Determining Air Flow in Cubic Ft./Min

Application Note

Rev. 10/31/06

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**.

Air Flow in CFM (Q) = Flow Velocity in Feet Per Minute (V) x 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.

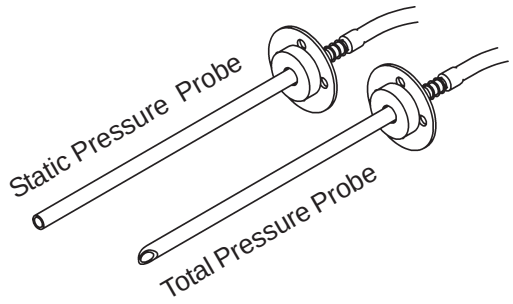

Fig 1: BAPI Pitot Tube Assembly, includes Static and Total Pressure Probe Assemblies (ZPS-ACC12)

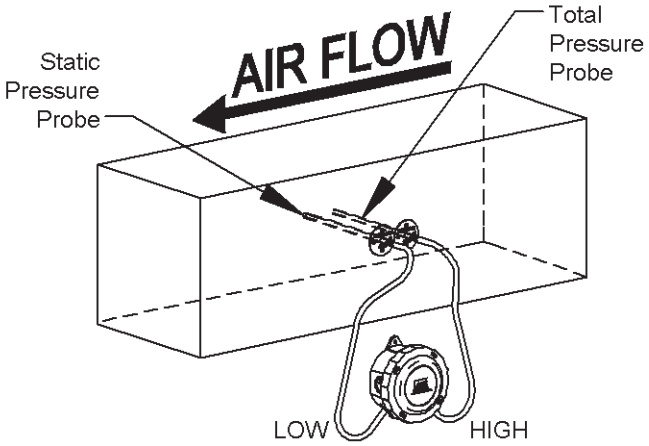

Fig 2: BAPI Differential Zone Pressure Sensor (ZPS) measuring Velocity Pressure

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

V = 4005 x **Sqrt(ΔP)**

V = Flow Velocity in feet per minute.
Sqrt() = Square root of the number in the parenthesis.
ΔP = 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 x Sqrt(0.75)

Sqrt(0.75) = 0.866 • 4005 x 0.866 = 3,468 • Flow Velocity = 3,468 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
π = 3.14159
r = radius of duct in feet

The equation for square or rectangular ducts is:

A = X x 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^2**

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

18" diameter is 1.5 feet, therefore the radius is .75 feet • $r^2 = 0.75^2 = 0.5265$ • $\pi = 3.14159$
$A = 3.14159 \times 0.5625 = 1.77\ Ft^2$

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:

Air Flow in CFM (Q) = Flow Velocity in Feet Per Minute (V) x 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.

$V = 4005 \times Sqrt(\Delta P)$
$V = 4005 \times Sqrt(0.75)$
$Sqrt(0.75) = 0.866$ • $4005 \times 0.866 = 3,468$ • Flow Velocity = 3,468 Ft/Min

The **Duct Cross Sectional Area** is 1.65 Ft^2

$A = \pi \times r^2$
$\pi = 3.14159$ • $r^2 = 0.75^2 = 0.5625$
Duct Cross Sectional Area (A) = $3.14159 \times 0.5625 = 1.77\ Ft^2$

The **Air Flow** in CFM is 6,128 Ft^3/Min

Air Flow in CFM (Q) = Flow Velocity in Feet Per Minute (V) x Duct Cross Sectional Area (A)
Air Flow in CFM (Q) = 3,468 Ft/Min x 1.77 Ft^2 = 6,128 CFM

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