS bureau chief, convened a task force committee of academic, industry, and regulatory experts to compile an outline containing what the committee deemed were important safety, regulatory, inspection, equipment, and procedural topics that should be covered in the state examination. The purpose of the current manual is to provide a single, updated study reference for the safe, effective, and lawful practice of fumigation in Florida as outlined by the committee.

In 2002, the Pest Control Enforcement Advisory Council was created within FDACS. Appointed by the Commissioner of Agriculture for a four-year term, the 11-member panel is to advise the Commissioner on regulatory and enforcement policy of Florida's pest control industry [482.243]. The Council is composed of representatives from FDACS, the pest control industry, the scientific community, and a private consumer with the goal of ensuring industry enforcement and compliance, consumer protection, and public understanding of the pest control industry. Two of the Council members are to be actively involved and certified in structural fumigation.

This manual contains standard procedures that most fumigators in the state have adopted because of state regulations or because they make good technical or economic sense. No two companies in Florida conduct fumigations in exactly the same manner. It is not the intent of this manual to dictate how a fumigator accomplishes his/her task, only that he/she uses safe practices to control the target pest, abides by the product label, and follows all local, state, and federal laws.

Comments, questions and suggestions regarding this manual should be directed to Rudolf H. Scheffrahn at (954) 577-6312 or rhsc@ufl.edu

Structural fumigation is unlike any other category of modern pest control. It demands that a sequence of procedures be conducted in varying, and often, difficult physical environments using toxic gases and an assortment of heavy, costly, and specialized equipment. Fumigation is the only method of pest control that allows for complete and rapid eradication of a target organism within a defined space. Structural fumigation is a needed and rewarding profession in which the skill, precision, and creativity of the fumigator are constantly challenged.

As a result of Florida's subtropical climate, it is home to a greater diversity of structural and household pests than any other state. Among the target pests of structural fumigation are drywood termites, wood-boring beetles, aerial infestations of subterranean termites, and the occasional problematic household insect, spider, or rodent infestation. About 60,000 structural fumigations are conducted annually in Florida with the great majority targeting drywood termites.

Fumigation practices have changed dramatically since the 1980s when structural fumigations in Florida were split evenly between two fumigants, methyl bromide (Brom-O-Gas®, MB) and sulfuryl fluoride (Vikane®, SF). During the 1990s, MB was affected by production declines, increased aeration requirements, increased cost, and the promotion of alternatives by the United States Department of Agriculture (USDA) and United States Environmental Protection Agency (EPA). This led to a gradual shift toward SF use.

About that time period, studies began appearing that suggested the earth's stratospheric ozone layer was thinning. Human causes for this thinning were sought. And, along with several refrigerant gases, MB was determined to have ozone-depleting properties. In 1992, the United Nations Environment Programme, under their Montreal Protocol, agreed to freeze production and mandated that by 1995, the use of MB could not exceed 1991 levels and that this freeze would be followed by a gradual phase out.

A final restriction of MB use in the U.S., scheduled for 2005, would allow only for certain quarantine or emergency exemptions where no practical replacement for MB exists. For all these reasons, sulfuryl fluoride is now used for almost all structural fumigations in the U.S.

Although the loss of MB in structural fumigation has had the greatest impact on the fumigation industry, other significant changes have also occurred.

"Nylofume® bags," "active aeration," and "secondary locks" have been brought into the structural fumigation vocabulary. Instrumentation continues to improve, e.g., Fumiscopes with maintenance-free drying tubes and remote data access capabilities, electronic dosage calculators and cylinder scales, and remote and infrared thermometers. Future trends in structural fumigation may include supplementation of carbon dioxide or heat to enhance fumigant toxicity, use of volume-displacing balloons to reduce application dosage, and lighter, more efficient tarpaulins for enclosing a fumigated airspace.

It remains unlikely that any new fumigant will be discovered in the future. The relatively small pool of candidate molecules available does not include a single gas with some, or even a few, of the many desirable properties needed for a structural fumigant (see Chapter 3, Table 3-1).

In late 2001, chlorine dioxide was the first new structural fumigant to be used since SF was introduced some 40 years ago. Chlorine dioxide gas was implemented under a strict USEPA emergency exemption to decontaminate anthrax spores from several federal government buildings at the cost of hundreds of millions of dollars. Although chlorine dioxide has antibacterial properties, it is very short-lived, unstable, and explosive. In addition, this gas cannot be containerized, is highly corrosive, and is effective only in a narrow temperature and humidity range.

Unfortunately, structural fumigation is the only branch of pest control that is implicated in nonoperator human fatalities. An average of two deaths per year occur in the U.S. as the result of illegal entry (e.g., deliberate exposure, mental deficiency, drug-induced behavior, etc.) or incomplete evacuation (e.g., infirmed or suicidal inhabitants). Continuous enhancements to fumigation regulations have been made to prevent entry or ensure evacuation of fumigated structures. The use of warning signs, secondary locks, walk-through inspections, and chloropicrin application procedures have undoubtedly saved lives. Fumigators must continue to strictly adhere to these safety requirements to prevent accidents resulting in harm to the public-at-large, costly litigation, and rising insurance premiums; all of which could stifle the fumigation industry.

As with structural fumigation, the technology in commodity fumigation is evolving. On January 26, 2004, USEPA registered SF for use on certain food products. Dow Agrosciences will market this label of SF under the name ProFume® gas fumigant. Under this registration, SF can be used for postharvest control of insect and rodent pests infesting cereal grains, dried fruit and tree nuts in mills, processing plants, storage facilities and transportation vehicles for these commodities. Expanded uses for SF in commodity and quarantine fumigations are also anticipated. Commodity fumigations constitute only a small fraction of nonsoil fumigations in Florida because the state is not a significant producer of stored food products such as dried fruits, nuts, or grains. Most commodity fumigations in Florida are conducted as quarantine treatments of agricultural products at sea-ports. Note: In this manual, quarantine and commodity fumigations using methyl bromide and phosphine are placed in a separate chapter in anticipation of upcoming changes in those areas and to reflect their relatively minor, although important, use in Florida.

What is a Fumigant?

A fumigant is a chemical that, at a required temperature and pressure, can exist in the gaseous state in sufficient concentration to be lethal to a given organism [482.021 (8)]. Other pesticides are applied either as liquids (sprays, aerosols, ultra-low volume aerosols, etc.) or solids (granulars or dusts). Fumigants can be applied to structures, commodities, or soil.

What is a Fumigation?

Fumigation is the application of fumigant within a measured space that is enclosed by tarpaulins or otherwise sealed. The fumigant must be confined for a time and at a concentration sufficient to kill the target organism. At these concentrations, the fumigant is hazardous to human beings [482.021(9)].

Why Fumigate?

The great advantage of structural fumigation over other methods of pest control is that all target pests are killed within the fumigated space, regardless of their location. Fumigants follow all the physical laws of gases, therefore, their molecules diffuse freely through air and infiltrate the minutest of spaces. The disadvantage of fumigation is the lack of residual activity to protect the fumigated space from subsequent infestation.

When to Fumigate?

Structural fumigation is the treatment of choice when the target pest infestation cannot be fully accessed

or delineated, when there is evidence of a structural infestation but the source is unknown, or when the target pest must be eradicated because of a quarantine issue. Fumigations can be conducted at any time of year for rodents. However, when fumigating for insects in structures, the minimum temperature at the target site must be at least 40° F.

How to Fumigate?

The procedures for lawful, safe, and effective fumigations are described in this manual.

State Regulation, Certification, and Examination

The practice of commercial pest control in Florida is strictly regulated under the provisions of the Structural Pest Control Act, Chapter 482 of the Florida Statutes [482] and 5E-14 of the Florida Administrative Code [5E-14]. These laws and regulations are administered and enforced by the Florida Department of Agriculture and Consumer Services (FDACS), Bureau of Entomology and Pest Control, 1203 Governor's Square Blvd., Suite 300, Tallahassee, FL 32301-2961, telephone 850-921-4177, or Website at <http://doacs.state.fl.us/aesent/pestcntrl/pcpage1.html/>. In addition to staff at the administrative office in Tallahassee, the Bureau has 23 field inspectors and three supervisory personnel assigned to nine regional offices statewide.

The inherent dangers in structural fumigation are recognized in state law and authorize FDACS to issue an immediate stop-use or stop-work order for fumigation performed in violation of fumigant label requirements or department rules, or in a manner that presents an immediate serious danger to the health, safety, or welfare of the public, including, but not limited to, failure to use required personal protective equipment, failure to use a required warning agent, failure to post required warning signs, failure to secure a structure's usual entrances as required, or using a fumigant in a manner that will likely result in hazardous exposure to humans, animals, or the environment [482.051(6)]. If a stop order (FDACS form 13659) is issued, work cannot be resumed until corrections are made, verified, and the release section of the stop order is completed by FDACS [5E-14.108(4)]. The CO in charge must notify FDACS within 24 hours of any accidental human poisoning or death connected with fumigation or any pest control work performed on a job she or he is supervising [482.152(6)].

State law authorizes one business licensing program (Pest Control Business License) and two certification programs (Pest Control Operator's Certificate Program and the Limited Certification Program). Pest control within the meaning of this law includes all phases of

structural fumigation [482.021(21)]. Each pest control business location must be licensed by FDACS and the pest control operations of the business location must have a designated CO(s) in charge [482.071]. In order to issue a business license, the candidate must first either obtain a certificate through certain qualifications and examination [482.132], or obtain the services of a person already certified [482.071(2)(e)].

The CO must be certified in the category (or categories) in which the business wishes to operate, must have a primary occupation in the pest control business, and must be employed on a full-time basis by the licensed firm [482.152]. Presently, the categories are:

- General Household Pest and Rodent Control,
- Termite and Other Wood-Destroying Organisms Control,
- Lawn and Ornamental Pest Control, and
- Fumigation.

Pest control operator's certificates are issued to persons who pass the written examination(s) given by FDACS. The minimum qualifications for CO examination are 24 semester hours or 36 quarter hours of courses in entomology, pest control technology, and related subjects, plus one year of employment; or three years employment as a service employee of a licensee that performs pest control in the category of general household pest, termite, and fumigation [482.132(2)(e)].

A CO in charge of fumigation must train and/or verify training to each special fumigation identification cardholder (SPID) in proper fumigation procedures as required by regulations and fumigant label directions, and to know the location, purpose, use and maintenance of personal protective equipment and fumigant detection and safety devices and when and how to use this equipment. The fumigation CO must also train each identification cardholder, assigned to fumigation work, in basic fumigation procedures, self-contained breathing apparatus (SCBA) use, and the proper use of fumigant safety equipment and to report immediately to the CO in charge or his or her SPID any irregularities or emergencies [5E-14.108 (3)].

Pesticide Regulations

In the United States, fumigants are recognized as a specific category of pesticides. The U.S. Environmental Protection Agency (EPA) is responsible for evaluating all pesticides, including fumigants, before they can be used. Pesticides that meet EPA's requirements are granted a registration that permits their distribution, sale, and use according to specific use directions on their labels. The registration process involves scientific, legal, and administrative procedures through which EPA examines how a

product is used and how that use can impact human health and the environment.

The EPA regulates pesticides under broad authority granted in the following two major statutes:

- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) – requires all pesticides sold or distributed in the United States (including imported pesticides) to be registered by EPA. EPA can authorize limited use of unregistered pesticides or pesticides registered for other uses to address emergencies and special local needs.
- Federal Food, Drug and Cosmetic Act (FFDCA) – Requires EPA to set pesticide tolerances for all pesticides used in or on food. A tolerance is the maximum permissible level for pesticide residues allowed in or on commodities for human food and animal feed.

Under the Food Quality Protection Act of 1996, which amended both FIFRA and FDCA, EPA must find that a pesticide poses a “reasonable certainty of no harm” before that pesticide can be registered for use on food or feed.

The Pesticide Label

EPA must approve all label language before a pesticide can be sold or distributed in the United States. The overall intent of the label is to provide clear directions for effective product performance while minimizing risks to human health and the environment. It is a violation of federal law to use a pesticide in a manner inconsistent with its labeling. The courts consider a label to be a legal document. In addition, following labeling instructions carefully and precisely is necessary to ensure safe and efficacious use.

Florida State Pesticide Oversight

The FDACS Bureau of Pesticides registers, performs laboratory analyses, and conducts scientific evaluations of pesticides used in Florida to ensure that adverse effects to human health, animal health, or the environment do not occur. The Bureau operates under Chapter 487, Florida Statutes and Chapter 5E2 of the Florida Administrative Code. All pesticides distributed or sold in Florida must be registered by FDACS. Furthermore, because fumigants are restricted-use pesticides they can be purchased and used in Florida only by individuals that hold a state-certified operators license in the Fumigation category.

The Pesticide Registration Section registers pesticides that are distributed or offered for sale in Florida. Emergency exemptions from registration are also issued or processed by the Bureau of Pesticides and submitted

to EPA for action. Additionally, Special Registration Actions, such as experimental use permits (EUPs), special local need registrations (SLNs), new active ingredient (NAIs), and significant new use registrations (SNUs) are processed, reviewed, and issued through the Bureau.

Under Section 24(c) of FIFRA, states can register a new pesticide product for any use, or a federally

registered product for an additional use, as long as there is both a demonstrated “special local need” and a tolerance, exemption from a tolerance, or other clearance under the FFDCA. However, EPA can disapprove a state’s special local need registration.

Chapter 2

Wood-Destroying Insects

Drywood termites are by far the most important target pests of structural fumigations in Florida. Wood-boring beetles, and aerial infestations (including boats) of subterranean termites account for the other wood-destroying insects controlled by fumigation. Cockroaches, spiders, rodents, and other miscellaneous household pests are occasional targets of fumigations in the state.

Proper identification of the insect and/or damage is extremely important because this will determine the treatment strategy and, if fumigation is needed, the dosage of fumigant to be used. In Florida, it is a requirement that the complete common name(s) of the wood-destroying organism(s) to be controlled be listed on the sales contract [5E-14.105 (e)]. Although bodies of wood-destroying insects are sometimes difficult to collect, other clues to their identity may be found such as wings, damage pattern to wood, mud tubes, and fecal material (pellets or frass), and debris. This chapter describes wood-destroying insects that commonly infest structures in Florida and the characteristics used to identify them.

Termites

Termites are primitive, soft-bodied insects that live in colonies. Termite colonies have three member types or castes: reproductives, workers, and soldiers (Fig. 2-1).

The king and queen are the reproductives. They head the colony and produce offspring. Winged termites, called alates or “swarmers,” are also reproductives but do not mate and reproduce until after they have flown away from their home colony. Workers do all the labor in the colony including caring for the eggs, and feeding and grooming the very young termites, the reproductives, and the soldiers. Workers do damage as they search for and gather food for the colony. Soldiers defend the colony against intruders but cannot chew wood so they are dependent on the workers to feed them.

Termites belong to the insect order Isoptera. Within this order, termites are further classified into groups called families. All termites in Florida belong to one of the following three families:

1. Family Kalotermitidae: Drywood and Dampwood Termites
2. Family Rhinotermitidae: Subterranean Termites
3. Family Termitidae: Higher Termites (includes some subterranean and tree-dwelling species)



Figure 2-1. Castes of a West Indian drywood termite (*Cryptotermes brevis*) colony.

Drywood and Dampwood Termites (Family Kalotermitidae)

Although closely related, it is important to distinguish between drywood and dampwood termites when conducting a termite inspection. Colonies of both are restricted to wood; however, only drywood termites usually require a chemical treatment such as fumigation. Wood infested by dampwood termites must be periodically exposed to water from a roof leak, exposure to rainfall, leaky plumbing, condensation, etc., so they can be controlled by limiting water exposure to wood. When structural repairs are made to correct wood moisture problems, dampwood termites will no longer have sufficient moisture to survive. On the other hand, drywood termites require little or no external water to

complete their life cycle. Table 2-1 lists character similarities between drywood and dampwood termites, while Table 2-2 lists characters used to differentiate between the two groups.

Drywood Termites

Nesting habits. Drywood termites live in non-decayed, dry wood (Fig. 2-2) and do not need a connection with the ground. All the water they need to survive comes from the wood they eat and that produced within the cells of their bodies. Drywood termites eat both the softer spring and denser summer growth rings often leaving the infested wood riddled throughout with galleries (Fig. 2-3).

Table 2-1. Similarities between drywood (Cryptotermes and Incisitermes) and dampwood (Neotermes) termites

Alate wings have three or more pigmented veins in leading edge of wing
Alate wings have diagonal cross veins connecting pigmented veins in outer half
Soldiers and workers have head about as wide as pronotum
Soldiers have one or more teeth on the inside margin of the mandibles
Worker bodies are sausage shaped, only slightly narrowed near thorax
Workers have small, short legs in proportion to bodies
Fecal pellets are six sided in cross section when fresh or dried
Colonies are restricted to a single piece of wood or multiple pieces if joined by fasteners as in construction
Galleries meander across growth rings showing little preference for spring or summer growth

Table 2-2. Differences between some drywood (Cryptotermes and Incisitermes) and dampwood (Neotermes) termites

Drywood Termites	Dampwood Termites
Wood is dry, no evidence of water contact	Wood is damp or shows evidence of periodic water contact
Can occur in furniture and interior wood cabinets and fixtures	Never in furniture or fixtures, typically in exterior siding or beams
Fecal pellets small and dry, fall freely from opened galleries or “kickout” holes	Fecal pellets larger and sometimes clumped or partially dissolved, do not fall freely from opened galleries or “kickout” holes
Workers, soldiers, and alates intermediate in size	Workers, soldiers, and alates large in size
Less common north of Orlando	Not occurring north of Orlando
Flights peak in late Spring, early Summer	Flights peak in late Summer, early Fall
Soldiers of Cryptotermes have black plug-like heads and short mandibles	Soldiers always with orange heads and projecting mandibles
Alates with 3 pigmented veins in leading edge of wing near point of attachment to body	Alates with 4 or more pigmented veins in leading edge of wing near point of attachment to body



Figure 2-2. Wood infested by *C. brevis* split open to show gallery structure, termites, and fecal pellets.

Damage to wood. Drywood termites rarely break through to the outside of the wood except during dispersal flights when often only wings (Fig. 2-4) are left behind. They often feed to just under the surface of the wood leaving only a thin shell. Thus infested wood may appear solid from the outside but can be easily broken when probed. Drywood termites make small holes to the outside of wood to eject frass (fecal pellets) or as an exit for alates during a swarm. The tiny openings (1.5-2 mm), made for discarding frass, are called “kickout” holes (Fig. 2-5). When not in use, kickout holes are sealed with

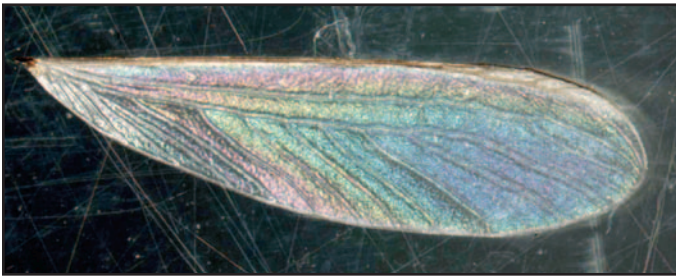


Figure 2-4. *Cryptotermes brevis* wing showing iridescent color from reflected light. Photo: B.J. Cabrera.



Figure 2-3. Cross-section of drywood termite-infested wood. Photo: B.J. Cabrera.

a veneer of liquid fecal material that dries into a thin sheet. Larger “tubes” of this brownish material are sometimes used to connect two adjoining pieces of wood. Piles or scatterings of frass on floors, windowsills, and other surfaces are an obvious sign of drywood termite infestations. The frass feels dry and gritty when rolled between the fingers. Viewed under a microscope, the pellets have six indentations (Fig. 2-6). Their color can range from light cream (Fig. 2-6) to reddish brown (Fig. 2-7) to black.



Figure 2-5. Drywood termite kickout holes on a painted wood surface.



Figure 2-6. Drywood termite fecal pellets are six-sided in cross section.

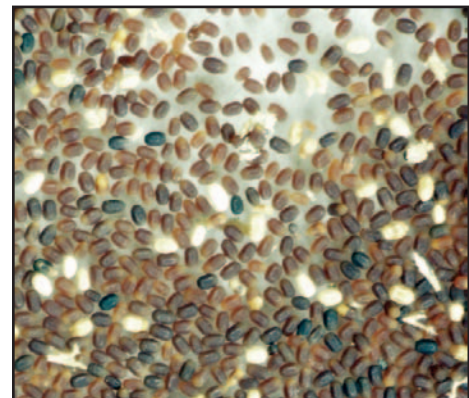


Figure 2-7. Drywood termite fecal pellets vary in color.

Pest species in Florida. West Indian drywood termite (*Cryptotermes brevis*) southeastern drywood termite (*Incisitermes snyderi*), and (rarely) western drywood termite (*I. minor*). All species have been found statewide, however drywood termites are far more common in the more tropical southern portions of Florida.

***Cryptotermes brevis*.** The West Indian drywood termite (Fig. 2-1) is a common drywood termite pest in Florida. Aside from framing and plywood, it infests doors, furniture, cabinetry, pallets, shelves, picture frames, and other household items. Alates (Fig. 2-8) are medium brown and about 11-12 mm long with wings. Under reflective light, their wings (9.5 mm long) have an iridescent sheen (Fig. 2-4). Swarms occur between dusk and dawn and peak between April and June with occasional flights any season. As with all drywood termites, the wings have three darkened veins on the leading edge of the wing (Fig. 2-9). Soldiers (5 mm long) have dark, wrinkled, and plug-like (phragmotic) heads (Fig. 2-1) used to block tunnels and prevent ants

from entering the galleries. Large workers are about 5 mm long.

***Incisitermes snyderi*.** The southeastern drywood termite, *I. snyderi*, is found throughout Florida. It is a slightly larger termite than *C. brevis*. Alates are about 11-12 mm long and are pale yellow-brown to pale reddish brown. Wings are about 9 mm long. Soldiers have projecting mandibles (Fig. 2-10) and average about 7.5 mm long while large workers are about 6.5 mm long. Swarming occurs at dusk or night from May through August. This termite has a higher moisture requirement than *C. brevis*, so structural infestations tend to be associated more with exterior wood such as siding, rafter tails, soffits, and patio framing.

***Incisitermes minor*.** The western drywood termite is an introduced species native to the southwestern U.S. Alates are 11-12.5 mm long. The head and pronotum is orange-brown and the abdomen is dark brown. The wings have a dark, smoky tint to them. Most flights



Figure 2-8. Drywood termite (*C. brevis*) alate floating on water.



Figure 2-9. Three pigmented veins on each overlapping drywood termite wing. Photo: B.J. Cabrera.

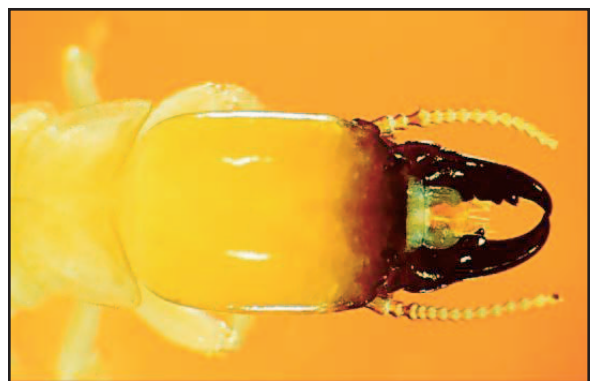


Figure 2-10. Toothed mandibles of drywood termite (*I. snyderi*) soldier.

occur in September through November. Soldiers are similar to *I. Snyderi* but differ in having dark reddish-brown heads and the third segment of the antenna is greatly enlarged and club-shaped. Infestations are typically found indoors.

Dampwood Termites

Nesting habits. Dampwood termites live in damp branches, logs, stumps, dead trees, and structural wood exposed to water. They also infest live trees, constructing galleries in the trunks and large branches. Dampwood termite galleries are often filled with clumped fecal pellets that often dissolve into a mudlike paste.

Wood damage. Dampwood termites create irregular cavities throughout the wood (Fig. 2-11). Structural infestations by dampwood termites occur in wood in contact with water or moist soil, or wood that is soaked by water from leaky pipes, sprinklers, leaks in roofs, etc. They cannot survive without a source of moisture.

Pest species in Florida. Three species of Florida dampwood termites in the genus *Neotermes* are known. One of these, *N. castaneus* (Fig. 2-11), is found as far north as Orange County (Orlando area). *Neotermes jouteli* and *N. luykxi* are found only in southeastern Florida. Alates of *N. castaneus* are about 15.5 mm long (wings 11.5 mm long, Fig. 2-12). Soldiers are about 11.5 mm long while workers average 8 mm in length.

Subterranean Termites (Family Rhinotermitidae)

Subterranean termites are in the termite family Rhinotermitidae. Subterranean termites differ from dry-wood and dampwood termites in a number of important biological and physical ways (Table 2-3).



Figure 2-11. Dampwood termite (*Neotermes castaneus*) colony showing soldiers, alates, and workers.

Nest habits. Subterranean termites nest underground and tunnel through soil in search of food. Subterranean termites build a network of tunnels in the ground that, in some species, can extend hundreds of feet. Besides wood, the main requirement for subterranean termite survival is moisture. Water from leaks, air conditioners, poorly placed sprinklers, or poor drainage from roofs and gutters can keep colonies thriving inside structures without a need for contact with the ground. Occasionally, subterranean termites, especially *Coptotermes*, will colonize upper portions of buildings without ground contact (aerial infestations) or even boats. In such cases, fumigation is an effective treatment option for subterranean termites.

Damage to wood. Subterranean termites prefer eating the less dense spring growth rings (visible as the lighter colored wood in the growth ring) rather than the harder, denser summer rings. This feeding habit gives wood damaged by subterranean termites a ringed appearance when viewed in cross-section. In extreme cases, solid wood can be reduced to a few thin strands of summer wood (Fig. 2-15). Subterranean termites may cover damaged wood with soil and their feces. They also make carton, a material made from their fecal material that dries and hardens to form a protective barrier against enemies such as ants.

Foraging and swarming tubes. Subterranean termites foraging above ground build tubes made from soil and feces. These covered trails (shelter tubes) provide protection and often appear on walls (Fig. 2-16). They are easily broken by hand and termites may be found inside.

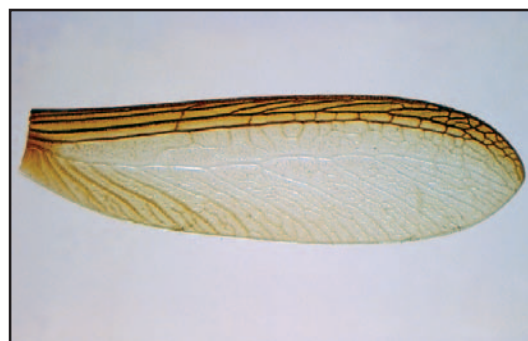


Figure 2-12. Dampwood termite (*N. castaneus*) wing with at least four pigmented veins in leading edge.

Table 2-3. Differences between drywood and dampwood termites (*Cryptotermes*, *Incisitermes*, *Neotermes*) and subterranean termites (*Reticulitermes*, *Coptotermes*, *Heterotermes*)

Drywood and Dampwood Termites	Subterranean Termites
Alate wings have three or more pigmented veins in leading edge of wing (Figs. 2-9, 2-12)	Alate wings have two pigmented veins in leading edge of wing (Fig. 2-13)
Alate wings have diagonal cross veins connecting pigmented veins in outer half (Fig. 2-8)	Alate wings have no diagonal cross veins connecting pigmented veins in outer half
Soldiers and workers have head about as wide as pronotum (Figs. 2-1, 2-10)	Soldiers and workers have head wider than pronotum (Figs. 2-14, 2-17)
Soldiers have one or more teeth on the inside margin of the mandibles or heads plug-shaped	Soldiers have no teeth on the inside margin of the mandibles (Fig. 2-17)
Worker bodies are sausage-shaped, only slightly narrowed at thorax (Fig. 2-1)	Worker bodies are more hourglass shaped than sausage shaped (Fig. 2-14)
Workers have small, short legs in proportion to bodies (Fig. 2-1)	Workers have larger, longer legs in proportion to bodies (Fig. 2-14)
Fecal pellets are six sided in cross section when fresh or freshly dried (Fig. 2-6)	Feces are liquid and dry as spots used to line foraging tubes
Colonies are restricted to a single piece of wood or multiple pieces if joined by fasteners when used in construction	Colonies forage considerable distances between food sources via underground and aboveground foraging tubes (Fig. 2-16)
Galleries meander across growth rings showing little food preference to spring or summer growth	Galleries begin in softer spring growth rings before summer rings are eaten
Nest in wood above ground	Nest underground, or if above ground, in nest material called carton



Figure 2-13. Subterranean termite (*Reticulitermes*) wing showing the characteristic two pigmented veins on leading edge.

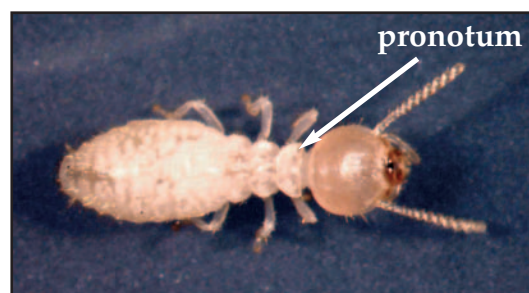


Figure 2-14. Subterranean (*Coptotermes*) termite worker. Note constricted thorax. Photo: K. Wheeler.



Figure 2-15. A timber reduced to strands of denser summer growth wood by subterranean termites. Photo: B.J. Cabrera.

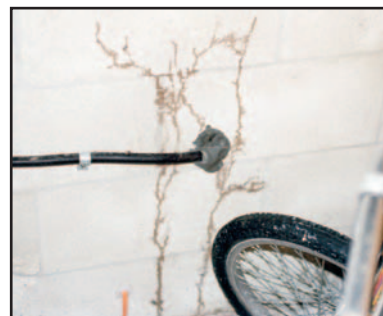


Figure 2-16. Subterranean termite foraging tubes. Photo: B.J. Cabrera.

pronotum



Figure 2-17. View of subterranean termite soldiers showing lack of teeth on mandibles. Each also has a head that is wider than the pronotum. L to R: *Coptotermes*, *Heterotermes*, and *Reticulitermes*.



Figure 2-18. *Reticulitermes* alate. Photo: B.J. Cabrera.



Figure 2-19. Formosan subterranean termite alate. Photo: B.J. Cabrera.

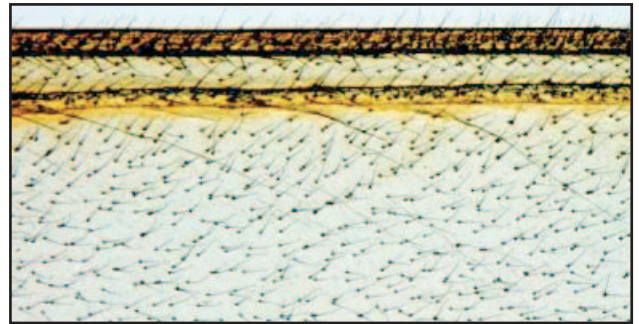


Figure 2-20. Close-up of pigmented veins and tiny hairs on a Formosan subterranean termite wing.

Pest species in Florida. Three species of native subterranean termites in the genus *Reticulitermes* occur throughout Florida (Figs. 2-17, 2-18) including the Eastern subterranean termite, *R. flavipes*, the dark southern subterranean termite, *R. virginicus*, and the light southern subterranean termite, *R. hageni*. Three non-native species of subterranean termites are also in Florida. The Formosan subterranean termite, *Coptotermes formosanus* (Figs. 2-17, 2-19 and 2-20), is found in localized areas throughout much of the state, while a related species, the Asian subterranean termite, *Co. gestroi*, occurs in Miami and the Florida Keys. A *Heterotermes* species native to Jamaica is established in Miami (Fig. 2-17). Distributions of these three exotic species are associated with human development. The uncommon Cuban subterranean termite, *Prorhinotermes simplex*, is restricted to the southeastern coast of Florida.

Higher Termites (Family Termitidae)

Pest species in Florida. One species, *Amitermes floridensis*, the Florida darkwinged subterranean termite, is native to central Florida and is mostly a nuisance pest due to large dispersal flights after rain. This species



Figure 2-21. Tree termite (*Nasutitermes costalis*) soldier.

occasionally builds foraging tubes on structures but usually limits attack to wood in contact with soil. The second higher termite, *Nasutitermes costalis* (= *N. corniger*), or “tree termite” (Fig. 2-21), was discovered in 2001 in Broward County and is the subject of an eradication effort begun in 2003. The above-ground nesting habit of arboreal termites like *N. costalis* lends itself to fumigation. Between 2001 and 2003, several structures and boats infested by *Nasutitermes* species were successfully fumigated.

Wood-Destroying Beetles

Many species of beetles eat wood. Some feed on living wood while others eat only dead wood. Beetles infesting seasoned wood are those most likely to be found infesting structures. The immature stage, or larva, accounts for the feeding damage that usually is noticed after the adult beetle chews itself out of the infested wood. After termites, wood-destroying beetles are the main reason for structural fumigations in Florida. In this section, the major structure-infesting beetles in Florida are described.

True powderpost beetles – “lyctids” (Family Lyctidae)

Adult. The name “powderpost beetle” is often given to any small wood-infesting beetle. However, in the strictest sense there is only one group of true powderpost beetles. The following characteristics separate them from the other wood-destroying beetles found in structures:



Figure 2-22. Magnified view of a true powderpost beetle (*Lyctus* species). Photo: B.J. Cabrera.

- Elongate, flattened body
- Small size—measuring from about 2.2-7.5 mm long
- Head visible (not hidden by pronotum) when beetle is viewed from above (Fig. 2-22)
- Last two segments of the antennae are enlarged forming a “club” (Fig. 2-23)

Frass. True powderpost beetle frass is very fine: like flour or talcum powder and does not contain any pellets or bits of wood.

Wood damage. Larvae cause tremendous damage as they feed inside the wood. When they bore out of wood, adults make round exit holes (Fig. 2-24). The holes are about 0.8-3.2 mm in diameter. Frass falls out of the holes as the beetles emerge and collects outside and below the infested wood in piles (Fig. 2-25). True powderpost beetles will reinfest the same or nearby pieces of wood.

Type of wood infested. Powderpost beetles infest hardwoods (such as oak, maple, ash, walnut, alder,



Figure 2-23. Last two antennal segments are enlarged forming a “club.” Photo: B.J. Cabrera.

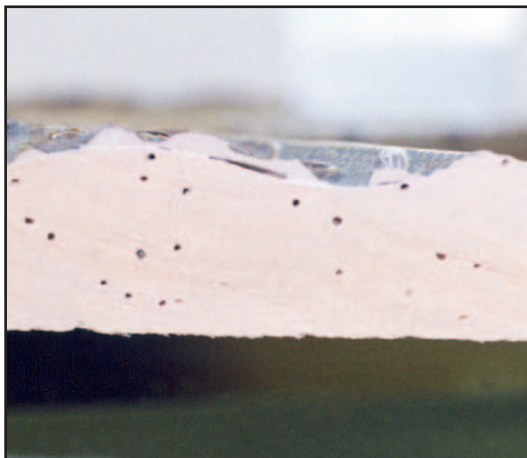


Figure 2-24. Powderpost beetle exit holes. Photo: B.J. Cabrera.



Figure 2-25. Powderpost beetle frass accumulating below wall paneling.

cherry, beech, and mahogany). These woods are often used in furniture, cabinetry, flooring, paneling, trim, picture frames, sculptures, tool handles, and decorative objects. Powderpost beetles also infest bamboo. These woods have small pores where the beetles lay their eggs. True powderpost beetles do not infest softwoods (such as pine, spruce, and fir).

Biology and life cycle. After mating, the female lays her eggs in the pores, or cracks and crevices of the wood. After one to three weeks, the eggs hatch. The larvae create tunnels and produce frass as they eat through the wood. After a period of several weeks or months, the larva stops feeding and becomes a pupa. Development to the adult occurs in this stage. Depending on factors such as temperature and wood quality, the time between egg and adult can take from six months to over a year. Typically, true powderpost beetles reinfest wood. However, a coating of paint, lacquer, varnish, or sealant on the wood that blocks the pores prevents further egg laying.

True powderpost beetles prefer newer, seasoned hardwoods with at least 3% starch content. Bamboo also has a high starch content—another reason why it is prone to infestation by lyctids. Wood moisture content of roughly 8 to 32% also is needed for development and survival.

True powderpost beetles in Florida

Lyctus species. Most true powderpost beetle infestations in Florida are by the genus *Lyctus*. These beetles are small, elongate, and black to brown in color (Figs. 2-22 and 2-23). The most common species of *Lyctus* in Florida are:

- *L. brunneus*, the brown lyctus beetle
- *L. plannicollis*, the southern lyctus beetle
- *L. linearis*, the European lyctus beetle
- *L. africanus*



Figure 2-26. A *Minthea* powderpost beetle. Photo: B.J. Cabrera.

Minthea species. Exotic *Minthea* powderpost beetles are easy to recognize because their bodies are covered with erect, light-colored flat hairs (Fig. 2-26). However, they have the same general lyctid color, size, and body shape. *Minthea* is native to Southeast Asia and often ends up in Florida in wood and furniture imported from that part of the world.

Anobiids – “deathwatch” beetles (Family Anobiidae)

Adult. Anobiid beetles are brown, dark brown to red-brown. Body shapes vary from long and thin to oval or stout. Lengths range from about 1.1-8 mm. The head is often hidden by the hood-shaped pronotum when viewed from above (Fig. 2-27). Antennae have different forms but the last three segments are usually enlarged or if not, the antennal segments are saw-toothed or antler-like.

Frass. When feeding on softwoods, anobiid beetle frass consists of small, dry, lemon-, or bun-shaped fecal pellets (Fig. 2-28) without indentations. The frass is often loosely packed inside the wood. Small bits of chewed wood may also be mixed in with it. In hardwoods, the frass is more powdery, has less pellets, and is more tightly packed.

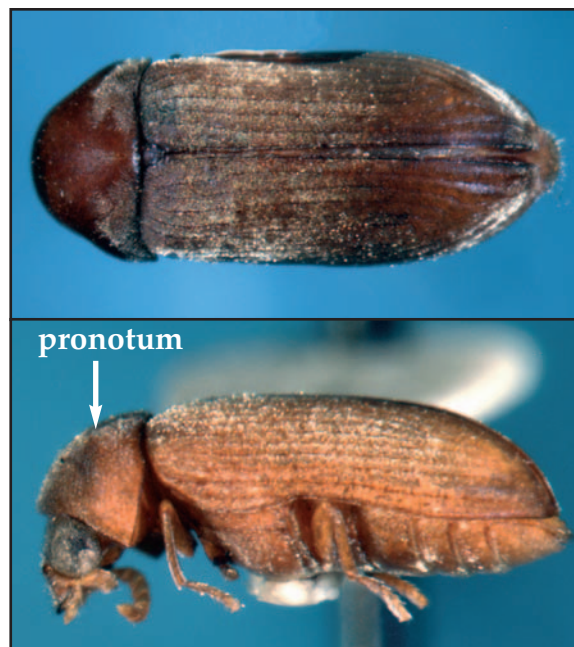


Figure 2-27. (top) Top and (bottom) side view of an anobiid beetle (*Euvrilletta peltata*) showing heads hidden underneath a hooded pronotum). Photo: B.J. Cabrera.

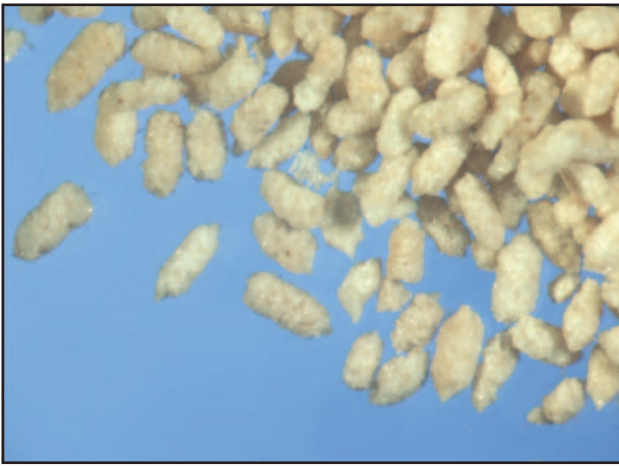


Figure 2-28. Anobiid beetle frass. Note the lack of indentations compared with drywood termite pellets. Photo: B.J. Cabrera.



Figure 2-29. Anobiid beetle emergence holes. Photo: B.J. Cabrera.

Wood damage. Anobiid beetles make round exit holes (Fig. 2-29) between 1.5-3 mm in diameter and will re-infest wood. Severely infested wood is riddled with many holes and is greatly deteriorated.

Type of wood infested. Anobiids attack both soft- and hardwoods. They prefer wood with moisture content between 12 to 30%. Anobiid infestations tend to occur in damp places such as subfloor and crawlspace areas with poor ventilation.

Biology and life cycle. Females lay eggs in cracks, crevices, and holes on the surface of wood. Larvae hatch after 6 to 21 days and burrow into the wood. The larvae create tunnels as they feed and pack the space behind them with frass. Like other beetles, anobiid larvae go through several stages, increasing in size until they pupate in cells just below the surface of the wood. Pupation takes from 4 days to 3 weeks, depending on the species. Adult beetles emerge from the wood to mate. Anobiid beetles typically reinfest wood from which they have emerged. Total development time from egg to adult takes from one to three years.

Anobiid beetles in Florida. Most of the major structural wood-infesting anobiid beetles found in the U.S. are uncommon in Florida though they may occasionally appear in isolated cases.

***Euvrilletta peltata*.** Formerly known as *Xyletinus peltatus*, this reddish-brown to dark brown beetle (Fig. 2-27) is probably the most likely wood-infesting anobiid to be encountered in Florida. It is widely distributed throughout the eastern U.S. where it is often found infesting damp cellar joists and flooring—especially if there is fungus. It is about 3.5-6.5 mm long, has large eyes, and the wing covers are covered with fine yellow hairs and lined with rows of tiny pits.

False powderpost beetles – bostrichids (Family Bostrichidae)

Another major group of beetles that infest dead and structural wood are the false powderpost beetles. They are given this name because their damage is similar to that of the true powderpost beetles.

Description.

Adult. False powderpost beetles are dark brown to black beetles. Some characteristics used for identification include:

- a large pronotum that often has bumps or knobs on it. (Fig. 2-30),
- the head is often hidden by the pronotum when the beetle is viewed from above,
- cylindrical or stout body,
- elytra (wing covers) often covered with rows of pits,
- ends of wing covers sometimes have small spines,
- short antennae with last 3 or 4 segments saw-tooth shaped and enlarged forming a club.

Frass. Bostrichid frass contains small bits of wood, a few pellets, and fine powder. It feels gritty and tends to clump together.

Wood damage. False powderpost beetles cause damage typical of other wood-boring beetles. Adults make round exit holes as they emerge from wood. Unlike powderpost beetles and anobiids, female bostrichids bore into the wood to lay their eggs.

Type of wood infested. False powderpost beetles attack both soft- and hardwoods but they prefer the latter. They infest wood that has no less than 10% wood moisture content and generally like newer versus aged wood. Unlike true powderpost beetles and anobiids,

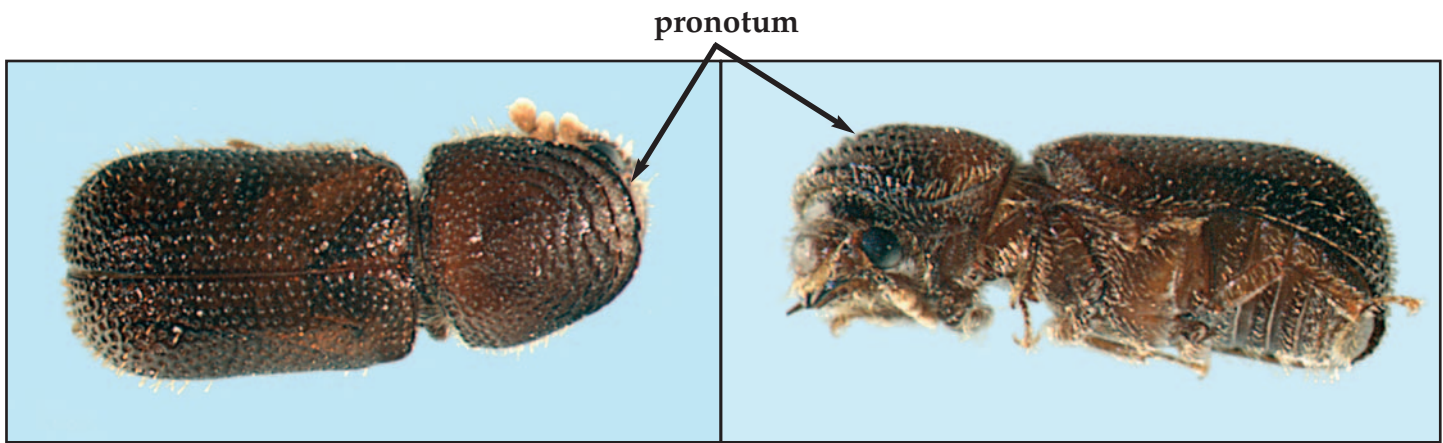


Figure 2-30. A false powderpost beetle, the bamboo borer. Top view (left) and side view (right). This specimen collected on Big Pine Key emerging from a rattan chair. Photo: B.J. Cabrera.

false powderpost beetles do not usually reinfest the same piece of wood after it has become dry and seasoned.

Biology and life cycle. Female powderpost beetles lay eggs in cracks or crevices or chew a small hole in wood and lay the eggs inside. Once the larvae hatch, they burrow into the wood and feed until they pupate. After several days, the adult emerges by chewing a hole in the wood.

False powderpost beetles in Florida. Many infestations occur in wood brought in from outside the country. However, some exotic species may be established in Florida. One, the bamboo borer, *Dinoderus minutus* (Fig. 2-30), is a small species found worldwide including the Caribbean, and South and Central America. It is commonly found in bamboo but will also infest dried foods, seeds, and roots. It is reddish brown and about 2.5-3.5 mm long.

Heterobostrychus aequalis is native to Southeast Asia and the south Pacific. It attacks lumber and is also known to infest oak trees in Florida. Adult beetles are reddish brown to brownish black, 6-13 mm long, with males having a curved spine at each end of each wing cover. The red-shouldered hickory borer, *Xylobiops*

basilaris, is found in the eastern U.S. It is less than 6 mm long and is mostly black, except for the first 1/3 of the wing covers that are reddish to yellow. The wing covers have three spiny projections at the ends.

Old House Borer – a longhorn beetle (Family Cerambycidae)

The old house borer, *Hylotrupes bajulus*, is one of the largest wood-infesting beetles found in structures and is a common pest in many parts of the southeastern U.S.

Description.

Adult. Old house borers are dark gray, brown-black to black beetles with light-colored hairs on the head and thorax (Fig. 2-31). The body is elongated, a bit flattened, and from 15-25 mm long. Other features used for identification include:

- antennae about half as long as the body
- oval or round pronotum
- two shiny, round bumps without hair on the pronotum
- elytra may have light-colored horizontal stripes about halfway down



Figure 2-31. Old House borer, *Hylotrupes bajulus*, adult. Photo: B.J. Cabrera.



Figure 2-32. Old House borer exit hole. Photo: B.J. Cabrera.

Larva. Long-horned beetle larvae are known as “round-headed borers” because larvae and emergence holes are not flattened like those of “flat-headed borers” (Buprestidae). Late stage old house borer larvae are actually larger than the adults and grow to between 19-41 mm long. Sometimes they can be heard feeding on the wood.

Frass. Old house borer frass is a mixture of fine powder and pellets tightly packed into the tunnels. Large amounts of frass may collect on surfaces below the exit holes.

Wood damage. The larvae can inflict tremendous damage as they feed and burrow through a piece of wood. Sometimes they will consume most of the inner wood leaving only a thin outer shell. Beetles emerging from wood make oval exit holes measuring 6-10 mm across (Fig. 2-32).

Type of wood infested. Old house borers infest softwoods such as pine, fir, and spruce and prefer recently seasoned wood generally less than 10 years old. Eggs may be laid in wood stored in lumberyards; thus infested wood can be built into a structure. Rafters, attic and floor joists, and studs are commonly infested. Heavy infestations of old house borer pose a serious threat to homes. Wood pallets and packing crates may also be infested.

Biology and life cycle. Beetles begin emerging in the late spring and continue through summer. The males

come out first and wait near where females will emerge. Eggs are laid in cracks and crevices and in tight spaces between pieces of wood. The eggs hatch and the larvae burrow into the wood and feed. The larval stage lasts from 2 to 10 years on average. Development time depends on temperature, humidity, and wood moisture content and may sometimes take over 10 years under less favorable conditions. Adult emergence, mating, and larval feeding are greatest during the summer when wood moisture is at its highest levels.

Old House Borer in Florida. Due to its habit of infesting wood in lumberyards and its widespread distribution in the southeastern U.S., the old house borer is found occasionally throughout Florida. Apparently, it does not occur in the wild in the U.S.

Structural Pests That Are Not Wood-Destroying

Although most structural fumigations in the United States are for wood-destroying insects, structural infestations of other pests may arise where fumigation is needed. Examples of such cases are large or severe infestations, infestations in difficult to treat locations, and when standard methods of nonfumigant control are not working. Among such insect pests are cockroaches, carpet beetles, stored-product beetles and moths, clothes moths, bedbugs, and spiders. Rodents such as rats and mice are typically the only vertebrate pests for which a fumigation may be prescribed.

Chapter 3

Physical Properties of Sulfuryl Fluoride

Sulfuryl fluoride (SF) is an inorganic (non-carbon containing) compound with the formula SO_2F_2 and a molecular weight of 102. At atmospheric pressure, SF is a gas above -67°F . German chemists first synthesized SF in 1935. In the mid-1950s, Dow Chemical Company evaluated the potential of SF as a structural fumigant. Dow's research efforts, headed by Doane Stewart working in Seal Beach, California, demonstrated that SF had most of the desirable properties of a structural fumigant (Table 3-1), especially for control of drywood termites. In 1960, Dow began marketing the gas under the trade name Vikane®.

Container. Dow AgroSciences manufactures SF as Vikane® gas fumigant in Pittsburg, CA. A total of 125 lbs of SF is packaged in metal cylinders (Fig. 3-1) that weigh an additional 70-100 lbs. A valve cover is screwed over the valve opening to prevent against accidental release and a bonnet is screwed onto the neck of the cylinder to protect the release valve (Fig. 4-4). The valve cover and bonnet must be reattached whenever the cylinder is not in use. The cylinder is fitted with an internal "dip" tube that runs from the release valve on top of the cylinder to near the bottom of the cylinder. The tube allows the vapor pressure exerted by the gas in the top of the

Table 3-1. Fumigant properties: ideal versus sulfuryl fluoride

Desirable Properties of a Structural Fumigant	Properties of Sulfuryl Fluoride
Toxic to active target pest	Same
Toxic to insect eggs	Only at high concentrations
Low toxicity to humans, pets, plants	Toxic at working concentrations
No human skin penetration	Same
Antidote available	No antidote
Warning odor	Odorless
Nonflammable, nonexplosive	Same
Nonreactive, noncorrosive gas	Same below 752°F
Nonreactive, noncorrosive liquid	Corrosive liquid
Low sorption, rapid aeration	Same
Stable for storage in cylinder	Same
Stable as gas in air	Same
High vapor pressure	Same
High diffusion rate	Same
High desorption rate	Same
Low water solubility	Same
No food residues	Low residues of fluorides, sulfates
No postfumigation odor	Same
Low ozone depletion potential	Same
Low cost	Moderate/high cost

cylinder to push only liquid out of the valve when opened so SF is delivered fast and without cylinder frosting. Only the last 3-5 pounds of SF in the bottom of the cylinder (where the dip tube does not reach) is released from the valve as a gas or combination gas and liquid.

Cylinders should be stored upright in a locked and well-ventilated storage area. On vehicles, the cylinders must be secured, in an upright position, to a sturdy support and be in an airspace separate from the driving compartment. If a cylinder leak is detected, follow label directions by donning a self-contained breathing apparatus (SCBA) and correcting the problem. If the leak cannot be corrected, move the cylinder away from buildings and people until the cylinder is empty.

Liquid Properties (Table 3-2). SF is a clear, colorless liquid that has a relative density (weight) 1.32 times that of water. In open air – 1 atmosphere of pressure or about 15 pounds per square inch (PSI) – SF liquid boils at -67° F. Therefore, it is possible to see non-boiling liquid

SF in an open container in air temperature below -67° F. Such low temperatures can only be found in ultra-low-temperature freezers or in Antarctica on a very cold winter's day.

SF remains as a liquid in the cylinder and shooting tube at temperatures warmer than -67° F because the vaporizing liquid and condensing gas are in a pressure equilibrium. This “vapor pressure” is the force exerted by the SF gas inside the cylinder and shooting line. The vapor pressure of SF increases as the temperature increases (Table 3-3). Vapor pressure is a good measure of the volatility of a compound. Volatility is the force exerted by gas molecules to escape from the liquid phase and enter the gas phase. Volatility increases with increasing vapor pressure. For SF, a typical working vapor pressure in the cylinder is between 220 and 350 PSI. Therefore, the minimum burst pressure rating for the cylinder adapter assembly and shooting tube should be no less than 500 PSI.

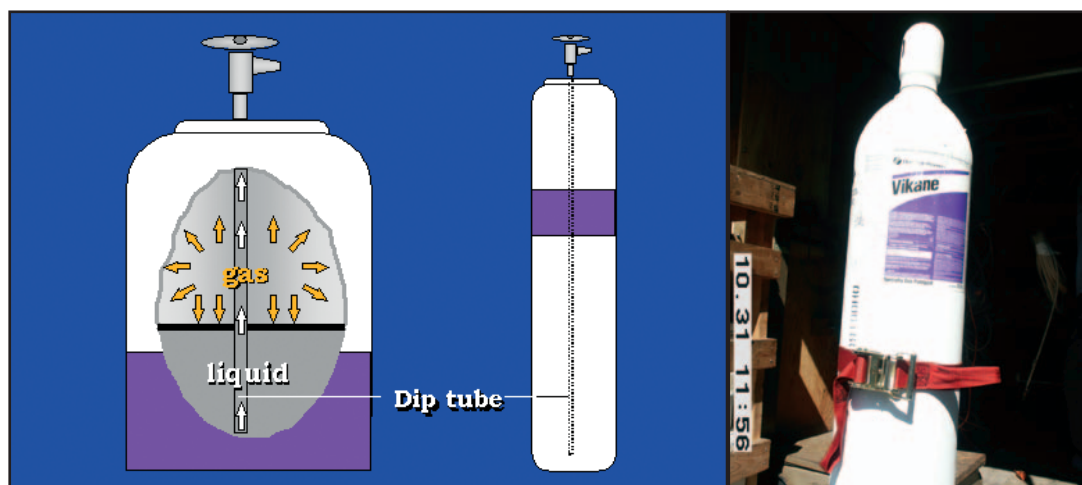


Figure 3-1. Interior mechanics of a Vikane® cylinder (left). Carrying strap allows for easier and safer movement of cylinder (right). Note that bonnet is attached (valve cover not visible).

Table 3-2. Important physical properties of sulfuryl fluoride

Liquid	Gaseous
Colorless	Colorless
Nonflammable	Nonflammable
Boiling Point -67° F	Odorless at working concentrations
Density 1.32 times water	Vapor density 3.5 times air
Heat of vaporization 81 BTU	Water solubility 0.075% (low)
Incompatible with aluminum or magnesium	Decomposes at 752° F

Table 3-3. Cylinder vapor pressure of sulfuryl fluoride

Temp (°F)	Pressure (PSI or lbs/sq inch)
32	128
38	142
50	170
68	224
86	289
104	364

When SF volatilizes from a liquid into a gas, it requires energy in the form of heat. This required heat energy (or “heat of vaporization”) is taken from the surrounding atmosphere. The heat of vaporization for SF liquid equals 81 BTU/pound. One BTU is equal to the amount of heat required to raise the temperature of one pound of water by 1° F. One pound of liquid SF released into an air space removes enough heat to lower the temperature of 1,000 cubic feet (abbreviated as “1 Mcf”) of air by 4.5° F.

When packaged as Vikane®, SF is 99.8% pure. It contains traces of hydrofluoric acid and other corrosive impurities. Because of these impurities, Vikane® *liquid* will damage glass, metal, or other corrosion-susceptible materials.

Like all liquids, SF has flow resistance or viscosity. The viscosity of SF can be used to control the rate at which it leaves the cylinder through a shooting tube. This flow rate must be limited so that the vaporizing SF’s cooling effect does not cause condensation in the airspace where it is released. If SF is released too quickly

into airspace with a relative humidity of 70% or more (not uncommon in Florida) and the temperature in the airspace drops by 10° F or more, water vapor in the air will condense and fall as a liquid. This condensation occurs because the capacity of air to hold water vapor decreases as the air is cooled (Table 3-4). The temperature at which condensation begins is termed the dew point. Condensation caused by excessive SF release is called a “fog out” or “rain out.” Water formed by the condensation can stain or damage fabrics and furnishings.

Preventing “Fog Outs”. Because SF must be released with the cylinder valve wide open and because there is no way to control temperature and humidity, fog outs can be prevented by regulating three factors: 1) volume of room where SF is released, 2) release rate, and 3) air exchange rate. To avoid fog outs, always select the largest room of the structure in which to release the SF so air exchange is enhanced. The release rate can be controlled by the inner diameter (smaller = slower) and length (longer = slower) of the shooting tube (Table 3-5). Air exchange can be enhanced by placing fans so that there is rapid mixing of cooled air near the release site with warmer air from the surroundings. If the release rate is about 2 lbs/minute and fans are exchanging at least 2 Mcf air/minute, then fog outs are unlikely at the 1X rate. In fact, the Vikane® label requires a shooting fan capacity of 1 Mcf for every pound/minute released. When high concentrations (greater than 1X or during short-term fumigations) or large quantities (for large structures) are required, or when the release site volume is small, or air exchange is difficult, modifications in SF should be considered. SF should be released in intervals of several minutes separated by several minutes of no release to insure that the air temperature recovers sufficiently around the release site. Multiple release sites can also be used to avoid a fog out by distributing the cooling effect of the SF release among several different locations in the structure.

Table 3-4. Temperature drop needed to reach dew point

%Rel. Hum.	Temp. °F	Dewpoint °F	Temp. Drop
50	50	32.0	18.0
70	50	40.5	9.5
90	50	47.0	3.0
50	60	41.0	19.0
70	60	50.0	10.0
90	60	57.0	3.0
50	70	50.5	19.5
70	70	60.0	10.0
90	70	67.0	3.0
50	80	60.0	20.0
70	80	69.0	11.0
90	80	77.0	3.0
50	90	69.0	21.0
70	90	79.0	11.0
90	90	87.0	3.0
50	100	78.0	22.0
70	100	88.5	11.5
90	100	96.5	3.5

Table 3-5. Effect of tube diameter and length on SF flow rate at 65° F

Tube Inside Diameter (inches)	Tube Length (feet)	Pounds SF per minute
1/8	100	2.0
1/8	50	2.8
1/8	25	4.0
1/4	25	20.0
1/2	25	45.0

Gas Properties (Table 3-2). SF is a colorless gas that has a density 3.5 times that of air. At working concentrations, SF has no odor. At very high concentrations, SF has a distinct sulfurous odor—a serious warning that a potentially dangerous exposure is occurring! SF is a non-flammable gas, is only very slightly soluble in water (750 ppm max.), and is essentially nonreactive to most materials.

Diffusion is the dispersal of gas molecules in a defined space and is usually defined in terms of rate. Desorption, often called “degassing,” is the release of gas molecules from a material or surface to which the gas has sorbed or attached. Desorption is the opposite of adsorption. Adsorption is the affinity or “stickiness” of gas molecules on a given material. The diffusion and desorption characteristics of SF are very important with relation to structural fumigation. Because of its high vapor pressure (low boiling point), SF diffuses very quickly. Rapid diffusion aids the movement of SF in large open areas, building voids, and tiny cracks, crevices, insect galleries, and kick-out holes that connect ambient air to pest harborages. On the other hand, weak adsorption followed by rapid desorption during SF aeration ensures that residual amounts of fumigant are both miniscule and short lived after aeration. Both the high diffusion and desorption rates of SF work in tandem to allow the gas to aerate rapidly from structures.

Toxicity. Sulfuryl fluoride controls numerous structural pests (Chapter 2). At relatively low dosages, SF is not as toxic to insect eggs as it is to larvae, pupae, and adult stages. The general rule is that the more active the target pest, the lower the dosage needed to control it. For insects, the warmer the temperature, the lower the SF dosage. The Vikane® label allows for a wide range of dosages from ½ to 10 times the drywood termite rate to compensate for the reduced susceptibility of different stages and species of pests. To ensure that sufficient SF is released to control the intended target pest without overdosing the structure, the Vikane® label requires correct pest identification.

The CT Rule and Half Loss Time. At a given temperature, the toxicity of SF, or any other fumigant, is determined by two factors: 1) fumigant concentration (C), expressed in ounces/Mcf, and 2) exposure time (T), expressed in hours. The product of these factors (C x T), or the “CT product” is the effective dosage and is expressed in ounce-hours/Mcf or simply “ounce hours” (OH). The standard Vikane® dosage is based on the drywood termite rate or “1X” rate. Dosages for other target

pests are calculated as a multiple of this rate. As the temperature increases, the dosage or OH requirement for insects decreases.

Equilibrium time can be estimated or can be determined exactly by measuring the gas concentration at two independent locations within the structure (one reading sampled near the release site and a second from a remote site). When the concentration at these locations is the same, the fumigant is said to be in equilibrium or is “equally distributed”.

Exposure time, T, begins at fumigant equilibrium. Fumigant concentration (C), however, changes over the course of the fumigation. Because no seal is perfect, SF concentration will decrease. This concentration decrease can be accurately measured by monitoring the concentration during the fumigation. It can also be estimated based on the condition of the ground seal, tarp condition, underseal (soil type or slab), volume, and wind speed. The measure of gas confinement is expressed as the amount of time for gas concentration to decrease by half or its “half-loss time” (HLT). To *estimate* HLT, Dow AgroSciences has developed the Fumiguide® B slide rule. To obtain an *actual* measure of HLT, the Fumiguide® electronic calculator and the Fumiguide® Y calculator can be used to calculate HLTs based on Fumiscope® measurements taken at two or more timed intervals during the fumigation period.

When a fumigant leaks from a confined space, it does not do so in a proportional or linear manner (Fig. 3-2). When half of the fumigant has leaked out in a given time, then after the same time period, only ¼ of the original amount of fumigant leaves, then ⅛ the original amount, and so on. Half-loss decay calculations are complex and require the use of the Fumiguide® electronic or Fumiguide® Y calculator to calculate HLTs.

Concentration equivalents. Although SF is typically measured in ounces applied to each Mcf of the volume to be fumigated, it is also useful to know these concentrations in parts per million or ppm. At room temperature, 1oz/Mcf equals 239 parts per million. Therefore, a concentration of 8 oz/Mcf equals 239 x 8 or 1,912 parts SF in 998,088 parts air or about 0.2% of the airspace volume. The most important measurement in ppm for a fumigator to know is that the *maximum* reentry concentration for SF is 5 ppm. When SF concentrations are 5 ppm or less, continuous human exposure is deemed safe.

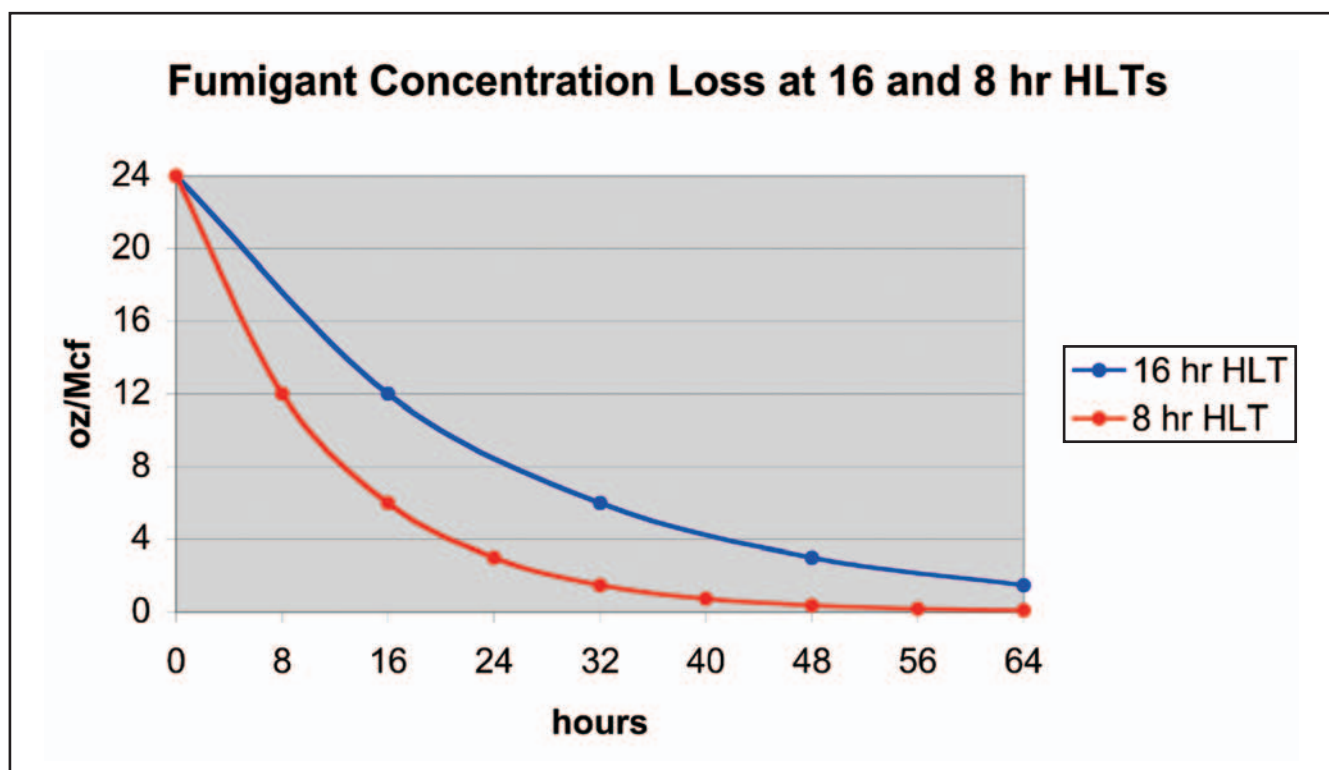


Figure 3-2. Fumigant concentration decline curve at two half-loss times, 8 and 16 hours.

Precautionary Statements

SF is a hazard to humans and animals due to its inhalation toxicity. This makes SF a Category I (Highly Toxic) pesticide requiring the use of “DANGER (PELIGRO)” and “POISON” warning words and the Skull & Crossbones signage symbol. The following warning and first aid statements are taken from the Vikane® label and are very important to remember in order to avoid an accident or correctly respond to one:

- **Extremely Hazardous Liquid and Vapor Under Pressure**
- **Inhalation of Vapors May Be Fatal**
- **Liquid May Cause Freeze Burns of Exposed Skin**
- **Do not get into eyes, on skin, or on clothing**
- **Vikane® gas fumigant is odorless and tasteless**
- **Exposure to toxic levels may occur without warning or detection by the user**

First Aid – See Chapter 7.

In humans and other vertebrates, the route of entry is by inhalation as it does not penetrate the skin.

Chapter 4

Fumigation Vehicle and Transport Requirements

Some fumigation companies prefer two different vehicles in their fumigation fleet for moving personnel and equipment to the fumigation site. A durable, high-payload equipment truck is used to hold heavy supplies like tarpaulins, sand snakes, clamps, shovels, etc. and should have enough seating for the tent crew (Fig. 4-1). A second hazardous materials (hazmat)-approved “shooting” truck is used to hold application, monitoring, and clearance equipment including SF cylinders, chloropicrin, weighing apparatus, fans, tubing, Fumiscopes®, clearance detectors such as the Interscan, SCBAs, etc., and seating for the certified operator, SPID, and/or trained assistant (Fig. 4-2). Some fumigation companies transport sealing and shooting equipment in a single, hazmat-approved, vehicle (Fig. 4-3). If the company operates a retail business, a third vehicle, usually a light truck can be used to conduct inspections or transport additional crew to the job site. The inspector/salesperson typically carries only inspection equipment (flashlight, wood probe), measuring equipment, contractual paperwork, customer instructions, and sales brochures.

Equipment vehicle layout:

- Ladder racks and ladders with nonslip bases
- Tarpaulin compartment
- Snake/sand compartment

- Shovel, rake, and hoe storage
- Jug for drinking water or electrolyte drinks

Shooting vehicle inventory:

- DOT-required placarding for transport of SF and chloropicrin
- DOT hazmat registration number (both sides of vehicle)
- Nondriving compartment storage with fasteners for SF cylinders
- Nondriving compartment storage for chloropicrin in DOT-approved box
- Fire extinguisher
- Monitoring/clearance/SCBA storage
- Eye protection (face shield or goggles)
- First aid kit
- Eye wash kit
- Reflective roadside warning triangles when vehicle is disabled
- Flashlight
- Toolbox for secondary locks, cylinder wrenches, screwdriver
- Labels and MSDSs for all hazardous materials on board
- Shipping papers
- Driver medical certificate



Figure 4-1. Equipment truck loaded with sand snakes, tarps and sealing hardware. Note: ladder rack that can also be used for easy roof access.



Figure 4-2. “Shooting” vehicles. Enclosed storage compartment (top). Open-air storage compartment and placarding (bottom). Note that driving compartments must be separated from SF storage. Note: Incorrect placard holder position. Holders should be turned and remounted by 90 degrees (bottom right).



Figure 4-3. Combination vehicle for hauling both sealing and shooting equipment. Photos: M. Weinberg.

Commercial Driver License

The Florida Department of Highway Safety and Motor Vehicles (FDHSMV) requires a class “C” commercial driver’s license (CDL) for the operation of any size vehicle when hazardous materials are carried in placardable amounts. An “H” CDL endorsement is also required of the driver when transporting hazardous materials

(hazmat). If not transporting hazmat, a class “B” CDL is required if the vehicle’s declared weight or GVWR is 26,001 pounds or more. Specific regulations governing the issuance of a CDL can be obtained from any county office of the FDHSMV or at:

<http://www.hsmv.state.fl.us/handbooks/Commercial/>

FDHSMV administers CDL knowledge and skill tests. The CDL knowledge tests include the General Knowledge Test and the Hazardous Materials Test. A score of at least 80% is required to pass. There is no limit on the number of times an applicant may take the written tests. Three types of CDL skill tests are also required: the pretrip inspection test, the basic control skill test, and the road test. The applicant must take these tests in a vehicle “representative” of those that may be driven with the class license being sought.

To obtain a CDL in Florida the applicant must:

- be a resident of Florida;
- be at least 18 years old to drive intrastate (within Florida) and 21 years to drive interstate (between Florida and any or all other states);
- surrender any and all driver licenses issued by Florida or any other state;
- not be under suspension, revocation, cancellation or disqualification in Florida or any other state;
- submit a valid medical report or card;
- provide proof of your social security number such as the social security card itself or your W-2 form (photocopies are not acceptable);
- pass all required tests and pay the proper license fee.

You can be disqualified and lose your CDL for certain traffic convictions if committed while operating a commercial motor vehicle. If convicted of two serious traffic violations within three years, you will lose your license for 60 days. A third conviction within three years results in a 120-day disqualification. A driver will be disqualified for one year for a first time conviction of the following offenses while operating a commercial motor vehicle: driving with an alcohol concentration of 0.04 percent or more; leaving the scene of an accident; using a commercial motor vehicle in the commission of a felony; or refusing to take a blood alcohol test. When operating a motor vehicle in Florida, consent to alcohol testing is given by the driver.

If convicted of any of the above violations while transporting placarded hazardous materials, the disqualification time is increased to three years. If any level of alcohol is detected, law enforcement officers can place a commercial driver out-of-service for a period of 24 hours.

Transportation of Hazardous Materials

This section is a general overview of rules and regulations regarding transportation of hazardous materials (hazmat) as it relates to structural fumigation. Specific laws and regulations governing the transportation of hazardous materials can be obtained from the Florida Department of Transportation, 605 Suwannee Street,

Tallahassee, Florida, 32399-0450, their Web site at <http://www.dot.state.fl.us/>, or by calling (850) 414-4100.

Hazardous material is any substance that has been determined to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce. As part of its overall commercial vehicle safety mission, the Florida Department of Transportation Office of Motor Carrier Compliance (OMCC) is responsible for enforcing the federal Department of Transportation (DOT) regulations governing the transportation of hazardous materials on the highways.

Sulfuryl fluoride, chloropicrin, and other fumigants are designated as hazardous materials. Therefore, the transportation of these substances is regulated in Florida by the OMCC. By regulation, SF cylinders must be transported upright and secured to vehicle using chains, brackets, or other hardware. Valve covers and bonnets must also be secured during transport (Figs. 4-4, 4-5). Chloropicrin bottles must remain in their DOT-approved container, which also must be secured to the vehicle.

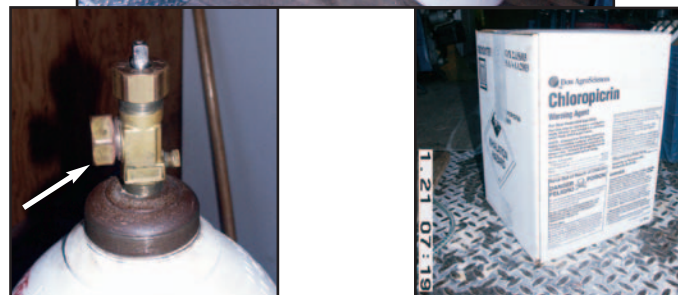


Figure 4-4. Interior transport of sulfuryl fluoride and chloropicrin (top). SF cylinders are upright, secured with bonnets (black arrow) and valve covers (bottom left, white arrow) attached. Chloropicrin bottles (see Fig. 7-4), inside their DOT-approved spill-resistant containers (bottom right) are secured in a rigid frame. Notice that chain (top photo) can abrade the paper label.



Figure 4-5. Exterior transport of sulfuryl fluoride. Vikane® cylinders must be upright, rigidly secured and with protective bonnets and valve covers attached. Note that the bottom bracket is missing and should be used.

Commercial Vehicle Law Enforcement

All OMCC law enforcement personnel receive training in enforcing the hazardous materials transportation regulations. As part of their routine commercial vehicle safety enforcement activities, they can inspect vehicles transporting these materials for compliance with the regulations, such as proper placarding and shipping papers. Additionally, a hazardous materials enforcement specialist is assigned in each OMCC field office.

The specialist's primary duties are to enforce the hazardous materials regulations and to assist other department personnel, as well as the industry, when questions arise regarding the application of the regulations. Enforcement personnel may also be called upon in the aftermath of a hazardous materials transportation incident to assist in determining whether violations of the regulations may have contributed to the causes of the incident.

By law, records, equipment, packaging, and containers under the control of a motor carrier, insofar as they affect safety in transportation of hazardous materials by motor vehicle, must be made available for examination and inspection by a duly authorized representative of the OMCC.

A person who knowingly violates a requirement of the Federal hazardous material transportation law is liable for a civil penalty of not more than \$27,500 and not less than \$250 for each violation. When the violation

is a continuing one, each day of the violation constitutes a separate offense.

Shipping Papers

Each person who offers a hazardous material for transportation shall describe the hazardous material on the shipping paper. A carrier may not transport a hazardous material unless it is accompanied by a shipping paper prepared in accordance with state and federal law. The shipping description of sulfuryl fluoride and chloropicrin on the shipping paper must include the following:

Proper shipping name	Sulfuryl fluoride	Chloropicrin
Hazard class or division	2.3	6.1
Identification number	UN2191	UN1580
Packing group	not assigned	I

For sulfuryl fluoride, the total quantity must be given with the unit of measure, e.g., 125 lbs. It is also a good idea to provide the amount of chloropicrin being shipped (i.e., one 16-ounce bottle).

Labels and MSDSs must be in the vehicle for each hazmat (fumigant and chloropicrin) transported.

Placarding

Each vehicle containing any quantity of a hazardous material or empty containers thereof must be placarded on each side and each end with the specific placard(s) identifying the hazardous materials (Fig. 4-6). A placard may be made of any material capable of withstanding, without deterioration or a substantial reduction in effectiveness, a 30-day exposure to open weather conditions. Each placard must measure at least 10.8 inches on each side and must have a solid line inner border approximately 0.5 inches from each edge. The hazard class text and division number must be shown in numerals and letters measuring at least 1.6 inches in height. Placards must be displayed in a "diamond-on-point" orientation.

Vehicles transporting hazmat must also have their DOT registration numbers displayed on both sides of the vehicle. Lettering must be at least two inches high displayed in a color that contrasts with that of the vehicle (Fig. 4-7).



Figure 4-6. The INHALATION HAZARD 2 (sulfuryl fluoride) placard (left) and the INHALATION HAZARD 6 (chloropicrin) placard must be in black and white as shown (right).



Figure 4-7. DOT registration number must be displayed on each side of hazmat vehicle.

Safety Training

Each hazmat employee shall receive safety training concerning:

- (1) Emergency response information including, emergency response telephone number and company information contact (Fig. 4-8).
- (2) Measures to protect the employee from the hazards associated with hazardous materials to

which they may be exposed in the work place, including specific measures the hazmat employer has implemented to protect employees from exposure; and

- (3) Methods and procedures for avoiding accidents, such as the proper procedures for handling packages containing hazardous materials.

EMERGENCY RESPONSE PROCEDURE
<p>IN THE EVENT OF AN ACCIDENT, SPILL, OR LEAK OF HAZARDOUS MATERIALS, <u>COMPANY NAME</u> WILL IMPLEMENT THE FOLLOWING RESPONSE PLAN:</p> <ul style="list-style-type: none"> ◆ Remove all persons from the spill or leak area ◆ Attend to any urgent medical needs ◆ If possible, contain spills or stop further leakage making sure to wear all necessary protective equipment (e.g. SCBA) ◆ Notify proper authorities and <u>company name</u> home office <ol style="list-style-type: none"> 1) Call 911 2) Call home office 3) Relay all details of incident including: <ul style="list-style-type: none"> - Personal injuries - Amount and type of hazmat spilled - Exact location or address - Description of all safety, first aid, practical treatment or containment procedures that have been made thus far - What other authorities (if any) have been notified

Figure 4-8. Example of an Emergency Response Plan must be carried in the hazmat vehicle at all times.

Driver Training

All placarded vehicles must stop at all railroad crossings. Each company transporting hazmat must have a random drug testing program which can be implemented in-house using test cups offered by drug testing laboratories or by sending employees to a drug test facility.

Hazmat driver training shall include the following subjects:

- (1) Pretrip safety inspection
- (2) Use of vehicle controls and equipment, including operation of emergency equipment
- (3) Operation of vehicle, including turning, backing, braking, parking, handling, and vehicle characteristics including those that affect vehicle stability, such as effects of braking and curves, effects of speed on vehicle control, dangers associated with maneuvering through curves, dangers associated with weather or road conditions that a driver may experience (e.g., thunderstorms or high winds), and high center of gravity
- (4) Procedures for maneuvering tunnels, bridges, and railroad crossings
- (5) Requirements pertaining to attendance of vehicles, parking, smoking, routing, and incident reporting
- (6) Loading and unloading of materials, including: compatibility and segregation of cargo in a mixed load, package handling methods, and load securement

Loading and Securing Hazardous Materials

The following assurances must be made when loading and unloading hazmat:

- (1) No hazardous material shall be loaded into or on, or unloaded from, any motor vehicle unless the handbrake is securely set and all other reasonable precautions are taken to prevent motion of the motor vehicle during such loading or unloading process.
- (2) No tools which are likely to damage the effectiveness of the closure of any package or other container, or likely to adversely affect such package or container, shall be used for the loading or unloading.
- (3) Any cylinder, or other packaging not permanently attached to a motor vehicle and containing any Class 2 (gases), Class 3 (flammable liquid), Division 6.1 (poisonous), Division 6.2 (infectious substance), Class 7 (radioactive), or Class 8 (corrosive) material must be secured against movement within the vehicle on which it is being transported, under conditions normally incident to transportation.

Incident Reporting

At the earliest practicable moment, each carrier who transports hazardous materials shall give notice after each incident that occurs during the course of transportation (including loading, unloading and temporary storage) in which:

As a direct result of hazardous materials: a person is killed; or a person receives injuries requiring his or her hospitalization; or the estimated carrier or other property damage exceeds \$50,000; or an evacuation of the general public occurs lasting one or more hours; or one or more major transportation arteries or facilities are closed or shut down for one hour or more; or the operational flight pattern or routine of an aircraft is altered or a situation exists of such a nature (e.g., a continuing danger to life exists at the scene of the incident) that, in the judgment of the carrier, it should be reported to the U.S. Department of Transportation even though it does not meet the above criteria.

Notice shall be given to the National Response Center by telephone (toll-free) at 800-424-8802. Each notice must include the following information:

- Name of reporter.
- Name and address of carrier represented by reporter.
- Phone number where reporter can be contacted.
- Date, time, and location of incident.
- The extent of injuries, if any.
- Classification, name, and quantity of hazardous materials involved, if such information is available.
- Type of incident and nature of hazardous material involvement and whether a continuing danger to life exists at the scene.

The U.S. Environmental Protection Agency requires persons in charge of facilities (including transport vehicles) to report any release of a hazardous substance in a quantity equal to or greater than its reportable quantity, as soon as that person has knowledge of the release, to the U.S. Coast Guard National Response Center at (toll free) 800-424-8802 or (toll) 202-267-2675.

Each carrier making a report under this section shall also make a report in writing, in duplicate, on DOT Form F 5800.1 (Rev. 6/89) to the Department within 30 days of the date of discovery, each incident that occurs during the course of transportation (including loading, unloading, and temporary storage) in which there has been an unintentional release of hazardous materials

from a package (including a tank). This report should include:

- (1) A copy of the hazardous waste manifest for the waste must be attached to the report.
- (2) An estimate of the quantity of the waste removed from the scene, the name and address of the facility to which it was taken, and the manner of disposition of any removed waste must be entered in Section IX of the report form (Form F 5800.1) (Rev. 6/89). Each carrier making a report under this section shall send the report to:

Information Systems Manager

DHM-63, Research and Special Programs
Administration

Department of Transportation, Washington, DC
20590-0001.

Note: Because SF and chloropicrin are “self-cleaning” and typically do not leave waste, the hazardous waste report should reflect these facts.

Job-Site Incidents

The above response actions are for incidents that occur on public roads. For incidents at the company or job site, the DOT is not involved. For company or job site incidents, local law enforcement and, if needed, medical response service should be notified by calling 911. State regulations require that the DOT be notified of any accidental human poisoning or death connected with pest control work performed on a job within 24 hours after the licensee has knowledge of the poisoning or death.

USA Patriot Act Requirements for CDL Hazmat Drivers

The Transportation Security Administration (TSA), Department of Homeland Security (DHS) has set regulations that the Florida Department of Highway Safety and Motor Vehicles and hazmat-endorsed CDL holders must follow to assess security threat standards for commercial drivers authorized to transport hazardous materials. TSA will require that fingerprint-based background checks must begin in all States on January 31, 2005. A State may not issue a license to operate a commercial motor vehicle transporting a hazardous

material unless the Secretary of Transportation has first determined that the individual does not pose a security risk.

The Attorney General, upon the request of a State in connection with issuance of a hazardous materials endorsement, will carry out a background records check of the individual applying for the hazmat endorsement and to notify the Secretary of the results. The Secretary then determines whether the individual poses a security risk warranting denial of the endorsement. The background records check includes (1) a check of the relevant criminal history databases; (2) in the case of an alien, a check of the relevant databases to determine the status of the alien under U.S. immigration laws; and (3) as appropriate, a check of the relevant international databases through Interpol-U.S. National Central Bureau or other means.

Drivers qualified to hold hazmat-endorsed CDLs in Florida must meet these standards:

- US citizen or lawful permanent resident.
- Not convicted in the past seven years of the following felony offenses including: violent crimes, extortion, robbery, bribery, smuggling, immigration violations, RICO (Racketeer Influenced and Corrupt Organizations Act) violations, controlled substance violations, dishonesty, fraud or misrepresentation, weapons violations, etc.
- Not released from prison in the past five years or not wanted or under indictment for committing felonies listed above.
- Not adjudicated mentally incompetent or committed to a mental institution.
- Not assessed by TSA as posing a threat of terrorism, a threat to national security, or to transportation security.

Drivers are required to self-report and surrender their hazmat endorsements if and when any disqualifying condition(s) occur.

The new TSA application and renewal process, including fingerprinting, will be offered at selected Florida Driver License Offices.

Chapter 5

Inspection and Measurement

The initial inspection of an infested structure is the foundation for the whole fumigation process. It will dictate the timing, resources, and special considerations needed to conduct a successful fumigation. This phase includes the identification of the target pest (Chapter 2), nature and location of the infestation, volume to be fumigated, special building details and equipment considerations, customer consultation, and cost estimate or contract execution.

When considering any structure as a candidate for fumigation, the inspector must determine that the structure offers sufficient distance along the entire length of the passageway between it and adjacent occupied structure(s) to permit comfortable, free, and reasonable passage for the crew to work; and for the CO or SPID to make tests along the passageway for escaping gas with gas-detecting equipment or to otherwise access the area.

If the proximity of a neighboring building(s) does not allow passage or there is uncertainty about the presence of common routes of gas exchange between structures, the fumigation cannot be performed unless the adjacent structure(s) is vacated [5E-14.111(5)].

Inspection equipment:

- Flashlight
- Ladder
- Screwdriver or other probe
- Hand lens
- Gloves*
- Dust mask*
- Camera*

Fumigation preparation equipment:

- Measuring wheel*
- Measuring tape
- Measuring stick*
- Laser distance measuring device*
- Inspection graph
- Pocket calculator
- Sales literature
- Vikane® Gas Fumigant Fact Sheet
- Customer prefumigation preparation instructions
- Paperwork: estimates, contracts (including waivers, exclusions), guarantees

*optional

Sometimes a property owner may request a Wood-Destroying Organism (WDO) inspection report (Florida

Form 13645). A written WDO report is usually conducted for a real estate transaction and a fee is charged for the inspection and report. A WDO report is not required for the fumigation inspection but must be completed when a customer requests a written report [482.226].

Responsibilities of the Salesperson

- Thorough inspection inside and out
- Accurate measurements
- Notation of special conditions, structural elements
- Convey the responsibilities and duties of the customer
- Provide the “Fact Sheet for Vikane® Gas Fumigant” (Attachment 5-1, 5-2) to the customer. In the case of multiunit structures, provide a fact sheet to one adult in each unit
- Complete proper treatment contract with property owner

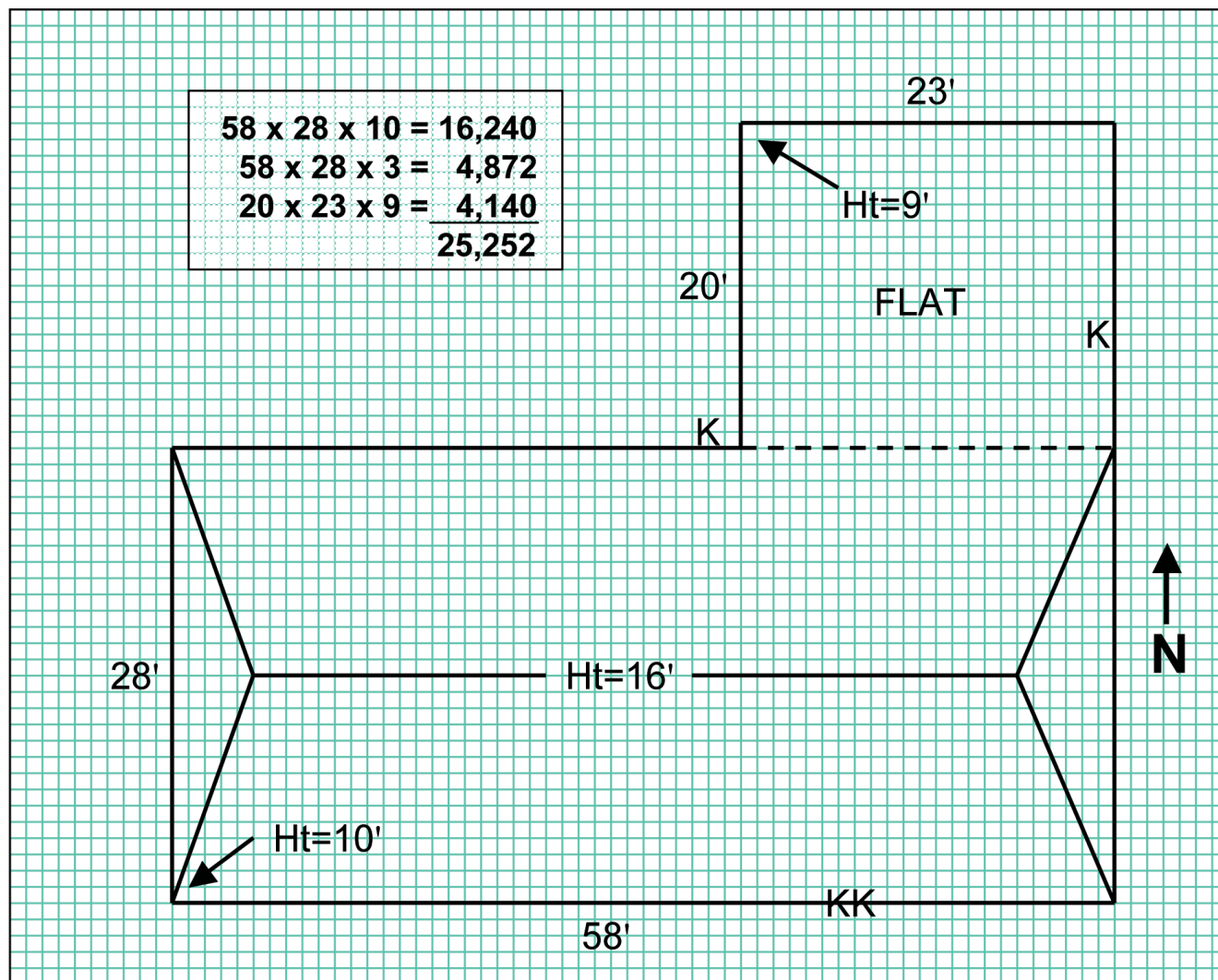
Structure Types. Sulfuryl fluoride can be used to fumigate dwellings (including mobile homes, multiunit and connected structures), buildings, construction materials, furnishings (household effects), shipping containers, and vehicles including automobiles, buses, surface ships, rail cars, and recreational vehicles (but not including aircraft).

Inspection. Identification of the pest and location of infestation should be documented on a schematic graph of the structure (Fig. 5-1A). The graph should also be used for recording measurements needed to calculate the volume of the structure. If accessibility does not allow inspection in an area where an infestation is likely, note the location of possible hidden damage on the graph. Figure 5-1B is a blank inspection graph that can be used for training purposes.

Measurement. A measuring wheel (Fig. 5-2) is a convenient and accurate tool for measuring the horizontal dimensions of a structure. For large, flat-roofed buildings, wheel measurements can be used on the roof. Vertical dimensions can be taken from the ground with a stiff measuring tape or a calibrated measuring stick. For tall structures, height can be best measured by dropping a measuring tape from the roof. Always measure the perimeter of the structure based on where the tarpaulin will fall using the roof overhang as a guide.

FUMIGATION INSPECTION GRAPH

Owner's name _____ Occupant _____
 Address _____ City _____ Zip _____
 Home phone _____ Business phone _____ Inspected by _____



ACTIVITY

☒ drywood termites K
☐ powderpost beetles PB
☐ old house borer OHB
☐ subterranean termites X
☐ other: _____

DAMAGE

☐ possible hidden PHD
☐ drywood termite KD
☐ powderpost beetle PBD
☐ fungus F
☐ old house borer OHBD
☐ subterranean termite X

SCALE

☒ 1:1
☐ 2:1
☐ _____

VOLUME

25,252 Mcf

CONSTRUCTION: frame block mobile home other _____ two-story or multi _____

FOUNDATION: slab crawl basement

ROOF: shingle tile slate cedar shake gravel other _____

EXTENUATING CONDITION(S): awning screen enclosure attached fence steep roof deck landscaping other: solar heater

Figure 5-1A. Example of a measurement and inspection graph. Note: This is not a WDO inspection form.

FUMIGATION INSPECTION GRAPH

Owner's name _____ Occupant _____
 Address _____ City _____ Zip _____
 Home phone _____ Business phone _____ Inspected by _____

ACTIVITY

☐ drywood termites K
☐ powderpost beetles PB
☐ old house borer OHB
☐ subterranean termites X
☐ other: _____

DAMAGE

☐ possible hidden PHD
☐ drywood termite KD
☐ powderpost beetle PBD
☐ fungus F
☐ old house borer OHBD
☐ subterranean termite X

SCALE

☐ 1:1
☐ 2:1
☐ _____

VOLUME

_____ Mcf

CONSTRUCTION: frame block mobile home other _____ two-story or multi _____

FOUNDATION: slab crawl basement

ROOF: shingle tile slate cedar shake gravel other _____

EXTENUATING CONDITION(S): awning screen enclosure attached fence steep roof deck landscaping other: solar heater

Figure 5-1B. This is a practice graph you can copy. Note: This is not a WDO inspection form, Florida Form 13645. See Glossary.



Figure 5-2. A measuring wheel allows for quick and accurate measurements on the ground or a flat roof. Measure the perimeter of a structure from where the tarp will drop.

Special Elements. Include special notations on graph for the following structural elements that may affect the structure’s volume or its sealing and preparation procedures:

- Flat roof
- Solar panel
- Basement
- Screened attached pool/patio enclosure
- Attached deck
- Foundation type: slab, crawlspace, or combination
- Electrical, telephone lines
- Special roof: steep, high, or parapet
- Chimney, satellite dish, weather vane
- Gas shut-off valve from street service or storage tank
- “Dry” plumbing drain(s) from structure to seawall or concrete walls

Customer Responsibilities. The customer must understand that some preparation is his/her responsibility and should be given written instructions indicating their requirements (see Chapter 6).

Contractual Agreement. Before a fumigation is conducted or payment received, a written contract must be approved by the customer and cosigned by the licensee or his/her representative. A second contract is not allowed for the same target pest without a signed, written consent letter by the customer. The following information must be included in the contract [5E-14.105]:

- Name, address, and signature of the owner/agent of building to be fumigated
- Address of building(s) to be fumigated
- Name, address, and signature of the licensee or his/her agent
- Date of completed contract
- Coverage dates and renewal period
- Name of target pest (e.g., drywood termite, wood-boring beetle, etc.)
- Time intervals for reinspection, if any
- Price for fumigation and renewals
- Conditions for retreatment
- If fumigation is guaranteed, warrantied, or bonded, specific wording is required
- Inspection reports, if any, must be retained by the licensee for 3 years

Notification Requirement. An inspector with the Bureau of Entomology and Pest Control having jurisdiction where the fumigation will take place, must be notified at least 24 hours before the pending fumigation [482.051 (4)]. Notification can be conducted by facsimile or e-mail. In emergencies when advance notification is not possible, the inspector can be notified by telephone—with written notification to follow. Any changes of required information after notification has been submitted must be resubmitted to the inspector. Notifications are required to include the following information [5E-14.110 (1-5)]:

- Fumigation company name and address
- Fumigant to be used
- Name and emergency phone number of CO or SPID in charge
- Address of structure to be fumigated
- Date and approximate time of fumigant release

Volume Calculation. Structural volume is the product of a building’s length (L), width (W), and average height (H). For a square or rectangular building, the volume is simply $L \times W \times H$, usually expressed in increments of a thousand cubic feet (Mcf). Therefore, the volume of a rectangular, flat-roofed building measuring 75 ft long by 40 ft wide by 12 ft high is $75 \text{ ft} \times 40 \text{ ft} \times 12 \text{ ft} = 36,000 \text{ ft}^3$ or 36 Mcf. For a structure with a typical gabled roof, the average height equals the height to the roofline plus one-half the height from the roofline to the peak (Fig. 5-3).

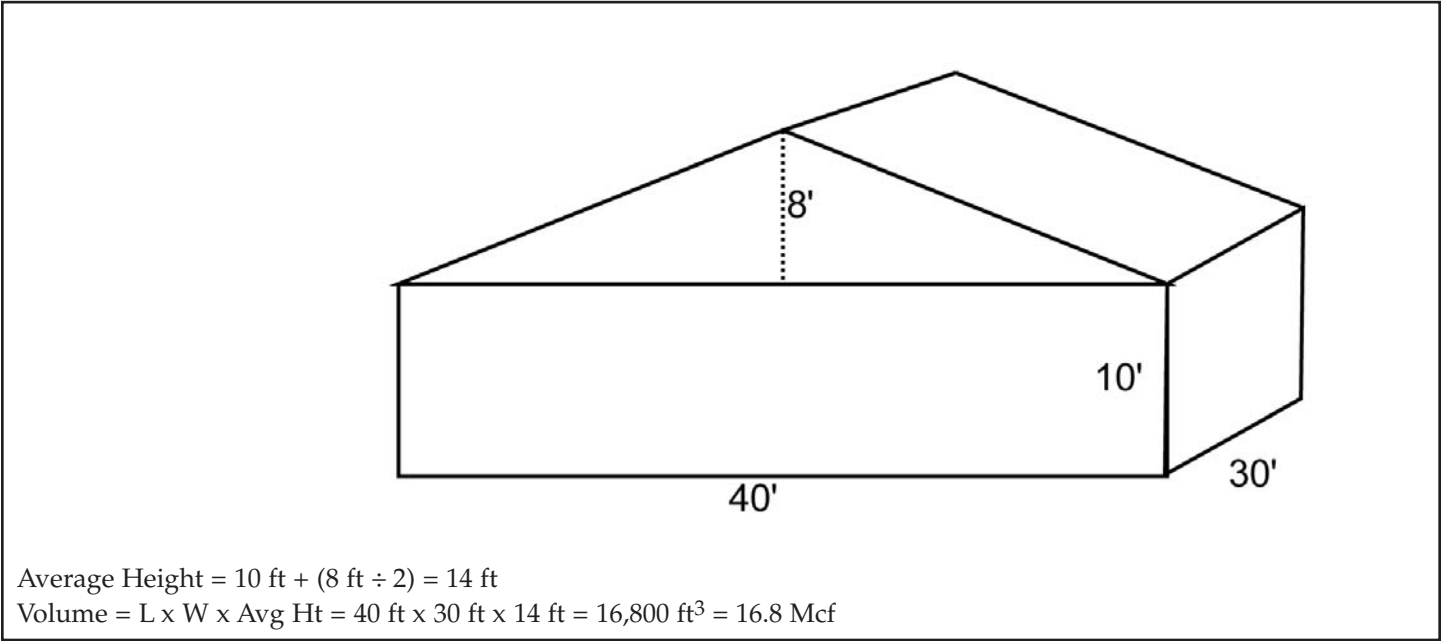


Figure 5-3. Most houses in Florida have some variation of a hip or gable roof. The volume below the roofline should be calculated separately from the volume above. The roof volume in these structures is calculated as the area covered by the roof multiplied by half the height: roof line to peak.

For more complex structures dividing the structure into easy-to-calculate sections and then adding the volume of each section together should measure total volume (Fig. 5-4).

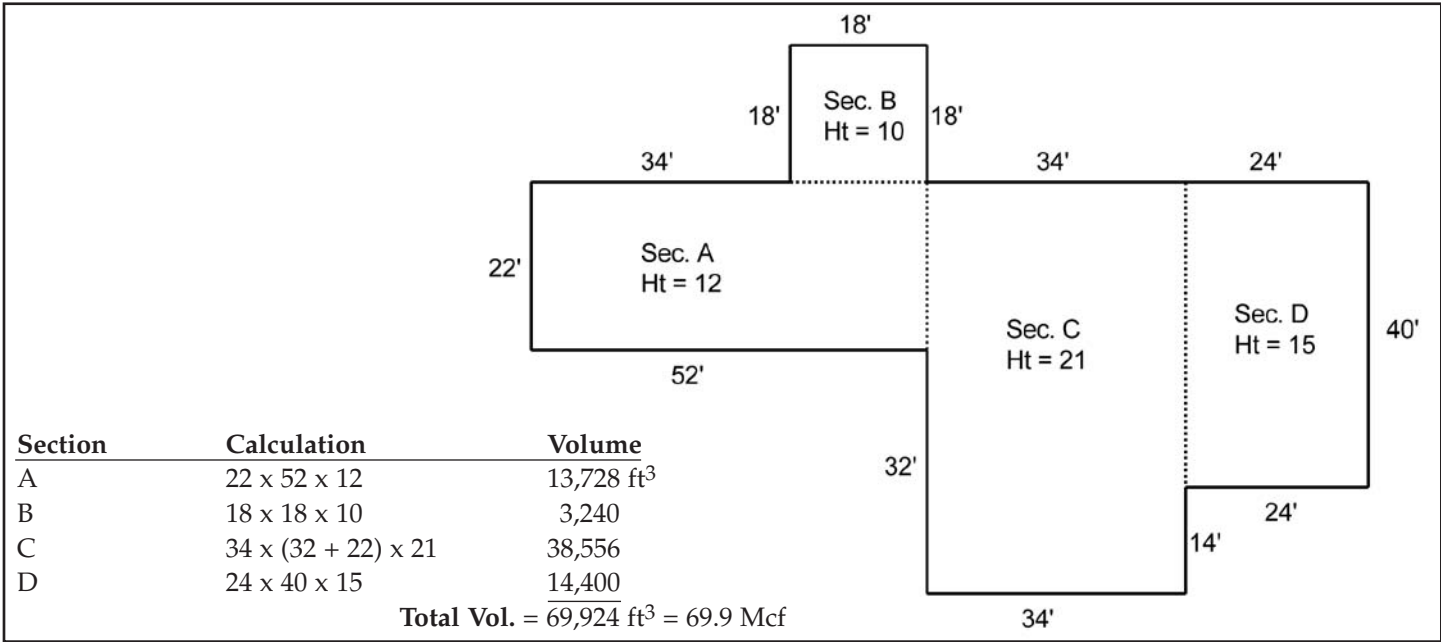


Figure 5-4. Complex structure should be divided into easy-to-measure sections. Volumes of each section can then be added together to give the total volume.

Specialty Products Product Bulletin



Dow AgroSciences LLC

9330 Zionsville Road

Indianapolis, IN 46268-1054

Fact Sheet for Vikane Gas Fumigant (Sulfuryl Fluoride)

In the interest of Dow AgroSciences' commitment to product stewardship, this fact sheet is intended to provide basic information about the product and how it is used. If you have specific questions about your fumigation, refer to documents provided by the fumigator or call the fumigator listed on the warning signs posted on your structure. If you have questions about Vikane® gas fumigant (the fumigant used) or the procedures described, call the Dow AgroSciences Customer Information Center at 1-800-352-6776.

WHY BUILDINGS ARE FUMIGATED

Insects that feed or tunnel into wood can seriously damage houses, apartments, and other dwellings or structures. Each year termites or other wood destroying insects damage approximately 2 million homes. Depending on the extent or location of the infestation, fumigation is the only total control method proven to eliminate certain infestations of wood destroying insects.

HOW BUILDINGS ARE FUMIGATED

Because Vikane is a gas, prior to fumigation, the structure is completely sealed. This serves to contain Vikane in the building so it can penetrate wood thoroughly and eliminate the pests. Depending on the construction of the building, the doors and windows may be sealed with tape and a plastic sheet, or the structure may be covered with a tarp. The building will remain sealed for 2-72 hours depending on the specifics of the job. Warning signs are posted around the building notifying people to keep out.

After the tarp or tape is removed, a professional fumigator will aerate the structure by opening the doors and windows. Fans may also be used to clear out the building. Once the dwelling has been thoroughly aerated, the fumigator is required to measure the level of any fumigant remaining in the living space to ensure it is below the EPA approved concentration for reentry by the occupants. Extremely low levels of fumigant can remain for a short period of time in dead air spaces between walls and inside cabinets as well as porous materials such as furniture. The small amount of fumigant in these areas will continue to dissipate for a few hours after the fumigation but at levels well below the established safe reentry concentration. Your building should not be cleared for reoccupancy until it is safe to enter. The fumigator will post a notice on your building indicating the day and time for reentry. Structures can be occupied only when the concentration is 5 parts per million or less (this represents a margin of safety - laboratory animals have been exposed to 100 parts per million for 2 weeks with no adverse effects.) Because Vikane is a true gas and not a vapor, aeration is rapid. Recent studies demonstrated that in most structures levels are less than 1 part per million within 6 hours of clearing and have no detectable levels of Vikane within 24 hours after the start of aeration.

*Trademark of Dow AgroSciences LLC
Vikane is a federally Restricted Use Pesticide.

Sulfuryl fluoride is a colorless, odorless gas, so a warning agent is added to the building that causes watery eyes and a scratchy throat. If you experience these symptoms in a structure that has been recently fumigated, you should leave immediately and call the pest control company to have your building retested.

SULFURYL FLUORIDE (POTENTIAL HEALTH RISKS FROM OVEREXPOSURE)

Sulfuryl fluoride is a gas and can potentially enter your body only through inhalation. Because it is a gas, it does not stay on dry surfaces, therefore, there is no exposure from touching treated surfaces.

Nervous system and respiratory irritation:

Overexposure to high levels of sulfuryl fluoride can result in nose and throat irritation and nausea. At high concentrations (such as those used during the fumigation) it can cause excess fluid in the lungs, sleepiness, pneumonia, and convulsions. These symptoms would be expected to appear within 8 hours after such an exposure. In the unlikely event you experience these symptoms in the building that has been recently fumigated, you should leave immediately. Consult your physician and call the pest control company to have your building retested.

Additional studies:

Sulfuryl fluoride has not been shown to cause birth defects in pregnant animals exposed under experimental conditions. In addition, current studies have demonstrated there are no mutagenic or genotoxic effects caused by exposure to sulfuryl fluoride.

Safety Precautions and Homeowner Preparation

- Discuss the treatment program in advance with your pest control company so you fully understand what will be done and what you need to do.
- Carefully follow the instructions you are given about what items you are to remove from your building.
- Stay out of the treated building until it is cleared for reentry.
- If you are interested or concerned, you should ask your pest control company to show the records of how your building was aerated before it was cleared to reentry.
- You may wish to increase ventilation by opening doors and windows.

If you have specific questions about your fumigation, refer to documents provided by the fumigator or call the fumigator listed on the warning signs posted on your structure. Call the Dow AgroSciences Customer Information Center at 1-800-352-6776 if you need additional information or have questions concerning the product.

**Specialty Products
Product Bulletin**



Dow AgroSciences

9330 Zionsville Road

Indianapolis, IN 46268-1054

Hoja Informativa de Vikane* (Fluoruro de Sulfurilo)

Cumpliendo con el compromiso de Dow AgroSciences en la administración del producto, el propósito de éste boletín es dar información básica acerca del producto y de su uso. Si tiene preguntas específicas acerca de su fumigación, lea los documentos que el fumigador le dió o llame al fumigador en el cartel aviso en su edificio. Si usted tiene preguntas adicionales acerca de Vikane (el fumigante) o de los procedimientos descritos, llame al Servicio Informativo del Consumidor de Dow AgroSciences al 1-800-352-6776.

Por Qué Se Fumigan Los Edificios

Los insectos que se alimentan o hacen túneles en la madera pueden causar daños severos a las casas, departamentos, otras viviendas y estructuras. Cada año las termitas y otros insectos destructivos de la madera, causan daños a más o menos 2 millones de casas. Dependiendo de la extensión y ubicación de la infestación, la fumigación es el único método de control total que se ha comprobado elimina ciertas infestaciones de insectos destructores de la madera.

Cómo Se Fumigan Los Edificios

Debido a que Vikane es un gas, la estructura tiene que sellarse completamente antes de la fumigación. Esto tiene el propósito de contener el Vikane en el edificio para que pueda penetrar eficazmente y eliminar la plaga. Dependiendo de la construcción del edificio, las puertas y ventanas podrían sellarse con cinta adhesiva y membrana de plástico, o la estructura podría cubrirse con una carpa. El edificio permanecerá sellado de 2-72 horas dependiendo en las especificaciones del trabajo. Alrededor del edificio se colocaran señales de advertencia notificando a la gente que se mantenga afuera del edificio.

Después que se quite la carpa o la cinta adhesiva, un fumigador profesional abrirá puertas y ventanas con el objeto de airear la estructura. También se puede utilizar ventiladores para renovar el aire del edificio. Una vez que la residencia se haya aireado completamente, el fumigador tiene que medir el nivel de fumigante que queda en el espacio habitable, para asegurarse que esté bajo la concentración aprobada por EPA para que los ocupantes puedan entrar nuevamente al edificio. Niveles extremadamente bajos del fumigante pueden quedar por un corto tiempo en espacios entre las paredes y en el interior de los armarios, como así también en materiales porosos como el de los muebles. En éstas áreas, pequeñas cantidades de fumigante continuarán disipándose por algunas horas después de la fumigación, pero a niveles más bajos de los establecidos para volver a entrar sin peligro. La entrada a su edificio no puede permitirse hasta que esté libre de peligro. El fumigador colocará avisos en su edificio indicando el día y la hora que puede entrar nuevamente. Las estructuras se pueden ocupar sólo cuando la concentración es de 5ppm o menos (esto representa un margen de seguridad - animales de laboratorio no han presentado efectos adversos después de exponerse a 100 partes por millón durante 2 semanas). Debido a que Vikane es un gas puro y no un vapor, la aireación es rápida. Estudios recientes han demostrado que después de 6 horas del despeje, en la mayoría de las

*Marca Registrada de Dow AgroSciences LLC
Vikane es un Pesticida de Uso Restringido por el Gobierno Federal.

estructuras, los niveles son de menos de 1 parte por millón, y después de 24 horas de haber empezado la aireación no se encuentran niveles detectables de Vikane. El fluoruro de sulfuro es un gas incoloro e inodoro, debido a estas propiedades al usarlo se agrega un agente de advertencia que causa ojos lagrimosos e irritación de la garganta. Si usted siente estos síntomas en una estructura que ha sido fumigada recientemente, abandónela inmediatamente y llame a la compañía de control de plagas para que vuelva a medir los niveles de residuo en el edificio.

FLUORURO DE SULFURO (POSIBILIDAD DE RIESGOS A LA SALUD DEBIDO A UNA EXPOSICION EXCESIVA)

El fluoruro de sulfuro es un gas y puede entrar a su cuerpo potencialmente sólo por inhalación. Por ser un gas, no permanece en superficies secas, por lo tanto, no habrá riesgo de una exposición al tocar las superficies tratadas.

Sistema nervioso e irritación al sistema respiratorio:

Una exposición excesiva a niveles altos de fluoruro de sulfuro pueden provocar irritación de la nariz y garganta, y náuseas. En altas concentraciones (como las que se usan al fumigar) puede causar exceso de líquido en los pulmones, somnolencia, pulmonía, y convulsiones. Estos síntomas podrían aparecer dentro de 8 horas después de haber sido expuesto. En la remota posibilidad de sufrir estos síntomas en un edificio que ha sido fumigado recientemente, usted debe abandonarlo inmediatamente. Consulte con su médico y llame a la compañía de control de plagas para que vuelva a medir los niveles de residuo en el edificio.

Estudios Adicionales:

El fluoruro de sulfuro no ha demostrado causar defectos de nacimiento en animales preñados y expuestos bajo condiciones experimentales. Además, estudios recientes han demostrado que no hay efectos mutagénicos o genotóxicos causados por la exposición a fluoruro de sulfuro.

PRECAUCIONES DE SEGURIDAD Y PREPARATIVOS DE LOS PROPIETARIOS

- Discuta de antemano el programa de tratamiento con su compañía de control de plagas de manera que usted entienda lo que se va a hacer y lo que usted tiene que hacer.
- Siga cuidadosamente las instrucciones que le den acerca de las cosas que usted tiene que sacar de su edificio.
- Permanezca fuera del edificio hasta que se declare libre de peligro para volver a entrar.
- Si usted está interesado o preocupado, puede pedir a su compañía de control de plagas que le muestre el informe de como se hizo la aireación de su edificio para declararlo libre de peligro para volver a entrar.
- Si usted desea, podría aumentar la ventilación abriendo puertas y ventanas.

Si tiene preguntas específicas acerca de su fumigación, lea los documentos que el fumigador le dió o llame al fumigador en el cartel de aviso en su edificio. Llame a Dow AgroSciences, al Servicio Informativo del Consumidor al 1-800-352-6776 si usted necesita información adicional o tiene preguntas acerca del producto.

U01-069-047 (08/01) DAS

Chapter 6

Interior and Exterior Preparation and Sealing

Florida State regulations specify that a structure to be fumigated must be made as gas-tight as is practicable [5E-14.111(7)]. However, it is up to the discretion of the fumigator as to the best method of sealing a structure. This can be done with conventional vinyl-coated tarpaulins, polyethylene or other plastic film, and/or tape. Structures or enclosed spaces that cannot be made reasonably gas-tight by sealing or tenting shall not be fumigated [5E-14.111(7)].

Sealing Materials and Equipment. For the typical tarpaulin fumigation of a house, thousands of pounds of sealing equipment are required. Normally, ladders are used to carry tarpaulins onto the roof. Sand or gravel-filled bags or “snakes” are dragged around the perimeter of the structure with a few taken on the roof when extra weight is needed to secure a tarp from the wind. See Chapter 10 for techniques and equipment used in specialty fumigations such as tape-and-seal, large volume, and steep buildings.

Safety Equipment:

- Safety line*
- Indoor/outdoor warning signs
- Cell phone, walkie-talkie*
- Secondary locks, devices (chains, sticks, etc.)

Sealing Materials:

- Tarps (various sizes available, typically 20'x40' or 40'x60')
- Clamps
- Snakes (sand, water)
- Poly 4-mil*
- Tape (masking and painter's)
- Caulk/foam sealant*
- Sand

Installation Equipment:

- Cranes/lifts/hoists*
- Ladder lift*
- Ladders
- Furring strips*
- Powder-actuated nail gun*
- Spray adhesive*
- Wheelbarrow
- Shovel/rake/hoe/pruning shears

Food and Tarpaulin Protection:

- Tarpaulin patch kit
- Corner/edge protection/aprons*
- Nylofume® bags
- Instructions for Nylofume® bags
- PVC pipe/fittings*

Fumigant Dispersal/Detection Equipment:

- Shooting hose(s)
 - Shooting stand
 - Polyethylene or tarpaulin protective sheet under shooting stand
 - Fans
 - Extension cords
 - Three-to-two-prong outlet adapters
 - Power strips
 - Monitoring lines (use only when monitoring with Fumiscope®)
 - RDA Fumiscope® (placed inside structure)*
 - CP pan with absorbent
- *optional

Multiunit Structures. When fumigating a single or several units, or rooms within or connected to a larger structure (e.g. town houses, apartments, or condominiums), the entire multiunit structure must be vacated before fumigation [5E 14.111(3)(b)]. The CO or SPID must be present and personally make a careful examination of all parts of the structure to be fumigated, including locked rooms, compartments and closets, and of structures or enclosed spaces physically joined to or in contact with the structure to be fumigated to verify that no persons have remained therein.

All units of the entire structure must be prepared as a fumigated structure, and all applicable rules, regulations, and label instructions apply, including occupant notification, structure preparation, posting, securing, and aeration. An adult occupant of each currently occupied unit must be provided with the Fact Sheet for Vikane® Gas Fumigant (see Attachments 5-1, 5-2). Ensure that all exterior entryways and exterior doors of individual units are secured with secondary locks so that only the state-licensed applicator in charge can gain access.

Chloropicrin need only be used in units where Vikane® is introduced. During aeration, check all units within the fumigated structure for concentration of SF with an approved clearance device. If SF concentration

of any nonfumigated units exceeds 5 ppm, use Aeration Procedure 1 or Aeration Procedure 2 (Chapter 9) to aerate the non-fumigated unit(s) based on the initial concentration of the fumigated unit(s).

Connected Structures. When one or more structures in a row of physically joined structures is to be fumigated, at least one additional complete building structure next to and on both sides of the structure to be fumigated must be vacated, provided there are no common drains, air ducts, conduits, attics or other means permitting escape or passage of the fumigant from the structure to be fumigated into the additional vacated building(s). If there are common routes permitting passage of the fumigant into the additional vacated building(s) then one more building must be vacated and so on. If this set of conditions cannot be met, the entire row of structures must be vacated or the fumigation shall not be carried out [5E-14.111(3)(a)].

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 Vikane® gas fumigant is introduced. For reentry, Vikane® concentration levels must be measured in any connected space or structure.

Tarpaulin Maintenance and Repair. If protected from excessive abrasion, most vinyl-coated nylon fabric tarpaulins will last for years. There are no specific recommendations for maintaining tarpaulins and cleaning is generally not required. Field patching of small holes and rips can be accomplished using masking, duct, or vinyl adhesive tapes. Repair of larger tears or holes can

be accomplished with glue or heat activated patch kits (Fig. 6-1). Tarpaulins need replacement when they begin to tear under normal weight and clamping stresses. One should consider that the appearance and condition of tarpaulins is a reflection of the fumigation company.

Interior Preparation. Interior preparation is best completed before the structure is sealed and secured when lighting and access becomes much more restricted. An interior/exterior preparation checklist (Fig. 6-5) should have been provided to the property owner/manager at the time of the sale. However, do not rely on the customer to complete the necessary tasks. It is the responsibility of the fumigator to ensure that all procedures and safety checks are completed. At minimum the occupant/owner checklist should include the following necessary interior preparations:

(1) All people, domestic animals, pets, and desirable growing plants must be removed from the structure before the fumigation begins.

(2) All consumable items must be protected or removed from the structure. Food, feed, drugs (including tobacco products), and medicinals (including those items in refrigerators and freezers) can remain in the structure if they are in plastic, glass, or metal bottles, cans, or jars with the original manufacturer's air-tight seal intact. Food, feed, drugs (including tobacco products), and medicinals (including those items in refrigerators and freezers) not in plastic, glass, or metal bottles, cans, or jars with the original manufacturer's air-tight seal intact, need to be removed from the fumigation site, or double-bagged in Nylofume® bags (Figs. 6-2, 6-3) which are available, with use instructions, from the fumigator (Attachment 6-1).

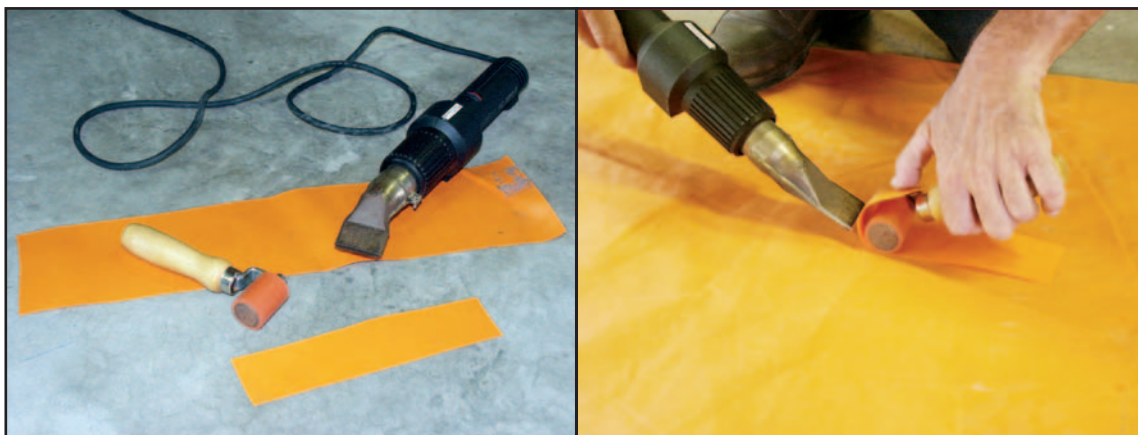


Figure 6-1. A heat patching kit can be used at the company site to repair damaged tarpaulins.
Photos: M. Weinberg.



Figure 6-2. Packaged Nylofume® bags used to protect commodities from sulfuryl fluoride.



Figure 6-3. Foods in a walk-in refrigerator in the process of being protected with Nylofume® bags (left). Unrefrigerated food items on counter are double-bagged and properly sealed using tape or “twist tie” (right).

- (3) Remove all waterproof covers – such as “Can’t Wet” – from all mattresses and pillows, or remove the mattresses and pillows from the structure.
- (4) Shut off automatic switch controls for any and all appliances and lighting systems that will be included in the space to be fumigated.
- (5) Notify fumigator of any known construction elements or connections such as ducting, piping, drainage, or central vacuum system that would allow the fumigant to enter any adjacent structure that is not under fumigation.
- (6) Electricity must be available, as it will be required to run fans during the fumigation process. If power is disconnected, then portable generator(s) must be used to supply needed electricity.

- (7) All cabinets, drawers, closets and interior doors must be opened including any utility or storage sheds that will be part of the fumigated space (Fig. 6-4). Raise blinds, open drapes and attic covers.
- (8) Provide fumigator with keys to the structure and to utility or storage sheds that will be part of the fumigated space. Fumigators must have in their possession any keys or an access device necessary to gain the immediate access to a structure, including secondary locking devices, during the entire time that the structure is under fumigation unless a waiver is issued for specialized structures by FDACS [\[5E-14.108\(5\)\]](#).



Figure 6-4. Cupboard (top and right) and closet doors (left) opened. Note that food in original unopened cans and jars does not need Nylofume® bag protection or removal from structure.

The fumigator must further inspect and prepare the following:

- (1) Ensure that all occupant/owner interior preparation procedures above have been completed.
- (2) Extinguish all flames and heating elements including pilot lights on ovens, water heaters, etc, and heating elements including those in pianos/organs.
- (3) Turn off heating and cooling systems.
- (4) Open all operable windows, except in tape-and-seal fumigations where they should be closed.
- (5) Open all operable interior doors including locked closets, appliance doors, and all openings to attics

and basements. Refrigerator and freezer doors may remain closed if they contain food that is protected by Nylofume® bags or sealed in the manufacturer's container.

- (6) Ensure that conditions for a "fog out" are eliminated (see Preventing "Fog Outs" in Chapter 3).
- (7) Place fans in structure so that equilibrium is rapidly reached with a minimum of one fan per sulfuryl fluoride release site with at least 1,000 cubic foot per minute capacity for each pound of SF released per minute. Fans are positioned for maximum heat

OCCUPANTS FUMIGATION PREPARATION CHECKLIST

All people must vacate the structure to be fumigated and attached structures. All living things (such as pets and growing plants) must be removed from these areas before the fumigation begins.

All items for human consumption (including foods, beverages, medicines, tobacco, etc.) which are not intact in the original manufacturers airtight containers (such as glass or metal), must be removed from the structure before fumigation, or double bagged in "Nylofume®" bags. Items not properly bagged will either be thrown out or bagged at additional cost.

The food inside refrigerators and freezers must also be placed in "Nylofume®" bags as mentioned above.

Remove all waterproof covers (such as "Can't Wet") from all mattresses and pillows, or remove the mattresses and pillows from the structure.

Shut off automatic switch controls for appliances, security alarms, and lighting systems that will be included in the space to be fumigated.

Shut off natural/propane gas lines leading to structure

Electricity must be available, as it will be required to run fans during the fumigation process.

Cut back shrubbery and tree branches that may obstruct the tents. Allow enough space for the tent to fall freely to the ground. Tree limbs growing over the roof must be trimmed back. Thoroughly water the ground around shrubs and plants located adjacent to the structure.

All cabinets, drawers, closets and interior doors must be opened. Raise blinds, open drapes and attic covers.

Articles that obstruct tenting (such as antenna guide wires, weather vanes, security cameras, etc.) must be removed.

All loose material (e.g. rocks, mulch, bark chips, pine needles, gravel, etc.) should be moved away from foundation to allow for best possible seal.

Retract all awnings.

The law requires that all buildings be locked during a fumigation using secondary locks. All entry door keys must be turned over to the fumigator in charge.

When masking tape must be used for sealing purposes, the fumigation company cannot be responsible for paint or plaster lifting off when tape is removed.

We will exercise due care in our fumigation procedures, but will not be responsible for broken roof tiles, gutters, solar units, foliage, or other inadvertent damage caused by properly performed procedures.

Notify us before the fumigation of any conduits, tunnels, pathways, etc., connecting the structure being fumigated to any other structure.

During the fumigation and aeration procedure, we will not be held responsible for vandalism, theft or breaking and entering.

The fumigated structure must not be reentered until it has been tested and declared safe for reentry by a licensed fumigator.

If you have any questions, please do not hesitate to call us at
_____ or _____

Figure 6-5. Example of a prefumigation checklist for duties to be performed by occupant(s)/owner(s) of structures to be fumigated.

exchange at the SF release site, and rapid diffusion and equilibrium of SF and CP. Extension cords ensure that the desired fan placement is achieved.

(8) Position one chloropicrin evaporation container (Fig. 6-6) for every 45 Mcf to be fumigated and/or for each story of a multistory structure. Place enough wicking agent into pan to absorb up to 3 oz CP. Do not use metal pan(s).

(9) For Florida conditions, it is recommended to use $\frac{1}{8}$ in. shooting hose with a minimum length of 100 feet. Route and clamp shooting line(s) to release sites and place protective sheet below shooting area(s).

Position shooting hose to direct SF flow into air stream of fan (Fig. 6-6). Label shooting hoses by location on the exterior end.

(10) Should monitoring be conducted, a minimum of two sample lines (Fig. 6-7) should be placed and secured in opposite compartments of the structure. Be sure that each line is labeled by location on the end outside. Also route power cord(s) to outside for Fumiscope®. For the RDA Fumiscope®, all monitoring lines remain in the building with the RDA (Fig. 6-7). Only a fresh air line is routed outside the seal.



Figure 6-6. Chloropicrin pan, shooting fan, and shooting stand with hose attached on tarpaulin.

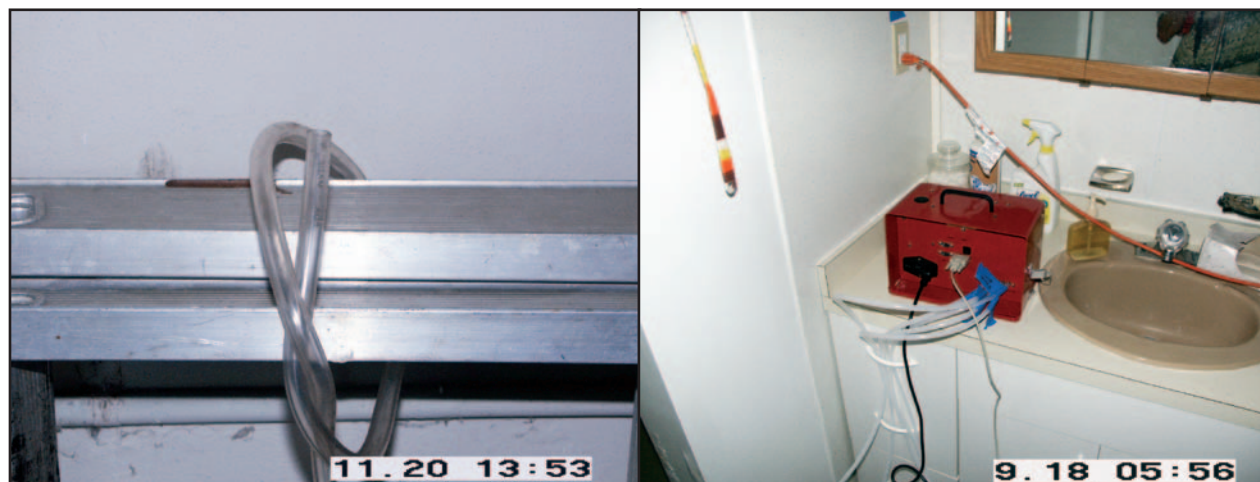


Figure 6-7. Monitoring line secured to ladder in a garage. Other end of line should be tagged with tape and marked "Garage" (left). RDA Fumiscopes® and monitoring lines remain in building (right).



Figure 6-8. Natural gas and propane leaks can cause disastrous result such as this explosion of a fumigated house in California. Credit: Orange County Register.

Exterior Preparation. The occupant/owner checklist should also include outdoor preparations for the structure to be fumigated. As with interior preparations, do not assume that the necessary exterior tasks were completed. At minimum the occupant/owner checklist should include the following necessary exterior preparations:

- (1) Shut off natural gas/propane delivery lines to structure to prevent accidental gas accumulation (Fig. 6-8).
- (2) Cut back shrubbery and tree branches to prevent damage to tarpaulins. Allow enough space for the tarpaulins to fall freely to the ground. Tree limbs growing over the roof must be trimmed back. If

- possible, place the tarpaulin between plants and structure. Most plants covered by tarpaulin and fumigated will be burned and lose foliage (Fig. 6-9). If plants must be covered, water root system well to reduce damage and improve chances for recovery.
- (3) Move all loose material (e.g., rocks, mulch, bark chips, pine needles, gravel, etc.) away from foundation to allow for best possible seal.
 - (4) Thoroughly water the soil around the perimeter of the structure up to 2 ft outward. Also water thoroughly around shrubs and plants located adjacent to the structure.
 - (5) Remove all obstructive articles such as antenna guide wires, weather vanes, security cameras, etc.
 - (6) Check for wildlife in crawlspaces and attics.

All entryways to the structure must be posted and secured to conform to the final prefumigation inspection requirements [5E-14.112] as follows:

- (1) Place a “DANGER” sign (skull and crossbones) on, or adjacent to, all exterior doors/entryways (Fig. 6-10) [5E-14.112(6)(7)(b)].
- (2) Lock and secure all exterior doors and entrances to the fumigated structure(s) with a secondary locking device(s) or barred or otherwise secured against unauthorized entry (Fig. 6-11) during the entire fumigation period, except during the active aeration period (Step 1 of SF aeration procedure), until the structure is declared to be safe for reoccupancy [5E-14.112 (7)(b)].



Figure 6-9. Plants are protected from fumigant damage (left). Ground vegetation shows darkening and death of leaves exposed to fumigant (right). Healthy leaves were outside of seal.

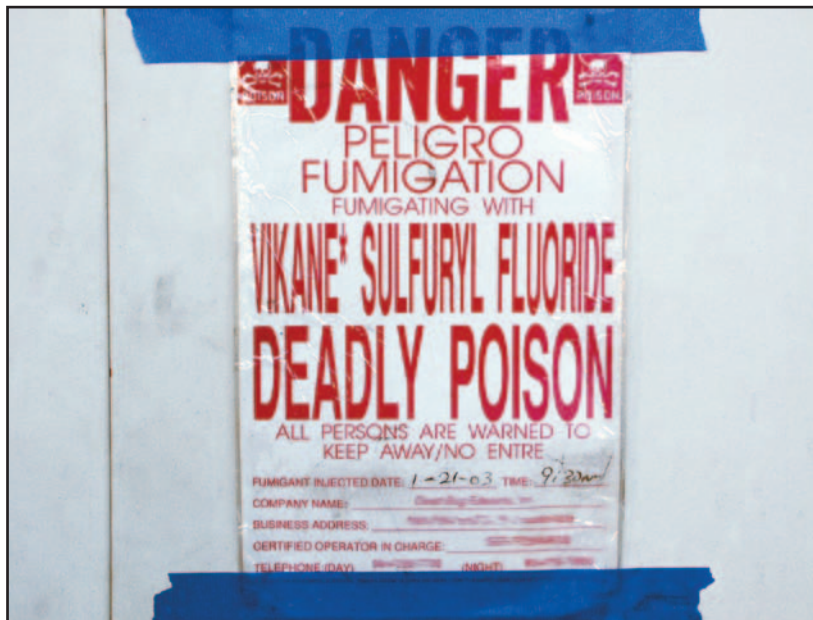


Figure 6-10. Exterior door marked with warning sign before the building is covered with tarpaulin.

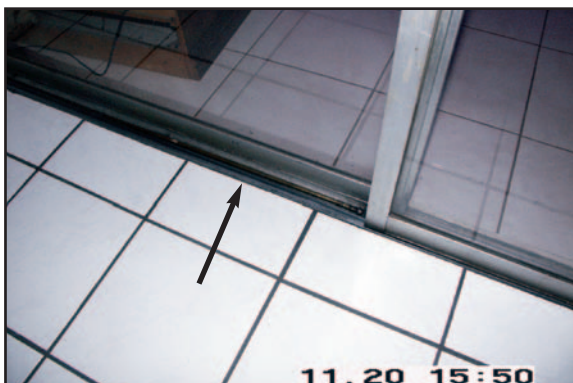
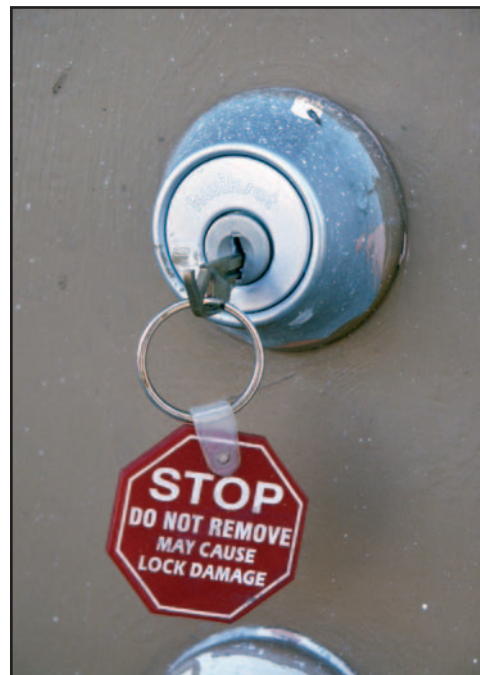


Figure 6-11. Chains with locks (top left); key block devices (top right); poles in tracks of sliding glass doors (arrow, bottom left); and clamshell key excluders (bottom right) are examples of secondary locking devices.

A secondary locking device is defined as any device, method or barricade, in addition to existing locking mechanisms, that is demonstratively effective in preventing an exterior door or entrance from being opened or entered by normal means by anyone other than the CO in charge or the SPID [5E-14.102(14)]. A door or entrance that, once locked from the interior with a lock that is not accessible from the exterior, does not require a secondary locking device or barricade [5E-14.112(7)(b)]. It is necessary to first lock doors with existing mechanisms before using certain secondary locks such as clamshell locks and key excluders. Entrances that do not have existing locking mechanisms or are inoperable must still be secured with a secondary locking device [5E-14.112(7)(c)].

Entryways may require barricading or barring to prevent entry such as placing poles in sliding door tracks or using a chain and lock on door handles. Barricade and barring is defined as the use of any material(s) that would physically prevent a person's access to the structure by way of any entrance or opening by normal means [5E-14.102 (15)]. If multiunit dwellings with internal stairwells at each floor can be secondarily secured at all ground level entrances, then no other secondary locking devices are necessary, provided that normal requirements [5E-14.112] are met. Multiunit dwellings with exterior stairwells or fire escapes must be secured or otherwise barricaded or barred to prevent entry from both ground and first floor levels and from any entrance to the structure accessed from the stairwell or fire escape. If neither of these conditions can be met, then all entrances to individual units and all exterior entrances must be secondarily secured [5E-14.112 (7) (d)].

Exterior Tarpaulin Sealing Procedure.

General safety hazards associated with sealing structures:

- Wet tarps can be slippery. Make sure tarps are dry and wear anti-slip shoes.
- Avoid power lines. Do not contact them with ladders, clamps, or any materials that conduct electricity. Do not touch power lines.

Ladder safety. The U.S. Consumer Product Safety Commission makes the following recommendations for the safe use of ladders:

- Make sure the weight your ladder is supporting does not exceed its maximum load rating. There should only be one person on the ladder at one time.

- Use a ladder that is the proper length for the job. Proper length is a minimum of 3 feet extending over the roofline or working surface. The three top rungs of a straight, single or extension ladder should not be stood on.
- Straight, single or extension ladders should be set up at about a 75-degree angle.
- All metal ladders should have slip-resistant feet (Fig. 6-12).
- Metal ladders will conduct electricity. Use a wooden or fiberglass ladder in the vicinity of power lines or electrical equipment. Do not let a ladder made from ANY material contact live electric wires.
- Be sure all locks on extension ladders are properly engaged.
- The ground under the ladder should be level and firm. Large flat wooden boards braced under the ladder can level a ladder on uneven ground or soft ground. A good practice is to have a helper hold the bottom of the ladder.
- Do not place a ladder in front of a door that is not locked, blocked or guarded.
- Keep your body centered between the rails of the ladder at all times. Do not lean too far to the side while working.
- Do not use a ladder for any purpose other than that for which it was intended.
- Do not step on the top step, bucket shelf, or attempt to climb or stand on the rear section of a stepladder.
- Never leave a raised ladder unattended.
- Follow use instruction labels on ladders.



Figure 6-12. Use metal ladder with slip-resistant feet.



Figure 6-13. Sand placement at critical concrete/lawn junction or over a curb.



Figure 6-14. Sand snake placement before tarps are dropped.

The perimeter of the structure where the tarpaulin meets the ground must be smooth. Rake debris away, and seal crevices, curbs, or immovable obstructions with sand (Fig. 6-13). Remove garden edging or add sand barrier if seal cannot be assured.

Position sand or water snakes around the perimeter. Sand snakes should be placed around the perimeter of the structure before tarpaulins are dropped (Fig. 6-14). Sand snakes should overlap at least 6-12 in. if completely filled with sand to prevent gaps where fumigant can leak (Fig. 6-15). Ends of water snakes should be rolled and securely clamped to prevent water leakage. Water snakes should be blocked in position to prevent them from rolling off of the tarp apron.

Cover corners or sharp structural edges with masking tape or corner pads (Fig. 6-16).

Transport tarps onto rooftop, drop to ground (Fig. 6-17), and then clamp together. Allow enough tarp for at least a 2-foot ground seal apron (Fig. 6-18).



Figure 6-15. Overlapping sand snakes (left) and water snake (right). Unlike what is shown here, water snakes should be blocked in place with sand snake or heavy object.



Figure 6-16. Masking tape (left) and nylon pads (right) can be used to protect tarpaulins from building corners and sharp edges.



Figure 6-17. A ladder lift can safely elevate tarpaulins onto a roof (left). Balance and coordination are vital to carry tarps up a ladder (top right). Tarps are dropped down from roof (bottom right).



Figure 6-18. Minimal wind could pull tarp under snakes (left). Extended apron with many snakes ensures secure seal (right).



Figure 6-19. A “false” seam on the left is used to remove slack. A “hot” seam on the right joins two separate tarps.

Two types of seams are used to tightly seal a structure (Fig. 6-19). “Hot” seams occur where two separate tarpaulins are connected and “cold” or “false” seams are made where loose seam material is gathered and tightened. Position one “hot” seam near a keyed entryway to allow entry by the fumigator for chloropicrin addition or emergency access.

Overlap tarps by about six inches, roll together, and then clamp (Fig. 6-20) from top to bottom. Tall or highly

stressed seams also require additional clamps (Fig. 10-5) to prevent “blow open” resulting from wind or storm.

Make provisions for water runoff so that water does not accumulate in large volume during a rainstorm (Fig. 6-21). Parapet walls on roofs, courtyards, and sunken areas in roofing should be fitted with a drainage relief system configured from PVC piping.



Figure 6-20. Fumigation clamp holding tarpaulin seam. Transporting clamps en masse on rope loops.

Warning Signs

Florida State Rules are very specific about the appearance, timing, location, and content of warning signs [5E-14.112 (2)(6)]. In tape-and-seal fumigations, signs must be posted at or on all doors and entrances to the structure or enclosed space, and at least one warning sign on all outdoor sides of the structure or enclosed space not having a door or entrance. In tarpaulin fumigations, at least one warning sign must be posted at or on all doors and entrances to the structure or enclosed space and at least one warning sign on all sides of the outside of the tents or sealing covers of the structure or enclosed space being fumigated. Warning signs must be posted at all doors and entrances to common carriers or enclosed space fumigated and on all gangplanks, ladders, etc. from the dock, pier or land to the vessel being fumigated. On multiunit dwellings, warning signs must be posted at or on all exterior doors or entrance(s) of the structure which, depending on construction, might require sign(s) on all exterior doors or entrances of each individual unit or apartment. The warning words should be visible from any approach to the structure.

Warning signs must contain the following information in addition to warning words (Fig. 6-22)

[5E-14.11 (3)]:

- Date and time fumigant was injected
- Company Name
- Company Business Address
- Certified Operator in Charge (or designated SPID)
- Emergency Day Telephone
- Emergency Night Telephone



Figure 6-21. Always account for water drainage of a tarped structure. The courtyard roof of this Florida building filled with water after a heavy rainstorm and collapsed.

All information displayed on warning signs must be accurate and legible. The name and telephone number of the CO in charge of fumigation, or the CO or SPID who introduced the fumigant must be displayed. All emergency phone numbers must be a phone number, cell phone number, or beeper of a person familiar with the job and trained to respond to fumigation emergencies and equipped with label required respiratory protection and gas detection equipment. Answering machines, beepers or voice mail systems are prohibited [5E-14.112 (5)].

Warning signs must be made of stiff weatherproof material [5E-14.112 (2)] and conform to the following visual requirements [5E-14.112 (4)]: Warning signs must be printed in indelible red letters on a white background. The words “DANGER” and “DEADLY POISON” shall be in block lettering at least two inches high. The name of the fumigant shall be at least five-eighths inch high. The skull and crossbones symbol shall be at least one inch high. All other lettering on the sign must be not less than one-half (½) inch high. It is recommended that warning text also be printed in Spanish (Fig. 6-23).

Warning signs posted on the outside of tarps or sealing covers (Fig. 6-23) shall not be removed before commencement of aeration and such warning signs posted on or at entrances to the structure (itself), enclosed space or commodities being fumigated shall not be removed until the end of the fumigation period, when aeration has been completed and the premises declared safe for reoccupancy [5E-14.112 (6)].

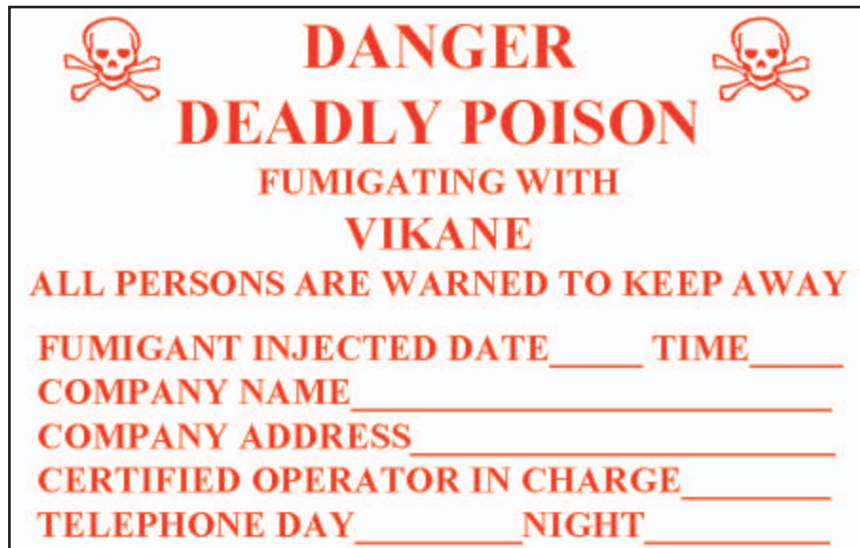


Figure 6-22. Required coloration and suggested layout of warning sign.

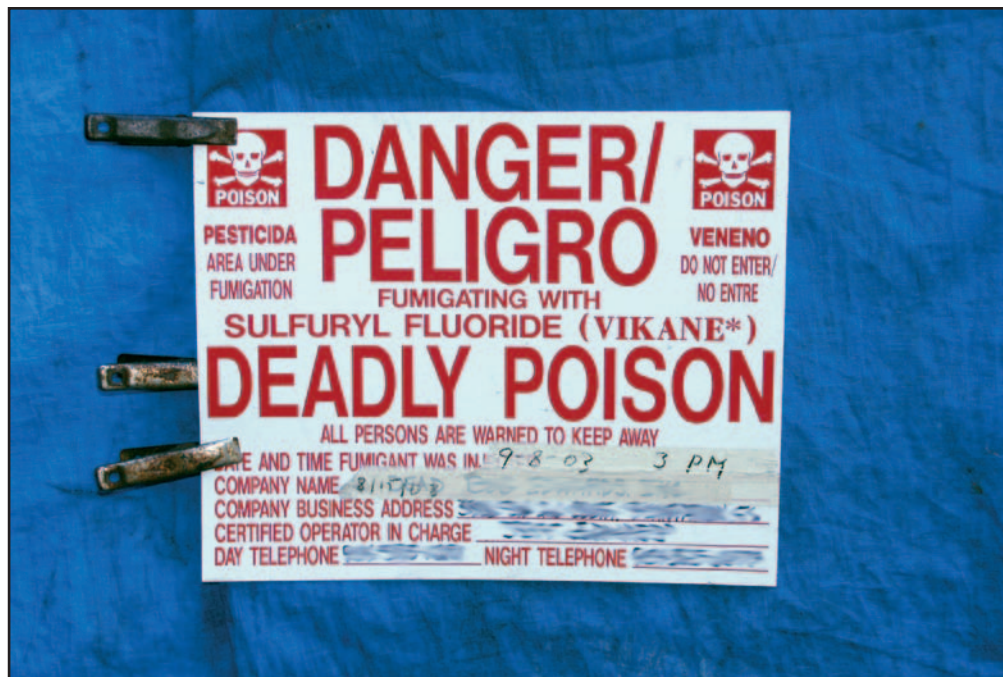


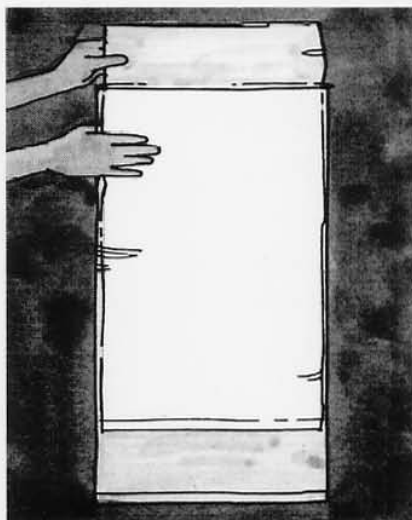
Figure 6-23. Exterior warning sign clamped to tarpaulin. Warning in Spanish language is advised. Clamps are a good way to ensure that signs are securely affixed to a structure. Note: Handwritten information has been blurred to protect the privacy of the company. In reality, the information is completely legible.

How to use Nylofume* bags to protect food and other commodities during fumigations with Vikane* gas fumigant.

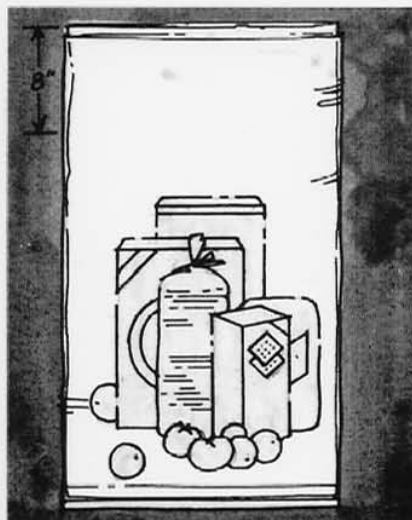
Nylofume bags are made from a special nylon polymer film. Research has demonstrated that double-bagging, as shown below, achieves optimum protection.

All items such as food, feed, drugs, and medicine (including those items in refrigerators and freezers) must either be removed from the structure being fumigated or be sealed in protective Nylofume* bags

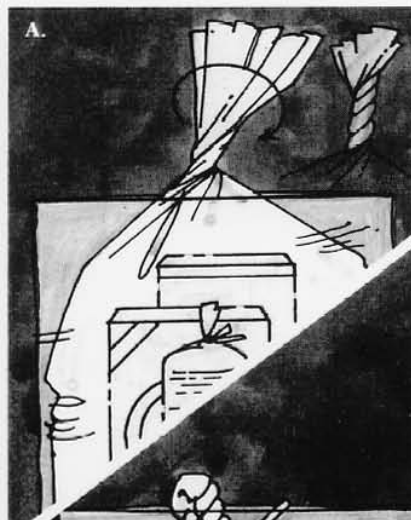
To assure proper sealing and good protection, please follow these instructions carefully:



1. While bags are still empty, place one inside another. Double-bagging helps assure effective protection.



2. Place items to be protected inside the inner bag. Do not overfill – leave clearance on top for adequate closure of the bags.



3. Twist the top of the inner bag, fold once and secure the fold in place using a suitable fastener such as a twist tie, tape, rubber band, or string.



4. Repeat step 3 with the outer bag.



5. Check the seal by pressing gently against the sides of the bag and listening for air leaks. No air should be able to escape.

IMPORTANT: Keep these and other such bags out of children's reach.



Dow AgroSciences

Dow AgroSciences LLC
Indianapolis, IN 46268-1054

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Vikane is a federally Restricted Use Pesticide.

Continued on next page

To Bag Or Not To Bag... That Is The Question.

Protecting consumable items like food, feed and medicine is part of every fumigation with Vikane* gas fumigant. However, from time to time questions arise about which items need to be double-bagged in Nylofume* bags, and which items can remain in the structure unbagged during the fumigation. Here are some examples to guide you as you prepare your home for fumigation.

Bag these...



Pretzels and other foods packaged in plastic bags need to be bagged or removed.



Animal feed, like human food, needs to be bagged or removed.



Foods packaged in cardboard boxes, like cereal, need to be bagged or removed because the interior plastic bag may not be airtight.



Spices without their original manufacturer's airtight seal intact must be bagged or removed.



Eggs must be bagged or removed from the structure.



Aspirin and other similar ingestible medicines need to be bagged or removed.



Cottage cheese should be bagged or removed because resealable containers, including Tupperware and other storage containers, do not form airtight seals.



Ice cubes should be discarded before the fumigation and the icemaker turned off.

No need to bag these...



Unopened 2-liter plastic bottles with manufacturer's airtight seal intact can remain unbagged. Shake 2-liter bottles to confirm that the airtight seal is still intact.



Unopened canned products like soup may remain unbagged because unopened metal cans provide an airtight seal.

When in doubt, take it out...

If there's any question as to the seal on an item, the best approach is to take it out of the structure to be fumigated or to double bag it.

Chapter 7

Introduction of Chloropicrin and Sulfuryl Fluoride

Introduction of the warning agent and fumigant is a critical phase because it marks the beginning of an airborne hazard within the structure. During chemical introduction, two persons trained in the use of sulfuryl fluoride, with one being the certified operator (CO) or special identification card holder (SPID) and the second being a CO, SPID, or trained ID card holder, must be present [5E-14.108(2)]. Both persons must be knowledgeable in the use of SCBA. Personnel using SCBA must pass a medical exam. When crew members are present on the fumigation site, two properly functioning SCBAs must be available at the fumigation site at all times from fumigant release until the structure is secured following active aeration. Two SCBAs do not need to be present at the fumigation site for activities that do not involve worker exposure to fumigant concentrations above 5 ppm such as remote monitoring, using a Fumiscope®, using a TIF leak detector, job site cleanup, FDACS inspections, and Quality Assurance Reviews [5E-14.108(6)]. Should some abnormal hazard develop, it is the responsibility of the supervisor of the fumigation to take necessary safety precautions to protect the public health and safety [5E-14.112(7)(a)].

1. Measure Temperature of the Soil or Slab. When possible measure wind and relative humidity (RH).

Equipment:

- thermometers (slab, soil, or infrared, Fig. 7-1)
 - remote weather station and wireless temperature sensors (Fig. 7-3)*
 - anemometer* (for measuring wind speed)
 - hygrometer* (for measuring RH)
- *optional

2. Calculate Dosage.

Equipment:

- Fumiguide electronic calculator (Fig. 7-2)
 - or
 - Fumiguide B slide rule
 - Fumiguide Y slide rule*
- *optional

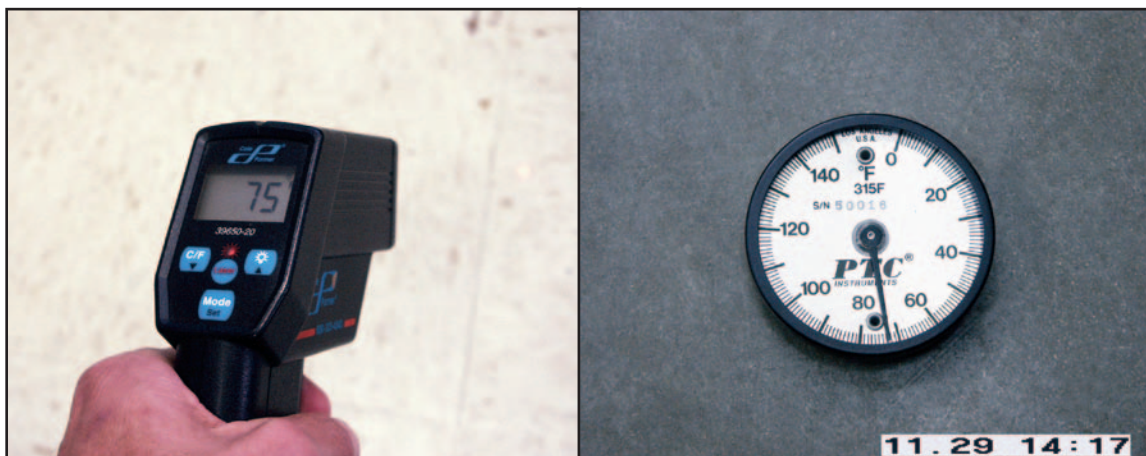


Figure 7-1. Infrared surface thermometer with laser sight (left) and metal coil mechanical slab thermometer (right).



Figure 7-2. Fumiguide® electronic calculator.

A Fumiguide® calculator (electronic or slide rule B) must be used to determine the amount of SF to be introduced into a structure. All the variables required to calculate this amount (SF weight in pounds) should be known. These include target pest, tarp or seal condition, ground seal condition (where the tarp meets ground), wind speed, volume, underseal (slab or crawl), underseal soil type for crawl space structures, slab or soil temperature, exposure time, relative humidity, fan amperage, chloropicrin dosage, and whether the job is monitored or not. The Fumiguide® calculator will prescribe a maximum shooting rate (shooting hose length and ID) based on relative humidity, temperature, and fan capacity. The calculator will also determine the amount of chloropicrin needed based on selected CP dosage.

Table 7-1 illustrates how different parameters have variable effects on dosage (oz/Mcf). Data set 1 is based on a typical Florida house in the summer. Under the given conditions in Data 1, the structure will require 5.7 oz/Mcf or 8.9 pounds of SF. When the dosage factor is increased 10 times (drywood termite to beetle dosage) as

in Data 2, the dosage is increased 1000% – proportional to the increase in the dosage factor. In Data 3, the tarp condition is changed from “good” to “poor”, resulting in a 14% increase in calculated dosage. Likewise, when the ground seal rating is changed from “medium” to “poor” (Data 4), the resulting increase of 9% is also rather minimal. However, when the wind speed is increased from 5 to 25 mph (Data 5), the dosage required for the same structure increases 47%.

As the volume of a structure increases, the surface-to-volume ratio decreases. This means that larger volume structures have a smaller surface from which to lose fumigant relative to the increased absolute load of fumigant within the structure. The Fumiguide electronic calculator accounts for the surface-to-volume effect as in the example with Data 6. A 100-fold increase in volume results in a 19% reduction in calculated dosage required when all other conditions remain constant.

Underseal and temperature have very profound effects on calculated dosages. When the underseal is deemed to be porous or leaky, as when a crawl space structure rests on sandy loam soil (Data 7), the amount of fumigant required is 277% that needed for the same structure standing on a nonporous underseal (Data 1). Temperature affects the activity or respiration rate of animals, such as insects, that do not produce body heat. Therefore, a drop in exposure temperature of 30° F (Data 8), results in the 55° F structure requiring 288% the fumigant of the 85° F structure (Data 1). It is sometimes possible to preheat a building before fumigation to reduce exposure time or fumigant concentration, however, gradual cooling will result in a lower average temperature during the fumigation. Remote monitoring can be used to ensure target site temperature (Fig. 7-3).

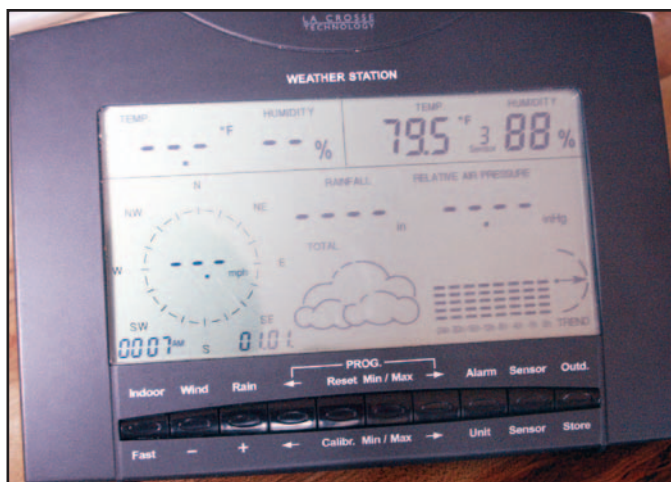


Figure 7-3. A weather station can measure temperature inside a fumigated building (left) using a wireless sensor(s) (right).

Table 7-1. Effect of a single parameter change (highlighted) on SF half loss times and dosages required from output of Fumiguide® electronic calculator

Parameters	Data 1	Data 2	Data 3	Data 4	Data 5	Data 6	Data 7	Data 8	Data 9	Data 10
Pest dosage factor	1X (dwt)	10X	1X	1X	1X	1X	1X	1X	1X	1X
Tarp or seal condition	Good	Good	Poor	Good	Good	Good	Good	Good	Good	Good
Ground seal	Medium	Medium	Medium	Poor	Medium	Medium	Medium	Medium	Medium	Medium
Wind Speed (mph)	5	5	5	5	25	5	5	5	5	5
Volume (Mcf)	25	25	25	25	25	2500	25	25	25	25
Underseal type	Slab	Slab	Slab	Slab	Slab	Slab	S. loam	Slab	Slab	Slab
Slab temperature (°F)	85	85	85	85	85	85	85	55	85	85
Exposure time (hours)	20	20	20	20	20	20	20	20	48	20
Monitored or not	No	No	No	No	No	No	No	No	No	Yes
RH	75	75	75	75	75	75	75	75	75	75
Amps per shooting fan	3	3	3	3	3	3	3	3	3	3
Chloropicrin rate	10	10	10	10	10	10	10	10	10	10
Calculations:										
Est. HLT (hours)	23.4	23.4	15.6	17.5	9	95.4	3.9	23.4	23.4	23.4
Dosage (oz/Mcf)	5.7	57.2	6.5	6.2	8.4	4.6	15.8	16.4	3.4	4.3
Pounds required	8.9	89.4	10.2	9.8	13.2	724.6	24.6	25.7	5.3	6.7
Oz-hr required	64.7	647.5	64.7	64.7	64.7	64.7	64.7	186.1	64.7	64.7
Max. shoot rate (lbs/min)	1.8	1.6	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
CP needed (oz)	2.5	2.5	2.5	2.5	2.5	250	2.5	2.5	2.5	2.5
% of Data 1 dosage	100%	1000%	114%	109%	147%	81%	277%	288%	60%	75%

Aside from the unconventional preheating of a structure, the fumigator has control of only a few of the parameters used in calculating fumigant dosage. These include tarp and ground seal conditions (which are shown above to have relatively minimal effect on dosage), exposure time, and whether the fumigation is monitored or not. When exposure time in the example above is increased from 20 to 48 hours (Data 9), the dosage required decreases by 40%. Likewise, when a fumigation is monitored, the calculated dosage decreases 25%. Both of these latter factors can have a profound effect on the economics of large-structure fumigations. For example, if monitored, the large structure in Data 6 would require 181 fewer pounds of sulfuryl fluoride.

Relative humidity, fan amperage (capacity), and chloropicrin rate have no effect on the dosage of fumigant required.

3. Conduct Final Pre-Application Inspection

Equipment:

- flashlight

Before the warning agent and fumigant are applied, the CO or SPID must make a final, personal inspection of the structure to ensure that the structure is properly prepared for fumigation. The final inspection must be conducted immediately before the fumigant is to be applied and must ensure the following [5E-14.112(1)]:

- (1) All preparations for fumigation as directed by the label are completed including bagging or removing foods and medicinals and opening all internal doors and compartments.
- (2) No unauthorized person is present within the structure or enclosed space to be fumigated or in any adjacent structures or spaces that are required to be vacated for the fumigation. Within these spaces, all locked rooms, compartments and closets must also be inspected [5E-14.111(4)].
- (3) All open fires, flames, pilot lights, and electrical heating elements are turned off.

Inspections of multi-unit dwellings follow special provisions. On multi-unit dwellings, the CO or SPID must conduct a thorough, systematic inspection of each room in every unit to ensure that all provisions specified in (1)-(3) above have been completed. Then, exterior doors and/or entrances of each inspected unit must be secured against unauthorized reentry while preparations and inspection of other units or areas of the structure are completed. This may require the temporary use of secondary locks on entrances that are to be left unattended between the time of inspection and the introduction of the fumigant. If an individual unit or units cannot be

safely secured while preparations of other areas are taking place, then those units must be reinspected immediately before the fumigant is to be applied [5E-14.112(1)(d)].

4. Chloropicrin application (5-10 min before introduction of SF)

Equipment:

- CP pan with absorbent (preinstalled)
- chloropicrin bottle in shipping container
- chloropicrin graduated container with lid
- chemically resistant gloves
- chemically resistant goggles/face shield
- flashlight
- keys or locking mechanisms for secondary locks

Chloropicrin application requirements:

- 1 oz/10-15 Mcf
- 1 release site per floor
- 1 release site per 30-45 Mcf
- 3 oz maximum per release site
- 1 release site per sulfuryl fluoride release site

First Aid

Chloropicrin (CP) is a dangerous poison. Chloropicrin vapor is highly irritating to eyes, lungs, and mucous membranes and liquid is highly caustic to skin.

If chloropicrin is inhaled, move victim to fresh air. If victim not breathing give artificial respiration. If victim's breathing is difficult give oxygen. Get medical attention immediately.

If chloropicrin liquid contacts skin, immediately flush skin with water for at least 15 minutes while removing contaminated clothing, shoes, or other items covering skin. Get medical attention.

If chloropicrin contacts eyes immediately flush eyes with water for at least 30 minutes. Get medical attention immediately.

If chloropicrin is swallowed, do not induce vomiting, give victim large amounts of water or milk. Get medical attention immediately.

Chloropicrin is used effectively to discourage persons from entering a fumigated structure. At warning concentrations, chloropicrin does not affect target pests. With the aid of a fan, chloropicrin will completely evaporate from the release pan in one hour or less depending on the wind speed over the pan and the temperature. Theoretically, the label rate of 1 oz chloropicrin per 10-15 Mcf should provide 17-24 ppm of chloropicrin in the airspace at equilibrium. Chloropicrin vapor is sorptive on solid materials and significantly less than the calculated value is actually present in the airspace. An airborne concentration of at least 3-4 ppm should be sufficient to

prevent human entry (Tables 7-2, 7-3). It is recommended that the maximum rate of chloropicrin (1oz/10Mcf) be used in small crawl space structures and the minimum (1oz/15Mcf) in larger slab structures. State rules require the use of no less than one fluid ounce of chloropicrin per 15,000 cubic feet of space to be fumigated [5E-14.111 (6)].

Before beginning the release procedure, chloropicrin pan(s) (Fig. 7-4) should already be in position. To help avoid chemical burns (Fig. 7-4) wear chemically resistant gloves and goggles (Fig. 7-5). While outside, measure CP in graduated container and attach spill-proof lid. Replace cap on CP bottle, place bottle in protective packaging,

and secure packaging in hazmat vehicle. Transport graduated container to indoor release site through a specified seam and/or entryway. Dispense CP into evaporation pan (Fig. 7-5).

If released at more than one location, transport containers to all release sites first, then pour CP into pans one by one, beginning at the location furthest from the open seam/exit point. The graduated container should be left open next to the evaporating pan. Secure the specified seam and/or entryway while leaving the structure. When dispensing chloropicrin in large structures requiring numerous evaporation pans, the use of an SCBA is highly recommended.

Table 7-2. Broad human response to chloropicrin (Military)

ppm	time	symptom
0.3-0.4	3-30 sec	eye irritation
4	continuous	unfit for combat
15	few sec	lung injury
119	30 min	lethal

Table 7-3. Typical human response to chloropicrin in structures

ppm	time	symptom
1	2-4 min	eye tingle
1.8	1-2 min	eye tingle
2.3	1-2 min	eye tearing
5.1	30 sec-1 min	tearing, cough
6.6-7.7	3-12 sec	eye burn, cough
10 or more	immediate	intolerance



Figure 7-4. Graduated container with lid, evaporation pan, and chloropicrin bottle (left). Chloropicrin burn on forearm (right).



Figure 7-5. Gloves and goggles must be worn (left) when chloropicrin is being dispensed (right).

5. Sulfuryl Fluoride Application

Equipment:

- sulfuryl fluoride cylinder
- cylinder hose adapter (attaches cylinder to shooting hose, Fig. 7-6)
- hose clamp (attaches shooting hose to hose adapter, Fig. 7-6)
- adjustable wrench
- scale (hanging or top load, 300 lb capacity minimum)
- self-contained breathing apparatus (SCBA)

First Aid

Sulfuryl fluoride (SF) is a dangerous poison. Sulfuryl fluoride vapor is odorless and tasteless at lethal concentrations. Liquid SF can cause freeze burns to the skin and freeze damage to eyes. In all cases of overexposure: nausea, difficulties in breathing, abdominal pain, slowing of movements and speech, numbness in extremities, get medical attention immediately. Take the person to a doctor or emergency treatment facility.

If sulfuryl fluoride is inhaled, move victim to fresh air. Keep the person warm and at rest. Make sure the person can breathe freely. If breathing has stopped, give artificial respiration. Do not put anything in the mouth of an unconscious person.

If sulfuryl fluoride liquid contacts skin, immediately apply water to contaminated areas of clothing before removing the clothing. Once the area has thawed, remove contaminated clothing, shoes, and other items covering skin. Wash contaminated skin thoroughly or shower the person.

If sulfuryl fluoride liquid contacts eyes, hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

When handling SF, wear goggles or face shield and slip-resistant shoes. Do not wear gloves or boots as these can trap leaking SF liquid. Remove bonnet and valve cover from cylinder. Place SF cylinder on scale. Connect hose adapter to cylinder (Fig. 7-6). For electronic scales tare scale to zero. For beam balance scales, balance cylinder and then subtract weight by desired amount of sulfuryl fluoride. Open cylinder valve all the way with wrench so that the valve is completely open: a flow rate is controlled by the length and diameter of the hose, not by metering at valve. Dispense until desired weight of SF is released. If releasing SF into more than one hose, divide the total amount to the proportional volume of each release site. After release, replace valve cover and protective bonnet. Secure SF cylinder in a hazmat vehicle.

6. Leak detection

Equipment:

- halogen leak detector
- interscan gas analyzer*

*optional

If one is unsure about the quality of the seal (ground seal, seams, tape-and-seal jobs, etc.), it is advisable to use a halogen leak detector (Fig. 7-7) to identify and correct leaks, especially if a job is not monitored.



Figure 7-6. Hose clamp and hose adapter assembly (left). SF being released into structure (right).



Figure 7-7. Tif halogen gas leak detector (left) being used to locate leaks (right) so they can be sealed.

Chapter 8

Monitoring Sulfuryl Fluoride Concentration

Monitoring fumigant concentration is usually not mandatory. However, some customers or contracts may require that monitoring be conducted and documented. When fumigating very large structures where there may be uncertainty about the quality of the seal (e.g. tape-and-seal jobs), or rate of equilibrium (e.g., fire walls in unit buildings), it is highly recommended that the job be monitored. The incentive is that monitored rates for Vikane® are 25% lower than nonmonitored rates. In large jobs, the reduced fumigant cost compensates for the added equipment and labor costs needed to monitor the site. In addition, monitoring also ensures a successful fumigation – thus avoiding a costly retreatment.

The first reading determines if equilibrium is progressing normally. Usually, monitoring requires that readings be taken at equilibrium (typically one hour after introduction), at about 2-3 hours after equilibrium – and before aeration. This schedule allows the fumigator to measure the actual half loss time (HLT) and add SF – if needed – to ensure that the fumigation is successful. Finally, to ensure that no gas concentration loss has occurred (due to windstorm or vandalism), the fumigator can take intermediate readings.

Monitoring, which is always done outside of the fumigated space, can be conducted by one person. If, for whatever reason, reentry of the building is required during fumigation, or if additional fumigant is released – two persons trained in the use of SCBA must be present. One of these persons, must be the CO or SPID; the other a CO, SPID, or trained ID card holder. Two SCBAs do not need to be present at the fumigation site for routine monitoring [5E-14.108 (6)].

Equipment:

- monitoring lines (preinstalled and prelabeled by location) using traditional Fumiscope®
 - outdoor power cord (preinstalled from structure)
 - Fumiscope® (calibrated)
 - Drierite for Fumiscopes® (retrofitted model “D” and later need no Drierite)
 - umbrella*
 - folding table*
 - air pump to evacuate long monitoring lines*
 - RDA Fumiscope® with communications connection*
- *optional

Resolve the quantity and location of monitoring lines during the sealing phase (Chapter 6). To verify equilibrium, monitoring lines should be located in each compartment of a building – including different floors, attic areas, basements, and garages. Some monitoring line locations should be near fumigant introduction site(s) and some should be located as far removed from introduction site(s) as possible.

The Fumiscope® (Fig. 8-1) is a thermal conductivity detector used to measure the concentration of fumigant in the sealed airspace. It is accurate to 1 oz/Mcf. Always keep the Fumiscope® in shade (use umbrella if necessary) and make sure that the humidity trap used to dry air entering the instrument is working. Secure the Fumiscope® on a level work surface such as a sidewalk, driveway, or folding table. Before sampling from very long (over 100 ft) monitoring lines, it is helpful to “prime” the line with an air pump to more quickly pull



Figure 8-1. Two Fumiscopes® in use (left). Fumiscope® powered by auto battery adapter (right).

an internal air sample from the structure. When all monitored locations have equivalent concentrations (within 1 oz/Mcf), the SF is in equilibrium in the airspace of the structure. Record time of equilibrium because concentrations measured at different times after equilibrium will be used to calculate the actual half loss time and accumulated dose. If the last reading is taken just before aeration, the actual accumulated dose can be determined by using the Fumiguide® electronic calculator or Fumiguide® slide rule.

RDA Fumiscope®. Available in late 2004, the Remote Data Acquisition (RDA) Fumiscope® (Fig. 8-2) will allow for fumigant monitoring via telephone/cell

phone connection from the fumigation site to a home, office, or portable computer. Unlike the traditional Fumiscope®, the RDA is placed *inside* the structure. An outside air line and up to four monitoring lines are attached to each RDA unit. The RDA also records temperature and humidity. Acquisition of real-time or pre-programmed interval readings is obtained with RDA software using a PC modem connection. The software creates reports that detail and summarize all data stored in the RDA during the fumigation. The RDA Fumiscope® eliminates the necessity of on-site visits and automates report production for job documentation and customer needs.

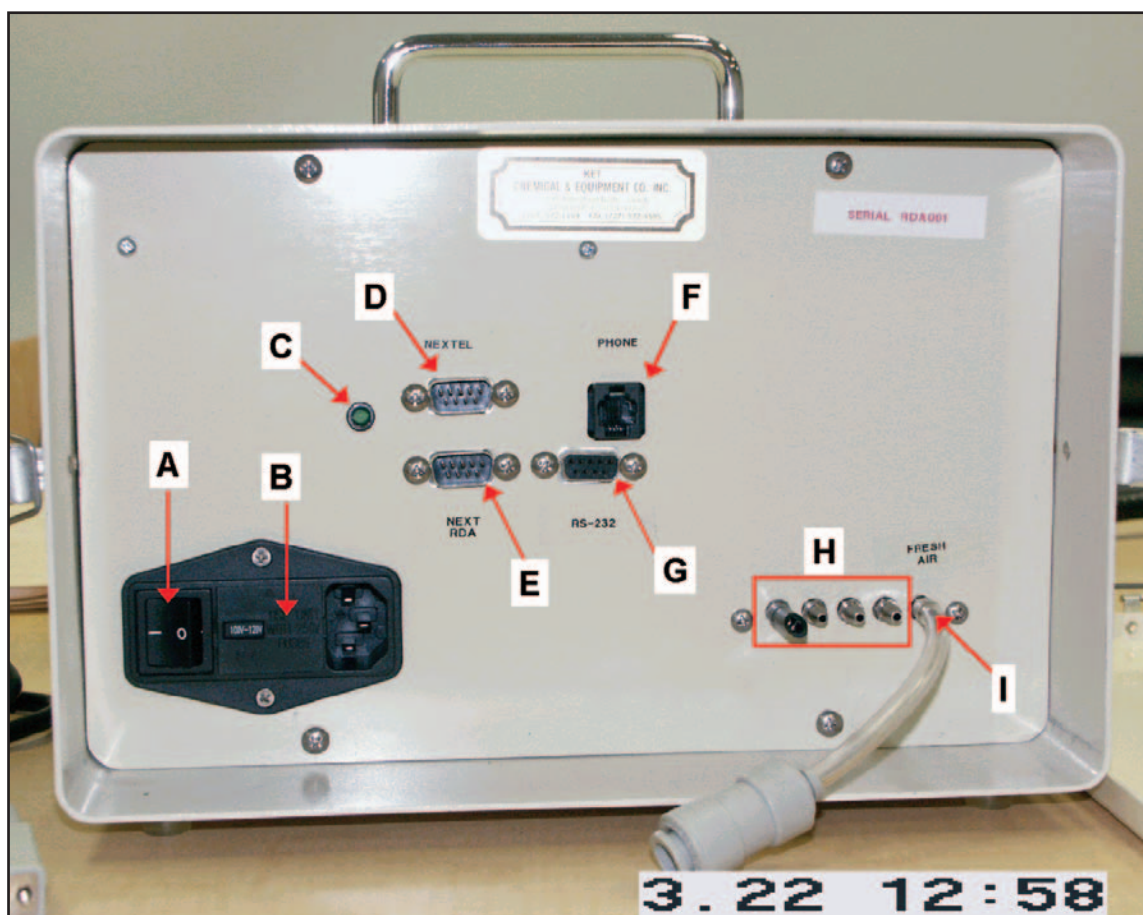


Figure 8-2. RDA Fumiscope® **A)** Power on/off switch. **B)** Power receptacle and voltage converter module1. **C)** Activity indicator light. Blinks every 2 seconds when power is on and the unit is idle. Blinks rapidly when data is being transmitted. **D)** Nextel® cell phone connection to the host, one of the three ways to connect to the host computer. **E)** Connection to downstream unit 2. This is an RS-232 connector, a second host computer connection. **F)** Phone connection to the host. This is a J-11 phone jack, the third host computer connection. **G)** Direct connection to the host. This is an RS-232 connector and 3rd host connection. **H)** Gas collection ports, numbered 1-4, left to right. **I)** Fresh air port. Caption text courtesy of Larry Witt, Key Chemical and Equipment Co.

Chapter 9

Aeration and Clearance of Sulfuryl Fluoride

In this critical phase of the fumigation, the structure is reverted to its original habitable condition minus, of course, living target pests. Two persons trained in the use of SF, with one being a CO or SPID and the second being a CO, SPID or trained crew person who must be a regular ID cardholder, must be present during the first opening of the seal until the structure is secured (Step 2 below) [5E-14.108(2)]. Both must be knowledgeable in the use of SCBA. During the first opening of the seal until the structure is secured, two functioning SCBAs must be on hand [5E-14.108(6)]. Only a CO or SPID can use clearance detection equipment to determine residual fumigant concentration after the aeration procedure [5E-14.113(1)] and only a CO or SPID can declare a fumigated structure or enclosed space safe for entry and occupancy [5E-14.113(2)].

Equipment:

- flashlight
- clearance device: Interscan gas analyzer* *or* Miran infrared gas analyzer
- duplicate interscan gas analyzer *or* Miran infrared gas analyzer**
- AC adapter *or* battery packs
- SCBA (minimum of two)
- extra full air tank for SCBA***
- clearance notice sign
- dated treatment sticker

*Interscan gas analyzer must be calibrated within one month before use as a clearance device. All other approved detection devices must be calibrated according to manufacturer recommendations.

**Can be located at business licensee address.

***Recommended.

Aeration Procedure

After the required exposure period or ounce-hour accumulation, the process of aerating the structure begins when the first seal is opened. Other outside work includes removing ground seal weights (snakes, sand, etc.) and clamps (Fig. 9-1), opening all tarpaulin seams (Fig. 9-2) and dropping and folding all tarpaulins. At the same time as the outdoor work proceeds, Step 1 of the aeration procedure can begin by unlocking and opening all exterior doors (Fig. 9-3) and windows in tape-and-seal fumigations and operating aeration fans.

The aeration procedure (first opening of seal until clearance) is divided into three steps. Illustrated examples of the aeration procedures are given in Figure 9-4.

Step 1: Open the seal and begin to aerate by opening all operable doors (for all fumigations) and windows (for tape-and-seal fumigations) and by the use of one or more fans. Total fan capacity, using one or more fans, must displace a total of 5,000 Cfm. When the last door or window is opened and fans are running, the “active” aeration period begins. Aerate in this manner for one-hour minimum.

Note: During the initial one-hour “active” aeration procedure, any and all persons entering fumigated airspace must wear approved respiratory protection until the concentration of Vikane® is confirmed not to exceed 5 ppm using an approved detection device.



Figure 9-1. Sand snakes (and clamps) removed to free tarps for opening and removal.



Figure 9-2. Seams are opened allowing SCBA-wearing fumigator to enter the structure and open all exterior doors to initiate Step 1 of the aeration procedure.



Figure 9-3. Step 1 of aeration procedure begins when the fumigator (wearing SCBA if external door is within fumigated space) has opened all operable external doors. For tape-and-seal fumigations, doors and windows must be unsealed and opened for active aeration. For tarpaulin fumigations, all operable windows should already be open during the fumigation. SCBA properly worn (inset).

Step 2: Secure the structure with secondary locks, reposition any warning signs that were moved and do not allow reentry for a minimum of six or eight hours from the start of aeration. The start of aeration is defined as the time when the first seal is opened. During this time the structure must remain posted with warning signs.

Note: Steps 1 and 2 must be completed in sequence

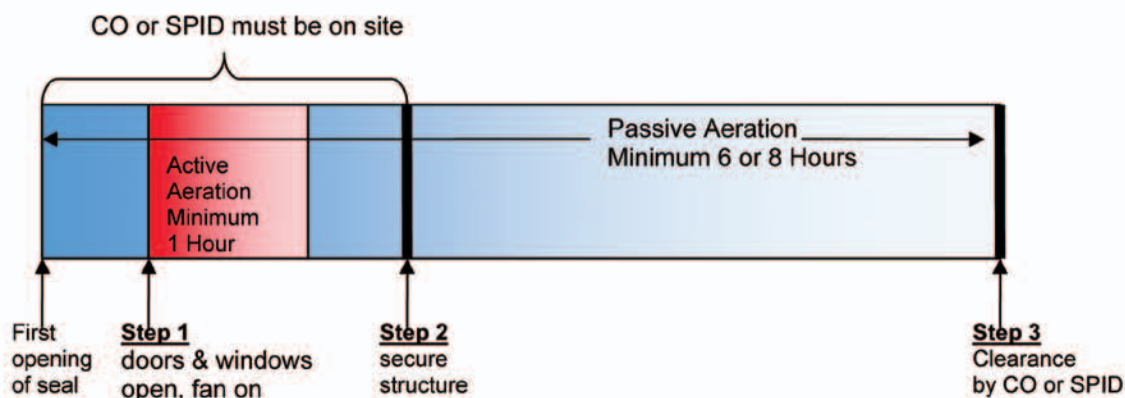
If the initial dosage of SF was calculated to be less than 16 oz/Mcf, Step 3 (below) can begin after a minimum of six hours from the start of aeration (Label Aeration Procedure 1). At a dosage of 16 oz/Mcf or more, Step 3 can commence after a minimum of eight hours from the start of aeration (Label Aeration Procedure 2). This minimum six- or eight-hour period is often referred to as the “passive” aeration period.

Step 3: This is the clearance procedure. After the minimum six- or eight-hour passive aeration period, the fumigator enters the structure with an operable Interscan or Miran detector and measures the concentrations of Vikane® gas fumigant in breathing zones in

each room. If any concentration of Vikane® is greater than 5 ppm, the fumigator must ventilate the structure with all operable doors and windows open for at least ten minutes. The structure may be pronounced “clear” and be reoccupied when the concentration is 5 ppm or less in each room.

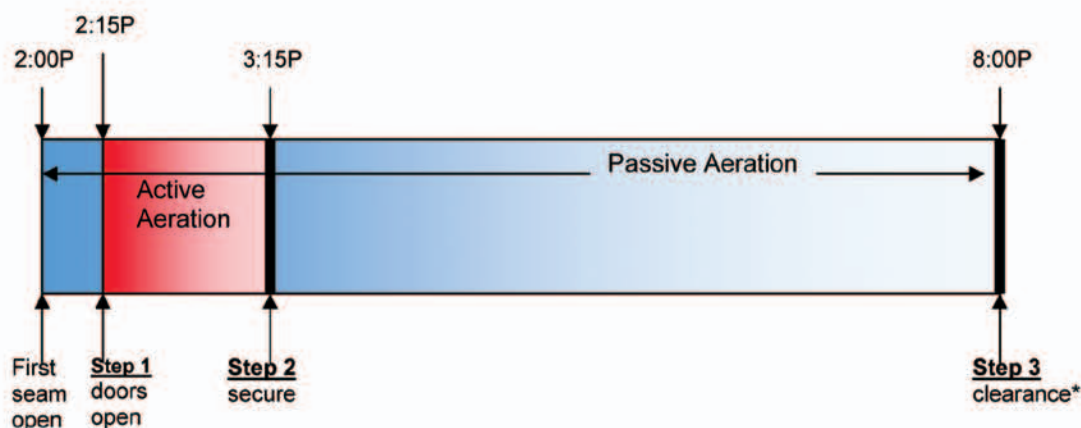
Clearance and Reoccupancy

The CO or SPID must determine that the concentration of SF is below 5 ppm in the breathing zone (area located anywhere between the floor and ceiling [5E-14.102(13)]) of each room – and that beds and bedding therein have been safely ventilated. [5E-14.113(1)]. During the clearance of a unit structure each room in each unit must be individually tested [5E-14.111(3)(b)] with a label-approved device such as an Interscan gas analyzer (Figs. 9-5, 9-6) or a Miran infrared gas analyzer (Fig. 9-7). No person, other than the CO, SPID, or trained crew person, wearing an SCBA, may enter, occupy or reoccupy the fumigated structure for any reason before completion of the aeration procedure(s) and declaration of clearance [5E-14.113(1)]. Each business licensee location must possess and maintain at least two label-approved,



Example 1. 25 Mcf house (less than 16oz/1 Mcf starting dosage).

2:00P First opening of seal
 2:15P Step 1 (doors and widows open, fan[s] running)
 3:15P Step 2 (doors locked after minimum 1 hour active aeration)
 8:00P Step 3 (clearance begins after minimum 6 hours from first opening of seal)



Example 2. 300 Mcf multiunit residence (more than 16oz/1 Mcf starting dosage).

10:00A First opening of seal
 11:30A Step 1 (doors and widows open, fans running)
 2:00P Step 2 (doors locked after 2.5 hour active aeration)
 7:00A Step 3 (clearance begins after overnight [21-hour] aeration)

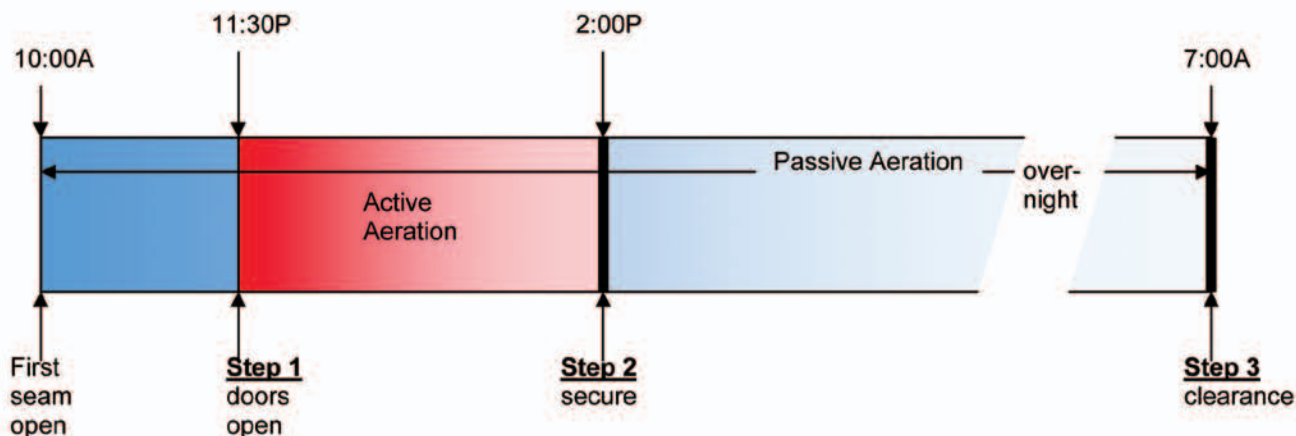


Figure 9-4. Examples of aeration procedure sequences for Vikane®

clearance devices so that at least one is properly functioning at all times in accordance with the fumigant label directions [5E-14.108(7)].

The CO or SPID shall not permit any unauthorized person to enter the structure or enclosed space fumigated until the clearance procedure shows that the entire structure or space fumigated and adjacent vacated structures are safe for human occupancy. When the site is deemed safe, the CO or SPID must conspicuously post written clearance notices (Fig. 9-8) on all entrances of the fumigated structure or enclosed space. The clearance

notices must include the signature of the CO or SPID and the exact date and hour of release for occupancy [5E-14.113(2)]. All chloropicrin containers must be removed from the structure [5E-14.113(1)].

After the building has been cleared and posted, the following final procedures below can be completed:

- remove secondary locking devices
- remove all equipment from site
- lock doors using normal mechanism
- attach dated treatment sticker to water heater or in an attic location

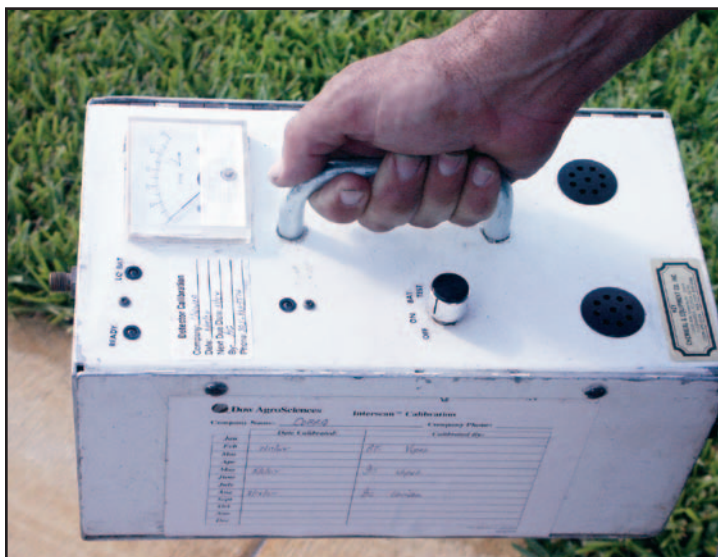


Figure 9-5. Interscan gas analyzer.



Figure 9-6. Interscan connected to wall outlet (note protective carrying case) (left). Interscan gas analyzer with portable battery pack (right).



Figure 9-7. Miran infrared gas analyzer (left). In use (right).



Figure 9-8. After the structure is cleared, notices replace warning signs at each entryway. Example of a posted clearance notice (inset).

Chapter 10

Specialty Fumigations

Although the majority of fumigations are tarpaulin-sealed buildings of less than 100 Mcf, occasionally a fumigator may be asked to bid on a very large, unusual, or challenging structure. Tarpaulin fumigation of structures with very high or large roofs may require the use of cranes, lifts, or hoists to safely and efficiently raise tarps, sand snakes, and clamps to their required locations. For tape-and-seal fumigations, 4-mil polyethylene sheeting secured with masking tape and/or spray adhesive works well to seal vents, doorways – or other, larger potential leakage sites.

Sealing Large or Tall Structures. When the exterior of a large-volume structure cannot be properly sealed without tarpaulins, it is safer and often more economical

to rent a boom lift (Fig. 10-1) or crane (Fig. 10-2) to deliver personnel, tarpaulins, sand snakes, and other heavy loads onto the roof. A boom lift or scissors lift can also be used to perform clamping in high locations (Fig. 10-5). When the pitch of the roof is too steep to allow for delivery of equipment, a worker trained in the use of mountain climbing ropes can assist in securing the tarpaulins (Figs. 10-3, 10-4). Because of added stress on tarps due to wind and weight, clamping intervals should be decreased (Fig. 10-5) and tarp aprons and the weight on them should be increased (Fig. 6-18). If wind is a major factor, consider using ropes to secure tarpaulins. Always install tarpaulins from the upwind side first.



Figure 10-1. Boom lift improves safety and efficiency for tarping large structures (left and right).



Figure 10-2. A crane can deliver tarpaulins near center of roof (left and right).



Figure 10-3. Climbing expertise is required for steep roofs. Photos: M. Weinberg.



Figure 10-4. A belt slide can be used to access vertical or steep sections of tall buildings. Photos: M. Weinberg.



Figure 10-5. Elevated clamping from a boom lift (left) and a scissors lift (right). Note the close spacing of clamp intervals on the left.

Tape-and-Seal and Combination Tarp/Tape Fumigations. Many larger buildings have impermeable walls and roofs (Fig. 10-6). These buildings can be adequately sealed by selective installation of polyethylene sheeting, masking tape, and tarpaulins to seal doorways, windows, and air-handling units (Figs. 10-7, 10-8). Very

small leaks can be sealed with foam sealant. For large doorways, polyethylene sheeting can be secured with overlying furring strips that are secured to the structure with a nail gun (Fig. 10-9). Tape can be used to secure tarpaulins to gas-tight outer walls and fixtures (Fig. 10-10).



Figure 10-6. For this warehouse fumigation, tarpaulins were used to seal larger areas like delivery bays and sturdy air-handling units. Polyethylene sheeting was used for sealing smaller leaks.



Figure 10-7. Smaller and lighter air handlers can be sealed using lightweight 4-mil polyethylene sheeting (left) secured with spray adhesive and masking or duct tape (right).



Figure 10-8. Large and strong air handlers can be covered with tarpaulins and secured with sand snakes (top left and right). Attention to detail is important to prevent unwanted leaks around downspouts and small vents (bottom left and right).



Figure 10-9. Furring strips were nailed into concrete walls (left) using a powder-actuated nail gun to support tarpaulin or 6-mil polyethylene sheeting (bottom right). Sand snakes were used on horizontal surfaces (center and top right).

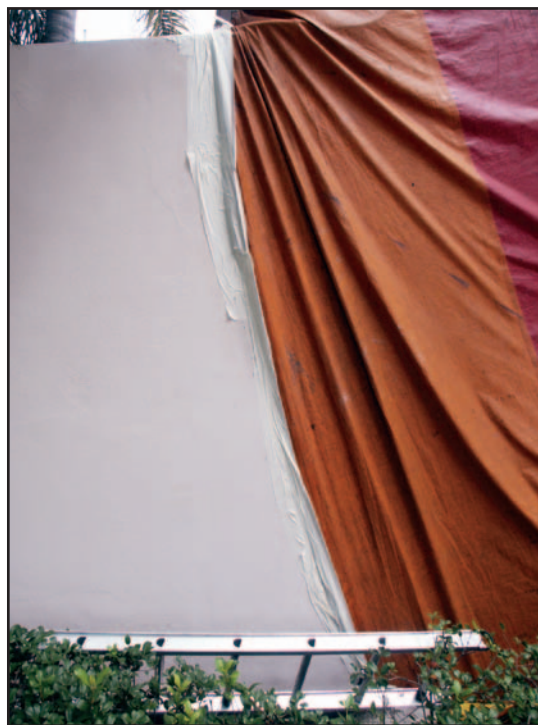


Figure 10-10. Tape can be used to secure a tarpaulin to an impermeable wall.

Compartmental Fumigations. State law defines a compartmental fumigation as a spot fumigation [5E-14.102(7)]. Spot fumigations are useful when the area to be fumigated can be separated by a seal from the remainder

of the structure (Fig. 10-11). Signage, secondary locks, and all other requirements for a fumigation must be adhered to for the entire building in which the spot fumigation is conducted.



Figure 10-11. Here is a good example of fumigating a targeted part of a larger structure. All three photos show only the church pews (infested with drywood termites) were covered and snaked using standard methods. The outside of the church was secured as though the entire church was being fumigated.

Boat Fumigations. The watertight exteriors of boats allow for tape-and-seal fumigations (Fig. 10-12), however, it may be more efficient to use tarpaulins to seal smaller boats or those that have a low profile (Figs. 10-13 to 10-15). Fumigation of pleasure craft, public vessels, or vessels of 15 gross tons or smaller not engaged in passenger service must follow the same procedures that are used for fumigating structures on land. In the rare event

that a commercial oceangoing ship is to be fumigated, the fumigator and ship's captain (or owner) shall follow all applicable regulations under U.S. Coast Guard, DOT, Chapter 1, Part 147A "Interim Regulations for Shipboard Fumigation."

Be sure that the mast connection on sailboats is sealed below deck or that the mast is lowered.



Figure 10-12. Here, 4-mil polyethylene sheeting and nonresidue masking tape is used for a gas-tight seal on a 153-ft. boat.



Figure 10-13. Because sulfuryl fluoride is nearly insoluble in water, tarps can be dropped directly into the water.



Figure 10-14. Note the depression on the bow created by the railings in the boat at right. Provisions for storm runoff were made using a PVC pipe drain leading to a side seam.



Figure 10-15. Sealing this boat in dry dock was accomplished using a combination of standard nylon/vinyl tarpaulins and 4-mil polyethylene sheeting. The poly was used to avoid damage and provide a tighter seal around the tower struts and supports.

Chapter 11

Commodity and Quarantine Fumigation

Commodity and quarantine fumigations are used to eradicate pests from products as they are moved between producers, warehouses, and retail markets. The principles of commodity fumigation are the same as those for structural fumigation: A confined air space is created around a commodity in which a fumigant is released in order to eliminate a pest infesting the commodity.

Quarantine fumigation is simply a commodity fumigation ordered by an importation-regulating agency to protect domestic agriculture from imported exotic plant pests.

The three primary gases used for commodity fumigation are methyl bromide (MB), phosphine or hydrogen phosphide, and recently, sulfuryl fluoride. The

properties of sulfuryl fluoride have been discussed in Chapter 3. Comparisons of physical properties of the three gases are summarized in Table 11-1; use patterns of the three gases are summarized in Table 11-2.

Methyl Bromide

Although methyl bromide (MB) use has become more limited, it is still very important as a commodity fumigant where it is used as a 100% formulation. Fumigants containing MB and either 0.25 or 0.5% chloropicrin are restricted to nonfood applications. MB is an excellent biocide, effective in controlling insects, mites, rodents, weed seeds, nematodes, and many plant disease organisms. Recent research indicates that it is also effective in killing human and livestock pathogens

Table 11-1. Physical properties of commodity fumigants

Fumigant	Methyl bromide	Phosphine	Sulfuryl fluoride
Formula	CH ₃ Br	PH ₃	SO ₂ F ₂
Boiling point	38° F	-125° F	-67° F
Vapor density relative to air	3.3	1.2	3.5
Flammability	Nonflammable	Flammable if exceeds 1.79% of the air volume	Nonflammable
Formulation	Liquid fumigant is contained in pressurized cylinders	Aluminum phosphide, Magnesium phosphide pellets or tablets. PH ₃ and mixtures of PH ₃ and CO ₂ contained in pressurized cylinders.	Liquid fumigant is contained in pressurized cylinders
Incompatibilities	Liquid: aluminum, magnesium, zinc, and alkali metals, some plastics. Exposure to sulfur-containing materials may cause malodors Gas: Exposure to sulfur-containing materials may cause malodors. Decomposes in flame, or glowing filament to produce HBr acid	Solid formulations can spontaneously ignite if contacted by water, acids, or chemicals. Gas: Can corrode copper, brass, copper alloys, and precious metals such as gold and silver. Can react with metallic salts on photographic film	Liquid: Glass, metals Gas: Decomposes in flame, glowing filament to produce HF acid
Threshold Limits	5 ppm	0.3 ppm	5 ppm

Table 11-2. Comparison of uses for different commodity fumigants

Use	Methyl bromide	Phosphine	Sulfuryl fluoride
Processed Food and Food Commodities/Livestock feed/Hay	Yes	Yes	No
Grain, nuts, dried fruit	Yes	Yes	Yes
Fruits and Vegetables	Yes, for most types	Few	No
Empty structures and bins	No	No	Yes
Living plants, including bulbs, corms, tubers, rhizomes, roots, and seeds	Yes	Seeds	No
Railroad cars during transport	No	Yes	No
Trucks and trailers during transport	No	No, unless they are being transported by train or ship	No

such as anthrax. MB can give effective control in only two- to 24-hour treatment duration – depending on concentration. This rapid turnaround time makes it the preferred fumigant for quarantine treatments. Historically, sulfuryl fluoride had largely replaced MB for structural fumigations by the 1990s. In 1992, MB was listed as an ozone-depleting substance and plans were made to reduce and eventually eliminate its use worldwide. By January 2006, MB may be discontinued for all uses except quarantine and preshipment treatments of commodities.

MB is transported as a liquid in compressed gas cylinders (Fig. 11-4), similar to sulfuryl fluoride. It is available in cylinders of 50, 100, 175, 200, 360, and 1500 lbs – as well as, 1- to 1.5-lb. single-use cans. Due to its high boiling point, MB liquid usually must be warmed to at least 130° F by passing it through a heat exchanger so it will rapidly convert to a gas at the end of the shooting hose. Note: MB should not be used if the temperature in the commodity will drop below 45° F.

Personal protection equipment for use when releasing the gas from the cylinder of MB includes face shield (Fig. 11-4) or safety glasses with brow and temple sideshields. Do not wear goggles or contact lenses when handling MB because goggles or contact lenses can catch and hold liquid fumigant to the eyes. This increases tissue freeze/chemical damage in case of an accidental exposure. Wear long-sleeved shirts, long pants, shoes and socks (Fig. 11-4). Do not wear sandals or rubber boots. Rubber boots, rubber protective clothing, tight clothing, and jewelry may catch and hold fumigant on

the skin causing chemical burns to become more severe. Do not wear gloves while releasing gas from the cylinder for the same reason. You must use a self-contained breathing apparatus (SCBA) in the presence of MB if the concentration is greater than 5 ppm or the concentration is unknown.

MB detectors include halogen (halide) flame detectors, thermal conductivity detectors (Fumiscope® or GOW-MAC, Fig. 11-5), electronic detectors: including electrochemical detectors, photoionization detectors (PID), and infrared detectors, and colorimetric detector tubes for clearance (e.g., Kitagawa tubes, Fig. 11-8). Colorimetric detector tubes directly read MB content in a specific volume of air. They are used for clearance confirmation because they do not suffer from electronic or sensor failure that leads to false negative results.

MB cylinders should be stored, transported, and recycled similar to sulfuryl fluoride cylinders. Review the label and product training manuals for specific requirements. Partially empty single-use cans should never be stored. Cans are not returnable containers. Empty cans should be aerated in a secure, remote location for 12 hours before disposal. They can then be recycled or disposed of in a sanitary landfill, depending on local regulations.

Commodity Fumigations in Florida

In Florida, most commodity fumigations are conducted at major ports of entry on fresh, imported fruits and vegetables, and some stored products that arrive in cargo containers. All port fumigations use MB because

these treatments must be effective against a wide range of pests, be done quickly, and be nondamaging to the commodity. Agricultural inspectors with the U.S. Department of Homeland Security, Customs and Border Protection, review ship or airplane manifests and inspect incoming containers for prohibited – and allowed – agricultural products. Inspectors determine which commodities must be fumigated before they can be delivered to market. The presence or potential presence of an “actionable” pest will require that the entire container be fumigated. Each required fumigation is directed and supervised by a USDA-Animal and Plant Health Inspection Service (APHIS) Plant Protection and Quarantine (PPQ) officer. The PPQ officer determines the dosage of MB by referring to the PPQ Treatment Manual. The manual stipulates the exposure time and MB concentration based on the type of commodity and temperature. The officer then determines the amount of MB to be applied based on the volume of the container. A CO or SPID who is paid by the commodity importer conducts the fumigation per FDACS regulations.

Figures 11-1 to 11-8 illustrate the sequence of procedures and equipment involved in a typical MB container fumigation at a seaport.



Figure 11-1. A PPQ inspector takes the internal temperature of a commodity (chayote) that requires fumigation. Most fresh commodities are refrigerated and are colder than ambient air when fumigated.



Figure 11-2. Fruit boxes are removed from the top of the container (trailer) to form a 2-ft headspace to aid in MB circulation (right). MB shooting fan and shooting hose in the container headspace (top left). Boxes from headspace are placed under the same container from which they were removed (bottom left).



Figure 11-3. The container is tarped, snaked, and clamped as in a typical structural fumigation. Some containers can be taped and sealed, requiring a separate fumigation for the boxes removed from the headspace. The fumigation is conducted in a secure location marked with warning signs on the container (top left) and around the secured area (bottom left).



Figure 11-4. Methyl bromide is introduced into the commodity container in Fig 11-3. A 100-lb. cylinder of 100% MB is resting on a top loading scale that has been adjusted to read the desired weight loss. MB flows from the open valve into a heat exchanger (upper right) that converts the liquid into a hot gas ($>130^{\circ}\text{F}$) exiting through the heat resistant red shooting hose. Note the SPID is wearing a full face shield, long-sleeve shirt, long pants, socks and shoes, but no gloves.

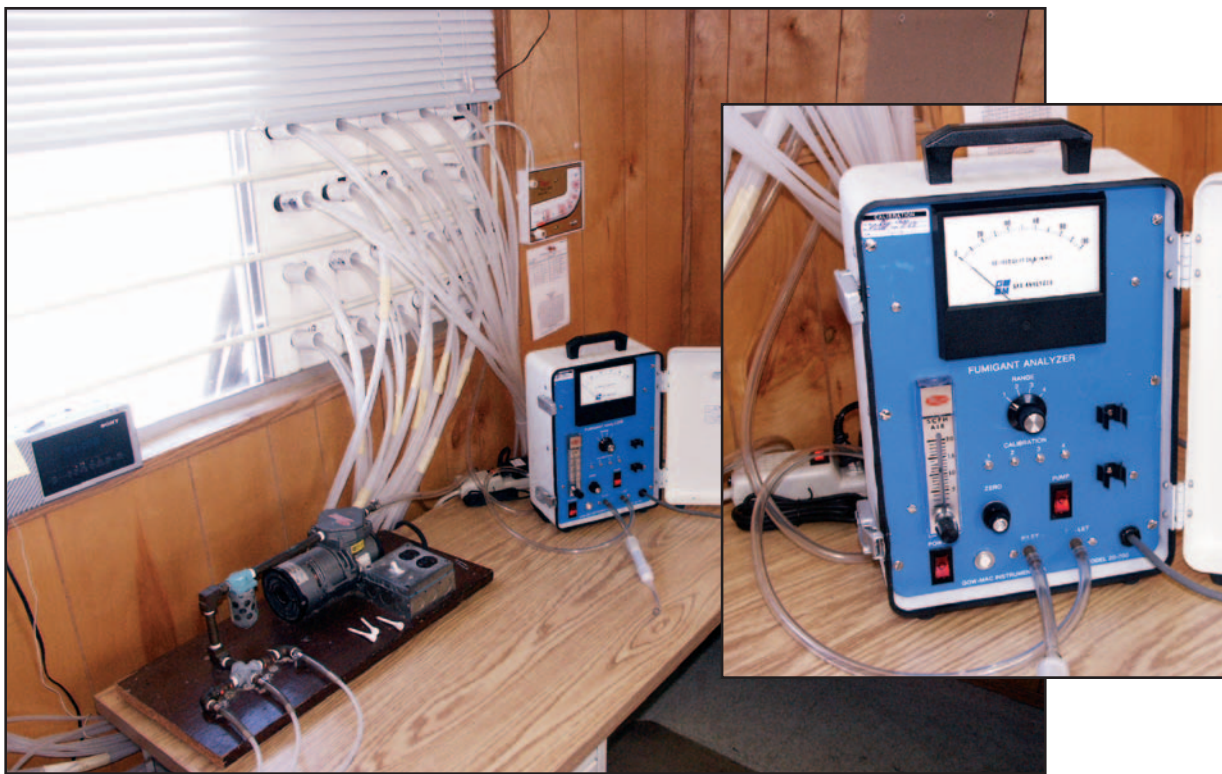


Figure 11-5. Monitoring station. After the fumigant has been introduced, air samples from inside the tarped container are drawn through the monitoring tubes and the concentration of fumigant is determined using a GOW-MAC gas analyzer (right). Four monitoring lines (three inside and one below container) are measured. The golf tees by the vacuum pump seal the monitoring tubes when the tubes are not in use.



Figure 11-6. Passive aeration proceeds by removing clamps and snakes. The tarpaulin is removed a few minutes later.



Figure 11-7. Active aeration proceeds by forcing air into container with one fan and pulling air out with a second fan. Note that boxes under container continue to aerate passively.



Figure 11-8. The commodity is cleared for release after 5 ppm or less MB is detected. The SPID, wearing an SCBA, is using a Kitagawa tube and pump apparatus (top right).

Phosphine

Phosphine or hydrogen phosphide (PH_3) is a toxic gas produced when water vapor reacts with either aluminum phosphide or magnesium phosphide. It is also available as a compressed gas mixture of 2% phosphine and 98% CO_2 called ECO₂Fume® Fumigant Gas and a compressed gas of 100% phosphine called VAPORPH₃OS® that is mixed with CO_2 at the time of introduction for large fumigations.

Phosphine is often used to fumigate commodities because it is easy to use and has a wide range of applications. Its disadvantages are that it can be corrosive to certain metals: copper, copper alloys like brass and bronze, silver, and gold – widely used in electronic equipment, wiring, motors, and plumbing fittings. Further, when phosphine is present in high concentrations with oxygen, it can spontaneously ignite. Corrosion can occur when phosphine exceeds 100 ppm and the relative humidity exceeds 50% (Fig. 11-9). Warm, humid conditions increase the danger of corrosion.

Phosphine gas at concentrations at or above 18,000 ppm – or 1.8% by volume – can spontaneously ignite in the presence of oxygen. Fortunately, these high concentrations rarely occur during normal fumigations. On the other hand, small volumes of gas inside piles of pellets or tablets of metallic phosphide in humid conditions can

reach these concentrations and spontaneously ignite. For this reason, bulk pellets or tablets should always be spread out in a single layer in their holding containers. Occasionally, pellets or tablets remaining in a partially used flask can react with moisture in the air to generate phosphine gas. When the container is opened again and allows oxygen in, a small flame or explosion may be generated. For this reason, previously opened flasks should always be aimed away from the face and eyes when they are subsequently opened.

Manufacturers have worked to improve the safety and convenience of using metal phosphides. Metallic phosphides are often formulated with nontoxic ammonium carbamate ($\text{NH}_2\text{COONH}_4$). Ammonium carbamate breaks down to yield two ammonia molecules (NH_3) and one carbon dioxide molecule (CO_2). The ammonia acts as a temporary warning agent or odorant and the carbon dioxide helps to minimize ignition dangers. Carbon dioxide is also mixed with phosphine gas in cylinders to prevent ignition when it is released into the fumigation space. Prepackaged, gas-permeable blister packs (Fig. 11-10) hold individual tablets separately and allow the gas to slowly escape while retaining the solid residual material and preventing it from contaminating the commodity. This makes posttreatment cleanup simple and easy.



Figure 11-9. Corrosion of copper alloy (brass) fixtures due to high humidity, warm temperatures, and phosphine concentrations above 100 ppm. Photo courtesy of Degesch America.



Figure 11-10. Prepackaged tablets are secured in gas-permeable blister packs that allow the gas to escape while retaining the powdery residue. This is a prepackaged form called ropes. Photo courtesy of Degesch America.

The metallic phosphides are produced in rounded tablets (3 grams) that yield about 1 gram of phosphine gas. The smaller pellets (0.6 gram) yield 0.2 grams of phosphine gas. The treatment rates vary with type of fumigation, but generally average 33 grams of gas (33 tablets or 165 pellets) per 1,000 cu. ft. of volume. Aluminum phosphide normally requires a minimum exposure time of 48 hours for pellets and 72 hours for tablets and the reaction rate is dependent on temperature and humidity. The required exposure period can extend to 192-240 hours (8-10 days) at 40-53° F. Do not fumigate with phosphine if the temperature is below 40° F. Magnesium phosphide requires a minimum exposure time of 36-48 hrs, depending on formulation, because it produces more gas in a shorter period of time. These relatively long treatment periods are the main reason that phosphine is seldom used for quarantine fumigations. For convenience, tablets and pellets are packaged in a variety of forms such as sheets of 33 tablet blister packs, 32 sheet long strips called ropes, gas permeable bags, bag belts (equal to 4 bags), and bag blankets (equal to 100 bags).

Personal protection equipment for handling metallic phosphide includes dry gloves if handling pellets, tablets, or spent residual dust. Gloves are not required if fumigant and spent residue are confined in packaged products. No respiratory protection is needed if the concentration of phosphine gas is less than 0.3 ppm. If the concentration is between 0.3-15 ppm, a fullface canister gas mask for phosphine is acceptable (Fig. 11-11). If the

concentration of phosphine gas is greater than 15 ppm or the concentration is unknown, a Self-Contained Breathing Apparatus (SCBA) is required (Fig. 11-11).

Hydrogen phosphide detector tubes are available to measure high and low concentrations. Low-level detector tubes are used for industrial hygiene monitoring and clearing the fumigation. Samples for industrial hygiene monitoring should be taken around the outside of the fumigation site at the height of a worker's breathing zone. These samples should be taken periodically as spot checks – and whenever a garlic-like or ammonia odor is detected.

Treatment using metallic phosphides is very simple. The volume to be fumigated is calculated. The container to be fumigated is made as air tight as possible by sealing vents or tarping the container. A sampling line is installed if gas concentrations are to be monitored. When the container or structure is ready, the appropriate quantity of tablets, pellets, or prepackaged material is counted and placed inside the space to be fumigated.

Phosphine gas is released from metallic phosphide relatively slowly. But, in hot and/or humid conditions, it is advisable to wear respiratory protection during placement of solid fumigant because these conditions can speed up phosphine generation – and gas levels may exceed safe thresholds in a short period of time. In addition, the tablets or pellets should be spread out as much as possible to promote more rapid distribution of the gas to equilibrium (Fig. 11-12).



Figure 11-11. A canister gas mask with full face shield can be used in phosphine concentrations between 0.3-15 ppm (left). Above 15 ppm or if concentration is unknown, a SCBA is required (right). Photo courtesy of Degesch America.



Figure 11-12. Use of aluminum phosphide prepackaged rope. Photo courtesy of Degesch America.

Pellets can be mixed directly with grain during the loading process or can be injected after the grain is in place. The presence of the metal hydroxide residue is not a concern in grain because it is removed during the cleaning process before grinding the grain into meal or flour.

Railroad cars can be treated with phosphine during transit (Fig. 11-13). Containers and semitrailers may be fumigated with phosphine but only if they are being shipped on board a train or ship. Fumigation warning signs and required opening instructions must be secured to the outside of the railcar or container. The fumigator or trained person opening the car must use protective equipment if the phosphine concentration is greater than

0.3 ppm or unknown. The shipper of a railcar under fumigation is required to notify the receiver that the fumigated railcar is in transit to their location. This allows the receiver to have a licensed fumigator or trained person prepared to open and clear the shipment when it arrives. The fumigator who opens and clears the railcar at the destination is almost never the one who introduced the fumigant before departure. That is why the opening instructions are so important: They tell what and how much fumigant was used, when it was applied, where the fumigant was placed, what safety equipment is needed, etc.



Figure 11-13. Methods of securing metallic phosphide products during railcar shipment. Metallic phosphide packets can be secured to cardboard to facilitate recovery of spent packets (left). Packets can be secured under hatches by covering opening with a permeable cloth, placing the phosphide packets on the cloth, and sealing with plastic film (right). Photos courtesy of Degesch America.

Disposal of spent metallic phosphide materials is relatively simple (Fig. 11-14). The dry method requires the spent residue or prepackaged products to be placed in a ventilated metal container that allows any residual metallic phosphide to finish reacting and the phosphine produced to be dissipated in the air. This container must be secured in an open, well-ventilated area away from people.

The wet method involves submerging the spent material in containers of water for 6-36 hours depending on the formulation. This forces any residual metallic phosphide to react with water and the liberated phosphine escapes into the air. Respiratory protection must be worn if the material is being deactivated using the wet method under one of the following conditions: if the material is only partially spent; or the amount of metallic phosphide present is unknown. The residual material should be held below the surface with enough weight to keep it from floating to the surface. Partially spent packages could ignite if they float to the surface. After using either method, the remaining metal hydroxides can be disposed of in a landfill. The fully reacted residue and packaged products are considered special waste and are not considered toxic waste.

Sulfuryl Fluoride

In January 2004, USEPA registered SF for use on certain food products. Dow AgroSciences will market this label of SF under the name ProFume® Gas Fumigant. Under this registration, SF can be used for postharvest control of insect and rodent pests infesting cereal grains, dried fruit and tree nuts in mills, processing plants, storage facilities, and transportation vehicles for these

commodities. Expanded uses for SF in commodity and quarantine fumigations are also anticipated. The structural uses, properties, and safety requirements for SF are discussed in Chapters 3-9.

Museum Fumigations

Museums are specialized situations that store a wide variety of valuable and vulnerable materials that could be damaged by numerous stored product, fabric, wood, and paper pests. Wooden artifacts, wool clothing, books, papers and parchments, dried plant specimens, and mammal and bird museum specimens can be destroyed by pests like wood-destroying insects, clothes moths and carpet beetles, cockroaches, silverfish, cigarette and drugstore beetles, and dermestid hide beetles. Most museums have programs in place to reduce the risk of introduction of pests including fumigation of all material brought into the museum. The fumigant of choice for these vault or chamber fumigations is sulfuryl fluoride. Follow the Vikane label for anticipated pests. Vault fumigations are usually shot at the 10X rate to ensure killing the eggs of pest beetles.

Phosphine may corrode copper, brass, bronze, gold, and silver artifacts and materials containing these metals such as electronic equipment and photographic negatives. MB can react with sulfur-bearing compounds in artifacts and specimens containing leather, feathers, fur, animal skins, and foam rubber protecting fragile objects. The dimethyl disulfide produced when MB reacts with certain sulfur-bearing compounds results in an unpleasant odor. These problems make phosphine and MB undesirable for museum fumigations.



Figure 11-14. Deactivation of spent metallic phosphide. Dry (left) and wet methods (right). Photos courtesy of Degesch America.

Additional Resources

Commodity and quarantine fumigations are highly specialized forms of pest control. This chapter is meant as an introduction to this category of fumigation. Below is a list of resources available on the Internet for those of you that are interested in more information on this topic:

Bond, E. J. 1989. Manual of fumigation for insect control. Food and Agriculture Organization of the United Nations, Plant Production and Protection Paper 54. <http://www.fao.org/docrep/X5042E/X5042E00.htm>

Degesch America, Inc. for training manuals, labels, and MSDSs for phosphine products. <http://www.degeschamerica.com/index.shtml>

Great Lakes Chemical Corporation. 1998. Fumigation Guide. <http://www.e1.greatlakes.com/agproduct/pdf/FUMI-GATI.PDF>

Great Lakes Chemical Corporation Methyl Bromide product labels and MSDSs.

Two Product lines for methyl bromide:

- Quarantine label/MSDS at <http://www.e1.greatlakes.com/agproduct/quarantine.html>
- Commodity label/MSDS at <http://www.e1.greatlakes.com/agproduct/commodity.html>

USDA-Animal and Plant Health Inspection Service, Plant Protection and Quarantine. 2002. Treatment Manual. http://www.aphis.usda.gov/ppq/manuals/pdf_files/TM.pdf

Publications

Anonymous. 2003. Vikane Gas Fumigant Structural Fumigation Manual. Dow AgroSciences LLC, Indianapolis, IN.

Bennett, G.W, J.M. Owens, and R.M. Corrigan. 2003. Truman's Scientific Guide to Pest Management Operations, 6th Ed. Advanstar Communications, Cleveland, OH.

Thoms, E., and T. Phillips. 2004. Fumigation. *In*: A. Mallis, Handbook of Pest Control, 9th Ed. GIE Media, Inc., Cleveland, OH.

School of Structural Fumigation

The University of Florida School of Structural Fumigation (formerly Broward Community College Florida School of Structural Fumigation) is a one-week, intensive program providing instruction on all aspects of structural fumigation. Offered every November at the UF/IFAS Ft. Lauderdale Research & Education Center.

<http://conference.ifas.ufl.edu/fumigation/>

Renny Perez is the Director. For more information call Dr. Brian Cabrera at (954) 577-6363, Dr. Bill Kern at (954) 577-6329, or Sarah Kern at (954) 577-6383.

Appendix

2

Safety Checklist

Personal protection of fumigators and fumigation employees, as well as the public at large, is of utmost importance. Below is a list of safety recommendations based on the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); Occupational Safety and Health Administration (OSHA), National Fire Protection Association (NFPA), and industry-proven or best management practices(BMP).

Fumigation Employee Personal Safety

- eye protection
- slip-resistant footwear
- certification in first aid and CPR
- fire extinguishers at job sites
- ladders with nonslip bases
- training in proper lifting techniques

Fumigant Storage

- local requirements met (indoor or outdoor)
- storage area locked when unattended (indoor or outdoor)
- storage area posted with “Poisonous Gas” placard (indoor or outdoor)
- indoor storage ventilated from floor to wall or roof
- indoor storage with continuous ventilation fan
- cylinders upright
- valve caps and bonnets on
- cylinders secured in position

Fumigant Respiratory Protection

- two SCBAs at each release and initial aeration site
- two people trained in SCBA at each release and initial aeration site
- SCBAs inspected regularly
- SCBA air tanks equipped with low-capacity alarms

Fumigation Vehicle

- placards on all sides
- annual inspection reports/labels
- inspection records
- preventative maintenance checklist
- shipping papers on board
- hazmat registration on board
- equipment secured
- MSDSs and Labels on board
- first aid kits available
- state DOT numbers on sides of vehicle
- tires and vehicle condition in good shape
- fire extinguisher on board

DOT Hazmat Driver Qualifications

- commercial driver's license and certificate of compliance
- certification of road test
- annual list of traffic violations
- annual review of driving record
- controlled substance test
- controlled substance training materials

Appendix

3

State Pest Control Statutes and Rules

Sections of 482 pertaining to fumigation - All sections of 482 shall be understood before certification examination.

FLORIDA STATUTES: CHAPTER 482 PEST CONTROL

482.021 Definitions. For the purposes of this chapter, and unless otherwise required by the context, the term:

(3) "Category" means a distinct branch or phase of pest control for which a pest control operator's certificate may be issued such as: fumigation, general household pest control, termites and other wood-destroying organisms pest control, lawn and ornamental pest control, and such a combination or division of such branches of pest control as the department may by rule establish.

(8) "Fumigant" means a chemical which, at a required temperature and pressure, can exist in the gaseous state in sufficient concentration to be lethal to a given organism. This definition implies that a fumigant acts as a gas in the strictest sense of the word. This definition excludes aerosols that are particulate suspensions of liquids or solids dispersed in air.

(9) "Fumigation" means the use, within an enclosed space or in or under a structure or tarpaulins, of a fumigant in concentrations that may be hazardous to human beings.

(21) "Pest control" includes:

(d) All phases of fumigation, including:

1. The treatment of products by vault fumigation; and
2. The fumigation of boxcars, trucks, ships, airplanes, docks, warehouses, and common carriers;

(25) "Special identification cardholder" means a person to whom an identification card has been issued by the department showing that the holder is authorized to perform fumigation.

482.051 Rules.--The department has authority to adopt rules pursuant to ss.120.536(1) and 120.54 to implement the provisions of this chapter. Prior to proposing the adoption of a rule, the department shall counsel with members of the pest control industry concerning the proposed rule. The department shall adopt rules for the protection of the health, safety, and welfare of pest control employees and the general public which require:

(4) That a licensee, before performing general fumigation, notify in writing the department inspector having jurisdiction over the location where the fumigation is to be performed, which notice must be received by the department inspector at least 24 hours in advance of the fumigation and must contain such information as the department requires. However, in an authentic and verifiable emergency, when 24 hours' advance notification is not possible, advance telephone or telegraph notice may be given; but such notice must be immediately followed by written confirmation providing the required information.

(6) That the department may issue an immediate stop-use or stop-work order for fumigation performed in violation of fumigant label requirements or department rules, or in a manner that presents an immediate serious danger to the health, safety, or welfare of the public, including, but not limited to, failure to use required personal protective equipment, failure to use a required warning agent, failure to post required warning signs, failure to secure a structure's usual entrances as required, or using a fumigant in a manner that will likely result in hazardous exposure to humans, animals, or the environment.

482.111 Pest control operator's certificate.

(2)(a) The department shall issue pest control operator's certificates in several categories, including fumigation, general household pest control, lawn and ornamental pest control, and termites and other wood-destroying organisms pest control.

(9) In the event of the loss of a certified operator in charge or other emergency, one or more emergency pest control certificates may be issued by the department, upon the request of the licensee, to one or more designated identification

cardholders for a period of 30 days. The department may issue additional emergency certificates to one or more designated identification cardholders for periods not exceeding 30 days, for up to a maximum of 1 year. The sum of the periods for which emergency certificates are issued to the same licensee may not exceed 1 year during any 3-year period except in the event of the death of a certified operator in charge, in which case, additional emergency certificates may be issued for an extension of up to 120 days. The department shall collect \$50 for each emergency certificate issued. Upon request by the department, the licensee shall submit interim reports at 30-day intervals containing documented evidence indicating specific actions being taken by the licensee to fill the vacancy created by the loss of a certified operator in charge. The department shall adopt rules and prescribe forms for this purpose; however, an emergency certificate may not be issued in the category of fumigation.

(10) Prior to the expiration date of a certificate, the certificate holder must complete 2 hours of approved continuing education on legislation, safety, pesticide labeling, and integrated pest management and 2 hours of approved continuing education in each category of her or his certificate or must pass an examination given by the department. The department may not renew a certificate if the continuing education or examination requirement is not met.

(a) Courses or programs, to be considered for credit, must include one or more of the following topics:

1. The law and rules of this state pertaining to pest control.
2. Precautions necessary to safeguard life, health, and property in the conducting of pest control and the application of pesticides.
3. Pests, their habits, recognition of the damage they cause, and identification of them by accepted common name.
4. Current accepted industry practices in the conducting of fumigation, termites and other wood-destroying organisms pest control, lawn and ornamental pest control, and household pest control.

482.132 Qualifications for examination and certification.

(2) Each applicant for examination for a pest control operator's certificate must possess the minimum qualifications specified in one of the following paragraphs:

(e) Twenty-four semester hours or 36 quarter hours of courses in entomology, pest control technology, and related subjects, plus 1 year of employment as a service employee of a licensee that performs pest control in the category of general household pest, termite, and fumigation. Such an applicant is qualified only for examination in the categories of general household pest control, termite and other wood-destroying organisms pest control, and fumigation.

482.151 Special identification card for performance of fumigation.

(1) Any individual who performs fumigation must be a special identification cardholder, unless such individual is a certified operator who is certified in the category of fumigation. When performing fumigation, a special identification cardholder or certified operator may act only under the direction and supervision of the certified operator in charge.

(2) The department shall prescribe by rule the qualifications, privileges, duties, and limitations of holders of special identification cards.

(3) The department may issue special identification cards to qualified individuals who pass written examinations that may include practical demonstration. The application forms shall be prescribed by the department.

(4) The department, in its rules, shall provide for such matters as required qualifications for applicants for examination, written or practical phases or categories of examinations, and time of examinations. The fee for an examination shall be set by the department but may not be more than \$200 or less than \$100 for each category; however, until rules setting these fees are adopted by the department, the fee for each category shall be \$100.

(5) An application must be made and the issuance fee paid to the department for an original special identification card within 60 days after the postmark date of written notification of passing the examination. The fee for issuance of an original special identification card shall be set by the department but may not be more than \$100 or less than \$50; however, until a rule setting this fee is adopted by the department, the fee shall be \$50. During a period of 30 days following expiration of the 60-day period, an original special identification card may be issued; however, the department shall assess a late issuance charge of \$25, which must be paid in addition to the issuance fee. An original special identification card may not be issued after expiration of the 30-day period, without reexamination.

(6) An application to the department for renewal of a special identification card must be made on or before an anniversary date set by the department. The fee for renewal of a special identification card shall be set by the department but may not be more than \$100 or less than \$50; however, until a rule setting this fee is adopted by the department, the

renewal fee shall be \$50. After a grace period not exceeding 30 calendar days following such renewal date, the department shall assess a late renewal charge of \$25, which must be paid in addition to the renewal fee.

(7) Unless timely renewed, a special identification card automatically expires 180 calendar days after the anniversary renewal date. Subsequent to such expiration, a special identification card may be issued only upon successful reexamination and upon payment of examination and issuance fees due, as provided in this section.

(8) Prior to the expiration date of a special identification card, the cardholder must:

- (a) Complete 2 hours of approved continuing education on legislation, safety, and pesticide labeling and 2 hours of approved continuing education in the fumigation category; or
- (b) Pass an examination in fumigation given by the department.

(9) If a special identification cardholder becomes a member of the Armed Forces of the United States on active duty, the renewal fee and continuing education requirements are waived while the individual remains on active duty as a member of the Armed Forces.

482.152 Duties of certified operator in charge of pest control activities of licensee.

A certified operator in charge of the pest control activities of a licensee shall have her or his primary occupation with the licensee and shall be a full-time employee of the licensee, and her or his principal duty shall include the responsibility for the personal supervision of and participation in the pest control activities at the business location of the licensee as the same relate to:

- (1) The selection of proper and correct chemicals for the particular pest control work performed.
- (2) The safe and proper use of the pesticides used.
- (3) The correct concentration and formulation of pesticides used in all pest control work performed.
- (4) The training of personnel in the proper and acceptable methods of pest control.
- (5) The control measures and procedures used.
- (6) The notification of the department of any accidental human poisoning or death connected with pest control work performed on a job she or he is supervising, within 24 hours after she or he has knowledge of the poisoning or death.

482.211 Exemptions. This chapter does not apply to:

- (1) Pest control, except for fumigation, performed by a person upon her or his own individual residential property.

482.243 Pest Control Enforcement Advisory Council.

(1) The Pest Control Enforcement Advisory Council is created within the department. The Commissioner of Agriculture shall appoint all members of the council. The purpose of the council is to advise the Commissioner of Agriculture regarding the regulation of pest control practices and to advise government agencies with respect to those activities related to their responsibilities regarding pest control. The council shall serve as the statewide forum for the coordination of pest control related activities to eliminate duplication of effort and maximize protection of the public.

(2) The council shall consist of 11 members as follows: a representative of the department; a citizen not involved in the conduct of pest control; a state university urban entomologist; and eight persons each holding a pest control operator's certificate issued under s. 482.111, of whom two shall be actively involved in termite control, two shall be actively involved in general household pest control, two shall be actively involved in structural fumigation, and two shall be actively involved in lawn and landscape pest control. Each member shall be appointed for a term of 4 years and shall serve until a successor is appointed.

Sections of 5E-14 pertaining to fumigation - All sections of 5E-14 shall be understood before examination.

FLORIDA ADMINISTRATIVE CODE: CHAPTER 5E-14 ENTOMOLOGY - PEST CONTROL REGULATIONS

PART NO. 1 PUBLIC HEALTH AND SAFETY

5E-14.102 Definitions.

In addition to those terms contained in Section 482.021, F.S., the following terms shall mean:

- (1) "Application of fumigant(s)" – Release of fumigant(s) into structure or enclosed space.
- (2) "Fumigation operation" – All details prior to application of fumigant(s), the application of fumigant(s), fumigation period and post fumigation details as herein outlined.
- (3) "Fumigation period" – Period of time from application of fumigant(s) until the ventilation of structure is completed, and the structure is declared safe for occupancy.
- (4) "General fumigation" – Application of fumigant(s) to one (1) or more rooms or their contents in a structure or to entire structure; or to commodities under gas-tight sheets or tarpaulins.
- (7) "Spot fumigation" – Application of fumigant to localized harborage or infestation within, on or under a structure or enclosed space, or to a lawn under tarpaulins.
- (9) "Multi-Unit structure" – A structure, consisting of one or more stories, composed of functionally distinct units, such as stores, offices, apartments, townhouses, and condominiums, in which units share a common wall of wood or metal studs or single masonry walls, including fire walls.
- (11) "Multi-unit dwelling" is defined as a multi-unit structure whose primary function is to serve as living quarters for people, such as apartment buildings, condominiums, duplexes, and town homes.
- (12) "Direct Supervision" requires the personal presence of either the certified fumigation operator or his or her special fumigation identification cardholder at the fumigation job site.
- (13) "Breathing Zone" is defined as the area of space in each room of a fumigated structure located anywhere between the floor and ceiling.
- (14) "Secondary Locking Device" is defined as any device, method or barricade, in addition to existing locking mechanisms, that is demonstratively effective in preventing an exterior door or entrance from being opened or entered by normal means by anyone other than the certified operator in charge or his special fumigation identification cardholder.
- (15) "Barricade and Barring" is defined as the use of any material(s) that would physically prevent a person's access to the structure by way of any entrance or opening by normal means.
- (16) "Access device" is defined as a lockbox or other on-site device that stores the key to the fumigated structure.

5E-14.105 Contractual Agreements in Public's Interest - Control and Preventive Treatment for Wood-Destroying Organisms.

- (1) Each licensee must enter into a written contract with the property owner or his authorized agent for each treatment for control or prevention of wood-destroying organisms.
- (2) Such contract or an exact facsimile thereof must be given to the property owner or his authorized agent for acceptance or rejection before any portion of the work is done and before payment, in part or in full, is received by the licensee. The contract shall clearly set forth the following information:
 - (a) The complete name and address of the property owner or authorized agent and the complete address of the property to be treated.
 - (b) All buildings or structures on the property to be included for treatment.
 - (c) The complete name and business address of the licensee.
 - (d) The date upon which the written contract is entered into, the period of time covered by the contract, and renewal option, if any.
 - (e) The complete common name(s) of the wood-destroying organism(s) to be controlled.
 - (g) Whether or not reinspections are to be made under the contract and, if so, approximate time intervals between reinspections, and fees other than renewal fees for same, if any.
 - (h) The conditions under which retreatments (for reinfestation) will be made; and conditions under which repairs will be made, if any.

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- (i) The total maximum price to be charged for treatment service, the exact annual renewal fees to be charged under the contract, if any; and the total maximum price to be charged for structural repairs, if any, shown separately.
 - (j) If the performance of the work is guaranteed by any type or form of bond, the obligations of the bond shall be set forth specifically: i.e., necessary retreatments, repairs, etc. in wording identical to that in the bond itself.
 - (k) The signature of the licensee or his authorized representative, and the signature, or when unavailable the verbal consent, of the property owner or authorized agent.
- (6) When periodic reinspections or retreatments are specified in wood-destroying organisms preventive or control contracts, the licensee shall furnish the property owner or his authorized agent, after each reinspection or retreatment, a signed report of the condition of the property with respect to presence or absence of wood-destroying organisms covered by the contract and whether retreatment was made. A copy of the inspection report shall be retained by the licensee for a period of not less than three (3) years.
- (7) A structure shall not be knowingly placed under a second contract for the same wood-destroying organism control or preventive treatment in disregard of the first contract, without first obtaining specific written consent in letter form signed by property owner or authorized agent.

5E-14.108 Fumigation Requirements - General Fumigation.

- (1) Each general fumigation (subsection 5E-14.102(4), F.A.C.) shall be personally directed, supervised and performed by a certified fumigation operator or personally by a special fumigation identification card holder authorized by the Department and designated by and under the direction and supervision of the certified fumigation operator in charge (Section 482.151, F.S.). Such certified fumigation operator or his designated special fumigation identification card holder shall be available and on call at all times during the fumigation period (subsection 5E-14.102(3), F.A.C.) of each general fumigation (subsection 5E-14.102(4), F.A.C.) job in progress.
- (2) During a general fumigation, whenever the presence of two (2) persons trained in the use of the fumigant is required by the fumigant label, at least one of these persons must be either the certified operator in charge of fumigation or his designated special fumigation cardholder, and the second trained person can be a certified fumigation operator, a special identification cardholder or an identification cardholder. Two (2) trained persons shall be present at each fumigation site for the introduction of the fumigant, entry during fumigation and from the start of aeration (first opening of the seal) until the active aeration period with all operable doors and windows open, if required by the fumigant label is completed and the structure is secured for the remaining aeration period. The certified operator in charge of fumigation or his designated special identification cardholder shall be present at those times required by the fumigant label or by subsections 5E-14.108(1), 5E-14.111(4), 5E-14.112(1), and 5E-14.113(1) and (2), F.A.C.
- (3) It shall be the duty of the certified operator in charge of fumigation to carry out the following:
- (a) Train and/or verify training to each special fumigation identification cardholder in proper fumigation procedures as required by regulations and fumigant label directions, and to know the location, purpose, use and maintenance of personal protective equipment and fumigant detection and safety devices and when and how to use this equipment.
 - (b) Train each identification cardholder, assigned to fumigation work, in basic fumigation procedures, SCBA (self contained breathing apparatus) use and the proper use of fumigant safety equipment and to report immediately to the certified operator in charge or his special fumigation identification cardholder any irregularities or emergencies.
- (4) The Department shall issue an immediate stop-use or stop-work order, DACS 13659 (03-02), incorporated by reference, for fumigation performed in a manner that presents an immediate serious danger to the health, safety or welfare of the public. Fumigant use or work cannot be resumed until corrections are made, verified and the release section of the stop order is completed by Department personnel.
- (5) Fumigators must have in their possession any keys or an access device necessary to gain the immediate access to a structure, including secondary locking devices, during the entire time that the structure is under fumigation (fumigant release, exposure period, aeration and until properly determined clear of all fumigant), unless a waiver is issued for specialized structures by the Department of Agriculture and Consumer Services.
- (6) When crew members are present on the fumigation site, two properly functioning, positive pressure, self-contained breathing apparatus (SCBA) must be available at the fumigation site at all times when the structure is under fumigation (fumigant release, exposure period, aeration and at other times when state law or the fumigant label requires the use or presence of a SCBA). Two SCBA do not need to be present at the fumigation site for activities that do not involve worker exposure to fumigant concentrations above thresholds permitted by the fumigant label. Such activities could include, but

would not be limited to, remote monitoring, using a Fumiscope, TIF leak detection, job site cleanup, DACS inspections, and Quality Assurance Reviews.

(7) Each business licensee location performing fumigation must possess and maintain at least two, label-approved, clearance devices so that at least one is properly functioning at all times in accordance with either the device manufacturer or the fumigant label directions, whichever is more restrictive.

5E-14.110 Fumigation Requirements - Notices.

Each licensee, before performing general fumigation, shall in advance notify in writing the department inspector having jurisdiction over the location where the fumigation operation is to be performed. Such notices shall be received by the department inspector at least twenty-four (24) hours in advance of the fumigation period. The notice shall state the following:

- (1) Company name and business location address.
- (2) Accepted common or trade name and active ingredients of fumigant to be used.
- (3) Name of certified operator in charge and/or his designated special fumigation identification card holder, together with his day and night telephone numbers.
- (4) Location (address) and type of structure to be fumigated.
- (5) Date of and, as nearly as possible, the approximate time of release of fumigant, and approximate length of fumigation period. Any change(s) in information required in written notices by this regulation shall be reported in writing in advance of the fumigation period.

Exceptions: In authentic and verifiable emergencies only, when twenty-four (24) hours advance notification is not possible, advance telephone or telegraph notice shall be given, and such notice immediately followed by written confirmation stating the required information.

5E-14.111 Fumigation Requirements - Application; Restrictions and Precautions.

- (1) For purposes of fumigation "structure" shall mean: any building including its foundation, walls and roof but excluding any surfacing portions such as driveways or walkways that merely lie on the land and provide no means for a fumigant to pass outside of the fumigation seal.
- (2) Neither the structure nor enclosed space to be fumigated nor any part or parts thereof shall be occupied by persons during the fumigation period. In addition, structures or enclosed spaces which are physically joined to or in contact with the structure to be fumigated shall not be occupied by persons during the fumigation period. (See subsections 5E-14.111(3) and (4), F.A.C.) This requirement may be waived in the fumigation of commodities in industrial areas when it is determined upon prior inspection by the certified operator in charge that no danger to human life or health exists.
- (3)(a) In the event one or more structures in a row of physically joined structures is to be fumigated, at least one additional complete building structure next to and on both sides of the structure to be fumigated must be vacated, provided there are no common drains, air ducts, conduits, attics or other means permitting escape or passage of the fumigant from the structure to be fumigated into the additional vacated building(s). If there are common means permitting passage of the fumigant into the additional vacated building(s) then one more building must be vacated and so on. If this set of conditions cannot be met, the entire row of structures must be vacated or the fumigation shall not be carried out.
- (b) In the event one or more units in a multi-unit structure (see subsection 5E-14.102(9), F.A.C.) are to be fumigated, the entire multi-unit structure must be vacated prior to fumigation and individually tested for clearance in accordance with label instructions following fumigation. If these requirements cannot be met, the fumigation shall not be performed.
- (4) It shall be the duty of the certified operator in charge or his designated special fumigation identification card holder to be present and personally to make a careful examination of all parts of the structure to be fumigated, including locked rooms, compartments and closets, and of structures or enclosed spaces physically joined to or in contact with said structure, to verify that no persons have remained therein.
- (5) Fumigation of structures shall be performed in strict accordance with the registered label and labeling directions and precautions for the intended use and type of structure, provided there is sufficient distance along the entire length of the passageway between the structure(s) to be fumigated and all adjacent occupied structure(s) to permit comfortable, free and reasonable passage for the crewmen to work; for the certified operator or his special fumigation identification card

holder to make tests along the passageway for escaping gas with gas-detecting equipment and otherwise. If these requirements cannot be met, the fumigation shall not be performed unless the adjacent structure(s) is vacated.

(6) When fumigating structures with methyl bromide, sulfuryl fluoride or any other relatively odorless gas, technical chloropicrin shall be used separately as a warning agent immediately prior to release of the relatively odorless gas at the rate of not less than one fluid ounce per 15,000 cubic feet of space to be fumigated. Registered label mixtures of at least one-fourth of one percent chloropicrin by net weight analysis may be used in lieu of the above.

Exceptions: This section shall not apply to the fumigation of common carriers (trucks, box cars, refrigerator cars), the fumigation of tobacco warehouses and factories, the fumigation in tanks, vaults or chambers, or the fumigation of commodities in industrial areas when it has been determined by prior inspection by the certified operator in charge that no danger to human life or health exists.

(7) The structure or enclosed space must be made as gas-tight as is practicable. Structures or enclosed spaces which cannot be made reasonably gas-tight by sealing or tenting shall not be fumigated.

Specific Authority 482.051 FS. Law Implemented 482.051(1), 482.152, 482.241 FS., Section 1, Chapter 92-203, Laws of Florida.

History—New 1-1-77, Amended 6-27-79, 6-22-83, Formerly 10D-55.111, Amended 8-11-93.

5E-14.112 Fumigation Requirements - Prefumigation Inspections, Evacuation, Warning Notices (Signs), Special Safety Precautions and Responsibilities.

(1) Final pre-application of fumigant and evacuation inspection: Before the fumigant(s) is to be applied, the certified operator in charge or his designated special fumigation identification card holder must make a final, personal inspection of the structure and shall ensure that:

(a) All preparations for fumigation as directed by the label have been completed.

(b) No unauthorized person is present within the structure or enclosed space to be fumigated or in any adjacent structures or spaces that are required by these regulations to be vacated because of danger from the fumigation operation.

(c) No open fires, flames, pilot lights or oil lamps are burning.

(d) The final inspection must be conducted immediately before the fumigant is to be applied, unless the structure is a multi-unit dwelling, in which case, the following special provision shall apply: On multi-unit dwellings, the certified fumigation operator in charge and/or his designated special fumigation identification cardholder shall conduct a thorough, systematic inspection of each room in every unit to ensure that all provisions specified above have been completed. Then, exterior doors and/or entrances of each inspected unit shall be secured against unauthorized re-entry while preparations and inspection of other units or areas of the structure are completed. This may require the temporary use of secondary locks on entrances that are to be left unattended between the time of inspection and the introduction of the fumigant. If an individual unit or units cannot be safely secured while preparations of other areas are taking place, then those units must be re-inspected immediately before the fumigant is to be applied.

(2) Prior to the application of fumigant(s), suitable warning signs of stiff, weather-proof material must be securely affixed and conspicuously posted as follows:

(a) In tape-and-seal fumigation operations: at or on all doors and entrances to the structure or enclosed space, and at least one (1) warning sign on all sides of the structure or enclosed space not having a door or entrance;

(b) In tent fumigation operations and also including commodity fumigations: at least one (1) warning sign posted at or on all doors and entrances to the structure or enclosed space and at least one (1) warning sign on all sides of the outside of the tents or sealing covers of the structure, enclosed space or commodities being fumigated;

(c) At all doors and entrances to common carriers or enclosed space fumigated;

(d) Upon all gangplanks, ladders, etc. from the dock, pier or land to vessel.

(e) On multi-unit dwellings, warning signs must be posted at or on all exterior doors or entrance(s) of the structure which, depending on construction, might require sign(s) on all exterior doors or entrances of each individual unit or apartment.

(3) Warning signs shall conform in design and information set forth as follows:

(Skull and Crossbones Symbol)

DANGER FUMIGATING WITH
(Accepted common name of Fumigant)
DEADLY POISON
ALL PERSONS ARE WARNED
TO KEEP AWAY

(Skull and Crossbones Symbol)

Date and time fumigant was injected _____
Company Name _____
Company Business Address _____
Certified Operator in Charge _____
(or designated Spec. Fum. Iden. Card Holder)
Day Telephone _____
Night Telephone _____

(4) Signs required must be printed, painted or made in indelible red ink or paint insoluble in water, on white background. The words "DANGER" and "DEADLY POISON" shall be in block lettering at least two (2) inches high. The name of the fumigant shall be at least five-eighths (5/8) inch high. The skull and crossbones symbol shall be at least one (1) inch high. All other lettering on the sign must be not less than one-half (1/2) inch high.

(5) All information displayed on warning signs must be accurate and legible. The name and day and night telephone number of the certified operator in charge of fumigation, or a certified fumigation operator, or a special fumigation identification cardholder who introduced the fumigant at the fumigation site must be displayed on the warning sign. Additional numbers and other contact information may be placed on the sign. All emergency phone numbers must be a phone number, mobile/cell phone number or beeper number in the possession of a person familiar with the job and trained to respond to fumigation emergencies and equipped with label required respiratory protection and gas detection equipment. Answering machines, beepers or voice mail systems that do not provide a mechanism for immediate notification to an individual as described above are prohibited. A 24-hour manned answering service that can immediately contact a certified fumigation operator or a special fumigation identification cardholder of the company who can respond to the emergency is acceptable.

(6) Such warning signs posted on the outside of tents or sealing covers shall not be removed prior to commencement of ventilation: and such warning signs posted on or at entrances to the structure (itself), enclosed space or commodities being fumigated shall not be removed until the end of the fumigation period, when ventilation has been completed and the premises declared safe for reoccupancy as required by subsections 5E-14.113(1) and (2), F.A.C. Ventilation shall be conducted with due regard for the public safety.

(7) Special safety precautions, responsibilities.

(a) When conditions involving abnormal hazards exist, it shall be the responsibility of the person exercising direct and personal supervision of the fumigation operation to take such safety precautions additional to those prescribed by this chapter as are reasonably necessary to protect the public health and safety.

(b) All exterior doors and entrances to the fumigated structure(s) shall be posted with a warning sign on or at each door or entrance prior to the release of the fumigant, locked, and secured with a secondary locking device(s) or barred or otherwise secured against entry until the end of the exposure period, then opened for ventilation and relocked, barred or otherwise secured against reentry, including the reinstallation of the secondary locking device(s), until declared to be safe for reoccupancy by the person exercising direct and personal supervision of the fumigation operation as required by subsections 5E-14.113(1) and (2), F.A.C. A door or entrance, that, once locked from the interior with a lock that is not accessible from the exterior, does not require a secondary locking device or barricade.

(c) Entrances which do not have existing locking mechanisms or are inoperable must still be secured with a secondary locking device.

(d) If multi-unit dwellings with internal stairwells accessing each floor can be secondarily locked or secured, barred or barricaded at all ground level entrances, then no other secondary locking devices are necessary, provided that the requirements of subsection 5E-14.112(1), F.A.C., are met. Multi-unit dwellings with exterior stairwells or fire escapes must be secured or otherwise barricaded or barred to prevent entry from both ground and first floor levels and from any entrance to the structure accessed from the stairwell or fire escape. If neither of these conditions can be met, then all entrances to individual units and all exterior entrances must be locked or secured, barricaded or barred with secondary locking devices.

Specific Authority 482.051 FS. Law Implemented 482.051(1), 482.152 FS. History—New 1-1-77, Amended 6-27-79, Formerly 10D-55.112, Amended 4-17-03.

5E-14.113 Fumigation Requirements - Final Post-fumigation Clearance Inspection.

(1) The certified operator in charge or his designated special fumigation identification card holder shall personally determine by using label-approved gas-detecting devices, verified and/or calibrated as required by either the device manufacturer or the fumigant label directions, whichever is more restrictive, that the entire structure or enclosed space fumigated, and also including beds and bedding therein, has been safely ventilated as required by fumigant label directions, to permit safe human entry and occupancy or reoccupancy. No person, other than the certified fumigation operator in charge, his designated special fumigation identification cardholder, or trained identification cardholder, utilizing the label-approved respiratory protective equipment or gas detecting device, may enter, occupy or reoccupy the fumigated structure for any reason prior to completion of the aeration procedure(s) and declaration of clearance. All warning agent containers shall be removed from the structure. In no instance shall ventilation or aeration time be less than that recommended by manufacturer of fumigant on the registered label.

(2) Declaring structure or enclosed space fumigated safe for entry and occupancy or reoccupancy: The certified operator in charge or his designated special fumigation identification card holder shall not permit or allow any unauthorized person to enter or occupy or reoccupy the structure or enclosed space fumigated until the aeration procedures as required by the fumigant product label are completed, and he has personally checked the breathing zone of each room within the fumigated structure for fumigant levels with suitable gas-detecting equipment or device required by the fumigant label and found the structure to be safe for human entry and occupancy, and he shall personally certify by his own signature as a result of his final personal inspection and monitoring examination of the entire structure or space fumigated that the same and adjacent vacated structures are safe for human entry, occupancy or reoccupancy. Such notice of clearance shall be in writing and shall be conspicuously posted by the certified fumigation operator in charge or his designated special fumigation identification cardholder on all entrances of the fumigated structure or enclosed space. Clearance notices may not be posted prior to performing the clearance inspection with the label required gas-detection equipment. The signature of the certified operator in charge or his designated special fumigation identification card holder and the exact date and hour of release for reentry and reoccupancy shall be set forth in all notices. In no case shall the notice of clearance be post-dated.

PART NO. 2 APPLICATION FOR EXAMINATION

5E-14.117 Application for Examination for Pest Control Operator's Certificate and Special Identification Card.

(9) Applicants may be examined for certification in one or more of the following categories of pest control:

- (a) Fumigation;
- (b) General household pest control, which includes rodent control;
- (c) Termite or other wood-infesting organism control;
- (d) Lawn and ornamental pest control.

(10) The applicant for examination shall have participated in within this state, and under the supervision of a certified operator, a minimum of 15 jobs in each category in which the applicant seeks certification. The applicant shall submit as part of the application, and on forms provided, a statement from the said supervising certified operator that the jobs have been participated in by the applicant under his supervision and that the applicant has demonstrated the requisite knowledge to perform and supervise such work. Applicants for the fumigation examination shall submit evidence of having participated in 15 general fumigations (subsection 5E-14.102(4), F.A.C.).

(12) Applicants shall be examined for special identification card in fumigation pursuant to Section 482.151(3), F.S.

(13) Each applicant for examination shall submit evidence of having participated in as many general fumigation operations as possible but not fewer than 15 general fumigation operations within this state under the supervision of a certified operator certified in fumigation.

PART NO. 5 SPECIAL IDENTIFICATION CARD

5E-14.136 Special Identification Card Issuance, Renewal Fees, Forms, and Duties.

(1) There shall be one category of special identification card, to wit: fumigation.

(2) Application shall be made and the issuance fee paid to the Department for the original special identification card within 60 days from the date of written notification of passing examination. During a period of 30 days following the expiration of the 60-day period, an original special identification card may be issued, however, a late issuance charge of

\$25 shall be assessed and paid in addition to the issuance fee. Further, no original special identification card shall be issued after expiration of the 30-day period without reexamination.

(3) Application to the Department for renewal of each special identification card shall be made on or before June 1 of each year. The issuance fee for each special identification card and for each renewal there of shall be \$100. After a grace period of 30 calendar days following the anniversary date of each year, there shall be a late renewal charge of \$25, which shall be assessed and paid in addition to the renewal fee. Unless timely renewed, each special identification card shall automatically expire 180 calendar days after the renewal date. Subsequent to such expiration, a special identification card may be issued only upon successful reexamination and upon payment of examination and issuance fees due, as provided by this rule.

(4) On or before April 1 of each year the Department shall mail to each special identification cardholder at his last known address of record, a renewal form, DACS 13641, Rev. 3/02, incorporated by reference, for use in applying for renewal of his special identification card. Copies may be obtained from the Bureau of Entomology and Pest Control, 1203 Governors Square Boulevard, Suite 300, Tallahassee, Florida 32301-2961.

(5) Each special identification cardholder shall notify the Department in writing within ten (10) days of any change of his employment status or mailing address.

(6) No person shall use a special identification card in any category for which the certified operator in the charge of the pest control activities of the licensee is not properly certified.

(7) While performing pest control duties a special identification cardholder shall carry on his person a special identification card issued by the Department.

(8) A special identification cardholder shall always perform his functions under the direction and supervision of his certified operator. No special identification cardholder shall perform any pest control work independently of or without the knowledge and direction of his certified operator.

PART NO. 6 LICENSEES

5E-14.140 Emergency Pest Control Certificate - Qualifications, Applications, Restrictions.

(5) An emergency certificate shall not be issued in the category of fumigation.

Appendix

4

Vikane® and Chloropicrin Labels and MSDS Sheets

Specimen Label

RESTRICTED USE PESTICIDE DUE TO INHALATION TOXICITY

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.



Vikane*

Specialty Gas Fumigant

*Trademark of Dow AgroSciences LLC

For control of: Existing infestations of insects and related pests such as (or including) drywood termites, Formosan termites, powder post beetles, death watch beetles, old house borers, bedbugs, cockroaches, clothes moths, rodents (rats, mice), and the larvae and adults of carpet beetles (except egg stage), oriental, American, and brown-banded cockroaches.

For use in: Dwellings (including mobile homes), buildings, construction materials, furnishings (household effects), shipping containers and vehicles including automobiles, buses, surface ships, rail cars, and recreational vehicles (but not including aircraft).

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

Active Ingredient	
sulfuryl fluoride	99.8%
Inert Ingredients	0.2%
Total	100%

EPA Reg. No. 62719-4

Keep Out of Reach of Children

DANGER  **POISON**
PELIGRO

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.)

Precautionary Statements

Hazards to Humans and Domestic Animals

Extremely Hazardous Liquid And Vapor Under Pressure • Inhalation of Vapors May Be Fatal • Liquid May Cause Freeze Burns of Exposed Skin

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

First Aid

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.

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 15-20 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.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

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

Liquid Vikane in the eye may cause damage due to refrigeration or freezing.

Notice: Read the entire label. Use only according to label directions. **Before buying or using this product, read "Warranty Disclaimer" and "Limitation of Remedies" elsewhere on this label.**

In case of emergency endangering health or the environment involving this product, call 1-800-992-5994. If you wish to obtain additional product information, visit our web site at www.dowagro.com.

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

Directions for Use

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

Read all Directions for Use carefully before applying.

Storage and Handling

Store in dry, cool, well ventilated area under lock and key. Post as a pesticide storage area. Do not contaminate water, food, or feed by storage.

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 use rope slings, hooks, tongs, or similar devices to unload cylinders. Transport cylinders using hand truck or fork truck to which the cylinder can be firmly secured. 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 5 parts per million (ppm) or less, as determined by a detection device with sufficient sensitivity such as an INTERSCAN or MIRAN gas analyzer. For more detailed information on the source and use of air monitoring devices or respirators, consult the Vikane Gas Fumigant Structural Fumigation Manual.

Cylinder and Product Disposal: Promptly return all empty cylinders to your distributor of Vikane. 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.

General Information

Before using, read and follow all label precautions and directions. Prior to the parties entering into a fumigation agreement, the Fact Sheet for Vikane must be provided to an adult occupant of the structure to be fumigated.

Vikane is a highly hazardous material and should be used only by 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.

When used for fumigation of enclosed spaces, such as houses and other structures, warehouses, vaults, chambers, trucks, vans, boxcars, ships, and other transport vehicles, 2 persons trained in the use of this product, at least one being an applicator that is licensed/certified by the state, must be present during introduction of fumigant, reentry prior to aeration, and during the initiation of the initial aeration procedure. **Two persons need not be present if monitoring is conducted remotely (outside the area being fumigated).**

If fumigating for insect pests, do not apply when temperature at site of pest activity is below 40°F. This temperature may be measured at the slab foundation, sub-floor soil, or wherever the coolest part of the structure may be. This restriction does not apply when fumigating for rodents.

When fumigating a single unit/room within or connected to a larger structure (such as town houses, apartments, condominiums) all units of the entire structure must be vacated during the fumigation and aeration periods.

Remove edible items from the structure before the fumigation if they cannot be adequately sealed to prevent exposure to Vikane. Chloropicrin must be used as described on the label to warn of an ongoing fumigation.

Preparation for Fumigation

Structural Fumigation

Remove from the structure to be fumigated all persons, domestic animals, pets, and desirable growing plants. Remove mattresses (except waterbeds) and pillows completely enveloped in water proof covers or remove covers. Food, feed, drugs (including tobacco products), and medicinals (including those items in refrigerators and freezers) can remain in the structure if they are in plastic, glass, or metal bottles, cans, or jars with the original manufacturer's air-tight seal intact. Food, feed, drugs (including tobacco products), and medicinals (including those items in refrigerators and freezers) not in plastic, glass, or metal bottles, cans, or jars with the original manufacturer's air-tight seal intact, need to be removed from the fumigation site, or double bagged in Nylofume* bags, which are available from distributors of Vikane gas fumigant.

Note: Extinguish all flames, including pilot lights of water heaters, gas refrigerators, ranges, ovens, broilers, 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.

Specimen Label Revised 04-15-03

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 Vikane in them is 5 ppm or less.

Multi-unit Structures

When fumigating a single unit/room within or connected to a larger structure (such as town houses, 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 Vikane. Ensure that all exterior entranceways and exterior doors of 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 units where Vikane is introduced. During aeration, check all units within the fumigated structure for Vikane concentration with an approved clearance device. If concentration of any non-fumigated units exceeds 5 ppm, use Aeration Procedure 1 or 2 to aerate the non-fumigated units based on the initial concentration of the fumigated unit(s).

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. Any connected structure must be vacated during the fumigation process unless it is isolated from the structure to be fumigated by methods which prevent passage of the fumigant from the structure to be fumigated into the connected structure. Note: connected structures must be vacated if required by state laws or regulations. 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 Vikane is introduced. Vikane concentration levels must be measured (see Aeration and Reentry) in any connected space or structure.

Tarpaulin Fumigation

Open operable windows. 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 all low edges of the cover (such as with soil, sand, or weighted "snakes"). To minimize escape of gas through the soil and to avoid injury to nearby plants, wet soil outward from foundation to the cover if not sufficiently moist to act as a barrier for the gas.

Taped Fumigation

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

Chamber Fumigation

For chamber fumigation use a gas-tight chamber with adequate circulation.

Construction Materials, Furnishings (Household effects), and Vehicles

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

Fumigation of Surface Ships in Port

Surface ships in size up to and including large ocean-going ships may be fumigated with Vikane 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, DOT, Title 46, Shipping, section Parts 147A.1-147A.43. Except for those persons involved in fumigation, no people, plants, or pets may be on-board during 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.

Edible commodities 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 the fumigation and aeration periods. If reentry is necessary before aeration is completed, positive pressure self-contained respiratory protection must be worn.

Warning Agent

Chloropicrin is a warning agent introduced into the structure during fumigation. 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 shallow 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 shallow 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/ 10,000 to 15,000 cubic feet - (30 ml/283 to 425 cubic meters) of space to be fumigated. 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 "Step (1)" of "Aeration Procedure 1 or 2" 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.

Chloropicrin is a warning agent which 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 persons certified to apply Vikane or under their supervision. Fumigators must observe the precautionary statements and safety recommendations appearing on the label of this product.

Specimen Label Revised 04-15-03

Protective Clothing

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 Vikane until thoroughly aerated and cleaned.

Respiratory Protection

If the concentration of Vikane in the fumigated area (as measured by a detector device with sufficient sensitivity such as an INTERSCAN or MIRAN gas analyzer) does not exceed 5 ppm (20 mg/cubic meter), no respiratory protection is required. 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 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 Vikane Gas Fumigant Structural Fumigation Manual.

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 doors or doorways. A locking device or barricade must be demonstratively effective in preventing an exterior door or doorway from being opened using normal opening or entering processes by anyone other than the certified applicator in charge of the fumigation or persons in his/her on-site direct supervision. Consult state and local regulations for any supplementary instructions and local restrictions on securing against entry.

Dosage and Exposure Time

For fumigation to control drywood termites and non-egg stages of other insect and related structural and household pests, the Fumiguide* calculator(s) 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 indicated multiple factor of the drywood termite dosage (as determined by Fumiguide calculator(s)) for pests listed in the following table:

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

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

† 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.

†† More than 1 fumigation may be needed to control the infestation after egg hatch.

For fumigation to control rodents, use sufficient gas to accumulate at least 36 ounce-hours following equilibrium, regardless of ambient air temperature. Refer to the Vikane Gas Fumigant Structural Fumigation Manual.

The Fumiguide B Calculator is to be used for unmonitored structures to coordinate fumigant rates with temperatures, a 20 to 24 hour exposure period, and an estimated HLT.

The Fumiguide Y Calculator is used in conjunction with Fumiguide B when fumigant concentrations are monitored and/or there are measured variations in exposure time.

The Fumiguide Calculator is a hand held microprocessor which performs the functions of both the Fumiguide B and Y calculators and includes relative humidity as a calculating factor.

These calculators, Directions For Use, and referenced literature may be obtained from Dow AgroSciences.

Introducing the Fumigant

Release the fumigant from outside the structure, tent, or vehicle. 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 pounds per square inch (psi). Direct the fumigant into the blast of air from a fan(s) having a capacity of at least 1,000 cubic feet per minute (cfm) for each pound of Vikane released per minute. Damage to household materials can occur if insufficient fan capacity is used for the rate of Vikane released. 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. **To Prevent Damage, Do Not Apply Fumigant Directly To Any Surface.**

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 Vikane in the treated site is 5 ppm or less.

Specimen Label Revised 04-15-03

Aeration and Reentry

No one should be in treated areas if the level of Vikane is above 5 ppm unless provided with a NIOSH or MSHA approved positive pressure self-contained breathing apparatus (SCBA, not SCUBA) or combination air supplied/SCBA respirator, such as manufactured by Ranger, Survivair, Scott, or MSA. **Note: during the initial one hour aeration procedure, approved respiratory protection must be worn until the concentration of Vikane is confirmed not to exceed 5 ppm with an approved detection device.** Since the INTERSCAN and MIRAN 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 in excess of 5 ppm, leave the affected area immediately.

Only an approved detection device of sufficient sensitivity, such as the INTERSCAN or MIRAN, can be used to confirm a concentration of Vikane of 5 ppm or less. The INTERSCAN must be calibrated within one month prior to use as a clearance device. All other approved detection devices must be calibrated according to manufacturer recommendations. The concentration of Vikane must be monitored in breathing zones. Structure must remain posted for fumigation until cleared for reentry.

Select the appropriate procedure based on the fumigation rate:

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

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

Aeration Procedure 1

These steps must be completed in sequence.

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 Vikane in breathing zones of each room. If the concentration of Vikane is greater than 5 ppm, ventilate structure with operable doors and windows open for at least 10 minutes. Structure may be reoccupied when concentration is 5 ppm or less.

Aeration Procedure 2

These steps must be completed in sequence.

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 Vikane in breathing zones of each room. If the concentration of Vikane is greater than 5 ppm, ventilate structure with operable doors and window open for at least 10 minutes. Structure may be reoccupied when the concentration Vikane is 5 ppm or less.

For more detailed information on the source and use of air monitoring devices or respirators, consult the Vikane Gas Fumigant Structural Fumigation Manual. 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.

Warranty Disclaimer

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

Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. 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 temperature, 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 Dow AgroSciences or the seller. All such risks shall be assumed by buyer.

Limitation of Remedies

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

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

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

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 Dow AgroSciences 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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Dow AgroSciences LLC • Indianapolis, IN 46268 U.S.A.

Label Code: D02-069-012

LOES Number: 010-01957

EPA-Accepted 01/02/01

Specimen Label Revised 04-15-03

Revisions:

1. Added shipping containers to the use site list.
2. Revised First Aid Statements.
3. Clarified "Direct Supervision" requirement such that two persons trained in the use of the product, at least one must be a state licensed/certified applicator, must be present during fumigant introduction, reentry prior to aeration, and initiation of the initial aeration procedure.
4. Deleted fish as a pet to be removed from the fumigated structure and added tobacco products to list of items requiring special attention as part of the structural fumigation preparation.
5. Added sections describing Multi-unit and Connected Structures.
6. Cited correct regulation for fumigation of surface ships in port.
7. Aeration and Reentry: Specified respiratory protection for initial one hour aeration procedure. Added clearance device calibration requirements. Step sequence of Aeration Procedures and total fan capacity specified. Added breathing zone measurements in each room.

Specimen Label Revised 04-15-03

MATERIAL SAFETY DATA SHEET



VIKANE* GAS FUMIGANT

Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

Effective Date: 10/7/03
Product Code: 91503
MSDS: 000506

1. PRODUCT AND COMPANY IDENTIFICATION:

PRODUCT: Vikane* Gas Fumigant

COMPANY IDENTIFICATION:

Dow AgroSciences
9330 Zionsville Road
Indianapolis, IN 46268-1189

2. COMPOSITION/INFORMATION ON INGREDIENTS:

Sulfuryl fluoride	CAS# 002699-79-8	99.8%
Impurities Associated with the Active Ingredient		0.2%

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200). In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

3. HAZARDOUS IDENTIFICATIONS:

EMERGENCY OVERVIEW

Hazardous Chemical. Colorless, odorless compressed gas. Evacuate immediate area if leak occurs. Excessive vapor concentrations are attainable and a single exposure may cause death. Toxic to pets, fish, wildlife, and avian.

EMERGENCY PHONE NUMBER: 800-992-5994

POTENTIAL HEALTH EFFECTS: This section includes possible adverse effects, which could occur if this material is not handled in the recommended manner.

EYE: Essentially non-irritating to eyes. Liquid may cause frostbite.

SKIN: Essentially non-irritating to skin. Liquid may cause frostbite. No adverse effects anticipated by skin absorption.

INGESTION: Moderate toxicity if swallowed. The oral LD₅₀ for rats is 100 mg/kg. Swallowing is unlikely because of the physical state.

INHALATION: Vapor concentrations are attainable which may be fatal with single exposure. Excessive exposure may cause severe irritation to upper respiratory tract (nose and throat) and lungs. The LC₅₀ for a 4-hour exposure for rats is 991-1122 ppm.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: In animals, effects have been reported on the following organs: brain, central nervous system, kidney, lung, respiratory tract and thyroid gland. Observations in animals include convulsions and tremors. May cause fluorosis of teeth and bones.

CANCER INFORMATION: Did not cause cancer in laboratory animals.

TERATOLOGY (BIRTH DEFECTS): Birth defects are unlikely. Exposures having no effect on the mother should have no effect on the fetus. Did not cause birth defects in animals; other effects were seen in the fetus only at doses which caused toxic effects to the mother.

REPRODUCTIVE EFFECTS: In animal studies, did not interfere with reproduction.

4. FIRST AID:

EYES: In case of frostbite, immediately flush eyes with water; remove contact lenses, if present, after the first 5 minutes, then continue flushing eyes for at least 15 minutes. Obtain medical attention promptly preferably from an ophthalmologist.

SKIN: If shoes, gloves, or clothing covering skin become wet with sulfuryl fluoride, immediately apply water to contaminated clothing before removing. Once area has thawed, remove contaminated items covering skin. Wash thoroughly or shower.

INGESTION: If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Seek medical attention.

INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, oxygen should be administered by qualified personnel. Call a physician or transport to a medical facility.

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NOTE TO PHYSICIAN: Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient. Sulfuryl fluoride 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). The prediction of possible human effects is based in part on observations made on laboratory animals. It is predicted that persons exposed to sulfuryl fluoride will show little evidence of intoxication at first, unless the concentration is very high (>400 ppm). Early symptoms of exposure to sulfuryl fluoride are respiratory irritation and central nervous system depression. Excitation may follow. Slowed movement, reduced awareness, and slow or garbled speech may be noted. It is essential to keep such an individual at bed rest for at least 24 hours. Clinical observations should be directed at the pulmonary, hepatic, and renal systems. Prolonged exposure can produce lung irritation, pulmonary edema, nausea, and abdominal pain. Repeated exposure to high concentrations can result in significant lung and kidney damage. Convulsions may ensue with respiratory arrest being the terminal event. Assisted respiration may be necessary. Clinical observation is essential. There is no known antidote for over-exposure to sulfuryl fluoride.

5. FIRE FIGHTING MEASURES:

FLASH POINT: Not applicable
METHOD USED: Not applicable

FLAMMABLE LIMITS

LFL: Not combustible
UFL: Not combustible

EXTINGUISHING MEDIA: Sulfuryl fluoride is not combustible. However, if cylinders are in a fire area, water can be used to keep them cool to help prevent discharge of product caused by melted fusible plugs on the cylinders. Use of water will also help to scrub out part of any hydrofluoric acid and sulfur dioxide, which may be formed by decomposition of the product in a fire.

FIRE & EXPLOSION HAZARDS: Cylinders exposed to fire may vent and release toxic gas through melted fusible plugs on cylinders. Although sulfuryl fluoride is not combustible, in temperatures exceeding 400°C (752°F), it will degrade to form hydrogen fluoride and sulfur dioxide.

FIRE-FIGHTING EQUIPMENT: Wear positive-pressure, self-contained breathing apparatus and full protective clothing. When fighting fires in atmospheres containing potentially high concentrations of sulfuryl fluoride, encapsulating protective suits should be worn due to possible formation of hydrofluoric acid. Protective suit material should be compatible with exposure to hydrofluoric acid.

6. ACCIDENTAL RELEASE MEASURES:

ACTION TO TAKE FOR SPILLS/LEAKS: Evacuate immediate area if cylinder begins to leak. Use a NIOSH or MSHA approved positive-pressure, self-contained breathing apparatus (SCBA) or combination air-supplied/SCBA respirator, such as manufactured by Ranger, Survivair, Scott, or MSA, for entry into affected areas to correct problem. For leaking cylinders occurring near structure being fumigated, place the cylinder inside the designated structure if it can be done safely. If leaking cylinder occurs elsewhere, 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 5 ppm or less, as determined by a detection device with sufficient sensitivity such as an INTERSCAN or MIRAN gas analyzer. For detailed information on the source and use of air monitoring devices or respirators, consult Dow AgroSciences at 800-992-5994.

7. HANDLING AND STORAGE:

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Handling: Keep out of reach of children. Do not breathe gas. Keep all unnecessary people and pets out of area containing sulfuryl fluoride gas. Storage: Store in original container and away from heat and dwellings.

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MATERIAL SAFETY DATA SHEET



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8. EXPOSURE CONTROLS/PERSONAL PROTECTION:

These precautions are suggested for conditions where a potential for exposure exists. Emergency conditions may require additional precautions.

EXPOSURE GUIDELINE: Sulfuryl fluoride: ACGIH TLV is 5 ppm TWA, 10 ppm STEL. OSHA PEL is 5 ppm TWA.

ENGINEERING CONTROLS: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines. Lethal concentrations may exist in areas with poor ventilation.

RECOMMENDATIONS FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS:

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below exposure guideline. When respiratory protection is required, use a NIOSH approved self-contained breathing apparatus or positive-pressure airline with auxiliary self-contained air supply. For emergency and other conditions where the exposure guideline may be exceeded, use a NIOSH approved positive-pressure self-contained breathing apparatus or positive pressure airline with auxiliary self-contained air supply. In confined or poorly ventilated areas, use a NIOSH approved self-contained breathing apparatus or positive pressure airline with auxiliary self-contained air supply.

SKIN PROTECTION: No special skin protection should be needed. Skin contact with the liquid may cause freeze damage if the liquid is confined to the skin; do not wear gloves or rubber boots.

EYE PROTECTION: Use chemical goggles.

APPLICATORS AND ALL OTHER HANDLERS: Refer to the product label for personal protective clothing and equipment.

9. PHYSICAL AND CHEMICAL PROPERTIES:

BOILING POINT: -67°F (-55°C)
VAPOR PRESSURE: 15.2 atmospheres @ 20°C
VAPOR DENSITY: 4.3 g/L @ 20°C
SOLUBILITY IN WATER: Practically insoluble
SPECIFIC GRAVITY: 1.35 @ 20°C
APPEARANCE: Colorless
ODOR: Odorless compressed gas

10. STABILITY AND REACTIVITY:

STABILITY: (CONDITIONS TO AVOID) Cylinders may leak or rupture in a fire.

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID) Strong base.

HAZARDOUS DECOMPOSITION PRODUCTS: Sulfur dioxide and hydrogen fluoride under fire conditions with hydrocarbons.

HAZARDOUS POLYMERIZATION: Not known to occur.

11. TOXICOLOGICAL INFORMATION:

MUTAGENICITY: In-vitro and animal genetic toxicity studies were negative.

12. ECOLOGICAL INFORMATION:

ENVIRONMENTAL FATE:

MOVEMENT & PARTITIONING:

Bioconcentration potential is low (BCF <100 or Log Pow <3). Potential for mobility in soil is very high (Koc between 0 and 50).

Log octanol/water partition coefficient (Log Pow) is estimated using a structural fragment method to be 0.41. Soil organic carbon/water partition coefficient (Koc) is estimated to be 6.124.

Henry's Law Constant (H) is estimated to be 3.28E-02 atm-M³/mole.

DEGRADATION & PERSISTENCE:

The hydrolysis half-life is 18 minutes to 3 days.

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VIKANE* GAS FUMIGANT

ECOTOXICOLOGY:

Material is highly toxic to aquatic invertebrates on an acute basis (LC₅₀ or EC₅₀ is between 0.1 and 1 mg/L.

Acute immobilization EC₅₀ in water flea (*Daphnia magna*) is 0.62 mg/L.

Growth inhibition EC₅₀ in green alga (*Selenastrum capricornutum*) is 3.05 mg/L.

Growth inhibition EC₅₀ in green alga (*Selenastrum capricornutum*) is 0.83 mg/L.

13. DISPOSAL CONSIDERATIONS:

DISPOSAL METHOD: Promptly return all empty cylinders to Dow AgroSciences. Wastes are toxic. Improper disposal of excess waste is a violation of federal law. If these wastes can not be disposed of by use according to label instruction, consult your state pesticide or the hazardous waste representative at the nearest EPA regional office for guidance.

14. TRANSPORT INFORMATION:

U.S. DEPARTMENT OF TRANSPORTATION (DOT) INFORMATION:

Do not ship this material by air.

For all other modes of transportation:
SULPHURYL FLUORIDE/2.3/UN/2191/POISON
INHALATION HAZARD/ZONE D

15. REGULATORY INFORMATION:

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations.

U.S. REGULATIONS

SARA 313 INFORMATION: This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372:

CHEMICAL NAME	CAS NUMBER	CONCENTRATION
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Sulfuryl Fluoride	002699-79-8	99.8%
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SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard
A delayed health hazard
A sudden release of pressure hazard
A reactive hazard

TOXIC SUBSTANCES CONTROL ACT (TSCA): All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

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VIKANE* GAS FUMIGANT

STATE RIGHT-TO-KNOW: The following product components are cited on certain state lists as mentioned. Non-listed components may be shown in the composition section of the MSDS.

CHEMICAL NAME	CAS NUMBER	LIST
Sulfuryl Fluoride	002699-79-8	NJ3 PA1

NJ3=New Jersey Workplace Hazardous Substance (present at > or = to 1.0%).
PA1=Pennsylvania Hazardous Substance (present at > or = to 1.0%).

OSHA HAZARD COMMUNICATION STANDARD: This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:

<u>Category</u>	<u>Rating</u>
Health	3
Flammability	0
Reactivity	1

COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT (CERCLA, or SUPERFUND): To the best of our knowledge, this product contains no chemical subject to reporting under CERCLA.

16. OTHER INFORMATION:

MSDS STATUS: Revised Section: 2, 3, 4, 8, 11, 12 & 14
Reference: DR-0015-5588
Replaces MSDS dated: 5/22/01
Document Code: D03-069-447
Replaces Document Code: D03-069-446

The Information Herein Is Given In Good Faith, But No Warranty, Express or Implied, Is Made. Consult Dow AgroSciences for Further Information.

*Trademark of Dow AgroSciences

Specimen Label



Chloropicrin

Warning Agent

For Non-Pesticidal Use Only

For Use only by applicators certified to apply Vikane* gas fumigant or persons under their direct supervision.

NOTE: Chloropicrin Warning Agent is a highly hazardous material and must be handled only by individuals trained in its proper use. Consult Dow AgroSciences for correct procedure before using.

Active Ingredients:	
Chloropicrin	96.0%
Inert Ingredients	4.0%
Total	100.0%

Contains 13.7 pounds of chloropicrin per gallon.

Keep Out of Reach of Children

DANGER
PELIGRO



POISON

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.)

IN ALL CASES OF OVEREXPOSURE, GET MEDICAL ATTENTION IMMEDIATELY BY TRANSPORTING TO AN EMERGENCY TREATMENT FACILITY.

First Aid

If inhaled: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

If case of skin contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing or other items covering the skin and shoes. Get medical attention. Air expose shoes or clothing outside and do not wear until free of all traces of contamination.

If case of eye contact, immediately flush eyes with plenty of water for at least 30 minutes. Get medical attention immediately.

If swallowed, do not induce vomiting. Give large amounts of water or milk; get medical attention immediately.

Note to Physician: Chloropicrin is a volatile liquid that is an active ingredient in tear gas. As a gas it is a powerful lacrymator. Symptoms of overexposure are profuse lacrymation, respiratory distress and vomiting. Pulmonary edema may develop later.

Notice: Read the entire label. Use only according to label directions. Before buying or using this product, read "Warranty Disclaimer" and "Limitation of Remedies" elsewhere on this label.

In case of emergency endangering health or the environment involving this product, call 1-800-992-5994. If you wish to obtain additional product information, visit our web site at www.dowagro.com (See Vikane)

Precautionary Statements

Hazards to Humans and Domestic Animals

DANGER

Causes Severe Burns Of Eye Or Skin. May Be Fatal If Absorbed Through The Skin. Causes Severe Burns of Mouth And Throat if Swallowed. May Be Fatal If Inhaled. May Cause Severe Allergic Respiratory Reaction. High Concentration Can Cause Lung Injury.

Do not get in eyes, on skin or on clothing. Avoid breathing gas/vapor. Do not take internally. Avoid prolonged or repeated respiratory contact. Use only with adequate ventilation. Wash thoroughly after handling.

Personal Protective Equipment

The following Personal Protective Equipment must be worn when handling and dispensing chloropicrin:

- **Chemical-resistant gloves (such as neoprene)**
- **Full face shield or chemical goggles**
- **Respiratory Protection:** When air concentrations exceed a level of 0.1 ppm, wear NIOSH approved positive pressure supplied-air respirator for organic vapors.

Chemical Hazard

Chloropicrin is severely corrosive of metal containers made of magnesium, aluminum, or their alloys.

Storage and Handling

Storage: Store upright in a cool, dry, well-ventilated area under lock and key. Store only in original container. Do not contaminate water, food or feed by storage or disposal.

Spill and Leak Procedures: Evacuate immediate area of spill or leak. Use a self-contained breathing apparatus (SCBA) for entry into affected area to correct the problem. Move the leaking or damaged containers outdoors or to an isolated location, observing strict safety precautions. Work upwind if possible. Allow spilled material to evaporate, or absorb onto vermiculite, dry sand, earth, or similar absorbent material. Thoroughly aerate absorbent materials outdoors prior to disposing on site or at an approved disposal facility. Do not permit entry into spill area or cleanup area by unprotected persons until the concentration of chloropicrin is determined to be less than 0.1 ppm, by testing with an approved detection device.

Disposal: Allow empty container to aerate with cap off within secure area, such as within the structure during fumigation. Replace cap. Dispose of in a sanitary landfill or by other approved state and local procedures.

Directions for Use

Chloropicrin is a warning agent introduced into the structure prior to fumigation with Vikane® gas fumigant. 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 shallow chloropicrin evaporation container. Do not use 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 shallow 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/10,000 to 15,000 cubic feet - (30 ml/283 to 425 cubic meters) of space to be fumigated. Use one introduction site per 20,000 to 45,000 cubic feet.

Removal of all chloropicrin evaporation containers from the fumigated space during "Step (1)" of "Aeration Procedure 1 or 2," referenced on the product label for Vikane, will aid in the dissipation of the warning agent from the structure.

Warranty Disclaimer

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

Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Personal injury (possibly including death), property (including plant) damage, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including abnormal conditions (such as excessive wind or aeration), the manner of application, or other factors, all of which are beyond the control of Dow AgroSciences. 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, replacement of amount of product used.

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

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 Dow AgroSciences is authorized to vary or exceed the terms of the "Warranty Disclaimer" or this "Limitation of Remedies" in any manner.

*Trademark of Dow AgroSciences LLC
Dow AgroSciences LLC • Indianapolis, IN 46268 USA

Label Code: D02-152-001
Initial Printing

Specimen Label Revised 09-19-01

MATERIAL SAFETY DATA SHEET



Emergency Phone: 800-992-5994
Dow AgroSciences LLC
Indianapolis, IN 46268

Effective Date: 7/22/99
Product Code: 16651
MSDS: 006416

CHLOROPICRIN

1. PRODUCT AND COMPANY IDENTIFICATION:

PRODUCT: Chloropicrin

COMPANY IDENTIFICATION:

Dow AgroSciences
9330 Zionsville Road
Indianapolis, IN 46268-1189

2. COMPOSITION/INFORMATION ON INGREDIENTS:

Chloropicrin	CAS # 000076-06-2	96%
Trace quantities of water and HCl		4%

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR) 1910.1200. In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

3. HAZARDOUS IDENTIFICATIONS:

EMERGENCY OVERVIEW

Hazardous. Colorless liquid with intensely irritating tear gas odor. May cause severe eye irritation with corneal injury which may result in permanent impairment of vision, even blindness. Painful irritation of the eyes at 1 ppm or less; a concentration of 15 ppm for longer than 1 minute is intolerable to humans. Single prolonged exposure may result in the material being absorbed in amounts which could cause death. LD₅₀ for skin absorption in rabbits is 62 mg/kg. Oral LD₅₀ for male rats is 250 mg/kg. Single brief (minutes) inhalation exposure to easily attainable concentration may cause serious adverse effects, even death. Toxic to fish and aquatic organisms. DOT Classification is **CHLOROPICRIN, 6.1, UN1580, I, POISON-INHALATION HAZARD, HAZARD ZONE B.**

EMERGENCY PHONE NUMBER: 800-992-5994

POTENTIAL HEALTH EFFECTS: This section includes possible adverse effects which could occur if this material is not handled in the recommended manner.

EYE: May cause pain. May cause severe eye irritation with corneal injury which may result in permanent impairment of vision, even blindness. Vapors cause lacrimation, and painful irritation of the eyes at 1 ppm or less; a concentration of 15 ppm for longer than 1 minute is intolerable to humans because of the intense irritation produced.

SKIN: Short single exposure may cause severe skin burns. A single prolonged exposure may result in the material being absorbed in amounts which could cause death. The LD₅₀ for skin absorption in rabbits is 62 mg/kg. Vapors may irritate skin. May cause more severe response if skin is abraded (scratched or cut). Vapors may increase susceptibility to infections.

INGESTION: Single dose oral toxicity is moderate. The oral LD₅₀ for male rats is 250 mg/kg. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause serious injury, even death. May cause severe burns of the mouth and throat. Ingestion may cause gastrointestinal irritation or ulceration. In animals, effects have been reported on the following organ: liver.

INHALATION: A single brief (minutes) inhalation exposure to easily attainable concentrations may cause serious adverse effects, even death. Excessive exposure may cause lung injury. May cause respiratory sensitization in susceptible individuals. Excessive exposure may cause methemoglobinemia, thereby impairing the blood's ability to transport oxygen. In humans, effects have been reported on the following organs: heart, kidney, and liver. Signs and symptoms of excessive exposure may include cyanosis, nausea, vomiting, diarrhea, abdominal cramps, and/or central nervous system effects. Initial symptoms due to low-level exposure may not seem severe but death may ensue due to delayed effects of lung injury and/or infection. DOT Classification is **CHLOROPICRIN, 6.1, UN1580, I, POISON-INHALATION HAZARD, HAZARD ZONE B.**

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: Effects have been reported on the following organ: stomach.

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CHLOROPICRIN

CANCER INFORMATION: Available data are inadequate to evaluate carcinogenicity.

TERATOLOGY (BIRTH DEFECTS): Birth defects are unlikely. Exposures having no effect on the mother should have no effect on the fetus. Did not cause birth defects in animals; other effects were seen in the fetus only at doses which caused toxic effects to the mother.

REPRODUCTIVE EFFECTS: In animal studies, has been shown not to interfere with reproduction.

4. FIRST AID:

EYES: Immediate and continuous irrigation with flowing water for at least 30 minutes is imperative. Prompt medical consultation is essential.

SKIN: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician if irritation persists. Call a physician if irritation persists. Destroy and dispose of leather items which cannot be decontaminated (i.e. shoes, watchbands, belts).

INGESTION: Do not induce vomiting. Call a physician and/or transport to emergency facility immediately.

INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, oxygen should be administered by qualified personnel. Call a physician or transport to a medical facility.

NOTE TO PHYSICIAN: Methemoglobinemia may aggravate any pre-existing condition sensitive to a decrease in available oxygen, such as chronic lung disease, coronary artery disease or anemias. If burn is present, treat as any thermal burn, after decontamination. May cause tissue destruction leading to stricture. If lavage is performed, suggest endotracheal and/or esophageal control. No specific antidote. Supportive care. Treatment based on judgment of the physician in response to reactions of the patient. Persons receiving a significant exposure to this material by inhalation should be observed 24-48 hours for delayed pulmonary edema.

5. FIRE FIGHTING MEASURES:

FLASH POINT: Not combustible
METHOD USED: Not applicable

FLAMMABLE LIMITS

LFL: Not applicable
UFL: Not applicable

EXTINGUISHING MEDIA: All conventional extinguishing media are suitable.

FIRE & EXPLOSION HAZARDS: Not a combustible. Heated material decomposes violently at 233°F (112°C) especially when in contact with metals. Toxic and irritating gases will emit.

FIRE-FIGHTING EQUIPMENT: Wear self-contained breathing apparatus and protective clothing, evaluate area, cool containers with water spray from remote location.

6. ACCIDENTAL RELEASE MEASURES:

ACTION TO TAKE FOR SPILLS/LEAKS: Evacuate immediate area of spill or leak. Use a NIOSH approved air purifying respirator approved for organic vapors, self contained breathing apparatus, or an air supplied respirator. Move leaking or damaged containers outdoors or to an isolated location. Allow spilled material to evaporate into dry sand, earth or similar absorbent material, which may be disposed on site, or at an approved disposal facility. Do not permit entry into spill area or clean-up area by unprotected persons until concentration of chloropicrin is determined to be less than 0.1 ppm. Contact Dow AgroSciences at 800-992-5994 for large spills.

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7. HANDLING AND STORAGE:

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Avoid any possible contact with liquid or vapor. Measure chloropicrin concentration with a Matheson-Kitagawa detection device using tube 172. Store upright in a cool, dry, well ventilated area under lock and key. Post as a pesticide storage area. Do not contaminate water, food, or feed by storage or disposal. Persons moving or handling containers should wear protective clothing. Open container only in a well ventilated area wearing protective clothing and respiratory protection if necessary.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION:

These precautions are suggested for conditions where the potential for exposure exists. Emergency conditions may require additional precautions.

EXPOSURE GUIDELINE(S):

Chloropicrin: ACGIH TLV and OSHA PEL are 0.1 ppm. ACGIH classification is A4.

ENGINEERING CONTROLS: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines. Lethal concentrations may exist in areas with poor ventilation.

RECOMMENDATIONS FOR MANUFACTURING, COMMERCIAL BLENDING, AND PACKAGING WORKERS:

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. When respiratory protection is required, use a NIOSH approved positive-pressure supplied-air respirator for organic vapors.

SKIN PROTECTION: Use protective clothing impervious to this material. Selection of specific items such as faceshield, gloves, boots, apron, or full body suit will depend on operation. Use gloves, impervious to this material, at all times. Safety shower should be located in immediate work area. Remove contaminated clothing immediately, wash skin area with soap and water, and launder clothing before reuse. Items which cannot be decontaminated, such as shoes, belts and watchbands, should be removed and destroyed.

EYE/FACE PROTECTION: Use chemical goggles. Wear a face-shield which allows use of chemical goggles, or wear a full-face respirator to protect face and eyes when there is any likelihood of splashes. Eye wash fountain should be located in immediate work area.

APPLICATORS AND ALL OTHER HANDLERS: Please refer to the product label for personal protective clothing and equipment.

9. PHYSICAL AND CHEMICAL PROPERTIES:

BOILING POINT: 233°F (112°C)
VAPOR PRESSURE: 18.3 @ 20°C
VAPOR DENSITY: Approximately 5.7 (Air = 1.0)
SOLUBILITY IN WATER: 0.2 g/100 g
SPECIFIC GRAVITY: 1.66
APPEARANCE: Colorless liquid
ODOR: Intensely irritating tear gas odor

10. STABILITY AND REACTIVITY:

STABILITY: (CONDITIONS TO AVOID) Unstable under fire conditions. Avoid temperatures above 140°F (60°C)

INCOMPATIBILITY: (SPECIFIC MATERIALS TO AVOID)
Organic amines, reducing agents and sulfuric acid.
Incompatible with containers or equipment made of aluminum, magnesium or their alloys.

HAZARDOUS DECOMPOSITION PRODUCTS: Highly toxic phosgene and toxic nitrogen oxide.

HAZARDOUS POLYMERIZATION: Not known to occur.

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11. TOXICOLOGICAL INFORMATION:

MUTAGENICITY: Has been shown to have mutagenic activity in bacteria. Animal mutagenicity studies were inconclusive.

12. ECOLOGICAL INFORMATION:

ENVIRONMENTAL FATE

MOVEMENT & PARTITIONING: Bioconcentration potential is low (BCF <100 or Log Pow <3). Potential for mobility in soil is high (Koc between 50 and 150). Measured log octanol/water partition coefficient (Log Pow) is 2.09. Log octanol/water partition coefficient (Log Pow) is estimated using a structural fragment method to be 1.32. Soil organic carbon/water partition coefficient (Koc) is estimated to be 36.05-62. Log air/water partition coefficient (Log Kaw) is -1.15. Henry's Law Constant (H) is estimated to be 2.15E-03 atm-M3 mole.

DEGRADATION & PERSISTENCE: Tropospheric half-life is estimated to be 4.8 hours. Theoretical oxygen demand (ThOD) is calculated to be 0.10 p/p.

ECOTOXICOLOGY: Material is highly toxic to fish on an acute basis (LC₅₀ is between 0.1 and 1.0 mg/L). Acute LC₅₀ in fathead minnow (*Pimephales promelas*) is 0.3 mg/L.

13. DISPOSAL CONSIDERATIONS:

DISPOSAL METHOD: Do not contaminate food, feed, or water by storage or disposal. Wastes are toxic. Improper disposal of excess waste is a violation of federal law. If wastes cannot be used according to the label directions, dispose of in accordance with all applicable local, state or federal requirements. Contact your state pesticide or environmental control agency, or the hazardous waste representative at the nearest EPA regional office for guidance.

14. TRANSPORT INFORMATION:

For DOT regulatory information, if required, consult transportation regulations, product shipping papers or contact your Dow AgroSciences representative. DOT Classification is **CHLOROPICRIN, 6.1, UN1580, I, POISON-INHALATION HAZARD, HAZARD ZONE B.**

15. REGULATORY INFORMATION:

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numerous federal, state or provincial, and local laws and regulations.

U.S. REGULATIONS

SARA 313 INFORMATION: This product contains the following substances subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372:

CHEMICAL NAME	CAS NUMBER	CONCENTRATION
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Chloropicrin	000076-06-2	96%
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SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard
A delayed health hazard

MATERIAL SAFETY DATA SHEET



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TOXIC SUBSTANCES CONTROL ACT (TSCA): All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

STATE RIGHT-TO-KNOW: The following product components are cited on certain state lists as mentioned. Non-listed components may be shown in the composition section of the MSDS.

CHEMICAL NAME	CAS NUMBER	LIST
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Chloropicrin	000076-06-2	NJ2 NJ3
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NJ2=New Jersey Environmental Hazardous Substance (present at greater than or equal to 1.0%).

NJ3=New Jersey Workplace Hazardous Substance (present at greater than or equal to 1.0%).

OSHA HAZARD COMMUNICATION STANDARD: This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) RATINGS:

Health	4
Flammability	0
Reactivity	3

COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT (CERCLA, or SUPERFUND): To the best of our knowledge, this product contains no chemical subject to reporting under CERCLA.

16. OTHER INFORMATION:

MSDS STATUS: Revised Sections 3, 9, 10 & 15
Reference: DR-0001-6375
Replaces MSDS Dated: 7/20/99
Document Code: D03-000-002
Replaces Document Code: D03-000-001

The Information Herein Is Given In Good Faith, But No Warranty, Express Or Implied, Is Made. Consult Dow AgroSciences For Further Information.

Glossary of Fumigation Terms

actionable pest

An agricultural pest species that is considered by the USDA to be a potential threat to U.S. agriculture and therefore must be eliminated from a shipment by fumigation

active aeration

Minimum one-hour aeration of a structure beginning when “Step 1” of SF aeration is completed in which the seal is open, one or more circulating fans are on, and all operable doors and windows are open.

Aeration Procedure 1

Label aeration procedure when fumigating a structure at 16 oz/Mcf or less Vikane®.

Aeration Procedure 2

Label aeration procedure when fumigating a structure at more than 16 oz/Mcf of Vikane®.

alates

Also called “swarmers,” these mature, winged termites leave the colony during dispersal flights or swarms. After flight, males and females pair, locate nest sites, and become future kings and queens of colonies. Alates constitute the reproductive caste.

Anobiid beetles or “deathwatch” beetles

Wood-infesting beetles belonging to the insect family Anobiidae, having heads covered by a hood-shaped pronotum, producing bun-shaped fecal pellets, and infesting both hardwoods and softwoods.

APHIS (Animal and Plant Health Inspection Service)

A division of USDA that includes the Plant Protection and Quarantine (PPQ) program which oversees fumigation of some imported commodities.

boiling point

Temperature at a given pressure (usually atmospheric) when a liquid instantaneously changes into a gas.

bonnet

The screw-on metal cover that protects the valve and valve cover on the fumigation cylinder.

Bureau of Entomology and Pest Control

An office within the Division of Agriculture Environmental Services of Florida DACS that regulates and licenses the State’s pest control industry.

Bureau of Pesticides

An office within the Division of Agriculture Environmental Services of Florida DACS that registers, tests, and evaluates pesticides used in the State.

Category I (highly toxic) pesticide

A pesticide that is considered highly toxic (LD50 < 50 mg/kg) and requires the signal words Danger – Poison and the skull and crossbones on its label.

certified operator

A person who has a current pest control operator’s certificate from DACS [\[482.021\(4\)\]](#) in one of four categories of pest control.

certified operator in charge (CO)

A certified operator whose main occupation is pest control, is employed full-time by a licensee, and who is in charge of supervising the license holder’s operation in the pest control category(ies) in which the operator is certified. [\[482.021\(5\)\]](#).

Cfm

Cubic feet per minute. A measure of fan air movement capacity.

Chloropicrin (CP)

The chemical used as a gaseous warning agent for fumigations; highly irritating at low concentrations causing immediate tearing and coughing.

clearance

The final phase (Step 3) of aeration in which a detection device such as an Interscan or Miran is used to determine that the fumigant concentration is at or below the threshold concentration that is required for reoccupancy.

clearance notice

A notice, signed by the CO or SPID, indicating the fumigated structure has been declared safe for human occupancy; it must be posted at all entrances to the structure.

Commercial driver's license, Class C or CDL

A special driver's license permitting the holder to drive a vehicle that carries hazmat in placardable amounts.

Commissioner of Agriculture

The statewide elected leader of the Florida DACS.

commodity

Any agricultural product for commercial consumption or use.

commodity fumigation

The fumigation of a commodity, usually with methyl bromide or phosphine, often conducted on a commercial carrier such as a trailer.

condensation

The change of a substance from a gas to a liquid, as a result of temperature drop or pressure increase.

connected structures

Structures that are connected in such a way – by pipes, ducts, conduits, for example – that a fumigant can move by diffusion from one structure to another.

CT Product

The lethal dosage of fumigant expressed in ounce-hours (OH) obtained by multiplying the fumigant concentration (C, oz/Mcf) by the hours of exposure (T).

CT Rule

The principle that generally insures target pest kill as long as its CT product is achieved. This allows for shorter exposures at higher concentration or vice versa depending on job requirements.

dampwood termites

In Florida, termites belonging to the family Kalotermitidae that require a high moisture content for development and survival.

desorption

Latent release of gas molecules into an airspace from attachment or adsorption onto a material or surface; also known as "degassing."

detector tube

A monitoring tool used for clearance or measurement through which a specific volume of air is drawn followed by a graduated color change in the presence of a specific gas such as methyl bromide.

dew point

The temperature at which water condenses as a liquid from the air.

diffusion rate

The rate at which gas molecules disperse within spaces (such as rooms, cracks and crevices, voids, and termite galleries) from areas of high concentration to areas of low concentration.

dip tube

A plastic tube inside a Vikane® cylinder through which liquid fumigant is forced out of an upright cylinder through the release valve due to cylinder pressure.

dosage

The total number of ounce-hours during the fumigant exposure period.

DOT

The Department of Transportation – the federal department that develops and regulates all policies related to the transport of hazmat.

drywood termites

Termites of the family Kalotermitidae that live in sound, dry wood and require no connection to the soil or other water sources.

Emergency Response Plan

A required, written document detailing the steps to be taken should an emergency situation occur involving hazmat.

enclosed space

The area in which the fumigant is intended to be confined.

EPA or USEPA

United States Environmental Protection Agency. The federal agency responsible for registering pesticides and enforcing pesticide regulations.

equilibrium

The time at which the concentration of fumigant is the same throughout the enclosed space indicating that the fumigant molecules are evenly dispersed.

evaporation pan

A nonmetallic container made for the placement of an absorbent material onto which liquid chloropicrin is poured before fumigant release.

experimental use permit (EUP)

A Special Registration Action that can be issued, reviewed or processed by DACS Bureau of Pesticides, operating under Chapter 487, Florida Statutes and Chapter 5E2 of the Florida Administrative Code.

fact sheet

An information sheet provided to the customer that describes the fumigation process, the health effects of sulfuryl fluoride, and safety precautions and preparations to be taken before the fumigation.

false powderpost beetles

Wood-infesting beetles in the beetle family Bostrichidae usually with heads hidden beneath a hood-like pronotum that has small bumps or projections on it. They produce a frass that is a coarse powder mixed with some small pellets.

false seam

A seam consisting of excess or slack from a single tarp that is rolled and clamped to obtain a tighter fit on the structure.

fan capacity

The displacement of air by a fan measured in Mcf.

FDACS

The Florida Department of Agricultural and Consumer Services.

Federal Food, Drug and Cosmetic Act (FFDCA)

The federal law that requires EPA to set pesticide tolerances (maximum legally allowed levels) for pesticide residues in food.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

A federal law which requires all pesticides used in the United States to be registered by the EPA, and authorizes EPA to set labeling requirements to prevent harmful effects on health or the environment.

Federal Motor Carrier Safety Administration (FMCSA)

Administration with the U.S. Department of Transportation responsible for reducing accidents involving large trucks and buses.

first opening

The initial step in the aeration procedure when the enclosed space is first opened for aeration after the exposure period is completed.

Florida Administrative Code, 5E-14

A set of rules and regulations created and enforced by the FDACS Bureau of Entomology and Pest Control to regulate the profession of pest control including fumigation.

Florida Department of Transportation Office of Motor Carrier Compliance (OMCC)

The state agency that enforces laws pertaining to commercial use of vehicles on public roads.

Florida Structural Pest Control Act, Chapter 482

The chapter within Title XXXII (32) of the Florida Statutes which is a collection of state laws to regulate the profession of pest control including fumigation.

fog out

Condensation of fumigant gas in an air space caused by introducing a gas too rapidly into a space resulting in rapid cooling of air below dew point. Contributing factors include insufficient fan capacity, a shooting hose that has too large a diameter or is too short, and introducing fumigant into an enclosed space with a volume that is too small.

Food Quality Protection Act

Enacted in 1996, this federal law amends both FIFRA and FFDCA, uses a single, health-based standard for all pesticides in all foods; uses special standards for infants and children; speeds up approval of 'safer' pesticides; and requires periodic reevaluation of pesticide registrations and tolerances.

frass

Insect fecal material and debris.

fumigant

A chemical that, under room conditions, exists as a gas at a concentration lethal to a pest organism [\[482.021 \(8\)\]](#).

fumigation

The use of a fumigant within a measured and enclosed space at a concentration and duration that is lethal to the target organism [\[482.021 \(9\)\]](#).

Fumiguide

An electronic (or slide rule) calculator, used to determine the amount (lbs.) of sulfuryl fluoride required for a given fumigation; variables such as target pest, volume, tarp or seal condition, ground seal condition, wind speed, underseal type, temperature, and exposure time are used in calculating this amount.

Fumiscope®

A thermal conductivity detector that measures the amount of fumigant present in an enclosed space. The RDA Fumiscope® allows for monitoring fumigant concentrations off-site.

GVWR (Gross Vehicle Weight Rating)

The maximum loaded weight of a vehicle, including fuel, fluids, and full payload.

ground seal

The boundary formed between the tarpaulin or wall construction and the ground.

half loss time or HLT

The amount of time it takes to lose half the amount of fumigant from an enclosed space as a result of leakage or sorption.

halide

salts (ionic molecules) containing a negative ion of fluorine, chlorine, bromine, iodine, or astatine (known as halogens).

halogen leak detector

A device used for locating fumigant leaks from an enclosed space.

hazardous material

Any substance that has been determined to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce.

hazmat

A contracted form of the term 'hazardous material'.

heat of vaporization

The amount of energy, in the form of heat, needed to convert a liquid into a gas.

higher termites

The most advanced termites having a sterile worker caste and no single-celled organisms to aid digestion of wood. They are in the termite family Termitidae.

hot seam

A seam that is formed when two separate tarps are rolled and clamped together. A poorly clamped hot seam will leak fumigant.

Interscan gas analyzer

A portable instrument that detects sulfuryl fluoride concentrations between 1 to 50 ppm. It is used mainly as a clearance device/detector.

label

A document containing detailed instructions for the legal and proper use of an EPA-registered pesticide.

larva

The immature stage of insects that undergo complete metamorphosis in which the young look completely different than the adult, for example caterpillar/butterfly, maggot/fly. The name also is used for very young termites.

Mcf

One thousand cubic feet. M is the Roman numeral representing 1000.

measuring wheel

A wheel equipped with a handle and calibrated counter that is pushed along a surface to measure linear distances.

metallic phosphide

A metallic salt of aluminum or magnesium phosphorous that reacts with water vapor to produce phosphine gas.

methyl bromide

A chemical once widely used for structural, soil, and commodity fumigations but its use now is more limited. Because it has a relatively high boiling point (38° F) the liquid is heated using a heat exchanger in order to introduce it into a structure as a gas.

Miran infrared gas analyzer

A portable instrument used to measure fumigant concentrations during clearance. It houses a pump to draw in air samples and an infrared analyzer to detect sulfuryl fluoride in an airspace.

monitoring lines

Plastic tubes that run from separated locations in a structure to a Fumiscope; used for monitoring large-scale fumigations or when actual rather than estimated fumigant concentrations are needed during a fumigation.

MSDS (Material Safety Data Sheet)

A document containing information on a specific chemical's physical and chemical properties; data on toxicity and other health-related concerns; as well as instructions for treatment in case of accidental exposure.

multiunit dwelling

A structure having one or more stories containing tenants that occupy stores, offices, apartments, townhouses, and condominiums, sharing common walls.

notification

A requirement before any fumigation in which the CO must give written notice of intent to fumigate to the DACS inspector who has jurisdiction of the area where the fumigation will take place.

Nylofume® bags

Special clear, nylon bags that are resistant to penetration by sulfuryl fluoride and used to protect foods and medicines during a fumigation.

Occupational Safety and Health Administration (OSHA)

The federal agency responsible for the on-the-job safety of American workers. A subset of the Department of Labor (DOL).

Office of Motor Carrier Compliance (OMCC)

The federal office responsible for enforcing the federal Department of Transportation (DOT) regulations governing the transportation of hazardous materials on the highways.

old house borer

A beetle in the family Cerambycidae that infests lumber. Larvae chew extensive galleries and adults leave oval-shaped exit holes in infested wood when they emerge.

ounce hours or OH

The effective total accumulated dosage. It is determined by multiplying the fumigant concentration in ounces/Mcf by the exposure time in hours. Final ounce-hour accumulations must exceed the specified ounce hours required to eradicate the target pest.

parts per million or PPM

A measure of concentration in which there is a number of parts of a substance in 1,000,000 total parts of substance. Thus one ppm equals one part in 1 million total parts.

passive aeration

The minimum six- or eight-hour period between the first opening of the seal until clearance begins. Clearance cannot begin until active aeration is completed.

Pest Control Enforcement Advisory Council

An 11-member council appointed by the Commissioner of Agriculture that gives advice on pest control regulation to the Commissioner, advises state agencies on regulation enforcement, compliance, and consumer protection, and promotes public understanding of the pest control industry.

phosphine

Hydrogen phosphide (PH₃) gas. A commodity fumigant produced from the reaction of aluminum or magnesium phosphide pellets with moisture in air.

placard

A durable sign required on all vehicles transporting hazmat, it must have on it the hazard class text and number of the hazmat on board.

Plant Protection and Quarantine (PPQ)

Every required commodity fumigation is directed and supervised by a USDA-APHIS Plant Protection and Quarantine (PPQ) officer using the PPQ Treatment Manual as a guide.

polyethylene

A plastic composed of a strong, lightweight, chemical-resistant polymer (molecule made of repeated units).

prefumigation checklist

A list given to the occupants of the structure to be fumigated that details preparations and duties that occupants must perform to prepare for the fumigation.

pronotum

The part of an insect located just behind the head, it is the upper surface of the first segment of the thorax; in termites it is a shield-like plate; in some beetles it is a bell- or hood-shaped piece that projects over the head.

ProFume®

The trade name of sulfuryl fluoride used for commodity fumigation.

quarantine fumigation

Fumigations, usually conducted at international ports-of-entry, to eradicate exotic pests that may be infesting shipments of agricultural or material goods.

Quality Assurance Review (QAR)

A job site inspection conducted by a manufacturer or fumigation company representative not in charge of the job site to ensure that a fumigation is done per label and local requirements.

RDA Fumiscope®

See Fumiscope®

reentry concentration

The threshold concentration of a fumigant at or below which it is safe for a structure to be reoccupied; for sulfur fluoride it is 5 ppm.

release valve

The valve at the top of the cylinder which must be turned to release the fumigant.

reoccupancy

The point after a fumigation when a structure can be safely entered and inhabited without the use of safety equipment.

SCBA or Self-contained breathing apparatus

A breathing device that allows the wearer to safely occupy a structure that has above-threshold levels of fumigant and chloropicrin. It consists of a full face mask with a hose connected to an air tank carried on the back; air is delivered via positive pressure thus preventing harmful gas from entering the mask.

secondary locks

Any type of device on a door, window, or other such barricade to entry that is not the primary locking mechanism, that prevents an outside door or entrance from being opened or entered by normal means by anyone other than the CO or SPID; examples include clam shell locks, split keys, a pole or bar placed in the rail of a sliding glass door, chains with a lock, etc.

secure the structure

The process of removing all normal means of entry into a structure to be fumigated by locking all doors, barring all entries, and conducting a thorough inspection of all rooms and spaces to ensure that the structure is completely unoccupied.

shipping papers

A document that describes a hazmat being transported; it contains the name, hazard class or division, amount, identification number, and packing group of the material.

shooting hose

The tube through which a fumigant is introduced or 'shot' into a structure or space; it runs from the fumigant cylinder release valve and ends inside the space to be fumigated; it should be kink-resistant, flexible, and have a minimum burst pressure of 500 pounds per square inch.

shooting stand

A supporting structure that securely holds the end of the shooting hose to keep it off the floor and direct the incoming fumigant towards the circulating fan thus ensuring rapid dispersion to prevent a 'fog-out.'

special local need registration (SLN)

A Special Registration Action that can be issued, reviewed or processed by DACS Bureau of Pesticides, operating under Chapter 487, Florida Statutes and Chapter 5E2 of the Florida Administrative Code.

snake

Tubular bags filled with sand or water that are used to weigh down the tarps and establish an effective ground seal. They can also prevent tarps from being blown loose by winds.

soldier

A caste in a termite colony that is specially adapted for defending the colony against enemies; adaptations include large, heavy mandibles, thick, plug-shaped heads, or pores or snouts that secrete noxious chemicals. Soldiers are very useful for species identification.

sorption

The process of fumigant being taken up (absorption) or held (adsorption) onto materials and surfaces.

SPID or Special fumigation identification card holder

A person who has an FDACS-issued ID card showing that he or she is licensed to perform fumigations under the direction of a certified operator in charge.

spot fumigation

A fumigation applied to a restricted or localized space within a larger structure that has no connection to other parts of the structure so that area can be separately sealed and fumigated.

Step 1 of aeration

The aeration phase when the seal is opened, all doors and windows are open, and all aeration fans are activated.

Step 2 of aeration

The aeration phase when the structure is secured after a minimum of one-hour active aeration.

Step 3 of aeration

The aeration phase when all breathing zones of the structure have been determined to be at 5 ppm SF or less using appropriate detection equipment.

Structural Pest Control Act, Chapter 482

The chapter within Title XXXII (32) of the Florida Statutes, which is a collection of state laws that contains all the state regulations for pest control including fumigation.

subterranean termites

Termites, in the families Rhinotermitidae and Termitidae, that nest underground, build subterranean tunnels, and forage above ground for wood and other materials containing cellulose.

Sulfuryl fluoride (SF)

The active ingredient in the fumigant known by the trade name Vikane®. At atmospheric pressure, it becomes a gas at -67° F.

swarmers

Also called alates, these mature, winged termites leave the colony during dispersal flights or swarms. After flight, males and females pair, locate nest sites, and become future kings and queens of colonies. Swarmers constitute the reproductive caste.

swarming

Dispersal of winged, sexually mature termites for the purpose of mating and starting new colonies.

tape-and-seal

A type of fumigation which is allowed when the main exterior of a structure is relatively gas tight so that tarping is not required. Areas of leakage such as windows, doorways, and vents, are made gas-tight using polyethylene sheeting and tape.

tarpaulin

A large vinyl-coated nylon, canvas, or polyester sheet used to seal a structure or other spaces for fumigation.

TIF leak detector

A commercially available electronic device that detects leaks of halogenated gasses at working concentrations.

Transportation Security Administration (TSA)

The federal agency responsible for the security of aviation and transportation created November 19, 2001 by the Aviation and Transportation Security Act (ATSA). A subset of the Department of Homeland Security (DHS). TSA is within the federal Department of Transportation (DOT).

true powderpost beetles

Small, elongate beetles in the family Lyctidae that attack hardwood and bamboo, and produce a fine, powder-like frass.

underseal

The substrate beneath a structure being fumigated, either concrete foundation or a crawl space and the soil type beneath it.

USDA

United States Department of Agriculture. The federal department in charge of all aspects of agriculture; it also manages agricultural, forest, and range lands; supports farming; and promotes domestic agriculture and forestry in the world economy.

valve cover

A cap that screws on to the cylinder valve opening used to prevent accidental release of fumigant even if the valve is opened.

vapor density

The weight of a gas compared to the weight of air.

vapor

A term often used in place of "gas."

vapor pressure

The pressure exerted within a space by a gas evaporating from a liquid.

Vikane®

The trade name for sulfuryl fluoride used in fumigation. Profume® is the name of sulfuryl fluoride used for commodity fumigation.

warning sign

A sign that must be posted at all external entrances and all sides of a structure warning that the structure is being fumigated, it also contains information on who is performing the fumigation and contact information in case of emergency.

wing venation

The pattern of veins on an insect wing.

wood-boring beetles

Beetles whose larvae feed on and whose adults bore through wood.

wood-destroying insect (WDI)

Any insect that attacks and damages wood, especially termites and wood-boring beetles.

wood-destroying organism (WDO)

Any organism that attacks and damages wood, including insects, wood-decaying fungi, and marine borers.

Wood-Destroying Organism (WDO) inspection report (Florida Form 13645)

A WDO report is not required for the fumigation inspection but must be completed when a customer requests a written report. It is usually requested for a real estate transaction and a fee is charged for the inspection and report.

workers

In termites, the caste in a termite colony responsible for maintaining the nest, caring for the eggs, feeding the reproductives, young, and soldiers, and foraging for food.

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