CHAPTER 41

LOCAL EXHAUST SYSTEMS

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INTRODUCTION

Local exhaust systems are employed to capture air contaminants — dusts, fumes, mists, vapors, hot air and even odors — at or near their point of generation or dispersion, to reduce contamination of the breathing zone of workers. Local ventilation is frequently used and is generally the preferred method for controlling atmospheric concentrations of airborne materials that present potential health hazards in the work environment. As discussed in Chapter 39, this type of ventilation is preferred over general exhaust ventilation for the following reasons:[1-2]

1. If the local exhaust system is properly designed, the control of a contaminant can be complete; therefore, the exposure of workmen to contaminants from the sources exhausted can be prevented. With general ventilation the contaminant concentration has been diluted where the exposure occurs, and at any given workplace this dilution may be highly variable, and therefore inadequate at certain times.
2. The volume of required exhaust is usually much less with local ventilation; therefore, the required volume of make-up air is less. A saving in both capital investment and heating and cooling costs is realized.
3. The contaminant is concentrated in a smaller volume of air; therefore, if a dust collector or other air pollution control device is needed, it is less costly. As a first approximation the costs of air pollution control are proportional to the volumetric rate of air handled.
4. Many local exhaust systems can be designed to capture large settleable particles or at least confine them within an enclosure, and thus greatly reduce the labor required for housekeeping.
5. Auxiliary equipment in the workroom is better protected from the deleterious effects of the contaminant, such as corrosion and abrasion.
6. Local exhaust systems usually require a fan of higher pressure characteristics to overcome pressure losses in the ventilation system. Therefore, the performance of the fan system is not likely to be grossly affected by wind velocity or an inadequate supply of make-up air. This is in contrast to general ventilation which can be affected severely by seasonal factors or an inadequate supply of make-up air.

COMPONENTS OF A LOCAL EXHAUST SYSTEM

A local exhaust system consists of four elements as shown in Figure 41-1: 1) hoods, 2) ducts, 3) air cleaning device (cleaner) and 4) air moving device (fan).

Typically, the system is a network of branch ducts connected to hoods or enclosures, main ducts, air cleaner for separating solid contaminants from the air stream, an exhaust fan, and a discharge stack to the outside atmosphere.

Hoods

A hood is a structure designed to enclose or partially enclose a contaminant-producing operation and to guide air flow in an efficient manner to capture a contaminant. The hood is connected to the ventilation system via a duct which removes the contaminant from the hood. The design and location of the hood is crucial in determining the success of a local exhaust system.

Ductwork

The function of the ductwork in an exhaust system is to provide a channel for flow of the contaminated air exhausted from the hood to the point of discharge. The importance of the ductwork design is underscored in the following points:

a. In the case of dust, the duct velocity must be high enough to prevent the dust from settling out and plugging the ductwork.
b. In the absence of dust, the duct velocity should strike an economic balance between ductwork cost and fan, motor and power costs.
c. The location and construction of the ductwork must provide sufficient protection against external damage, corrosion and erosion, to provide a long, useful life for the local exhaust system.

Air Cleaner

Most exhaust systems for contaminants other than hot air need an air cleaner. Occasionally the collected material has some economic reuse value, but usually this is not the case. To collect and dispose of the contaminant is usually inconvenient and an added expense.

This subject is discussed in greater detail in Chapter 43; it is beyond the scope of this chapter to elaborate on the details of air cleaning for exhaust gas streams. Obviously, the growing concern with air pollution control, and attainment of air quality goals by legal restriction of emissions from sources of atmospheric discharge, place new importance on the air cleaning device within a local exhaust system.

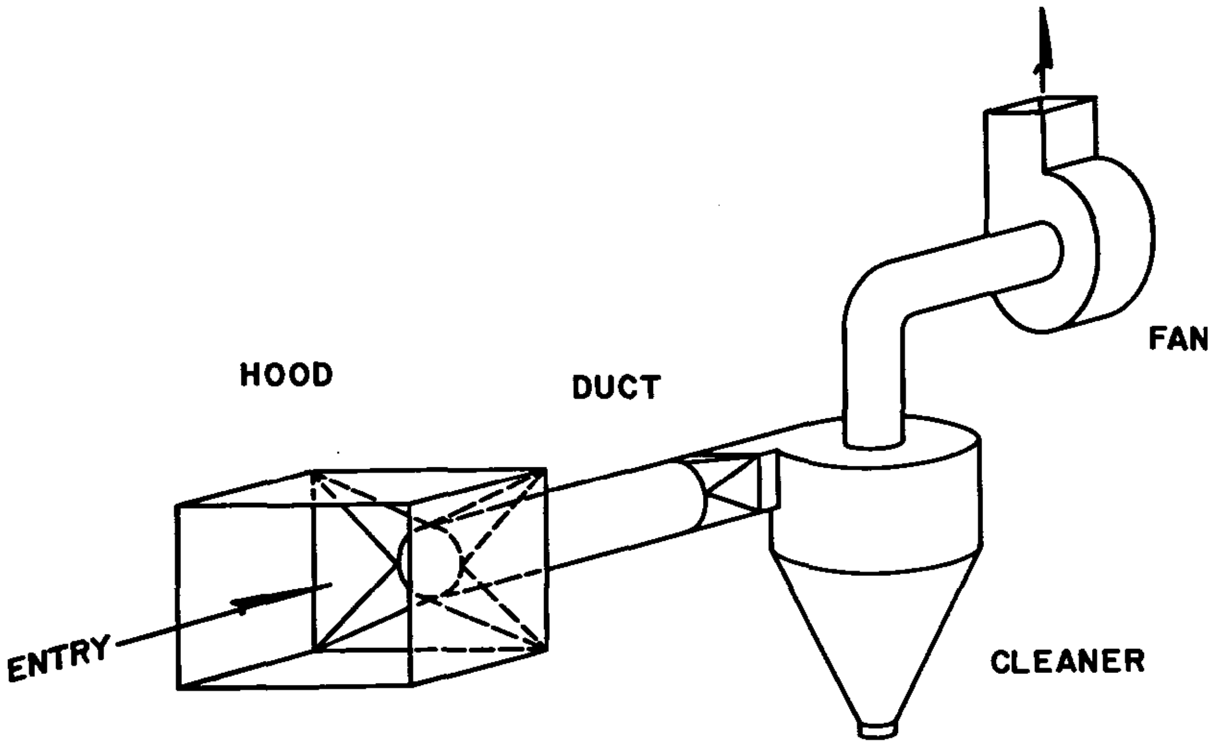


Figure 41-1. Elements of a Local Exhaust System

Air Moving Device

Centrifugal fans are the mainstay of air movers for local exhaust systems. Wherever practicable a fan should be placed downstream from the collector so that it will handle clean air. In such an arrangement, the fan wheel can be the backward curved blade type which has a relatively high efficiency and low power cost. For equivalent air handling the forward curved blade impellers run at somewhat lower speeds, and where noise is a factor, this may be important. Where chips and other particulate matter have to pass through the impeller, the straight blade or paddle wheel type fan is best because it is least likely to clog.

Fans and motors should be mounted on substantial platforms or bases and isolated by anti-vibration mounts. At the fan inlet and outlet the main duct should attach through a vibration isolator — a sleeve or band of very flexible material, such as rubber or fabric.

When the system has several branch connections, consideration should be given to using a belt drive instead of direct connected motor. The need for increased air flow at a future date can then be accommodated, to some degree, by adjusting the fan speed. The subject of air movers is covered in greater detail in Chapter 42.

PRINCIPLES OF LOCAL EXHAUST

When applying local exhaust ventilation to a specific problem, control of the contaminant is more effective if the following basic principles are followed:

1. Enclose the source as completely as practicable;
2. Capture the contaminant with adequate velocities;
3. Keep the contaminant out of worker's breathing zone;
4. Supply adequate make-up air; and
5. Discharge the exhausted air away from air inlet systems.

Enclose the Source

A process to be exhausted by local ventilation should be enclosed as much as possible. This will generally provide better control per unit volume of air exhausted. This principle is illustrated in Figure 41-2. Nevertheless, the requirement of adequate access to the process must always be considered. An enclosed process may be costly in terms of operating efficiency or capital expenditure, but the savings gained by exhausting smaller air volumes may make the enclosure worthwhile.

Capture the Contaminant with Adequate Velocities

Air velocity through all hood openings must be high enough to contain the contaminant and, moreover, remove the contaminant from the hood. The importance of optimum capture and control velocity is discussed further in the following sections.

Keep the Contaminant Out of Worker's Breathing Zone

Exhaust hoods that do not completely enclose the process should be located as near as possible to the point of contaminant generation and should provide air flow in a direction away from the worker toward the contaminant source (see Figure 41-3).

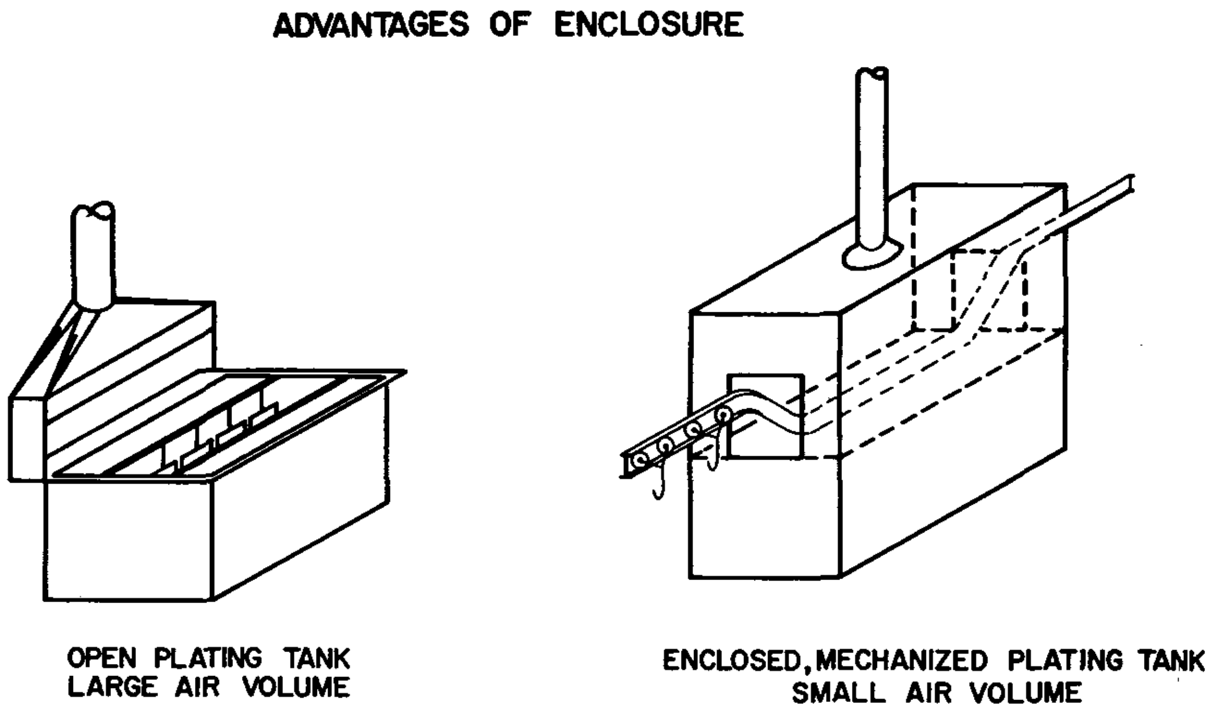


Figure 41-2. Advantages of Enclosure.

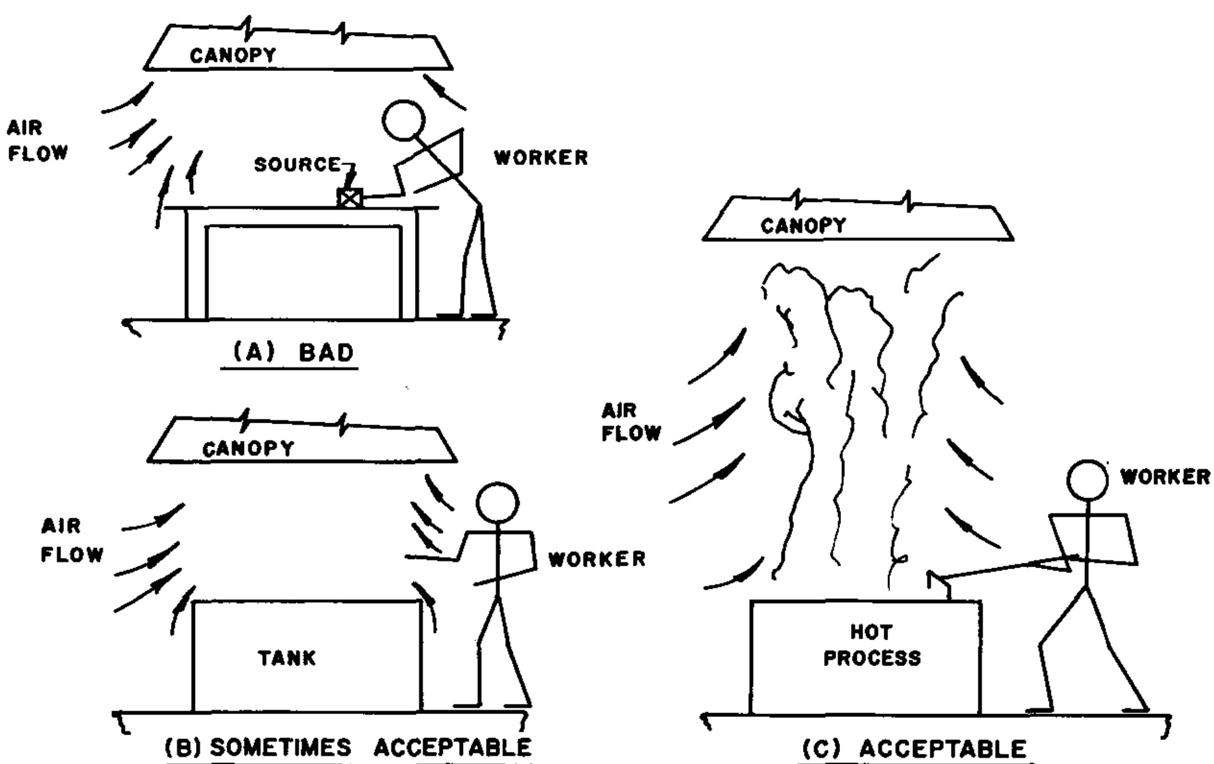


Figure 41-3. Use and Misuse of Canopy Hoods.

This item is closely related to the characteristics of blowing and exhausting from openings in ductwork and is also considered in more detail in the following sections.

Provide Adequate Air Supply

Every cubic foot of air that is exhausted from a building or enclosure must be replaced to keep the building from operating under negative pressure. This applies to local exhaust systems as well as general exhaust systems. Additionally, the incoming air must be tempered by a make-up air system before being distributed inside the processing area. Without sufficient make-up air, exhaust ventilation systems cannot work as efficiently as intended.

Discharge the Exhausted Air Away from Air Inlets

The beneficial effect of a well-designed local-exhaust system can be offset by undesired recirculation of contaminated air back into the work area. Such recirculation can occur if the exhausted air is not discharged away from supply air inlets. The location of the exhaust stack, its height, and the type of stack weather cap all can have a significant effect on the likelihood of contaminated air re-entering through nearby windows and supply air intakes. This subject is treated in more detail in Chapter 42.

FUNDAMENTAL CONCEPTS IN LOCAL EXHAUST VENTILATION

Capture and Control Velocities

All local exhaust hoods perform their function in one of two ways. One way is by creating air movement which draws the contaminant into the hood. The air velocity created at a point outside a non-enclosing hood, which accomplishes this objective, is called "capture velocity." Other exhaust hoods essentially enclose the contaminant source and create an air movement which prevents the contaminant from escaping from the enclosure. The air velocity created at the openings of such hoods is called the "control velocity."

The determination of the two quantities, control velocity and capture velocity, is the basis for the successful design of any exhaust hood. The air velocity which must be developed by the exhaust hood at the point or in the area of desired control is based on the magnitude and direction of the air motion to be overcome and is not subject to direct and exact evaluation (see Table 41-1). Many empirical ventilation standards, especially concerning dusty equipment like screens and conveyor belt transfers, are based on "cfm per foot of belt width" or similar parameters. These are called exhausted rate standards. They are easily applied, are usually based on successful experience, and usually give satisfactory results if not extrapolated too far. In addition, they minimize the effort and uncertainty involved in calculating the fan action of falling material, thermal heads within hoods, air currents, etc. However, such standards have three major pitfalls:

1. They are not fundamental.
2. They presuppose a certain minimum quality of hood or enclosure design although it may not be possible or practical to achieve the same quality of hood design in a new installation.
3. They are valid only for circumstances sim-

TABLE 41-1
RANGE OF CAPTURE VELOCITIES*

Condition of Dispersion of Contaminant	Examples	Capture Velocity, fpm
Released with practically no velocity into quiet air.	Evaporation from tanks; degreasing, etc.	50-100
Released at low velocity into moderately still air.	Spray booths; intermittent container filling; low speed conveyor transfers; welding; plating; pickling.	100-200
Active generation into zone of rapid air motion.	Spray painting in shallow booths; barrel filling; conveyor loading; crushers.	200-500
Released at high initial velocity into zone of very rapid air motion.	Grinding; abrasive blasting,	500-2000

In each category above, a range of capture velocity is shown. The proper choice of values depends on several factors:

Lower End of Range	*Upper End of Range*
1. Room air currents minimal or favorable to capture.	1. Disturbing room air current.
2. Contaminants of low toxicity or of nuisance value only.	2. Contaminants of high toxicity.
3. Intermittent, low production.	3. High production, heavy use.
4. Large hood — large air mass in motion.	4. Small hood — local control only.

*Comm. on Industrial Ventilation, *Industrial Ventilation*, 12th edition, ACGIH, p. 4-5.

ilar to those which led to their adoption. It should be clear then, that the nature of the process generating the contaminant will have an important role in determining the required capture velocity.

Air Flow Characteristics of Blowing and Exhausting

The flow characteristics at a suction opening are much different from the flow pattern on a supply or discharge opening. Air blown from an opening maintains its directional effect in a fashion similar to water squirting from a hose. The effect is so pronounced that it is often called "throw." However, if the flow of air through the same opening is changed such that it operates as an exhaust or intake opening with the same volumetric rate of air flow, the flow becomes almost completely nondirectional and its range of influence is greatly reduced. As a first approximation, when air is blown from a small opening, the velocity thirty diameters in front of the plane of the opening is about 10% of the velocity at the discharge. However, the same reduction in velocity is achieved at a much smaller distance in the case of exhausted openings, such that the velocity equals 10% of the face velocity at a distance of one diameter from the exhaust opening. Figure 41-4 illustrates this point. For this reason, local exhaust hoods must not be applied for any operation which cannot be conducted in the immediate vicinity of the hood.

Air Flow into Openings

Air flow into round openings was studied extensively by DallaValle.[3] His theory of air flow into openings is based on a point source of suction which draws air from all directions. The velocity at any point in front (distance X) of such a source is equivalent to the quantity of air (Q) flowing to the source divided by the effective area of the sphere of the same radius.

Conversely,

$$Q = VA$$

$$A = 4\pi X^2$$

So, $$Q = V(12.57\,X^2)$$

Where Q = air flow, cfm
V = velocity at point X, fpm
X = centerline distance, ft
A = pipe area, ft^2
π = 3.1416, dimensionless constant

Postulating that a point source is approximated by the end of an open pipe, Dalla Valle[3] and Brandt[4] determined the actual velocity contours for a circular opening, as shown in Figure 41-5. These contours, or lines of constant velocity, are best described by the following equation:

$$Q = V\,(10\,X^2 + A)$$

Effects of Flanging

Flanges surrounding a hood opening force air to flow mostly from the zone directly in front of the hood. Thus, the addition of a flange to an open duct or pipe improves the efficiency of the duct as a hood for a distance of about one diameter as shown in the following equation:

$$Q = 0.75\,V\,(10\,X^2 + A)$$

For a flanged opening on a table or bench:

$$Q = 0.5\,V\,(10\,X^2 + A)$$

Table 41-2 illustrates other hood types and gives the air volume formulae which apply.[2]

Slots

Caution must be used in applying the generalized continuity equation when the width to length ratio (aspect ratio) of an exhaust opening approaches 0.1, since the opening becomes more like a slot. Using the same line of reasoning as

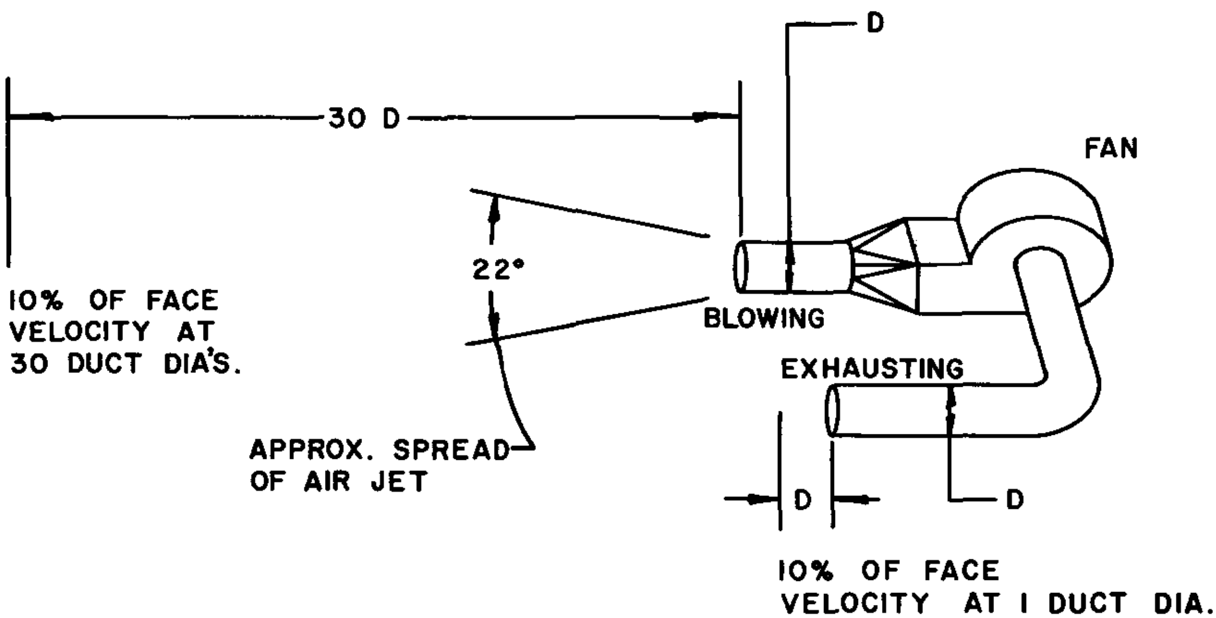
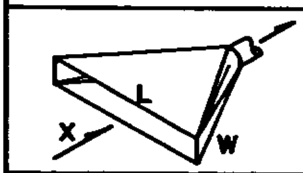
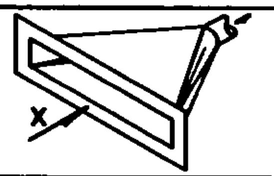
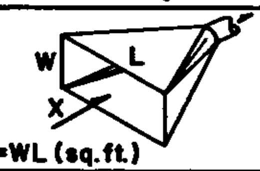
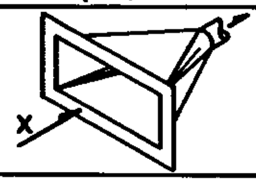
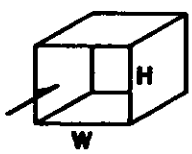
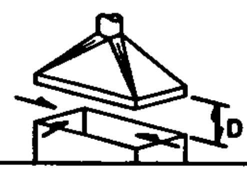


Figure 41-4. Air Flow Characteristics of Blowing and Exhausting.

TABLE 41-2
INDUSTRIAL VENTILATION*

HOOD EXHAUST VS. CAPTURE VELOCITY

HOOD TYPE	DESCRIPTION	ASPECT RATIO $\frac{W}{L}$	AIR VOLUME
	SLOT	0.2 OR LESS	Q=3.7 LVX
	FLANGED SLOT	0.2 OR LESS	Q=2.8 LVX
 A=WL (sq.ft.)	PLAIN OPENING	0.2 OR GREATER AND ROUND	$Q=V(10X^2+A)$
	FLANGED OPENING	0.2 OR GREATER AND ROUND	$Q=0.75V(10X^2+A)$
	BOOTH	TO SUIT WORK	Q=VA=VWH
	CANOPY	TO SUIT WORK	Q=1.4 PVD P=PERIMETER D=HEIGHT

*Comm. on Industrial Ventilation, *Industrial Ventilation*, 12th edition, ACGIH, p. 4-4.

DallaVallee, Silverman[5] considered the slot to be a line source of suction. Disregarding the end, the area of influence then approaches a cylinder and the velocity is given by:

$$V=\frac{Q}{2\pi XL}$$

Where: L = length of slot, ft.
X = centerline distance, ft.
π = 3.1416, dimensionless constant

Correcting for empirical versus theoretical considerations, the design equation which best applies for freely suspended slots is:

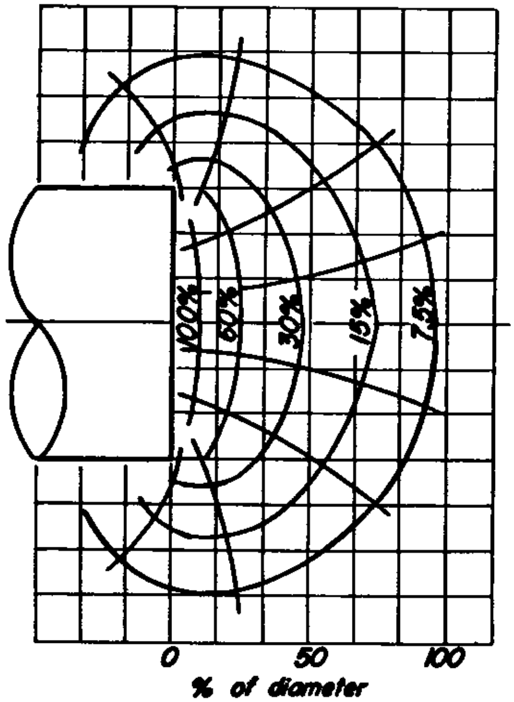
$$V=\frac{Q}{3.7\,XL}$$

Flanging the slots will give the same benefits as flanging an open pipe so that only 75% of the air is required to produce the same velocity at a given point. Therefore, for a flanged slot:

$$V=\frac{Q}{2.8\,XL}$$

Air Distribution in Hoods

To provide efficient capture with a minimum expenditure of energy, the air flow across the face of a hood should be uniform throughout its cross section. For slots and lateral exhaust applications this can be done by a "fish tailing" design. An easier method of design is to provide a velocity of 2,000-2,500 feet per minute into the slot with a low velocity plenum or large area chamber behind it. For large, shallow hoods, such as paint spray



American Conference of Governmental Industrial Hygienists — Committee on Industrial Ventilation: Industrial Ventilation — A Manual of Recommended Practice, 12th Edition. Lansing, Michigan, 1972.

Figure 41-5. Velocity Contours for a Circular Opening.

booths, lab hoods, and draft shake-out hoods, the same principle may be used. In these cases unequal flow may occur with a concentration of higher velocities near the take-offs. Baffles provided for the hood improve the air distribution and reduce pressure drop in the hood giving the plenum effect. Where the face velocity over the whole hood is relatively high or where the hood or booth is quite deep, baffles may not be required.

Entrance Losses in Hoods

The negative static pressure that is exhibited in the ductwork a short distance downstream from the hood is called the "hood static pressure," SP_h. This term represents the energy needed to:

1. Accelerate the air from ambient velocity (often near zero) to the duct velocity;
2. Overcome the frictional losses resulting from turbulence of the air upon entering the hood and ductwork.

Therefore, $SP_h = VP + h_e$

where VP = velocity pressure in the duct

and h_e = hood entry loss

The hood entry loss, h_e is expressed as a function of the velocity pressure, VP. For most types of hoods $h_e = F_h VP$, where F_h is the hood entry loss factor. For plain hoods where the hood entry loss is a single expression, $F_h VP$, the VP referred to is the duct velocity pressure. The hood static pressure can be expressed as:

$$SP_h = VP_{duct} + h_e$$

$$\text{or} \quad SP_h = VP_{duct} + F_h VP_{duct} = (1 + F_h)\, VP_{duct}$$

However, for slot and plenum or compound hoods there are two entry losses; one through the slot and the other into the duct. Thus,

$$SP_h = he_{slot} + VP_{duct} + he_{duct} =$$

$$F_{slot} \times VP_{slot} + VP_{duct} + F_{duct} \times VP_{duct}.$$

The velocity pressure resulting from acceleration through the slot is not lost as long as the slot velocity is less than the duct velocity, as is usually the case.

Another constant used to define the performance of a hood is "coefficient of entry," C_e. This is defined as a ratio of the actual air flow to the flow that would exist if all the static pressure were present as velocity pressure. Thus,

$$C_e = \frac{Q \text{ actual}}{Q_{VP} = SP_h} = \frac{4{,}005\, A\sqrt{VP}}{4{,}005\, A\sqrt{SP_h}} = \sqrt{\frac{VP}{SP_h}}$$

This quantity is constant for a given shape of hood and is very useful for determining the flow into a hood by a single hood static pressure reading. The coefficient of entry, C_e, is related to the hood entry loss factor, F_h, by the following equation only where the hood entry loss is a single expression:

$$C_e = \sqrt{\frac{1}{1 + F_h}}$$

Page 4-12 (Figure 4-8) of *Industrial Ventilation* provides a listing of the entry loss coefficient (C_e) and the entry loss (h_e) in terms of velocity pressure (VP). Most of the more complicated hoods have coefficients obtained by combining some of these simpler shapes.

Static Suction

One method of specifying the air volume for a hood is to specify the hood static pressure, SP_h, and duct size. The hood static pressure at a typical grinding wheel hood is two inches of water. This reflects a conveying velocity of 4500 feet per minute and entrance coefficient (C_e) of 0.78. For other types of machinery where the type of exhaust hood is relatively standard, a specification of the static suction and the duct size is given in Alden[6] and other reference sources. Specification of the static suction without duct size is, of course, meaningless because decreased size increases velocity pressure and static suction, while actually decreasing the total flow and the degree of control. Therefore, static suction measurements for standard hoods or for systems where the air flow has been measured previously are quite useful to estimate, in a comparative way, the quantity of air flowing through the hood.

Duct Velocity for Dusts and Fumes

The air velocity for transporting dusts and fumes through ductwork must be high enough that the particles will not settle and plug the ducts. This minimum velocity, called "transport velocity," is typically 3,500 to 4,000 linear feet per minute. At these velocities, frictional loss from air moving along the surface of the ducts becomes significant; therefore, all fittings, such as elbows and branches, must be wide-swept, gradual, and with smooth interior surfaces. The cross-sectional area of the main duct generally will equal the sum of the areas of cross sections for all branches upstream, plus a safety factor of approximately twenty percent. When the main duct is enlarged to accommodate an additional branch, the connection should be tapered and not abrupt.

Local exhaust systems for gases and vapors may have lower duct velocities (1,500 to 2,500 feet per minute) because there is little to settle and plug the ducts. Lower velocities reduce markedly the frictional and pressure losses against which the fan must operate, thereby realizing a saving in power cost for the same air flow.

EXHAUST HOODS AND THEIR APPLICATIONS

The local exhaust "hood" is the point at which air enters the exhaust system, and the term is used in a broad sense to include all suction openings, regardless of their shape or their physical disposition. Hoods in the context of this discussion embrace all types of such openings including suspended, canopy-type hoods, booths, exhausts through grille work in the floor or bench top, slots along the edge of a tank or table, the open end of a pipe, and, in a general sense, exhaust from most enclosures.

Hoods ventilate process equipment by capturing emissions of heat or air contaminants which are then conveyed through ductwork to a more convenient discharge point or to air pollution control equipment. The quantity of air required to capture and convey the air contaminants depends upon the size and shape of the hood, its position relative to the points of emission and the nature and quantity of the air contaminants.

Exhaust hoods should enclose as effectively as practical the points where the contaminant is released. They should create air flow through the zone of contaminant release of such magnitude and direction so as to carry the contaminated air into the exhaust system. Exhaust hoods and enclosures may also serve the important function of keeping materials in the process by preventing their dispersion.

Hoods can be classified conveniently into three broad groups: enclosures, receiving hoods, and exterior hoods. Booths, such as the common spray-painting enclosure, are a special case of enclosing hoods and will be discussed separately.

Enclosures

Enclosures normally surround the point of emission or contaminant generation, either completely or partially. In essence, they surround the contaminant source to such a degree that all dispersive actions take place within the confines of the hood. Because of this, enclosures require the lowest exhaust rate of the three hood types. A typical enclosed hood is illustrated in Figure 41-6.

Enclosure hoods are economical and efficient. They should be used whenever possible, especially when the contaminant is a hazardous material. Materials having high toxicity or corrosiveness and fine dusts must be effectively controlled for workers' health and safety. Hoods handling these materials should be carefully designed so as not to accumulate the contaminants.

Booth Type Hoods

Booths are typified by the common laboratory hood or spray painting booth in which one face of an otherwise complete enclosure is open for access. Air contamination takes place inside the enclosure and air is exhausted from it at such a rate as to induce an average velocity through the opening that will be sufficient to overcome escape tendencies of the air within it. The three walls of the booth greatly reduce exhaust requirements, but not to the extent of a complete enclosure.

A list of several enclosure hoods and their application is shown in Table 41-3.

TABLE 41-3.
ENCLOSURE HOODS AND THEIR APPLICATIONS

Hood	Application
Booth	Laboratory Paint and metal spraying Arc welding Bagging machines
Machine Enclosure	Bucket elevators (complete enclosure) Vibrating screens Storage bins Mullers — Mixers Crushers Belt conveyor (transfer points) Packaging machines Abrasive blast cabinets

Receiving Hoods

The term "receiving hoods" refers to those hoods in which a stream of contaminated air from a process is exhausted by a hood located specifically for that purpose. Two common types of receiving hoods are canopies and grinding hoods. Canopy hoods frequently are located directly above various hot processes. A canopy hood is shown in Figure 41-7. They receive contaminated air which rises into the hood primarily by reason of its own buoyancy. This type of receiving hood is similar to an exterior hood in that the contaminated air originates beyond the physical boundaries of the hood. The fundamental difference between receiving and exterior hoods is in the way air moves to the hood; i.e., the entire air flow is induced by the receiving hood, but flows more freely to the exterior hoods. However, canopy hoods are adversely affected by crossdrafts and are less efficient than total enclosures. They cannot be used to capture toxic vapors if people must work in a position between the source of contamination and the hood.

Contaminants from a grinding or polishing wheel are too heavy to be captured by conventional air-flow patterns created by exhaust hoods.

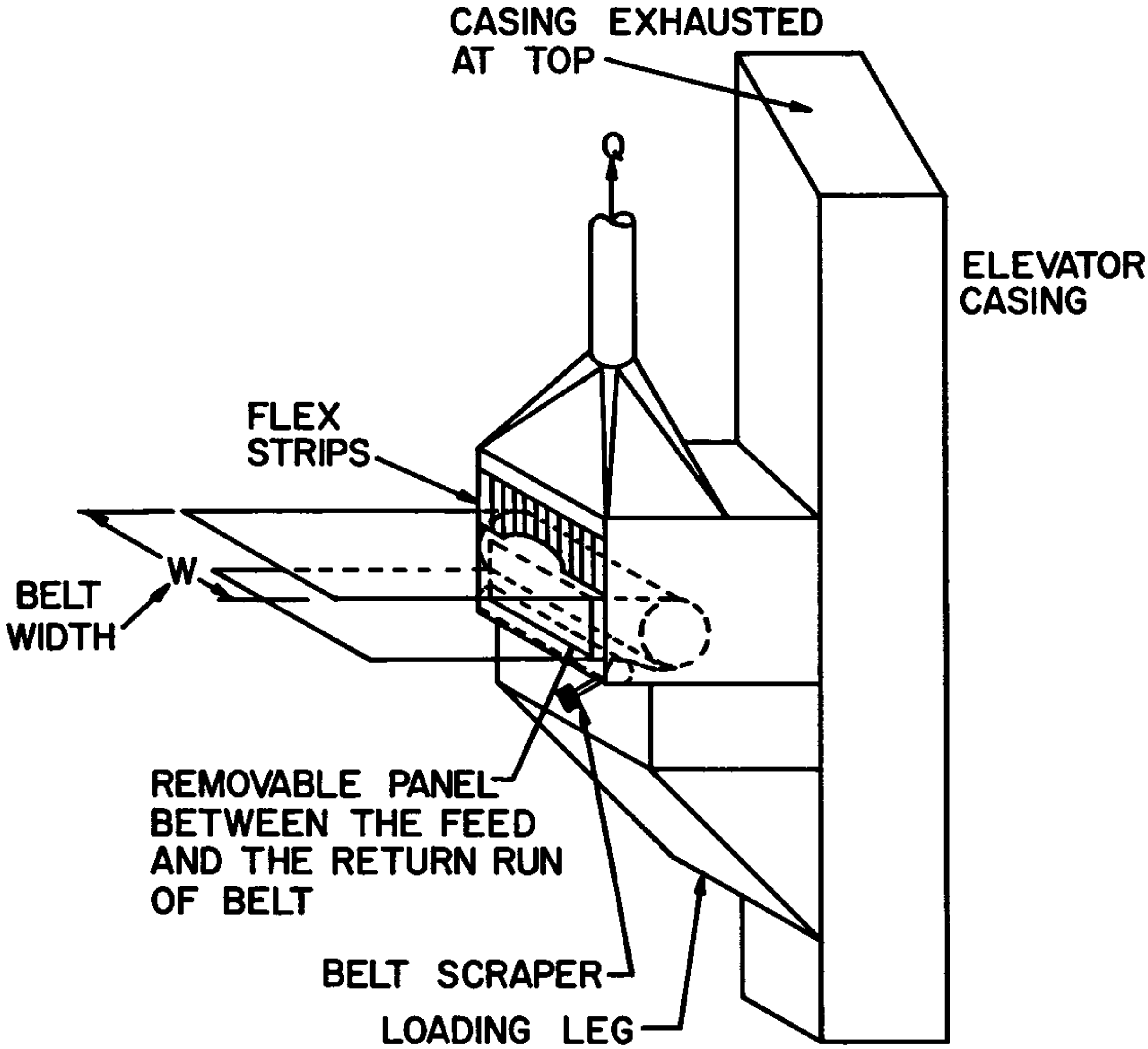


Figure 41-6. A Typical Enclosed Hood.

Hence, this type of hood is also located in the pathway of the contaminant. Heavy particulates are released into the hood by inertial forces from the grinding (or polishing) wheel. If hood space is limited by the process, baffles or shields may be placed across the line of throw of the particles to remove their kinetic energy. Then, lower air velocities are required to capture and carry the particles into the hood. A typical grinding wheel hood is shown in Figure 41-8.

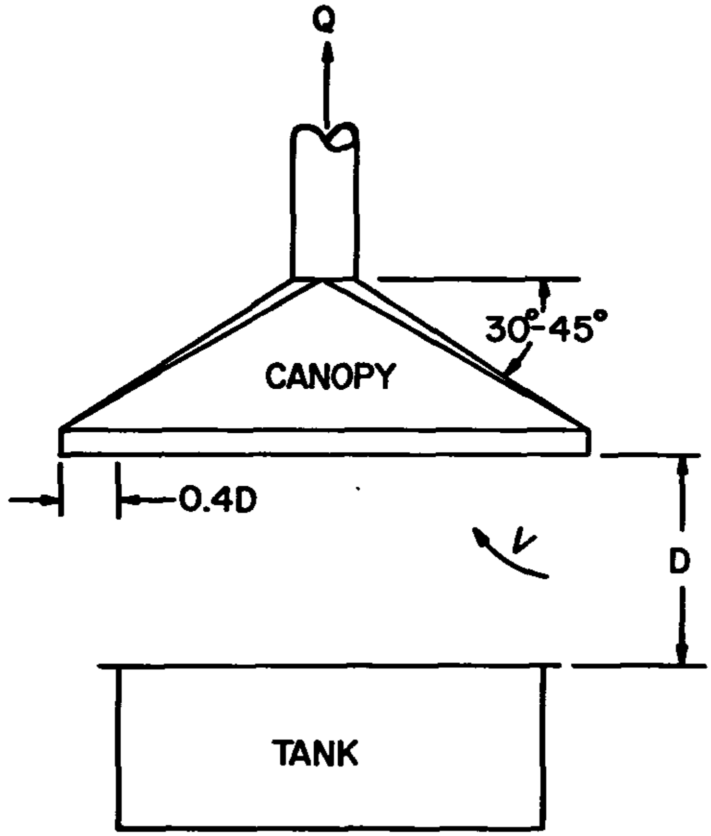
Some common receiving hoods are listed in Table 41-4.

Exterior Hoods

Exterior hoods must capture air contaminants being generated from a point outside the hood itself — sometimes relatively far away. These differ from enclosures or receiving hoods in that they must "reach" beyond their own dimensions and capture contaminants without the aid of natural phenomena (e.g., natural drafts, buoyancy

TABLE 41-4.
RECEIVING HOODS AND THEIR APPLICATIONS

Hood	Application
Grinding	Surface grinders Stone and metal polishing
Woodworking	Shapers, stickers, saws, jointers, molders, planers
Stone cutting	Granite and marble cutters and grinders. Granite surfacing
Sanding	Belt and drum sanding operations
Portable	Hand grinding, chipping
Canopy	Hot processes evolving fumes



$$Q = 1.4\,PDV$$

where

Q = RATE OF AIR EXHAUSTED, cfm.

P = PERIMETER OF SOURCE, ft.

D = VERTICAL DISTANCE BETWEEN SOURCE AND CANOPY, ft.

V = REQUIRED AVERAGE AIR VELOCITY THROUGH AREA BETWEEN SOURCE AND CANOPY, fpm.

Figure 41-7. A Canopy Hood.

inertia, etc.). Exterior hoods must create directional air currents adjacent to the suction opening to provide exhausting action. They are sensitive to external conditions and may be rendered completely ineffectual by even a slight draft through the area. They also require the most air to control a given process. Of the three hood types, exterior hoods are the most difficult to design. They are used when the mechanical requirements of a process will not permit the obstruction that total or partial enclosure would entail. This class of hood includes the numerous types of suction openings located adjacent to sources of contamination which are not enclosed. These hoods include exhaust slots on the edges of tanks (see Figure 41-2) or surrounding a work bench, exhaust duct ends located close to a small area source, large exhaust hoods arranged for lateral exhaust across an adjacent area, exhaust grilles in the floor or bench work below the contaminating action, certain canopy hoods and large propeller exhaust fans on outer walls adjacent to a zone of contamination.

A more complete list of external hoods and their applications is given in Table 41-5.

VENTILATION STANDARDS AND REGULATIONS

Regulations resulting from the Occupational Safety and Health Act of 1970 include several standards for local ventilation, both for the pre-

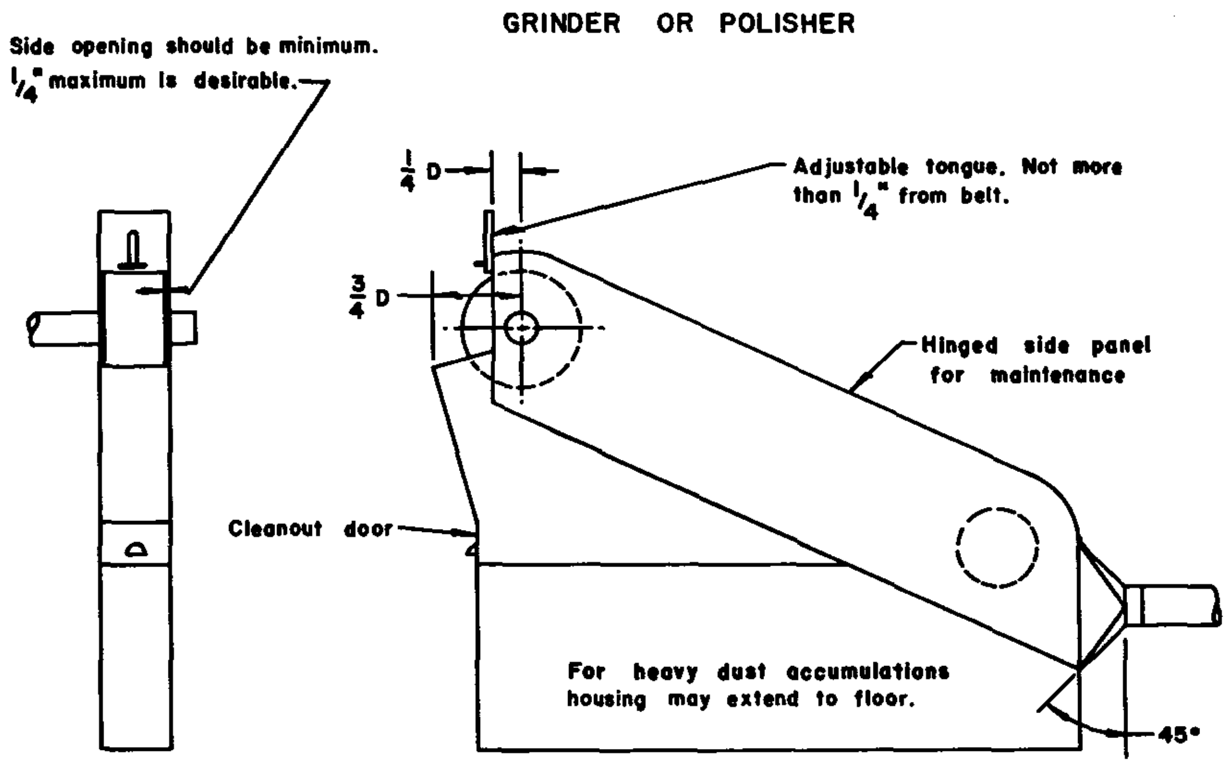


Figure 41-8. A Grinding Wheel Hood.

vention of fire and explosion and for controlling hazardous materials in the workroom to prevent illness or injury. In late 1972, such regulations included specific ventilation requirements for:

1. Abrasive blasting;
2. Grinding, polishing and buffing;
3. Spray finishing operations;
4. Open surface tanks;
5. Welding, cutting and brazing;
6. Gaseous hydrogen;
7. Oxygen;
8. Flammable and combustible liquids in storage rooms and enclosures; and
9. Dip tanks containing flammable or combustible liquids.

The bases of these OSHA standards have been the consensus-type standards developed by organizations such as the American National Standards Institute and the National Fire Protection Association. It is quite likely that the number and specificity of ventilation standards will increase with time, both under the regulations of the Occupational Safety and Health Administration and by the added interest in occupational health and safety at all levels of government.

It is important to understand that standards and codes define minimum standards of ventilation. Most of these have developed as "rule-of-thumb" values, usually based on successful experience. As a result, they tend to be inflexible and can be inadequate for design purposes. If not used with caution, especially in new installations they can cause a false sense of security and result in excessive expense when it is found necessary to modify or replace inadequate ventilation equipment.

TABLE 41-5
EXTERNAL HOODS AND THEIR APPLICATIONS

Hood	Application
Slot	Open tanks
Push-Pull	Plating tanks Cementing and lay-up tables
Down draft	Floor or bench type grinding, welding, low fog painting
Side draft	Some op[illegible] surface tanks Shakeout grates
Small canopy	Cool to warm processes
Wall fan (hood)	Some plastics operations Feed mill

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