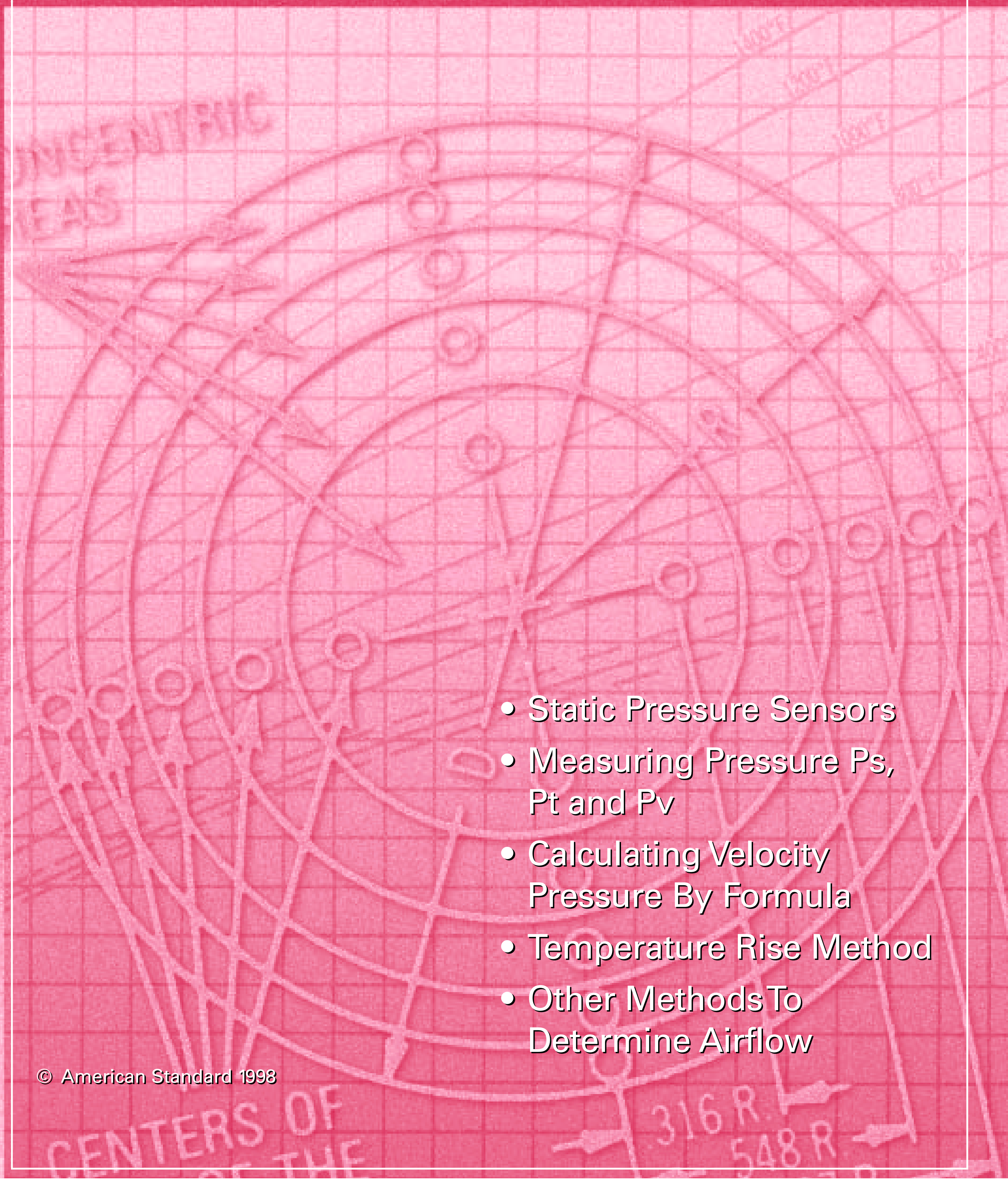
Airflow Measurement



- Static Pressure Sensors
- Measuring Pressure Ps, Pt and Pv
- Calculating Velocity Pressure By Formula
- Temperature Rise Method
- Other Methods To Determine Airflow

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Note: This publication is general in nature and is intended for INSTRUCTIONAL PURPOSES ONLY. It is not to be used for equipment selection, application, installation, or specific service procedures.

Airflow Measurement

Commercial air conditioning equipment is designed for a particular airflow across the evaporator. The flow rates for a design may be as low as 160 C.F.M. per ton to a high of 1600 C.F.M. per ton. If the airflow is not adjusted to the design amount, the performance of the equipment will not meet design nor will the conditioned space meet design. Before equipment is charged or a performance test run, design airflow must be established. When design calls for varying amounts of make-up air, the make-up air dampers must be placed in the maximum open position at which they will be operated and at the closed or minimum position at which they will be operated, and airflow checked in both positions. When the system uses an air unit (a separate coil enclosure apart from the air handler which depends on its airflow to be created by the air handler), it will have an additional adjustable damper so proper airflow can be established through itself. Repeated adjustment of total airflow and air unit airflow may be necessary to obtain design airflow through both units. Once design airflow has been established, balancing of the system may be performed. When the system has been balanced, total airflow should again be checked. If return air from the conditioned space is dampered off, any airflow through the air unit must be checked and adjusted if necessary.

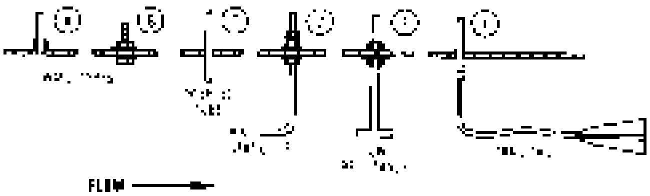
One reliable method to obtain airflow in the field is with the heat rise method, but in many cases, this method will not be applicable and alternate methods must be used. When service information is available, external static pressure and blower pulley R.P.M. can be used to determine airflow. Pressure drop across the evaporator coil or filters will also give reliable airflow information. When no service information is available, a transverse of the duct system with a Pitot tube or electronic anemometer will give reliable airflow information.

In air conditioning and heating, it is mandatory to understand the characteristics of air and techniques used to determine airflow. Air density affects the performance of any air moving device and the density must be known to effectively determine airflow. Air density is caused by a combination of three factors which are barometric pressure, temperature, and relative humidity. Air velocity, the distance traveled per unit of time, is usually expressed in feet per minute (F.P.M.). By multiplying air velocity by the cross section area of a duct, you can determine the air volume flowing past a point in the duct per unit of time. Volume of flow is usually measured in cubic feet per minute (C.F.M.). When force or pressure from a fan blade or a blower wheel causes the air to move, the moving air acquires a force or pressure component in its direction of motion due to its weight and inertia. This force is called velocity pressure. It is measured in inches of water column. In an operating duct system, a second pressure is always present. It is independent of air velocity or movement and is known as static pressure.

Static pressure exerts pressure upon the sidewalls of the duct. Total pressure is the combination of static and velocity pressures and is also measured in water column. It is an important and useful concept to us because it is easy to determine and although velocity pressure is not easy to measure directly, it can be determined easily by subtracting static pressure from total pressure. This subtraction need not be done mathematically. It can be done automatically with the instrument hook up. In the field the only air measurements that can be obtained are those of static pressure, total pressure and temperature. With these, air velocity and volume can be quickly calculated.

Static Pressure Sensors

To sense static pressure, six types of devices are commercially available from Dwyer. These are connected with tubing to a pressure indicating instrument. Figure 1-C and Figure 1-F are commonly used in the field.



Types of Static Pressure Sensing Devices
Figure 1

Figure 1-A shows a simple thru-wall static pressure tap. This is a sharp, burr-free opening through a duct wall provided with a tubing connection of some sort on the outside. The axis of the tap or opening must be perpendicular to the direction of flow. This type of tap or sensor is used where air flow is relatively slow, smooth and without turbulence. If turbulence exists, impingement, aspiration or unequal distribution of moving air at the opening can reduce the accuracy of readings significantly.

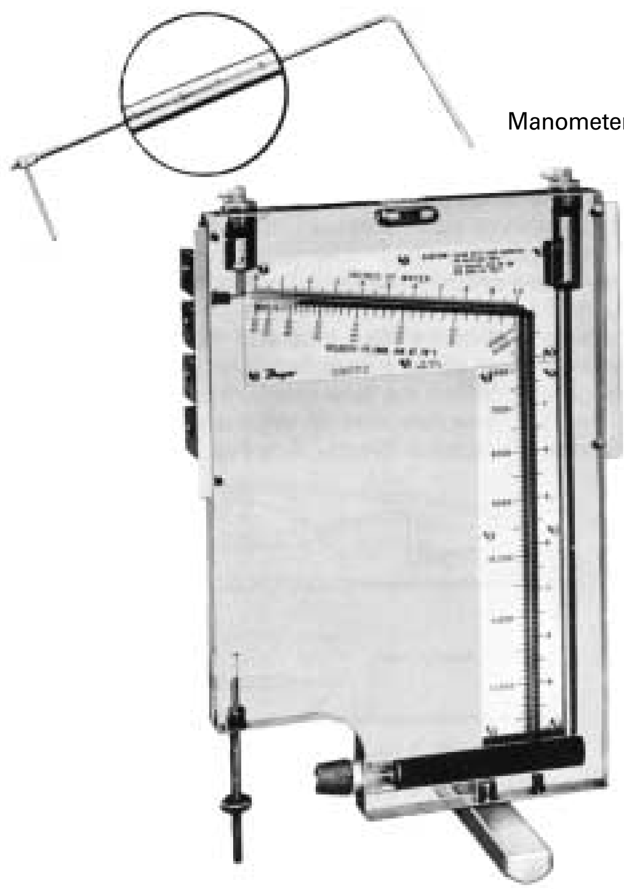
Figure 1-B shows the Dwyer No. A-308 Static Pressure Fitting. Designed for simplified installation, it is easy to install, inexpensive, and provides accurate static pressure sensing in smooth air at velocities up to 1500 F.P.M.

Figure 1-C shows a simple tube through the wall. Limitations of this type are similar to wall type 1-A.

Figure 1-D shows a static pressure tip which is ideal for applications such as sensing the static pressure drop across industrial air filters and refrigerant coils. Here the probability of air turbulence requires that the pressure sensing openings be located away from the duct walls to minimize impingement and aspiration and thus ensure accurate readings. For a permanent installation of this type, the Dwyer No. A-301 or A-302 Static Pressure Tip is used. It senses static pressure through radially-drilled holes near the tip and can be used in airflow velocities up to 12,000 F.P.M.

Figure 1-E shows a Dwyer No. A-305 low resistance Static Pressure Tip. It is designed for use in dust-laden air and for rapid response applications. It is recommended where a very low actuation pressure is required for a pressure switch or indicating gage – or where response time is critical.

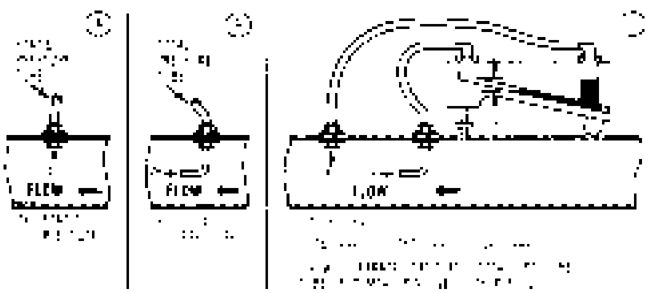
Under field conditions, air turbulence in a duct or plenum often makes it impossible to quickly install and align a rigid static pressure sensor to take accurate readings. Under these circumstances, the Dwyer Trail-Tail® Static Pressure Sensor (Figure 1-F) can be quickly inserted through a small hole in the duct and will trail into automatic alignment with the air stream. The pressure sensing holes in this device are thus presented at a 90° angle to actual airflow assuring quick, consistent, accurate readings.



Measuring Static Pressure, Total Pressure & Velocity Pressure

In sensing static pressure we make every effort to eliminate the effect of air movement. To determine velocity pressure, it is necessary to determine these effects fully and accurately. This is usually done with an impact tube which faces directly into the air stream. This type of sensor is frequently called a "total pressure pick-up" since it receives the effects of both static pressure and velocity pressure.

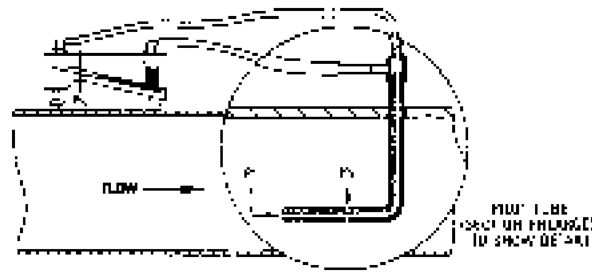
In Figure 2, note that separate static connections (A) and total pressure connections (B) can be connected simultaneously across a manometer (C). Since the static pressure is applied to both sides of the manometer, its effect is cancelled out and the manometer indicates only the velocity pressure.



Types of Pressure Measurements
Figure 2

To translate velocity pressure into actual velocity requires either mathematical calculation, reference to charts or curves, or prior calibration of the manometer to directly show velocity. In practice this type of measurement is usually made with a Pitot tube which incorporates both static and total pressure sensors in a single unit.

Essentially, a Pitot tube consists of an impact tube (which receives total pressure input) fastened concentrically inside a second tube of slightly larger diameter which receives static pressure input from radial sensing holes around the tip. The air space between inner and outer tubes permits transfer of pressure from the sensing holes to the static pressure connection at the opposite end of the Pitot tube and then, through connecting tubing, to the low or negative pressure side of a manometer. When the total pressure tube is connected to the high pressure side of the manometer, velocity pressure is indicated directly. See Figure 3.



Pitot Tube
Figure 3

Since the Pitot tube is a primary standard device used to calibrate all other air velocity measuring devices, it is important that great care be taken in its design and fabrication. In modern Pitot tubes, proper nose or tip design — along with sufficient distance between nose, static pressure taps and stem — will minimize turbulence and interference. This allows use without correction or calibration factors. All Dwyer Pitot tubes are built to AMCA and ASHRAE standards and have unity calibration factors to assure accuracy.

To ensure accurate velocity pressure readings, the Pitot tube tip must be pointed directly into (parallel with) the air stream. As the Pitot tube tip is parallel with the static pressure outlet tube, the latter can be used as a pointer to align the tip properly. When the Pitot tube is correctly aligned, the pressure indication will be maximum.

Because accurate readings cannot be taken in a turbulent air stream, the Pitot tube should be inserted at least 8½ duct diameters downstream from elbows, bends or other obstructions which cause turbulence. To ensure the most precise measurements, straightening vanes should be located 5 duct diameters upstream from the Pitot tube.

Calculating Velocity Pressure By Formula

Manometers for use with a Pitot tube are offered in a choice of two scale types. Some are made specifically for air velocity measurement and are calibrated directly in feet per minute. They are correct for standard air conditions: i.e. air density of .075 lbs. per cubic foot which corresponds to dry air at 70°F, barometric pressure of 29.92 inches Hg. To correct the velocity reading for other than standard air conditions, the actual air density must be known. It may be calculated if relative humidity, temperature and barometric pressure are known.

Most manometer scales are calibrated in inches of water column. Using readings from such an instrument, the air velocity may be calculated using the basic formula:

For Standard Air:

With dry air at 70°F, barometric pressure of 29.92 inches Hg., use the following formula:

$$\textbf{Velocity} = 4004.4\sqrt{\textbf{Velocity Pressure}}$$

With dry air at 29.92 inches mercury, air velocity can be read directly from curves on the next page.

For Other Than Standard Air:

To determine dry air density, use the formula:

$$d = 1.325\frac{P_b}{T}$$

Where:

d = Air density in pounds per cubic foot.

P_b = Barometric (or absolute) static pressure in inches of mercury.

T = Absolute temperature (indicated temperature in °F plus 460°).

$$V = 1096.7\sqrt{\frac{h_v}{d}}$$

Where:

V = Velocity in feet per minute.

h_v = Velocity pressure in inches of water.

d = Density of air in pounds per cubic foot.

DRY AIR AT 29.92 INCHES MERCURY AND 70°F

Pv	V	Pv	V	Pv	V
.01	400	.18	1699	.35	2369
.02	566	.19	1745	.36	2403
.03	694	.20	1791	.37	2436
.04	801	.21	1835	.38	2468
.05	895	.22	1878	.39	2501
.06	981	.23	1920	.40	2533
.07	1059	.24	1962	.41	2564
.08	1133	.25	2002	.42	2595
.09	1201	.26	2042	.43	2626
.10	1266	.27	2081	.44	2656
.11	1328	.28	2119	.45	2686
.12	1387	.29	2155	.46	2716
.13	1444	.30	2193	.47	2745
.14	1498	.31	2230	.48	2774
.15	1551	.32	2265	.49	2803
.16	1602	.33	2300	.50	2832
.17	1651	.34	2335	.51	2860

VELOCITY CORRECTIONS TO DRY AIR AT 29.92 INCHES MERCURY

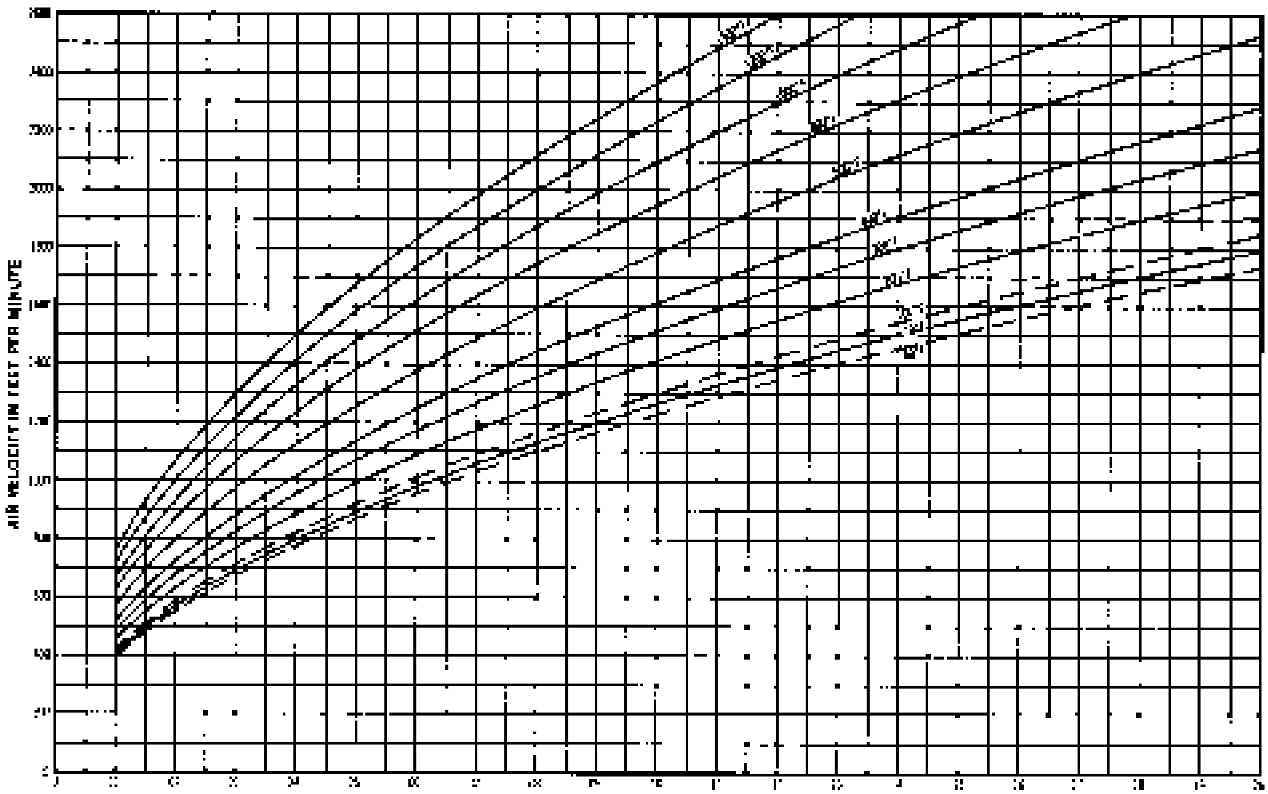
Multiply Velocity by Correction

Altitude	Correction
0'	1.00
1000'	1.04
2000'	1.08
3000'	1.11
4000'	1.17
5000'	1.21

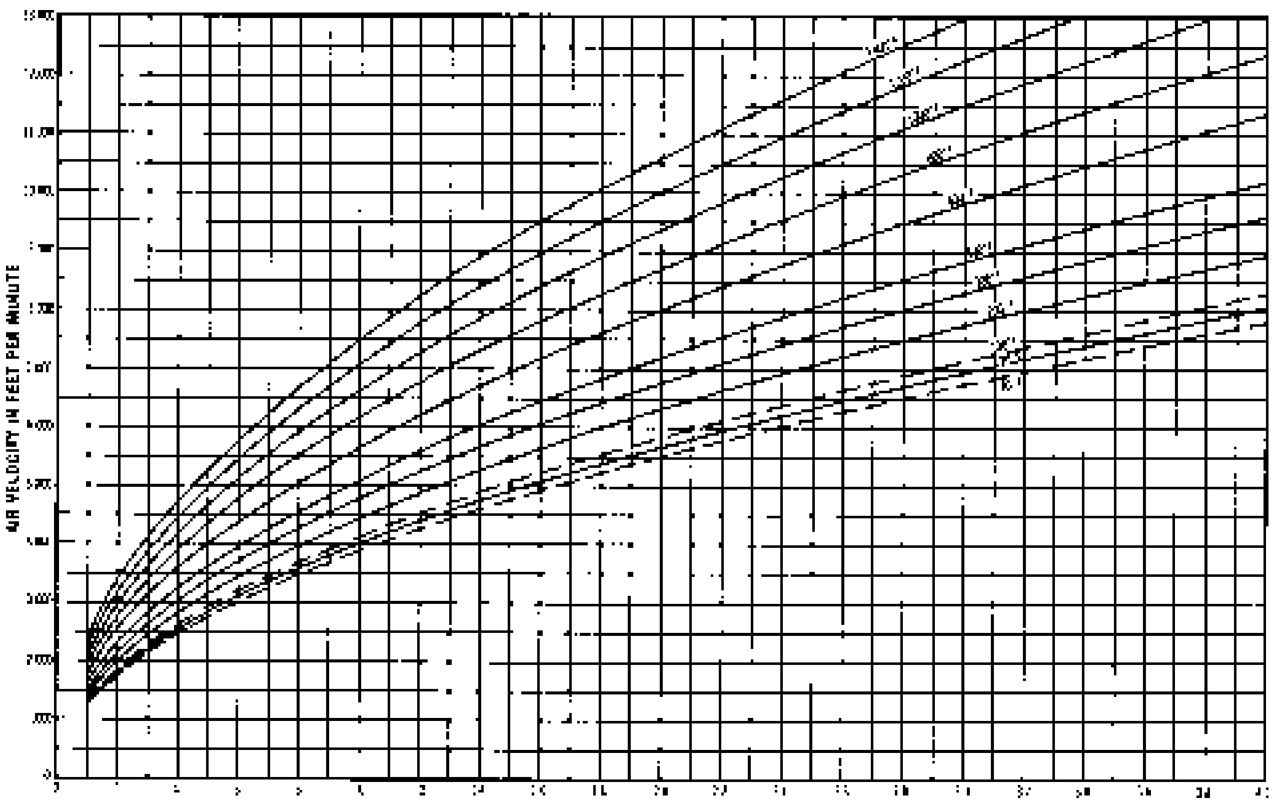
Temperature	Correction Dry	Correction 50% RH
50°F	.96	.97
60°F	.98	.99
70°F	1.00	1.01
80°F	1.02	1.04
90°F	1.04	1.06
100°F	1.06	1.09
110°F	1.08	1.12
120°F	1.09	1.16

Air Velocity Flow Charts

Dry Air At 29.92 Inches Mercury



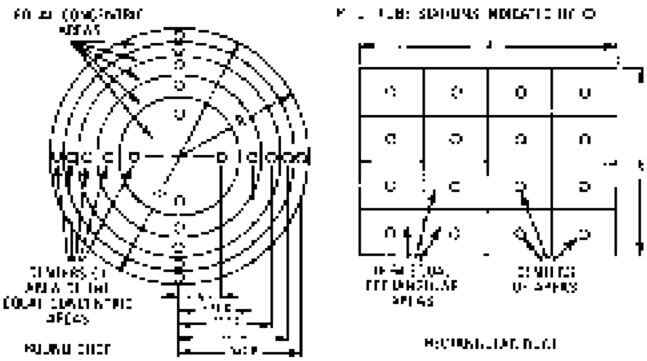
Gauge Reading with Pitot Tube (Velocity Pressure) in Inches of Water



Gauge Reading with Pitot Tube (Velocity Pressure) in Inches of Water

How To Take Traverse Readings

In practical situations, the velocity of the air stream is not uniform across the cross section of a duct. Friction slows the air moving close to the walls, so the velocity is greater in the center of the duct.



Traverse on Round and Square Duct Areas
Figure 4

To obtain the average total velocity in ducts of 4" diameter or larger, a series of velocity pressure readings must be taken at points of equal area. A formal pattern of sensing points across the duct cross section is recommended. These are known as traverse readings. Figure 4 shows recommended Pitot tube locations for traversing round and rectangular ducts.

In round ducts, velocity pressure readings should be taken at centers of equal concentric areas. At least 20 readings should be taken along two diameters. In rectangular ducts, a minimum of 16 and a maximum of 64 readings are taken at centers of equal rectangular areas. Actual velocities for each area are calculated from individual velocity pressure readings. This allows the readings and velocities to be inspected for errors or inconsistencies. The velocities are then averaged.

By taking Pitot tube readings with extreme care, air velocity can be determined within an accuracy of ±2%. For maximum accuracy, the following precautions should be observed:

1. Duct diameter should be at least 24 times diameter of Pitot tube.
2. Locate the Pitot tube in a duct section providing 8½ or more duct diameters upstream and 1½ or more diameters downstream of Pitot tube free of elbows, size changes or obstructions.
3. Provide an egg-crate type of flow straightener 5 duct diameters upstream of Pitot.
4. Make a complete, accurate traverse.

In small ducts or where traverse operations are otherwise impossible, an accuracy of ±5% can frequently be achieved by placing the Pitot tube in the center of the duct. Determine velocity from the reading, then multiply by 0.9 for an approximate average.

Determining Volume Flow

Once the average air velocity is known, the airflow rate in cubic feet per minute is easily computed using the formula:

$Q = AV$

Where:

Q = Quantity of flow in cubic feet per minute.

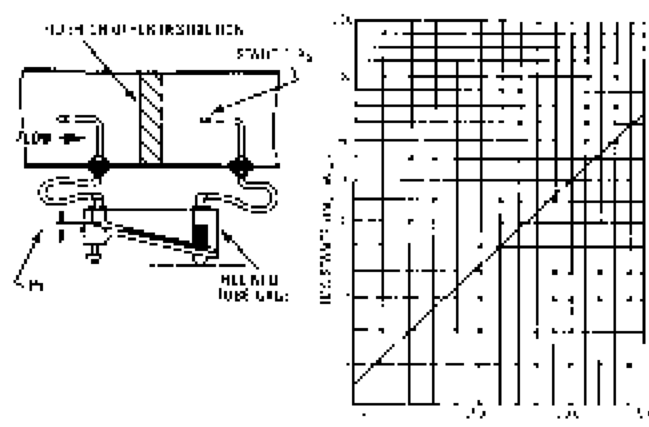
A = Cross sectional area of duct in square feet.

V = Average velocity in feet per minute.

Determining Air Volume By Calibrated Resistance

Service Facts contain pressure drops for evaporator coils on some models.

Manufacturers of air filters often publish data from which approximate air flow can be determined. It is characteristic of such equipment to cause a pressure drop which varies proportionately to the square of the flow rate. Figure 5 shows a typical filter and a curve for airflow versus resistance. Since it is plotted on logarithmic paper, it appears as a straight line. On this curve, a clean filter which causes a pressure drop of .50 inches w.c. would indicate a flow of 2,000 C.F.M.



Differential Measurement Across Duct Restriction
Figure 5

For example, assuming a manufacturer's specification for a filter, coil, etc:

Given Flow Q (ft³/min.) = at differential "h" (inches w.c.)

To determine flow at other differentials the formula is:

$$\textbf{Qn (other flows)} = Q\sqrt{\frac{h_n}{h}}$$

Where:

Q = Quantity of flow in cubic feet per minute.

h = Differential in inches water column.

h_n = Differential (other flow conditions).

Temperature Rise Method

In servicing air conditioning systems, it is not always necessary to precisely determine the airflow. In many cases, a good approximation is sufficient. For this reason, the temperature rise method of measurement is used.

The chart (Figure 7 on page 10) relies upon the temperature rise formula:

$$\text{C.F.M.} = \frac{\text{BTU Output}}{\text{ĐT} \times 1.08}$$

The chart shows the temperature rise when a specific amount of heat is added to the system air. If the input is known exactly, this is a precise method of measurement. But in service situations, this may not be possible. Therefore, you need to know how to apply the chart to determine a practical answer.

If the equipment you are servicing is a gas furnace, this chart may also be used if you understand how furnaces perform. The AFUE rating on a gas furnace does not tell how the furnace converts gas fuel to heat energy under constant or "steady state" operation. It must not be used to calculate airflow unless it is above eighty percent efficient. If the AFUE is above eighty, the higher number may be used.

All gas furnaces produce approximately eighty percent efficiency in constant operation. (Input capacity x .80 = Output capacity) This was the basis for the rating called Bonnet Capacity found on older furnaces. When the furnace has operated until the output temperature has stabilized, this rise may be used to approximate the airflow for service purposes.

To use this method, take the input from the gas meter flow and multiply by the percentage of efficiency (either eighty percent or above). This will give you output BTU's, which may be used on the chart.

For furnaces burning propane fuel gas, the manifold pressure should be set to 11.0 inches water column pressure since propane orifices are rated at 11.0 inches. The input may then be closely estimated. Don't forget to reset the manifold pressure to 10.5 inches when you have performed the temperature rise.

THIS METHOD SHOULD BE USED WHEN A CLOSE APPROXIMATION IS ALL THAT IS NEEDED. When the question is, "Do I have enough airflow for a two ton system?", this method will answer the question.

Measuring Power Consumption of Any AC Connected Load

1. Measure power input to electric resistance heaters and indoor fan motor (Figure 6).
2. **CAUTION:** Observe all notes on Figure 6. The electric resistance heaters and indoor fan motor ONLY MUST be operating for this test.

Alternate Power Input Measurement – Single Phase Only. See SP210 (Service Procedures Manual, Pub. No. 34-1005) For 3 Phase Heater Measurements.

This method is less accurate than watt-hour meter measurement and should be used only when the heat pump system is not connected to a watt-hour meter or when other appliances connected to the watt-hour meter cannot be interrupted.

1. Measure voltage supply at heater and fan motor.
2. Measure ampere draw by ALL heaters and fan motor.
3. **CAUTION:** Do not use nameplate ratings. Voltage and amp draw must be measured.
4. Multiply total measured amp draw by measured voltage to obtain watts input.

   Example: Where measured voltage is 218 volts and measured amp draw is 36.5,

   Watts = 218 x 36.5 = 7597 or 7.597 KW.
5. Turn off breakers or fuses to all electrical devices except device to be measured.
6. Record time in seconds required for 20 revolutions of watt-hour meter disc. (Any other number of revolutions may be counted if desired.)

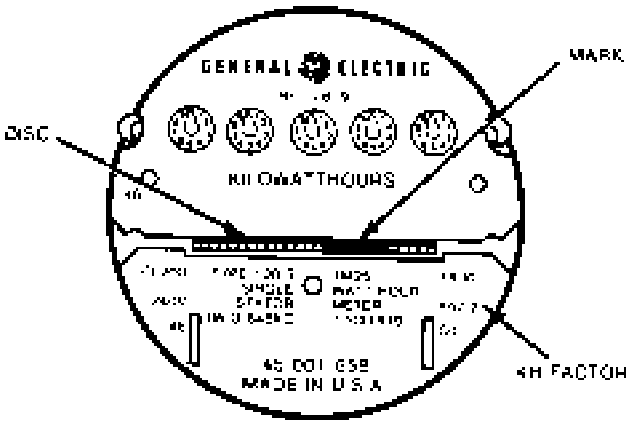
7. Multiply revolutions by KH factor, which is stamped on the meter face, (usually 3.6 or 7.2).
8. Multiply total above by a constant; 3.6 (converts watt seconds to kilowatt hours).
9. Divide this total by the time **in seconds** required for 20 revolutions of the meter disc.

   Example:

   $$KWH = \frac{\text{Disc. Rev. x KH Factor x 3.6}}{\text{Seconds}}$$

   $$KWH = \frac{20 \times 7.2 \times 3.6}{65 \text{ Seconds}} = \frac{518}{65}$$

   $$KWH = 8.0$$



Watthour Meter
Figure 6

Airflow Calculation

1. Establish airflow (Figure 7 on page 10) using KW input and temperature rise determined in preceding tests or calculate by the formula:

   $$C.F.M. = \frac{KW \times 3413}{ÐT \times 1.08}$$

   Where:

   KW = measured input by watt-hour meter ÐT = supply air °F minus return air °F.

   3413 = BTU per KW.

   1.08 = specific heat air constant.

   Example:

   Where measured input = 10 KW and measured ÐT = 20°F.

   $$C.F.M. = \frac{10 \times 3413}{20 \times 1.08} = 1580$$

CAUTION: When measuring electric heaters used in conjunction with heat pumps, the heat pump circuits MUST be disabled such that measurements are made on electric resistance heaters only.

Heat Pump Capacity Measurement

1. Set room thermostat "Electric Heat-Normal" switch to "Normal" position.
2. Set thermostat heating temperature dial at 90°.
3. Turn off breakers or fuses to all electric resistance heaters. The heat pump and indoor fan only must be operating for this test.
4. Measure temperature rise (Figure 6).
5. Establish BTU output (Figure 7) using measured airflow and measured temperature rise as known quantities or calculate from the formula:

   BTU = C.F.M. x ÐT x 1.08

   Where:

   C.F.M. = total measured airflow.

   ÐT = supply air °F minus return air °F.

   1.08 = specific heat air constant.

   Example:

   Where measured airflow is 1580 C.F.M. and measured temperature rise is 28°F.

   BTU = 1580 x 28 x 1.08 = 47,779

Coefficient Of Performance

1. Measure power input to the heat pump system (Figure 6). Establish COP by dividing measured KW input to KW output equivalent (Figure 7).

   Example:

   Where measured input is 7 KW and measured output is 47779 BTU.

   Heat output column in Figure 7 shows 47779 BTU is equivalent to approximately 14 KW.

   $$COP = \frac{output}{input} - \frac{14}{7} - 2.0$$

   Example:

   Where measured output is 47779 BTU and measured input is 7.0 KW

   $$COP = \frac{47779}{7 \times 3413} = 1.999$$

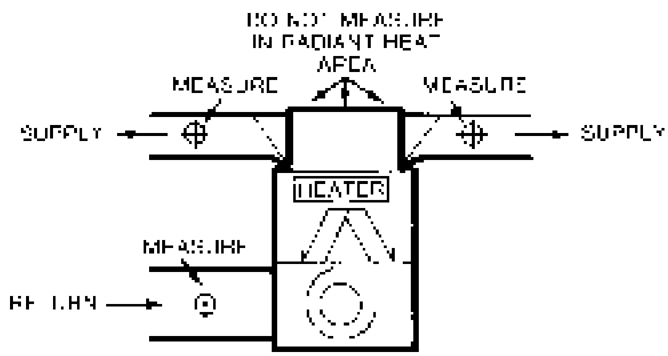
   Compare measured quantities to Product Data Manuals. Results should be within 10% of published data.

Temperature Rise Measurement (Figure 6)
Heat Pump Air Handler

1. Use same thermometer for return and supply to avoid thermometer error.

Airflow Measurement

2. Do not measure in radiant heat area. True air temperature cannot be measured in radiant heat areas – See Figure 7A.
3. Measure within six feet of air handler. Measurement at return and supply grilles is inaccurate.
4. Use average temperature when more than one duct is connected to plenum.
5. Be sure air temperature is stable before measurement.
6. Measure downstream from any mixed air source.
7. Record temperature difference in return air and supply air (ĐT).



Heat Pump Air Handler
Figure 7A

HEAT OUTPUT		AIRFLOW — CUBIC FEET PER MINUTE																														
		400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200	3300	3400
KW	BTU	TEMPERATURE RISE — DEGREES FAHRENHEIT																														
3	10242	24	19	16	14	12																										
4	13656	32	25	21	18	16	14	13																								
5	17070	39	32	26	23	20	18	16	14	13																						
6	20484	47	38	32	27	24	21	19	17	16	15	14																				
7	23898	55	44	37	32	28	26	22	20	18	17	16	15	14																		
8	27312	63	51	42	36	32	28	25	23	21	19	18	17	16	15	14																
9	30726	71	57	47	41	36	32	28	26	24	22	20	19	18	17	16	15	14														
10	34140	79	63	53	45	39	35	32	28	26	24	22	21	20	19	18	17	16	15	14												
11	37554	87	69	58	50	43	39	35	32	29	27	25	23	22	20	19	18	17	16	15	14	13										
12	40968	95	76	63	54	47	42	38	34	32	29	27	25	24	22	21	20	19	18	17	16	15	14									
13	44382		82	68	58	51	46	41	37	34	32	29	27	26	24	23	22	21	20	19	18	17	16	15								
14	47796		89	74	63	56	49	44	40	37	34	32	30	28	26	25	23	22	21	20	19	18	17	16	15							
15	51210		95	79	68	59	53	47	43	39	36	34	32	30	28	26	25	24	23	22	21	20	19	18	17	16						
16	54624			84	72	64	56	50	46	42	38	36	34	32	30	28	27	25	24	23	22	21	20	19	18	17	16					
17	58038			89	77	67	60	54	49	45	41	38	36	34	32	30	28	27	26	24	23	22	21	20	19	18	17	16				
18	61452			95	82	72	64	56	52	48	44	40	38	36	34	32	30	28	27	26	25	24	23	22	20	19	18	17	16			
19	64866				86	75	67	60	55	50	46	42	40	38	36	34	32	30	29	27	26	25	24	23	22	21	20	19	18	17		
20	68280				90	79	70	63	57	53	49	45	42	40	37	35	33	32	30	29	27	26	25	24	23	22	22	21	20	20	19	
21	71694				95	83	74	66	60	55	51	47	44	41	39	37	35	33	32	30	29	28	27	26	25	24	23	22	21	21	20	19
22	75108				99	87	77	69	63	58	53	50	46	43	41	39	37	35	33	32	30	29	28	27	26	25	24	23	22	22	21	20
23	78522					91	81	73	66	61	56	52	48	45	43	40	38	36	35	33	32	30	29	28	27	26	25	24	23	23	22	21
24	81936					95	84	76	69	63	58	54	51	47	45	42	40	38	36	34	33	32	30	29	28	27	26	25	24	24	23	22
25	85350					99	88	79	72	66	61	56	53	49	46	44	42	40	38	36	34	33	32	30	29	28	27	26	25	25	24	23
26	88764						91	82	75	68	63	59	55	51	48	46	43	41	39	37	36	34	33	32	30	29	28	27	26	26	25	24
27	92178						95	85	78	71	66	61	57	53	50	47	45	43	41	39	37	36	34	33	32	30	29	28	28	27	26	25
28	95592						98	88	80	74	68	63	59	55	52	49	47	44	42	40	38	37	35	34	33	32	31	30	29	28	27	26
29	99006							92	83	76	71	65	61	57	54	51	48	46	44	42	40	38	37	35	34	33	32	31	30	29	28	27
30	102420							95	86	79	73	68	63	59	56	53	50	47	45	43	41	40	38	36	35	34	33	32	31	30	29	28

CAUTION: When Measuring Electric Heaters Used in Conjunction with Heat Pumps, The Heat Pump Circuits MUST be Disabled Such That Measurements Are Made on Electric Resistance Heaters Only.

Airflow Measurements – Electric Heaters
Figure 7

Other Methods To Determine Airflow

Airflow (C.F.M.) can be determined with the use of service information, from the table below, which gives external static pressure and blower R.P.M.

To determine blower R.P.M., a hand-held digital photo tach is required.

Evaporator Fan Performance 20 Ton TWE240B — Air Handler

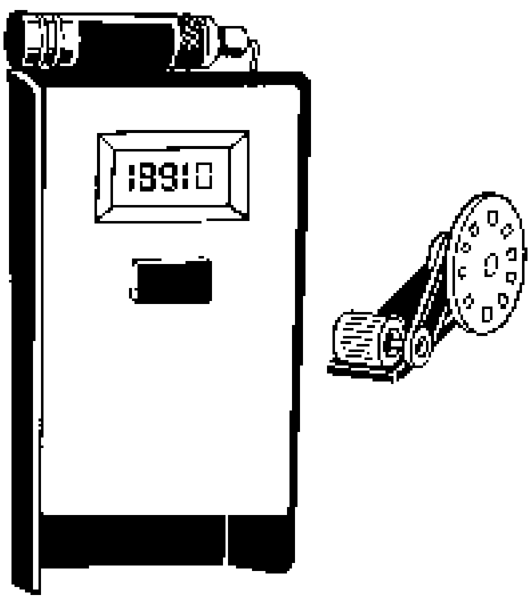
	External Static Pressure (Inches of Water Gauge)																					
	.10"		.20"		.30"		.40"		.50"		.60"		.70"		.80"		.90"		1.00"		1.20"	
CFM	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
6400	—	—	—	—	570	1.41	612	1.57	654	1.70	696	1.81	743	2.06	781	2.25	808	2.40	831	2.55	893	2.86
6800	—	—	—	—	593	1.58	635	1.74	677	1.90	722	2.08	762	2.29	794	2.46	820	2.61	846	2.76	894	3.07
7200	—	—	573	1.59	615	1.75	657	1.92	700	2.09	747	2.30	781	2.52	806	2.56	831	2.81	856	2.96	904	3.29
7600	—	-	603	1.84	651	1.98	694	2.15	731	2.38	766	2.57	793	2.74	819	2.86	844	3.02	869	3.17	919	3.55
8000	585	1.97	633	2.11	686	2.21	730	2.39	764	2.66	785	2.81	809	2.85	832	3.09	857	3.20	882	3.37	931	3.80
8400	619	2.20	657	2.35	710	2.54	752	2.73	778	2.94	801	3.09	823	3.24	848	3.39	873	3.55	895	3.71	947	4.14
8800	652	2.43	685	2.60	733	2.88	770	3.07	794	3.22	818	3.38	837	3.50	863	3.55	889	3.86	915	4.04	960	4.47
9200	682	2.76	720	2.98	763	3.19	790	3.37	917	3.52	834	3.68	858	3.94	884	4.01	909	4.20	932	4.40	975	4.83
9600	711	3.58	766	3.36	787	3.52	827	3.67	828	3.82	852	3.99	878	4.17	904	4.35	929	4.54	949	4.75	990	5.20

5 HP Standard Motor & Field Supplied Low Static Drive

5 HP Standard Motor & Low Static Drive Kit

5 HP Standard Motor and Sheaves

7.5 HP Oversized Motor & Sheaves



Digital Photo Tach
Figure 8

Figure 9

On an air handler with an external mounted motor, removal of V-belt cover is required to gain access to the blower pulley.

The digital photo tach allows the R.P.M. of the blower to be taken with all air handler panels in place. If the air handler has an enclosed motor and blower assembly, a hole must be drilled in the access panel in line with the blower pulley rim.

Other Methods To Determine Airflow

Figure 10

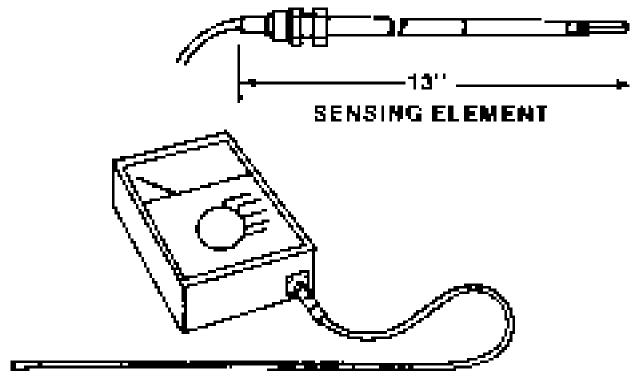


Figure 11

1. Apply reflective sticker if needed to blower pulley per digital photo tach instructions and inspect blower pulley and motor pulley to determine size and type.
2. Drill hole in access panel in line with blower pulley if required.
3. Obtain blower R.P.M. with digital photo tach.
4. Obtain external static pressure.
5. Consult service information for model involved and determine C.F.M. from applicable chart.

Airflow (C.F.M.) can also be determined by the use of electronic air velocity meters which work on the principle that when a known substance is heated, its resistance to current flow changes. In the air sensor tip a sensor substance, similar to a thermister, is heated by a control heater circuit and its resistance is measured. The meter, instead of being calibrated in OHMS is calibrated in feet per minute. The greater the velocity, the greater the cooling effect and the greater the resistance change. The duct must be traversed and the different readings averaged. Once velocity is known and the free area of the duct is known, C.F.M. can be found.