Getting the Most From Your Duct Blaster

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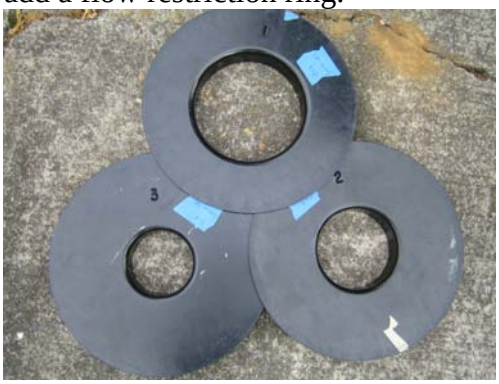
The Duct Blaster, made by the Energy Conservatory, or similar devices like it, is a durable, versatile calibrated fan/flexible duct assembly that accurately measures airflow over a range of about 30 to 1400 CFM. This means it can be very helpful in determining the performance of duct systems, supply and return registers, air handlers, and exhaust fans.

How Does it Work?

The fan assembly is an injection-molded, flaring 10" diameter smooth, round orifice with a known calibration that relates pressure drop across the orifice to a certain amount of air flowing through the orifice. The pressure tap found on the fan housing is attached to a metal flow sensor ring installed near the fan motor.

The amount of air going through the fan assembly is controlled by a rheostat operated by the tester. Depending on the amount of air that is being measured, a black plastic flow restriction ring may be needed. The flow restriction rings are also round, smooth orifices that increase the pressure drop across the entire fan assembly, thereby increasing the accuracy of he measurement. When the pressure drop across the fan assembly drops to below about 20 Pa, it is time to add a flow restriction ring.



Duct leakage tests typically involve pressurizing the duct system to a testing pressure of 25 or 50 Pa. If this pressure cannot be reached with a flow restriction ring installed, a less restrictive ring should be used.

If the fan is used in depressurization mode, it must include both the foam flow conditioner piece and a low flow ring to work properly. The depressurization mode is needed to measure supply register flows with a flow box and is preferred by some in making duct leakage measurements since it helps keep the temporary tape on the registers.

Flow equations can be found in the instruction manual that comes with the Duct Blaster. Also, some of the newer digital pressure gauges contain these flow equations and can display flows during testing.

Tests Described in These Handouts

Detailed instructions and data entry forms for 4 tests are attached. These tests are:

1) Duct pressurization test (to determine total and net duct leakage)
2) Duct depressurization test (to determine total and net duct leakage)
3) Air handler flow test (to determine whether the system is moving sufficient air to ensure capacity and efficiency upstream of the duct system; most manufacturers suggest around 400 CFM/ton of nominal air conditioner capacity or *approximately* 400 CFM/30,000 Btu/hr of gas furnace capacity)
4) Supply register flow tests (to determine how much air is actually being delivered to the conditioned space)

Tools You Will Need

1) Duct Blaster or equivalent with tubing and low flow rings
2) Pressure gauge (digital preferred)
3) Static pressure tap
4) Device that can be used as a flow box (if measuring supply flows)
5) Cardboard scraps, cheaper duct tape, better masking tape

Duct Pressurization Tests (Total and Exterior Duct Leakage)

Set-up procedure for duct pressurization tests:

1. *Set blower door to pressurize house. May have to flip fan (from normal BD test position) if house leaky.*
2. *Set up for total test first; attach Duct Blaster to best point in system (typically at or near furnace).*
3. *If testing supply side, attach duct tester fan to furnace cabinet with cardboard and tape or directly to blower mount. (If you remove the blower, be careful with wires and record how to re-connect them.)*
4. *Tape all registers. Use appropriate tape (Long Mask) for friable surfaces.*
5. *Set up pressure tubes so that pressure gauge can read duct pressure WRT outside, duct tester fan pressure, and house pressure (for exterior duct leakage test).*
6. *Measure duct pressure in plenum or register. If you select a register, make sure it is not disconnected from the rest of the duct system. Specify on protocol sheet where duct pressure is measured. Use Pitot tube or static pressure tap for this measurement.*
7. *Make sure doors/access panels that go to buffer spaces such as the garage, attic, or are closed during the testing.*

Performing total duct pressurization test

1. *For "both sides" test, pressurize supply and return side to about 50 Pascals WRT outside with smallest flow ring possible. Fan pressure should be at least 20 Pa to ensure accuracy.*
2. *If split test (testing supply or return alone), once ducts are pressurized to near 50 Pa, check pressure in other side of system WRT outside. (Check return if testing supply; supply if testing return.) This pressure should be zero or close to zero. If not, check system split.*
3. *Measure the duct system pressure WRT outside. Record in table (next page).*
4. *Measure duct tester fan pressure. Look up flow in table, use gauge* ***(make sure the pressure gauge you are using is paired with the right duct tester)*** *or use flow equation.*
5. *Repeat steps 1-3 with ducts at about 25 Pa WRT outside.*
6. *Check flow exponent. (Formula on next page.) Repeat tests as needed.*
7. ***If you cannot reach 50 Pa or 25 Pa, test to the highest pressure you can reach and enter this in the 50 Pa column. Use a test pressure of half this pressure for the low pressure test.***
8. *Note any unusual testing conditions (wind, etc.):*

Total Duct Leakage Data (note duct pressure WRT outside does not have to be exactly 50 or 25 Pa)

	Both sides		Supply or Return (circle one)	
	50 Pa	25 Pa	50 Pa	25 Pa
Duct P	____	____	____	____
Ring	____	____	____	____
Fan P	____	____	____	____
Flow	____	____	____	____

Note position of pressure tap(s) in supply and return system:

To check each test, calculate flow exponent. The flow exponent, n, = $\ln(Q_{50}/Q_{25})/\ln(P_{50}/P_{25})$*. If flow exponent not between 0.50 and 0.75, repeat test.*

Performing exterior duct leakage test:

1. *Exterior house doors and garage doors should be closed for exterior duct leakage test.*
2. *Pressurize the house to about 50 Pascals WRT outside.*
3. *Pressurize tested part of duct system to about 50 Pascals with smallest flow ring possible.*
4. *Measure pressure of ducts WRT house. Make sure blower door flow does not impinge on pressure tap measuring house pressure.*
5. *Adjust duct tester speed controller so that duct pressure WRT house is zero or very close.*
6. *Re-check pressure of ducts WRT outside.*
7. *Measure duct tester fan pressure. Look up flow in table, use gauge* ***(make sure gauge is paired with the right duct tester)*** *or use flow equation. Record duct pressure WRT out, DB fan pressure, DB fan ring.*
8. ***If you cannot reach 50 Pa or 25 Pa, test to the highest pressure you can reach and enter this in the 50 Pa column. Use a test pressure of half this pressure for the low pressure test.***
9. *Repeat steps 2-7 with house and ducts at about 25 Pa WRT outside.*
10. *Check flow exponent (as above).*
11. *Note any unusual testing conditions (wind, etc.):*

Duct Leakage to Outside Data (note duct pressure WRT outside may not be exactly 50 or 25 Pa)

	Both sides		Supply or Return (circle one)	
	50 Pa	25 Pa	50 Pa	25 Pa
Duct P	____	____	____	____
Ring	____	____	____	____
Fan P	____	____	____	____
Flow	____	____	____	____

Duct Depressurization Tests (Total and Exterior Duct Leakage)

Set-up procedure for duct depressurization tests:

1. *Set blower door to depressurize house. If you have just done a blower door test, you will not need to make any change.*
2. *Set up for total test first; attach Duct Blaster to best point in system.*
3. *For depressurization tests, you must install the foam flow conditioner ("honeycomb") into the round transition piece that attaches to the snorkel and you must also one of the low flow rings.*
4. *If testing supply side, attach duct tester fan to furnace cabinet with cardboard and tape or directly to blower mount. (If blower removed, be careful with wires and record how to re-connect them.)*
5. *Tape all registers. Use appropriate tape (Long Mask) for friable surfaces.*
6. *Set up pressure tubes so that pressure gauge can read duct pressure WRT outside and duct tester fan pressure WRT tap on snorkel transition piece* ***(important).***
7. *Measure duct pressure in plenum or register. If you select a register, make sure it is not disconnected from the rest of the duct system. Specify on protocol sheet where duct pressure is measured. Use Pitot tube or static pressure tap for this measurement.*
8. *Make sure doors/access panels that go to buffer spaces such as the garage, attic, or are closed during the testing.*

Performing total duct leakage test

9. *For "both sides" test, depressurize supply and return side to about -50 Pascals WRT outside with smallest flow ring possible. Absolute value of fan pressure should be at least 20 Pa to ensure accuracy. If it is not, install low flow ring with smaller opening.*
10. *If split test (testing supply or return alone), once ducts are depressurized to near -50 Pa, check pressure in other side of system WRT outside. (Check return if testing supply; supply if testing return.) This pressure should be zero or close to zero. If not, check system split.*
11. *Measure the duct system pressure WRT outside. Record in table (next page).*
12. *Measure duct tester fan pressure. Look up flow in table, use gauge* ***(make sure the pressure gauge you are using is paired with the right duct tester)*** *or use flow equation.*
13. *Repeat steps 1-3 with ducts at about 25 Pa WRT outside.*
14. *Check flow exponent. (Formula on next page.) Repeat tests as needed.*
15. ***If you cannot reach -50 Pa or -25 Pa, test to the highest pressure you can reach and enter this in the -50 Pa column. Use a test pressure of half this pressure for the low pressure test.***
16. *Note any unusual testing conditions (wind, etc.):*

Total Duct Leakage Data (note duct pressure WRT outside does not have to be exactly 50 or 25 Pa)

	Both sides		Supply or Return (circle one)	
	-50 Pa	-25 Pa	-50 Pa	-25 Pa
Duct P	____	____	____	____
Ring	____	____	____	____
Fan P	____	____	____	____
Flow	____	____	____	____

Note position of pressure tap(s) in supply and return system:

Calculate flow exponent. The flow exponent, n, = $ln(Q_{50}/Q_{25})/ln(P_{50}/P_{25})$. If flow exponent not between 0.50 and 0.75, repeat test.

Performing exterior duct leakage test:

12. *Exterior house doors and garage doors should be closed for exterior duct leakage test.*
13. *Depressurize the house to about -50 Pascals WRT outside.*
14. *Pressurize tested part of duct system to about -50 Pascals with smallest flow ring possible.*
15. *Measure pressure of ducts WRT house. Make sure blower door flow does not impinge on pressure tap measuring house pressure.*
16. *Adjust duct tester speed controller so that duct pressure WRT house is zero or very close.*
17. *Re-check pressure of ducts WRT outside.*
18. *Measure duct tester fan pressure. Look up flow in table, use gauge* ***(make sure gauge is paired with the right duct tester)*** *or use flow equation. Record duct pressure WRT out, DB fan pressure, DB fan ring.*
19. ***If you cannot reach -50 Pa or -25 Pa, test to the highest pressure you can reach and enter this in the -50 Pa column. Use a test pressure of half this pressure for the low pressure test.***
20. *Repeat steps 2-7 with house and ducts at about 25 Pa WRT outside.*
21. *Check flow exponent (as above).*
22. *Note any unusual testing conditions (wind, etc.):*

Duct Leakage to Outside Data (note duct pressure WRT outside may not be exactly -50 or -25 Pa)

	Both sides		Supply or Return (circle one)	
	-50 Pa	-25 Pa	-50 Pa	-25 Pa
Duct P	____	____	____	____
Ring	____	____	____	____
Fan P	____	____	____	____
Flow	____	____	____	____

Calculate flow exponent. The flow exponent, n, = $ln(Q_{50}/Q_{25})/ln(P_{50}/P_{25})$. If flow exponent not between 0.50 and 0.75, repeat test.

Measuring System Airflow (TrueFlow or Duct Blaster)

Set-up: *Turn on air handler (by using fan-only switch or by turning on heat/AC). It is best to call for the flow that will be used during most of the year. Drill access hole as needed and point hooked end of static tap into airflow.* ***Do not drill into the duct at any point where you are concerned with hitting something.***

Measure pressure in supply plenum. Record pressure below as Normal System Operating Pressure (NSOP). Also measure pressure in return plenum and record:_____

Place appropriate plate and spacers into filter slot. Turn on air handler and record supply static pressure with TrueFlow in place (TFSOP) and pressure drop across plate.

Plate used (14 or 20) _____

Normal System Operating Pressure (NSOP) _____Pa
True Flow System Operating Pressure (TFSOP) _____Pa
Correction Factor* √(NSOP/TFSOP) _____

Plate pressure drop _____Pa
Raw Flow (CFM)_____
Corrected Flow _____CFM

*if using DG-700, unnecessary to record CF (but still a good idea)

Air Handler Flow Measurement Using Duct Blaster

Record normal system operating pressure (NSOP) as described in flow plate test. Install split between supply and return so that all air flowing through Duct Blaster will go into supply side. Install Duct Blaster on furnace (best without snorkel). ***Turn on air handler to get speed you are interested in.*** Turn Duct Blaster on and slowly increase flow until the supply plenum pressure is the same as NSOP. Check to make sure the pressure in the return system is 0 or very close to 0 (to confirm system split is good). Record Duct Blaster flow pressure, ring#, and CFM.

NSOP _____Pa Ring # _____

Flow pressure _____Pa Air Handler flow _____CFM*

Note: if NSOP cannot be reached, record highest pressure reached (HPR):_____Pa

The Correction Factor table supplied with the TrueFlow can be used to correct the CFM* measured above to the flow at actual conditions. Substitute HPR for TFSOP in making the correction. Mathematically, the Correction Factor is ***square root***(NSOP/HPR)

Record the Correction Factor here_____

Multiply Air Handler Flow recorded at HPR _____ by Correction Factor _____

to get Corrected Air Handler Flow_____

Supply Register Flow Measurements w/DB & Flowbox

1. *Registers should generally be numbered starting at the front door and proceeding clockwise. Or note location below next to number.*
2. *Construct a flow box that will be placed over registers; you may want to use weatherstripping to deal with irregular surfaces. Punch a small hole in the flow box so that you can measure the pressure inside the box with respect to the room.*
3. *Make sure to insert the honeycomb flow conditioner into the round transition piece and connect the flex duct and a low-flow ring (ring 3 recommended to start) to the inlet flange of the Duct Blaster. Connect the square transition piece of the Duct Blaster to the flow box.*
4. *The digital pressure gauge will be used both to measure the flow through the Duct Blaster and to determine when the flow out of the register has been neutralized by the depressurizing action of the Duct Blaster.*
5. *Turn on the air handler to the speed desired.*
6. *Place the flow box on the register you are measuring and turn on the Duct Blaster until the pressure in the flow box is 0 WRT the room. At this point, record the DB fan pressure and convert to CFM. This is the flow out of the register.*

Register location	**Toe kick? Normally partially or fully closed? Other notes:**	**Flow (CFM)**	**Flow (CFM) method: _____**	**Flow (CFM) method: _____**
S1				
S2				
S3				
S4				
S5				
S6				
S7				
S8				
S9				
S10				
S11				
S12				
S13				
S14				
S15				
	Supply sum			

Notes: