Dust Collection and Extraction

Efficient dust collection is achieved when using outlets and ducting with a round cross section, and an air velocity at the center of the duct comprised between 30 and 35 ms^{-1} (98 to 115 fps). At these velocities the airflow has the ability to remove wood dust and large wood particles even if the airflow works against gravity.

In practical life the air velocity is measured using an indirect method: the measure of the static pressure at the center of the outlet or at the center of the duct. The relationship between the two is expressed by means of complex mathematical formulas that are normally developed through lab testing. We therefore suggest the use of charts, in metric or imperial units. Given the diameter (in inches or in millimeters) of an outlet or a duct, the chart provides the values of the necessary airflow and its relevant static pressure.

A simple formula to accurately calculate the dust collection requirements for each outlet is the following:

In metric units: D x D / 40 = liters per second (where D is in mm)

In imperial units: D x D x 36 = CFM (where D is in inches)

An excellent rule-of-thumb for the static pressure is that the value for the static pressure almost always equals the value of the diameter of the outlet.

Example:

A machine has 3 outlets with a diameter of 4.5" and 1 outlet with a diameter of 5.75": How much dust collection is required?

Each 4.5" outlet will require: 4.5 x 4.5 x 36 = 729 CFM

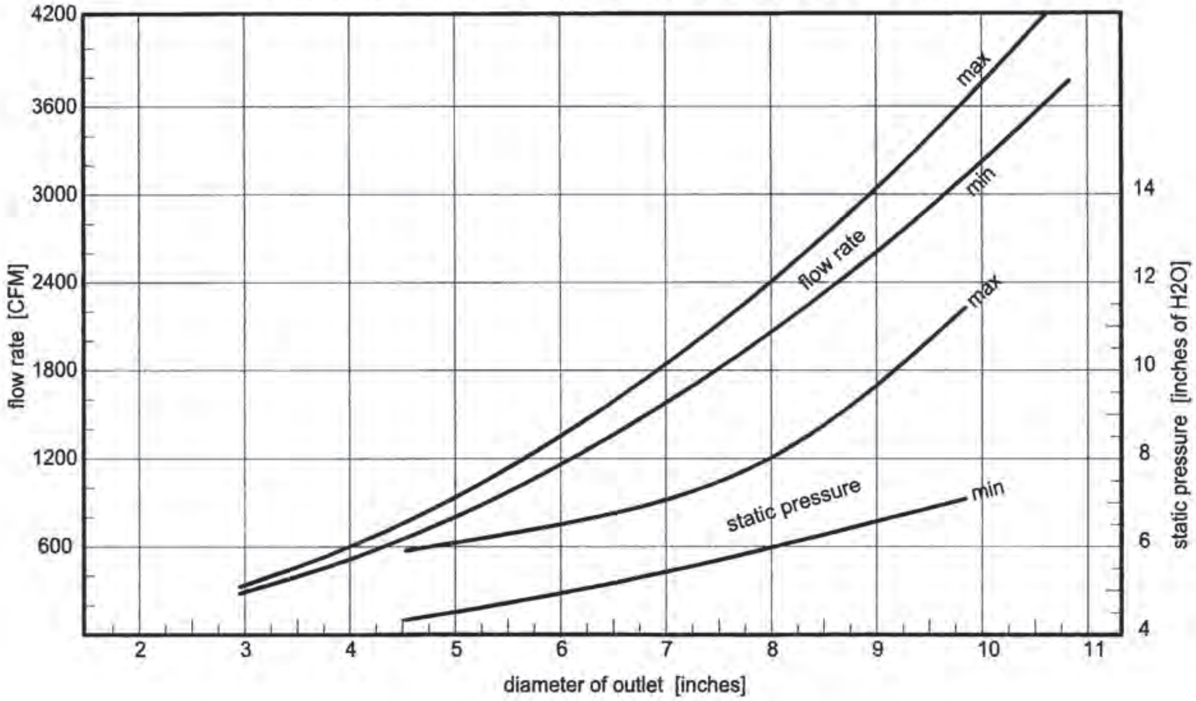
The 5.75" outlet will require: 5.75 x 5.75 x 36 = 1190 CFM

The total dust collection requirement is: 729 + 729 + 1190 = 2648 CFM

The static pressures measured at each outlet shall be 4.5 inches of H_2O for the 4.5" outlets, and 5.75 inches of H_2O for the 5.75" outlet.

Once the dust collection is in place, ask your installer to double check the efficiency of the system by measuring the value of the static pressure at each outlet. When it falls within the limits of the charts, the system is efficiently removing dust and other wood particles.

DUST COLLECTION CHART FOR ROUND OUTLETS (IMPERIAL UNITS)



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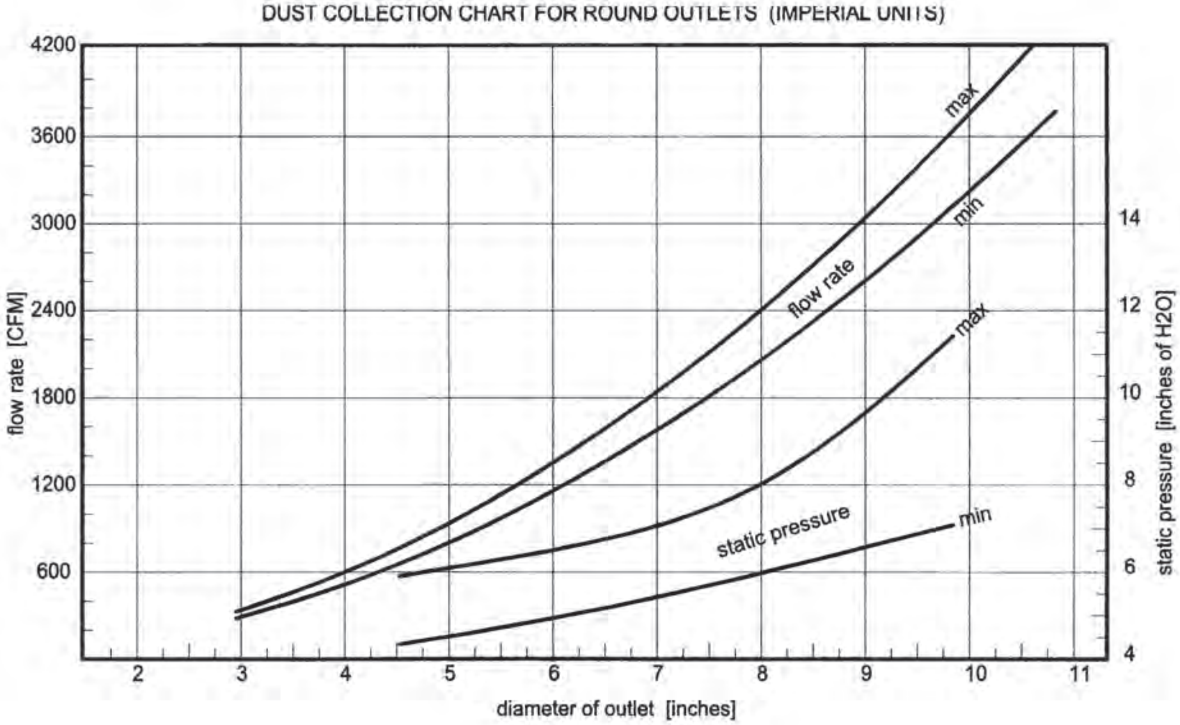

Understanding the Measurement of Actual Air Flow in Dust Collection Pipes and Ducts

The mass of air (Q) that is being moved by the fans through a dust collection pipe can be accurately measured when the temperature (T), the pressure (P), the velocity (V), the cross section area (S) of the pipe, the content of humidity and the composition of the air are known.

In practical applications, as with dust collection systems, the temperature and pressure are considered to be constant, and the humidity to be irrelevant, introducing in this way a negligible error in the calculation of the air flow, which is therefore expressed by the following formula:

$$Q(\text{cu.ft/sec}) = V(\text{ft/sec}) \times S(\text{sq.ft})$$

Or, since the air flow Q is usually measured in cu.ft/min, and the ducts diameter in inches (with the cross section area S in sq.inch):

$$Q(\text{cu.ft/min}) = 0.42 \times V(\text{ft/sec}) \times S(\text{sq.inches})$$

Assuming that a tract of pipe is made of a constant diameter (same cross section), the measurement of Q becomes as simple as measuring V, i.e. the velocity of the air in the pipe.

A good practical system to measure the velocity is based on the measurement of the dynamic Pressure (Pd) by means of a pressure gauge. The velocity V is calculated by the following formula:

$$V(\text{ft/sec}) = 265 \times d \times \sqrt{Pd(\text{inchH2O})}$$

Where d is the density (lbs/cu.ft) of the air at normal conditions (at sea level and at 60°F the density is typically 0.08072 lbs/cu.ft). The dynamic Pressure is measured in inches of water (inch H_2O). The above formula is therefore valid for moderate elevation above the sea level. With the increase of the elevation the air becomes thinner (lower density). To achieve an efficient extraction capacity a dust collection system placed at high elevations must develop a larger dynamic Pressure Pd.

The dynamic Pressure is measured as the difference between the total Pressure Pt and the static Pressure Ps:

$$Pd(\text{inchH2O}) = Pt(\text{inchH2O}) - Ps(\text{inchH2O})$$

Figure 1 shows the measurement of the static Pressure Ps in a pipe duct under pressure (fan pressurized) and Figure 2 shows the measurement of the static Pressure in an aspirated pipe duct (by a fan extractor).

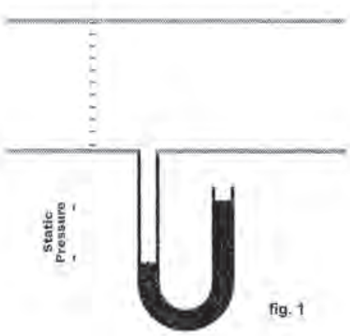

fig. 1

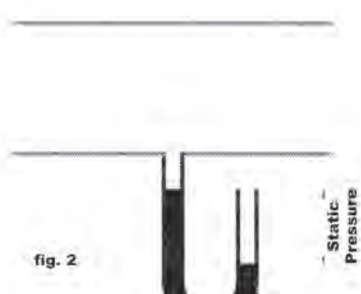

fig. 2

The air moving in a pipe duct also contains an energy due to the mass (of air) moving at a high velocity. Figure 3 shows how the total Pressure Pt measures in an aspirated pipe duct and in a pressurized pipe duct.

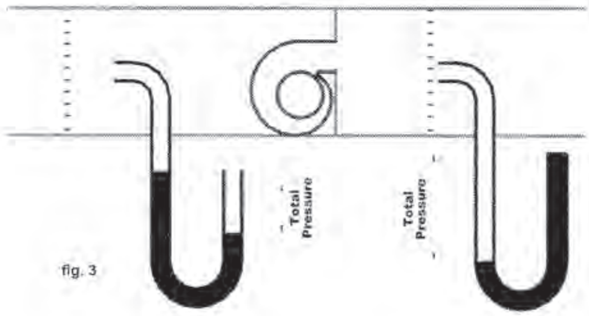

fig. 3

Since the dynamic Pressure is the difference between the total Pressure and the static Pressure, Fig. 4 shows how in practice the static Pressure Ps is "subtracted" from the total Pressure Pt in the two cases of an aspirated pipe duct and a pressurized pipe duct.

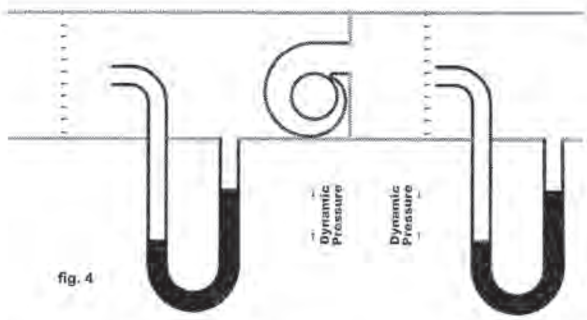

fig. 4

In real applications the flow of the air is not uniform and it is higher at the center of the duct and minimal at the wall of the duct. Joints, curves, and bends in the ducting also introduce turbulences that are detrimental to the achievement of good sustained dynamic Pressure. This is the reason why installers of good dust extraction systems place so much care in avoiding sudden changes of shapes and build joints and bends that do not disrupt the air flow. Measurements of the pressure in dust extraction ducts shall always be taken in a portion of the duct were the flow is as uniform and as undisturbed as possible, i.e. away from areas of possible turbulence. The measurement of the dynamic Pressure (Pd) shall be taken at the center of the duct, while the measurement of the static Pressure (Ps) shall be taken at the wall of the duct.