Operating Instructions for the
DG-700
Pressure and Flow Gauge

Operating Instructions for the DG-700 Pressure and Flow Gauge

The Energy Conservatory
2801 21st Ave. S., Suite 160
Minneapolis, MN 55407
Ph.: (612) 827-1117
Fax: (612) 827-1051
www.energyconservatory.com

Manual Edition May 2012

ENERGY CONSERVATORY WARRANTY

EXPRESS LIMITED WARRANTY:

Seller warrants that this product, under normal use and service as described in the operator's manual, shall be free from defects in workmanship and material for a period of 24 months, or such shorter length of time as may be specified in the operator's manual, from the date of shipment to the Customer.

LIMITATION OF WARRANTY AND LIABILITY:

This limited warranty set forth above is subject to the following exclusions:

a) With respect to any repair services rendered, Seller warrants that the parts repaired or replaced will be free from defects in workmanship and material, under normal use, for a period of 90 days from the date of shipment to the Purchaser.
b) Seller does not provide any warranty on finished goods manufactured by others. Only the original manufacturer's warranty applies.
c) Unless specifically authorized in a separate writing, Seller makes no warranty with respect to, and shall have no liability in connection with, any goods which are incorporated into other products or equipment by the Purchaser.
d) All products returned under warranty shall be at the Purchaser's risk of loss. The Purchaser is responsible for all shipping charges to return the product to The Energy Conservatory. The Energy Conservatory will be responsible for return standard ground shipping charges. The Customer may request and pay for the added cost of expedited return shipping.

The foregoing warranty is in lieu of all other warranties and is subject to the conditions and limitations stated herein. NO OTHER EXPRESS OR IMPLIED WARRANTY IS PROVIDED, AND THE SELLER DISCLAIMS ANY IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY.

THE EXCLUSIVE REMEDY OF THE PURCHASER FOR ANY BREACH OF WARRANTY shall be the return of the product to the factory or designated location for repair or replacement, or, at the option of The Energy Conservatory, refund of the purchase price.

The Energy Conservatory's maximum liability for any and all losses, injuries or damages (regardless of whether such claims are based on contract, negligence, strict liability or other tort) shall be the purchase price paid for the products. IN NO EVENT SHALL THE SELLER BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES. The Energy Conservatory shall not be responsible for installation, dismantling, reassembly or reinstallation costs or charges. No action, regardless of form, may be brought against the Seller more than one year after the cause of action has accrued.

The Customer is deemed to have accepted the terms of this Limitation of Warranty and Liability, which contains the complete and exclusive limited warranty of the Seller. This Limitation of Warranty and Liability may not be amended or modified, nor may any of its terms be waived except by a writing signed by an authorized representative of the Seller.

TO ARRANGE A REPAIR: Please call The Energy Conservatory at 612-827-1117 before sending any product back for repair or to inquire about warranty coverage. All products returned for repair should include a return shipping address, name and phone number of a contact person concerning this repair, and the purchase date of the equipment.

Table of Contents

CHAPTER 1 FEATURE SUMMARY 1

1.1 Feature List 1

- 1.1.a Pressure Measurements: 1
- 1.1.b Auto Zeroing: 1
- 1.1.c Time Averaging: 1
- 1.1.d Air Flow and Velocity Measurements: 1
- 1.1.e Display “HOLD”: 1
- 1.1.f Specialized *@ 50* and *@ 25* Leakage Measurement Mode: 2
- 1.1.g Specialized Air Handler Flow Measurement Mode: 2
- 1.1.h Automated Blower Door Testing, Cruise Control and Data Logging: 2

1.2 Overview of Gauge Operating Modes 2

1.3 Gauge Face and Buttons 3

1.4 Input/Output Ports on the DG-700 4

- 1.4.a USB and Serial Communication Ports: 4
- 1.4.b Fan Control Output Jack: 4
- 1.4.c AC Power Input Jack: 4

1.5 Overview of the Time Averaging Feature 5

- 1.5.a Description of Time Averaging Periods: 5
- 1.5.b Illustration of Time-Averaging Operation (First 10 seconds of operation): 5
- 1.5.c Resetting the Time Averaging Measurement Buffer: 5

1.6 Overview of the Baseline Pressure Measurement Feature (Channel A) 6

- 1.6.a Buttons Used with Baseline Pressure Feature: 6
- 1.6.b Restarting the Baseline Measurement: 7
- 1.6.c Clearing and Exiting from the Baseline Pressure Procedure: 7

1.7 Auto-Off Feature 7

CHAPTER 2 PRESSURE/PRESSURE MODE 8

2.1 Mode Summary 8

2.2 Overview of Pressure/Pressure Mode 8

2.3 Changing the Pressure Units 8

2.4 Changing the Time Averaging Period 9

2.5 Using the Baseline Pressure Feature 9

- 2.5.a Example: Measuring Building Depressurization from an Exhaust Fan 9

CHAPTER 3 PRESSURE/FLOW MODE 11

3.1 Mode Summary 11

3.2 Overview of Pressure/Flow Mode 11

3.3 Changing the Selected Test Device and Configuration 11

3.4 “LO” Displayed on Channel B 12

3.5 Changing the Air Flow Units 12

3.6 Changing the Time Averaging Period 12

3.7 Using the Baseline Pressure Feature in Pressure/Flow Mode 12

- 3.7.a Example: Using the Baseline Feature During a Blower Door Depressurization Test 12

❑ 3.7.b Entering Baseline Readings into TECTITE Software When Using the Baseline Feature: 13

CHAPTER 4 PRESSURE/FLOW @ 50 AND @ 25 MODES 14

4.1 Mode Summary 14

4.2 Overview of Pressure/Flow @ *50* and @ *25* Modes 14

❑ 4.2.a Pressure/Flow @ *50* Mode: 14

❑ 4.2.b Pressure/Flow @ *25* Mode: 14

❑ 4.2.c Benefits of Using the @ *50* and @ *25* Modes: 15

4.3 Changing the Selected Test Device and Configuration 15

4.4 "-----"or "LO" Displayed on Channel B 15

4.5 Changing the Leakage Units 16

4.6 Changing the Time Averaging Period 16

4.7 Using the Baseline Pressure Feature in Pressure/Flow Mode 16

4.8 Leakage Estimate Calculations Used in the @ *50* and @ *25* Modes 16

❑ 4.8.a @ *50* Mode: 16

❑ 4.8.b @ *25* Mode: 17

❑ 4.8.c Errors in Leakage Estimates: 17

CHAPTER 5 PRESSURE/AIR HANDLER FLOW MODE 19

5.1 Mode Summary 19

5.2 Overview of Pressure/Air Handler Flow Mode 19

5.3 Changing the Selected Test Device and Configuration 19

5.4 "-----"or "LO" Displayed on Channel B 20

5.5 Changing the Air Handler Flow Units 20

5.6 Changing the Time Averaging Period for the Step 2 Procedure 20

5.7 Test Procedure For Measuring Air Handler Flow 20

❑ 5.7.a Step 1: Measuring the NSOP 20

❑ 5.7.b Step 2: Measuring the TFSOP and Adjusted Air Handler Flow 21

5.8 Flow Resistance Correction Factors Used in the DG-700 22

CHAPTER 6 PRESSURE/VELOCITY MODE 23

6.1 Mode Summary 23

6.2 Overview of Pressure/Velocity Mode 23

6.3 Changing the Air Velocity Units 23

6.4 Changing the Time Averaging Period 23

6.5 Air Velocity Calculations Used in the DG-700 23

CHAPTER 7 SERVICING AND MAINTENANCE 24

7.1 Gauge Calibration and Servicing 24

❑ 7.1.a Calibration: 24

❑ 7.1.b Servicing/Repairs: 24

7.2 Low Battery Indicator/Battery Replacement 24

❑ 7.2.a Low Battery Indicators: 24

❑ 7.2.b Battery Replacement: 24

7.3 Troubleshooting/Resetting the DG-700 25

7.4 AC Power Supply Specifications 25

APPENDIX A QUICK GUIDES FOR USING THE DG-700 WITH ENERGY CONSERVATORY TEST DEVICES 26

A.1 One-Point 50 Pascal Building Depressurization Test using the Model 3 Minneapolis Blower Door™ and DG-700 Digital Gauge 26

A.2 One-Point 25 Pascal Total Leakage Duct Pressurization Test Using the Seried B Minneapolis Duct Blaster® and DG-700 Digital Gauge 28

A.3 Using the TrueFlow® Air Handler Flow Meter and the DG-700 Digital Gauge 30

A.4 DG-700 Connections Needed to Conduct Automated Blower Door Tests 32

A.5 Using the DG-700's Cruise Control Feature 36

Chapter 1 Feature Summary

The DG-700 Pressure and Flow Gauge is a multi-functional differential pressure gauge with 2 independent measurement channels. In addition to providing high resolution pressure measurements, the DG-700 is programmed to operate with other Energy Conservatory test devices to provide air flow measurements during building performance test procedures. The DG-700's dual pressure channels and air flow measurement features make it ideally suited for a wide range of building performance testing applications including:

- Blower Door airtightness testing.
- Duct system airtightness testing.
- Air handler flow measurements.
- Exhaust fan flow measurements.
- Building depressurization and combustion safety testing.

1.1 Feature List

❑ 1.1.a Pressure Measurements:

- Simultaneous display of 2 independent differential pressure channels (**A** and **B**).
- Each pressure channel has a range of –1,250 Pascals to +1,250 Pascals.
- Accuracy of pressure channels is +/- 1% of reading, or 2 times the resolution, whichever is greater.
- Auto ranging with 0.1 Pascal resolution.
- Choice of pressure units (Pascals or Inches w.c.).
- Specialized "**Baseline**" feature on **Channel A** allows user to measure and record a baseline pressure reading, and then display the baseline adjusted pressure reading.

❑ 1.1.b Auto Zeroing:

- Auto-zeroing feature for both measurement channels automatically adjusts for sensitivity to position and operating temperature during operation (automatically activated every 10 seconds).

❑ 1.1.c Time Averaging:

- Choice of 4 time-averaging options (1 second, 5 second, 10 second and Long-Term average). The time-averaging feature stabilizes readings when measuring fluctuating signals (e.g. windy conditions).

❑ 1.1.d Air Flow and Velocity Measurements:

- The DG-700 will calculate and display air flow readings on **Channel B** for the following Energy Conservatory test devices: (choice of units - cubic feet per minute (CFM), meters^3 per hour (m^3/hr), liters per second (l/s))
  - Model 3 Minneapolis Blower Door™ fans (110V and 220V).
  - Model 4 Minneapolis Blower Door fans (220V).
  - Series A and B Minneapolis Duct Blaster® fans.
  - Exhaust Fan Flow Meter.
  - TrueFlow® Air Handler Flow Meter.
- The DG-700 will calculate and display air velocity readings on **Channel B** from a standard pitot tube. (choice of units – feet per minute (FPM), meters per second (m/s))

❑ 1.1.e Display "HOLD":

When the "**HOLD**" button is pushed, the DG-700 display is temporarily frozen with the most recent readings and settings. The Hold feature is turned off by pushing the "**HOLD**" button a second time.

❑ 1.1.f Specialized @ *50* and @ *25* Leakage Measurement Mode:

- For one-point airtightness tests of building and duct systems, the DG-700 will display on **Channel B** estimated leakage rates adjusted to either 50 Pascals or 25 Pascals of test pressure.
- Choice of leakage units (CFM @, m^3/hr @ , l/s @, sq. inches @ , sq. centimeters @).

❑ 1.1.g Specialized Air Handler Flow Measurement Mode:

- Designed for measuring air handler flow rates using a TrueFlow Air Handler Flow Meter or a Duct Blaster fan.
- Automatically adjusts displayed air flow rate using measured system operating pressures (**NSOP** and **TFSOP**).
- Choice of air flow units (cfm, m^3/hr, l/s).

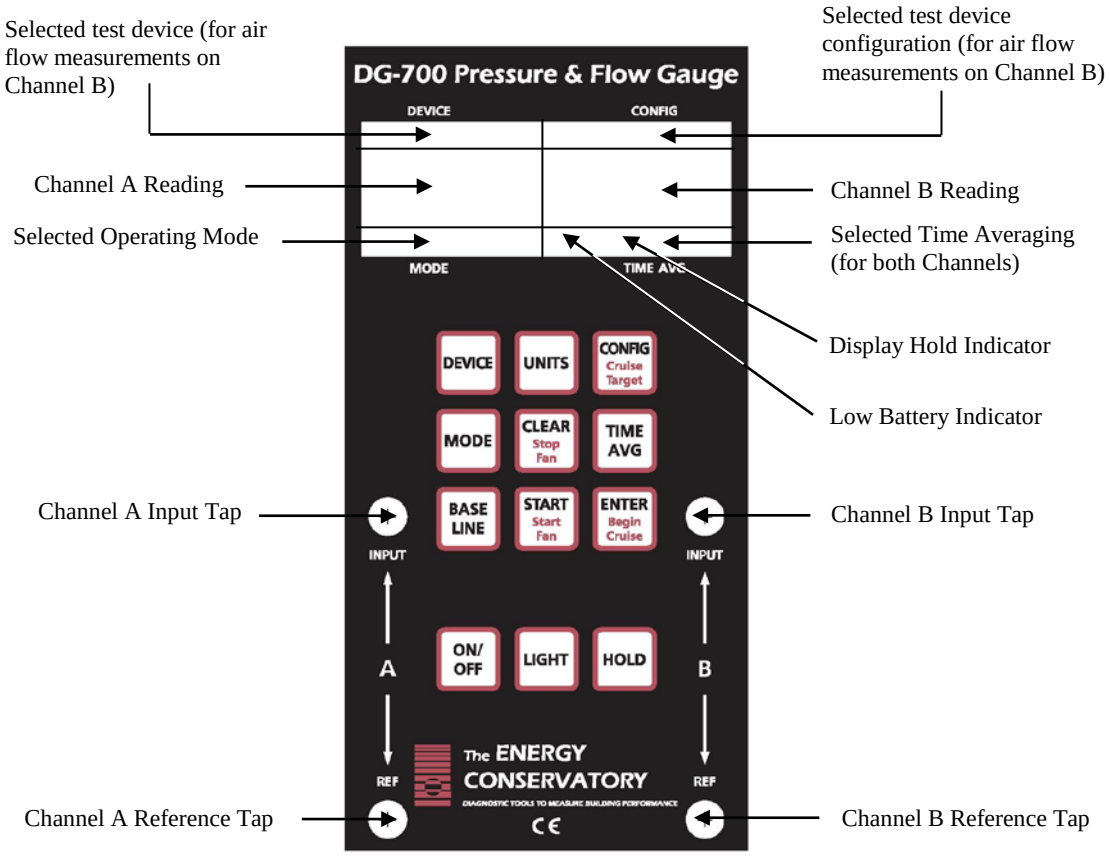
❑ 1.1.h Automated Blower Door Testing, Cruise Control and Data Logging:

- The DG-700 can be used along with a computer and specialized TEC software (TECTITE, TECTITE Express or TECLOG2) to conduct fully automated Blower Door tests.
- The Cruise Control feature allows you to automatically control a Blower Door or Duct Blaster fan to maintain a constant 75Pa, 50 Pa, 25 Pa or 0 Pa building pressure without having the gauge connected to a computer.
- Both of the DG-700's pressure channel readings can be recorded using TEC's TECLOG2 data logging software.

1.2 Overview of Gauge Operating Modes

Mode	Application	Channel A Display	Channel B Display
Pressure/Pressure (PR/ PR)	Multi-purpose pressure measurements.	Pressure in units chosen (Pa, in w.c.).	Pressure in units chosen (Pa, in w.c.).
Pressure/Flow (PR/ FL)	Multi-purpose pressure and air flow measurements.	Pressure in Pascals.	Nominal (unadjusted) air flow from the selected Energy Conservatory test device, in units chosen (CFM, m^3/h, l/s).
Pressure/Flow @ 50 Pa (PR/ FL@50)	Specialized mode for one-point Blower Door building airtightness test.	Building pressure in Pascals.	Building leakage at 50 Pascals in units chosen (CFM@50, m^3/h@50, l/s@50, in^2@50, cm^2@50). Leakage rate is determined by continuously adjusting the measured air flow from the selected Blower Door fan to a building pressure of 50 Pascals, using the real-time **Channel A** building pressure reading.
Pressure/Flow @ 25 Pa (PR/ FL @25)	Specialized mode for one-point total leakage duct airtightness test.	Duct system pressure in Pascals.	Total duct leakage at 25 Pa in units chosen (CFM@25, m^3/h@25, l/s@25, in^2@25, cm^2@25). Leakage rate is determined by continuously adjusting the measured air flow from the selected duct testing fan to a duct pressure of 25 Pascals, using the real-time **Channel A** duct pressure reading.
Pressure/AH Flow (PR/ AH)	Specialized mode for measuring air handler flow rates using a TrueFlow Air Handler Flow Meter or a Duct Blaster fan.	Normal system operating pressure (**NSOP**) and test flow system operating pressure (**TFSOP**) in Pascals.	Total air handler flow in units chosen (CFM, m^3/h, l/s). Air flow from the selected Energy Conservatory test device is continuously adjusted using the measured **NSOP** and **TFSOP** readings from **Channel A**.
Pressure/Velocity (PR/ V)	Pressure and air velocity measurements.	Pressure in Pascals.	Air velocity in units chosen (FPM, m/s).

1.3 Gauge Face and Buttons



Button	Purpose
DEVICE	Used to select the Energy Conservatory test device connected to **Channel B** (not active in **PR/PR** mode).
UNITS	Selects the pressure and air flow units for **Channels A** and **B**.
CONFIG	Used to select the configuration for the currently chosen test device (not active in **PR/PR** mode).
MODE	Selects the current operating mode.
CLEAR	Used to exit out of a **Baseline** pressure measurement procedure. When in **PR/AH** mode, resets gauge back to beginning of AH flow measurement procedure (i.e. **NSOP** measurement). Also used to turn off the **Cruise Control** feature.
TIME AVG	Used to select the time averaging mode (not active during **Baseline** and **NSOP** measurements).
Begin Cruise	Initiates **Cruise Control** feature (not active in **PR/AH** and **PR/V** modes).
Start Fan	Starts the fan for **Cruise Control**.

Button	Purpose
BASELINE	Initiates **Baseline** pressure measurement procedure on **Channel A** (not active in **PR/AH** mode).
START	Used to start measurement procedure for **Baseline** and **NSOP** measurements. Also used to reset time averaging buffers and manually initiate auto-zero.
ENTER	Used to accept and enter **Baseline** and **NSOP** pressure readings. After entering **Baseline** reading, **Channel A** will display baseline adjusted pressure.
ON/OFF	Turns gauge On and Off.
LIGHT	Turns display backlight On and Off.
HOLD	Turns display Hold feature On and Off.
Stop Fan	Turns off the fan for **Cruise Control**.
Cruise Target	Used to select the Cruise Target Pressure.

1.4 Input/Output Ports on the DG-700

❑ 1.4.a USB and Serial Communication Ports:

The DG-700 contains both a USB and a DB-9 serial communication port, either of which can be used to create a 2-way communication link between the gauge and a computer. This communication link can be used (along with TEC software) to conduct automated Blower Door tests and to data log both pressure channels.

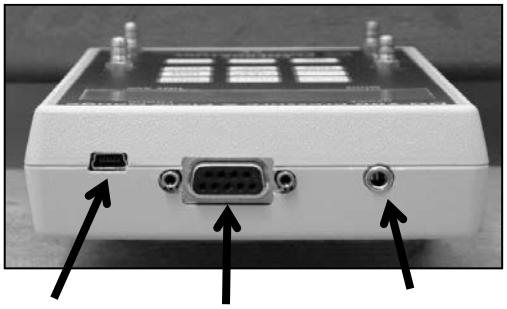
- Automated Blower Door testing requires the TECTITE, TECTITE Express or TECLOG2 software, a Blower Door fan speed controller with a communication jack (standard equipment since September 2004), a fan control cable, and a communication cable (either USB or 9 pin serial) to connect the DG-700 to a user supplied laptop computer.
- Data logging of pressure measurements requires the TECLOG2 software (available from www.energyconservatory.com), and a communication cable (either USB or 9 pin serial) to connect the DG-700 to a user supplied laptop computer.

❑ 1.4.b Fan Control Output Jack:

The fan control output jack provides a speed control signal which is used to control a Blower Door or Duct Blaster fan during an automated Blower Door test, or with the Cruise Control feature. A fan control cable is used to connect the fan control output jack to the communication jack on the side of the fan speed controller.

❑ 1.4.c AC Power Input Jack:

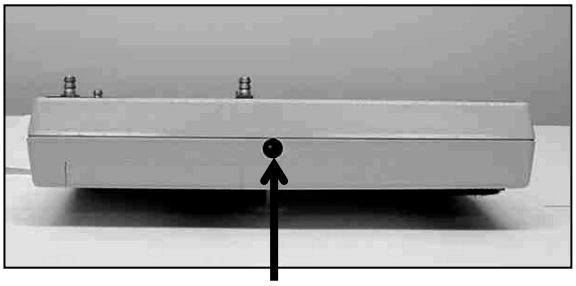
The AC power input jack can be used with an optional AC power supply to provide a long term power source for the gauge (to be used when data logging). The gauge is normally powered by 6 AA batteries located in the rear battery compartment. When the AC power supply is plugged in, the power supply bypasses the batteries in the battery compartment. See Chapter 7 for AC power supply specifications. **Note:** Always turn off the gauge before plugging in the AC power supply.



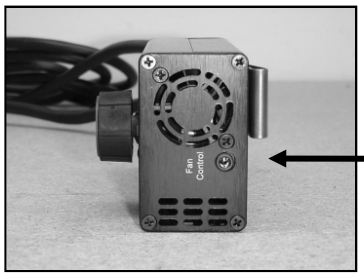
USB Communication Port

Serial Communication Port

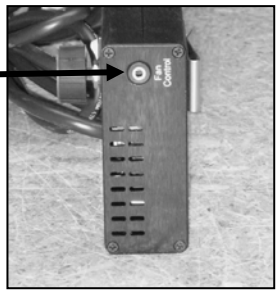
Fan Control Output Jack



AC Power Input Jack



Communication Jacks (Blower Door and Duct Blaster Speed Controllers)



1.5 Overview of the Time Averaging Feature

The DG-700 has a choice of 4 time averaging periods which are applied to both measurement channels. When the gauge is turned on, the default time averaging period is ***1 second average***. **To change the selected time averaging period**, press the **TIME AVG** button. The currently selected time averaging period is shown in the **TIME AVG** portion of the gauge display.

❑ 1.5.a Description of Time Averaging Periods:

- ***1 Second Average (1)*** – Both measurement channels are updated once per second with the average of the readings from the previous 1 second. The ***1 Second Average*** is the default time averaging period when turning on the gauge, and is the period most commonly used.
- ***5 Second Average (5)*** – Both measurement channels are updated once every 5 seconds with the average of the readings from the previous 5 second period. When first activated, the display shows "---" until the first 5 second measurement buffer has been recorded. The ***5 Second Average*** should be used when the ***1 Second Average*** reading is fluctuating more than desired.
- ***10 Second Average (10)*** – Both measurement channels are updated once every 10 seconds with the average of the readings from the previous 10 second period. When first activated, the display will show "---" until the first 10 second measurement buffer has been recorded. The ***10 Second Average*** mode should be used when the 5 Second Average reading is fluctuating more than desired.
- ***Long Term Average (L)*** – Both measurement channels are updated once per second with the running average of all readings taken after the ***Long Term Average*** period is activated. When using ***Long Term Average***, the gauge continuously adds the current measurements to the measurement buffer and displays the average value of all recorded measurements. The gauge will operate for approximately 2 hours when using ***Long Term Average*** before the measurement buffer is overloaded. When the buffer is overloaded, both channel readings will re-start a new long-term average period.

❑ 1.5.b Illustration of Time-Averaging Operation (First 10 seconds of operation):

1 Second Average:

Seconds:	1	2	3	4	5	6	7	8	9	10
Pressure	12	5	10	2	6	15	8	12	2	6
Signal:										
Display:	12	5	10	2	6	15	8	12	2	6

5 Second Average:

Seconds:	1	2	3	4	5	6	7	8	9	10
Pressure	12	5	10	2	6	15	8	12	2	6
Signal:										
Display:	--	--	--	--	7	7	7	7	7	9

10 Second Average:

Seconds:	1	2	3	4	5	6	7	8	9	10
Pressure	12	5	10	2	6	15	8	12	2	6
Signal:										
Display:	--	--	--	--	--	--	--	--	--	8

Long Term Average:

Seconds:	1	2	3	4	5	6	7	8	9	10
Pressure	12	5	10	2	6	15	8	12	2	6
Signal:										
Display:	12	9	9	7	7	8	8	9	8	8

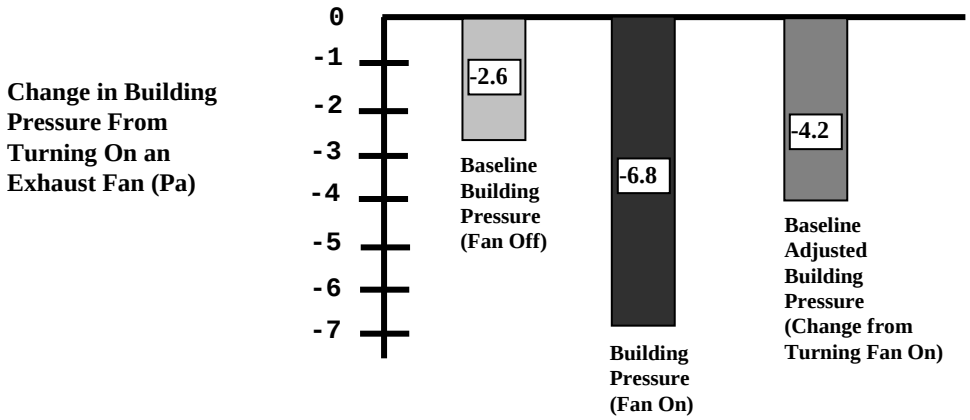
❑ 1.5.c Resetting the Time Averaging Measurement Buffer:

When using the ***5 second***, ***10 second*** or ***Long Term*** averages, it is sometimes desirable to reset and restart the time averaging measurement buffer when an unwanted signal has been recorded during a time averaging period (e.g. someone steps on the tubing during a ***Long Term Average*** measurement). To reset and restart the time averaging measurement buffer for both channels, press the **START** button.

1.6 Overview of the Baseline Pressure Measurement Feature (Channel A)

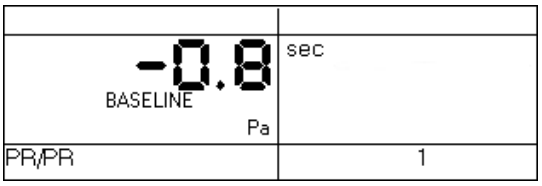
The **Baseline** feature on **Channel A** allows the user to measure and record a baseline pressure reading, and then display the baseline adjusted pressure on the gauge. For purposes of this manual a baseline pressure reading is defined as a pressure measurement made under a specific operating condition, which will be used to determine the change in pressure created by a change in the operating condition.

A common building performance application requiring use of a baseline pressure reading is determining the extent of building depressurization caused by turning on an exhaust fan. In order to accurately quantify the building depressurization, the user first needs to know the building pressure (with reference to outside) prior to the exhaust fan being turned on. This initial pressure reading, known as the baseline building pressure, can be quickly measured and then used to adjust the final building pressure reading (after the exhaust fan is turned on) to determine the actual change in building pressure caused by fan operation. In the example below, the building depressurization measured from the exhaust fan operating is –4.2 Pascals (i.e. the building pressure changed from –2.6 Pa to –6.8 Pa when the exhaust fan was turned on).

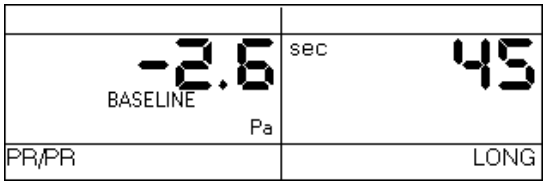


❑ 1.6.a Buttons Used with Baseline Pressure Feature:

Pressing the **BASELINE** button initiates the baseline pressure measurement feature. The word "BASELINE" will begin to flash in the **Channel A** display, indicating that the baseline feature is active. At this point, the gauge is monitoring the real-time **Channel A** pressure reading, but is not recording the reading. The **Channel B** display is not active at this time.

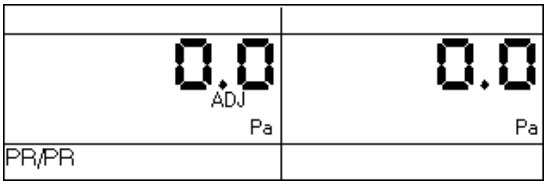


Press the **START** button to begin recording a baseline pressure reading. Once the **START** button is pressed, the word "BASELINE" stops flashing and the gauge begins recording a ***long term average*** baseline pressure reading on **Channel A**. During the baseline measurement procedure, the **Channel B** display is used as a timer to let the user know how long (in seconds) the baseline measurement has been active. The longer the measurement time, generally the more stable the baseline reading typically becomes.

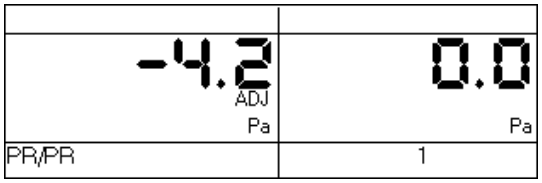


ENTER

Once you are satisfied with the baseline pressure reading, press the **ENTER** key to accept and enter the baseline pressure reading into the gauge. After pressing **ENTER**, **Channel A** will now display the baseline adjusted pressure reading (i.e. the measured baseline pressure reading will be subtracted from the current **Channel A** pressure measurement). The icon "**ADJ**" appears in the **Channel A** display to indicate that the baseline adjusted pressure reading is displayed. The time averaging period for the gauge reverts back to whatever period was selected prior to pressing the **BASELINE** button. In addition, **Channel B** also reverts back to displaying an unadjusted pressure reading.



Now create a change in the operating condition of the building (e.g. turn on and exhaust fan). **Channel A** will display the change in building pressure caused by the change in operating condition.



❑ 1.6.b Restarting the Baseline Measurement:

START

During a baseline measurement procedure (i.e. while the gauge is recording the long term average baseline pressure), the baseline measurement procedure can be restarted by pressing the **START** button. When **START** is pressed, the measurement buffer and time counter for the baseline reading is cleared and a new baseline reading is immediately started.

BASE LINE

Once a baseline measurement has been taken and entered into the gauge (i.e. ADJ appears below the **Channel A** reading), a new baseline measurement procedure can be initiated by pressing the **BASELINE** button.

❑ 1.6.c Clearing and Exiting from the Baseline Pressure Procedure:

CLEAR

Pressing the **CLEAR** button clears the baseline measurement buffer and turns the baseline feature off. The gauge will remain in the operating mode selected prior to the **BASELINE** button being pressed.

Note: If the gauge **Mode** is changed while the baseline measurement feature is active, the baseline measurement buffer is cleared and the baseline feature is turned off.

1.7 Auto-Off Feature

In order to preserve battery life, the DG-700 gauge will automatically shut off if no keys are pressed for 2 hours. The auto-off feature can be disabled by simultaneously pressing the **CLEAR** and **ENTER** buttons. The auto-off feature is automatically re-enabled whenever the gauge is turned off and then back on.

Chapter 2 Pressure/Pressure Mode

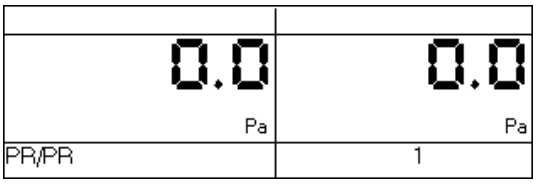
2.1 Mode Summary

Mode	Application	Channel A Display	Channel B Display
Pressure/Pressure (PR/PR)	Multi-purpose pressure measurements.	Pressure in units chosen (Pa, in w.c.).	Pressure in units chosen (Pa, in w.c.).

2.2 Overview of Pressure/Pressure Mode

ON/ OFF

The DG-700 gauge is turned on by pressing the **ON/OFF** button once. When first turned on, the gauge is automatically placed in the **Pressure/Pressure (PR/PR)** operating mode and immediately begins monitoring and displaying pressure readings for both **Channels A** and **B**. The default pressure units for both channels is Pascals, and the default time averaging period is ***1 second average***.



Each channel on the DG-700 measures the pressure difference between either of the top Input pressure taps and its corresponding bottom Reference pressure tap. The gauge can monitor and display both positive and negative pressure readings (i.e. bi-directional). In order to display the correct "sign" of the pressure reading (i.e. positive or negative), it is important that the pressure taps are used consistently and logically. The top Input taps should always be connected to the pressure signal(s) you are trying to measure. The bottom Reference taps should always be connected to the reference pressure(s) you are measuring the pressure signal with reference to.

For example, let's set up the gauge to measure the pressure in a house with reference to outside using **Channel A**. If you are standing in the house, connect tubing to the **Channel A Reference** tap and run it outside, while leaving the **Channel A Input** tap open to the house. The gauge will now display the pressure difference between the house and outside, along with the correct sign of the reading. If the house is at a lower pressure than outside (e.g. from an exhaust fan running), then the pressure reading displayed on the gauge will have a minus sign "-" in front of the reading.

On the other hand, if you are standing outside and wish to make the same reading, connect a piece of tubing to the **Channel A Input** tap and run it into the house, while leaving the **Channel A Reference** tap open to the outside. The gauge will now display the same house to outside pressure difference as above, along with the correct sign. **Note:** In either case, if you had connected the tubing to the wrong tap on **Channel A**, the display would show the correct differential pressure reading, however, the reading would have the wrong sign.

2.3 Changing the Pressure Units

UNITS

When in the **PR/PR** operating mode, the DG-700 can display pressure readings in units of **Pascals** or **inches w.c.**. The default pressure units for the gauge is **Pascals** for both **Channels A** and **B**. To change the pressure units for both channels, press the **UNITS** button. The selected pressure units are shown on the gauge display directly below each of the channel readings.

2.4 Changing the Time Averaging Period

TIME AVG

The DG-700 has a choice of 4 time averaging periods which are applied to both pressure measurement channels. The default time averaging period is ***1 second average***. To change the selected time averaging period, press the **TIME AVG** button. The selected time averaging period is shown in the **TIME AVG** portion of the gauge display. (See **Section 1.5** for an overview of the time averaging feature).

2.5 Using the Baseline Pressure Feature

BASE LINE | START | ENTER

The **Baseline** feature on **Channel A** allows the user to measure and record a baseline pressure reading, and then display the baseline adjusted pressure reading. (See **Section 1.6** for an overview of the baseline pressure feature)

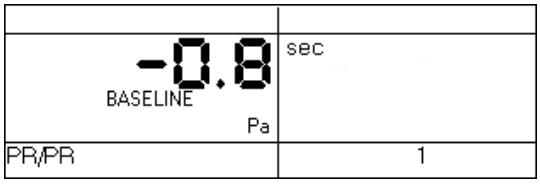
❑ 2.5.a Example: Measuring Building Depressurization from an Exhaust Fan

A common building performance application requiring use of a baseline pressure reading is determining the extent of building depressurization caused by turning on an exhaust fan. In order to accurately quantify the building depressurization, the user first needs to know the building pressure (with reference to outside) prior to the exhaust fan being turned on. This initial pressure reading, known as the baseline building pressure, can be quickly measured and then used to adjust the final building pressure reading (after the exhaust fan is turned on) to determine the actual change in building pressure caused by fan operation.

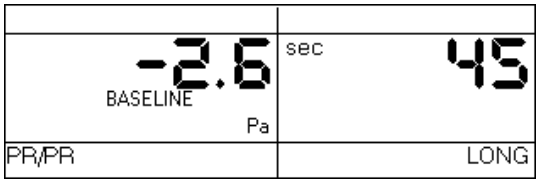
- Set up **Channel A** to measure building pressure with reference to outside (e.g. run tubing from the **Channel A Reference** tap to outside and leave the **Channel A Input** tap open to the building – assumes the gauge is in the building).

- With the exhaust fan off, turn on the gauge and leave it in the **PR/PR** mode.

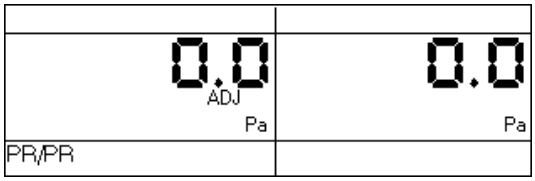
- Press the **BASELINE** button. The word "BASELINE" will begin to flash in the **Channel A** display, indicating that the baseline feature has been initiated. At this point, the gauge is monitoring the real-time **Channel A** baseline pressure reading, but is not recording the reading. The **Channel B** display is not active at this time.



- Press the **START** button to begin the baseline measurement procedure on **Channel A**. Once the **START** button is pressed, the word "BASELINE" stops flashing and the gauge begins recording a ***long term average*** baseline pressure reading on **Channel A**. During the baseline measurement procedure, the **Channel B** display is used as a timer to let the user know how long (in seconds) the baseline measurement has been active. The longer the measurement time, generally the more stable the baseline reading typically becomes. In the screen to the right, the measured baseline pressure is –2.6 Pascals (measured over the past 45 seconds).

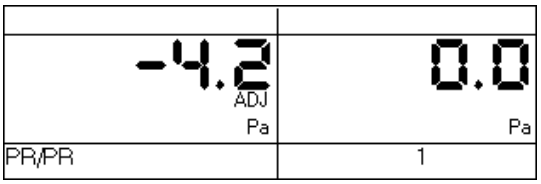


- Once you are satisfied with the baseline pressure reading, press the **ENTER** key to accept and enter the baseline pressure reading into the gauge. After pressing **ENTER**, **Channel A** will now display the baseline adjusted pressure reading (i.e. the measured baseline pressure reading will be



subtracted from the current **Channel A** pressure measurement). The icon "**ADJ**" appears in the **Channel A** display to indicate that the baseline adjusted pressure reading is displayed. The time averaging period for the gauge reverts back to whatever period was selected prior to pressing the **BASELINE** button. **Note:** At this point, **Channel B** also reverts back to displaying an unadjusted pressure reading.

- Turn on the exhaust fan. **Channel A** will now display the actual change in building pressure created by the exhaust fan. In the screen to the right, the building depressurization measured from the exhaust fan operating is –4.2 Pascals (i.e. the building pressure changed from –2.6 Pa to –6.8 Pa when the exhaust fan was turned on).



- While displaying the baseline adjusted pressure on **Channel A**, the user can change the selected time averaging period if the pressure reading is fluctuating more than desired.
- **Channel B** can be used to simultaneously measure any other unadjusted pressure signal, such as the flue pressure in a combustion appliance.

Note: Pressing the **CLEAR** button clears the baseline measurement buffer and turns the baseline feature off. If the gauge **Mode** is changed while the baseline measurement feature is active, the baseline measurement buffer is cleared and the baseline feature is turned off.

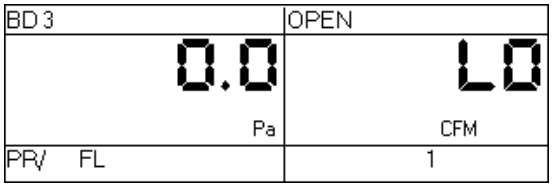
Chapter 3 Pressure/Flow Mode

3.1 Mode Summary

Mode	Application	Channel A Display	Channel B Display
Pressure/Flow (PR/ FL)	Multi-purpose pressure and air flow measurements.	Pressure in Pascals.	Nominal (unadjusted) air flow from the selected Energy Conservatory test device, in units chosen (CFM, m^3/h, l/s).

3.2 Overview of Pressure/Flow Mode

The **Pressure/Flow** mode is a multi-purpose mode used to measure a test pressure on **Channel A** while simultaneously measuring air flow from an Energy Conservatory test device on **Channel B**. The **Pressure/Flow** mode a very versatile operating mode and is typically used whenever simultaneous pressure and air flow measurements are needed (except when using the specialized **PR/ FL@50**, **PR/ FL@25** and **PR/ AH** modes).



To select the **Pressure/Flow** mode, press the **MODE** button until the selected operating mode shown on the gauge display is **PR/ FL**. When first entering this mode, the default pressure units on **Channel A** is Pascals, the default air flow units on **Channel B** is CFM (cubic feet per minute), and the default selected test device is the Model 3 (110V) Minneapolis Blower Door. The default time averaging period is ***1 second average***.

3.3 Changing the Selected Test Device and Configuration

The DG-700 can display air flow from the following Energy Conservatory test devices on **Channel B**:

- Model 3 (110V) Minneapolis Blower Door™ fans (**BD 3**).
- Model 3 (220V) Minneapolis Blower Door™ fans (**BD 3 220**).
- Model 4 (220V) Minneapolis Blower Door fans (**BD 4**).
- Series A Minneapolis Duct Blaster® fans (**DB A**).
- Series B Minneapolis Duct Blaster® fans (**DB B**).
- Exhaust Fan Flow Meter (**EXH**).
- TrueFlow® Air Handler Flow Meter (**TF**).

Press the **DEVICE** button to toggle through the available test devices. The currently selected test device is shown in the Device section of the gauge display. The Model 3 (110V) Minneapolis Blower Door is the default test device when first entering the **PR/ FL** mode.

Once a test device is selected, the configuration of the device (i.e. flow rings, door position or plate installed) can be selected by pressing the **CONFIG** button. The currently selected device configuration is shown in the Config section of the gauge display.

3.4 "LO" Displayed on Channel B

Whenever "**LO**" appears on **Channel B** in the **PR/ FL** mode, the pressure signal from the test device is too low to provide a reliable air flow reading. The message "**LO"** appears on the **Channel B** display under the following two conditions:

- **"LO"** is continuously displayed on **Channel B** when there is negligible air flow through the test device.
- **"LO"** alternates with a flow reading when the air flow reading through the device is unreliable (i.e. you are trying to measure a flow outside of the calibrated range of the test device in its current configuration). If possible, the user should change the test device configuration to match the flow rate being measured (e.g. install a flow ring or a smaller flow ring).

3.5 Changing the Air Flow Units

When in the **PR/ FL** operating mode, the DG-700 can display air flow readings on **Channel B** in units of **CFM**, **m^3/hr,** or **l/s**. The default air flow unit is **CFM**. To change the air flow unit for **Channel B**, press the **UNITS** button. The selected air flow units are shown on the gauge display directly below the **Channel B** readings. The pressure unit for **Channel A** is always **Pascals** when in the **PR/ FL** mode.

3.6 Changing the Time Averaging Period

To change the selected time averaging period for both **Channel A** and **B**, press the **TIME AVG** button. The selected time averaging period is shown in the **TIME AVG** portion of the gauge display. (See **Section 1.5** above for a complete description of the time averaging periods.)

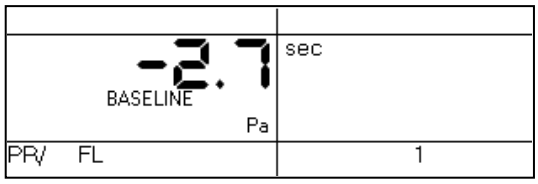
3.7 Using the Baseline Pressure Feature in Pressure/Flow Mode

The **Baseline** feature on **Channel A** allows the user to measure and record a baseline pressure reading, and then display the baseline adjusted pressure reading. This feature is commonly used during both building and duct airtightness test procedures where the user wishes to display the actual change in building or duct pressure caused by operation of the Blower Door or duct airtightness testing fan. In order to accurately determine the change in pressure from the test fan, the user first needs to know the building or duct system pressure (with reference to outside) prior to the test fan being turned on. This initial baseline pressure reading can be quickly measured and then used to adjust the test pressure readings to determine the actual change in pressure caused by operation of the Blower Door or duct airtightness test fan. (See **Section 1.6** for an overview of the baseline pressure feature)

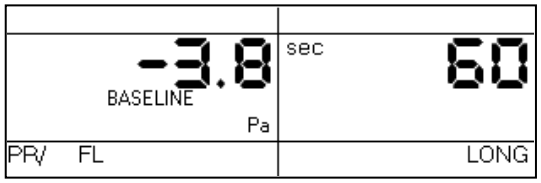
❑ 3.7.a Example: Using the Baseline Feature During a Blower Door Depressurization Test

- Set up **Channel A** to measure building pressure with reference to outside (e.g. run tubing from the **Channel A Reference** tap to outside and leave the **Channel A Input** tap open to the building – assumes the gauge is in the building). Run tubing from the **Channel B** Input tap to the pressure tap on the Blower Door fan.
- With the Blower Door off and the No-Flow Plate installed, turn on the gauge and put it the **PR/ FL** mode by pressing the **MODE** button.
- Select the Blower Door fan device you will be using by pressing the **DEVICE** button (Model 3 fan is the default test device when entering the **PR/ FL** mode).

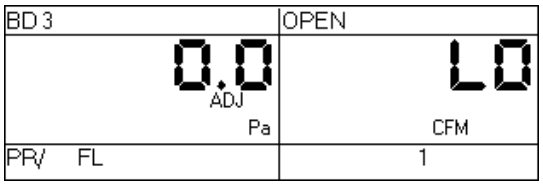
- Press the **BASELINE** button. The word "BASELINE" will begin to flash in the **Channel A** display, indicating that the baseline feature has been initiated. At this point, the gauge is monitoring the real-time **Channel A** baseline building pressure (i.e. the existing building pressure caused by stack and wind effects), but is not recording the reading. The **Channel B** display is not active at this time.



- Press the **START** button to begin the baseline measurement procedure on **Channel A**. Once the **START** button is pressed, the word "BASELINE" stops flashing and the gauge begins recording a ***long term average*** baseline building pressure reading on **Channel A**. During the baseline measurement procedure, the **Channel B** display is used as a timer to let the user know how long (in seconds) the baseline measurement has been active. The longer the measurement time, generally the more stable the baseline reading typically becomes. In the screen to the right, the measured baseline building pressure is –3.8 Pascals (measured over the past 60 seconds).

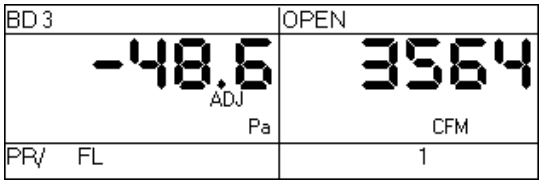


- Once you are satisfied with the baseline pressure reading, press the **ENTER** key to accept and enter the baseline pressure reading into the gauge. After pressing **ENTER**, **Channel A** will now display the baseline adjusted building pressure reading (i.e. the measured baseline pressure reading will be subtracted from the current **Channel A** pressure measurement). The icon "**ADJ**" appears in the **Channel A** display to indicate that the baseline adjusted pressure reading is displayed. The time averaging period for the gauge reverts back to whatever period was selected prior to pressing the **BASELINE** button. **Channel B** is now set up to display the air flow through the Blower Door fan (it will read **LO** until the fan is turned on).



  Note: With the Blower Door fan off and the No-Flow Plate installed, the baseline adjusted building pressure on **Channel A** should be reading close to zero. However if it is windy, there may be fluctuations either side of 0.

- Install the appropriate flow ring and turn on the Blower Door fan. **Channel A** will now display the baseline adjusted building pressure while **Channel B** displays the flow through the Blower Door fan. In the screen to the right, the DG-700 is measuring an actual building depressurization –48.6 Pascals caused by the 3,564 CFM of air flow through the Blower Door fan (open fan).



- If the readings are fluctuating more than desired, change the time averaging period to ***5 second average***, ***10 second average*** or ***long term average***.
- Record the building pressure and fan flow readings at the various target building pressures used in your test procedure.

❑ 3.7.b Entering Baseline Readings into TECTITE Software When Using the Baseline Feature:

- When using the **Baseline** feature, and the TECTITE program to analyze your test data, be sure to enter "0" into the Pre and Post Test Baseline fields in the Manual Data Entry Table. This is because the **Baseline** feature automatically subtracts the measured baseline pressure from the building test pressure readings.

Note: Pressing the **CLEAR** button clears the baseline measurement buffer and turns the baseline feature off. If the gauge **Mode** is changed while the baseline measurement feature is active, the baseline measurement buffer is cleared and the baseline feature is turned off.

Chapter 4 Pressure/Flow @ *50* and @ *25* Modes

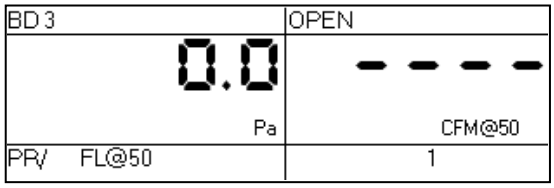
4.1 Mode Summary

Mode	Application	Channel A Display	Channel B Display
Pressure/Flow @ *50* Pa (PR/ FL @50)	Specialized mode for one-point Blower Door building airtightness test.	Building pressure in Pascals.	Building leakage at 50 Pascals in units chosen (CFM@50, m^3/h@50, l/s@50, in^2@50, cm^2@50).
Pressure/Flow @ *25* Pa (PR/ FL @25)	Specialized mode for one-point total leakage duct airtightness test.	Duct system pressure in Pascals.	Total duct leakage at 25 Pa in units chosen (CFM@25, m^3/h@25, l/s@25, in^2@25, cm^2@25).

Note: Appendix A contains Quick Guides for using the DG-700 to conduct one-point building and duct system airtightness tests using the ***@50*** and ***@25*** features.

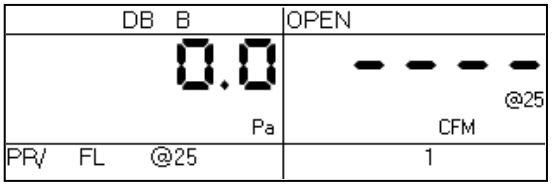
4.2 Overview of Pressure/Flow @ *50* and @ *25* Modes

❑ 4.2.a Pressure/Flow @ *50* Mode:



The **Pressure/Flow @ *50*** mode is used to conduct a one-point Blower Door building airtightness test. In this mode, **Channel A** is used to measure building pressure while **Channel B** is used to display estimated building leakage at a test pressure of 50 Pascals. The leakage estimate shown on **Channel B** is determined by mathematically adjusting the measured air flow from the selected Blower Door fan using the real-time **Channel A** building pressure reading and a Can't Reach Pressure factor (see Section 4.8 below).

❑ 4.2.b Pressure/Flow @ *25* Mode:



The **Pressure/Flow @ *25*** mode is a specialized mode used for conducting a one-point total leakage duct airtightness test. In this mode, **Channel A** is used to measure duct system pressure while **Channel B** is used to display estimated total duct leakage at a test pressure of 25 Pascals. The leakage estimate shown on **Channel B** is determined by mathematically adjusting the measured air flow from the selected Duct Blaster fan using the real-time **Channel A** duct system pressure reading and a Can't Reach Pressure factor (see Section 4.8 below).

To select the **Pressure/Flow @ *50*** or ***@ 25*** modes, press the **MODE** button until the selected operating mode shown on the gauge display is **PR/ FL @50** or **PR/ FL @25**. When first entering either of these two modes, the default pressure units on **Channel A** is Pascals, the default leakage units on **Channel B** is **CFM *@ 50*** or ***25***, and the default time averaging period is ***1 second average***.

❑ 4.2.c Benefits of Using the *@ 50* and *@ 25* Modes:

The ***@ 50*** and ***@ 25*** modes provide four distinct benefits for one-point building and duct airtightness testing:

- The operator no longer needs to waste time adjusting and re-adjusting the fan speed control to achieve a test pressure of **exactly** 50 or 25 Pascals – just get close to the target pressure and make your measurement. As long as the test pressure displayed on **Channel A** is within 5 Pascals of the 50 or 25 Pascal target pressure, any errors introduced by estimating the leakage on **Channel B** will typically be very small (less than 1% - see Tables 4.1 and 4.2 below for more information).
- The leakage estimate displayed on **Channel B** will typically be very stable because of the continuous adjustments made using the **Channel A** test pressure.
- If you can not achieve the target test pressure of 50 or 25 Pascals because the building or duct system is extremely leaky, a leakage estimate at the target pressure will automatically be displayed on **Channel B**.
- When in the ***@ 50*** or ***@ 25*** modes, leakage estimates can be displayed as a leakage rate (e.g. **CFM @**, **m^3/hr @**, **l/s @**), or as a leakage area (e.g. **square inches @** or **square centimeters @**) to visualize the physical size of the measured air leaks.

4.3 Changing the Selected Test Device and Configuration

When in the **Pressure/Flow *@ 50*** or ***@ 25*** modes, the following Energy Conservatory test devices can be selected:

- Model 3 (110V) Minneapolis Blower Door™ fans (**BD 3**).
- Model 3 (220V) Minneapolis Blower Door™ fans (**BD 3 220**).
- Model 4 (220V) Minneapolis Blower Door fans (**BD 4**).
- Series A Minneapolis Duct Blaster® fans (**DB A**).
- Series B Minneapolis Duct Blaster® fans (**DB B**).

Press the **DEVICE** button to toggle through the available test devices. The currently selected test device is shown in the Device section of the gauge display.

Once a test device is selected, the configuration of the device (i.e. flow rings, door position or plate installed) can be selected by pressing the **CONFIG** button. The currently selected device configuration is shown in the Config section of the gauge display.

4.4 "-----"or "LO" Displayed on Channel B

Whenever "**-----**" or "**LO**" appears on **Channel B** in the **PR/ FL *@ 50*** or ***@ 25*** modes, the DG-700 can not calculate a reliable leakage estimate. The messages "**-----**" and "**LO**" appear on **Channel B** under the following three conditions:

- **"-----**" is continuously displayed when the test pressure from **Channel A** is below the minimum test pressures listed below. Estimating leakage results when the test pressure is below these values may result in large errors.
  - 10 Pascals when in the ***@ 50*** mode.
  - 5 Pascals when in the ***@ 25*** mode.
- "**LO**" is continuously displayed when there is negligible air flow through the test device.
- "**LO**" alternates with a flow reading when the air flow reading through the device is unreliable (i.e. you are trying to measure a flow outside of the calibrated range of the test device in its current configuration). If possible, you should change the test device configuration to match the flow rate being measured (e.g. install a flow ring or a smaller flow ring).

4.5 Changing the Leakage Units

UNITS

When in the **Pressure/Flow *@ 50* or *@ 25*** operating modes, the DG-700 can display leakage results on **Channel B** in units of **CFM@**, **m^3/hr@, l/s@, in^2@**, and **cm^2@**. The default air flow unit is **CFM@**. To change the leakage units for **Channel B**, press the **UNITS** button. The selected leakage units are shown on the gauge display directly below the **Channel B** readings. The pressure unit for **Channel A** is always **Pascals** when in the **Pressure/Flow *@ 50*** or ***@ 25*** modes.

4.6 Changing the Time Averaging Period

TIME AVG

To change the selected time averaging period for both **Channel A** and **B**, press the **TIME AVG** button. The selected time averaging period is shown in the **TIME AVG** portion of the gauge display. (See **Section 1.5** for an overview of the time averaging periods.)

4.7 Using the Baseline Pressure Feature in Pressure/Flow Mode

BASE LINE START ENTER

The **BASELINE** feature on **Channel A** allows the user to measure and record a baseline pressure reading, and then display the baseline adjusted pressure reading. This feature is commonly used during both building and duct airtightness test procedures where the user wishes to display the actual change in building or duct pressure caused by operation of the Blower Door or duct airtightness testing fan. In order to accurately determine the change in pressure from the test fan, the user first needs to know the building or duct system pressure (with reference to outside) prior to the test fan being turned on. This initial baseline pressure reading can be quickly measured and then used to adjust the test pressure readings to determine the actual change in pressure caused by operation of the Blower Door or duct airtightness test fan. (See **Sections 1.6, 2.5 and 3.7** for a description and examples on how to use the **Baseline** feature.)

4.8 Leakage Estimate Calculations Used in the *@ 50* and *@ 25* Modes

❑ 4.8.a *@ 50* Mode:

The following equation is used to estimate ***leakage rates*** when in the ***@ 50*** mode:

$$\textbf{Displayed Leakage Rate (Channel B)} = \textbf{Measured Blower Door Air Flow Rate} \times \left\{ \frac{50}{\textbf{Current Test Pressure (Pa) (Channel A)}} \right\}^{0.65}$$

The following equation is used to estimate ***leakage area*** when in the ***@ 50*** mode (square inches):

$$\textbf{Displayed Leakage Area (Channel B)} = \frac{\textbf{Estimated Leakage Rate (CFM50)}}{7.495}$$

The following equation is used to estimate ***leakage area*** when in the ***@ 50*** mode (square centimeters):

Displayed Leakage Area (Channel B) = **Estimated Leakage Rate (CFM50)** / **1.1617**

Note: Leakage areas calculated by the DG-700 are Equivalent Orifice Leakage Areas (EOLA), which are defined as the area of a sharp edged hole that would leak at the same flow rate as the estimated leakage rate, when the hole is subjected to the target test pressure (e.g. 50 Pa or 25 Pa). The purpose of the EOLA estimate is to provide a simple physical interpretation of the cumulative size of the leaks measured by the airtightness test. The EOLA estimates are not appropriate for use in specific infiltration models (such as the LBL or AIM infiltration models) which require leakage area estimates calculated using different equations and assumptions.

❑ 4.8.b *@ 25* Mode:

The following equation is used to estimate ***leakage rates*** when in the ***@ 25*** mode:

$$\textbf{Displayed Leakage Rate (Channel B)} = \textbf{Measured Duct Blaster Air Flow Rate} \times \left\{ \frac{25}{\textbf{Current Test Pressure (Pa) (Channel A)}} \right\}^{0.60}$$

The following equation is used to estimate ***leakage area*** when in the ***@ 25*** mode (square inches):

Displayed Leakage Area (Channel B) = **Estimated Leakage Rate (CFM25)** / **5.3**

The following equation is used to estimate ***leakage area*** when in the ***@ 25*** mode (square centimeters):

Displayed Leakage Area (Channel B) = **Estimated Leakage Rate (CFM25)** / **0.8215**

❑ 4.8.c Errors in Leakage Estimates:

Tables 4.1 and 4.2 below show the errors in the ***@ 50*** and ***@ 25*** leakage estimates from the following 2 sources:

- The actual test pressure (**Channel A**) not being equal to the target pressure (i.e. 50 or 25 Pascals), and
- The actual exponent of the leaks being measured differing from the assumed exponent of 0.65 (for ***@ 50***) and 0.60 (for ***@ 25***).

For example, Table 4.1 shows that for a one-point 50 Pa Blower Door building airtightness test, a 2.5% error would be introduced if the leakage estimate was determined at an actual test pressure of 30 Pa (**Channel A**), and the actual exponent of the leaks was 0.60 rather than the assumed value of 0.65.

Table 4.1: Error in Leakage Estimate for @ *50* Mode

		Actual exponent "n"					
		0.5	**0.55**	**0.6**	**0.65**	**0.7**	**0.75**
Test	**10**	21.4%	14.9%	7.7%	0.0%	-8.4%	-17.5%
Pressure in Pa	**15**	16.5%	11.3%	5.8%	0.0%	-6.2%	-12.8%
(Channel A)	**20**	12.8%	8.8%	4.5%	0.0%	-4.7%	-9.6%
	25	9.9%	6.7%	3.4%	0.0%	-3.5%	-7.2%
	30	7.4%	5.0%	2.5%	0.0%	-2.6%	-5.2%
	35	5.2%	3.5%	1.8%	0.0%	-1.8%	-3.6%
	40	3.3%	2.2%	1.1%	0.0%	-1.1%	-2.3%
	45	1.6%	1.0%	0.5%	0.0%	-0.5%	-1.1%
	50	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	55	-1.4%	-1.0%	-0.5%	0.0%	0.5%	0.9%
	60	-2.8%	-1.8%	-0.9%	0.0%	0.9%	1.8%
	65	-4.0%	-2.7%	-1.3%	0.0%	1.3%	2.6%

Table 4.2: Error in Leakage Estimate for @ *25* Mode

		Actual exponent "n"					
		0.5	**0.55**	**0.6**	**0.65**	**0.7**	**0.75**
Test	**5**	14.9%	7.7%	0.0%	-8.4%	-17.5%	-27.3%
Pressure in Pa	**10**	8.8%	4.5%	0.0%	-4.7%	-9.6%	-14.7%
(Channel A)	**15**	5.0%	2.5%	0.0%	-2.6%	-5.2%	-8.0%
	20	2.2%	1.1%	0.0%	-1.1%	-2.3%	-3.4%
	25	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	30	-1.8%	-0.9%	0.0%	0.9%	1.8%	2.7%
	35	-3.4%	-1.7%	0.0%	1.7%	3.3%	4.9%
	40	-4.8%	-2.4%	0.0%	2.3%	4.6%	6.8%

Chapter 5 Pressure/Air Handler Flow Mode

5.1 Mode Summary

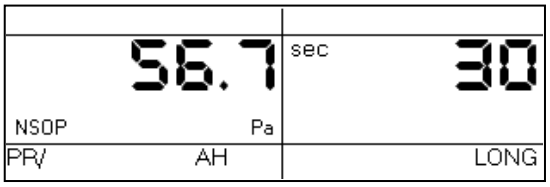
Mode	Application	Channel A Display	Channel B Display
Pressure/AH Flow (PR/ AH)	Specialized mode for measuring air handler flow rates using a TrueFlow Air Handler Flow Meter or a Duct Blaster fan.	Normal system operating pressure (**NSOP**) and test flow system operating pressure (**TFSOP**) in Pascals.	Total air handler flow in units chosen (CFM, m^3/h, l/s). Air flow from the selected Energy Conservatory test device is continuously adjusted using the measured **NSOP** and **TFSOP** readings from **Channel A**.

Note: Appendix A contains a Quick Guide for using the DG-700 with the **Pressure/Air Handler Flow** feature.

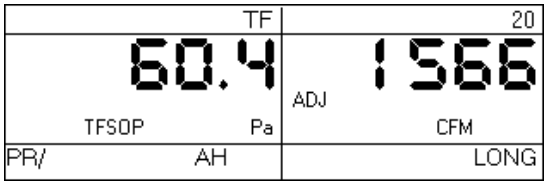
5.2 Overview of Pressure/Air Handler Flow Mode

The **Pressure/Air Handler Flow** mode is a specialized mode used to measure air handler flow with a TrueFlow Air Handler Flow Meter or a Duct Blaster fan. The **PR/ AH** mode consists of the following 2-step procedure:

- **Step 1:** When first entering the **PR/ AH** mode, **Channel A** is set up to measure a Normal System Operating Pressure (**NSOP**) in the duct system, under normal operating conditions (e.g. existing filter in place, no test device installed). Pressing the **START** button initiates a ***long-term average*** **NSOP** pressure measurement, and pressing **ENTER** records and enters the **NSOP** reading into the gauge.



- **Step 2:** Once the **NSOP** measurement is made and entered into the gauge (**Step 1**), the gauge is set up to simultaneously measure the Test Flow System Operating Pressure (**TFSOP**) on **Channel A**, and to display the estimated air handler flow rate on **Channel B**. The flow rate estimate shown on **Channel B** is determined by continuously adjusting the measured air flow from the selected test device using a flow resistance correction factor calculated from the **NSOP** and **TFSOP** pressure readings.



(**Estimated Air Handler Flow = Test Device Flow** x **Flow Resistance Correction Factor**)

Note: TFSOP is the operating pressure in the duct system, at the same location used for the **NSOP** reading, with a TrueFlow Metering Plate or Duct Blaster fan installed. **TFSOP** is referred to in the TrueFlow Operation Manual as the TrueFlow System Operating Pressure.

To select the **Pressure/Air Handler Flow** mode, press the **MODE** button until the selected operating mode shown on the gauge display is **PR/ AH**.

5.3 Changing the Selected Test Device and Configuration

When in the **Step 2** part of the **PR/ AH** procedure, press the **DEVICE** button to select the test device being used to measure air handler flow. When using the **PR/ AH** mode, the TrueFlow Metering Plates (**TF**) and the Duct Blaster fans (**DB A** or **DB B**) are the only compatible test devices.

Once a test device is selected, the configuration of the device (i.e. flow rings, or plate installed) can be selected by pressing the **CONFIG** button. The currently selected device configuration is shown in the Config section of the gauge display.

5.4 "-----"or "LO" Displayed on Channel B

Whenever "-----" or "**LO**" appears on **Channel B** in the **Step 2** part of the **PR/ AH** procedure, the DG-700 can not display a reliable air handler flow estimate. The messages "-----" and "**LO**" appear on **Channel B** under the following three conditions:

- "-----" is continuously displayed when either the recorded **NSOP** reading, or the current **TFSOP** reading is below 2 Pa.
- "**LO**" is continuously displayed when there is negligible air flow through the test device.
- "**LO**" alternates with a flow reading when the air flow reading through the device is unreliable (i.e. you are trying to measure a flow outside of the calibrated range of the test device in its current configuration). If possible, you should change the test device configuration to match the flow rate being measured (e.g. if using a Duct Blaster fan, install a flow ring or a smaller flow ring).

5.5 Changing the Air Handler Flow Units

When in the **PR/ AH** mode, the DG-700 can display air handler flow on **Channel B** in units of **CFM**, **m^3/hr**, and **l/s**. The default air flow unit is **CFM**. To change the flow units for **Channel B**, press the **UNITS** button while in the **Step 2** part of the procedure. The selected flow units are shown on the gauge display directly below the **Channel B** readings. The pressure unit for **Channel A** is always **Pascals** when in the **PR/ AH** mode.

5.6 Changing the Time Averaging Period for the Step 2 Procedure

To change the selected time averaging period for the **Step 2** part of the **PR/ AH** procedure, press the **TIME AVG** button. The selected time averaging period is shown in the **TIME AVG** portion of the gauge display. (See **Section 1.5** for an overview of the time averaging periods.) During the **Step 1** part of the procedure, the time average feature is always set to ***long-term average***.

5.7 Test Procedure For Measuring Air Handler Flow

❑ 5.7.a Step 1: Measuring the NSOP

- Open a window or door between the building and outside to prevent pressure changes in the building during the test. If the air handler fan is installed in an unconditioned zone (e.g. crawlspace, attic), open any vents or access doors connecting that zone to the outside (or to the building) to prevent pressure changes in the zone during the test.

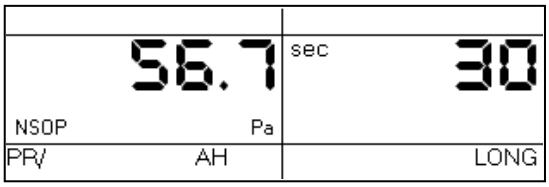
- Make sure all supply and return registers are open and untapped. Replace filters if they are dirty (or keep dirty filters in place if you want to measure flow in a "as found" condition). Turn on the air handler.

- Insert a static pressure probe into the supply plenum, or in a main supply trunk line a few feet away from the supply plenum. Make sure the static pressure probe is pointing into the air flow created by the air handler fan.

- Connect a piece of tubing to the static pressure probe. Connect the other end of the tubing to the **Channel A Input** tap on the DG-700. The **Channel A Reference** tap should be connected to the inside of the building, or it can be connected to an unconditioned zone containing the air handler provided that the zone remains at the same pressure as the building during the test.

- Turn on the gauge and put it the **PR/ AH** mode by pressing the **MODE** button. The icon "NSOP" will begin to flash in the **Channel A** display, indicating that the **PR/ AH** measurement feature has been initiated. At this point, the gauge is monitoring the real-time **Channel A NSOP** pressure, but is not recording the reading. The **Channel B** display is not active at this time.

- Press the **START** button to begin the **NSOP** measurement procedure on **Channel A**. Once the **START** button is pressed, the icon "NSOP" stops flashing and the gauge begins recording a ***long term average*** **NSOP** pressure reading on **Channel A**. During the measurement procedure, the **Channel B** display is used as a timer to let the user know how long (in seconds) the NSOP measurement has been active. The longer the measurement time, generally the more stable the reading typically becomes. In the screen to the right, the measured NSOP pressure is 56.7 Pascals (measured over the past 30 seconds).



- Once you are satisfied with the **NSOP** reading, press the **ENTER** key to accept and enter the reading into the gauge. Turn off the air handler, and leave the static pressure probe in place and connected to the gauge.

❑ 5.7.b Step 2: Measuring the TFSOP and Adjusted Air Handler Flow

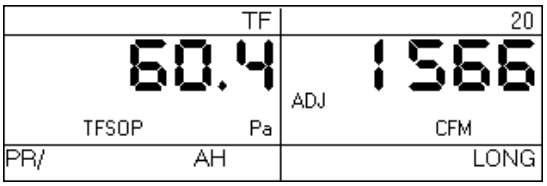
- Once the **NSOP** measurement is made and entered into the gauge (**Step 1**), the gauge is set up to simultaneously measure the Test Flow System Operating Pressure (**TFSOP**) on **Channel A**, and to display the estimated air handler flow rate on **Channel B**.

- Install the test device used to measure air handler flow (either a TrueFlow Metering Plate, or a Duct Blaster Fan). Connect the test device to **Channel B**. Refer to the TrueFlow or Duct Blaster operation manuals for installation instructions.

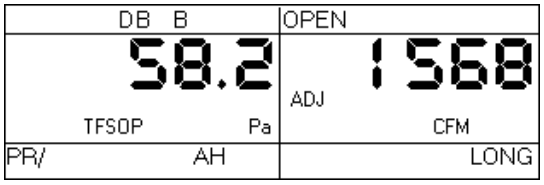
- Select the installed test device and device configuration on the DG-700 using the **DEVICE** and **CONFIG** buttons.

If Using a TrueFlow Metering Plate

- Turn on the air handler. **Channel A** will now display the **TFSOP** reading from the static pressure probe, and **Channel B** will display adjusted air handler flow. The flow rate estimate shown on **Channel B** is determined by continuously adjusting the measured air flow from the TrueFlow Metering Plate using a flow resistance correction factor calculated from the **NSOP** and **TFSOP** pressure readings. If the readings are fluctuating, change the time averaging setting to ***5 second***, ***10 second***, *or* ***long-term average*** using the **TIME AVG** button.



If Using a Duct Blaster Fan (Pressure Matching Method)



- Turn on the air handler. Now turn on and adjust the Duct Blaster fan (along with the air handler fan) so that the **TFSOP** reading on **Channel A** is close (within 5 Pa) to the **NSOP** reading entered into the gauge in **Step 1**. There is no need to exactly match the **NSOP** and **TFSOP** pressures, because the gauge is making an adjustment to the measured Duct Blaster fan flow using a flow resistance correction factor calculated from the **NSOP** and **TFSOP** pressure readings. If the readings are fluctuating, change the time averaging setting to ***5 second***, ***10 second***, *or* ***long-term average*** using the **TIME AVG** button.

  Note: If you are unable to get the **TFSOP** to within 5 Pascals of the **NSOP** reading, the gauge will continue to display an adjusted air handler flow rate using the calculated flow resistance correction factor. The greater the difference between the **NSOP** and **TFSOP** readings, the higher the probability that the flow resistance correction factor will introduce errors into the flow estimate.

5.8 Flow Resistance Correction Factors Used in the DG-700

The following equation is used to calculate the flow resistance correction factor used by the DG-700 in the **PR/ AH** mode:

$$\textbf{Flow Resistance Correction Factor} = \left\{ \frac{\textbf{NSOP}}{\textbf{TFSOP}} \right\}^{\mathbf{0.50}}$$

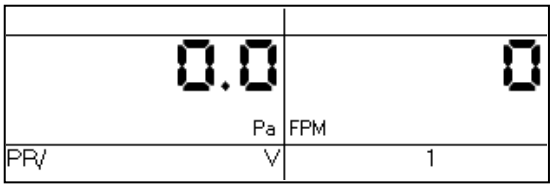
Chapter 6 Pressure/Velocity Mode

6.1 Mode Summary

Mode	Application	Channel A Display	Channel B Display
Pressure/Velocity (PR/ V)	Multi-purpose pressure and air velocity measurements.	Pressure in Pascals.	Air velocity in units chosen (FPM, m/s).

6.2 Overview of Pressure/Velocity Mode

The **Pressure/Velocity** mode is a multi-purpose mode used to measure a pressure signal on **Channel A** and/or measure an air velocity reading from a pitot tube connected to **Channel B**.



To select the **Pressure/Velocity** mode, press the **MODE** button until the selected operating mode shown on the gauge display is **PR/ V**. When first entering this mode, the default air velocity unit on **Channel B** is feet per minute (FPM). **Channel A** always displays pressure readings in Pascals when in the **PR/ V** mode.

6.3 Changing the Air Velocity Units

When in the **PR/ V** operating mode, the DG-700 can display air velocity readings on **Channel B** in units of **feet per minute** or **meters per second**. To change the air velocity units for **Channel B**, press the **UNITS** button. The selected units are shown on the **Channel B** display directly below the channel reading.

6.4 Changing the Time Averaging Period

To change the selected time averaging period for both **Channel A** and **B**, press the **TIME AVG** button. The selected time averaging period is shown in the **TIME AVG** portion of the gauge display. (See **Section 1.5** above for a complete description of the time averaging periods.)

6.5 Air Velocity Calculations Used in the DG-700

The following equations are used to calculate air velocity from a pitot tube connected to **Channel B**. **Note:** The pitot tube should be set up to measure velocity pressure in order for the DG-700 to correctly display air velocity readings.

$$\text{Air Velocity (feet/minute)} = 1096.2 \left\{ \frac{\text{Velocity Pressure (in. wc)}}{0.075\ (\text{lb/ft}^3)} \right\}^{0.50}$$

$$\text{Air Velocity (meters/second)} = 1.4142 \left\{ \frac{\text{Velocity Pressure (Pa)}}{1.204\ (\text{Kg/m}^3)} \right\}^{0.50}$$

Chapter 7 Servicing and Maintenance

7.1 Gauge Calibration and Servicing

❑ 7.1.a Calibration:

The DG-700 is calibrated at our factory prior to being shipped. A sticker on the back of the gauge case will indicate the date of calibration, as well as the next recommended recalibration date. Under normal operation, we recommend that the gauge be recalibrated once every two years. Gauge recalibration is a service provided by The Energy Conservatory for a small fee ($80 as of 7/1/13). Gauges needing recalibration should be sent to:

The Energy Conservatory
2801 21st Ave. S., Suite 160
Minneapolis, MN 55407
Attn: Digital Gauge Recalibration

When returning a gauge for calibration, please print out the Equipment Return Form from our website (www.energyconservatory.com/sites/default/files/documents/equipment_return_form.pdf), fill it out completely, and include a copy of the completed form along with the equipment being returned.

❑ 7.1.b Servicing/Repairs:

All factory authorized repairs for the DG-700 gauge are conducted at the above address. To have your gauge repaired, send the gauge to the above address along with a completed copy of our Equipment Return Form (see above).

7.2 Low Battery Indicator/Battery Replacement

The DG-700 is powered by 6 AA batteries located in the battery compartment on the back of the gauge. We recommend that Alkaline or rechargeable batteries (e.g. nickel-metal hydride or NiCd) be used with this gauge. Whenever the gauge is turned on, the battery voltage is measured and temporarily displayed in the **Channel B** display area.

❑ 7.2.a Low Battery Indicators:

A low battery icon "**BAT**" begins to blink on the gauge display when it is time to replace (or recharge) the batteries. The **BAT** icon is set to appear when the measured battery voltage drops below 6.0 volts. The gauge will continue to provide reliable operation for a short time following appearance of the **BAT** icon. Once the batteries have discharged to a level which prohibits reliable operation, the words "LO BAT" appear in the **Channel A** and **B** display areas, and the gauge will no longer function. Fully charged batteries will typically provide 4-5 days of continuous operation before the **BAT** icon appears on the gauge display.

❑ 7.2.b Battery Replacement:

To remove the existing batteries from the battery compartment, first turn off the gauge, and then remove the battery compartment cover plate by sliding it away from the gauge. Carefully remove each battery from the battery compartment.

Carefully replace the 6 AA batteries. Be sure to insert the batteries with the proper polarity (+/-) as illustrated on the inside of the battery compartment. Replace the battery compartment cover.

7.3 Troubleshooting/Resetting the DG-700

If the DG-700 gauge locks up or otherwise appears to be displaying inconsistent readings, try the following steps to reset the gauge.

- Simply turn the gauge off for 5 seconds and then turn it back on (using the **ON/OFF** button).
- If turning the gauge off and on does not take care of the problem (or you were unable to turn the gauge off), first remove the batteries from the battery compartment. Once the batteries have been removed, hold down the **ON/OFF** button for 10 seconds to fully discharge the gauge's internal electronic components. Carefully replace the 6 AA batteries. Be sure to insert the batteries with the proper polarity (+/-) as illustrated on the inside of the battery compartment. Turn the gauge back on.
- If neither of the steps above takes care of the problem, you will need to send the gauge back to The Energy Conservatory for servicing (see Section **7.1.b** above).

7.4 AC Power Supply Specifications

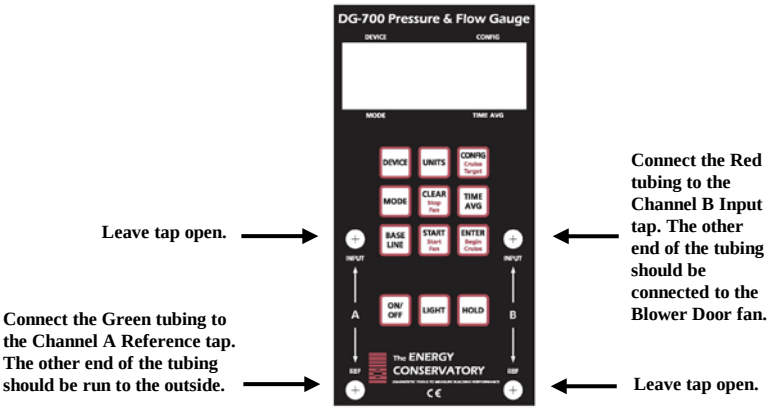
The AC power input jack can be used with an optional AC power supply to provide a long term power source for the gauge (to be used when data logging). The gauge is normally powered by 6 AA batteries located in the rear battery compartment. When the AC power supply is plugged in, the power supply bypasses the batteries in the battery compartment. **Note:** Always turn off the gauge before plugging in the AC power supply.

Universal Specifications for Power Supply: 100-240V/50/60Hz Input, 12VDC Output, Center "+", 12mm Barrel Length, 3 W Min. Output (International mains adapters included).

Appendix A Quick Guides for Using the DG-700 with Energy Conservatory Test Devices

A.1 One-Point 50 Pascal Building Depressurization Test using the Model 3 Minneapolis Blower Door™ and DG-700 Digital Gauge

1. **Install the Blower Door system.**
   a) Install the aluminum frame and nylon panel in an exterior doorway of a large open room.
   b) Attach the gauge mounting board and fan speed controller to a door, or to the aluminum frame gauge hanger bar, using the C-clamp on the back of the mounting board.
   c) Secure the DG-700 gauge onto the mounting board (using the Velcro strips) and connect tubing to the DG-700 as shown in the illustration to the right.
   d) Run approximately 3 - 5 feet of the remaining end of the **Green** tubing outside through one of the patches in the bottom corners of the nylon panel. Be sure the outside end of the tubing is well away from the exhaust flow of the Blower Door fan and is protected from the wind.
   e) Install the Blower Door fan, with the Flow Rings and No-Flow Plate attached, into the large hole in the nylon panel. The exhaust side of the fan should be outside, and the inlet side of the fan (the side with the Flow Rings) should be inside the building.



   f) Insert the female plug from the fan speed controller into the receptacle located on the fan electrical box. The remaining cord (power cord) should be plugged into a power outlet that is compatible with the voltage/frequency of the fan motor and speed controller.
   g) If your fan has a direction switch, be sure it is set to blow air out of the building.
   h) The remaining end of the **Red** tubing should now be connected to the pressure tap on the Blower Door fan electrical box.
   i) If your DG-700 gauge and fan speed control are compatible for Cruise Control, install the fan control cable into the 3.5 mm communication jacks located on the top of the DG-700 and on the side of the speed controller (otherwise skip this step).

2. **Prepare the building for the Test.**
   a) Close all exterior doors and windows, and open all interior doors. Because few house basements can be completely sealed from the house and usually some conditioning of the basement is desirable, they are typically included as conditioned space.
   b) Adjust all combustion appliances so that they do not turn on during the test.
   c) Be sure all fires are out in fireplaces and woodstoves. Close all fireplace and wood stove doors to prevent scattering of ashes.
   d) Turn off any exhaust fans, vented dryers, and room air conditioners.

3. **Conducting the Test.**
   a) Turn on the DG-700 by pressing the **ON/OFF** button.
   b) Press the **MODE** button twice to put the gauge into the **PR/ FL @50** Mode. In this Mode, **Channel A** is used to measure building pressure while **Channel B** is used to display the estimated building leakage at a test pressure of 50 Pascals. (The leakage estimate shown on **Channel B** is determined by mathematically adjusting the actual air flow from the Blower Door fan using the **Channel A** building pressure reading and a Can't Reach Pressure factor.)

c) With the fan inlet still covered press the **BASELINE** button to initiate the building baseline measurement procedure on **Channel A**. Press **START** to begin the baseline measurement. During a baseline measurement, **Channel A** will display a long-term average baseline pressure reading while **Channel B** is used as a timer in seconds to show the elapsed measurement time. When you are satisfied with the baseline measurement, press the **ENTER** button to accept and enter the baseline reading into the gauge. The **Channel A** display will now show an **ADJ** icon to indicate that it is displaying a baseline adjusted building pressure value.

Fan Configuration	Flow Range (cfm) for Model 3 Fan
Open (no Flow Ring)	6,300 - 2,435
Ring A	2,800 - 915
Ring B	1,100 - 300
Ring C	330 - 85

d) Remove the No-Flow Plate from the Blower Door fan and install the Flow Ring which you think best matches the needed fan flow (see Table to the right).

e) Check (and adjust if necessary) the selected test Device (i.e. fan) and Configuration (i.e. Flow Ring) shown in the upper part of the gauge display to match the fan and Flow Ring being used in the test. For example, the Device icon for the Model 3 (110V) Blower Door fan is **BD 3**, and the Configuration icon for Ring A is **A1**. Press the **DEVICE** button to change the selected fan. Press the **CONFIG** button to change the selected Flow Ring.

f) Turn on the Blower Door fan.

If Using Cruise Control:

Turn the Blower Door speed control knob to the "just on" position (i.e. from the off position, turn the controller knob clockwise only until you feel the click and no farther, the fan will not be turning). Now press the **Begin Cruise (Enter)** button. The **Channel A** display will now show the number 50 (your target Cruise pressure). Press the **Start Fan (Start)** button. The Blower Door fan will now slowly increase speed until the building depressurization displayed on Channel A is approximately -50 Pascals.

If Manually Controlling Fan:

Turn on the Blower Door fan by slowly turning the fan controller clockwise. As the fan speed increases, the building depressurization displayed on **Channel A** should also increase. Continue to increase the fan speed until the building depressurization shown on **Channel A** is between –45 and –55 Pascals. Do not waste time adjusting and re-adjusting the fan speed control to achieve a test pressure of exactly –50 Pascals.

g) **Channel B** will now display the One-Point 50 Pascal leakage estimate. Record this number. If the leakage estimate is fluctuating more than desired, try changing the Time Averaging setting on the gauge by pressing the **TIME AVG** button and choosing the ***5*** or ***10*** second or ***Long-term*** averaging period. (If "------" or "**LO**" appear on **Channel B**, see **#4** below).

h) Turn off the Blower Door fan. If you are using Cruise Control, this is done by pressing the **Stop Fan (Clear)** button).

4. "-----" or "LO" appearing on Channel B

Whenever "-----" or "**LO**" appears on **Channel B** in the **PR/ FL @ 50** Mode, the DG-700 can not calculate a reliable leakage estimate. The messages "-----" and "**LO**" appear on **Channel B** under the following three conditions:

a) "-----" is continuously displayed when the building test pressure from **Channel A** is below a minimum value of 10 Pascals. Estimating building leakage results when the test pressure is below this value may result in large errors. If possible, install a larger Flow Ring or remove the Flow Rings to generate more fan flow.

b) "**LO**" is continuously displayed when there is negligible air flow through the test device.

c) "**LO**" alternates with a flow reading when the air flow reading through the device is unreliable (i.e. you are trying to measure a flow outside of the calibrated range of the test device in its current configuration). If possible, you should change the test device configuration to match the flow rate being measured (e.g. install a Flow Ring or a smaller Flow Ring). Be sure the fan is off when changing Flow Rings.

Note: If you change the Flow Rings on the fan, be sure to change the Configuration setting on the gauge to match the installed Ring.

A.2 One-Point 25 Pascal Total Leakage Duct Pressurization Test Using the Series B Minneapolis Duct Blaster® and DG-700 Digital Gauge

1. **Connect the Duct Blaster fan to the duct system.**

a) Choose a location to install the Duct Blaster fan. In single, double or triple returned systems, the largest and closest return to the air handler is usually the best choice. Note: In multi-return systems (a return in every room), installing at the air handler cabinet is often best.

b) Remove any remote filters from the chosen return and then connect the black square transition piece to the return using temporary tape. Completely seal the remaining open area of the return with tape.

c) Pull the Duct Blaster fan and flex duct out of the carrying case. Connect the flex duct to the **exhaust** side of the fan (i.e. the side with the metal guard) using the round transition piece and connect trim. Connect the open end of the flex duct to the square transition piece using the velcro strap on the flex duct.

Fan Configuration	Flow Range (cfm) For Series B Duct Blaster
Open (no Flow Ring)	1,500 - 600
Ring 1	800 – 225
Ring 2	300 – 90
Ring 3	125 – 10

d) Connect the fan speed controller to the fan and plug it into a grounded power outlet.

e) Install the Flow Ring which you think best matches the needed fan flow.

f) If your DG-700 gauge and fan speed controller are compatible with Cruise Control, install the fan control cable into the 3.5 mm communication jacks located on top of the DG-700 and on the side of the speed controller (otherwise skip this step).

2. **Prepare the duct system and house for the Test.**

a) Adjust the HVAC system controls so that the air handler does not turn on during the Test.

b) Temporarily seal off all remaining supply and return registers, and combustion or ventilation air inlets which are connected to the duct system. Use ***Duct Mask*** ™ temporary register sealing material provided with your Duct Blaster, or use painters tape and paper.

c) Turn off any exhaust fans, vented dryers, and room air conditioners.

d) Remove all central filters (i.e. in air handler or return plenum).

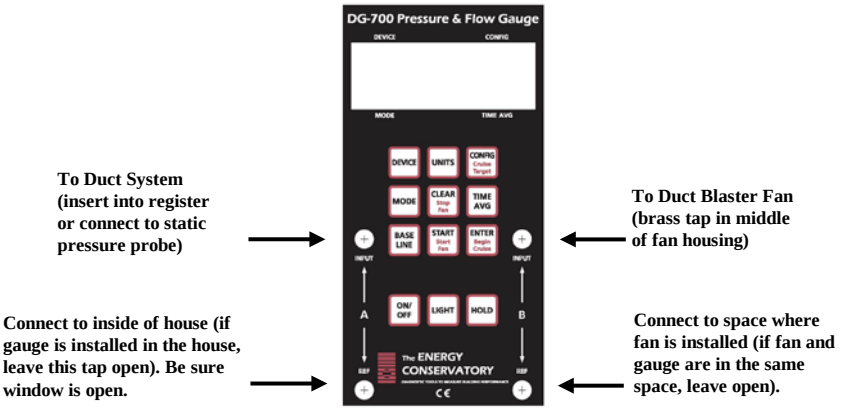
e) Open a door or window between the house and outside to prevent changes in house pressure when the Duct Blaster is running.

f) If the Duct Blaster is installed in an attic, garage or crawlspace - open vents or access panels or doors from these spaces to the outside.

3. **Connect tubing to DG-700 Pressure Gauge.**

a) Select a location to measure duct pressure. The best location for measuring duct pressure is often in the supply trunkline or plenum. Drill a small hole (1/4" to 3/8" OD) into the duct to allow a static pressure probe to be installed. Install the static pressure probe with the end of the probe pointing into the air flow from the Duct Blaster fan. If the duct system is reasonably airtight (e.g. less than 200 cfm25 of leakage), duct pressures can be measured at any supply register by inserting the end of the tubing through the temporary register seal.

b) Connect tubing to the DG-700 as shown in the illustration to the right.



4. **Conducting the Test.**

a) Turn on the gauge by pressing the **ON/OFF** button.

b) Press the **MODE** button three times to put the guage into the **PR/ FL @25** Mode. In this Mode, **Channel A** is used to measure duct system pressure while **Channel B** is used to display estimated duct leakage at a test pressure of 25 Pascals. (The leakage estimate shown on **Channel B** is determined by mathematically adjusting the actual air flow from the Duct Blaster fan using the **Channel A** duct system pressure reading and a Can't Reach Pressure factor.)

c) Check (and adjust if necessary) the selected test Device (i.e. fan) and Configuration (i.e. Flow Ring) shown in the upper part of the gauge display to match the fan and Flow Ring being used in the test. For example, the Device icon for the Series B Duct Blaster fan is **DB B**, and the Configuration icon for Ring 2 is **B2**. Press the **DEVICE** button to change the selected fan. Press the **CONFIG** button to change the selected Flow Ring.

d) Turn on the Duct Blaster fan.

If Using Cruise Control:

Turn the Duct Blaster speed controller to the "just on" position (i.e. turn the controller knob all the way down counter-clockwise and flip the on/off switch to "ON" – the fan will not be turning). Now press the **Begin Cruise (Enter)** button. The **Channel A** display will now show the number 25 (your target Cruise pressure). Press the **Start Fan (Start)** button. The Duct Blaster fan will now slowly increase speed until the duct pressurization displayed on Channel A is approximately 25 Pascals.

If Manually Controlling Fan:

Turn on the Duct Blaster fan controller and slowly turn the fan controller knob clockwise. As the fan speed increases, the duct pressurization displayed on **Channel A** should also increase. Continue to increase the fan speed until the duct pressurization shown on **Channel A** is between 20 and 30 Pascals. Do not waste time adjusting and re-adjusting the fan speed control to achieve a test pressure of exactly 25 Pascals.

e) **Channel B** will now display the One-Point 25 Pascal Total Duct Leakage estimate. If the leakage estimate is fluctuating more than desired, try changing the Time Averaging setting on the gauge by pressing the **TIME AVG** button and choosing the ***5*** or ***10*** second or ***Long-term*** averaging period. (If "------" or "**LO**" appear on **Channel B**, see **#5** below).

5. "-----" or "LO" appearing on Channel B

Whenever "-----" or "**LO**" appears on **Channel B** in the **PR/ FL @ 25** Mode, the DG-700 can not calculate a reliable leakage estimate. The messages "-----" and "**LO**" appear on **Channel B** under the following three conditions:

a) "-----" is continuously displayed when the duct test pressure from **Channel A** is below a minimum value of 5 Pascals. Estimating duct leakage results when the test pressure is below this value may result in large errors. If possible, install a larger Flow Ring or remove the Flow Rings to generate more fan flow.
b) "**LO**" is continuously displayed when there is negligible air flow through the test device.
c) "**LO**" alternates with a flow reading when the air flow reading through the device is unreliable (i.e. you are trying to measure a flow outside of the calibrated range of the test device in its current configuration). If possible, you should change the test device configuration to match the flow rate being measured (e.g. install a Flow Ring or a smaller Flow Ring). Be sure the fan is off when changing Flow Rings.

Note: If you change the Flow Ring on the fan, be sure to change the Configuration setting on the gauge to match the installed Ring.

A.3 Using the TrueFlow® Air Handler Flow Meter and the DG-700 Digital Gauge

1. Measure the Normal System Operating Pressure (NSOP) with the existing filter in place.

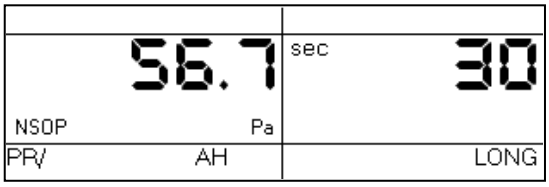
a) Locate the air handler system filter and replace if it is dirty.

b) Install a static pressure probe into the ductwork at one of the 3 locations listed below:

- Insert the static pressure probe into the side surface of the supply plenum. The side of the supply plenum chosen should not have a trunk line, distribution duct or supply register connected to it. The static pressure probe should point into the airstream.
- Or, insert the tip of the static pressure probe into a "dead-end" corner of the supply plenum. A "dead-end" corner is a corner of the plenum that does not have a trunk line connection, distribution duct connection or supply register within 8 inches of the corner.
- Or, insert the static pressure probe in the side surface of the return plenum. The side of the return plenum chosen should not have a trunk line, return duct or return register connected to it. The location chosen should also be at least 24 inches upstream from the TrueFlow Metering Plate, and at least 24 inches downstream from any 90 degree corners or return trunk line connections. The static pressure probe should point into the airstream. **Note:** if the Metering Plate will be installed at a remote filter grille, the static pressure probe may not be installed in the return plenum (i.e. install it in the supply plenum).

c) Connect a piece of tubing between the static pressure probe and the **Channel A Input** tap. If the gauge is in the house during the test procedure, leave the **Reference** tap on **Channel A** open. If the gauge is not in the house during the test procedure (e.g. attic, crawlspace), run additional tubing from the **Channel A Reference** tap to inside the house.

d) Turn on the air handler fan to the desired speed. Now turn on the gauge and put it the **PR/ AH** mode by pressing the **MODE** button 4 times. The icon "**NSOP**" will begin to flash in the **Channel A** display. At this point, the gauge is monitoring the real-time **Channel A NSOP** pressure, but is not recording the reading. The **Channel B** display is not active at this time.



e) Press the **START** button to begin the **NSOP** measurement procedure on **Channel A**. Once the **START** button is pressed, the **NSOP** icon stops flashing and the gauge begins recording a long term average **NSOP** pressure reading on **Channel A**. During the measurement procedure, the **Channel B** display is used as a timer to let the user know how long (in seconds) the **NSOP** measurement has been active. The longer the measurement time, generally the more stable the reading typically becomes. In the screen to the right, the measured **NSOP** pressure is 56.7 Pascals (measured over the past 30 seconds).

f) Once you are satisfied with the **NSOP** reading, press the **ENTER** key to accept and enter the reading into the gauge. Turn off the air handler fan, and leave the static pressure probe in place and connected to the gauge on **Channel A**.

2. Install the TrueFlow Metering Plate in an Existing Filter Slot.

a) Remove the existing filter and set it aside.

b) Choose and assemble the metering plate and spacers needed to match the filter slot size.

Filter Slot (in. x in.)	Flow Metering Plate	Spacer Dimension (in. x in.)	
		Spacer 1	Spacer 2
14 x 20	#14	------	------
14 x 25	#14	5 x 14	------
16 x 20	#14	2 x 20	------
16 x 24	#14	2 x 20	4 x 16
16 x 25	#14	2 x 20	5 x16
18 x 20	#14	4 x 20	------
20 x 20	#20	------	------
20 x 22	#20	2 x 20	------
20 x 24	#20	4 x 20	------
20 x 25	#20	5 x 20	------
20 x 30	#20	10 x 20	------
24 x 24	#20	4 x 20	4 x 24

c) Install the assembled metering plate into the filter slot. Be sure the front side of the metering plate is facing into the air flow (front side has two diamond shaped labels on it). The H-channel gasket should provide a seal around the metering plate - all of the air flow should pass through the metering plate and not around it. Be sure that the ends of the flexible tubing connections attached to the plate's pressure sensing grids remain out of the filter slot. Occasionally, drilling holes into the ductwork may be required as a pathway for the ends of the flexible tubing. The flexible tubing can be passed through one of the plate's metering holes if this helps in getting the tubing ends outside of the filter slot.

- Obstructions within 6 inches upstream or 2 inches downstream of the metering plate that are blocking air flow through any of the metering holes may reduce the accuracy of the device.
- If there is an obstruction and there is a spacer attached to the metering plate, try to install the metering plate so that the spacer is directly in front of the obstruction (this will minimize the effect of the obstruction on the flow measurement).
- If the metering plate is installed directly downstream of a 90 degree bend in the duct system, and there is a spacer attached to the plate, install the metering plate so that the spacer is on the inside corner of the bend (see diagram to right).

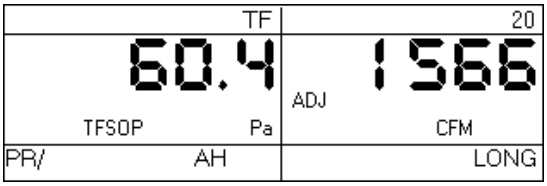
d) Close the filter access opening. Be careful not to pinch off the flexible tubing connections. Temporarily seal around the filter slot cover with masking tape to prevent air leakage. **Note:** If you are installing the metering plate at the filter grille of a single return duct system, simply push the plate into the empty filter rack. Make sure that the front of the metering plate is facing out (into the air flow). Keep the filter grille door open for the remainder of the test.

3. Connect the Metering Plate to the DG-700.

a) Connect the tubing from the installed metering plate to the DG-700. Connect the Red ("total pressure grid") tubing connection to the **Channel B Input** pressure tap. Connect the Green ("static pressure grid") tubing connection to the **Channel B Reference** pressure tap. **The Channel A Input** tap should remain connected to the static pressure probe.

4. Measure the TrueFlow System Operating Pressure (TFSOP) and Adjusted Total Air Handler Flow.

a) Check and adjust if necessary the selected test Device and Configuration shown in the upper part of the gauge display to match the metering plate installed in **Step 2** above. When using the TrueFlow Metering Plates, the Device icon should always be set to **TF**, and the Configuration icon should be set to **14** or **20** depending on which metering plate is installed. Changes to the selected Device and Configuration are made by pressing the **DEVICE** and **CONFIG** buttons.



b) Turn the air handler fan back on to the same speed as used in **Step 1** above. **Channel A** will now display the **TFSOP** reading from the static pressure probe, and **Channel B** will display adjusted air handler flow. The static pressure probe should be in exactly the same position as it was in **Step 1** above. The air handler flow rate estimate shown on **Channel B** is determined by continuously adjusting the measured air flow from the TrueFlow Metering Plate using a flow resistance correction factor calculated from the **NSOP** and **TFSOP** pressure readings. If the readings are fluctuating, change the time averaging setting to ***5 second***, ***10 second***, *or* ***Long-Term*** average using the **TIME AVG** button.

c) Record the adjusted air flow reading from **Channel B**. In the screen to the right, the adjusted air flow reading is 1,566 CFM. This result is the estimated air flow at the measurement location with the existing filter in place. Turn off the air handler fan.

Note: When the TrueFlow Air Handler Flow Meter is installed at a remote filter grille, it is possible to make a correction to the measured flow through the metering plate which increases the accuracy of the flow measurement. See **Appendix C** of the TrueFlow manual for more details.

A.4 DG-700 Connections Needed to Conduct Automated Blower Door Tests

In order to perform fully automated Blower Door tests using a DG-700, you will need the following components:

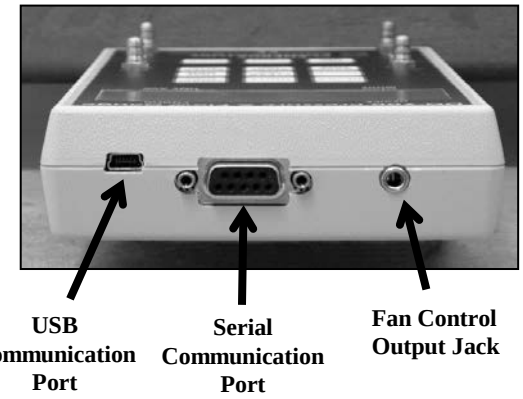
- A fan control cable to connect the fan control output jack on the DG-700 to the communication jack on the side of the Blower Door fan speed controller. **Note:** If your Blower Door speed controller does not have a communication jack on the side of the controller box, you will need to purchase a new speed controller.
- A communication cable (either USB (A-mini B), or 9-pin serial) to connect the DG-700 to your laptop computer.
- TECTITE (3.0 or higher) software CD.

Connection Instructions.

1. Install the TECTITE software onto your computer. Once the software is installed, run the TECTITE program and access the TECTITE Operation Manual directly from the program's Help Menu. Refer to this manual on how to operate the TECTITE software.
2. Install the Blower Door system as described in the Blower Door operation manual.
3. Connect the DG-700 to your computer using either a USB cable or a 9-pin serial communication cable.

- If using a USB cable, follow these instructions:
  - Insert the installation CD labeled "USB Drivers for DG-500 and DG-700 Digital Pressure Gauges" into a CD drive on your computer (this CD should have been provided with all DG-700 gauges equipped with a USB Communication Port). Your computer should automatically run the file "autoinstall.bat" from the CD which will install the necessary USB drivers onto your computer.
  - Once the USB drivers are installed, plug the "A" (larger) end of the USB communication cable into an open USB port on your computer. Plug the "mini B" (smaller) end of the cable into the USB Communication Port on top of the DG-700.
  - The computer operating system should locate the DG-700 gauge and perform the necessary setup on your computer.

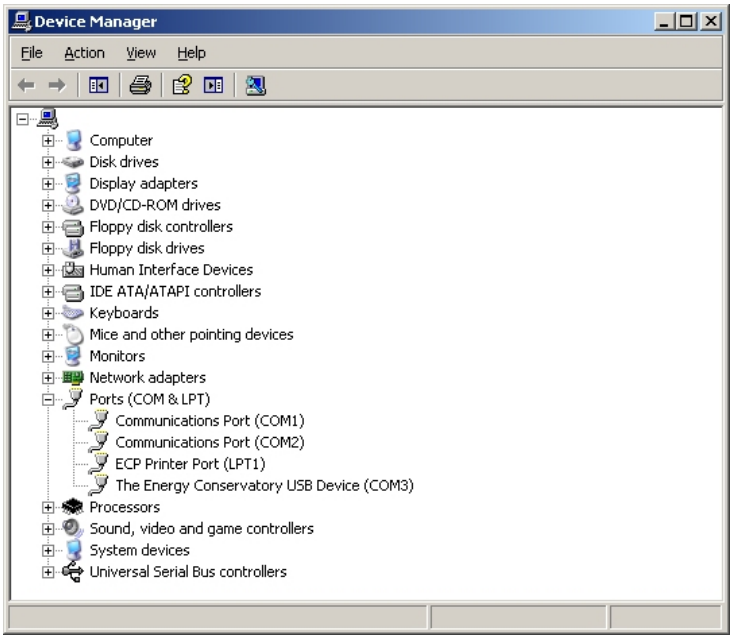
- If using a 9 pin serial cable, plug the male end of the cable into the serial communication port on the top of the gauge, and the female end of the cable should be plugged into an open serial communication port on your computer.



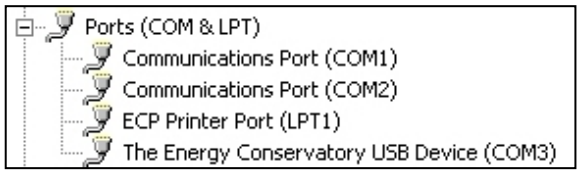
- To check if the USB communication drivers have been properly installed on your computer, or to see if your computer has an available serial communication port for a 9 pin serial cable, you will need to access the **Device Manager** in your Windows operating system.

  – To access the **Device Manager** in **Windows XP** or **2000**, click on **Start**, then right-click on the **My Computer** shortcut and select **Properties**. This will cause the **System Properties** window to appear. To open the **Device Manager**, click on **Hardware** and then **Device Manager**.
  – To access the **Device Manager** in **Windows Vista**, click on **Start**, then right-click on the **Computer** shortcut and select **Properties**. This will cause the **System** window to appear. To open the **Device Manager**, click on **Device Manager**.

  From the **Device Manager** window, open the **Ports** icon to show which communication ports are currently installed on your computer. In the case illustrated below, the computer has 3 installed communication ports which can be used to interface with a TEC digital gauge.

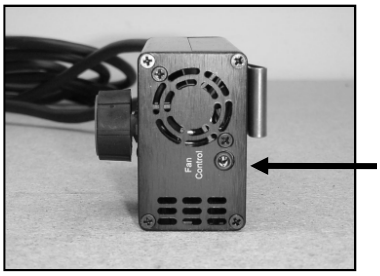


  – **COM1** and **COM2** are existing serial communication ports which can be used to communicate with a DG-700 gauge using a standard 9 pin serial cable.
  – **COM3** is a custom communication port created by successfully installing the USB drivers for the DG-700 gauge. (Note: In order for a custom device communication port to be listed under the **Ports** icon, the DG-700 gauge must be connected to your computer.)



  If no **COM** ports are listed (or a **Ports** icon does not exist), then either the computer does not have installed serial communication ports, you have not properly installed the USB drivers to create a custom USB Device communication port, or a DG-700 gauge is not connected to the computer.

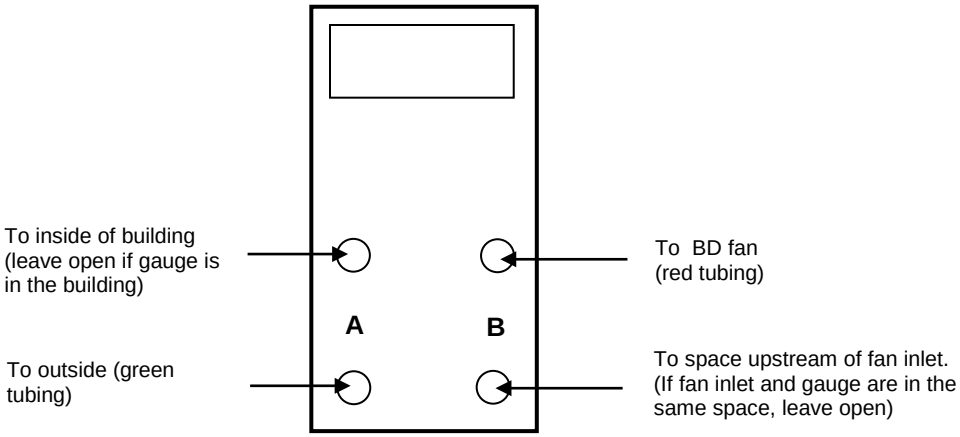
4. Connect the DG-700 to the Blower Door fan speed controller using the fan control cable. Plug one end of the cable into the 3.5 mm fan control output jack on the top of the DG-700, and plug the other end of the cable into the communication jack on the side of the fan speed controller box.



Communication Jack (Blower Door Speed Controller)

Fan Control Cable

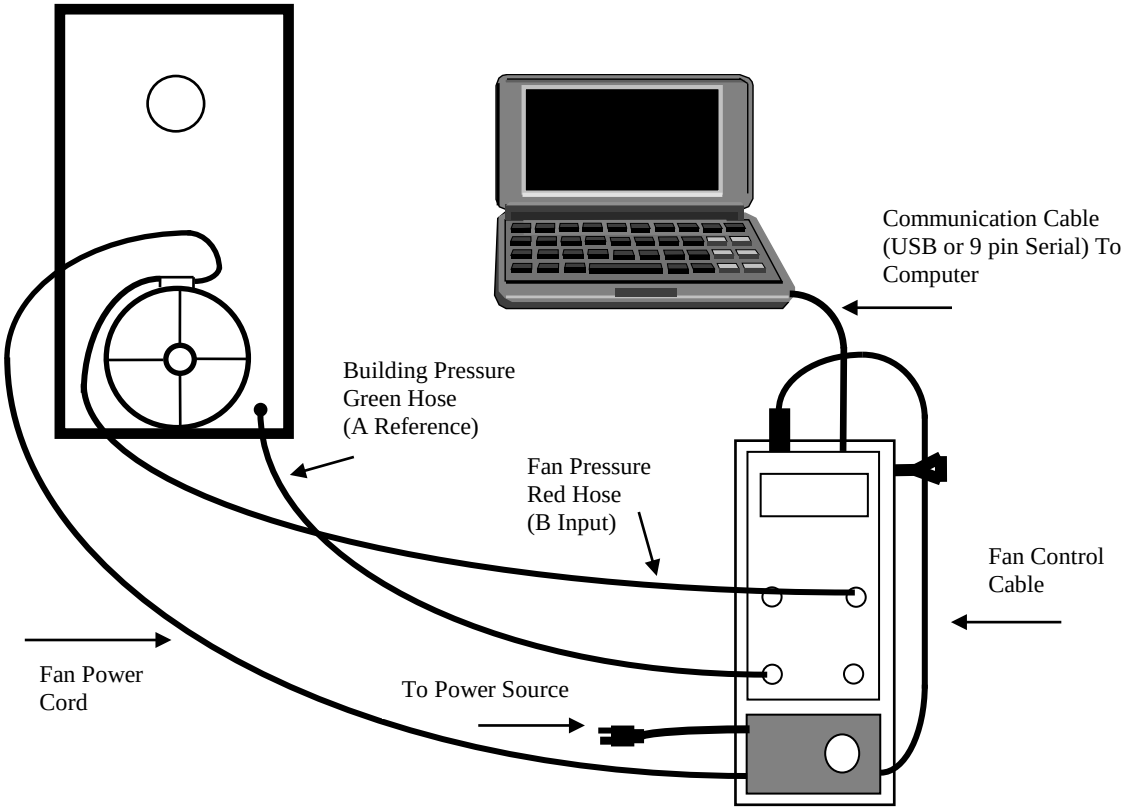
5. Connect tubing between the DG-700 and the Blower Door system (tubing connections are detailed in the Blower Door operation manual).



6. Now turn on the Blower Door fan speed controller to the "just on" position (the fan should not be turning in this position). The speed control knob should be turned all the way down, without being clicked into the "off" position.

7. Turn on the DG-700 gauge.

8. Refer to the TECTITE and Blower Door manuals for instructions on how to conduct the Blower Door test.


Communication Cable
(USB or 9 pin Serial) To
Computer
Building Pressure
Green Hose
(A Reference)
Fan Pressure
Red Hose
(B Input)
Fan Control
Cable
Fan Power
Cord
To Power Source

A.5 Using the DG-700's Cruise Control Feature

All new DG-700 gauges include a Cruise Control feature which allows you to automatically control Minneapolis Blower Door and Duct Blaster fans to maintain a constant building or duct pressure without having the gauge connected to a computer. Common applications of the Cruise Control feature include:

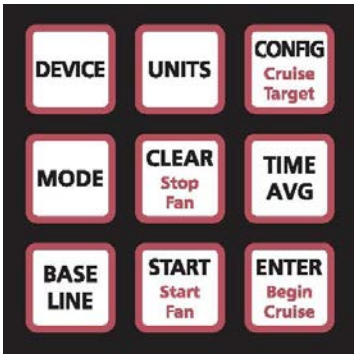
- Quickly measuring building airtightness using a "one-point" 50 Pa test.
- Quickly measuring duct airtightness using a "one-point" 25 Pa **total leakage** test.
- Simultaneously controlling both the Blower Door and Duct Blaster fans during a **leakage to outside** duct airtightness test. During this test, Cruise Control on the Blower Door's DG-700 will maintain a contant 25 Pa building pressure while the DG-700 gauge connected to the Duct Blaster fan maintains a constant 0 Pa pressure in the duct system.
- Maintaining a constant building pressure while pressure pan testing, or locating and sealing building and duct system air leaks.
- Performing series leakage to quantify leakage rates between various zones within a building.

In order to use the Cruise Control feature you will need the following 3 items:

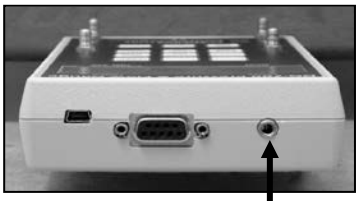
- A "Cruise compatible" DG-700 gauge. Your DG-700 is compatible with Cruise Control if the CONFIG, CLEAR, START, and ENTER keys have additional red lettering below the main black script.

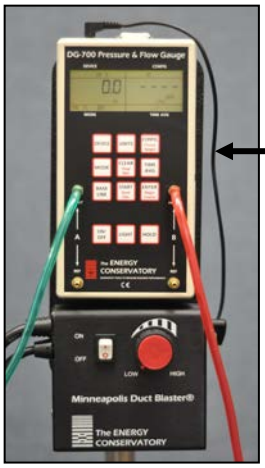
- A Blower Door or Duct Blaster fan speed controller with a 3.5 mm communication jack on the side of the controller box.

- A fan control cable to connect the DG-700 fan control jack to the speed controller communication jack.



Fan Control cable.





Fan control cable.

Fan control jacks.

Cruise Overview

Cruise Control uses the DG-700's fan control feature to continuously adjust the Blower Door or Duct Blaster fan to maintain a constant Cruise target pressure on **Channel A** of the gauge. Cruise Control can be used in the following gauge Modes to maintain the listed target pressures:

Gauge Mode	Cruise Target Pressures Available
PR/ FL @50	50 Pa
PR/ FL @25	25 Pa
PR/ FL	75 Pa, 50 Pa, 25 Pa, +0, -0
PR/ PR	75 Pa, 50 Pa, 25 Pa, +0, -0

Before starting Cruise, the Blower Door or Duct Blaster and DG-700 should be completely set-up (including tubing connections), the gauge should be in the Mode you wish to use, and the correct Device and Configuration settings should be entered. If you wish to Cruise with a baseline pressure adjustment applied to **Channel A**, simply use the Baseline feature first before beginning Cruise. You will also need to install the fan control cable and turn the fan speed controller to the "just on" position:

- Model 3 Blower Door "just on" - from the off position, turn the controller knob clockwise only until you feel the click and no farther - the fan will not be turning.
- Duct Blaster "just on" – turn the controller knob all the way down (counter-clockwise) and flip the on/off switch to "ON" – the fan will not be turning.

Begin Cruise button: When you are ready to begin Cruise, press **Begin Cruise** to enter Cruise setup. A Cruise target pressure will appear in the **Channel A** display and the Cruise icon will flash. The flashing Cruise icon indicates that the gauge is ready to begin Cruising but is not yet controlling the fan. If you are in the **PR/ FL** or **PR/ PR** modes, you may change the Cruise target pressure at this point by pressing the **Cruise Target** button. **Note:** You can not change the Cruise target pressure when in the **PR/ FL @50** and **PR/ FL @25** modes.

Start Fan button: Press **Start Fan** to instruct the DG-700 to begin ramping up the fan to achieve the target pressure on **Channel A**. The fan will slowly start increasing speed until the pressure reading on **Channel A** matches the Cruise target pressure. The fan will simply run at full speed if the target pressure can not be achieved. Whenever the DG-700 is calling for full fan speed, the gauge will emit a beeping sound.

Stop Fan button: Press **Stop Fan** to turn off the fan when you are done Cruising. When the fan is turned off by pressing **Stop Fan**, the DG-700 returns to the Cruise setup state (i.e. the Cruise icon is flashing and a Cruise target pressure is displayed on **Channel A**). You may re-start Cruise again by pressing **Start Fan**, or exit the Cruise feature altogether by pressing the **CLEAR** button.

The fan will also be stopped while Cruising under the following circumstances:

- If **Channel A** registers a pressure of 100 Pa or more, the fan will automatically be shut down and the gauge will revert back to the Cruise setup state.
- Pressing the **HOLD** button will shut down the fan and freeze the display. Pressing **Start Fan** from a display freeze will re-start Cruise. Pressing the **HOLD** button a second time from a display freeze will return the gauge to the Cruise setup state.
- The DG-700's auto-off feature will shut down the gauge and turn off the fan after 2 hours of run-time (if no buttons are pressed during that time).

Cruising Zero (+0 and -0)

Cruising Zero is designed for specialized testing and research applications. Cruising Zero is useful if you want to control the Blower Door fan to remove an existing pressure from a building , duct system or other enclosure. When using the fan to pressurize a space (that is currently depressurized) use +0 as your Cruise target pressure. When using the fan to depressurize a space (that is currently pressurized), use –0 as the Cruise target pressure. Refer to specific test procedures for more information on using Cruise Zero.