Series 160S "S" Type Pitot Tubes
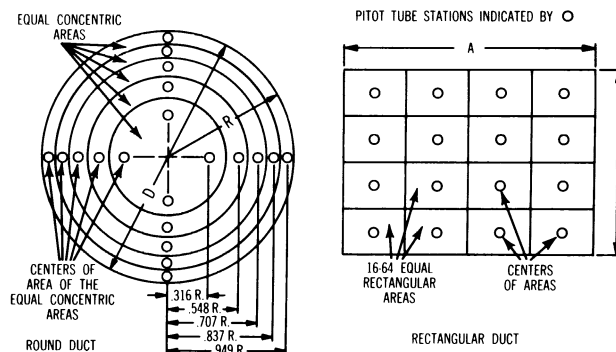
Operating Instructions

FIG. 4 — TRAVERSE ON ROUND AND SQUARE DUCT AREAS

Series 160S Pitot Tubes are designed to meet the need of the environmental testing field for an inexpensive, yet accurate and reliable way to measure the flow of particulate-laden air or gas streams. These pitot tubes use large 5/16″ diameter stainless steel tubing for both total and static pressures to avoid plugging. Versatile 1/8″ female NPT connections enable use with any type of piping or tubing. Two barbed tubing adapters are included for use with 3/16″ I.D. rubber or vinyl tubing.

This instrument was built to allow measurement of flows by the procedures detailed in U.S. Environmental Protection Agency publication 40 CFR Change 1, Application A, Method 2. For complete information, refer to that publication and the procedures contained within.

INTRODUCTION

The **total pressure** of a flowing air stream in a duct or pipe is the sum of the **static** or bursting pressure exerted on the sidewalls and the **velocity** or impact pressure of the moving air. The difference between **total** and **static** pressure is called **velocity pressure**, which can be used to determine the linear rate of air movement expressed in FPM (feet per minute). A pitot tube has two tubes arranged to sense both pressures simultaneously. By connecting these two tubes differentially to a manometer, **velocity pressure** is indicated directly and the corresponding air velocity can be calculated after applying the appropriate correction factor. For maximum accuracy of ±2%, as in laboratory applications, care is required and the following recommendations should be followed.

1. Duct diameter should be 4″ or larger.
2. Point **total pressure** opening upstream facing flow and **static pressure** opening downstream pointing in the direction of the flow. The faces of both openings must be perpendicular to the airflow.
3. Make an accurate traverse per drawings; calculate the the velocities at each point and average them.
4. Take readings in a smooth, straight duct section a minimum of 8½ duct diameters in length upstream and 1½ diameters downstream from the pitot tube.
5. Provide an egg-crate type straightener upstream from the pitot tube.

TAKING AIR VELOCITY READINGS

To measure air velocity with a Series 160S Pitot Tube, make a 13/16″ (20 mm) opening in side of duct. Permanent-mount models require a 1″ female NPT opening. Note: permanent mounting is not recommended with insertion lengths over 24″ (61 cm) due to risk of excessive deflection. Connect tubing from total pressure port to high pressure side of manometer and from static pressure port to the low pressure side. If reading is negative, reverse connections.

Make a series of readings traversing the duct in horizontal and vertical planes. Using velocity pressures recorded at each location, calculate velocities and average them for final velocity value. If circumstances do not permit or require an accurate traverse, center the pitot tube in the duct, determine the pressure differential (velocity pressure), calculate actual center velocity, and multiply this value by 0.9. Tests run in this manner should be accurate within ±5%.

CALCULATING VELOCITY

$$\textbf{Air Velocity} = 1096.2 \, (C_p) \sqrt{\frac{P_v}{D}}$$

where:

P_v = Sensed pressure difference (velocity pressure) in inches of water column

D = Air density in lbs./ft.^{3} (dry air = .075)

C_p = Pitot tube coefficient: 0.84

$$\textbf{Air Density} = 1.325 \times \frac{P_B}{T}$$

P_B = Barometric pressure in inches of mercury

T = Absolute Temperature (Indicated Temperature in °F plus 460)

Flow in cubic feet per minute equals duct cross sectional area in square feet x air velocity in feet per minute.

With dry air at 29.9 inches of mercury, air velocity can be read directly from temperature correction charts on reverse.

AIR VELOCITY IN FEET PER MINUTE (top chart, y-axis 0 to 14,000)
GAGE READING WITH 160S PITOT TUBE (VELOCITY PRESSURE) IN INCHES OF WATER (x-axis 0.0 to 4.0)

Temperature curves: 1400°F, 1200°F, 1000°F, 800°F, 600°F, 400°F, 300°F, 200°F, 100°F, 70°F, 40°F

AIR VELOCITY IN FEET PER MINUTE (bottom chart, y-axis 0 to 3,200)
GAGE READING WITH 160S PITOT TUBE (VELOCITY PRESSURE) IN INCHES OF WATER (x-axis 0.00 to 0.20)

Temperature curves: 1400°F, 1200°F, 1000°F, 800°F, 600°F, 400°F, 300°F, 200°F, 100°F, 70°F, 40°F

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