

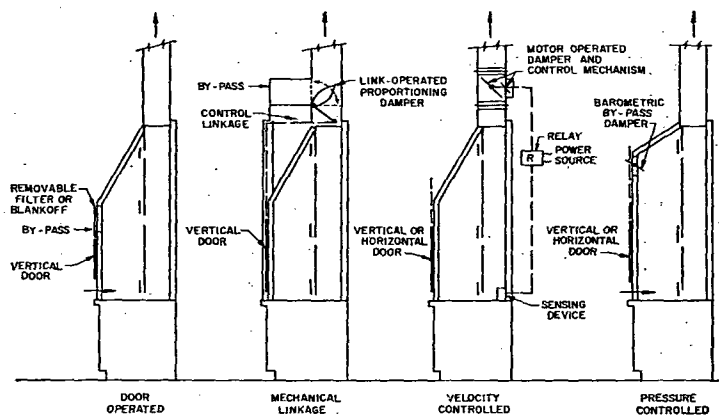


Fig. 2 Bypass Arrangements for Updraft Hoods

gasketed lighting fixtures and weatherstrip door seals, (4) adjustment of plenum slots for maximum exhaust at the head of the hood under high thermal operations, and (5) temperature or pressure sensing alarms for safety indication.

Face Velocity Control. Variations in the resistance of a hood exhaust system reflect directly in face velocity variations. Two common causes are: (1) varying the face opening, and (2) filter resistance build-up.

Doors on hoods do not contribute to hood performance but are often required for shielding purposes. In order to control face velocities between prescribed design limits on hoods equipped with doors, a proportional air bypass device is required. Two types applicable to hoods with single uplift doors are: (1) a bypass opening located in a front panel directly above the hood door positioned so that the door func-

tions as a damper as it is raised and lowered, and (2) a bypass damper opening to the hood canopy above the door which is mechanically linked to the door for proportional air bypass. Bypass devices applicable to both vertically or horizontally operable doors are: (1) a barometric damper responsive to the pressure variations produced in the hood as its face opening is varied, and (2) a bypass damper operated by an air velocity sensitive controller. Figs. 2 and 3 illustrate bypass arrangements.

Increases in fume hood exhaust system pressures due to filter loading can range from 25 to 35 percent of the clean filter condition when high efficiency filters are employed. Constant pressure regulation may be attained by an automatic pressure controlled damper in the duct system or by a similarly controlled bypass damper which admits air into the

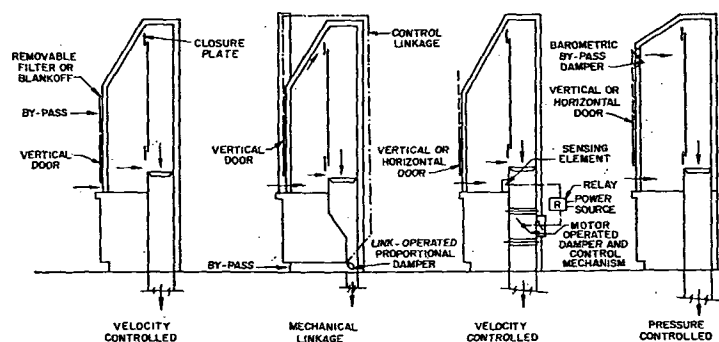


Fig. 3 Bypass Arrangements for Downdraft Hoods

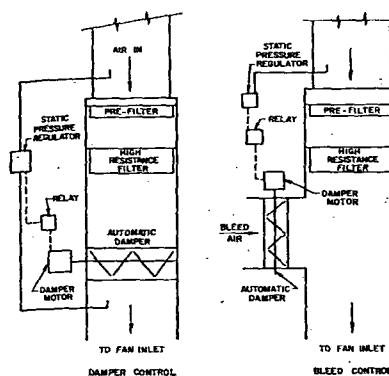


Fig. 4 Variable Resistance, Constant Volume Air Flow Control

exhaust system when the filter is clean and gradually closes as filter resistance builds up. Fig. 4 illustrates a variable resistance control.

Performance Tests. Performance tests for hoods require: (1) measured exhaust air rate by a calibrated orifice, (2) a traverse of face velocity readings in the plane of the face opening for maximum, intermediate and minimum openings, and (3) heavy and light smoke tests under varying door positions.

EXHAUST SYSTEMS

Laboratory exhaust systems can be classified on the basis of hood characteristics and the method of system operation and control as: (1) constant volume, and (2) variable volume systems. These classifications can be further defined on the basis of the arrangement of the major system components such as the fans, plenums or duct mains, and branches as: (a) individual, or (b) central systems.

Constant Volume Systems

A constant volume system exhausts a fixed air quantity from each hood. Hoods served by such systems and equipped with doors must have individual bypasses for air volume and face velocity regulation.

Since a system of this type will function with the same air volume being handled for any given set of conditions, the total number of exhaust hoods which can be installed throughout the facility must be limited by the capacity of the exhaust system and the ability of the supply system to provide make-up air. Constant volume systems are simple to balance and highly stable, and in most installations there is no need for continuous control of air balance during normal operation.

The constant volume system is flexible with respect to the number and location of hoods but may incur high owning and operating costs because of the large air volumes handled. These costs may impose a practical limitation on the total number of hoods that can be installed in the building.

Variable Volume Systems

Since laboratory air is usually not re-circulated, the cost of circulating, heating and cooling may be high if based upon

the maximum air demand. In most laboratories, the installed hood capacity is seldom actively used at any one time and a system which enables the application of a usage diversity factor to the installed hood capacity can reduce the size of the exhaust system required. Operating economies can be achieved by reducing the air flow during periods when the hoods are not in use or when they may be operated at less than full capacity. A reduction in exhaust air volume coupled with constant hood face velocity when the hood face opening is partially closed may be achieved by the control arrangement shown for the velocity-controlled hood in Fig. 2. The sensing element responds to changes in hood face velocity and operates a motorized damper in the exhaust duct to maintain the face velocity within the desired range. When the hood is served by an individual exhaust fan, the operation of the damper will usually be sufficient to reduce the fan capacity but it may be supplemented by a static pressure regulator in the duct operating inlet vanes or a discharge damper at the fan. In large central systems, a manual damper affords a satisfactory means for branch ducts but it must be supplemented by static pressure regulators in the exhaust plenums operating fan inlet vanes or discharge dampers for system volume regulation.

Variable volume systems can provide initial and operating economies by limiting the normal operating air handling to less than the total required to exhaust all of the hoods and by permitting the shutting down of inactive hoods during off shifts. More freedom in the installation of hoods is permissible since the total number of hoods that may be provided is not directly dependent on the capacity of the exhaust system.

Variable volume systems, however, are difficult to balance, less stable in operation and more difficult to control than constant volume systems. Extensive, sensitive instrumentation and controls are required with high initial and maintenance costs.

A particular operating problem is the regulation of the total simultaneous operating hood openings to match design hood usage factors. If the collective area of operating hood openings at any one time exceeds design opening diversity values face velocity requirements will not be achieved. If, on the other hand, total hood openings are less than design values, bypass devices are required on hoods to maintain supply air rates, provide adequate thermal capacity, and assure air balance and flow patterns.

Individual Systems

Individual exhaust systems utilize a separate exhaust connection, exhaust fan, and discharge duct for each fume hood. This arrangement is extremely flexible since the exhaust for the hood or space served by the fan or exhaust duct does not directly affect the operation of any other area of the building. The individual system permits selective operation of individual hoods by simply starting or stopping the fan motor. Shutdowns for repair or maintenance are localized. The unitary arrangement permits selective application of: (1) special exhaust air filtration, (2) special duct and fan construction for corrosive fumes, (3) emergency power connections to fan motors, and (4) off-hour operation. Individual exhaust fans are simple to balance and when coupled with constant air volume provide a very stable and very easily controlled system.

Although more fans are used than for central systems, the overall space requirements are usually less for individual systems because of the small, direct duct connections.

Where high discharge stacks are required because of extreme, generalized contamination of the effluent, individual systems may not be applicable.