APPENDIX A

CARE AND HANDLING OF HEPA FILTERS

H. Gilbert and J. H. Palmer[1]

High reliance can be placed on the high-efficiency particulate air (HEPA) filter if precautions are taken in handling, storage, and installation. Inspection upon delivery, upon withdrawal from stock, and before and after installation is important. A filter unit should be inspected each time it is handled to guard against installation of a damaged item.

The precautions and recommendations in this Handbook are based upon field experience and development.

A.1 Packaging and Shipping

Packaging practice varies among the filter unit manufacturers. Normally, units are packaged in cardboard cartons with various means of providing internal strengthening and impact resistance of the carton. A carton will usually contain one of the larger units, such as the 1500-cfm, $24 \times 24 \times 11\ 1/2$-inch unit; or it may have two 500-cfm, 24×24, $5\ 7/8$-inch units. The smaller sizes, the 125-cfm, $12 \times 12 \times 12\ 7/8$-inch, and the smaller units, frequently are packaged in individual cardboard cartons and crated in multiples.

When a filter is placed in the carton, it is inserted so that the pleated folds are vertical to prevent damage in shipment. To prevent sagging of the pleats, vertical positioning of the pleats must be maintained during subsequent handling and storage. Most important, filter units should also be installed vertically for operation.

The shipping carton is marked with a vertical arrow and the notation "this side up" to indicate positioning of the carton in the transport vehicle. Other markings, "handle with care," "use no hooks," etc., may be found on some containers.

When a filter unit is shipped with pleats in the horizontal position, the vibration that occurs during transportation and the jarring that usually accompanies handling often cause the filter medium to split or to break at the adhesive line, which will appear as a hairline crack.

Occasionally, the manufacturer positions a filter unit improperly in the container. Cartons frequently are not placed in trucks according to the vertical arrow, and they are not handled consistently with the care designated. Consequently, inspection to verify that filters have been packed properly is necessary upon delivery at destination. Experience has shown filters should not be shipped by rail.

A.2 Receiving and Unloading

Inspection starts when a delivery of filter units reaches the purchaser, even while the load is still aboard the carrier. As the shipment is being unloaded, each carton should be inspected for external damage and improper positioning in the cargo space (i.e., the carton placed with arrow directed horizontally). Damaged cartons, including those with corners dented and those improperly oriented in the truck, should be set aside

[1] *Updated and adapted from H. Gilbert and J. H. Palmer, High-Efficiency Particulate Air Filter Units, USAEC Report TID-7023, August 1961.*

for particularly careful inspection of their contents. Damage will be more prevalent when filter units are loaded with mixed cargoes or are shipped in a partially loaded carrier.

The filter unit must be removed carefully from its carton. The acceptable method for removal is to open the top flaps of the container after removing the sealing tape. With flaps folded back, the carton should be inverted or upended gently to place the exposed end of the filter unit on a flat surface, preferably the floor. The surface must be clear of nuts, bolts, and similar protrusions. Then withdraw the carton from the filter unit. Attempts to remove the filter unit from the carton by grasping below the exposed filter case can result in irreparable damage if fingers puncture the delicate filter medium attached immediately below the case.

A.3 Shipping

HEPA filters should be shipped under controlled conditions insofar as practicable. Too often, after the cartons have been carefully arranged in a truck-trailer body, the shipper removes them at an interchange station, stacks them temporarily in the terminal (under completely uncontrolled conditions), and then stacks them into another truck-trailer. Handling under such conditions is usually careless, and attention to proper orientation of the cartons may be nonexistent. As a minimum, it is recommended that cartons be steel-banded to a skid or pallet, no more than 6 1/2 feet high, in the specified vertical orientation. Plywood crates are preferred (see Figure 3.14). Skids (pallets) must not be stacked one above the other unless bracing is provided in the truck-trailer body or railroad car to prevent the weight of the upper load from resting on the lower. This will force the shipper to keep the cartons in their proper orientation and prevent him from throwing or dropping them indiscriminately.

Another control is to require that the filters be packed properly in a scaled truck-trailer body or in a sealed containerized-freight unit, not to be opened until arrival at the specified delivery point. The trailer or containerized-freight unit should be unloaded by personnel employed at the delivery site who have been thoroughly instructed in the proper care and handling of HEPA filters. Mixed-load shipments should be avoided.

A.4 Storage

Following receipt and inspection, the filter unit should be repacked carefully in the carton in which it was shipped and received. All packing material for internal strengthening of the carton and for protection of the filter unit should be replaced properly. Pleats of the filter unit should be positioned to conform to the orientation marking on the carton; this should be done routinely whether the filter unit will be installed at an early date or whether it will be stored.

Cartons of filter units should be positioned in storage to conform to the vertical arrow, and manufacturer's recommendations for storage heights should be followed. When recommendations are not available, filter units $24 \times 24 \times 11\ 1/2$ inches and $24 \times 24 \times 5\ 7/8$ inches should be stacked not more than three filter units high. Alternate the position of each level so as to not have one filter support the one above it.

Mixing other items and materials with filter units in storage should be avoided to prevent damage to the filter units. Recommended aisle widths consistent with good warehousing practice should be provided to reduce damage of filter units from materials-handling equipment and other traffic. Filter units should not be stored in locations where they will be exposed to dampness, excessive heat or cold or rapidly changing temperatures. An NQA-1 Level B storage or equivalent should be used.

A.5 Handling

Mechanical warehousing equipment is recommended for handling large quantities of filter units. Skids and pallets should be used to provide a flat bed for movement of the units. Chains, slings, and hooks obviously must not be used. The cartons should be placed on the pallet so that the arrow on the carton points vertically.

In physically handling a packaged filter unit, a person must make certain that the carton is picked up at opposite corners and deposited carefully on the floor or other surface. The carton should not be dropped or jarred. Any filter unit dropped, whether or not in the carton, should be reexamined for damage as prescribed in Appendix B.

When a filter unit is lifted, it must be grasped only along the outer surface of the case. Even slight contact of fingers at almost any point within the case can puncture the filter medium.

A handle or grip is sometimes attached permanently to the wood filter case for ease of installation and removal of the filter unit. In such instances, care must be taken in attaching the handle. Screws should not be pounded for starting, and nails should never be used. The recommended method is to drill starting screw holes, making certain that the drill and the length of screws do not penetrate through the frame and pierce the filter medium attached (screws must not be longer than 3/4 inches). Pounding may crack the filter medium and possibly loosen the adhesive seal that bonds the filter pack within the frame. Attachment of a handle to a metal-frame filter unit is not recommended.

Filter units should be kept in shipping cartons when moved from one location to another. When transferred for installation, the units should be unloaded at a point, which so far as practicable, will reduce physical handling. Filter units should remain in cartons until ready for installation and then should be unpacked as prescribed in Section A.2.

If for any reason an unpackaged filter unit must be placed with its face on the floor or other surface, the surface must be cleared of every object or irregularity that might damage the filter pack.

A.6 Installation

Personnel responsible for installation of the filter unit must be carefully instructed in proper handling technique. They should know that the filter pack within the frame is delicate and must not be damaged during installation. Equally important is that the filter unit must be installed so that unfiltered air will not leak past the unit. The following installation procedure, as a minimum, should be used:

1. Carefully remove filter unit from shipping carton, following the procedure described under Section A.2.

2. Carefully inspect both faces of the filter unit for cracks in the filter medium, for damage of separators, and for separation of the filter pack at the frame.

3. Ensure that the gasket is cemented firmly to the frame and that the gasket pieces are butted or mated at the joints.

4. The gasket must be compressed firmly. Compression should be applied evenly and equally at all points in increments of 5 feet-pound or less, with the filter frame completely covering the opening.

5. Install the filter with pleats and separators in the vertical position. This will eliminate sagging of pleats from accumulated weight of materials stopped by the filter unit.