Myths comparing DucTesters and Duct Blasters exploded

Myth 1: my Duct Blaster will measure 1000 CFM of duct leakage
Myth 2: my Duct Blaster will measure 850 CFM at 500 Pa (two inches of water).
Myth 3: I can measure well over 1000 CFM using my @ pressure feature.

It is instructive to look at Duct Tester specs and see what they really mean. Looking at accuracy is revealing as well. The following tests were done on a single return system in a 2500 Square foot house near our shop in Everson, WA. We used a MN Duct Blaster™ and the Retrotec Model 300.

	on 10" flex in Free Air	on 10" flex at 25 Pa	on 10" flex at 50 Pa	on 10" flex at +10.9 Pa	on 10" flex at -10.7 Pa	on 10" flex at +20.6 Pa
Retrotec Model 300 spec		780 CFM				
measured on gauge		760 CFM		688 CFM	680 CFM	692 CFM
actual flow				688 CFM	682 CFM	692 CFM
error				0 %	0.4 %	0 %
				at +10.5 Pa	at -8.4 Pa	at +20.4 Pa
TEC Duct Blaster spec	1250 CFM		1000 CFM			
measured on gauge	998 CFM			741 CFM	529 CFM	733 CFM
actual flow				676 CFM	604 CFM	688 CFM
error				8.9%	-14.3%	6.1%

Test procedure and results

Results were from a freshly calibrated Model 300 so we assume the error is close to zero.

The duct testers were used in to pressurize a leaky duct system a 100% speed to measure total flow and error. At maximum speed the Model 300 produced +10.9 Pa with a measured flow of 688 CFM while the Duct Blaster displayed 741 CFM it only managed +10.5 Pa indicating its flow rate must have been lower. Extrapolation of the test pressure gave an actual flow or 676 CFM meaning it overstated its flow by 8.9 %.

Next the ducts were measured in the preferred depressurization direction where similar test pressure were created using the Model 300 but much less pressure on the Duct Blaster since Ring 1 must be used with the flow conditioner attached which limits flow. The maximum reading was reduced to 529 CFM but the actual flow was 604 CFM for a -14.3% error.

Why do specs not match performance?

Specs give flow with flex duct attached at pressures of 25 and 50 Pa but when a real test is conducted, pressures will be much higher at maximum flow. The duct tester must overcome the combined resistance of 12 feet of 10" flex, a return register, the blower wheel in the airhandler and finally the duct leaks. In the tests performed the duct tester had to blow against a pressure of 200 Pa to realize a supply test pressure between 8.4 and 20.7 Pa.
This extra pressure causes the maximum flow rate of the Model 300 to drop a small amount from 780 to about 690 CFM due to the centrifugal blower used whereas the Duct Blaster drops a much larger amount from its spec of 1000 CFM down to an actual average flow rate of 680 CFM. Slightly less than the Model 300.

This extra pressure is not needed if extra time is taken to connect the duct tester to the airhandler cabinet because in this case around 90 Pa is lost in the 10"flex, another 100 Pa across the return grill

Myth 1: my duct tester will measure 1000 CFM

None of the duct testers sold today will measure 1000 CFM due to the high back pressure. The Model 300 and the Duct Blaster can go up to 700 CFM maximum in most duct systems. Leakage values above that are rather meaningless in any case since it means that the majority of the airhandler flow is not being directed by the ducts.

Myth 2: my duct tester will measure 850 CFM at 500 Pa (two inches of water).

Exercise #2 demonstrates that the flow can be zero and still the Duct Blaster will show over 800 CFM on the gauge.

Myth 3: I can measure well over 1000 CFM using my @ pressure feature.

When attached to the return register, it is nearly impossible to get an accurate reading much above 500 CFM in most cases. Return test pressures will be high which will exaggerate return leaks.

The Duct Blaster will not accurately measure flows above 500 CFM because of back pressure limitations.

How does the TEC axial fan compare to the Retrotec centrifugal blower?

The TEC axial fan performs well against small pressures and is well suited to tests that do not require a flex as duct testing does. At 250 Pa the TEC fan flow drops to 650 CFM whereas the Retrotec blower drops to 750 CFM making it well suited to testing ducts. As the pressure drop increases the axial fan will begin to stall in the center causing flow to be created only at the blade tips. In extreme cases, air flow will stop altogether but the duct tester will continue to measure flow even though none exists. See the exercises at the end to experience this for yourself.

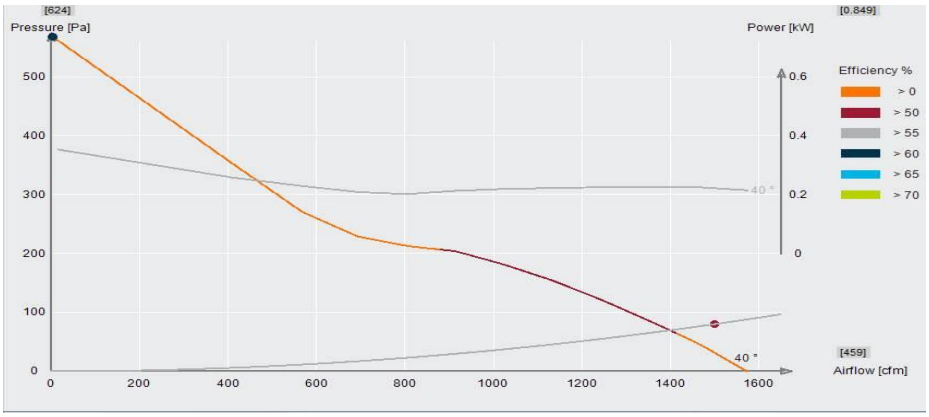

Figure 1 TEC Fan Curve shows 650 CFM at 250 Pa

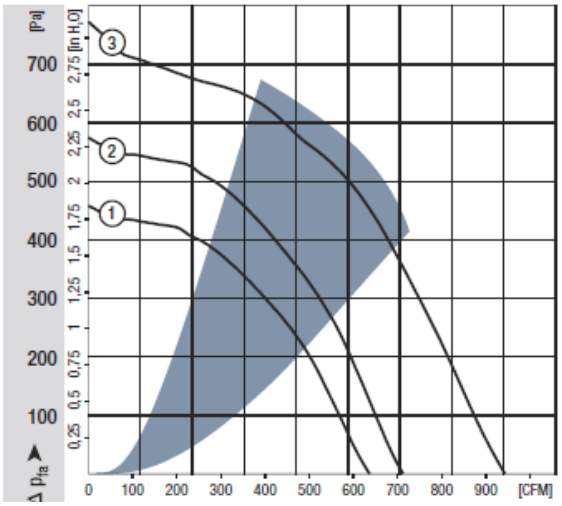

Figure 2 Retrotec Fan Curve shows 750 CFM at 250 Pa

What about accuracy?

Both manufacturers claim +/- 3% of reading throughout the measurement range. All Retrotec Model 200s were adjusted to meet this spec but it was time consuming so the Model 300 was developed where accuracy could be controlled with use of all injection molded parts including a modified elliptical nozzle inlet that would be stable over a wider range of flows and back pressures. Duct Blasters met this spec under low pressure drop conditions but as this test shows, it will not perform well at high back pressures.

Tests in Pressurize and Depressurize directions show the Duct Blaster with errors of 8.9 and 14.3% which means they differ by 23.2%. Even if the calibration of the Model 300 with which it was compared was incorrect, the Duct Blaster actually disagrees with itself by 23.2%.

Learning exercises

Use these exercises to check your duct tester and to realize its limitations. The exercise 3 if for discovering what your maximum flows actually are so you'll recognize problem readings in the field. At full speed on Open Range both Retrotec and TEC will have about 100 Pa pressure drop across the flex itself. Typically the air handler and return grill will add 110 Pa to this with an additional 25 Pa pressure in the supply plenum.

You could test a real system and find out the same conclusions but you would not know what the correct result was supposed to be. You could test on two ranges to see if they differed which would identify at least one type of problem, namely your duct tester readings may not agree with themselves as ours did not in this exercise.

1. On Open range lay the Duct Blaster on the floor with no flex attached and with the outlet screen facing the floor. Tape it to the floor with a pressure probe underneath the fan. Run it up to full speed and you'll see a pressure of around 560 Pa. The flow will now read around 860 CFM when it must be zero because the outlet is completely blocked. This demonstrates and extreme example of what happens when axial fan blade stall and cause flow to pass the sensors where no flow exists.

2. Repeat the same test on the Model 300. It will probably not give a flow reading at all but try it.

3. Create test similar to the one we just did by using a box with an 8 x 8 inch square hole cut in it. Larger box size is better. Connect the flex to the box and the outlet of your duct tester to the flex. Connect Channel A to the box using a static probe out of the air stream. Connect Channel B to the fan pressure tube. Run fan at full speed. Read the CFM from the gauge and compare it to the CFM from the table or use the formula:

CFM = square root of fan pressure x Area in square inches x 1.075

Box pressure	CFM with 8 x 8" hole	Box pressure	CFM with 8 x 8" hole
25	344	90	653
30	377	95	671
35	407	100	688
40	435	105	705
45	462	110	722
50	486	115	738
55	510	120	754
60	533	125	769

65	555	130	784
70	576	135	799
75	596	140	814
80	615	145	828
85	634	150	843

4. Try different ranges and different speeds.
5. Run the same test in depressurization which may be more accurate for smaller boxes because there is less turbulence at the hole.
6. Reduce the hole size to 4x4 to check your duct tester at lower flows.

Box pressure	CFM with 4 x 4" hole	Box pressure	CFM with 4 x 4" hole
20	77	33	99
21	79	34	100
22	81	35	102
23	82	36	103
24	84	37	105
25	86	38	106
26	88	39	107
27	89	40	109
28	91	41	110
29	93	42	111
30	94	43	113
31	96	44	114
32	97	45	115

Recommendations for Accurate Results

All users

Check your fan against this box to ensure you understand its performance limitations on maximum flow and minimum flows.

Measure duct leakage to outdoors in leaky systems because the total flow needed will be much lower improving the chance for an accurate test.

Leaky systems can be divided at the airhandler so returns and supplies are measured separately. This also helps to identify where the leaks are.

Duct Blaster users

Check the Back Pressure using the pressure tap on the flange. You should not go above 100 Pa to keep errors to a minimum. This will restrict maximum flow to around 500 CFM in most cases.

Never use Open range to test ducts. If that amount of flow is needed you're probably running at too high a back pressure to be accurate. Always use Ring 1 or smaller. The maximum flow with Open is 680 and 600 CFM for Ring 1 so there is not much advantage to using Open in any case and a lot of risk.

Check Ring 3 against Ring 2 since Ring 3 may be out by 25%. Usually Ring 2 is ok. Check against a field calibration plate. You may have to center the ring around the pressure sensor to get good readings.

Ensure the reference hose is connected to the collar when depressurizing, otherwise the results will be overstated by 60%.

For high flow applications:

> Remove the return grille to reduce back pressure if possible, or
> Connect the Fan to the blower compartment when testing leaky systems to avoid high back pressures.

Retrotec users

Use the Hole Flow Device in your gauge to measure flow in the box.
Ensure Yellow and Green tubes are connected when depressurizing. This is normal practice.