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Treatment Manual

Certifying Facilities

Certification of Atmospheric Fumigation Chambers

Contents

Construction and Performance Standards

Discussion (Overview)

The primary purpose of a program fumigation is to obtain quarantine control of the pests in all stages of development in or on the product being fumigated. A properly constructed fumigation chamber will provide an enclosure into which the product can be loaded and where the fumigant will be maintained at the prescribed concentration for the required exposure period.

The primary consideration in the construction of an atmospheric fumigation chamber is to make it as gas tight as possible. In addition, circulation equipment must be installed to distribute the fumigant properly throughout the chamber. The chamber must retain these qualities of tightness and fumigant circulation during every fumigation.

Although chamber sizes are not restricted to specific dimensions, chambers should be sized according to the volume of material to be fumigated. Experience has shown that two moderately sized chambers would be preferable to one large facility.

The construction material may be selected according to the type of product to be fumigated and the method of operation involved. Wood construction of wood frame with light metal sheathing could be utilized if the products to be fumigated are lightweight and are to be hand loaded. Heavy products often loaded by machinery or handtrucks would require that the construction be of heavy gauge sheet metal, masonry, or metal plates. It is advisable to construct the chamber in the most durable manner consistent with its intended use.

Auxiliary equipment will be required to measure, vaporize, circulate, and exhaust the fumigant. Such equipment should be sized according to the volume of the chamber. When a relatively small amount of fumigant is used, it is often measured by volume in graduated dispensers (MB only). When larger amounts are used, the fumigant is most often measured by weight.

For the fumigant methyl bromide (MB) a volatilizing unit through which the fumigant passes is located outside the chamber.

For the fumigant sulfuryl fluoride (SF), no volatilizer or graduated dispenser should be used. For phosphine (PH), a chamber is generally not used because phosphine will corrode copper and brass (including tubing, fans, and electrical wiring).

Fans or blowers developing the prescribed minimum air movement are essential to the proper distribution of the fumigant.

Chambers may be equipped with heating or refrigeration units depending on the climatic environment and the products to be fumigated. Product injury or an ineffective fumigation may occur within certain temperature ranges. Although provisions for temperature control are not generally mandatory, in certain fumigation operations temperature control is necessary and therefore must be considered in the design and construction.

While complete construction details for an atmospheric fumigation chamber are not contained in the following narrative and illustrations, sufficient information is available to develop specifications for a proposed structure. Firms considering chambers for approval by the U.S. Department of Agriculture should submit drawings to the Director, Oxford Plant Protection Laboratory, USDA-APHIS-PPQ, 901 Hillsboro Street, Oxford, NC 27565.

Basic Elements for Design and Construction of Chambers

- Must be gas tight and must remain so during every use.
- Must be provided with an efficient system for circulating and exhausting the fumigant.
- Must be provided with an efficient system of dispensing the fumigant.
- Must be provided with suitable fittings to facilitate a pressure-leakage test and gas concentration sampling.
- Should be provided with a recording thermometer when product temperatures are critical or treatments are of such duration that temperature variations could affect the efficiency of the fumigation.

- Should be provided with heating or refrigeration units when they are required for fumigation efficiency or to prevent product injury.
- Should be equipped with removable, slatted floors unless all material placed in the chamber is on pallets or carts.

The criteria listed above deal primarily with the efficiency of the fumigation chamber itself. In determining the ultimate design and construction, it is essential to give consideration to the safe and practical operation of the facility.

Gas-Tight Construction

Interior surfaces must be impervious to the fumigant. Joints must be sealed with proper compound, solders, or welds. All doors and vents must be provided with proper gaskets. All openings such as for wiring, thermometer, tubing, ports for pressure-leakage tests, etc., must be made gas-tight.

Interior surfaces whether metal, cement, concrete block, tile, or plywood must be painted with epoxy resin, vinyl plastic, or asphalt base paints. Such paint coverings make the surfaces less sorptive, an important factor in maintaining gas concentrations.

Important

Aluminum base paints are **not** acceptable because of the corrosive effect caused by a reaction between such paints and the fumigant. A list of sources for approved paints is available from the Riverdale office.

When wood or wood and sheet metal are used in construction, it is critical that all joints and seams be sealed with nonhardening mastic. This makes a gas-tight seal and allows for expansion and contraction without leakage. In masonry construction, the mortar between all courses of cement blocks should be jointed to produce a smooth compact surface. Poured concrete structures should also have smooth compact surfaces.

The construction and fastening of chamber doors is most critical. Doors may be hinged from the top or side, or on a davit. A chamber door hinged at the top is less apt to sag. Refrigerator hinges should be used if the door is hinged at the side. A high quality gasket, such as neoprene must be provided along the entire perimeter of the chamber facing. To obtain maximum tightness, the doors must be fastened uniformly against the gaskets.

Circulation and Exhaust Systems

Various methods can be used to circulate the fumigant within the chamber. Equipment should be capable of circulating air at the rate of at least one-third the volume of the chamber per minute. The rate of

airflow of the blower should give approximately one complete change of air per minute, based on the volume of the empty chamber. For smaller chambers, a suitable circulating fan will usually provide the necessary air movement. For larger chambers, effective gas distributions can be obtained by using a circulating or squirrel cage fan which picks up the air/gas mixture from a duct reaching near the floor and blowing it across the top of the load. A blower located outside the chamber may also be used, but this method considerably increases the possibilities of leakage. Non-sparking explosion-proof units are required with some fumigants.

Exhaust blowers should also be sized according to the volume of the chamber. Volume of enclosure (in cubic feet) divided by the sum of cubic feet per minute (cfm) of the exhaust fan(s) or exhaust blower equals the number of minutes required per complete gas volume exchange. (2) Sixty minutes divided by the number of minutes per gas volume exchange equals the number of complete gas exchanges per hour. The result should be in the range of 4 to15. The faster the rate of aeration the better, particularly for perishable commodities. If the exhaust flow is connected to a methyl bromide recovery system, this device must not impede the flow rate to less than 4 volumes per hour. Frequently, circulation and exhaust systems are designed to utilize the same blower. Venting to the outside is essential, and the exhaust stack should extend well above all nearby structures. Compliance with local safety ordinances is essential.

Fumigant Dispensing System

The dispensing system needed will vary with the types of fumigants in use. The fumigant MB is usually introduced into the chamber through a tube extending from the supply cylinder. Within the chamber this tube should be provided with properly spaced openings through which the fumigant is dispersed. Fumigants in small quantities are generally measured by volume using a graduated dispenser. The dispenser is located in the introduction line between the supply cylinder and the volatilizer. For larger quantities the supply cylinder is placed on a platform scale and the fumigant used is measured by weight. The measured amount of fumigant must pass through a volatilizer where it is converted from a liquid to a vapor. The volatilizer is most often constructed of copper tubing immersed in a hot water bath which should be kept near the boiling point. The introduction tube for MB should be located in the uppermost part of the chamber.

Pressure-leakage Test for NAP Fumigation Chambers

Before a chamber is used for fumigation, the manometer can be used during a pressure-leakage test as a measure of tightness. An opening (usually 1 inch diameter) should be provided in the chamber for the use of a blower or other means for the introduction of air to create a

positive pressure in the chamber. An additional opening, such as a gas sampling line opening, must be provided for the manometer. The procedure for testing is as follows:

1. Close chamber as for fumigation.
2. Attach one end of the manometer to the chamber opening.
3. Use vacuum cleaner blower or similar apparatus to create pressure of 25 mm as measured on an open-arm, kerosene or water filled manometer.
4. Discontinue blower and close its entry.
5. Observe time for pressure to recede from 25 to 2.5 mm in the open arm.

The time lapse for the chamber pressure to recede from 25 to 2.5 mm in the open arm must be 22 or more seconds for minimum approval. Chambers shall be reinspected every 6 months when 22 to 29 seconds are recorded. Chambers which retain the pressure for 30 seconds or longer should be tested annually. (Chambers used for fumigating cherries for export to Japan are required to meet a higher standard—the time lapse for the chamber pressure to recede from 25 to 2.5 mm must be 60 or more seconds for minimum approval.) Inability to develop or maintain adequate pressure indicates considerable leakage. In such cases, the chamber operator may use a smoke bomb or other device in an effort to determine the areas of leakage.

Electronic manometers are also available and may be used in lieu of the Open-arm (U-tube) type.

Directions for using this equipment are explained in the Equipment section.

Other Auxiliary Equipment

According to the needs of the operation, other auxiliary equipment should be provided. When heat is required, steam pipes or low temperature electric strip heaters are generally recommended. Open flame or exposed electric coils should not be used as they tend to break down the gas and form undesirable compounds. Refrigeration units should be sized to the volume of the chamber and the type and amount of commodity involved. Recording thermometers when required are usually attached to the outside of the chamber with a remote sensing unit attached to the inside wall or inserted into the product.

Figure 6-1-1 through ***Figure 6-1-4*** illustrate various construction features and auxiliary equipment.

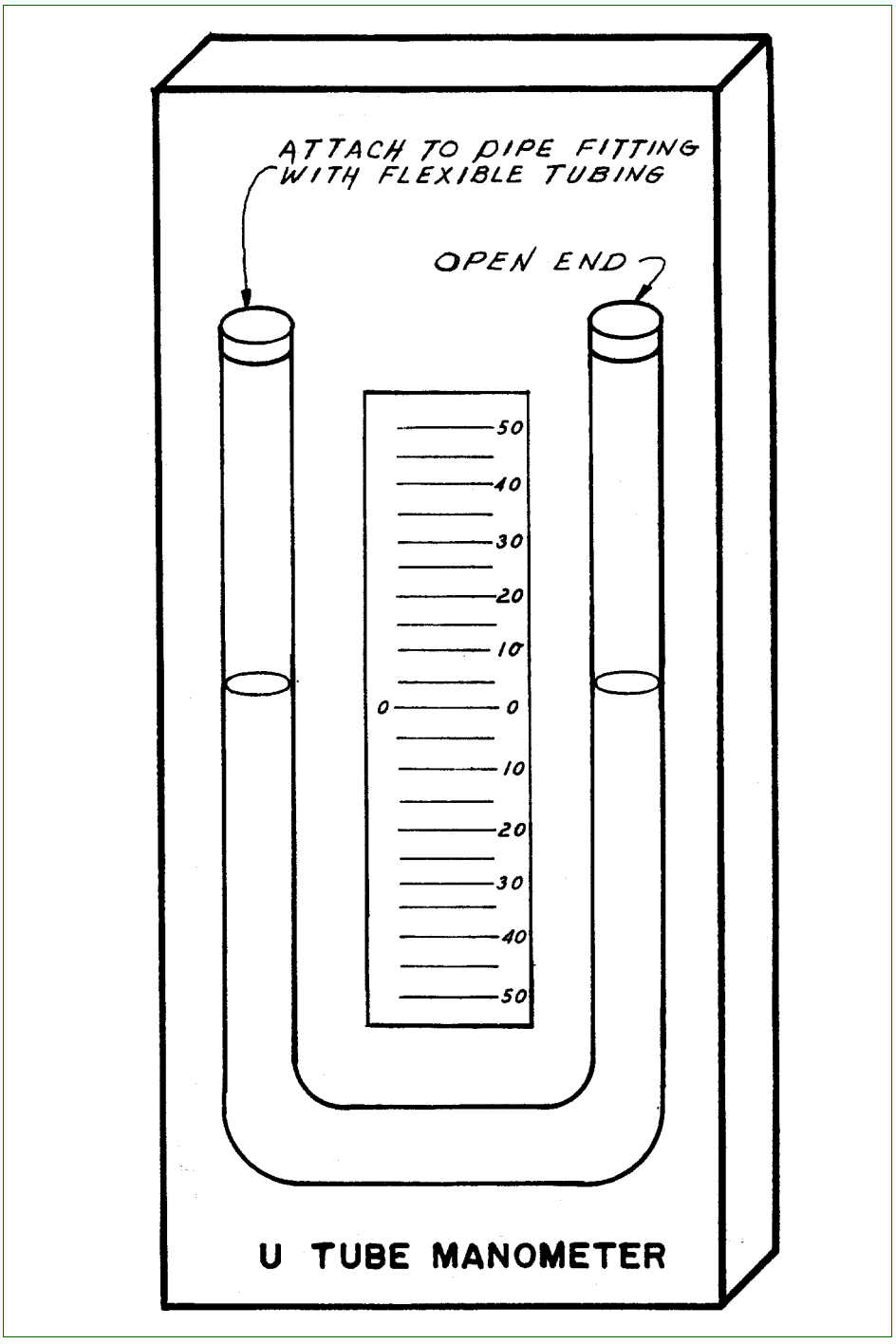

FIGURE 6-1-1: U Tube Manometer

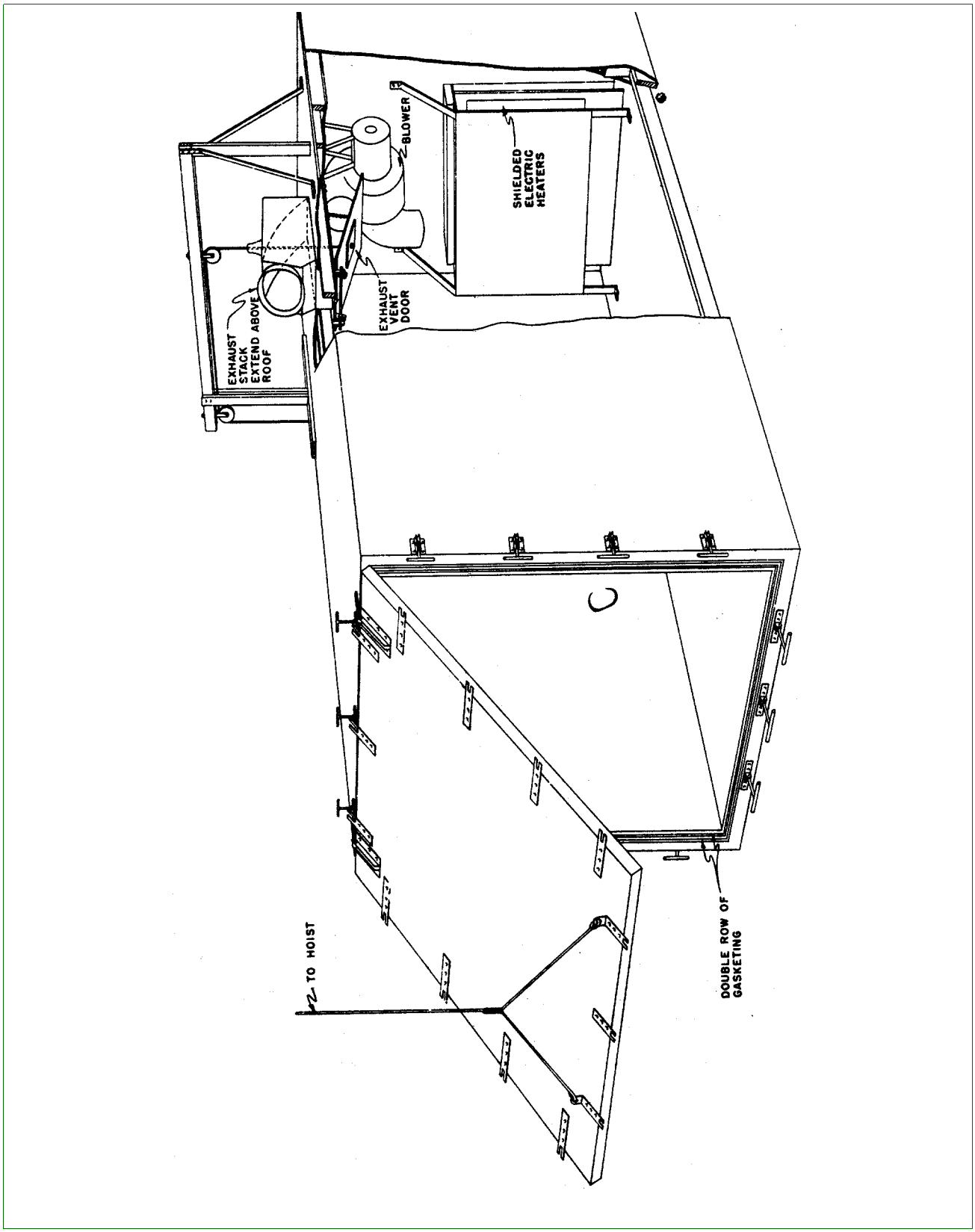

FIGURE 6-1-2: Generalized Plan of Atmospheric Fumigation Chamber Showing Heat and CIrculation Systems

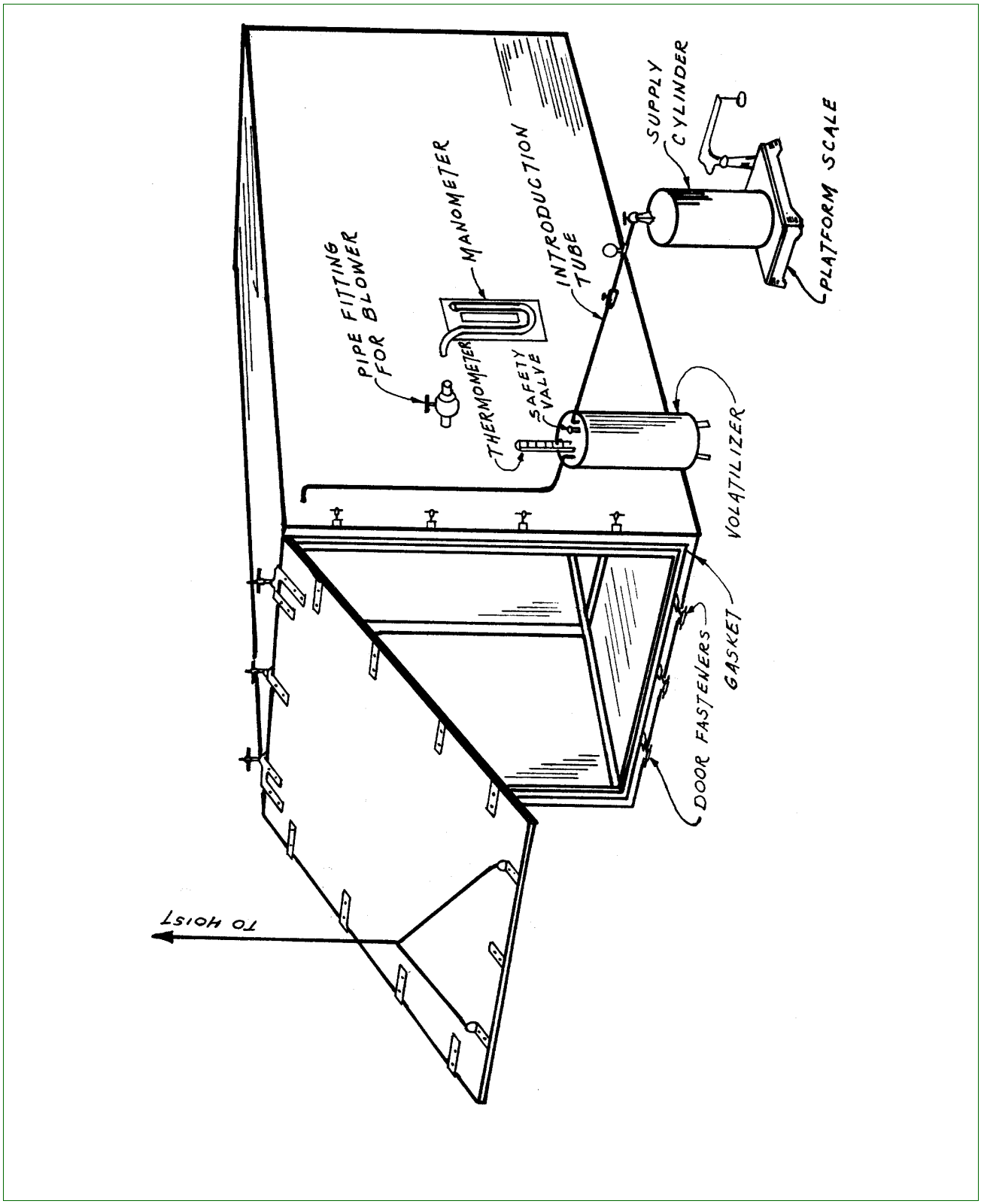

FIGURE 6-1-3: Generalized Plan of an Atmospheric Fumigation Chamber

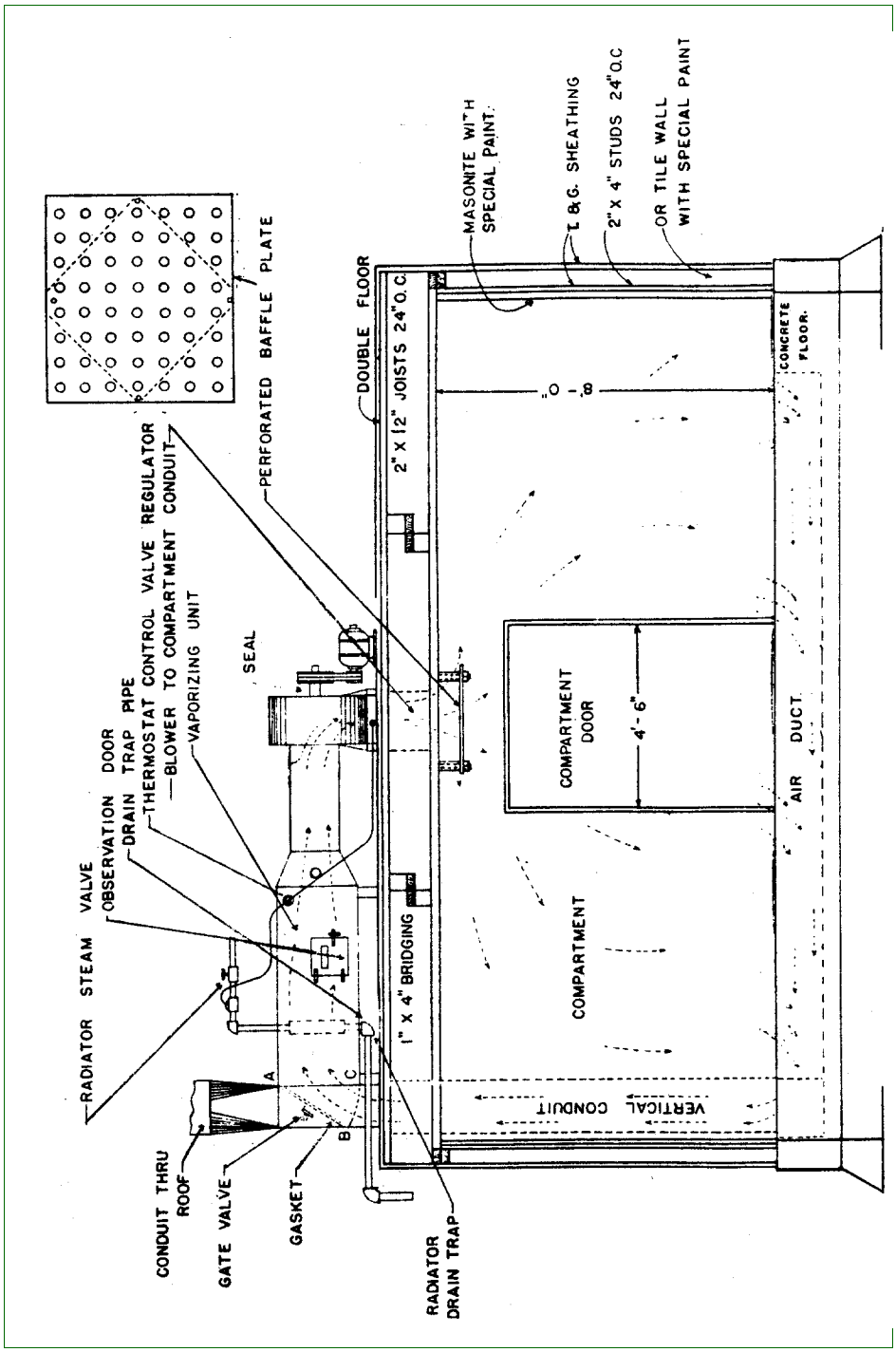

FIGURE 6-1-4: Forced-air Circulation Plan for Fumigation Chamber