

# Positive and Negative Ductwork Accreditation (PANDA) System

User's Manual



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# Chapter 1

## Unpacking and Parts Identification

Carefully unpack the PANDA system and instrument cases from the shipping container. Check the individual parts against the list of components below. If anything is missing or damaged, notify TSI Incorporated immediately.

The PANDA system consists of the following:

Qty	Description	Part Number
1	4-metre long Ø100-mm plastic flexi-tube	6002667
1	Primary duct adapter spigot plus rubber bung (to fit to test duct)	6002638
1	Cam lock primary spigot (to connect flexi-duct to PANDA)	—
2	Ø100-mm adjustable over lock straps	6002683
2	500-mm silicone tubes (red)	AFL9020004
2	500-mm silicone tubes (blue)	AFL9020005
1	Smoke pellets	AFL9004167
1	Smoke pellet instructions	—
1	User's manual	6002895
1	Smoke cap holder assembly	AFL71549801
1	K-type thermocouple probe	AFL82859201
2	Instrument adapter	—

The following two instruments should be used in conjunction with the PANDA unit:

<b>TA460-P Multi-function Instrument</b>	Refer to Operation and Service Manual (TSI P/N 1980585) supplied with the instrument for additional parts supplied as standard.
<b>PVM620 Micromanometer</b>	Refer to Operation and Service Manual (TSI P/N 1980588) supplied with the instrument for additional parts supplied as standard.



## Chapter 2

### **Preparing PANDA for Duct Leak Testing**

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The following procedure should be followed carefully so that safe and accurate leakage testing can be achieved:

1. Connect the PANDA system to a suitable supply voltage. This system **must** be connected to Earth, protected by a 30 mA mains RCD.
2. Position the PANDA unit near to where the leakage test is to be carried out. This will reduce the need to add more flexible tube.
3. Fit the primary duct adapter spigot (with rubber bung) to one end of the 100-mm diameter flexi-tube and make an air-tight seal using one of the over lock straps supplied. Fit the 100-mm diameter secondary cam lock flexi-tube connector to the other end of the flexi-tube and make an air-tight seal using the other over lock strap supplied.
4. Connect the 5-metre long silicone tube to the static pressure connector on the primary duct adapter.
5. Securely fit the primary duct adapter spigot/flexi-tube assembly in a position on the ductwork to be pressure tested.
6. The fitting of the flexi-tube and the duct static pressure tube onto the PANDA is dependent on the type of leak test being carried out. There are four major categories of duct leakage test that can be carried out with the PANDA and each test procedure is covered in [Chapter 3](#).



## Chapter 3

# Configuring PANDA for Leak Testing

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## Positive Duct Static Pressure Leak Test High Leakage Rate (10 to 200 l/s)

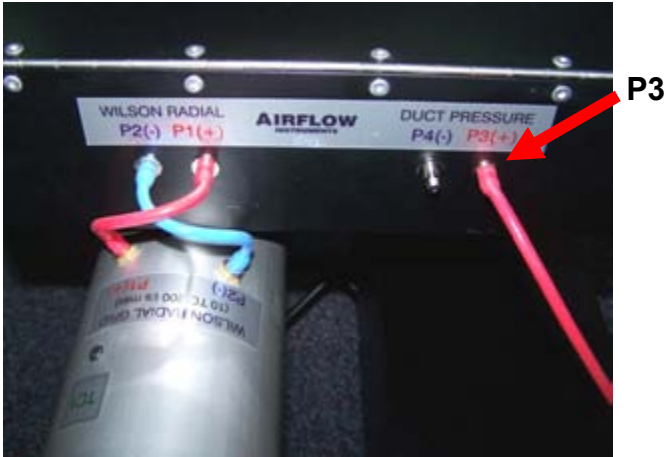
### Connections to PANDA

1. Connect the 100-mm diameter Cam Lock connector with Test Duct to the Outlet spigot of the Fan unit (Figure 1).



**Figure 1**  
**Cam Lock Connector with Test Duct Mounted to Fan Outlet**

2. Connect the 5-metre long Silicone Tube to the connector marked **P3 (+)** at the back of the top box (Figure 2). Connect the other end of the tube to the Static Pressure Tap on the Primary Duct Adapter.



**Figure 2**  
**P3(+)** Connection for the Duct Pressure Measurement

3. Insert the Thermocouple Probe in position **TC1** (Figure 3).



**Figure 3**  
**Thermocouple (T1) Mounting Location**

## Connect Instruments to PANDA

Fit Instrument Tube Adapters to the two instruments (Model TA460-P and Model PVM620) and connect to the Bulkhead which is positioned on the back panel inside the top box (See Figure 4).

1. Connect the PVM620 (+) to the Duct Pressure **P3(+)**.
2. Connect TA460-P (+) and (-) to Flow Grid **P1(+)** and **P2(-)**.

*Note: To perform positive or negative Low leakage rate test, the TA460-P will be connected directly to the Low Flow Nozzle Adapter. See sections on Low Leakage Rate Tests for more information.*

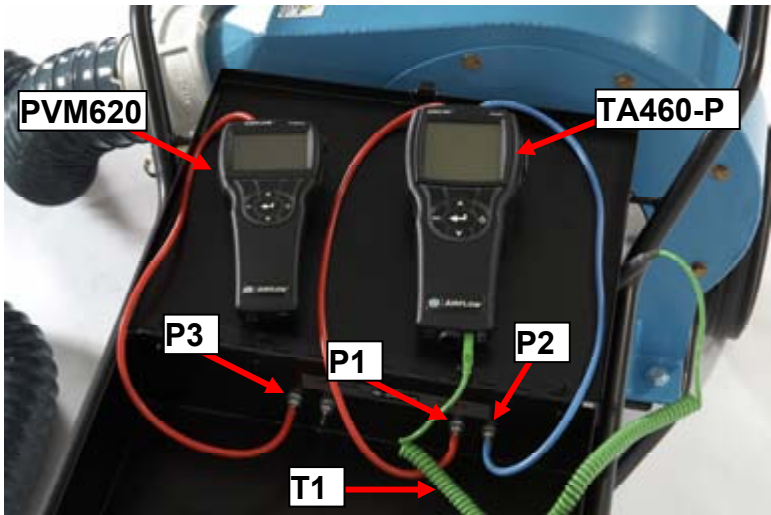


Figure 4

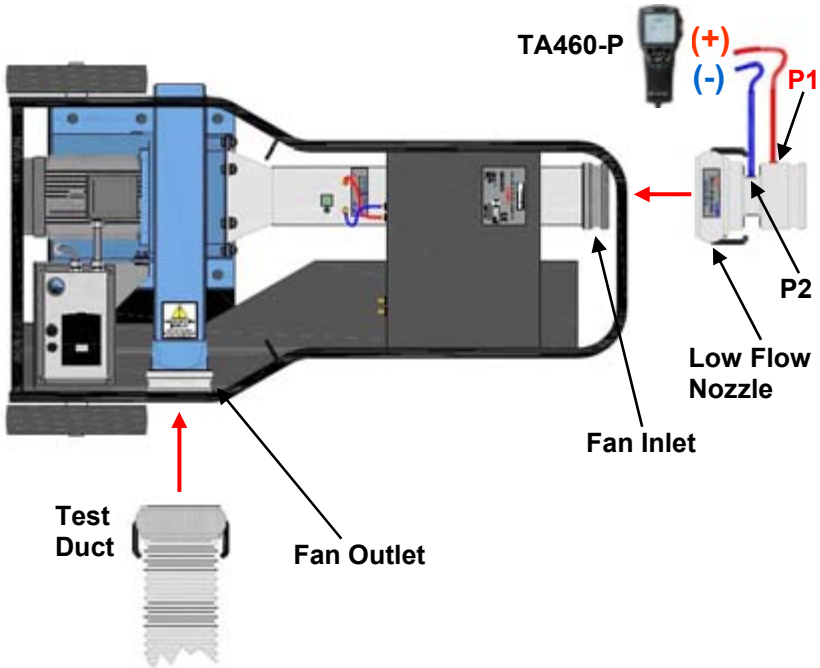
**Instrument Connections on the Inside of the Black Panel Enclosure for Positive and Negative High Pressure Leak Tests**

3. Connect the 2-pin Thermocouple Connector (**T1**) to one of the available sockets on the TA460-P (refer to TA460-P instruction manual for setting up the instrument to record temperature).

# Positive Duct Static Pressure Leak Test Low Leakage Rate (1.0 to 13.0 l/s)

## Fit Low Flow Nozzle Adapter to PANDA

Fit Low Flow Nozzle to the Inlet duct of the Fan (Figure 5).



**Figure 5**  
**Configuration for Positive Duct Static Leak Test for Low Leakage Rate**

## Connections to PANDA

1. Fit Test Duct to Fan Outlet (Figure 1 and Figure 5).
2. Connect the 5-metre long Silicone Tube to the connector marked **P3 (+)** at the back of the top box (Figure 2). Connect the other end of the tube to the Static Pressure Tap on the Primary Duct Adapter.
3. Connect the 2-pin Thermocouple Connector (not shown) to one of the available sockets on the TA460-P (refer to TA460-P instruction manual for setting up the instrument to record temperature—Figure 3).

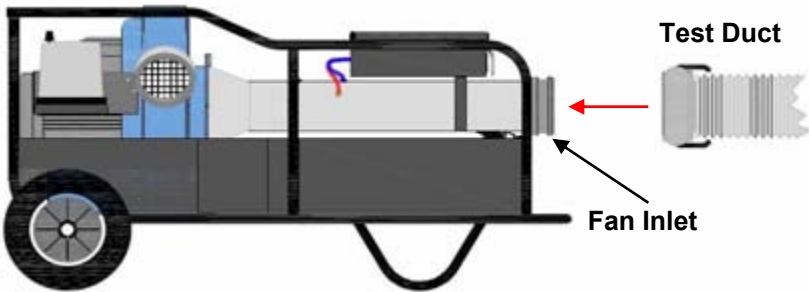
## **Connect Instruments to PANDA**

1. Connect the PVM620 (+) to the Duct Pressure **P3(+)**.
2. Connect TA460-P (+) and (-) to Low Flow Nozzle **P1(+)** and **P2(-)** (Figure 5).
3. Connect the 2-pin Thermocouple Connector (not shown) to one of the available sockets on the TA460-P (refer to TA460-P instruction manual for setting up the instrument to record temperature—Figure 3).

# Negative Duct Static Pressure Leak Test High Leakage Rate (10 to 200 l/s)

## Connections to PANDA

1. Connect the 100-mm diameter Test Duct to the Inlet Duct Spigot of the Fan unit (see Figure 6).



**Figure 6**  
**Configuration for Negative Duct Static Pressure Leak Test  
for High Leakage Rate**

2. Connect the 5-metre long Silicone Tube to the connector marked **P3 (+)** at the back of the top box (Figure 2). Connect the other end to the Static Pressure Tap on the Primary Duct Adapter.
3. Insert the Thermocouple Probe in position **TC1** (Figure 3).

## Connect Instruments to PANDA

Fit Instrument Tube Adapters to the two instruments (Model TA460-P and Model PVM620) and connect to the bulkhead which is positioned on the back panel inside the top box (See Figure 4).

1. Connect the PVM620 (+) to the Duct Pressure (Figure 4) **P3(+)**.
2. Connect TA460-P (+) and (-) to the Flow Grid (Figure 4).
3. Connect the 2-pin Thermocouple Connector (not shown) to one of the available sockets on the TA460-P (refer to TA460-P instruction manual for setting up the instrument to record temperature).

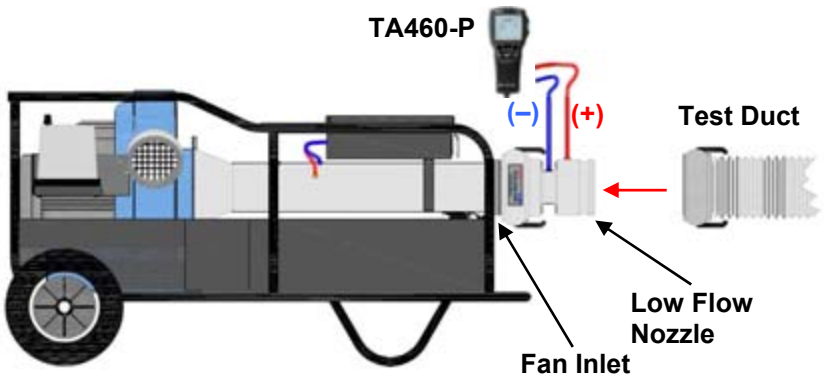
# Negative Duct Static Pressure Leak Test Low Leakage Rate (1.0 to 13.0 l/s)

## Fit Low Flow Nozzle Adapter to PANDA

Fit Low Flow Nozzle to the Inlet duct of the Fan (Figure 7).

## Connections to Panda

1. Fit Test Duct to Low Flow Nozzle (Figure 7).
2. Connect the 5-metre long Silicone Tube to the connector marked **P3 (+)** at the back of the top box (Figure 2). Connect the other end of the tube to the Primary Duct Adapter.
3. Connect the 2-pin Thermocouple Connector (**T1**) to one of the available sockets on the TA460-P (refer to TA460-P instruction manual for setting up the instrument to record temperature— Figure 3).



**Figure 7**  
Configuration for Negative Duct Static Pressure Leak Test  
for Low Leakage Rate

## Connect Instruments to PANDA

1. Connect the PVM620 (+) to the Duct Pressure **P3(+)**.
2. Connect TA460-P (+) and (-) to Low Flow Nozzle (Figure 6) **P1(+)** and **P2(-)**.

3. Connect the 2-pin Thermocouple Connector (**T1**) to one of the available sockets on the TA460-P (refer to TA460-P instruction manual for setting up the instrument to record temperature—Figure 3).

## Chapter 4

### Instrument Settings

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#### **PVM620 (Duct Static Pressure Measurement)**

Refer to the PVM620 instruction manual for detailed information on instrument setup and operation.

1. Turn ON the PVM620.
2. Zero the PVM620 pressure sensor with no pressure applied to the (+) or (-) ports (leave ports open to atmosphere when zeroing the sensor).
3. Connect the (+) port on the PVM620 to P3 (+) to measure the duct static pressure.

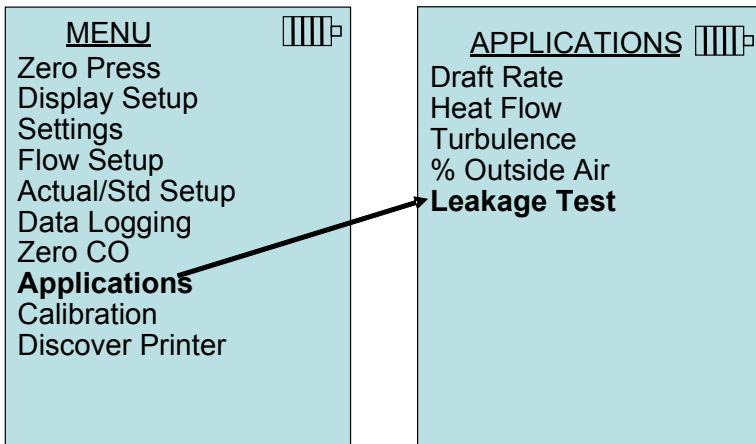
***Note:** If you are required to automatically record the Duct Static Pressure over a specific period of time, the instruments log mode and log settings will require changing to suit the user's requirements.*

#### **TA460-P (Volume Flow Leakage Measurement)**

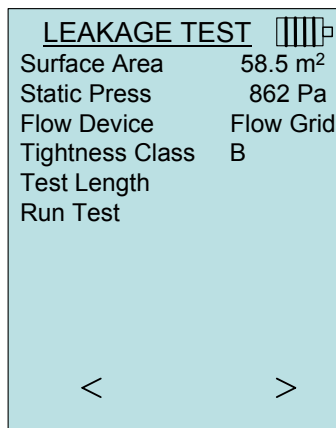
Refer to the TA460-P instruction manual for detailed information on instrument setup and operation.

1. Turn ON the TA460-P.
2. Zero the TA460-P pressure sensor with no pressure applied to the (+) or (-) ports (leave ports open to atmosphere when zeroing the sensor).
3. Connect the TA460-P to the PANDA based on the type of leakage test being performed. See [Chapter 3](#) for more information.
4. Initiate the Leakage Test Application by performing the following:


To perform a Leakage Rate test, go into the main Menu of the TA460-P and scroll down to **Applications** and press **ENTER**. Scroll down to **Leakage Test** and press **ENTER**.




Setup the Leakage Test by inputting data into the following screen:



<b>Surface Area</b>	Enter the surface Area of the duct being tested.
<b>Static Pressure</b>	Enter the static pressure as measured by the PVM620.
<b>Flow Device</b>	Choose the flow device (Nozzle or Flow Grid) that is measuring the flow rate.
<b>Tightness Class</b>	Input the tightness class the duct being tested. See <a href="#">Appendix B</a> for more information.
<b>Test Length</b>	Press the <b>ENTER</b> key to adjust test length using the arrow keys, press <b>ENTER</b> to accept. Test length is adjustable from 1 second to 59:59 minutes.
<b>Run Test</b>	Highlight <b>Run Test</b> and press <b>ENTER</b> to start Leakage Rate Test.

<u>LEAKAGE TEST</u> 	
Leak Factor	0.3758 l/s/m <sup>2</sup>
Leak Limit	0.728 l/s/m <sup>2</sup>
Leak Rate	21.98 l/s
Status	<b>Pass</b>
Flow Device	Flow Grid
Baro Press	743.3 mm Hg
Temperature	23.6°C
Time	0:00
Standard	Test 003
	Sample
Test Done	0
	SAVE PRINT

Status <b>Pass</b>	Leak Factor is below Leak Limit.
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<u>LEAKAGE TEST</u> 	
Leak Factor	1.5147 l/s/m <sup>2</sup>
Leak Limit	0.728 l/s/m <sup>2</sup>
Leak Rate	147.11 l/s
Status	<b>Fail</b>
Flow Device	Flow Grid
Baro Press	743.3 mm Hg
Temperature	23.6°C
Time	0:00
Standard	Test 003
	Sample
Test Done	0
	SAVE PRINT

Status <b>Fail</b>	Leak Factor is above Leak Limit.
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## Chapter 5

### Starting PANDA Unit

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Now the PANDA system is ready to carry out a manual Duct leakage test. The following procedure will power up the PANDA system and explains the basic requirements to achieve a duct leakage test. For more definitive leakage testing information, please refer to the National or International Standard requirements for the leakage test being adopted:

1. Make sure the Inverter Controls are in the OFF position and the multi-turn potentiometer Fan Speed Controller is fully wound counter-clockwise before connecting the PANDA to a suitable Mains electrical supply (See Figure 8).



**Figure 8**  
**Connecting PANDA to Mains Electrical Supply**  
**(230V Inverter Shown)**

**Note:** 110V Inverter excludes separate on/off switch as shown above.

2. Once the above checks have been made, the PANDA unit is ready to be switched on. Position the Mains Power switch of the inverter to the ON position. The mains electrical supply is now powering the Inverter speed controller; however, the Fan motor is still not energized.
3. Position the Fan Control switch to the RUN position. The Fan motor has now been energized and the Fan impeller rotational speed can be manually controlled.
4. Using the High/Low Fan Speed Controller multi-turn potentiometer, the impeller speed can be increased and decreased with clockwise or counter-clockwise movement.

**Note:** *The 110/120V Inverter excludes a separate on/off switch. Therefore, the unit can be turned on via the Fan Control Switch as shown in Figure 8. The operation of the unit is then identical to steps 3 and 4 above.*

# Appendix A

## Specifications

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Specifications are subject to change without notice.

### Pressure Measurement (PVM620)

Range .....	± 3,735 Pa (± 15 in. W.G.)
Resolution .....	0.1 Pa (0.001 in. W.G.)
Accuracy .....	1% of reading ±1 Pa (± 0.005 in. W.G.)
Actual Duct Static Range.....	±2,500 Pa (± 10 in. W.G.) at Zero Flow

### Volume Flow Measurement (TA460-P)

Wilson Radial Flow Grid.....	High leakage range: 10 to 200 l/s (36 to 720 m <sup>3</sup> /hr, 21 to 424 cfm)
15 mm Conical Inlet Nozzle	
Adapter .....	Low leakage range: 1 to 13 l/s (3.6 to 46.9 m <sup>3</sup> /hr, 2 to 27.5 cfm)
Resolution .....	0.01 l/s (0.01 m <sup>3</sup> /hr, 0.01 cfm)
Accuracy .....	± 2.5% of reading ±0.01 l/s (± 0.04 m <sup>3</sup> /hr, ± 0.02 cfm)

### Temperature Measurement (TA460-P)

K Type thermocouple probe .....	To EN60584 (IEC 584)
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### Barometric Pressure Measurement (TA460-P)

Range .....	690 to 1,241 hPa (517.5 to 930.87 Hg, 20.36 to 36.648 in. Hg)
Accuracy .....	±2% of reading

**Power Requirements**

Model PAN321* .....	220 to 240 V, 1 Phase, 50/60 Hz, 10A
Model PAN321-110* .....	110 to 120 V, 1 Phase, 50/60 Hz, 16A
Model PAN311** .....	220 to 240 V, 1 Phase, 50/60 Hz, 10A
Model PAN311-110** .....	110 to 120 V, 1 Phase, 50/60 Hz, 16A

**Weight** ..... 71 kg (157 lbs.)

**Dimensions (LWH)** ..... 1,130 mm x 660 mm x 510 mm  
(44.5 in. x 26 in. x 20 in.)

**TA460-P and PVM620**..... See spec sheets for details on individual instruments.

\* Model: instruments included

\*\* Model: instruments **NOT** included

# Appendix B

## Leak Testing Limits

Ductwork leakage is calculated as a leakage factor  
[Leakage flow rate per unit duct surface area ( $\text{m}^3 \cdot \text{s}^{-1} \text{m}^{-2}$ )]  
Factor = Flow rate/Duct surface area.

The Maximum permitted leakage factor for the Ductwork according to its air tightness class is shown in the table below:

Ductwork Classification Table

Air Tightness Class	Static Pressure Limit ( $p_s$ ) Pa		Air Leakage Limit ( $f_{max}$ ) $\text{m}^3 \cdot \text{s}^{-1} \text{m}^{-2}$
	Positive	Negative	
A	500	500	$0.027 \times p_t^{0.65} \times 10^{-3}$
B	1,000	750	$0.009 \times p_t^{0.65} \times 10^{-3}$
C	2,000	750	$0.003 \times p_t^{0.65} \times 10^{-3}$
D <sup>1</sup>	2,000	750	$0.001 \times p_t^{0.65} \times 10^{-3}$

<sup>1</sup> Ductwork for special applications

**Note:** The appropriate air tightness class should be selected from the instrument Leakage tester application before starting a test.

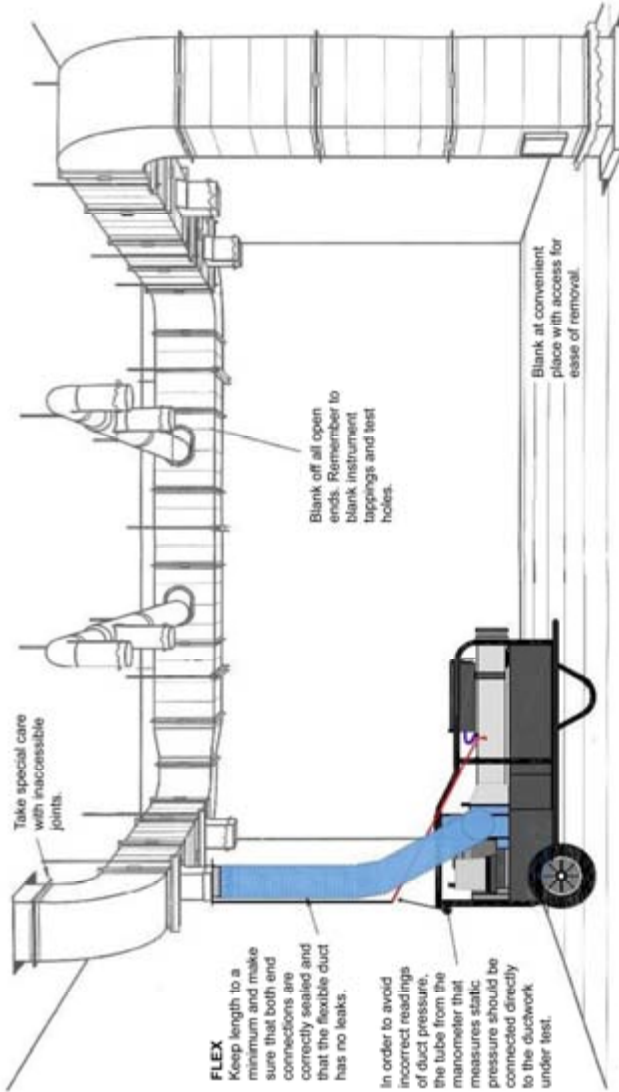
The following is a list of some of the standards and guides for leakage testing that the Panda leakage tester can be used in conjunction with:

<b>BS EN 12237:2003</b>	Ventilation for buildings—Ductwork—Strength and leakage of circular sheet metal ducts.
<b>BS EN 1507:2006</b>	Ventilation for buildings—Sheet metal air ducts with rectangular section—Requirements for strength and leakage.
<b>DW/143</b>	HVCA—A practical guide to Ductwork leakage testing.
<b>Eurovent 2/2</b>	Air leakage rate in sheet metal air distribution systems.



# Appendix C

## Typical Setup



### SEQUENCE OF TEST

1. Prepare test sheet.
2. Connect and adjust test rig to correct pressure.
3. Read off leakage rate
4. Repeat if necessary (allow time to cure)
5. Maintain test for 15 minutes.
6. Switch off and allow to zero.
7. Reapply test pressure and check reading.
8. Record details on test sheet and obtain signature.

### WARNING

Take care not to over pressurize system under test.

### HOW TO FIND LEAKS

1. **Look** - at blanks, access openings and difficult joints.
2. **Listen** - with test rig running, leaks should be audible.
3. **Feel** - running your hand (particularly if wet) over joints can help locate leaks.
4. **Soap and Water** - paint over joints and look for bubbles.
5. **Smoke Pellet** - placed inside ductwork (obtain permission for use).



## Appendix D

### **Procedure for Using Smoke Pellets in Leakage Testers**

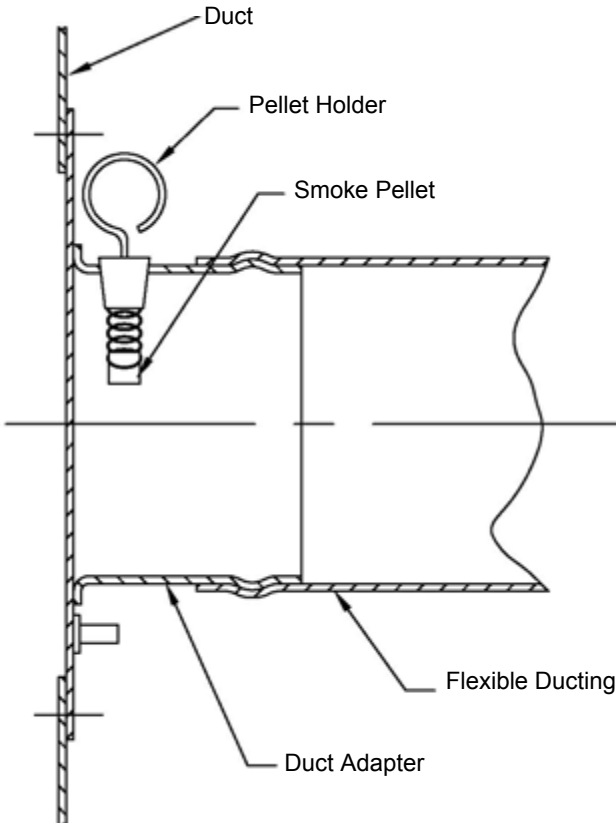
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As shown in the sketch a rubber bung is fitted into the hole in the duct adapter which holds the wire coil.

When a smoke pellet is required to be used, remove the bung and fit a pellet into the wire coil as shown in the sketch.

Light the pellet and immediately plug into the hole in the duct adapter and proceed with the test.

The pellet should emit dense white smoke for up to a minute.



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