GET IN TOUCH WITH YOUR AIR SIDE

by Rob Falke

Like a doctor taking a blood pressure reading, measuring static pressure should be at the heart of every HVAC system exam

- EDITOR'S NOTE
- TOOLS OF THE TRADE
- AIR DIAGNOSTICS TRAINING

Static pressure is an indication of the operating condition of an HVAC system. Just as a doctor measures blood pressure to begin his examination, so should service techs, sales people, and duct renovation specialists measure static pressure to begin their diagnostics.

Are you really doing your job if you fail to measure static pressure every time you service a unit? The answer is no.

In a recent survey conducted at the National Balancing Institute, less than 6% of the companies surveyed said they measured static pressure on a regular basis. In fact, many companies measure static pressure only as a last resort when they're in trouble and have exhausted all other traditional testing.

History tells us that our industry measured static pressure decades ago. When and why did we lose the habit of testing this basic factor that affects the total operation of our product? How did we lose touch with the air side of HVAC systems?

In the Beginning . . .

Two hundred years ago at the beginning of the industrial age when ventilation began to be used, a method of measuring air flow and air pressure was required, and the "U-tube manometer" was invented. This instrument is still used today. It's a 1Ú4-in. tube formed into a 'U' shape . A scale is written on it in inches, and it's filled half-full with water.

When pressure is collected in the duct with a static pressure tip. The pressure travels through the hose to the manometer, or pressure reading gauge. The distance the pressure moves the water is inches of water column (w.c.).

Modern instruments usually use pressure sensors to interpret the readings digitally, which makes our jobs much easier. But the old liquid-filled gauges still do the job if that's all you have to get started.

How long does it take to read static pressure? About five minutes. Drill holes into the duct or equipment to insert your static pressure tip, set up the pressure-measuring gauge, and read and record the supply and return sides of the system for a total external static pressure reading. That's all there is to it.

Solving the Mysteries of ESP

ESP isn't your ability to read minds, or guess airflow; it stands for external static pressure. This is the reading that manufacturers refer to in their fan performance data. Esp is a total of the two pressures taken just outside of the furnace or air handler, or before the air enters the equipment and just after it leaves the equipment.

Manufacturers know the resistance inside the equipment. The ESP rating tells us what resistance the coil, ductwork, filter, and grilles need to be designed at so the fan can deliver the required airflow.

Ideally, there would be return air filter grilles out in the system, and a nice, smooth transition between the coil and the furnace to drill into. But real-life situations often force us to take pressure readings elsewhere.

For instance, on the return side of the system there's often a filter placed into the top or bottom of a furnace. The resistance of the filter must be included in the total resistance that the fan sees. The real-life solution is to drill into the side of the blower compartment and measure the negative pressure at that point.

On the supply side, the coil sits directly on top of or below the furnace. This isn't an ideal situation for measuring static pressure either, but in real-life fieldwork there are two main practices for measuring positive static pressure.

The first is to drill into the coil housing between the coil and the furnace. I hope you shuddered a little when you read that, because we all hate the hissing sound when we drill into a coil. But if you're careful, that doesn't happen. Here's how: drill a pilot hole with a sheath, or stopper on the end of your drill bit that only allows it to penetrate the coil housing only 1Ú4-in. Then look and feel inside to see if the coast is clear for testing.

Some coils have a secondary wall that you must also penetrate to get into the airflow; this must be drilled through also.

The second way to gain access to the supply side air stream is to remove the high limit switch, and take a pressure reading there. Be certain the power is off when removing the switch, or you'll blow a fuse. Also, because the hole is much larger than the static pressure tip, you must use a seal (your hand or a piece of tape will do) to seal off the pressure.

The Proper Steps

Let's measure static pressure step-by-step. First, read the nameplate data on the air handler or furnace to determine its static pressure rating. This is often the maximum amount of static pressure or resistance that the fan can handle and still deliver 400 cfm/ton on high speed.
Second, since total external static pressure is what we're measuring, we'll need to take two readings: one on the supply side of the fan, and one on the return side of the fan.
To measure in-duct air pressures, drill two 3Ú8-in. holes in the duct to insert the static pressure tip.
Third, connect the static pressure tip to the hose, and attach the hose to the pressure connection on the Magnehelic® gauge. The top (or high connection) is for positive or supply pressure. The bottom (or low connection) is for the negative or return pressure.
Fourth, level and zero the pressure gauge to ensure accurate repeatable readings. Then insert the static pressure tip into the duct with the tip facing into the airflow.
Fifth, read the pressure on the gauge, and record the reading on the supply side, then on the return side. These readings can be taken at one time, but diagnostic ability increases when each side is read separately.
Use a (+) sign before the positive or supply side reading to show where it was taken, and a (-) sign before the negative or return side reading.
Add the two pressures. Disregard the positive and negative signs before the pressures, because each pressure is an absolute number &emdash; each pressure is "seen" and affects the fan as a force, so they must be added together to determine the total resistance the fan sees. For example a +.23 w.c. plus a -.19 w.c. equals a total static pressure reading of .42-in. w.c..
Record the pressure readings on your diagnostic report or on your service ticket. Our techs often write the pressures on the cooling coil for future use. Any change in static pressure reveals a change in the system that should be addressed for the system to operate properly.
Most residential and light commercial systems under five tons are rated to deliver 400 cfm at a static pressure of .5-in. w.c. Maximum static pressure increases with larger units.
Be certain to always read the nameplate data to determine the total static pressure that the unit was manufactured for. Also, obtaining a copy of the manufacturer's fan curve data can be very helpful in interpreting static pressure and airflow readings

Measure the Components

Static pressure drop can be measured over each component of a system by taking a pressure reading on each side of the component. Subtract the readings from each other to determine to drop over that component.

Static pressure can be traced from the grilles all the way back to the fan. Try adding together the pressure drops over each of the components of the system. This isn't the usual procedure for measuring pressure, but it presents a great learning opportunity.

For example, a cooling coil may have a reading on one side of +.36-in. and a reading on the other side of +.06-in. Subtract the two from each other, and the pressure drop is .30-in. over the coil.

Remember, total external static pressure is a total of all the pressure drops in the system, as you measure back to the fan. Any reading is a total of all the pressure drops from the grille, back to that point.

Here are some examples of residential or light commercial pressure drops. Check the engineering data as you design, and you may be surprised.

Component	Pressure Drops
Cooling coil	.01-in. to 0.5-in.
Disposable filters	.05-in. to .30-in.
Pleated filters	.10-in. to .45-in.
Electrostatic filters.	.20-in. to .80-in.
Grilles and registers	02-in. to. 15-in.
Transitions, Boots	.05-in. to .35-in.
Elbows.	.01-in. to .10-in.
100-ft. duct length	.05-in. to .20-in.

Diagnostics Clues

There are hundreds of combinations of different static pressure readings we've found over the years. The basic premise is that if static pressure is high, there may be blockage, or the duct may be undersized.

If static pressure is low, there's a good chance that there may be duct leakage, or that the fan is dirty or damaged (see my previous articles on diagnostics, complete with charts: CB, August 1997, p. 54, and October 1997, p. 70).

Keep in mind that with about one in 20 field static pressure readings you'll get what we call a "goofy" reading (I realize that's not a very technical term, but it's accurate). Where do these readings come from? Pressure equalizes immediately, but air also "rolls" and "bounces" around as it passes through ductwork. Occasionally, the turbulence of the air inside will give a false reading. It will just be way too high, or way too low. Because perfect conditions don't exist in the field, the answer is to drill another hole a few inches away and try again.

Don't Miss This Opportunity

More than 80% of the duct systems in residential and light commercial applications don't work as designed. Do your service agreements include the duct system? If not, this is a significant business opportunity that you're missing.

Your best access into the duct renovation market is to include the duct system in your service agreements. What this includes is having the service tech measure static pressure on each service visit. Remember, this takes five minutes or less. If pressures are very high, or very low, send out a salesperson with a flow hood and a manometer to identify the problem, and propose a repair or replacement of the duct work.

One reason we have service agreements is to gain additional income from repairs, so start repairing the real problem with the system, and not just the equipment. Besides, in most areas of the country there is very little competition for quality duct renovation and air balancing.

Prescribing HVAC repairs without competition from other contractors in a way that will delight your customers - that's our definition of opportunity.

Rob Falke *is an owner of Saunders Air Conditioning, as well as Balancing Ltd., an air balancing company. Falke, an NEBB-certified air balancer, is also president of the National Balancing Institute, which provides air balancing training as well as complete air balancing business startup packages for HVAC contractors. To reach Rob, call the National Balancing Institute at 800/633-7058.*

EDITOR'S NOTE: Rob Falke was a speaker at *HVAC Comfortech '97*, the

selling and maintaining residential comfort systems.

The seminar's educational program included subjects ranging from air side diagnostics to building your business through service agreements. Attendees had a choice of three educational tracks to follow: Managing and Growing Your Business; Sales and Marketing; and HVAC Technologies and Opportunities. Vital comfort and safety topics such as moisture control and carbon monoxide in the home were also focused on, and panel discussions addressed issues such as utility deregulation and consolidation in the HVAC industry.

Along with the educational program, participants toured a Product Showcase that featured displays from more than 100 suppliers of products and services to the residential comfort industry. For more information on HVAC Comfortech '98, which will be held September 9-12 in Nashville, TN, contact Marge Smith at 216/931-9343.

TOOLS OF THE TRADE

There are many fair, good, and excellent quality digital manometers on the market. We've paid more than $1,500 for some we use daily in commercial air balancing, but many fall into the $300 to $500 range. For less than $150 (excluding a drill) you can assemble the following items and have a terrific starter kit with everything you need to begin measuring pressures.

- Dwyer Model 2001AV Magnehelic® Gauge
- 8-ft. of 1Ú4-in. (ID) neoprene or rubber tubing
- Static pressure tip
- 1- 3Ú8-in. drill bit
- 100- 3Ú8-in. plastic test hole plugs
- 1- 6-in. x 1Ú8-in. stainless steel tube
- 1- Drill bit sheath (for drilling into coil housings, and not the coil)

Air Diagnostics Training

The National Balancing Institute offers air balancing seminars, manuals, forms, and test equipment especially designed for hvac contractors. To learn more about this exciting and profitable growth area, call the NBI at 800/633-7058.

NBI Training Schedule.

- September 14-15 &emdash; Nashville, TN
- September 22-23 &emdash; Cincinnati, OH
- October 13-14 &emdash; Las Vegas, NV
- October 27-28 &emdash; Houston, TX
- November 5-6 &emdash; Orlando, FL
- November 10-11 &emdash; Baltimore, MD
- November 24-25 &emdash; Bristol, England
- December 1-2 &emdash; Los Angeles, CA
- December 9-10 &emdash; Phoenix, AZ

Call the NBI for seminar rates, group discounts, and information on in-house training.