Blower Door Testing

Basics and Beyond





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Agenda

- RESNET Chapter 8
- TECTITE Inputs
- Dealing with Wind
- Pressure Matching and “Nulling” Methods to measure exhaust fan flows
- Baselines and ZPD
- Testing with Multiple-Fans

Revised RESNET Test

- Revised RESNET BD Test (Chapter 8)
  - Effective 1/3/12
  - Three building enclosure test options, including a simple one-point test.
  - Has added a way to determine when the test results are adversely affected by wind.
  - Specifies when and how to adjust flows for temperature and elevation.
  - Possible to do a test without software (but software makes it much easier).
  - CFM50 adjusted for level of accuracy

Three RESNET Test Options

- One-point test
- Multi-point test
- Repeated single-point test
- Tests may be de-pressurization or pressurization

Performing a One-Point Test

- Without Software
  - Gather data and use temperature charts & elevation formula
- With Software
  - Manual data entry
    - Gather data for manual entry into TECTITE 4.0 software or iTEC RESNET iOS (Apple) app
  - Automated test
    - Use TECTITE 4.0 software for an automated test

Performing a One-Point Test

- No Software – gather data
  - Record five 10 second average (minimum) baseline readings to determine the level of accuracy
  - Perform Blower Door test using the Baseline and CFM50 functions.
  - Adjust for temperature using charts (not required if delta T less than 30F)
  - Adjust for elevation using a formula (not required if altitude less than 5,000 ft)
  - TEC Quick Guide: Collecting Data for a Manual RESNET One-Point Airtightness Test includes a data collection form

Performing a One-Point Test

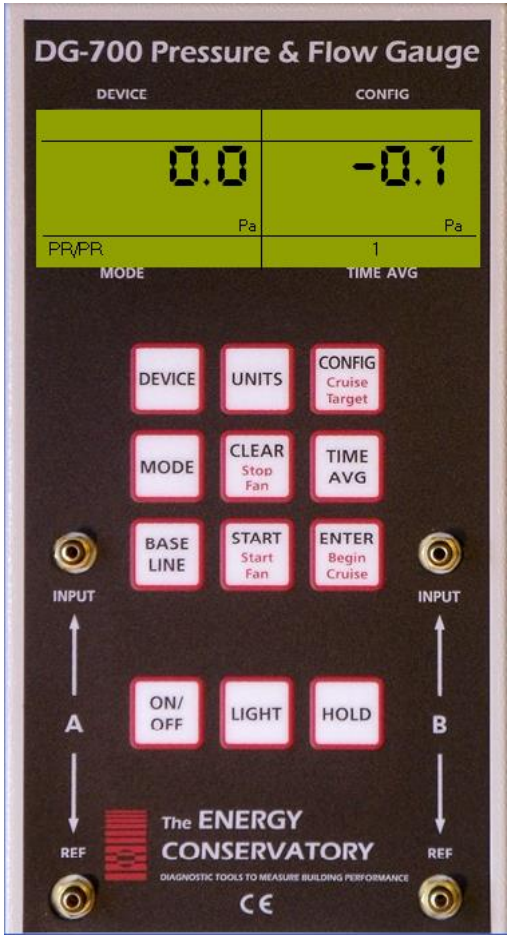
- Determine level of accuracy using Baseline readings
  - Determine Baseline range
    - Difference between highest and lowest reading
  - Less than 5 Pa range = *Standard Level of Accuracy*
  - Between 5 Pa and 10 Pa = *Reduced level of Accuracy*
  - Greater than 10 Pa = 1 point-test *can not be performed*

Performing a One-Point Test

- Taking Baseline w / longer time period
  - Longer time period should result in narrower range
  - If you lengthen the baseline time period, you must also lengthen the test time period
- Perform the Blower Door test

One-Point Manual Test

- RESNET Quick Guide and Form



RESNET One-Point Airtightness Test Form

Technician: _____ **Date:** _____

Building Address: _____

Building Address: _____

Section A

Pre-Test Baseline Pressure Readings
(Include sign of reading)

Time Averaging Period (seconds)

Largest Baseline Reading | |

minus

Smallest Baseline Reading | |

Baseline Range | |

Check the appropriate accuracy level below, based on the size of the Baseline Range.

- ☐ **Standard Accuracy Test** (Baseline Range less than 5.0 Pa)
- ☐ **Reduced Level of Accuracy Test** (Baseline Range between 5.0 and 10.0 Pa)
- ☐ **Invalid Test** (Baseline Range greater than 10.0 Pa)

Section B

If Using TEC Software: (PR/FL Mode)		**Nominal Building Pressure (Pa)**		**Nominal Fan Flow (CFM)**		**Fan Configuration**
If Not Using Software: (PR/FL@50 Mode)		**Induced Building Pressure (Pa)**		**Nominal CFM50**		**Fan Configuration**

Section C

	Indoor Temp (F):		**Outdoor Temp (F):**		**Site Elevation (ft)**		

Blower Door Fan

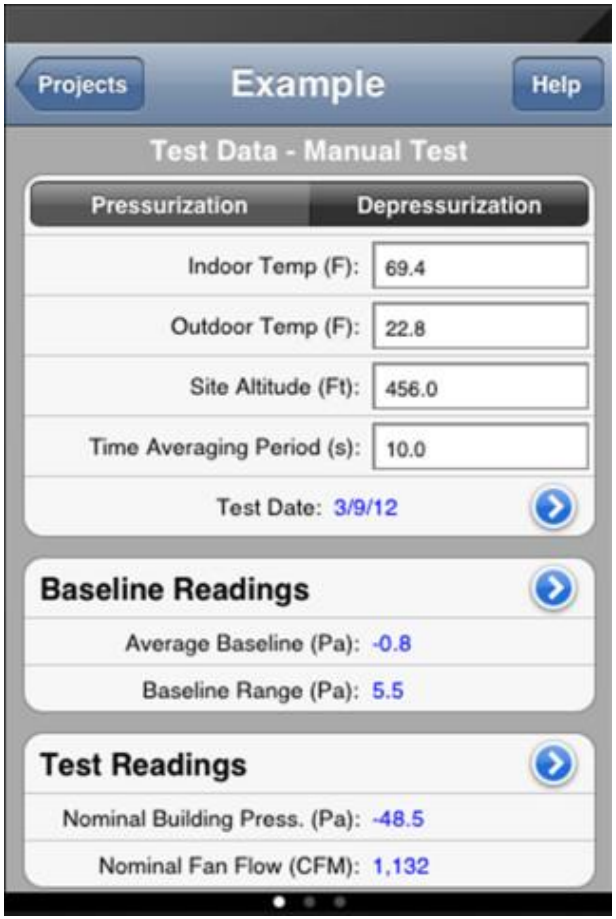
- **Model:** _____
- **Serial Number:** _____

Digital Gauge

- **Model:** _____
- **Serial Number:** _____

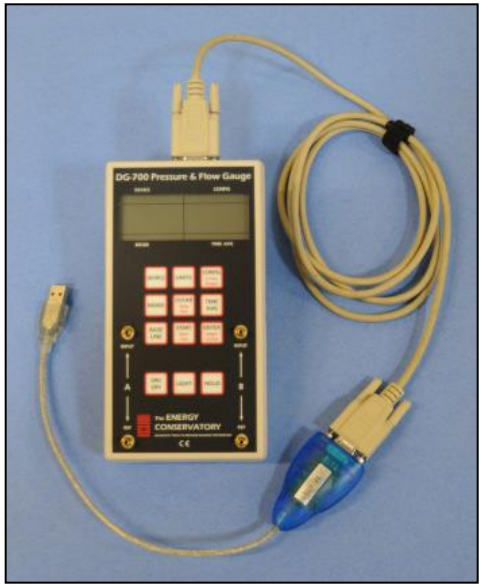
One-Point Manual Test

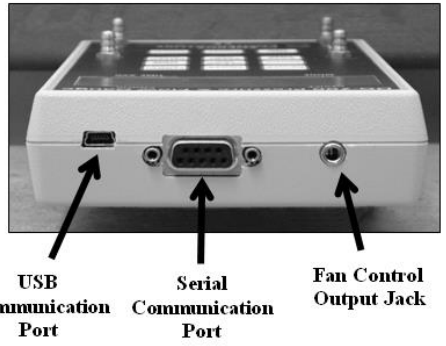
- Enter results from a RESNET One-Point Test into TECTITE 4.0 or iTEC RESNET – both generate reports



Automated Testing

- Connection options



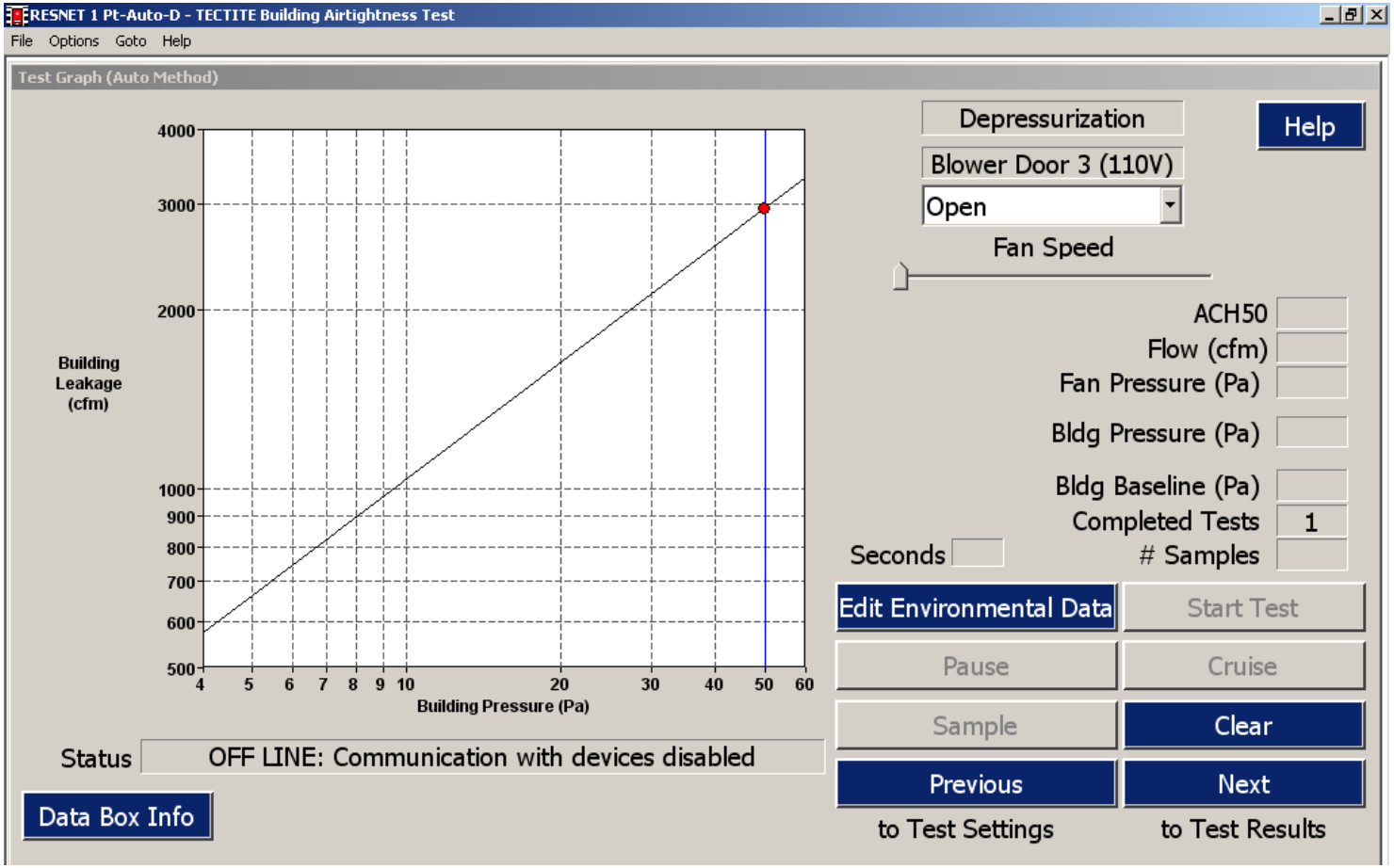


Automated Testing

- Run an automated RESNET Test

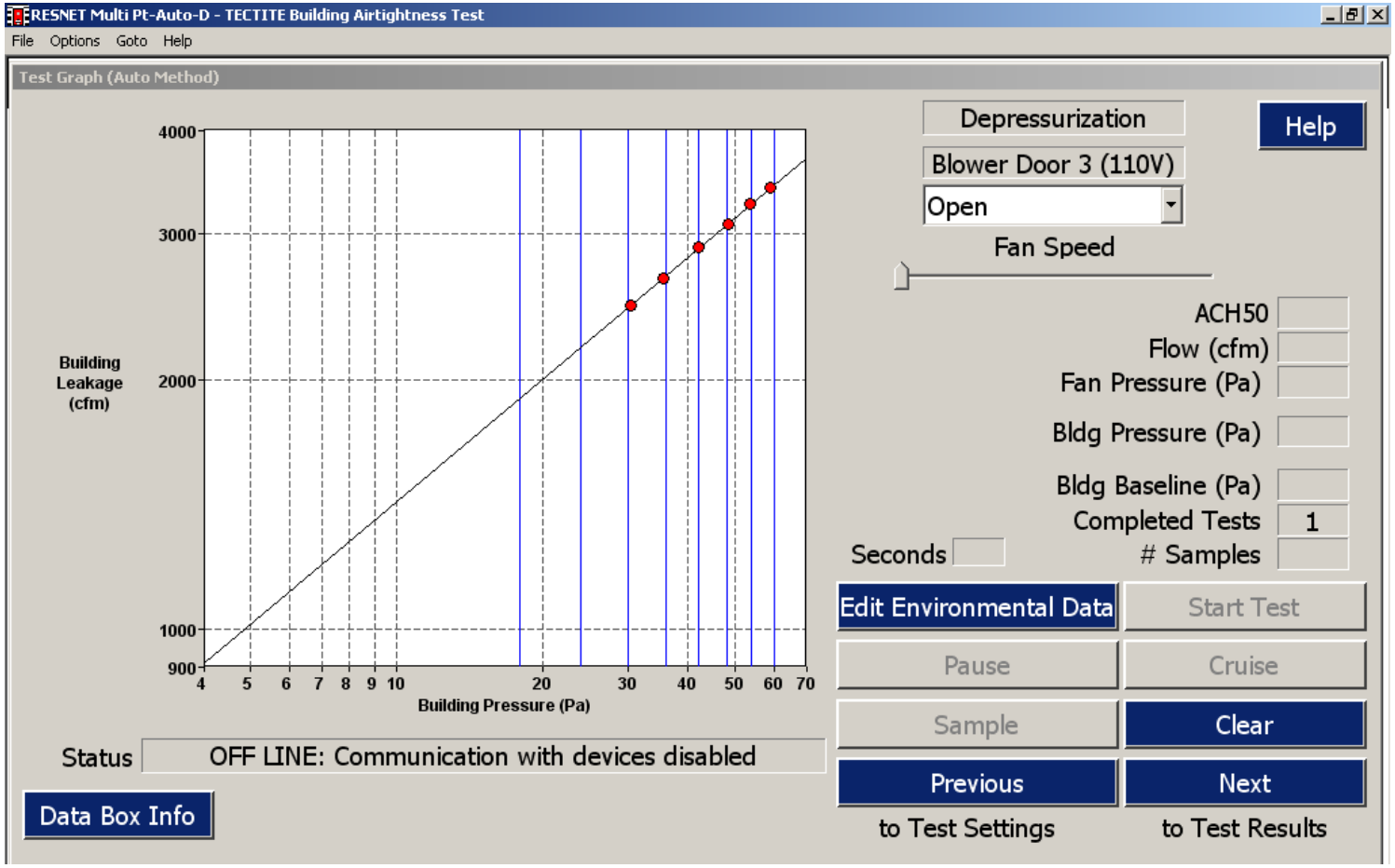
One-Point Automated Test

- Automated RESNET One-Point Test



Multi-Point Automated Test

- Automated RESNET Multi-Point Test



Repeated Single-Point Automated Test

- Automated RESNET Repeated Single-Point Test

Indoor Temperature (°F)	Outdoor Temperature (°F)	Altitude (ft)
90.0	0.0	100.0

Data Points

Baseline Pressure (Pa)	Nominal Building Pressure (Pa)	Baseline Adjusted Building Pressure (Pa)	Fan Pressure (Pa)	Nominal Flow (cfm)	Adjusted CFM50	Fan Configuration
0.1	-50.3	-50.4	50.2	3424	2955	Open
-0.4	-49.2	-48.8	49.2	3392	2990	Open
-0.5	-49.8	-49.3	49.6	3405	2981	Open
-0.2	-51.1	-50.9	51.3	3460	2966	Open
-0.5	-50.8	-50.3	50.7	3439	2971	Open

Time Averaging Period: 10

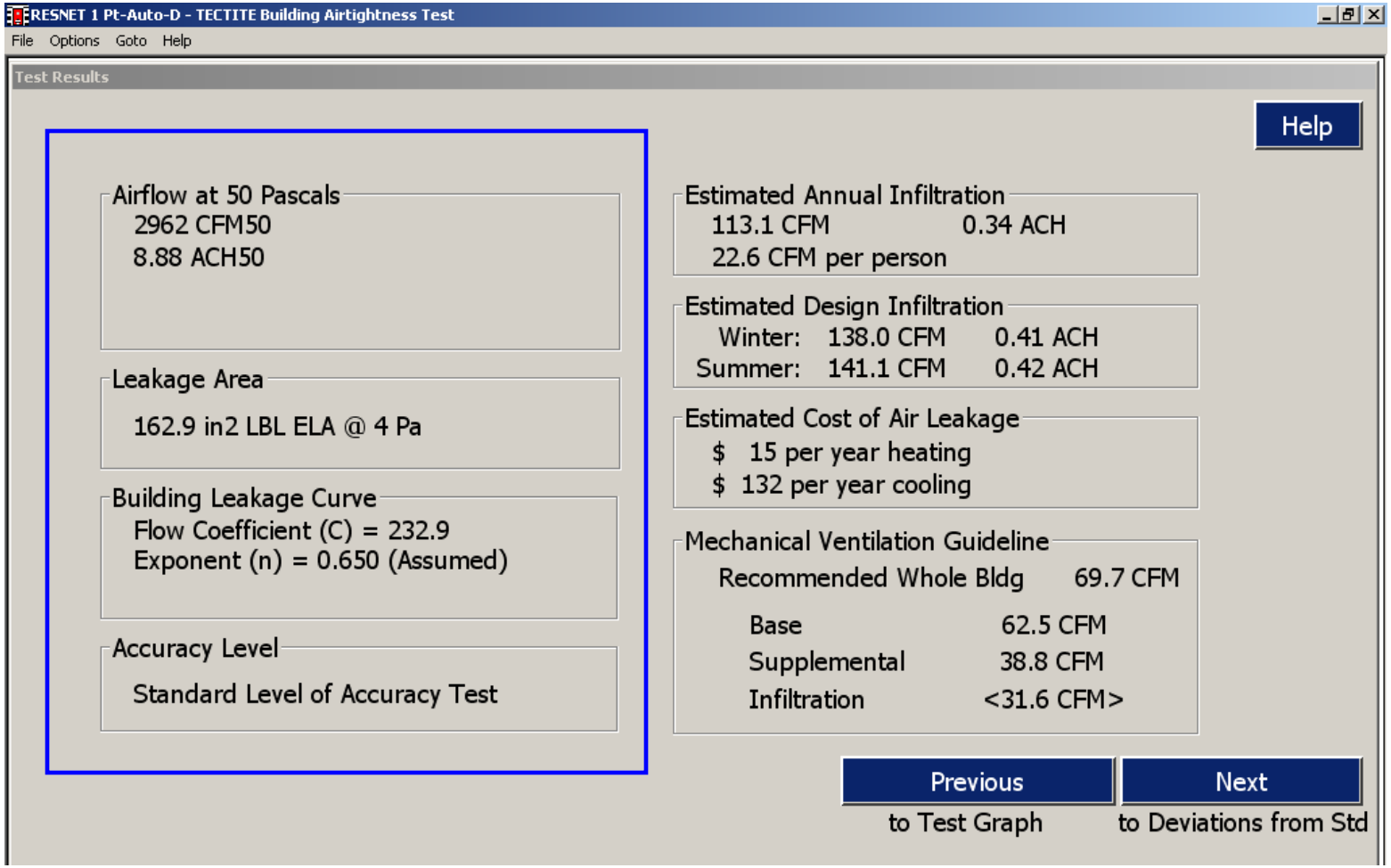
Deviations from Standard RESNET Repeated Single-Point Test - Test Parameters

None

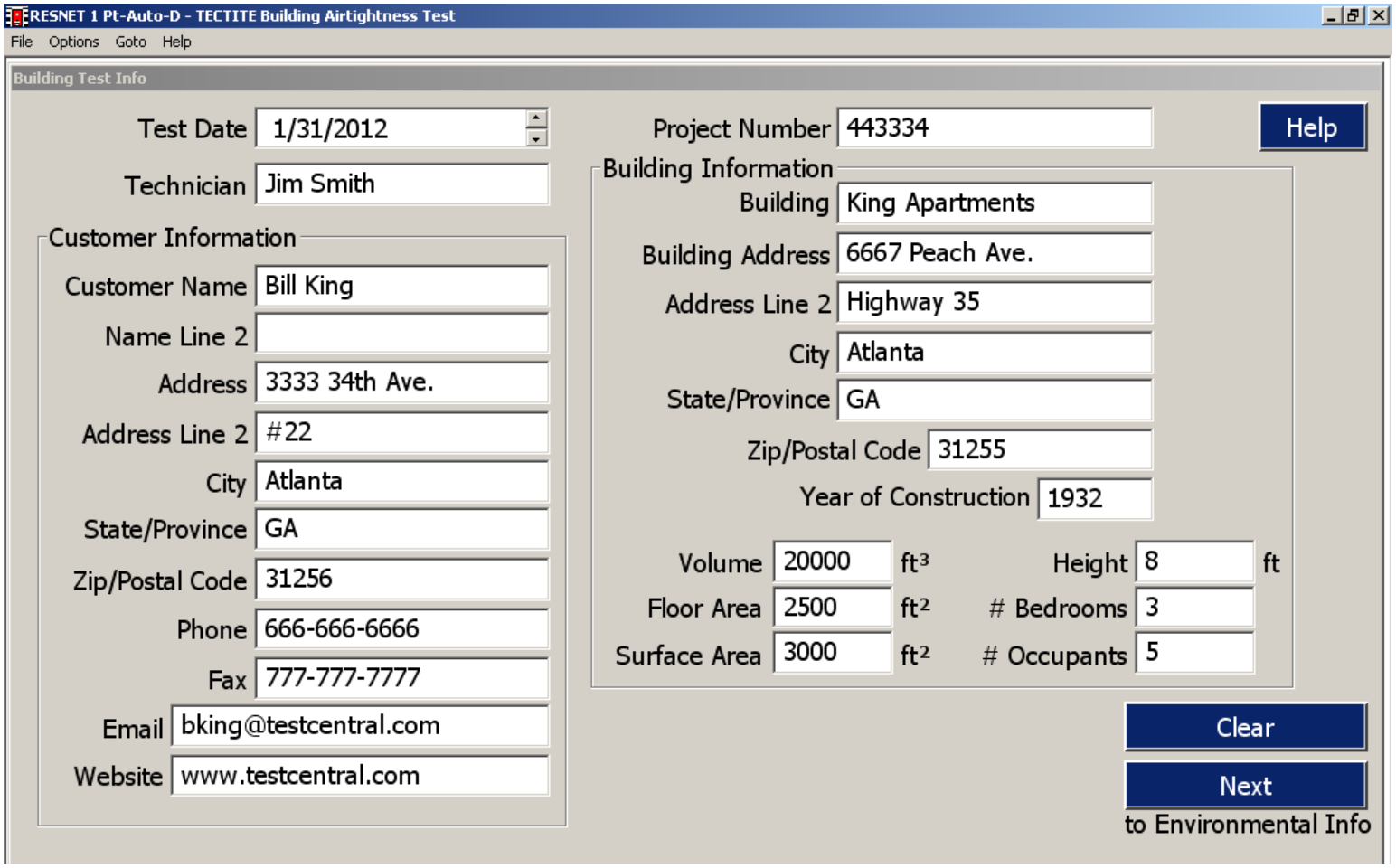
Standard vs Reduced Accuracy

- Standard Accuracy Test
  - One-Point Test (Baseline Range < 5 Pa)
  - Multi-Point and Repeated Single-Point (Calculated uncertainty < 10%)
- Reduced Accuracy Test
  - One-Point Test (Baseline Range 5 – 10 Pa)
  - Multi-Point and Repeated Single-Point (Calculated uncertainty > 10%)
  - Must adjust CFM50 for extra uncertainty - add approx 10 percent CFM50 penalty for HERS rating or testing to determine if building meets an airtightness threshold (such as IECC 2012)

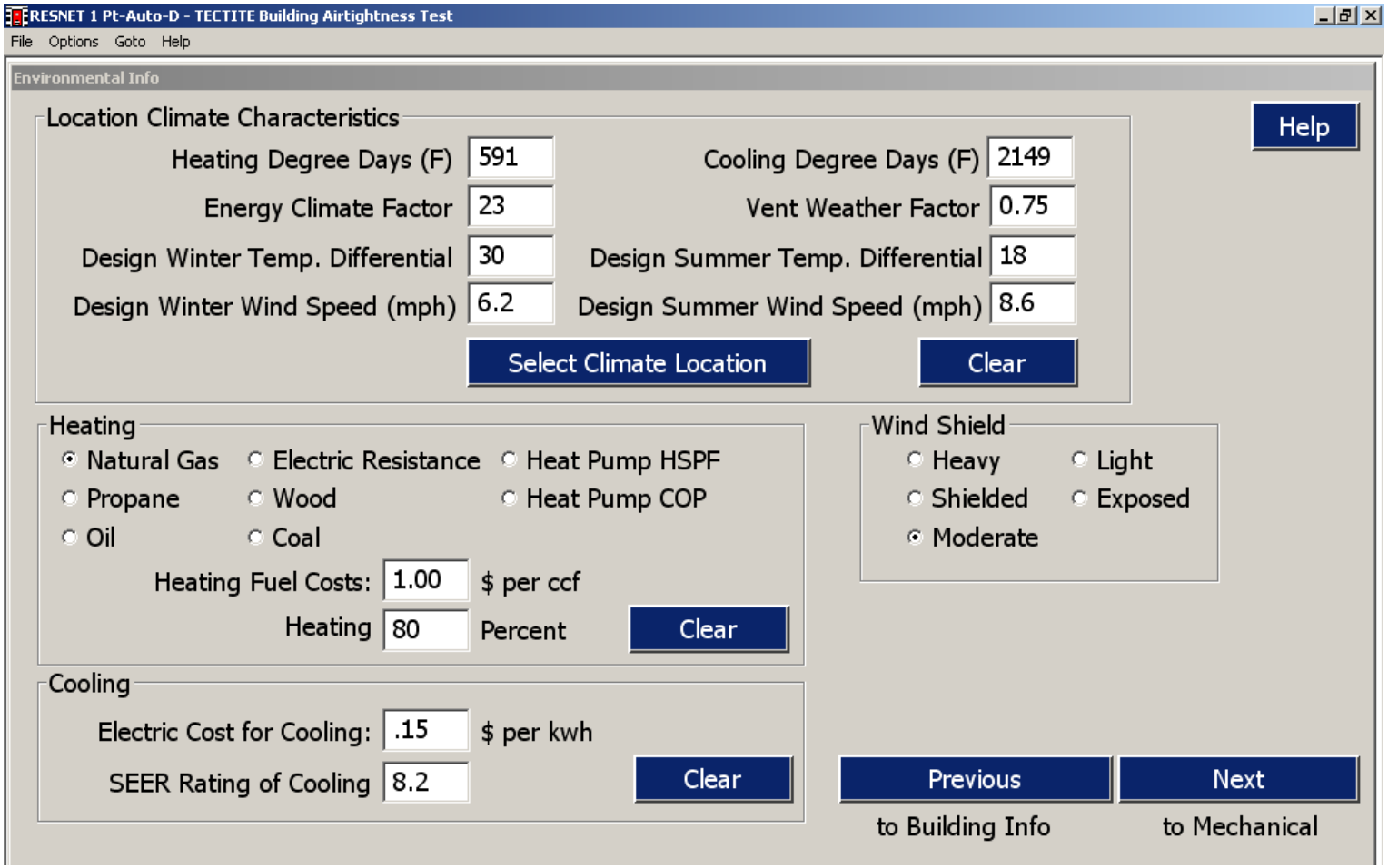
TECTITE Results – Basic



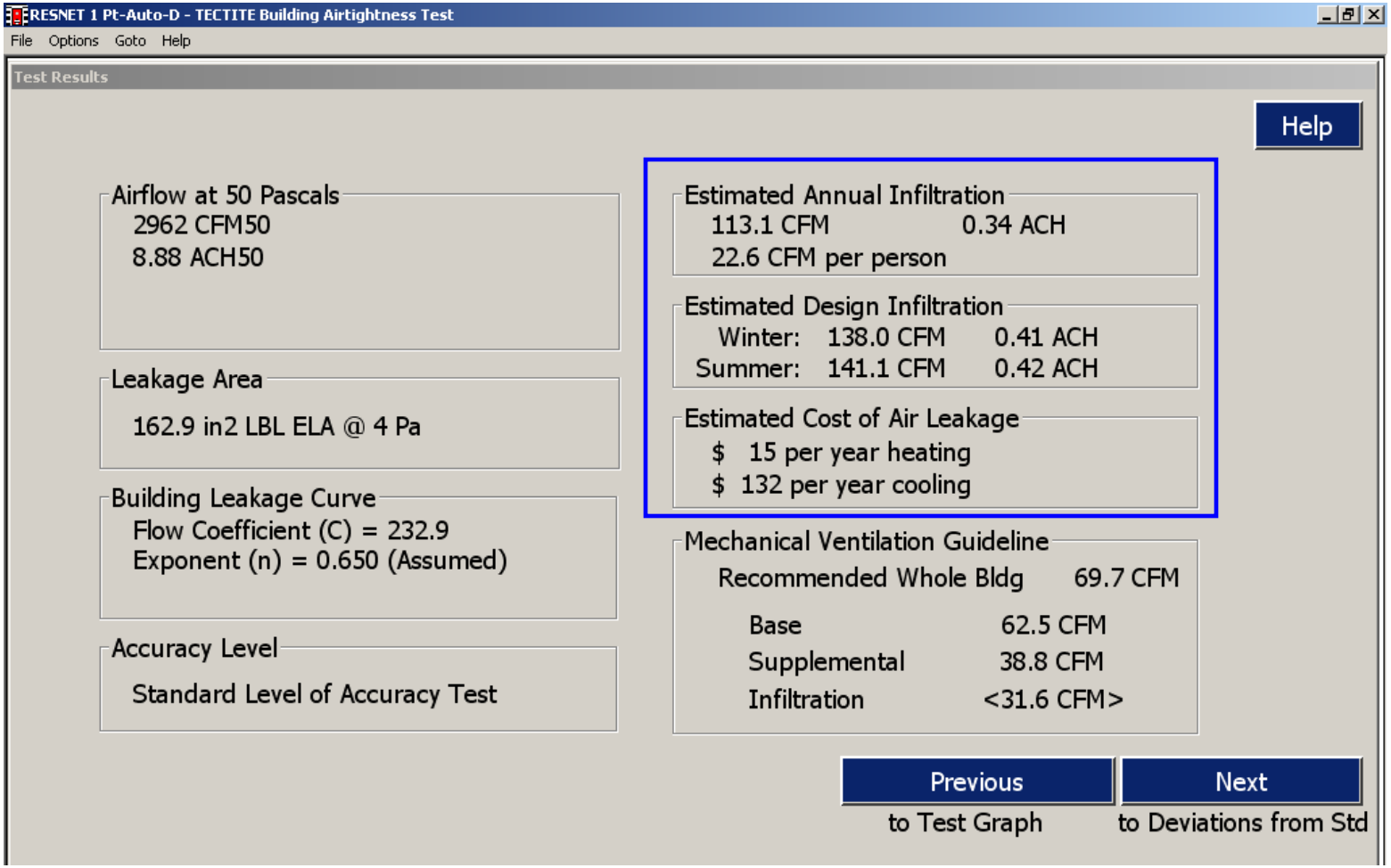
TECTITE Inputs – Building Info



TECTITE Inputs – Environmental Info



TECTITE Results – Environmental Info



11 COMPARISON OF PFT AND LBL RESULTS

The LBL model results using the modified parameters are compared with the PFT results in Fig. 11.1. The line indicates equality. The two methods track one another reasonably well although there is considerable scatter. The variability of infiltration rates increases at higher levels of infiltration and both distributions are skewed positive. Large negative deviations from the one-one line may indicate homes with large occupancy effects.

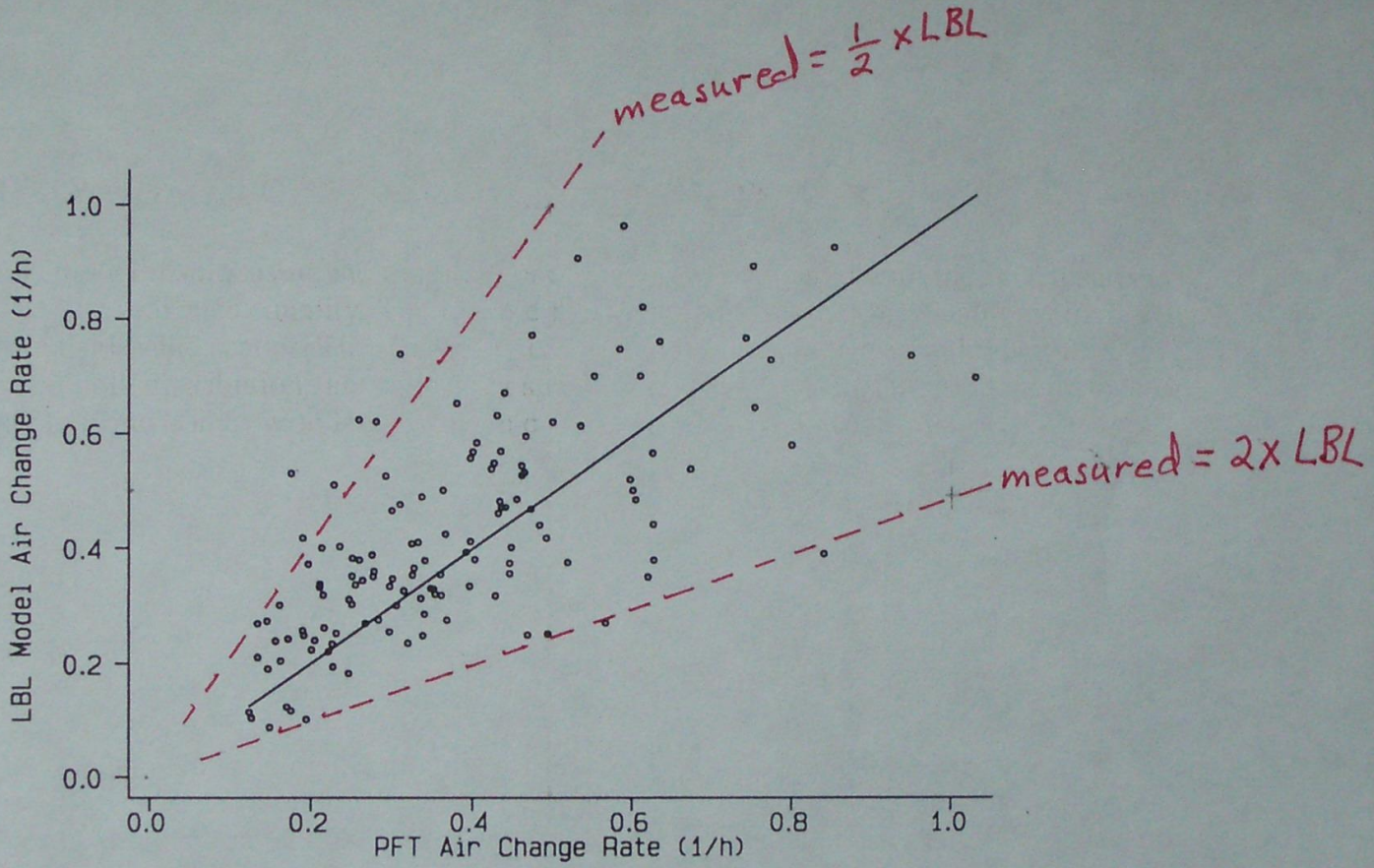
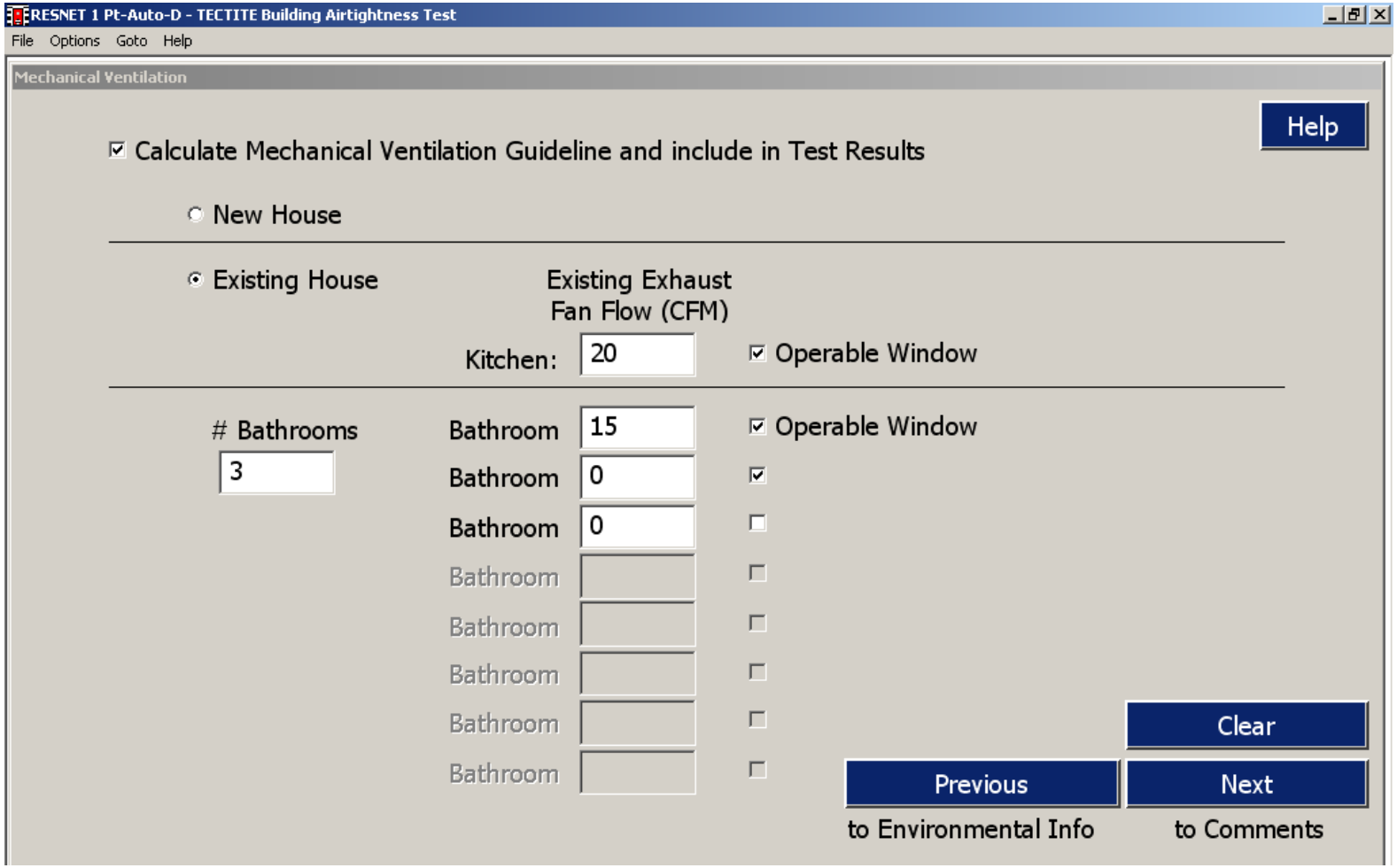
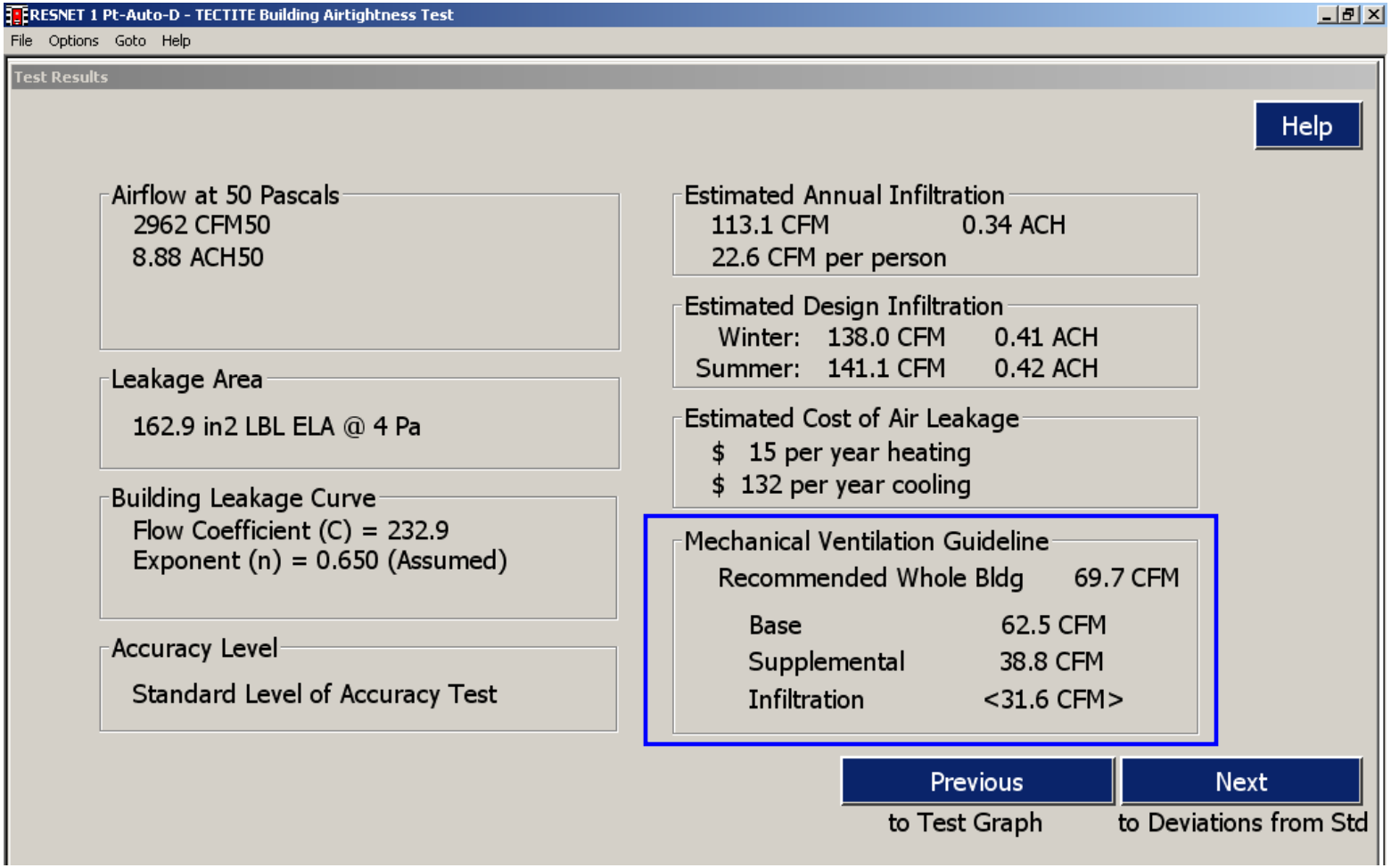


Figure 11.1. Comparison of PFT and LBL model results
LBL hourly predictions used National Weather Service data for the duration of the PFT test. The line indicates equality.

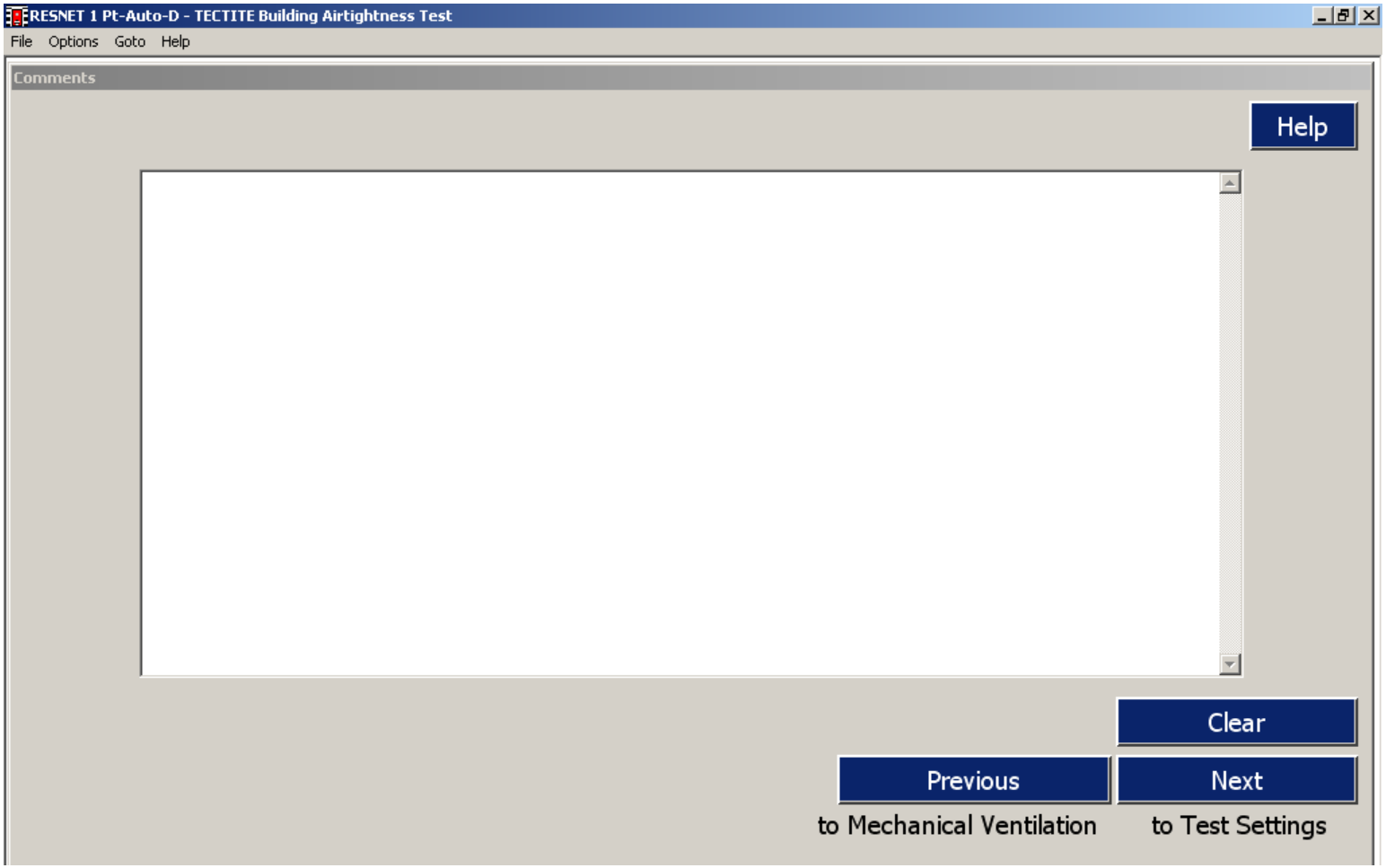
TECTITE Inputs – Mechanical Ventil.



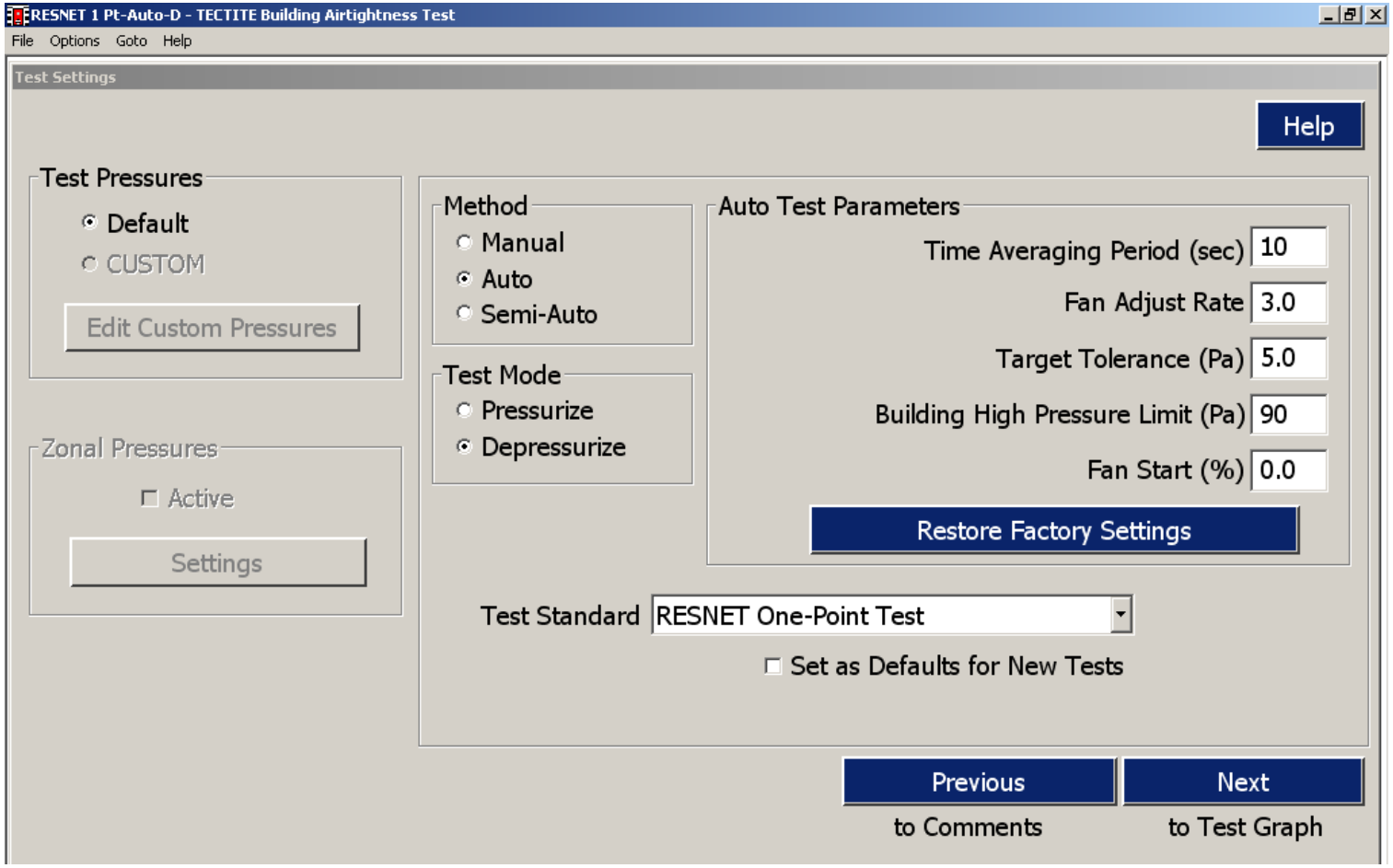
TECTITE Results – Mechanical Ventil.



TECTITE Inputs – Comments



TECTITE Inputs – Test Settings



TECTITE - Report

BUILDING LEAKAGE TEST

Joe's Garage
We Can Fix It
5566 99th Ave.
#22
Spokane, WA 55555
Phone: 666-666-6666 Fax: 666-666-6667
Email: jim@spudco.com Website: www.spudco.com

Date of Test: 1/31/2012

Customer: Bill King
a.k.a. Killer
3333 34th Ave.
#22
Wheaton, IL 60187
Phone: 666-666-6666
Fax: 777-777-7777
Email: bking@testo.com
Website: www.bking.com

Test File: RESNET 1 Pt-Auto-D
Technician: Jim Smith
Project Number: 443334

Building Address: King Apartments
6667 Peach Ave.
Highway 35
Atlanta, GA 5555

Test Results

1.	Airflow at 50 Pascals: (50 Pa = 0.2 w.c.)	2962 CFM50 8.88 ACH50
2.	Leakage Area:	162.9 in2 LBL ELA @ 4 Pa
3.	Building Leakage Curve:	Flow Coefficient (C) = 232.9 Exponent (n) = 0.650 (Assumed)
4.	Test Settings:	Test Standard: RESNET One-Point Test Test Mode: Depressurization
5.	Accuracy Level	Standard Level of Accuracy Test

Infiltration Estimates

1.	Estimated Average Annual Infiltration Rate:		113.1 CFM 0.34 ACH 22.6 CFM per person		
2.	Estimated Design Infiltration Rate:	Winter:	138.0 CFM 0.41 ACH	Summer:	141.1 CFM 0.42 ACH

Cost Estimates

Dealing with Wind

- Blower Door Testing
  - Location of the enclosure reference
  - Shielding of the tubing
  - Baseline function of the DG-700
  - Multiple 10 second averages
    - Baseline and @50
  - Long term averages
  - Accuracy of the test


COMPACT
CARS ONLY
BECAUSE OF
LOADING DOCK
ENTRANCE
LARGER VEHICLES
AT YOUR OWN RISK


5
DSI

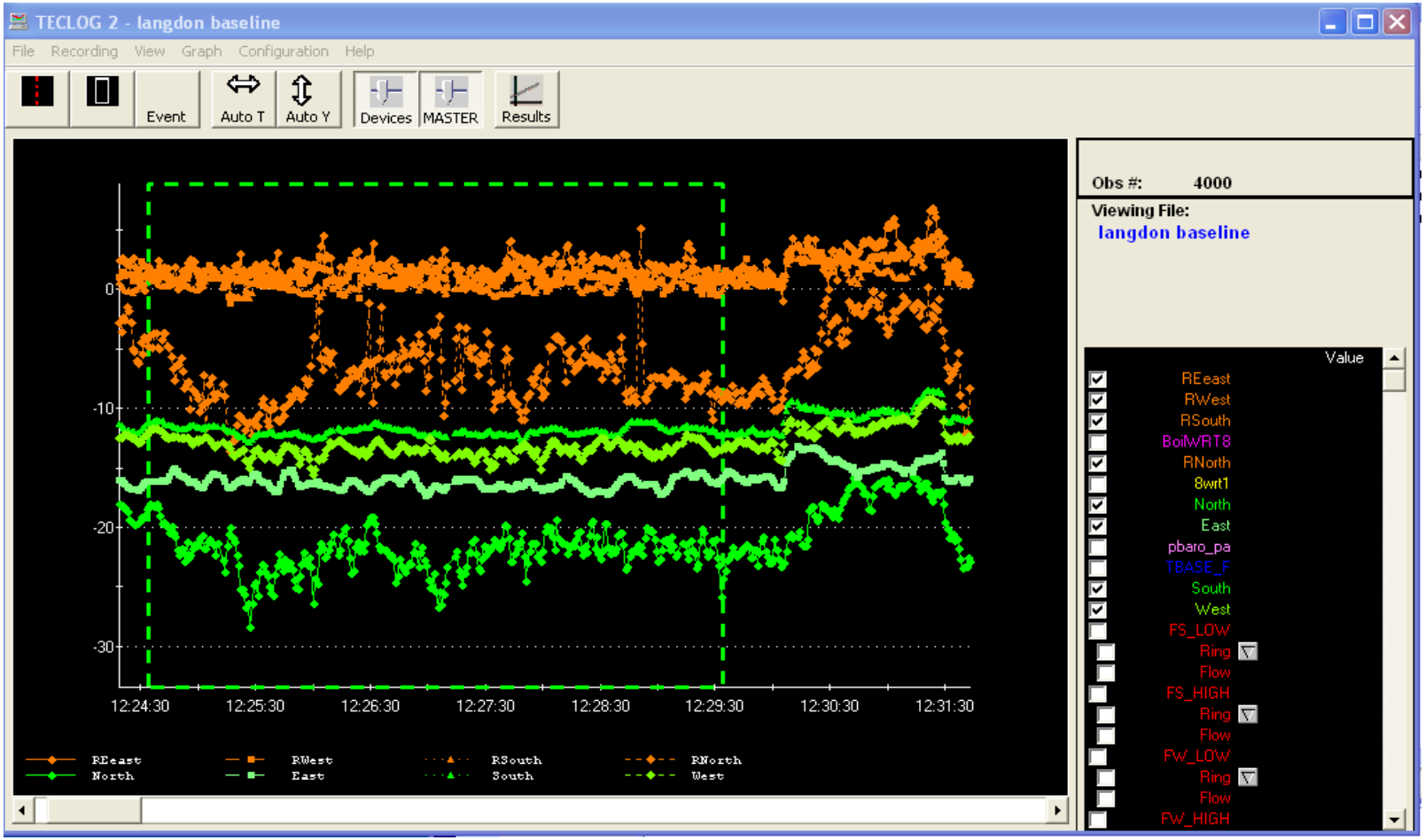
Dealing with Wind

- Worst Case Depressurization
  - What is your depressurization limit?
  - Multiple 10 second averages
    - Baseline and worst case
  - What is the range of your numbers
  - On / off with fans
  - Accuracy?
  - When is it too windy?


2
1
0
-1
-2
-3
-4
-5
-6
Dryer On
Kitchen Fan On
Bath Fan On
WH On
17:23:00
17:25:00
17:27:00
17:29:00
17:31:00
17:33:00
17:35:00
17:37:00
17:39:00
CA2
WH Vent

Dealing with Wind

- Baseline period
  - 11 story building – 4 sides, roof and ground level



Pressure Matching Method (Nulling)

- Measuring flow of large kitchen fans:
  - Set up blower to pressurize the home
  - Cap blower & enter baseline into DG-700
  - Install ring C on blower door (50-300 CFM)
  - With fan on, Set DG-700 to cruise 0 (not -0)

Pressure Matching Method (Nulling)

- Measuring flow + pressure systems:
  - Set up blower to depressurize the home
  - Enter baseline into DG-700
  - Install ring C on blower door (80-300 CFM)
  - Set DG-700 to cruise -0 (not 0)

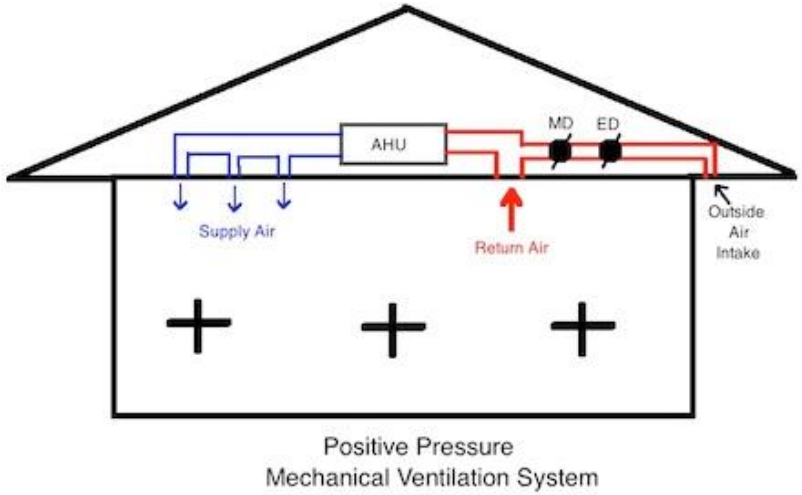


Photo from EnergyVangaurd.com

Nulling Example

- A big, leaky enclosure and wind limit precision

- 2500 ft^2, 8 ft high, 3 ACH50 = 1000 CFM50

  CFM(1) = 79

  CFM(.1) = 18

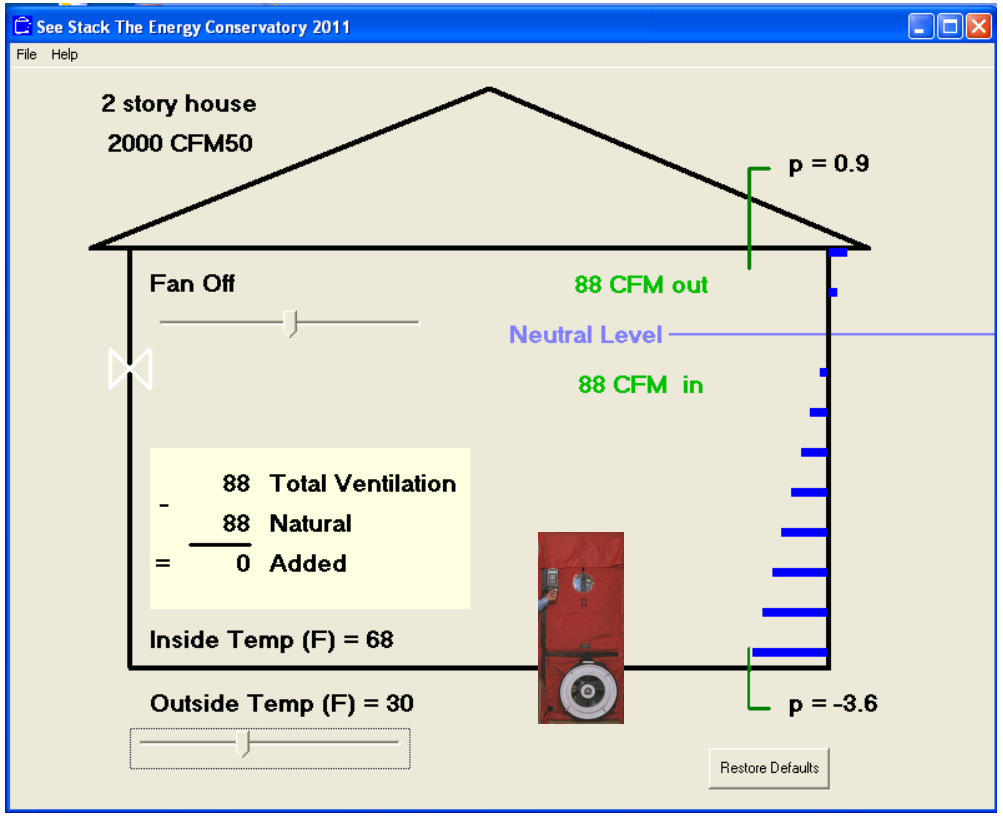
- .6 ACH50 = 200 CFM50

  CFM(1) = 16

  CFM(.1) = 4

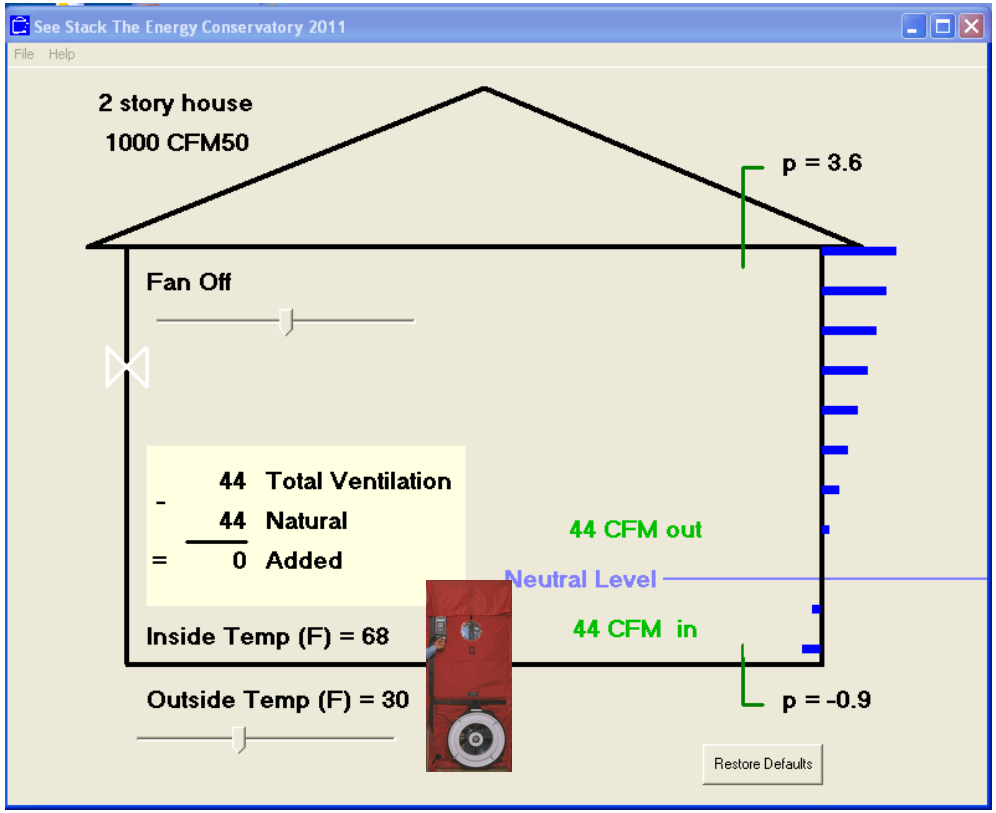
Baselines and ZPD

- Importance of measuring baseline attic ΔP
  - Lots of attic air leaks – 2000 CFM50
  - High NPP
  - 30° outside
  - 2 story
  - Baseline:
    - -3.6 at BD
    - + 0.9 at attic



Baselines and ZPD

- Importance of measuring baseline attic ΔP
  - Sealed attic bypasses – 1000 CFM50
  - Low NPP
  - 30° outside
  - 2 story
  - Baseline:
    - -0.9 at BD
    - + 3.6 at attic



Testing with Multiple Fans

- Multi fan testing – 2 or 3 fan systems

Two Fan Single-Point Protocol

- Primary gauge and Secondary gauge
- Enter baseline and turn primary fan all of the way up
- Determine which flow ring – start secondary fan before removing ring
- Bring to 50 Pa and add flows together.

Equipment and Software Options

- Software options:
  - Manual data entry
    - New version of TECTITE
    - TECTITE Express
  - Automated testing
    - TECLOG2

Equipment and Software Options

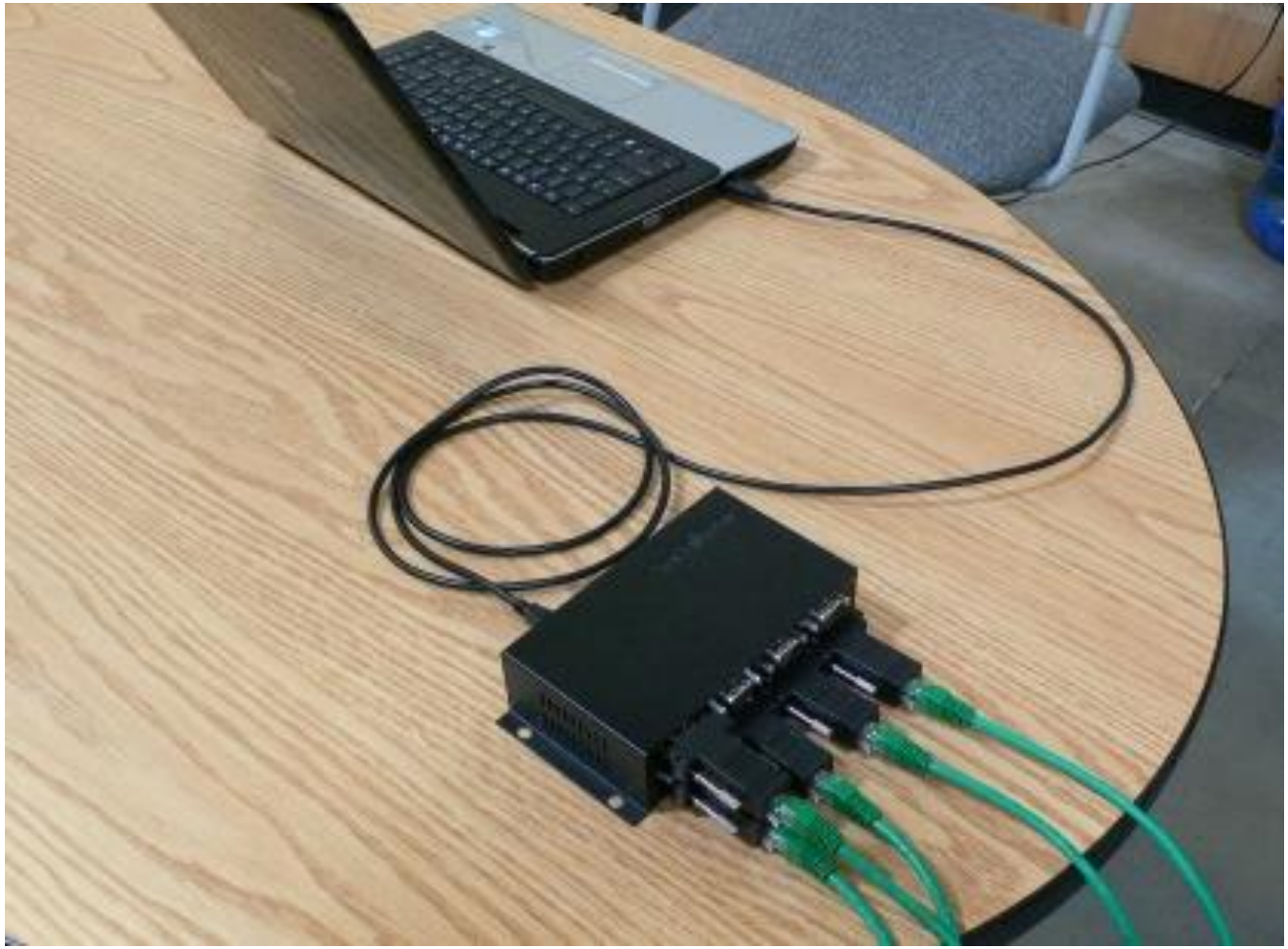
- TECTITE Express
  - Test to CGSB, EN13829, E779-10
  - Simplified report
    - No savings info
    - No infiltration information

Equipment and Software Options

- TECLOG2
  - Will control up to 24 fans with one slide bar
  - Will average multiple outdoor references
  - Can monitor interior pressures during test
  - Set channel to measure
    - Flow, BD or DB
    - Envelope pressure of pressure
  - Can be used for long term pressure monitoring

Multi-Fan Testing

Data Acquisition Hardware



At the Other End…

Two Gauges and Three Fans

Gauge 1

A: Envelope Press.

B: Bottom Fan

3 Controllers

Gauge 2

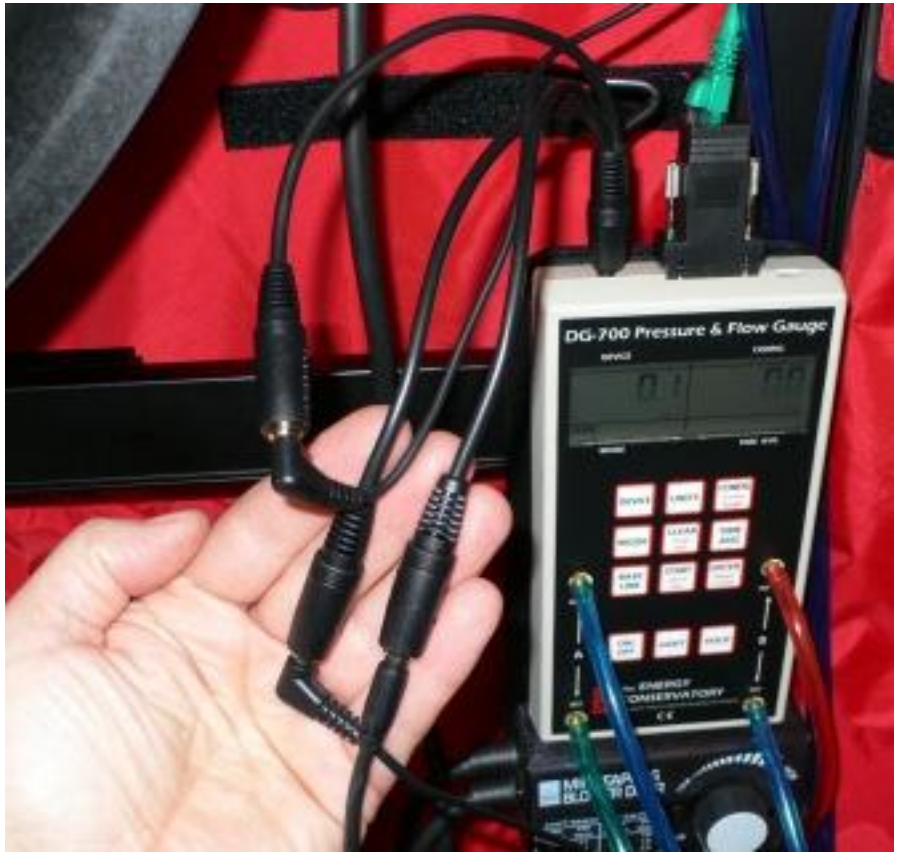
A: Middle Fan

B: Top Fan

- No open taps on gauges
- Combine two CAT5 cables into one
- Fans plugged into separate circuits

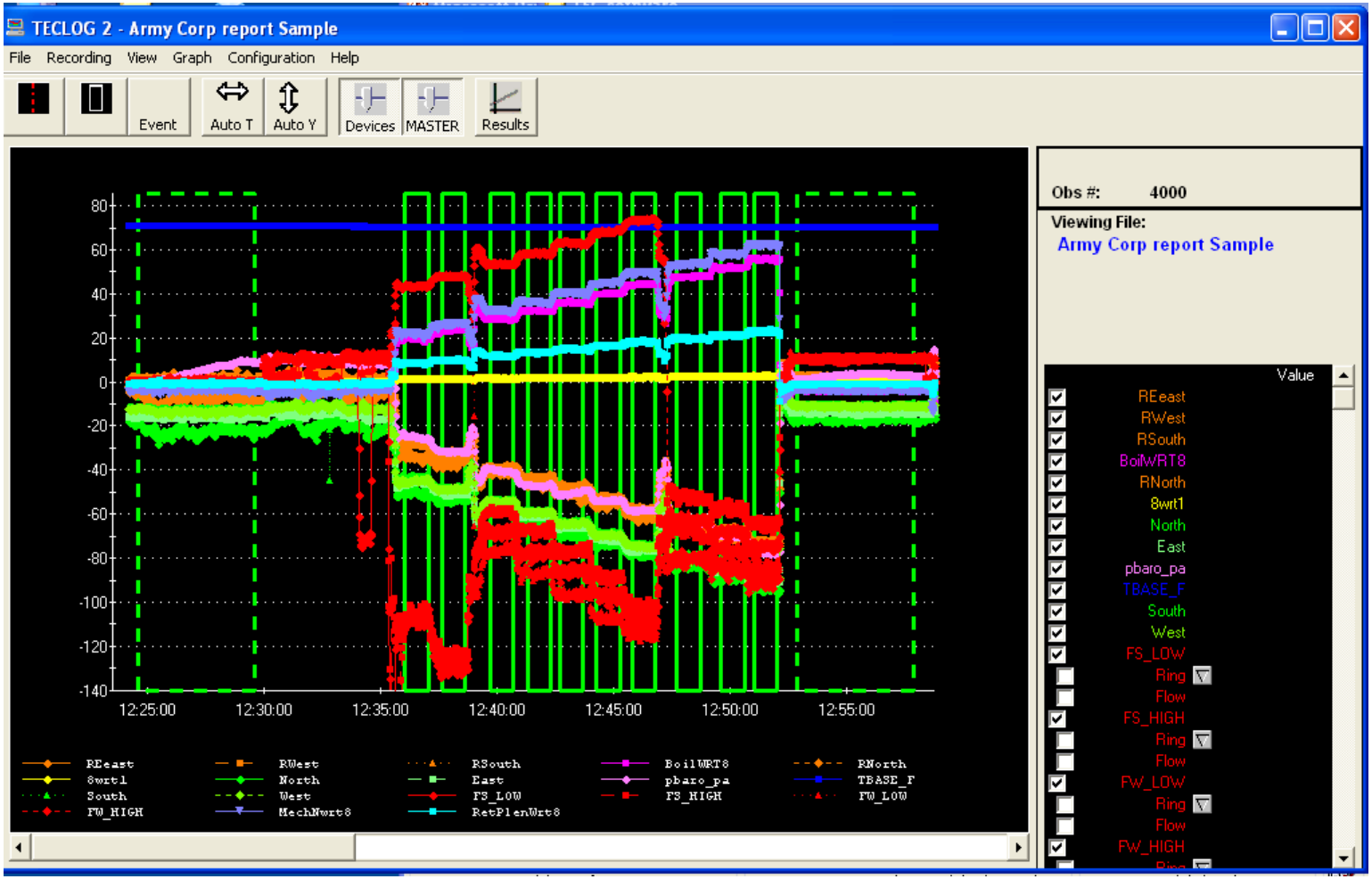
Fan Control Splitter

Master control slide bar controls all fans



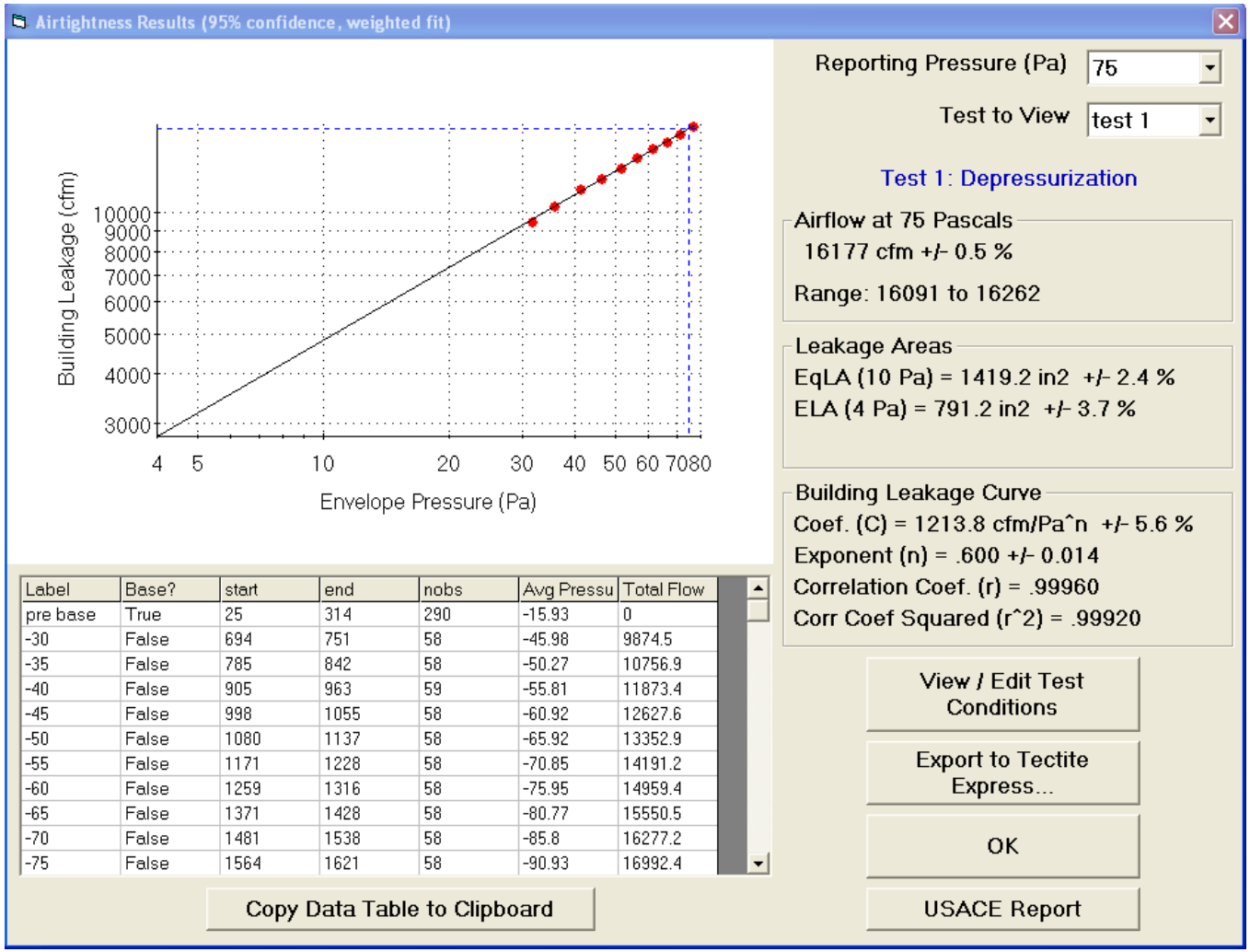
Testing with Multiple Fans

- TECLOG2 software



Testing with Multiple Fans

- TECLOG2 software



Label	Base?	start	end	nobs	Avg Pressu	Total Flow
pre base	True	25	314	290	-15.93	0
-30	False	694	751	58	-45.98	9874.5
-35	False	785	842	58	-50.27	10756.9
-40	False	905	963	59	-55.81	11873.4
-45	False	998	1055	58	-60.92	12627.6
-50	False	1080	1137	58	-65.92	13352.9
-55	False	1171	1228	58	-70.85	14191.2
-60	False	1259	1316	58	-75.95	14959.4
-65	False	1371	1428	58	-80.77	15550.5
-70	False	1481	1538	58	-85.8	16277.2
-75	False	1564	1621	58	-90.93	16992.4

Blower Testing

Basics and Beyond

Thank You!

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