THE ENERGY CONSERVATORY *UPDATE*

Manufacturer of Diagnostic Tools
to Measure Building Performance

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Inside:

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Measured Efficiency of Forced Air Duct Systems in the Pacific Northwest

A 1994 study by Larry Palmiter and Paul Francisco of Ecotope, Inc. provides important new details on the efficiencies of residential forced air duct systems.

The study measured the efficiency of forced air duct systems in 24 electrically heated houses located in the Pacific Northwest, including both heat pump and forced air heating systems. The houses were closely monitored in order to calculate two separate measures of duct system efficiency. Aggressive duct sealing retrofits were performed on 6 of the houses and the efficiencies were remeasured.

The majority of the study houses (22) were chosen because they had over 50 percent of the their duct systems located outside of the conditioned space. Locating duct systems in unconditioned spaces is a common practice in large portions of the United States and has been shown in numerous studies to contribute to significant energy losses. Two additional houses were studied which had all of the ductwork located within the conditioned space in order to provide a reference to compare against the larger sample.

For each duct system, a Heat Delivery Efficiency was calculated by measuring the air flow and delivery temperatures at each supply register, and monitoring the energy input to the electric heating system. The Heat Delivery Efficiency is the percentage of energy input to the heating system which is actually delivered to the room via the supply duct system. Heat not delivered through the registers can be attributed to either duct air leakage losses, or duct conduction losses.

Additionally, a System Efficiency was calculated by comparing actual heating system energy use with a coheating system designed to duplicate the interior temperatures under normal operating conditions. The System Efficiency measurement accounts for any recapture of duct losses to the house, and therefore is a better measure of the overall operating efficiency of the duct system and its impact on energy use.

See Page 2

(Duct System Efficiency from Page 1)

Note: The System Efficiency measurement does not include the effects of increased infiltration during fan-off times and differential pressurization due to door closure, therefore it can be assumed to be an upper bound on the actual duct system efficiency.

Exterior Duct Systems:

For the base sample of 22 houses with exterior duct systems, the average Heat Delivery Efficiency was measured at 56.2%. This means that nearly 44 percent of the energy input to the heating system was lost due to air leakage and conduction before being delivered through the supply ductwork. The study found that on average, air leakage and conduction contributed equally to the efficiency losses. It should be pointed out that the duct systems in the base sample were quite well insulated, with a median duct insulation R-value of 7.0. Average duct leakage to the outside for these houses was measured at 436 CFM50 using a combined Duct Blaster and Blower Door test procedure.

The average System Efficiency of the 22 exterior duct houses was measured at 71.0%, indicating that the recapture of duct losses to the house increased the overall efficiency of the duct system by nearly 15 percentage points from 56.2%. Despite the recapture of duct losses, these 22 houses still used approximately 40 percent more heating energy than would identical houses with electric resistance heating (i.e. no duct system).

Interior Duct Houses:

Equally intriguing were the findings on the sample of 2 houses with interior duct systems. The average Heat Delivery Efficiency for these 2 houses was measured at 66.8%. While this value is significantly higher than the Heat Delivery Efficiency for exterior duct systems, it still points to large duct losses for interior duct systems. However, the average System Efficiency for these two houses was measured at 97.9%, indicating that almost all of the duct losses for the interior duct systems was recaptured as useful heat to the house. This finding is particularly important because it suggests that efforts to seal duct leaks in interior duct houses may not be warranted from an energy efficiency perspective.

Because of the very limited sample size however, this conclusion needs to be examined more closely through further research.

Duct System Retrofits:

Extensive duct system repairs were performed on 6 of the exterior duct houses and the impact of the repairs on duct system efficiency was measured. The primary focus of the duct repairs was to reduce air leakage in the duct system. For the 6 houses, duct leakage to the outside was reduced by an average of 70%, from a pre-repair leakage rate of 541 CFM50 to 161CFM50.

The actual reduction in space heating energy use under the test conditions was 16.4% for the sample. This level of energy savings is consistent with previous duct retrofit studies performed on exterior duct houses. Cost information for the retrofit work was not provided in the paper we reviewed.

Despite extensive repairs to the duct system and fairly high levels of duct insulation, the 6 (retrofitted) houses still use 20% more energy than would identical non-ducted houses.

The average measured System Efficiency for the 6 houses increased from 69.2% to 82.8% following the repairs. Despite extensive repairs to the duct system and fairly high levels of duct insulation, these 6 houses still use 20% more energy than would identical non-ducted houses.

Ecotope is a research and consulting firm located in Seattle, Washington.

Affordable Comfort Housing Performance Association

If you insulate and air seal houses or duct systems, evaluate energy efficiency problems, manage housing and energy programs, or otherwise work to improve housing perfornance, you are invited to join the Affordable Comfort Housing Performance Association (ACHPA). The ACHPA's goal is to create long term, consumer driven markets for high quality housing performance services through consumer eduction, marketing support and state and federal energy policy development.

ACHPA is hoping to recruit 1,000 members the first year. Charter memberships are $75. Contact Helen Perrine, Executive Director of Afforable Comfort, Inc. at 800-344-4866 for more information.

New Duct Leakage Training Video Available

The Energy Conservatory has produced a new video tape on duct leakage diagnostics and repair.

The two hour video demonstrates diagnostic procedures using a blower door, pressure pan, digital pressure gauge and Duct Blaster. Duct leakage problems found in 3 case study houses are detailed along with demonstra-tions of repairs made to the duct systems. The tape also includes a classroom discussion of basic air flow principles and the role they play in determining the interactions between duct leakage, building pressures and house erformance.

The classroom and field training is conducted by John Tooley, one of the leading experts on this subject. John's vast experience and enthusiasm allow him to present the material in a clear and consise way.

The video was recorded this past June in Raleigh-Durham, North Carolina along with assistance from the North Carolina Alternative Energy Corporation and Jack Orum, a local HVAC contractor.

The training tape retails for $75 and will be an excellent reference for both beginning and experienced field technicians performing duct leakage testing and repair.

Pressure Pan Handbook

A new 16 page handbook on diagnosing duct leakage with a pressure pan and blower door is available from the Energy Conservatory for $5.00. The handbook draws heavily on the work of John Tooley of Natural Florida Retrofit and Bruce Davis of the North Carolina Alternative Energy Corporation.

Topics covered in the handbook include typical field procedures, example pressure pan results, pressure pan screening criteria and tips on taking pressure pan measurements. And for those of you who are tired of making their own pressure pans, TEC now manufactures and sells a 10"x14"x4" molded ABS plastic pressure pan complete with a 6 foot extension pole for high wall or ceiling registers. The TEC pressure pan sells for $45.

How Can I Revive My Old Model 2 Blower Door Fan?

You've been using that old reliable friend for almost eight years now. The motor still runs great, but the Model 2 fan housing is getting pretty beat up, maybe even missing a few pieces. Is there anything I can do to revive it, short of replacing the whole fan?

The answer is yes. An increasing number of our customers are having their old Model 2 fan housing replaced with our new injection molded urethane housing. The old fan is first disassembled and inspected to see which parts may be reused. "We try to use as much of the old fan as possible" says Bill Tatam of TEC. Parts typically re-used include the motor, motor mount and fan prop.

The upgrade includes new electrical components, flow sensor and low-flow rings. "The final product looks and acts just like a new Model 3 fan" says Tatam.

The cost for a complete fan housing retrofit is typically $575, assuming we can re-use the motor, mount and prop. If your speed controller is currently mounted on the top of the fan housing, you will also need to purchase a new remote speed controller for $75.00. Call TEC for more information.

Automated Performance Testing System
To Be Field Tested

The Energy Conservatory's new Automated Performance Testing (APT) System will soon be field tested by a small group of weatherization and research organizations around the country. The APT system can be used to conduct fully automated building or duct airtightness tests using the Minneapolis Blower Door or Duct Blaster, as well as provide multi-channel data logging capability for monitoring building pressures and other important performance/IAQ indicators.

The heart of the APT system is a fully automated pressure monitoring module which operates the Blower Door or Duct Blaster fan using software developed by TEC. From a portable computer, you can select between various airtightness testing procedures and watch while the APT system performs the test including adjusting the fan speed, simultaneously monitoring the building pressure and fan flow, and precisely measuring and recording the results.

The APT system is also a data logger. It comes ready to measure 2 separate differential pressures with a resolution of 0.1 Pascals. Other standard features include 8 analog voltage input connections for monitoring optional air quality/temperature sensors, and 2 switchable digital outputs. The APT software allows users to see a real-time graphic display of measured signals, as well as control sampling frequency and other data logging parameters. The Automated Performance Testing System should be available in the Spring of 1996.

Automated Airtightness Testing Features:

- Single or Multi-Point Test Options
- Cruise Control for Maintaining Constant Building Pressures During Pressure Testing
- Duct Leakage Test Options
- Automated Precision Pressure Measurements Reduce Variability of Test Results from Wind and Operator Error
- Built-In Data Analysis, Report Generator and File Storage Features.

Data Logging Features:

- Two Precision Auto-Zeroing Pressure Channels
- Real Time or Recorded Graphic Signal Display
- Repetitive Testing Program for Accurate Measurement of Small Changes in Building Pressures
- Eight Differential Analog Voltage Inputs for Optional Sensors
- Two Switchable Digital Outputs
- User Configurable Software for Custom Sensor Calibration

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