Veris Application Note

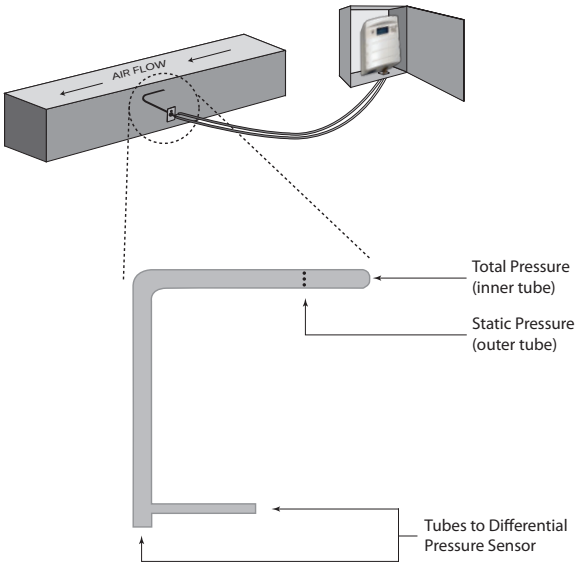
Determining Air Flow

Introduction

Air flow in cubic feet per minute (CFM) is a useful quantity to determine when examining air quality issues. Calculate air flow in a duct by measuring the air flow velocity in feet per minute (FPM) and multiplying by the duct cross sectional area in square feet (ft^2).

Determine the Flow Velocity

First, measure the velocity pressure in the duct. Use a differential pressure sensor in combination with a pitot tube assembly.



The sensor's output will be the velocity pressure (the difference between total pressure and static pressure in the duct).

To calculate flow velocity, use the following equation:

$$V = C * \sqrt{\frac{(2 * p_w * g_c)}{\rho}}$$

where:

V = Flow velocity (FPM)

p_w = velocity pressure (in. H_20)

ρ = density of air (lb_m/ft^3) (see table for estimates)

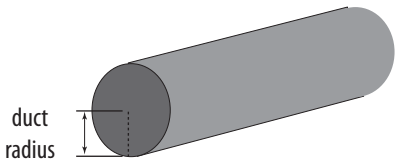
g_c = gravitational constant = 32.174 lb_m*ft/$lb_f s^2$

C = unit conversion factor (to feet and from in. H_20) = 136.8

Air Densities at Different Elevations:

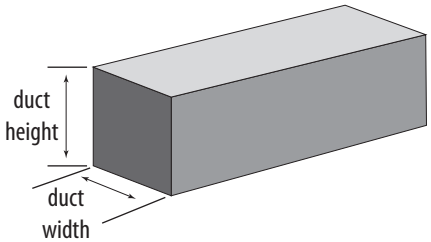
Elevation (ft)	Density (lb/ft^3)
0	0.0745
500	0.0732
1000	0.0719
1500	0.0706
2000	0.0693
2500	0.0680
3000	0.0668
3500	0.0656
4000	0.0644
4500	0.0632
5000	0.0620
7500	0.0564

Determine Cross Sectional Area



For round ducts, calculate area using the formula

Area = π * r^2, where r is the duct radius (in feet) and π = 3.14.



For rectangular ducts, calculate area using the formula

Area (ft^2) = duct height (ft) * duct width (ft)

Determine Air Flow

Once the flow velocity and cross sectional area are known, air flow is easily calculated by multiplying these values.

Air flow (CFM) = flow velocity * cross sectional area

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Example

Calculate the air flow in a round duct with a 3 foot diameter at an elevation of 1000 feet above sea level. Assume the velocity pressure is 0.7 in. H_2O.

First, calculate the flow velocity:

$$V = C * \sqrt{\frac{(2 * p_w * g_c)}{\rho}}$$

$$V = 136.8 * \sqrt{\frac{(2 * 0.7 \text{ in. } H_2O * 32.174 \text{ lb}_m\text{ft/lb}_f s^2)}{0.0719 \text{ lb}_m\text{ft}^3}}$$

$V = 3424$ FPM

Second, calculate the cross sectional area of the duct:

$A = \pi * r^2$

$A = \pi * (1.5 \text{ ft})^2$

$A = 7 \text{ ft}^2$

Third, multiply the two values:

Air flow (CFM) = flow velocity * cross sectional area

Air flow = 3424 FPM * 7 ft^2

Air flow = 23,968 CFM

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