

TECTITE (Ver. 4.0 - WiFi)
(Building Airtightness Test Analysis Program)

Software User's Guide



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Chapter 1 Introduction to TECTITE

TECTITE (Ver. 4.0 - WiFi) is an automated building airtightness testing program for PC's. The TECTITE program can be used with the Model 3 or Model 4 Minneapolis Blower Door™ or the Series B Duct Blaster® fans to conduct fully automated Blower Door airtightness tests. During a Blower Door test, the program controls the speed of the Blower Door fan, prompts for installation or removal of flow rings, records both building pressure and fan airflow, and calculates and stores test results. TECTITE can also be used to analyze manually collected Blower Door test data.

1.1 TECTITE Features

- Computerized control of Minneapolis Blower Door fans using either a DG-700 or DG-1000 Digital Pressure Gauge, or an APT system.
- Choice of four pre-set test protocols (CGSB 149.10-M86, RESNET One-Point Test, RESNET Multi-Point Test, and the RESNET Repeated Single-Point Test) and custom test options.
- Compatible with wireless communication from the DG-1000 Gauge, and from the TEC WiFi Link adapter (DG-700) to wirelessly connect your gauge to your computer and TECTITE.
- Calculation and display of airtightness test results, including deviation from standards listings.
- Measurement and display of multiple building zone pressures during a CGSB Blower Door test (requires additional DG-700, or APT system with 3 or more pressure channels).
- Automated operation and on-screen instructions reduce operator error, eliminates time spent zeroing gauges and adjusting fan speed, and ensures that tests are conducted the same way every time.
- Multiple simultaneous pressure measurements of building pressure and fan air flow reduce the variability of test results from wind.
- Cruise control for maintaining a constant building pressure during diagnostic tests or airsealing.
- Calculates need for mechanical ventilation based on estimated annual natural infiltration rates and ASHRAE 62.2-10 whole building ventilation guideline.
- Estimated design infiltration rates can be used in Manual J load calculations.
- Choice of report formats including a simple easy-to-read homeowner report, or a detailed technical report, plus a built-in PDF file report generator.
- Manual mode for analyzing and displaying manually collected test data.

During automated testing, TECTITE adjusts the speed of the Blower Door fan while simultaneously monitoring the building pressure and fan air flow using 2 differential pressure channels built into either the DG-700 or DG-1000 gauge, or the APT's Data Acquisition Box (DAB). One pressure channel is used to measure building pressure while the other pressure channel is used to measure Blower Door fan air flow. Wired communications between the DG-700, DG-1000 or DAB and your computer is provided through either a USB, Ethernet or RS-232 serial communication link. In addition, TECTITE can connect wirelessly with a DG-1000 gauge and the TEC WiFi Link adapter (DG-700) to provide a communication link through your computer.

1.2 Auto Versus Manual Operation

The TECTITE program can be run using three different operating methods:

- The program can be used to fully automate a Blower Door airtightness test using the DG-700 or DG-1000 gauge, or an APT DAB (**Auto Method**). The Auto Method provides automated collection of building pressure and fan flow data, and computerized control of the Blower Door fan.
- The **Semi-Auto Method** provides automated collection of the building pressure and fan flow data, but the Blower Door fan is controlled manually.
- The program can also be used to enter and analyze manually collected Blower Door test data (**Manual Method**).

The three different operating methods are selected from the Test Settings screen (using the **Method** field). The Test Settings screen is discussed in more detail later in *Chapter 6*. Much of the operation of the TECTITE program is the same for the Manual, Semi-Auto and Auto Methods.

1.3 Help Buttons

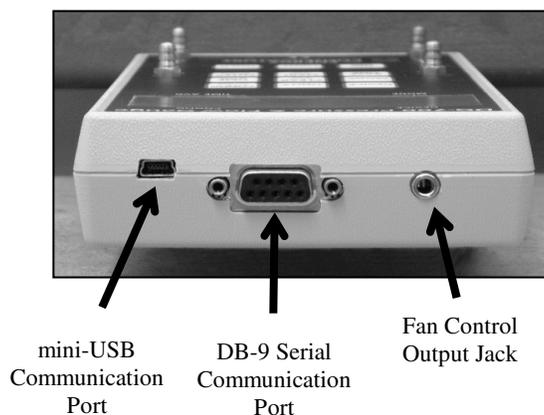
Each screen in the TECTITE program contains a Help button to provide you with detailed information for that screen. Wherever you see the Help button, clicking on it will open a text window. We recommend that you use all the Help buttons the first time you run the program.

Chapter 2 Setting Up the Hardware for Automated Testing

Note: If you will not be conducting Automated or Semi-Automated Blower Door tests, skip to Chapter 3.

2.1 Hardware Set Up Using a DG-700

1. Install the Blower Door system as described in the Blower Door operation manual.
2. There are three options for connecting your DG-700 gauge to your computer to create the 2-way communication link needed for automated testing with TECTITE:
 - Connect the mini-USB port on the DG-700 gauge to a standard USB port on your computer (**Note:** some older DG-700 gauges do not contain a mini-USB port).
 - Install a TEC WiFi Link adapter onto the DB-9 serial communication port on the DG-700 gauge and wirelessly connect to your computer.
 - Connect the DB-9 serial communication port on the DG-700 directly to a DB-9 port on your computer.



Using the mini-USB Port

In order to use the mini-USB communication port on your DG-700 gauge, you will need a USB cable (A to mini B), and you will need to install the necessary USB drivers onto your computer. The DG-700 USB driver is available from The Energy Conservatory's website (www.energyconservatory.com), or from the Windows Update service.

Using the TEC WiFi Adapter (Direct Connect AP Mode)

Insert the male DB-9 connector on the TEC WiFi Link into the female DB-9 connector on the DG-700 gauge. Tighten the two attachment screws on the TEC WiFi Link. Attach the Power Jumper Cable between the TEC WiFi Link and DG-700. Install the power jumper cable into the power input jacks on the TEC WiFi Link and DG-700 gauge. The jumper cable allows the gauge to provide power to the TEC WiFi Link. Light #1 (blue) on the TEC WiFi Link will turn on indicating that it is receiving power.



Turn on the DG-700. Once the ON/OFF button is pressed light #2 (green) on the TEC WiFi Link will begin to blink. Light #2 will then turn on solid indicating that it is broadcasting a wireless network access point. The display on the DG-700 should be dashed to indicate that it is ready to be controlled remotely (the keypad is not functional when the display is dashed).

On your computer select and connect to the TEC WiFi Link wireless network. The network will be named “DG700-<SN>” (where SN is the serial number of the DG-700 gauge). The first time you connect to this network, you may be asked for a password/security key - enter the default password/security key **tecwifi12** TECTITE should now be able to detect the gauge and create a communication link.

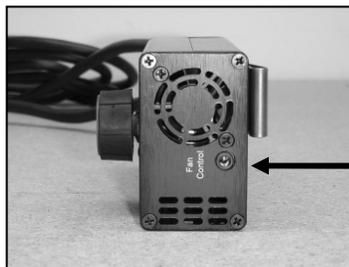


Note: The method used to connect to the wireless network will depend on the model and operating system of your computer. If your computer is currently connected to another wireless network, you may need to disconnect from that network before connecting to the TEC WiFi Link network. The DG-700 gauge must be on in order for the TEC WiFi Link network to be visible from your computer.

Using the DB-9 Serial Port

If you will be using the DB-9 Serial Communication Port on the DG-700 gauge, simply plug the male end of a standard 9-pin serial cable into the serial port on the top of the DG-700, and the female end should be plugged into an open serial communication port on your computer.

3. In order for TECTITE to control the speed of the Blower Door fan, you will need to connect the DG-700 to the Blower Door fan speed controller using the fan control cable. One end of the fan control cable should be plugged into the 3.5 mm fan control output jack on the top of the DG-700, and the other end of the cable should be plugged into the side of the fan speed controller case. **Note:** If you will be conducting a Semi-Auto test and manually controlling the Blower Door fan, you will not need to install the fan control cable.

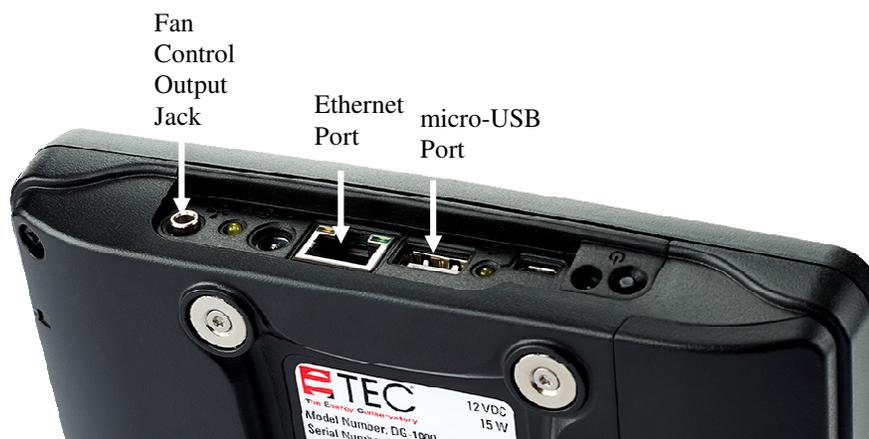


Communication Jack
(Blower Door Speed
Controller)

4. Connect tubing between the DG-700 and the Blower Door system (tubing connections are detailed in the Blower Door operation manual).
 - *Channel A Input Tap*: connect to inside of building (leave open if gauge is in the building).
 - *Channel A Reference Tap*: connect to outside (typically use green tubing).
 - *Channel B Input Tap*: connect to BD fan (typically use red tubing).
 - *Channel B Reference Tap*: connect to space upstream of fan inlet (if fan inlet and gauge are in the same space, leave the tap open).

2.2 Hardware Set Up Using a DG-1000

1. Install the Blower Door system as described in the Blower Door operation manual.
2. There are three options for connecting your DG-1000 gauge to your computer to create the 2-way communication link needed for automated testing with TECTITE:
 - Connect the micro-USB port on the DG-1000 gauge to a standard USB port on your computer.
 - Wirelessly connect to your computer using the gauge’s built-in WiFi adapter.
 - Connect the Ethernet port on the DG-1000 to a router or Ethernet switch, and connect the router or switch to your computer. **Note:** The router or Ethernet switch must be running DHCP server.



Using the micro-USB Port

In order to use the micro-USB communication port on your DG-1000 gauge, you will need a USB cable (A to micro B), and you will need to install the necessary USB drivers onto your computer. To enable the micro-USB port on a gauge, go to the main DG-1000 Settings screen and select [Network Configuration] ... [Mode - USB]. The networking status in the Network Configuration screen will show “Not Connected”. Now install one end of an USB cable into the micro-USB port on the DG-1000 gauge and the other end into a standard USB port on your computer. The Windows Update service on your computer will start and try to access the internet and find and install the appropriate driver (USB Ethernet/RNDIS Gadget). Once the driver is installed, the network status on the gauge will change to “Connected”. TECTITE should now be able to detect the gauge and create a communication link. **Note:** your computer must have an internet connection in order to find and install the driver.

Using the DG-1000's Built-in Wireless Adapter

WiFi (Create Network)

The DG-1000's built-in WiFi module can be configured to create and broadcast a wireless network that can be connected to directly from a computer. To enable this feature, go to the main DG-1000 Settings screen and select [Network Configuration] ... [Mode - WiFi (Create Network)]. The networking status in the Network Configuration screen will now show "Broadcasting" and the gauge will begin broadcasting a secured wireless network.

On your computer select and connect to the DG-1000 wireless network. The network will be named "DG1000-<SN>" (where SN is the serial number of the DG-1000 gauge). The first time you connect to this network, you may be asked for a password/security key - enter the default password/security key **dg1000pw**. TECTITE should now be able to detect the gauge and create a communication link. **Note:** The method used to connect to the wireless network will depend on the model and operating system of your computer. If your computer is currently connected to another wireless network, you may need to disconnect from that network before connecting to the DG-1000 wireless network.

WiFi (Join Network)

The DG-1000's built-in WiFi module can also be configured to join an existing wireless network (typically created by a router). When set up in this mode, the gauge will search for a specific wireless network and automatically join the network. You can then remotely access the gauge using TECTITE if your computer is also connected to the same wireless network.

Typically you would bring your own router into the building to use this feature, however, an existing building router can be used if you know the network name (SSID) and Password. Using the WiFi (Join Network) feature can extend the effective WiFi communication distance between your gauge and your computer.

To enable WiFi (Join Network) mode for the gauge, go the main DG-1000 Settings screen and select [Network Configuration] ... [Mode - WiFi (Join Network)] ... [Configuration - SSID - Password]. Fill in the SSID and Password fields with the name and password of the wireless network you are connecting to. After pressing Apply, the gauge will apply the network settings and begin searching for the wireless network and will join it (providing that the SSID and Password match). The networking status in the DG-1000 Settings screen will update and show "Joined" and list the SSID of the network if a connection has been made.

On your computer, select and connect to the same wireless network. Once this connection is made, TECTITE should be able to detect the gauge and create a communication link.

Using the Ethernet Port

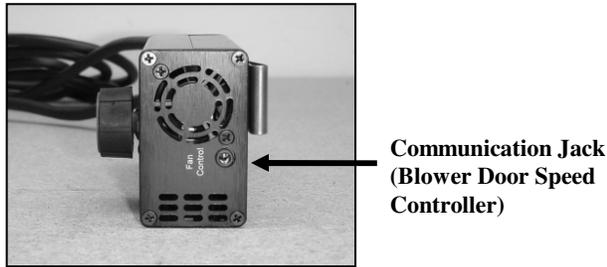
The Ethernet port on the DG-1000 can be used to create a network that can be used by your computer and TECTITE to create a communication link. Using the gauge's Ethernet requires a router or Ethernet switch that can manage the network connections (typically done by DHCP Server running on the router or switch). You can also use a standard Ethernet switch as long as it is connected to a device running DHCP Server.

To enable the Ethernet port on a gauge, go the main DG-1000 Settings screen and select [Network Configuration] ... [Mode - Ethernet]. The networking status in the Network Configuration screen will show "Not Connected". Now install one end of an Ethernet cable into the port on the DG-1000 gauge

and the other end into an Ethernet port on the router or switch. The Network Configuration status should update to show “Connected”.

Now you will need to connect your computer to this same router or switch. This can be done by connecting the Ethernet port on the computer to the router or switch, or by wirelessly connecting the computer to the wireless network being broadcast by the router. Once the computer is connected to the network, TECTITE should be able to detect the gauge and create a communication link. Ethernet cables can be up to 328 feet long and still provide a robust communication link.

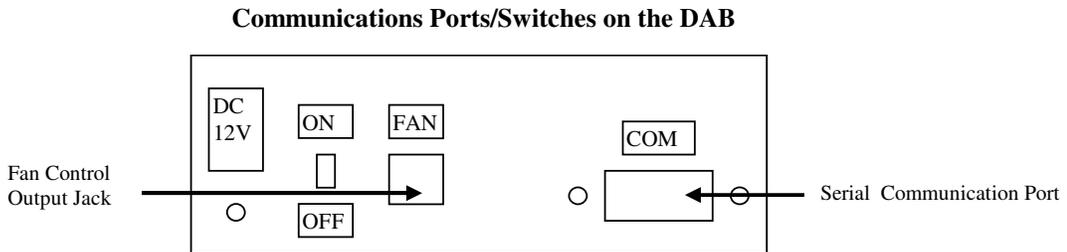
3. In order for TECTITE to control the speed of the Blower Door fan, you will need to connect the DG-1000 to the Blower Door fan speed controller using the fan control cable. One end of the fan control cable should be plugged into the 3.5 mm fan control output jack on the top of the DG-1000, and the other end of the cable should be plugged into the side of the fan speed controller case. **Note:** If you will be conducting a Semi-Auto test and manually controlling the Blower Door fan, you will not need to install the fan control cable.



4. Connect tubing between the DG-1000 and the Blower Door system (tubing connections are detailed in the Blower Door operation manual).
 - *Channel A Input Tap:* connect to inside of building (leave open if gauge is in the building).
 - *Channel A Reference Tap:* connect to outside (typically use green tubing).
 - *Channel B Input Tap:* connect to BD fan (typically use red tubing).
 - *Channel B Reference Tap:* connect to space upstream of fan inlet (if fan inlet and gauge are in the same space, leave the tap open).

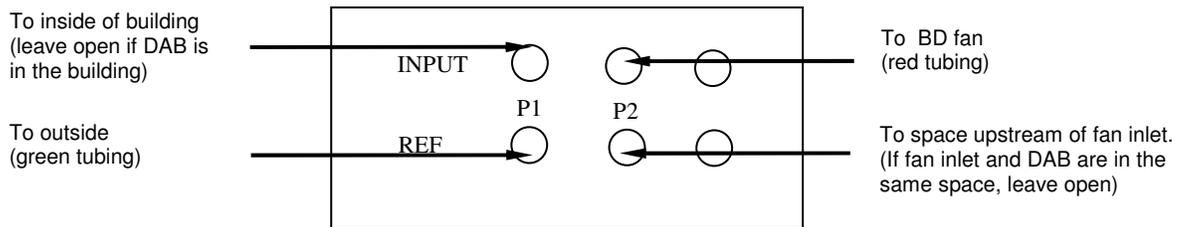
2.3 Hardware Set Up Using an APT System

1. Install the Blower Door system as described in the Blower Door operation manual.
2. Connect the APT Data Acquisition Box (DAB) to your computer using a 9 pin serial cable. The male end of the cable should be plugged into the COM port on the end of the DAB, and the female end should be plugged into an open serial communication port on your computer.



Note: If your computer does not have a serial port, but does have a USB port, you will need to purchase an after-market USB to Serial Port adapter (contact TEC for adapter recommendations).

3. Connect the Blower Door fan speed controller to the DAB using the fan control cable provided. The phone plug end of the cable is plugged into the Fan Control Output Jack on the end of the DAB while the other end of the cable is plugged into the communication jack on the side of the speed controller.
4. Connect tubing between the DAB and the Blower Door system (tubing connections are detailed in the Blower Door operation manual). **Note:** If you will be measuring building zone pressures during the airtightness test using Channels P3 – P8, refer to *Chapter 10* for more information on installing tubing from the DAB to the zones to be tested.



Chapter 3 Setting Up the Building for Testing

After installing the Blower Door system, you will need to set up the building in its normal heating or cooling mode. This typically includes closing adjustable openings and preparing combustion appliances. **Refer to your Blower Door manual for more specific instructions , or refer to set-up guidelines specifically referenced in the Test Standard you are using.**

3.1 Adjustable Openings

- Close all storm and prime windows.
- Close all exterior doors and attic or crawlspace hatches connected to conditioned spaces.
- Open all interior doors to rooms that are heated or cooled. The object here is to treat the entire building as one connected space. Because few basements can be completely sealed from the building and usually some conditioning of basement air is desirable, they are typically included as conditioned space.
- Tape plastic over window air conditioners if they appear to be a source of air leakage into the building and they are removed during the heating season.

3.2 Combustion Appliances/Exhaust Devices

- Adjust all combustion appliances so they do not turn on during the test. This is commonly done by temporarily turning off power to the appliance, or setting the appliance to the “pilot” position. *Note: If vented combustion appliances turn on during a depressurization test, it is possible for flames to be sucked out of the combustion air inlet (flame rollout). This is a fire hazard and can possibly result in high CO levels.*
- Be sure that fires in fireplaces and woodstoves are completely out. Take precautions to prevent ashes from being blown into the building during the test. In most cases closing dampers and doors is sufficient, but when they are leaky or absent, it will be necessary to tape fireplace doors shut, clean out the ashes, or cover the ashes with newspaper.
- Turn off all exhaust fans, vented dryers, air conditioners and air handler fans.

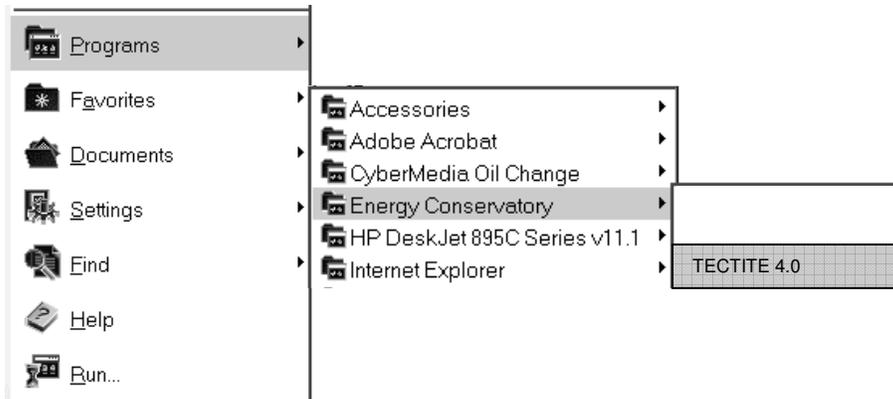
Chapter 4 Starting the TECTITE Program

4.1 Turn on the Gauge or DAB and Fan Speed Controller (Auto Methods Only)

- Turn on the DG-700, DG-1000, or DAB (plug in the DAB's power supply if necessary).
- Turn the Blower Door fan speed controller to the "just on" position (the fan should not be turning in this position). The speed control knob should be turned all the way down, without being clicked into the "off" position. **Note:** The speed controller should have already been plugged into the fan and into a power source.

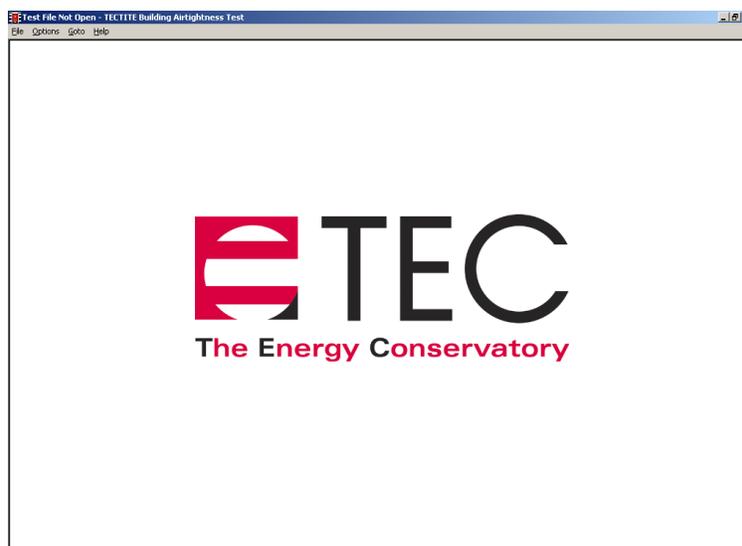
4.2 Starting TECTITE

To start TECTITE, click on **Start...All Programs...Energy Conservatory...TECTITE 4.0**.



The main TECTITE screen will now appear, with the Main Menu containing **File, Options, Goto** and **Help** located in the upper left hand corner.

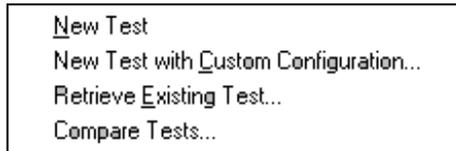
Main TECTITE Screen



Chapter 5 Overview (Auto, Semi-Auto and Manual Methods)

5.1 Starting a New Test

To start using the TECTITE program, open the File Menu by clicking on **File** in the Main Menu. The top of the File Menu contains three starting options:



- ⇒ **New Test** is selected to begin a new building airtightness test using the factory default program settings. Both the Test Standard Selection and Equipment Information windows are automatically opened so that you can select the appropriate test standard, and the correct fan model being used for the test. After selecting the test standard and fan model, the Building Test Information screen will appear.
- ⇒ **New Test with Custom Configuration** is selected to begin a new building airtightness test using custom configuration files which you have previously created and saved. Using configuration files is the most efficient way to run TECTITE. Creating and saving configuration files is discussed in *Chapter 14*. After selecting a configuration file to load, the Building Test Information screen will appear.
- ⇒ **Retrieve Existing Test** lets you recall a previously saved building test file. After selecting the building test file to retrieve, the values from the retrieved file are loaded into the program, and the Building Test Information screen appears. Once a file is recalled, it may be viewed, edited and re-saved (with the same or a different file name). Refer to *Chapter 11* for more information on retrieving and saving files.
- ⇒ **Compare Tests** lets you recall two previously saved building test files and compare the saved test results. After selecting the two test files to compare, a compare test results screen appears. Refer to *Chapter 18* for more information on using the Compare Tests feature.

Menu choices are selected by clicking on the desired option. We recommend that first time users begin by selecting **New Test**. The other starting options should be explored after familiarizing yourself with the TECTITE program.

5.2 Input Screens

The first 4 screens of TECTITE are input screens where you will enter information about the customer, the building being tested, local climatic conditions, information related to mechanical ventilation needs, and any relevant comments that you would like to save along with the test file. An overview of the 4 screens are shown on the next page. You can click on individual fields to enter information, or use the **Tab** key to quickly move between fields. To clear a screen, click on the **Clear** button at the bottom of each page. When you are finished with a screen, click on the **Next** button to proceed. At any time, you can step back to earlier screens by using the **Previous** button.

Input Screens

Building Test Information Screen:

The Building Test Info screen is used to input information about the customer for whom the airtightness test is being performed, as well as the address and physical dimensions for the building being tested.

Environmental Information Screen:

The Environmental Info screen is used to enter weather and energy cost information needed to calculate various test result variables (e.g. design infiltration rates).

Mechanical Ventilation Screen:

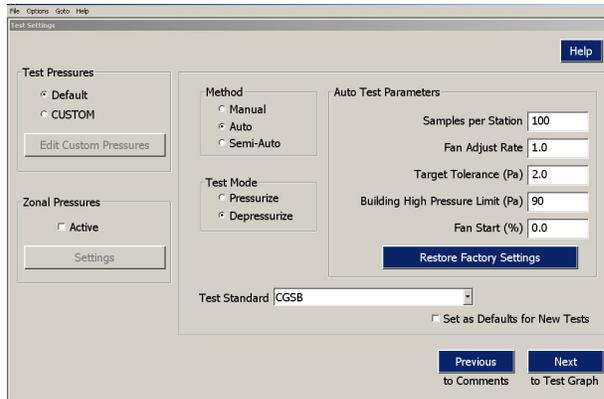
This screen is used to determine if whole-building mechanical ventilation calculations (based on ASHRAE 62.2-2010) will be performed and reported by TECTITE. In addition, the inputs necessary to calculate the alternate compliance supplement for existing housing can be entered from this screen.

Comments Screen:

The Comments screen is used to enter an unlimited number of lines of comments on the building being tested. Comments are stored with the test file and are printed out along with the test report.

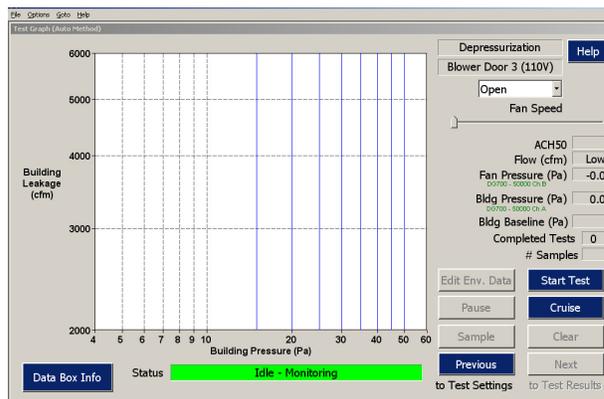
5.3 Auto Test Method

After completing the Comments screen, click on **Next** to move to the Test Settings screen. (**Note:** If you want to operate using the Manual data entry method, refer to the Section 5.4 below.)



Test Settings Screen:

The Test Settings screen is used to input settings that will be used during the airtightness test. When conducting automated tests, be sure the **Method** button is set to **Auto** (or **Semi-Auto** if you will be conducting a Semi-Auto test). Click on **Next** to move to the Test Graph screen.

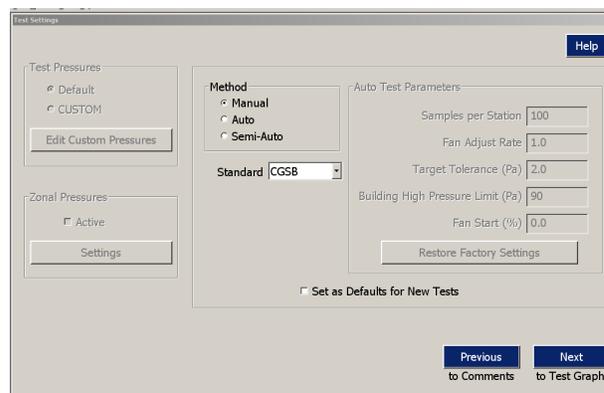


Test Graph (Auto Method):

The automated airtightness test and cruise control features are controlled from this screen. During an automated test, Blower Door test data are collected by TECTITE at a series of target building pressures which are designated by the vertical blue lines on the graph. To begin a test, click on the **Start Test** button.

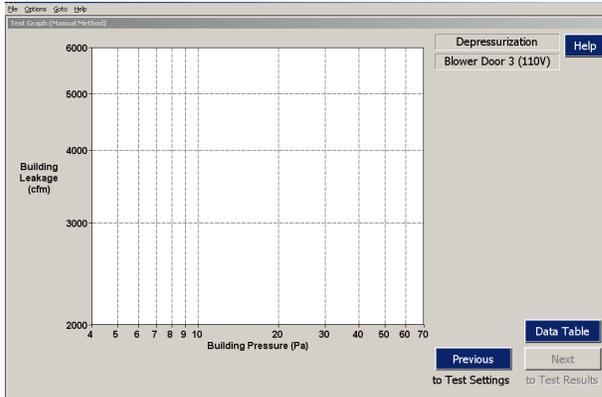
5.4 Manual Test Method

After completing the Comments screen, click on **Next** to move to the Test Settings screen:



Test Settings Screen:

To set the program for manual entry of Blower Door test data (i.e. building and fan pressure readings), be sure the **Method** button is set to **Manual**. Click on **Next** to move the Test Graph screen.



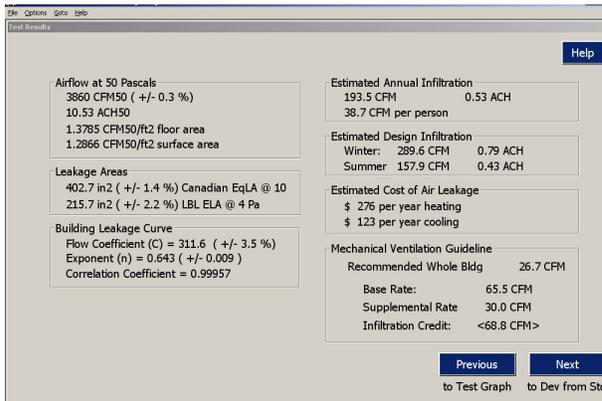
Test Graph (Manual Method):

When using Manual Method, manually entered test data are displayed on this screen. To begin entering data, click on the **Data Table** button.

Data Table:

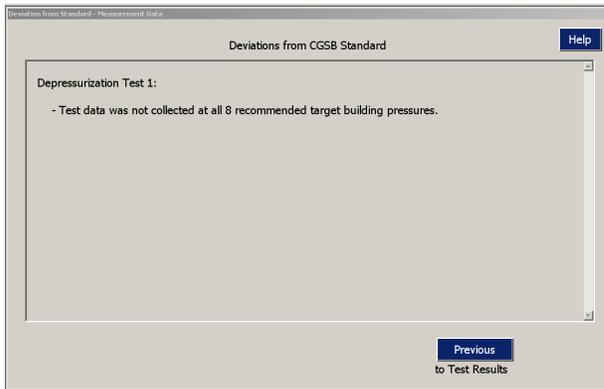
The data table is used to input Blower Door test data that were collected manually, rather than collected automatically by TECTITE. The format of the data table will depend on the selected Test Standard. The data table to the right is for a CGSB test and allows entry of up to 12 sets of Blower Door test readings, plus pre-test and post-test baseline building pressure readings, and temperatures during the test. After you have entered all data into the table, click on **OK** to return to the Test Graph.

5.5 Test Results



Test Results:

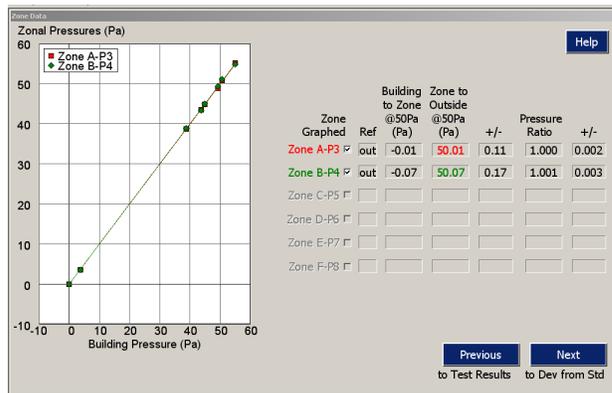
To look at the calculated test results, click on **Next** from the Test Graph screen. Test results are automatically calculated using all data points displayed on the graph, and values entered into the Input screens. From the Test Results screen, click on **Next** to see the Deviations from Standard screen. **Note:** If you are conducting an Automated (or Semi-Auto) test, and were measuring zone pressures during the Blower Door test, the **Next** button will first take you to the Zone Data screen, before going the Deviations from Standard screen..



Deviations from Standard:

This screen lists aspects of the current test data that deviate from the selected Test Standard.

5.6 Zone Data (CGSB Test - Auto and Semi Auto Methods Only)

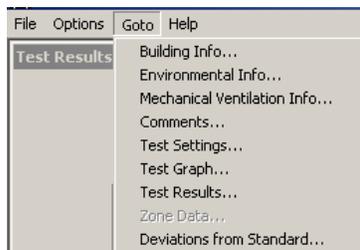


Zone Data:

To look at the measured zone data, click on **Next** from the Test Results screen.

5.7 Using the Goto Menu

The **Goto** item in the Main Menu allows you to quickly move to any active screen within the TECTITE program. Clicking on **Goto** will bring up the following dialog box.



Simply click on one of the active choices to immediately move to that screen. If no test data have been taken (or manually entered), the Test Results, Zone Data and the Deviations from Standard screens will not be available.

Chapter 6 Editing the Input and Test Settings Screens

6.1 Building Test Information Screen

The Building Test Information screen is used to input both customer and building specific information. To enter information, click on individual fields, or use the **Tab** key to quickly move between fields. To clear the screen, click on the **Clear** button. When you are finished entering the information, click on **Next** to move to the Environmental Information screen.

The first three fields on this screen are used to enter the date of the test, the name of the technician performing the test, and an optional project number. The Customer Information section contains fields to input the name, address and contact information of the customer for whom the airtightness test is being conducted.

The Building Information section is used to input the address and physical measurements for the building being tested. If any of the fields in the Building Information section are left blank, the test can still be completed, however test results requiring those inputs will not be calculated or displayed on the Test Results screen.

All information entered on this screen is stored as part of the test file.

Building Test Information Screen

Volume: Enter the volume of the building's intentionally heated or cooled spaces. If you are testing a building with a basement, we recommend that you include the basement if it is to be kept closer to inside temperature than outside temperature. (If you include the basement in your volume calculation, perform the Blower Door test with any doors between the basement and the building kept open.).

If you enter a value of 0 (or leave the field blank), Air Changes per Hour at 50 Pascals will not be calculated or printed.

Floor Area: Enter the floor area of the building. This value typically includes all floors in intentionally heated or cooled spaces. If you have included the basement in your volume calculation, also include the basement in the floor area calculation.

If you enter a value of 0 (or leave the field blank), this variable will not be calculated.

Surface Area: Enter the surface area of the exterior envelope of the building. This value typically includes all walls, floors and ceilings bordering the volume being tested. You may define surface area using your own convention, or it may be defined by the test protocol you are using.

If you enter a value of 0 (or leave the field blank), this variable will not be calculated.

Height: Enter the average above grade building height. This average should include the above grade part of a basement if it is included in the volume calculation. Do not include an attic space unless the attic is conditioned space and is included in the volume calculation.

If you enter a value of 0 (or leave the field blank), all variables requiring this field will not be calculated.

of Bedrooms: Enter the number of bedrooms for the building being tested. This number is used to determine ventilation requirements. The occupancy of the building is assumed to be the number of bedrooms plus one, or the number of occupants (see below), whichever is larger.

of Occupants: Enter the number of occupants that are living in the building. When determining the occupancy of a building, the program uses either the # of occupants, or the # of bedrooms plus one, whichever is greater.

6.2 Environmental Information Screen

The Environmental Information screen is used to enter climate information and building features needed to calculate certain air leakage test results such as the estimated annual and design infiltration rates, and the estimated annual cost of air leakage. If any of the fields on this screen are left blank, the test can be completed, however, test results requiring those inputs will not be calculated or displayed on the Test Results screen. All information entered on this screen is stored in both test and configuration files.

To enter climate information, you can use the **Select Climate Location** button to select from a list of over 200 cities, or you can click or **Tab** through the individual fields to enter the information manually. To clear the Climate fields, click on the **Clear** button. When you are finished entering environmental data, click on **Next** to move to the Mechanical Ventilation screen, or **Previous** to move back to the Building Information screen.

Environmental Information Screen

Location Climate Characteristics:

The program contains a listing of climate data from selected cities in the United States and Canada. You can automatically load this information into the Climate Characteristics section by clicking on the **Select Climate Location** button, and then selecting the city closest to your test site using the **Location** selection field.

Heating Degree Days: Enter the number of base 65 degree F heating degree days for the location closest to the building being tested. This field is used in the estimation of annual air leakage costs.

Cooling Degree Days: Enter the number of base 70 degree F cooling degree days for the location closest to the building being tested. This field is used in the estimation of annual air leakage costs.

Energy Climate Factor: Enter the energy climate adjustment factor for the location closest to the building being tested. The energy climate factor is used to estimate the average annual natural infiltration rates for purposes of estimating the annual cost of air leakage. The energy climate factor is part of a simplified version of the LBL infiltration model developed by Max Sherman, and is discussed in more detail in Appendix E of the Operation Manual for the Model 3 Minneapolis Blower Door. The calculation procedure for estimating the annual cost of air leakage can be found in the Model 3 Blower Door Operation Manual.

Ventilation Weather Factor: Enter the ventilation weather factor for the location closest to the building being tested. The ventilation weather factor is used to estimate the average annual natural infiltration rate for purposes of estimating ventilation rates due to infiltration. Ventilation weather factors used in TECTITE can be found in ASHRAE Standard 136. The calculation procedure used to estimate average annual infiltration rates is based on ASHRAE Standard 136.

Design Winter Temperature Difference and Wind Speed: Enter the design winter temperature difference and wind speed for the location closest to the building being tested. The design winter temperature difference and wind speed are used to calculate the infiltration rate under design winter conditions. The estimated design infiltration rate can be used in ACCA Manual J load calculations in lieu of Manual J's infiltration estimation procedure. The calculation procedure used to estimate design

infiltration rates is based on the LBL infiltration model and is discussed in more detail in the ASHRAE Fundamentals Handbook, Chapter on Infiltration and Ventilation.

Design Summer Temperature Difference and Wind Speed: Enter the design summer temperature difference for the location closest to the building being tested. The design summer temperature difference and wind speed are used to calculate the infiltration rate under design summer conditions. The estimated design infiltration rate can be used in ACCA Manual J load calculations in lieu of Manual J's infiltration estimation procedure. The calculation procedure used to estimate design infiltration rates is based on the LBL infiltration model and is discussed in more detail in the ASHRAE Fundamentals Handbook, Chapter on Infiltration and Ventilation.

Heating and Cooling Equipment Information:

Heating Fuel Type: Click on the fuel type used for heating.

Heating Fuel Costs: Enter the fuel cost for the selected heating fuel type. For example, for natural gas (Gas), enter the cost in \$ per CCF.

Heating Efficiency: Enter the annual seasonal efficiency (i.e. AFUE) for the heating system. For example, for a gas furnace with an 82.5% AFUE, enter 82.5. **Note:** If the building is heated with an electric heat pump, use the HSPF or COP rating.

Elect. Cost for Cooling: Enter the \$ cost per KWH for the cooling system. For example, enter 0.08 if your electrical rate is 8 cents per KWH.

SEER Rating of Cooling System: Enter the SEER rating for the cooling system.

Wind Shield Factor: Click on the appropriate building wind shielding class. The windshield factor is used in the infiltration model which estimates natural infiltration rates.

Shielding Class Description:

Heavy:	Very heavy shielding; large obstructions surrounding the perimeter within two building heights; typical downtown shielding.
Shielded:	Obstructions around most of the perimeter, building or trees within 30 feet in most directions; typical suburban shielding.
Moderate:	Some obstructions within two building heights, thick hedge, solid fence or one neighboring building.
Light:	Few obstructions, a few trees or a small shed.
Exposed:	No obstructions.

6.3 Mechanical Ventilation Screen

This screen is used to determine if whole-building mechanical ventilation calculations (based on ASHRAE Standard 62.2-2010) will be performed and reported by TECTITE. In addition, the inputs necessary to calculate the alternative compliance supplement for existing houses (Appendix A of 62.2-2010) can be entered from this screen.

Mechanical Ventilation Screen

To perform the whole building mechanical ventilation calculations, click the check box at the top of the screen. Once the calculation feature is checked, you must choose between **New House** and **Existing House**.

New House: When **New House** is selected, it is assumed that the Local Exhaust Airflow requirements of Standard 62.2-2010 have been met and TECTITE simply calculates the whole-building ventilation requirements based on occupancy and floor area.

Existing House: When **Existing House** is selected, the user must input information for the Kitchen and Bathrooms of the house (including rated or measured fan flow rates, and the presence of operable windows). From this information TECTITE calculates any necessary supplemental whole-building ventilation requirements for the house due to ventilation deficits in the Kitchen and Bathrooms. The calculated supplemental ventilation is then added to the whole-building requirements that are based on occupancy and floor area. An adjustment to whole-building requirements is also made by applying an Infiltration Credit based on the results of the Blower Door test using the methodology contained in 62.2-2010.

To clear the Mechanical Ventilation screen, click on the **Clear** button. When you are finished entering information on this screen, click on **Next** to move to the Comments screen, or **Previous** to move back to the Environmental Information screen.

6.4 Comments Screen

The Comments screen can be used to enter an unlimited number of lines of comments on the building being tested. Comments are saved along with the building test file and are printed out as part of the test report. Typical comments entered on this screen include client interview information, building and weather conditions during the test, and the location of major air leakage sites. To begin entering comments, click anywhere within the comment box to activate the cursor. To clear the Comments screen, click on the **Clear** button. When you are finished entering comments, click on **Next** to move to the Test Settings screen, or **Previous** to move back to the Mechanical Ventilation screen.

Note: You can access standard Windows copy and paste commands within the Comments screen by clicking on the right mouse button. This allows you to easily move text between TECTITE and other text editing programs such as Microsoft Word.

6.5 Test Settings Screen

The Test Settings screen is used to set up the airtightness test procedures to be used by the TECTITE program. To edit the Test Settings screen, click on individual fields, or use the **Tab** key to quickly move between fields. When you are finished selecting test settings, click on **Next** to move to the Test Graph screen, or **Previous** to move back to the Comments screen.

Note: When using the Manual Method for data entry, only the **Standard** and **Method** fields are active.

Test Settings Screen

Test Standard: Choose from the following four Test Standards:

- ⇒ **CGSB (149.10-M86):** The Canadian General Standards Board standard consists of an 8 point Blower Door test conducted at target building pressures varying from 50 to 15 Pascals. A single pre and an optional post test baseline building pressure reading are taken. The CGSB standard allows for either a depressurization test, or a pressurization test to be performed.
- ⇒ **RESNET One-Point:** The RESNET One Point standard consists of a single-point Blower Door test performed at a target building pressure 50 Pascals. A series of 5 pre-test baseline building pressure readings are taken to determine the accuracy level of the test. The RESNET One Point standard allows for either a depressurization test, or a pressurization test to be performed.
- ⇒ **RESNET Multi-Point Test:** The RESNET Multi-Point standard consists of an 8 point Blower Door test conducted at a minimum of 8 target building pressures. The target building pressures may vary from 60 to 15 Pascals, and both a single pre and post test baseline building pressure reading are taken. The calculated uncertainty in CFM50 is used to determine the accuracy level of the test. The RESNET Multi-Point Standard allows for either a depressurization test, or a pressurization test to be performed.

- ⇒ **RESNET Repeated Single-Point Test:** The RESNET Repeated Single-Point standard consists of a series of repeated single-point tests (minimum of 5 repeated tests) conducted at a target building pressure of 50 Pascals. Each test includes a single pre-test baseline building pressure reading. The calculated uncertainty in CFM50 is used to determine the accuracy level of the test. The RESNET Repeated Single-Point standard allows for either a depressurization test, or a pressurization test to be performed.

The choice of Test Standard will affect the data entry requirements and the test results.

Method: Click on **Manual** if you will be manually entering the Blower Door airtightness test readings (i.e. building and fan pressure readings). Select **Auto** if a fully automated test will be performed including computerized control of the Blower Door fan. Select **Semi-Auto** if the test data will be collected automatically, but the Blower Door fan will be controlled manually.

Test Mode: Click on **Pressurize** if the Blower Door will be blowing air into the building (i.e. the building will be at a higher pressure than outside), or select **Depressurize** if the Blower Door will be blowing air out of the building (i.e. the building will be at a lower pressure than outside).

Test Pressures (only available for CGSB and RESNET Multi-Point Tests - when **Auto** and **Semi-Auto** Methods are selected):

- ⇒ **Default:** the test will be performed at the target building pressure values specified in the selected test standard. For most users, this is the preferred test method.
- ⇒ **Custom:** allows the user to create a custom list of up to 12 target building target pressures at which Blower Door data will be collected. Once **Custom** has been selected, click on the **Edit Custom Pressures** button to open the list of custom target building pressures. Click on the **Help** button on the custom pressure list window for more information.

Zonal Pressures (only available for CGSB Tests - when **Auto** or **Semi-Auto** Methods are selected):

If you are using multiple DG-700 gauges (1 primary and up to 3 auxiliary gauges), or an APT System with 3 or more pressure channels, you can activate the Zonal Pressures feature (by clicking on the **Active** button) to allow the simultaneous measurement of building zone pressures during the Blower Door test. Once activated, the **Settings** button can be used to access the Zonal Pressures Set-Up screen. Click on the **Help** button in the Zonal Pressures Set-Up screen, or refer to *Chapter 10* for more information on using this feature. **Note:** This feature is currently not available for DG-1000 gauges.

Auto Test Parameters (only available when **Auto** or **Semi-Auto** Methods are selected):

- ⇒ **Samples Per Station:** This field is only available if the CGSB test standard is selected and controls the number of readings (or samples) of building pressure and fan flow that are taken at each pressure station (i.e. target building pressure) during an automated test. Each reading or sample is displayed on the graph as a small dot as it is collected. The default number of samples is 100, and should work fine for most test applications (you may vary this number from 1 to 1000). In most cases, larger numbers of samples will lead to higher correlation coefficients. This field also controls the number of pre and post test baseline building pressure readings that are taken during an automated CGSB test sequence. If the Zonal Pressures feature is active, the **Samples Per Station** also determines the number of zone pressure measurements taken for each active zone pressure channel.

- ⇒ **Time Averaging Period:** This field is only available if one of the RESNET Test Standards is selected. The **Time Averaging Period** controls the length of time that each baseline building pressure, building test pressure, and fan flow readings are taken during the test. For all three RESNET test standards, the **Time Averaging Period** should be at least 10 seconds.

- ⇒ **Fan Adjust Rate (not available when Semi-Auto is selected):** During either an automated airtightness test or a cruise procedure, the computer is in charge of adjusting the fan speed to reach the desired (or target) building pressures. The **Fan Adjust Rate** determines how quickly the fan speed changes as the computer tries to achieve the target building pressure. For most cases, the factory default **Fan Adjust Rate** of 1.0 will work fine. In some cases, such as windy weather, it may be necessary to reduce the fan adjust rate to prevent the fan from responding too quickly to pressure changes caused by the wind. In such cases, try a lower setting (e.g. 0.2 or 0.1) so that the fan adjusts slowly enough to successfully complete the test. If you would like to speed up fan response, try a higher setting (e.g. 2.0 or 3.0).

Note: When changing the Fan adjust rate, do not enter values greater than 5 or less than 0.1. In addition, the fan speed can be manually adjusted by dragging the manual fan speed adjustment slider on the Test Graph, or by pressing down on the **Up** and **Down** arrow keys (the arrow keys are only active when the manual adjustment slider is highlighted).

- ⇒ **Target Tolerance (not available when Semi-Auto is selected):** The **Target Tolerance** is used by TECTITE to determine whether the measured building pressure is close enough to the target building pressure so that data collection may begin. The **Target Tolerance** is a number (in Pascals) stating how close the actual building pressure needs to be to the target pressure before a reading will be taken. In most cases the factory default setting of 2 (Pa) works fine. In windy weather you may need to increase the target tolerance (e.g. 3 or 4) to account for the fluctuations in building pressure caused by the wind. The **Target Tolerance** used has little impact on the final test results, but your particular test standard (e.g. CGSB) may require you to get very close to your target pressures.

Note: If during an automated test you would like to manually instruct the computer to go ahead and take data, click on the **Sample** button. At this point the computer will proceed with data collection just as if it had decided that the target tolerance had been met.

- ⇒ **Building High Pressure Limit:** If TECTITE detects a building pressure higher than the set **Building High Pressure Limit**, the fan will shut off immediately and you will be informed that the maximum allowable building pressure was exceeded. The purpose of the **Building High Pressure Limit** is to prevent damage to the building from excessive test pressures. The default setting is 90 Pa. If the maximum allowable building pressure is exceeded during a Semi-Auto test, you will see a warning message and should immediately shut down the fan.

Note: The Blower Door fan calibration parameters are not accurate above test pressures of 100 Pa.

- ⇒ **Fan Start % (not available when Semi-Auto is selected):** Enter a number, typically in the range 1% to 25%. At the beginning of an automated test or cruise procedure, the fan output signal from the gauge or DAB will immediately be set to this value to reduce the delay associated with fan startup. A good value for this parameter can be determined by manually moving the fan control slider and estimating at which point the fan begins to turn. This allows you to customize the computer control to the particular combination of fan motor and controller being used. This value is stored in the building test files (.bld) and configuration files (.cfa). The default value is 0.

The **Fan Start %** setting will not affect the minimum fan output which may occur during cruising or automated testing. The computer will still be allowed to reduce the fan output below the **Fan Start %** value if needed to achieve low target pressures.

Note: If you input an inappropriately high **Fan Start %**, the fan will begin operation at a high speed and may trigger the warning message (**Exceeded Maximum Building Pressure**). Reduce the **Fan Start %** setting if this occurs.

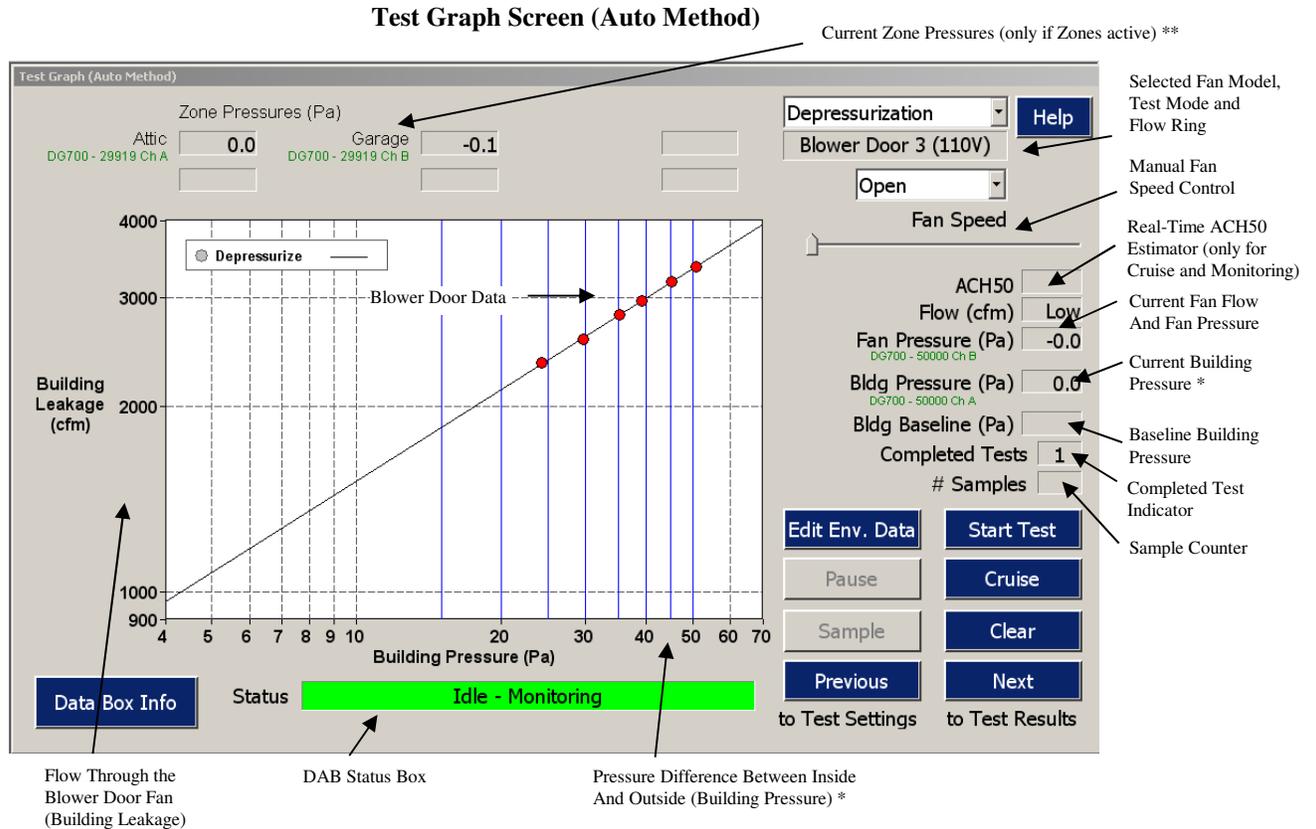
⇒ **Restore Factory Settings:** The **Restore Factory Settings** button will restore the factory default settings for all five Auto Test Parameter fields.

Set as Defaults for New Tests: Clicking on this box will save the currently selected Standard, Method, Test Mode and Auto-Test Parameters so that they will be used for all future new tests.

Chapter 7 Conducting an Automated Airtightness Test

7.1 Overview of Test Graph Screen (Auto Method)

The automated airtightness test is conducted from the Test Graph screen. The main feature of the Test Graph screen is a plot of Blower Door fan airflow (or building leakage) on the vertical axis versus building pressure on the horizontal axis. During a Blower Door test, data are automatically collected at a series of pre-set target building pressures, which are designated by the vertical (blue) lines on the graph. The target building pressures are determined in the **Test Pressures** section of the Test Settings screen.



* Building pressure values shown on the graph and in the Bldg Pressure status window are adjusted for the measured baseline pressure.

** Zonal pressure values shown in the Zone Pressure status windows are adjusted for measured zonal baseline pressure.

During a fully automated test sequence, the Blower Door fan will turn on and increase speed until the building pressure reaches the highest target pressure line shown on the graph (e.g. 50 Pa for a CGSB test). Once the appropriate building pressure is achieved, TECTITE takes a number of simultaneous measurements of building pressure and fan airflow (the default number of samples is 100 for a CGSB test). Each sample is displayed on the graph as a small dot as it is collected. When the system is finished collecting samples for the first target pressure line, the average value of all samples for that target pressure is displayed as a red circle. The fan speed is then reduced until the building pressure reaches the next target pressure line and the data collection process is repeated. The number of data samples taken at each target building pressure is determined by the **Samples per Station** field in the Test Settings screen. Once data has been collected at each target pressure, a best fit regression line is drawn through the data points.

Note: If you are conducting a Semi-Automated test sequence, you will need to manually adjust the Blower Door fan to achieve the appropriate building pressure, and then press the **Sample** button to initiate the automated measurement of building pressure and fan flow.

If the **Zonal Pressures** feature has been activated from the Test Settings screen, the Zone Pressure status window will display the current measured zone pressures during the course of the automated test. While TECTITE is collecting data for the building airtightness test (from Channels P1 and P2), it will also collect data from each active zone pressure channel (P3 – P8). The number of data samples taken for each active zone pressure channel is determined by the **Samples per Station** field in the Test Settings screen.

In addition to the graphical display, the TECTITE program will provide a series of messages or prompts on the Test Graph Screen to ensure that proper testing procedures are followed. The program also detects common testing or equipment problems (e.g. tubing connected to the wrong pressure tap) and provides a warning message to the operator.

7.2 Selecting the Fan Model

Before beginning a test, be sure that the selected fan model displayed at the top right side of the Test Graph screen matches the Blower Door fan being used. To change the selected fan model, click on **Options...Equipment Info** from the Main TECTITE Menu.

Equipment Information Window

In the Equipment Information window, select the appropriate fan model, and then click on **OK**. You may also input a fan serial number which will be stored along with the building test file, and is printed out on the test report. Importantly, if you change the selected fan model while test data are displayed on the graph, the test data will be automatically cleared.

7.3 Establishing a Communication Link(s)

Establishing Communication Between TECTITE and the DG-700, DG-1000 or APT DAB:

Before beginning an automated test or cruise procedure, TECTITE checks to be sure that your computer is communicating properly with the DG-700, DG-1000, or APT DAB(s) that will be used for the test. Automated testing, Semi-Automated testing or cruising cannot begin until the necessary communication link(s) have been established. Once the proper communication links have been established, the message **Idle - Monitoring** appears in a green DAB Status window at the bottom of the Test Graph screen and the **Start Test** button is activated.

- ⇒ **Primary Device:** The **Primary Device** is the DG-700, DG-1000 or APT DAB that will be used to measure building pressure and fan flow during the Blower Door test.

Checking the **AUTO SELECT** button in the Device Connection window will allow TECTITE to automatically search for TEC devices on all available communication ports and wireless networks on your computer. **AUTO SELECT** is the preferred option to establish communication with your TEC Device. **AUTO SELECT** will attempt to establish a communication link with the first Energy Conservatory Device that it finds. If a communication link is established, this device is considered the **Primary Device**. Wireless communication is only enabled when **AUTO SELECT** is checked.

If you uncheck **AUTO SELECT**, you may specify a **Primary COM Port** (COM 1 through COM 256) to connect with a DG-700 gauge or with an APT DAB.

Device Connection Window

Device Connection

OFF LINE: Communication with devices disabled Help

AUTO SELECT (Primary Device Only)

Primary Device Test

Aux devices are used with the Zonal Pressure Feature only.

Aux 1 Device Test

Aux 2 Device Test

Aux 3 Device Test

Scan for Devices

OK

- ⇒ **Aux: Aux Device(s)** are additional DG-700s or APT DABs that can be used exclusively to measure zonal pressures during the Blower Door test. The **Aux COM Port(s)** are the communication ports on your computer that will be used to communicate with the **Aux Device(s)**. **Aux Devices** can only be used with the Zonal Pressures feature of TECTITE. This version of TECTITE does not support wireless or Ethernet connections to **Aux Devices**.

Note: If the **Primary Device** is an APT DAB with 3 or more pressure channels, you can use installed pressure channels 3 through 8 on the APT DAB along with the Zonal Pressure feature, without specifying an **Aux COM Port**.

- ⇒ **Scanning for Devices:** The easiest way to quickly check your computer for all currently connected Energy Conservatory Devices is to use the **Scan for Devices** button in the Device Connection window. Once the Scan window is open, clicking on **Start Scan** will provide a list of all Energy Conservatory Devices that TECTITE can currently locate and establish a communication link with. The list includes devices connected through all wired communication ports, and through the computer's wireless network adapter.

Note: The Energy Conservatory Device must be ON to be detected.

For more information on establishing communication between your computer and a DG-700, DG-1000, and DAB, see *Chapter 15*.

7.4 Starting an Automated Test

Start Test Button:

Clicking on the **Start Test** button will begin an automated airtightness test sequence. The TECTITE program will guide you through the test sequence using a series of operator messages.

A fully automated test sequence includes the following steps:

1. The operator is prompted to enter specific environmental data (temperatures, barometric pressure, etc.) for the test being performed.
2. The operator is prompted to cover the fan inlet so that the TECTITE can measure the baseline building pressure (due to wind and stack effects) prior to the test. Install the flow ring set including the no-flow plate or install a nylon fan cap to cover the fan inlet opening, then click on **OK**.
3. TECTITE will automatically begin to measure the pre-test baseline building pressure. The number of building baseline readings made will depend on the selected **Test Standard** and **Samples per Station** fields in the Test Setting screen. Once the pre-test baseline measurement is completed, the average value of the baseline readings is displayed in the **Bldg Baseline (Pa)** status window on the right side of the screen. All subsequent building pressure measurements shown on the graph and in the Building Pressure status window will be adjusted by this measured baseline pressure. TECTITE will also measure the baseline pressure for any active zone pressure channel at the same time.
4. The operator is prompted to remove the fan inlet cover and install the appropriate flow ring on the fan for the beginning of the test. Use your best judgment and install the flow ring that you think will provide the correct airflow for the highest target pressure. Don't worry if you guess wrong, the program will instruct you to install a different ring later on if you start with the wrong one. Click on **OK** after you've removed the inlet cover and installed the chosen flow ring.
5. The operator is now prompted to indicate which flow ring was installed on the fan. Select the appropriate ring and click on **Proceed with Test**.

6. The fan will automatically turn on and increase speed until the building pressure reaches the highest target pressure line shown on the graph.¹ The current fan airflow and building pressure is shown on the graph by the moving Fan Airflow and Building Pressure Cursor. Once the appropriate target building pressure is achieved, TECTITE takes a number of simultaneous readings of building pressure and fan airflow. Each reading is displayed on the graph as a small dot as it is collected. Once the program is finished collecting readings for the first target pressure line, the average value of all readings for that target pressure is displayed as a red circle. The fan speed is then reduced until the building pressure reaches the next lowest target pressure line and the data collection process is repeated. **Note:** If the Zonal Pressures feature has been activated from the Test Settings screen, the Zone Pressure status window will display the current measured zone pressure during the course of the automated test. While TECTITE is collecting data for the building airtightness test (from Channels P1 and P2), it will also collect and store data from each active zone channel (P3 – P8).
7. After data have been collected for the last target pressure line, the fan turns off and the operator is again prompted to cover the fan inlet for another set of baseline building pressure readings.
8. All data are now automatically adjusted for the average of the two baseline readings, and the test is completed. A “best fit” line is then drawn through the data points (i.e. red circles) on the graph.
9. Calculated test results can be seen by clicking on **Next**. The measured zone pressure data are available from the Zone Data screen (click **Next** from the Test Results Screen, or use the **Goto** Menu Item).

Using the Sample Button (manually activating data collection):

The **Sample** button is used to manually activate data collection for a target building pressure line during an automated test sequence, rather than waiting for TECTITE to automatically activate data collection. This button is particularly useful if it is windy and the building pressures are fluctuating causing a long time delay before automated data collection begins at each target pressure line. In addition, if you are conducting a Semi-Automated test, you must use the **Sample** button to initiate the data collection process.

Using the Clear Button (Clearing Data From the Graph):

The **Clear** button is used to clear all Blower Door data from the graph. This will not affect the information that you have entered into the test input screens, or any results that you have previously saved. **Clear** is typically used to prepare the graph for a new test. Clicking on the **Clear** button will also clear all stored zone pressure data.

Conducting and Displaying Multiple Tests on the Same Graph:

Data from more than 1 automated test can be displayed on the Test Graph at one time if you are conducting a CGSB test. This occurs when conducting a second airtightness test (using **Start Test**) and not clearing data before beginning the next test. If data from multiple tests with the same test mode are displayed on the graph (for example, 2 depressurization tests), test results are calculated using all displayed data. The main reason for combining multiple tests with the same test mode is to increase the repeatability of test results. This is particularly useful in windy weather.

The **Completed Tests** indicator, located on the right-hand side of the Test Graph Screen, shows the total number of completed tests being displayed on the graph.

¹ If the program is unable to reach the highest target pressure line with the fan running full speed, the operator will be prompted to change to the next larger flow ring. If the fan is in open configuration and still not able to reach the highest target pressure line, the program will display the message “Can’t Reach Target Pressure...Collecting Data at Highest Building Pressure” (see Section below - Operator Messages During the Automated Airtightness Test).

Using the Pause Button:

Once an automated test has been initiated, the **Pause** button can be used to temporarily pause the test sequence. After clicking on **Pause**, the fan will turn off and the message *The Test Is Paused* appears on screen. From this message box, the user has 3 options:

- ⇒ Clicking on **Adjust Auto Test Settings** allows you to change the *Fan Adjust Rate*, the *Target Tolerance*, the *Building High Pressure Limit* and the *Fan Start %* fields during the middle of a test.
- ⇒ Clicking on **Proceed With Test** will restart the test sequence from where the **Pause** button was activated.
- ⇒ Clicking on **Stop Test** allows you to end the current test sequence.

7.5 Stopping an Automated Test

In addition to using the **Pause** button, the fan can be quickly turned off during a test by pressing the **Esc** key, or by clicking on the **Stop Test** button. After the fan has been turned off, the user can choose to end the current test sequence, or can restart the test. If data from more than one test are being displayed on the graph, stopping a test will not clear data from previously completed tests. In addition, stopping a test will not affect information that you have typed into the test input screens, or any test results that you have previously saved.

7.6 Adjusting the Auto Test Parameters

The Test Settings screen contains a number of **Auto Test Parameter** fields which are used to adjust data collection and fan control variables during the automated test sequence. Refer to *Chapter 6* for a detailed description of each of the **Auto Test Parameter** fields. As noted above, the **Auto Test Parameters** can also be adjusted in the middle of a test sequence by clicking on the **Pause** button.

7.7 Operator Messages During the Automated Test

During the airtightness test, TECTITE provides a series of on-screen messages or prompts to the operator to ensure that proper testing procedures are followed. In addition, the program detects common testing or equipment problems (e.g. tubing connected to the wrong pressure tap) and provides a warning message to the operator. On the following pages is a listing of many of the on-screen test procedure and operator warning messages provided by the TECTITE program:

On- Screen Procedure Messages	Operator Action Required
<p>Cover fan inlet to measure starting building pressure baseline. Press OK when ready. <u>or</u></p> <p>Cover fan inlet to measure ending building pressure baseline. Press OK when ready.</p>	<p>Cover the fan inlet so that TECTITE can measure the baseline building pressure (due to wind and stack effects) prior to, or following completion of the test. Install either the no-flow plate or the nylon fan cap to seal off the fan inlet opening.</p>
<p>Remove fan inlet cover and install appropriate flow ring. Press OK when ready.</p>	<p>Remove the no-flow plate or nylon fan cap from the fan inlet so that the fan can be turned on. Install the flow ring that you think will provide the appropriate air flow for the beginning of the test.</p>
<p>Which flow ring is installed?</p>	<p>Select the flow ring that is currently installed on the fan, and then click on Proceed with Test.</p>
<p>Install Ring _ and press here to continue test, OR Press here to end test at previous test pressure.</p>	<p>The program has determined that a different flow ring should be installed on the fan. Install the ring listed in the message. If the listed ring is not available, or you wish to end the test at this point, click on the end test message.²</p>
<p>Remove all rings and press here to continue test, OR Press here to end test at previous test pressure.</p>	<p>The program has determined that all flow rings should be removed from the fan. Remove all rings from the inlet of the fan. You may also select to end the test at this point.</p>
<p>This will end testing. Do you wish to end it? <u>or</u></p> <p>This will end cruising. Do you wish to end it?</p>	<p>This message appears when you have pressed Esc or clicked on Stop Test during a test, or while the cruise control feature is active. To end the test or turn off cruise control, click on Yes.</p>

On-Screen Warning Messages	Operator Action Required
<p>Can not reach target pressure and have open fan. Collecting data at highest building pressure.</p>	<p>No action required. If the fan is in open configuration (i.e. no flow plates installed), running at full speed, and not able to reach the target pressure line, TECTITE will automatically collect data at the highest achievable building pressure.</p>
<p>Warning: Wrong sign (+/-) on building pressure. Check A/P1. Do you wish to terminate test?</p>	<p>The measured building pressure on Channel A/P1 is changing in the wrong direction from the indicated Test Mode. Check to be sure the A/P1 Reference tap is connected to the outside, the A/P1 Input tap is measuring the pressure inside of the building, and that the direction of the Blower Door fan flow is consistent with the indicated Test Mode (i.e. depressurization vs. pressurization). Click on Yes to end the test and No to continue the test.</p>
<p>Warning: Wrong sign (+/-) on fan pressure. Check B/P2. Do you wish to terminate test?</p>	<p>The measured fan pressure on Channel B/P2 is changing in the wrong direction. Check to be sure the B/P2 Input tap is connected to the Blower Door fan, and the B/P2 Reference is measuring the pressure in the space upstream of the fan inlet. Click on Yes to end the test and No to continue the test.</p>
<p>Warning: Not detecting fan pressure. Check B/P2. Press OK to terminate test.</p>	<p>The measured fan pressure on Channel B/P2 is less than 1 Pa, but the building pressure is changing. Possible fan pressure tubing disconnect. Check to be sure the B/P2 Input tap is connected to the Blower Door fan, and the B/P2 Reference is measuring the pressure in the space upstream of the fan inlet. Click on OK to end test.</p>
<p>Warning: Not detecting fan or building pressure. Check system. Press OK to terminate test.</p>	<p>The program is not detecting a fan or building pressure reading, even though the program is calling for full fan speed. Check building and fan pressure tubing connections to the TEC Device. If the fan was not running, check the fan speed controller to make sure:</p> <ul style="list-style-type: none"> - It is properly connected to the fan and plugged into power. - The speed control knob is turned on. - The speed controller is connected to the TEC Device. <p>Click on OK to end test.</p>

² If you end the test and data has been collected for at least one previous target pressure line, test results will be calculated using all data collected prior to ending.

On Screen Warning Messages	Operator Action Required
<p><i>Warning: At full fan speed but <2 Pa building pressure. Check system. Press OK to terminate test.</i></p>	<p>The measured building pressure on Channel A/P1 is less than 2 Pa when the fan is at full speed. First check that the A/P1 Reference tap is connected to the outside, and the A/P1 Input is measuring the pressure inside of the building. Second, check that outside windows and doors in the building are closed and that there are no other large openings to the outside preventing the building pressure from changing. Click on OK to end test.</p>
<p><i>Warning: Not detecting building pressure on A/P1.</i></p>	<p>The program is not detecting a change in building pressure, even though the fan pressure is at least 50 Pa. Check that one end of the (green) building reference tubing is connected to the A/P1 Reference tap, and that the other end is placed outside of the building and away from the Blower Door fan flow. Click on End Test to terminate test.</p> <p><u>Advanced Users:</u> If you are conducting an advanced procedure where you are trying to maintain or measure very small (or zero) building pressures (e.g. “cruising zero”), you can temporarily turn off this message by checking the Turn off this warning box.</p>
<p><i>Warning: Excessive building pressure fluctuation for the current target pressure.</i></p>	<p>While attempting to reach a target pressure line, the measured building pressure has been fluctuating beyond the Target Tolerance for more than 90 seconds. To determine the cause of the fluctuating building pressure problem, and the appropriate operator action, see <i>Chapter 15 – Problem 3</i>. To make changes to the auto test settings, click on Adjust Auto Test Settings, to proceed with the test, click on Proceed with Test, or to end the test, click on Stop Test.</p>
<p><i>Warning: Maximum allowable building pressure exceeded.</i></p>	<p>The default maximum allowable measured building pressure is 90 Pascals. This maximum pressure is designed to prevent accidental damage to the building being tested. In addition, calibration formulas for the Blower Door fans may not be accurate at back pressures greater than 90 Pascals, depending on the flow ring installed and the fan pressure.</p> <p>If you set the Fan Start % setting too high, the fan will begin operation at a high speed and may inadvertently trigger this warning. Reduce the Fan Start % setting if this occurs. In addition, lowering the Fan Adjust Rate setting may also help to prevent this message inadvertently being triggered (the Fan Start % and Fan Adjust Rate can be changed by clicking on the Adjust Auto Test Settings button in the warning screen). To proceed with the test or cruise procedure, click on Proceed with Test/Cruise, or to end the procedure, click on Stop Test/Cruise.</p>
<p><i>No test pressures available.</i></p>	<p>No test pressures have been selected in the Test Pressures field in the Test Settings screen. Automated testing can not begin until test pressures have been entered, or the default pressure setting is selected.</p>
<p><i>Data for more than one test will be combined on the graph.</i></p>	<p>Data from more than 1 automated test with the same test mode can be combined and displayed on the Test Graph at one time. This occurs when conducting a second airtightness test (using Start Test) and not clearing data before beginning the test. The main reason to combine data from multiple automated tests (with the same test mode) is to increase the repeatability of the test results in windy weather.</p> <p>If you start a new test while data are currently displayed on the graph, a warning message appears to let you know that you are attempting to combine data from multiple tests. If you would like to save the current test data to a file before adding additional data points, you will need to select Cancel Test and save the data file before proceeding.</p>

On Screen Warning Messages	Operator Action Required
<p><i>Communication lost. Testing ended.</i></p> <p style="text-align: center;"><i>or</i></p> <p><i>Communication lost. Cruising ended.</i></p>	<p>Communication between the TEC Device and your computer have been disrupted, and the current test or cruise procedure has been ended. If you were conducting an airtightness test when communication was lost, the test sequence is ended and all data from the current test are cleared from the graph.</p> <p>Note: If the fan is still running, it can be stopped by completely turning off the knob on the fan speed controller.</p> <p>Lost communication can be caused by a poor connection between the TEC Device and your computer, or by a loss of power to the Device. If using a communication cable, check the connection between the computer and the TEC Device. If using wireless communication, try to move the computer closer to the Device. Also check that the Device has proper power or battery charge. Click on OK to return to the Test Graph screen. See <i>Chapter 15</i> for more information on lost communications.</p>
<p><i>Warning: Flow too small to measure. Press OK to terminate test.</i></p>	<p>You are trying to measure a fan flow below the acceptable operating range of the equipment. Click on OK to end the test.</p>
<p><i>Cannot start the test because there are not enough pressure channels for the existing test data. Do you wish to clear the data, deactivate Zonal testing, and proceed with the test?</i></p>	<p>You are trying to combine data for more than 1 test, and the current DAB being used has fewer pressure channels than were used during the first test. For example, this message would appear if a 5 pressure channel DAB was used to record 3 zone pressures during the first test, and you are now using a 4 pressure channel DAB to combine data with the first test. Click on Yes to clear all existing test data, deactivate the zonal testing feature, and proceed with a new test, or click on No to end the current test sequence.</p>
<p><i>Low Battery Warning. Press OK to end procedure.</i></p>	<p>TECTITE has detected that the TEC Device battery is critically low. The user is advised to end the current test sequence and do following action:</p> <p><u>DG-1000</u> Plug in the power adapter to the device to recharge the Li-ion batteries. A full battery charge using the fast charger takes approximately 3 hours. The gauge can be operated while the batteries are charging. This warning is activated if TECTITE detects a battery voltage below 3.33V. The current DG-1000 battery voltage can be viewed by clicking on the Data Box Info button.</p> <p><u>DG-700</u> Replace the 6 AA batteries (located in the compartment in the back of the instrument) before resuming testing. Be sure the gauge is turned off before replacing the batteries. This warning is activated if TECTITE detects a battery voltage below 5.6 volts. The current DG-700 battery voltage can be viewed by clicking on the Data Box Info button.</p> <p><u>APT DAB</u> Plug in the power supply to the DAB. You may need to let the DAB's internal NiCd battery charge for 20-30 minutes before resuming testing. The fully charged NiCd battery will power the DAB for approximately 6 - 12 hours of testing. If you are using your APT DAB for the first time, we recommend that you fully charge the DAB battery overnight before beginning testing. The DAB can be also be operated with the power supply plugged in. A green light located next to the 12V terminal on the DAB will turn on whenever the power supply is providing power. The DAB's battery will charge even when the DAB is in operation, however the time required to fully charge the battery is increased.</p> <p>Click on OK to return to the Test Graph.</p>

7.8 Manually Adjusting the Fan Speed

The fan speed can be manually adjusted by dragging the manual fan speed control slider on the Test Graph screen, or by pressing down on the **Up** and **Down** arrow keys. In order for the fan speed control slider to work, a communication link between the computer and TEC Device must have been established, and the message **Idle - Monitoring** should appear in the DAB Status Window.

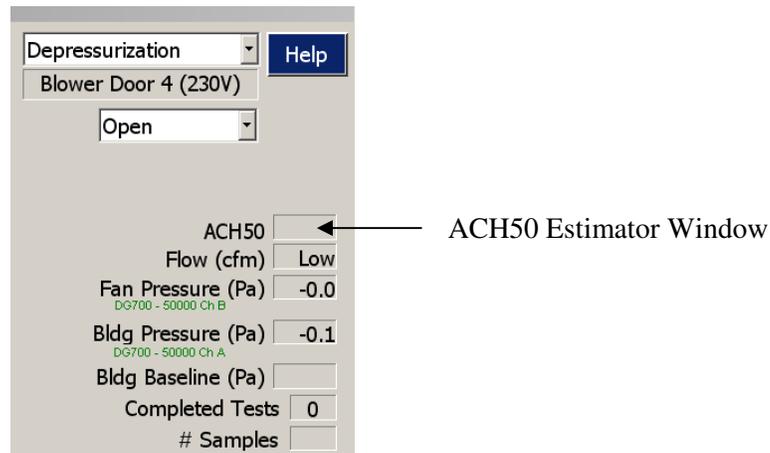
If you are conducting a Semi-Automated test, the manual fan speed control slider is not available, and you will need to manually turn the Blower Door fan speed controller knob in order to adjust the fan speed.

7.9 Real-Time ACH50 Estimator

During **Idle - Monitoring** (or when the Cruise Control feature is active), TECTITE can display a real-time estimate of Air Changes per Hour at 50 Pascals of building pressure in the ACH50 Estimator Window. To estimate ACH50, TECTITE uses the current measured fan flow, the volume estimate input into the Building Information screen, and an assumed Building Leakage Curve exponent (n value) of 0.65. The ACH50 estimator window is only active when the current building pressure is between 40 and 60 Pascals, and a valid fan flow measurement is being made. The Real-Time ACH50 display is useful for quickly estimating building leakage rates before conducting a full airtightness test.

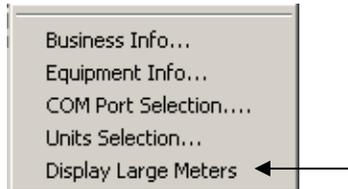
Note: The Real-Time ACH50 estimator is not active during an automated test sequence.

Real-Time ACH50 Estimator



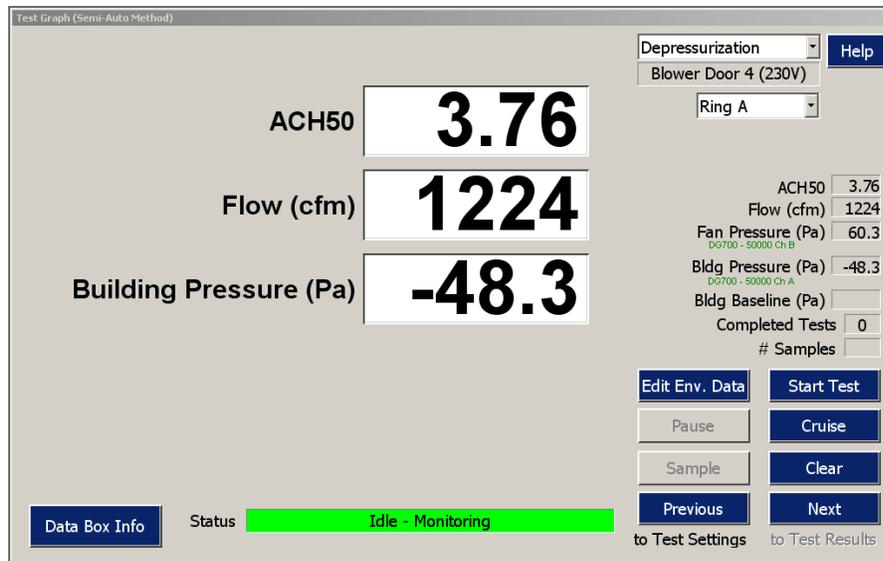
7.10 Using the Display Large Meters Feature

The Display Large Meters feature replaces the graph on the Test Graph (Auto Method) screen with 3 large status windows showing Real-Time ACH50, Current Fan Flow, and Current Building Pressure. The feature can be toggled on and off by clicking on **Display Large Meters** from the Options Menu.



The Display Large Meters feature is particularly useful when looking at the computer screen from a distance while “Cruising” or manually adjusting the Blower Door fan in **Idle-Monitoring** mode. The Real-Time ACH50 Status Window is only active when the current building pressure is between 40 and 60 Pascals, and a valid fan flow measurement is being made. The Real-Time ACH50 display is not active during an automated test sequence.

Display Large Meters Feature



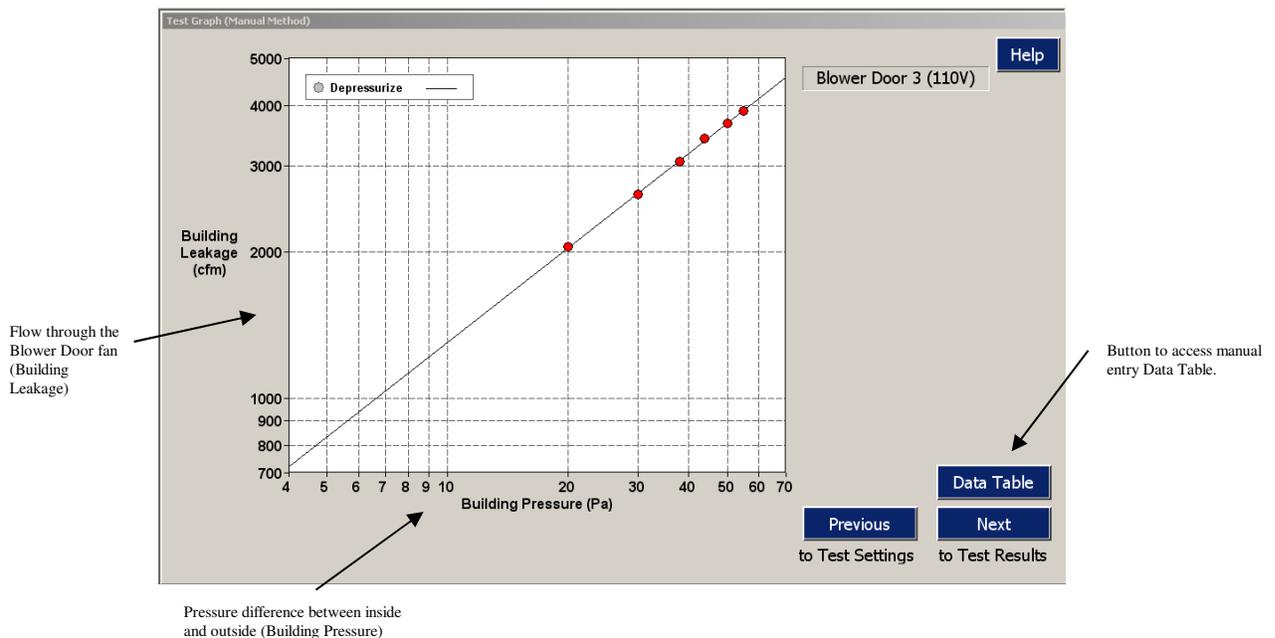
Chapter 8 Using the Manual Data Entry Method

8.1 Overview of Test Graph Screen (Manual Method)

Manual Method is used to input Blower Door test data (e.g. building pressure and fan airflow readings) that were collected manually, rather than collected automatically by TECTITE. The Manual Method option is only available if the **Method** field is set to **Manual** from the Test Settings screen

The figure below shows a sample Test Graph screen when using Manual Method. Like the Auto Method Test Graph screen, the main feature of the Manual Method Test Graph screen is a plot of Blower Door fan airflow (or building leakage) on the vertical axis versus building pressure on the horizontal axis. However, when using Manual Method, all auto control buttons and status windows have been removed, and replaced with a **Data Table** button which opens a simple data entry table. Test data entered into the Data Table are plotted on the graph, and a best-fit regression line is automatically drawn through the plotted data points.

Test Graph Screen (Manual Method)



8.2 Selecting the Fan Model

Before entering data into the Data Table, select the Blower Door fan model being used for the test. To select the fan model, click on **Options** located in the Main TECTITE Menu. From the Options Menu, select **Equipment Info**. In the Equipment Information window, select the appropriate fan model from the pull-down list.

You may also input a fan serial number which will be stored along with the building test file, and is printed out on the detailed test report. In addition, when conducting a Manual test, you can also input and store a micromonometer (gauge) serial number and custom calibration date. If you are conducting an Automated or Semi-Automated test, the TECTITE software automatically stores the micro-monometer (TEC Device) serial number and calibration date as part of the building test file.

Equipment Information Window (Manual Test)

The screenshot shows a dialog box titled "Equipment Information" with a "Help" button in the top right. It contains the following fields and controls:

- Manufacturer: Energy Conservatory
- Model: Model 3 (110V)
- Serial Number: (empty)
- Manual Test Micromanometer: Energy Conservatory
- DG-700
- Buttons: Enter Custom Fan Calibration, Calibration Date, Set as Defaults for New Tests, Cancel, OK

Note: If you change the selected fan model while test data are displayed on the graph, the test data will be automatically cleared from the graph and the Data Table.

8.3 Entering Test Data into the Data Table

The Data Table screens allow entry of test data (building pressures and fan flows), plus baseline building pressures and environmental test data (temperatures and site altitude).

The layout and required data entry of the Data Table depends on the selected Test Standard. For each set of test readings, you must enter the measured building pressure (in Pa), the fan configuration corresponding to this set of readings (i.e. which Flow Ring was installed on the fan), and the measured fan flow used to generate the building pressure. Fan flow can either be entered directly (by choosing the **Flow** button in the Flow Data Source field), or by entering the fan pressure signal in Pascals (by choosing the **Fan Pressure** button in the Flow Data Source field). If you enter the fan pressure signal, the flow value will be automatically determined by TECTITE.

Data Table for Manual Entry of Test Readings (CGSB Test Standard)

The screenshot shows a dialog box titled "Manual Test Data Entry" with a "Help" button in the top right. It contains the following fields and controls:

- Pre-Test Baseline (Pa): (empty)
- Building Pressure (Pa): #1 to #12
- Fan Config (Up-Down Arrow keys): #1 to #12
- Fan Pressure (Pa): #1 to #12
- Fan Flow (cfm): #1 to #12
- Post-Test Baseline (Pa): (empty)
- Flow Data Source: Fan Pressure, Flow
- Fan: Blower Door 3 (110V)
- Mode: Depressurization
- Buttons: Enter/Edit Temperature Data, Clear Data, OK

Data Table for Manual Entry of Test Readings (RESNET One-Point Test Standard)

Data Table for Manual Entry of Test Readings (RESNET Multi-Point Test Standard)

Data Table for Manual Entry of Test Readings (RESNET Repeated Single-Point Test Standard)

Entering Baseline Readings into the Data Table:

The baseline building pressure is the pressure between the building and outside before the Blower Door fan is turned on. Use of baseline pressure readings in the Table allows the program to quickly adjust the manually collected test readings for baseline stack and wind effects. The process for entering the baseline pressure readings depends on which Test Standard is selected on the Test Settings screen.

⇒ **Entering Baseline Readings for a CGSB Test.**

The CGSB test standard requires entry of a single Pre-Test baseline building pressure reading. You may also enter an optional Post-Test baseline reading. Baseline readings are entered directly into the appropriate field in the Data Table. If you leave the Post-Test baseline field empty, the program will simply use the Pre-Test reading when adjusting for baseline pressure effects.

Note: If you are using the DG-700 or DG-1000 built-in Baseline feature, enter 0 into the Pre-Test baseline field (you may leave the Post-Test baseline field blank). This is because the Baseline feature has already adjusted the building pressure reading(s) for baseline effects.

⇒ **Entering Baseline Readings for a RESNET One-Point Test.**

The RESNET One-Point Test standard requires that a series of 5 Pre-Test baseline building pressure readings be taken. Click on the **Enter/Edit Baseline Readings** button to open a baseline entry screen. Enter 5 separate pre-test baseline building pressure readings in this screen. Be sure to include the proper sign of the reading when entering the values. Once the 5 baseline readings are entered, the screen will display the average of the 5 readings, and the calculated range of the readings (i.e. the largest reading minus the smallest reading).

If the calculated range of the baseline readings is greater than 10.0 Pa, the test is not valid and the operator is instructed to clear the baseline readings and to restart the test with a longer time averaging period.

Field	Value
Baseline 1	-1.0
Baseline 2	-2.0
Baseline 3	-1.5
Baseline 4	-2.0
Baseline 5	-1.0
Average Baseline	-1.5
Baseline Range	1.0

Note: Do not use the built-in Baseline feature with this Test Standard because you will need to take and enter 5 separate baseline readings as part of the test procedure.

⇒ **Entering Baseline Readings for a RESNET Multi-Point Test.**

The RESNET Multi-Point Test standard requires that baseline building pressures be made both before (Pre-Test) and after (Post-Test) the test readings are taken with the Blower Door fan operating. These baseline readings are entered directly in the appropriate Data Table fields.

Note: Do not use the built-in Baseline feature with this Test Standard because you will need to take both a Pre-Test and a Post-Test baseline building pressure reading.

⇒ **Entering Baseline Readings for a RESNET Repeated Single-Point Test.**

The RESNET Repeated Single-Point Test standard requires that a Pre-Test baseline building pressures reading be taken for each repeated single-point test. Each row in the Data Table contains a field to enter the Pre-Test baseline reading.

Note: If you are using the built-in Baseline feature, enter 0 into the Pre-Test baseline field(s). This is because the Baseline feature has already adjusted the building pressure reading(s) for baseline effects.

Entering Environmental Data into the Data Table:

- ⇒ **CGSB Test:** Click on the **Enter/Edit Temperature Data** button to enter the Inside and Outside temperatures during the test.
- ⇒ **RESNET Tests:** Click on the **Enter/Edit Temperature and Altitude Data** button to enter the Inside and Outside temperatures during the test, and the site altitude for the building being tested.

Additional Tips on Using the Manual Data Entry Table:

All Test Standards:

- ⇒ Be sure you have the gauge set up properly (refer to your Blower Door or digital gauge manual). If you have set the gauge up properly, building pressure readings will be read from Channel A, and fan flow readings will be read from Channel B.
- ⇒ Be sure to include the proper sign of all baseline readings.
- ⇒ If you are Depressurizing the building, enter the building pressure readings as negative numbers (TECTITE automatically places a negative sign in the building pressure entry fields if the Test Mode is set to Depressurize).
- ⇒ If you are Pressurizing the building, enter the building pressure readings as positive readings.

CGSB Test:

- ⇒ If you are using the **Baseline** feature, enter 0 into the baseline fields. This is because the **Baseline** feature has already adjusted the building pressure reading(s) for baseline effects.
- ⇒ Do not use the **@50** feature when conducting a CGSB Test because you will need to enter test data at a variety of building pressures (CGSB Test requires 8 test readings)..

RESNET One-Point Test:

- ⇒ Do not use the **Baseline** feature when conducting a RESNET One-Point Test. Five individual pre-test baseline readings are entered as part of the test data entry procedure.
- ⇒ If you are using the **@50** feature to conduct the test, always enter the building pressure as 50 Pa. This is because the **@50** feature automatically adjusts the displayed flow reading to a test pressure of 50 Pa.

RESNET Multi-Point Test:

- ⇒ Do not use the **Baseline** feature when conducting a RESNET Multi-Point Test. Two individual baseline readings (pre and post) are entered as part of the test data entry procedure.
- ⇒ Do not use the **@50** feature when conducting a RESNET Multi-Point Test because you will need to enter test data at a variety of building pressures (RESNET Multi-Point Test requires 8 test readings)..

RESNET Repeated Single-Point Test:

- ⇒ If you are using the **Baseline** feature, enter 0 into the baseline fields. This is because the **Baseline** feature has already adjusted the building pressure reading(s) for baseline effects.
- ⇒ If you are using the **@50** feature to conduct the repeated tests, always enter the building pressure as 50 Pa. This is because the **@50** feature automatically adjusts the displayed flow reading to a test pressure of 50 Pa.

When you are finished entering test data into the Table, click on OK to return to the Test Graph. You can clear the Table at any time by clicking on the **Clear Data** button.

Chapter 9 Viewing Test Results (Auto and Manual Method)

Once an automated test has been completed, or test data have been manually entered into the Data Table, test results are automatically calculated using all data points displayed on the graph, and values entered into the input screens. To view the Test Results screen, click on **Next** from either Test Graph screen.

Test Results Screen (CGSB Test Standard)

The screenshot shows a software window titled "Test Results" with a menu bar (File, Options, Goto, Help) and a "Help" button. The main area is divided into several sections:

- Airflow at 50 Pascals:** 3860 CFM50 (+/- 0.3 %), 10.53 ACH50, 1.3785 CFM50/ft² floor area, 1.2866 CFM50/ft² surface area.
- Leakage Areas:** 402.7 in² (+/- 1.4 %) Canadian EqLA @ 10, 215.7 in² (+/- 2.2 %) LBL ELA @ 4 Pa.
- Building Leakage Curve:** Flow Coefficient (C) = 311.6 (+/- 3.5 %), Exponent (n) = 0.643 (+/- 0.009), Correlation Coefficient = 0.99957.
- Estimated Annual Infiltration:** 193.5 CFM, 0.53 ACH, 38.7 CFM per person.
- Estimated Design Infiltration:** Winter: 289.6 CFM, 0.79 ACH; Summer: 157.9 CFM, 0.43 ACH.
- Estimated Cost of Air Leakage:** \$ 276 per year heating, \$ 123 per year cooling.
- Mechanical Ventilation Guideline:** Recommended Whole Bldg: 26.7 CFM, Base Rate: 65.5 CFM, Supplemental Rate: 30.0 CFM, Infiltration Credit: <68.8 CFM>.

At the bottom, there are "Previous" and "Next" buttons. Below "Previous" is the text "to Test Graph", and below "Next" is "to Dev from Std".

9.1 Overview of Test Results Screen

Airflow At 50 Pascals:

- ⇒ **CFM50:** This is the airflow needed to create a change in building pressure of 50 Pascals, and is the most commonly used measure of building airtightness.
- ⇒ **ACH50:** The Air Changes per Hour at 50 Pascals is another commonly used measure of building airtightness. ACH50 is the number of complete air changes that will occur in one hour with a 50 Pascal pressure being applied uniformly across the building envelope. ACH50 is a useful method of adjusting (or normalizing) the building leakage rate by the size (volume) of the building. If you did not enter the building volume on the Building Test Info screen, ACH50 will not be calculated.
- ⇒ **CFM50/ft² Floor Area:** This is the CFM50 divided by the entered floor area of the building. This calculation adjusts (or normalizes) the building leakage rate by the floor area of the building. If you did not enter the floor area on the Building Test Info screen, this variable will not be calculated. **Note:** Only displayed when using the CGSB Standard.

- ⇒ **CFM50/ ft² Surface Area:** This is the CFM50 divided by the entered surface area of the building. This calculation adjusts (or normalizes) the building leakage rate by the surface area of the building. If you did not enter the surface area on the Building Test Info screen, this variable will not be calculated. **Note:** Only displayed when using the CGSB Standard.

Leakage Areas:

Once the leakage rate for the building has been measured, it is useful to estimate the cumulative size of all leaks or holes in the building's air barrier. The estimated leakage areas not only provide us with a way to visualize the physical size of the measured holes in the building, but they are also used in infiltration models to estimate the building's natural air change rate (i.e. the air change rate under natural weather conditions).

The Results screen includes one or two leakage area calculations (depending on the selected Test Standard), based on differing assumptions about the physical shape of the hole, which are compatible with the two most commonly used infiltration models.

- ⇒ **Equivalent Leakage Area (EqLA):** EqLA is defined by Canadian researchers at the Canadian National Research Council as the area of a sharp edged orifice (a sharp round hole cut in a thin plate) that would leak the same amount of air as the building does at a pressure of 10 Pascals. The EqLA is used in the AIM infiltration model (which is used in the HOT2000 simulation program). The EqLA is only displayed if the CGSB Test Standard is selected.
- ⇒ **Effective Leakage Area (ELA):** ELA was developed by Lawrence Berkeley Laboratory (LBL) and is used in their infiltration model. The Effective Leakage Area is defined as the area of a special nozzle-shaped hole (similar to the inlet of your Blower Door fan) that would leak the same amount of air as the building does at a pressure of 4 Pascals.

Building Leakage Curve:

- ⇒ **Air Leakage Coefficient (C) and Exponent (n):** Once an automated airtightness test sequence (or manual entry of data into the table) has been completed, a "best-fit" line (called the Building Leakage Curve) is drawn through the collected Blower Door data. The Building Leakage Curve can be used to estimate the leakage rate of the building at any pressure. If you have conducted a single point test, the program assumes an exponent (n) of 0.65 in its calculation procedures.³

³ The assumed exponent value of 0.65 is a typical value for residential construction.

The Building Leakage Curve is defined by the variables Coefficient (C) and Exponent (n) in the following equation:

$$Q = C \times P^n$$

where:

Q is airflow into the building.

C is the Coefficient.

P is the baseline adjusted pressure difference between inside and outside the building.

n is the Exponent.

Example: Use the Building Leakage Curve to estimate the exhaust fan airflow in a building needed to create a 5 Pa negative pressure. From our Blower Door test we determined the following Building Leakage Curve variables.

$C = 110.2$ (CFM) $n = 0.702$ From the equation above:

Airflow (at 5 Pa) = $110.2 \times 5^{0.702} = 341$ CFM. In other words, we estimate from the Building Leakage Curve that it would take exhaust fans with a combined capacity of 340 CFM to cause a 5 Pa pressure change in this building.

⇒ **Correlation Coefficient:** The correlation coefficient is a measure of how well the collected Blower Door data fit onto the "best-fit" Building Leakage Curve. The closer all data points are to being exactly on the Building Leakage Curve, the larger the calculated correlation coefficient (Note: the largest possible value for the correlation coefficient is 1.0). Under most operating conditions, the correlation coefficient will be at least 0.99 or higher.

Testing in very windy weather can sometimes cause the correlation coefficient to be less than 0.99. In this case, you may want to repeat the test, or increase the number of Samples Per Station. Achieving a correlation coefficient of 0.99 or higher is particularly important in the estimation of Leakage Areas, or when using the Building Leakage Curve to estimate leakage rates at low building pressures. **Note:** The Correlation Coefficient is not displayed when conducting a single point test.

Estimated Annual Infiltration:

Estimating the natural infiltration rate of a building is an important step in evaluating indoor air quality and the possible need for mechanical ventilation. Blower Doors do not directly measure the natural infiltration rates of buildings. Rather, they measure the building leakage rate at pressures significantly greater than those normally generated by natural forces (i.e. wind and stack effect). Blower Door measurements are taken at higher pressures because these measurements are highly repeatable and are less subject to large variations due to changes in wind speed and direction.

In essence, a Blower Door test measures the cumulative hole size, or leakage area, in the building's air barrier (see **Leakage Areas** above). From this measurement of leakage area, estimates of natural infiltration rates can be made using mathematical infiltration models. The TECTITE program uses the calculation procedure contained in ASHRAE Standard 136-1993 to estimate the average annual natural infiltration rate for purposes of evaluating indoor air quality and the need for mechanical ventilation.

CFM, ACH and CFM/person: The estimated annual natural infiltration rate (based on ASHRAE Standard 136-1993) is expressed in Cubic Feet per Minute (CFM), Air Changes Per Hour (ACH), and CFM per person. When determining occupancy for the CFM/person calculation, the program uses the number of bedrooms plus one, or the number of occupants, whichever is greater.

Notes on Estimated Annual Infiltration Rates:

- ⇒ Daily and seasonal naturally occurring air change rates will vary dramatically from the estimated average annual rate calculated here due to changes in weather conditions (i.e. wind and outside temperature).
- ⇒ The physical location of the holes in the building air barrier compared to the assumptions used in the infiltration model will cause actual annual infiltration rates to vary from the estimated values. Research done in the Pacific Northwest on a large sample of houses suggests that estimated infiltration rates for an individual house (based on a Blower Door test) may vary by as much as a factor of two or more when compared to PFT tracer gas tests. (PFT tracer gas tests are one of the most accurate methods of measuring actual natural infiltration rates.)
- ⇒ The annual average infiltration estimates from ASHRAE Standard 136-1993 should be used only for evaluating detached single-family dwellings, and are not appropriate for use in estimating peak pollutant levels or energy loss due to infiltration. If any of the building leakage is located in the forced air distribution system, actual air leakage rates may be much greater than the estimates provided here. Duct leaks result in much greater air leakage because they are subjected to much higher pressures than typical building leaks.

Estimated Design Infiltration:

In addition to estimating an annual infiltration rate above, the program estimates the design winter and summer infiltration rates for the building. The design infiltration rates are the infiltration rates used to calculate winter and summer peak loads for purposes of sizing heating and cooling equipment. The calculated design infiltration rates can be used in ACCA Manual J load calculations in lieu of the estimation procedures listed in Manual J. The estimation procedure uses the design wind speed and temperature difference values input into the Climate Information Screen, and are based on the calculation procedures listed in the ASHRAE Fundamentals Handbook, Chapter on Infiltration and Ventilation.

Winter and Summer: CFM, ACH: The estimated design infiltration rates are expressed in Cubic Feet per Minute (CFM), and Air Changes per Hour (ACH).

Mechanical Ventilation Guideline:

It is possible, even easy in the case of new construction or when air sealing work is done by trained skilled contractors, to increase the airtightness of a house to the point where natural air change rates (from air leakage) may not provide adequate ventilation rates to maintain acceptable indoor air quality. To help evaluate the need for mechanical ventilation in buildings, national ventilation guidelines have been established by ASHRAE. The recommended whole building mechanical ventilation rate presented in this version of TECTITE is based on ASHRAE Standard 62.2-10, and is only appropriate for low-rise residential structures.

Recommended Whole Building Mechanical Ventilation Rate: This value is the recommended whole building ventilation rate to be supplied on a continuous basis using a mechanical ventilation system. It is calculated by adding the **Base Rate** to the **Supplemental Rate** (existing houses only), and then subtracting the **Infiltration Credit** (existing houses only).

Base Rate: The **Base Rate** is based on 7.5 CFM per person (or number of bedrooms plus one, whichever is greater), plus 1 CFM per 100 square feet of floor area. This guideline assumes that in addition to the mechanical ventilation, natural infiltration is providing 2 CFM per 100 square feet of floor area.

Supplemental Rate: For existing houses, TECTITE calculates any necessary supplemental whole-building ventilation requirements for the house due to ventilation deficits in the Kitchen and Bathrooms (based on inputs in the Mechanical Ventilation screen).

Infiltration Credit: For existing houses where the estimated annual natural infiltration rate (based on the Blower Door test) is greater than 2 CFM per 100 square feet of floor area, the recommended whole building mechanical ventilation rate is reduced to provide ventilation credit for excess infiltration. In these cases, the recommended mechanical ventilation rate is reduced by the following amount:

$$0.5 \times (\text{estimated annual natural infiltration rate (CFM)} - 0.02 \text{ CFM} \times \text{sq. ft. of floor area})$$

Notes on Mechanical Ventilation Guidelines:

- ⇒ ASHRAE Standard 62.2-10 also contains requirements for local kitchen and bathroom mechanical exhaust systems. These local exhaust systems may be incorporated into a whole building ventilation strategy. Consult Standard 62.2-10 for more information on ventilation strategies and specific requirements and exceptions contained in the Standard.
- ⇒ Compliance with the ventilation guideline does not guarantee that a moisture or indoor air quality (IAQ) problem will not develop. Many factors contribute to indoor air quality including ventilation rates, sources and locations of pollutants, and occupant behavior. Additional testing (including combustion safety testing) is needed to fully evaluate air quality in buildings. In many cases, a combination of pollutant source control and mechanical ventilation will be required in order to ensure adequate indoor air quality.

Estimated Cost of Air Leakage:

The program estimates the annual cost associated with air leakage, both for heating and cooling. The equations used to calculate the annual cost for air leakage are:

$$\text{Annual Heating Cost} = \frac{26 \times \text{HDD} \times \text{Fuel Price} \times \text{CFM}_{50}}{N \times \text{Seasonal Efficiency}} \times 0.6$$

- HDD is the annual base 65 F heating degree days for the building location.
- The Fuel Price is the cost of fuel in dollars per Btu.
- N is the Energy Climate Factor from the Climate Information Screen (adjusted for wind shielding and building height). See Appendix E of the Model 3 Blower Door Operation Manual for more information on this calculation procedure.
- Seasonal Efficiency is the AFUE rating of the heating system.

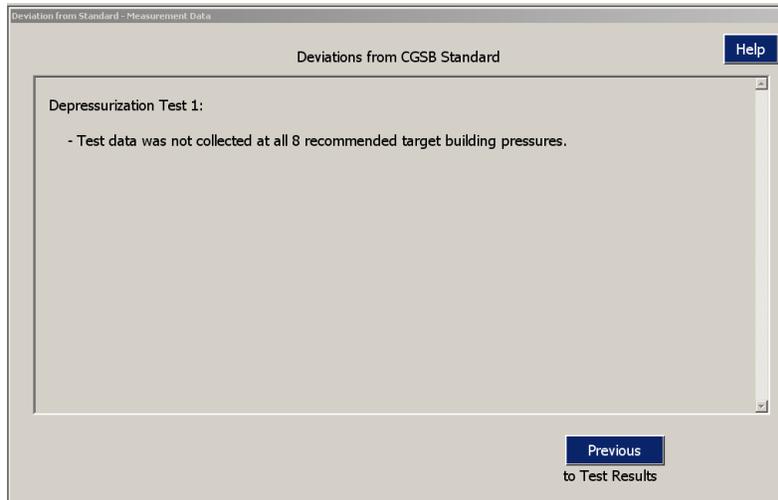
$$\text{Annual Cooling Cost} = \frac{.026 \times \text{CDD} \times \text{Fuel Price} \times \text{CFM}_{50}}{N \times \text{SEER}}$$

- CDD is the base 70 F cooling degree days for the building location.
- The Fuel Price is the cost of electricity in dollars per kwh.
- N is the Energy Climate Factor from the Climate Screen (adjusted for wind shielding and building height). See Appendix E of the Model 3 Blower Door Operation Manual for more information on this calculation procedure.
- SEER is the SEER rating for the air conditioner.

Note: Cooling Cost procedure is based on sensible loads only. In hot humid climates, latent loads due to air leakage can be greater than the sensible loads which are estimated by this procedure.

9.2 Deviations from Standards Screen

The Deviations from Standard screen is accessed by clicking on **Next** from the Test Results screen. This screen lists aspects of the current test data that deviate from the selected Test Standard.



Note: If you are conducting an automated test, and are measuring zone pressures during the Blower Door test, the Zone Data screen will appear before the Deviations from Standards screen. The Zone Pressure feature of TECTITE is discussed in more detail in *Chapter 10*.

Chapter 10 Measuring Building Zone Pressures

Many important air leaks in a building are not direct leaks to the outside. Indirect air leaks, or “series leaks”, often follow complicated paths through building cavities and through unconditioned zones (such as attics, crawlspaces or garages) on their way into or out of the building. Attic bypasses are a good example of a series leak. Air leaving the house first must flow through the ceiling/attic boundary and then through the attic/roof boundary before exiting the house.

Diagnostic procedures have recently been developed to help analyze series leakage paths in buildings. These diagnostic procedures, usually called pressure diagnostics, combine standard Blower Door airtightness tests with building zone pressure measurements to help prioritize airsealing activities. The TECTITE program can be used to automate the measurement of building zone pressures during a building airtightness test. The zone pressure test results can then be used directly as a performance measurement, or as inputs into a separate series leakage analysis program (such as the ZPD Calculation Utility program available at no charge from The Energy Conservatory - www.energyconservatory.com).

10.1 Using the Zonal Pressure Measurement Feature

In order to make use of TECTITE’s zonal pressure measurement feature, you must select the CGSB Test Standard, and TECTITE must be able to establish a communication link with Device(s) containing a total of 3 or more installed pressure channels. We need at least 3 pressure channels because 2 of the channels (from the **Primary Device**) are already being used to measure the building pressure and Blower Door fan flow. For example, if your **Primary Device** is an APT DAB with 5 installed pressure channels, you would be able to use pressure channels P3, P4 and P5 on this Device to measure up to 3 zone pressures by activating P3, P4 and P5 in the Zonal Pressures Set-Up screen. On the other hand, if your **Primary Device** is a DG-700 gauge, then you will need to use one or more **Aux Devices** to utilize the Zonal Pressures feature. For example, if you use one additional Aux DG-700, you would be able to use the two pressure channels from this Device to measure up to 2 zone pressures by activating P3 and P4 in the Zonal Pressures Set-Up screen. **Note:** This feature is currently not available for DG-1000 gauges.

To activate the zonal pressure feature, first click on the **Active** button in the Zonal Pressures field on the Test Settings screen. Now click on the **Settings** button to bring up the Zonal Pressures Set-Up screen.

Zonal Pressures Set-Up Screen

Activate	Zone Name	With Reference To	
		Outside	Inside
P3 <input type="checkbox"/>	Zone A	<input checked="" type="radio"/>	<input type="radio"/>
P4 <input type="checkbox"/>	Zone B	<input checked="" type="radio"/>	<input type="radio"/>
P5 <input type="checkbox"/>	Zone C	<input checked="" type="radio"/>	<input type="radio"/>
P6 <input type="checkbox"/>	Zone D	<input checked="" type="radio"/>	<input type="radio"/>
P7 <input type="checkbox"/>	Zone E	<input checked="" type="radio"/>	<input type="radio"/>
P8 <input type="checkbox"/>	Zone F	<input checked="" type="radio"/>	<input type="radio"/>

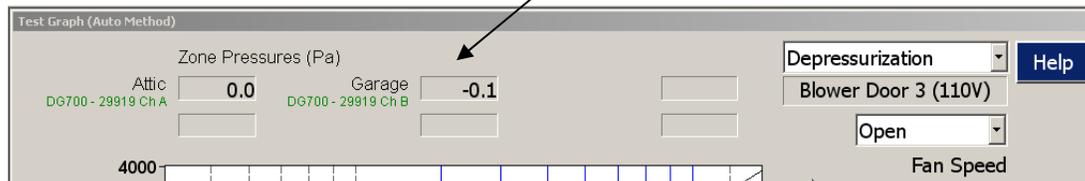
From this screen you can configure TECTITE to measure zonal pressures during the automated airtightness test. For each installed pressure channel that you want to use, click on the appropriate check box under “Activate”. Edit the corresponding Zone Name field with a descriptive label for the zone being measured. Now choose the reference pressure location for that zone in the “With Reference To” field. When choosing the reference pressure location for a zone, we recommend that you choose “outside” if the zone being measured is intended to be better connected to the outside (such as in the case of a vented attic, or a garage), or choose inside if the zone is intended to be better connected to the inside (such as in the case of most basements).

The information that you have entered on the Zonal Pressure Set-Up screen will be stored when you save a test file or a configuration file. You may wish to make zonal pressure set-up part of your default configuration file (see *Chapter 14* for information on creating and using configuration files). Once you have completed the Zonal Pressure Set-Up screen, click on **OK** to return to the Test Settings screen.

10.2 Taking and Storing Zone Pressure Measurements

Once the Zonal Pressures feature has been activated and the Set-Up screen completed, zone pressure status windows will appear at the top of the Test Graph screen (Auto and Semi-Auto Methods). Active status windows will only appear for pressure channels that have been activated in the Set-Up screen and are communicating properly with a TEC Device. For each active status window, the channel and serial number of the Device being used to monitor the zone pressure is listed to the left of the window. If the status windows are blank and either of the following two messages appear in the DAB Status Window at the bottom of the Test Graph screen (**Insufficient Channels for Test**, or **Aux Device IS NOT CONNECTED**), refer to *Chapter 15* for help on troubleshooting your communication/setup problem.

Zone Pressure Status Windows



Before beginning your airtightness test, you will need to connect tubing to the pressure channels being used to measure zone pressures. The first step is to connect tubing between the zone being monitored and the appropriate Input tap on the DG-700 or DAB. You will also need to connect the Reference pressure tap for each zone channel to the reference space that you have designated in the Zonal Pressure Set-Up screen (i.e. outside or inside). For example, if you have set up a channel to measure attic pressure with reference to outside, you will need to connect the channel reference tap to tubing running outside.

Note: If more than 1 channel is being referenced to the outside, you can run a single piece of tubing to the outside and use “T” connectors (along with short pieces of tubing) to connect the outside tubing to multiple reference pressure taps.

To begin taking zone pressure measurements, you must initiate an airtightness test sequence by clicking on the **Start Test** button. Zone pressure measurements, including baseline zone pressures, are taken at the same time that TECTITE is collecting building pressure and fan flow measurements for the airtightness test. For example, if you are conducting a standard CGSB airtightness test procedure at 8 separate target building pressures, TECTITE will collect 8 sets of zone pressure measurements, along with a pre-test and

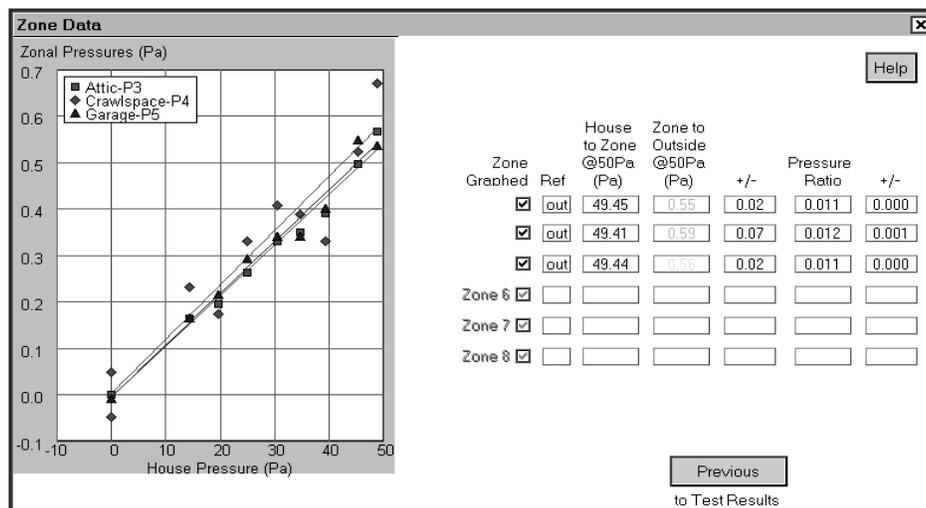
post-test baseline measurement. The number of samples taken at each target pressure for the zone pressure channels is determined by the **Samples Per Station** field on the Test Setting screen.

Note: Zonal pressures displayed in the status windows are adjusted for their current baseline zone pressure readings. During a test sequence, numbers only appear in the zone pressure status windows during data sampling.

10.3 Viewing Zone Data

Once the automated Blower Door test is completed, the measured zone data are shown on the Zone Data screen. To view the Zone Data screen, click on **Next** from the Test Graph screen, or choose **Zone Data** from the Goto Menu.

Zone Data Screen



10.4 Overview of Zone Data Screen

The left side of the Zone Data screen contains a graph of measured zonal pressure (y-axis) versus house pressure (x-axis). The pressure data points shown on the graph are not adjusted for measured baseline zone pressures, and the baseline pressure measurements themselves are included on the graph. Each data point shown on the graph is an average of all samples taken for that zone at a particular target building pressure. Data for an individual zone can be temporarily removed from the graph by clicking on the zone name or the check box next to the name. The graph is automatically re-scaled to accommodate all active zone channels.

The columns to the right of the graph provide summary data for each zone. The summary data can be used directly as a performance measurement, or as inputs into a separate series leakage analysis program.

House to Zone @ 50 Pa: This is the estimated change in house to zone pressure (in Pascals) that would occur when the house to outside pressure is changed by 50 Pascals, based on a linear relationship between house pressure and zone pressure.

Zone to Outside @ 50 Pa: This is the estimated change in zone to outside pressure (in Pascals) that would occur when the house to outside pressure is changed by 50 Pascals, based on a linear relationship between house pressure and zone pressure.

+/-: The third numerical column is the estimated repeatability of the **House to Zone @ 50 Pa**, and the **Zone to Outside @ 50 Pa** estimates. If you were to repeat this test under the same building setup and weather conditions, the new results would not likely differ by more than the estimated repeatability.

Pressure Ratio: This is the **Zone to Outside @ 50 Pa** estimate divided by 50. The Pressure Ratio will almost always be a number between 0 and 1. If the Pressure Ratio is between 0.0 and 0.5, then the zone being measured is better connected to outside than inside. If the Pressure Ratio is between 0.5 and 1.0, then the zone being measured is better connected to inside than outside. As a simple memory aid: remember that “0 = Outside” and “1 = Inside”.

Example Pressure Ratios

House to Zone @ 50 Pa	Zone to Outside @ 50 Pa	Pressure Ratio
50	0	0.00 (zone is outside)
49	1	0.02
45	5	0.10
40	10	0.20
30	20	0.40
25	25	0.50
20	30	0.60
10	40	0.80
5	45	0.90
1	49	0.98
0	50	1.00 (zone is inside)

+/-: The fifth numerical column is the estimated repeatability of the **Pressure Ratio**. If you were to repeat this test under the same building setup and weather conditions, the new **Pressure Ratio** would not likely differ by more than the estimated repeatability.

Note: If you have set up the pressure hoses to your DAB correctly, the **House to Zone @ 50** and **Zone to Outside at 50** estimates will almost always appear as positive numbers, whether you are depressurizing or pressurizing the building. If these estimates appear as negative numbers, you have probably connected the hoses incorrectly, or have designated the wrong reference location in the Zone Pressure Set-Up Screen.

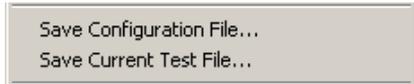
10.5 ZPD Input Table

If you are using The Energy Conservatory’s ZPD Calculation Utility program to estimate air leakage rates from zones monitored during an automated Blower Door test, the ZPD Input Table contains all of the test data required to be input into the calculation utility program. The ZPD Input Table can be found at the end of the Zone Data Report which is available from the main **File** menu (see **Chapter 12 Printing Test Reports** for more information). The ZPD Input Table is not displayed on the Zone Data Screen.

Chapter 11 Saving and Retrieving Building Test Files

11.1 Saving Building Test Files

Test files can be saved at any time by selecting **File** from the Main TECTITE Menu, and then clicking on **Save Current Test File** which appears in the File Menu.

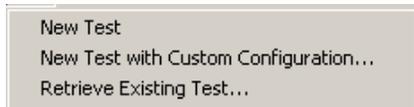


Saved building test files contain all information entered into the Building Test Information, Environmental Information, Mechanical Ventilation, Comments and Test Setting screens, as well as all test data shown on the Graph. When saving a test file, you will need to enter a file name in the file save window that appears on screen. You may also choose a different destination folder for the saved file by using the folder options appearing in the file save window. All building test files are automatically given a *.blt* extension.

Note: If you want to create a PDF file of the building test reports, refer to *Chapter 12 Printing Test Reports*. The PDF format is a “printed page” viewable file that will display identically on all computers.

11.2 Retrieving Building Test Files

To retrieve a previously saved building test file for viewing, editing or printing, first select **File** from the Main TECTITE Menu, and then click on **Retrieve Existing Test** which appears in the File Menu.



After selecting the **Retrieve Existing Test** option, a file select window will appear on screen which lists all the building (*.blt*) files contained in the current default folder. To select a file, click on the file name from the list and then click on **Open**. Once the file has been selected, the file information is loaded into the TECTITE program and the Building Test Info screen appears. To change the folder being listed, use the folder options appearing in the file select window.

11.3 Retrieving a Saved Test as the Starting Point for a New Test

If you want to perform a repeat test at a building that you have previously tested, it is very convenient to start by retrieving the old test. Choose **Retrieve Existing Test** from the File menu and select the old building test file. As you go through the data entry screens, check for any information that has changed since the old test was performed.

Importantly, when you get to the Test Graph screen click on the **Clear Data** button. This clears the data on the Graph so that you can perform a new airtightness test. Use of the **Clear Data** button will not affect the original building test file stored on your computer. When you are done, save your new test using a new file name.

Manual Method Users:

When using the Manual data entry method, the data on the graph can be cleared by clicking on the **Clear Data** button from the Data Table window.

Chapter 12 Printing Test Reports

12.1 Printing and Preview Options

Report printing and previewing options are available by clicking on **File** in the Main Menu.



The TECTITE program allows you to print, preview or create a PDF file for a set of pre-formatted reports including a Customer Report, Detailed Report, Test Graph, and Zone Data Report.

Note: The report format is dependent on the Test Standard selected in the Test Settings screen. In addition, the actual length of the Test Report and Zone Data Reports depend on the number of data points collected during the test.

The Customer Report contains the basic building airtightness test results and a simplified description of how to interpret the test results. Detailed Reports contain a complete listing of the building airtightness data and results, as well as any comments input into the Comment Screen. The Zone Data Report contains a listing of all measured zone pressures and estimated building to zone and zone to outside pressures at 50 Pascals of building pressure, as well as a graph of zone pressures versus building pressures. In addition, the end of the Zone Data Report includes a ZPD Input Table which contains test data which can be directly input into The Energy Conservatory's ZPD Calculation Utility program used to estimate the leakage rate of monitored zones. **Note:** The Zone Data Report is only available if the building test file currently loaded into TECTITE contains zone pressure data.

The Test Graph is similar to the graph of fan flow (or leakage) vs. building pressure from the Test Graph screen. It can be used to visually estimate the relationship between air leakage and building pressure.

The printing and preview functions within TECTITE utilize the printer drivers and configuration options currently installed in your computer.

Creating a PDF File of the Test Reports:

TECTITE makes it easy to create a PDF file of any of the reports. Simply choose the **Print Report to PDF File** option, and then enter the name and location of the file to be saved in the file save window that appears. Once created, these files can be viewed on any computer that has PDF viewing software installed.

12.2 Putting Your Business Name and Logo on the Reports

The name, address and contact information for your business can be placed at the top of the first page of all printed reports by completing the Business Info window. To access the Business Info window, click on **Options** in the Main Menu, and then click on **Business Info** from the Options Menu. Information entered in the Business Info window is saved as part of the data files.

Business Information Window

The screenshot shows a window titled "Business Info" with the following fields and buttons:

- Name
- Name Line 2
- Address
- Address Line 2
- City
- State/Province
- Zip/Postal Code
- Phone
- Fax
- Email
- Website
- Report Header Logo
- Load New Logo
- Delete Logo
- Clear
- Cancel
- OK
- Help

Adding Your Logo to the Top of Printed Reports:

To insert a logo at the top of the printed reports, simply click on the **Load New Logo** button. In the Select Logo File window which appears, find and select the desired image file from your computer. TECTITE allows you to choose the following file types for a logo image: bmp, jpg, tif and emf.

TECTITE makes a copy of the selected file and places the copy in the appropriate program directory on your computer. The selected logo image is automatically placed in the upper left hand corner of the printed reports. The image is placed in a 2.25 inch wide by 1.375 inch high box, and the program sizes the image (using its saved aspect ratio) to maximize its size within the box. Logo images which have a 2.25 to 1.375 width to height ratio will completely fill the image box. Images with any other aspect ratio will only completely fill the image box in one dimension.

To delete the stored logo image file, click on the **Delete Logo** button.

Chapter 13 Cruise Control

The Cruise Control feature automatically adjusts the speed of the Blower Door fan to maintain a constant building pressure while the operator or technician performs additional diagnostic or air-sealing procedures. While cruising, the program displays the current building pressure and fan flow, and displays current zone pressures if the zonal pressures feature is active. However, TECTITE does not store fan flow, building pressure or zone pressure data while cruising. Common applications of the Cruise Control feature include:

- ⇒ Pressure pan testing for evaluating leakage in forced air duct systems.
- ⇒ Maintaining a constant building pressure while locating and sealing air leaks.
- ⇒ Quickly estimating the building leakage rate before conducting a full airtightness test.
- ⇒ Series leakage tests such as the Leakage Area Matching Method, or Add-a-Hole method to quantify leakage rates between various zones within a building.

Note: The Cruise Control feature can only be used if your Blower Door fan speed control has a communication jack on the side of the controller, and you have installed the fan control cable between the controller and your TEC Device.

13.1 Starting the Cruise Control Feature

Before using the Cruise Control feature, be sure that the building and fan pressure tubing is properly connected to the TEC Device.

- Ch A/P1 Input Tap: Connect to inside of building (leave open if gauge is in building).
- Ch A/P1 Reference Tap: Connect to outside.
- Ch B/P2 Input Tap: Connect to Blower Door fan.
- Ch BP2 Reference Tap: Connect to space upstream of fan inlet (if gauge and fan inlet are in the same space, leave open).

Cruise Control is activated from the Test Graph screen and can only begin if a communication link has been established between your computer and the TEC Device. If a communication link has been established, the message **Idle - Monitoring** appears in the green DAB Status Window and the **Start** and **Cruise** buttons are available. For more information on establishing a communication link between your computer and your TEC Device, see *Chapter 15*.

To activate the Cruise Control feature, click on the **Cruise** button from the Test Graph screen. Now fill in the **Cruise Pressure** field and select a **Baseline** option in the Cruise Test Conditions window which appears on screen.

Cruise Test Conditions Window

Cruise Pressure:

Enter the building pressure (in Pa) that you would like the Blower Door fan to maintain. Always enter the cruise pressure as a positive number, even if you are depressurizing the building. For example, if the test mode is set to depressurize, and you wish to cruise at a building pressure of -50 Pa, enter the cruise pressure as 50. The TECTITE program will now adjust the speed of the Blower Door fan until the cruise pressure is achieved, and will continuously adjust the fan speed to maintain the cruise pressure.

Baseline:

- ⇒ **No Baseline:** This option is used when you want to cruise without first measuring and adjusting for the baseline building pressure. In other words, you will not adjust the displayed building pressure by the measured baseline pressure. If you are displaying zone pressures while cruising, they will not be adjusted for the baseline zone pressure.
- ⇒ **Cruise With Baseline:** This option is used when you want to adjust the displayed building pressure by the measured baseline building pressure. Use this feature when you want to *change* the building pressure by the specified cruise pressure. For most users, this is the preferred cruising method. If you are displaying zone pressures while cruising, they will be adjusted for the measured baseline zone pressures.

After clicking on **OK** in the Cruise Test Conditions window, you will be asked to indicate which flow ring will be installed on the fan during cruising. Click on the appropriate ring and then click on **Proceed with Cruise**. This allows the program to display the fan airflow, as well as the building and zone pressures

while cruising. Current fan airflow and building pressure are displayed in the Status Windows on the right side of the Test Graph screen, and by the moving cursor on the graph.⁴ The entered cruise pressure is displayed on the graph by a red vertical line.

13.2 Ending Cruise/Stopping the Fan

Once Cruise Control has been activated, there are two ways to turn off the cruise feature:

- ⇒ Click on **Pause** or press the **Esc** key. This immediately stops the fan, and the operator is allowed to either adjust the **Auto Test Settings**, re-start cruising or terminate the cruise procedure.
- ⇒ Click on **Stop Cruise**. This immediately stops the fan and ends the cruise procedure.

13.3 Real-Time ACH50 Estimator

When the Cruise Control feature is active, TECTITE will display a real-time estimate of Air Changes per Hour at 50 Pascals of building pressure (ACH50) on the Test Graph screen. To estimate ACH50, TECTITE uses the current measured fan flow, the volume estimate input into the Building Test Info screen, and an assumed Building Leakage Curve exponent (n value) of 0.65. The ACH50 display window is only active when the current building pressure is between 40 and 60 Pascals, and a valid fan flow measurement is being made. The on-screen ACH50 display is useful for quickly estimating building leakage rates before conducting a full airtightness test.

Real-Time ACH50 Estimator

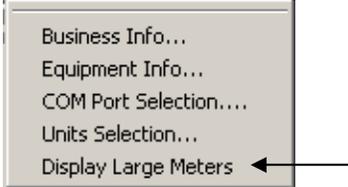
The screenshot shows the 'Real-Time ACH50 Estimator' window. It features a 'Blower Door 3' button, a 'Depressurization' button, and a 'Ring A' dropdown menu. Below these is a 'Fan Speed' slider. To the right is a 'Help' button. The main area contains several data fields: 'ACH50' (with an arrow pointing to it from the label 'ACH50 Estimator Window'), 'Flow (cfm)', 'Fan Pressure (Pa)' (0.0), 'Bldg Pressure (Pa)' (0.4), 'Bldg Baseline (Pa)' (0.0), 'Completed Tests' (1), and '# Samples'.

Note: The Real-Time ACH50 display is also active when TECTITE is in the **Idle – Monitoring** mode and the user is manually adjusting the fan speed (and the current building pressure is between 40 and 60 Pa). The Real-Time ACH50 display is not active during an automated test sequence.

⁴ If you activate the **Cruise** option while Blower Door data are being displayed on the graph, the data will remain on the graph and will not be affected or changed in any way.

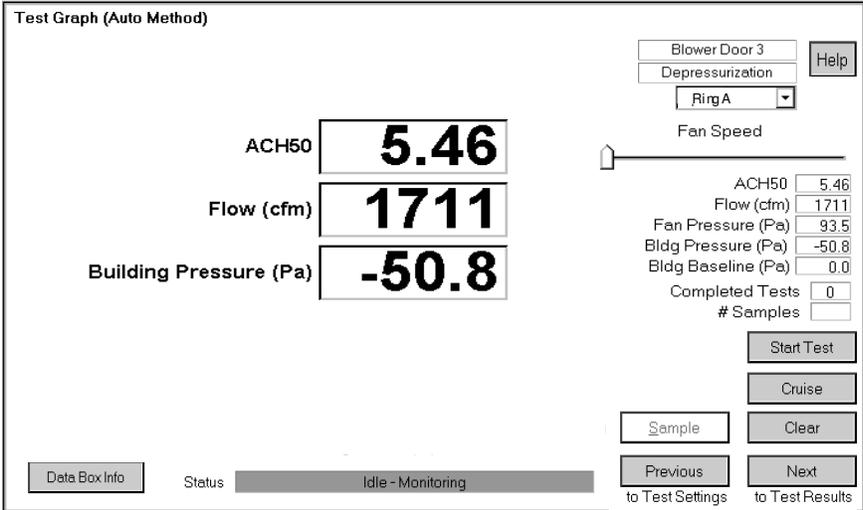
13.4 Using the Display Large Meters Feature

The Display Large Meters feature replaces the graph on the Test Graph (Auto Method) screen with 3 large status windows including Real-Time ACH50, Current Fan Flow, and Current Building Pressure. The feature can be toggled on and off by clicking on **Display Large Meters** from the Options Menu.



The Display Large Meters feature is particularly useful when looking at the computer screen from a distance while cruising or manually adjusting the Blower Door fan in Idle-Monitoring mode. The Real-Time ACH50 display window is only active when the current building pressure is between 40 and 60 Pascals, and a valid fan flow measurement is being made. The Real-Time ACH50 display is not active during an automated test sequence.

Large Meter Display



Chapter 14 Creating and Using Configuration Files

14.1 What is a Configuration File?

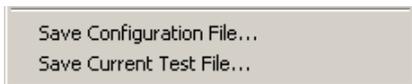
There is a significant amount of data entry required in filling out all of the screens of TECTITE. A configuration file is a place to save test settings, building and customer information, and comments that you routinely use so they can be quickly loaded into the program. The configuration file can then be used as a shortcut for speeding up data entry for future tests. A configuration file looks just like a building test file, except that no test data (i.e. building pressure or fan airflow readings) are stored in configuration files.⁵

14.2 How to Create a Configuration File

Before creating a configuration file, first be sure to save any current test data loaded into TECTITE by using the **Save Current Test File** option from the File Menu.

Now select the **New Test** option from the File Menu. Proceed through the Input and Test Settings screens, filling in only the information which will be always be the same for your testing. If there are any “standard” comments which you would like to have on all tests, type them in on the Comments screen at this time. On the Test Settings screen, choose the settings you wish to save. Finally, open the Business Info and Equipment Info windows (found in the Options Menu) and complete the appropriate fields.

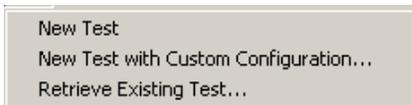
When you have finished entering information and settings that you wish to save, select **Save Configuration File** from the File Menu.



When saving a configuration file, you will need to enter a file name and file location in the file saving browser that appears on screen. All configuration files are automatically given a *.cfa* extension.

14.3 How to Use Configuration Files

To use a configuration file when conducting a new test, click on **New Test with Custom Configuration** from the File Menu.



After selecting the “Custom Configuration” option, a file browser will appear on screen. Select a *.cfa* file from the list (or browse to the file location) and then click **Open**. Once the configuration file has been opened, the file information is loaded into the TECTITE program and the Building Test Info screen appears.

⁵ Information entered using the Options Menu (e.g. Business Info and Equipment Info screens) are also stored when a configuration file is created.

After loading the selected configuration file, complete the remaining data entry fields and proceed with the test. Importantly, you are not “locked into” the entries which were loaded from your configuration file. You can always edit all data entry fields during the test.

Some users may wish to create custom configuration files for a variety of testing situations they frequently encounter. For example, a user may have separate configuration files for each city where they frequently test. Configurations can also be created which are specific to:

- test location
- test standard
- house type
- fan model and serial number
- testing protocol (e.g. custom pressure lists)
- calm versus windy conditions

Keep in mind that the Comments screen can be a particularly useful part of custom configuration files by containing “boiler plate” comments which you would like to print out (or edit) for all tests.

Chapter 15 Troubleshooting TECTITE

15.1 Basic Tips

- If there is an on-screen warning message, refer to the list of Operator Messages in *Chapter 7*.
- If you are having trouble completing an automated Blower Door test or Cruise procedure, first check that the Blower Door and DG-700, DG-1000 or DAB system are set up as shown in *Chapter 2*.

Refer to example problems below for information on more specific operating problems.

Problem 1: *When trying to start an automated test or cruise procedure from the Test Graph screen, the Start and Cruise buttons are grayed out and the DAB Status Box is displaying the message: “Primary Device IS NOT CONNECTED”.*

The Primary Device is the DG-700, DG-1000 or APT DAB that will be used to measure building pressure and fan flow during the Blower Door test. When the Method field (in the Test Settings screen) is set to **Auto** or **Semi-Auto**, and you are viewing the Test Graph, TECTITE will attempt to establish a communication link with a **Primary Device** using the method specified in the Device Connection window. Failure to establish a communication link will result in the **Primary Device IS NOT CONNECTED** message appearing.

There are two options for specifying a **Primary Device** in the Device Connection window:

- Checking the **AUTO SELECT** button in the Device Connection window will allow TECTITE to automatically search for TEC devices on all available communication ports and wireless networks on your computer. **AUTO SELECT** is the preferred option to establish communication with your TEC Device. **AUTO SELECT** will attempt to establish a communication link with the first Energy Conservatory Device that it finds. If a communication link is established, this device is considered the Primary Device.
- If you uncheck **AUTO SELECT**, you may specify a specific **Primary COM Port** (COM 1 through COM 256) to connect with a DG-700 gauge or with an APT DAB. **Note:** This option does not work with a DG-1000 gauge.

The easiest way to quickly check your computer for all currently connected Energy Conservatory Devices is to use the **Scan for Devices** button in the Device Connection window. Once the Scan window is open, clicking on **Start Scan** will provide a list of all Energy Conservatory Devices that TECTITE can currently locate and establish a communication link with. The list includes devices connected through all wired communication ports, and through the computer’s wireless network adapter. **Note:** The Energy Conservatory Device must be ON to be detected.

Other items to check if you are having communication problems:

- If you are using a wired connection, make sure that you have properly installed the communication cable between your computer and the Energy Conservatory Device.
- If you are using a DG-1000 or TEC WiFi Link to wirelessly communicate between your computer and the gauge, follow the instructions that came with the gauge or WiFi Link. Lost communication could be caused by a weak wireless signal, interference on the wireless network, or incompatibility of the laptop internal wireless network adapter. Try moving the laptop closer to the gauge, or changing the AP broadcast channel if you are using wireless Access Point (AP) create network mode.

- Check that the Energy Conservatory Device has been turned ON and has power.
- Make sure you are not running 2 copies of TECTITE at the same time.

Once the proper communication link has been established, the message **Idle Monitoring** appears in a green DAB Status Window at the bottom of the Test Graph screen.

Problem 2: *During an automated test, the program never starts taking data at a target pressure line, even though the Airflow and Building Pressure Cursor appears to be bouncing around the target pressure. After a few minutes the message “Warning excessive building pressure fluctuation for the current target pressure..” appears.*

In order for the TECTITE program to start taking data at any target pressure line, it must first determine that the current measured building pressure is within a specified range from the target building pressure. This specified range is called the **Target Tolerance**. If the current measured building pressure is fluctuating beyond the **Target Tolerance**, then data collection for that target pressure will not begin. Fluctuating building pressure readings can be caused by improper installation of the building pressure reference tubing, or by windy weather.

- First check to be sure that the outside end of the building pressure tubing (e.g. the green tubing connected to the Channel A/P1 Reference tap) is not placed directly in the exhaust airflow of the Blower Door fan. You must be careful to run the end of the tubing well away (at least 5 feet to the side) from the exhaust of the fan. A good location for the end of the building pressure tubing is at the base of the building where it meets the ground.

Note: Although it is common practice for Blower Door operators to insert the open end of the building pressure tubing a few inches through the patch on the nylon panel, and leave it, we have determined that this set up practice can create inaccurate building pressure readings due to the exhaust airflow from the fan hitting the end of the tubing. You should always follow the tubing set-up practice listed above to prevent fluctuating building pressures.

- If the building pressure tubing is installed correctly, the fluctuating building pressures are probably caused by wind. Try increasing your Target Tolerance to 3 or 4 from the default value of 2 (the Target Tolerance can be changed by clicking on the Adjust Auto Test Settings button in the warning screen). If this doesn't work, increase the Target Tolerance to 5 or greater, or use the **Sample** button (see below).
- During an automated test, you can manually instruct the computer to go ahead and take data by clicking on the **Sample** button. At this point, the computer will proceed just as if it has decided that the Target Tolerance for the current pressure station line had been met.

Note: As the Target Tolerance is increased from the default value of 2, gathered data may not be as close to the target pressure lines as would be the case when using the default value. This has negligible effect on the final test results. However, some test standards do require that the measured building pressures be within a specified range of the target pressure (e.g. the CGSB test standard requires that the measured building pressures be within +/- 2.5 Pa of the specified target pressure).

Problem 3: *When trying to start an automated test or cruise procedure from the Test Graph screen, the Start and Cruise buttons are grayed out and the DAB Status Box is displaying the message: “Aux X Device IS NOT CONNECTED”.*

Aux Device(s) are additional DG-700s or APT DABs that can be used exclusively to measure zonal pressures during the Blower Door test using the Zonal Pressures feature. If a communication link has been

established with the **Primary Device**, and the Zonal Pressures feature has been turned on (Test Settings screen), TECTITE first checks to see if the **Primary Device** has sufficient pressure channels to measure the active zone pressure channels. For example, if your **Primary Device** is an APT DAB with 6 installed pressure channels, you would be able to measure up to 4 zone pressures without needing an **Aux Device** (the first two channels on the **Primary Device** are always used to measure building pressure and Blower Door fan flow). On the other hand, if your **Primary Device** is a DG-700 gauge, then you will need to use two Aux DG-700's to measure 4 zone pressures.

If the **Primary Device** does not have sufficient channels, then TECTITE tries to establish a communication link with an Energy Conservatory Device using the specified **Aux 1 COM Port**. If a communication link can not be established through the **Aux 1 COM Port**, then the message “Aux 1 Device IS NOT CONNECTED” appears. If a communication link is established through the **Aux 1 COM Port** but there are still insufficient pressure channels available for the active zone pressures measurements, then TECTITE repeats the same process for the designated **Aux 2** and **Aux 3 COM Ports**. **Note:** When specifying **Aux COM Ports**, always use the **Aux COM Ports** in order from Aux 1 to Aux 3.

AUTO SELECT must be unchecked in order to specify **Aux COM Ports**. If you will not be using the Zonal Pressures feature, leave all three **Aux COM Ports** set to **None** and uncheck the **Active** button in the Zonal Pressure feature field in the Test Setting screen. **Note:** DG-1000 gauges cannot be used as **Aux Devices** with this version of TECTITE.

Problem 4: *When trying to start an automated test or cruise procedure from the Test Graph screen, the Start and Cruise buttons are grayed out and the DAB Status Box is displaying the message: “Insufficient channels for test.”*

The “Insufficient channels for test” message appears under the following circumstances:

A communication link has been established with the **Primary Device** and any designated **Aux Devices**, and

- The Zonal Pressures feature has been activated (Test Setting screen), and
- There are insufficient pressure channels available for the active zone pressure measurements.

You will either need to specify additional **Aux COM Ports** and **Devices**, or reduce the number of active zone pressure measurement channels, or turn off the Zonal Pressures feature.

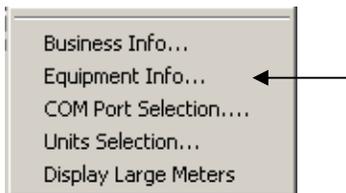
Problem 5: *When trying to start an automated test or cruise procedure from the Test Graph screen, the Start and Cruise buttons are grayed out and the DAB Status Box is displaying the message: “OFF LINE: Communication with devices disabled.”*

The OFF LINE feature is used to prevent TECTITE from communicating with **Primary** or **Aux Devices** when viewing the Test Graph screen. This feature increases the responsiveness of TECTITE when viewing previously stored data files. In order to conduct automated Blower Door tests, you will need to uncheck the OFF LINE feature box in the Device Connection window.

Chapter 16 Entering Custom Fan Calibration Parameters

The TECTITE program comes installed with factory default fan calibration parameters for the Model 3 and Model 4 Minneapolis Blower Door and Series A and B Duct Blaster fans. The fan calibration parameters are used by the program to convert the measured fan pressure in Pascals to airflow in Cubic Feet per Minute.

If your Blower Door fan was custom calibrated by The Energy Conservatory, you can input your custom calibration parameters directly into the TECTITE program in lieu of the factory default values. To enter custom fan calibration parameters open the Equipment Info window by clicking on **Options....Equipment Info** from the Main TECTITE Menu.



Equipment Information Window (Auto and Semi-Auto Methods)

 A screenshot of the 'Equipment Information' dialog box. It has a title bar 'Equipment Information' and a 'Help' button in the top right. The main area contains three columns: 'Manufacturer' with a text box containing 'Energy Conservatory', 'Model' with a dropdown menu showing 'Model 3 (110V)', and 'Serial Number' with an empty text box. Below these is a button labeled 'Enter Custom Fan Calibration'. At the bottom left is a checkbox labeled 'Set as Defaults for New Tests'. At the bottom right are 'Cancel' and 'OK' buttons.

From the Equipment Info window, be sure you have selected the appropriate fan model from the pull down menu, and then input the fan serial number. Now click on the **Enter Custom Fan Calibration** button to open the Fan Calibration Parameter window.

Note: If you are conducting an Automated or Semi-Automated test, the TECTITE software will automatically store the micromonometer serial number and calibration information as part of the building test file. If you are conducting a Manual test, the Equipment Info window will include fields where you can input and store a micromonometer serial number and calibration date (see **Equipment Information Window (Manual Method)** below).

Note 2: If you change the selected fan model while test data are being displayed on the graph, the test data will automatically be cleared.

Fan Calibration Parameters Window

	Coefficient	Exponent
Open	506.8	0.4879
Ring A	190.1	0.4876
B	60.67	0.4955
C	21.37	0.5132
D	7.216	0.4942
E	2.726	0.5267

Values in RED are custom (Not default)

Custom Calibration Date: []

Buttons: Set to Defaults, OK, Help

The Fan Calibration Parameter window shows the calibration parameters being used by the program for the currently selected fan model and selected airflow units. There is a unique set of parameters for each of the flow ring configurations used with the fan. The individual calibration parameters can be edited by using the **Tab** key, or by clicking on the input fields. Whenever you input a custom calibration parameter, the new value shown in the field will be displayed in red, rather than black for the default values. You can easily return all calibration parameters to the factory default values by clicking on **Set to Defaults**. The currently entered fan calibration parameters are stored as part of the data file.

Note: Most users should never have to edit fan calibration parameters. The default fan calibration parameters which come with TECTITE are valid for all standard Minneapolis Blower Door and Duct Blaster fans. This feature is necessary only if you receive custom calibration parameters for your fan from The Energy Conservatory.

Equipment Information Window (Manual Method)

Equipment Information

Help

Manufacturer: Energy Conservatory Model: Model 3 (110V) Serial Number: []

Fan: [] Enter Custom Fan Calibration

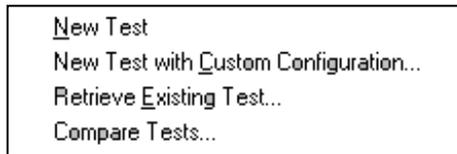
Manual Test Micromanometer: Energy Conservatory Model: DG-700 Calibration Date: []

Set as Defaults for New Tests

Buttons: Cancel, OK

Chapter 17 Using the Compare Tests Feature

The Compare Tests features allows you to select two previously saved building test files and to quickly compare the stored test results. To use this feature, select **File** from the Main TECTITE Menu, and then click on **Compare Tests** which appears in the File Menu.



17.1 Choosing the Test Files to Compare

After selecting the **Compare Tests** option, a file browser titled “Select Building Test File #1 to Compare” will appear on screen which lists all the building (.*bl*d) files contained in the default folder. Select the first file by clicking on a file name from the list and then click on **Open**. Once the first file has been selected, a second file browser titled “Select Building Test File #2 to Compare” will appear. Select the second file and once again click on **Open**.

After both files have been selected, a comparison of the test results from the two files will be displayed on the screen. Both the numeric change and percent change between the two tests are displayed for each of the test result items. If a test result item is missing from one or both of the building files, then comparison results for that item will not be displayed. If zone data were collected for either building file, it can be viewed by clicking on the **Zone Data** button. A graph comparing the building leakage curves for both selected building files can be viewed by clicking on the **Test Graph** button.

To exit the Compare Tests feature, simply select a different option from the top of the **FILE** menu, or exit the TECTITE program.

17.2 Printing and Preview Options

Printing and previewing options for the Compare Tests feature are available by clicking on **File** in the Main Menu. The Comparison Report contains the same information that is displayed on the Compare Test Results screen, plus any zone data that were collected for either building file. The Comparison Graph displays the building leakage curve for both selected test files. The printing and preview functions within TECTITE utilize the printer drivers and configuration options currently installed in your computer.