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.

STATE OF HAWAII
Department of Agriculture
ACCEPTED
LICENSE NO. 8459.3

ZYTHOR

02/13

Use to control existing infestations of all life stages of listed pests such as drywood termites, beetles (old house borer, powderpost, deathwatch), bedbugs, clothes moths, German cockroaches and rodents (rats, mice). Use to control existing infestations of non-egg life stages only of insects such as dermestid beetles (furniture carpet, carpet) and cockroaches (oriental, American, brown-banded). Use to control existing infestations of above ground Formosan termites.

For use in disinfesting structures such as dwellings, buildings, warehouses, mobile homes. For use in disinfesting vehicles such as automobiles, buses, recreational vehicles, surface ships, shipping containers, rail cars, (except aircraft). For use in disinfesting materials (construction) and furnishings (household effects).

When using, observe local, state and federal rules and regulations concerning the use of warning agents, detection devices, respiratory protection, protective clothing, security requirements and posting of warning signs.

ACTIVE INGREDIENT

Sulfuryl fluoride	99.3%
OTHER INGREDIENTS	0.7%
TOTAL	100.0%

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.)

In case of emergency endangering health or the environment involving ZYTHOR, call 1-800-369-4352.

Ensystex II, Inc.

2713 Breezewood Ave., Fayetteville, NC 28303 USA

FIRST AID	
In all cases of overexposure, when symptoms such as nausea, difficulty in breathing, abdominal pain, slowing of movements and speech or numbness in extremities are exhibited, get medical attention immediately. Take affected person to a doctor or emergency treatment facility.	
If inhaled:	Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.
If liquid is on skin or on clothing:	Immediately apply water to contaminated area of clothing before removing. Once area has thawed, remove contaminated clothing, shoes and other items covering skin. Rinse skin immediately with plenty of water for 15-20 minutes. 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. Liquid fumigant in the eye may cause damage due to refrigeration or freezing. Call a poison control center or doctor for treatment advice.

HOT LINE NUMBER

Have the product container or label with you when calling a poison control center or doctor, or when going for treatment. You may also call 1-800-424-9300 for emergency medical treatment information.

NOTE TO PHYSICIAN

ZYTHOR is a gas that has no warning properties such as odor, color or eye irritation. (Chloropicrin, which is used as a warning agent in conjunction with ZYTHOR, is the active ingredient in tear gas and will cause tearing.) Early symptoms of exposure to ZYTHOR 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.

READ THIS ENTIRE LABEL BEFORE USING THIS PRODUCT. ALL PARTS OF THIS LABEL ARE EQUALLY IMPORTANT FOR SAFE AND EFFECTIVE USE OF THIS PRODUCT. AS NECESSARY, CONSULT WITH THE LEAD STATE PESTICIDE REGULATORY AGENCY TO DETERMINE OR REMAIN INFORMED OF THE CURRENT REGULATORY STATUS, REQUIREMENTS AND RESTRICTIONS CONCERNING THE USE OF THIS PRODUCT FOR FUMIGATION IN THE STATE OF INTENDED USE. CALL ENSYSTEX II, INC. (PHONE 1-866-367-8467) IF YOU HAVE ANY QUESTIONS OR DO NOT UNDERSTAND ANY PART OF THIS LABEL.

APPLICATION PERSONNEL MUST PARTICIPATE IN ENSYSTEX II'S ZYTHOR TRAINING AND STEWARDSHIP PLAN

THE ZYTHOR APPLICATOR'S MANUAL IS PART OF THE LABELING FOR ZYTHOR.

Notice: Before buying or using this product, read "Terms and Conditions of Use", "Warranty Disclaimer", "Inherent Risks of Use" and "Limitation of Remedies" sections of this label. If terms are unacceptable, return at once unopened.

EPA Reg. No. 81824-1

EPA Establishment Numbers (Circled letters after Establishment Numbers below correspond to first letter in Lot # on the container label.)

68732 – DEU – 002 Ⓐ

73925 – CHN – 001 Ⓑ

81805 – CHN – 001 Ⓒ

NET CONTENTS: As marked on container

Zythor is a registered trademark of Ensystex II, Inc.

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

DANGER **POISON**

PELIGRO

Extremely Hazardous Liquid And Vapor Under Pressure • Fatal If Inhaled • May be Fatal if Swallowed • Causes Irreversible Eye Damage • Contact with Liquid Causes Freeze Burns Of Exposed Skin

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

Protective Clothing

Wear splash resistant goggles or full face shield for eye protection during introduction of fumigant or when working around any lines containing fumigant under pressure. Do not wear gloves or rubber boots. Do not reuse clothing or shoes that have become contaminated with liquid fumigant until they have been thoroughly aerated and cleaned. Splash resistant goggles are defined as goggles designed and made of material that allows no measurable movement of the liquid pesticide being used to pass through them during use.

Respiratory Protection

Use of an approved Respiratory Protection Device (see *Respiratory Protection Devices*) is required to enter or remain within a fumigated space anytime the concentration of ZYTHOR within the breathing zone of that space is known to exceed 1 ppm or is unknown, such as at the start of the aeration process. Breathing zones are defined as areas within the fumigated structure where individuals typically stand, sit or lie down.

If the concentration of ZYTHOR within the breathing zone of the fumigated space, as measured by an approved and properly calibrated Low Fumigant Level Detection Device (see *Low Fumigant Level Detection Devices*), does not exceed 1 ppm, no respiratory protection is required to enter or remain within the fumigated space. Because the approved detection devices give immediate readings of the levels of fumigant present, respiratory protection is not required when these devices are in use after the initial 1 hour aeration procedure is completed. However, whenever a fumigant level reading exceeding 1 ppm is obtained within the breathing zone of a fumigated space, anyone within the fumigated space not using an approved Respiratory Protection Device must immediately leave the fumigated space and remain outside the fumigated space until fumigant level readings of 1 ppm or greater are no longer obtained within the breathing zone of the fumigated space. The fumigated space must remain posted until cleared for re-occupancy. Refer to the Zythor Applicator's Manual for further details.

Respiratory Protection Devices

Use a NIOSH or MSHA approved positive pressure Self-Contained Breathing Apparatus (SCBA, not SCUBA) or combination air supplied/SCBA respirator, such as those manufactured by Ranger, Survivair, Scott, or MSA, when respiratory protection is required (see *Respiratory Protection*). Required Respiratory Protection Devices must be on site and operational before an application of ZYTHOR begins.

Before using any make or brand of Respiratory Protection Device, learn how to use it correctly. Determine that it is in good working order, that it has an air supply sufficient to supply air for the period of time the device will be in use, that it fits properly and that it provides an adequate seal around the face.

Low Fumigant Level Detection Devices

As part of the aeration/clearance process or cylinder leak procedure, an approved Low Fumigant Level Detection Device capable of confirming a concentration of ZYTHOR of 1 ppm or less, such as the SPECTROS SF-ExplorIR, INTERSCAN or MIRAN gas analyzers, should be used to sample the air within the breathing zone of the fumigated space to confirm the level of fumigant, if any, that is still present. The INTERSCAN gas analyzer must be calibrated within one month prior to its use as a Low Fumigant Level Detection Device. All other approved Low Fumigant Level Detection Devices must be calibrated according to their manufacturer's recommendations.

ENVIRONMENTAL HAZARDS

Sulfuryl fluoride is highly toxic to fish and wildlife. Avoid exposure to non-target organisms.

PHYSICAL AND CHEMICAL HAZARDS

Sulfuryl fluoride is a colorless, odorless, non-irritating toxic gas. ZYTHOR cylinders are under pressure and must not be stored near heat or open flame. Exposure of the cylinder(s) to temperatures above 158°F will cause a fusible plug in the valve body to melt and the contents to be released into the atmosphere. Under high heat conditions (temperatures above 752°F), ZYTHOR can decompose into sulfur dioxide (SO_2), hydrofluoric acid (HF) and other decomposition products. Hydroflouric acid is highly reactive and can corrode or damage many materials including metals, glass, ceramic finishes, fabrics, etc.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal. Do not ship or store with food, feed, drugs or clothing.

Pesticide Storage: Store in a dry, cool, well ventilated area under lock and key. Post as a pesticide storage area. Store cylinders upright, secured to a rack or wall to prevent tipping. Storage of ZYTHOR in occupied buildings and spaces is prohibited unless storage area(s) is equipped with either 1) a permanently mounted and properly maintained and functioning sulfuryl fluoride monitoring device designed to alert occupants of the building to the presence of sulfuryl fluoride in the air of the storage area at a level greater than 1 ppm or 2) a continuously operating forced air ventilation system that meets all applicable ordinances pertaining to the storage of hazardous materials.

Cylinder Return: Refillable container. When cylinder is empty, close valve, screw safety cap onto valve outlet and replace protection bonnet. Follow registrant's instructions for return of empty or partially empty cylinders. Only the registrant is authorized to refill cylinders. Do not use cylinders for any other purpose. Always follow the proper cylinder handling directions.

Pesticide Disposal: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide is a violation of Federal law. If the 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.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Carefully read and follow all Directions For Use. **The Zythor Applicator's Manual is part of the labeling for Zythor.**

ZYTHOR is a highly hazardous material and must be used only by individuals trained in its proper use and knowledgeable of its possible hazards. All local, state and federal rules and regulations regarding security requirements, reentry, aeration, clearance, posting of warning signs and use of detection devices, warning agents and respiratory protection equipment must be observed when fumigating with ZYTHOR.

Do not apply this product without first computing the dose to be applied with the Fumicalc software program. The Fumicalc program, which is available from Ensystex II, Inc., is part of the labeling for this product and must be used to calculate any dose of ZYTHOR.

Two persons trained in the use of ZYTHOR, at least one of whom is an applicator licensed/certified to perform fumigations by the state in which the application is being performed, must be present on site during any release of ZYTHOR, during any reentry into the fumigated space within the exposure period and during initiation of the initial aeration procedure. Two persons, however, need not be present if monitoring is conducted remotely (outside the area being fumigated) and no one enters the fumigated space.

If fumigating for insect pests, do not apply ZYTHOR when the lowest temperature at a site of pest activity within the fumigated space is below 40°F. Generally, the lowest temperature in a slab structure is found at the slab foundation and the lowest temperature in a crawl space structure is found just below the surface of the crawl space soil. No temperature restriction applies when fumigating for rodents.

Remove, food, feed, drugs (including tobacco products) and medicinals from the structure before the fumigation if they cannot be protected against exposure to ZYTHOR (see *Preparation for Fumigation*). Chloropicrin must be used to warn of the presence of fumigant within the fumigated space (see *Warning Agent*).

Handling and Transportation of Cylinders

Cylinders must 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 or move cylinders. Transport cylinders using a 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 cylinders securely and only in an upright position. ZYTHOR cylinders should never be transported by aircraft under any circumstances.

Do not remove valve protection bonnet and safety cap until immediately before use. Replace safety cap and valve protection bonnet as soon as practical after use.

The cylinder valve is designed to retain a small amount of fumigant within the cylinder when the pressure within the cylinder falls below a certain pressure. This feature prevents the introduction of unauthorized substances into the cylinder when it is empty. This is facilitated by a spring loaded residual pressure feature incorporated into the valve that cuts off gas flow when the pressure of the remaining gas falls below a certain low level. Do not attempt to defeat this mechanism as serious injury could result.

Cylinder Leak Procedure

Evacuate immediate area of leak. Use an approved Respiratory Protection Device (see *Respiratory Protection Devices*) for entry into affected areas to correct the problem. Move leaking or damaged cylinder outdoors or to an isolated location, observing strict safety precautions. Work upwind from the cylinder if possible. Entry into the affected area by persons not using approved Respiratory Protection Devices is not permitted until the concentration of ZYTHOR in the breathing zone of the affected area is determined to be 1 ppm or less, as determined by an approved Low Fumigant Level Detection Device (see *Low Level Fumigant Detection Devices*). Refer to the Zythor Applicator's Manual for further details.

Compressed Gas Hazards

The release of fumigant under high pressure can be forceful, creating a potential for personal injury.

A fog-out can occur if ZYTHOR is released too rapidly. The chances of this condition occurring may be decreased by following the instructions contained in this label (see *ZYTHOR Release Preparation*).

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

PREPARATION FOR FUMIGATION

Structure Occupant Fact Sheet

Prior to the application of ZYTHOR to a structure, the ZYTHOR Fact Sheet must be provided to an adult occupant of the structure to be fumigated. In the case of a multi-unit or connected structure (see below), the ZYTHOR fact sheet must be provided to an adult occupant of each currently occupied individual living unit within these structures.

Fumigating Part(s) of a Structure (including Portions of a Multi-unit Structure)

When fumigating unit(s)/room(s) that are a part of or are within a larger structure (such as one or more units of a town house, apartment or condominium building/complex) the space within all units/rooms of the entire structure must be considered to be fumigated space with respect to all requirements concerning structure entrance security, posting, evacuation, reentry, aeration and clearance. Chloropicrin needs to be used only within the fumigated units/rooms of the structure. If during clearance the concentration of Zythor in the breathing zone of a unit/room is discovered to be greater than 1 ppm, ventilate the unit/room by opening operable doors and windows and continue to measure the concentration of Zythor in the breathing zone until it is 1ppm or less. Structure may be reoccupied when concentrations of Zythor in the breathing zones of all units/rooms in the structure is 1 ppm or less. Breathing zones are defined as areas within the units/rooms where individuals typically stand, sit or lie down.

Fumigating Connected Structures

A connected structure or area is defined as any structure or area connected to or having in common with the space to be fumigated any construction elements (e.g. pipes, conduits, ducts, cavities, voids, etc.) which could possibly allow the passage of fumigant out of the fumigated space into the connected structure(s) or area(s).

If state rules and regulations do not permit the continued occupancy of a structure or area connected to a structure that is being fumigated during the fumigation process, the space within the entire connected structure(s) or area(s) must be considered to be a fumigated space with respect to all requirements concerning structure entrance security, posting, evacuation, reentry, aeration and clearance. If the continued occupancy of connected structures is permitted during fumigations by state rules and regulations and continued occupancy of connected structures will occur during the fumigation process, adhere to the procedures contained within the state rules and regulations for isolating the connected structure(s) from the fumigated space before allowing for such occupation to occur. Chloropicrin needs to be used only within the fumigated space. Concentration levels of Zythor must be measured in the breathing zones in any connected structure(s) or area(s) to confirm concentrations are 1 ppm or less before the structure(s)/area(s) can be reoccupied.

What to Remove from the Fumigated Space

Remove all persons, domestic animals, pets and desirable growing plants from the space to be fumigated. Remove mattresses (except waterbeds) and pillows completely enveloped in waterproof covers or alternately remove or unseal / unzip covers.

Food, feed, drugs (including tobacco products) and medicinals (including those items in refrigerators and freezers) can remain within the fumigated space if they are contained within plastic, glass or metal containers with the original manufacturer's air-tight seal intact.

Remove fish tanks containing live fish, or remove the fish, or develop a plan for preparing the tank for fumigation. If necessary, exclude water in the tank and biological filters, if present, from the fumigated space by sealing with gas resistant tarps or sheeting. If water aeration is required during the fumigation, provide fresh air from outside the fumigated space for the tank aerator.

Protective Bagging of Open Food, Feed and Drugs

Food, feed, drugs (including tobacco products) and medicinals (including those items in refrigerators and freezers) not in plastic, glass or metal containers with the original manufacturer's air-tight seal intact must be removed from the fumigated space or protected against exposure to ZYTHOR if they are left within the fumigated space.

Items can be protected against exposure to ZYTHOR by double bagging them in Fumiguard, Nylofume® or Master Fume® bags. Fumiguard bags, which are available from Ensystex II (and Nylofume and Master Fume bags) are made of a material highly resistant to permeation from gases such as sulfuryl fluoride. Double bag in Fumiguard, Nylofume or Master Fume bags all items that must be protected against exposure to ZYTHOR that will be left within the fumigated space. Double bagging is performed by placing an item in a Fumiguard, Nylofume or Master Fume bag, twisting the top of the bag closed tightly and then securing the twisted part of the bag in its closed position. The closed bag is then double bagged by placing the closed bag inside another bag which is secured closed in the same manner as the inner bag.

Extinguishing Flames and Disconnecting Heat Sources

Extinguish all flames, including pilot lights of furnaces, water heaters, dryers, gas refrigerators, gas logs, ranges, ovens, broilers, open flames, etc. Turn off or unplug all electrical heating elements such as those in heaters, dryers, pianos, organs, etc. Shut off automatic switch controls for appliances and lighting systems that will be contained within the fumigated space. Contact your local gas company to determine what procedures should be followed in your area for shutting off natural gas or propane service. Gas service must be shut off at the main service valve. Sulfuryl fluoride can react with strong bases such as some photo developing solutions.

Doors and Openings to Closed Spaces

Open and leave open all operable internal doors. Open and leave open all operable openings to rooms, attics, sub-areas, storage rooms and closets. Open and leave open operable doors, covers or lids of any space within which fumigant could accumulate and linger during aeration including storage cabinets, drawers, storage chests and appliances (such as washers, dishwashers, dryers, microwave ovens, conventional ovens, refrigerators, freezers, etc.).

Appliances

Turn off and/or disconnect appliances as appropriate to the circumstances. Alternately leave refrigerators and freezers operating and their doors closed if the choice is made to leave properly sealed items inside of them. If the choice is made to leave sealed items in closed refrigerators and freezers during the exposure period, the appliance's doors must be opened and left open at some point during aeration and clearance of the fumigated space until the concentration of ZYTHOR within their interior is 1 ppm or less as measured by an approved and properly calibrated Low Fumigant Level Detection Device.

Air Circulation

Based on the circumstances, it may be necessary to actively circulate the air in all or part of the fumigated space with properly positioned fans after the release of ZYTHOR to assure its rapid dispersion within all of the fumigated space. Parts of the structure that may warrant consideration for active air circulation may include basements, dead air spaces and areas located long distances from a point of ZYTHOR introduction into the fumigated space. If possible, position and aim fans in such a manner that air closer to the point(s) of ZYTHOR release is circulated towards points farther from the point(s) of ZYTHOR release.

Fumigant Confinement

The methods and materials used to confine the fumigant to a space to be fumigated can vary depending on the nature of the space (e.g., structure, vehicle, chamber, vessel) and the inherent resistance of the surfaces that form the space to the movement of the fumigant out of it (e.g., masonry walls vs. wood walls). The more gas tight the fumigated space inherently is or can be rendered to be, the higher the level of fumigant confinement that can be attained. Consider a monitored application of ZYTHOR (see *Monitored Vs. Un-Monitored Application*) to any fumigated space where there is uncertainty as to whether or not an adequate level of ZYTHOR can be confined to that space for the intended duration of the exposure period.

Structure Fumigation Using A Tarpaulin

When and to the extent needed, use tarpaulin(s) made of a material that effectively confines and is sufficiently impermeable to the passage of the fumigant through it such as vinyl coated nylon or polyethylene sheeting of at least 4 mil thickness to cover the structure or portion of the structure containing the space to be fumigated. Seal all seams between adjacent tarpaulins. Seal all edges of the tarpaulin that touch the ground or ground level surface to that surface with, for example, soil, sand or weighted snakes resting on the edge of the tarp. After tarping, make sure that all operable windows and interior doors of the fumigated space are open. Leave windows closed if required by local and/or state regulations.

Fumigant can be lost (and damage to plants outside the fumigated space around the exterior of a fumigated structure can occur) when it is able to penetrate the soil surface within the fumigated space adjacent to where the tarpaulins rest against the ground and move outward. This movement is retarded when the soil between the foundation of the structure and the outermost edge of the tarpaulin around the perimeter of the structure contains a high level of moisture. If soil around the foundation of the structure is not sufficiently moist to act as a barrier to fumigant movement, wet all soil between the foundation of the structure and the outermost edge of the tarpaulin around the perimeter of the structure and around the root zone of plants that may be potentially affected.

Structure Fumigation Without Using a Tarpaulin

For fumigated spaces or structures that can be adequately sealed against the excess movement of fumigant out of them without the use of a tarpaulin, seal adequately around exterior doors, windows, vents, fireplaces and other openings of the fumigated space. Use sealing materials and techniques proven to adequately retard the movement of fumigant out of a fumigated space such as tape and polyethylene sheeting. To minimize escape of fumigant through the soil and to avoid injury to nearby plants, wet soil (if not sufficiently moist) around the structure to act as a barrier to fumigant movement.

Chamber Fumigation

Fumigations with ZYTHOR may be conducted in permanent fumigation chambers enclosed within, or connected to, a larger structure. A permanent chamber is defined as a durable hard-walled structure engineered specifically for fumigation that effectively confines ZYTHOR. Monitor indoor areas around the permanent fumigation chamber for ZYTHOR concentrations with an approved and properly calibrated Low Fumigant Level Detection Device during the fumigation, especially during fumigant introduction. No one is permitted in areas where the concentration of fumigant in the air is greater than 1 ppm unless they are using an approved Respiratory Protection Device. Aerate ZYTHOR from the chamber by venting it directly to the outside of the structure using a ventilation system that does not release ZYTHOR into the structure within which the chamber is located.

Fumigation of Construction Materials, Furnishings (Household effects) Vehicles and Shipping Containers

Preparations must be as appropriate to the particular circumstances. Create a sufficiently gas tight seal that will adequately confine the fumigant to the fumigated space for the planned exposure period based on the directions for tarpaulin, non-tarpaulin and chamber fumigation above. If the sealed fumigant space is created within a larger structure (e.g., vehicle fumigated within a garage), the space within the entire structure should be considered fumigated space with respect to all requirements concerning preparation for fumigant introduction (except fumigant confinement and warning agent), structure entrance security, posting, evacuation, reentry, aeration and clearance. Stationary vehicles should be prepared and sealed following the instructions above. Vehicles, trucks, trailers, shipping containers, railcars, etc. may be fumigated with ZYTHOR, however all aeration/clearance procedures must be completed before these are transported or driven over public roads.

Fumigation of Surface Ships in Port

Surface ships in size up to and including large ocean-going ships may be fumigated with ZYTHOR to control the pests listed on this label. The applicator and the ship's captain (or owner) shall follow all applicable regulations including those contained in the Code of Federal Regulations, Title 46 – Shipping, Chapter 1 - Coast Guard, Part 147A. Except for those persons involved in the 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 the use of Respiratory Protection Devices and Low Fumigant Level Detection Devices. Emergency procedures, cargo ventilation, periodic monitoring, 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, when appropriate, of the leakage in order that corrective action can be taken by them.

Food,feed, drugs (including tobacco products) and medicinals shall not be exposed to the fumigant. If they are not removed from the vessel they shall be protected from exposure to the fumigant. The vessel must not be moved during the period of time between initial fumigant application and final clearance.

Approved Respiratory Protection Devices must be worn during reentry into the fumigated space when reentry occurs between the time of initial fumigant application and final clearance and a concentration of more than 1 ppm of fumigant is detected in a breathing zone of the fumigated space during that period.

Warning Agent

Chloropicrin is a warning agent that must be released within the space to be fumigated prior to introduction of ZYTHOR into that space. Even at very low levels of concentration in the air, unprotected exposure to chloropicrin in the air causes tearing and smarting of the eyes accompanied by a disagreeable, penetrating smell. Chloropicrin must be released into the fumigated space only by a Certified Applicator or someone under their direct supervision. Applicators must observe the chloropicrin precautionary statements and personal protective equipment appearing on this label, see the *Warning Agent* section of the manual.

Chloropicrin must be released within a fumigated space at least 5 minutes prior to introduction of the fumigant. Apply/release 1 fluid oz of chloropicrin per 10,000 to 15,000 cubic feet – (30 ml of chloropicrin per 283 to 425 cubic meters) of fumigated space or alternately use the chloropicrin dosage rate calculated by the Fumicalc program for the fumigated space. Establish at least one chloropicrin introduction site for each 45,000 cubic feet (1275 cubic meters) of fumigated space. When applying chloropicrin at multiple chloropicrin introduction points within a structure, start at the point farthest from the exit and work toward the exit. Dispense no more than 3 fluid ounces (90 ml) of chloropicrin into a single evaporation container. Distribution of chloropicrin throughout a fumigated space is enhanced by applying/releasing it as follows:

1. Place a shallow, wide container directly behind a fan in its air stream.
2. Place a handful of wicking agent, (e.g., cotton) in the bottom of the container.
3. Pour the chloropicrin over the wicking agent.

Do not place chloropicrin into a container made of magnesium, aluminum, or their alloys, as chloropicrin may severely corrode these metals. Removal of all chloropicrin evaporation containers from the fumigated space as soon as possible after commencement of the initial aeration procedure will speed dissipation of the chloropicrin from the fumigated space.

The use of chloropicrin is not required when fumigating railcars and shipping containers; however if chloropicrin is not used, a thorough pre-fumigation walk-through inspection must be performed of each railcar or shipping container with their doors being immediately locked upon leaving each car or container. A guard must be continuously posted during the period between ZYTHOR introduction and final clearance if no chloropicrin is used.

Securing Fumigated Structure Entrances

During the Exposure Period and Step 2 of the aeration procedures, fumigated structure(s) must be secured against the possibility of entry into the structure(s) by anyone other than a Certified Applicator or persons under their direct supervision. Two levels of security against unauthorized entry must be employed at each exterior entrance during those periods, if practicable. In addition to the use of existing locking mechanisms, if present, a secondary locking device must also be used. A locking device, such as a secondary lock, or barricade must be demonstratively effective in preventing an exterior door or doorway from being opened from the exterior using normal opening or entering processes by anyone other than the certified applicator in charge or the fumigation or persons under his/her direct supervision. Consult state and local regulations for any supplementary instructions and/or restrictions on securing against unauthorized entry into fumigated structures.

Posting of Fumigated Spaces

All entrances and all sides of the fumigated space including those within structures, chambers, vehicles, ships and stacks must be posted and placarded with warning signs. Signs must remain legible during the entire posting period. Post warning signs in advance of the fumigation in order to keep unauthorized persons away. All signs must bear the following in English and Spanish:

1. The signal word “DANGER/PELIGRO” and the SKULL and CROSSBONES symbol in red.
2. The statement, “Area under fumigation, DO NOT ENTER/NO ENTRE”.
3. The date of the fumigation.
4. Name and EPA Registration Number of the fumigant.
5. Name, address, and telephone number of the fumigation company and the licensed/certified applicator.

Only a certified applicator may authorize removal of the signs and only when the concentration of Zythor within the structure where individuals typically stand, sit or lie down (breathing zone) is 1 ppm or less.

DETERMINING DOSES AND EXPOSURE PERIODS FOR ZYTHOR

The amount of ZYTHOR applied to the fumigated space is referred to as the dose. The level of fumigant present in the air is referred to as the concentration. Dose is expressed in pounds of fumigant and concentration is expressed in ounces of ZYTHOR per thousand cubic feet of fumigated space. Achieving target pest mortality with ZYTHOR is dependent upon the concentration of ZYTHOR present in the air the target pest is breathing. However, it is also dependent upon the length of the period of time the target pest is exposed to that concentration (exposure period) and the temperature. For a given temperature and rate of ZYTHOR loss from the fumigant space, increases in the concentration of ZYTHOR can reduce the length of the exposure period required to kill a pest. Conversely, under the same temperature and rate of fumigant loss conditions, increases in the length of the exposure period can reduce the concentration of ZYTHOR required to kill the same pest. Concentration in ounces per thousand cubic feet multiplied by the number of hours in the exposure period is referred to as the Kill Power Index.

The Fumicalc computer program, designed to run on most types of desktop and laptop computers and many handheld computers, is used to calculate the Kill Power Index that must be achieved within a fumigant space to kill the target pest and the dose and exposure period necessary to achieve that Kill Power Index. The Fumicalc program is part of the ZYTHOR labeling and must be used to calculate all doses and exposure periods for ZYTHOR. The Fumicalc accepts as inputs the factors necessary to compute these values for all labeled target pests. The Fumicalc program is available from Ensystex II, Inc.

Certain insects are more susceptible to exposure to ZYTHOR than others. This means higher Kill Power Indexes must be achieved for certain Target Pests compared to that needed to kill others. Higher Kill Power Indexes can be achieved for any fumigated space by administering a higher Concentration of ZYTHOR and/or extending the Exposure Period, all of which is handled by the Fumicalc automatically. All you have to do is tell the Fumicalc the Target Pest and it makes any necessary adjustments to the Kill Power Index.

The egg stage of some Target Pests are not susceptible to sulfuryl fluoride and thus cannot be killed by ZYTHOR. In this case it may be advisable to fumigate once at a concentration sufficient to control the post-embryonic (larva, pupa, adult) stages. After any surviving insect eggs have hatched, but prior to these insects’ maturation and deposition of new eggs, fumigate a second time, again at the post-embryonic life stage concentration.

The Kill Power Index necessary to control different target pests is expressed in the following table as multiples of the Kill Power Index required to kill Drywood termites (Index = 1), assuming the applications occurred under the same conditions. When the egg stage of a Target Pest cannot be killed with ZYTHOR, the multiple of the Drywood Termite Kill Power Index that must be achieved to kill the non-egg stages only is given instead. These multiples apply to the use of ZYTHOR within all types of fumigated spaces.

Refer to the Zythor Applicator’s Manual for further details.

Kill Power Indexes for Different Pests (Drywood Termite Index = 1)

Pests	Multiple of the Drywood Termite Kill Power Index	Comments
Rodents[1]	1/2x	
Carpet Beetles	1x	Eggs are not killed
Cockroaches (except German)[1]	1x	Eggs are not killed
Cockroach (German) [1]	1x	
Furniture Carpet Beetles	3x	Eggs are not killed
Bedbugs[1]	3x	
Old House Borers	4x	
Formosan Termites[1]	4x	Above ground termites only are killed. Use in combination with other methods to kill infestations originating below ground.
Clothes Moths	6x	
Powder Post Beetles and Death Watch Beetles	10x	
[1]Do not use less than the specified dosage factors when treating for rodents, cockroaches, bedbugs, and termites.		

MONITORED VS. UNMONITORED APPLICATION

Monitor or monitoring refers to the periodic measurement of the actual concentration of ZYTHOR contained within the air of the fumigated space. Monitoring confirms the concentration of ZYTHOR to which the Target Pest is exposed and allows for correction of variations of the actual from the expected concentration of ZYTHOR, if necessary. Monitoring can increase the accuracy with which the needed Kill Power Index is applied and is particularly recommended when a high level of precision is necessary. A monitored or unmonitored application of ZYTHOR can be made to any fumigated space for the control of any type of Target Pest. The ZYTHOR Fumicalc calculator is designed to calculate the dose of ZYTHOR (and supplements to the dose during the course of the fumigation in the case of a monitored application, if needed) for any fumigated space for both monitored and unmonitored applications.

ZYTHOR RELEASE PREPARATION

Prepare to release the ZYTHOR through a shooting tube to be attached to the ZYTHOR cylinder whose discharge end is positioned within the fumigated space. The system for introduction of ZYTHOR into the fumigated space (tubing, connectors, etc.) should be free of leaks and designed to withstand a minimum burst pressure of 500 pounds per square inch (psi).

If monitoring will occur, run gas sampling lines from representative locations within the fumigated space to exterior monitoring points before ZYTHOR introduction.

Preventing Fogouts

ZYTHOR is packaged as a liquid under pressure. When it is released into the fumigated space it must be converted into a gas to be effective as a fumigant. This process of release and conversion, if not properly prepared for and controlled, can result in damage to surfaces within the fumigated space from contact with water condensed from the air as the liquid to gas conversion process cools the air into which the fumigant is introduced and nearby surfaces. Damage can also occur when unconverted liquid fumigant, possibly present in the fumigated space after it is released but before it converts to a gas, comes into contact with surfaces that might be damaged by its presence.

The conversion of ZYTHOR from a liquid in the cylinder to a gas requires a source of heat. The heat to make this conversion is taken from the air into which the ZYTHOR is released as it contacts the air. The need for heat to make this conversion can cause problems when the release of fumigant removes enough heat from the air to cause the air temperature to drop below its Dew Point temperature. The amount of moisture a parcel of air can hold is dependent upon its temperature. The Dew Point temperature for a parcel of air is the temperature at which that air is holding as much moisture as it can hold. If the temperature of air falls below its Dew Point temperature, fog can form and moisture can condense from the air onto nearby surfaces if the temperature of these surfaces is low enough. The higher the percent relative humidity and the lower the temperature of surfaces in the fumigated space before the introduction of fumigant, the greater the chance fog will form in the air and/or condensation will form on surfaces.

Condensation can damage surfaces it forms on if they are sensitive to the presence of moisture.

The conversion of the fumigant from liquid to gas normally occurs almost instantaneously when it is released into the fumigated space, however it is possible that, based on the circumstances, some fumigant will remain in its liquid form for a short period of time after it has been released. This can be a problem if this super-cooled liquid fumigant is deposited onto surfaces that can be damaged by its presence, however brief.

Care must be taken to reduce the chances that moisture is condensed from the air within the fumigated space during fumigant application or that unconverted liquid fumigant is present within the fumigant space long enough to come to rest on surfaces. One way to accomplish both of these is to maximize the amount of air into which the fumigant is released. The greater the number of "units" of air used to vaporize each "unit" of fumigant, the less heat that must be removed from each "unit" of air during the conversion process. This reduces the possibility that the capacity of the air into which the fumigant is released to hold water or fumigant will be exceeded. Increase the volume of air into which the fumigant is released, and thereby maximize the rate of fumigant vaporization from liquid to gas, by situating the discharge end of the fumigant shooting tube on the positive pressure side of an operating fan (blast side) located within a large open area of the fumigated space. The air movement capacity of the fan should be at least 1,000 cubic feet per minute for each pound of ZYTHOR released per minute.

Using a small inside diameter shooting tube (1/8 inch) can also reduce the chances of un-vaporized fumigant coming to rest on surfaces within the fumigated space. To further protect against the effects of un-vaporized fumigant on surfaces, it is recommended that protective sheeting, such as polyethylene plastic, be placed on the floors in the vicinity of any fumigant release point**. In order to prevent damage, do not apply fumigant directly to any surface.**

Special care must be taken when the percent relative humidity of the air within the fumigated space is high (the amount of moisture in the air is high compared to the total amount it can hold). If necessary delay the fumigation until conditions are more favorable such as when the relative humidity within the structure to be fumigated is lower.

ZYTHOR RELEASE

Before introducing the fumigant, verify that all required safety equipment is available and in good working order. Position the ZYTHOR cylinder(s) outside the space to be fumigated. Do not connect cylinders to introduction equipment until all fumigation warning signs have been posted and the space to be fumigated is clear of persons, non-target animals and is properly secured.

Release the ZYTHOR from outside the fumigated space. Wear splash resistant goggles or full face shield for eye protection during introduction of fumigant or when working around any lines containing fumigant under pressure. Do not wear gloves or rubber boots.

AERATION AND CLEARANCE

Aeration

The final step in using ZYTHOR is to remove it from within the fumigated space (aeration) and to confirm its absence from the breathing zone of the fumigated space after the completion of the aeration process (clearance). Aeration of ZYTHOR from a fumigated space involves actively exhausting and/or allowing the ZYTHOR to dissipate from the fumigated space out into the atmosphere. Clearance involves sampling the air within the breathing zone of the fumigated space with an approved and properly calibrated Low Fumigant Level Detection Device until readings given by the detection device indicate that fumigant is no longer present above 1 ppm within the breathing zone of the fumigated space. Only when certain periods of time (see *Aeration Procedures* below) have elapsed after the initiation of the aeration process and the level of fumigant remaining within the breathing zone of the fumigated space is confirmed at the end of those time periods to no longer exceed 1 ppm can final clearance for re-occupancy be given. Breathing zones are defined as areas within the structure where individuals typically stand, sit or lie down.

Special attention must be given to aerating attics and forced air handling system ducts. Active aeration of attics can be accomplished by directing a fan into attic access openings. Air handling systems can be aerated by activating the system blower or alternately directing a fan into one or more return vents.

Refer to the Zythor Applicator's Manual for further details.

Respiratory Protection Requirements During Aeration and Clearance

The processes of aeration and clearance of the fumigated space require entry into the fumigated space while the level of ZYTHOR in the air within the breathing zone of the fumigated space still exceeds 1 ppm. All persons entering and/or remaining inside the fumigated space between the time of initial application of ZYTHOR to the fumigated space and final clearance of the fumigated space must adhere to the requirements of the *Respiratory Protection, Respiratory Protection Devices* and *Low Fumigant Level Detection Devices* sections of this label.

Aeration Procedures

There are two approved procedures for aeration. The aeration procedure used for a fumigated space is based on the total amount of ZYTHOR per thousand cubic feet that was released within the fumigated space during the exposure period. All structures into which a total of more than 16 ounces of ZYTHOR per thousand cubic feet of fumigated space has been released during the Exposure Period must be aerated using Aeration Procedure 2. All other fumigated spaces can be aerated using either Aeration Procedure 1 or Aeration Procedure 2.

Aeration Procedure 1 – Applied Dose 16 oz/1000 cubic feet or less
These steps must be completed in sequence.

Step (1): Aerate the fumigated space with all operable windows and doors open, aided by the use of 1 or more fans, for a minimum of 1 hour. All of the fans used shall, in total, be capable of displacing at least 5,000 cubic feet of air per minute. The fans may be turned off for the remainder of the aeration period if desired.

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

Step (3): After the minimum 6 hour waiting period, measure the concentration of ZYTHOR in the breathing zone of each room of the fumigated space using an approved and properly calibrated Low Fumigant Level Detection Device. If a concentration of ZYTHOR greater than 1 ppm is detected in the breathing zone, ventilate the fumigated space by opening operable doors and windows and continue to measure the concentration of Zythor in the breathing zone until it is 1 ppm or less. Fumigated space may be cleared for re-occupancy when the concentration of ZYTHOR as measured with an approved and properly calibrated Low Fumigant Level Detection Device is determined to be 1 ppm or less in the breathing zone.

Aeration Procedure 2 – Applied Dose More Than 16 oz/1000 cubic feet
These steps must be completed in sequence.

Step (1): Aerate the fumigated space with all operable windows and doors open, aided by the use of 1 or more fans, for a minimum of 1 hour. All of the fans used shall, in total, be capable of displacing at least 5,000 cubic feet of air per minute. The fans may be turned off for the remainder of the aeration period if desired.

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

Step (3): After the minimum 8 hour waiting period, measure the concentration of ZYTHOR in the breathing zone of each room of the fumigated space using an approved and properly calibrated Low Fumigant Level Detection Device. If a concentration of ZYTHOR greater than 1 ppm is detected in the breathing zone, ventilate the fumigated space by opening operable doors and window and continue to measure the concentration of Zythor in the breathing zone until it is 1 ppm or less. Fumigated space may be cleared for re-occupancy when the concentration of ZYTHOR as measured with an approved and properly calibrated Low Fumigant Level Detection Device is determined to be 1 ppm or less in the breathing zone.

Final Clearance and Re-occupancy

Do not reoccupy fumigated space, i.e., structure, ship, vehicle or chamber, or move fumigated vehicles until aeration is complete and clearance has been given. Warning signs must remain posted until aeration is completed and final clearance for re-occupancy is given.

TERMS AND CONDITIONS OF USE

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

WARRANTY DISCLAIMER

ENSYSTEX II warrants that this product conforms to the chemical description on the label and that it is reasonably fit for the purposes stated on the label when used in strict accordance with the directions for use, subject to the inherent risks set forth below. **TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, ENSYSTEX II MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.**

INHERENT RISKS OF USE

It is impossible to eliminate all risks associated with use of this product. Lack of performance or other unintended consequences may result because of factors such as use of the product contrary to the label directions or contrary to the dosage and/or exposure period recommendations of the Fumicalc, adverse conditions (such as unfavorable temperatures, high humidity, unfavorable soil conditions, excessive rainfall, etc.), abnormal conditions (such as excessive winds, tornadoes, hurricanes), presence of other materials, the manner of application or other factors, all of which are beyond the control of ENSYSTEX II or the seller. All such risks shall be assumed by the Buyer and User.

LIMITATION OF REMEDIES

To the extent consistent with applicable law, the exclusive remedy for losses or damages resulting from the use of this product (including claims based on contract, negligence, strict liability or other legal theories), shall be limited to, at ENSYSTEX II's election, one of the following: Refund of purchase price paid by the buyer or user for product bought or replacement of amount of product used.

ENSYSTEX II shall not be liable for losses or damages resulting from handling or use of this product unless ENSYSTEX II is promptly notified of such loss or damage in writing. In no case shall ENSYSTEX II be liable for consequential or incidental damages or losses even if ENSYSTEX II knew of, was advised of, or should have been aware of the possibility of such damages.

The terms of the Terms and Conditions of Use, Warranty Disclaimer, Inherent Risks of Use and this Limitation of Remedies cannot be varied by any written or verbal statements or agreements. No employee or sales agent of ENSYSTEX II 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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ZYTHOR

Applicator's Manual

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Version 2013.1

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.

APPLICATION PERSONNEL MUST PARTICIPATE IN
ENSYSTEX II'S ZYTHOR TRAINING AND STEWARDSHIP PLAN

THE ZYTHOR APPLICATOR'S MANUAL IS PART OF THE LABELING FOR ZYTHOR

In case of an emergency endangering health, call Prosar at 1-800-369-4352. This is a special number for Zythor emergencies only.

In case of an emergency endangering the environment call Chemtrec at 1-800-424-9300.

If you wish to obtain additional product information call us at 1-866-367-8467

The information, specifications, procedures, methods and recommendations herein are presented in good faith, are believed to be accurate and reliable, but may well be incomplete and/or not applicable to all conditions or situations that may exist or occur. No representation, guarantee or warranty is made as to the accuracy, reliability or completeness of said information, specifications, procedures, methods or recommendations or that application or use of any of the same will avoid hazards, accidents, losses, damage or injury of any kind to persons or property or give desired results.

Readers are cautioned to satisfy themselves as to the suitability of said information, specifications, procedures, methods and recommendations for the purposes intended prior to use.

This manual is not a replacement for the label directions contained on the now current Zythor label. If there is a conflict between what is contained in this manual and the now current label, all uses of Zythor must be in compliance with the current label. Each individual fumigator is responsible for complying with all laws and regulations pertaining to the use, storage and transportation of this product.

Zythor is a highly hazardous material and should be used only by individuals trained in its proper use and knowledgeable of its possible hazards. All local, state and federal rules and regulations regarding security requirements, reentry, aeration, clearance, posting of warning signs and use of detection devices, warning agents and respiratory protection equipment must be observed when fumigating with Zythor.

Do not apply this product without first computing the dose to be applied with the Fumicalc software. The Fumicalc program, which is available from Ensystex II, Inc., is part of the labeling for this product and must be used to calculate any dose of Zythor.

Read the entire Zythor label and this Applicator's Manual before using Zythor. This Applicator's Manual is not intended to supercede label requirements or state and local regulations. This manual will be periodically revised to reflect additional use patterns or label modifications, and knowledge obtained through continuing research and experience. The Applicator's Manual includes recommendations for using Zythor and describes the safe handling and storage of this product. Each fumigator using Zythor is responsible for complying with all federal, state, and local regulations or codes regulating the use of this product. Because regulations and the enforcement of regulations can change, the fumigator should stay informed about state and local regulations in areas where they operate.

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Carefully read and follow all Directions For Use.

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Introduction

Structural Fumigation - Are you committed?

Fumigation is a very specialized form of structural pest control. It is used to control a limited number of pests that cannot be easily or effectively controlled any other way.

One critical characteristic that distinguishes fumigation and fumigants from almost all other methods and forms of structural pest control is that, improperly handled or applied, fumigants can create real and immediate hazards to life and property. The decision to practice the science and art of fumigation should not be taken lightly, as mistakes can have real and possibly permanent adverse consequences. It is critical to understand this before you proceed further.

The foundation of successful and safe fumigating is knowledge and attention to detail. There is simply no substitute for this. You must be committed to learning and continually relearning all of the most up to date technical aspects and regulatory procedures that must be adhered to for every fumigation, without exception.

Fumigation is useful for the same reasons it is dangerous. Applied at a sufficient concentration and held in place within a defined space inhabited by a target pest for a sufficient exposure period, a fumigant can kill almost any living organism wherever it is located. Every fumigation has essentially the same purpose (control of a target pest), but every fumigation is also unique. However there are basic principles and procedures of fumigation in general and the use of Zythor in particular that applies to every Zythor fumigation. This manual is intended to inform you of these with regards to the use of Zythor. However it is not possible to cover all that is known about fumigation in this manual. For this reason, it is important for you to continually seek out and learn new information about fumigation wherever it can be found.

Zythor Stewardship

Ensystex II takes seriously its role as the manufacturer of Zythor. We make every effort to deliver to you a fumigant product that is effective and when used correctly and as directed, safe. However once a cylinder of Zythor has left our possession we have no control over how it is stored, transported and used.

For that reason, Ensystex II implemented the Zythor Stewardship Program. This program is a cooperative effort between Ensystex II and Zythor users designed to reinforce with all persons involved in the use of Zythor the need to use it in a responsible and safe manner.

The Zythor Stewardship program involves recurrent training in the correct and safe use of Zythor. It also involves on site inspections of actual uses of Zythor by Ensystex II personnel. These inspections are designed to identify and help resolve any variances from the then current standards in the use of Zythor.

Stewardship of Zythor is an critical aspect of being a Zythor User. Failure to participate in the Zythor Stewardship Program could result in a refusal by Ensystex II to continue to sell you Zythor. Failure to use Zythor properly could also result in a refusal to sell you Zythor.

If you have observations, comments or recommendations concering the Zythor Stewardship Program in particular or anything about Zythor in general, we would like to hear from you. Call us at 1-866-367-8467 or email us at info@ensystex.com.

Zythor Stewardship Program

Ensystex II is committed to the safe and effective use of Zythor every time it is used. The Zythor Stewardship Program best exemplifies our commitment. The responsible parties of all entities that use Zythor are obligated to sign a Zythor Stewardship Agreement and to actively participate in the Zythor Stewardship Program. By signing the Zythor Stewardship Agreement, the signing party is committing their entire organization to its active and ongoing participation in the Zythor Stewardship Program for as long as they use Zythor.

While no amount of planning, training and care can assure that no mishaps will ever occur during a fumigation, the Zythor Stewardship Program is based upon the precept that training and attention to detail can go a long way towards making the fumigation process safer than it would otherwise be.

Certified Applicator and Trained Person Required Participation in the Use of Zythor

Zythor must be used only by Certified Applicators or persons under their direct supervision. Additionally, any use of Zythor must be permitted by the Certified Applicator's certification. For the purposes of the Zythor label, a Certified Applicator is defined as a person licensed/certified by the state to use Zythor.

Two persons trained in the use of Zythor, at least one of who is an applicator licensed/certified to perform fumigations by the state in which the application is being performed, must be present on site during any release of Zythor, during any reentry into the fumigated space within the exposure period and during initiation of the initial aeration procedure. . Two persons, however, need not be present if monitoring is conducted remotely (outside the area being fumigated) and no one enters the fumigated structure.

Some states may have more stringent requirements concerning the presence of a Certified Applicator and/or trained persons during the different phases of use of Zythor. Consult your state regulatory authorities for further information.

Why Fumigants and Fumigation?

The principle advantage of a fumigant is that, practically speaking, it can kill a target pest wherever it may be located within the fumigated space. No matter how deep within a piece of wood or what finished surface the pest may be located behind, a fumigant can, in almost every instance, reach and kill that pest. This is the overwhelming advantage of fumigation compared to other forms of control.

Fumigants are able to do this because they are true gases. A gas, by its nature, tends to occupy the entire space into which it has been released. A gas can penetrate into almost any area, including into the pores in a piece of wood and deep into its interior. (Fumigant penetration can be limited by moisture, but the level of moisture found in a piece of wood that forms a part of a structure is unlikely to reach or exceed the level necessary to interfere with the ability of a fumigant to fully penetrate that wood.)

The pests that are killed by a fumigant are also susceptible to other methods of control. For instance, drywood termites can be killed by practically any type of pesticide if that pesticide is applied to the termite or the area occupied by the termite. However the limitation faced by non-fumigants is severe. If the location of every termite cannot be determined, the non-fumigant will not be successful in fully eradicating the termite problem.

The one limitation of fumigation, at least in terms of its ability to control pests, is that it leaves no residual. Once a fumigant has dissipated from the fumigated space, any newly invading pests will not be killed.

Zythor Material Safety Data Sheet

ZYTHOR GAS FUMIGANT

Emergencies

Spill or Environment 1-800-424-9300 (Chemtrec)

Health 1-800-369-4352 (Prosar)

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name: Zythor

Chemical Name: Sulfuryl fluoride

Company: Ensystex II, Inc.

Address: 2713 Breezewood Ave., Fayetteville, NC 28303

Daytime Phone: 1-866-367-8467

2. COMPOSITION / INFORMATION ON INGREDIENTS

Sulfuryl fluoride 99.3% CAS# 2699-79-8 EINECS#: 220-281-5

Carbon dioxide 0.5% CAS# 124-38-9

3. HAZARDS IDENTIFICATION

Compressed gas harmful by inhalation. Sulfuryl fluoride has no warning properties such as odor, color or eye irritation. Exposure to toxic and even lethal levels may occur without warning or detection during a single exposure. Evacuate immediate area if leak occurs. Releases hydrogen fluoride upon decomposition by high heat.

4. FIRST-AID

In all cases of overexposure, when symptoms such as nausea, difficulty in breathing, abdominal pain, slowing of movements and speech or numbness in extremities are exhibited, get medical attention immediately. Take affected person to a doctor or emergency treatment facility.

Inhalation: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Excessive exposure may severely irritate upper respiratory tract. Consult a physician in all cases.

Eye Contact: Hold eye open and rinse slowly and gently with water for at least 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Liquid fumigant in the eye may cause damage due to refrigeration or freezing.

Skin Contact: Immediately apply water to contaminated area of clothing before removing. Once area has thawed, remove contaminated clothing, shoes and other items covering skin. Rinse skin immediately with plenty of water for 15-20 minutes.

Note to Physician: Sulfuryl fluoride is a gas that has no warning properties such as odor, color or eye irritation. (Chloropicrin, (CAS# 76-06-2) which is used as a warning agent in conjunction with sulfuryl fluoride, is the active ingredient in tear gas and will cause tearing.) 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. Such individuals should rest in bed for at least 24 hours. 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.

5. FIRE-FIGHTING MEASURES

Extinguishing Media: This product does not burn. All means of extinguishing are acceptable. If cylinders are in a fire area, remove them if possible. Alternately, water can be used to keep them cool to prevent discharge of product due to the melting of fusible plugs in the cylinder valves which will occur at temperatures above 158°F. Use of water may also help to scrub out part of any hydrofluoric acid and sulphur dioxide which may be formed by decomposition of the product in a fire.

Hazardous Combustion Products: At temperatures above 752°F, sulfuryl fluoride will decompose into hydrogen fluoride and sulfur dioxide.

Fire fighting Equipment: Firefighters should wear protective clothing and use self-contained breathing apparatus. 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

Personal Precautions: Wear appropriate safety clothing, respiratory protection devices and eye/face protection (see Section 8). Evacuate unprotected personnel that are nearby.

Leak Procedure: Evacuate immediate area of leak. Move leaking cylinder to an isolated location observing strict safety precautions. If safe to do so, try to stop leak. Work upwind from the cylinder, if possible. Entry into affected area(s) by persons not using approved respiratory protection devices is not permitted until the concentration of sulfuryl fluoride in the air of the affected area(s) is determined to be 1 ppm or less, as determined by an approved Low Fumigant Level Detection Device (such as ExplorIR, Interscan, or Miran gas analyzer).

7. HANDLING AND STORAGE

Handling: Use good personal hygiene. Follow proper cylinder handling directions. See Section 8 for control measures.

Storage: Keep out of reach of children. Product should be stored in compliance with local regulations. Store in a well ventilated, cool, dry area. Keep away from heat sources.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Ventilation and respiratory protection information given below is applicable to handling sulfuryl fluoride during production, packaging, transportation and storage. Applicators should refer to the product label for personal protection equipment requirements during application.

Exposure Limits: ACGIH TLV is 5 ppm TWA, 10 ppm STEL. OSHA PEL is 5 PPM TWA. Provide general and/or local exhaust ventilation to control airborne levels below the exposure limits.

Respiratory Protection: Atmospheric levels should be maintained below the exposure guidelines. When respiratory protection is required or during emergency conditions, use a NIOSH approved positive pressure self-contained breathing apparatus or positive pressure airline with auxiliary self-contained air supply.

Hand/Skin Protection: No 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/Face Protection: Splash resistant goggles/face shield. Splash resistant goggles are defined as goggles designed and made of material that allows no measurable movement of the liquid pesticide being used to pass through them during use.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance/Odor: Colorless, odorless

Relative vapor density (air=1): 3.5 at 68 ^{O}F (20 ^{O}C)

Boiling point/range: - 67 ^{O}F (-55.4 ^{O}C)

Water solubility: Practically insoluble

Vapor pressure: 15.2 atmospheres at @ 68 ^{O}F (20 ^{O}C)

10. STABILITY AND REACTIVITY

Chemical Stability: Stable under normal storage conditions.

Conditions to Avoid: Avoid heating product to its decomposition temperature.

Materials to Avoid: Strong bases.

Hazardous Decomposition Products: Hydrogen fluoride and sulfur dioxide upon heating above decomposition temperature.

Additional Information: Hazardous polymerization will not occur.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity: Inhalation LC50/Rat/991 ppm Oral LD50/Rat/100mg/kg

Irritation: Reacts with mucous membranes

Chronic Toxicity: Inhalation, after repeated exposure, various species, **Target organ:** respiratory system, nervous system, kidney, skeleton, 20 ppm, observed effect

No teratogenic effect

Carcinogenic Designation: None

12. ECOTOXICOLOGICAL INFORMATION

Acute Ecotoxicity: No Data

Chronic Ecotoxicity: No Data

Other effects: Product is known to have herbicide and insecticide properties

13. DISPOSAL CONSIDERATIONS

Promptly return all empty cylinders to Ensystex II. Follow proper cylinder handling and waste disposal guidelines (see label).

14. TRANSPORT INFORMATION

DOT Proper Shipping Name: Sulfuryl Fluoride; Technical Shipping Name: Sulfuryl Fluoride; DOT Hazard Class: 2.3; DOT Label: Poison Gas; DOT Packing Group: Inhalation Hazard Zone D ; DOT ID#: UN2191

15. REGULATORY INFORMATION

The information herein is given in good faith, but no warranty, expressed or implied, is made. Consult Ensystex II for further information.

TSCA 8(b): Yes

SARA Hazard Classifications:

Immediate (Acute) Health Hazard: Yes

Delayed (Chronic) Health Hazard: Yes

Sudden Release of Pressure Hazard: Yes

Reactive Hazard: Upon heating above decomposition temperature

Fire Hazard: No

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.

Sulfuryl Fluoride 002699-79-8 NJ3 PA1

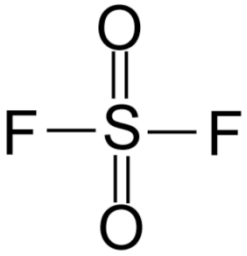
OSHA HAZARD COMMUNICATION STANDARD: This product is a “Hazardous Chemical” as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Sulfuryl Fluoride

Sulfuryl Fluoride Physical Properties

The active ingredient in Zythor is sulfuryl fluoride. Sulfuryl fluoride is commonly referred to as SF.

Sulfuryl fluoride's molecular formula is SO_2F_2 meaning it consists of one sulfur atom, two oxygen atoms and two fluorine atoms.



Sulfuryl Fluoride molecular structure

Sulfuryl fluoride is an inorganic compound. This simply means it does not contain carbon. Its lack of a carbon atom (which is very reactive) makes it a relatively unreactive molecule as a gas. Unreactive means it does not combine with or change due to exposure to or interaction with other compounds. This lack of reactivity is one of the biggest advantages of sulfuryl fluoride as a fumigant compared to other fumigants such as methyl bromide. Methyl bromide can, for instance, adversely react with certain substances commonly found within structures. (There are however circumstances under which Zythor can, due to residual ingredients left in it during the manufacturing process, cause damage if it is applied improperly).

Sulfuryl fluoride is odorless and colorless. While these at first glance appear to be advantages, that is in fact not the case as this means there is no warning of their presence. During the use of Zythor, these two limitations are dealt with by adding a warning agent to the fumigated space.

The boiling point of sulfuryl fluoride is -67° F at normal atmospheric pressure meaning it exists only as a gas in the atmosphere. Its vapor density is 3.5 times that of air. The vapor pressure of sulfuryl fluoride is relatively high at 15.2 atmospheres at @ 20° C; an important attribute that will be discussed later.

The water solubility of sulfuryl fluoride is low at 0.075% meaning it is practically insoluble in water.

Sulfuryl fluoride decomposes at 752° F. For this reason all heat sources and flames must be extinguished within spaces to which it is applied. The specific gravity or density of sulfuryl fluoride is 1.32, meaning in liquid form it is 1.32 times as heavy as an equal volume of water.

One pound of sulfuryl fluoride will lower the temperature of 1000 cubic feet of dry air 4.5° F.

One pound of sulfuryl fluoride occupying 1000 cubic feet of unoccupied space equals 3850 ppm at normal room temperature and pressure.

Sulfuryl Fluoride vs. The Ideal Fumigant

Sulfuryl fluoride has many (but not all) of the properties that an ideal fumigant would possess.

Ideal Fumigant Properties that Sulfuryl Fluoride Possesses

Sulfuryl fluoride is suitably toxic to the non-egg stages of all target insects.

As mentioned earlier, sulfuryl fluoride is generally speaking, not reactive with substances normally found within structures. (There are some exceptions such as photographic chemicals). As long as no flame is present there is generally no possibility of damage to or corrosion of any substance due to exposure to sulfuryl fluoride. (There however does exist a possibility of damage from exposure to some minute amounts of residual ingredients contained in Zythor as explained in the *Zythor Formulation and Residual Ingredients* section.)

Sulfuryl fluoride is not explosive at any concentration in the air.

A highly desirable property of sulfuryl fluoride is its high vapor pressure mentioned earlier. Because of its high vapor pressure, sulfuryl fluoride diffuses or penetrates throughout a fumigated space and porous objects (such as wood) within it at a rapid rate. Sulfuryl fluoride is weakly adsorbed by these same materials meaning that when the exposure period is completed and the seal is broken, it quickly aerates out of the fumigated space and is relatively quickly desorbed from the objects it has penetrated.

Ideal Fumigant Properties that Sulfuryl Fluoride Lacks

Sulfuryl fluoride lacks any warning odor alerting a person to its presence as referred to earlier. For this reason chloropicrin must be added to the fumigated space before Zythor is introduced as explained in the *Warning Agent* section.

There is no antidote to sulfuryl fluoride. Persons that are exposed are treated symptomatically.

Another disadvantage of sulfuryl fluoride is its relatively lower toxicity to insect egg stages than to the non-egg stages as explained in the *Toxicity of Sulfuryl Fluoride to Pests* section.

Sulfuryl fluoride and the Ozone Layer

Fluorine compounds without chlorine or bromine in their molecules have no potential to deplete the ozone layer. Therefore sulfuryl fluoride, unlike methyl bromide, does not affect the ozone layer. As a fumigant, sulfuryl fluoride has a bright future.

Toxicity of Sulfuryl Fluoride to Target Pests

Sulfuryl fluoride is highly effective against a number of important structural pests, the most important being drywood termites. The toxicity of sulfuryl fluoride varies among different insect pests. Generally speaking, the more active a pest is, the more susceptible it is to sulfuryl fluoride. Also the higher the temperature, the lower the amount of sulfuryl fluoride necessary to kill the pest.

Because of substantial differences in the susceptibility of different pests to sulfuryl fluoride, it is critical that the target pest be properly identified before the fumigation commences. Incorrect pest identification can result in under-dosing or overdosing the job resulting in either a failure to control the target pest or the waste of un-needed sulfuryl fluoride.

For convenience, sulfuryl fluoride's toxicity to pests (and the amount that must be applied to control a particular target pest) is expressed as a multiple of its toxicity to drywood termites, with the level applicable to drywood termites being expressed as 1X. This is explained in more detail in the *Determining Doses and Exposure Periods* section.

Differences in Effectiveness Against Different Insect Life Stages

Sulfuryl fluoride is less toxic to the egg stage of insects than to the non-egg stages. The lower toxicity to eggs is the result of the inability of sulfuryl fluoride to easily penetrate insect egg shells.

Control of eggs with sulfuryl fluoride can be achieved by increasing the concentration of sulfuryl fluoride in the air or by increasing the length of time the target pest is exposed to it. These increases in dosage and/or exposure time are built into the values contained in the *Determining Doses and Exposure Periods* section.

Increases in concentration are not necessary to control unhatched eggs of social insects such as termites. This is because the larval stages of termites are unable to survive without adult care. The eggs may still hatch even after exposure to sulfuryl fluoride, but the hatched larval stage dies shortly thereafter due to a lack of care.

Pests Controlled With Zythor

Zythor can be used to control:

- existing infestations of all life stages of pests such as drywood termites, beetles (old house borer, powderpost, deathwatch), bedbugs, clothes moths, German cockroaches and rodents (rats, mice).
- existing infestations of non-egg life stages only of insects such as dermestid beetles (furniture carpet, carpet) and cockroaches (oriental, American, brown-banded). The poor action of Zythor against the eggs of these insects makes it unlikely that control of these insects can be achieved with one application of Zythor. Expect to have to make multiple applications of Zythor to control these insects.
- existing infestations of above ground Formosan termites.

Types of Sites at Which Zythor Can be Used

Zythor can be used to disinfest:

- structures such as dwellings, buildings, warehouses, mobile homes.
- vehicles such as automobiles, buses, recreational vehicles, surface ships, shipping containers, rail cars, (except aircraft).
- materials (construction) and furnishings (household effects).

Temperature Restrictions on the Use of Zythor Against Insects

If fumigating for insect pests, do not apply Zythor when the lowest temperature at a site of pest activity within the fumigated space is below 40°F. Generally the lowest temperature in a slab structure is found at the slab foundation and the lowest temperature in a crawl space structure is found just below the surface of the crawl space soil. No temperature restriction applies when fumigating for rodents.

Zythor Cylinders

Zythor is furnished in steel cylinders. These cylinders are designed to allow for the safe handling of Zythor in almost any conceivable condition or situation. The cylinders are designed to withstand a high level of abuse (accidental or otherwise). However the widest margin of safety is enjoyed when the cylinders are handled according to the following procedures.

Zythor Vapor Pressure

Zythor exits the cylinder from a valve in the top of the cylinder. This valve is attached to an internal dip tube connected to the bottom of the valve. This dip tube runs straight down from the bottom of the valve to the bottom of the cylinder. Zythor exits the cylinder at the bottom of the cylinder where it enters the dip tube. Once inside the dip tube the Zythor travels upwards to the valve where it exits the valve into the shooting hose.

Zythor enters the dip tube and exits the cylinder because of the vapor pressure of the sulfuryl fluoride. The vapor pressure of sulfuryl fluoride within the cylinder is the result of the evaporation of sulfuryl fluoride into the portion of the cylinder not filled with liquid sulfuryl fluoride. This gaseous sulfuryl fluoride presses down against the liquid sulfuryl fluoride below it. The vapor pressure of sulfuryl fluoride is considerable and it can increase substantially with increases in temperature.

Increases in temperature increase the vapor pressure because at higher temperatures more molecules of sulfuryl fluoride are able to escape the liquid phase and become a gas than at a lower temperature. At 32° F Zythor exerts a pressure of 128 pounds per square inch (psi) on the walls of the cylinder. At 68° F the pressure exerted climbs to 224 psi. At 104° F the pressure exerted rises even higher to 364 psi. However, the pressure rating of the cylinders exceeds by a wide margin the amount of pressure that could be exerted by the sulfuryl fluoride at any temperature to which the cylinder would normally be subjected.

The high vapor pressure of sulfuryl fluoride is why it is important to always use shooting hoses with a burst pressure of at least 500 psi. If the shooting hose were to ever become clogged, the high-pressure resistance rating of the hose would prevent bursting of the hose.

As long as the level of sulfuryl fluoride in the cylinder is above the hole at the bottom of the dip tube, sulfuryl fluoride exits the cylinder as a liquid. Once the level of sulfuryl fluoride falls below this level, the last small amount of sulfuryl fluoride in the cylinder exits the cylinder as a gas. It takes considerably longer for sulfuryl fluoride to exit the cylinder as a gas than as a liquid and for this reason it make take a considerable amount of time to finish emptying a cylinder of its last remaining contents.

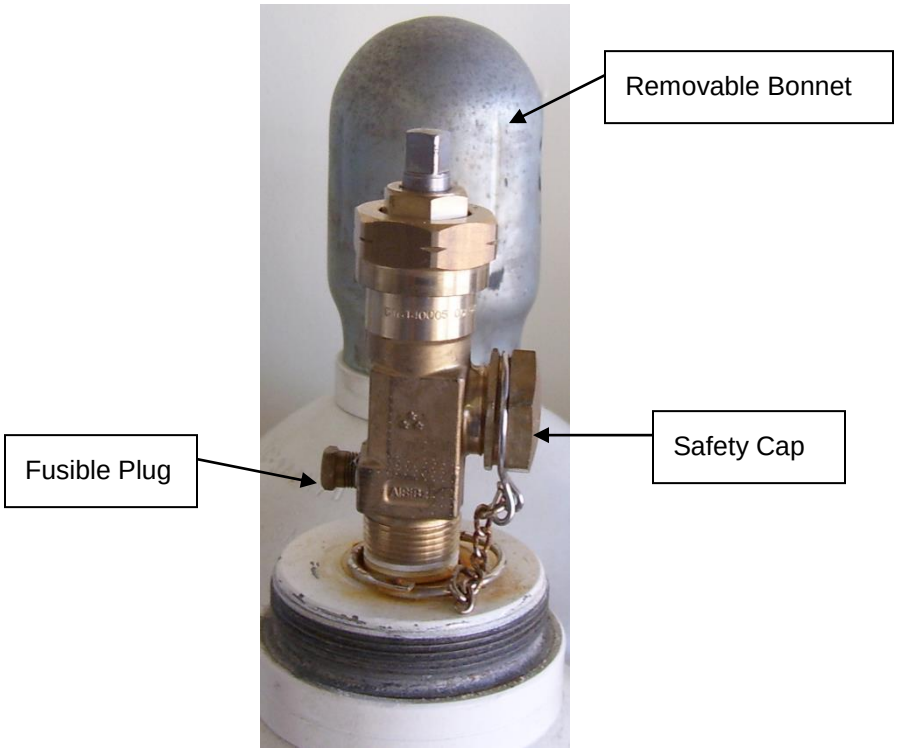
Handling and Transportation of Cylinders

Cylinders must 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 or move cylinders. Transport cylinders using a 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 cylinders securely and only in an upright position.** Zythor cylinders should never be transported by aircraft under any circumstances.

Regulations require that containers of sulfuryl fluoride and chloropicrin be secured against movement within any vehicle within which they are being transported. Cylinders should always be capped and secured in an upright position.

Refer to the *Transporting Zythor* section for more information on this subject.

Cylinder Valve



Cylinder Valve Protection

The most vulnerable part of the cylinder is the valve and its connection to the cylinder. For this reason do not remove the valve protection bonnet or the safety cap until immediately before use. Replace safety cap and valve protection bonnet as soon as practical after use.

Cylinder Valve Outlet Threads

The Zythor cylinder valve outlet is a CGA 660 outlet. The threads on this outlet at 1.030 inch right hand threads, 14 threads per inch, straight thread fitting.

Residual Pressure Device

The cylinder valve is designed to retain a small amount of fumigant within the cylinder when the pressure within the cylinder falls below a certain pressure. This feature prevents the introduction of unauthorized substances into the cylinder when it is empty. This is facilitated by a spring loaded residual pressure feature incorporated into the valve that cuts off gas flow when the pressure of the remaining gas falls below a certain low level. Do not attempt to defeat this mechanism as serious injury could result.

Cylinder Leak Procedure

- Evacuate immediate area of leak.
- Use an approved Respiratory Protection Device (see *Respiratory Protection Devices*) for entry into affected areas to correct the problem.
- Move leaking or damaged cylinder outdoors or to an isolated location, observing strict safety precautions.
- Work upwind from the cylinder if possible.
- Entry into the affected area by persons not using approved Respiratory Protection Devices is not permitted until the concentration of Zythor in the breathing zone of the affected fumigated area is determined to be 1 ppm or less, as determined by an approved Low Fumigant Level Detection Device (see *Low Level Fumigant Detection Devices*).

The cylinder valve is equipped with a Belleville disc spring. This highly engineered spring is designed to keep continuous pressure on the valve packing which makes it unlikely a leak will ever occur. In the unlikely event a leak does occur, simply close the valve. Closing the valve restores metal to metal contact inside the valve at the point at which gas enters the valve from the cylinder. In the highly unlikely event that closing the valve does not stop the escape of gas from the cylinder, keep the area around the cylinder clear until the cylinder is empty and the level of Zythor in the breathing zone immediately around the cylinder has been confirmed to be 1 ppm or less.

Report any cylinder leaks to Ensystex II and follow any instructions you are given concerning cylinder return.

Protection Against Cylinder Rupture Due to Fire

Zythor cylinders are under pressure and must not be stored near heat or open flame. Exposure of the cylinder(s) to temperatures above 158°F will cause a fusible plug in the valve body to melt and the contents to be released into the atmosphere (see picture above). This feature is intended to protect against the cylinder rupturing due to excess gas pressure caused by high heat. Whenever a Zythor cylinder is involved in a high heat situation, it must be assumed that Zythor will be or has been released into the surrounding air due to the melting of the fusible plug.

Empty Cylinders

Empty cylinders must be handled with the same level of care and according to the same procedures used for non-empty cylinders. Never attempt to refill a cylinder.

Fire Fighting

Extinguishing Media: This product does not burn. All means of extinguishing are acceptable. If cylinders are in a fire area, remove them if possible. Alternately, water can be used to keep them cool to prevent discharge of product due to the melting of fusible plugs in the cylinder valves which will occur at temperatures above 158°F. Use of water may also help to scrub out part of any hydrofluoric acid and sulphur dioxide which may be formed by decomposition of the product in a fire.

Hazardous Combustion Products: Zythor is not combustible. However, in temperatures exceeding approximately 400°C (752°F), Zythor will degrade to form hydrogen fluoride (HF) and sulfur dioxide (SO_2). Each mole (102 gm) of sulfuryl fluoride will degrade to form 2 moles (40 gm) of HF. However, the HF actually produced during fires involving Zythor may be insignificant because Zythor rapidly escapes from structures unless confined.

Fire Fighting Equipment: Firefighters must wear protective clothing and use self-contained breathing apparatus. 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.

Physical, Chemical and Environmental Hazards of Sulfuryl Fluoride

Decomposition in High Heat Conditions

Under high heat conditions (temperatures above 752°F), Zythor can decompose into sulfur dioxide (SO_2), hydrofluoric acid (HF) and other decomposition products. Hydrofluoric acid is highly reactive and can corrode or damage many materials including metals, glass, ceramic finishes, fabrics, etc.

Compressed Gas Hazards

The release of fumigant under high pressure can be forceful, creating a potential for personal injury. The rapid discharge of Zythor through introduction equipment will result in the cooling of parts of the equipment and the cylinders. Contact with the cooled equipment can cause frostbite.

Environmental Hazards

Sulfuryl fluoride is highly toxic to fish and wildlife. Avoid exposure to non-target organisms.

Zythor Formulation and Residual Ingredients

The nominal concentration of sulfuryl fluoride in Zythor is 99.3% with 0.7% other ingredients.

Of the 0.7% other ingredients, 0.5% is carbon dioxide. This carbon dioxide is present due to the carbon catalyst used in the sulfuryl fluoride manufacturing process.

The remaining 0.2% other ingredients consists of residual ingredients related to the sulfuryl fluoride manufacturing process.

The residual ingredients are important to note because they are highly reactive. It is possible for damage to occur to glass, tile, metal (copper, silver, steel, stainless steel, brass, aluminum, etc.) and other materials on account of the presence of these residual ingredients in Zythor if certain precautions are not taken during its release into the fumigated space.

When the precautions recommended in this manual and on the Zythor label are adhered to and Zythor is correctly released according to the recommendations made in this manual and on the Zythor label, the possibility of damage due to the presence of these residual ingredients in Zythor can be effectively eliminated.

The potential for problems with the residual ingredients exists when they become mixed with water or are discharged in very low temperature conditions. The most important way that the residual ingredients become mixed with water is when the release of Zythor causes a fogout. Low temperatures can cause problems because under these conditions the residual ingredients may remain in liquid form for a longer period of time than usual after they exit the shooting hose and may splash onto a sensitive unprotected surface. Refer to the *Preventing Fogouts* section of this manual and the Zythor label for more information.

Worker Protection

Sulfuryl fluoride is a colorless, odorless, non-irritating toxic gas. When using Zythor, certain precautions must be taken when there is the potential for respiratory exposure to air that contains more than 1 ppm (4 mg / cubic meter) of sulfuryl fluoride. These mandatory precautions include the use of protective clothing, respiratory protection devices and devices to detect levels of sulfuryl fluoride in the air. Protective clothing, respiratory protection devices and sulfuryl fluoride detection devices needed to comply with these precautions are explained in the next three sections. When complying with these precautions, the clothing and devices used to comply must be in compliance with all the requirements contained in the next sections including specified type of clothing and devices and routine maintenance and calibration of devices.

Always adhere to the then current manufacturer and regulatory recommendations and requirements concerning the use, care, calibration and maintenance of all worker protection related equipment and devices.

Protective Clothing

Wear splash resistant goggles or full face shield for eye protection during introduction of fumigant or when working around any lines containing fumigant under pressure. Do not wear gloves or rubber boots. Do not reuse clothing or shoes that have become contaminated with liquid fumigant until they have been thoroughly aerated and cleaned. Splash resistant goggles are defined as goggles designed and made of material that allows no measurable movement of the liquid pesticide being used to pass through them during use.

Respiratory Protection

Use of an approved Respiratory Protection Device (see *Respiratory Protection Devices*) is required to enter or remain within a fumigated space anytime the concentration of Zythor within the breathing zone of that space is known to exceed 1 ppm or is unknown, such as at the start of the aeration process. Breathing zones are defined as areas within the fumigated structure where individuals typical stand, sit or lie down.

If the concentration of Zythor within the breathing zone of a fumigated space, as measured by an approved and properly calibrated Low Fumigant Level Detection Device (see *Low Fumigant Level Detection Devices*), does not exceed 1 ppm, no respiratory protection is required to enter or remain within the fumigated space. Because the approved detection devices give immediate readings of the levels of fumigant present, respiratory protection is not required when these devices are in use after the initial 1 hour aeration procedure is completed. However, whenever a fumigant level reading exceeding 1 ppm is obtained within a breathing zone of a fumigated space, anyone within the fumigated space not using an approved Respiratory Protection Device must immediately leave the fumigated space and remain outside the fumigated space until fumigant level readings of greater than 1 ppm are no longer obtained within a breathing zone of the the fumigated space. The fumigated space must remain posted until cleared for re-occupancy.

Respiratory Protection Devices

Use a NIOSH or MSHA approved positive pressure Self-Contained Breathing Apparatus (SCBA, not SCUBA) or combination air supplied/SCBA respirator, such as those manufactured by Ranger, Survivair, Scott, or MSA, when respiratory protection is required (see *Respiratory Protection*). Required Respiratory Protection Devices must be on site and operational before an application of Zythor begins.

Before using any make or brand of Respiratory Protection Device, learn how to use it correctly. Determine that it is in good working order, that it has an air supply sufficient to supply air for the period of time the device will be in use, that it fits properly and that it provides an adequate seal around the face.

SCBA Safety

The following are suggested practices that will enhance the level of SCBA use safety.

- Users of SCBA should be determined by a doctor to be physically able to use SCBA. This status should be reviewed annually.
- Written Standard Operating Procedures (SOP) on the use, including emergency procedures, and maintenance procedures for SCBA should be developed and maintained.
- Workers should be fit tested for SCBA and should be instructed in its proper use by a person knowledgeable in its correct use.
- SCBA should not be worn if conditions (such as a beard and glasses) prevent a good seal of the mask against the face.

Low Fumigant Level Detection Devices

As part of the aeration/clearance process or cylinder leak procedure, an approved Low Fumigant Level Detection Device capable of confirming a concentration of Zythor of 1 ppm or less, such as the SPECTROS SF-ExplorIR, INTERSCAN or MIRAN gas analyzers, should be used to sample the air within the breathing zone of the fumigated space to confirm the level of fumigant, if any, that is still present. The INTERSCAN gas analyzer must be calibrated within one month prior to its use as a Low Fumigant Level Detection Device. All other approved Low Fumigant Level Detection Devices must be calibrated according to their manufacturer's recommendations.

Toxicity of Sulfuryl Fluoride

Acute Toxicity (Oral, Inhalation, Dermal)

In acute oral toxicity studies using rats and guinea pigs, sulfuryl fluoride has been shown to be moderately toxic. It has been placed in Toxicity Category II by the EPA for these effects (Category I indicates the highest and Category IV the lowest level of acute toxicity). Sulfuryl fluoride has been placed in Toxicity Categories III and IV for acute inhalation and Category IV for acute dermal vapor toxicity.

Neurotoxicity

A two-day neurotoxicity study using rats showed no effects at the highest dose levels.

Subchronic Toxicity

Four subchronic toxicity studies using rats, rabbits and dogs showed similar results. At high levels of exposure effects included fluorosis of the teeth, decreased body weights, and effects to the lung, nervous system and brain.

Developmental Toxicity

In developmental toxicity studies using rats and rabbits, at the highest dose levels, some maternal toxicity (reduced body weight gain) and developmental toxicity (reduced fetal body weights) were observed.

Reproductive Toxicity

Zythor is unlikely to have effects on the development of offspring. A reproductive toxicity study using rats showed parental effects to the lungs and brain, and reduced pup weights only at high levels.

Mutagenicity

Sulfuryl fluoride was negative in three mutagenicity studies.

Sulfuryl Fluoride Toxicity

LD_{50} (oral) for rats:	100 mg/kg
LD_{50} (inhalation) for rats: 4 hours (male rats) 4 hours (female rats) 1 hour (male rats) 1 hour (female rats)	 1122 ppm 991 ppm 3730 ppm 3021 ppm
NOEL (No Effect Level) for rats and rabbits during 90 days, 6 hours a day, 5 days a week exposure	30 ppm
NOEL for rats during a 9 weeks, 6 hours a day, 5 days a week exposure	100 ppm

First Aid / Poisoning Symptoms

In case of an emergency endangering health, call Prosar at 1-800-369-4352. This is a special number for Zythor emergencies only.

Poisoning Symptoms

Because it is colorless, odorless and at low concentrations, non-irritating to mucous membranes, the potential exists for undetected exposure to Zythor. The potential for harm and or death from sulfuryl fluoride poisoning depends upon the level and duration of any exposure.

It is not known what levels of exposure in humans cause precisely what effects because no dose response studies have been conducted on humans. However exposure to higher concentrations for longer periods of time can be expected to result in increasingly more serious effects.

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

Exposure to progressively higher concentrations is expected to result in convulsions, tremors and/or strychnine-like muscular rigidity. Rats exposed to 1000 ppm began to show CNS depression 15 minutes after initiation of exposure, and slight eye irritation was evident after 2 hours. By 3 1/2 hours, the animals were moribund and/or convulsive, and some died shortly after termination of the 4-hour exposure. Rats exposed to 1425 ppm were sedated in 20 minutes, prostrate in 40 minutes, convulsive after 1 to 2 hours and dead in 4 hours. Humans exposed to high concentrations of Zythor may experience respiratory irritation, nausea, abdominal pain, central nervous system depression, slowing of movements and speech, and numbness in the extremities. Survival after exposure to high concentrations can occur even following convulsions, if exposure has been brief.

Physician Information

The prediction of possible effects in human beings is based in part on observations made on laboratory animals. On this basis, depending on length of exposure, it is predicted that persons exposed to Zythor will probably show little evidence of intoxication at first unless the concentration was moderate to high (>500 ppm). Initial effects will probably be depression on the CNS with slow speech and body movement being the first signs noted. Convulsions may ensue with respiratory arrest being a terminal event. Assisted respiration may be necessary. An exposed patient should be removed to fresh air and put at rest. Keep exposed individual at bed rest and under observation for at least 24 hours. Clinical observation should be directed at the pulmonary, hepatic and renal systems. A postmortem finding in a fatality attributed to sulfuryl fluoride was pulmonary edema. Death was attributed to cardio-respiratory failure. **There is no known antidote.** Clinical observation is essential. Treatment is based on the clinical judgment of the physician and the individual reaction of the patient.

In case of an emergency endangering health, call Prosar at 1-800-369-4352. This is a special number for Zythor emergencies only.

First Aid

FIRST AID	
In all cases of overexposure, when symptoms such as nausea, difficulty in breathing, abdominal pain, slowing of movements and speech or numbness in extremities are exhibited, get medical attention immediately. Take affected person to a doctor or emergency treatment facility.	
If inhaled:	Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.
If liquid is on skin or on clothing:	Immediately apply water to contaminated area of clothing before removing. Once area has thawed, remove contaminated clothing, shoes and other items covering skin. Rinse skin immediately with plenty of water for 15-20 minutes. 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. Liquid fumigant in the eye may cause damage due to refrigeration or freezing. Call a poison control center or doctor for treatment advice.
HOT LINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor, or when going for treatment. You may also call 1-800-369-4352 for emergency medical treatment information.	
NOTE TO PHYSICIAN	
Zythor is a gas that has no warning properties such as odor, color or eye irritation. (Chloropicrin, which is used as a warning agent in conjunction with Zythor, is the active ingredient in tear gas and will cause tearing.) Early symptoms of exposure to Zythor 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.	

Storage and Disposal of Zythor

Do not contaminate water, food or feed by storage or disposal. Do not ship or store with food, feed, drugs or clothing.

Pesticide Storage

Store in a dry, cool, well ventilated area under lock and key. Post as a pesticide storage area. Store cylinders upright, secured to a rack or wall to prevent tipping. Storage of Zythor in occupied buildings and spaces is prohibited unless storage area(s) is equipped with either 1) a permanently mounted and properly maintained and functioning sulfuryl fluoride monitoring device designed to alert occupants of the building to the presence of sulfuryl fluoride in the air of the storage area at a level greater than 1 ppm or 2) a continuously operating forced air ventilation system that meets all applicable ordinances pertaining to the storage of hazardous materials.

Cylinder Return

When cylinder is empty, close valve, screw safety cap onto valve outlet and replace protection bonnet. Follow registrant's instructions for return of empty or partially empty cylinders. Only the registrant is authorized to refill cylinders. Do not use cylinders for any other purpose. Always follow the proper cylinder handling directions.

Pesticide Disposal

Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide is a violation of Federal law. If the 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.

Transporting Zythor

The following is a brief overview of the regulations applicable to the transportation of sulfuryl fluoride and chloropicrin. Consult regulatory authorities in your state for more detailed information on this important subject.

Hazardous Materials Transportation

Sulfuryl fluoride and chloropicrin are classified as hazardous materials. Any transportation of hazardous materials (or empty containers that have been emptied of these substances) must be in accordance with all federal, state and local regulations applying to the movement of hazardous materials.

Driver Licensing

Any person operating a vehicle transporting hazardous materials such as sulfuryl fluoride and chloropicrin must be specially licensed. Qualifications to transport these materials include having a commercial driver's license (CDL) with an H (hazmat) endorsement. Consult your state for information concerning the qualifications, training and testing necessary to obtain and maintain this level of licensing and this endorsement.

Special new requirements related to the USA Patriot Act also apply to persons driving vehicles transporting hazardous materials.

Shipping Papers

Whenever a hazardous material is transported, it must be described on a "shipping paper". The shipping paper for a shipment including sulfuryl fluoride and/or chloropicrin must include the following:

Proper Shipping Name	Hazard Class or Division	Identification Number	Packing Class
Sulfuryl fluoride	UN2191	2.3	Not assigned
Chloropicrin	UN1580	6.1	I

It is required that the Label and MSDS for these products also be in the vehicle.

Placarding

Any vehicle transporting hazardous material (or empty containers that contained hazardous materials) must be placarded. Placards (shown below) must be placed on all four sides of the transporting vehicle. Specific regulations cover the durability, size and orientation of placards on the vehicle as well as what appears on the placard. The "2" placard is for sulfuryl fluoride and the "6" is for chloropicrin.

DOT Vehicle Markings

Vehicles transporting hazardous materials must have their DOT registration numbers displayed on both sides of the vehicle. The numbers and lettering must comply with requirements concerning their size and color.

Safety Training

Drivers of vehicles containing hazardous materials must be trained to know what to do in the event of an accident or release of the material they are transporting. They must also know how to contact emergency responders. Additionally, they must also be trained to know how to protect themselves and others from the effects of the materials they are transporting in the event of an accidental release. An emergency response procedure such as that shown below must also be carried in the vehicle.

Sample Emergency Response Plan for Vehicle

EMERGENCY RESPONSE PROCEDURE

IN THE EVENT OF AN ACCIDENT, SPILL OR LEAK OF HAZARDOUS MATERIALS, THE FOLLOWING MEASURES SHOULD BE TAKEN:

1) Remove all persons from the spill or leak area.
2) Attend to any urgent medical needs.
3) If possible contain spill or stop further leakage, making sure to wear all protective equipment (such as SCBA).
4) Notify proper authorities by dialing 911. Relay all details of incident including:
   - Personal Injuries
   - Amount and type of hazardous material spilled. Sulfuryl fluoride is UN 2191. Chloropicrin is UN 1580.
   - Exact Location or Address
   - Description of what you have done to contain leaks (if any).
5) Call Chemtrec at 1-800-424-9300 if an accidental release of Zythor occurs.
6) Call Prosar at 1-800-369-4352 for health emergencies related to the release of Zythor.

Incident Reporting

Certain incidents involving the transportation of any hazardous material must be reported to the U. S. Department of Transportation and/or other authorities. Refer to the appropriate regulations for more information.

Preparation for Fumigation

Structure Occupant Fact Sheet

Prior to the application of Zythor to a structure, the Zythor Fact Sheet must be provided to an adult occupant of the structure to be fumigated. In the case of a multi-unit or connected structure (see below), the Zythor fact sheet must be provided to an adult occupant of each currently occupied individual living unit within these structures.

See the *Zythor Structure Occupant Fact Sheet* excerpts at the end of this section.

Fumigation of Parts of Structures and Connected Structures

Most uses of Zythor involve the fumigation of entire structures, vehicles or items. For different reasons, such as economy, convenience or necessity, it may be desirable to apply Zythor to only parts of a structure. Also, structures to be fumigated may in some way be connected to other structures that are not being fumigated in such a way that it cannot be completely assured that movement of Zythor from the fumigated structure to a non-fumigated structure can be prevented. When either of these conditions applies to the structure(s) being fumigated, the requirements contained in the next two sections apply to the un-fumigated sections of a partially fumigated structure and/or the connected structure.

Fumigating Part(s) of a Structure (including Portions of a Multi-unit Structure)

When fumigating unit(s)/room(s) that are a part of or are within a larger structure (such as one or more units of a town house, apartment or condominium building/complex) the space within all units/rooms of the entire structure must be considered to be fumigated space with respect to all requirements concerning structure entrance security, posting, evacuation, reentry, aeration and clearance. Chloropicrin needs to be used only within the fumigated units/rooms of the structure. If during clearance the concentration of Zythor in the breathing zone of a unit/room is discovered to be greater than 1 ppm, ventilate the unit/room by opening operable doors and windows and continue to measure the concentration of Zythor in the breathing zone until it is 1ppm or less. Structure may be reoccupied when concentrations of Zythor in the breathing zones of all units/rooms in the structure is 1 ppm or less. Breathing zones are defined as areas within the units/rooms where individuals typically stand, sit or lie down.

Fumigating Connected Structures

A connected structure or area is defined as any structure or area connected to or having in common with the space to be fumigated any construction elements (e.g. pipes, conduits, ducts, cavities, voids, etc.) which could possibly allow the passage of fumigant out of the fumigated space into the connected structure(s) or area(s).

If state rules and regulations do not permit the continued occupancy of a structure or area connected to a structure that is being fumigated during the fumigation process, the space within the entire connected structure(s) or area(s) must be considered to be a fumigated space with respect to all requirements concerning structure entrance security, posting, evacuation, reentry, aeration and clearance. If the continued occupancy of connected structures is permitted during fumigations by state rules and regulations and continued occupancy of connected structures will occur during the fumigation process, adhere to the procedures contained within the state rules and regulations for isolating the connected structure(s) from the fumigated space before allowing for such occupation to occur. Chloropicrin needs to be used only within the fumigated space. Concentration levels of Zythor must be measured in the breathing zones in any connected structure(s) or area(s) to confirm concentrations are 1 ppm or less before the structure(s)/area(s) can be reoccupied.

What to Remove from the Fumigated Space

Remove all persons, domestic animals, pets and desirable growing plants from the space to be fumigated. Remove mattresses (except waterbeds) and pillows completely enveloped in waterproof covers or alternately remove or unseal / unzip covers.

Remove fish tanks containing live fish, or remove the fish, or develop a plan for preparing the tank for fumigation. If necessary, exclude water in the tank and biological filters, if present, from the fumigated space by sealing with gas resistant tarps or sheeting. If water aeration is required during the fumigation, provide fresh air from outside the fumigated space for the tank aerator.

Food, feed, drugs (including tobacco products) and medicines (including those items in refrigerators and freezers) can remain within the fumigated space if they are contained within plastic, glass or metal containers with the original manufacturer's airtight seal intact.

Protective Bagging of Open Food, Feed and Drugs

Food, feed, drugs (including tobacco products) and medicinals (including those items in refrigerators and freezers) not in plastic, glass or metal containers with the original manufacturer's air-tight seal intact must be removed from the fumigated space or protected against exposure to Zythor if they are left within the fumigated space.

Fumiguard Bags

Items can be protected against exposure to Zythor by double bagging them in Fumiguard, Nylofume® or Masterfume® bags. Fumiguard bags, which are available from Ensystex II, and (Nylofume and Masterfume bags) are made of a material highly resistant to permeation from gases such as sulfuryl fluoride. Double bag in Fumiguard, Nylofume or Masterfume bags all items that must be protected against exposure to Zythor that will be left within the fumigated space. Double bagging is performed by placing an item in a Fumiguard, Nylofume or Masterfume bag, twisting the top of the bag closed tightly and then securing the twisted part of the bag in its closed position. The closed bag is then double bagged by placing the closed bag inside another bag which is secured closed in the same manner as the inner bag.

Fumiguard, Nylofume and Masterfume bags offer a much higher level of protection against sulfuryl fluoride exposure than polyethylene bags. Never attempt to protect items from exposure using any type of bag not approved by Ensystex II.

Extinguishing Flames and Disconnecting Heat Sources

Extinguish all flames, including pilot lights of furnaces, water heaters, dryers, gas refrigerators, gas logs, ranges, ovens, broilers, open flames, etc. Turn off or unplug all electrical heating elements such as those in heaters, dryers, pianos, organs, etc. Shut off automatic switch controls for appliances and lighting systems that will be contained within the fumigated space. Follow procedures required by the local gas company when shutting off natural gas or propane service. The local gas company or other appropriate authority will need to turn on gas service after it has been turned off to determine that the gas flow and pressure are normal. Sulfuryl fluoride can react with strong bases such as some photo developing solutions.

Doors and Openings to Closed Spaces

Open and leave open all operable internal doors. Open and leave open all operable openings to rooms, attics, sub-areas, storage rooms and closets. Open and leave open operable doors, covers or lids of any space within which fumigant could accumulate and linger during aeration including storage cabinets, drawers, storage chests and appliances (such as washers, dishwashers, dryers, microwave ovens, conventional ovens, refrigerators, freezers, etc.).

Appliances

Turn off and/or disconnect appliances as appropriate to the circumstances. Alternately leave refrigerators and freezers operating and their doors closed if the choice is made to leave properly sealed items inside

of them. If the choice is made to leave sealed items in closed refrigerators and freezers during the exposure period, the appliance's doors must be opened and left open at some point during aeration and clearance of the fumigated space until the concentration of Zythor within their interior is 1 ppm or less as measured by an approved and properly calibrated Low Fumigant Level Detection Device.

Zythor Structure Occupant Fact Sheet Excerpts

The following language is excerpted from the Zythor Structure Occupant Fact Sheet.

Before the fumigation of a structure with Zythor can be conducted, certain important preparatory steps must be taken to ensure the safety and effectiveness of the fumigant application. Close adherence to the steps below can help ensure that this occurs.

It is your responsibility to perform these preparatory steps before the fumigation crew arrives. The fumigation cannot proceed until all the items on this list of preparatory steps that are applicable to your structure have been completed.

Fumigated structures must be locked during the fumigation period. Make arrangements to leave the keys to the structure with your fumigator and to retrieve them afterwards.

Electricity must be on for the fumigation to be performed. It is needed to power the fans that circulate the Zythor throughout the structure.

Interior Preparations

Things that must be removed from the structure:

All persons, living plants and non-target animals including plants on outdoor patios that if left in place would be under or close to the fumigation tent.

Mattresses and pillows with waterproof covers that cannot be removed (not waterbeds). Items fitting this description that are not removed will be removed by your fumigator.

Fumigant sensitive items not properly sealed against exposure to the fumigant as explained next.

Things that must either be protected from exposure to the fumigant or removed from the structure:

Generally speaking, any food, beverage, drug, medicinal or toiletry item that is consumed or put in the mouth that is not still sealed within its manufacturer's original factory sealed airtight container must either be removed from the structure or specially sealed within gas tight Fumiguard bags provided by your fumigator. Items to be sealed include food within your refrigerator or freezer. After they are properly bagged, items from the refrigerator or freezer can be replaced there for the duration of the fumigation. Remove shelves if needed to create space for these items in bags. Items that must be removed or bagged that are not removed or bagged may be trashed by your fumigator.

Bag or remove these items:

Food packed in plastic bags such as chips, pasta and rice even if they have not been opened

Food packed in cardboard boxes such as cereal and crackers even if they have not been opened

Spices and salt and pepper shakers where the seal has been broken

Dairy products and eggs

Ice and water

Any item stored in a resealable container

Produce

Pet food and bird seed in bags

Tobacco products

Things that do not need to be bagged or removed:

Dental hygiene products, including toothpaste, mouthwash, dental adhesives, denture cleanser and tooth whitening products

Unopened plastic, metal or glass cans, jars or bottles

Shampoo, soap and cosmetics, externally applied lotions and ointments

Unopened bottles of liquor and wine sealed with a cork when stored horizontally.

Clothes

Things that must be turned off and/or extinguished:

Heating and air conditioning system (The fan in the air conditioning system may be use by your fumigator at different times during the fumigation to circulate the Zythor.)

Burglar alarm

Gas at the main valve or tank (By law this must be done by gas company in some areas.)

Heating elements in heaters, pianos and organs

Pilot lights in heaters, hot water heaters, ovens, ranges, broilers, gas refrigerators, dryers, automatic lighting systems, gas lamps, etc. (Your fumigator will not be responsible for relighting pilot lights.)

Automatic lighting and appliance controls

Other preparations:

Unlock and open all cabinets, drawers, closets, attic accesses and interior doors. Safes and locked storage areas must be left unlocked or keys/combinations must be provided to your fumigator.

Remove vehicles from garages and carports. (Unlock and open trunk if they cannot be moved.)

Unzip plastic garment bags.

Raise blinds and open drapes.

Remove valuables such as jewelry and furs and empty safes

Exterior Preparations

The evening before the fumigation, thoroughly water the soil around shrubs and plants immediately adjacent to the structure and the soil within 18 inches of the structure. This is intended to protect these items from damage from fumigant seeping into the ground around the perimeter of the structure. There is no guarantee that this watering will completely protect these or any plants from damage.

Move items and trim trees sufficiently to allow the fumigation tent to fall freely from the roof edge straight down to the ground.

Mulch, rocks, stones or debris may have to be moved at points around the structure in order to create points where the fumigation tent can rest firmly against the ground. At your option, ask your fumigator exactly what needs to be done and you can make these preparations yourself. If instead you allow your fumigator to move these items, there is no guarantee that they will be placed back into the exact same area or configuration from which they were removed.

Fences and other abutments to the structure that extend more than 5 feet out from the structure may need to be detached in order to drop the tent to the ground at that point. Your fumigator will inform you if this is the case at your structure and if a craftsman such as a carpenter or bricklayer is needed to make any necessary alterations.

Retract any awnings, valences or shades.

Remove (as requested) any TV antenna guidewires.

Special Note About Cats

Be particularly careful to make sure that no cats, including neighbor’s cats, are left within or under the structure during the fumigation. You may want to notify neighbors with cats when your house is going to be fumigated if there is a space in or under your house that cats can occupy without your knowledge.

THINGS FOR WHICH YOUR FUMIGATOR CANNOT BE RESPONSIBLE

Broken roof shingles or tiles, patio covers, gutters, antennas, electrical wires or solar heater panels

Damage caused by the application and removal of tape to a painted or plaster surface of the structure

Vandalism, theft or breaking and entering at the structure (The structure is not guarded during the fumigation period. At your option you may guard the structure yourself or you may make arrangements to hire a guard service.)

Damage to trees, shrubs or plants due to breakage or exposure to the fumigant

Damage to plant and vine trellises

The weather, which may delay the fumigation if unsafe conditions such as high wind or lightning are present or expected or if low temperatures occur that would make the fumigant less effective.

Damage to doors that must secure by nailing shut that cannot be properly locked

THINGS YOU SHOULD TELL YOUR FUMIGATOR

Advise your fumigator if there are any connections between the structure and another structure such as conduits, ducting, drain lines, vacuum lines or tunnels that could possibly allow the passage of fumigant from the fumigated structure to another structure. Severe injury or death could result.

Normally, all operable windows will be opened by your fumigator after the structure is tented and will remain open until the initial aeration procedure is completed. Let your fumigator know if any windows cannot be opened.

AFTER THE FUMIGATION IS COMPLETED

Do not attempt to reenter or reoccupy the structure until you are told by your fumigator that the structure is clear for reentry.

If you are interested or concerned, you should ask your fumigator to show you the records of how your structure was aerated before it was cleared for reentry.

It is not necessary to wash dishes, linens or clothes exposed to Zythor.

You may wish to increase ventilation of your structure by opening doors and windows for a period of time after your return. This may reduce the chances of encountering any residual chloropicrin warning agent.

Fans

Fans can serve three purposes during the course of a Zythor fumigation.

- They can help assure conversion of Zythor from a liquid to a gas as fast as possible upon release from the cylinder. This is done by positioning the exit end of the shooting hose in the stream of the fan and releasing Zythor into the stream as explained in the Zythor. When used in this fashion, fans serve as heat exchangers.
- Continuous circulation of Zythor within the fumigated space during the duration of the exposure period to assure that equilibrium is maintained (although this is not normally necessary).
- Accelerating the exhausting of Zythor laden air from the fumigated space as part of the aeration process.

Typical Zythor Application and Circulation Fan

The most important attribute of a fan is its cubic foot per minute rating, especially with respect to the release of Zythor. The Zythor label requires that Zythor be released into the stream of a fan of a certain capacity based on the rate at which Zythor is being released from the cylinder. Refer to the *Zythor Release Preparation* section for more information on this subject.

Air Circulation

Based on the circumstances, it may be necessary to actively circulate the air in all or part of the fumigated space with properly positioned fans after the release of Zythor to assure its rapid dispersion within all of the fumigated space. Parts of the structure that may warrant consideration for active air circulation may include basements, dead air spaces and areas located long distances from a point of Zythor introduction into the fumigated space. If possible, position and aim fans in such a manner that air closer to the point(s) of Zythor release is circulated towards points farther from the point(s) of Zythor release.

Fumigant Confinement

The methods and materials used to confine the fumigant to a space to be fumigated can vary depending on the nature of the space (e.g., structure, vehicle, chamber, vessel) and the inherent resistance of the surfaces that form the space to the movement of the fumigant out of it (e.g., masonry walls vs. wood walls). The more gas tight the fumigated space inherently is or can be rendered to be, the higher the level of fumigant confinement that can be attained. Consider a monitored application of Zythor (see *Monitored Vs. Un-Monitored Application*) to any fumigated space where there is uncertainty as to whether or not an adequate level of Zythor can be confined to that space for the intended duration of the exposure period.

Structure Fumigation Using A Tarpaulin

When and to the extent needed, use tarpaulin(s) made of a material that effectively confines and is sufficiently impermeable to the passage of the fumigant through it such as vinyl coated nylon or polyethylene sheeting of at least 4 mil thickness to cover the structure or portion of the structure containing the space to be fumigated. Seal all seams between adjacent tarpaulins. Seal all edges of the tarpaulin that touch the ground or ground level surface to that surface with, for example, soil, sand or weighted snakes resting on the edge of the tarpaulin. After tarping, make sure that all operable windows and interior doors of the fumigated space are open. Leave windows closed if required by local and/or state regulations.

Fumigant can be lost (and damage to plants outside the fumigated space around the exterior of a fumigated structure can occur) when it is able to penetrate the soil surface within the fumigated space adjacent to where the tarpaulins rest against the ground and move outward. This movement is retarded when the soil between the foundation of the structure and the outermost edge of the tarpaulin around the perimeter of the structure contains a high level of moisture. If soil around the foundation of the structure is not sufficiently moist to act as a barrier to fumigant movement, wet all soil between the foundation of the structure and the outermost edge of the tarpaulin around the perimeter of the structure and around the root zone of plants that may be potentially affected.

Structure Fumigation Without Using a Tarpaulin

For fumigated spaces or structures that can be adequately sealed against the excess movement of fumigant out of them without the use of a tarpaulin, seal adequately around exterior doors, windows, vents, fireplaces and other openings of the fumigated space. Use sealing materials and techniques proven to adequately retard the movement of fumigant out of a fumigated space such as tape and polyethylene sheeting. To minimize escape of fumigant through the soil and to avoid injury to nearby plants, wet soil (if not sufficiently moist) around the structure to act as a barrier to fumigant movement.

Chamber Fumigation

Fumigations with Zythor may be conducted in permanent fumigation chambers enclosed within, or connected to, a larger structure. A permanent chamber is defined as a durable hard-walled structure engineered specifically for fumigation that effectively confines Zythor. Monitor indoor areas around the permanent fumigation chamber for Zythor concentrations with an approved and properly calibrated Low Fumigant Level Detection Device during the fumigation, especially during fumigant introduction. No one is permitted in areas where the concentration of fumigant in the air is greater than 1 ppm unless they are using an approved Respiratory Protection Device. Aerate Zythor from the chamber by venting it directly to the outside of the structure using a ventilation system that does not release Zythor into the structure within which the chamber is located.

Fumigation of Construction Materials, Furnishings (Household effects), Vehicles and Shipping Containers

Preparations must be as appropriate to the particular circumstances. Create a sufficiently gas tight seal that will adequately confine the fumigant to the fumigated space for the planned exposure period based on the directions for tarpaulin, non-tarpaulin and chamber fumigation above. If the sealed fumigant space is created within a larger structure (e.g., vehicle fumigated within a garage), the space within the entire structure should be considered fumigated space with respect to all requirements concerning preparation for fumigant introduction (except fumigant confinement and warning agent), structure entrance security, posting, evacuation, reentry, aeration and clearance. Stationary vehicles should be prepared and sealed following the instructions above. Vehicles, trucks, trailers, shipping containers, railcars, etc. may be fumigated with Zythor, however all aeration/clearance procedures must be completed before these are transported or driven over public roads.

Fumigation of Surface Ships in Port

Surface ships in size up to and including large ocean-going ships may be fumigated with Zythor to control the pests listed on this label. The applicator and the ship's captain (or owner) shall follow all applicable regulations including those contained in the Code of Federal Regulations, Title 46 – Shipping, Chapter 1 - Coast Guard, Part 147A. Except for those persons involved in the 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 the use of Respiratory Protection Devices and Low Fumigant Level Detection Devices. Emergency procedures, cargo ventilation, periodic monitoring, 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, when appropriate, of the leakage in order that they can take corrective action.

Food, feed, drugs (including tobacco products) and medicinals shall not be exposed to the fumigant. If they are not removed from the vessel they shall be protected from exposure to the fumigant. The vessel must not be moved during the period of time between initial fumigant application and final clearance.

Approved Respiratory Protection Devices must be worn during reentry into the fumigated space when reentry occurs between the time of initial fumigant application and final clearance and a concentration of more than 1 ppm of fumigant is detected in the fumigated space during that period.

Warning Agent (Chloropicrin)

Zythor is odorless. For this reason, the addition to the air within the fumigated space of an agent that warns a person's senses to the presence of a foreign substance in the air is an essential precondition to each and every release of Zythor. The warning agent used with Zythor is chloropicrin, more commonly referred to as tear gas.

Chloropicrin is a warning agent that must be released within the space to be fumigated prior to introduction of Zythor into that space. Even at very low levels of concentration in the air, unprotected exposure to chloropicrin in the air causes tearing and smarting of the eyes accompanied by a disagreeable, penetrating smell. Chloropicrin must be released into the fumigated space only by a Certified Applicator or someone under their direct supervision. Applicators must observe the chloropicrin precautionary statements and personal protective equipment appearing on this label.

Chloropicrin Precautionary Statements

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 concentrations 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.

Chloropicrin Personal Protective Equipment

Some materials that are chemical-resistant to this product for the period of the expected typical exposure are barrier laminate ≥ 14 mils, neoprene rubber ≥ 14 mils and viton ≥ 14 mils. For more options, follow the instructions for category H on the chemical-resistance category selection chart.

- All persons applying chloropicrin must wear:
  - long-sleeved shirt and long pants,
  - chemical-resistant gloves, and
  - Splash-resistant protective eyewear or face shield (Do NOT wear goggles).
- Persons applying chloropicrin must wear either a positive pressure self-contained breathing apparatus or combination air-supplied/SCBA when applying chloropicrin to more than two chloropicrin introduction points within a single fumigated structure.
- The employer of any person applying chloropicrin must make sure that they are provided and correctly wear the required PPE. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

Chloropicrin First Aid

If inhaled:

Move person to fresh air. Keep warm.

If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible.

Do not give anything by mouth to an unconscious person.

Call a Poison Control Center or doctor for further treatment advice.

If on skin or clothing:

Immediately remove contaminated clothing, shoes or any other item on skin.

Rinse skin immediately with plenty of water for 15-20 minutes.
Call a Poison Control Center or doctor for treatment advice.

If in eyes:
Hold eye open and rinse slowly and gently with water for 15-20 minutes.
Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
Call a Poison Control Center or doctor for treatment advice.

If swallowed:
Call a poison control center or doctor for treatment advice.
Have person sip a glass of water if able to swallow.
Do not induce vomiting unless told to do so by a poison control center or doctor.
Do not give anything by mouth to an unconscious person.

Note to Physician: Chloropicrin is a volatile liquid that is an active ingredient in tear gas. As a gas it is a powerful lachrymator. Symptoms of overexposure are profuse lachrymation, respiratory distress and vomiting. Pulmonary edema may develop later.

Chloropicrin Chemical Hazard

Chloropicrin is severely corrosive to metal containers made of magnesium, aluminum, or their alloys. Do not dispense chloropicrin into containers containing these metals.

Chloropicrin Storage and Handling

Chloropicrin 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.

Chloropicrin 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 0.15 ppm, by testing with an approved detection device.

Chloropicrin 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 stated and local procedures.

Physical Properties of Chloropicrin vs. Sulfuryl Fluoride

There are important differences between the chemical characteristics of chloropicrin and sulfuryl fluoride. The vapor pressure of chloropicrin is considerably lower than that of sulfuryl fluoride and chloropicrin's boiling point is approximately 300°F higher than that of sulfuryl fluoride. This difference means that all other things being equal, chloropicrin will remain resident within a fumigated space longer than sulfuryl fluoride. As important as it is to use a sufficient amount of chloropicrin, it is just as important to not use too much.

The Zythor label requires the use of 1 ounce of chloropicrin per 10,000 to 15,000 cubic feet of fumigated space. This chloropicrin application rate is equal to 17-24 parts per million of chloropicrin in the air. This level far exceeds the level of chloropicrin (1/3 ppm) need to cause tearing in humans

Excess Exposure Periods

If the exposure period is longer than 24 hours is poor, it is possible that the level of chloropicrin will dissipate to the point that it no longer serves as an effective deterrent to entry. This is mainly because of the adsorption of chloropicrin onto solid surfaces. This should be taken into consideration whenever the length of an exposure period exceeds this amount of time.

Measuring Chloropicrin Concentrations in the Air

If necessary, chloropicrin concentrations in the air within the fumigated space can be measured with a direct reading detection device, for example a Matheson-Kitagawa, Dräger, or Sensidyne tube. Use these tubes according to the manufacturers' directions and recommendations. Any entry into the fumigated space to test for chloropicrin concentrations must be made according to the restrictions on reentry contained in the Zythor label. The direct reading detection devices used must have a sensitivity of at least 0.15 ppm for chloropicrin. Since sensory irritation (tearing, burning of the eyes or nose) can be experienced at 0.15 ppm, it is possible that a person may experience sensory irritation before a reading is registered on a direct reading detection device.

Chloropicrin Dose and Distribution

Chloropicrin must be released within a fumigated space at least 5 minutes prior to introduction of the fumigant. Apply/release 1 fluid oz of chloropicrin per 10,000 to 15,000 cubic feet – (30 ml of chloropicrin per 283 to 425 cubic meters) of fumigated space or alternately use the chloropicrin dosage rate calculated by the Fumicalc program for the fumigated space. Establish at least one chloropicrin introduction site for each 45,000 cubic feet (1275 cubic meters) of fumigated space. When applying chloropicrin at multiple chloropicrin introduction points within a structure, start at the point farthest from the exit and work toward the exit. Dispense no more than 3 fluid ounces (90 ml) of chloropicrin into a single evaporation container.

Distribution of chloropicrin throughout a fumigated space is enhanced by applying/releasing it as follows:

1. Place a shallow, wide container directly behind a fan in its air stream.
2. Place a handful of wicking agent, (e.g., cotton) in the bottom of the container.
3. Pour the chloropicrin over the wicking agent.
4. Establish at least one chloropicrin introduction site on each floor of a multistory structure.

Points to remember when preparing to release and releasing chloropicrin:

- Do not place chloropicrin into a container made of magnesium, aluminum, or their alloys, as chloropicrin may severely corrode these metals.
- Keep in mind that chloropicrin can be at least temporarily absorbed onto furnishings within a structure. Attempt to establish all chloropicrin introduction sites away from upholstered furniture, mattresses and clothes closets for instance, to minimize the chance of this occurring.
- Be careful not to spill chloropicrin onto wood or concrete as it can be absorbed by these surfaces. Once spilled on these surfaces it is released only very slowly back into the atmosphere creating the potential for a persistent odor situation.
- Removal of all chloropicrin evaporation containers from the fumigated space as soon as possible after commencement of the initial aeration procedure will speed dissipation of the chloropicrin from the fumigated space.
-

CHLOROPICRIN MEASURING CUP

CHLOROPICRIN TRAY

Exceptions to the Use of Warning Agent

The use of chloropicrin is not required when fumigating railcars and shipping containers; however if chloropicrin is not used, a thorough pre-fumigation walk-through inspection must be performed of each railcar or shipping container with their doors being immediately locked upon leaving each car or container. A guard must be continuously posted during the period between Zythor introduction and final clearance if no chloropicrin is used.

Securing Fumigated Structure Entrances

During the Exposure Period and Step 2 of the aeration procedures, fumigated structure(s) must be secured against the possibility of entry into the structure(s) by anyone other than a Certified Applicator or persons under their direct supervision. Two levels of security against unauthorized entry must be employed at each exterior entrance during those periods, if practicable. In addition to the use of existing locking mechanisms, if present, a secondary locking device must also be used. A locking device, such as a secondary lock, or barricade must be demonstratively effective in preventing an exterior door or doorway from being opened from the exterior using normal opening or entering processes by anyone other than the certified applicator in charge or the fumigation or persons under his/her direct supervision.. Consult state and local regulations for any supplementary instructions and/or restrictions on securing against unauthorized entry into fumigated structures.

Secondary Locks

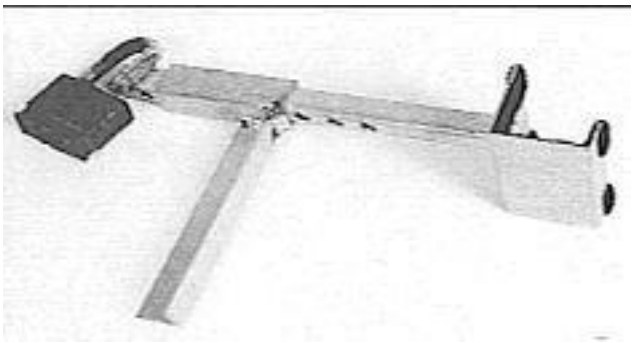
As described above, secondary locks are used to prevent doors from being opened by normal means. There are three common forms of secondary locks as shown below.

The device on the top left is called a KEE-BLOK but is more commonly referred to as a Clamshell. It fits over a locked doorknob, blocking access to the keyhole. The device on the top right is called a J Safe Lock. It can be used to secure doors that cannot be locked by blocking the key mechanism. On the bottom is a key-way or split key. The two parts of the key are first inserted into a locked lock. One piece of the key is removed with the other remaining in place. The internal lock mechanism retains the one piece, thereby blocking use of a key and preventing entrance.

KEE –BLOK (CLAMSHELL)

J-SAFE

KEY- WAY



J – SAFE

Posting of Fumigated Spaces

All entrances and all sides of the fumigated space including those within structures, chambers, vehicles, ships and stacks must be posted and placarded with warning signs. Signs must remain legible during the entire posting period. Post warning signs in advance of the fumigation in order to keep unauthorized persons away. All signs must bear the following in English and Spanish:

1. The signal word “DANGER/PELIGRO” and the SKULL and CROSSBONES symbol in red.
2. The statement, “Area under fumigation, DO NOT ENTER/NO ENTRE”.
3. The date of the fumigation.
4. Name and EPA Registration Number of the fumigant.
5. Name, address, and telephone number of the fumigation company.

Only a certified applicator may authorize removal of the signs and only when the concentration of Zythor within the structure where individuals typically stand, sit or lie down (breathing zone) is 1 ppm or less.

Determining Doses and Exposure Periods for Zythor

The amount of Zythor applied to the fumigated space is referred to as the dose. The level of fumigant present in the air is referred to as the concentration. Dose is expressed in pounds of fumigant and concentration is expressed in ounces of Zythor per thousand cubic feet of fumigated space. Achieving target pest mortality with Zythor is dependent upon the concentration of Zythor present in the air the target pest is breathing. However, it is also dependent upon the length of the period of time the target pest is exposed to that concentration (exposure period) and the temperature. Temperature is important because it affects the metabolic rate of insects. For a given temperature and rate of Zythor loss from the fumigant space, increases in the concentration of Zythor can reduce the length of the exposure period required to kill a pest. Conversely, under the same temperature and rate of fumigant loss conditions, increases in the length of the exposure period can reduce the concentration of Zythor required to kill the same pest. Concentration in ounces per thousand cubic feet multiplied by the number of hours in the exposure period is referred to as the Kill Power Index.

Fumicalc

The Fumicalc computer program, designed to run on most types of desktop and laptop computers and on Palm PDA devices, is used to calculate the Kill Power Index that must be achieved within a fumigant space to kill the target pest and the dose and exposure period necessary to achieve that Kill Power Index. The Fumicalc program is part of the Zythor labeling and must be used to calculate all doses and exposure periods for Zythor. The Fumicalc accepts as inputs the factors necessary to compute these values for all labeled target pests. The Fumicalc program is available from Ensystex II, Inc.

Certain insects are more susceptible to exposure to Zythor than others. This means higher Kill Power Indexes must be achieved for certain Target Pests compared to that needed to kill others. Higher Kill Power Indexes can be achieved for any fumigated space by administering a higher Concentration of Zythor and/or extending the Exposure Period, all of which is handled by the Fumicalc automatically. All you have to do is tell the Fumicalc the Target Pest and it makes any necessary adjustments to the Kill Power Index.

Temperature Determination

As explained above, temperature is a critical input in the Zythor Dose determination process. The lower the temperature, the greater the Dose that must be added to the fumigated space, and vice versa. A more complete explanation of the importance of temperature can be found in the *Zythor Dose Calculation Basics* section. Generally, the lowest temperature in a slab structure is found at the slab foundation and the lowest temperature in a crawl space structure is found just below the surface of the crawl space soil.

Infrared Thermometer for Measuring Slab Underseal Temperature

Kill Power Indexes for Different Pests

The Kill Power Index necessary to control different target pests is expressed in the following table as multiples of the Kill Power Index required to kill Drywood termites (Index = 1), assuming the applications occurred under the same conditions. When the egg stage of a Target Pest cannot be killed with Zythor (as explained below), the multiple of the Drywood Termite Kill Power Index that must be achieved to kill the non-egg stages only is given instead. These multiples apply to the use of Zythor within all types of fumigated spaces.

Pests	**Multiple of the Drywood Termite Kill Power Index**	**Comments**
Rodents[1]	1/2x	
Carpet Beetles	1x	Eggs are not killed
Cockroaches[1] (except German)	1x	Eggs are not killed
Cockroach[1] (German)	1x	
Furniture Carpet Beetles	3x	Eggs are not killed
Bedbugs[1]	3x	
Old House Borers	4x	
Formosan Termites[1]	4x	Above ground termites only are killed. Use in combination with other methods to kill infestations originating below ground.
Clothes Moths	6x	
Powder Post Beetles and Death Watch Beetles	10x	
[1]Do not use less than the specified dosage factors when treating for rodents, cockroaches, bedbugs, and termites.		

Insect Egg Stage Vulnerability to Zythor

The egg stage of some Target Pests are not susceptible to sulfuryl fluoride and thus cannot be killed by Zythor. In this case it may be advisable to fumigate once at a concentration sufficient to control the post-embryonic (larva, pupa, adult) stages. After any surviving insect eggs have hatched, but prior to these insects' maturation and deposition of new eggs, fumigate a second time, again at the post-embryonic life stage concentration.

Monitored or Un-Monitored Application

Monitor or monitoring refers to the periodic measurement of the actual concentration of Zythor contained within the air of the fumigated space. Monitoring confirms the concentration of Zythor to which the Target Pest is exposed and allows for correction of variations of the actual from the expected concentration of Zythor, if necessary. Monitoring can increase the accuracy with which the needed Kill Power Index is applied and is particularly recommended when a high level of precision is necessary. A monitored or Un-Monitored application of Zythor can be made to any fumigated space for the control of any type of Target Pest. Monitoring is particularly recommended when the structure has only been taped and sealed or when fumigating very large structures.

The Zythor Fumicalc calculator is designed to calculate the dose of Zythor (and supplements to the dose during the course of the fumigation in the case of a monitored application, if needed) for any fumigated space for both Monitored and Un-Monitored applications.

Zythor Application Monitoring

The goal of the monitoring process is to measure the actual concentration of Zythor in the air. This is done by extracting and analyzing small samples of Zythor laden air from the fumigated space on a periodic basis as needed and measuring the concentration of Zythor in that air with a specialized device called a Fumiscope. The concentration readings are input into the Fumicalc where they are used to computer the real Gas Loss Index for the fumigated space (as opposed to an estimated Gas Loss Index).

In addition to confirming the concentration of Zythor in the air, monitoring a fumigated space at multiple points can help identify imbalances in the distribution of fumigant within the fumigated space, either due to leakage or a failure to distribute Zythor properly upon its introduction. Often times these discrepancies can be corrected during the exposure period by reactivating fans or sealing leaks.

Monitoring can also be used to determine when equilibrium of the Zythor in the air throughout the fumigated space has been achieved.

When monitoring is to be performed, certain preparations to facilitate sampling of the air within the fumigated space must be made prior to the introduction of Zythor, as explained next.

Monitoring Hoses

The samples of Zythor-containing air needed to perform monitoring calculations are removed from the fumigated space to the exterior through monitoring hoses. Monitoring preparations include locating and routing one or more hoses from the inside of the fumigated space to the exterior. One end of each monitoring hose is placed within the fumigated space and the other end is placed outside the fumigated space with the outer end of the house far enough from the structure being fumigated that anyone operating a Fumiscope attached to the hose is not too close to the fumigated space.

Periodically, small samples of Zythor-containing air are suctioned or extracted from the fumigated space through the hose into the Fumiscope which is attached to the exterior end of the hose.

Monitoring Hose Information

- Monitoring hoses must consist of ¼” to 3/8” I. D. clear vinyl tubing.
- When more than one hose is being used, label the exterior end of each hose to avoid confusion as to which hose is routed to which area within the fumigated space.
- Cap the exterior ends of hoses with tape when they are not attached to the Fumiscope in order to keep moisture from entering and accumulating in the hoses.
- Route hoses in such a way that that there is no possibility for constrictions to occur in a hose after its placement. One potential point of constriction is created wherever a hose is routed through a window opening. Secure opened windows to make sure they do not descend and crimp the monitoring hose during the exposure period.
- Place monitoring hoses at each different level of the structure including within the attic and beneath the sub floor, if present.
- If the structure is divided into separate sections such as towers, wings or apartments, separate sets of hoses should be run to each section.
- The interior ends of monitoring hoses should be placed approximately 4 feet above floor level in the fumigated space.
- Monitoring hose ends should be secured in place so that they do not become constricted or displaced at any time during the exposure period.
- After placement of the monitoring hoses and before Zythor is introduced, confirm that air will flow freely through them.

Fumiscope

The Fumiscope is a specialized device for determining the concentration of sulfuryl fluoride in a sample of fumigated space air. The Fumiscope measures the concentration of sulfuryl fluoride in the air based on thermal conductivity. It does this by comparing the conductivity of a blank dry sample of air to that of a sample of dry air containing sulfuryl fluoride. The readings taken with a Fumiscope are inputted into the Fumicalc as part of the Monitored Application process. These readings are used to calculate a Gas Loss Index.

Fumiscope Models

There are several different Fumiscope models. Use the Fumiscope according to the manufacturer's directions for your particular model.

Fumiscope Calibration and Care

Proper use of the Fumiscope includes its routine calibration and maintenance. A Monitored Application is only as good as the concentration readings taken by the Fumiscope and inputted into the Fumicalc. Failure to routinely calibrate and maintain your Fumiscope will invariably result in erroneous readings.

Zythor Equilibrium and Monitoring Timing

Monitored Application concentration readings must be taken according to the prescribed time intervals. Monitoring should begin only after the Zythor has been allowed to reach equilibrium within the fumigated space.

Optionally, the achievement of equilibrium can be determined by taking samples from different locations within the fumigated space and comparing them to each other. This is possible only if provision has been made for multiple monitoring points. The closer the values of readings from different parts of the structure are to each other, the closer the Zythor within the fumigated space is to equilibrium.

It is advisable to begin timing of the exposure period only after equilibrium has been reached. In the absence of readings being taken for the purpose of determining whether or not equilibrium has been achieved, it is recommended that the first monitoring readings not be taken until at least one hour has elapsed from the completion of the application of the Initial Dose.

Zythor Release Preparation

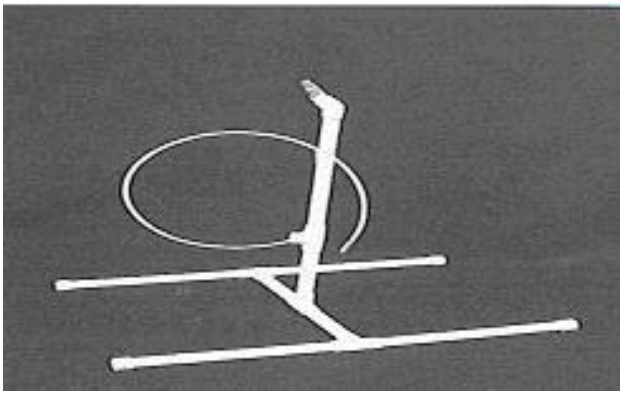
Prepare to release the Zythor through a shooting tube to be attached to the Zythor cylinder whose discharge end is positioned within the fumigated space. The system for introduction of Zythor into the fumigated space (tubing, connectors, etc.) should be free of leaks and designed to withstand a minimum burst pressure of 500 pounds per square inch (psi).

If monitoring will occur, run gas sampling lines from representative locations within the fumigated space to exterior monitoring points before Zythor introduction as explained in the *Zythor Application Monitoring* section.

Selecting and Setting Up Zythor Release Points

Care must be taken in locating and preparing Zythor release points. Following the points below can increase the speed at which fumigant equilibrium is reached within the fumigated space while avoiding any damage due to the release of Zythor.

- Zythor should be released into the largest space within the structure for reasons explained in the next section. Within large structures, multiple release points should be used. Generally, there should be one release point for each 20,000 to 40,000 cubic feet.
- Situate the discharge end of each fumigant shooting tube on the positive pressure side of an operating fan (blast side) located within a large open area of the fumigated space. The air movement capacity of the fan should be at least 1,000 cubic feet per minute for each pound of Zythor released per minute.
- The release rate of Zythor can be controlled by the diameter and length of the shooting hose. Refer to the *Fogout Avoidance Steps* section for more information on this subject.
- There should be at least one release point on each story of a multilevel structure, but it is generally not necessary to establish a release point in the attic.
- The release of Zythor should never be directed towards any nearby vertical surfaces such as walls. Use a shooting stand to securely position your release point. Alternately clamp the hose to the shooting fan such that the release occurs in the strongest part of the fan air stream.
- The flooring under the release point and the flooring in front of the release point (in the direction that Zythor is discharged) should be protected with polyethylene plastic sheeting.



SHOOTING STAND

Preventing Fogouts

Zythor is packaged as a liquid under pressure. When it is released into the fumigated space it must be converted into a gas to be effective as a fumigant. This process of release and conversion, if not properly prepared for and controlled, can result in damage to surfaces within the fumigated space from contact with water condensed from the air as the liquid to gas conversion process cools the air into which the fumigant is introduced and nearby surfaces. Damage can also occur when unconverted liquid fumigant, possibly present in the fumigated space after it is released but before it converts to a gas, comes into contact with surfaces that might be damaged by its presence.

The conversion of Zythor from a liquid in the cylinder to a gas requires a source of heat. The heat to make this conversion is taken from the air into which the Zythor is released as it contacts the air. The need for heat to make this conversion can cause problems when the release of fumigant removes enough heat from the air to cause the air temperature to drop below its Dew Point temperature. The amount of moisture a parcel of air can hold is dependent upon its temperature. The Dew Point temperature for a parcel of air is the temperature at which that air is holding as much moisture as it can hold. If the temperature of air falls below its Dew Point temperature, fog can form and moisture can condense from the air onto nearby surfaces if the temperature of these surfaces is low enough. The higher the percent relative humidity and the lower the temperature of surfaces in the fumigated space before the introduction of fumigant, the greater the chance fog will form in the air and/or condensation will form on surfaces. Condensation can damage surfaces it forms on if they are sensitive to the presence of moisture.

The conversion of the fumigant from liquid to gas normally occurs almost instantaneously when it is released into the fumigated space. However it is possible that, depending upon the circumstances, some fumigant will remain in its liquid form for a short period of time after it has been released. This can be a problem if this super-cooled liquid fumigant is deposited onto surfaces that can be damaged by its presence, however brief.

Care must be taken to reduce the chance that moisture is condensed from the air within the fumigated space during fumigant application or that unconverted liquid fumigant is present within the fumigant space long enough to come to rest on surfaces. One way to accomplish both of these is to maximize the amount of air into which the fumigant is released. The greater the number of “units” of air used to vaporize each “unit” of fumigant, the less heat that must be removed from each “unit” of air during the conversion process. This reduces the possibility that the capacity of the air into which the fumigant is released to hold water or fumigant will be exceeded. Increase the volume of air into which the fumigant is released, and thereby maximize the rate of fumigant vaporization from liquid to gas, by situating the discharge end of the fumigant shooting tube on the positive pressure side of an operating fan (blast side) located within a large open area of the fumigated space. The air movement capacity of the fan should be at least 1,000 cubic feet per minute for each pound of Zythor released per minute.

Using a small inside diameter shooting hose (1/8 inch) can also reduce the chances of un-vaporized fumigant coming to rest on surfaces within the fumigated space. To further protect against the effects of un-vaporized fumigant on surfaces, it is recommended that protective sheeting, such as polyethylene plastic, be placed on the floors in the vicinity of any fumigant release point**. In order to prevent damage, do not apply fumigant directly to any surface.**

Special care must be taken when the percent relative humidity of the air within the fumigated space is high (the amount of moisture in the air is high compared to the total amount it can hold). If necessary delay the fumigation until conditions are more favorable such as when the relative humidity within the structure to be fumigated is lower.

The next section provides further additional basic information on preventing problems with fogouts.

Additional Fogout Basics

All air contains some amount of moisture, referred to as humidity. The maximum amount of moisture a parcel of air can hold varies with its temperature. The lower its temperature, the less moisture the parcel of air can hold. This is why humidity is referred to as “relative” humidity. Relative humidity is an expression of the percent of the maximum moisture carrying capacity of a parcel of air that has been attained. Fog is visible moisture in the air that appears when the air has reached its maximum moisture carrying capacity. The temperature at which a parcel of air has reached it maximum moisture carrying capacity is referred to as its “Dew Point” temperature. The number of degrees that the temperature of a parcel of air must be reduced to reach its Dew Point is called its “Dew Point Depression”. When air is brought to its Dew Point temperature the relative humidity is 100% meaning the air is saturated with water and cannot hold any more water *at that temperature*.

The maximum level of moisture that a parcel of air can hold can be reached by putting more moisture into that parcel of air at a constant temperature or by lowering the temperature of the air while holding the amount of moisture in the air constant. The lowering of the temperature of a parcel of air containing a fixed amount of moisture to the point that the air reaches or exceeds it moisture carrying capacity is the basis for the fogout problems that can occur during the release of Zythor into a fumigated space.

Sulfuryl Fluoride Release Cooling

When sulfuryl fluoride is released from the cylinder it must be converted from a liquid to a gas. This conversion requires heat and therein lies the potential for fogouts. The heat necessary to convert the sulfuryl fluoride from a liquid to a gas is removed from the atmosphere into which the sulfuryl fluoride is being discharged. Each pound of sulfuryl fluoride released into the atmosphere removes enough heat from the air to lower the temperature of one thousand cubic feet of air by 4.5^{O} F.

The removal of heat from the atmosphere (lowering of the air temperature) can cause gaseous water in the air to condense from a gas into visible moisture (fog) the same way that fog forms on cool, damp nights. The greatest potential for fogouts exists when the relative humidity is above 70 percent within the fumigated space and the temperature of the air is reduced by 10° F or more on account of the release of sulfuryl fluoride.

Temperature, Relative Humidity and Fogouts

As mentioned earlier, when the temperature of a parcel of air is equal to its Dew Point temperature, the relative humidity is 100% meaning the air is saturated with water. However the maximum amount of moisture a parcel of air can hold varies greatly based on the value of the Dew Point Temperature. When the Dew Point is 86 ^{O} F and the relative humidity is 100%, the air is holding 4 ½ times as much moisture at it would be holding if the Dew Point was 41 ^{O} F and the relative humidity was 100%. Remember, the higher the Dew Point, the more moisture that will be available to be squeezed from the atmosphere and the greater the potential for fogouts.

Rules of Thumb to live by are:

The warm air is, the more moisture it can hold. The colder air is, the less moisture it can hold.

The greater the level of relative humidity, the closer the temperature is to its Dew Point.

It is particularly important to avoid releasing Zythor into a hot area, such as a an unairconditioned garage where it is circulated into a cool air-conditioned area.

Zythor Residual Ingredients

If Zythor is discharged into a fog, the small amount of highly reactive residual ingredients in Zythor can mix and react with the water. If this water containing the reaction products settles onto a surface, the reaction products can damage the surfaces onto which they settle.

Condensation Damage

Even if no residual ingredients are present in the Zythor, the condensation of the fog into liquid water droplets that fall onto sensitive surfaces can cause damage due to staining.

Fogout Avoidance Steps

The key to avoiding problems with the residual ingredients in Zythor or staining caused by condensing moisture is to assure that Zythor is converted from a liquid to a gas as soon after discharge from the shooting hose as possible and that no fog is created at the discharge site. In almost every case, fogouts can be easily avoided if a few steps are taken to anticipate and avoid circumstances that can cause fog to form.

There are three sulfuryl fluoride release variables that can be easily controlled to help avoid the formation of fog at the discharge site.

- Decreases in the rate at which sulfuryl fluoride is being discharged from the hose.
- Increases in the rate at which the air in the proximity of the release site is being exchanged for air away from the release site.
- Choosing the largest (in volume) release site within the fumigated space.

Creating differences in the Discharge Rate

Decreasing the rate at which Zythor is being discharged can help avoid fogouts. The slower the release rate, the less heat that is extracted from the air for a given period of time. Because the valve must be fully opened (never just cracked) whenever Zythor is being discharged from the cylinder, the only way to vary the rate of release of sulfuryl fluoride from the cylinder is by decreasing the diameter of the hose through which it is being released and/or increasing the length of the hose.

Decreasing the diameter of the hose restricts the rate at which sulfuryl fluoride can move through the hose. Lengthening the hose takes advantage of the resistance or friction that the sulfuryl fluoride encounters as it moves through the hose. Differences in tubing diameter and length can have a dramatic effect on the rate at which sulfuryl fluoride is released.

Effect of hose interior diameter on discharge rate

A 1/2 inch I. D. hose 25 feet long releases sulfuryl fluoride at a rate of 45 pounds per minute.

A 1/8 inch I. D. hose 25 feet long releases sulfuryl fluoride at a rate of 4 pounds per minute.

Effect of hose length on discharge rate

A 1/8 inch I. D. hose 25 feet long releases sulfuryl fluoride at a rate of 4 pounds per minute.

A 1/8 inch I. D. hose 100 feet long releases sulfuryl fluoride at a rate of 2 pounds per minute

For this reason, discharge sulfuryl fluoride through a 1/8 inch I. D. hose, preferably at least 100 feet long. This shooting hose specification assures a relatively slow rate of discharge into the fumigated space. Longer hoses can reduce the flow rate even further.

In some circumstances it may be advisable to release Zythor into the fumigated space in a stepwise fashion. Repeatedly starting and stopping the release of Zythor allows the temperature of the air to recover between the periods of release.

Varying the Rate of Air Exchange

Another important way to avoid a fogout is to continually exchange the air at the point of Zythor discharge. As Zythor is released it cools the air into which it is being released. Exchanging this air for nearby warmer air decreases the possibility that the temperature of any of the air within the fumigated space will fall below its Dew Point. This is because the fan is operating as a "heat exchanger".

The easiest way to exchange air at the discharge site is to discharge the Zythor into the stream of a fan. The Zythor label requires that it be discharged into the flow of a fan with a rated capacity equal to or greater than one thousand cubic feet per minute for each pound per minute of Zythor released. For example, if Zythor is released at a rate of 3 pounds per minute, the release should be into the stream of a fan that has the capacity to move at least 3,000 cubic feet of air per minute.

Volume of the Release Site(s)

The smaller the space (room) into which Zythor is discharged, the more likely it is that a fogout will occur. This is because the smaller the space, the more likely it is that the air in the room as a whole will be brought closer to its Dew Point regardless of how vigorously the air is exchanged. The easy solution is to always discharge Zythor within the largest space within the fumigated space.

In some circumstances it may be advisable to release Zythor at multiple points within the fumigated space, particularly if there are no suitably large rooms to serve as a single point release site.

Reconsidering Releasing Zythor When "Fogout Favorable" Conditions Exist

Sometimes adhering to the recommendations concerning the three release variables is not sufficient to avoid a fogout. This may be because the temperature of the air in the fumigated space and the level of the moisture in the air are in a relationship too favorable for fog to form.

If this is the case, it is advisable to delay the fumigation until conditions are more favorable (humidity is lower and/or temperature is higher or both.) Alternately the temperature of the air can be increased by running the heat prior to application (remember all heat sources and flames must be extinguished prior to introduction of sulfuryl fluoride) or running a dehumidifier within the fumigated space prior to fumigant release.

Special Consideration for Applications other than 1X

Anytime the rate at which Zythor is being applied is greater than the drywood termite 1X rate, special attention must be paid to the potential for fogouts. Higher levels of Zythor application can push the temperature of the air within the fumigated space substantially lower than a 1X application, increasing the possibility of a fogout.

Zythor Release

Two persons trained in the use of Zythor, at least one of who is an applicator licensed/certified to perform fumigations by the state in which the application is being performed, must be present on site during any release of Zythor.

Before introducing the fumigant, verify that all required safety equipment is available and in good working order. Position the Zythor cylinder(s) outside the space to be fumigated. Do not connect cylinders to introduction equipment until all fumigation warning signs have been posted and the space to be fumigated is clear of persons, non-target animals and is properly secured.

Release the Zythor from outside the fumigated space. Wear splash resistant goggles or full-face shield for eye protection during introduction of fumigant or when working around any lines containing fumigant under pressure. Do not wear gloves or rubber boots.

Unprotected persons should stand well clear of any cylinder releasing Zythor in case a shooting hose may become detached.

Weighing Zythor

The scales used to dispense Zythor should be re-calibrated regularly. Regardless of the technique used to determine the amount of Zythor removed from the cylinder, do not suspend the cylinder from its valve.

An efficient way to weigh Zythor is using a hanging scale and a hanging bonnet as pictured below. The hanging bonnet must be screwed onto the cylinder in place of the safety bonnet before the cylinder is hung from the scales.

HANGING SCALE AND HANGING BONNET

Releasing Zythor

Open valve slowly at first, then turn the valve open a minimum of at least one full turn to release Zythor. Do not “crack” the valve in order to attempt to regulate the flow of sulfuryl fluoride. Cracking the valve can lead to frosting of the shooting hose. This is because the reduced flow of Zythor out of the cylinder into the hose allows for there to be space within the hose that is not filled with liquid. This space allows the liquid sulfuryl fluoride to expand and convert to a gas before it exits the hose. This conversion requires heat and the removal of this heat (as the gas exits the hose) can cause the outside of the hose to freeze.

As explained earlier, the configuration of the dip tube within the cylinder means that any amount of Zythor below the bottom of the dip tube will exit as a gas. This gaseous Zythor will exit the hose at a much slower rate than the liquid Zythor. In addition, its conversion to gas within the cylinder may cause the cylinder and hose to freeze. If this occurs, be sure to protect any sensitive surfaces that may be damaged by the dripping of melt water off of the cylinder and hoses.

Fumigant Seal Leak Detection

After Zythor is applied, it is a good idea to check the quality of the seal by probing around the outside of the tarps with a leak detector. A good detection unit to use is a TIF leak detector. These detectors can detect the presence of all types of fluorine-containing gases including sulfuryl fluoride. TIF detectors have been shown to be able to detect levels of sulfuryl fluoride down to 50 ppm in the air.

TIF detectors do not monitor levels of sulfuryl fluoride low enough or accurately enough to be used as clearance devices and should never be used for that purpose.

If a leak is detected, clear the area of unprotected personnel (personnel not wearing a SCBA). An operating SCBA must be worn when fixing leaks. If it is necessary to re-enter the structure prior to aeration to fix a leak, adhere to all procedures concerning number of personnel required to be present, availability and use of SCBA, etc. when doing so.

TIF LEAK DETECTOR

Aeration and Clearance

Aeration

The final step in using Zythor is to remove it from within the fumigated space (aeration) and to confirm its absence from the breathing zone of the fumigated space after the completion of the aeration process (clearance). Aeration of Zythor from a fumigated space involves actively exhausting and/or allowing the Zythor to dissipate from the fumigated space out into the atmosphere. Breathing zones are defined as areas within the structure where individuals typically stand, sit or lie down.

Clearance involves sampling the air within the breathing zone of the fumigated space with an approved and properly calibrated Low Fumigant Level Detection Device until readings given by the detection device indicate that fumigant is no longer present above 1 ppm within the breathing zone of the fumigated space. Only when certain periods of time (see *Aeration Procedures* below) have elapsed after the initiation of the aeration process and the level of fumigant remaining is confirmed at the end of those time periods to no longer exceed 1 ppm in the breathing zone of the fumigated space can final clearance for re-occupancy be given.

Special attention should be given to aerating attics and forced air handling system ducts. Active aeration of attics can be accomplished by directing a fan into attic access openings. Air handling systems can be aerated by activating the system blower or alternately directing a fan into one or more return vents.

Two persons trained in the use of Zythor, at least one of who is an applicator licensed/certified to perform fumigations by the state in which the application is being performed, must be present on site during initiation of the initial aeration procedure. (Aeration procedures may vary significantly by state according to state regulations. Consult your state regulator for more guidance on this important subject.)

Aeration Dynamics of Sulfuryl Fluoride

There are four factors that can influence the amount of time need to complete the aeration process. These factors are:

- Adsorption and desorption of sulfuryl fluoride by and from surfaces
- Temperature
- Concentration of fumigant in the air at the end of the exposure period
- Rate of air exchange

One of the great advantages of sulfuryl fluoride as a fumigant is its ability to rapidly diffuse to almost any point in the fumigated space immediately after it is applied. This includes an ability to penetrate relatively quickly into almost any porous surface or substance. Equally important is its tendency to rapidly aerate from any space to which it has been confined. It also aerates from porous substances that it has penetrated at a relatively rapid rate. However, there can be differences in the amount of time needed to remove Zythor from spaces of the same size based on these factors.

Adsorption of Sulfuryl Fluoride

Sulfuryl fluoride can, however, be adsorbed to some degree by certain materials found in structures. Adsorption (as opposed to *absorption*) involves the partitioning of a gas onto the surface of a solid. The amount of adsorption of a gas onto a solid that occurs is related to the physical nature of the gas and the adsorbing solid and is greatly dependent upon phenomenon such as electrostatic forces that are beyond the scope of this manual. An important target of sulfuryl fluoride adsorption is polystyrene foam insulation.

The amount of adsorption of sulfuryl fluoride that occurs is a function of the adsorbing solid and the concentration of the sulfuryl fluoride in the air with a larger amount of sulfuryl fluoride being adsorbed the greater the sulfuryl fluoride air concentration. Any adsorbed sulfuryl fluoride is no longer available as a fumigant within the fumigated space, but sulfuryl fluoride is not adsorbed in large enough amounts to affect its concentration in the air. The main impact of adsorption is related to the aeration process.

When the seal is broken at the end of the exposure period and the concentration of sulfuryl fluoride in the air is reduced, any amounts of sulfuryl fluoride that have been adsorbed are slowly released off of the solid surfaces and back to the atmosphere. The process is called desorption. Desorption occurs because of the reduced concentration of sulfuryl fluoride in the air surrounding the solid.

The time that it takes for the total desorption of sulfuryl fluoride from all surfaces in the fumigated space to occur can be a limiting factor as to how quickly the fumigated space can be declared clear. No matter how quickly the level of sulfuryl fluoride is reduced in the air of the fumigated space by the strategic placement of fans and opening of windows and doors, a certain extra amount of time must be allowed for this desorption to occur. The amount of time necessary for total desorption to occur can vary based on how much sulfuryl fluoride has been adsorbed by the surfaces within the fumigated space. Desorption is one reason why it is important (and necessary) to adhere to the time constraints placed on the aeration/ clearance process.

The best proof that adsorption/desorption occurs could be demonstrated by aerating a structure for a relatively short period of time and then resealing it. Monitoring of the air for its sulfuryl fluoride concentration beginning as soon as resealing was completed and extending over a period of time thereafter would likely show the concentration of sulfuryl fluoride increasing as time passed. This would occur on account of sulfuryl fluoride being released back into the air from the surfaces onto which it had been adsorbed (desorption). This desorption would be occurring because the level of sulfuryl fluoride in the air surrounding the solid had been decreased by the short aeration period.

The re-aeration or continuation of aeration that sometimes must occur at the end of the required aeration waiting period because of a high reading is normally caused by the small amounts of sulfuryl fluoride that were desorbed after the windows and door were closed at the end of the initial aeration period.

Effect of Temperature on Desorption

Temperature can have a significant effect on how quickly desorption of sulfuryl fluoride from surfaces occurs. The higher the temperature, the faster desorption occurs and the faster the remaining sulfuryl fluoride will diffuse out of the fumigated space.

Effect of Concentration at End of Exposure Period on Desorption

The concentration of Zythor in the fumigated space at the end of the exposure period can also affect the amount of time needed to totally desorb all sulfuryl fluoride from all surfaces. The higher the concentration of Zythor in the air at the end of the exposure period, the longer it will take the desorption process to occur. This is simply because more adsorption occurs at higher concentrations, as higher concentrations literally push more sulfuryl fluoride onto the surfaces. When higher than 1X amounts of Zythor are used, for instance when beetles are the target pest, a long aeration period may be required to clear the structure.

Effect of the Rate of Air Exchange

The rate of air exchange can be controlled by the proper placement of fans and the opening of doors and windows.

Respiratory Protection Requirements During Reentry/Aeration/Clearance

The processes of aeration and clearance of the fumigated space require entry into the fumigated space while the level of Zythor in the air within the breathing zone of the fumigated space still exceeds 1 ppm. All persons entering and/or remaining inside the fumigated space between the time of initial application of Zythor to the fumigated space and final clearance of the fumigated space must adhere to the requirements of the *Respiratory Protection, Respiratory Protection Devices* and *Low Fumigant Level Detection Devices* sections of the Zythor label and this manual. These sections are repeated below from earlier in this manual for emphasis.

Respiratory Protection

Use of an approved Respiratory Protection Device (see *Respiratory Protection Devices*) is required to enter or remain within a fumigated space anytime the concentration of Zythor within the breathing zone of that space is known to exceed 1 ppm or is unknown, such as at the start of the aeration process.

If the concentration of Zythor within the breathing zone of the fumigated space, as measured by an approved and properly calibrated Low Fumigant Level Detection Device (see *Low Fumigant Level Detection Devices*), does not exceed 1 ppm, no respiratory protection is required to enter or remain within the fumigated space. Because the approved detection devices give immediate readings of the levels of fumigant present, respiratory protection is not required when these devices are in use after the initial 1 hour aeration procedure is completed. However, whenever a fumigant level reading exceeding 1 ppm is obtained within the breathing zone of a fumigated space, anyone within the fumigated space not using an approved Respiratory Protection Device must immediately leave the fumigated space and remain outside the fumigated space until fumigant level readings of 1 ppm or greater are no longer obtained within the fumigated space. The fumigated space must remain posted until cleared for re-occupancy.

Respiratory Protection Devices

Use a NIOSH or MSHA approved positive pressure Self-Contained Breathing Apparatus (SCBA, not SCUBA) or combination air supplied/SCBA respirator, such as those manufactured by Ranger, Survivair, Scott, or MSA, when respiratory protection is required (see *Respiratory Protection*). Required Respiratory Protection Devices must be on site and operational before an application of Zythor begins.

Before using any make or brand of Respiratory Protection Device, learn how to use it correctly. Determine that it is in good working order, that it has an air supply sufficient to supply air for the period of time the device will be in use, that it fits properly and that it provides an adequate seal around the face.

SCBA

Low Fumigant Level Detection Devices

As part of the aeration/clearance process or cylinder leak procedure, an approved Low Fumigant Level Detection Device capable of confirming a concentration of Zythor of 1 ppm or less, such as the SPECTROS SF-ExplorIR, INTERSCAN or MIRAN gas analyzers, should be used to sample the air within the breathing zone of the fumigated space to confirm the level of fumigant, if any, that is still present. The INTERSCAN gas analyzer must be calibrated within one month prior to its use as a Low Fumigant Level Detection Device. All other approved Low Fumigant Level Detection Devices must be calibrated according to their manufacturer's recommendations.

INTERSCAN GF1900

Aeration Preparation and Safety

Aeration is a time to apply maximum attention to safety. The start of the initial aeration period is probably the point of greatest potential danger during a fumigation. The goal of any aeration should be to remove the sulfuryl fluoride from the fumigated space and discharge it into the atmosphere while minimizing its impact on any non-target organism.

Aeration Preparation

Preparations for an efficient and lower impact aeration should be included as part of the overall fumigation preparation process. Doing this can minimize the amount of time required to complete the aeration of the fumigated space. Preparations for aeration that must be made before the fumigation takes place include:

- Opening all interior doors including attic and basement entry doors.
- Opening doors on cabinets and appliances.
- Placing and orienting fans to maximize the exhausting of Zythor laden air to the exterior when they are reactivated after the seal is broken.
- Orienting tarps so that seams are away from outdoor plants, if possible.

Aeration Safety

The following comments (some are requirements according to the Zythor label or local regulations) can increase the margin of safety during aeration:

- Two persons should be present from the first opening of the seal until the securing of the structure at the end of the initial aeration period. One of these persons must be licensed/certified in fumigation.
- Both of these persons must be knowledgeable of the fumigation process, know how to use a SCBA and be equipped with a functional SCBA.
- Initiate the aeration by breaking the seal on the downwind side of the structure.
- Next break the seal on the upwind side of the structure. If a high dose of sulfuryl fluoride (greater than 1X) was applied to the structure, allow aeration of most of the sulfuryl fluoride through the opened seams before removing the tarpaulin from the structure.
- If plants are near the structure, restrict the release of sulfuryl fluoride into the air at the beginning of the aeration process to avoid overexposing plants. Open seams that are away from plants first.
- Remove the tarpaulin weights (snakes, etc.) and clamps first.
- With workers on the roof and on the ground, peel the tarp off the structure (as opposed to dropping them straight down off the roof).
- The first action inside the structure must be to open all exterior doors and to activate fans and, if necessary, to reorient fans to exhaust air from the structure. The combined capacity of all fans operating during aeration should, at a minimum, equal 5,000 cubic feet per minute.
- **Timing for the one hour active aeration period should begin only after all doors and windows have been opened and fans activated.**
- Any persons not protected by an SCBA should remain clear of areas around the structure where the concentration of sulfuryl fluoride exceeds 1 ppm. Avoid areas downwind from the structure.
- **At the end of the initial aeration period, the structure must be re-secured. Secondary locks and the warning signs must be repositioned on the outside of the structure at all entrances.**
- Only a certified/licensed operator can authorize the removal of warning signs which can only occur after the expiration of the aeration period (see next section).

Aeration Procedures

There are two approved procedures for aeration. The aeration procedure used for a fumigated space is based on the total amount of Zythor per thousand cubic feet that was released within the fumigated space during the exposure period. All structures into which a total of more than 16 ounces of Zythor per thousand cubic feet of fumigated space has been released during the Exposure Period must be aerated using Aeration Procedure 2. All other fumigated spaces can be aerated using either Aeration Procedure 1 or Aeration Procedure 2.

Aeration Procedure 1 – Applied Dose 16 oz/1000 cubic feet or less

These steps must be completed in sequence.

Step (1): Aerate the fumigated space with all operable windows and doors open, aided by the use of 1 or more fans, for a minimum of 1 hour. All of the fans used shall, in total, be capable of displacing at least 5,000 cubic feet of air per minute. The fans may be turned off for the remainder of the aeration period if desired.

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

Step (3): After the minimum 6 hour waiting period, measure the concentration of Zythor in the breathing zone of each room of the fumigated space using an approved and properly calibrated Low Fumigant Level Detection Device. If a concentration of Zythor greater than 1 ppm is detected in the breathing zone, ventilate the fumigated space by opening operable doors and windows and continue to measure the concentration of Zythor in the breathing zone until it is 1 ppm or less. Fumigated space may be cleared for re-occupancy when the concentration of Zythor as measured with an approved and properly calibrated Low Fumigant Level Detection Device is determined to be 1 ppm or less in the breathing zone.

Aeration Procedure 2 – Applied Dose More Than 16 oz/1000 cubic feet

These steps must be completed in sequence.

Step (1): Aerate the fumigated space with all operable windows and doors open, aided by the use of 1 or more fans, for a minimum of 1 hour. All of the fans used shall, in total, be capable of displacing at least 5,000 cubic feet of air per minute. The fans may be turned off for the remainder of the aeration period if desired.

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

Step (3): After the minimum 8 hour waiting period, measure the concentration of Zythor in the breathing zone of each room of the fumigated space using an approved and properly calibrated Low Fumigant Level Detection Device. If a concentration of Zythor greater than 1 ppm is detected in the breathing zone, ventilate the fumigated space by opening operable doors and windows and continue to measure the concentration of Zythor in the breathing zone until it is 1 ppm or less. Fumigated space may be cleared for re-occupancy when the concentration of Zythor as measured with an approved and properly calibrated Low Fumigant Level Detection Device is determined to be 1 ppm or less in the breathing zone.

Final Clearance and Reoccupancy

Do not reoccupy a fumigated space, i.e., structure, ship, vehicle or chamber, or move fumigated vehicles until aeration is complete and clearance has been given. Warning signs must remain posted until aeration is completed and final clearance for re-occupancy is given.

Zythor Dose Calculation Basics

Fumicalc

All Zythor Doses are calculated using the Fumicalc software program, a revolutionary advance in the art of fumigant dose calculation. The Fumicalc and its ease of use means it is not necessary to have an in depth understanding of how a Dose is calculated to use Zythor correctly. However it is useful to have a simple understanding of the factors involved in calculating a Dose and how they affect the amount of the Dose. For this reason the following sections on the particulars of how a Dose is calculated are included in this manual as a lead up to an explanation of how to use the Fumicalc.

Among other things, the following sections contain discussions of concepts called Kill Power Index (more commonly referred to as Ounce Hours) and Gas Loss Index (more commonly referred to as Half Loss Time). **You are not required to understand how to compute a Gas Loss Index or a Kill Power Index in order to use Zythor correctly or to successfully use the Fumicalc to compute a Dose.** Instead the Fumicalc handles all of this for you seamlessly. These values are calculated by the Fumicalc and are displayed on the Fumicalc screen for your reference.

Dose, Concentration, Exposure Period

The space into which the Zythor will be released is referred to as the fumigated space. The goal of any fumigation is to apply to the air of the fumigated space that the Target Pest is breathing a Concentration of the fumigant that is sufficient to kill the Target Pest. The amount of Zythor applied to a fumigated space is referred to as the Dose and is expressed as pounds of Zythor. The level of fumigant present in the air of the fumigated space is referred to as the Concentration, which is expressed as ounces of Zythor per 1000 cubic feet of fumigated space. The period of time that the Dose is confined to the fumigated space is referred to as the Exposure Period.

Kill Power Index

For any species of insect living in any temperature environment, there is a certain level of exposure to Zythor that can kill that insect. That level, which is dependent only upon the type of Target Pest and the temperature (for reasons explained later), is referred to as the Kill Power Index. For a given temperature and Target Pest, the Kill Power Index as computed by the Fumicalc is always the same value.

The application of the required Kill Power Index to the Target Pest is a function of both the Concentration of Zythor in the air the Target Pest is breathing and the length of time the Target Pest is exposed to that Concentration. Importantly, increases or decreases in the Concentration can be compensated for by increases or decreases in the length of time the Target Pest is exposed to that Concentration. For a given (constant) temperature, and provided there is no loss of fumigant from the fumigant space, increasing the Concentration will reduce the length of the Exposure Period required to kill a Target Pest. Conversely, at the same temperature and under the same no loss of fumigant conditions, increasing the length of the Exposure Period will reduce the Concentration of Zythor required to kill the same Target Pest. This means that for a given temperature, there are essentially an infinite number of combinations of Concentration and Exposure Periods that could be used to kill a Target Pest. When using Zythor, this interchangeability of Concentration and Exposure Period (ability to substitute one for the other) is expressed in the following equation:

Kill Power Index = Concentration (in ounces) X Exposure Period (in hours)

The Kill Power Index equation above is simply a mathematical expression of the infinite number of relationships between Concentration and Exposure Period that could be used to administer a given Kill Power Index to a fumigated space.

Target Kill Power Index

The Kill Power Index that must be achieved for a given fumigated space under a given set of conditions is referred to as the Target Kill Power Index.

Achieving the application of the Target Kill Power Index to the fumigated space is the goal of any application of Zythor.

When using the Fumicalc or applying Zythor, you do not have to understand how to compute a Target Kill Power Index. The Fumicalc computes the Target Kill Power Index for you automatically based on the inputs you make into the Fumicalc. To compute the outputs you need to make an Zythor application, all the Fumicalc needs to know is the Target Pest and temperature of the fumigation site (as explained in Kill Power Index Variables below) and six other pieces of information (as explained in the Gas Loss Index section below).

Remember, the Target Kill Power Index that must be achieved for a fumigated space, as computed by the Fumicalc, is dependent on only two inputs you make into the Fumicalc – temperature and Target Pest – for reasons that are explained next.

Target Kill Power Index and Target Pest

Certain insects are more susceptible to exposure to Zythor than others. This means higher Kill Power Indexes must be achieved for certain Target Pests compared to that needed to kill others. Higher Kill Power Indexes can be achieved for any fumigated space by administering a higher Concentration of Zythor and/or extending the Exposure Period, all of which is handled by the Fumicalc automatically. All you have to do is tell the Fumicalc the Target Pest and it makes any necessary adjustments to the Kill Power Index.

There are significant differences between the susceptibility of the embryonic (egg) stages and post-embryonic (non-egg i.e. larva, pupa and adults) stages of the same species of almost all target insects to Zythor. These differences mean higher Concentrations and/or longer Exposure Periods must be used when the mortality of the eggs of the target insect(s) is required (which is normally the case), as compared to the Zythor Concentrations and/or Exposure Period combinations required to kill their non-egg stages only.

(The egg stage of some target insects are not susceptible to sulfuryl fluoride and thus cannot be killed by Zythor. In this case it may be advisable to fumigate once at a concentration sufficient to control the post-embryonic (larva, pupa, adult) stages. After any surviving insect eggs have hatched, but prior to these insects' maturation and deposition of new eggs, fumigate a second time, again at the post-embryonic life stage concentration.)

The Kill Power Index necessary to control different pests and their different life stages is expressed in the following table as multiples of the Kill Power Index required to kill Drywood termites (Index = 1), assuming the applications occurred under the same conditions. When the egg stage of a Target Pest cannot be killed with Zythor, the multiple of the Drywood Termite Kill Power Index that must be achieved to kill the non-egg stages only is given instead. These multiples apply to the use of Zythor within all types of fumigated spaces.

Kill Power Indexes for Different Pests (Drywood Termite Index = 1)

Pests	Multiple of the Drywood Termite Kill Power Index	Comments
Rodents[1]	1/2x	
Carpet Beetles	1x	Eggs are not killed
Cockroaches[1] (except German)	1x	Eggs are not killed
Cockroach[1] (German)	1x	
Furniture Carpet Beetles	3x	Eggs are not killed
Bedbugs[1]	3x	
Old House Borers	4x	
Formosan Termites[1]	4x	Above ground termites only are killed. Use in combination with other methods to kill infestations originating below ground.
Clothes Moths	6x	
Powder Post Beetles and Death Watch Beetles	10x	
[1]Do not use less than the specified dosage factors when treating for rodents, cockroaches, bedbugs, and termites.		

Target Kill Power Index and Temperature

Temperature affects the value of the Target Kill Power Index because most of the Target Pests (all except Rodents) are cold-blooded insects. This means their breathing rate and body temperature vary with the temperature of their environment. Higher temperatures cause their biological systems to be more active and rate of respiration to be higher thereby making them more susceptible to Zythor. This means less Zythor and/or shorter Exposure Periods are sufficient to kill the Target Pests when they are in a higher temperature environment as opposed to a lower temperature environment. The lower the Target Pest's breathing rate and body temperature, the less susceptible they are to Zythor. This means more Zythor and/or longer Exposure Periods are needed to kill them when they are in a low temperature environment. **The higher the temperature the lower the Target Kill Power Index. The lower the temperature the higher the Target Kill Power Index.**

Temperature Restriction and Limitation for Insects

Fumicalc will not accept a temperature input lower than 40 degrees ^{O}F. This is consistent with the restriction against applying Zythor at a temperature lower than 40 degrees ^{O}F.

Preset Temperature for Rodents

When fumigating for rodents, there are no temperature restrictions. This is because rodents are warm-blooded. (When you select rodents as your Target Pest when using the Fumicalc, the temperature slider bar is hard coded at 80 ^{O}F and cannot be changed for this Target Pest.)

Target Pest and temperature are the only input values the Fumicalc needs to determine the Target Kill Power Index for a particular application of Zythor. Once you have correctly entered these two variables, the numerical Target Kill Power Index value for that application is set (constant) and will not change during the course of the application – unless you change the temperature and/or the Target Pest.

Gas Loss Index

Despite the best of efforts of a fumigation crew to seal a fumigated space before application, a certain amount of fumigant will be lost during the Exposure Period. This loss is dependent upon several factors including some that are beyond the applicator's control. These include wind, underseal type, volume, etc. The inevitable loss of Zythor during the Exposure Period must be taken into account when determining the Dose of Zythor. This loss is accounted for by the calculation of a Gas Loss Index.

The Gas Loss Index is a mathematical expression of the rate at which gas is being (or is expected to be) lost from within the fumigated space. (It is more commonly referred to as Half Loss Time). It is not necessary to compute or deal with a Gas Loss Index to use Zythor. However a knowledge of what the Gas Loss Index is can be useful for a safe and effective fumigation.

Ideally, no fumigant gas would be lost from within the fumigated space during the Exposure Period. However no fumigation seal is perfect, as mentioned earlier. And with sulfuryl fluoride you are dealing with a highly volatile gas with a high penetrating power. This high volatility and high penetrating power is valuable when it comes to killing a Target Pest, wherever it may be within the fumigated space. However, the high volatility and high penetrating power of Zythor make its potential rate of loss from the fumigated space during the course of the Exposure Period an important factor to take into account when calculating the total amount of Zythor that must be applied to achieve the Target Kill Power Index.

Estimated Gas Loss Index vs. Actual Gas Loss Index

The Gas Loss Index is simply the time it would take for one half of the Zythor within a fumigated space to be lost out into the atmosphere.

Estimated Gas Loss Index

The Fumicalc calculates an *Estimated* Gas Loss Index for any fumigated space based on five factors you input into the Fumicalc – tarpaulin condition, seal condition, under seal type, wind speed and volume. Each of these factors can affect the rate of gas loss and therefore must be taken into account when determining an Estimated Gas Loss Index. (These five factors and their importance are explained later.) Estimated Gas Loss Indexes are calculated for Un-Monitored and Monitored Applications.

Actual Gas Loss Index

The Fumicalc can determine an *Actual* Gas Loss Index based on two consecutive Concentration Readings of the actual concentration of Zythor present in the air within the fumigated space. Actual Gas Loss Indexes are calculated only for Monitored Applications.

Because Fumicalc automatically handles all of the calculations concerning each of the two types of Gas Loss Indexes and their impact on the amount of the Dose of Zythor that needs to be applied to the fumigated space, the importance of you knowing or referencing the Gas Loss Index is limited to its value as an indicator of the integrity of your seal of the fumigated space. For instance, a low Actual Gas Loss Index (short amount of time for one half the Zythor within the fumigated space to be lost) might indicate you have a significant leak in your seal while a high actual Gas Loss Index (long amount of time to lose one half of the Zythor applied) might confirm the quality of the good job you did sealing the fumigated space.

Unlike the Target Kill Power Index value which you cannot affect, you can affect the Gas Loss Index for a fumigated space by, for example, creating a very tight seal or not making an application during high wind conditions. However there are limits to the effect you can have on the Gas Loss Index. Some factors such as underseal type and volume are normally beyond your control and must be compensated for with more Zythor or a longer Exposure Period or both. However, Fumicalc handles all this automatically.

Choosing a Planned Exposure Period

When using the Fumicalc, the infinite number of Concentration and Exposure Period combinations that can be used to kill a Target Pest are practically dealt with by choosing and inputting into the Fumicalc a set period of planned exposure of the Target Pest to Zythor. This period of exposure is referred to as the Planned Exposure Period. Once a Planned Exposure Period is input into the Fumicalc, the required Dose of Zythor to achieve the Target Kill Power Index is then calculated by the Fumicalc. The Fumicalc does this by inserting your designated Planned Exposure Period into the Kill Power Index equation which allows it to compute the Dose that it then displays.

The length of a Planned Exposure Period is chosen based on two factors - convenience and economy. Because of the relationship between Exposure Period and Concentration, a Planned Exposure Period of essentially any length could theoretically be calculated. However, for practical reasons, the Fumicalc imposes a minimum Planned Exposure Period of 2 hours and a maximum of 72 hours.

The practical question in determining the length of a Planned Exposure Period is how much extra you are prepared to pay for extra Zythor to shorten this period of time. When making this determination, keep in mind that the longer the Planned Exposure Period chosen, the less the amount of Zythor saved for each extra unit of time. At some point, the savings on Zythor cost are outweighed by the increased length of the period of inconvenience to the occupants of the fumigated structure or space.

Choosing Dose Instead of Exposure Period

The Fumicalc is designed to allow the inputting of the Planned Exposure Period, but it is not designed to allow for the input of a Dose. This does not mean you cannot, within limits, choose your Dose instead of your Planned Exposure Period. This can be done by observing on the Fumicalc increases and decreases in the Dose as different length Planned Exposure Periods are selected.

Actual Vs. Theoretical Amounts of Zythor

Leakage of Zythor from the fumigated space (which the Fumicalc automatically takes into account and which must be compensated for with extra Zythor) means that multiplying the actual concentration of Zythor recommended by the Fumicalc times the Planned Exposure Period will not result in a value identical to the calculated and displayed Target Kill Power Index. The important thing to remember is that with the Fumicalc, all of this is handled automatically.

Monitored vs. Un-Monitored Application

Zythor can be applied to the same fumigated space under the same conditions two different ways – as a Monitored Application or as an Un-Monitored Application. Monitored or monitoring refers to the periodic measurement of the actual concentration of Zythor contained within the air of the fumigated space during the Planned Exposure Period. Monitoring confirms the level of Zythor to which the Target Pest is being exposed and allows for correction of variations of the actual from the expected Concentration of Zythor, if necessary. The advantages of a Monitored Application include potential savings in the amount of fumigant used (for reasons explained later) and confirmation that the Target Pest has actually been exposed to the recommended concentration of Zythor for the chosen Exposure Period.

Monitor when a high level of fumigant application precision is necessary. A Monitored or Un-Monitored application of Zythor can be made to any fumigated space for the control of any type of Target Pest. The Fumicalc is designed to calculate the Dose of Zythor (and supplements to the Initial Dose during the Exposure Period in the case of a Monitored Application, if needed) for any fumigated space for both Monitored and Un-Monitored Applications.

Differences in Zythor Amounts for Un-Monitored Vs. Monitored Applications

An Un-Monitored Application is a less precise approach to fumigation than a Monitored Application. The Fumicalc compensates for the lower level of precision of an Un-Monitored Application with a higher Initial Dose of Zythor. Assuming that the pre-application estimation of temperature, volume and gas loss conditions are correct, the amount of Zythor applied to a fumigated space as calculated by the Fumicalc is 33% greater for an Un-Monitored Application to a space than for a Monitored Application to the same space under the same conditions. This extra amount of Zythor is intended as protection against errors in assumptions made about the rate of loss of Zythor from the fumigated space during the Exposure Period.

However, if the pre-application assumptions input into the Fumicalc for an Un-Monitored Application are grossly incorrect and/or gas is lost from the fumigated space at a rate significantly greater than calculated, it is possible that the amount of Zythor applied to a Un-Monitored Application will not be sufficient to kill the Target Pest regardless of the greater Initial Dose that was applied. In contrast, the monitoring of a Monitor Application would discover any errors in values entered or incorrect assumptions concerning fumigant loss which would be compensated for by the application of additional Zythor.

The best way to prevent the failure of an Un-Monitored Application is to be careful when deciding upon and making the inputs into the Fumicalc for that type of application.

Un-Monitored Application

With an Un-Monitored Application, the amount of a single Dose of Zythor is determined prior to Zythor application. After the application of this single Dose of Zythor to begin the Exposure Period, normally no additional amounts of Zythor are applied to the fumigated space during the Exposure Period. Also, no effort is normally made during the course of an Un-Monitored application to determine the concentration of Zythor actually present within the fumigated space.

Monitored Application

To begin a Monitored Application, an Initial Dose of Zythor is first determined. (The process of determining the Initial Dose for a Monitored Application is identical to the process of determining the single Dose for an Un-Monitored Application.) During the course of the Exposure Period, the Concentration of Zythor in the air of the fumigated space is measured at regular intervals with a monitoring device such as a Fumiscope. These Concentration Readings are inputted into the Fumicalc along with the time they are taken. If the Concentration of Zythor is determined to have fallen below a certain level or the rate of loss of Zythor is found to be greater than anticipated, applications of additional Doses of Zythor to the fumigated space are made based on calculations automatically made by the Fumicalc.

Monitored or Un-Monitored – Making the Choice

The choice of which type of application to make (Monitored vs. Un-Monitored) is a decision left to the applicator based on the circumstances at hand for the particular application in question. Generally speaking, Un-Monitored applications are made to smaller sites when the potential for errors in the calculation of the amount of Zythor to apply is minimal and the fumigant cost savings made possible by monitoring the application are minimal compared to the labor cost of performing readings of the amount of Zythor present.

Monitored applications are generally made to large fumigated spaces or to smaller fumigated spaces where the cost in terms of money or inconvenience would be very large if it was necessary to repeat the application. Reasons to monitor large fumigated spaces include the need to eliminate the potential for a large error in the estimation of the correct amount of Zythor to be applied to this type of space for an Un-Monitored Application (uncertainty about the true condition of the seal, etc.) or the potential for monetary savings due to the lower rate of application possible with the Monitored Application. Tape and seal jobs should also be considered to be candidates for monitoring because of uncertainty about the quality of the seal.

However monitoring is not always restricted to larger or smaller specialty sites. Monitoring of other types of smaller sites may be desirable under certain circumstances such as a porous underseal or when fumigating for a Target Pest that is controlled only with very high concentrations of Zythor. Zythor can be lost through a porous layer of soil such as sand. Monitoring can help make sure that these losses are measured and compensated for. When fumigating for a Target Pest that is controlled only with high levels of Zythor, monitoring an application can reduce the amount of Zythor that must be used vs. an Un-Monitored application as explained earlier.

Regardless of the type of application you choose to make, the Fumicalc handles the calculation of the needed Doses seamlessly.

Fumicalc

All Doses of Zythor are calculated using Fumicalc. Fumicalc is a JAVA language computer program designed to allow for the quick and easy calculation of the amounts of Zythor required to fumigate any site permitted on the Zythor label for the control of any Target Pest on the label.

Fumicalc is part of the labeling for Zythor and must be used to calculate all amounts of Zythor applied to any site.

Fumicalc Desktop / Laptop and Palm PDA Versions Available

Fumicalc is designed to run on most desktop and laptop computers as well as Palm handheld PDAs with little or no special configuration of your computer other than the installation on your computer of the Fumicalc program (and JAVA if it is not already present on your computer). **The Fumicalc program is available from Ensystex II, Inc.**

Using Fumicalc is straightforward and simple. However, at all times you should exercise a high degree of care in entering information into Fumicalc. The Fumicalc is designed to prevent many different types of incorrect and mistaken entries. This helps increase the chances that the entries you make into the Fumicalc are correct. For instance, you cannot enter times in the future and are cautioned to double check later Concentration readings that are higher than earlier ones when no Zythor has been added between the readings. However there are limits to Fumicalc's ability to keep you from entering incorrect data. The output of the Fumicalc is only as reliable as the data you input into it. Failure to make correct inputs could result in failure to control the Target Pest and/or the creation of an unsafe fumigation situation or condition.

The desktop and laptop versions of Fumicalc are designed to calculate Doses for Un-Monitored and Monitored Applications.

The Palm version is designed to be used to calculate Doses for Monitored Applications and estimates of Monitored Application initial doses.

Installing Fumicalc on Your Computer or Palm PDA

Fumicalc Installation

Follow the instructions provided for installation on your particular computing device.

Understanding Fumicalc Inputs that Affect the Initial Dose

Before proceeding to instructions on how to use the Fumicalc, it is useful to include a discussion of the importance of each variable that must be inputted into the Fumicalc to compute an Initial Dose.

There are eight variables that affect the amount of the Initial Dose. Three of these variables are related to the Target Pest. Five of these variables are related to the quality of the seal of the fumigated space. These variables and their relevance to the calculation of the Initial Dose are explained in the next two sections.

Target Pest Related Factors Affecting Initial Dose

Target Pest

As explained earlier, there are wide variations in the susceptibility of different Target Pests to Zythor that need to be taken into account when calculating the Initial Dose. For that reason, the first action when using the Fumicalc is designating the Target Pest.

Temperature

Temperature and Target Pest are the only two variables used to calculate the Target Kill Power Index. As explained earlier, temperature is critically important because it affects the susceptibility of the insect to Zythor. For this reason, low temperatures can significantly increase the Target Kill Power Index needed to kill the insect.

Differences in temperature can result in substantial increases or decreases in the dose of Zythor that must be applied to the fumigated space to control a particular Target Pest. For example, fumigating at 50 degrees vs. 70 degrees can mean an almost three fold increase in the amount of Zythor that must be applied to control the same Target Pest, all other conditions being equal. The importance of inputting the correct temperature cannot be overstated.

In determining the temperature for input into the Fumicalc, the worst-case scenario (lowest temperature) must be applied. The lowest temperature at a point of potential Target Pest infestation within the fumigated space must be located and inputted into the Fumicalc. Entering a value greater than the lowest temperature actually present can result in an insufficient Dose of Zythor being applied to the fumigated space and a failure of the application to eradicate the Target Pest.

Locating the Lowest Temperature in the Fumigated Space

Generally the lowest temperature at a site of total slab construction will be found by measuring the temperature of the slab itself at a point where it is shaded. For a structure containing a crawl space, the lowest temperature within the fumigated space will generally be found approximately three inches beneath the surface of the soil in the crawl space. Taking multiple temperature readings will help you locate the lowest temperature at the site.

Planned Exposure Period

The Planned Exposure Period is the period, expressed in hours, that you are planning to contain the calculated Dose within the air of the fumigated space. This factor is considered to be Target Pest related because its length is related to the Kill Power Index.

Big differences in the length of the Planned Exposure Period can also cause significant differences in the amount of Zythor that must be applied at the site. For instance, choosing a Planned Exposure Period of 10 hours versus 24 hours can cause an almost two fold difference in the amount of Zythor that must be applied at the site. The longer the Planned Exposure Period, the less Zythor that must be applied. It is critical to input into the Fumicalc the Planned Exposure Period to which you fully expect and plan to adhere. Any negative variation in the length of the actual exposure from the Planned Exposure Period will likely result in a failure to achieve the Target Kill Power Index.

Seal Condition Related Factors Affecting Initial Dose

Underseal

Underseal (meaning the substrate under the structure at ground level) can have a big effect on the calculated Dose. This is because different underseal surfaces allow Zythor to escape from the fumigated space at different rates. Differences in underseal, for example slab vs. sand, can result in a more than 8 fold difference in the amount of Zythor that must be applied to the fumigated space. In some situations, such as a sand underseal and Dose greater than 1X, it may make sense to attempt to improve the quality of the underseal. This can in some cases be accomplished by placing a layer of a gas-retarding barrier, such as polyethylene sheeting, on the ground under the fumigated space.

Some structures such as split-level houses can have a concrete and soil underseal. Also choose as the underseal the more porous of the different underseals.

Tarpaulin and Seal Quality

This factor refers to the quality of the tarpaulin and the integrity of the joining together (clamping and taping) of the tarpaulins where they meet and where the tarpaulin touches the ground. These variables are highly subject to the opinion of the person entering the values into the Fumicalc. If in doubt, downgrade these values to a lower value, thereby increasing the amount of the Initial Dose.

Wind

Wind speed, entered in miles per hour, can also have an effect on Dose. A high wind speed can cause a more rapid dissipation of the Zythor from the fumigated space, meaning the Fumicalc must make an upward adjustment in the Initial Dose to compensate for the Zythor that will be lost.

Volume

The volume of the fumigated space, in thousands of cubic feet, is a self-explanatory factor.

Using the Fumicalc Desktop / Laptop Version

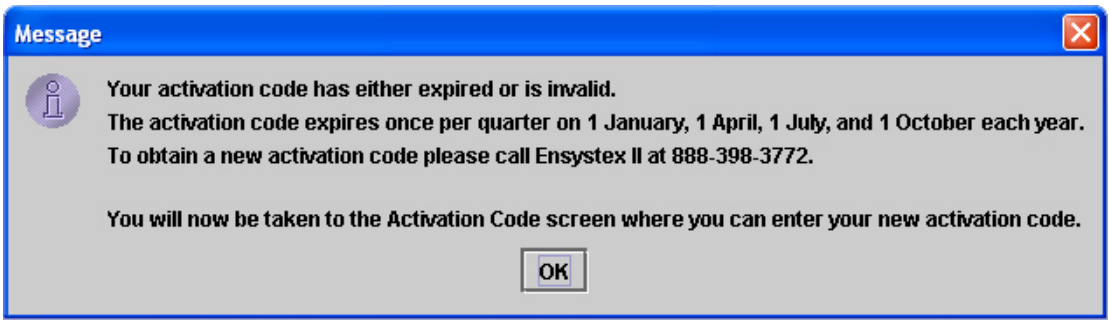
As explained earlier there are two versions of Fumicalc. The Desktop/Laptop Version is explained here. Refer to the appropriate section for instructions on using the Palm PDA version.

The only difference between the two versions of the Fumicalc is that you must use the Desktop / Laptop Version in order to performed a Monitored Application. (The Palm Version *will* calculate estimates of the initial dose for a Monitored Application but cannot be used to compute additional Doses.)

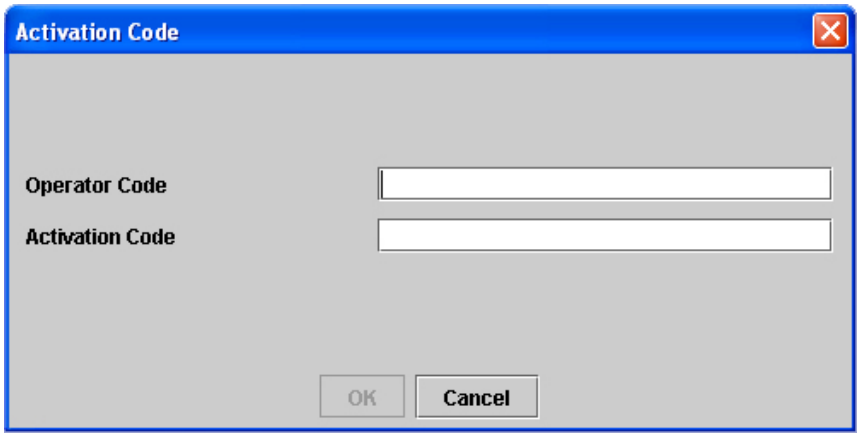
Starting and First Use of Fumicalc

Start the Fumicalc by clicking on the Fumicalc icon on your desktop.

To use the Fumicalc you must enter an Operator Code and an Activation Code. If you are starting the Fumicalc for the first time and no Codes have been entered, the following box will appear. This box will also appear when your attempt to start the Fumicalc and your codes have expired.



After clicking on OK, you will be taken to the following screen. Enter the codes you have been given to proceed.



Using the Desktop / Laptop Version of Fumicalc

Start the Fumicalc by clicking on the FUMICALC icon on your desktop as explained earlier. When it is started three options, Language, Target Pest and Activation Code, are highlighted in the top bar. A third option Enable/Disable Columns (which applies only to Monitored Applications and will be explained later) is grayed out at this time.

Adjustments to the On Screen Size of the Fumicalc Window

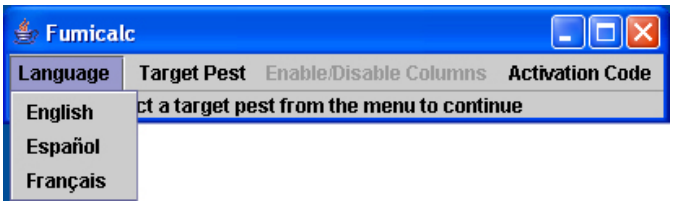
After starting the Fumicalc you may need to grab the lower right hand corner of its window and stretch it out in order for it to display properly. Adjusting the size of the Fumicalc window to as large a size as possible allows you to view the greatest amount of information at one time.

Editing the Activation Code

Every three months the activation code must be updated. This can be done by selecting the Active Code box on the top bar. When this is done the View / Edit activation code option will appear as shown below.

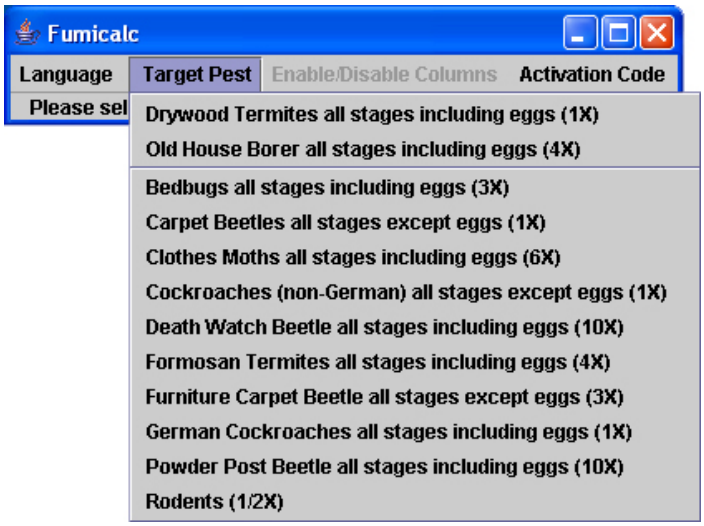
Language Selection

Fumicalc defaults to English when it is started. Select your language of choice if it is different than English (Spanish and French are available). The Fumicalc allows for switching between languages "on the fly". This means you can change from, for example, English to Spanish at any time during an application. This allows for persons speaking different languages to work with the Fumicalc on the same application.



Target Pest

Next choose your Target Pest by clicking on that heading and selecting your Target Pest from the list. Zythor is labeled for use against a wide variety of pests. Zythor is most commonly used against Drywood Termites or Old House Borers which are at the top of the Target Pest list. Be careful in choosing your Target Pest because, as explained earlier, there are significant differences between the Kill Power Index and amounts of Zythor that must be applied to control different Target Pests. If you are fumigating for different pests, select as the Target Pest the pest that requires the highest Kill Power Index (see table). The Target Pest selected is displayed across the top of the Fumicalc at all times.



Two Reasons to Make Sure you Make the Correct Target Pest Choice

A mistake in choosing the correct Target Pest could result in the use of too much Zythor, resulting in an unnecessary expenditure. The use of too little Zythor could result in a failure to control the Target Pest and the need to do the fumigation again. For instance 10 times more Zythor is needed to control all stages of Deathwatch Beetles than to control Drywood Termites under the same gas loss, volume and temperature conditions.

The Fumicalc allows for the input of many different variables and values. All of these except one can be changed at any time during a fumigation at which time Fumicalc automatically re-computes all outputs. **The one variable that cannot be changed after input without having to discard all entries in order to re-compute is Target Pest.** You must be careful to always correctly choose your Target Pest before beginning computations with the Fumicalc. The ability of Fumicalc to re-compute Doses is of no use if the Dose has already been applied.

Recovering from Incorrect Input of Target Pest

It is possible to recover from choosing the wrong Target Pest by writing down all the Concentration Readings and Dose added values you have inputted into the Fumicalc, closing and restarting the Fumicalc and reentering these same Concentration Reading and Dose added values for the correct Target Pest.

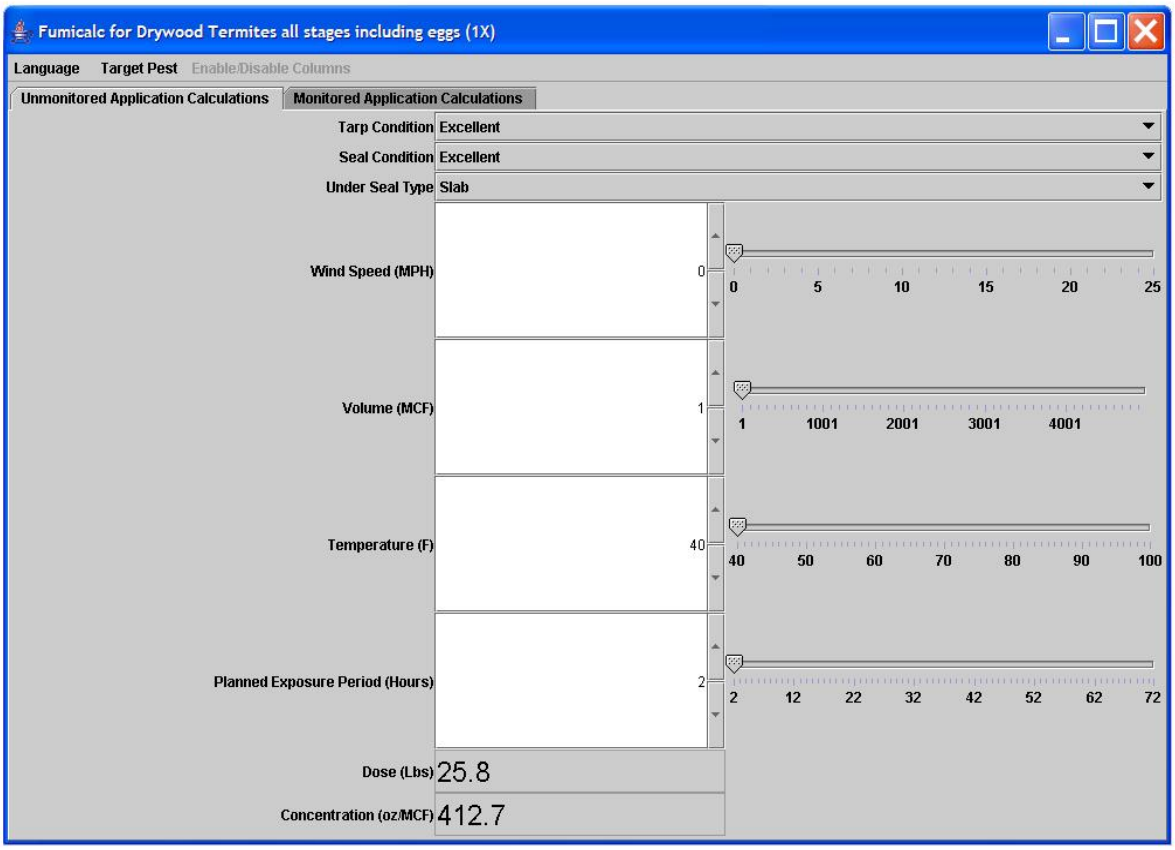
Importance of Computer Clock Accuracy

Once you have chosen your Target Pest, you are asked to confirm that your computer clock is set to the correct time.

The importance of this cannot be overstated if you are performing a Monitored Application (see next section). It is absolutely critical that your computer clock be set correctly before you make any inputs into the Fumicalc. Fumicalc keeps up with the progress of a Monitored Application based on the time you tell it certain events occurred. These are compared to the computer clock time. If the computer clock time is incorrect, the Fumicalc could issue recommendations that would not make any sense thereby jeopardizing the effectiveness of your application.

Monitored Application vs. Un-Monitored Application – Time to Choose

The next step in using the Fumicalc is choosing the type of Application you are making, Un-Monitored or Monitored. **Anytime the Fumicalc is first opened, it is set to an Un-Monitored Application. Change to a Monitored Application by clicking on the Monitored Application Calculations Tab.**



Importance of Choosing Correct Type Application

It is important to choose correctly when selecting your type of application – Monitored or Un-Monitored. The screens used to calculate the Initial Dose for both types of applications are identical except for the name at the top of the screen.

However the two values or amounts of the outputs at the bottom of the screen (Dose and Concentration) are different for the two types of applications, even if the exact same values are entered for each variable.

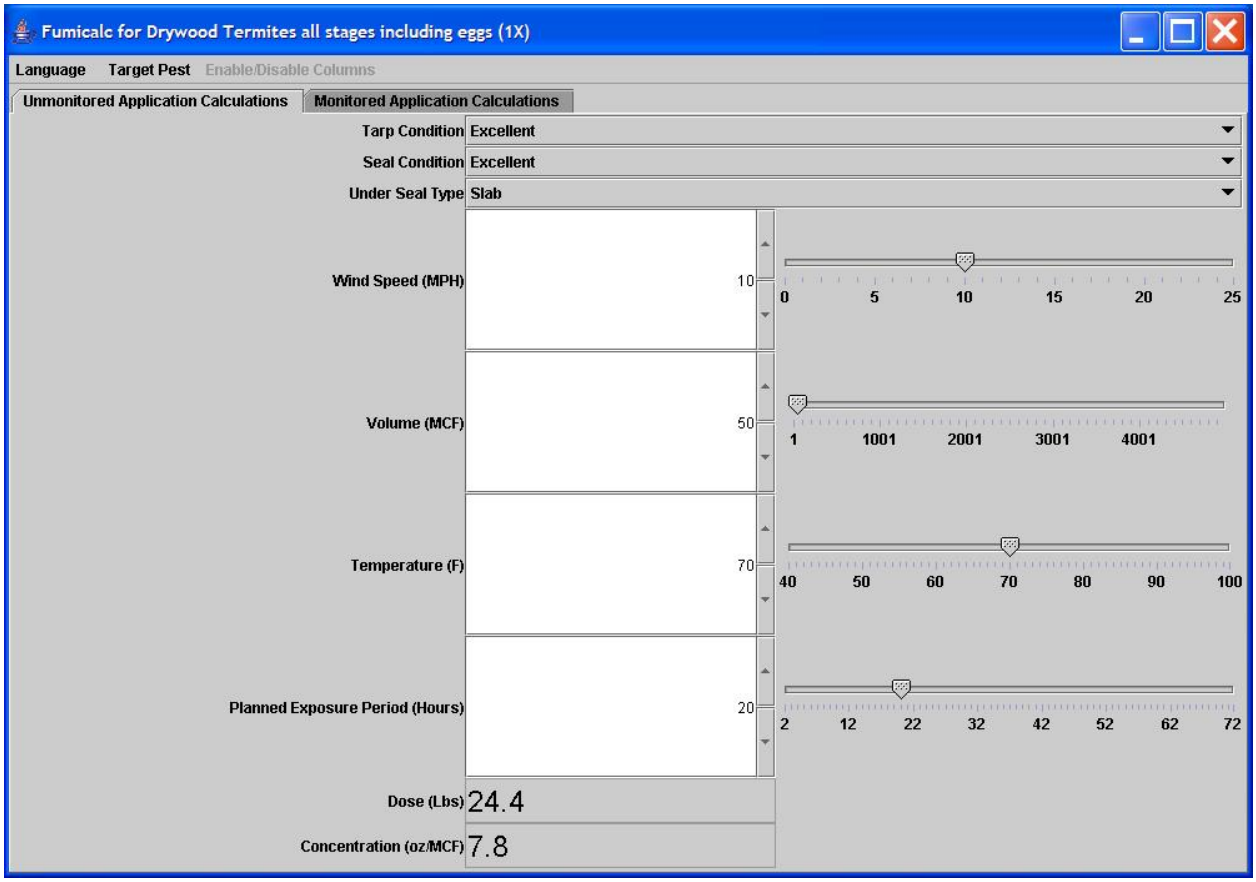
You must be careful in selecting the tab for the type of application you are performing to make sure the values you compute are applicable to your type of fumigation – Monitored or Un-Monitored.

Un-Monitored Application

The use of the Fumicalc when performing an Un-Monitored Application is limited to calculating an Initial Dose. The only exceptions to this occur when there is a break in the seal during the Exposure Period and the amount of an extra additional Dose to compensate for the amount lost has to be calculated.

Fumicalc Un-Monitored Application Dose Calculation Inputs

When you select the *Un-Monitored Application Calculations* tab, you are taken to the Dose Calculation page. On this page, inputs are made from which the Dose is calculated and outputs are given.



The first three inputs – Tarpaulin Condition, Seal Condition and Underseal Type - are selected from Pulldown boxes.

Tarpaulin Condition is a subjective value. The choices are Excellent, Good, Medium, Fair and Poor.

Seal condition is also a subjective value. The choices are also Excellent, Good, Medium, Fair and Poor.

Underseal Type choices are Slab, Clay, Loam, Sandy Loam and Sand. These values are self-explanatory.

The last four inputs – Wind Speed, Volume, Temperature and Planned Exposure Period – can be entered either directly or they can be selected with a slider bar.

Wind is entered in miles per hour.

Volume is entered in thousand cubic feet.

Temperature is entered in degrees Fahrenheit.

Planned Exposure Period is entered in hours.

Understanding the Fumicalc Un-Monitored Dose Calculation Outputs

After all eight variables are inputted on the first screen, you are given four outputs.

Dose - Expressed in pounds of Zythor. For an Un-Monitored Application, this is the only output that requires any action on the part of the applicator. That action is to apply and confine this Dose of Zythor to the fumigated space for the length of the Planned Exposure Period.

You can easily explore the effect of shorter or longer Planned Exposure Periods on the amount of the Dose by sliding the Planned Exposure Period bar back and forth to either lengthen or shorten the Planned Exposure Period. As you move the slider bar for Planned Exposure Period back and forth, note the increases and decreases in the amount of Zythor necessary to achieve the Target Kill Power Index.

Concentration - Expressed in ounces of Zythor per thousand cubic feet. This is the amount of Zythor that ideally you would expect to find within the fumigated space if at the moment the Dose was applied it reached equilibrium and was measured by a Concentration Reading device such as a Fumiscope. This output is for informational purposes only.

Estimated Gas Loss Index and Target Kill Power Index - If the cursor is held over either of the first two outputs, the third and fourth outputs, Estimated Gas Loss Index and Target Kill Power Index, will be displayed as a pop-up. (This is not shown in the illustration above). No action is required of the applicator based on these two outputs. They are displayed for informational purposes only. These values never change during the course of an Un-Monitored Application unless one of the previously entered factors is changed.

Proceeding on an Un-Monitored Application

If you are performing an Un-Monitored application and you have settled on the length of your Planned Exposure Period, the Dose of Zythor is the only Fumicalc output that requires any further action on your part. That action is to apply that amount of Zythor to the fumigated space provided your pre-application preparations are in conformance with the Zythor label.

The only exception to a single Dose of Zythor on an Un-monitored Application is if the seal is broken and it is necessary to apply additional amounts of Zythor to reach the Target Kill Power Index within the Planned Exposure Period.

Correcting Variable Input Mistakes For an Un-Monitored Application

Any variable you have entered, except Target Pest, can be changed at any time for an Un-Monitored Application. If you change any value (except Target Pest), the change will be taken into account by the Fumicalc and the new corrected Dose will be shown after you make the change.

If you have already applied a previously calculated Dose and the new corrected Dose is greater than the amount you have already applied to the fumigated space, apply to the fumigated space the amount of Zythor by which the new Dose exceeds the amount you have already applied. Calculate this amount by subtracting the Dose you applied from the new corrected Dose. Because there is no way to know how much of the Target Kill Power Index has been already achieved for the time already elapsed, it is advisable to start the Planned Exposure Period over in order to make sure you achieve the Target Kill Power Index.

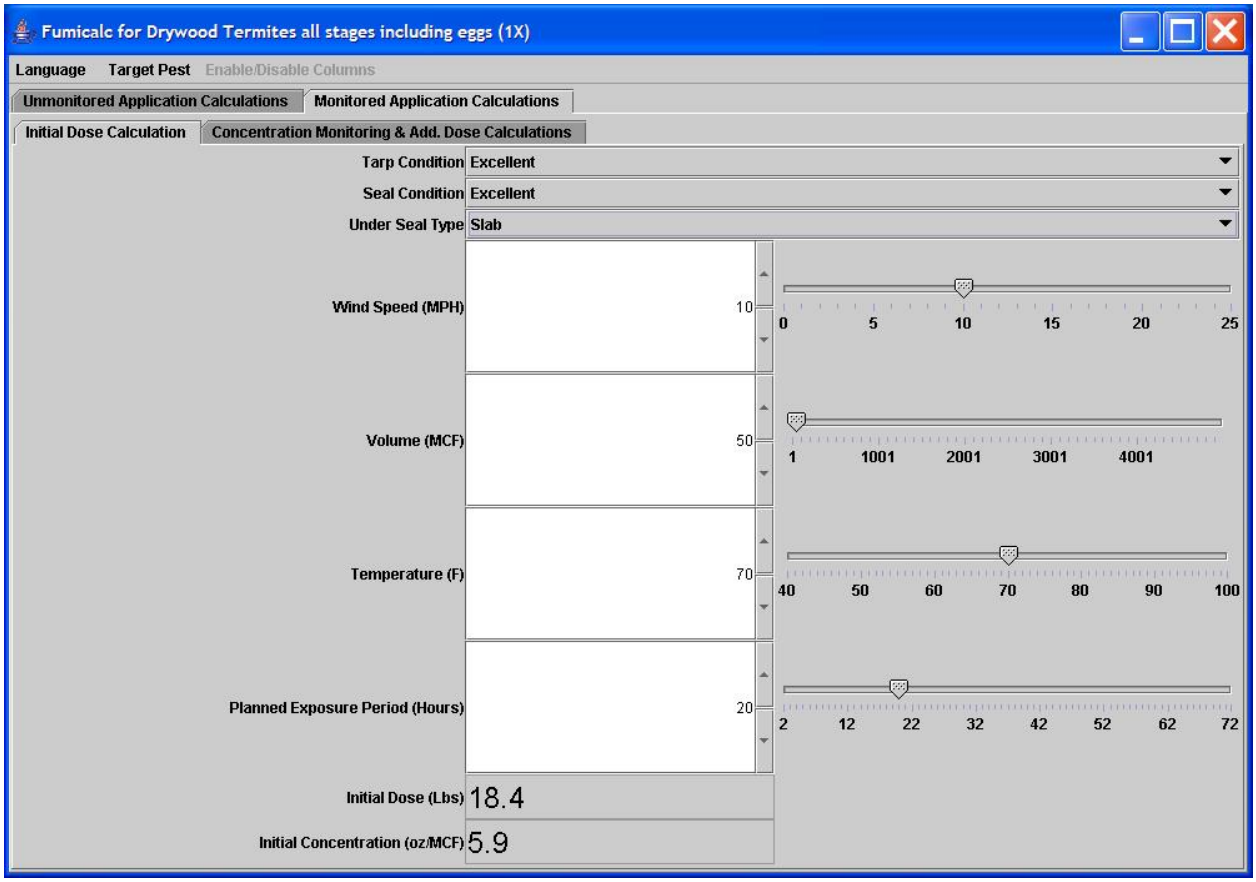
If after correcting a variable, the calculated Dose is less than the amount you actually applied, there is no need for further action. If desired, you may be able to take advantage of the excess Dose applied by shortening the Planned Exposure Period. To do this slide the Planned Exposure Period slider left to a lower value until the Dose value equals the amount you actually applied. This is the new Exposure Period that would be sufficient to apply the Target Kill Power Index.

Monitored Application

The use of the Fumicalc when performing a Monitored Application involves multiple steps. The first step is to calculate the Initial Dose. The second step involves periodic readings of the actual Concentration levels and their input into the Fumicalc to determine if there is a need for additional Doses during the course of the Exposure Period.

Fumicalc Monitored Application Initial Dose Calculation Inputs

When you click on the *Monitored Application Calculations* tab you will see two tabs underneath this tab. One is labeled *Initial Dosage Calculation*. The other is labeled *Concentration Monitoring and Additional Dose Calculations*. Click on the *Initial Dosage Calculation* tab to make absolutely sure you are on the correct screen to begin your monitored application Initial Dose calculations.



On this page, inputs are made from which the Initial Dose is calculated. The inputs are made according to the previous explanation of each of them and their importance.

The first three inputs – Tarpaulin Condition, Seal Condition and Underseal Type - are selected from Pulldown boxes.

Tarpaulin Condition is a subjective value. The choices are Excellent, Good, Medium, Fair and Poor.

Seal condition is also a subjective value. The choices are also Excellent, Good, Medium, Fair and Poor.

Underseal Type choices are Slab, Clay, Loam, Sandy Loam and Sand. These values are self-explanatory.

The last four inputs – Wind Speed, Volume, Temperature and Planned Exposure Period – can be entered either directly or they can be selected with their slider bar.

Wind is entered in miles per hour.

Volume is entered in thousand cubic feet.

Temperature is entered in degrees Fahrenheit.

Planned Exposure Period is entered in hours.

Understanding the Fumicalc Monitored Application Initial Dose Calculation Outputs

After all eight variables are input on the first screen, you are given four outputs.

Dose - Expressed in pounds of Zythor. For a Monitored Application, this is the only output on this screen that requires any action on the part of the applicator. That action is to apply and confine this amount of Zythor to the fumigated space.

You can easily explore the effect of shorter or longer Planned Exposure Periods on the amount of the Initial Dose by sliding the Planned Exposure Period bar back and forth to either lengthen or shorten the Planned Exposure Period. As you move the slider bar for Planned Exposure Period back and forth, note the increases and decreases in the amount of Zythor necessary to achieve the Target Kill Power Index.

Concentration - Expressed in ounces of Zythor per thousand cubic feet. This is the amount of Zythor that ideally you would expect to find within the fumigated space if at the moment the Dose was applied it reached equilibrium and was measured by a Concentration Reading device such as a Fumiscope. This output is for informational purposes only.

Estimated Gas Loss Index and Target Kill Power Index - If the cursor is held over either of the first two outputs, the third and fourth outputs, Estimated Gas Loss Index and Target Kill Power Index, will be displayed as a pop-up. (These are not shown in the illustration above). No action is required of the applicator based on these outputs. They are displayed for informational purposes only. These values never change during the course of a fumigation unless one of the variables is changed.

Calculating the Initial Dose is only the first step of using the Fumicalc on a Monitored Application.

Correcting Variable Input Mistakes For a Monitored Application

When you make a Monitored Application, you can change any of the inputs on the *Initial Dose Calculation* page up until the moment you enter the time and amount of the Initial Dose into the Fumicalc on the *Concentration Monitoring and Additional Dose Calculations* page (as explained below). After the applied Initial Dose value is inputted into the Fumicalc, you can no longer change Tarpaulin Condition, Seal Condition, Underseal Type and Wind Speed. This is because these variables are only used to calculate the Initial Dose (which has already been applied as signified by its entry into Fumicalc). You are still allowed to change the three remaining variables. Changes to these three variables - Volume, Temperature and Planned Exposure Period - can be made on the *Concentration Monitoring and Additional Dose Calculations* page.

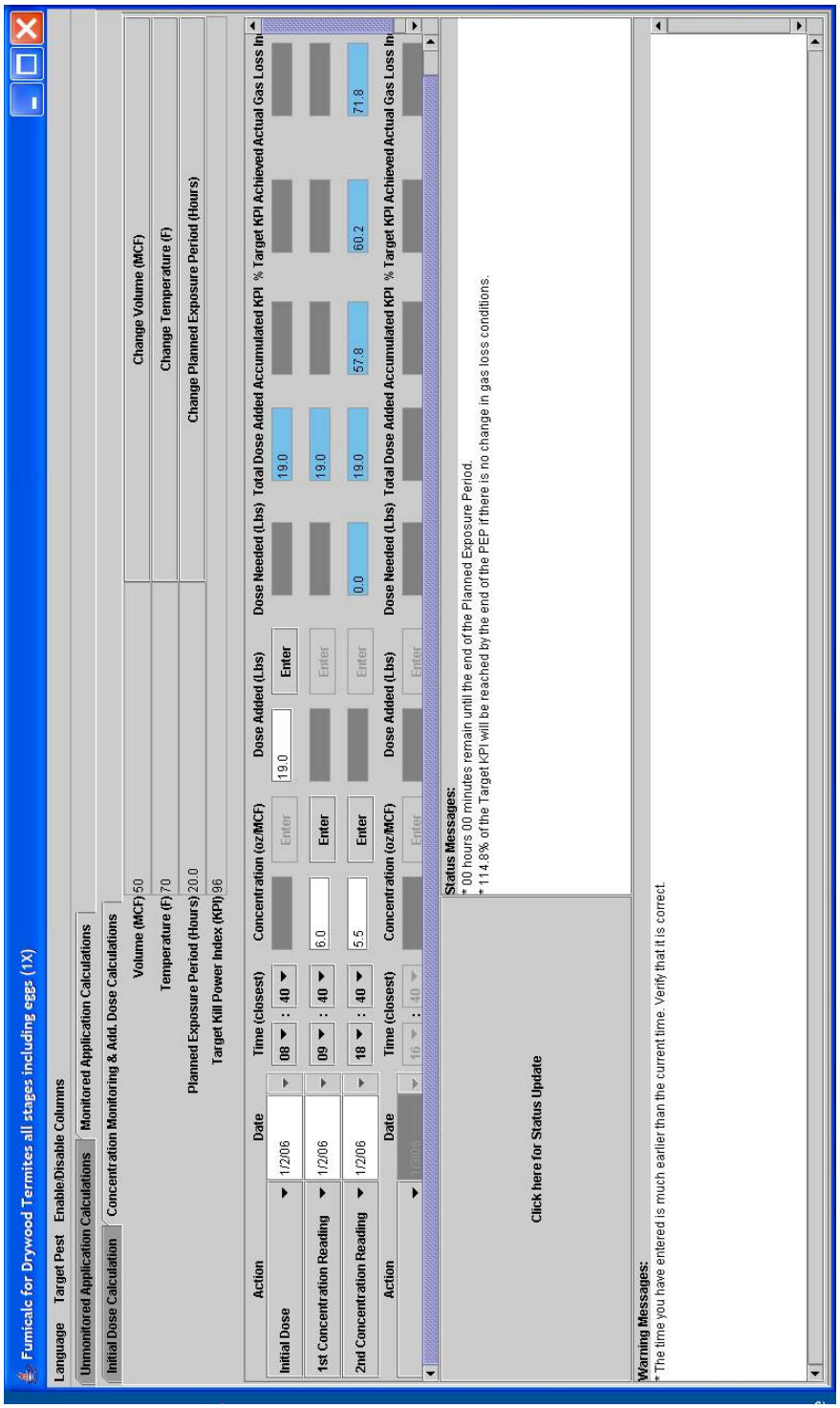
Proceeding on a Monitored Application

As explained in the discussion of Monitored vs. Un-Monitored, a Monitored Application is a much more precise form of Zythor application than an Un-Monitored Application. However to enjoy the benefits of this precision, several extra steps and actions are still necessary after the Initial Dose has been applied.

As explained earlier, a Monitored Application involves periodic Concentration Readings of the amount of Zythor in the air within the fumigated space. The Fumicalc is designed to accept these Concentration Readings and the time they are taken as inputs. Based on these inputs, the Fumicalc computes amounts of additional Zythor, if any, that need to be applied to make sure the Target Kill Power Index is achieved within the Planned Exposure Period. These Concentration Readings are also the basis upon which the Fumicalc confirms the application of the Kill Power Index.

Concentration Monitoring and Additional Dose Calculations Page

After selecting a Planned Exposure Period and calculating the Initial Dose on the first page of the Fumicalc as previously explained, click on the *Concentration Monitoring & Add. Dose Calculations* tab to advance to the next page shown below.



This screen is divided into four sections – Initial Input Correction, Action, Status Messages and Warning Messages.

Initial Input Correction Section – This section allows you to correct Volume, Temperature and Planned Exposure Period in the event these were entered incorrectly on the *Initial Dose Calculation* page. As explained earlier, until the Initial Dose is entered on this page (explained later), it is possible to return to the *Initial Dose Calculation* page to change any variable. Once the Dose is entered on this page, you are restricted to being able to change only three of the seven factors you input. All changes to these three inputs must be made in this section on this page. (You cannot change the other four variables you input on the *Initial Dose Calculation* page because they are only used to calculate the Initial Dose which has already been applied.)

Action Section – Three types of information are inputted and outputted in this section – Action Inputs, Action Outputs and Informational Outputs. The action inputs are Doses actually added and the time they were added and Concentration Readings taken and the time they were taken. When action inputs are made and the enter key is pressed, Action Outputs and Informational Outputs are displayed on the same line on which the Action Inputs were entered. Action outputs are Additional Doses needed. Informational outputs are related to Kill Power Index and Gas Loss Index.

Status Section – In this section helpful status messages are displayed. Types of messages include reminders of the length of time until the end of the Planned Exposure Period.

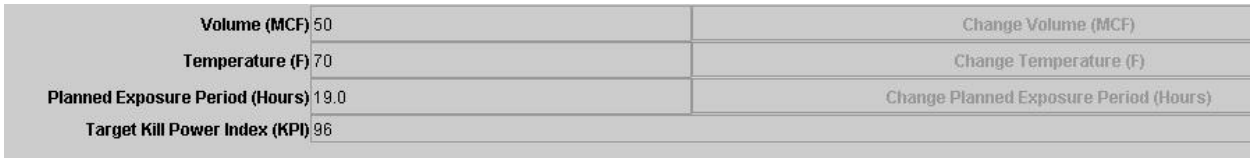
Warning Section – In this section, warnings concerning the course of the application are displayed. It is important to read these warnings carefully and act on or abide by them in order to accumulate the Target Kill Power Index within the Planned Exposure Period.

Initial Input Correction Section

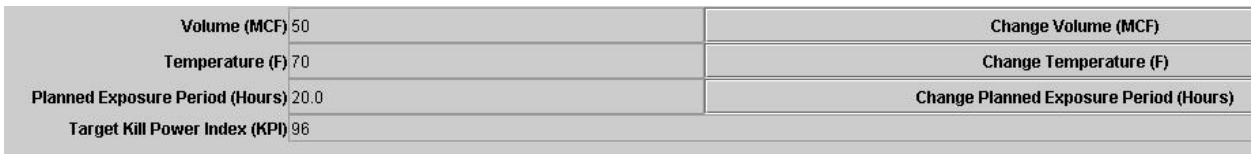
Changing the Three Kill Power Index Related Factors After The Initial Dose Is Applied

At the top of the *Concentration Monitoring & Add. Dose Calculations* page, one below the other, are repeats of the Volume, Temperature and Planned Exposure Period values entered on the Initial Dose Calculation page. To the right of each of these is a change bar. These change bars are usable only after you have entered the Initial Dose on this page. These bars are grayed out until that entry is made on this page after which they turn black and become usable.

Change bars grayed out because an initial dose has not been entered



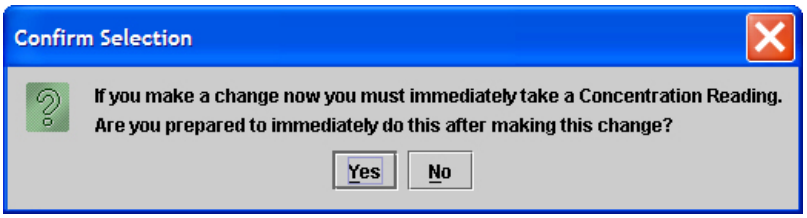
Change bars no longer grayed out because an initial dose has been entered



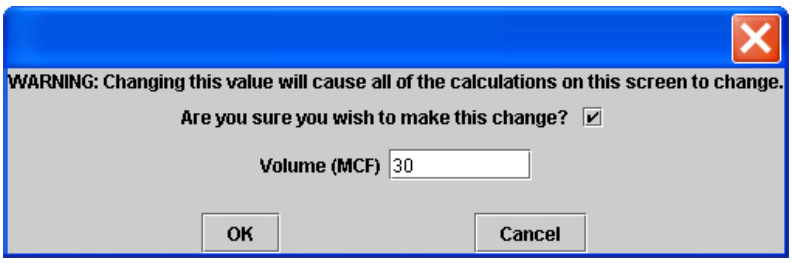
As explained earlier, changes can be made to any of the seven input values on the first page up until the moment the Initial Dose is entered. After the Initial Dose is entered, all the variables on the first page are grayed out. After that time, changes to four of the variables (Tarpaulin Condition, Seal Condition, Underseal Type and Wind) can no longer be made. These variables are only used to compute the Initial Dose. Since the Initial Dose has already been applied (as signified by its entry on this page as explained below), changes to this Dose and the variables used to calculate it are no longer possible or needed.

Changes to the remaining three variables can be made at any time during the fumigation by pressing the Change Bar beside the variable to be corrected. You are allowed to change any of these three variables at any time up until the end of the Planned Exposure Period. Changes to these variables are permitted because changes to these variables can alter the Kill Power Index (Temperature) or Dose of Zythor needed (Volume and Planned Exposure Period) to achieve the Kill Power Index. If you were not allowed to correct mistaken entries of these three variables, it could result in a failure to achieve the true Target Kill Power Index.

If and when any of these three variables are changed, changes to the Kill Power Index and any additional dose of Zythor, if needed, are re-calculated automatically. When you choose to make a change to one of these three variables after the Initial Dose has been inputted, you will received the following warning:



If you select yes, you are then presented with the follow-up warning shown below:



You must check the box and enter the new value to proceed. If you do not check the box, the change is not allowed.

The Fumicalc needs an immediate Concentration reading to compute the amount of an Additional Dose of Zythor (if any) needed based on this new information, in order to reach the corrected Target Kill Power Index before the expiration of the Planned Exposure Period. **(Exception - If you are making a change to one of the three variables before the first two Concentration Readings are entered, you will not receive this warning to take a Concentration Reading immediately. Instead, you should simply take these readings at their normal times when prompted. The Additional Dose needed, if any, will be computed after the 2nd Concentration Reading.)**

Target Kill Power Index

The next line displays the Target Kill Power Index. This Kill Power Index has been computed based on the temperature and Target Pest you have inputted. If these entries have been entered correctly, this value will never change during the course of the fumigation (but will change if you make corrected entries as explained above).

Remember, the sole purpose of the fumigation is to apply this Kill Power Index to the fumigated space. The entry of Dose and Concentration readings in the next section will help make sure you accomplish this as efficiently as possible.

Action Section

A different action is entered on each line of the Action Section, one after the next. There are five types of actions from which to choose. The Action Section dynamically adjusts what inputs it needs and what outputs it makes on each line based on the type of action you select for that line. Once an action is selected, the configuration of that line is adjusted to match the chosen action. Input blocks where entries are permitted are white. Input blocks where entries are not permitted are grayed out.

Choosing the Action Type

There are five different actions to choose from:

Initial Dose

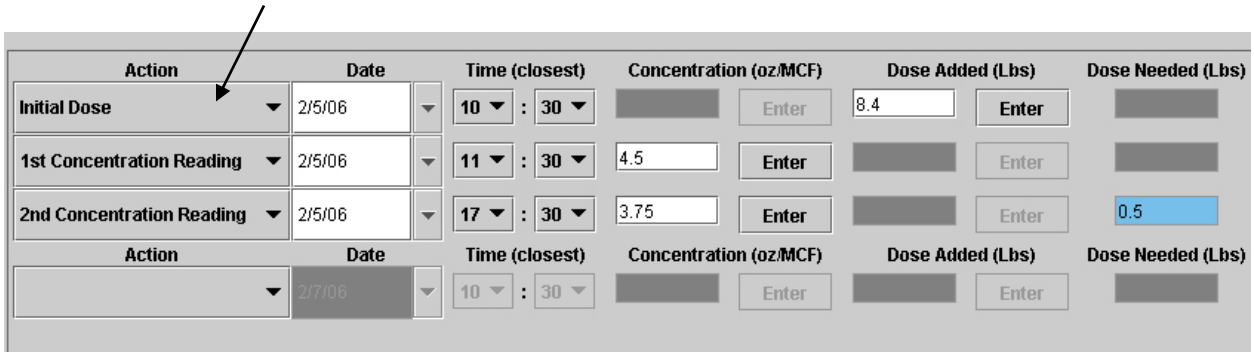
1st Concentration Reading

2nd Concentration Reading

Additional Dose

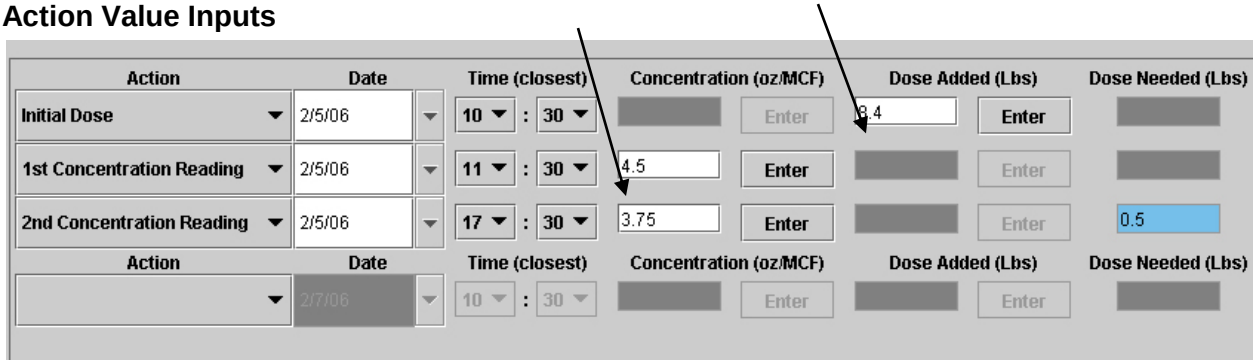
Additional Concentration Reading.

The first three must be chosen in sequence as the first three actions for any application as shown below.



After these three actions are entered in sequence, you may choose either Additional Dose or Additional Concentration Reading as your next action entry as needed. As noted above, the Fumicalc determines which types of inputs and outputs must occur on each line based on the type of action you have chosen to enter on that line.

Action Value Inputs

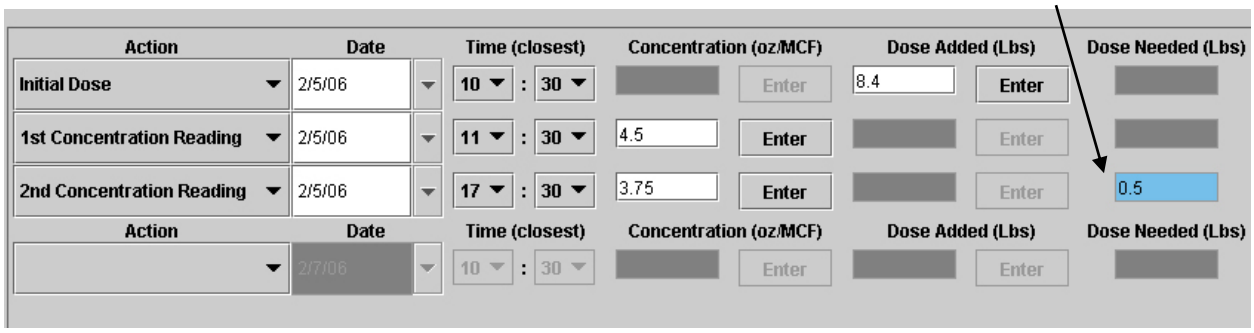


Date and Time – Input the date and time of the current action. The default provided is the current time and date. This can be changed by clicking on the date or pulling down the pulldown box. Time is entered in five minute increments.

Concentration (oz/MCF) – This input is available only if you have chosen to enter a reading (see arrow).

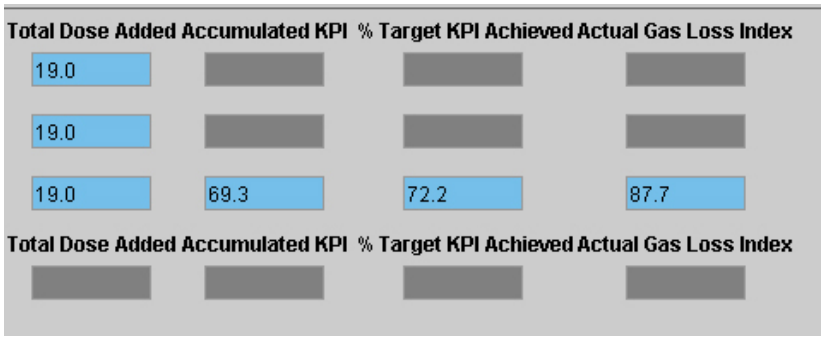
Dose Added (Lbs.) – This input is available only if you have chosen to enter a Dose (see arrow).

Action Required Outputs



Dose Needed (Lbs.) – The only output in the Action Section upon which you must take action is recommendations to add additional Zythor to the fumigated space (see arrow).

Information Only Outputs



Total Dose Added (Lbs.) – The total amount of Zythor you have actually entered into the fumigated space. The last value in this column is the most up to date value and is the sum of all the Dose values you have entered into the Fumicalc. This column is updated only when a Dose of Zythor is added to the fumigated space and the addition of that Dose is entered into the Fumicalc.

Accumulated KPI (Kill Power Index) – This amount is updated whenever a new Concentration Reading is entered into the Fumicalc. The last value in this column reports the actual total Kill Power Index you have achieved as of the last Concentration Reading. This value is updated only when a Concentration Reading is entered. The last value in this column is cumulative for the entire elapsed Exposure Period and is the most up to date value.

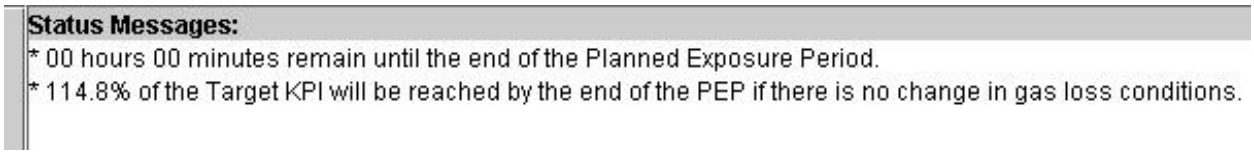
% Target KPI Achieved – This column reports progress in the achievement of the Target Kill Power Index as a percent of the Target Kill Power Index. This percentage is updated whenever a new Concentration Reading is entered into the Fumicalc. The last value in this column is cumulative and is the most up to date value.

Actual Gas Loss Index – This column reports the Gas Loss Index as calculated based on the last two Concentration Readings. This amount is not cumulative for the Planned Exposure Period but is instead the Gas Loss Index only between the last two Concentration Readings.

Enable/Disable Columns

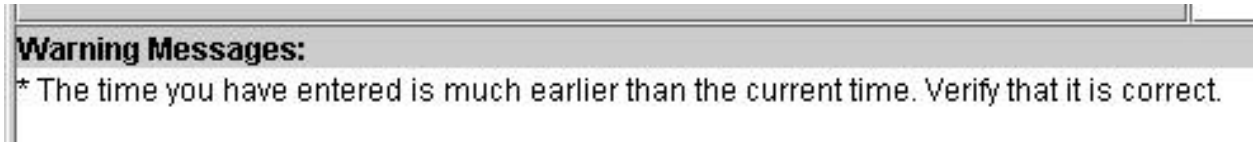
This option, at the top of the box allows you to disable and re-enable certain columns in the Action Section. Click on the name of the column to enable or disable it.

Status Section



Directly below the Action Section is the Status Section. Within this box are displayed messages that keep you up to date on the progress of your application. Clicking on the button to the left of the box will update the amount of time remaining until the end of the Planned Exposure Period. Advice concerning additional Doses is also displayed here.

Warning Section



Within this box, at the bottom of the page, warnings and other messages are displayed that may require action on your part. You may be prompted by a warning in this box to reconsider an action you took (such as entering an Additional Dose when the Fumicalc was anticipating a Concentration Reading) or an advisory as to when to next take a particular action (such as taking another Concentration Reading at a certain time).

Entering Doses and Concentration Readings

All Dose and Concentration Reading entries are made in the Action Section as previously explained. These are the only two types of entries made in the Action Section (and these are also the only inputs needed by Fumicalc to compute progress towards achieving the Target Kill Power Index).

All Doses Added are entered in pounds of Zythor. All Concentration Readings are entered in ounces of Zythor per thousand cubic feet of the fumigated space. Take all Concentration Readings with a properly functioning and calibrated Concentration measuring device such as a Fumiscope. As part of the Dose or Concentration Reading entry process, you must enter the time each of these were applied or taken.

Initial Dose Entry

The first entry you make on this page is the amount of the Initial Dose and the time at which you finished applying it. Do this by clicking on the first box in the Action column and selecting Initial Dose. Be sure to enter the correct date and time you finished entering the Initial Dose. The default inserted is the current date and time. Make changes to these values by clicking on the date and time shown.

After you enter the Initial Dose you are notified to take your 1st Concentration Reading one hour later as follows:

Take your 1st Concentration Reading at HH:MM.

The 1st Concentration Reading is normally taken one hour after the completion of the Initial Dose application. Waiting this amount of time allows the Zythor to reach equilibrium within the fumigated space. This helps make sure the 1st Concentration Reading is reasonably correct.

1st Concentration Reading

Click on the box at the beginning of the second line under Action to enter the 1st Concentration Reading. Be sure to enter the correct date and time the 1st Concentration Reading was taken. The default is the current time. If you enter a time and date significantly earlier than the current time, you will be cautioned to make sure your date and time is correct. If the time you have entered is considerably earlier than the current time you will receive this warning:

The time you have entered is much earlier than the current time. Verify that it is correct.

You cannot enter times in the future.

When the 1st Concentration Reading is inputted, the Fumicalc is able to make a preliminary determination as to whether the level of Zythor in the air is *not* adequate to reach the Target Kill Power Index within the Planned Exposure Period. Preliminary determination simply means before the 2nd Concentration Reading is taken. The Fumicalc classifies a 1st Concentration Reading as inadequate and gives a warning message if, even under perfect conditions of no gas loss during the entire Planned Exposure Period, it would still not be possible to accumulate the required Target Kill Power Index within the Planned Exposure Period with the amount of Zythor the 1st Concentration Reading indicates is present. The Fumicalc however *cannot*, based on the 1st Concentration Reading alone, make a judgment as to whether the level of gas is sufficient to deliver the Target KPI within the Planned Exposure Period. This is because a 2nd Concentration Reading is needed to determine a Gas Loss Index.

If the 1st Dosage Reading is found to not be inadequate as explained above, you will receive the following message to take your 2nd Concentration Reading one hour after the time of the 1st Concentration Reading.

Take your 2nd Concentration Reading at HH:MM

If based on the 1st Concentration Reading the Fumicalc determines the level of Zythor within the fumigated space to be inadequate under even perfect conditions to achieve the Target Kill Power Index, you will receive the following notice to take your 2nd Concentration Reading thirty minutes from the time of the 1st Dosage Reading instead of the normal one hour.

Based on this Concentration Reading, it appears that the level of gas now present in the envelope is inadequate to complete the job within the Planned Exposure Period.

If you deliberately under-dosed in order to take the first two Dosage Readings to more accurately determine the total amount of gas actually needed, take and enter another Dosage Reading in 30 minutes so that an amount of additional gas to be added can be calculated.

If you have not deliberately under-dosed, verify that you have entered Volume, Temperature and Planned Exposure Period correctly. Also check the quality of your seal to make sure there are no leaks. Take and enter another Concentration Reading in 30 minutes so that an amount of additional gas to be added can be calculated.

2nd Concentration Reading

After the 2nd Concentration Reading is inputted, the Fumicalc calculates its first measured Gas Loss Index (as opposed to the estimated Gas Loss Index it calculated based on the variables input on the first screen as part of the Initial Dose calculation process). Based on the differences in two Concentrations and the time remaining in the Planned Exposure Period, the Fumicalc calculates the Additional Dose that must be added, if any, in order to achieve the Target Kill Power Index within the Planned Exposure Period. If the amount of Zythor present in the structure is sufficient, the word None will appear in the Dose Needed column. If extra Zythor is needed, the amount of extra Zythor needed will appear in the Dose Needed column. The following message will also appear if an Additional Dose is needed:

If the Dose Needed/Additional Dose of XX.X pounds is added and there is no change in gas loss conditions, 100% of the Target KPI should be achieved by the end of the Planned Exposure Period.

If the Dose Needed /Additional Dose is not added and there is no change in gas loss conditions, only XX.X% of the Target KPI will be achieved by the end of the Planned Exposure Period.

Dose Needed / Additional Doses

If the addition of an Additional Dose has been recommended, select Additional Dose on the next line in the Action column. Enter the amount of Zythor actually added to the fumigated space and the time you finished injecting the Dose. All Dose Needed/Additional Doses are entered in this same fashion.

Additional Concentration Readings

The Fumicalc is designed to help you achieve the Target Kill Power Index within the Planned Exposure Period in a precise manner without wasting Zythor. However to do this with a high level of precision, the Fumicalc must be supplied with fresh information (Concentration readings and additional Doses added) on a regular basis. As discussed earlier, take the 1st Concentration Reading one hour after the Initial Dose is applied and take the 2nd Concentration Reading one hour after the 1st Concentration Reading (after thirty minutes if the 1st Concentration is judged to be very low). The greater the number of Concentration readings entered after that on a regular basis, the greater the likelihood the Target KPI will be precisely applied within the Planned Exposure Period with the least amount of Zythor used.

Remember, the Kill Power Index is a function of both concentration and time. The earlier the need to add Zythor is realized (and it is actually added), the less Zythor must be added to reach the Target KPI. The later additional Zythor is added, the more that must be added to compensate for the lack of time left before the Planned Exposure Period expires.

Fumigation Progress Reporting

Total Dose Added

The Total Dose Added, provided so that the total amount of Zythor used can be reported as necessary for regulatory purposes, is reported in the Total Dose Added column in the Action Section. The amount in this column is updated whenever a Dose is added.

Kill Power Index

Whenever a Concentration Reading is taken, the Fumicalc updates the progress of the fumigation towards achieving the Target Kill Power Index in the form of updates to two columns in the Action Section - % KPI Achieved (Percent Kill Power Index Achieved) and Accumulated KPI (Accumulated Kill Power Index). % KPI reports progress towards accumulation of 100% of the indicated Target Kill Power Index as a percentage. Accumulated KPI reports the absolute Kill Power Index that has actually been attained as of the last Concentration Reading that was entered.

Gas Loss Index

The Actual Gas Loss Index, also reported in the Action Section, is updated whenever a second or later Concentration Reading is taken. The Gas Loss Index values are calculated based on a comparison of the last two Concentration Readings. They are not cumulative for the elapsed Planned Exposure Period. When using the Fumicalc, an understanding of how to compute the Gas Loss Index (also referred to as Half Loss Time) is not required. However these values are given in order to keep the user informed of the rate of gas loss from the fumigated space. Inordinately low Gas Loss Index values might be an indication that excessive amounts of gas are being lost from the fumigated space. **(Remember, low Gas Loss Index values mean a high rate of fumigant loss.)**

Planned Exposure Period Expiration and Target Kill Power Index Achievement

A terminal Concentration reading should always be taken and entered into the Fumicalc prior to breaching the envelope at the end of the Planned Exposure Period. Enter this terminal Concentration Reading in the Action Section and confirm that the Target KPI has been achieved. The Target KPI has been achieved when the word DONE appears in the % KPI Attained column and the following message is displayed in the Status Box:

100% of Target KPI Achieved. DONE.

Planned Exposure Period Expiration – Target Kill Power Index Not Achieved

It is quite possible to reach the end of the Planned Exposure Period without having achieved 100% of the Target Kill Power Index. If you are taking Concentration readings at regular intervals and have applied Additional Doses of Zythor as recommended, this should happen only very infrequently. The most likely reason you will end up in this situation is if you have failed to follow the recommendations for adding Additional Doses or failed to take enough Concentration Readings to allow the Fumicalc to accurately quantify the amount of Zythor leaking out of the fumigated space.

If you come to the end of the Planned Exposure Period and you have not achieved your Target Kill Power Index, the Fumicalc will give you the following warning:

The Planned Exposure Period has expired. However the Target Kill Power Index has not been achieved. Increase the length of the Planned Exposure Period by clicking Change Planned Exposure Period and extending the length of the Planned Exposure Period.

Remember, Kill Power Index is a function of the Concentration of Zythor within the fumigated space and the length of the Exposure Period. Lengthening the Planned Exposure Period is the easiest way to still achieve the Target Kill Power Index. Do this by clicking on the Change Planned Exposure Period tab. When you click on this tab you will be asked to affirm you want to make this change by checking the box provided. Once you have done this, enter the new extended length of the Planned Exposure Period. After you have done this, the following warning will be given:

If you make a change now you must immediately take a Concentration Reading. Are you prepared to immediately do this after making this change?

You are required to take an Additional Dosage Reading as soon as you change the Planned Exposure Period. This reading is needed by the Fumicalc to compute whether or not an Additional Dose will be required to reach the Target Kill Power Index before the expiration of the new extended Planned Exposure Period you have chosen.

Correcting Mistakes and Handling Error Messages

Removing an Action

You can at any time remove an action by simply clicking the bar in the action column for that action and selecting the blank. This will remove any entries made for that action and any messages associated with that action. If you remove an action that is followed by other actions, it will remove that action and any actions after it. Be careful in removing any actions as you could lose valuable data if you do so.

Entering Another Concentration Reading When the Fumicalc Expects an Additional Dose to be Entered

If a Concentration reading is entered and a Dose needed is calculated, the Fumicalc expects that the next entry will be an additional Dose. If instead you chose to enter another Concentration reading you will receive the following warning:

YOU HAVE CHOSEN TO ENTER ANOTHER CONCENTRATION READING INSTEAD OF ADDING THE DOSE NEEDED COMPUTED AFTER THE LAST CONCENTRATION READING. IF YOUR ACTION CHOICE IS INCORRECT, RE-SELECT THE CORRECT ACTION FOR THIS LINE NOW.

If you choose to proceed with entering the Concentration reading and, based on the new Concentration Reading, an additional Dose is still needed, you will receive the following message:

THE NEW DOSE NEEDED REPLACES THE PREVIOUSLY RECOMMENDED DOSE NEEDED THAT YOU DID NOT ADD.

If you choose to proceed with entering the Concentration reading and, based on the new Concentration reading, there is no longer a need for an additional Dose, you will receive the following message:

AN ADDITIONAL DOSE IS NO LONGER RECOMMENDED BASED ON THIS NEW CONCENTRATION READING. NO DOSE NEEDS TO BE ADDED.

Entering a Concentration Reading Higher Than the Last Concentration Reading

The Fumicalc expects that a Concentration reading following an earlier Concentration reading will be lower than the earlier reading if no Zythor has been added between the readings. If a later reading is higher than an earlier one you will receive the following message:

According to your entries no gas has been entered during the time period between the last two readings. However the last reading entered is higher than the reading entered previous to it.

Verify that all readings have been entered correctly.

This higher reading may be correct if gas recirculation has occurred between readings that redistributed gas in the structure.

If you make any corrections to readings a recalculation will be made automatically.

You will also receive the following message to enter another reading in thirty minutes to confirm a concentration reading that is higher than the last one if this occurs:

Take another concentration reading in 30 minutes to confirm the higher concentration.

Time Later Than the Next Event

If you make an error entering the time of an event, you can correct the time of that event as long as the time makes sense relative to the event before and after it. You cannot enter a time for an event that is later than the time of the next event.

Event Time Entered Outside the Planned Exposure Period

Anytime you attempt to enter an action whose time is outside of the Planned Exposure Period, you will receive the following message:

The date and time you have selected is outside of the Planned Exposure Period you have designated. Please verify that the:

1) date and time you have entered is correct.

2) length of the Planned Exposure Period you have entered is correct.

3) the computer clock is set to the correct time.

(You are permitted to enter one last terminal Concentration Reading after the end of the Planned Exposure Period without this message appearing.)

Breach of Envelope during a Monitored Application

A breach of the envelope during the Planned Exposure Period is a simple situation to recover from with the Fumicalc. First, correct the breach condition as quickly as possible. After the breach is repaired, take an additional Reading. At that point an updated % KPI will be calculated and an amount of additional Zythor to add, if any will be calculated.

Any inaccuracy in the calculations will be limited to the fact that the additional Reading taken after the breach will be lower than it would have been if it had been taken before the breach. This means the calculated % Target KPI will most likely be lower than its actual value.

If you have sufficient personnel, a good strategy in the event of a breach is to have someone take an Additional Reading as soon as the breach occurs, preferably moments after it happens. Then take another Reading after it is repaired so that the Fumicalc can calculate how much gas needs to be added to reach the Target KPI before the end of the Planned Exposure Period.

If a breach occurs and a substantial amount of gas is lost, it may be advisable to extend the Planned Exposure Period to reduce the amount of Zythor that has to be added to compensate for the lost Zythor (Remember, KPI = Concentration X Planned Exposure Period).

Using the Fumicalc Palm Version

The Fumicalc Palm Version is designed for convenient handheld use in the field however it does have certain limitations.

Limitations of the Fumicalc Palm Version

The Palm Version of the Fumicalc can be used to do two things:

1) Perform calculations for Unmonitored Applications up to 500,000 cubic feet.
2) Perform calculations for estimates of amounts of gas needed for Monitored Applications up to 500,000 cubic feet.

The Palm Version of the Fumicalc has two limitations that do not apply to the Desktop / Laptop Version. First, it cannot perform calculations for an actual Monitored Application. Second, it cannot compute amounts of Zythor to be applied to fumigated spaces larger than 500,000 cubic feet. To perform calculations for these types of applications, you must use the Fumicalc Desktop / Laptop Version.

Setting Up Your Palm For Fumicalc

Instructions specific to certain Palm models are included at the end of this section.

Setting the Date and Time:

From the Main Screen, click on Prefs with the Stylus. Then click on Date and Time under General. Set the date and time by clicking on each box.

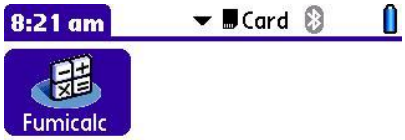
Inserting and removing the SD Card

Fumicalc runs directly from the SD card. It is not loaded into the memory of the Palm. The SD card must always be present in the Palm for Fumicalc to run. Insert the SD Card containing Fumicalc supplied to you into the SD Card slot on the top of your Palm. Make sure you have the notch in the SD Card properly oriented before inserting it (notch to the left).

Starting the Fumicalc:

The Palm can be started by either inserting the SD card into the SD Card slot or pressing the start button.

If the Fumicalc icon is not showing on the screen in the upper left hand corner, you must first move to the screen containing the Fumicalc icon. You can do this two ways. Tap the HOUSE icon on the lower left hand corner of the screen with the stylus until the Fumicalc icon appears. You can also remove the SD card and insert it again to turn the Palm off and back on at which time it will display this screen.



If you have previously entered your Operator and Activation Code, the following screen will appear.

If you have not entered your Operator and Activation Code, the following screen will appear instead.

Operator Number and Activation Code Entry

The first step in using the Fumicalc is to enter your pre-assigned Operator Code and Activation Code. The Operator Code is permanent however the Activation Code must be updated every three months. Activation Codes are available only to Zythor Operators. If you do not have a current Activation Code (Fumicalc refuses to allow you to proceed past this screen), call 1-866-FOR-THOR (367-8467) for a current code if you do not have one.

To enter either of the code numbers, tap the boxes on the screen with the stylus to select that box. Then tap on the 123 in the lower right hand corner beside the magnifying glass to launch the keypad. Enter the number from the keypad and then press Done.

After these two Codes are entered correctly, the Zire 31 is ready to run the Fuimcalc. Use of the Fumicalc should be self explanatory to anyone with experience computing fumigant doses.

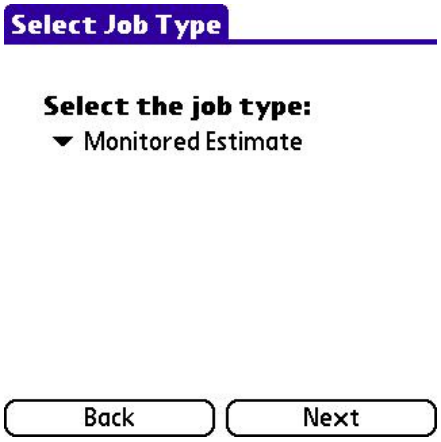
If either of the numbers you enter are incorrect, the following screen will appear. This screen will also appear whenever the Activation Code has expired.

Navigating the Palm Screens

Some Palm PDAs have a “five way” button at the bottom that allows easy navigation through the Fumicalc screens. However for some older Palm PDAs, the five way button cannot be used to navigate through the Fumicalc. In this event, use the stylus to make your selections. Fumicalc installed on Palm’s with the Palm 5.0 or greater operating system can be navigated with the five way button.

Selecting Job Type

The next step is to select the type of job you are interested in calculating, either an Unmonitored Application or an estimate for a Monitored Application. It is critical that the correct selection be made, as there are substantial differences in the Dose of Zythor the Fumicalc computes for each type of Application.



Un-Monitored Application Dose and Monitored Initial Dose Calculation

After the type of job is selected, the remaining inputs are identical for both types of applications. Remember, the use of the Fumicalc when performing a Monitored Application is limited to calculating an Initial Dose.

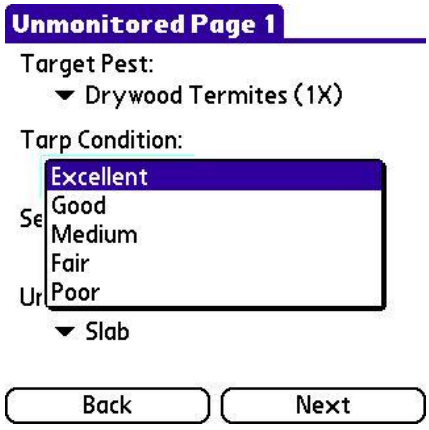
The screens below are for an Unmonitored Application. The variables inputted into the Fumicalc are identical for a Monitored Application Estimate. However, the headings shown at the top of the screen and values calculated by the Fumicalc are different when Monitored Application Estimate is chosen.

Un-Monitored Application Dose Calculation Inputs

The use of the Fumicalc Palm Version is very straightforward. A Dose is calculated after the eight necessary variables are inputted.

Un-Monitored Page 1

The first four inputs – Target Pest, Tarpaulin Condition, Seal Condition and Underseal Type - are selected from Pulldown boxes. An example of a pulldown box for tarpaulin condition is shown below.



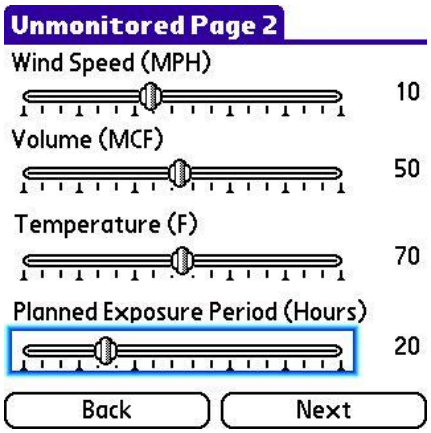
Target Pest is self-explanatory.

Tarpaulin Condition is a subjective value. The choices are Excellent, Good, Medium, Fair, Poor

Seal condition is also a subjective value. The choices are also Excellent, Good, Medium, Fair, Poor

Underseal Type choices are Slab, Clay, Loam, Sandy Loam and Sand. These values are self-explanatory.

Un-Monitored Page 2



The last four inputs – Wind Speed, Volume, Temperature and Planned Exposure Period – are entered with individual slider bars. The slider can be activated with a stylus. However, newer Palm devices have a five way navigator button that makes it very easy to make these inputs and to toggle between the different inputs.

Wind Speed is entered in miles per hour.

Volume is entered in thousand cubic feet.

Temperature is entered in degrees Fahrenheit.

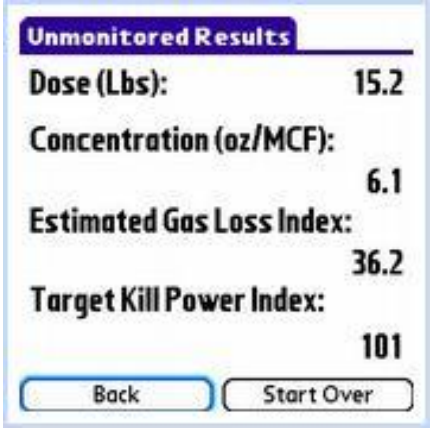
Planned Exposure Period is entered in hours.

After these entries are made proceed to the next page for your outputs by pressing *Next.*

> **An important note about using the five way navigator to enter Volume (MCF):** Even when it is usable (Palm with 5.0 or greater operating system), the five way navigator button can only increment Volume in units of five. Simply tap on the screen beside the Volume slider with the stylus to increment Volume in units of one.

Un-Monitored Results

After all eight variables are inputted on the first two screens, you are given four outputs on the last page.



Dose - Expressed in pounds of Zythor. For an Un-Monitored Application, this is the only output that requires any action on the part of the applicator. That action is to apply and confine this Dose of Zythor to the fumigated space for the length of the Planned Exposure Period.

You can easily explore the effect of shorter or longer Planned Exposure Periods on the amount of the Dose needed by clicking back to the last page and sliding the Planned Exposure Period bar back and forth to either lengthen or shorten the Planned Exposure Period.

Concentration - Expressed in ounces of Zythor per thousand cubic feet. This is the amount of Zythor that you would ideally expect to find within the fumigated space if at the moment the Dose was applied it reached equilibrium and was measured by a Concentration Reading device such as a Fumiscope. This output is for informational purposes only.

Estimated Gas Loss Index and Target Kill Power Index - No action is required of the applicator based on these two outputs. They are displayed for informational purposes only. These values never change during the course of an Un-Monitored Application unless one of the previously entered factors is changed and the Dose calculation process is repeated.

Proceeding on an Un-Monitored Application

If you have settled on the length of your Planned Exposure Period, the Dose of Zythor is the only Fumicalc output that requires any further action on your part. That action is to apply that amount of Zythor to the fumigated space provided your pre-application preparations are in conformance with the Zythor label.

The only exception to a single Dose of Zythor on an Un-monitored Application is if the seal is broken and it is necessary to apply additional amounts of Zythor to reach the Target Kill Power Index within the Planned Exposure Period.

Correcting Variable Input Mistakes For an Un-Monitored Application

Any variable you have entered can be changed at any time. If you change any value the Fumicalc will take the change into account and the new corrected Dose will be shown after you make the change.

If you have already applied a previously calculated Dose and the new corrected Dose is greater than the amount you have already applied to the fumigated space, apply to the fumigated space the amount of Zythor by which the new Dose exceeds the amount you have already applied. Calculate this amount by subtracting the Dose you applied from the new corrected Dose. Because there is no way to know how much of the Target Kill Power Index has been already achieved for the time already elapsed, it is advisable to start the Planned Exposure Period over in order to make sure you achieve the Target Kill Power Index.

If after correcting a variable, the calculated Dose is less than the amount you actually applied, there is no need for further action.

Setting Up and Running Fumicalc on a Palm Zire 31

Find in the box supplied the following items related to using Fumicalc:

Zire 31 Palm PDA

Hard Protective Case

AC Charger

Car Charger

SD Card containing the Fumicalc program (This card may already inserted into the top of the Zire 31 when you receive it.)

You may also find these extra items that are not needed to use the Fumicalc:

Protective Soft Flip Cover (replaced by the hard case)

USB cable

Palm software

Charging the Zire 31 battery

The Zire must be removed from the Hard Protective Case in order to be charged. Plug the Charger (AC or Car) into the small round socket on the left side of the Zire 31 behind the tiny rubber flip door. The battery icon beside the clock on the Zire 31 screen indicates the charge level of the battery.

Turning the Zire 31 on and off

Press the button with the vertical green stripe on the lower left hand corner to turn the Zire 31 on and off. Inserting the SD card will also turn the Zire 31 on (see next section).

The five way navigator button is not fully usable on the Zire 31.

Refer to the *Using the Fumicalc Palm Version* section of the Zythor Applicator's Manual for further instructions on using the Fumicalc.

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

WARRANTY DISCLAIMER

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It is impossible to eliminate all risks associated with use of this product. Lack of performance or other unintended consequences may result because of factors such as use of the product contrary to the label directions or contrary to the dosage and/or exposure period recommendations of the Fumicalc, adverse conditions (such as unfavorable temperatures, high humidity, unfavorable soil conditions, excessive rainfall, etc.), abnormal conditions (such as excessive winds, tornadoes, hurricanes), presence of other materials, the manner of application or other factors, all of which are beyond the control of ENSYSTEX II or the seller. All such risks shall be assumed by the Buyer and User.

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To the extent consistent with applicable law, the exclusive remedy for losses or damages resulting from the use of Zythor (including claims based on contract, negligence, strict liability or other legal theories), shall be limited to, at ENSYSTEX II's election, one of the following: Refund of purchase price paid by the buyer or user for product bought or replacement of amount of product used.

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