

one-fifteenth of the open area of the hood. Frequently, it will be found necessary to branch the main duct in order to obtain a uniform distribution of flow. *Canopy hoods* should extend 6 in. laterally from the tank for every 12 in. elevation, and wherever possible they should have side and rear aprons so as to prevent short circuiting of air from spaces not directly over the vats or tanks. In most cases, hoods of this type take advantage of the natural tendency of the vapors to rise, and air velocities may be kept low. Cross drafts from open doors or windows disturb the rise of the vapors and therefore provision must be made for them. The air velocities required also depend upon the character of the vapors given off, cyanide fumes, for example, requiring an air velocity of approximately 75 fpm on the surface of the tank and acid and steam vapors requiring velocities as low as 25 to 50 fpm. The total volume of air flow necessary to obtain these velocities may be approximately determined from the equation:

$$Q = 1.4 PDV \quad (4)$$

where

Q = total volume of air handled by hood, cubic feet per minute.

P = perimeter of the tank, feet.

D = distance between tank and hood opening, feet.

V = air velocity desired along edges and surface of tank, feet per minute.

Lateral Exhaust Systems

The lateral exhaust method, as developed for chromium plating⁸, is applicable in many instances in preference to the canopy type hoods. The method makes use of drawing air and fumes laterally across the top of vats or tanks into slotted ducts at the top and extending fully along one or more sides of the tanks. The slots are 1 in. wide and for effective ventilation a 2000 fpm exhaust air velocity at the slot face is advisable. In addition, the duct should not be required to draw the air laterally for a distance of more than 18 in. and the level of the solution should be kept 6 to 8 in. below the top of the tanks.

It has also been determined that a similar control may be used for tanks wider than 3 ft when the same velocity (2000 fpm) is maintained through a slot which is increased $\frac{1}{4}$ in. for every foot of width greater than 3 ft. When these slots must be extended more than 6 ft in length some method of spreading the flow is necessary to provide even air flow distribution through the entire slot length. This can be accomplished by tapering the slot, which incidentally will add to the resistance of the system. A more economical approach is to place properly spaced vanes in the side ducts, or to branch the side ducts⁹.

The flexible exhaust tube method may be advantageously used for removing dust or fumes. Flexible tubes having one end connected to an exhaust system and a slotted hood attached to the other end may be shaped at will to fit in with industrial processes without affecting the ease

of operation. Efficient dust or fume removal may be had with use of relatively small exhaust volumes. This type of system may be used on swing grinders, portable grinding wheels, soldering operations, stone cutting, rock drilling, etc.

Spray Booths

In the design of an efficient spray booth, it is essential to maintain an even distribution of air flow through the opening and about the object being sprayed. While in many instances spraying operations can be performed mechanically in wholly enclosed booths, the volatile vapors may reach injurious or explosive concentrations. At all times the concentrations of these vapors, and particularly those containing benzol, should be kept well below 100 parts per million in the breathing zone of the worker. Spray booth vapors are dangerous to the health of the worker and care should be taken to minimize exposure to them.

It is recommended in the design of spray booths that the exhaust duct be located at the end of the booth opposite the opening. In front of this duct should be placed baffle plates which will cause a uniform air velocity distribution across the frontal area. The air volume should be sufficient to maintain a velocity of not less than 100 fpm over the open area of the booth (150 fpm is preferable where benzol or lead is present in the paint) and the vapors should be discharged through a suitable stack to permit dilution. It is good practice to pass the fumes or vapors through baffle type washers or scrubbers designed for efficient spray removal.

Hoods for Chemical Laboratories

Hoods used in chemical laboratories are generally provided with sliding windows which permit positive control of the fumes and vapors evolved by the apparatus. Their design should offer easy access for the installation of chemical equipment and should be well lighted. Air velocities should exceed 50 fpm when the window is opened to its maximum height.

Kitchen Hoods

The length and width of kitchen hoods should be such as to extend beyond the extreme projection of the ranges, broilers, etc., over which they are installed. The minimum projection or overlap should be 12 in. Where space conditions permit, range hoods should be about 2 ft high so as to provide a reservoir to confine momentary bursts of smoke and steam until the exhaust system can evacuate the hood. As in the case of industrial hoods, range hoods should be located as low as possible to increase their effectiveness.

In general the amount of air to be exhausted from restaurant range hoods is at the rate of 100 fpm per square foot of face area. Thus, a hood 4.5 ft wide by 30 ft long has a face area of 135 sq ft, which multiplied by 100 fpm velocity results in a total air quantity to be exhausted of 13,500 cfm. In some cases where the application is principally frying and where it is not practical to install a hood 2 ft high it is recommended that the face velocity be increased from 100 to 150 fpm, depending on peak load conditions in the kitchen. Exhaust connections to range hoods should always be made at the top and back of hoods, and should be spaced pref-

⁸Health Hazards in Chromium Plating, by J. J. Bloomfield and William Blum (*U. S. Public Health Report*, Vol. 43, No. 26, September 7, 1928).

⁹New Data for Practical Design of Ventilation for Electroplating, by W. P. Battista, Theodore Hatch and Leonard Greenburg (*Heating, Piping and Air Conditioning*, February, 1941, p. 81). Ventilation of Plating Tanks, by Allen D. Brandt (*Heating, Piping and Air Conditioning*, July, 1941, p. 434).