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APT System Used to Automate Home Inspections in Minneapolis Sound Insulation Program

Approximately 80 houses per month around the Minneapolis/St. Paul International Airport are currently receiving improvements to reduce the level of noise inside the home from jet aircraft flying overhead. The sound insulation program, managed by the Center for Energy and Environment (CEE) for the Metropolitan Airport Commission, installs acoustical windows and doors, air conditioning systems (to allow windows to be closed during the summer), as well as traditional weatherization improvements such as wall and attic insulation and airsealing to reduce the interior sound levels by at least 5 decibels from existing conditions. The improvements, installed at no cost to the homeowner, average around \$25,000 per household.

As part of the program, detailed 3 to 5 hour inspections are performed on each house before and after improvements are installed to identify health and safety problems such as inadequately drafting combustion appliances, very tight building envelopes, appliances producing carbon monoxide, and excessive mechanical room depressurization from exhaust fans. If health and safety problems are identified during the initial inspection, homeowners are provided with a work plan and required to correct the problems, at their own cost, before sound insulation improvements are undertaken. Problems found after improvements have been installed are corrected by the program. The detailed inspections also include a "series leakage" quality control procedure which measures pressures in unconditioned attics and garages during a blower door airtightness test to help determine if airsealing work needs to be done in those spaces.

⇒ *Using the APT System to Solve the Program's Complex Data Collection Needs*

The detailed inspections being used in the sound insulation program incorporate some of the most comprehensive and complex test procedures ever utilized in a residential improvement program. In addition to the obvious problems of collecting and documenting such a large amount of data for each house, it is important that the tests be conducted in a consistent and repeatable manner, and that the inspectors be able to look at and interpret the data on a real-time basis. Dave Bohac, who manages the program for CEE, decided that automating many of the test procedures would be the best solution for meeting these wide ranging program needs.

The heart of the automation process is the Energy Conservatory's Automated Performance Testing (APT) system. Using custom software written by Dave Bohac of CEE, the APT system is used to automate a vent performance and worst-case combustion zone depressurization test, appliance CO production test, and the blower door and "series leakage" pressure tests.

⇒ ***Vent Performance Tests:***

During the automated vent performance test, appliance draft and combustion room pressures are continuously monitored under a variety of house conditions using the APT's precision pressure channels. Spillage is also detected and recorded using 3 APT temperature sensors mounted just below the appliance draft hood. The main purpose of the test is to insure that the appliance can vent properly under both normal and worst-case pressure conditions. By examining the real-time draft, spillage and combustion zone pressure data under the various house conditions, technicians can quickly assess venting performance and determine if a venting problem is due to a venting system deficiency, or a house pressurization problem. In addition, all data collected by the APT system is stored and later copied into a master data base to allow for program wide comparisons and reporting.

⇒ ***CO Production Tests:***

CO production under normal operating conditions is measured using a hand-held digital monoxer for combustion appliances in the house. For water heaters, furnaces and boilers, CO levels are also monitored under chimney downdraft conditions using a unique test procedure developed by CEE and TEC. To create the downdraft condition, the APT system is used to control a blower door fan which depressurizes the house to the point where a steady 2 Pa positive pressure is maintained in the vent connector. The sound insulation program measures CO levels under downdraft conditions because recent field observations have shown that some appliances can produce large amounts of CO under downdraft conditions, while producing little or no CO under normal operating conditions. During the downdraft test, the APT system is also monitoring ambient CO levels using an ambient CO sensor (sold by TEC) to help protect the inspector against excessive CO exposure.

⇒ ***Blower Door and Series Leakage Tests:***

The detailed inspections also include a blower door airtightness test to help determine if mechanical

ventilation is needed in the houses. Using the APT's fan speed control feature and built-in pressure channels, the blower door test procedure has been completely automated. During the blower door test, the APT system is also used to simultaneously measure the pressure in unconditioned zones such as attics or garages to allow for a quick assessment of airsealing priorities. Automation of the blower door and series leakage tests speeds up the entire procedure, helps insure that the tests are done consistently, and allows for much more repeatable measurements in all weather conditions.

⇒ ***Inspection Results:***

Results from approximately 1,900 pre-improvement inspections show that 86% of the houses failed one or more portions of the health and safety test procedure. The largest reason for failure has been venting system deficiencies including undersized chimney liners and vent pipes, excessive horizontal vent pipe length, and holes and gaps in the vent pipes themselves due to poor maintenance or improper installation.

Excessive CO production accounts for next highest failure rate. Test results have shown that about 5% of water heaters and 11% of furnaces have excessive CO levels under natural draft conditions. When the appliances are tested under down draft conditions, failures due to excessive CO increases by 50%.

The measured airtightness level in about 25% of the predominately 1920 - 1960 era houses has also been found to be tighter than program standards, even before improvements have been installed. Once improvements are installed, the houses become significantly tighter with about 75% failing the airtightness standard. Mechanical ventilation systems are automatically installed in all houses that test tighter than the program standard.

Jim Fitzgerald, senior building analyst for the project, says that the automated test procedure gives CEE much more confidence in their test procedures. "Using the APT system has allowed us to institutionalize detailed quality control measurements in a high production program that would otherwise be impossible. We now have a great deal of confidence that all our houses are working properly once we've finished the improvements." For more information on the Minneapolis Sound Insulation Program, email Dave Bohac at dbohac@mncee.org.

Windows 95 Test Analysis Software for your Blower Door

We have recently upgraded our Blower Door Test Analysis software to be fully compatible with Windows 95/98/NT computers. The new program, called TECTITE, is designed specifically for use with Model 3 Minneapolis Blower Door systems. The program's simple data entry screens, built-in report generator, on-line help and graphing capabilities makes it easier than ever to document and present blower door test results to a homeowner or client.

In addition to analyzing manually collected test data, the TECTITE program is fully compatible with The Energy Conservatory's Automated Performance Testing (APT) system. If you own an APT system, TECTITE can be used to fully automate the blower door test including adjusting the speed of the blower door fan while simultaneously collecting and storing the building pressure and fan flow data. TECTITE even includes a "Cruise Control" feature which works with the APT System to maintain a constant building pressure while the operator performs diagnostic or airsealing activities.

TECTITE Features

- ⇒ Calculates and displays building airtightness test results including CFM50, air changes per hour, leakage areas, building leakage curve and estimated natural infiltration rates.
- ⇒ Choice of report formats including an easy-to-read homeowner report, or a detailed technical report.
- ⇒ On-line help and simple data entry screens make TECTITE extremely easy to use.
- ⇒ Estimated annual natural infiltration rates and building ventilation guidelines can be used to help determine the need for mechanical ventilation.
- ⇒ Estimated design infiltration rates can be used in Manual J load calculations.
- ⇒ Airtightness test results are calculated using the CGSB 149.10-M86 Standard.
- ⇒ Includes both manual and automated test modes.
- ⇒ The TECTITE program costs \$100 (including manual).

Check Out our New Web Site

(www.energyconservatory.com)

As promised, our Web site has been updated to include the most recent product information, technical support services, and links to other interesting sites containing information on performance testing and energy efficient products and services. The new site also includes a free listing of contractors in the US and Canada providing house and duct system airtightness testing services. To date, there are about 100 contractors on the list and we would like to see many more.

To add your company to the list, simply visit our web site at www.energyconservatory.com, click on the **Contractors** button from our Home Page, and then click on **Add Your Company to the Contractor List**. There is no charge to be included in the contractor list, and list is updated about once every 2 weeks.

Product Briefs

- ⇒ We have added a padded blower door fan case to our product line. The new case is made out of the same tough cordura material as our existing soft shell fan case, but also includes plenty of high density shock absorbing foam to protect your blower door fan from the bangs and bumps of everyday use. The padded fan case is perfect for anyone who keeps their blower door system in the back of a truck. Available for \$250.00.
- ⇒ Have you ever wished you could control your blower door fan from upstairs while conducting zone pressure tests of attics? One simple solution to this problem is our 40 foot long blower door fan extension cord. One end of the extension cord plugs into the blower door fan and the other end connects to the fan speed controller. This lets you bring the fan speed controller upstairs with you, making it a lot easier to conduct pressure tests in multiple story houses. Two extension cords can be combined so you can take your speed controller up to 80 feet away from the fan. Extension cords are available for \$25 each.

Automated Zone Pressure Testing Software Being Developed

Estimating leakage rates in unconditioned zones of a house (e.g. attics, crawlspaces) is potentially one of the most useful diagnostic procedures that you can perform with a blower door. These procedures, often referred to as “series leakage testing” or “zone pressure diagnostics” combine standard blower door tests with additional pressure measurements and mathematical formulas and tables to estimate leakage rates and help prioritize airsealing treatments. Many state weatherization programs and private building diagnosticians have incorporated one or more zone pressure measurements into their standard audit and quality control testing procedures.

Currently, most technicians doing series leakage testing use a hand-held digital manometer to manually measure zone pressures while the blower door is depressurizing the house to 50 Pascals with respect to outside. One of the biggest problems technicians are having in the field is getting repeatable and precise zone pressure measurements in windy weather. Wind can cause the zone pressure measurement to fluctuate significantly, making it sometimes very difficult to interpret the readings from the digital gauge, even when using the gauge’s time-averaging feature. In addition, keeping track of baseline zone pressures (i.e. the zone pressure before the blower door is turned on) can be complicated and confusing to many technicians.

Automated Zone Testing Software continued

One solution to this problem may be new software being developed by TEC for our Automated Performance Testing (APT) system. This new software will automate zone pressure measurements during an APT controlled blower door test. During the automated blower door test, the APT system will simultaneously measure and record the pressures in any zone connected to the APT system. Once the blower door test has been completed, the program will display the zone pressure measurements on screen, along with the estimated uncertainty of the measurements. By automating the data collection process, the APT system can collect hundreds of times more readings than is practical using a hand-held gauge, giving you repeatable measurements in both calm and windy weather conditions. The program will also automatically measure and adjust for baseline zone pressures, greatly simplifying the measurement procedure.

The zone testing features are being incorporated into our Windows 95 TECTITE software (see article on Page 3). Users will need an APT system with 3 or more pressure channels to utilize the zone testing features. A beta-test version of the program is being tested this fall by a number technicians and researchers including selected low-income weatherization agencies. Look for more information on this program in upcoming editions of the *UPDATE* .

UPDATE



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