

Smacna Hvac Air Duct Leakage Test Manual

Duct Leakage Testing HVAC Air Duct Leakage Test Manual HVAC Air Duct Leakage Test Manual DW143 Guide to Good Practice Alternative Procedure to Home Energy Rating System Rater Nonresidential Duct Leakage Test Verification Reducing Uncertainty for the DeltaQ Duct Leakage Test HVAC Testing, Adjusting, and Balancing Field Manual HVAC Air Duct Leakage Test Manual 2nd Ed A Practical Guide to Ductwork Leakage Testing Development of a New Duct Leakage Test System Air Leakage Test Standard 1st Ed. 2020 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems Evaluation of the Repeatability of the Delta Q Duct Leakage Testing Technique Including Investigation of Robust Analysis Techniques and Estimates of Weather Induced Uncertainty The Delta Q Method of Testing the Air Leakage of Ducts Residential Forced-air System Cabinet Leakage and Blower Performance National Standards for Total System Balance Home Energy Rating System (HERS) Technical Manual 2005 Building Energy Efficiency Standards Nonresidential Compliance Manual LABORATORY EVALUATION OF THE DELTA Q TEST FOR DUCT LEAKAGE Home Energy Rating System John Diem Sheet Metal and Air Conditioning Contractors' National Association (U.S.) Building and Engineering Services Association Joe Loyer John Gladstone Smacna Heating and Ventilating Contractors' Association Smacna National Environmental Balancing Bureau (U.S.) Lynn Wray

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to comply with the international energy code most states now require duct testing for both new construction and retrofit duct leakage testing provides an in depth

understanding of duct leakage testing procedures methods of expressing results and terminology building science is the study of a building s interaction between the structure and its components a structure s occupants mechanical systems and the surrounding outdoor environment all play a role in the performance of a building duct leakage testing covers duct leakage testing methods or total leakage leakage to the outside using a duct pressurization tester modified blower door subtraction methods

the thermal distribution system couples the hvac components to the building envelope and shares many properties of the buildings envelope including moisture conduction and most especially air leakage performance duct leakage has a strong influence on air flow rates through building envelopes usually resulting in much greater flows than those due to natural infiltration because unbalanced duct air flows and leaks result in building pressurization and depressurization as a tool to estimate this effect the deltaq duct leakage test has been developed over the past several years as an improvement to existing duct pressurization tests it focuses on measuring the air leakage flows to outside at operating conditions that are required for envelope infiltration impacts and energy loss calculations for duct systems the deltaq test builds on the standard envelope tightness blower door measurement techniques by repeating the tests with the system air handler off and on the deltaq test requires several assumptions to be made about duct leakage and its interaction with the duct system and building envelope in order to convert the blower door results into duct leakage at system operating conditions this study examined improvements to the deltaq test that account for some of these assumptions using a duct system and building envelope in a test laboratory the laboratory measurements used a purpose built test chamber coupled to a duct system typical of forced air systems in us homes special duct leaks with controlled air flow were designed and installed into an airtight duct system this test apparatus allowed the systematic variation of the duct and envelope leakage and accurate measurement of the duct leakage flows for comparison to deltaq test results this paper will discuss the laboratory test apparatus design construction and operation the various analysis techniques applied to the calculation procedure and present estimates of uncertainty in measured duct leakage

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duct leakage is a key factor in determining energy losses from forced air heating and cooling systems several studies francisco and palmiter 1997 and 1999 andrews et al 1998 and siegel et al 2001 have shown that the duct system efficiency cannot be reliably determined without good estimates of duct leakage specifically for energy calculations it is the duct leakage air flow to outside at operating conditions that is required existing test methods either precisely measure the size of leaks but not the flow through them at operating conditions or measure these flows with insufficient accuracy the deltaq duct leakage test method was developed to provide improved estimates of duct leakage during system operation in this study we developed the analytical calculation methods and the test procedures used in the deltaq test as part of the development process we have estimated uncertainties in the test method both analytically and based on field data and designed automated test procedures to increase accuracy and reduce the contributions of operator errors in performing field tests in addition the test has been evaluated in over 100 houses by several research teams to show that it can be used in a wide range of houses and to aid in finding limits or problems in field applications the test procedure is currently being considered by astm as an update of an existing duct leakage standard

establishes a uniform and systematic set of procedures for the performance of the testing adjusting and balancing of environmental or heating ventilating and air conditioning hvac systems

the deltaq test is a method of estimating the air leakage from forced air duct systems developed primarily for residential and small commercial applications it uses the changes in blower door test results due to forced air system operation previous studies established the principles behind deltaq testing but raised issues of precision of the test particularly for leaky homes on windy days details of the measurement technique are available in an astm standard astm e1554 2007 in order to ease adoption of the test method this study answers questions regarding the uncertainty due to changing weather during the test particularly changes in wind speed and the applicability to low leakage systems the first question arises because the building envelope air flows and pressures used in the deltaq test are influenced by weather induced pressures variability in wind induced pressures rather than temperature difference induced pressures dominates this effect because the wind pressures change rapidly over the time period of a test the second question needs to be answered so that deltaq testing can be used in programs requiring or giving credit for tight ducts e g california s building energy code cec 2005 deltaq modeling biases have been previously investigated in laboratory studies where there was no weather induced changes in envelope flows and pressures laboratory work by andrews 2002 and walker et al 2004 found biases of about 0 5 of forced air system blower flow and individual test uncertainty of about 2 of forced air system blower flow the laboratory tests were repeated by walker and dickerhoff 2006 and 2008 using a new ramping technique that continuously varied envelope pressures and air flows rather than taking data at pre selected pressure stations as used in astm e1554 2003 and other previous studies the biases and individual test uncertainties for ramping were found to be very close less than 0 5 of air handler flow to those found in for the pressure station approach walker and dickerhoff also included estimates of deltaq test repeatability based on the results of field tests where two houses were tested multiple times the two houses were quite leaky 20 25 air changes per hour at 50pa 0 2 in water ach50 and were located in the san francisco bay area one house was tested on a calm day and the other on a very windy day results were also presented for two additional

houses that were tested by other researchers in minneapolis mn and madison wi that had very tight envelopes 1 8 and 2 5 ach50 these tight houses had internal duct systems and were tested without operating the central blower sometimes referred to as control tests the standard deviations between the multiple tests for all four houses were found to be about 1 of the envelope air flow at 50 pa 0 2 in water q50 that led to the suggestion of this as a rule of thumb for estimating deltaq uncertainty because deltaq is based on measuring envelope air flows it makes sense for uncertainty to scale with envelope leakage however these tests were on a limited data set and one of the objectives of the current study is to increase the number of tested houses this study focuses on answering two questions 1 what is the uncertainty associated with changes in weather primarily wind conditions during deltaq testing 2 how can these uncertainties be reduced the first question is addressing issues of repeatability to study this five houses were tested as many times as possible over a day weather data was recorded on site including the local windspeed the result from these five houses were combined with the two bay area homes from the previous studies the variability of the tests represented by the standard deviation is the repeatability of the test method for that house under the prevailing weather conditions because the testing was performed over a day a wide range of wind speeds was achieved following typical diurnal variations of low wind in the early morning and greatest winds in the late afternoon early evening typically about ten tests were performed in each house to answer the second question different data analysis techniques were investigated that looked at averaging techniques elimination of outliers limiting leak pressures etc in order to minimize the influence of changing wind conditions during the test the objective was to find a reasonable compromise between test precision and robustness because many of the changes to the analysis to make the test more robust limit its ability to examine wide ranges of pressures and leakage flows a secondary goal of this study is to show that deltaq uncertainties are acceptable for testing low leakage systems therefore houses with low duct leakage were deliberately chosen to be tested

the deltaq test has been developed in order to provide better estimates of forced air system air leakage for use in energy efficiency calculations and for compliance testing of duct systems the deltaq test combines a model of the house and duct system with the results of house pressurization tests with the air handler on and off to determine the duct leakage air flows to outside conditioned space at operating conditions the key advantage of the deltaq test over other methods is that it determines the air leakage flows directly rather than requiring interpretation of indirect measurements the results from over 200 field and laboratory tests are presented the laboratory tests have shown that the deltaq repeatability uncertainties are typically 1 or less of system fan flow and that the accuracy of the test is between 1 3 and 2 5 of fan flow or 13 cfm to 25 cfm 6 to 12 l s for this system

using a residential size duct system in a controlled laboratory setting the repeatability and accuracy of the delta q test for air leakage in residential duct systems have been measured more than 100 delta q tests were performed these were compared with results using fan pressurization and also with results of a procedure delta q plus that uses leakage hole size information to select the leakage pressures to be used in the delta q algorithm the average error in supply or return leakage for the fan pressurization test was 6 4 of system fan flow for the delta q test it was 3 4 of fan flow while for delta q plus it was 1 9 of fan flow

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