

breathing zones. The objective to keep in mind in all cases is to take advantage of the natural tendency of the material to move upward or downward.

In another class of operation the main objective is to prevent the escape of dust into the surrounding atmosphere, the removal of some dust from the machine or enclosure being merely incidental. The dust-creating apparatus is enclosed within a housing which is made as tight as practicable, and sufficient suction is applied to the enclosure to maintain an inward air leakage, thus preventing escape of the dust. While the exhaust system is required to handle only the air which leaks in through the crevices and openings in the enclosure, yet in many installations leakages are very high and great care is required to obtain satisfactory results with a system of this kind. The inward-leakage principle is utilized for controlling dust in the operating of tumbling barrels, grinding, screening, elevating, and similar processes.

Certain dust and fume producing operations are best carried on by isolating the process in a separate compartment or room and then applying general ventilation to this space. The compartment or room in which the work is performed should be as small as is consistent with convenience in handling the work. The ventilating system should be designed so that a strong current of clean air is drawn across the operator, and away from him toward the work, where the dust is picked up and carried from the room.

### DESIGN PROCEDURE

The first step in the design of an exhaust system is to determine the number and size of the hoods and their connections. No general rules, however, can be given since hood and duct dimensions are determined by the characteristics of the operations to which they are applied. When a tentative decision regarding the set-up has been made, it is then necessary to obtain the suction and air velocities required to effect control. At this point the designer must rely upon the prevailing practice and on such physical data relating to hoods, duct systems and collectors as are available. Finally, in choosing the fan, the area of the intake should be equal to or greater than the sum of the areas of the branch ducts. The speed, of course, must be sufficient to maintain the estimated suction and air velocities in the system. In general, the most important requirements of an efficient exhaust and collecting system are as follows<sup>1</sup>:

1. Hoods, ducts, fans and collectors should be of adequate size.
2. The air velocities should be sufficient to control and convey the materials collected.
3. The hoods and ducts should not interfere with the operation of a machine or any working part.
4. The system should do the required work with a minimum power consumption.
5. When inflammable dusts and fumes are conveyed, the piping should be provided with an automatic damper in passing through a fire-wall.
6. Ducts and all metal parts should be grounded to reduce the danger of dust explosions by static electricity.
7. The design of an exhaust system should afford easy access to parts for inspection and care.

<sup>1</sup>For more detailed requirements see Safe Practice Pamphlets Nos. 32 and 37, published by the National Safety Council, Chicago.

### REQUIREMENTS FOR SUCTION AND VELOCITY

The removal of dust or waste by means of an exhaust hood requires a movement of air at the point of origin sufficient to carry it to a collecting system. The air velocities necessary to accomplish this depend upon the physical properties of the material to be eliminated and the

TABLE 1. SIZE OF CONNECTIONS FOR WOOD-WORKING MACHINERY

| TYPE OF MACHINE                                        | DIAMETER OF CONNECTIONS IN INCHES |
|--------------------------------------------------------|-----------------------------------|
| Circular saws, 12-in. diam.....                        | 4                                 |
| Circular saws, 12-24 in. diam.....                     | 5                                 |
| Circular saws, 24-40 in. diam.....                     | 6                                 |
| Band saws, blade under 2 in. wide.....                 | 4                                 |
| Band saws, blade 2-3 in. wide.....                     | 5                                 |
| Band saws, blade 3-4 in. wide.....                     | 6                                 |
| Band saws, blade 4-5 in. wide.....                     | 7                                 |
| Band saws, blade 5-6 in. wide.....                     | 8                                 |
| Small mortisers.....                                   | 6                                 |
| Single end tenoners.....                               | 6                                 |
| Double end tenoners.....                               | 7                                 |
| Double end, double head tenoners.....                  | 10                                |
| Planers, matchers, moulders, stickers, jointers, etc.— |                                   |
| With knives, 6-10 in.....                              | 5-6                               |
| With knives, 10-20 in.....                             | 6-8                               |
| With knives, 20-30 in.....                             | 6-10                              |
| Shapers, light work.....                               | 4-5                               |
| Shapers, heavy work.....                               | 8                                 |
| Belt sander, belt less than 6 in. wide.....            | 5                                 |
| Belt sander, belt 6-10 in. wide.....                   | 6                                 |
| Belt sander, belt 10-14 in. wide.....                  | 7                                 |
| Drum sander, 24 in.....                                | 5                                 |
| Drum sander, 30 in.....                                | 6                                 |
| Drum sander, 36 in.....                                | 7                                 |
| Drum sander, 48 in.....                                | 8                                 |
| Drum sander, over 48 in.....                           | 10                                |
| Disc sander, 24 in. diam.....                          | 5                                 |
| Disc sander, 26-36 in. diam.....                       | 6                                 |
| Disc sander, 36-48 in. diam.....                       | 7                                 |
| Arm sander.....                                        | 4                                 |

direction and speed with which it is thrown off. If the dust to be removed is already in motion, as is the case with high-speed grinding wheels, the hood should be installed in the path of the particles so that a minimum air volume may be used effectively. It is always desirable to design and locate a hood so that the volume of air necessary to produce results is as small as possible.

The static suction at the throat of a hood is frequently used in practice as a measure of the effectiveness of control. This is of considerable value where exhaust systems adapted to particular operations have been standardized by practice. Tables 1 and 2 present the duct sizes usually employed for standard wood-working machinery and for grinding and buffing wheels. Static pressures, which in practice have been found necessary to control and convey various materials, are given in Table 3. It must be remembered, however, that the *suction* is merely a rough