9020184/E/497

AIRFLOW™

Telescopic Pitot-Static Tube

Note: to prevent the concentric flexible tube from the Pitot becoming 'crimped', ensure that the Pitot is replaced into its wallet/case nose end first. If the tube does become crimped, immerse the crimped portion into hot water to restore it to its correct shape

1. Introduction

The telescopic pitot-static tube is an addition to the established range of one piece and jointed pitot-static tubes manufactured by Airflow Developments since 1955.

The telescopic pitot-static tube, in common with most Airflow pitot-static tubes incorporates the modified semi-ellipsoidal nose form recommended for flow measurement in BS1042 Section 2.1 : 1983.

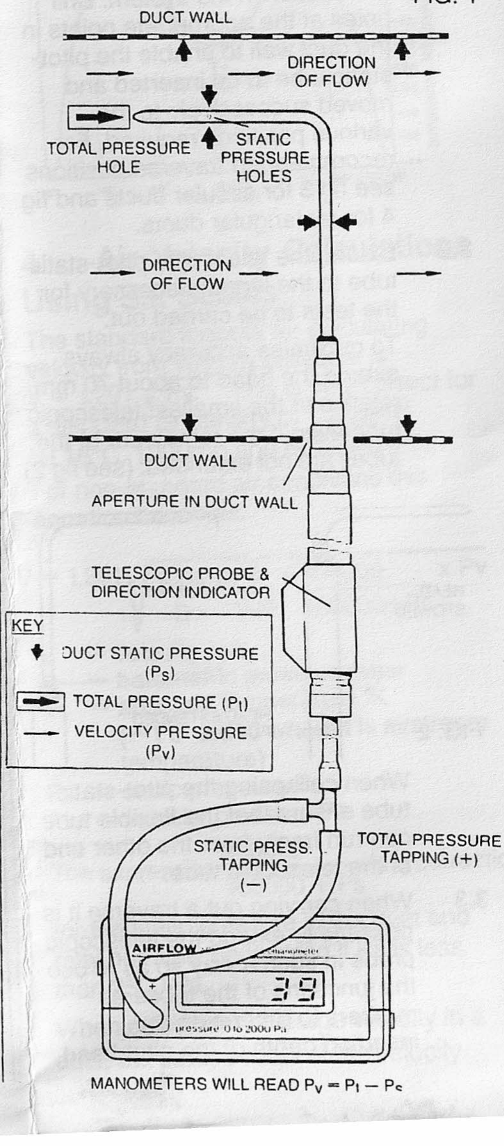
The telescopic pitot-static tube has the advantage of convenience and portability over one piece pitot-static tubes. When not in use it can be reduced to a length of 200 mm, whilst in use, it can be extended to 980 mm. It is not intended for use as a permanent installation and may be used up to a maximum temperature of 100°C for short periods only.

2. Description of the telescopic pitot-static tube

The pitot-static tube consists of a 4 mm diameter pitot-static head protruding, when extended, 70 mm from a seven section telescopic tube. Concentric flexible tubes pass through the telescopic section, protrude about 300 mm from the end when the telescopic tubes are fully extended, and terminate in a 'tee' piece from which connections to a manometer are made.

A direction indicator is clipped to the largest diameter section of the telescopic tube. This can be adjusted to align with the head direction prior to insertion in a duct. Care must be taken with alignment during insertion and with general handling.

FIG. 1



3. Use of the pitot-static tube

3.1 To determine the velocity or volume flow in a ducted system it is usually necessary to carry out a 'traverse' with the pitot-static tube in a plain section of duct, and at right angles to the duct walls. If possible, the section chosen should be at least six diameters (or equivalent) downstream of any bend or obstruction in the system. Drill holes at the appropriate points in the duct wall to enable the pitot-static tube to be inserted and moved successively to the various positions required. For recommended traverse positions see fig 3 for circular ducts and fig 4 for rectangular ducts.

3.2 Extend the telescopic pitot-static tube to the length necessary for the tests to be carried out.

To maximise accuracy always extend the head to about 70 mm relative to the smallest telescopic tube even if the remainder of the tubes are not extended: (see fig 2)

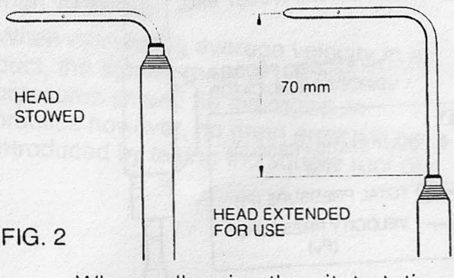


FIG. 2

When collapsing the pitot-static tube ensure that the flexible tube can run freely from the other end of the telescopic tube.

3.3 When carrying out a traverse it is possible to extend the telescopic probe in such a way so as to use the junctions of the tubes as markers to determine the insertion depth of the pitot head.

3.4 Connect the total and static pressure tappings on the pitot-static tube 'tee' piece to the + and — connectors of a sensitive manometer (see fig 1). The manometer will then indicate the velocity pressure (P_V). [Velocity pressure (P_V) = total pressure (P_t) — static pressure (P_S)]. From the velocity pressure, the velocity and volume flow can be found.

The slide rule supplied with each pitot-static tube may be used to speed up velocity calculations.

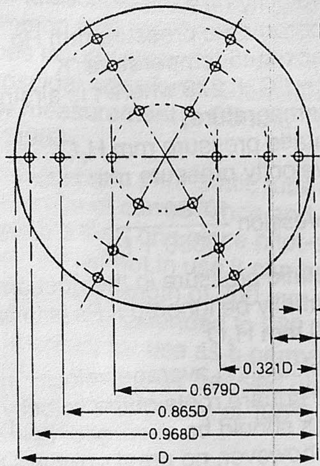
3.5 To obtain the best result ensure that the tip of the pitot-static tube faces directly into the flow in the duct. Reliable results will only be obtained if the flow in the duct is substantially parallel to the walls. If swirl or cross flow is suspected, this can be checked by inserting the pitot-static tube in several positions and turning the head in both pitch and yaw to find the angle at which the maximum velocity pressure is obtained. If this is no more than about 15° from being parallel to the duct walls, no great error will occur in the results. See fig 5 for the effect of yaw angle.

3.6 To measure the total pressure (P_t) or static pressure (P_S) only, connect the applicable tapping on the 'tee' of the pitot-static tube to the appropriate manometer connector leaving the other connector open to atmosphere.

3.7 The telescopic pitot-static tube is particularly suited for use with electronic manometers such as those found in the Airflow APM, EDM or MEDM ranges. The MEDM 500 model can give direct readings of pressure, velocity or volume flow and can memorise and average readings. Airflow also manufacture a range of liquid in glass manometers which may be used with the telescopic pitot-static tube. In common with all smaller pitot-static tubes, due to the small size of the pitot head and flexible connecting tubes, telescopic pitot-static tubes will exhibit marginally slower response times, than larger pitot-static tubes when used with liquid in glass manometers.

3.8 The telescopic pitot-static tube can be used with 2 mm bore silicon rubber tubing as supplied with the APM range or 5 mm bore PVC tubing supplied with liquid in glass manometers.

FIG. 3



Log Linear rule for traverse points on 3 diameters in a circular duct

Note: Should difficulty in access make it impossible to traverse on more than two diameters; these should be mutually at right angles and the numbers of points on each line must be increased to 10. The spacing should be as follows:
0.019D 0.077D 0.153D 0.217D 0.361D
0.639D 0.783D 0.847D 0.923D 0.981D

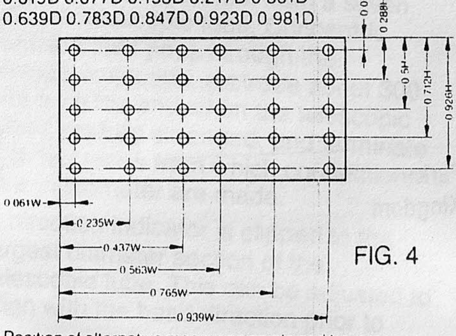


FIG. 4

Position of alternative measuring points and traverse lines relative to side lengths for rectangular ducts

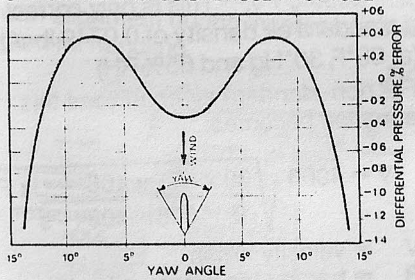
No of points or traverse lines	Position relative to inner wall
5	0.074, 0.288, 0.5, 0.712, 0.926,
6	0.061, 0.235, 0.437, 0.563, 0.765, 0.939,
7	0.053, 0.203, 0.366, 0.5, 0.634, 0.797, 0.949,

Log Tchebycheff Rule for Rectangular Ducts

Note: Distance between measuring stations should not exceed 200mm

FIG. 5

EFFECT OF YAW ANGLE ON PRESSURE OUTPUT OF MODIFIED ELLIPSOIDAL NOSE PITOT TUBE



4. Air Velocity Calculations Using S.I. Scales

The standard formula for calculating velocity from velocity pressure is $V = 1.291\sqrt{Pv}$. This is only correct for a standard air density of 1.2kg/m^3 (at 16°C, 1000mb and 65%RH)

For non-standard air conditions this equation becomes:

$$V = 1.291\sqrt{\frac{1000}{B} \times \frac{T}{289} \times \frac{100000}{100000+Ps} \times Pv}$$

V = velocity m/s
B = barometric pressure mbar
T = absolute temperature °K
(= t°C + 273 where t is airstream temperature)
Ps = static pressure Pa
Pv = velocity pressure Pa

The expression $\frac{100000}{100000 + Ps}$ is a correction for the static pressure in the duct and may normally be ignored if Ps is less than 2500 Pa.

When calculating average velocity in a duct, the square roots of the velocity pressures should be averaged. In practice however, no great error will be introduced by taking the square root of the average of velocity pressures when the majority of the readings do not vary by more than about ±25% from a mean figure.

5. Air Velocity Calculations Using Imperial Scales

The standard formula for calculating velocity from velocity pressure is $V = 4000 \sqrt{Pv}$. This is only correct for a standard air density of 0.0749 lbs/ft^3 (at 68°F, 30"Hg and 65%RH)

For non-standard air conditions this equation becomes:

$$V = 4000 \sqrt{\frac{30}{B} \times \frac{T}{528} \times \frac{408}{408+Ps} \times Pv}$$

V = velocity ft/min
B = barometric pressure ins Hg
T = absolute temperature °R (= t°F + 460 where t is airstream temperature)
Ps = static pressure ins wg
Pv = velocity pressure wg

The expression $\frac{408}{408 + Ps}$ is a correction for the static pressure in the duct and may normally be ignored if Ps is less than 10 ins wg.

When calculating average velocity in a duct, the square roots of the velocity pressures should be averaged. In practice however, no great error will be introduced by taking the square root of the average of velocity pressures when the majority of the readings do not vary by more than about ±25% from a mean figure.

6. Air Velocity Calculations Using Metric Scales

The standard formula for calculating velocity from velocity pressure is $V = 4.05 \sqrt{Pv}$. This is only correct for a standard air density of 1.2kg/m^3 (at 20°C, 762mmHg and 65%RH).

For non-standard air conditions this equation becomes:

$$V = 4.05 \sqrt{\frac{762}{B} \times \frac{T}{293} \times \frac{10363}{10363 + Ps} \times Pv}$$

V = velocity m/s
B = barometric pressure mm Hg
T = absolute temperature °K (= t°C + 273 where t is airstream temperature)
Ps = static pressure mm H_2O
Pv = velocity pressure mm H_2O

The expression $\frac{10350}{10350 + Ps}$ is a correction for the static pressure in the duct and may normally be ignored if Ps is less than 250 mm H_2O.

When calculating average velocity in a duct, the square roots of the velocity pressures should be averaged. In practice however, no great error will be introduced by taking the square root of the average of velocity pressures when the majority of the readings do not vary by more than about ±25% from a mean figure.

TSI Instruments Ltd.

Stirling House, 373 Stirling Road, Cressex Business Park
High Wycombe, Buckinghamshire, HP12 3RT United Kingdom
tel +44 (0) 1494 459200 *fax* +44 (0) 1494 459700
e-mail answers@tsi.com *web* www.tsi.com