1 to 5 in. connection, 2 in. suction, (from Table 4) 605 × 1 equals	605 cfm
1 to 4 in. connection, 2 in. suction, (from Table 4) 386 × 1 equals	386 cfm
1 to 5 in. connection, 2 in. suction, (from Table 4) 605 × 1 equals	605 cfm
2 to 6 in. connection, 2 in. suction, (from Table 4) 867 × 2 equals	1,734 cfm
TOTAL	3,330 cfm

The next step in the calculations is to determine the maintained resistance of the system, which corresponds to the static pressure that the exhaust fan must produce to obtain the proper volume of air and suction at the hoods.

This maintained resistance is composed of the following elements:

1. Loss through the hoods. This is usually assumed as equal to the suction maintained at the hoods, in this problem 2 in.
2. Frictional resistance or loss in piping system. This is a function of the pipe diameter and the velocity of flow and accordingly it is necessary to compute the friction for each section and to add the components together.
3. Pressure drop or loss through the collector. For an exhaust system such as the one under consideration it is customary to choose a collector having an inlet of the same, or slightly greater, diameter than the main discharge pipe leading to the collector.

The friction per 100 ft of length for various pipe diameters and velocities can be read from Table 5.

The friction for intermediate pipe sizes not given in the table can be computed from the table values, from the relation that the friction in two pipes, the velocity remaining constant, is inversely proportional to the ratio of the diameters. This can be written:

$$z_2 = z_1 \frac{d_1}{d_2} \tag{3}$$

z_1 = friction in pipe of d_1 diameter.
z_2 = friction in pipe of d_2 diameter.

The total pipe friction is calculated to be 3.49 in. of water. The individual steps in the calculation are given in Table 7.

The effective length of pipe is determined by adding to the actual length a sum to compensate for the effect of elbows as given in the note at the bottom of Table 5.

In this problem the main discharge pipe is 13 in. in diameter and a collector having a 14 in. inlet is selected. The area of the collector inlet is 1.069 sq ft.

Velocity at collector inlet:

$$V = \frac{3{,}330}{1.069} = 3{,}120$$

$$\text{Collector Drop} = C\left(\frac{V}{1{,}000}\right)^2$$

$$= 0.145\left(\frac{3{,}120}{1{,}000}\right)^2 = 1.4 \text{ in. of water.}$$

The total resistance of the system as indicated in Table 8 is 6.89 in. of water. Therefore an exhaust fan to handle 3,330 cfm at 7 in. static pressure will be required.

TABLE 8. TOTAL RESISTANCE OF THE SYSTEM SHOWN IN FIG. 1

1. Loss at hoods	2.00 in. of water
2. Loss through piping	3.49 in. of water
3. Loss at collector	1.40 in. of water
TOTAL resistance of system	6.89 in. of water

SELECTING THE FAN

The usual types of ventilating fans are unsuitable for exhaust systems which are required to handle materials such as shavings, sawdust, emery dust, etc. Higher pressures are required than in ventilating work and in addition housings and blast wheel must be so constructed that the materials handled do not deposit in them. While the fans used in different exhaust systems are more or less of the same general type, modifications are frequently necessary to fit them for handling such materials as long shavings, strips of paper, cotton, pulverized coal, etc.

Where considerable quantities of explosive dust or inflammable materials pass through the exhaust fan, the blast wheel should be constructed of brass composition, copper or other soft metal and in all cases ample clearance should be provided between blast wheels and housings.

Where stringy or fibrous material is to be handled through the fan, a fan wheel especially designed for that purpose should be employed.

For further data on the selection of fans, see Chapter 34.

COLLECTORS

The most common method of separating the dust and other materials from the air is to pass the mixture through a centrifugal or "cyclone" collector. In this type of collector the mixture of the air and material is introduced on a tangent, near the cylindrical top of the collector, and the whirling motion sets up a centrifugal action causing the comparatively heavy materials suspended in the air to be thrown against the side of the separator, from which position it spirals down to the tail piece, while the air escapes through the stack at the center of the collector.

For most systems, the inlet size of the collector may be the same as the diameter in inches of the main pipe leading to it. The larger the collector within certain limits the better will be the separation, and the less will be the back pressure on the fan and the power consumed.

Special construction is sometimes required for fine dust, also some blowpipe manufacturers use a special type of collector for furnace feed, the object being to deliver the material to furnaces as uniformly as possible.

When more than one fan delivers into a single collector a back pressure valve is required to prevent one fan blowing back through the other in case the second fan should stop for any reason.

In most plants, where wood refuse is used for fuel, it is delivered by gravity directly from the collector to the furnace. The discharge pipe leading from the bottom of the collector is divided and the junction is furnished with a switch or valve so arranged that when the material comes too fast for the fires it can be diverted into a reserve bin.