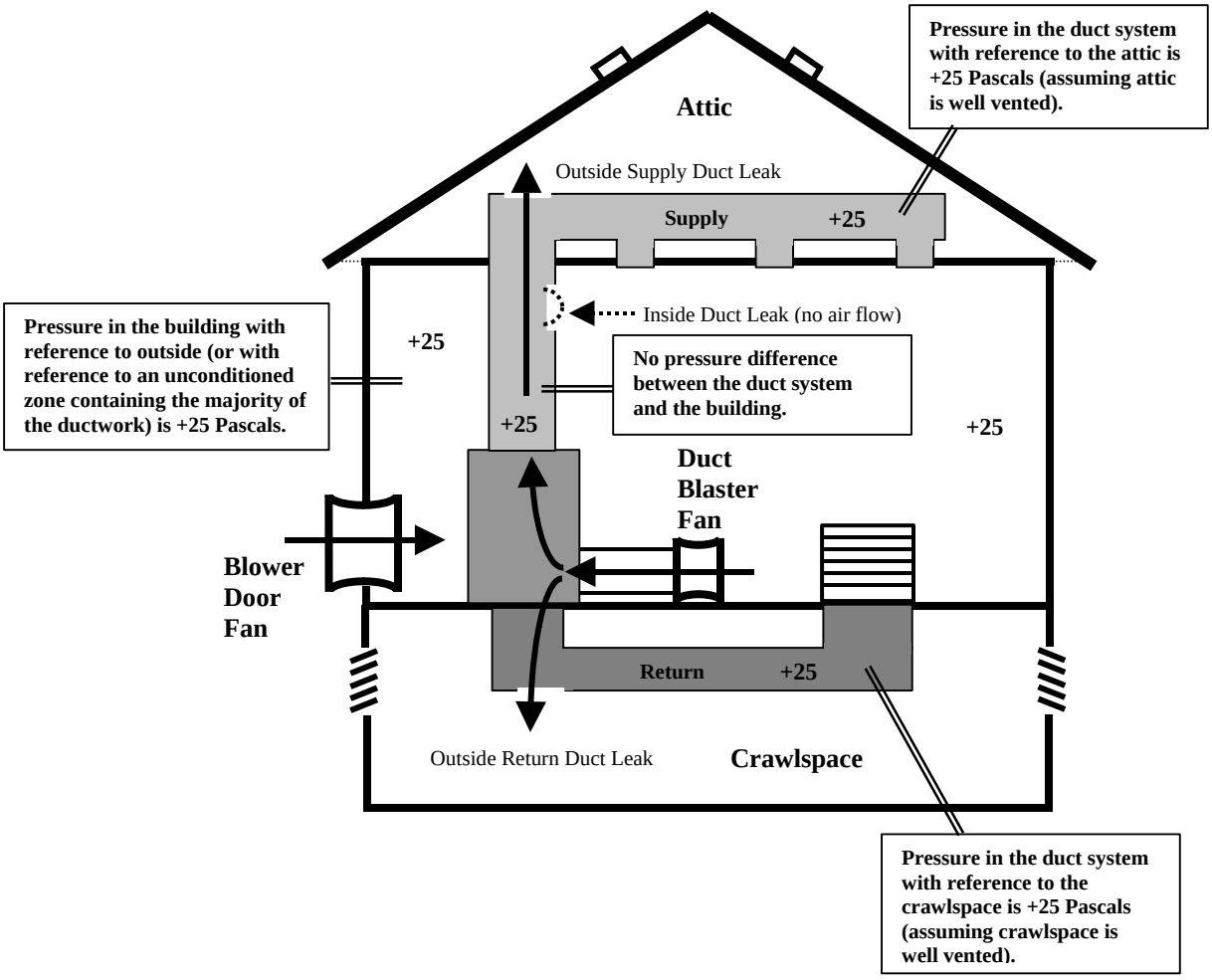
Chapter 7 Conducting a Leakage to Outside Pressurization Test

This chapter covers the test procedures for conducting a **Leakage to Outside Pressurization Test**. The Leakage to Outside Test is used to measure the duct leakage rate to the outside of the building only, when the duct system is subjected to a uniform test pressure. This test procedure requires simultaneous use of both a Duct Blaster and Blower Door system.

During this procedure, a Blower Door fan will be used to pressurize the building to the test pressure, while the Duct Blaster system is used to pressurize the duct system to the same pressure as the building. Because the duct system and the building are at the same pressure, there will be little or no leakage between the ducts and the building during the leakage rate measurement.

Figure 2: Illustration of Leakage to Outside Pressurization Test
(at a Test Pressure of 25 Pascals)
with Duct Blaster Fan Installed at Air Handler



The air flow through the Duct Blaster fan required to pressurize the duct system to the same pressure as the building (while the Blower Door is pressurizing the building to the test pressure) is the measured duct leakage rate to the outside.

The following instructions assume you have set up the Duct Blaster system for a pressurization test as outlined in Chapter 5 above. Information on how to conduct a Leakage to Outside **Depressurization** Test (i.e. pulling air out of the duct system) is discussed in Chapter 11.

Note: It is possible to separately measure supply and return duct leaks by installing a temporary barrier in either the supply or return opening to the air handler cabinet. With a temporary barrier in place, each side of the duct system can be tested independently. It is also possible to separately measure supply and return leakage before the air handler or furnace unit has been installed.

7.1 Final Preparations (Set Up Blower Door in Building)

Install the Blower Door system in a centrally located exterior door, including a gauge to measure building pressure. You will need to prepare the building for a Blower Door test as described in the Blower Door Operation Manual including closing all exterior doors and windows, opening all interior doors, and adjusting combustion appliances to remain off during the test. The Blower Door fan should be set up to pressurize (or blow air into) the building. Importantly, we will not be measuring air flow through the Blower Door fan during this test procedure. Refer to your Blower Door manual for complete instructions on Blower Door system installation.

7.1.a Building Pressure Measurements:

During the test, you will need to monitor the change in building pressure caused by the Blower Door system. Typically the Blower Door building pressure gauge will be setup to measure building pressure with reference to the outside (this is the typical set up for a Blower Door test).

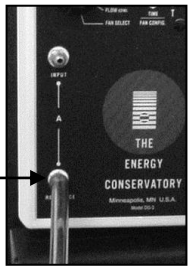
However, if you are testing a duct system that is located primarily in one unconditioned zone (e.g. a single attic or single crawlspace), you have the option of setting up the building pressure gauge to measure building pressure with reference to that zone, rather than with reference to outside. The purpose of making this change is to ensure that the duct leaks located in that zone are subjected to the full test pressure.

For example, it is possible that a crawlspace containing most of the ductwork may be significantly pressurized by air being forced into that zone from the Blower Door fan (through air leaks between the building and the crawlspace). In this case, you may underestimate the duct leakage rate if you are measuring building pressure with respect to outside during your test because the leaks in the crawlspace ductwork will not be subjected to the full test pressure (i.e. they will be subjected to the test pressure minus the crawlspace pressurization caused by the Blower Door fan). Changing the reference tap on the Blower Door building pressure gauge from outside to the crawlspace would eliminate the underestimation problem in this building.

- *Using a Digital Gauge to Monitor Building Pressure:*

If you are using a separate DG-700 or DG-3 gauge to monitor building pressure, connect the outside building pressure tubing to the **CHANNEL A Reference** tap.

Connect the outside building pressure tubing to the Blower Door **CHANNEL A Reference** tap. The other end of this tubing should either be run to the outside, or to the unconditioned zone which contains the majority of the ductwork.



7.2 Choose the Test Pressure

For the Leakage to Outside Pressurization Test, we will be simultaneously pressuring the duct system and the building to the same test pressure. For residential duct systems, we generally recommend that 25 Pascals (0.10 inches w.c.) be used as the test pressure. This pressure has been adopted by the majority of residential duct testing programs in the U.S. because 25 Pascals represents a typical operating pressure seen in many residential systems. In cases where 25 Pascals is not a representative pressure in the duct system being tested, it may be appropriate to use a different test pressure. For example, in small commercial HVAC systems which typically operate at higher duct pressures than residential systems, it may be appropriate to use a test pressure greater than 25 Pascals. In extremely leaky duct systems (e.g. more than 600 cfm of leakage at 25 Pascals), such as duct systems found in many basement style houses, the typical operating pressures in the duct system may be significantly less than 25 Pascals. In this case it may be appropriate to use a test pressure lower than 25 Pascals.

7.3 Leakage to Outside Test Procedures Using the DG-700

The following test procedure covers use of the DG-700 for the Leakage to Outside Test procedure. This procedure assumes that a test pressure of 25 Pascals is being used.

a) Turn on the building pressure gauge and pressurize the building to 25 Pascals.

Turn on the Blower Door building pressure gauge and set it to measure pressure on **Channel A**. Slowly turn on the Blower Door fan and begin to pressurize the building. Increase the Blower Door fan speed until the building is pressurized to the test pressure of 25 Pascals, as measured on the building pressure gauge. In leaky buildings, you may need to remove all Flow Rings from the Blower Door fan in order pressurize the building to the test pressure. Leave the Blower Door fan running.

Note: If the Blower Door pressure gauge and Blower Door fan speed controller are compatible with Cruise Control, use the Cruise Control function to maintain the 25 Pa building pressurization.

b) Turn on the Duct Blaster DG-700 and put it in the proper Mode.

Turn on the gauge by pressing the **ON/OFF** button. Press the **MODE** button once to put the Duct Blaster gauge into the **PR/ FL** mode. The **PR/ FL** mode is a multi-purpose mode used to measure a test pressure on **Channel A** while simultaneously measuring air flow from the Duct Blaster fan on **Channel B**.

c) Choose a Flow Ring for the Duct Blaster fan.

Fan Configuration	Flow Range (cfm) for Series B DB fan
Open (no Flow Ring)	1,500 - 600
Ring 1	800 - 225
Ring 2	300 - 90
Ring 3	125 - 10

Install the Flow Ring which you think best matches the needed fan flow. Installation of Flow Rings will depend on the tightness level of the duct system being tested. For example, for relatively leaky duct systems (greater than 600 CFM25), you will want to start the test using the Open Fan configuration (i.e. no Flow Rings installed). As you test tighter duct systems, you will need to install Flow Rings 1, 2, or 3. Refer to the Table to the right for approximate flow ranges of the fan using the various Flow Rings configurations. Don't worry if you guess wrong and start the test with the incorrect Flow Ring - you can change the Fan Configuration during the test procedure.

d) Enter the selected Flow Ring into the Gauge.

In order for the DG-700 to properly display fan flow, you need to input the Duct Blaster fan model and selected Flow Ring into the gauge. 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.

Press the **DEVICE** button to change the selected Duct Blaster fan.

Device Icon

DB A Series A Duct Blaster fan **DB B** Series B Duct Blaster fan

Once the fan is selected, the configuration of the fan can be selected by pressing the **CONFIG** button. The currently selected Flow Ring configuration is shown in the Config section of the gauge display.

Config Icon

OPEN	No Flow Ring	**B2**	Ring 2
A1	Ring 1	**C3**	Ring3

Also be sure that **Channel B** is showing the proper air flow units for your test (this should typically be set to **CFM**). Units can be changed by pressing the **UNITS** button.

e) With the Blower Door fan continuing to run, turn on and adjust the Duct Blaster fan.

If Manually Controlling the Duct Blaster Fan:

Turn on the Duct Blaster fan controller and slowly turn the fan controller knob clockwise. Increase the fan speed until the pressure between the duct system and the building (displayed on **Channel A**) reads zero.

If Using Cruise Control for the Duct Blaster Fan:

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 50 (the default target Cruise pressure). Press the **Cruise Target (Config)** button twice to change the target Cruise pressure to +0. Press the **Start Fan (Start)** button. The Duct Blaster fan will now slowly increase speed until the pressure between the duct system and the building (displayed on **Channel A**) reads zero.

f) Re-check the building pressure.

Re-check the building pressure gauge and if necessary, re-adjust the Blower Door fan speed to maintain a test building pressure of 25 Pascals. **Note:** If the Blower Door fan is being controlled by Cruise Control, skip to step **g)** below,

g) Re-check the duct pressure.

If you are manually controlling the Duct Blaster fan, re-check the Duct Blaster system and if necessary, re-adjust the Duct Blaster fan until the pressure between the duct system and the building reads zero **(Channel A** on the Duct Blaster DG-700).

Channel B on the Duct Blaster DG-700 will now display the CFM25 leakage to outside 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. Record the CFM25 leakage to outside estimate and turn off both the Blower Door and Duct Blaster fans.

(If "LO" appears on **Channel B**, see below).

Whenever "**LO**" appears on **Channel B** in the **PR/ FL** Mode, the DG-700 can not display a reliable fan flow reading. The message "**LO**" appears on **Channel B** under the following two conditions:

- "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).

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.

7.4 What If You Can Not Pressurize the Building to the Test Pressure with the Blower Door Fan?

If the Blower Door system is unable to pressurize the building to the test pressure because one of the Flow Rings was installed on the Blower Door fan, remove the Flow Ring and repeat the test. If you are not able to pressurize the building to the test pressure because the building is too leaky, then you will need to conduct the test at the highest achievable building pressure and use the Can't Reach Pressure Factors in Table 4 below to estimate the final duct leakage rate.

Table 4: Can't Reach Pressure Factors (25 Pa Target**)**

Duct Pressure (Pa)	CRP Factor	Duct Pressure (Pa)	CRP Factor
24	1.02	14	1.42
23	1.05	13	1.48
22	1.08	12	1.55
21	1.11	11	1.64
20	1.14	10	1.73
19	1.18	9	1.85
18	1.22	8	1.98
17	1.26	7	2.15
16	1.31	6	2.35
15	1.36	5	2.63

Example: With the Blower Door fan running at full speed (& no Flow Rings attached), you are only able to pressurize the building to 18 Pascals. While the Blower Door is pressurizing the building to 18 Pascals, adjust the Duct Blaster fan to create zero pressure between the duct system and the building. At this point the measured Duct Blaster fan flow is 450 cfm. The corresponding CRP Factor for a building pressure of 18 Pascals is 1.22. The estimated duct leakage to outside at a test pressure of 25 Pascals is 450 x 1.22 = 549 cfm.

$$\text{Can't Reach Pressure Factor} = \left\{ \frac{25}{\text{Current Test Pressure (Pa) (Channel A)}} \right\}^{0.60}$$

Note: The TECBLAST program automatically applies the CRP Factors to test data.

7.5 What If You Can Not Pressurize the Duct System to the Same Pressure as the Building with the Duct Blaster Fan?

If the Duct Blaster fan was unable to create a pressure difference of zero between the duct system and the building (while the Blower Door is pressurizing the building to the test pressure) because one of the Flow Rings was installed, remove the Flow Ring from the Duct Blaster fan and repeat the test. If you were not able to create a pressure difference of zero because the duct system is extremely leaky to the outside, then the test will need to be performed at a lower building pressure and the Can't Reach Pressure Factors (Table 4) used to estimate the final duct leakage rate.

Example: Because you were unable to create a pressure difference of zero between the duct system and the building, re-adjust the Blower Door to pressurize the building to a lower pressure (e.g. 20 Pascals). While the Blower Door is running, adjust the Duct Blaster fan to create a pressure difference of zero between the duct system and the building. If you are still unable to create a pressure difference of zero, repeat the test at an even lower building pressure (e.g. 15 Pascals). Finally, multiply the flow through the Duct Blaster fan needed to create a pressure difference of zero by the appropriate CRP factor.

For example, with the Blower Door pressurizing the building to 15 Pascals, the flow through the Duct Blaster fan needed to create a pressure difference of zero (between the duct system and the building) is 1,200 cfm. The corresponding CRP Factor for a building pressure of 15 Pascals is 1.36. The estimated duct leakage to outside at a test pressure of 25 Pascals is 1200 x 1.36 = 1,632 cfm.

Note: The TECBLAST program will automatically apply the CRP Factors to test data.

7.6 Before Leaving the Building

Be sure you have returned the building to its original condition before leaving. This includes removing any temporary register seals, turning HVAC controls to their original settings and closing access doors or vents opened during the test. In addition, it is highly recommended that the test procedures outlined in Chapters 14 and 15 be performed before leaving the building.