Pitot Tube Assembly

Instructions & Operation

16325_ins_pitot

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Product Identification

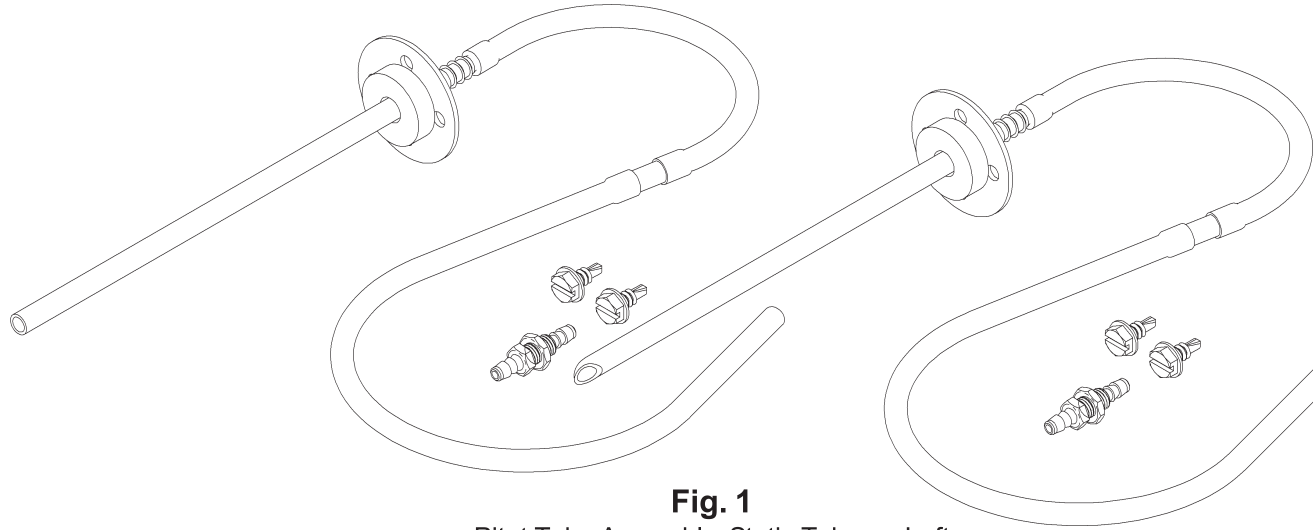

Fig. 1
Pitot Tube Assembly, Static Tube on Left
and Total Tube on Right

Mounting

Locate a spot in the duct to mount the pitot tube assembly. Ideally the position should be 5 duct diameters or more from any damper, bend, duct size change, fan or diffuser. If you are using rectangular duct use the larger of the two dimensions.

Drill mounting holes in the duct for the two tubes as shown in Figure 2. Drill the screw holes to fit your mounting screws. The screw supplied by BAPI self drill so no screw holes are needed. Be sure to face the arrows on the tubes in the direction of the airflow, See Figure 3.

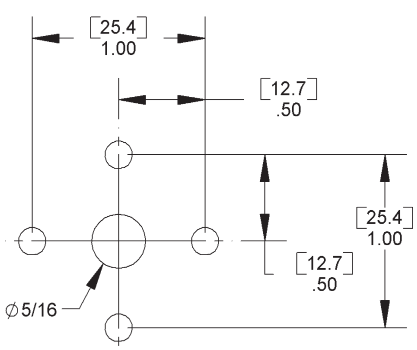

Fig. 2: Mounting Hole Dimensions

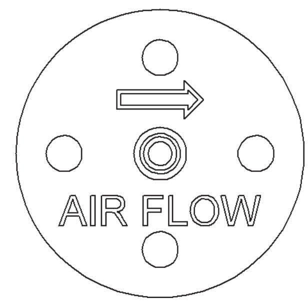

Fig. 3:
Arrow on Tube Mounting Flange

Mount the total tube upstream of the static tube. The total tube has its tip bent to "scoop" up the air. Connect the total tube to the high port of a differential pressure transmitter. Connect the static tube to the low port of a differential pressure transmitter. BAPI recommends the BAPI ZPS pressure transmitter. See Figure 4.

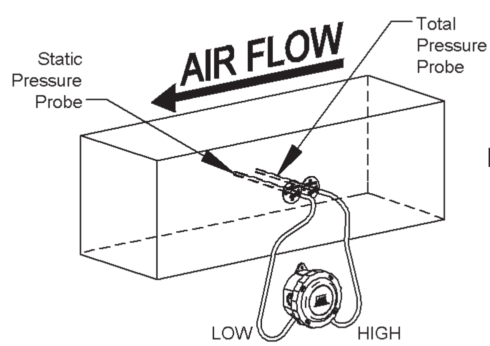

Fig. 4:
Pitot Assembly and ZPS
pressure transmitter
mounted in a duct.

Specifications subject to change without notice.

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Operation

Air only moves due to pressure differences. Air flows from high pressure to low pressure. A fan mechanically increases the air pressure in ductwork. Air flows from the fan to the diffusers. The total pressure in the duct consists of two parts, the static pressure and the velocity pressure.

When you blow up a balloon and tie it off the static pressure in the balloon keeps it inflated. Static pressure pushes equally in all directions. If you replace the balloon with a closed off air duct and a fan the same phenomenon happens, static pressure pushes equally in all directions. As you open the damper at the end of the closed duct air starts to move and the static pressure lowers. The moving air converts a portion of the static pressure into the velocity pressure of the moving air.

A tube in the duct aligned into the airflow senses the velocity pressure as well as the static pressure (total tube). The air colliding with the total tube comes to rest and converts its moving pressure back into static pressure. The new static pressure at the opening of the total tube is the duct static pressure added to the velocity pressure of the moving air.

A tube in the duct at right angles to the airflow senses only the static pressure (static tube). The difference between the total pressure reading and the static pressure reading is the velocity pressure. BAPI's ZPS is a true differential pressure transmitter, if you connect the total tube to the HIGH port on the ZPS and the static tube to the LOW port on the ZPS, then the transmitters out put will be the velocity pressure.

Velocity pressure is always a positive number applied in the direction of airflow. The airflow velocity can be calculated from the velocity pressure. Bernoulli's equation (shown below) is solved to find the relation between the airflow velocity and the velocity pressure. Airflow in cubic feet per minute is found by multiplying the velocity found above by the area of the duct in square feet.

The cooling or heating capacity of the airflow is proportional to its density. HVAC design is based on standard air at sea level. If the job site is in the mountains you may need to increase the airflow to satisfy the heating or cooling load. The increase is simply the ratio of air density at sea level to the air density at altitude. The ratio is know as the flow correction factor

The data in the table below represents NASA's Standard Atmosphere (http://www.pdas.com/e2.htm). Altitude and sigma (air density at altitude divided by sea-level density) were in the NASA data, BAPI derived the Flow Correction Factor. For example, Denver, Colorado is at an altitude of 5,000 feet, so the air is about 86% (sigma) of the density of sea level air. Therefore you need to increase the flow from the calculated flow by 16% to compensate.

Altitude	sigma	Flow Correction Factor
-1000 ft	1.03	0.97
0 ft	1.00	1.00
1000 ft	0.97	1.03
2000 ft	0.94	1.06
3000 ft	0.92	1.09
4000 ft	0.89	1.13
5000 ft	0.86	1.16
6000 ft	0.84	1.20
7000 ft	0.81	1.23
8000 ft	0.79	1.27
9000 ft	0.76	1.31

Bernoulli's Equation

$$V = \left(\sqrt{2G \times \frac{V_P \times D_W}{D_A}} \times \frac{1\text{ft}}{12\text{in}} \right) \times \frac{60\,\text{sec}}{1\text{min}}$$

Where:

V = Airflow velocity in feet per minute

G = Earth's gravitational constant (32 ft/sec^2)

V_P = Velocity pressure in inches of water (Total pressure - Static pressure)

D_W = Density of water at 70°F (62.72lb/ft^3)

D_A = Density of air at 70°F, 29.92 in Mg atmospheric pressure and 50% RH (0.075 lb/ft^3)

1ft/12in = Convert inches to feet

60sec/1min = Convert seconds to minutes

The equation, using the values for Standard Air, simplifies to:

$$V = 4005\sqrt{V_P}$$

Troubleshooting

PROBLEM	POSSIBLE SOLUTIONS
Velocity pressure reading is incorrect	- Make sure that the total tube is pointing directly upstream - Make sure that the static tube is perpendicular to the airflow - Make sure that the hoses from the static and total tubes do not have any kinks in them - Make sure that the total tube is connected to the high pressure port on the pressure transmitter and the static tube is connected to the low pressure port of the pressure transmitter - Troubleshoot the pressure transmitter.

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