SOIL VAPOR MITIGATION PILOT TEST AND BUILDING B-31 WORK PLAN

LAPP INSULATOR SITE REMEDIAL CONSTRUCTION
SITE NO. 819017
LEROY, GENESEE COUNTY, NEW YORK

Prepared For:

NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF ENVIRONMENTAL REMEDIATION
REMEDIAL BUREAU B
WORK ASSIGNMENT D007622-11.2

Prepared By:

URS CORPORATION
257 WEST GENESEE STREET
BUFFALO, NEW YORK 14202

JUNE 2018

SOIL VAPOR MITIGATION PILOT TEST AND BUILDING B-31 WORK PLAN

LAPP INSULATOR SITE

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LIST OF ACRONYMS AND ABBREVIATIONS

CFM	Cubic Feet per Minute
HVAC	Heating, Ventilation, and Air Conditioning
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OSHA	Occupational Safety and Health Administration
PFET	Pressure Field Extension Testing
PVC	Polyvinyl Chloride
SOW	Scope of Work
SSD	Subslab Depressurization
THWN	Thermoplastic Heat and Water-resistant Nylon-coated
TSDF	Treatment, Storage and Disposal Facility
VOC	Volatile Organic Compound
w.c.	Inches Water Column

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LAPP INSULATOR SITE

1.0 INTRODUCTION

URS performed SVI sampling on May 10-12, 2017; August 30-31, 2017; and December 18-19, 2017 in five buildings at the Lapp Insulator Site. One of the buildings is currently occupied by PCore Electric Co. Inc. (PCore); this building will be referred to herein as the "PCore Building". The other buildings, occupied by Lapp Insulator, are a former hazardous waste storage building (FHW), a storage and shipment building (B-31), and two active manufacturing buildings (B-35 and B-37). These buildings are shown on Drawing G-001.

URS prepared separate summary reports for the May and August events. The December event was included in the January 2018 report which also re-summarized the May and August 2017 sampling events, All reports were uploaded to the NYSDEC file transfer service (FTS) site. The information from all three sampling events was used to determine future site activities.

Based on the soil vapor intrusion sampling results, the NYSDEC, NYSDOH, and URS determined that soil vapor mitigation is required for B-31, B-35, B-37 and the PCore Buildings. The NYSDEC and NYSDOH requested URS to prepare the remedial design and perform soil vapor mitigation in B-31, B-35, and PCore Buildings only.

A Pilot Test will be conducted to collect the information necessary to design the SSD System in the P-Core and B-35 buildings. At the request of the Department, URS is also installing the SSD System in building B-31.

This Work Plan provides general requirements for the Pilot Text and the installation of the SSD System in building B-31. This document includes a detailed description of the work to be performed, the equipment and materials used, conceptual layouts, and directions for data gathering.The work is being performed in accordance with Task 8 of Work Assignment WA#D007622-11.2.

2.0 DESIGN BASIS

An effective vapor Subslab Depressurization (SSD) System requires a minimum sub slab negative pressure field. An industry standard of -0.01 inches water column (w.c.) has been chosen as the target pressure for mitigation.

The Pilot Test is a critical component in the entire process because the pilot test results will be used for the remedial design. Where the extraction points and monitoring points are located are the objectives of the pilot study and shall serve as the foundation for the design.

3.0 SCOPE OF WORK

A Pilot Test will be conducted to collect the information necessary to design the SSD System in the P-Core and B-35 buildings. The Pilot Test will include the installation of a temporary SSD System in an approved area of the P-Core Building. The Soil Vapor Mitigation Pilot Test work is expected to begin in Spring 2018.

In addition, at the request of the Department, URS was instructed to prioritize the installation of the SSD System in Lapp Insulator building B-31. A permanent system will be installed concurrent with the implementation of the Pilot Test, and will be modified as required to achieve the desired results.

The results of the Pilot Test will be used to prepare a Design Analysis Report, Design Drawings and Specifications, including a construction cost estimate for Buildings B-35 and the PCore Building.

4.0 GENERAL REQUIREMENTS

4.1 Health and Safety

URS shall provide all the necessary facilities, equipment, supplies and personnel to perform the work in accordance with applicable Occupational Safety and Health Administration (OSHA) standards and standard industrial practices for Health and Safety at hazardous waste sites. Refer to the approved project Health and Safety Plan.

URS shall be responsible for site security within the Project Site during the duration of the Contract.

URS shall provide all labor, materials, tools, and equipment and maintain ongoing activities and protect workers and property during the construction activities. Work shall conform to all applicable association, city, county, and state regulations and requirements.

4.2 Geophysical Survey

To ensure that any buried utilities are avoided during intrusive work, URS will contact DigSafe NY 2 to review any available as-built site plans of underground utilities and will coordinate a geophysical subcontractor to perform a geophysical survey in any locations where floor penetrations or excavations are anticipated.

4.3 Mobilization/Demobilization

The Contractor shall mobilize equipment and materials to the site. URS will work with Lapp/P-Core facility personnel to establish temporary laydown/work areas that are convenient for all parties.

5.0 SITE WORK

5.1 P-Core Building: Pilot Test

Before selecting the final extraction point location, URS will ensure that there are no contaminant entry or short-circuit points; including cracks and other openings in the building slab that could impact the results by sealing them with a non-VOC emitting material. The location of the extraction point should not be in proximity to known exterior walls, underground structures, foundations, pits, or other physical characteristics that could impact results.

For the pilot test, URS will drill an extraction hole and apply a vacuum to produce a vacuum field. This extraction hole will be created by core cutting a 5 inch diameter round hole through the floor slab and then auguring out soil to a depth of approximately 12 inches. The physical characteristics of the sub slab material will be recorded. The excavated soils will be transported out of the building and placed into a drum for waste characterization and disposal.

A 4-inch diameter Schedule 40 PVC pipe with screen, pea gravel fill and 2” camlock hose fitting will be installed vertically in the extraction point, extending to a wall penetration then outside to the temporary SSD System skid. All void spaces around the floor penetrations will be sealed with cement or bentonite. The SSD System exhaust points will be located a minimum of one foot above the roof-line, and be a minimum of 10 feet away from windows, doorways, or other openings that are less than 2 feet below the discharge point and 10 feet away from any adjacent or attached buildings and any Heating, Ventilation, and Air Conditioning (HVAC) or other intakes. These minimum setbacks are consistent with NYSDOH standards. The proposed drawings are included in Appendix A and equipment cut-sheets are included in Appendix B.

Pressure field extension testing (PFET) points will be installed to determine the radius at which the system extraction point is creating a negative pressure in the sub-slab. 1/2"-1” test holes will be drilled at discrete locations at field-selected varying distances from the suction hole to determine the radius of influence in relation to the vacuum applied (PFET points shall be located approximately 10’, 20’, 30’,40’, 50’ from the extraction point). A ¼” stainless steel tube with Swageloc fitting shall be inserted. All void spaces around the floor penetrations will be sealed with non-VOC emitting material (cement or bentonite for permanent probes, modeling clay or beeswax for temporary probes) or a rubber or cork plug. Vacuum will be applied using a bypass bleed valve with a top static vacuum range of approximately 65"w.c. and an airflow of approximately 125 CFM. A micro-manometer with a minimum accuracy of 0.01"w.c. will be used to make pressure differential measurements. The specific objective of this mapping is to produce a design that will generate a vacuum field with a minimum coverage of a -0.01"w.c. pressure differential between the indoor space and sub-slab material with the slab itself being the defining barrier. These measurements can be interpolated or extrapolated to project an expected radius of influence.

A rotating vain or thermal anemometer will be used on the exhaust to determine air flow measurements.

The test will be performed at 100%, 66% and 33% blower capacity, and monitoring point data shall be collected every 20 minutes for a minimum of 1 hour until vapor extraction rates and vacuum readings have stabilized. The test data shall be recorded on the Data Collection Form included as Appendix C.

5.2 Building 31: Southeast Office and North Workroom SSD System Installation

The individual SSD Systems proposed for the Building 31 Southeast Office and North Workroom will consist of sub-slab vapor extraction systems similar to radon mitigation systems that are typically installed at residential and small commercial structures. Each SSD System will utilize an extraction point, consisting of a four-inch diameter PVC pipe penetrated to just below the floor slab. The system construction will include a four-inch diameter schedule PVC piping installed from the extraction point to the exterior of the building where the piping would be connected to an in-line weather-proof radon fan, and ultimately to an exhaust discharge point.

The SSD System exhaust discharge points will be located a minimum of one foot above the roof-line, and be a minimum of 10 feet away from windows, doorways, or other openings that are less than 2 feet below the discharge point and 10 feet away from any adjacent or attached buildings and any Heating, Ventilation, and Air Conditioning (HVAC) or other intakes. These minimum setbacks are consistent with NYSDOH standards.

Each radon fan will be a Fantech HP 220, or equivalent. Each of these SSD Systems will include a riser pipe-mounted vacuum port to read vacuum at the extraction point, alarm light (for quick visual determination of whether the system is operating), and lockable power control switch.

Drawings for the systems are included in Appendix A and equipment cut-sheets are included in Appendix B.

6.0 ELECTRICAL

6.1 SOW (for an EC) for Pilot Test SSD System Skid

A diesel generator shall be required to power the Pilot Test SSK System Skid. 1. The basis of design for this diesel generator is Kohler model 15REOZK with a 4D3.1 alternator or A/E approved equal. It shall provide 14.00 kW/kVA when operating at 240/120 volts, 1-phase, 60 Hz, 1.00 power factor. The generator set shall be capable of a 125°C Prime. This generator shall consist of a 72 hour (approximately 123 gallon) subbase tank and sound enclosure. The enclosure shall have a maximum sound pressure level (of 8) at 60 Hz with full load at 64 dBA measured around the perimeter of the unit at a distance of 7 m (23 ft). The generator enclosure shall be located in close proximity to the skid and 5 ft. from building's exterior wall. This generator shall have a 60A, 2-pole, molded-case circuit breaker, a remote annunciator (assume a maximum distance of 200 feet), and an emergency stop pushbutton mounted on the generator. This generator shall be EPA certified and shall be installed per NEC and all local applicable codes. Refer to attached cut sheets regarding the basis of design generator and the sound enclosure with subbase tank.

The generator shall feed a resin encapsulated transformer that feeds an exterior load center in a NEMA 3R enclosure and shall be mounted near the skid. The transformer shall be 10 kVA rated, 240-208/120V, single phase, aluminum wound, maximum sound level of 50 dB, and the basis of design shall be 'Eaton, FR179.' The load center shall be rated 208/120V 1-phase, 3-wire, with a 60A, 2-pole main circuit breaker; 10kA symmetrical amp rating, have a minimum of 12 circuits, and shall have one (1) 20A, 2-pole circuit breaker to feed the system skid. The feeder between the generator and the transformer shall be 2#6 and 1#10 ground in 3/4"C Rigid Galvanized Steel (RGS). The feeder between the transformer and the load center shall be 3#6 and 1#10 ground in 3/4"C RGS. Conductors shall be stranded and Thermoplastic Heat and Water-resistant Nylon-coated (THWN).

The motor starter of the system skid shall be furnished by the manufacture and installed by the electrical contractor. The branch circuit between the load center, the starter, and the motor shall be 2#12 and 1#12 ground in 1/2"C RGS. Conductors shall be solid and THWN rated. Refer to drawing G-002 for approximate skid location.

Electrical installation shall be installed in a workmanlike manner and shall follow NEC and all local applicable codes. All permit fees shall be provided by the electrical contractor.

6.2 SOW (for an EC) for Radon Fans in Building 31

The electrical contractor shall provide a 120V, 20A GFCI, non-feed through, weather-resistant receptacle with a weatherproof enclosure on a dedicated branch circuit for the Radon fan. The receptacle device shall be thermoplastic and the color gray. Feed this dedicated circuit to the nearest 208/120V or 240/120V existing panel. Assume the maximum distance of 100 feet from the Radon fan to the nearest existing panel. Provide a 20A, 1-pole circuit breaker to replace an existing space within the existing panel. The breaker shall match the kA symmetrical amp rating of other circuit breaker within the existing panel and the circuit breaker shall be compatible with the existing manufactured panel. The branch circuit shall be 3#12 and 1#12 ground in 3/4"C EMT. Conductors shall be solid and THHN rated. Refer to drawing G-003 for approximate Radon fan location.

Electrical installation shall be installed in a workmanlike manner and shall follow NEC and all local applicable codes. All permit fees shall be provided by the electrical contractor.

APPENDIX A - DRAWINGS

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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: EM
DRAWN BY: EM
CHECKED BY: CP
PROJ. ENGR. CP

URS Corporation
New York
257 West Genesee Street, Suite 400
Buffalo, New York 14202-2657
(716)856-5636 - (716)856-2545 fax

JOB NO. 11176787

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

LAPP INSULATOR
SOIL VAPOR MITIGATION PILOT TEST AND BUILDING B-31 WORK PLAN
NYSDEC SITE 819017

PILOT TEST SITE PLAN

Scale: AS SHOWN | Date: MAY 2018 | G-001

WARNING
IT IS A VIOLATION OF SECTION 7209, SUBDIVISION 2, OF THE NEW YORK STATE EDUCATION LAW FOR ANY PERSON OTHER THAN WHOSE SEAL APPEARS ON THIS DRAWING, TO ALTER IN ANY WAY AN ITEM ON THIS DRAWING. IF AN ITEM IS ALTERED, THE ALTERING ENGINEER SHALL AFFIX TO TO THE ITEM HIS SEAL AND THE NOTATION "ALTERED BY" FOLLOWED BY HIS SIGNATURE AND THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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New York
257 West Genesee Street, Suite 400
Buffalo, New York 14202-2657
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LAPP INSULATOR
SOIL VAPOR MITIGATION PILOT TEST AND BUILDING B-31 WORK PLAN
NYSDEC SITE 819017

PCORE BUILDING
PILOT TEST PLAN

Scale: AS SHOWN | Date: MAY 2018 | G-002

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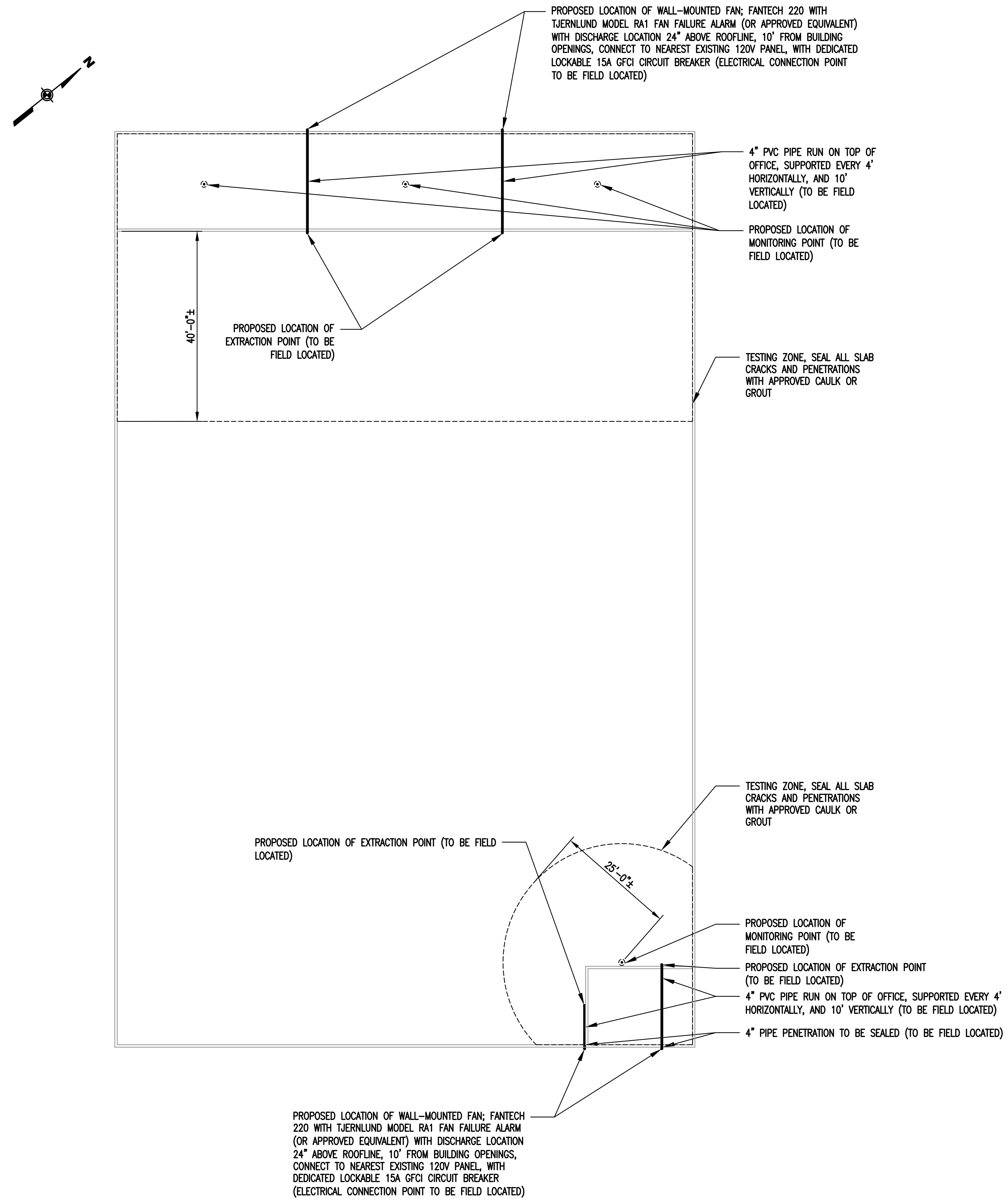

0' 8' 16' 24' 32'
SCALE: 1/16"= 1'-0"

WARNING
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New York
257 West Genesee Street, Suite 400
Buffalo, New York 14202-2657
(716)856-5636 - (716)856-2545 fax

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NYSDEC SITE 819017

BUILDING 31
SOIL VAPOR MITIGATION PLAN

Scale: AS SHOWN | Date: MAY 2018 | G-003

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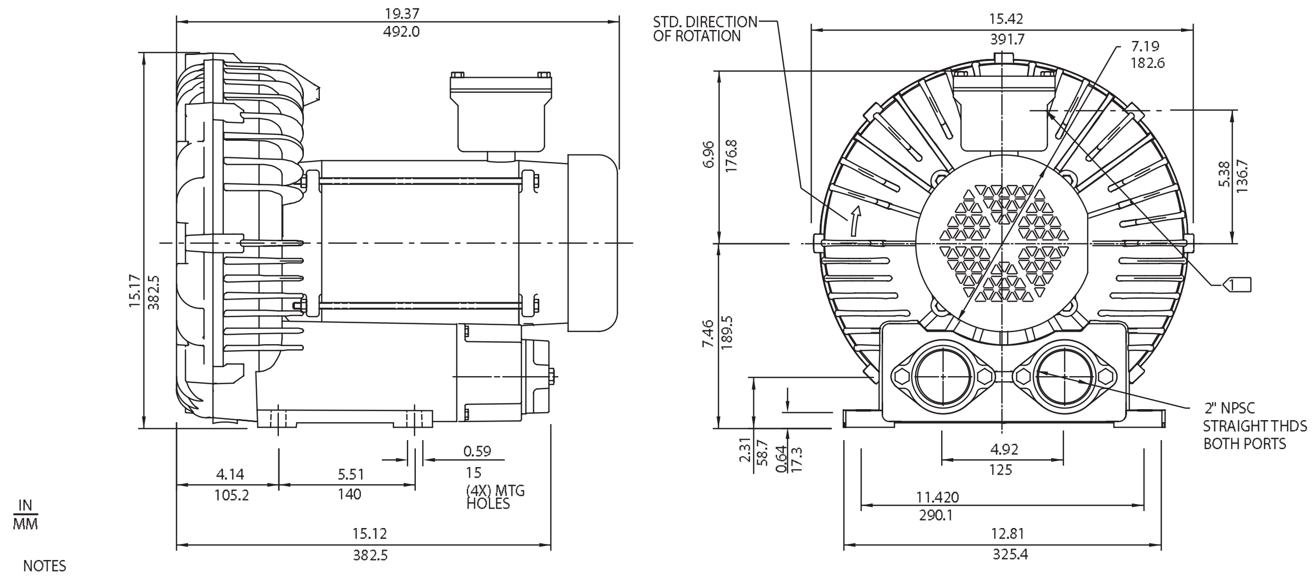
APPENDIX B – EQUIPMENT DATA

Environmental / Chemical Processing Blowers

ROTRON®

EN 656 & CP 656

3.0 HP Sealed Regenerative w/Explosion-Proof Motor



NOTES
1. TERMINAL BOX CONNECTOR HOLE 3/4" NPT.
2. DRAWING NOT TO SCALE, CONTACT FACTORY FOR SCALE CAD DRAWING.
3. CONTACT FACTORY FOR BLOWER MODEL LENGTHS NOT SHOWN.

		Part/Model Number			
		EN656M5XL	EN656M72XL	EN656M86XL	CP656FU72XLR
Specification	**Units**	**080060**	**080059**	**080058**	**080142**
Motor Enclosure - Shaft Mtl.	-	Explosion-proof-CS	Explosion-proof-CS	Explosion-proof-CS	CHEM XP-SS
Horsepower	-	3	3	3	3
Phase - Frequency	-	Single-60 hz	Three-60 hz	Three-60 hz	Three-60 hz
Voltage	AC	208-230	208-230/460	575	208-230/460
Motor Nameplate Amps	Amps (A)	15.5-14.5	7.4/3.7	3.0	7.4/3.7
Max. Blower Amps	Amps (A)	17	10/5	4.1	10/5
Locked Rotor Amps	Amps (A)	95-86	54/27	21.6	54/27
Service Factor	-	1	0/0	0	0/0
Starter Size	-	1.0	1.0	1.0	1.0
Thermal Protection	-	Class B - Pilot Duty	Class B - Pilot Duty	Class B - Pilot Duty	Class B - Pilot Duty
XP Motor Class - Group	-	I-D, II-F&G	I-D, II-F&G	I-D, II-F&G	I-D, II-F&G
Shipping Weight	Lbs	142	117	117	117
	Kg	64.4	53.1	53.1	53.1

Voltage - ROTRON motors are designed to handle a broad range of world voltages and power supply variations. Our dual voltage 3 phase motors are factory tested and certified to operate on both: **208-230/415-460 VAC-3 ph-60 Hz** and **190-208/380-415 VAC-3 ph-50 Hz**. Our dual voltage 1 phase motors are factory tested and certified to operate on both: **104-115/208-230 VAC-1 ph-60 Hz** and **100-110/200-220 VAC-1 ph-50 Hz**. All voltages above can handle a ±10% voltage fluctuation. Special wound motors can be ordered for voltages outside our certified range.

Operating Temperatures - Maximum operating temperature: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F rated motors or 120°C for Class B rated motors. Blower outlet air temperature should not exceed 140°C (air temperature rise plus inlet temperature). Performance curve maximum pressure and suction points are based on a 40°C inlet and ambient temperature. Consult factory for inlet or ambient temperatures above 40°C.

Maximum Blower Amps - Corresponds to the performance point at which the motor or blower temperature rise with a 40°C inlet and/or ambient temperature reaches the maximum operating temperature.

XP Motor Class - Group - See Explosive Atmosphere Classification Chart in Section I

AMETEK DYNAMIC FLUID SOLUTIONS
75 North Street, Saugerties, NY 12477
USA: +1 215-256-6601 - Europe: +49 7703 930909 - Asia: +86 21 5763 1258
Customer Service Fax: +1 215.256.1338
www.ametekdfs.com

Environmental / Chemical Processing Blowers

EN 656 & CP 656

ROTRON®

3.0 HP Sealed Regenerative w/Explosion-Proof Motor

FEATURES

- Manufactured in the USA - ISO 9001 and NAFTA compliant
- Maximum flow: 212 SCFM
- Maximum pressure: 75 IWG
- Maximum vacuum: 73 IWG
- Standard motor: 3.0 HP, explosion-proof
- Cast aluminum blower housing, impeller , cover & manifold; cast iron flanges (threaded); teflon® lip seal
- UL & CSA approved motor with permanently sealed ball bearings for explosive gas atmospheres Class I Group D minimum
- Sealed blower assembly
- Quiet operation within OSHA standards

MOTOR OPTIONS

- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepowers for application-specific needs

BLOWER OPTIONS

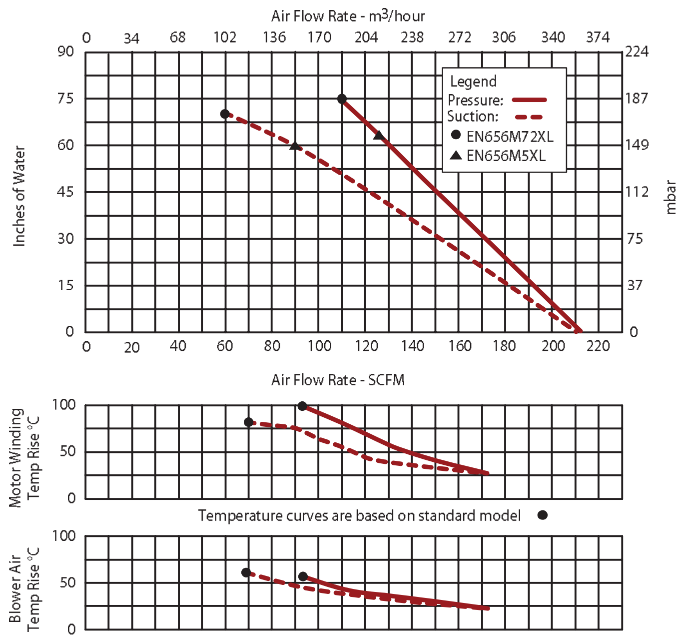
- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

ACCESSORIES

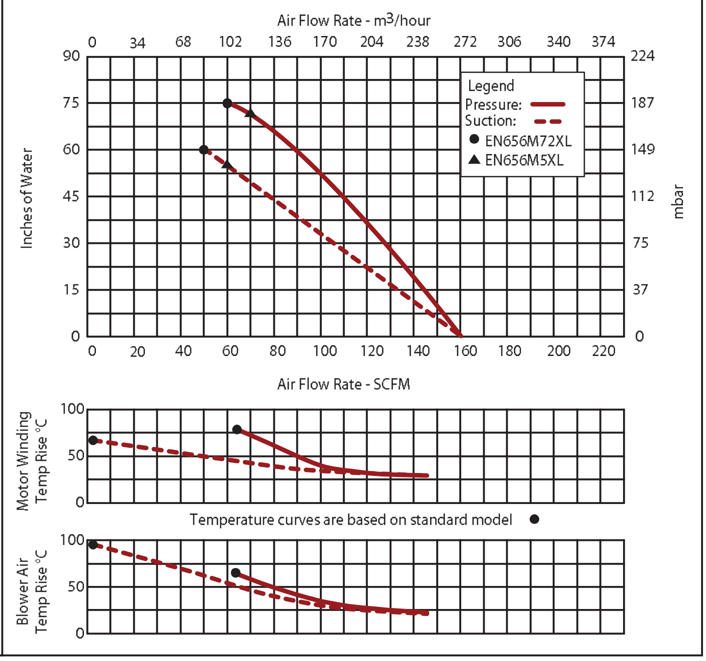
- Flowmeters reading in SCFM
- Filters & moisture separators
- Pressure gauges, vacuum gauges, & relief valves
- Switches - air flow, pressure, vacuum, or temperature
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package

Blower Performance at Standard Conditions

60 Hz



50 Hz



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75 North Street, Saugerties, NY 12477
USA: +1 215-256-6601 - Europe: +49 7703 930909 - Asia: +86 21 5763 1258
Customer Service Fax: +1 215.256.1338
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KOHLER.

Model: 15REOZK

208-600 V **Diesel**

ISO 9001 KOHLER NATIONALLY REGISTERED

EPA-Certified for Stationary Emergency Applications

Ratings Range

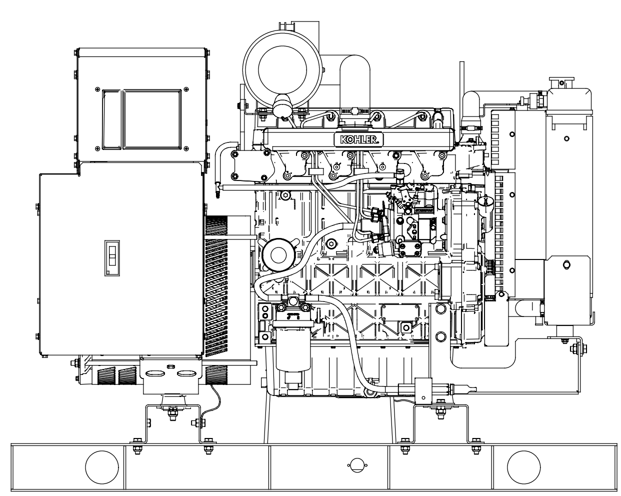
		60 Hz
Standby:	**kW**	14.0-17.0
	kVA	14.0-21.3
Prime:	**kW**	13.0-15.0
	kVA	13.0-18.8

Standard Features

- Kohler Co. provides one-source responsibility for the generating system and accessories.
- The generator set and its components are prototype-tested, factory-built, and production-tested.
- The 60 Hz generator set offers a UL 2200 listing.
- The generator set accepts rated load in one step.
- The 60 Hz generator set meets NFPA 110, Level 1, when equipped with the necessary accessories and installed per NFPA standards.
- The generator set engine is certified to meet the Environmental Protection Agency (EPA) emergency stationary emissions requirements.
- A one-year limited warranty covers all generator set systems and components. Two- and five-year extended limited warranties are also available.
- Alternator features:
  - Kohler's wound field excitation system with its unique PowerBoost™ design delivers great voltage response and short-circuit capability.
  - The brushless, rotating-field alternator has broadrange reconnectability.
- Other features:
  - Kohler designed controllers for one-source system integration and remote communication. See Controllers on page 3.
  - The low coolant level shutdown prevents overheating (standard on radiator models only).
  - Integral vibration isolation eliminates the need for under-unit vibration spring isolators.

Generator Set Ratings

				130°C Rise Standby Rating		105°C Rise Prime Rating	
Alternator	**Voltage**	**Ph**	**Hz**	**kW/kVA**	**Amps**	**kW/kVA**	**Amps**
4D3.1	120/208	3	60	16.0/20.0	55.5	14.0/17.5	48.6
	127/220	3	60	16.0/20.0	52.5	14.0/17.5	45.9
	120/240	3	60	16.0/20.0	48.1	14.0/17.5	42.1
	120/240	1	60	14.0/14.0	58.3	13.0/13.0	54.2
	139/240	3	60	16.0/20.0	48.2	14.0/17.5	42.1
	220/380	3	60	15.0/18.8	28.5	13.5/16.9	25.6
	277/480	3	60	16.0/20.0	24.1	14.0/17.5	21.0
	347/600	3	60	16.0/20.0	19.2	14.0/17.5	16.8
4D3.8	120/208	3	60	17.0/21.3	59.1	15.0/18.8	52.0
	127/220	3	60	17.0/21.3	55.9	15.0/18.8	49.2
	120/240	3	60	17.0/21.3	51.2	15.0/18.8	45.1
	120/240	1	60	16.0/16.0	66.7	14.0/14.0	58.3
	139/240	3	60	17.0/21.3	51.2	15.0/18.8	45.1
	220/380	3	60	17.0/21.3	32.4	15.0/18.8	28.5
	277/480	3	60	17.0/21.3	25.6	15.0/18.8	22.6
	347/600	3	60	16.5/20.6	19.8	14.5/18.1	17.4
4D5.0	120/208	3	60	17.0/21.3	59.1	15.0/18.8	52.0
	127/220	3	60	17.0/21.3	55.9	15.0/18.8	49.2
	120/240	3	60	17.0/21.3	51.2	15.0/18.8	45.1
	120/240	1	60	16.0/16.0	66.7	14.0/14.0	58.3
	139/240	3	60	17.0/21.3	51.2	15.0/18.8	45.1
	220/380	3	60	17.0/21.3	32.4	15.0/18.8	28.5
	277/480	3	60	17.0/21.3	25.6	15.0/18.8	22.6
	347/600	3	60	16.5/20.6	19.8	14.5/18.1	17.4
4D5.6	120/208	3	60	17.0/21.3	59.1	15.0/18.8	52.0
	127/220	3	60	17.0/21.3	55.9	15.0/18.8	49.2
	120/240	3	60	17.0/21.3	51.2	15.0/18.8	45.1
	120/240	1	60	16.0/16.0	66.7	14.0/14.0	58.3
	139/240	3	60	17.0/21.3	51.2	15.0/18.8	45.1
	220/380	3	60	17.0/21.3	32.4	15.0/18.8	28.5
	277/480	3	60	17.0/21.3	25.6	15.0/18.8	22.6
	347/600	3	60	16.5/20.6	19.8	14.5/18.1	17.4
4E3.1	120/240	1	60	15.5/15.5	64.6	14.0/14.0	58.3
4E3.8	120/240	1	60	16.5/16.5	68.8	15.0/15.0	62.5
4E5.6	120/240	1	60	17.0/17.0	70.8	15.0/15.0	62.5



RATINGS: All three-phase units are rated at 0.8 power factor. All single-phase units are rated at 1.0 power factor. *Standby Ratings:* Standby rating is applicable to varying loads for the duration of a power outage. There is no overload capability for this rating. *Prime Power Ratings:* At varying load, the number of generator set operating hours is unlimited. A 10% overload capacity is available for one hour in twelve. Ratings are in accordance with ISO-8528-1 and ISO-3046-1. For limited running time and continuous ratings, consult the factory. Obtain the technical information bulletin (TIB-101) for ratings guidelines, complete ratings definitions, and site condition derates. The generator set manufacturer reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever.

Alternator Specifications

Specifications	Alternator
Manufacturer	Kohler
Type	4-Pole, Rotating-Field
Exciter type	Brushless, Wound Field
Leads: quantity, type	12, Reconnectable 4, 110–120/220–240
Voltage regulator	Solid State, Volts/Hz
Insulation:	NEMA MG1
Material	Class H
Temperature rise	130°C, Standby
Bearing: quantity, type	1, Sealed
Coupling	Flexible Disc
Amortisseur windings	Full
Voltage regulation, no-load to full-load	Controller Dependent
One-step load acceptance	100% of Rating
Unbalanced load capability	100% of Rated Standby Current

- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting.
- Capable of sustained line-to-neutral short-circuit current of up to 300% of the rated current for up to 2 seconds. (IEC 60092-301 short-circuit performance.)
- Sustained short-circuit current enabling downstream circuit breakers to trip without collapsing the alternator field.
- Self-ventilated and dripproof construction.
- Windings are vacuum-impregnated with epoxy varnish for dependability and long life.
- Superior voltage waveform from a two-thirds pitch stator and skewed rotor.

Specifications		Alternator
Peak motor starting kVA:		(35% dip for voltages below)
480 V	4D3.1 (12 lead)	40
480 V	4D3.8 (12 lead)	48
480 V	4D5.0 (12 lead)	58
480 V	4D5.6 (12 lead)	75
240 V	4E3.1 (4 lead)	24
240 V	4E3.8 (4 lead)	31
240 V	4E5.6 (4 lead)	44

Application Data

Engine

Engine Specifications		
Manufacturer	Kohler Diesel	
Engine model	KDI1903M	
Engine type	4-Cycle, Naturally Aspirated	
Cylinder arrangement	3 Inline	
Displacement, L (cu. in.)	1.9 (114)	
Bore and stroke, mm (in.)	88 x 102 (3.46 x 4.02)	
Compression ratio	18:1	
Piston speed, m/min. (ft./min.)	367 (1206)	
Main bearings: quantity, type	4, Sleeve	
Rated rpm	1800	
Max. power at rated rpm, kWm (BHP)	21 (28)	
Cylinder head material	Cast Iron	
Crankshaft material	Cast Iron	
Valve material:		
Intake	Stainless Steel	
Exhaust	Stainless Steel	
Governor: type, make/model	Mech. (or Electronic *)	Electronic
Frequency regulation, no-load to full-load	Droop, 5% (or Isochr. *)	Isochronous
Frequency regulation, steady state	±0.5%	
Frequency	Fixed	
Air cleaner type, all models	Dry	

* Requires available electronic governor option

Exhaust

Exhaust System	
Exhaust manifold type	Dry
Exhaust flow at rated kW, m^3/min. (cfm)	4.7 (167)
Exhaust temperature at rated kW, dry exhaust, °C (°F)	585 (1085)
Maximum allowable back pressure, kPa (in. Hg)	6.0 (1.8)
Exhaust outlet size at engine hookup, mm (in.)	41 (1.6)

Engine Electrical

Engine Electrical System	
Battery charging alternator:	
Ground (negative/positive)	Negative
Volts (DC)	12
Ampere rating	50
Starter motor rated voltage (DC)	12
Battery, recommended cold cranking amps (CCA):	
Quantity, CCA rating	One, 650
Battery voltage (DC)	12

Fuel

Fuel System		
Fuel supply line, min. ID, mm (in.)	8.0 (0.31)	
Fuel return line, min. ID, mm (in.)	6.0 (0.25)	
Max. lift, electric fuel pump, m (ft.)	3.0 (10.0)	
Max. fuel flow, Lph (gph)	46.0 (12.2)	
Max. return line restriction, kPa (in. Hg)	20 (5.9)	17.7 (5.2)
Fuel filter		
Prefilter	74 Microns	
Primary/Water Separator	5 Microns @ 98% Efficiency	5 Microns @ 95% Efficiency
Recommended fuel	#2 Diesel	

Lubrication

Lubricating System	
Type	Full Pressure
Oil pan capacity, L (qt.)	7.9 (8.3)
Oil pan capacity with filter, L (qt.)	8.2 (8.7)
Oil filter: quantity, type	1, Cartridge
Oil cooler	—

Application Data

Cooling

Radiator System	
Ambient temperature, °C (°F) *	50 (122)
Engine jacket water capacity, L (gal.)	3.5 (0.93)
Radiator system capacity, including engine, L (gal.)	10.5 (2.8)
Engine jacket water flow, Lpm (gpm)	56.8 (15)
Heat rejected to cooling water at rated kW, dry exhaust, kW (Btu/min.)	19.2 (1092)
Water pump type	Centrifugal
Fan diameter, including blades, mm (in.)	406 (16.0)
Fan, kWm (HP)	0.6 (0.8)
Max. restriction of cooling air, intake and discharge side of radiator, kPa (in. H_2O)	0.125 (0.5)

* Enclosure reduces ambient temperature capability by 5°C (9°F).

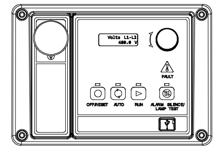
Operation Requirements

Air Requirements	
Radiator-cooled cooling air, m^3/min. (scfm) †	36.8 (1300)
Combustion air, m^3/min. (cfm)	1.7 (60)
Heat rejected to ambient air:	
Engine, kW (Btu/min.)	16.0 (910)
Alternator, kW (Btu/min.)	4.7 (267)

† Air density = 1.20 kg/m^3 (0.075 lbm/ft^3)

Fuel Consumption		
Diesel, Lph (gph) at % load	**Standby Rating**	
100%	5.8	(1.5)
75%	4.4	(1.2)
50%	3.1	(0.8)
25%	1.9	(0.5)
Diesel, Lph (gph) at % load	**Prime Rating**	
100%	5.2	(1.4)
75%	4.0	(1.1)
50%	2.8	(0.7)
25%	1.7	(0.4)

Controller



Decision-Maker® 3000 Controller

Provides advanced control, system monitoring, and system diagnostics for optimum performance and compatibility.

- Digital display and menu control provide easy local data access
- Measurements are selectable in metric or English units
- Remote communication thru a PC via network or serial configuration
- Controller supports Modbus® protocol
- Integrated hybrid voltage regulator with ±0.5% regulation
- Built-in alternator thermal overload protection
- NFPA 110 Level 1 capability

Refer to G6-100 for additional controller features and accessories.

Modbus® is a registered trademark of Schneider Electric.

KOHLER CO., Kohler, Wisconsin 53044 USA
Phone 920-457-4441, Fax 920-459-1646
For the nearest sales and service outlet in the US and Canada, phone 1-800-544-2444
KOHLERPower.com

Additional Standard Features

- Air Cleaner, Heavy Duty
- Alternator Protection
- Battery Rack and Cables
- Closed Crankcase Ventilation
- Oil Drain and Coolant Drain with Hose Barb
- Oil Drain Extension (with enclosure models only)
- Operation and Installation Literature
- Stainless Steel Fasteners on Enclosure (with enclosure models only)
- Rodent Guards

Available Options

Approvals and Listings

- ❑ CSA Certified
- ❑ IBC Seismic Certification
- ❑ UL2200 Listing

Enclosed Unit

- ❑ Sound Enclosure (with enclosed critical silencer)
- ❑ Weather Enclosure (with enclosed critical silencer)
- ❑ Stainless Steel Latches and Hinges

Open Unit

- ❑ Exhaust Silencer, Critical (kit: PA-352663)
- ❑ Flexible Exhaust Connector, Stainless Steel

Fuel System

- ❑ Flexible Fuel Lines
- ❑ Fuel Pressure Gauge
- ❑ Subbase Fuel Tanks

Controller

- ❑ Common Failure Relay
- ❑ Input/Output Module
- ❑ Manual Speed Adjust (requires Electronic Governor)
- ❑ Remote Annunciator Panel
- ❑ Remote Emergency Stop
- ❑ Run Relay

Cooling System

- ❑ Block Heater (700 W, 110–120 V)
  Required for ambient temperatures below 0°C (32°F).
- ❑ Radiator Duct Flange

Electrical System

- ❑ Alternator Strip Heater
- ❑ Battery
- ❑ Battery Charger, Equalize/Float Type
- ❑ Battery Heater
- ❑ Electronic Governor
- ❑ Line Circuit Breaker (NEMA type 1 enclosure)
- ❑ Line Circuit Breaker with Shunt Trip (NEMA type 1 enclosure)

Miscellaneous

- ❑ Air Cleaner Restriction Indicator
- ❑ Engine Fluids Added
- ❑ Rated Power Factor Testing

Literature

- ❑ General Maintenance
- ❑ NFPA 110
- ❑ Overhaul
- ❑ Production

Warranty

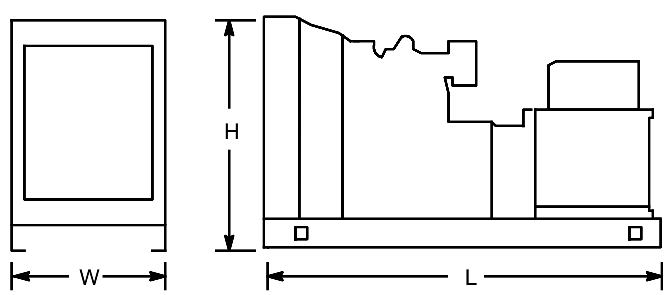
- ❑ 2-Year Basic Limited Warranty
- ❑ 5-Year Basic Limited Warranty
- ❑ 5-Year Comprehensive Limited Warranty

Other Options

- ❑ ____________________
- ❑ ____________________
- ❑ ____________________
- ❑ ____________________
- ❑ ____________________

Dimensions and Weights

Overall Size, L x W x H, mm (in.):
Open Unit Skid: 1400 x 813 x 1107 (55.1 x 32.0 x 43.6)
Enclosure Skid: 1938 x 813 x 1174 (76.5 x 32.0 x 47.0)
Weight (radiator model), wet, kg (lb.): 422 (930)



NOTE: This drawing is provided for reference only and should not be used for planning installation. Contact your local distributor for more detailed information.

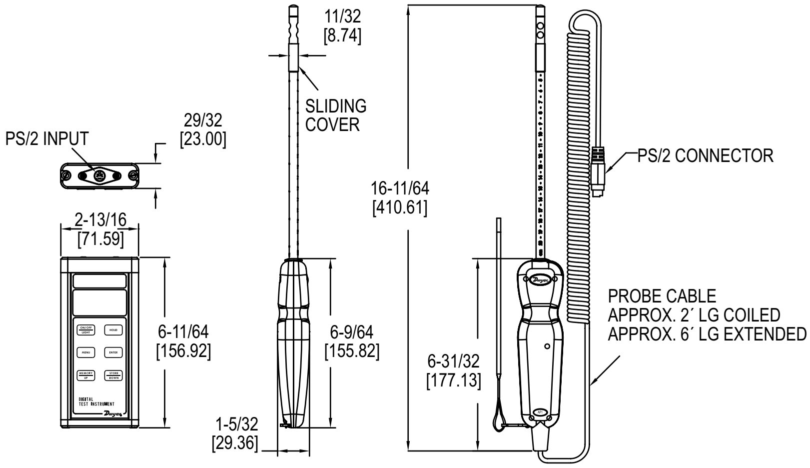
DISTRIBUTED BY:

MODEL 471B

THERMO-ANEMOMETER TEST INSTRUMENT

Measures Air Velocity or Air Volume and Temperature Simultaneously

New Six Button Operation Provides Quick Access to Enhanced Features



The **MODEL 471B** Thermo-Anemometer Test Instrument is a versatile dual function unit that quickly and easily measures air velocity or volumetric flow as well as air temperature in imperial or metric units. A stainless steel probe is included, which has a comfortable hand grip and etched insertion depth marks. The extruded aluminum housing fully protects electronics, yet is lightweight and comfortable to hold.

FEATURES/BENEFITS

- Compatible with Dwyer RP1 thermo-hygrometer and VP1 100 mm vane thermo-anemometer probes (sold separately)
- High contrast and backlit LCD for visibility in any condition
- Able to store up to 99 readings
- Integral sliding cover protects probe sensors when not in use
- Built-in volumetric air flow calculations

APPLICATIONS

- Duct traverses
- HVAC inspections
- Testing and balancing

SPECIFICATIONS

Service: Air velocity and temperature of clean, dry air.
Temperature Limits: Process air velocity: -20 to 212°F (-29 to 100°C); Process temperature: -40 to 212°F (-40 to 100°C); Ambient: 5 to 125°F (-15 to 51°C).
Display: 4.5 digit LCD.
Resolution: 0.1%, 0.1 °F/°C.
Range Air Velocity: 0 to 6000 FPM (0 to 30 m/s).
Accuracy Air Velocity: ±3% FS within temperature range of 40 to 90°F (4 to 32°C).
Range Volumetric Air Flow: 19,999 in selected flow units.
Range Temperature: -40 to 212°F (-40 to 100°C).
Accuracy Temperature: ±0.5°F (±0.28°C) from 32 to 122°F (0 to 50°C); ±1.5°F (±0.83°C) from -40 to 32°F (-40 to 0°C) & 122 to 212°F (50 to 100°C).
Probe Length: 8˝ (203 mm) insertion.
Cable Length: 28˝ (71 cm) retracted, 6 ft (183 cm) extended.
Power Requirements: 9 V alkaline battery, installed non-functional, user replaceable.
Weight: 16 oz (454 g).
Agency Approvals: CE.

MODEL CHART

Model	Description
471B-1	Digital thermo anemometer includes 9V battery, sensing probe, wrist strap, soft carrying case and instructions

ACCESSORIES - CASES

Model	Description
UHH-C1	Spare soft carrying case
A-160-CASE	Hard carrying case for longer probes (18˝ to 36˝)
A-47X-BOOT	Protective magnetic rubber boot

ACCESSORIES - PROBES

Model	Probe Length	Description
AP1	8˝	Thermo anemometer air velocity & temperature probe with coiled cable
AP1-18	18˝	Thermo anemometer air velocity & temperature probe with coiled cable
AP1-24	24˝	Thermo anemometer air velocity & temperature probe with coiled cable
AP1-36	36˝	Thermo anemometer air velocity & temperature probe with coiled cable

Replaceable Probe with Secure 6 Pin Adapter

Soft Carrying Case Included with Every Unit

A-47X-BOOT (Manometer not included)

COMMERCIAL GRADE FASTSET™ NON-SHRINK GROUT

PRODUCT NO. 1585-09

DIVISION **3**

Non-Shrink Grouting
03 62 00

PRODUCT DESCRIPTION

QUIKRETE® Commercial Grade FastSet™ Non-Shrink Grout is a high early strength commercial grade grout, requiring only the addition of water.

PRODUCT USE

QUIKRETE® FastSet™ Non-Shrink Grout is a dual-purpose product. As a non-metallic fluid grout meeting ASTM C1107, it is used for anchoring and grouting of anchor bolts, retrofitted reinforcing steel, steel column bases, bearing plates, precast concrete key ways and other installations that require high early and high ultimate strength. Non-shrink characteristics make it stable and capable of handling load transfers. As a repair material, the product meets ASTM C928 R3 and is used to make partial depth or full depth repairs to roads, bridges, industrial floors and other concrete surfaces.

SIZES

- QUIKRETE® FastSet™ Non-Shrink Grout - 60 lb (27.2 kg) bags

YIELD

- Yield will vary with water content. When used as a fluid grout, a 60 lb (27.2 kg) bag will yield approximately 0.58 cu ft (16.4 L). Yield will be reduced to approximately 0.55 cu ft (15.6 L) per bag at a flowable consistency. As a repair material placed at a 3" - 6" (76-152 mm) slump, a 60 lb (27.2 kg) bag will yield approximately 0.52 cu ft (14.7 L). When extended with 30 lb (13.6 kg) of high quality -1/2" (-12 mm) gravel, a 60 lb (27.2 kg) bag will yield approximately 0.7 cu ft (19.8 L).

TECHNICAL DATA

APPLICABLE STANDARDS

ASTM International

- ASTM C109/C109M Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
- ASTM C143/C143M Standard Test Method for Slump of Hydraulic Cement Concrete
- ASTM C191 Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
- ASTM C672/C672M Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
- ASTM C928 Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs
- ASTM C939 Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
- ASTM C1090 Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
- ASTM C1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- ASTM C1437 Standard Test Method for Flow of Hydraulic Cement Mortar

PHYSICAL/CHEMICAL PROPERTIES

Typical results, obtained with QUIKRETE® FastSet™ Non-Shrink Grout used as a grout, are shown in Table 1. Product complies with all the properties of ASTM C1107 when tested at 73 degrees F (23 degrees C) at a fluid consistency. Typical results obtained with QUIKRETE® FastSet™ Non-Shrink Grout used as a repair material are shown in Table 2. Product complies with applicable portions of ASTM C928 R3
when tested at the conditions specified in Table 2.

INSTALLATION

INSTRUCTIONS FOR USE AS A GROUT

MIXING

QUIKRETE® FastSet™ Non-Shrink Grout should be mechanically mixed for a minimum of 3 minutes.

- Use the minimum amount of water necessary to provide the desired flow (approximately 1 3/4 gal (6.6 L) for a fluid consistency)
- Do not exceed a flow of 20 seconds by ASTM C939
- Add most of the mixing water to the mixer first
- Add the powder to the water and adjust as needed to achieve the desired consistency
- For a flowable consistency, reduce the water content to approximately 1.5 gal (5.7 L) per bag

PLACEMENT

Surfaces to receive the grout must be clean and free of any type of foreign matter, grease, paint, oil, dust or efflorescence. In some cases, it may be necessary to roughen smooth surfaces or etch old ones with acid. The area should be thoroughly flushed and soaked with clean water prior to grouting, leaving no standing water. Place the grout quickly and continuously using light rodding to eliminate air bubbles.

CURING
A damp cure of at least 1 day is necessary to control the non-shrink characteristics and maintain strength levels.

WORKING TIME
When properly mixed to a fluid consistency, QUIKRETE® FastSet™ Non-Shrink Grout will fully comply with ASTM C1107 and retain a fluid consistency for 20 minutes at 70 degrees F (21 degrees C).

TEMPERATURE
Grout temperature should be maintained at 50 - 90 degrees F (10 - 32 degrees C) for best results. To achieve specified performance in accordance with ASTM C1107, maintain temperature as close to 70 degrees F (21 degrees C) as possible. Use cold water in hot weather and hot water in cold weather to achieve desired grout temperature. Do not pour grout if temperature is expected to go below 32 degrees F (0 degrees C) within a 12 hour period.

INSTRUCTIONS FOR USE AS A REPAIR MORTAR
MIXING
QUIKRETE® FastSet™ Non-Shrink Grout should be mechanically mixed for a minimum of 3 minutes. Use the minimum amount of water necessary to provide a slump of about 3" - 6" (76-152 mm). Add approximately 1 gal (3.8 L) of water to the mixer first. Add the powder to the water and adjust as needed to achieve the recommended consistency. For repairs deeper than 2" (51 mm), add 30 lb (13.6 kg) of high quality gravel with a top size of 1/2" (13 mm) or less to the mix. Mix water will vary depending on the dampness of the aggregate. Do not add more water than needed to achieve a slump of 3" - 6" (76 - 152 mm).

SURFACE PREPARATION
• Remove all spalled areas and areas of unsound concrete and patching
• The hole should have a vertical edge of 1/2" (12.7 mm) or more, formed by use of a pneumatic jackhammer or sawing. Holes should be chipped out to create a new, sound substrate
• After the chipping process is completed, the repair area must be cleaned by water blasting or other suitable method
• Dampen holes with clean water before patching. No puddles of water should be left in the hole

PLACEMENT
• The hole should be filled by placing material full depth, from one end to the other to eliminate part depth lifts between batches
• Consolidate the material in the hole by hand tamping or chopping with a shovel. This is particularly important around the edges
• Screed and finish patches with hand tools to create a surface finish equivalent to the existing slab finish

CURING
No special curing procedures are required. Curing at ambient conditions is preferable.

WARRANTY
The QUIKRETE® Companies warrant this product to be of merchantable quality when used or applied in accordance with the instructions herein. The product is not warranted as suitable for any purpose or use other than the general purpose for which it is intended. Liability under this warranty is limited to the replacement of its product (as purchased) found to be defective, or at the shipping companies' option, to refund the purchase price. In the event of a claim under this warranty, notice must be given to The QUIKRETE® Companies in writing. This limited warranty is issued and accepted in lieu of all other express warranties and expressly excludes liability for consequential damages.

TABLE 1 QUIKRETE® FASTSET™ NON-SHRINK GROUT TESTED AS A GROUT

Consistency	Fluid	Flowable	Plastic
Approximate water content per bag	1 3/4 gal (6.6 L)	1 1/2 gal (5.7 L)	1 1/4 gal (4.7 L)
Flow, ASTM C939	20 - 30 sec	-	-
Flow, at 5 drops, ASTM C1437	-	125 - 145	100 - 125
Working time	About 20 min	About 15 min	About 15 min
Setting time Final, ASTM C191	20 - 45 min	20 - 45 min	20 - 45 min
Compressive strength, ASTM C109			
3 hours after set	2000 psi (13.8 MPa)	2500 psi (17.2 MPa)	3000 psi (20.7 MPa)
24 hours	4000 psi (27.6 MPa)	4500 psi (31 MPa)	5000 psi (34.5 MPa)
7 days	5000 psi (34.5 MPa)	5500 psi (37.9 MPa)	6000 psi (41.4 MPa)
28 days	6500 psi (44.8 MPa)	7500 psi (51.7 MPa)	8000 psi (55.2 MPa)
Slant shear bond strength, ASTM C928			
1 day	1000 psi (6.9 MPa)	1000 psi (6.9 MPa)	1000 psi (6.9 MPa)
7 days	1500 psi (10.3 MPa)	1500 psi (10.3 MPa)	1500 psi (10.3 MPa)
Height change, ASTM C1090			
1, 3, 7 and 28 days	0 - 0.2%	0 - 0.2%	0 - 0.2%

TABLE 2 QUIKRETE® FASTSET™ NON-SHRINK GROUT TESTED AS A REPAIR MATERIAL			
	ASTM C928 R3 Specifications	FastSet™ Non-Shrink Grout	FastSet™ Non-Shrink Grout
Aggregate extension		None	30 lb (13.6 kg) of -1/2" (-12 mm) gravel
Slump, ASTM C143	> 3" (75 mm)	3" - 6" (75 - 150 mm)	3" - 6" (75 - 150 mm)
Setting time, ASTM C191 Final	No requirement	20 - 45 min	20 - 45 min
Compressive strength, ASTM C109			
3 hours	3000 psi (20.7 MPa)	3000 psi (20.7 MPa)	3000 psi (20.7 MPa)
24 hours	5000 psi (34.5 MPa)	5000 psi (34.5 MPa)	5000 psi (34.5 MPa)
7 days	5000 psi (34.5 MPa)	6000 psi (41.4 MPa)	6000 psi (41.4 MPa)
28 days	No requirement	8000 psi (55.2 MPa)	8000 psi (55.2 MPa)
Slant shear bond strength, ASTM C928			
1 day	1000 psi (6.9 MPa)	1000 psi (6.9 MPa)	1000 psi (6.9 MPa)
7 days	1500 psi (10.3 MPa)	1500 psi (10.3 MPa)	1500 psi (10.3 MPa)
Scaling resistance, ASTM C672	1 lb/ft3 (5 kg/m3)	0.004 lb/ft3 (0.064 kg/m3)	-

The QUIKRETE® Companies
One Securities Centre
3490 Piedmont Rd., NE, Suite 1300, Atlanta, GA 30305
(404) 634-9100 • Fax: (404) 842-1425

Operating Instructions for the DG-700 Pressure and Flow Gauge

Performance Testing Tools

612.827.1117 | www.energyconservatory.com

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The Energy Conservatory

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

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).

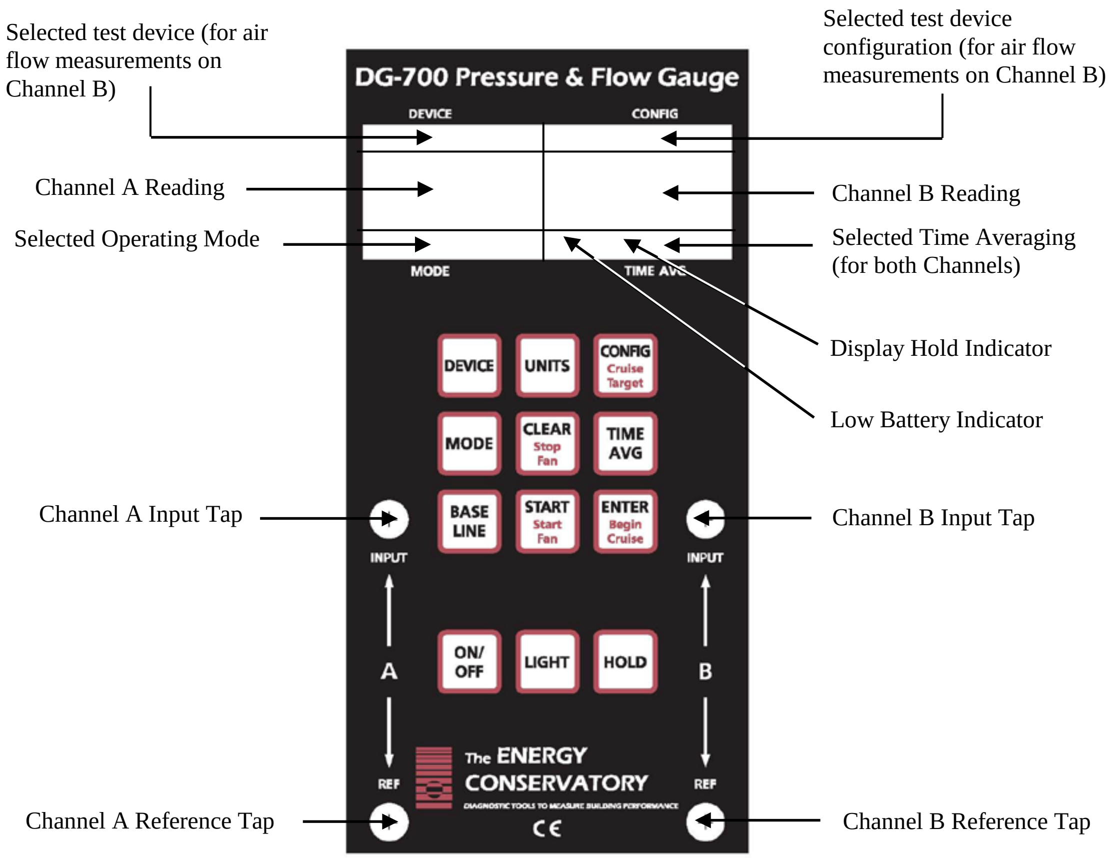
❑ 1.1.h Automated Blower Door Testing, Cruise Control and Data Logging:

- 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	Button	Purpose
DEVICE	Used to select the Energy Conservatory test device connected to **Channel B** (not active in **PR/PR** mode).	**BASELINE**	Initiates **Baseline** pressure measurement procedure on **Channel A** (not active in **PR/AH** mode).
UNITS	Selects the pressure and air flow units for **Channels A** and **B**.	**START**	Used to start measurement procedure for **Baseline** and **NSOP** measurements. Also used to reset time averaging buffers and manually initiate auto-zero.
CONFIG	Used to select the configuration for the currently chosen test device (not active in **PR/PR** mode).	**ENTER**	Used to accept and enter **Baseline** and **NSOP** pressure readings. After entering **Baseline** reading, **Channel A** will display baseline adjusted pressure.
MODE	Selects the current operating mode.	**ON/OFF**	Turns gauge On and Off.
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.	**LIGHT**	Turns display backlight On and Off.
TIME AVG	Used to select the time averaging mode (not active during **Baseline** and **NSOP** measurements).	**HOLD**	Turns display Hold feature On and Off.
Begin Cruise	Initiates **Cruise Control** feature (not active in **PR/AH** and **PR/V** modes).	**Stop Fan**	Turns off the fan for **Cruise Control**.
Start Fan	Starts 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.

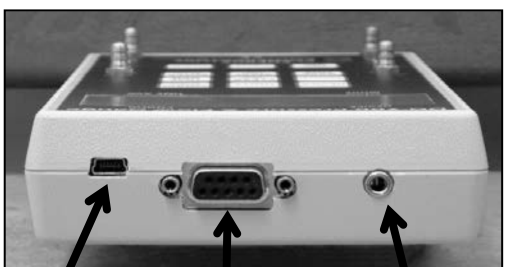
- Automated Blower Door testing requires the TECTITE, TECTITE Express or TECLOG2 software, a Blower Door fan speed controller with a communication jack (standard equipment since September 2004), a fan control cable, and a communication cable (either USB or 9 pin serial) to connect the DG-700 to a user 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.

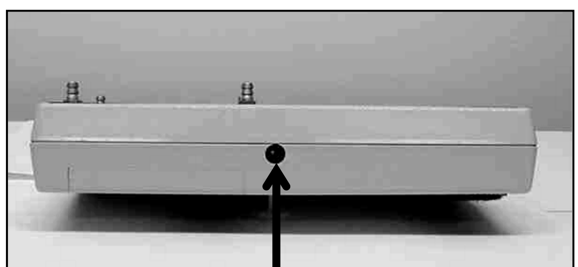
❑ 1.4.b Fan Control Output Jack:

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:

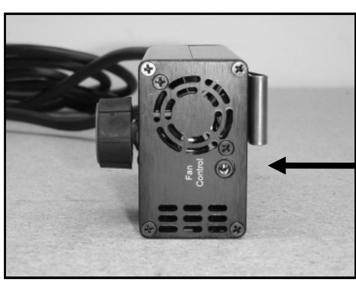
The AC power input jack can be used with an <u>optional</u> AC power supply to provide a long term power source for the gauge (to be used when data logging). The gauge is normally powered by 6 AA batteries located in the rear battery compartment. When the AC power supply is plugged in, the power supply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



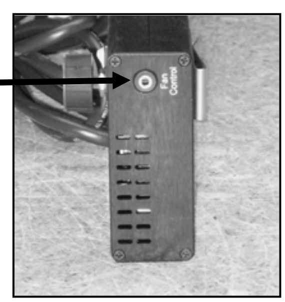


USB Communication Port **Serial Communication Port** **Fan Control Output Jack**

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 Signal:	12	5	10	2	6	15	8	12	2	6
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 Signal:	12	5	10	2	6	15	8	12	2	6
Display:	--	--	--	--	7	7	7	7	7	9

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

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

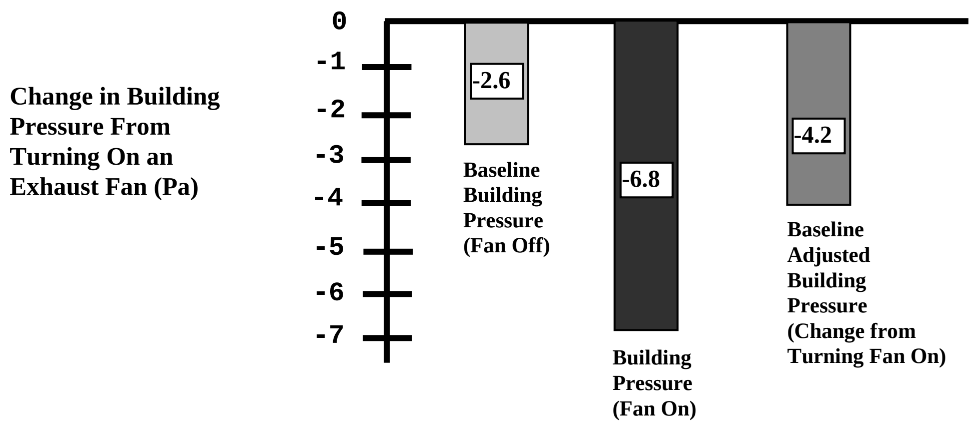
❑ 1.5.c Resetting the Time Averaging Measurement Buffer:

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)

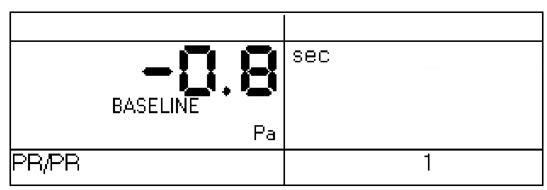
The **Baseline** feature on **Channel A** allows the user to measure and record a baseline pressure reading, and then display the baseline adjusted pressure on the gauge. For purposes of this manual a baseline pressure reading is defined as a pressure measurement made under a specific operating condition, 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).

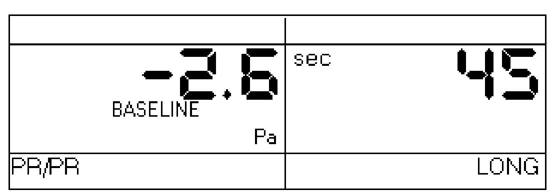


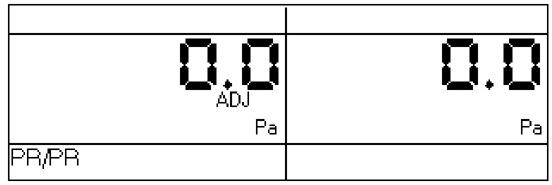
❑ 1.6.a Buttons Used with Baseline Pressure Feature:

Pressing the **BASELINE** button initiates the baseline pressure measurement feature. The word "BASELINE" will <u>begin to flash</u> 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.

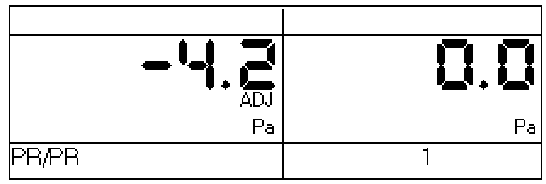


Press the **START** button to begin recording a baseline pressure reading. Once the **START** button is pressed, the word "BASELINE" <u>stops flashing</u> and the gauge begins recording a ***long term average*** baseline pressure reading on **Channel A**. During the baseline measurement procedure, the **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.





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:

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.

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:

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

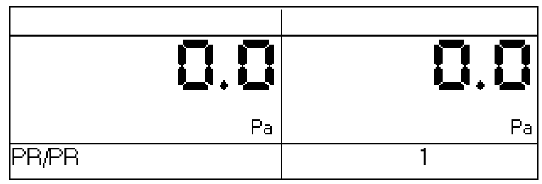
In order to preserve battery life, the DG-700 gauge will automatically shut off if no keys are pressed for 2 hours. The auto-off feature can be disabled by simultaneously pressing the **CLEAR** and **ENTER** buttons. The auto-off feature is automatically re-enabled whenever the gauge is turned off and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



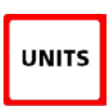
The DG-700 gauge is turned on by pressing the **ON/OFF** button once. When first turned on, the gauge is automatically placed in the **Pressure/Pressure (PR/PR)** operating mode and immediately begins monitoring and displaying pressure readings for both **Channels A** and **B**. The default pressure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



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

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

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)

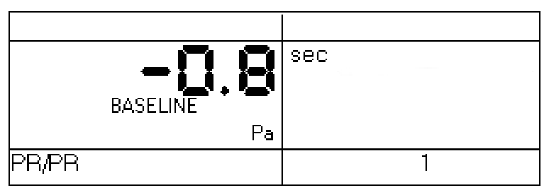
❑ 2.5.a Example: Measuring Building Depressurization from an Exhaust Fan

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.

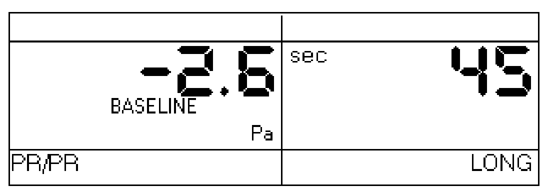
- Set up **Channel A** to measure building pressure with reference to outside (e.g. run tubing from the **Channel A Reference** tap to outside and leave the **Channel A Input** tap open to the building – assumes the gauge is in the building).

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

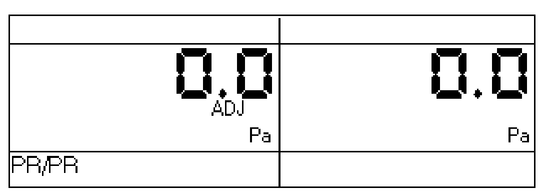
- Press the **BASELINE** button. The word "BASELINE" will <u>begin to flash</u> in the **Channel A** display, indicating that the baseline feature has been initiated. At this point, the gauge is monitoring the real-time **Channel A** baseline pressure reading, but is not recording the reading. The **Channel 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" <u>stops flashing</u> 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).

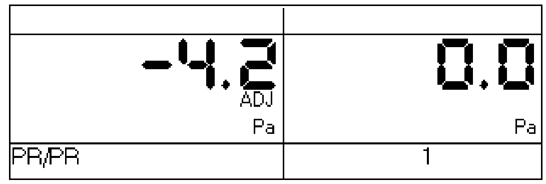


- Once you are satisfied with the baseline pressure reading, press the **ENTER** key to accept and enter the baseline pressure reading into the gauge. After pressing **ENTER**, **Channel A** will now display the baseline adjusted pressure reading (i.e. the measured baseline pressure reading will be



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.

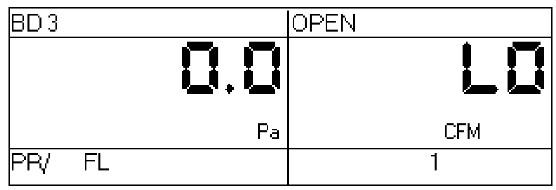
Chapter 3 Pressure/Flow Mode

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.)

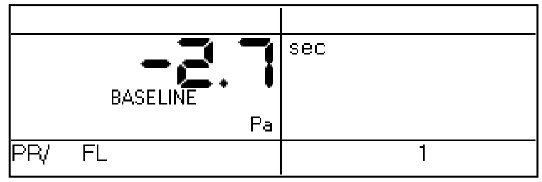
3.7 Using the Baseline Pressure Feature in Pressure/Flow Mode

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)

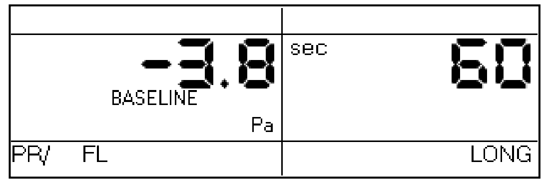
❑ 3.7.a Example: Using the Baseline Feature During a Blower Door Depressurization Test

- 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).

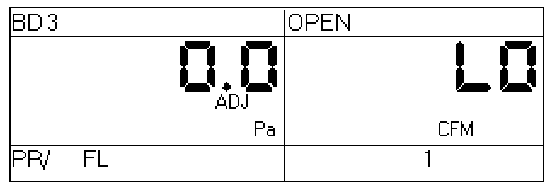
- Press the **BASELINE** button. The word “BASELINE” will begin to flash in the **Channel A** display, indicating that the baseline feature has been initiated. At this point, the gauge is monitoring the real-time **Channel A** baseline building pressure (i.e. the existing building pressure caused by 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).

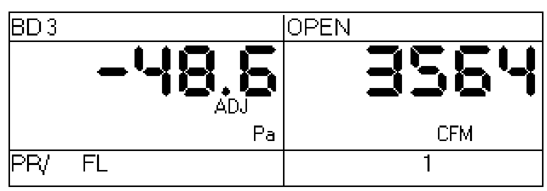


- Once you are satisfied with the baseline pressure reading, press the **ENTER** key to accept and enter the baseline pressure reading into the gauge. After pressing **ENTER**, **Channel A** will now display the baseline adjusted building pressure reading (i.e. the measured baseline pressure reading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

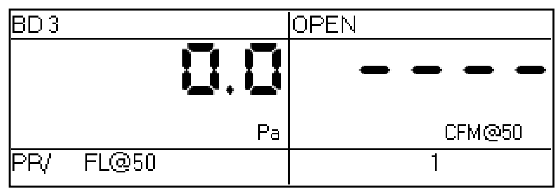
4.1 Mode Summary

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.

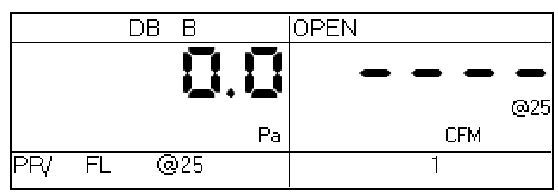
4.2 Overview of Pressure/Flow @ *50* and @ *25* Modes

❑ 4.2.a Pressure/Flow @ *50* Mode:

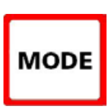


The **Pressure/Flow @ *50*** mode is used to conduct a one-point Blower Door building airtightness test. In this mode, **Channel A** is used to measure building pressure while **Channel B** is used to display estimated building leakage at a test pressure of 50 Pascals. The leakage estimate shown on **Channel 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

When in the **Pressure/Flow @ *50* or @ *25*** operating modes, the DG-700 can display leakage results on **Channel B** in units of **CFM@**, **m³/hr@, l/s@, in²@**, and **cm²@**. 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

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

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:

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

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

$$\begin{array}{c}\textbf{Displayed Leakage Area}\\ \textbf{(Channel B)}\end{array} = \begin{array}{c}\textbf{Estimated Leakage}\\ \textbf{Rate}\\ \textbf{(CFM50)}\end{array} \;/\; \textbf{7.495}$$

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

$$\textbf{Displayed Leakage Area (Channel B)} = \textbf{Estimated Leakage Rate (CFM50)} \;/\; \textbf{1.1617}$$

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:

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

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

$$\textbf{Displayed Leakage Area (Channel B)} = \textbf{Estimated Leakage Rate (CFM25)} \;/\; \textbf{5.3}$$

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

$$\textbf{Displayed Leakage Area (Channel B)} = \textbf{Estimated Leakage Rate (CFM25)} \;/\; \textbf{0.8215}$$

❑ 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

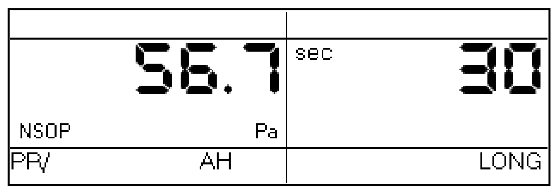
5.1 Mode Summary

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**.

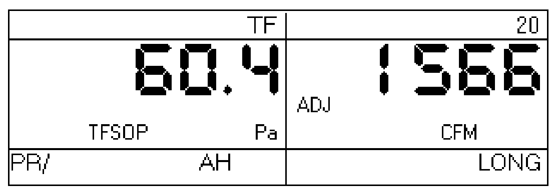
Note: Appendix A contains a Quick Guide for using the DG-700 with the **Pressure/Air Handler Flow** feature.

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:



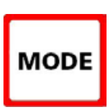
- **Step 1**: When first entering the **PR/ AH** mode, **Channel A** is set up to measure a Normal System Operating Pressure (**NSOP**) in the duct system, under normal operating conditions (e.g. existing filter in place, no test device installed). Pressing the **START** button initiates a ***long-term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

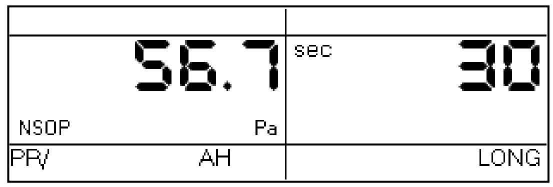
- Open a window or door between the building and outside to prevent pressure changes in the building during the test. If the air handler fan is installed in an unconditioned zone (e.g. crawlspace, attic), open any vents or access doors connecting that zone to the outside (or to the building) to prevent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

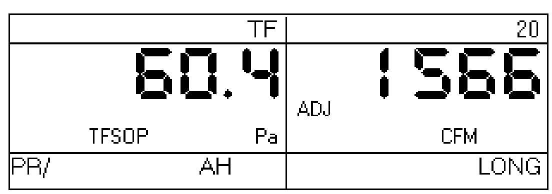
❑ 5.7.b Step 2: Measuring the TFSOP and Adjusted Air Handler Flow

- 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.

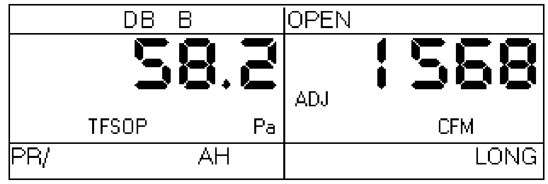
- Select the installed test device and device configuration on the DG-700 using the **DEVICE** and **CONFIG** buttons.

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:

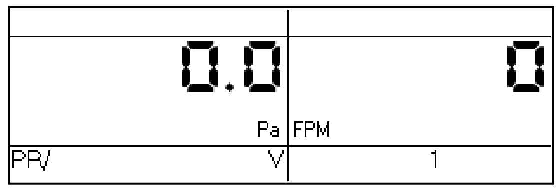
$$\textbf{Flow Resistance Correction Factor} = \left\{ \frac{\textbf{NSOP}}{\textbf{TFSOP}} \right\}^{\textbf{0.50}}$$

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

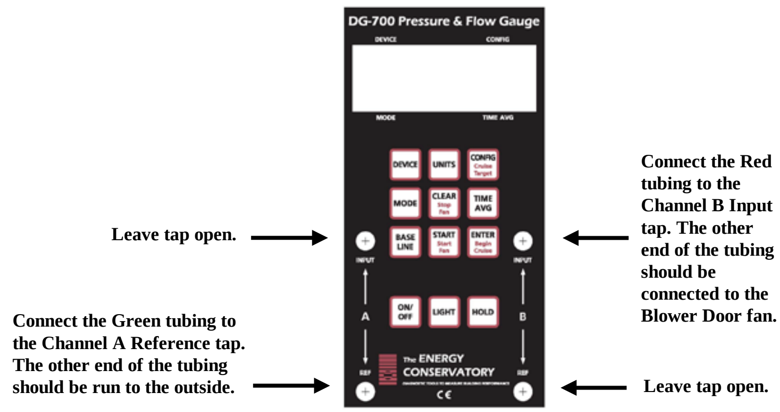
A.1 One-Point 50 Pascal Building Depressurization Test using the Model 3 Minneapolis Blower Door™ and DG-700 Digital Gauge

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.

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).

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

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).

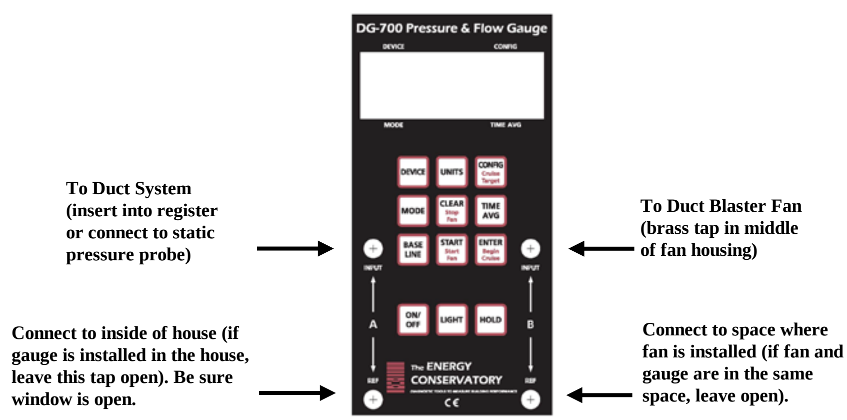
e) Open a door or window between the house and outside to prevent changes in house pressure when the Duct Blaster is running.

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 <u>three</u> 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.

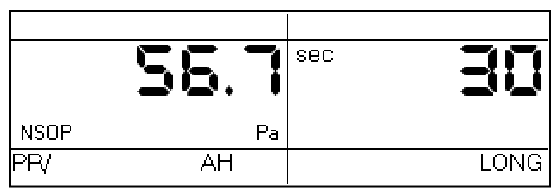
A.3 Using the TrueFlow® Air Handler Flow Meter and the DG-700 Digital Gauge

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.

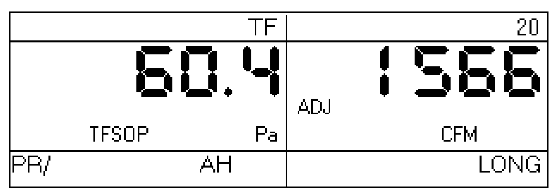
3. Connect the Metering Plate to the DG-700.

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.

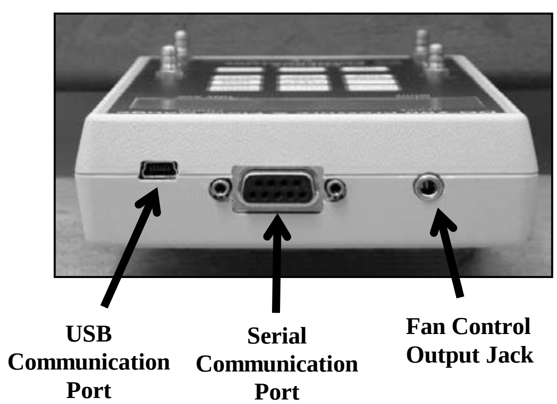
2. Install the Blower Door system as described in the Blower Door operation manual.

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.

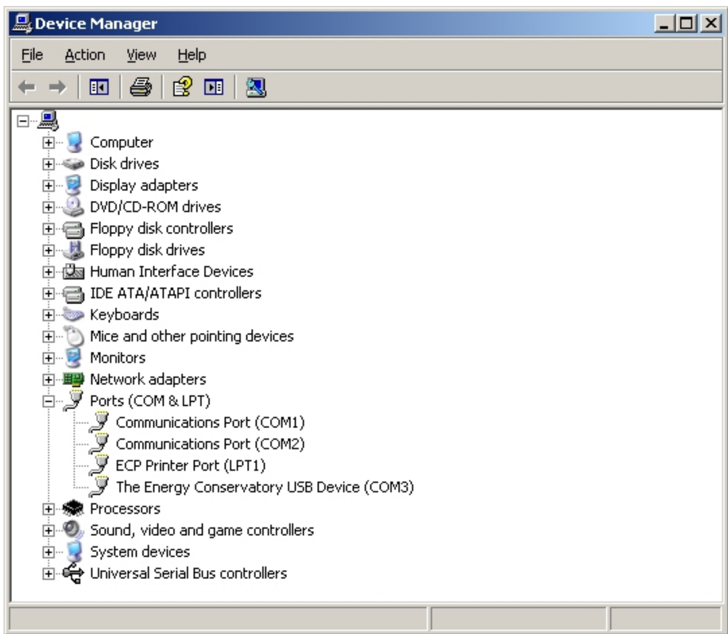
- If using a 9 pin serial cable, plug the male end of the cable into the serial communication port on the top of the gauge, and the female end of the cable should be plugged into an open serial communication port on your computer.



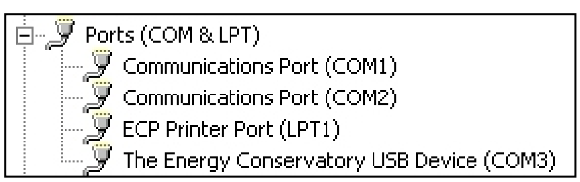
- To check if the USB communication drivers have been properly installed on your computer, or to see if your computer has an available serial communication port for a 9 pin serial cable, you will need to access the **Device Manager** in your Windows operating system.

  – 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.

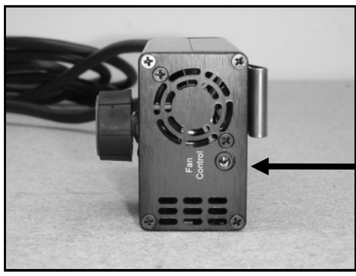


  – **COM1** and **COM2** are existing serial communication ports which can be used to communicate with a DG-700 gauge using a standard 9 pin serial cable.
  – **COM3** is a custom communication port created by successfully installing the USB drivers for the DG-700 gauge. (Note: In order for a custom device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

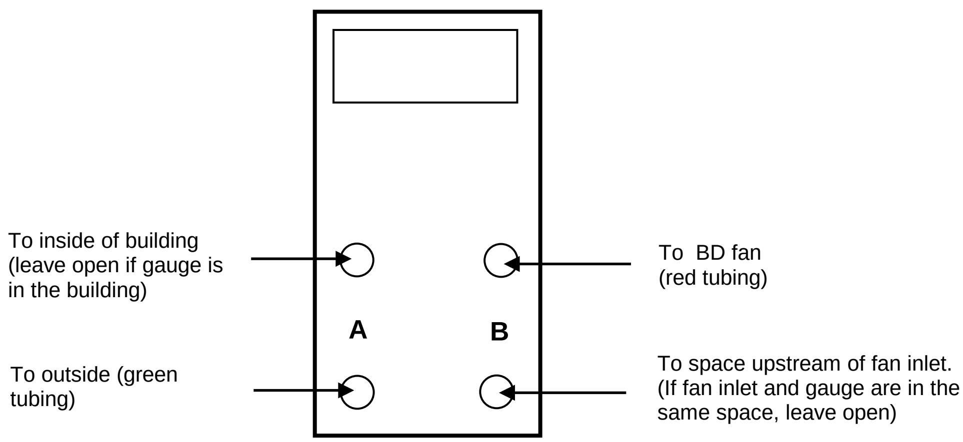


  If no **COM** ports are listed (or a **Ports** icon does not exist), then either the computer does not have installed serial communication ports, you have not properly installed the USB drivers to create a custom USB Device communication port, or a DG-700 gauge is not connected to the computer.

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.



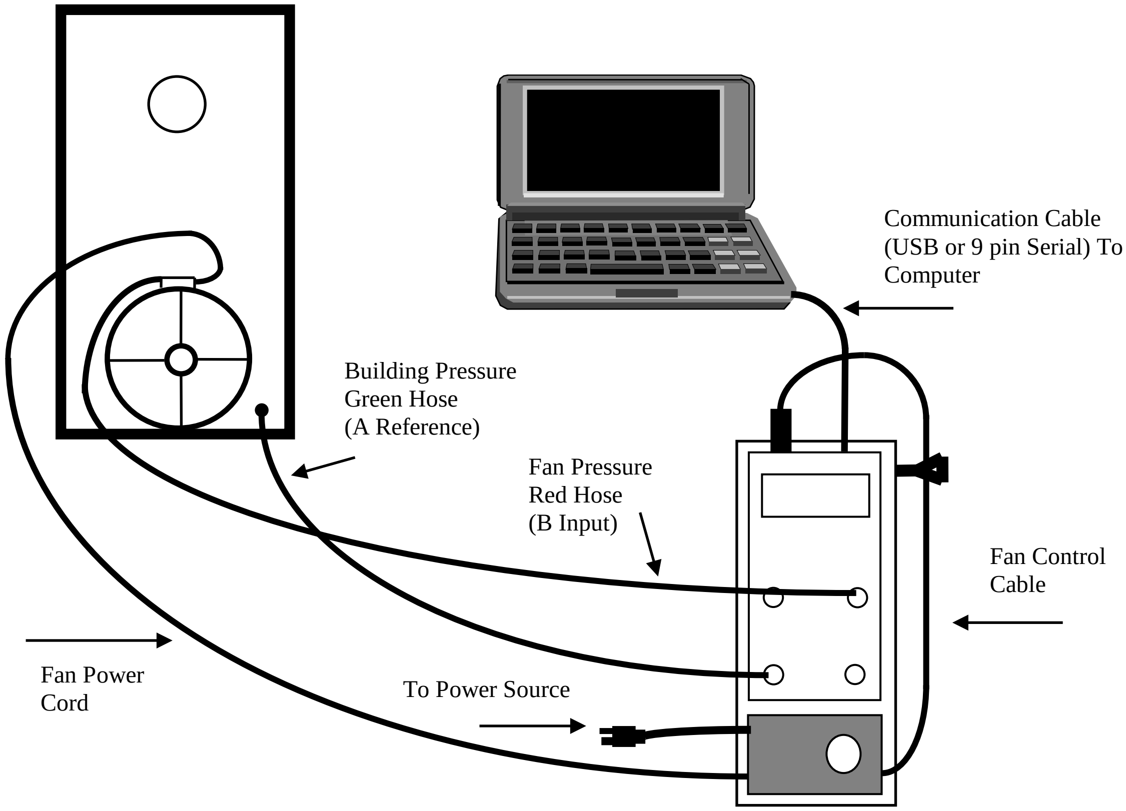
5. Connect tubing between the DG-700 and the Blower Door system (tubing connections are detailed in the Blower Door operation manual).



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

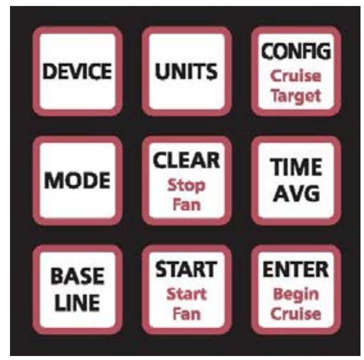
A.5 Using the DG-700's Cruise Control Feature

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:

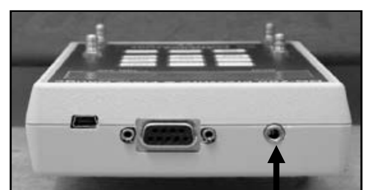
- Quickly measuring building airtightness using a "one-point" 50 Pa test.
- Quickly measuring duct airtightness using a "one-point" 25 Pa **total leakage** test.
- Simultaneously controlling both the Blower Door and Duct Blaster fans during a **leakage to outside** duct airtightness test. During this 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.

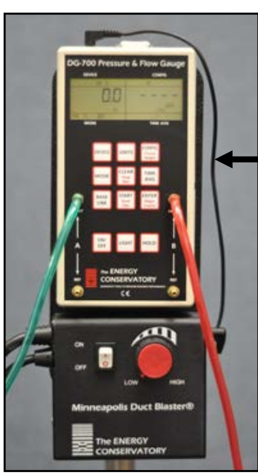
In order to use the Cruise Control feature you will need the following 3 items:

- 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.

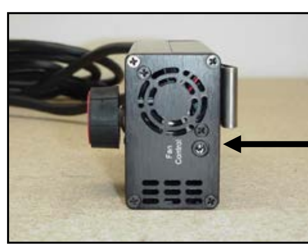


Fan Control cable.





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.

VELOCICALC® ROTATING VANE ANEMOMETER MODEL 5725

The VelociCalc® 5725 is a high performance, yet simple to use, rotating vane anemometer. High accuracy and reliability make the VelociCalc 5725 the professional's ideal tool for measuring unevenly distributed or fluctuating flows through heating and cooling coils, grilles, and filters.

It accurately measures air velocity and temperature, calculates flow rate, performs averaging, and can determine minimum and maximum readings. Using sweep mode, you can quickly provide one averaged reading of velocity or volume over a large measurement area. The large vane head automatically averages and dampens velocity and volume readings. The VelociCalc 5725 includes variable time constant, sampling and statistics functions and data logging capability.

Applications

+ Heating and cooling coil analysis
+ Grille measurements
+ Face velocity measurements
  - Filters
  - Kitchen exhausts

Features and Benefits

+ Reversible 4 in. (100 mm) head to read supply and exhaust flows
+ Calculates volumetric flow rate when user inputs duct shape and size, or area
+ Sampling function records multiple point measurements
+ Automatic averaging of air velocity
+ Simultaneously displays velocity and temperature
+ Sweep mode for one overall measurement
+ Optional 36 in. telescopic probe available
+ Compatible with optional Aircone flow hoods

Data Logging Features

+ Logs 12,700+ samples with a time and date stamp
+ Recall, review, store data
+ LogDat2™ downloading software included

TSI® UNDERSTANDING, ACCELERATED

SPECIFICATIONS

VELOCICALC® ROTATING VANE ANEMOMETER
MODEL 5725

Velocity

Range	50 to 6,000 ft/min (0.25 to 30 m/s)
Accuracy	±1.0% of reading ±4 ft/min (±0.02 m/s)

Duct Size

Range	0 to 500 ft^2 (0 to 46.45 m^2)

Volumetric Flow Rate

Range	Actual range is a function of velocity and duct area

Temperature

Range	40 to 113°F (5 to 45°C)
Accuracy	±2.0°F (±1.0°C)
Resolution	0.1°F (0.1°C)

Instrument Temperature Range

Operating (Electronics)	40 to 113°F (5 to 45°C)
Storage	-4 to 140°F (-20 to 60°C)

Data Storage Capabilities

Range	12,700+ samples and 100 test IDs

Logging Interval
1 second to 1 hour

Time Constant
User selectable

External Meter Dimensions (H x W x D)
3.3 in. x 7.0 in. x 1.8 in. (8.4 cm x 17.8 cm x 4.4 cm)

Meter Weight with Batteries
0.6 lbs (0.27 kg)

Power Requirements
Four AA-size batteries or optional AC adapter

Aircone Flow Hoods

Aircone Flow Hoods are a fast and accurate method of maximizing the usefulness of your 4 in. (100-mm) rotating vane anemometers. For a modest investment, you can enhance the capability of your rotating vane, turning it into an air volume flow balancing tool.

Features and Benefits

+ Rectangular and circular cones available
+ Measures volumetric flow at grilles, diffusers, and linears
+ Reads air volume quickly and accurately
+ Excellent choice for small grilles

TSI Aircone Flow Kit (p/n 801749) includes one each:

Rectangular	11.2 in. x 9.2 in. (285 mm x 235 mm)
Round	7.1 in. (180 mm) diameter
Range	0 to 210ft³/min (0 to 100 l/s, 0 to 360 m³/h)

Accessories

801748	Telescopic articulated extension 1.3 to 3.6 ft (0.4 to 1.1 m)

Specifications are subject to change without notice.

UNDERSTANDING, ACCELERATED

TSI Incorporated - Visit our website **www.tsi.com** for more information.

USA	**Tel:** +1 800 874 2811	**India**	**Tel:** +91 80 67877200
UK	**Tel:** +44 149 4 459200	**China**	**Tel:** +86 10 8219 7688
France	**Tel:** +33 4 91 11 87 64	**Singapore**	**Tel:** +65 6595 6388
Germany	**Tel:** +49 241 523030		

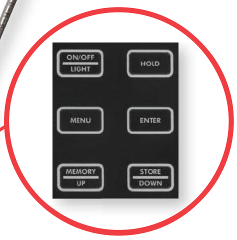
P/N 2980577 Rev C Printed in U.S.A.

Dwyer

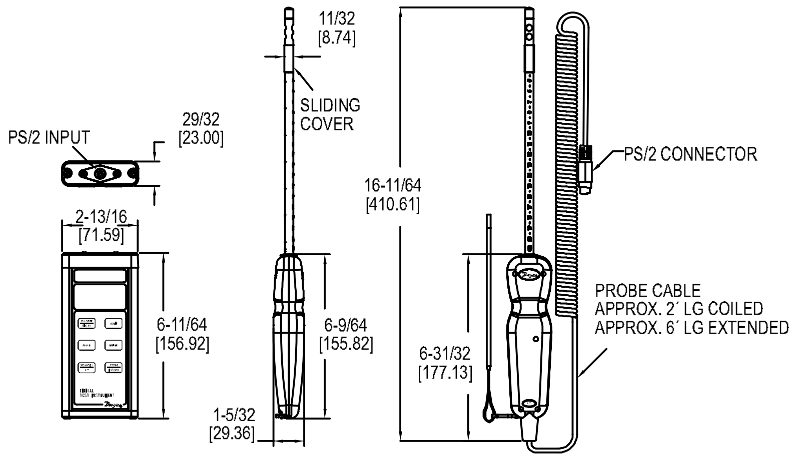
MODEL 471B

THERMO-ANEMOMETER TEST INSTRUMENT

Measures Air Velocity or Air Volume and Temperature Simultaneously



New Six Button Operation Provides Quick Access to Enhanced Features



The **MODEL 471B** Thermo-Anemometer Test Instrument is a versatile dual function unit that quickly and easily measures air velocity or volumetric flow as well as air temperature in imperial or metric units. A stainless steel probe is included, which has a comfortable hand grip and etched insertion depth marks. The extruded aluminum housing fully protects electronics, yet is lightweight and comfortable to hold.

FEATURES/BENEFITS

- Compatible with Dwyer RP1 thermo-hygrometer and VP1 100 mm vane thermo-anemometer probes (sold separately)
- High contrast and backlit LCD for visibility in any condition
- Able to store up to 99 readings
- Integral sliding cover protects probe sensors when not in use
- Built-in volumetric air flow calculations

APPLICATIONS

- Duct traverses
- HVAC inspections
- Testing and balancing

SPECIFICATIONS

Service: Air velocity and temperature of clean, dry air.
Temperature Limits: Process air velocity: -20 to 212°F (-29 to 100°C); Process temperature: -40 to 212°F (-40 to 100°C); Ambient: 5 to 125°F (-15 to 51°C).
Display: 4.5 digit LCD.
Resolution: 0.1%, 0.1 °F/°C.
Range Air Velocity: 0 to 6000 FPM (0 to 30 m/s).
Accuracy Air Velocity: ±3% FS within temperature range of 40 to 90°F (4 to 32°C).
Range Volumetric Air Flow: 19,999 in selected flow units.
Range Temperature: -40 to 212°F (-40 to 100°C).
Accuracy Temperature: ±0.5°F (±0.28°C) from 32 to 122°F (0 to 50°C); ±1.5°F (±0.83°C) from -40 to 32°F (-40 to 0°C) & 122 to 212°F (50 to 100°C).
Probe Length: 8˝ (203 mm) insertion.
Cable Length: 28˝ (71 cm) retracted, 6 ft (183 cm) extended.
Power Requirements: 9 V alkaline battery, installed non-functional, user replaceable.
Weight: 16 oz (454 g).
Agency Approvals: CE.

MODEL CHART

Model	Description
471B-1	Digital thermo anemometer includes 9V battery, sensing probe, wrist strap, soft carrying case and instructions

ACCESSORIES - CASES

Model	Description
UHH-C1	Spare soft carrying case
A-160-CASE	Hard carrying case for longer probes (18˝ to 36˝)
A-47X-BOOT	Protective magnetic rubber boot

ACCESSORIES - PROBES

Model	Probe Length	Description
AP1	8˝	Thermo anemometer air velocity & temperature probe with coiled cable
AP1-18	18˝	Thermo anemometer air velocity & temperature probe with coiled cable
AP1-24	24˝	Thermo anemometer air velocity & temperature probe with coiled cable
AP1-36	36˝	Thermo anemometer air velocity & temperature probe with coiled cable

Replaceable Probe with Secure 6 Pin Adapter

Soft Carrying Case Included with Every Unit

A-47X-BOOT (Manometer not included)

Industrial grade portable GFCIs

Industrial grade 20A portable GFCIs

Product description

2-pole, 3-wire grounding
20A, 120V/AC; 20A, 240V/AC

GFI12M1NN

GFI12M133

20A portable GFCIs, inline series

A	Rating V/AC	NEMA	NEMA Type	Connector style	Cord length	Cord gauge	Catalog no.*
20	120	N/A	4X	Flying leads - field wireable	2' (0.61m)	12/3 AWG	☐ GFI12M1NN
				Flying leads - field wireable	6' (1.83m)	12/3 AWG	☐ GFI12M2NN
				Flying leads - field wireable	25' (7.62m)	12/3 AWG	☐ GFI12M4NN
				Flying leads - field wireable	50' (15.24m)	12/3 AWG	☐ GFI12M6NN
20	240	N/A	4X	Flying leads - field wireable	2' (0.61m)	12/3 AWG	☐ GFI22M1NN
				Flying leads - field wireable	6' (1.83m)	12/3 AWG	☐ GFI22M2NN
				Flying leads - field wireable	25' (7.62m)	12/3 AWG	☐ GFI22M4NN
				Flying leads - field wireable	50' (15.24m)	12/3 AWG	☐ GFI22M6NN

*Automatic reset GFCIs are also available. When ordering automatic portable GFCIs replace "M" in catalog number with "A". Example: GFI12A1NN = Automatic; GFI12M1NN = Manual

Inline series - molded plug & connector

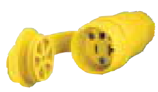
A	Rating V/AC	NEMA	NEMA Type	Connector style	Cord length	Cord gauge	Catalog no.
20	120	5-20	4X	Molded straight blade	2' (0.61m)	12/3 AWG	☐ GFI12M133
		L5-20	4X	Molded locking	2' (0.61m)	12/3 AWG	☐ GFI12M144
20	240	L6-20	4X	Molded locking	2' (0.61m)	12/3 AWG	☐ GFI22M144

*Automatic reset GFCIs are also available.When ordering automatic portable GFCIs replace "M" in catalog number with "A". Example: GFI12A133 = Automatic; GFI12M133 = Manual

Accessories for 20A portable GFCIs

Description	Catalog no.	NAFTA	RoHS
20A 125V/AC NEMA 5-20 watertight plug	☐ 14W33	•	•
20A 125V/AC NEMA 5-20 watertight connector	☐ 15W33	•	•
Standard depth portable outlet box with flip lids	☐ WD3059-DDN	•	•
20A 125V/AC NEMA 5-20 duplex straight blade receptacle - black	☐ BR20BK	•	•
20A 125V/AC NEMA L5-20 industrial receptacle	☐ AHL520R	•	•
20A 125V/AC NEMA 5-20 duplex straight blade corrosion resistant receptacle - yellow	☐ AH5362CRY	•	•

14W33



15W33

WD3059-DDN

BR20BK

AHL520R

AH5362CRY

Specification information: Specification grade 20A portable GFCIs: H-18
Compliances, specifications and availability are subject to change without notice

Indicates NAFTA compliant - Page Q-32 RoHS compliant - Page Q-32

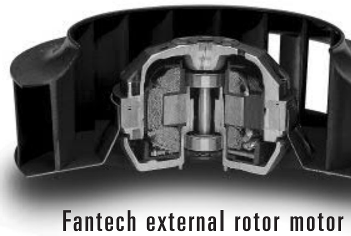
Fantech

HP SERIES

FANS FOR RADON APPLICATIONS
WITH IMPROVED UV RESISTANCE!

TRUST THE INDUSTRY STANDARD.
HERE'S WHY:

Don't put your reputation at stake by installing a fan you know won't perform like a Fantech! For nearly twenty years, Fantech has manufactured quality ventilation equipment for Radon applications. Fantech is the fan Radon contractors have turned to in over 1,000,000 successful Radon installations worldwide.



Fantech external rotor motor

FANTECH HP SERIES FANS MEET THE CHALLENGES OF RADON APPLICATIONS:

HOUSING
- UV resistant, UL Listed durable plastic
- UL Listed for use in commercial applications
- Factory sealed to prevent leakage
- Watertight electrical terminal box
- Approved for mounting in wet locations - i.e. Outdoors

MOTOR
- Totally enclosed for protection
- High efficiency EBM motorized impeller
- Automatic reset thermal overload protection
- Average life expectancy of 7-10 years under continuous load conditions

RELIABILITY
- Five Year Full Factory Warranty
- Over 1,000,000 successful radon installations worldwide

I M P R O V I N G I N D O O R A I R Q U A L I T Y T H R O U G H B E T T E R V E N T I L A T I O N

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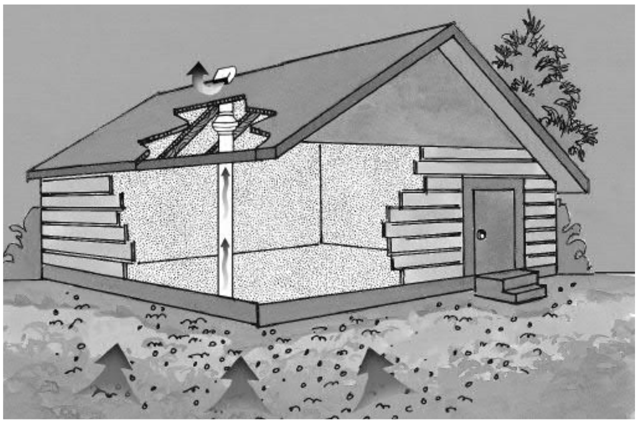


HP Series Fans are Specially Designed with Higher Pressure Capabilities for Radon Mitigation Applications

MOST RADON MITIGATORS WHO PREVIOUSLY USED THE FANTECH FR SERIES FANS HAVE SWITCHED TO THE NEW HP SERIES.

PERFORMANCE DATA

Fan Model	Volts	Wattage Range	Max. Amps	CFM vs. Static Pressure in Inches W.G.								Max. Ps
				0"	0.5"	0.75"	1.0"	1.25"	1.5"	1.75"	2.0"	
HP2133	115	14 - 20	0.17	134	68	19	-	-	-	-	-	0.84
HP2190	115	60 - 85	0.78	163	126	104	81	58	35	15	-	1.93
HP175	115	44 - 65	0.57	151	112	91	70	40	12	-	-	1.66
HP190	115	60 - 85	0.78	157	123	106	89	67	45	18	1	2.01
HP220	115	85 - 152	1.30	344	260	226	193	166	137	102	58	2.46

HVI MEMBER™

PERFORMANCE CURVES

Fantech provides you with independently tested performance specifications.

The performance curves shown in this brochure are representative of the actual test results recorded at Texas Engineering Experiment Station/Energy Systems Lab, a recognized testing authority for HVI. Testing was done in accordance with AMCA Standard 210-85 and HVI 916 Test Procedures. Performance graphs show air flow vs. static pressure.

Use of HP Series fans in low resistance applications such as bathroom venting will result in elevated sound levels. We suggest FR Series or other Fantech fans for such applications.

HP FEATURES INCLUDE

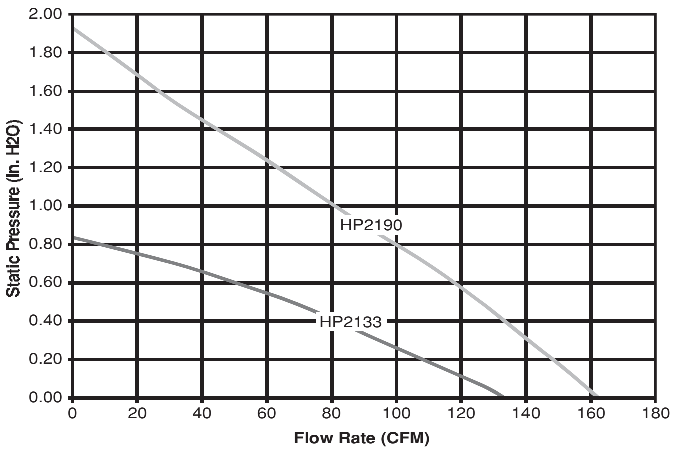
- Improved UV resistant housings approved for commercial applications.
- UL Approved for Wet Locations (Outdoors)
- Sealed housings and wiring boxes to prevent Radon leakage or water penetration
- Energy efficient permanent split capacitor motors
- External wiring box
- Full Five Year Factory Warranty

c UL us

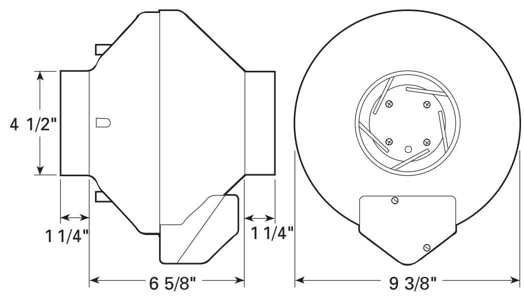
NOTE:

Installations that will result in condensate forming in the outlet ducting should have a condensate bypass installed to route the condensate outside of the fan housing. Conditions that are likely to produce condensate include but are not limited to: outdoor installations in cold climates, long lengths of outlet ducting, high moisture content in soil and thin wall or aluminum outlet ducting. Failure to install a proper condensate bypass may void any warranty claims.

HP2133 & HP2190 RADON MITIGATION FANS



Tested with 4" ID duct and standard couplings.



HP2133 – For applications where lower pressure and flow are needed. Record low power consumption of 14-20 watts! Often used where there is good sub slab communication and lower Radon levels.

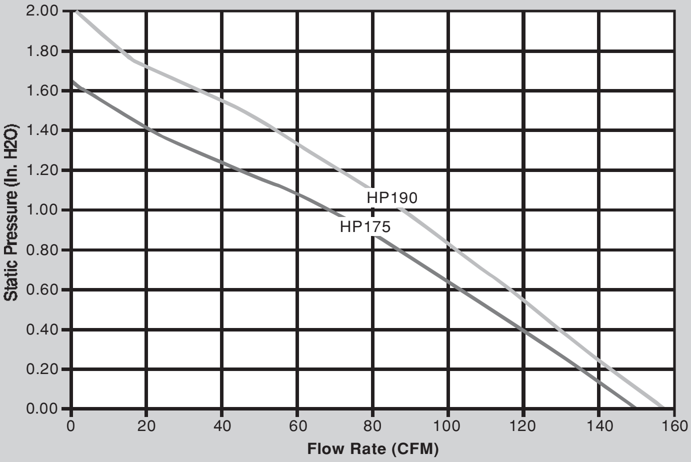
HP2190 – Performance like the HP190 but in a smaller housing. Performance suitable for the majority of installations.

Fans are attached to PVC pipe using flexible couplings.

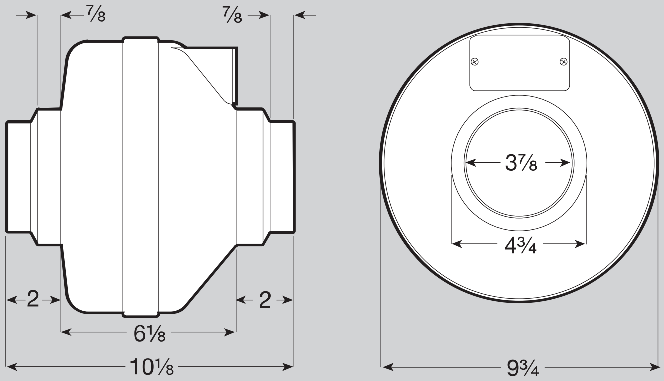
For 4" PVC pipe use Indiana Seals #156-44, Pipeconx PCX 56-44 or equivalent.

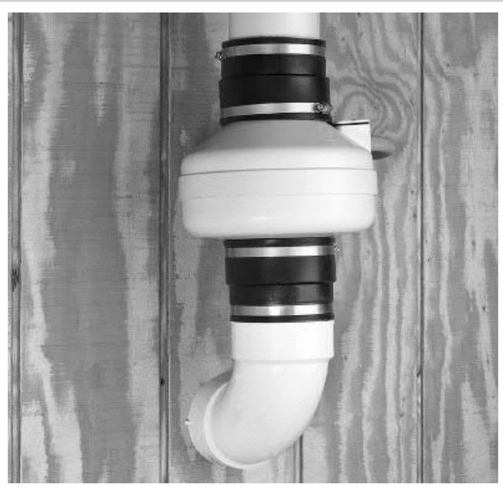
For 3" PVC pipe use Indiana Seals #156-43, Pipeconx PCX 56-43 or equivalent.

HP175 & HP190 RADON MITIGATION FANS



Tested with 4" ID duct and standard couplings.



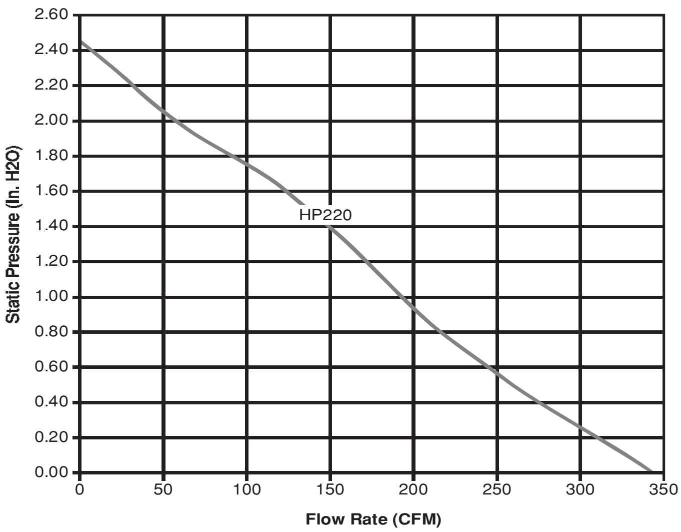


HP175 – The economical choice where slightly less air flow is needed. Often used where there is good sub slab communication and lower Radon levels.

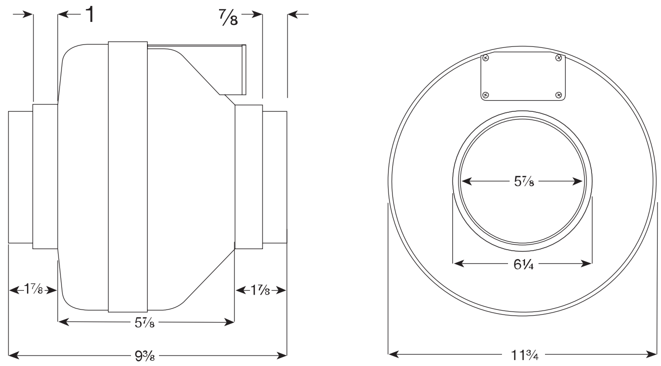
HP190 – The standard for Radon Mitigation. Ideally tailored performance curve for a vast majority of your mitigations.

Fans are attached to PVC pipe using flexible couplings.
For 4" PVC pipe use Indiana Seals #151-44, Pipeconx PCX 51-44 or equivalent.
For 3" PVC pipe use Indiana Seals #156-43, Pipeconx PCX 56-43 or equivalent.

HP220 RADON MITIGATION FAN



Tested with 6" ID duct and standard couplings.



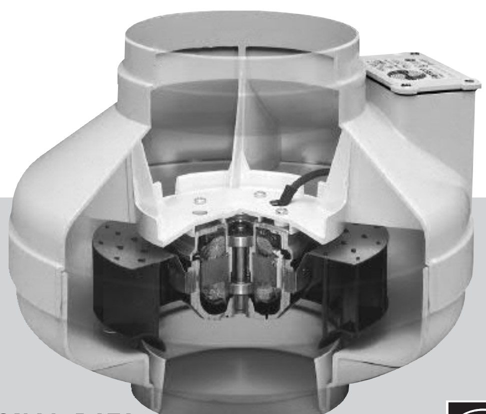
HP 220 – Excellent choice for systems with elevated radon levels, poor communication, multiple suction points and large subslab footprint. Replaces FR 175.

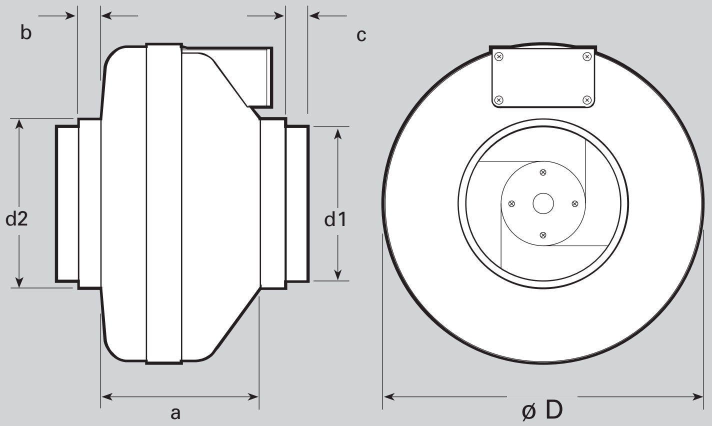
Fans are attached to PVC pipe using flexible couplings.
For 4" PVC pipe use Indiana Seals #156-64, Pipeconx PCX 56-64 or equivalent.
For 3" PVC pipe use Indiana Seals #156-63, Pipeconx PCX 56-63 or equivalent.

Fantech

FR SERIES

THE ORIGINAL MITIGATOR





DIMENSIONAL DATA

model	øD	d1	d2	a	b	c
FR100	9 1/2	3 7/8	4 7/8	6 1/8	7/8	7/8
FR110	9 1/2	3 7/8	4 7/8	6 1/8	7/8	7/8
FR125	9 1/2	–	4 7/8	6 1/8	7/8	–
FR140	11 3/4	5 7/8	6 1/4	5 7/8	1	7/8
FR150	11 3/4	5 7/8	6 1/4	5 7/8	1	7/8
FR160	11 3/4	5 7/8	6 1/4	6 3/8	1	7/8
FR200	13 1/4	7 7/8	9 7/8	6 1/4	1 1/2	1 1/2
FR225	13 1/4	7 7/8	9 7/8	6 1/4	1 1/2	1 1/2
FR250	13 1/4	–	9 7/8	6 1/4	–	1 1/2

All dimensions in inches

PERFORMANCE DATA

Fan Model	Energy Star	RPM	Volts	Rated Watts	Wattage Range	Max. Amps	CFM vs. Static Pressure in Inches W.G.							Max. Ps	Duct Dia.
							0"	.2"	.4"	.6"	.8"	1.0"	1.5"		
FR100	✓	2950	120	21.2	13 - 22	0.18	137	110	83	60	21	-	-	0.90"	4"
FR125	✓	2950	115	18	15 - 18	0.18	148	120	88	47	-	-	-	0.79"	5"
FR150	✓	2750	120	71	54 - 72	0.67	263	230	198	167	136	106	17	1.58"	6"
FR160	-	2750	115	129	103 - 130	1.14	289	260	233	206	179	154	89	2.32"	6"
FR200	✓	2750	115	122	106 - 128	1.11	408	360	308	259	213	173	72	2.14"	8"
FR225	✓	3100	115	137	111 - 152	1.35	429	400	366	332	297	260	168	2.48"	8"
FR250*	-	2850	115	241	146 - 248	2.40	649	600	553	506	454	403	294	2.58"	10"

FR Series performance is shown with ducted outlet. Per HVI's Certified Ratings Program, charted air flow performance has been derated by a factor based on actual test results and the certified rate at .2 inches WG.
** Also available with 8" duct connection. Model FR 250-8. Special Order.*

NOTE:
Installations that will result in condensate forming in the outlet ducting should have a condensate bypass installed to route the condensate outside of the fan housing. Conditions that are likely to produce condensate include but are not limited to: outdoor installations in cold climates, long lengths of outlet ducting, high moisture content in soil and thin wall or aluminum outlet ducting. Failure to install a proper condensate bypass may void any warranty claims.

FIVE YEAR WARRANTY

DURING ENTIRE WARRANTY PERIOD:
FANTECH will replace any fan which has a factory defect in workmanship or material. Product may need to be returned to the Fantech factory, together with a copy of the bill of sale and identified with RMA number.

FOR FACTORY RETURN YOU MUST:
- Have a Return Materials Authorization (RMA) number. This may be obtained by calling FANTECH either in the USA at 1.800.747.1762 or in CANADA at 1.800.565.3548. Please have bill of sale available.
- The RMA number must be clearly written on the outside of the carton, or the carton will be refused.
- All parts and/or product will be repaired/replaced and shipped back to buyer; no credit will be issued.

OR

The Distributor may place an order for the warranty fan and is invoiced.
The Distributor will receive a credit equal to the invoice only after product is returned prepaid and verified to be defective.

FANTECH WARRANTY TERMS DO NOT PROVIDE FOR REPLACEMENT WITHOUT CHARGE PRIOR TO INSPECTION FOR A DEFECT. REPLACEMENTS ISSUED IN ADVANCE OF DEFECT INSPECTION ARE INVOICED, AND CREDIT IS PENDING INSPECTION OF RETURNED MATERIAL. DEFECTIVE MATERIAL RETURNED BY END USERS SHOULD NOT BE REPLACED BY THE DISTRIBUTOR WITHOUT CHARGE TO THE END USER, AS CREDIT TO DISTRIBUTOR'S ACCOUNT WILL BE PENDING INSPECTION AND VERIFICATION OF ACTUAL DEFECT BY FANTECH.

THE FOLLOWING WARRANTIES DO NOT APPLY:
- Damages from shipping, either concealed or visible. Claim must be filed with freight company.
- Damages resulting from improper wiring or installation.
- Damages or failure caused by acts of God, or resulting from improper consumer procedures, such as:

1. Improper maintenance
2. Misuse, abuse, abnormal use, or accident, and
3. Incorrect electrical voltage or current.

- Removal or any alteration made on the FANTECH label control number or date of manufacture.
- Any other warranty, expressed, implied or written, and to any consequential or incidental damages, loss or property, revenues, or profit, or costs of removal, installation or reinstallation, for any breach of warranty.

WARRANTY VALIDATION
- The user must keep a copy of the bill of sale to verify purchase date.
- These warranties give you specific legal rights, and are subject to an applicable consumer protection legislation. You may have additional rights which vary from state to state.

DISTRIBUTED BY:

Alarms

Fan Failure Alarm

Model RA1

Tjernlund's Fan Failure Alarm alerts homeowners of a radon fan failure or ice induced pipe blockage. Alarm sounds when loss of exhaust flow is detected. Secondary gauge port allows installer to measure actual system exhaust pressure. Large bright indicator lights are easily visible. Mounts to any flat surface or PVC piping. Includes low voltage power supply, sensing tubing and mounting hardware. Compatible with all Active Sub-Slab Depressurization (ASD) systems.

PVC Pipe: Schedule 40

NSF®

>> PVC Schedule 40 Pipe, Type 1, Grade 1 - Plain End

PVC SCHEDULE 40 (WHITE)		PLAIN END		PVC 1120		ASTM D 1785
PART NO.	NOM. SIZE	UPC # 611942-	AVG. OD (IN.)	MIN. WALL (IN.)	MAX WORK PRESSURE AT 23° C OR 73° F	WT. PER 100 FT. (LBS.)
PVC 4005	½″ x 10′	06658	.840	.109	600 PSI	15.9
PVC 4005	½″ x 20′	03922	.840	.109	600 PSI	15.9
PVC 4007	¾″ x 10′	06661	1.050	.113	480 PSI	21.1
PVC 4007	¾″ x 20′	03925	1.050	.113	480 PSI	21.1
PVC 4010	1″ x 10′	06664	1.315	.133	450 PSI	31.3
PVC 4010	1″ x 20′	03928	1.315	.133	450 PSI	31.3
PVC 7100*	1¼″ x 10′	03945	1.660	.140	370 PSI	42.4
PVC 7100*	1¼″ x 20′	03946	1.660	.140	370 PSI	42.4
PVC 7112*	1½″ x 10′	03947	1.900	.145	330 PSI	51.8
PVC 7112*	1½″ x 20′	03948	1.900	.145	330 PSI	51.8
PVC 7200*	2″ x 10′	03949	2.375	.154	280 PSI	69.5
PVC 7200*	2″ x 20′	03950	2.375	.154	280 PSI	69.5
PVC 4025‡	2½″ x 20′	04205	2.875	.203	300 PSI	110.0
PVC 7300*	3″ x 10′	03951	3.500	.216	260 PSI	144.2
PVC 7300*	3″ x 20′	03952	3.500	.216	260 PSI	144.2
PVC 7400†	4″ x 10′	03953	4.500	.237	220 PSI	205.5
PVC 7400†	4″ x 20′	03954	4.500	.237	220 PSI	205.5
PVC 7500†	5″ x 20′	04837	5.563	.258	190 PSI	272.5
PVC 7600†	6″ x 10′	03955	6.625	.280	180 PSI	361.2
PVC 7600†	6″ x 20′	03956	6.625	.280	180 PSI	361.2
PVC 7800†	8″ x 10′	13087	8.625	.322	160 PSI	543.6
PVC 7800†	8″ x 20′	03958	8.625	.322	160 PSI	543.6
PVC 7910†	10″ x 20′	03959	10.750	.365	140 PSI	770.7
PVC 7912†	12″ x 20′	03961	12.750	.406	130 PSI	1019.0
PVC 7914†	14″ x 20′	04862	14.000	.437	130 PSI	1205.0
PVC 7916†	16″ x 20′	04918	16.000	.500	130 PSI	1575.7

*** Dual Marked ASTM D 1785 and ASTM D 2665.**

† Triple Marked ASTM D 1785 & ASTM D 2665 & ASTM F 480.

‡ Dual Marked ASTM D 1785 & ASTM F 480.

NOTE: When ordering, please specify plain end or bell end.

NSF Listed. Meets All Requirements of ASTM D 1784 and ASTM D 1785.

⚠ WARNING

Testing with or use of compressed air or gas in PVC / ABS / CPVC pipe or fittings can result in explosive failures and cause severe injury or death.

- NEVER test with or transport/store compressed air or gas in PVC / ABS / CPVC pipe or fittings.
- NEVER test PVC / ABS / CPVC pipe or fittings with compressed air or gas, or air over water boosters.
- ONLY use PVC / ABS / CPVC pipe or fittings for water or approved chemicals.
- Refer to warnings on PPFA's website and ASTM D 1785.

>> PVC Schedule 40 Pipe, Type 1, Grade 1 - Bell End*

PVC SCHEDULE 40 (WHITE)			BELL END		PVC 1120		ASTM D 1785
PART NO.	NOM. SIZE	UPC # 611942-	AVG. OD (IN.)	MIN. WALL (IN.)	MAX WORK PRESSURE AT 23° C OR 73° F	BELL DEPTH (IN.)	WT. PER 100 FT. (LBS.)
PVC 4005B**	½″ x 10′	04986	.840	.109	600 PSI	2.00	15.9
PVC 4005B**	½″ x 20′	03923	.840	.109	600 PSI	2.00	15.9
PVC 4007B**	¾″ x 10′	04987	1.050	.113	480 PSI	2.25	21.1
PVC 4007B**	¾″ x 20′	03926	1.050	.113	480 PSI	2.25	21.1
PVC 4010B**	1″ x 10′	04988	1.315	.133	450 PSI	2.50	31.3
PVC 4010B**	1″ x 20′	03929	1.315	.133	450 PSI	2.50	31.3
PVC 4012B§	1¼″ x 10′	04989	1.660	.140	370 PSI	2.75	42.4
PVC 4012B§	1¼″ x 20′	03930	1.660	.140	370 PSI	2.75	42.4
PVC 4015B§	1½″ x 10′	04990	1.900	.145	330 PSI	3.00	51.8
PVC 4015B§	1½″ x 20′	03931	1.900	.145	330 PSI	3.00	51.8
PVC 4020B†	2″ x 10′	04991	2.375	.154	280 PSI	4.00	69.5
PVC 4020B†	2″ x 20′	03932	2.375	.154	280 PSI	4.00	69.5
PVC 4025B‡	2½″ x 20′	04206	2.875	.203	300 PSI	4.00	110.0
PVC 7300B§	3″ x 10′	04853	3.500	.216	260 PSI	4.00	147.6
PVC 4030B†	3″ x 20′	03933	3.500	.216	260 PSI	4.00	144.2
PVC 7400B§	4″ x 10′	04835	4.500	.237	220 PSI	4.00	212.3
PVC 9400B†	4″ x 20′	03964	4.500	.237	220 PSI	5.00	210.6
PVC 7600B§	6″ x 10′	04850	6.625	.280	180 PSI	6.50	379.3
PVC 9600B†	6″ x 20′	03965	6.625	.280	180 PSI	6.50	373.2
PVC 7800B†	8″ x 10′	09903	8.625	.322	160 PSI	7.00	556.9
PVC 9800B†	8″ x 20′	03967	8.625	.322	160 PSI	7.00	564.0
PVC 7910B†	10″ x 20′	03960	10.750	.365	140 PSI	9.00	781.4
PVC 7912B†	12″ x 20′	03962	12.750	.406	130 PSI	10.00	1033.2
PVC 7914B†	14″ x 20′	04863	14.000	.437	130 PSI	10.00	1221.8
PVC 7916B†	16″ x 20′	04929	16.000	.500	130 PSI	10.00	1594.5

*** Bell dimensions meet either ASTM D 2672 or ASTM F 480, depending upon pipe diameter**
**** ASTM D 1785**
§ Dual Marked ASTM D 1785 & ASTM D 2665
† Triple Marked ASTM D 1785 & ASTM D 2665 & ASTM F 480
‡ Dual Marked ASTM D 1785 & ASTM F 480

WARNING

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- NEVER test PVC / ABS / CPVC pipe or fittings with compressed air or gas, or air over water boosters.
- ONLY use PVC / ABS / CPVC pipe or fittings for water or approved chemicals.
- Refer to warnings on PPFA's website and ASTM D 1785.

>> PVC Well Casing, Type 1, Grade 1

PVC SCHEDULE 40 (WHITE)		BELL END WELL CASING		PVC 1120		ASTM F 480
PART NO.	NOM. SIZE	UPC # 611942-	AVG. OD (IN.)	MIN. WALL (IN.)	BELL DEPTH (IN.)	WT. PER 100 FT. (LBS.)
PVC 4020B	2″X20′	03932	2.375	.154	4.00	69.5
PVC 4025B	2½″X20′	04206	2.875	.203	4.00	110.0
PVC 4030B	3″X20′	03933	3.500	.216	4.00	144.2
PVC 9400B	4″X20′	03964	4.500	.237	5.00	210.6
PVC 9600B	6″X20′	03965	6.625	.280	6.50	373.2
PVC 9800B	8″X20′	03967	8.625	.322	7.00	564.0
PVC 7910B	10″X20′	03960	10.750	.365	9.00	781.4
PVC 7912B	12″X20′	03962	12.750	.406	10.00	1033.2
PVC 7914B	14″X20′	04863	14.000	.437	10.00	1221.8
PVC 7916B	16″X20′	04929	16.000	.500	10.00	1594.5

>> PVC SDR Pipe

PR 200	PVC 1120		BELL END		ASTM D 2241		SDR 21
PART NO.	NOM. SIZE	UPC # 611942-	AVG. OD (IN.)	MIN. WALL (IN.)	MAX WORK PRESSURE AT 23° C OR 73° F	BELL DEPTH (IN.)	WT. PER 100 FT. (LBS.)
PVC 23155B	*½″ x 20′	03991	.840	.062	315 PSI	2.00	10.0
PVC 20007B	¾″ x 10′	10742	1.050	.060	200 PSI	2.25	11.8
PVC 20007B	¾″ x 20′	03984	1.050	.060	200 PSI	2.25	11.8
PVC 20010B	1″ x 20′	03986	1.315	.063	200 PSI	2.50	15.7
PVC 20012B	1¼″ x 20′	03987	1.660	.079	200 PSI	2.75	25.5
PVC 20015B	1½″ x 20′	03988	1.900	.090	200 PSI	3.00	32.4
PVC 20020B	2″ x 20′	03989	2.375	.113	200 PSI	4.00	50.8

*PR 315 / SDR 13.5

PR 160	PVC 1120		BELL END		ASTM D 2241		SDR 26
PART NO.	NOM. SIZE	UPC # 611942-	AVG. OD (IN.)	MIN. WALL (IN.)	MAX WORK PRESSURE AT 23° C OR 73° F	BELL DEPTH (IN.)	WT. PER 100 FT. (LBS.)
PVC 16012B	1¼″ x 20′	04211	1.660	.064	160 PSI	2.75	21.5
PVC 16015B	1½″ x 20′	04210	1.900	.073	160 PSI	3.00	26.6
PVC 16020B	2″ x 20′	04212	2.375	.091	160 PSI	4.00	41.4
PVC 16030B	3″ x 20′	04222	3.500	.135	160 PSI	4.00	90.8

MADE IN U.S.A.

NSF

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- Refer to warnings on PPFA's website and ASTM D 1785.

Agri Drain CORPORATION

PO Box 458 · 1462 340th Street · Adair, Iowa 50002
Phone: 1-800-232-4742 · Fax: 1-800-282-3353
www.agridrain.com · email: info@agridrain.com

1 1/2", 2", 3", 4", 6", & 8" Valterra Gate Valves

Inexpensive valve for industrial, agricultural, and commercial markets.

- Must provide a stable base, and installation using flexible couplers is recommended.
- Well suited as a drain valve to tanks.
- Attaches to SCH40 PVC pipe.
- Unrestricted flow.
- Quick opening.
- Trouble-free simplicity.
- 100% water tested at factory.
- Quick shutoff in low pressure or vacuum lines.
- Other sizes available.

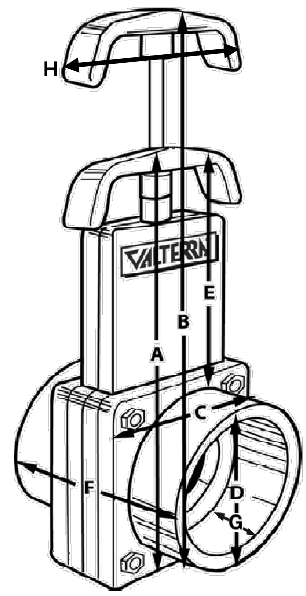
VALTERRA®

1 1/2" Valterra Gate Valve

Materials and Specifications					
	1 1/2"	**2"**	**3"**	**4"**	**6"/8"**
Color	White	White	White	White	White
Hubs	PVC	PVC	PVC	PVC	PVC
Body	PVC	PVC	PVC	PVC	ABS
Shaft	304SS	304SS	304SS	304SS	304SS
Paddle	Polypro	304SS	304SS	304SS	304SS
Handle	Plastic	Plastic	Plastic	Die Cast Aluminum	304SS
Seals	Sarlink	Sarlink	Sarlink	Sarlink	Sarlink
Max PSI Open/Closed	30/45	20/40	15/15	15/15	6/10

Dimensions and Hub Depth						
	1 1/2"	**2"**	**3"**	**4"**	**6"**	**8"**
A	6.5"	7.5"	9.25"	13.25"	22.75"	22.75"
B	8.625"	10.25"	13"	18"	31.125"	31.125"
C	2.896"	3.37"	4.37"	6.665"	11.1"	11.1"
D (Stub I.D.)	1.913"	2.387"	3.516"	4.518"	6.647"	8.655"
E	3.9375"	4.5"	5.1875"	7.4375"	13.25"	12.1875"
F	3.375"	3.5"	4.5"	5.1875"	11.125"	13.75"
G	1.25"	1.6"	1.8"	1.7"	4.375"	5.67"
H	3.25"	3.25"	3.25"	3.25"	3.5"	3.5"

"B" Dimension is height of valve in fully open position.



Extension Rods for Valterra Gate Valves

- Extension Rod for 1½"-4" Valve
  - Aluminum tube that easily threads onto valve shaft. Handle threads onto stub.
  - Available in 12", 24", 36", and 48" lengths.
- Extension Rod for 6"-8" Valve
  - Stainless steel rod with cotter pin(s) for assembly. Can attach multiple extensions together to achieve greater height.
  - Available in 12", 36", and 72" (two 36" pieces) lengths.

6" Valterra Gate Valve with Extension Rod

APPENDIX C – DATA COLLECTION FORM

SSD SYSTEM DATA COLLECTION FORM

Test Location	
Figure Number	
Date	
Technician Name	

Run at 100% Capacity					
Vacuum at Extraction Point (in. H_2O)					
Vacuum at Fan Inlet Point (in. H_2O)					
Pressure at Fan Outlet Point (in. H_2O)					
Pressure at Exhaust Outlet Point (in. H_2O)					
Airflow at Exhaust (ACFM)					
Test Point ID					
Distance from Extraction Point (ft).					
Time (20 minute intervals)	Induced Vacuum (in. H2O)				
Projected Radius of Influence					

Run at 66% Capacity					
Vacuum at Extraction Point (in. H_2O)					
Vacuum at Fan Inlet Point (in. H_2O)					
Pressure at Fan Outlet Point (in. H_2O)					
Pressure at Exhaust Outlet Point (in. H_2O)					
Airflow at Exhaust (ACFM)					
Test Point ID					
Distance from Extraction Point (ft).					
Time (20 minute intervals)	Induced Vacuum (in. H2O)				
Projected Radius of Influence					

Run at 33% Capacity					
Vacuum at Extraction Point (in. H_2O)					
Vacuum at Fan Inlet Point (in. H_2O)					
Pressure at Fan Outlet Point (in. H_2O)					
Pressure at Exhaust Outlet Point (in. H_2O)					
Airflow at Exhaust (ACFM)					
Test Point ID					
Distance from Extraction Point (ft).					
Time (20 minute intervals)	Induced Vacuum (in. H2O)				
Projected Radius of Influence					

Observations/Notes (cracks, setup, field changes, etc):

Photo Log: