

mains should be a certain percentage greater area than the sum of the connections, and still lower power consumption can be obtained by using larger branches and mains of equal area. While the rule of thumb method of determining size of mains works very well in many cases, yet it is always desirable to figure the mains and branches of the proper size to give the velocity which has been found best suited to the work to be done.

In certain special cases where explosive or poisonous dusts such as aluminum buffings, grain dust, powdered sugar, or lead dust are handled, increasing the size of the mains unduly would introduce a serious hazard.

TABLE 4. CUBIC FEET OF AIR HANDLED PER MINUTE THROUGH AVERAGE COLLECTING HOODS

Based on Coefficient of Orifice of 0.71 with 10 Per Cent Added for Leakage

| DIAMETER OF CONNECTION PIPE IN. | MAINTAINED SUCTION—IN. WATER GAGE |      |      |      |      |      |      |
|---------------------------------|-----------------------------------|------|------|------|------|------|------|
|                                 | 1                                 | 1½   | 2    | 2½   | 3    | 4    | 5    |
| 1½                              | 38                                | 47   | 54   | 61   | 67   | 76   | 86   |
| 2                               | 68                                | 84   | 97   | 108  | 118  | 136  | 153  |
| 2½                              | 107                               | 131  | 161  | 168  | 185  | 214  | 238  |
| 3                               | 153                               | 188  | 217  | 243  | 266  | 306  | 343  |
| 3½                              | 209                               | 256  | 296  | 330  | 362  | 418  | 466  |
| 4                               | 273                               | 334  | 386  | 431  | 473  | 546  | 609  |
| 4½                              | 345                               | 423  | 488  | 546  | 598  | 690  | 775  |
| 5                               | 427                               | 523  | 605  | 676  | 741  | 854  | 955  |
| 6                               | 614                               | 751  | 867  | 970  | 1062 | 1228 | 1373 |
| 7                               | 835                               | 1023 | 1181 | 1322 | 1448 | 1670 | 1870 |
| 8                               | 1092                              | 1337 | 1546 | 1727 | 1892 | 2184 | 2440 |
| 9                               | 1381                              | 1694 | 1953 | 2184 | 2387 | 2762 | 3091 |
| 10                              | 1705                              | 2090 | 2409 | 2695 | 2959 | 3410 | 3806 |

The maintained resistance of the exhaust system is composed of three factors: (1) loss through the hoods; (2) collector drop; and (3) friction drop in the pipes.

The collector drop in inches of water is given roughly by equation (2) but where possible the resistance of the particular collector to be used should be ascertained from the manufacturer as these resistances differ quite widely.

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

where

$C$  = a constant which depends upon the type of collector and ranges from 0.065 to 0.145.

$V$  = velocity in feet per minute of air entering the collector.

Friction drop in the pipes must be computed for each section where there is a change in area or in velocity. Find the velocities in each section of pipe starting with the branch most remote from the fan. The friction drop for these sections can be determined by reference to Table 5. Total friction loss in the piping system is the friction drop in the most remote branch plus the drop in the various sections of the main, plus the drop in the discharge pipe.

TABLE 5. FRICTIONAL RESISTANCE OF STRAIGHT CONVEYOR PIPE To Flow of Air Per 100 Feet of Pipe

| VEL. OF AIR IN FT. PER MIN. | LOSS OF PRESSURE IN INCHES FOR GIVEN DIAMETER PIPE |       |       |       |       |       |       |
|-----------------------------|----------------------------------------------------|-------|-------|-------|-------|-------|-------|
|                             | 4"                                                 | 5"    | 6"    | 7"    | 8"    | 10"   | 12"   |
| 2000                        | 1.92                                               | 1.53  | 1.28  | 1.09  | 0.962 | 0.770 | 0.640 |
| 2200                        | 2.32                                               | 1.85  | 1.55  | 1.32  | 1.16  | 0.932 | 0.778 |
| 2400                        | 2.77                                               | 2.22  | 1.84  | 1.58  | 1.39  | 1.01  | 0.924 |
| 2600                        | 3.26                                               | 2.60  | 2.17  | 1.86  | 1.63  | 1.30  | 1.08  |
| 2800                        | 3.76                                               | 3.01  | 2.52  | 2.15  | 1.89  | 1.51  | 1.26  |
| 3000                        | 4.33                                               | 3.46  | 2.88  | 2.47  | 2.08  | 1.73  | 1.44  |
| 3200                        | 4.93                                               | 3.94  | 3.28  | 2.82  | 2.47  | 1.97  | 1.64  |
| 3400                        | 5.56                                               | 4.45  | 3.71  | 3.18  | 2.78  | 2.22  | 1.85  |
| 3600                        | 6.23                                               | 4.98  | 4.15  | 3.56  | 3.12  | 2.49  | 2.08  |
| 3800                        | 6.95                                               | 5.55  | 4.62  | 3.97  | 3.48  | 2.78  | 2.32  |
| 4000                        | 7.69                                               | 6.15  | 5.13  | 4.40  | 3.85  | 3.08  | 2.57  |
| 4200                        | 8.48                                               | 6.78  | 5.65  | 4.85  | 4.25  | 3.49  | 2.83  |
| 4400                        | 9.26                                               | 7.41  | 6.18  | 5.30  | 4.63  | 3.71  | 3.09  |
| 4800                        | 11.05                                              | 8.85  | 7.38  | 6.32  | 5.55  | 4.43  | 3.69  |
| 5200                        | 13.00                                              | 10.50 | 8.66  | 7.44  | 6.50  | 5.21  | 4.34  |
| 5600                        | 15.25                                              | 12.05 | 10.05 | 8.61  | 7.55  | 6.03  | 5.05  |
| 6000                        | 17.30                                              | 13.85 | 11.52 | 9.89  | 8.66  | 6.92  | 5.76  |
|                             | 14"                                                | 16"   | 18"   | 20"   | 22"   | 24"   | 30"   |
| 2000                        | 0.550                                              | 0.482 | 0.428 | 0.385 | 0.350 | 0.320 | 0.257 |
| 2200                        | 0.655                                              | 0.582 | 0.578 | 0.465 | 0.423 | 0.388 | 0.310 |
| 2400                        | 0.790                                              | 0.693 | 0.617 | 0.553 | 0.504 | 0.462 | 0.369 |
| 2600                        | 0.930                                              | 0.810 | 0.722 | 0.650 | 0.590 | 0.542 | 0.434 |
| 2800                        | 1.07                                               | 0.932 | 0.838 | 0.754 | 0.685 | 0.628 | 0.503 |
| 3000                        | 1.24                                               | 1.08  | 0.961 | 0.865 | 0.788 | 0.722 | 0.577 |
| 3200                        | 1.41                                               | 1.23  | 1.09  | 0.985 | 0.895 | 0.820 | 0.657 |
| 3400                        | 1.59                                               | 1.43  | 1.24  | 1.11  | 1.01  | 0.925 | 0.742 |
| 3600                        | 1.78                                               | 1.56  | 1.38  | 1.25  | 1.13  | 1.04  | 0.832 |
| 3800                        | 1.99                                               | 1.74  | 1.54  | 1.39  | 1.26  | 1.16  | 0.926 |
| 4000                        | 2.20                                               | 1.92  | 1.71  | 1.54  | 1.40  | 1.28  | 1.03  |
| 4200                        | 2.43                                               | 2.12  | 1.88  | 1.70  | 1.54  | 1.42  | 1.13  |
| 4400                        | 2.66                                               | 2.33  | 2.06  | 1.85  | 1.68  | 1.54  | 1.24  |
| 4800                        | 3.17                                               | 2.77  | 2.46  | 2.22  | 2.02  | 1.85  | 1.48  |
| 5200                        | 3.72                                               | 3.25  | 2.89  | 2.61  | 2.36  | 2.16  | 1.75  |
| 5600                        | 4.32                                               | 3.78  | 3.35  | 3.02  | 2.74  | 2.52  | 2.01  |
| 6000                        | 4.95                                               | 4.33  | 3.85  | 3.46  | 3.14  | 2.89  | 2.31  |

## FRICTIONAL RESISTANCE OF ELBOWS

Elbows having a throat radius equal to the pipe diameter set up a resistance equivalent to a section of straight pipe approximately 10 diameters long. With a throat radius of 1½ times the diameter the resistance is about the same as seven diameters of straight pipe.

TABLE 6. DIAMETERS OF BRANCH PIPES AND CALCULATIONS OF MAIN FOR TYPICAL EXHAUST SYSTEM ILLUSTRATED IN FIG. 1

| MACHINE                       | DIAMETER OF BRANCH PIPES | AREA Sq. INCHES | TOTAL LOAD AREA Sq. INCHES | TOTAL LOAD AREA Sq. INCHES + 25% | SECTION OF MAIN | DIAMETER OF MAIN IN EVEN INCHES |
|-------------------------------|--------------------------|-----------------|----------------------------|----------------------------------|-----------------|---------------------------------|
| Rip Saw.....                  | 5 in.                    | 19.6            | 19.6                       | 25                               | B               | 6 in.                           |
| Cut-off Saw.....              | 4 in.                    | 12.6            | 32.2                       | 40                               | C               | 7 in.                           |
| Band Saw.....                 | 5 in.                    | 19.6            | 51.8                       | 65                               | D               | 9 in.                           |
| Planer Top Connection.....    | 6 in.                    | 28.3            | 80.1                       | 100                              |                 |                                 |
| Planer Bottom Connection..... | 6 in.                    | 28.3            | 108.4                      | 135                              | E & F           | 13 in.                          |