

Operating Instructions for the
Minneapolis Digital Pressure
And
Fan Flow Gauge
(Model DG-3)

March 2001



The **ENERGY**
CONSERVATORY

DIAGNOSTIC TOOLS TO MEASURE BUILDING PERFORMANCE

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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.

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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.

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Chapter 1 Feature Summary

Pressure and Fan Flow Measurement Capability

- The DG-3 gauge is designed to measure differential pressures in the range of -1,000 to +1,000 Pascals. The DG-3 gauge measures the pressure difference between the top "**Input**" pressure taps and its corresponding bottom "**Reference**" pressure tap.
- The DG-3 is capable of calculating and displaying flow (in CFM) for the Model 3 Minneapolis Blower Door fan, the Series B Minneapolis Duct Blaster® fan, the TrueFlow™ Air Handler Flow Meter and the Exhaust Fan Flow Meter.

Two Measurement Channels

The DG-3 gauge has two separate measurement channels which are connected to a single pressure transducer. The **CHANNEL** selection knob operates a valve which determines which set of **Input** and **Reference** pressure taps (**A** or **B**) are being monitored and displayed by the gauge.

Auto Zeroing

Like most digital pressure sensing devices, the DG-3 pressure gauge is sensitive to position and operating temperature. The DG-3 gauge automatically adjusts for this sensitivity by re-zeroing the pressure sensor during operation. There is no need to manually re-zero the gauge display, as with most other digital pressure gauges. The DG-3's auto zeroing capability makes it ideal for hand-held operation.

Sensing Operation/Time-Averaging

The DG-3's pressure sensor takes 8 separate pressure readings per second. The gauge has 4 different Time-Averaging periods; *1 Second*, *5 Second*, *10 Second* and *Long-Term*, which control how the display is updated with the pressure readings. The Time-Averaging feature stabilizes pressure readings when measuring fluctuating pressure signals (e.g. windy conditions). See Chapter 2 below for more information on how the display is updated under the various Time-Averaging periods.

Range Selection

When measuring pressures, the DG-3 gauge can be set to display measured pressures in a choice of 2 ranges:

- **200.0 (Low Range):** The gauge will measure pressures between -200.0 and +200.0 Pascals with a resolution of 0.1 Pascals.
- **2000 (High Range):** The gauge will measure pressures between -2,000 and +2,000 Pascals with a resolution of 1 Pascal. **Note:** The calibrated range of the DG-3 is -1,000 to +1,000 Pascals.

Over Pressurization

The DG-3 gauge is protected against over pressurization by a valve which automatically shuts off the pressure to the sensor when a large momentary pressure pulse is detected. When this happens, "OP" appears on the display. Over pressurization protection is only provided when the gauge is turned on.

Chapter 2 Selecting Gauge Settings/Gauge Operation

Time-Averaging

To select the Time-Averaging period, turn the **MODE** knob to the *Time Select* position (see Page 11 for a schematic of the gauge face). The display will now show the active Time-Averaging period for the gauge.

**If the
Display
Shows:**

**Then the Active
Time-Averaging Period Is:**

- 1** *1 Second Average* - The gauge reading will be updated once per second with the average of the pressure 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** *5 Second Average* - The gauge reading will be updated once every 5 seconds with the average of the pressure readings from the previous 5 second period. When first activated, the display will show "---" until the first 5 second period has been completed. The 5 Second Average should be used when the 1 Second Average reading is fluctuating more than desired.

- 10** *10 Second Average* - The gauge reading will be updated once every 10 seconds with the average of the pressure readings from the previous 10 second period. When first activated, the display will show "---" until the first 10 second period has been completed. The 10 Second Average mode should be used when the 5 Second Average reading is fluctuating more than desired.

- L** *Long Term Average* - The display will be updated approximately once per second with the running average of all pressure readings taken after the Long Term Average period is activated. The Long Term Average will operate for approximately 1-2 hours (depending on the RANGE selected) before the memory is overloaded. When the memory is overloaded, the display will begin to blink on and off with the last long-term average pressure reading.

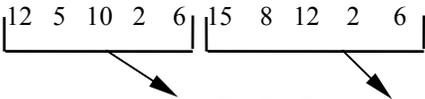
When first turning on the gauge from the "off" position, the default Time-Averaging period will be the 1 Second Average. To change the active Time-Averaging period, keep the **MODE** knob pointing to *Time Select*, and then toggle the **SELECT** switch down to select the desired period. Each time the **SELECT** switch is toggled down, the active Time Average period will change. The selected Time-Averaging period will be used for both **Channel A** and **B**.

Example Diagram of Time-Averaging Operation (First 10 seconds using High Range):

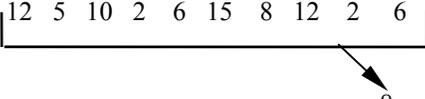
1 Second Average:

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

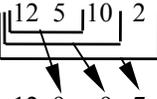
5 Second Average:

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 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

Measuring Pressures

After selecting the Time-Averaging period, turn the **MODE** knob to the **Pressure** position to measure differential pressures. The DG-3 gauge is designed to measure differential pressures in the range of -1,000 to 1,000 Pascals. (One Pascal is equivalent to 0.004 inches of water column). The DG-3 gauge measures the pressure difference between either of the top **Input** pressure taps and its corresponding bottom **Reference** pressure tap. The gauge is bi-directional, meaning that it can monitor and display both positive and negative pressure readings.

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 **Input** taps (marked "INPUT") should be connected to the pressure signal(s) you are trying to measure. The bottom **Reference** taps (marked "REFERENCE") 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 a hose 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 hose 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 hose to the wrong tap on **Channel A**, the display would show the correct pressure differential reading, except it would have the wrong sign.

Channel Selection: When the **CHANNEL** selection knob is pointing to "A", the gauge will display the pressure difference between the **A Input** tap and the **A Reference** tap. When the **CHANNEL** selection knob is pointing to "B", the gauge display shows the pressure difference between the **B Input** tap and the **B Reference** tap. The **CHANNEL** switch can be changed at any time, however, see **Note** below for impact on Time-Averaging functions.

Note: When changing the **CHANNEL** selection while you are in the 5 Second Average or 10 Second Average periods, you must wait for one complete 5 or 10 second display update before a meaningful reading is shown. If you change the **CHANNEL** while you are in the Long Term Average mode, you must reset the gauge (by turning the power off and on, toggling the **RANGE** switch, or moving the **MODE** switch away from and back to the **Pressure** setting) in order to display a meaningful reading.

Range Selection: The **RANGE** switch can be set to display measured pressures in one of 2 Ranges:

- **200.0 (Low Range):** The gauge will measure pressures between -200.0 and +200.0 Pascals with a resolution of 0.1 Pascals.
- **2000 (High Range):** The gauge will measure pressures between -2000 and +2000 Pascals with a resolution of 1 Pascal. **Note:** The calibrated range of the gauge is -1,000 to +1,000 Pascals.

Auto Zeroing: The DG-3 pressure gauge is sensitive to operating position and temperature. For this reason, the DG-3 gauge is designed to automatically adjust for this sensitivity by re-zeroing the pressure sensor during operation. When operating on **Low Range**, the gauge will re-zero once every 5 seconds. An audible clicking noise can be heard when the gauge is re-zeroing. When operating on **High Range**, the gauge will re-zero once every 30 seconds.

Example: With no hoses connected to the gauge, turn the **MODE** switch to the *Time Select* setting and select the 1 Second Average mode. Now turn the **MODE** switch to the *Pressure* setting and then toggle the **RANGE** switch to **200.0 (Low Range)**. Hold the gauge level (horizontal) in your hand. Once the display reads 00.0, move the position of the gauge so it is now vertical. Notice how the display changes because of sensitivity to position. Continue to hold the gauge in a vertical position, until you hear an audible click from the auto zeroing mechanism (this will happen within 5 seconds). The display will now be updated and revert back to a reading of 00.0.

When operating the gauge in **High-Range (2000)**, the auto zeroing mechanism is activated every 30 seconds. If you wish to zero more frequently while in this range, simply toggle the **RANGE** switch back and forth once to manually activate the auto zeroing mechanism. In addition, whenever switching between operating modes, the auto zeroing mechanism is activated. Because auto zeroing is only activated once every 30 seconds when in **High-Range**, always use **Low Range** when the gauge is not in a stable operating position (such as holding the gauge in your hand). This will allow the gauge to more quickly compensate for pressure reading fluctuations caused by changes in orientation.

Using the FLOW Feature

The **FLOW** feature allows the DG-3 to display air flow (in CFM) for either a Model 3 Minneapolis Blower Door fan, a Series B Minneapolis Duct Blaster fan, a TrueFlow Air Handler Flow Meter or an Exhaust Fan Flow Meter. The DG-3 will not display air flow for any other flow device including the Model 2 Minneapolis Blower Door fan.

To use the **FLOW** feature you must first select the flow measurement device being connected to the gauge. This is done by turning the **MODE** knob to the *Fan Select* position. The display will show "-SEL" to indicate that a flow measurement device has not yet been selected. The flow measurement device is selected by toggling the **SELECT** Switch up. Once the flow device has been selected, the device configuration can be selected by toggling the **SELECT** switch down.

If the Display Shows

Description

- SEL** Begin fan type selection by toggling the **SELECT** switch up.
- **up once** for the Model 3 Blower Door.
 - **up twice** for the Series B Duct Blaster.
 - **up 3 times** for the #14 TrueFlow Metering Plate.
 - **up 4 times** for the #20 TrueFlow Metering Plate.
 - **up 5 times** for the Exhaust Fan Flow Meter.

**If the
Display
Shows**

Description

-3-0 This indicates that you have chosen the **Model 3 Minneapolis Blower Door** fan, and that the fan is in the "Open" inlet configuration (e.g. no flow rings installed).

To change the fan inlet configuration for the Model 3 Blower Door fan, toggle the **SELECT** switch down.

-3-1 Model 3 Blower Door fan with Ring A installed.

-3-2 Model 3 Blower Door fan with Ring B installed.

-3-3 Model 3 Blower Door fan with Ring C installed.

-3-4 Model 3 Blower Door fan with Ring D installed.

-3-5 Model 3 Blower Door fan with Ring E installed.

-8-0 This indicates that you have chosen the **Minneapolis Duct Blaster** fan, and that the fan is in the "Open" inlet configuration (e.g. no flow rings installed).

To change the fan inlet configuration for the Minneapolis Duct Blaster fan, toggle the **SELECT** switch down.

-8-1 Duct Blaster with Ring 1 installed.

-8-2 Duct Blaster with Ring 2 installed.

-8-3 Duct Blaster with Ring 3 installed.

PL 14 This indicates that you have chosen the **#14 TrueFlow Metering Plate**.

PL 20 This indicates that you have chosen the **#20 TrueFlow Metering Plate**.

-E-1 This indicates that you have chosen the **Exhaust Fan Flow Meter**, and that the flow meter door is in the #1 position.

To change the door configuration for the Exhaust Fan Flow Meter, toggle the SELECT switch down.

-E-2 Flow Meter Door is in the #2 position.

-E-3 Flow Meter Door is in the #3 position.

In order for the gauge to display flow for the selected measurement device, the **CHANNEL** knob must set so that the gauge is monitoring the pressure **Channel (A or B)** that is connected to the device. To display flow in CFM, turn the **MODE** switch to the **Flow (CFM)** position. At this point, the pressure signal being read by the gauge will be converted to flow (in CFM) by using the calibration formula corresponding to the measurement device and configuration selected.

The DG-3 gauge will remember the selected flow device until you turn the gauge off. Once turned off, you will need to re-select the device and configuration setting before using the **Flow (CFM)** feature. Pressure readings can still be read from either **Channel A** or **B** (without a CFM conversion) by simply turning the **MODE** switch back to the **Pressure** setting.

Note 1: In order for the gauge to display flow for the selected measurement device, the **CHANNEL** knob must set so that the gauge is monitoring the pressure **Channel (A or B)** that is connected to the device. If you are using a Minneapolis Blower Door or Duct Blaster and have connected the pressure hoses to **Channel A** and **B** according to procedures listed in the operation manuals (i.e. **Channel A** measures house or duct pressure, and **Channel B** measures fan pressure), you should only use the **Flow (CFM)** mode when monitoring **Channel B**.

Note 2: If you turn the **MODE** switch to the **Flow (CFM)** position before a fan type and configuration have been selected, "-SEL" will appear on the display.

Impact of Time-Averaging Mode on Flow (CFM) Readings: The display updating features of Time-Averaging (described in Chapter 2 above) operate in exactly the same manner whether you are using the **Pressure** or the **Flow (CFM)** modes.

Recommended Range Settings For Blower Door or Duct Blaster Testing: We recommend that the **RANGE** switch be set to **High Range** when conducting a Blower Door or Duct Blaster test. This is because measured fan pressure readings (typically read on **Channel B**) are often greater than 200 Pascals, the maximum reading allowed with the **Low Range** setting. When using **High Range**, the gauge should be held in a steady position. This is usually done by attaching the gauge to the gauge board provided with the Blower Door or Duct Blaster system. If greater resolution of house and duct system pressures are needed (typically read on **Channel A**), the **Low Range** setting may be used when monitoring those pressures.

Fan Configuration/Blinking CFM Display: When using the **Flow (CFM)** mode, be sure the device configuration settings selected on the gauge correspond to the device setup being used in your test. Configuration settings for the gauge can be changed at any time (using **FAN SELECT**) to correspond to a change in device configuration during a test (e.g. adding or changing a flow ring).

In addition, it is extremely important that the configuration being used is appropriate for the flow range being measured. Trying to measure flows outside of the range of a particular configuration could result in large measurement errors. As an added check for this when using a Model 3 Blower Door or Series B Duct Blaster, the display will blink when the fan pressure signal used to calculate CFM is below an accepted level. When the display is blinking in the **Flow (CFM)** mode, this means you should install a flow ring on the fan, or install the next smaller size flow ring.

The display will blink in the *Flow (CFM)* mode when:

<u>Fan Configuration Entered is</u>	<u>And the Fan Pressure is</u>
3-0, 3-1, 3-2, 3-3, 8-0, 8-1, 8-2	Less than 30 Pa
3-3, 3-4, 3-5, 8-3	Less than 10 Pa

Note: The greatest accuracy in fan flow readings will always be achieved by installing the flow ring which generates the highest fan pressure reading while still providing the necessary fan flow.

Low Battery Indicator

The DG-3 includes a low battery indicator which appears on the display when the battery should be replaced. The low battery indicator appears in the upper left side of display just above the minus sign. When first activated, the low battery indicator may blink on only as the auto zero function is operating. As the battery wears down further, the low battery indicator will begin to appear constantly.

Importantly: The 9-volt battery (contained in the back battery compartment) should be replaced immediately following any appearance of the low battery indicator during gauge operation. Continued operation of the gauge when the low battery indicator is showing (even if only showing during auto zeroing function) may result in erroneous pressure and flow readings. Always replace the battery with an alkaline battery.

Over Pressurization

The DG-3 gauge has built-in over pressurization protection. When a large momentary pressure pulse is detected by the gauge, a valve automatically shuts off the pressure to the sensor and "OP" appears on the display. To reset the gauge, first remove the pressure pulse from the gauge pressure tap, and then toggle either the **RANGE** switch or the **SELECT** switch to clear the "OP" from the display. Battery life is reduced when "OP" is left on the display for extended periods of time. If you are using **Low-Range**, and frequently activate the over pressurization protection, reduce the pressure pulse or switch to **High-Range**.

Over pressurization protection is only provided when the gauge is in operation. Therefore, when connecting hoses which are under pressure to the gauge, always connect them when the gauge is operating. Also be aware that it is quite easy to generate large momentary pressure pulses by kinking, bending or stepping on hoses.

Warning: never blow into hoses or directly into the pressure taps as it may damage the sensor diaphragm.

Gauge Recalibration

The DG-3 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 year. Gauge recalibration is a service provided by The Energy Conservatory for a small fee. Gauges needing recalibration should be sent to:

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

Please include shipping instructions for returning the recalibrated gauge.

Other Servicing/Repair

All factory authorized repairs for the DG-3 gauge are conducted at the above address. To have your gauge repaired, send the gauge to the above address (Attn: Digital Gauge Repair) along with a detailed description of the problem encountered, and shipping instructions.

Chapter 3 Specifications (Model DG-3)

Calibrated Range: 0 - 200.0 Pascal (Low-Range) Bi-Directional
0 - 1,000 Pascal (High-Range) Bi-Directional

Resolution: 0.1 Pascal (Low-Range)
1 Pascal (High-Range).

Accuracy: +/- 1% of pressure reading, or +/- 2 counts (whichever is greater) up to 800 Pa.
+/- 2% of pressure reading from 800 to 1000 Pa.

Weight: 16.5 oz.

Operating Temperature Range: 32 F to 120 F.

Storage Temperature Range: -10 F to 160 F.

Battery: One 9 Volt alkaline or rechargeable ni-cad. Battery will last approximately 48 hours on continuous High-Range, or 24 hours on continuous Low-Range.

Display: LCD, 0.4" digit height.

Controls: MODE Switch (Off, Time-Averaging Select, Pressure Mode, Fan Flow Mode, Fan select)
RANGE Indicator (0-2000 Pa, 0-200.0 Pa).
AUTO ZERO function operates automatically whenever the gauge is turned on.
CHANNEL Switch allows either pressure signal, A or B, to be monitored and displayed.

Over Pressurization Safety: Built-in over pressurization safety protects sensor from momentary overpressurization. "OP" appears on display.

Fan Flow Calculations:

All fan flows displayed using the FLOW (CFM) mode are "corrected" to a standard air density of 0.075 lbs/cubic foot. The flows are corrected to standard air density according to the CGSB Standard CAN/CG-SB-149.10-M86. The correction is done in such a way that, for particular types of leaks (where the viscosity of air is negligible), the corrected flow is independent of barometric pressure. If the actual volumetric flow rate through the fan is needed, multiply the flow indicated on the gauge by:

$$\sqrt{\frac{0.075}{\text{actual air density} *}} \quad (\text{where air density is in lb/ft}^3)$$

or

$$\sqrt{\frac{1.204}{\text{actual air density} *}} \quad (\text{where air density is in Kg/m}^3)$$

* Use the density of air flowing through the fan.

The Duct Blaster fan flow calibration formulas used in all DG-3 gauges sold after January 1995 (serial # 1605 and greater) are for the Series B Duct Blaster fan.

Schematic of DG-3

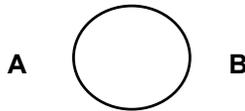
MINNEAPOLIS PRESSURE & FAN FLOW* GAUGE

*For Minneapolis Blower Door & Duct Blaster

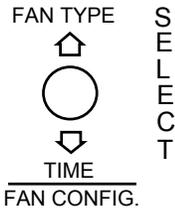
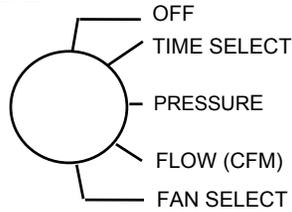


TWO CHANNEL - AUTO ZERO - TIME AVERAGING

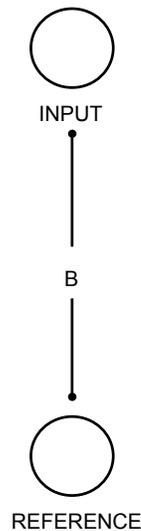
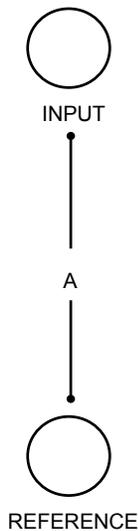
CHANNEL



MODE



RANGE



THE ENERGY CONSERVATORY

Minneapolis, MN U.S.A.
Model DG-3