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The ENERGY  
CONSERVATORY

DIAGNOSTIC TOOLS TO MEASURE BUILDING PERFORMANCE

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## A new device for field measurement of air handler flows

Measuring airflow in residential HVAC systems will soon be easier, faster, and more accurate based on a new study performed by researchers at Ecotope, Inc. in Seattle. The researchers, Larry Palmiter and Paul Francisco, studied the in-field performance of a new flow measurement device which fits into the filter slot of an air handler. Ecotope has been working with The Energy Conservatory (TEC) and the Washington State University Extension Program in Olympia, WA since 1997 on a project to develop a more accurate and simpler method of measuring flow through an air handler than traditional methods. The most widely used methods for estimating the air handler flow rate, (the temperature rise method, static pressure and fan curve method, and the Duct Blaster® isolated return method) have been found to be either problematic or time-consuming to perform.

The Air Handler Flow Project was funded under the Department of Energy's (DOE) Small Business Technology Transfer Program. The project was broken down into two phases. Phase 1 involved development of a prototype device that could be used to accurately measure flow moving through an air handler under a variety of upstream flow conditions. Phase 2 of the project encompassed refining the device for wide-spread use and manufacturing concerns, as well as the collection of detailed field measurements in a large sample of houses with comparisons to currently accepted methods of flow measurement.

Phase 1 was completed in 1998. The device (patent pending with TEC) developed in Phase I was a 20-inch x 20-inch perforated metal plate that was instrumented with small metal tubes up and downstream of the plate. The device was laboratory tested in a mock up air handler under a number of different duct configurations. The pressure signals from the sensing tubes were measured using an automated pressure logger and were then correlated to actual air flow measured under laboratory conditions. The tests yielded a single set of calibration parameters for the metering plate that worked over all flow ranges and configurations.

Phase II first involved refinements to the metering plate design by TEC. The device developed for Phase II was designed to temporarily replace the filter in a typical air handler system during the airflow measurement operation. The final design included 3 different sized plastic metering

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tering plates and 14 spacers, the air handler flow device (AHFD) can take measurements in up to 30 different sized filter slots, ranging from 10x20 to 30x30. If the filter location is directly adjacent to the air handler, the device will measure the total air handler flow. If the filter is located remotely at a central return, the device will measure the airflow through the central return.

Once the design was refined, Palmiter and Francisco, with assistance from Washington State University, performed detailed measurements on 65 typical residential systems. Their study compared the AHFD to the temperature rise method, and also compared each method for ease of use. In addition, the air flow through each air handler system was measured using the Duct Blaster isolated return method which uses a calibrated Duct Blaster® fan connected to the return side of the air handler. This measurement was assumed in the study to be the “true” flow value and was used to evaluate the accuracy of the other two methods. In some houses, the temperature rise method could not be used because the output capacity could not be measured or the heat pumps were not wired for resistance only operation. These are typical field measurement problems that the AHFD can address.

During the development of the field testing protocol, it was realized that the AHFD might change the flow rate in the air handler by being either more or less restrictive than the filter. To address this problem, a pressure correction method was devised whereby the pressure between a location in the duct system and the house would be measured both with the filter and with the AHFD. The nominal flow rate measured by the AHFD would then be multiplied by the square root of the ratio of the pressure difference with the filter to that with the flow plate. The research team found that more than half of the house systems required less than a 5% flow correction. There were a few cases where a large correction was necessary, though rarely was a flow correction of greater than 12%

was as simple and easy to use as the single point temperature rise method and required about the same amount of time when you include the time required to measure the output capacity. The AHFD was accurate over a wide range of return and fan location configurations. The more telling aspect of the new device was that it was about 4 times more precise than the single point temperature method. When each method was compared to the Duct Blaster isolated return method, the AHFD produced more values that were at or near the true value. Most readings were within  $\pm 7\%$  of the true flow. The single temperature method produced readings that ranged from 55% low to 78% high compared to the true value with most of the readings within  $\pm 30\%$  of the true flow.

Because the airflow rate through residential air handlers is such an important variable in estimating and optimizing the performance of heat pumps, air conditioners and furnaces, TEC is convinced that an accurate, dependable and easy to use device will become an essential tool for many residential HVAC contractors. TEC is currently field testing a number of prototype AHFD's and plans to have a product available for sale within 6 to 9 months. More information of pricing and availability should be in our next newsletter.

## Make Your Leakage Measurements Count!

Berkeley Lab Needs Your Leakage Data! The Lawrence Berkley National Laboratories, LBNL, is putting together a national leakage database (building envelopes and ducts). It will focus on new construction and measurements taken within one year of construction. (Data for other houses are welcome as well). The database will include blower door data, duct leakage data,

and house characteristics. LBNL's Max Sherman and Nance Matson will use the database to examine and report on national trends in air tightness and energy efficiency. Your participation will help them make sure their analyses and policy suggestions reflect the houses you work with.

To Contribute: Go to the Energy Performance of Buildings Web site (<http://epb.lbl.gov/database>) or contact Nance Matson ([nematson@lbl.gov](mailto:nematson@lbl.gov)) at 510-486-7328. Her mailing address is MS 90-3074, LBNL, Berkeley, CA

## TECBLAST™ is Here!

TECBLAST Ver. 1 can help you sell profitable duct testing and repair services by quickly analyzing and presenting duct leakage test results. TECBLAST, designed specifically for the Minneapolis Duct Blaster®, makes it easy to enter, analyze and store duct leakage test data.

TECBLAST's choice of professional looking reports makes it simple to document and present duct leakage test results to your customers. For those with lap-top computers, this powerful program can be brought right to the job site. TECBLAST will calculate and display duct leakage test results, including the leakage rate in CFM, leakage area in square inches, leakage as a percent of system airflow, and estimated annual system efficiency loss from

the measured leakage rate. The built-in report generator includes a choice of a one page easy to read homeowner report or a two page technical report. And each report can include your company logo, address and telephone for a more professional image.

A 30 day demonstration version of TECBLAST is now available on TEC's website ([www.energyconservatory.com](http://www.energyconservatory.com)). Simply visit our site and go to the **Products / Software** section to download the program. The demonstration version includes all the functions, calculations, and report generating features of the full TECBLAST program. TECBLAST is available from TEC for \$150 and includes a complete printed manual. Add TECBLAST to your duct leakage testing tools today. Call us for immedi-

## Minnesota Energy Code 2000

In April of this year the Minnesota State Legislature enacted a new state-wide energy code for residential homes. The new code builds on the previous version by making homes more energy efficient but also ensuring that each home has adequate fresh air and that combustion appliances, such as water heaters and furnaces, are safe in a tight house. The four major changes that are in the new code include mandatory mechanical ventilation, protection against depressurization in the combustion appliance zone (CAZ), specific language that clears up many issues on airsealing, and maximum U value for the window and door package.

In the previous code, mechanical ventilation for people was an option, now it is mandatory. A mechanical residential ventilation system must be installed which replaces, by direct or indirect means, air from habitable rooms with outdoor air at a rate of at least 0.05 cfm per square foot of floor area. In addition the people ventilation fans must be quiet. That means 1.0 sones or less and rated for continuous use. Builders have been aware of the previous version and have installed mechanical ventilation systems in many homes but will now be required to install in all homes. The state and local builders association goes along with this decision. This stance is very different than the reaction of the national builders association that has opposed such ventilation. The national associations have stated that opening windows should be sufficient to allow fresh air into the home. Obviously here in Minnesota, opening a window in January for any length of time would create other problems not to mention the energy bills.

Probably the most controversial addition to the code is protection against depressurization of the CAZ. While all interest groups agreed that it is very important, reaching

done but were unsure of how to proceed, the Gas Appliance Manufacturers Association who were trying to describe the differences between sealed combustion, power vented, direct vented and atmospherically vented, and the utilities because they get called in when problems exist. The code includes a series of prescriptive paths that specify which types of ventilation and make-up air systems can be used with various types of combustion appliances. For a long time, national codes have been clear about the need to provide make-up air to protect combustion appliances against depressurization, but they have given almost no guidance about how to do it. The new Minnesota code gives this guidance.

Airsealing was part of the previous code but changes this year provide specific airsealing language that was missing or confusing. For example, the code ensures that exterior wall corners, and intersections of interior partition walls with exterior walls, are framed so that insulation can be installed after the exterior sheathing is installed. Also, framing must accommodate a continuous interior air barrier even when interior framing meets an insulated ceiling or exterior wall. Builders and framers were most concerned with this issue due the training needed to get crews ready for the standard.

Something new to the code was the introduction of a maximum U-value for windows at 0.37. In discussions, parties were unsure of the optimal U value but agreed that 0.37 was an acceptable improvement. For the window manufacturers, the maximum U value effects the amount and size of windows, which the HVAC people then use for overall energy calculations and equipment sizing. As you may know Minnesota is home to both Anderson and  
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move 125 cfm.

Something that is not part of the code but is part of the legislation is the requirement that the new code have a follow-up study to the legislature by December 1, 2001. This study is to address the cost benefit of the new energy code, as well as air quality, building durability, moisture, enforcement, enforceability, and liability. This study will be a major undertaking with uncertain results.

When viewed from the big picture what came out of the negotiations and discussions was that the building community really wants to have prescriptive paths. These paths are useful to them so that they know how to build properly, and useful when discussing construction techniques with code and inspection officials. But at the same time the building community feels that prescriptive paths can be too restrictive and can be detrimental when an unusual building feature is incorporated into the design. Hopefully

**Open House** The Energy Conservatory has been in its new home for almost a year and we are celebrating with an open house on Monday, June 26, 2000 from 5 p.m. to 8 p.m. The Open House will give you, our

the new code strikes a balance that everyone in the building community, including the home owner, can work and live with. For more information you can visit the State of Minnesota's website at <http://www.dpsv.state.mn.us>.

**Upcoming Shows** The following is a list of industry tradeshow where TEC will be exhibiting. If you are in the area, stop by the booth and see some of the new products first hand.  
ComforTech, Atlanta, GA, September 7 – 9, 2000  
Energy Efficient Building Association, Denver, October 25 – 28, 2000  
ASHRAE, Atlanta, January 27 – 31, 2001

customers and friends, an opportunity to see our calibration facilities, view our products in action, put their hands on a brand new product, and meet and talk with the people that are the core to making Minneapolis the Blower Door capital of the world. Our building is located about 3 miles from Downtown Minneapolis. Our Open House is at the same time as the ASHRAE Annual Summer Meeting which will be held in downtown Minneapolis. So, if you're a local Minnesotan, or just a visitor to the land of 10,000 lakes, come by our place, enjoy some food, some

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