FLOW RATE CALCULATIONS USING A THERMOANEMOMETER OR MICROMANOMETER

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APPLICATION NOTE TSI-127 (A4)

Calculation of Flow Rate Using Velocity and Duct Size

This type of flow rate calculation applies to any measurement that occurs in a duct or pipe. Velocity is measured by the meter using a thermoanemometer probe or by a pitot tube that is attached to the pressure ports. The size of the duct or pipe (area is calculated by the instrument) must be entered into the instrument. For a circular pipe or duct, the diameter must be entered (either cm or inches) and for a rectangular duct, both the *x* and *y* dimensions need to be entered. The equations the meter uses for this flow rate calculation are as follows:

Area Formulas

To determine the area for a rectangular duct:

$A = L \times W/144$	$A = L \times W$

where:

A = ft^2	A = ft^2
L = length in inches	L = length in feet
W = width in inches	W = width in feet

$A = L \times W/10000$	$A = L \times W$

where:

A = m^2	A = m^2
L = length in centimeters	L = length in meters
W = width in centimeters	W = width in meters

To determine the area for round duct:

$A = \pi r^2/144$	$A = \pi r^2/10000$
A = ft^2	A = m^2
$\pi = 3.14$	$\pi = 3.14$
r = radius in inches	r = radius in centimeters

Example:

The dimension of a rectangular duct is 24 × 36 in. (61 × 91.4 cm) The average air velocity is 1000 fpm (5.08 m/s). Using the formula for determining the area of a rectangular duct, you will obtain an area of 6 ft^2 (0.557 m^2) Inputting the area into the volume flow formula along with the average velocity, you will obtain 6000 cfm (10196 m^3/h).

$A = L \times W/144$	$Q = AV$
A = 24 × 36 in./144	Q = 6 ft^2 × 1000 fpm
A = 6 ft^2	Q = 6000 cfm
or	
$A = L \times W/10000$	$Q = AV$
A = 61 × 91.4 cm/10000	Q = 0.55754 m^2 × 5.08 m/s
A = 0.55754 m^2	Q = 2.8323032 m^3/s × 60
	Q = 169.93819 m^3/min × 60
	Q = 10196 m^3/h

Calculation of Flow Rate Using Differential Pressure and a K-factor

Models with a differential pressure sensor and flow calculation capability can calculate flow rate from the square root of differential pressure and a K-factor. This type of flow rate calculation applies to measurements made on diffusers or flow stations with pressure taps designed for this purpose. Differential pressure is measured by the meter using the pressure ports. The K-factor must be entered into the instrument. The equation for this flow rate calculation is as follows:

$$\text{Flow Rate} = \left(\sqrt{p}\right)\left(K_f\right)$$

where:

p = differential pressure

K_f = K-factor

The source of the K-factor for this type of measurement is the manufacturer of the diffuser or flow station. These manufacturers specify the K-factor that must be used when making flow measurements using the pressure taps. Several K-factors are usually supplied, depending on the pressure and flow rate measurement units that are being used.

NOTE
TSI® Incorporated does not provide K-factors for this measurement. The K-factors must come from the manufacturers of the diffusers or flow stations through which the flow is being measured.

Example:

You are making a flow measurement using a diffuser with pressure taps. The manufacturer of the diffuser specified the K-factors listed in the table below.

Manufacturer-Supplied K-Factors

K-Factor	Pressure Units	Flow Units
112.3	inches H_2O	ft^3 / min
3.36	Pa	l/s
139.5	mm Hg	m^3 / hr

To make this measurement, select **pressure/Kfactor** in the Flow menu and enter the K-factor (112.3 or 3.36 or 139.5, depending on the pressure and flow rate units). The instrument automatically calculates the flow rate.

If the differential pressure measurement was 0.876 inches H_2O and the K-factor entered was 112.3, the flow rate displayed by the instrument would be:

$$\text{Flow Rate} = \left(\sqrt{0.876}\right)(112.3) = 105.1\ \text{ft}^3/\text{min}$$

If the differential pressure measurement was 218 Pa (0.218 kPa) and the K-factor entered was 3.36, the flow rate displayed by the instrument would be:

$$\text{Flow Rate} = \left(\sqrt{218}\right)(3.36) = 49.6\ \text{l/s}$$

If the differential pressure measurement was 1.64 mm Hg and the K-factor entered was 139.5, the flow rate displayed by the instrument would be:

$$\text{Flow Rate} = \left(\sqrt{1.64}\right)(139.5) = 178.6\ \text{m}^3/\text{hr}$$

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