

# 2

Treatment Manual

## Chemical Treatments

### *Fumigants • Phosphine • Tarpaulin (NAP Chamber or Container)*

---

#### Contents

Properties and Use	page-2-10-1
Leak Detection—Gas Analysis	page-2-10-2
Dosage	page-2-10-2
Safety Precautions	page-2-10-3
Storage and Handling	page-2-10-3
Protective Clothing	page-2-10-4
Respiratory Protection	page-2-10-4
Use of SCBA (Self-Contained Breathing Apparatus)	page-2-10-4
Safety	page-2-10-5
Disposal of Residue	page-2-10-6
First Aid Treatment	page-2-10-6
Bulk Fumigations	page-2-10-6
Sealing	page-2-10-6
Probing	page-2-10-6
Aeration	page-2-10-7
Container Fumigation	page-2-10-8
Concentration Readings	page-2-10-9

---

#### Properties and Use

Phosphine (generally abbreviated as PH) may be generated from either aluminum phosphide (AP) or magnesium phosphide (MP).

Aluminum phosphide and magnesium phosphide are available under various trade names (see [page-5-4-28](#)) as tablets, pellets, prepacks, bags, or plates. For example, each pellet of Phostoxin weighs 0.6 grams and yields approximately 0.2 grams of PH and each tablet weighs 3 g and yields approximately 1 g of PH. Each 34 g bag or sachet of Detia yields 11.4 g of PH. Each plate of Fumi-Cel weighs 117 g, contains 32.3 percent MP and liberates 33 g of PH. A high humidity (40 percent or more) is needed to generate the gas, and temperatures above 40 °F are needed to produce satisfactory results.

In the presence of moisture, phosphine (hydrogen phosphide, PH<sub>3</sub>), a colorless gas, is emitted. PH boils at -87.8 °C (-126 °F), is slightly soluble in water, has excellent penetrative power, and has approximately the same density as air. The lower level of flammability is 1.79 percent in air.

Flashpoint is 212 °F. Direct contact with a liquid could cause spontaneous combustion. In case of fire, a CO<sub>2</sub> dry chemical fire extinguisher should be used. *Never use water.* PH has an odor somewhat like garlic, which enables the gas to serve as its own warning agent. However, under some conditions, the odor may be lost, even at high toxic concentrations. Ammonia and carbon dioxide are also produced, which act as fire retardants.

**Copper, brass, gold, and silver are severely damaged by PH.** Other metals react to some extent, especially in high humidity. Normally, only electrical or electronic equipment (especially the contact points) and some household effects would be affected.

PH is used to control insects found with both plant and animal commodities, especially stored products, throughout the world. The program use of PH for commodities other than cotton, tobacco, and wood products may be limited because of the long exposure periods required compared to other fumigants. For some insects, long exposure to low concentrations is more effective than short exposure to high concentrations. The germination of most seeds does not seem to be affected, even with schedules higher than normally recommended for insecticidal use. Phosphine should not be used for fumigating growing plants, cut flowers and greenery, fresh fruits, or vegetables due to poor tolerance of these commodities. Phosphine is effective against most wood, cotton, tobacco, and grain insects in all stages of development. Phosphine leaves little or no residue. Baking and brewing qualities of treated commodities are unaffected.

---

## Leak Detection—Gas Analysis

Phosphine levels can be detected using either detector tubes or any electronic instrument such as the “Porta-Sens” detector. (See Equipment Section for instructions on how to use the Porta-Sens.) This equipment is used for determining both the high (fumigation concentration) and low (personnel safety) levels of PH. Halide or any flame detectors *are not* to be used for PH. T/C units (e.g., Gow-Mac or fumiscope) cannot be used for this fumigant.

PH is poisonous to man and animals. The threshold limit value for an 8-hour per day exposure is 0.3 ppm. The maximum concentration for a single exposure for animals should not exceed 50 ppm.

---

## Dosage

The dosage rate is usually measured in grams (g) per 1,000 cubic feet or grams per cubic meter and varies with the commodity, treatment temperature, and type of enclosure. However, some schedules may be

based on the weight of grain. Schedules for use against specific pests by commodity are listed in the Domestic Program Manuals or in this manual.

Always follow manufacturer's instructions on the number of pellets, tablets, bags, prepacs, or plates to be placed at one spot. (See **Table 2-10-1: Amount of Phosphine Liberated by Various Products.**)

**TABLE 2-10-1: Amount of Phosphine Liberated by Various Products**

Calculate amount of product needed by using the amount of phosphine released as shown in the right column.

Product	Type	Unit and weight in grams	Grams of phosphine*
Degesch Fumi-Cel <sup>1</sup>	MP	1 plate; 117.0	33.0
Degesch Fumi-Strip <sup>1</sup>	MP	16 plates; 1872.0	528.0
Degesch Phostoxin <sup>1</sup>	AP	1 tablet; 3.0	1.0
Degesch Phostoxin <sup>1</sup> Tablet Prepac Rope	AP	1 prepac; 99.0 (strip or rope of 33 tablets)	33.0
Detia	AP	1 tablet; 3.0	1.0
Detia Rotox AP	AP	1 pellet; 0.6	0.2
Detia Gas EX-B	AP	1 bag or sachet; 34.0	11.4
Fumiphos tablets	AP	1 tablet; 3.0	1.0
Fumiphos pellets	AP	1 pellet; 0.6	0.2
Fumiphos bags	AP	1 bag; 34.0	11.0
Fumitoxin	AP	1 tablet; 3.0	1.0
Fumitoxin	AP	1 pellet; 0.6	0.2
Fumitoxin	AP	1 bag; 34.0	11.0
Gastoxin	AP	1 tablet; 3.0	1.0
Gastoxin	AP	1 pellet; 0.6	0.2
"L" Fume	AP	1 pellet; 0.5	0.18
	AP	1 pellet; 0.6	0.22
Phos-Kill	AP	1 tablet; 3.0	1.1
Phos-Kill	AP	1 pellet; 0.6	0.22
Phos-Kill	AP	1 bag; 34.0	12.0

## Safety Precautions

### Storage and Handling

Although PH is flammable and may ignite when exposed to excessive moisture, the commercial precautions of AP and MP are considered fire-safe and explosion-safe when used in accordance with the

manufacturer's instruction. No more than ten pellets of Phostoxin should be placed in a single envelope which is supplied by the manufacturer. A Fumi-Cel plate should not contact another or the commodity.

### Protective Clothing

No protective clothing is necessary when handling prepacs or strips. Use dry cloth gloves when handling tablets, pellets, or dust. Be sure to aerate gloves and contaminated clothing in well-ventilated area prior to laundering. Particularly useful are surgical or disposable thin rubber or polyethylene gloves. Wash hands thoroughly after each use.

Containers of AP and MP should be stored in a cool, dry, locked, ventilated protected area not subject to extremes of temperature. Water must never be allowed to come in contact with AP or MP. Shelf life of unopened containers is virtually unlimited. When a tube or container is first opened, the odor of PH (garlic) and ammonia will be noticeable and a blue flame sometimes occurs. However, the quantity of free PH present within that container should not be considered dangerous.

---

## Respiratory Protection

### Use of SCBA (Self-Contained Breathing Apparatus)

The slow evolution of PH from the AP or MP enables the operator to dispense the tablets, pellets, packets, or plates, or pre-pack ropes safely, usually without the need for wearing an SCBA. However, an SCBA unit must be available at all times. The individual opening the chamber or container doors, or initially raising the tarpaulin following fumigation should wear an SCBA. Do not eat or smoke while dispensing AP, MP, or any pesticide, and not until after washing. Wash thoroughly after handling any pesticide. SCBA must be immediately available and must be used by persons who may be exposed to phosphine concentration above the threshold limit value (TLV). Respiratory protection will be worn by the PPQ Officer when within 30 feet of the enclosure under treatment

Threshold limit values for phosphine are as follows:

- ◆ Single exposure for continuous daily 8-hour exposure = 0.3 ppm.
- ◆ Short term exposure limit (STEL) = 1 ppm or 1 mg/m<sup>3</sup>.
- ◆ The threshold level of odor to the human nose is considered to range from 0.005 to 0.5 ppm.

## Safety

In addition to instructions and precautions found on the label, be certain to:

- ◆ Study and follow the recommended application procedure.
- ◆ Comply with all regulations.
- ◆ Allow only personnel properly trained in the use of phosphine products to conduct fumigations under the monitoring of a certified pesticide applicator.
- ◆ Ensure that first aid equipment and information are readily available.
- ◆ Check that approved respiratory protection (SCBA) is readily available for each applicator.
- ◆ Placard the area to be fumigated and an area extending 30 feet from the fumigation enclosure (or the entire building if less than 30 feet to the walls). Placards must include the name of the chemical, date of the fumigation, and name, address, and telephone number of applicator. See fumigant label for proper wording.
- ◆ Always work in pairs, never alone. At least two people trained in the use of the fumigant must be present during the introduction of the fumigant, and the testing and aeration periods.
- ◆ Never smoke, eat, or drink while handling phosphine producing materials.
- ◆ Always wash hands after handling phosphine materials.
- ◆ Never save excess or partially used packets, plates, etc. It cannot and must not be done. Phosphine gas will evolve and constitute a serious safety hazard. Dispose of all opened material following label instructions.
- ◆ Remove placards when aeration is complete and concentrations are below the TLV. Only certified pesticide applicators should be used to remove placards.
- ◆ Mechanically unload grain treated with phosphine. Dust from the residue may release a small amount of phosphine when particles land on the moist mucous membrane of the nose or mouth.
- ◆ Never use phosphine in vacuum fumigation, and never pull a vacuum during chamber aeration. This compound is unstable at reduced pressure that can occur during aeration.

### Disposal of Residue

Following treatment with AP, a powdery residue, essentially aluminum hydroxide, will remain in the envelope. This material should be collected and mixed in a container of water to which liquid detergent has been added (2 tablespoons of detergent per gallon of water). The liquid should then be buried or deposited in an approved pesticide disposal landfill.

Following treatment with MP, the plates may be disposed of by burial in an approved landfill or by burning where approved by local ordinances.

### First Aid Treatment

Immediate warning signs resulting from exposure to high concentration of PH include nausea, vomiting, and diarrhea. Progressive signs include vertigo, chest pains, dry cough, choking, intense thirst, enlarged pupils, and possible coma. Get the victim to fresh air, treat for shock, and **call a physician.**

---

## Bulk Fumigations



Refer to the section for tarpaulin fumigation with methyl bromide for additional information on the following:

- selecting fumigation sites
- placing gas sampling tubes
- sealing tarpaulins
- taking concentration readings
- securing fumigation areas

### Sealing

Make the fumigation enclosure as gas tight as possible. Phosphine can penetrate polyethylene tarpaulins at a very low rate; 4-mil tarpaulins can be used only once; 6-mil tarpaulins should be used whenever possible.

### Probing

When large quantities of grain or other commodity in bulk are to be treated, it will be necessary to “probe” tablets or pellets into the mass of the commodity for adequate distribution. Specially constructed probes made of steel tubing 1 1/4 inch in diameter are generally available as described below:

- ◆ **Head Piece**—Dosing device and numerical counter to indicate number of tablets used.
- ◆ **Tubing**—Usually in 3-foot sections, which can be added to one another to provide the desired length.
- ◆ **End Piece**—Cut obliquely and provided with a hinged flap, closing the entrance to the tube. When the tube is inserted into the commodity, the flap is closed and prevents the commodity from entering. When the probe is withdrawn, the flap opens due to the slightly larger diameter on the flap. The tablets or pellets are then released one at a time as the probe is withdrawn.

Grain or other bulk or loose commodities up to 30 feet deep can be probed. Best results are obtained by probing twice every square foot and as regularly as possible. Penetration of phosphine is up to 10 feet below the area in which the tablets are placed. When large bulk grain stores are treated, many probes may be placed prior to treatment. One head piece can be moved from probe to probe, or pellets or tablets can be placed in the tubes by hand (use surgical or disposable thin rubber or polyethylene gloves).

Gas generation starts within 4 hours of placement of the pellets or tablets (depending on relative humidity). Therefore, the whole procedure of pellet or tablet placement or tarpaulin covering must be accomplished within this time frame. It is possible to work in a probed area if the area is covered with a gas-proof tarpaulin. Special care should be taken to monitor gas concentrations to determine if toxic levels are approached and corrective action taken to prevent exposure.

If it is known ahead of time that grain or cottonseed will require treatment prior to placement in a means of conveyance or storage, the space should be sealed properly before loading. Tarpaulins of at least 6-mil thickness should be used if walls are permeable since lighter tarpaulins may tear. As the material is loaded, tablets or pellets can be metered into the bulk stream for even distribution of fumigant.

If a bulk shipment is in a large storage facility which has a high roof, it may be better to tarp on top of the grain rather than seal the roof. When side walls of the facility are not gas-impervious, tarpaulins can be placed around the outside of the facility to the height of the commodity. Again, 6-mil tarpaulins are preferred, since windy conditions can easily tear lighter gauge tarpaulins off the building.

---

## Aeration

Phosphine treated commodities must be aerated using either electric exhaust fans or by passive aeration in the open air following completion of treatment. Personnel must not be allowed to reenter

fumigated areas until gas concentrations are determined to be below the Threshold Limit Value's (TLV's) measured with a sensitive gas detection device.

Boxcars require little or no aeration after a 5-day treatment, but phosphine concentration must be measured and personnel not allowed entry until readings are below the TLV.

---

## Container Fumigation

In all container fumigations, it is recommended that the container be covered with a gas impervious tarpaulin following the usual tarpaulin fumigation procedures.

For new containers (5 years old or less), the use of a tarpaulin is not an absolute requirement if all vents can be sealed off. The age of the container is usually shown in a metal decal on one of the rear doors. Any container with obvious dents, punctures, nail holes, or parallel floor boards will require a tarpaulin. Any untarped containers, at the very least, must have their rear doors thoroughly taped at all four edges.



A relative humidity of at least 40% and an air temperature above 40 °F will produce satisfactory results for a phosphine fumigation.

If a gas tight enclosure can be assured for the fumigation, the following procedures may be used:

- ◆ Close and secure one of the doors. Seal all openings and joints. If possible, caulk all joints and drape entire doorway with polyethylene sheeting, securing the edges to the inner walls, floor, and ceiling with masking tape.
- ◆ Inspect the roof, floor, and walls for holes and/or cracks. Seal all openings with either masking tape or caulking compound. Containers require close inspection and a great deal of sealing to insure against leakage.
- ◆ Place half of the required packets or plates on each of two pieces of heavy cardboard, spacing them at least 1 inch apart with no overlap. Tape packets to board across both ends of the packet. *Do not* tape across middle of the packet. *Do not* exceed label dosage. Plates and packets must never be subdivided to reduce the amount of phosphine. Plates must never touch each other.

- ◆ Take prepared boards into the container and secure one board in each end, bag side up to the load. If load is covered with paper, secure cardboard to paper. As an alternative, boards may be securely nailed to the wall.
- ◆ If possible, drape remaining doorway with polyethylene film before door is closed. Secure edges to door jams and floor. Close door and secure. If doorway is draped with polyethylene, it may not be necessary to seal the door from the outside. If doorway is not draped, seal all cracks, openings, and joints with masking tape and/or caulking compound from outside.
- ◆ Placard all doors of the container with the appropriate warnings.

---

## Concentration Readings

The officer will take readings at the time indicated in the particular fumigation schedule using sampling tubes appropriate for the phosphine levels to be measured, or by using an electrochemical device approved by Oxford Plant Protection Laboratory.

Refer to the section for tarpaulin fumigation with methyl bromide for additional information on the following:

- ◆ selected fumigation sites
- ◆ placing gas sampling tubes
- ◆ sealing tarpaulins
- ◆ taking concentration readings
- ◆ securing fumigation areas

