

To calculate **Air Flow** in Cubic Feet per Minute (CFM), determine the **Flow Velocity** in feet per minute, then multiply this figure by the **Duct Cross Sectional Area**.

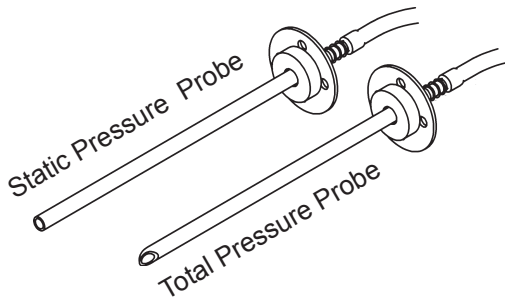
$$\text{Air Flow in CFM (Q)} = \text{Flow Velocity in Feet Per Minute (V)} \times \text{Duct Cross Sectional Area (A)}$$

### Determining Flow Velocity

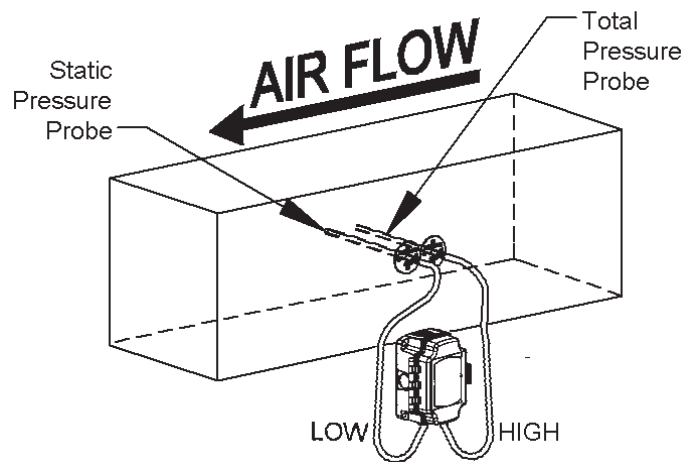
The easiest way to determine **Flow Velocity** is to measure the **Velocity Pressure** in the duct with a Pitot Tube Assembly connected to a differential pressure sensor. The Pitot Tube Assembly includes a Static Pressure Probe and a Total Pressure Probe.

A Total Pressure Probe, aligned into the airflow, senses the duct velocity pressure and the static pressure, which equals the total pressure. A Static Pressure Probe aligned at a right angle to the airflow senses only the static pressure. The difference between the total pressure reading and the static pressure reading is the **Velocity Pressure**.

If you connect the Total Pressure Probe to the HIGH port on a differential pressure sensor and the Static Pressure Probe to the LOW port on the differential pressure sensor, then the sensor's output will be the **Velocity Pressure**, as shown in the figures below.



**Fig 1:** BAPI Pitot Tube Assembly, includes Static and Total Pressure Probe Assemblies (ZPS-ACC12)



**Fig 2:** BAPI Differential Zone Pressure Sensor (ZPS) measuring Velocity Pressure

The **Flow Velocity** is then determined with the following equation:

$$V = 4005 \times \sqrt{\Delta P}$$

**V** = Flow Velocity in feet per minute.

$\sqrt{\quad}$  = Square root of the number to the right.

$\Delta P$  = The Velocity Pressure measured by the pressure sensor

Example: Measuring a **Velocity Pressure** of .75" W.C. equals a **Flow Velocity** of 3,468 Ft/Min.

$$V = 4005 \times \sqrt{0.75}$$

$$\sqrt{0.75} = 0.866 \quad \bullet \quad 4005 \times 0.866 = 3,468 \quad \bullet \quad \text{Flow Velocity} = 3,468 \text{ Ft/Min}$$

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### Determining Duct Cross Sectional Area

After obtaining the **Flow Velocity** from the previous procedure, that figure is now multiplied by the **Duct Cross Sectional Area** to determine the **Air Flow** in CFM.

There are two different equations for determining the **Duct Cross Sectional Area**, one for round ducts and one for square or rectangular ducts.

The equation for a round duct is:

$$A = \pi \times r^2$$

**A** = Duct Cross Sectional Area

$\pi$  = 3.14159

**r** = radius of duct in feet

The equation for square or rectangular ducts is:

$$A = X \times Y$$

**A** = Duct Cross Sectional Area

**X** = Duct height in feet

**Y** = Duct width in feet.

Example: An 18" diameter round duct has a Duct Cross Sectional Area of **1.77 Ft<sup>2</sup>**

$$A = \pi \times r^2 \text{ or } A = 3.14158 \times .5625$$

18" diameter is 1.5 feet, therefore the radius is .75 feet •  $r^2 = 0.75^2 = 0.5625$  •  $\pi = 3.14159$

$$A = 3.14159 \times 0.5625 = 1.77 \text{ Ft}^2$$

### Determining Air Flow in CFM

After obtaining the **Flow Velocity** and the **Duct Cross Sectional Area** from the previous two procedures, the **Air Flow** in CFM is determined by multiplying the two:

$$\text{Air Flow in CFM (Q)} = \text{Flow Velocity in Feet Per Minute (V)} \times \text{Duct Cross Sectional Area (A)}$$

#### Example

An 18" diameter round duct with a **Velocity Pressure** of .75" W.C. has an Air Flow of 6,128 CFM

The **Flow Velocity** is 3,468 Ft/Min.

$$V = 4005 \times \sqrt{\Delta P}$$

$$V = 4005 \times \sqrt{0.75}$$

$$\sqrt{0.75} = 0.866 \cdot 4005 \times 0.866 = 3,468 \cdot \text{Flow Velocity} = 3,468 \text{ Ft/Min}$$

The **Duct Cross Sectional Area** is 1.77 Ft<sup>2</sup>

$$A = \pi \times r^2$$

$$\pi = 3.14159 \cdot r^2 = 0.75^2 = 0.5625$$

$$\text{Duct Cross Sectional Area (A)} = 3.14159 \times 0.5625 = 1.77 \text{ Ft}^2$$

The **Air Flow** in CFM is 6,128 Ft<sup>3</sup>/Min

$$\text{Air Flow in CFM (Q)} = \text{Flow Velocity in Feet Per Minute (V)} \times \text{Duct Cross Sectional Area (A)}$$

$$\text{Air Flow in CFM (Q)} = 3,468 \text{ Ft/Min} \times 1.77 \text{ Ft}^2 = 6,128 \text{ CFM}$$

If you have any questions about this procedure, please call your BAPI representative.