



# Pressure Accessory Kit

**INSTRUCTION 0024-9406**

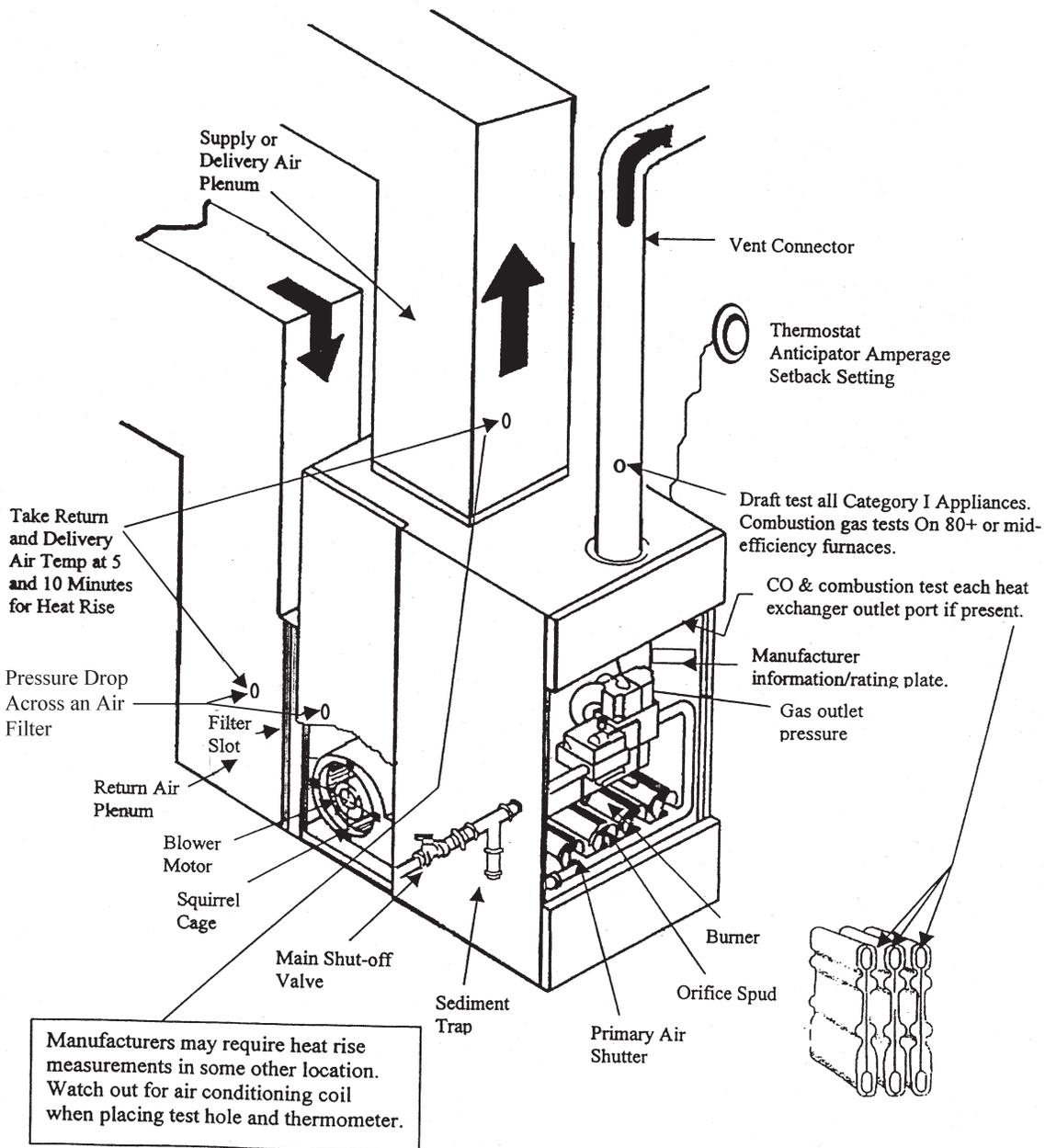
**(Part # 0024-8214)**

**Operation**

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**Figure 1. Typical Furnace showing various Testing Points**

## 1.0 INTRODUCTION

The Pressure Accessory Kit is a collection of parts to be used with the Bacharach, Inc. Fyrite® Pro or Portable Combustion Analyzer (PCA) to check various pressures such as the differential pressure and appliance gas pressure. Measurements can be made to insure proper installation, operation, and venting of heating systems as well as other combustion appliances.

Tests can be performed to ensure that proper installation and operation of HVAC equipment according to the manufacturer's specifications, as well as assuring that the system does not negatively effect the Indoor Air Quality.

Quality assurance pressure testing to check for and prevent back drafting of chimney flue gases (Carbon Monoxide) has become important because of modern building practices. As homes become more "air tight" due to the increased effort to insulate and eliminate air leaks, the chance of creating large inside to outside pressure differences increases. There are other factors beside the house having a good air barrier that can cause this increase such as, extra exhaust fans, additional combustion equipment (fireplaces, multiple gas water heaters, etc.), forced air heating, attached garages (made "air tight"), Multi-story homes (greater stack effect), plus more and larger rooms (creating more "zones"). As all of these factors effect the house creating a more negative inside pressure, the possibility of the colder outside air forcing its way down the chimney and causing a combustion gas back draft exists.

It is important that a worst case depressurization test be performed on any new homes under construction to prevent the back draft situation. Older homes should also be checked to make sure that the back draft condition does not exist, and should also be checked when making them "air tight", or when adding new exhaust fans or combustion equipment. The building codes for Canada and Minnesota now call for a worst case depressurization test on all new construction. Several other states are looking into enacting the same kind of codes.

The Pressure Accessory Kit consists of:

- 2 - 20 foot sections of 3/16 ID Tygon Tubing
- 1 - 4 foot section of clear 3/16 ID Tygon Tubing
- 1 - 1/8 x 6 in Pitot Tube (recommended for ducts 4 to 10 inches)  
(When required, a 5/16 x 18 in Pitot Tube, recommended for ducts 10 inches and larger, can be purchased separately)
- 1 - Static Pressure Tip with Magnet
- 1 - 3/16 Tube x 1/8 NPT Gas Valve Fitting
- 1 - 3/16 OD Flexible Brass Tube (12 inches)
- 2 - 3/16 inch Probe Fittings (for PCA and Fyrite Pro)

## 2.0 TESTS

This section explains some of the ways the Pressure Accessory Kit can be used. Various measurements can be made to check such things as house tightness, worse case depressurization, room by room pressure imbalances, buffer space measurements, as well as how the driving forces influence building pressures (wind, stack, ventilation systems, duct leakage, and single zone return systems).

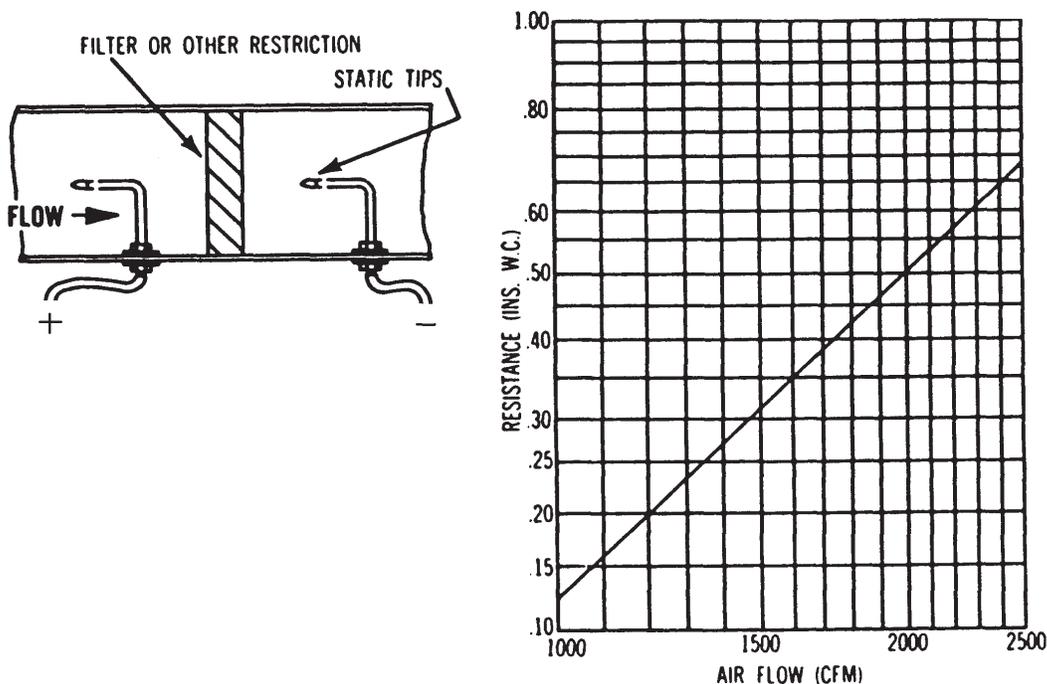
### NOTES:

1. For best results, it is a good habit to Zero the instrument before each measurement, or make sure the instrument has an additional warm-up time of 3 – 4 minutes when first turned on.
2. Orientation of the instrument is important, keep it in the same position through out testing. For accurate readings, the instrument should not be held during pressure testing.
3. For the most accurate measurement, place the instrument in a vertical (upright) position.
4. Zero the instrument (keeping it in the same position as the test) after each measurement.

***The Fyrite Pro (Models 102 or 125) comes with a magnetic boot which allows the instrument to be placed on a furnace duct in a vertical position for optimum operation as well as freeing up both hands.***

Below are a few of the tests that can be made with your instrument (set in the draft mode) using the parts supplied in this Kit. (The Kit's two Probe Fittings are to be used with the Bacharach, Inc. PCA and Fyrite Pro).

This manual will not attempt to cover the many, and sometimes laborious tests that can be performed using this Kit, such as taking transverse readings in a duct to get the average total velocity. For more information on pressure testing, contact Bacharach, Inc.



**Figure 2. Differential Measurement Across Duct Restriction**

## 2.1 Differential Pressure Measurement Across a Filter or Duct Restriction

The Differential Pressure across a restriction is measured by taking static pressure readings on both sides of the restriction and automatically calculating the Air Velocity in cfm (Also see Figures 1, 2 & 3). This measurement can be used to determine if the restriction could cause the furnace to work improperly or inefficiently (such as short cycling). Fixing the problem may be as simple as replacing a high efficiency filter with a basic one. To test:

1. Perform the Draft Zero calibration on the instrument, then set it to Draft mode.
2. Drill a hole (large enough to accept the Pitot Tube and Static Pressure Tip) on both sides of the furnace filter or other duct obstruction (such as an electronic air cleaner).
3. Place the Static Pressure Tip in the hole closest to the furnace, facing in the direction of air flow. Connect tubing from the “Tip” to the Negative (–) inlet of the instrument.
4. Place the Pitot Tube in the second hole, facing in the direction of air flow. Connect tubing from the Static side of the tube to the Positive (+) inlet of the instrument.
5. Check this measurement against the manufacturers specifications.

## 2.2 External Static Pressure Testing

The External Static Pressure (ESP) test is used to measure the static pressure that the HVAC fan has to operate against. This test is necessary to assure the correct airflow across the heat exchanger or coil. It is a critical part of all start up procedures as well as a valuable diagnostic tool in troubleshooting systems.

In order to calculate the airflow through the fan it is necessary to have the fan curve information for each unit you install. Below is a typical fan curve:

**External Static Pressure (Inches Of Water)**

Speed	0.10	0.20	0.30	0.40	0.50	0.60	0.70
High (cfm)	1410	1364	1306	1257	1196	1132	1048
Low (cfm)	1105	1088	1072	1044	1004	962	906

As you can see, the higher the ESP, the lower the cfm output of the fan. Inadequate cfm output can cause such problems as short cycling in furnaces as well as low efficiencies and capacities for heat pumps and air conditioners.

Each manufacturer lists their information differently. Sometimes the fan curve data includes filters and coils and other times it does not. You have to read the details closely. In most cases the maximum ESP that the furnace is designed to operate against is listed on the nameplate. The ESP test is also a useful guide for individuals sealing duct systems. Sealing leaky ducts often increases the ESP of a system thus restricting the airflow. Testing pre and post duct sealing is good standard practice and will tell you if your duct sealing has impacted the performance of the unit.

The ESP test is also useful to measure effectiveness of coil cleaning efforts and the effects of higher efficiency filters. The ESP will drop if a successful coil cleaning has been accomplished. Many high efficiency filters raise the ESP to the point of impacting the system efficiency.

Most fan curves are usually in Inches of Water Column (WC) or Pascal (Pa). Your instrument can be set to read either, and may also be capable of reading in Hectopascals (hPa) which is equal to 100 Pascals. One Inch of Water Column (WC) is equal to 2.49 Hectopascals (hPa).

### Standard External Static Pressure Test

**NOTE:** *If the house does not have returns in all rooms, also conduct this test with the doors closed.*

1. Select the units your fan curve is listed in (WC or hPa).
2. Perform the Draft Zero calibration on the instrument, then set it to Draft mode.
3. Connect one hose to the positive and one hose to the negative side of the instrument.
4. Connect the Static Pressure Tap to one hose, and the Pitot Tube (see Figure 1) using the side connector (Ps) to the other hose (the top connector may remain open).
5. Drill small holes as close to the fan inlet and outlet as possible. If the fan data includes a device such as the filter or a coil you must be on the other side. The more places you sample the more accurate your reading will be.
6. Take the reading directly from the instrument, this is your total ESP.

### ADDITIONAL TESTING

If high static pressure is found it is easy to discover if the high pressure is related to the return side or supply side of the duct work by doing a One-Sided Static Pressure Test. This test will help create a plan of action to correct the problem.

#### One-Sided Static Pressure Test

1. Select the desired units of measurement (WC or hPa).
2. Perform the Draft Zero calibration on the instrument, then set it to Draft mode.
3. Connect a hose to the negative port of the instrument.
4. Attach the Static Pressure Tip.
5. Insert the Static Pressure Tip end of the hose into the return side of the unit being tested (this reading should have a positive value).

### 2.3 Differential Pressure Measurement

This test is a simple method of determining which rooms are being pressurized and which rooms are being depressurized as a result of the HVAC fan running. The test is conducted with the interior doors of the house closed. A bedroom with two supplies and no returns will likely show up as being pressurized by the fan. The main body of the house containing the return(s) will likely be depressurized. Studies have shown that this situation can cause a 10 fold increase in the houses overall infiltration load.

If the room is being depressurized, there is more return air being removed from the room than supply air being delivered. If the room is being pressurized, there is more supply air being delivered than return air being removed. If there is no pressure difference, then the system is in balance or the room could be very leaky.

1. Connect a hose to the positive side of the instrument using the Flexible Brass Tube as the tip.
2. Perform the Draft Zero calibration on the instrument, then set it to Draft mode.
3. Place the metal tip under a door to the outside, away from the main body of the house.
4. Close all the interior doors of the house.
5. Turn on the HVAC system.
6. Record the manometer reading \_\_\_\_\_. In most cases this will be a negative number.
7. Place the hose under the door to each room of the house (remember to disconnect the hoses and zero the instrument before each measurement). You must add these readings to the reading recorded in Step 6 to get the actual Differential Pressure for each room.  
**Example:** *If the outside reading is -4 Pascals and the reading to a bedroom is +9 Pascals then the Differential Pressure between the bedroom and outside is +5 Pascals.*

As a alternative method, simply connect a long hose to negative side of the instrument and leave it under the door to the outside then check each room separately using a hose connected to the positive side of the instrument. The reading in this case will be the actual Differential Pressure.

## 2.4 Combination Gas Control Pressure Measurement

It is necessary in the initial installation and in troubleshooting of furnace problems to make sure that an appliance is getting the proper amount of fuel according to the manufacture's specifications.

1. Make sure the gas and thermostat are turned off to the appliance, or turn off the pilot.
2. Check the manufacturer's specifications for the proper gas control manifold pressure.
3. Locate the outlet access hole on the gas control manifold (see Figure #1).
4. Remove plug from the outlet side, screw in Gas Valve Fitting.
5. Perform the Draft Zero calibration on the instrument, then set it to the Draft mode.
6. Connect the Kit's short section of Tygon Tubing from the fitting to the instrument.
7. Turn on the gas and check that the outlet gas pressure is high enough to run the instrument and that it is within specifications.

8. Make any adjustments needed to the pressure regulator to bring the measurement within spec. If the pressure can be adjusted within range then go to Step #14. Otherwise, turn off the gas, disconnect the hose and fitting, then continue with Step #9.
9. Locate the inlet access hole on the gas control manifold. If one is found continue with Step #10, if not go to Step #15 then call the gas supplier to check incoming pressure.
10. Remove plug from the inlet side, screw in Gas Valve Fitting.
11. Perform the Draft Zero calibration on the instrument, then set it to the Draft mode.
12. Connect the Kit's short section of Tygon Tubing from the fitting to the instrument.
13. Turn on gas, check that the proper gas pressure is being delivered to the appliance, if not follow directions in Steps #14 & 15 then call the gas supplier to check incoming pressure. If the proper gas pressure is being applied to the Combination Gas Control and the outlet pressure can not be achieved, the unit may need to be replaced.
14. Turn off the gas, disconnect the hose and fitting, replace the plug.
15. Reset the furnace to its operating condition by reversing the procedure in Step #1.

## 2.5 Worst Case Depressurization Test (Back Drafting)

The purpose of a Worst Case Depressurization Test is to evaluate the possibility of any combustion appliance being exposed to negative pressures sufficient to cause back drafting. Back drafting occurs when a chimney or flue is not able to vent a combustion appliance properly.

There are many factors that can cause this condition including: height of the stack, outside & inside temperature, number of appliances sharing a flue, physical condition of the flue, etc.

### CAUTIONS

*Depressurization testing can cause **excessive amounts of CO**. A personal CO monitor should be worn by technicians involved in these tests.*

*Make sure all combustion equipment is turned **off** and can not accidentally come on during testing.*

### Preparing the Building and Combustion Appliance Zone

1. Identify all zones containing combustion appliances. They are referred to as the Combustion Appliance Zones or CAZs. Typical appliances include gas and oil furnaces, gas and oil water heaters, gas and wood stoves or fireplaces, and gas clothes dryers.
2. Are all registers normally open or are some normally closed? Ask the occupants.
3. How many combustion appliances are in the same zone? Are they used at the same time?
4. A fireplace can draw between 300 to 800 cfm. The blower door can be used to simulate a roaring fire.

5. Clean the lint trap on the clothes dryer. A dirty filter limits the cfm exhaust of a dryer.
6. Clean or replace furnace filters. Dirty filters limit the amount of air that the HVAC fan is able to move.
7. Determine the configuration of the buffer zones. Is the garage door usually open or closed? Are any crawl space vents usually open or closed?
8. Identify exhaust fans (these may include, but are not limited to): bath fans, kitchen fans, clothes dryers, attic fans, exhaust fans of any kind.

### House Configuration

Combustion appliances in CAZ	Fireplace – wood stoves – water heater
Location of CAZ	
Interior doors closed (list rooms)	
Air handler speed	high – low – med.
Furnace filter condition	clean – dirty
Dryer lint trap condition	clean – dirty
Crawl space vents	open – closed
Garage door	open – closed
Door to basement	open – closed
List registers closed (list rooms)	_____
List exhaust fans	Kitchen, mbath, bath2, bath3, Jennair, laundry, dryer, other _____

### Performing the Test on Each CAZ

1. Close all exterior doors and windows (with the exception of those windows normally open). If a blower door is in place, plug the fan hole (unless being use to simulate a fire in a fire-place).
2. Perform the Draft Zero calibration on the instrument, then set it to Draft mode.
3. While standing in the CAZ, place one end of a section of Tygon Tubing outside the house, and attach the other end to the reference (negative) tap of the instrument.
4. Close the interior doors to zones that do not contain return grilles.
5. Turn on the air handler (set the fan to the highest speed, in most cases this is achieved by the thermostat setting of “fan” or “air-conditioning”).
6. Set the instrument to read pressure, if the reading is negative the house is being depressurized. Record this number \_\_\_\_\_.
7. Turn on any fans in the CAZ.
8. Turn on fans located behind interior doors that were shut in Step #3.
9. While watching the reading, open these doors one at a time. If the CAZ goes more negative (for example minus 5 Pascals to minus 6 Pascals) keep the door open. If the CAZ becomes less negative (for example minus 5 Pascals to minus 4 Pascals) shut the door. Repeat this procedure for each room containing a fan. Record this number \_\_\_\_\_.

10. Turn off air handler and repeat Step 9. Record this number\_\_\_\_\_.
11. The highest negative number achieved is the worst case. Determine the highest negative number from Steps 9 or 10. Record here \_\_\_\_\_.

### How low can you go?

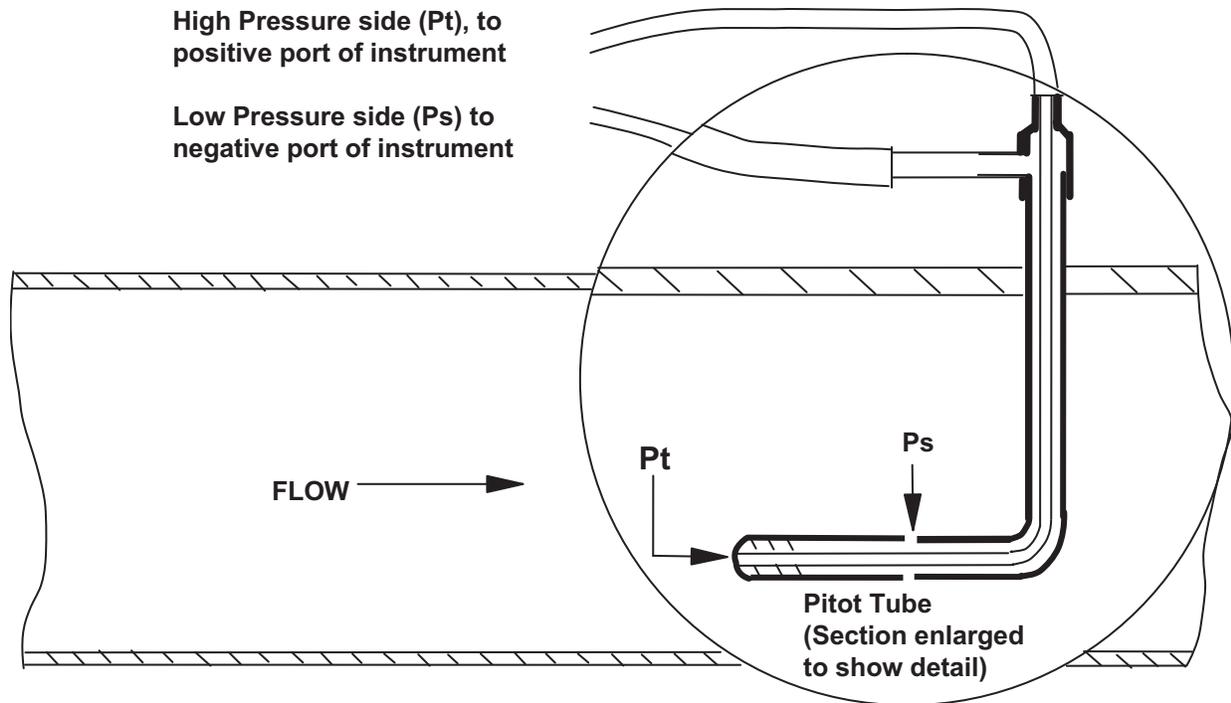
The back drafting of an appliance is dependent upon many variables. Due to these variables it is very important to determine at what pressure a given appliance will back draft. The Canadian Mortgagee and Housing Corporation has suggested the following limits.

Appliance	Chimney Height	Unlined Chimneys on exterior walls	Metal Lined, Insulated or interior Chimneys
Gas-Fired Furnace, Boiler, DHW Heater	13 or less	-5Pa	-5Pa
	14-20	-5Pa	-6Pa
	21+	-5Pa	-7Pa
Oil Fired Furnace, Boiler DHW Heater	13 or less	-4Pa	-4Pa
	14-20	-4Pa	-5Pa
	21+	-4Pa	-6Pa
Fireplace	N/A	-3Pa	-4Pa
Induced Draft Appliance	N/A	-15Pa	-15Pa

## 2.6 Air Velocity Measurement (Velocity Pressure)

The instrument can compute the Velocity Pressure (in Inches of Water) of air conditioning, heating and ventilation applications. The Velocity Pressure can then be converted into Air Velocity (in Feet per Minute) by using the charts in Figure 4.

1. Place the Pitot Tube into the opening of the duct to be measured.
2. Select the desired units to be measured.
3. Perform the Draft Zero calibration on the instrument, then set it to Draft mode.
4. Connect a hose from the negative port of the instrument to the top connection of the Pitot Tube (see Figure 3).
5. Connect a hose from the positive port of the instrument to the side connection of the Pitot Tube.
6. The reading will be the Total Pressure reading ( $P_t$ ) from the tip of the Pitot Tube (pointing directly into the flow), minus the Static Pressure reading ( $P_s$ ) from the sides of the Pitot Tube (indirect flow).



Pitot Tube senses total and static pressure.  
Instrument calculates velocity pressure  
(Difference between total and static pressure).

**Figure 3. Air Velocity Measurement using a Pitot Tube.**

# AIR VELOCITY FLOW CHARTS

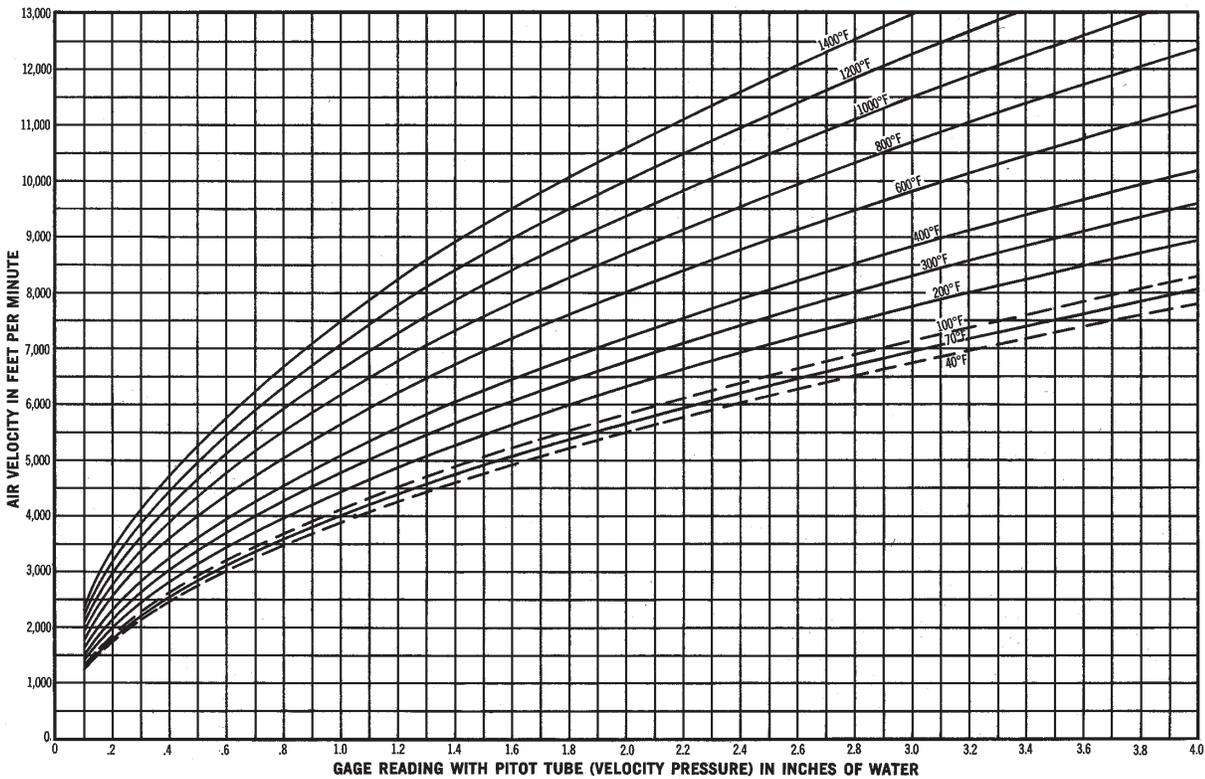
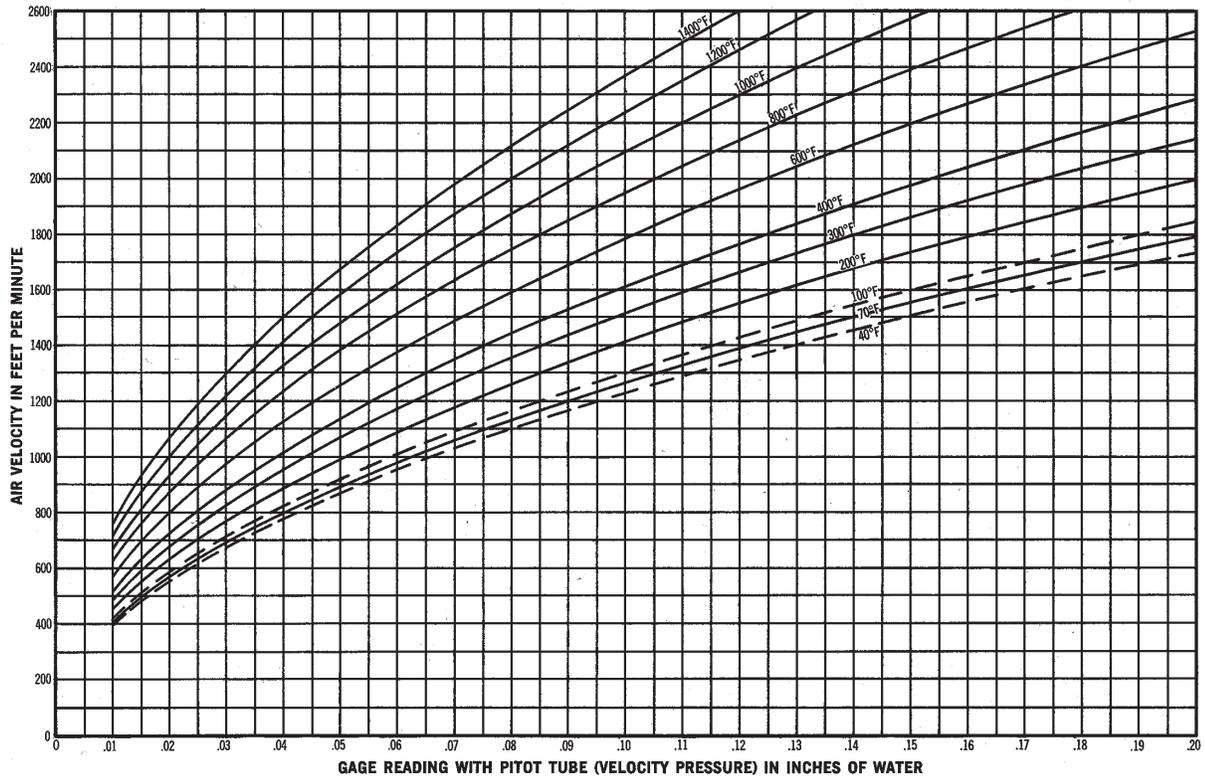


Figure 4. Conversion Chart: Velocity Pressure to Air Velocity