Operating Instructions for Panther Duct Leakage Tester (Metric)

ORIFLOW
Air Leakage Test Equipment

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Introduction

These operating instructions are for ORIFLOW models PANTHER air leakage testers. Take pride in knowing that you have purchased the best air leakage tester on the market. It is no secret that Oriflow manufactures the highest quality testers, and has unparalleled customer service and technical support.

The orifice plates available for your duct leakage tester are constructed from laser-cut 1.6 mm stainless steel and do not require recalibration for 5 years. Note the authority having jurisdiction may override this requirement, and if so, Oriflow has reasonable rates for re-calibrating orifice plates manufactured by Oriflow.

Safety Precautions

Before operating your tester, read the following safety precautions:

- ✓ DO NOT operate the tester in the rain,
- ✓ DO NOT operate the tester while it is near or in water,
- ✓ DO NOT operate the tester with a damaged electrical cord or plug,
- ✓ DO NOT remove the inlet safety screen,
- ✓ DO NOT touch the blower wheel when the unit is plugged in,
- ✓ DO NOT look into the discharge end of the tester when the unit is plugged in,
- ✓ DO NOT use the tester as a ladder or step stool,
- ✓ DO NOT allow children near the tester,

- ✓ DO use an extension cord of the proper gauge (see *Table 2*),
- ✓ DO use the proper voltage and line frequency listed on the motor nameplate,
- ✓ DO lock the caster when the tester is positioned horizontally,
- ✓ DO use the tester on level ground,
- ✓ DO secure the tester when transporting it,
- ✓ DO wear proper hearing protection, safety glasses and work gloves,
- ✓ DO seek assistance when lifting the tester (e.g., loading onto truck, going up or down stairs).

Prior to Testing

Are you Using the Correct Tester?

See Table 1 for the maximum capacity for each duct tester when using the largest orifice plate.

Table 1 – Duct Leakage Tester Capacities

Maximum Leakage Capacity (L/s)*									
Model	250 Pa	500 Pa.	1000 Pa	1500 Pa	2000 Pa.	2500 Pa	3000 Pa	3500 Pa	4000 Pa.
Lynx	260 L/s	255 L/s	215 L/s	110 L/s	—	—	—	—	—
Cobra	310 L/s	305 L/s	285 L/s	220 L/s	95 L/s	—	—	—	—
Panther	635 L/s	625 L/s	570 L/s	505 L/s	415 L/s	290 L/s	125 L/s	—	—
Rhino	770 L/s	730 L/s	670 L/s	630 L/s	560 L/s	490 L/s	420 L/s	310 L/s	225 L/s

* – Using the largest sized orifice available for the model listed.

System Preparation

Cap off all ends of system using clear plastic and duct tape or sheetmetal duct end caps. Make sure you test the part of the duct system that leakage testing is required. Usually, this is from the system fan up to, but not including, the VAV boxes (terminal units). Refer to the engineer's specifications and all applicable codes and test standards.

Power Requirements

Do you have an adequate power supply for your tester (see *Table 1*)?

Table 1 – Tester Amp Draw

Tester Model	Voltage	Flow Control Option*	Full Load Amps
Panther	115	Inlet Slide Gate	31
	230	Inlet Slide Gate	16

* - The only flow control option for the Panther is the inlet slide gate. If a speed controller is desired, consider the Rhino model.

Extension Cord Requirements

If you need an extension cord, is it the proper gauge? See *Table 2* below for extension cord requirements.

Table 2 – Required Extension Cord Wire Gauge

Tester Model	Voltage	Extension Cord Length (feet)	Wire Gauge
Panther	115	up to 50	8
		51 to 100	6
	230	up to 100	12

Flex-Duct Length

Make sure you have enough flexible-duct with your tester for the job. Each tester includes 3.8 m, which is enough for most applications. Extra lengths of flexible-duct are available at www.oriflow.com/products.

Determining Maximum Allowable Leakage

To determine the maximum allowable leakage for the project, use ORIFLOW's **free online programs** to make these calculations (www.oriflow.com/programs).

In the U.S., calculations are done for either of the two typical specifications:

1. Percentage of system flow, or
2. SMACNA Leakage Class.

In Europe, Australia and other countries outside of the U.S., the following specification is commonly used:

1. Pressure Classification (Class A, B, C or D)

If the specification uses SMACNA Leakage Class or Pressure Class, you will need to calculate the total duct system surface area.

Oriflow has FREE Adobe forms available that will calculate duct surface area given the duct shape, dimensions and length (www.oriflow.com/freeform). These forms also calculate Leakage Factor, allowable leakage and Pass/Fail criteria among other calculations.

Determining Which Orifice Plate to Use

After determining the allowable leakage at the system test pressure, refer to the following tables for the capacities of each orifice plate available for the PANTHER model testers. **The proper orifice plate is the one where the specified allowable leakage falls between the minimum and maximum leakage at the system static pressure**.

For example, if you are testing a system at 2500 Pa pressure and the maximum allowable leakage is 250 L/s, you will need a 125 mm orifice plate (Table 7). Notice that the other orifice plates do not have a minimum and maximum flow rate where 250 L/s lies between.

Table 3 – Tester Capacity using the 25mm Orifice Plate

System Static Pressure (Pa)	Minimum Flow Rate* (L/s)	PANTHER Tester Maximum Flow Rate (L/s)
500	2.4	21
1000	2.4	19
1500	2.4	17
2000	2.4	14
2500	2.4	12
3000	2.4	7

Table 4 – Tester Capacity using the 50mm Orifice Plate

System Static Pressure (Pa)	Minimum Flow Rate* (L/s)	PANTHER Tester Maximum Flow Rate (L/s)
500	12	90
1000	12	80
1500	12	70
2000	12	60
2500	12	50
3000	12	25

Determining Which Orifice Plate to Use (continued)

Table 5 – Tester Capacity using the 75mm Orifice Plate

System Static Pressure (Pa)	Minimum Flow Rate* (L/s)	PANTHER Tester Maximum Flow Rate (L/s)
500	50	185
1000	50	165
1500	50	145
2000	50	125
2500	50	95
3000	50	55

Table 6 – Tester Capacity using the 100mm Orifice Plate

System Static Pressure (Pa)	Minimum Flow Rate* (L/s)	PANTHER Tester Maximum Flow Rate (L/s)
500	105	385
1000	105	350
1500	105	310
2000	105	260
2500	105	200
3000	105	115

Table 7 – Tester Capacity using the 125mm Orifice Plate

System Static Pressure (Pa)	Minimum Flow Rate* (L/s)	PANTHER Tester Maximum Flow Rate (L/s)
500	190	625
1000	190	570
1500	190	500
2000	190	415
2500	190	290
3000	190	125

Install Orifice Plate and Upper Tube Section

The orifice plate that was determined from the previous section should now be installed with the serial number facing upwards, so the corresponding calibration certificate may be referenced after installation. Refer to *Figures 1* through *4*.

Figure 1 – Install Orifice Plate and then Rotate Clockwise

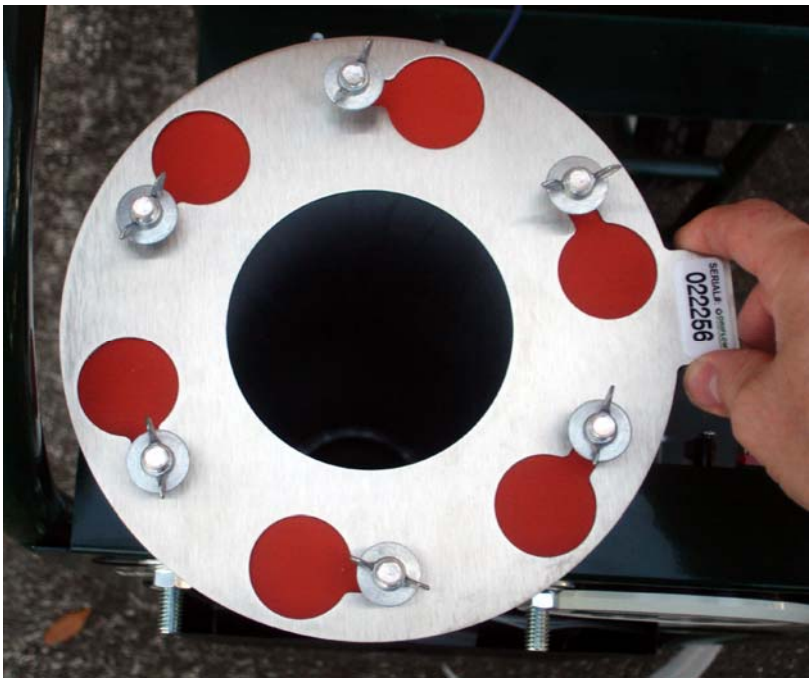

Figure 2 – Rotate Orifice Plate Clockwise until it Locks in Place

Install Orifice Plate and Upper Tube Section (continued)

After the orifice plate is locked in place, place the upper tube section over the bolt/wing nut set, rotate clockwise, and tighten wing nuts (Figures 3 and 4).

Figure 3 – Install Upper Tube Section and Rotate Clockwise

Figure 4 – Tighten Wing Nuts after Rotation

Connect Flexible Duct to Orifice Tube

See Figure 5 below for securing one end of the flexible duct to the orifice tube. Note that the worm-gear clamp should be slid over the flex-duct **before** connecting it to the orifice tube. Slide the flexible duct so that it overlaps the orifice tube 50 to 75 mm, and tighten clamp using a 8 mm nut driver.

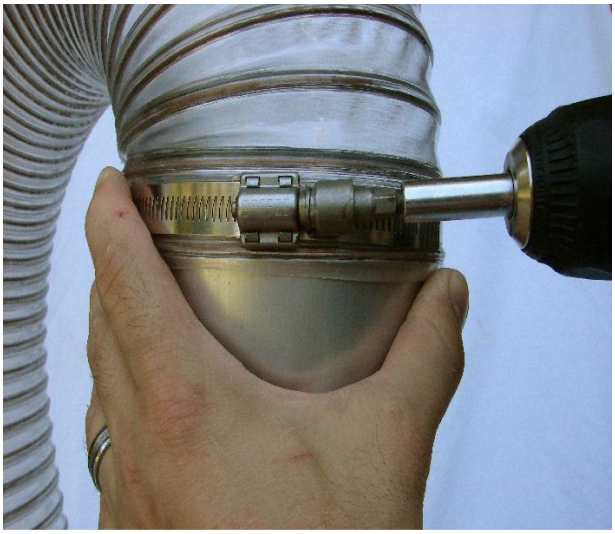

Figure 5 – Installing Flex-Duct on Tube

Connect Flex-Duct to Duct System

Connect the one end of the flex-duct to the duct system. Find a convenient location in the duct system where the tester has easy access. Make sure the connection is a sturdy, sealed tight connection. You don't want to create a leaky connection thereby adding to the system leakage.

Figure 6 – Connection to Duct System

System Test Pressure Connection

Refer to Figures 7 and 8. To monitor the system static pressure, you need to drill a 8 mm diameter hole at least 1 m away from the flex-duct connection. Next, insert the grey, plastic static pressure tap that is located on the end of the pressure tubing coming from the “DUCT SYSTEM” gauge. Seal the pressure tap to the duct wall using duct tape (Figure 7).

If the static pressure tap is missing, just insert end of pressure tubing from the “DUCT SYSTEM” gauge so that 150 to 305 mm of tubing is inside the duct system. Using putty or duct tape, seal the connection. See *Figure 8*.

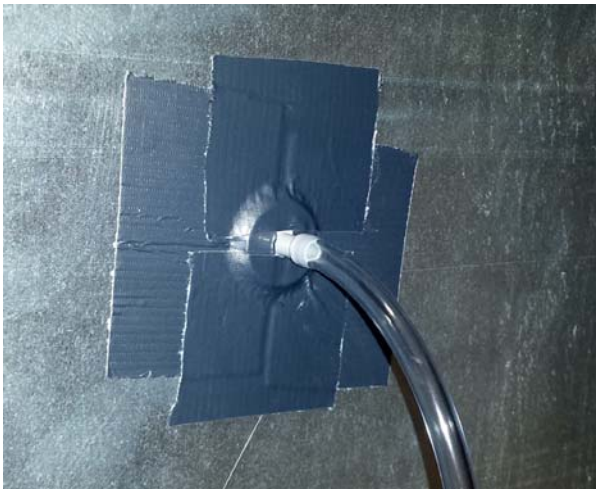

Figure 7 – Connection to Duct System using Static Pressure Tap

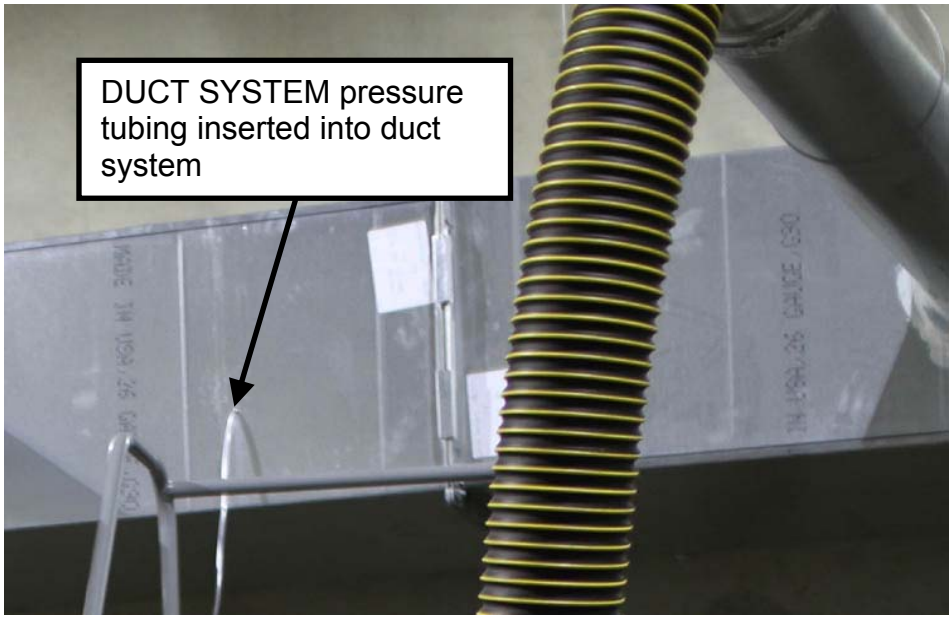

Figure 8 - Static Pressure Tubing Connection

Duct Leakage Test Setup (SUPPLY)

See *Figure 9* for the test setup for SUPPLY duct system testing (positive pressure testing). On the backside of the DUCT SYSTEM pressure gauge, move the pressure tubing to the pressure port labeled SUPPLY SYSTEM.

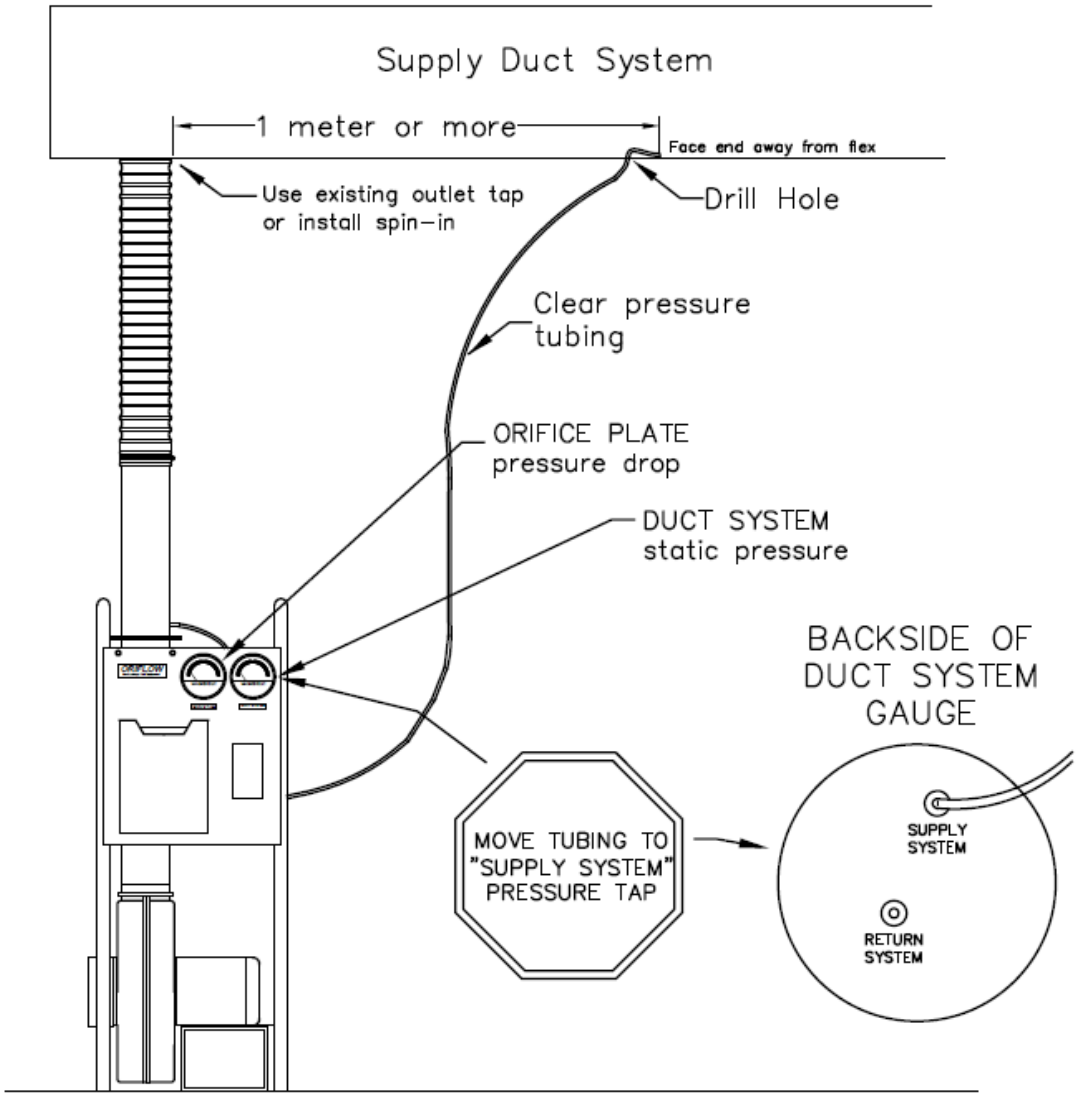

Figure 9 – Duct Leakage Test Setup for a SUPPLY System

Duct Leakage Test Setup (RETURN/EXHAUST)

Refer to *Figure 10* for the test setup required to measure air leakage of a RETURN/EXHAUST system (negative pressure testing). On the backside of the DUCT SYSTEM pressure gauge, move the pressure tubing to the pressure port labeled RETURN SYSTEM.

Connect flex-duct (must use HD flex; unit comes with SD flex) to the inlet of the blower so that air from the system is drawn into the blower.

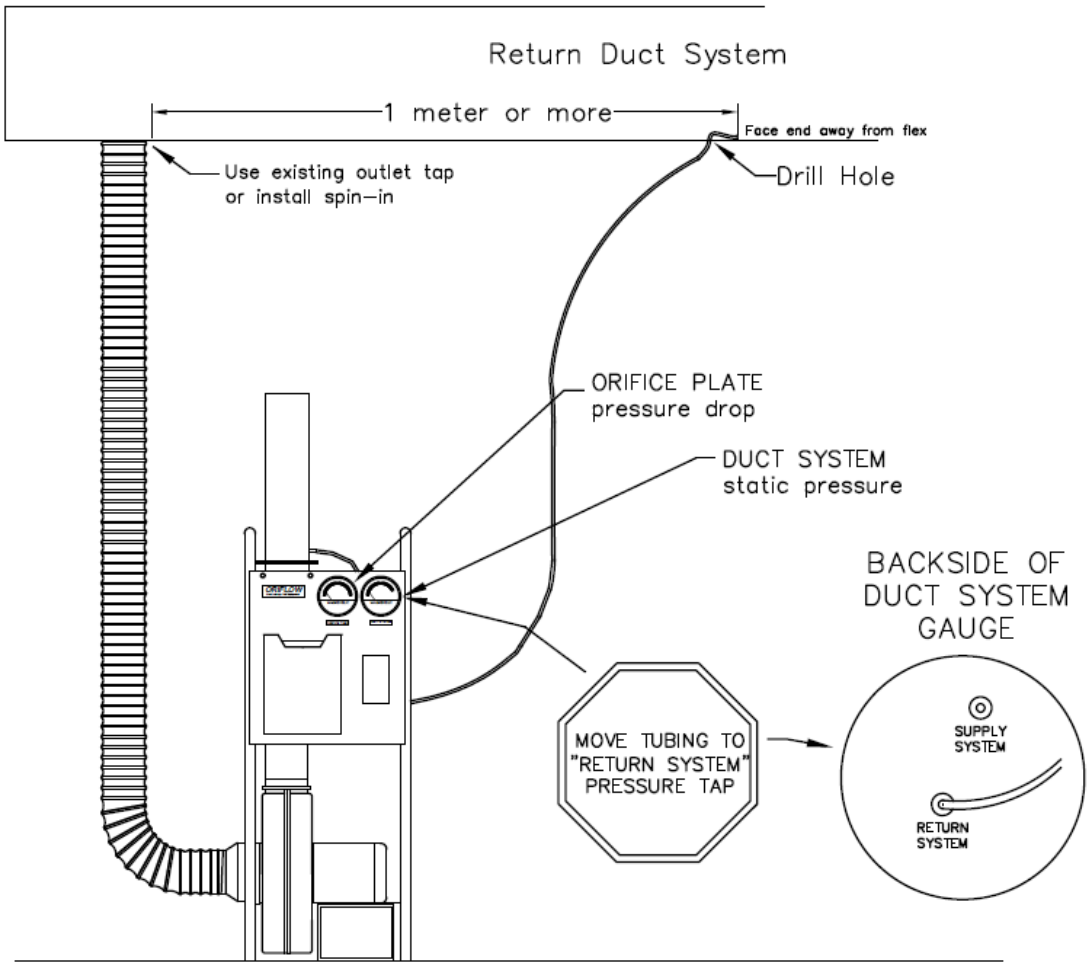

Figure 10 – Duct Leakage Test Setup for a RETURN/EXHAUST System

Zeroing Pressure Gauges

Before you turn on the tester, make sure both gauges have been zeroed.

Zeroing **Analog** Gauges

Using a small slotted screwdriver, turn the zero-adjustment screw on the gauge until the needle is aligned with the zero reading. Turning the screw clockwise increases the pressure reading; turning it counterclockwise decreases the reading. See *Figure 11*.

Figure 11 – Zeroing Analog Gauges

Zeroing **Digital** Gauges

First, turn on both gauges by pressing the black (or red) button located on the backside of each gauge.

Use the following steps to zero each digital gauge:

1. Press **MENU** button once.
2. Press ▼ arrow button until Adu shows on screen.
3. Press **E** button once to go into auto-zero mode
4. Press **E** button again and AUTO will be blinking on screen
5. Press **E** button a third time to complete the zeroing process.
6. Press **MENU** button two times to get back to the pressure reading.
7. Pressure should be reading zero or within +/- 4 Pa. If not, repeat steps.

Avoid Over-Pressurization

Prior to starting the blower, shut the inlet slide gate on models without the speed controller option. For models with the VFD speed controller, press and hold the DOWN button ▼ until the readout shows 10.00 (the lowest speed setting). If powering up for the first time, the reading will already be at 10.00. See Figure 12.

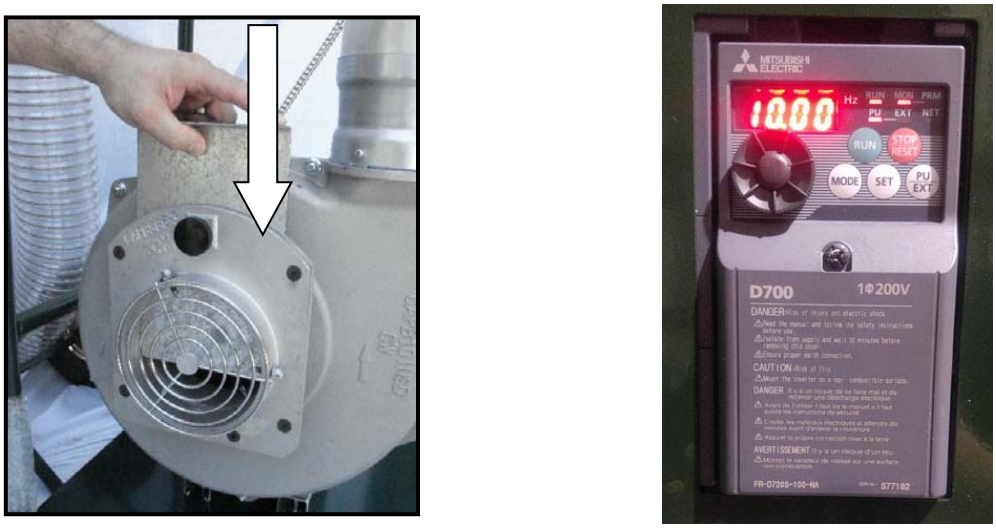

Figure 12 – Avoid Over-Pressurizing by Minimizing Air Delivery upon Startup (inlet slide model on left, VFD speed control model on right)

Obtaining System Test Pressure

Turn the blower on and **slowly** open the inlet slide gate if your tester has an inlet slide gate. If your tester has the VFD speed controller, **slowly** rotate knob clockwise. See Figure 13.

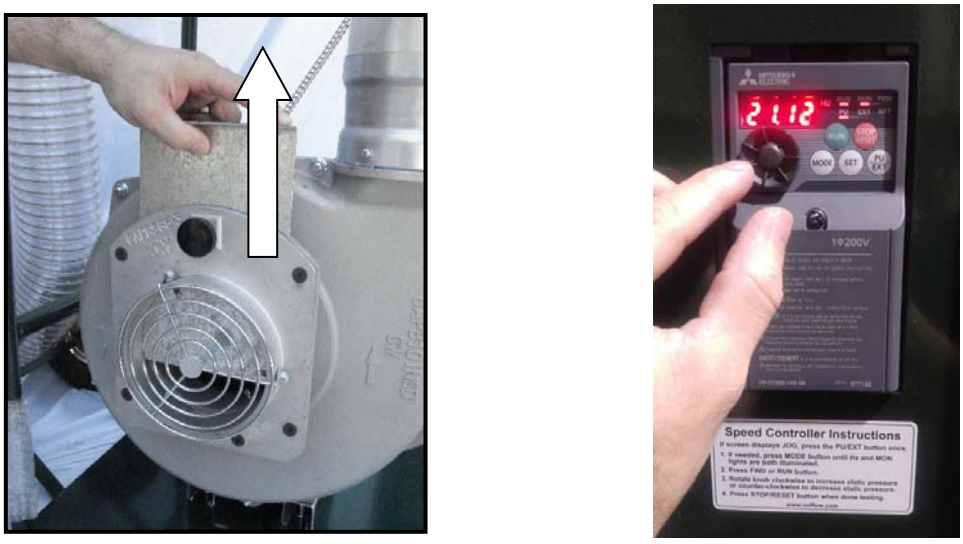

Figure 13 – Obtaining System Test Pressure (inlet slide model on left, VFD speed control model on right)

Obtaining System Test Pressure (continued)

Regardless of tester model used, pay attention to the “DUCT SYSTEM” gauge while increasing airflow. When you have reached the required system static pressure, tighten the set-screw on the inlet damper (or STOP rotating speed control knob).

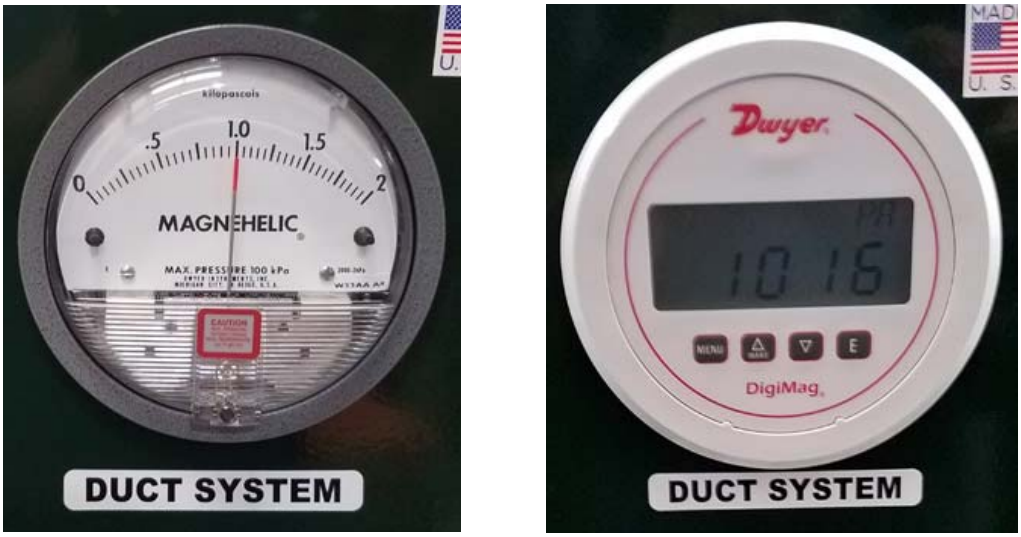

Figure 14 – Duct System Gauge Reading (analog on left, digital on right)

Determining the Leakage Rate

Now that you have obtained the system test pressure, note the pressure reading of the ORIFICE PLATE gauge (*Figure 15*). Refer to your calibration certificate to determine the leakage rate that corresponds to the gauge reading. An example of a calibration certificate is shown in *Figure 16*; it is for informational purposes only and used in the example shown on the next page. **Always refer to the calibration certificate(s) that came with your calibrated orifice plate(s).**

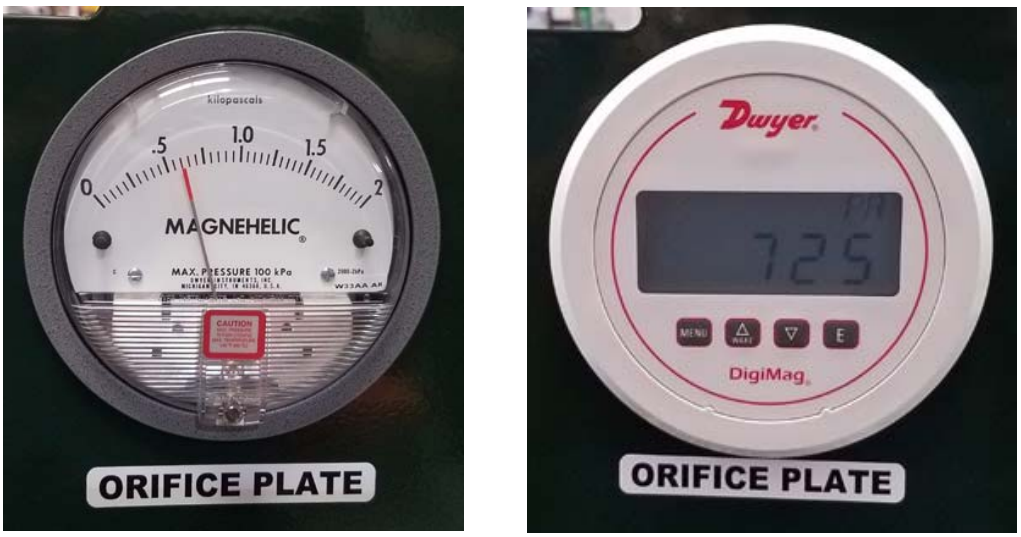

Figure 15 –ORIFICE PLATE Gauge Reading (analog on left, digital on right)

SAMPLE CALIBRATION CERTIFICATE
USE YOUR CERTIFICATE

Calibration Certificate for Plate No. 023294

Customer orifice plate was calibrated using ORIFLOW's proprietary internal test procedure OTP-TM-1105. The ORIFLOW laboratory follows applicable test procedures contained in ANSI/ASHRAE 41.1, 41.2 and 41.3. Calibration equipment is traceable to NIST. Estimated uncertainty of orifice plate flow reading is +/- 2%.

Issue Date:	06/20/17	Orifice Size:	**101.6 mm**	Material:	304 SS
Reference Meter:	Z50MC2-8	Orifice Serial #:	023294	Tube Diameter:	152.4 mm

Standard Temperature and Pressure (22.1 °C and 101.3 kPa)

"ORIFICE PLATE" Gauge Reading (Pa)	Leakage Rate (L/s)	"ORIFICE PLATE" Gauge Reading (Pa)	Leakage Rate (L/s)	"ORIFICE PLATE" Gauge Reading (Pa)	Leakage Rate (L/s)
0	0.0	423	148.3	846	209.7
25	36.0	448	152.6	871	212.8
50	50.9	473	156.8	896	215.8
75	62.3	498	160.8	921	218.8
100	71.9	523	164.8	946	221.7
124	80.4	548	168.7	971	224.6
149	88.1	572	172.5	996	227.5
174	95.2	597	176.2	1021	230.3
199	101.7	622	179.8	1045	233.1
224	107.9	647	183.4	1070	235.8
249	113.7	672	186.9	1095	238.6
274	119.3	697	190.3	1120	241.3
299	124.6	722	193.7	1145	243.9
324	129.7	747	197.0	1170	246.6
348	134.6	772	200.3	1195	249.2
373	139.3	797	203.5	1220	251.8
398	143.9	821	206.6	1245	254.3

You may use a calculator to calculate leakage using the "ORIFICE TUBE" gauge reading and the following equation:

Leakage (L/s) = 7.206 x $\sqrt{\text{ORIFICE PLATE Gauge Reading}}$

Figure 16 – **Example Calibration Certificate**. Use the calibration certificate that came with your orifice plate

Example (refer to Figures 15 and 16)

For an ORIFICE PLATE gauge reading of 725 Pa (Figure 15), the leakage rate is approximately 194 L/s using the calibration certificate shown in Figure 16 (see arrow).

For an exact value, use the equation that comes with every calibration certificate. For the example shown in Figure 16:

$$\textit{Leakage} = 7.206 \times \sqrt{\text{ORIFICE PLATE Gauge Reading}}$$

*where the value of "7.206" is a constant and will be specific to the orifice plate used (**every plate has its own value; yours will be different**). Using a calculator, take the square root of the gauge reading first, and then multiply by the constant for your orifice plate (for this example, the constant is "7.206"). The exact leakage is 7.206 x (square root of 725) = 194.0 L/s.*

Oriflow has FREE Adobe forms available that will calculate the leakage, leakage factor, allowable leakage, Pass/Fail criteria and duct surface area among other variables (www.oriflow.com/freeform).

Troubleshooting

Can't obtain system test pressure (THIS IS THE MOST COMMON ISSUE)
This happens when the system is leaking too much air. Make sure all outlets are sealed. Check corners of rectangular duct for excessive leakage. Inspect all duct and fitting joints for leakage. Make sure you seal all suspect joints and allow to cure 24 to 48 hours. Always refer to duct sealant manufacturer's instructions.

Check for these other sources of leakage:

- Rectangular duct joints (check and seal corners),
- Fire or smoke dampers,
- Duct joints (pay particular attention to flex-duct joints if they are part of the leak test),
- VAV boxes (pay particular attention to parallel box back draft dampers),
- Built-up air handlers,
- Plenums,
- Uncured duct sealant blow-thru (follow manufacturer instructions for cure time),
- Improperly sealed joints,
- Hot water coils and electric heaters,
- Open duct end that was supposed to be sealed/capped-off for the leak test.

A non-toxic smoke machine is an excellent tool for locating significant sources of leakage. Call ORIFLOW at 727-400-4881 or online at www.oriflow.com for more information.

Zero reading on "DUCT SYSTEM" gauge

If the gauge reading is zero, refer to the table below to fix this problem. Perform troubleshooting steps in the order shown in the *Table 7* below.

Table 7 –Troubleshooting steps when "DUCT SYSTEM" gauge is zero

Step	Scenario	What to do
1	Inlet damper was left shut, cutting off air to the system.	Open inlet damper slowly.
2	Pressure tubing connected to gauge incorrectly	Look at the P1 and P2 stickers that are located on the orifice tube and gauges. Make sure tubing from P1 tap matches the P1 tap on the "ORIFICE TUBE" gauge.
3	Plugged fitting or malfunctioning gauge.	Gently blow through other end of pressure tubing from "DUCT SYSTEM" gauge, and watch needle increase pressure reading.
4	System is leaking too much air.	Check for these other sources of leakage: • Rectangular duct joints (check and seal corners), • Fire or smoke dampers, • Duct joints (pay particular attention to flex-duct joints if they are part of the leak test), • VAV boxes (pay particular attention to parallel box back draft dampers), • Built-up air handlers, • Plenums, • Uncured duct sealant blow-thru (follow manufacturer instructions for cure time), • Improperly sealed or un-sealed joints, • Hot water coils and electric heaters, • Open duct end that was supposed to be sealed/capped-off for the leak test.

Zero reading on "ORIFICE TUBE" gauge

If the gauge reading is zero, refer to the table below to fix this problem. Perform troubleshooting steps in the order shown in *Table 8* below.

Table 8 –Troubleshooting steps when "ORIFICE TUBE" gauge is zero

Step	Scenario	What to do
1	Inlet damper was left shut, cutting off air to the system.	Open inlet damper slowly.
2	Plugged pressure taps.	Remove pressure tubing from "ORIFICE TUBE" gauge, and blow through each end to make sure the pressure taps on the orifice tube are clear.
3	Orifice plate too large for application.	If you are using a 102 mm ID orifice plate, and the system is leaking 20 L/s, you probably won't even notice the gauge needle moving. This will happen to larger orifice plates too. You need to use or purchase an orifice plate with a smaller bore diameter so that a small amount of airflow/leakage will result in a bigger pressure drop.
4	System is leaking very little air.	You'll know if this is true if the fan inlet is almost shut. Not likely unless system is small. Fix is to use plate with smaller bore diameter.
4	Pressure tubing connected incorrectly.	Look at the P1 and P2 stickers that are located on the orifice tube and gauges. Make sure they match.
5	Malfunctioning gauge.	Remove the clear pressure tubing from the lower pressure tap on the orifice tube and blow through the end of the tubing. The needle should move in response. If not, the gauge is faulty.
6	Not sure	The best way to make sure that your tester is working properly is to disconnect the flex duct from the system and turn the blower on, and slowly open the inlet damper. If you feel a lot of air coming out of the tube end, you should see a pressure reading on the gauge "ORIFICE TUBE".

"ORIFICE TUBE" gauge reading maxed out

- *Scenario 1*: The system is leaking too much air. Make sure all outlets are sealed. Check corners of rectangular duct for excessive leakage. Inspect all duct and fitting joints for leakage. Make sure you seal all suspect joints and allow curing time of 24 to 48 hours. Always refer to duct sealant manufacturer's instructions.

- *Scenario 2*: orifice plate bore could be too small, causing a high pressure drop at low to moderate flows. You need an orifice plate with a larger bore.

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