AIR CONDITIONING AND VENTILATING SYSTEMS

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1.0 SCOPE

This data sheet provides recommendations to prevent or restrict the spread of fire, smoke, and heat through air conditioning and ventilating systems. It also provides some general guidance on smoke control systems.

This data sheet applies to occupancies for which there is no occupancy-specific data sheet, including stores, shopping centers, and healthcare facilities. It does not apply to warehouses.

For occupancies that are highly susceptible to smoke damage, refer to the applicable occupancy-specific data sheets, including Data Sheet 7-36, *Pharmaceutical Operations*; Data Sheet 5-32, *Data Centers and Related Facilities*; Data Sheet 5-14, *Telecommunications*; and Data Sheet 1-3, *High-Rise Buildings*. For clean rooms, refer to Data Sheet 7-7, *Semiconductor Fabrication Facilities*, and Data Sheet 1-56, *Cleanrooms*.

This document does not address the use of flammable refrigerants in air conditioning and ventilating systems. Guidance on this subject can be found in Data Sheet 7-13, *Mechanical Refrigeration*.

1.1 Changes

January 2018. This document has been completely revised. The following major changes were made:

A. Revised the scope section to refer to occupancy-specific data sheets for highly smoke-susceptible occupancies.

B. Updated recommendations related to the use of noncombustible air filters

C. Updated recommendations related to the protection of combustible air filters.

1.2 Hazard

For detailed information, see Section 3.2 and FM Understanding the Hazard publication P0374, *Fire in Air Conditioning & Ventilating Systems*.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Construction and Location

2.1.1 Ducts

2.1.1.1 Use ducts constructed of steel, aluminum, concrete, masonry, or FM Approved materials.

2.1.1.2 Construct duct linings and coverings (including thermal insulations) of noncombustible or FM Approved material.

2.1.1.3 Do not extend ducts through walls or floors that need a fire-resistive rating. If penetrations can't be avoided, provide fire dampers to maintain a fire-resistive rating.

2.1.1.4 Where ducts pass through walls and floors serving as fire subdivisions, limit the opening in the construction around the fire damper to no larger than 1/2 in. (13 mm) average clearance on all sides. Seal the opening with FM Approved penetration fire stop material installed by an FM Approved fire stop contractor to obtain a rating equal to that of the wall or floor.

2.1.1.5 Do not use hallways as plenums.

2.1.1.6 Protect ducts that pass through combustible construction, or that are located inside combustible partitions or walls, with 1/4 in. (6 mm) noncombustible insulating material or maintain a minimum clearance of 2 in. (50 mm) between ducts and all combustible construction. Fill the spaces between the ducts and the combustible construction solidly with brick, mineral wool, or other noncombustible material.

2.1.1.7 Maintain the integrity of fire stopping at penetrations.

2.1.1.8 Enclose ducts that pass through more than one floor needing protection of vertical openings with walls having a fire rating equal to that of the floors. A fire-resistive shaft used as a duct need not be additionally enclosed (see Figures 1, 2, and 3).

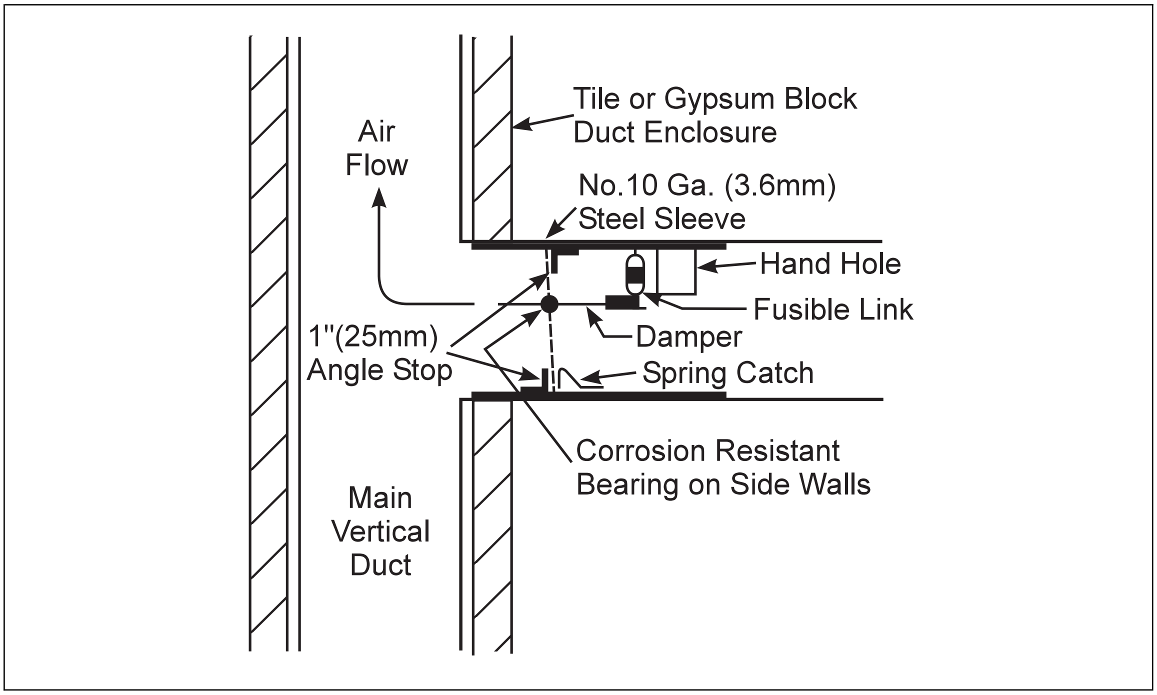

Fig. 1. Automatic hinged damper at junction of branch duct with main vertical duct.

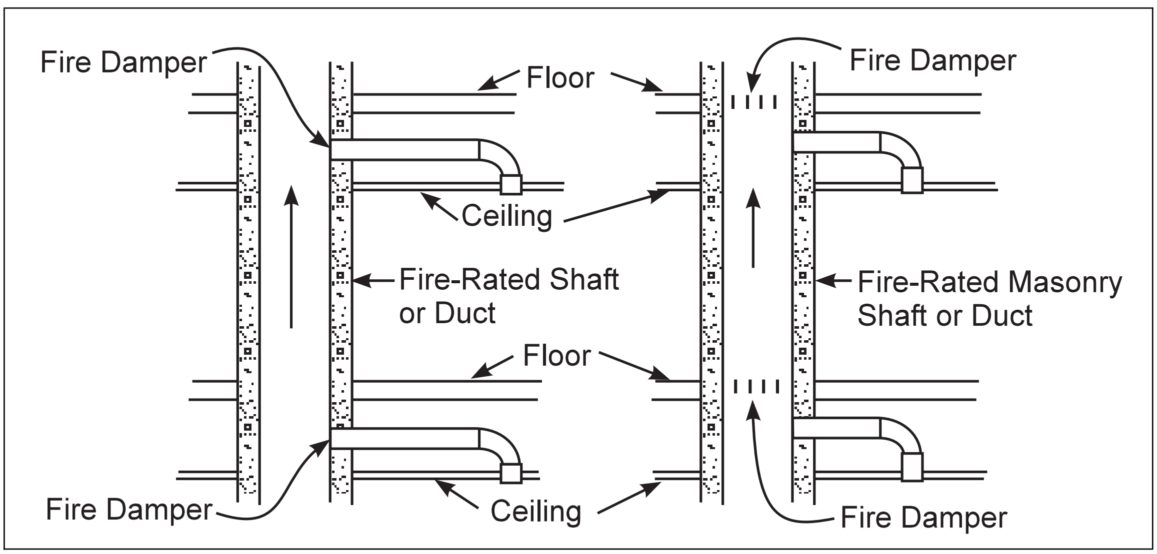

Fig. 2. Fire damper recommended at duct shafts and other fire separations

A. The enclosure of ducts is not required for branches that are cut off from the main portion of the duct by fire dampers (Figure 2).

B. When ducts extend through only one floor and fire dampers are installed at each point where the floor is penetrated, the fire dampers may be used in lieu of the enclosure.

C. Do not locate two or more ducts serving separate floors within the same fire-resistive enclosure unless fire dampers are installed where each branch extends from the enclosure.

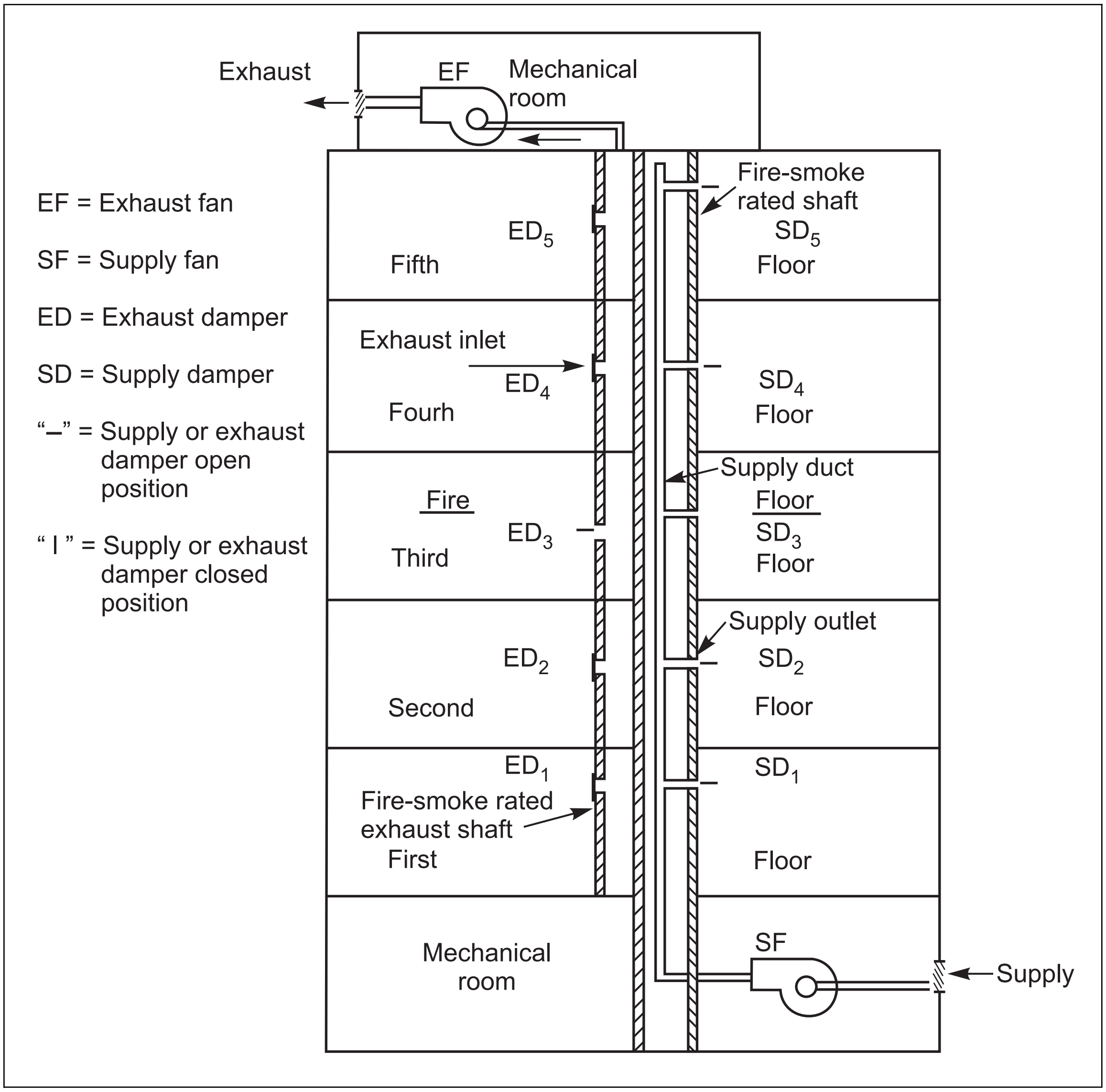

Fig. 3. Typical smoke control arrangement by using pressurization-exhaust method (section view): Fire is in Floor No. 3. Dampers SD_1, SD_2, SD_4, SD_5, and ED_3 remain open. Dampers SD_3, ED_1, ED_2, ED_4, and ED_5 will close.

2.1.2 Automatic Fire Doors and Fire Dampers

2.1.2.1 Design duct systems so ducts do not pass through walls or floors serving as fire subdivisions. If penetration cannot be avoided, install automatic fire doors or dampers in accordance with Data Sheet 1-42, MFL Limiting Factors.

2.1.2.2 If ducts pass through interior horizontal fire subdivisions of three-hour-fire resistance ratings, protect openings 18 in. (455 mm) or more in diameter or on longest dimension with a door arrangement having an overall fire rating equal to that of the subdivision (Figure 4). At openings not exceeding 18 in. (455 mm) in diameter or longest dimension, use 1/8 in. (3.2 mm) steel plates (Figure 5).

2.1.2.3 Arrange dampers as follows:

A. Equip walls that have less than three hours' fire resistance with automatic fire dampers of either the solid or louvered type (Figures 1, 5, and 6).

B. Install automatic fire dampers either at the outlet and inlet openings in the main vertical duct, or at the duct penetration in walls or floors serving as fire subdivisions (Figure 2).

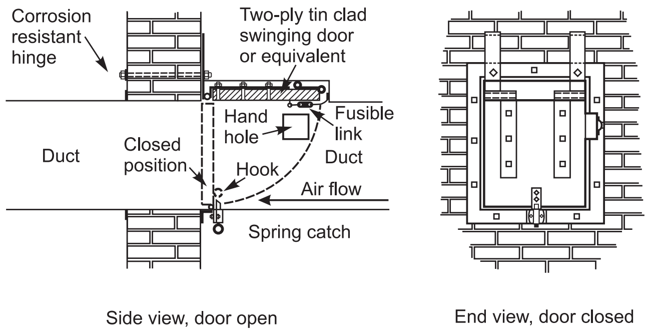

Fig. 4. Automatic fire door in duct at major fire separation; duct to be independent of fire separation.

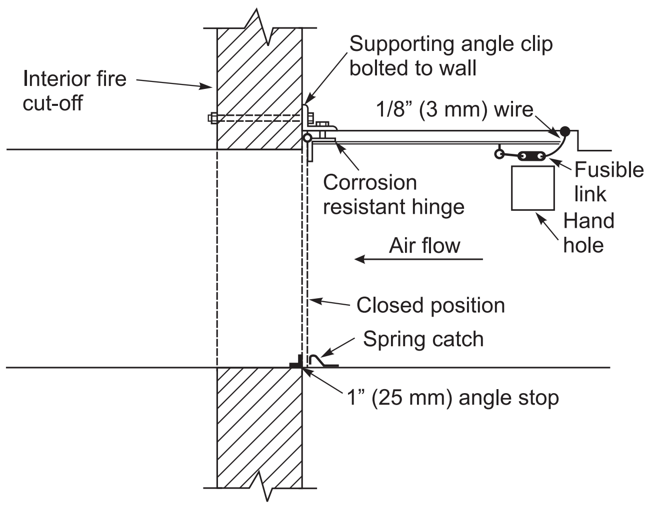

Fig. 5. Automatic hinged damper at interior fire cutoff

C. Use fire dampers that are third-party tested and listed by an accredited certification body.

2.1.2.4 When duct smoke detectors are used for interlocking with fans, provide and arrange detectors as outlined in Data Sheet 5-48, *Automatic Fire Detection*. Smoke detectors within ducts are usually located downstream of the air filters and ahead of any branch connections in the air supply systems, as well as being downstream of the last duct inlet.

2.1.2.5 Arrange fire doors and fire dampers to close automatically, in the direction of the air movement whenever possible, and to remain tightly closed upon operation of a fusible link, other FM Approved heat-actuated devices, or FM Approved smoke detectors. Use fusible links with a temperature approximately 50°F (28°C) above the maximum temperature that would normally be encountered within the system, but not less than 165°F (74°C).

2.1.2.6 Equip hinged fire doors and dampers with spring catches to hold them closed, with the pins of hinges made of corrosion-resistant material.

2.1.2.7 When the damper is intended for both fire-stopping and smoke-stopping, use combination smoke detectors (sensitive to both heat and smoke) for activation. Alternatively, the release mechanism can be both thermally responsive and sensitive to signals from smoke detectors.

2.1.2.8 When fire dampers and doors are designed to serve the dual function of fire-stopping and smoke-stopping, provide special features, such as gaskets, to ensure adequate sealing against any smoke leakage.

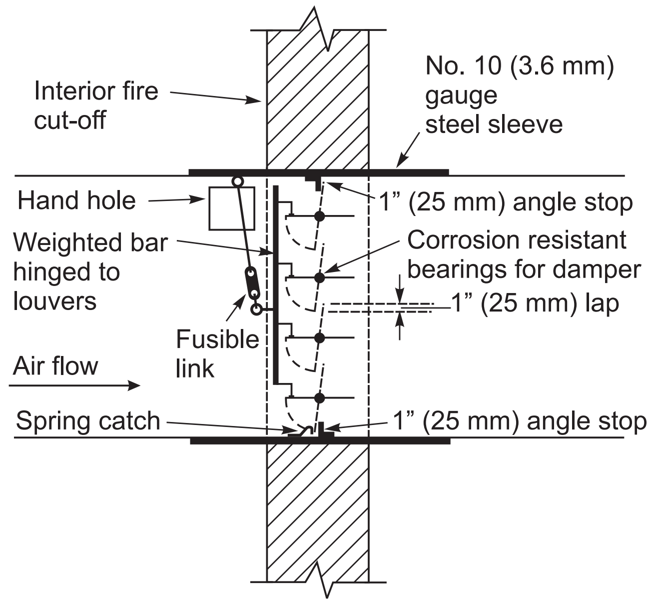

Fig. 6. Louvered automatic damper

2.1.3 Air Filters

2.1.3.1 Use filters that are listed in accordance with UL 900, Standard for Safety Air Filter Units, or equivalent local standards. Ensure air filters are third-party tested and listed by an accredited certification body.

2.1.4 Fans, Air Intakes, and Outlets

2.1.4.1 Locate fan motors outside of ducts.

2.1.4.2 Locate inside air intakes and outlets at least 3 in. (75 mm) above the floor. When located less than 7 ft (2.1 m) above the floor, provide them with a substantial grill or screen of 1/2 in. (13 mm) steel mesh for protection.

2.1.4.3 Locate the outdoor air intakes where there is the least possibility of drawing smoke back into the air conditioning and ventilating systems. Because smoke normally rises, the lower the intake, the less possibility of drawing in smoke. A less-desirable alternative is to provide charcoal filters or other special air filtration devices at the air intakes.

2.1.5 Design

2.1.5.1 Provide emergency power for critical air conditioning and ventilating systems.

2.2 Protection

2.2.1 Protect combustible filters in an air conditioning system as follows:

2.2.1.1 Provide sprinkler protection in combustible filter systems with capacities of 5,000 ft 3/min (142 m 3/min) and above. Arrange the sprinklers to wet the entire surface of the filters.

2.2.1.1.1 Provide a one-hour-rated fire door or damper downstream from the filters (Figure 7). Arrange the door or damper for closing by the activation of smoke detectors or combination smoke detectors. Arrange the detectors in accordance with Data Sheet 5-48. Do not cross-zone the system.

2.2.1.1.2 Arrange the supply and return fans of the air conditioning system to shut down on activation of smoke detectors or combination smoke detectors.

2.2.1.1.3 Provide duct detectors in supply and/or return ducts as outlined in Data Sheet 5-48.

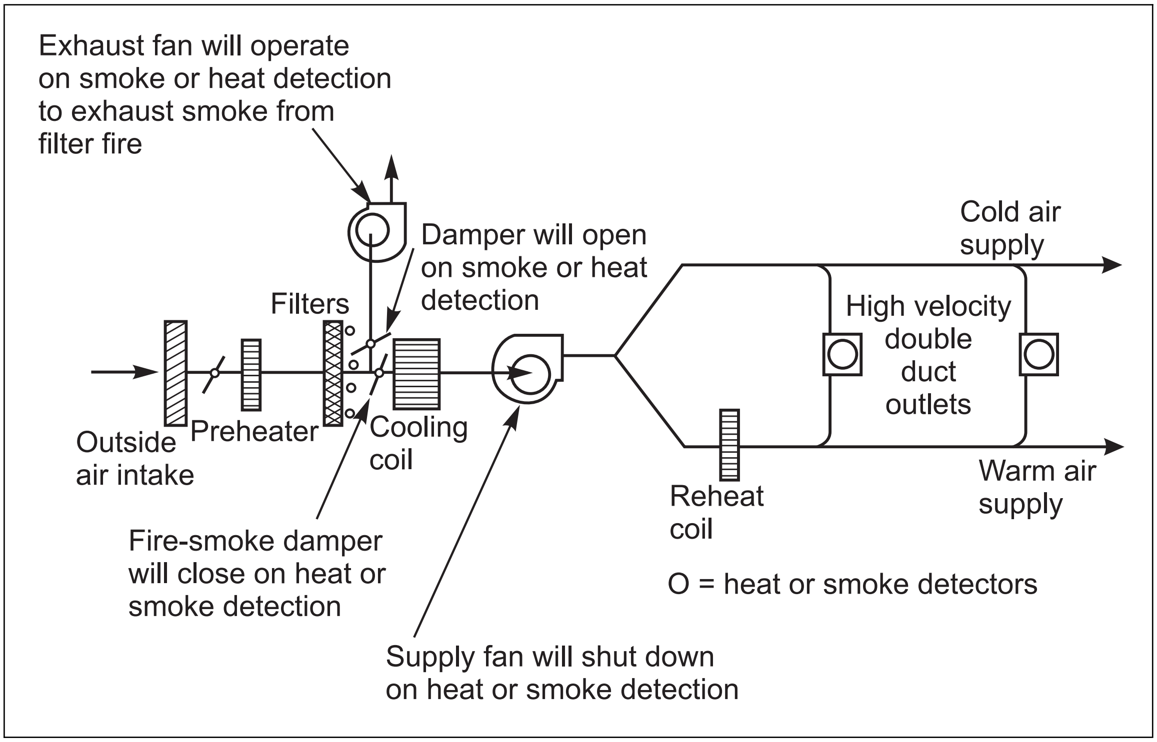

Fig. 7. Typical smoke-control arrangement for filter fires (plan view)

2.2.1.2 Protect combustible filters with capacity less than 5000 ft^3/min (142 m^3/min) per 2.2.1.1.1, 2.2.1.1.2, and 2.2.1.1.3 above.

2.2.2 Provide adequate sprinkler water drainage in the filter assembly when sprinklers are installed. (Refer to Data Sheet 7-78, *Industrial Exhaust Systems*.) Provide a u-bend water seal in the drainage line as needed.

2.2.3 No protection is required for FM approved or noncombustible exterior duct linings and coverings (including thermal insulations).

2.3 Equipment and Processes

2.3.1 Enclosed fan-cooled motors are preferable, but open squirrel-cage induction motors are tolerable.

2.4 Operation and Maintenance

2.4.1 General

2.4.1.1 Make ducts reasonably tight throughout with no openings other than those required for proper operation and maintenance of the system.

2.4.1.2 Provide suitable hand-hole openings with tightly fitted covers near the fire doors or dampers to make them accessible for inspection and maintenance.

2.4.1.3 Install fans to be readily accessible for inspection and maintenance. Secure these to substantial supports.

2.4.1.4 Examine the fresh-air intake when ducts are inspected. Items to be noted are accumulations of combustible material near the intake, presence of buildings or structures that may present an exposure to the intake allowing smoke and fire to be drawn in, and the operating condition of any automatic damper designed to protect the opening against an exposure fire.

2.4.1.5 Clean ducts and associated equipment at least every two years or whenever inspection indicates the need. Cleaning may be by vacuum or hand brushing.

2.4.1.6 Do not use plenum chambers for storage.

2.4.1.7 Never clean or re-use filters designed to be thrown away after use.

2.4.1.8 Check the system activating devices if accessible, such as fusible links, heat and smoke detectors, and electric thermostats to see that they are not loaded with residue or otherwise impaired.

2.4.1.9 Have adequately trained personnel inspect and test heat and smoke detector systems. Follow manufacturer's or installer's recommendations in maintaining, inspecting, and testing the equipment.

2.4.1.10 Arrange the overall system so it can be adequately tested every six months by simulating emergency-mode conditions.

2.4.1.11 Ensure all equipment requiring servicing and testing is readily accessible.

2.4.1.12 Ensure motors are readily accessible for inspection, lubrication, and maintenance.

2.4.1.13 Use an inspection form to obtain a thorough inspection. Ensure the form applies to the system or systems involved and lists the items needing attention. See Table 1 for a list of many of the required inspections and tests for equipment associated with air conditioning and ventilating systems.

Table 1. Inspection and Maintenance Schedules

Device	*Frequency*
Inspection of ducts	Quarterly
Inspection of plenum chambers	Quarterly
Inspection of filter electrical equipment	Quarterly
Inspection of fan and fan motors	Quarterly
Test overall air conditioning/ventilating system	Biannually
Inspect drive motors and gear reductions	Biannually
Inspect automatic fan controls	Annually
Inspect each fire door and fire damper	Annually

2.5 Ignition Source Control

2.5.1 Protect air-intake openings with automatic fire doors or dampers if the fire exposure is severe. Provide FM Approved heat-activated devices at air-intake openings to shut down fans in case of exposure fires.

2.5.2 Do not recirculate air from any space in which noticeable quantities of flammable vapor or combustible dust are given off. This does not consider industrial exhaust systems covered by other FM data sheets.

2.5.3 Screen and locate the outside air intake to avoid drawing in combustible or other foreign materials and to lessen the hazard from exposure fires. Also remove any accumulated rubbish or other waste from the vicinity of all air intakes.

2.5.4 Protect open motors having commutators or sliding contacts so sparks from the motors cannot reach adjacent combustible material.

2.6 Smoke Control

2.6.1 The air conditioning system can be designed to control smoke and thus lessen smoke damage by using one of the following methods:

A. Pressurization-exhaust method. The air conditioning system is designed to switch to a smoke control mode upon detection of smoke in the fire area (Figure 3). This operation automatically puts the fire area under exhaust, and areas adjacent to the fire into supply. To accomplish this, ensure the return-exhaust damper(s) in the fire area remain open, and the supply damper(s) close on smoke detection. In all other areas adjacent to the fire, ensure the supply dampers remain open and the exhaust-return dampers close on smoke detection. The intent is to prevent smoke spread to the adjacent areas of the fire and to purge the smoke from the fire area via exhaust (Figure 3).

B. Pressurization method. The pressurization method can be used to protect a property against smoke damage from exposure fires. This can be accomplished by designing the air conditioning system of the exposed property to pressurize it by maintaining the supply damper(s) in the open position and closing the exhaust damper(s) on smoke detection (Figure 8).

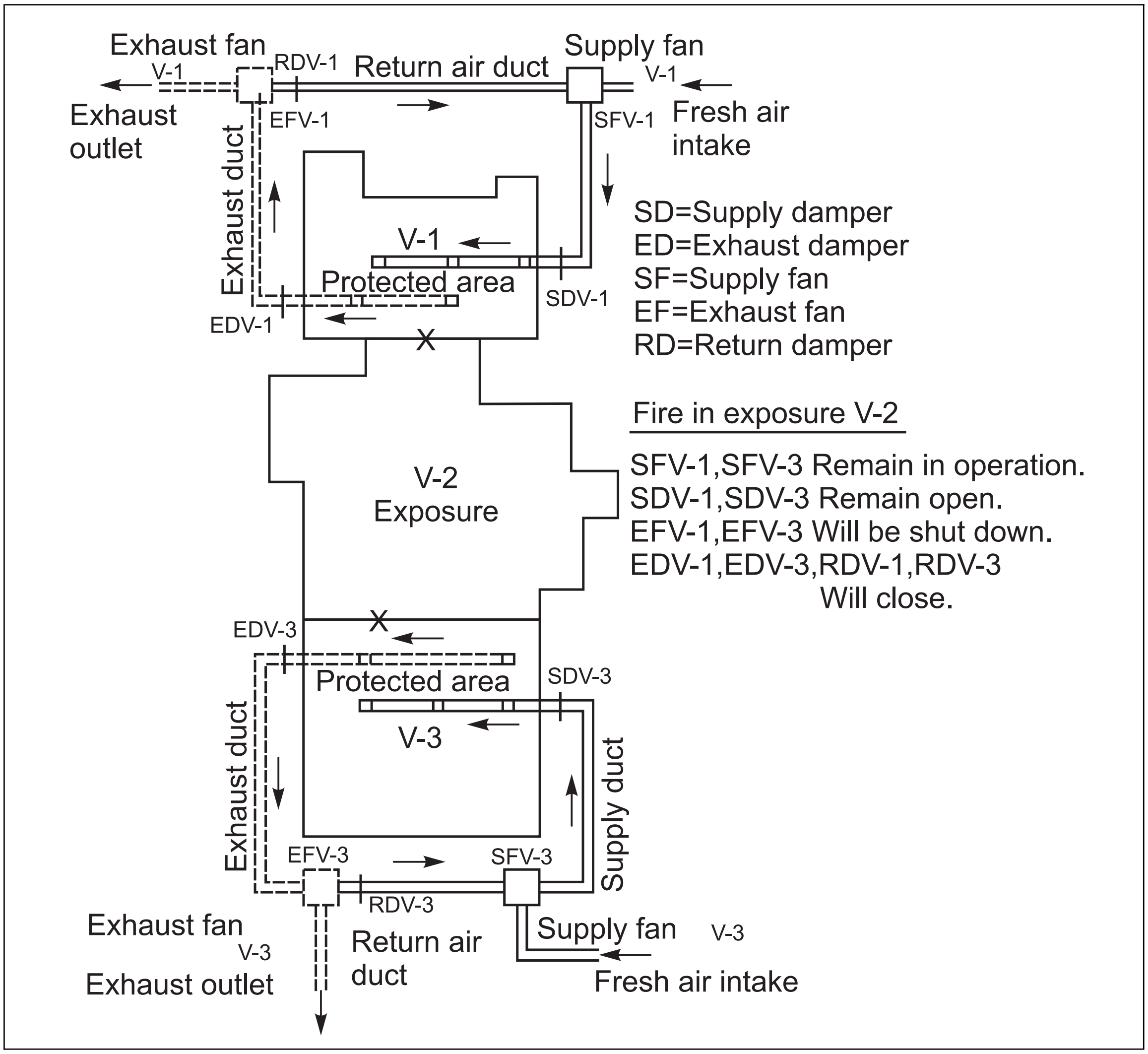

Fig. 8. Typical smoke control arrangement by pressurizing the protected area (plan view)

2.6.2 Activate the smoke-control system by using FM Approved smoke detectors or combination smoke detectors located within the zone covered by the specific smoke-control system. Arrange the type, location, and spacing of detectors in accordance with Data Sheet 5-48, Automatic Fire Detection.

2.6.3 Ensure dampers used for the smoke control arrangement have the dual function of stopping both fire and smoke, and are equivalent to the fire resistance rating of the assembly.

2.6.4 Do not pass supply and exhaust ducts serving one smoke zone through another smoke zone unless they are enclosed in a fire-smoke resistant enclosure (Figure 3).

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 Air Conditioning and Ventilating System Applications

This data sheet applies to air duct systems that move air mechanically and are used for heating, cooling, and ventilating. It does not apply to systems in dwellings, to systems for removal of flammable or corrosive vapors and residues, or to systems for conveying dust, stock, or refuse by means of air currents.

An air conditioning system consists of fans, ducts, controls, dampers, filters, intakes, and heating and/or cooling apparatus that remove used air from occupied spaces and recondition it. The air is then circulated back to occupied spaces to provide comfort to occupants or to provide a specific set of environmental conditions established within the conditioned space. The air conditioning system provides the simultaneous control of temperature, humidity, air motion, noise level, air cleanliness, and quality of ventilation.

In recent years, the characteristics of air-handling systems have changed. While separate steel duct systems have not been abandoned, many air-handling systems are using new methods to accomplish air distribution. Air is moved through cells integral with the structural load-bearing elements of the floor slabs, through ceiling voids, through shafts that act simultaneously as air ducts and enclosures for air ducts, and through various other means. Discharges are made through light fixtures, slits, and perforations. Air may be induced, recirculated, or exhausted. Steel ducts are frequently insulated externally or internally for thermal, vapor, or sound control. There are also new duct materials. Aluminum and glass fiber boards are commonly used for ducts, and frequent proposals are made for the use of plastics or paper-based ducts or channels. Flexible connectors, used in great numbers, frequently employ various plastics. The use of plastic ducts should be discouraged because they pose serious fire and smoke hazards.

One important function of many air conditioning systems is to control relative humidity. Primary and secondary cooling coils are often provided to cool the air as much as possible. The air is then reheated to a specified temperature, which lowers the relative humidity. Without reheat, room air could become saturated (100% relative humidity). This increases the chance that room air fogging (condensation of water vapor into moisture) and condensation on surfaces will occur.

3.2 Fire and Smoke Hazards

The principal hazard associated with air-handling systems is the propagation of fire and/or smoke through the air movement channels. The use of new types of interior finishes and plastic furnishings has increased the problem of smoke development in a fire. Some of these new materials can release great quantities of smoke and toxic gases when exposed to fire conditions.

Smoke in untenable concentrations can migrate to remote parts of a building in a matter of minutes via air-handling systems. On numerous occasions fire has been confined to its area of origin with limited fire damage, but smoke has spread through the air conditioning system to other areas, causing extensive damage and hampering manual fire fighting efforts.

The major factors that cause smoke to spread to areas outside the fire area are (a) temperature, (b) stack or chimney effect, and (c) mechanical air handling systems.

3.2.1 Temperature Effect of Fire

An expansion process is created during the initial stages of fire due to a continuous increase in temperature. This process causes smoke to move from the vicinity of the fire to adjacent areas, and it continues until the temperature rise stops.

3.2.2 Stack or Chimney Effect

Stack or chimney effect is air movement resulting from the difference in density between two interconnected columns of air at different temperatures. Hot smoke and gases from a fire generally move upward in climates where the outside temperature is lower than the indoor temperature. If the smoke temperature is higher than the ambient temperature, smoke rises. If the smoke temperature is lower than the ambient temperature, smoke descends.

In summer, when the outdoor temperature is higher than inside, the flow pattern is the reverse of that in the winter. However, air flows are considerably lower in the summer because the inside-to-outside temperature difference is much smaller.

The stack or chimney effect, therefore, accounts for most air movement in buildings under normal conditions. It also is responsible for the widespread distribution of smoke during the early stages of a fire. This is most evident during a smoldering fire or in areas far from the fire where the smoke has cooled off.

3.2.3 Mechanical-Air-Handling Systems

An air-handling system can rapidly transfer smoke from a fire area to other parts of the building. Central systems, therefore, have a potential for spreading smoke far beyond the origin of the fire.

This exposes a large area of the property to smoke damage and hampers manual fire fighting. For this reason, the system is sometimes shut down during fires. The ducts interconnecting various floors or areas may still provide significant paths for smoke migration, however, even though the system is shut down.

The ducts and other components of the system provide a ready means of spreading fire, smoke, and toxic gases throughout a building.

3.2.3.1 Plenums

A plenum is an air compartment or chamber in which one or more ducts are connected, and which forms part of an air-distribution system.

Plenums generally are constructed of galvanized steel or aluminum. However, the space above suspended ceilings or below raised floors is frequently used as a supply, return, or exhaust plenum to reduce the amount of sheet metal work. The plenum chamber is connected with the conditioned area by openings through either the floor or ceiling. These spaces may be insulated and they are generally used to run electrical wiring and other auxiliary services. When a fire occurs in this occupancy, fire and smoke may spread to the conditioned area.

3.2.3.2 Plastic Ducts

Despite being a hazard, plastic ductwork is used in buildings. Fire can quickly penetrate plastic ductwork from either the exterior or the interior. Invariably, such ductwork will add fuel to the fire and will release large volumes of smoke. Fiberglass-reinforced plastic ducts are solid, high-density materials generally 1/8 in. (3.2 mm) to 1/4 in. (6.35 mm) thick with a hard, shiny surface. PVC and polypropylene are other plastics often used for ductwork, although their use is predominantly industrial.

3.2.3.3 Fibrous Glass Ducts

Some fibrous glass duct materials of low combustibility have been FM Approved. Some of the fire tests conducted on this material have shown that, under severe fire exposure, the duct will spread fire and collapse. Consequently, ductwork fabricated of this material should be used only in buildings of noncombustible construction and occupancy, unless automatic sprinklers are provided.

Fibrous glass ducts consist of a low-density composition of noncombustible glass fibers and a small quantity of resin binder, preformed or prefabricated into units of circular and rectangular cross-section and having an exterior jacket of aluminum foil or pigmented film.

The fibrous glass duct can be used in mechanical air-handling systems that operate from -2 to 2 in. (-500 to 500 Pa) water gage static pressure with a conveying velocity of 2000 ft/min (610 m/min) or less. This type of system is known as a low-pressure ductwork system.

Space limitations in modern buildings have restricted the size of air conditioning ducts. Therefore, high velocities must be employed to convey the necessary volume of air. The increased velocities are accompanied by higher duct friction losses. In order to maintain flow against the higher duct friction, it is necessary to have greater pressures at the air source and through the ducts.

The terms “high velocity” and “high pressure” refer to design and construction requirements for a velocity above 2000 ft/min (610 m/min) and static pressure above 2 in. (500 Pa) or below -2 in. (-500 Pa) water gage. Smoke removal systems usually operate within this high-velocity range; fibrous glass ducts are suitable only for low-pressure duct work systems, and thus, not for smoke removal purposes.

3.2.3.4 Filters

Noncombustible filters can collect combustible dust and lint during normal air conditioning operation. Therefore, the combustibility and smoke generation of a filter after a period of service partly depends on the nature and quantity of contaminants collected. Consequently, each case must be evaluated individually.

The most common types of filters used in modern air conditioning systems are panel filters (Figure 9), dry-type extended surface filters (bag type) (Figure 10), automatic moving-curtain viscous or dry impingement filters (Figure 11), automatic self-cleaning viscous air filters (Figure 12), and electronic air filters (Figures 13, 14, and 15).

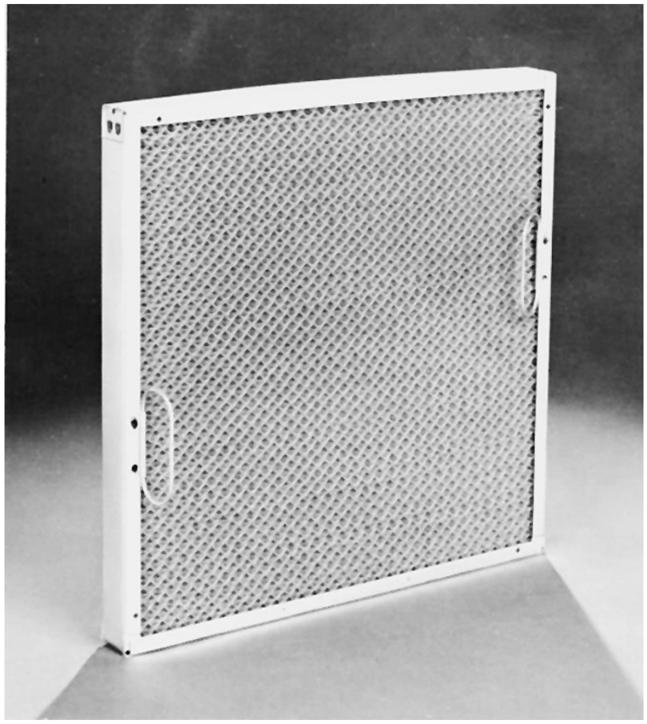

Fig. 9. Panel filters, permanent (Courtesy of American Air Filter Co.)

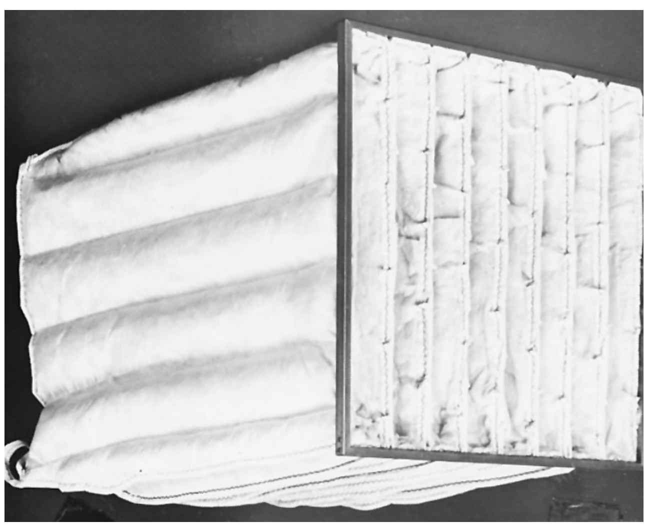

Fig. 10. Dry-type extended surface filters (bag type) (Courtesy of American Air Filter Co.)

Minimum efficiency reporting value (MERV) ratings are used to quantify the ability of an air conditioning filter to remove dust from the air as it passes through the filter and as a means of evaluating filter efficiency. Higher MERV ratings mean fewer dust particles pass through the filter. MERV ratings range from 1 to 16. Filters typically used for residences are often in the 1 to 4 MERV range and usually disposable filters. Filters for commercial and industrial use are typically in the 9 to 12 MERV range. Hospitals and other very clean environments will use filters in the 13 to 16 MERV range.

Fig. 11. Moving-curtain viscous or dry impingement automatic roll filters (Courtesy of American Air Filter Co.)

3.2.3.5 Fire Doors and Dampers

Fire subdivisions are vital in the control of fire spread. Consequently, openings in fire subdivisions must be protected. Fire doors and dampers can protect openings in fire subdivisions through which ducts, registers, and grills penetrate.

Fire doors and fire dampers are primarily for the prevention of fire spread, while smoke dampers are for the prevention of smoke spread. A fusible link responds to a rise in temperature, which is an indication of fire, but a smoke detector should be used if it is important to sense cool smoke. Fire dampers or doors can be arranged to have a dual function of stopping fire and/or smoke. To perform dual functions it is necessary to provide a release mechanism that is both thermally responsive and sensitive to signals from smoke detectors.

The air-conditioning system can spread smoke rapidly, and is normally shut down in the event of fire. However, special operating modes, other than shutdown, may be devised in particular situations to help restrict the spread of fire and smoke (Figure 3). Such systems must be designed with a knowledge of the fire and smoke situations that may occur, of the dominant mechanisms of smoke movement, delineation of smoke control objectives, and building air leakage characteristics.

The sprinkler alarm may be interconnected with the smoke control system to activate this system in case the smoke and heat detectors fail.

3.3 Panel Filters

3.3.1 Disposable Filters

Disposable panel filters are widely used as pre-filters to higher efficiency filters or to protect heating and cooling coils from becoming coated with dirt. These filters are made up of coarse fibers with high porosity. The filter media is coated with a viscous substance, such as oil, which acts as an adhesive on particles that impinge on the fibers.

3.3.2 Permanent Filters

Permanent metal filters are coated with a viscous adhesive to increase dust holding capacity. When the filters are fully loaded they are cleaned, a fresh coating of adhesive is applied, and they are reinstalled (Figure 9).

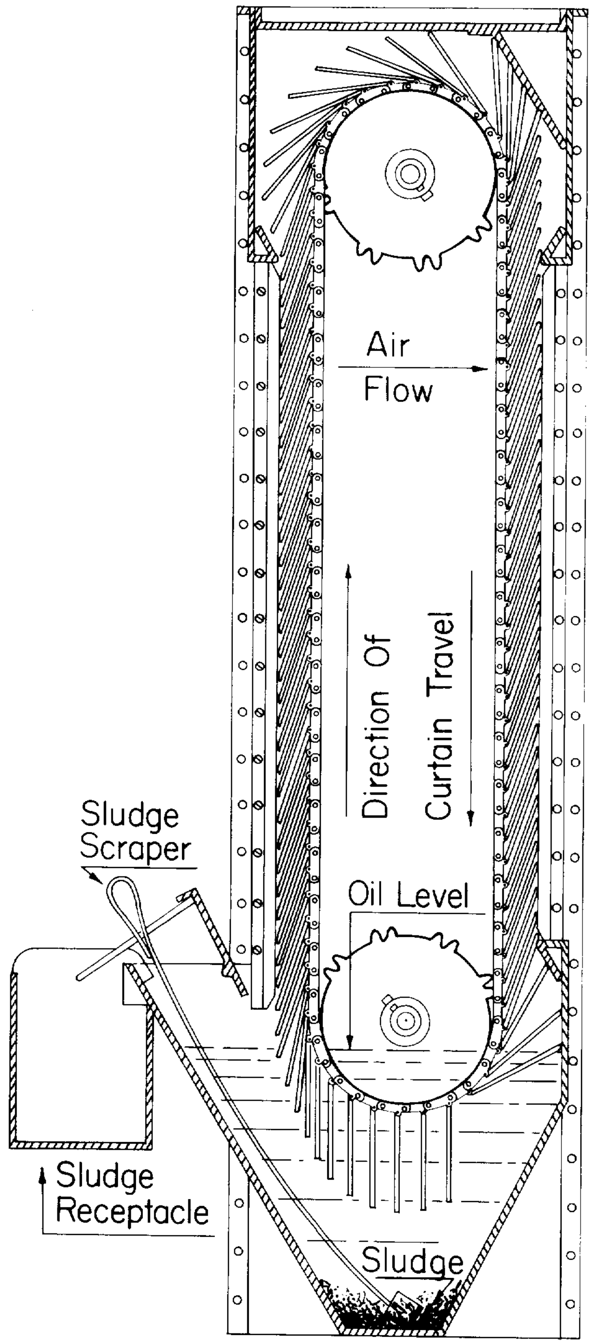

Fig. 12. Automatic self-cleaning viscous air filters (Courtesy of American Air Filter Co.)

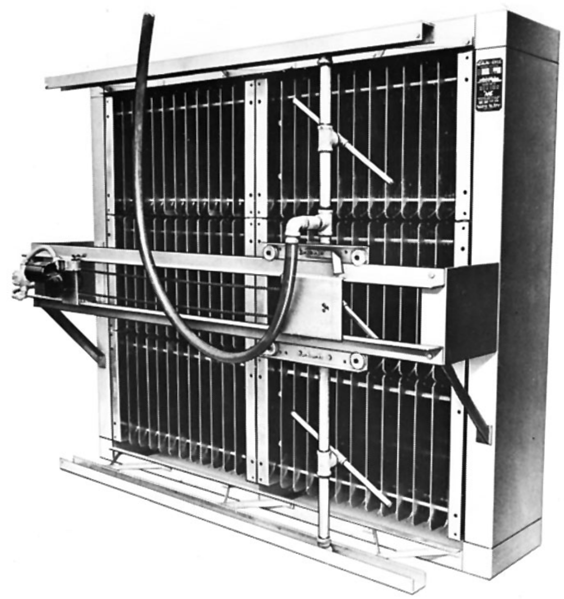

Fig. 13. Electronic air filters (Courtesy of American Air Filter Co.)

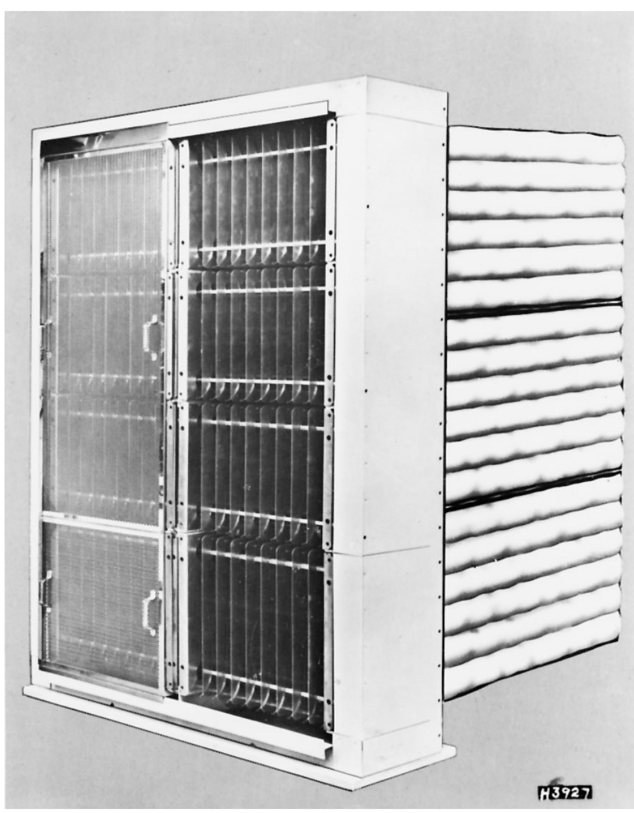

Fig. 14. Electronic air filters with extended surface filter storage section (Courtesy of American Air Filter Co.)

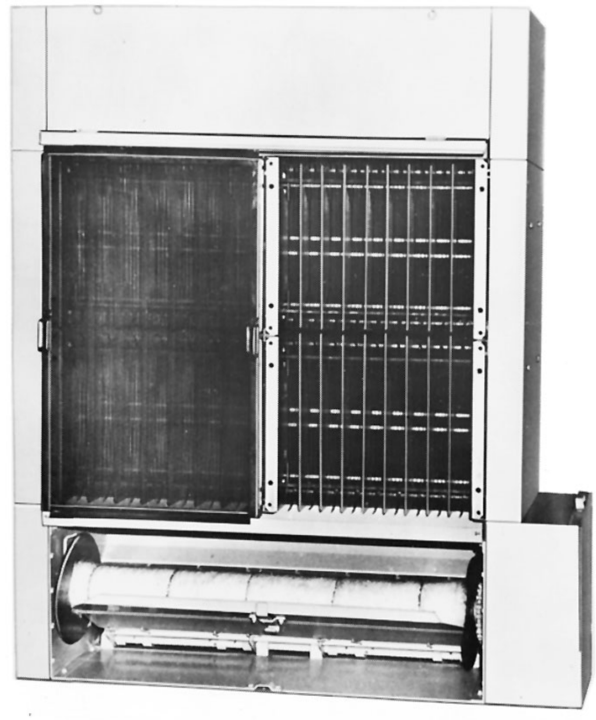

Fig. 15. Electronic air filters with automatic roll filter storage section (Courtesy of American Air Filter Co.)

3.4 Dry Extended Surface Filters (Bag Type)

The media used in this type of filter are random fiber mats or blankets of varying thickness, fiber, size, and densities. Media of bonded glass fiber, cellulose fibers, wool felt, asbestos, synthetics, and other materials have been used commercially. The medium in filters of this class is frequently supported by a wire frame in the form of pockets or V-shaped pleats. In other designs, the medium may be self-supporting because of inherent rigidity or because air flow inflates it into extended form (Figure 10). When the filters are filled with dirt, they are discarded and replaced with clean media.

3.5 Automatic Moving-Curtain Viscous or Dry Impingement Filters

Automatic moving-curtain viscous filters are available in two main types. In one type, random fiber medium is furnished in roll form. Fresh medium is fed automatically across the face of the filter, while the dirty medium is rewound onto a roll at the bottom. When the roll is exhausted, the tail of the medium is wound onto the take-up roll, and the entire dirty roll thrown away. A new roll is then installed, and the cycle repeated (Figure 11). Random fiber (nonwoven) dry media of relatively high porosity also are used in moving-curtain (roll) filters for general ventilation service (Figure 11). The arrangement is similar to the moving-curtain viscous impingement type filters. The main difference is that the medium is dry.

3.6 Automatic Self-Cleaning Viscous Air Filters

This type of filter is made in vertical self-contained sections of one base width and in a wide range of standard heights of 6, 8, 9, 10 and 12 ft (1.8, 2.4, 2.7, 3 and 3.65 m).

Each section consists of a base or reservoir assembly and top assembly joined by vertical side panels. The panels are arranged to overlap and form filtering curtains across the air openings at front and rear of the filter (Figure 12). The traveling curtain intermittently passes through the viscous adhesive reservoir, where the media give up dust load and at the same time take on a new coating of viscous adhesive. The media thus form a continuous curtain which moves up one face and down the other face. The media curtain, being formed of metal and continually cleaned and renewed with fresh adhesive, lasts the life of the filter mechanism.

Periodically, the precipitated dirt must be removed from the viscous adhesive reservoir. This is generally done by scraping the dirt into a tray, which can be conveniently suspended from the reservoir lip.

3.7 Electronic Air Filters

Electronic air filters use electrostatic principles to collect particle matter. However, they operate on lower voltages than the type commonly used in industrial systems. The more commonly used filters are the electronic type (Figure 13), electronic air filters with extended surface filter storage section (Figure 14), and electronic air filters with automatic roll filter storage section (Figure 15).

3.7.1 Electronic Type Filter

The collector plate assembly in this type of filter consists of alternately grounded and charged aluminum plates (Figure 13). A strong electrostatic field is set up between the plates by applying approximately 5800 volts direct current to the charged plates. Upon entering the field, the charged dust particles are repelled by the plates of the same polarity and attracted to the plates of opposite polarity. As these particles are precipitated onto the plates, they are held there by a viscous adhesive coating applied to the plates.

The filters are equipped with a motorized vertical washing header and adhesive applicator header complete with spray nozzles. The completely automatic washing and adhesive cycle may be initiated manually or automatically through a timing mechanism preset for job conditions. Frequency of maintenance varies with dirt load (approximately 2 to 6 weeks).

3.7.2 Electronic Air Filters with Extended Surface Filter Storage Section

The filter consists of a close-coupled agglomerator section and a storage section (Figure 14). The agglomerator section contains the all-aluminum plates. The ionizer voltage is 12.0 KV and the plate voltage 5.8 KV. All insulators are shielded from the dirty air stream.

The storage section consists of 2 by 2 ft (0.6 by 0.6 m), high-efficiency, dry-type replaceable cartridges. The cartridges are made of fiberglass fibers, supported on the air-leaving side by flexible scrim. This prevents the metal boxes from closing the grid. The replaceable cartridges are collapsible and do not require storage space of more than 2 by 2 by 4 ft (0.6 by 0.6 by 1.2 m) per cartridge.

Minute dust particles are electronically attracted and adhere to each other on the dry plates of the agglomerator section. As the trapped dust particles build up (agglomerate) on the collector plates, the mass increases until the accumulation is swept off the plates by the air stream. Dirt is then carried onto the media in the storage section.

3.7.3 Electronic Air Filters with Automatic Roll Filter Storage Section

The unit consists of an agglomerator section and storage section combined into one integral filter (Figure 15).

The electronic precipitation principle employed in the agglomerator section is a method of removing dust and smoke from the air by electrical attraction. This is accomplished by imposing an electrostatic charge of definite polarity on the dust particle through ionization, and collecting the charged particles on metal plates of opposite polarity.

Minute dust particles are electrostatically attracted and adhere to each other on the dry plates of the agglomerator section. As the trapped dust particles build up on the collector plates, the mass increases until the accumulation is swept off the plates by the air stream. This accumulation is then carried onto the bonded glass fiber media of the storage section.

The glass fiber blanket is fed automatically in small increments down the face of the storage section from a roll at the top. The used media and accumulated dirt are wound tightly into a compact roll at the bottom. The used roll is discarded and replaced with a new one.

Though the filtering medium itself may be noncombustible, in some cases, combustible dust and lint may accumulate in the filters during normal operations. This may cause substantial increase of the fire hazard in the air conditioning system.

4.0 REFERENCES

4.1 FM

Data Sheet 1-3, *High-Rise Buildings*
Data Sheet 1-42, *MFL Limiting Factors*
Data Sheet 1-56, *Cleanrooms*
Data Sheet 5-14, *Telecommunications*
Data Sheet 5-32, *Data Centers and Related Facilities*
Data Sheet 5-48, *Automatic Fire Detection*
Data Sheet 7-7, *Semiconductor Fabrication Facilities*
Data Sheet 7-13, *Mechanical Refrigeration*
Data Sheet 7-78, *Industrial Exhaust Systems*

4.2 Other

National Fire Protection Association (NFPA). NFPA 70, *National Electrical Code*.

National Fire Protection Association (NFPA). NFPA 90A, *Installation of Air Conditioning and Ventilating Systems*.

Underwriters Laboratories (UL). UL 586, *Standard for High Efficiency, Particulate, Air Filter Units*.

Underwriters Laboratories (UL). UL 900, *Standard for Safety Air Filter Units*.

American Society of Heating, Refrigerating and AirConditioning Engineers (ASHRAE). *2015 ASHRAE Handbook-HVAC Applications*.

APPENDIX A GLOSSARY OF TERMS

FM Approved: Product and services that have satisfied the criteria for FM Approval. Refer to the *Approval Guide*, an online resource of FM Approvals, for a complete listing of products and services that are FM Approved.

APPENDIX B DOCUMENT REVISION HISTORY

January 2018. This document has been completely revised. The following major changes were made:

A. Revised the scope section to refer to occupancy-specific data sheets for highly smoke-susceptible occupancies.

B. Updated recommendations related to the use of noncombustible air filters

C. Updated recommendations related to the protection of combustible air filters.

January 2012. Clarified the use of Class1/Class 2 air filters per revised UL listing process. Added detail on MERV ratings for filters.

May 2007. Added additional detail on fabric air duct systems and pre-insulated duct systems.

January 2001. The document has been reorganized to provide a consistent format.