

**Instructions
for
Pressure
Diagnostics**

Program “Press”

Solving for

Minneapolis Blower Door™, Model 3

Duct Blaster™

Basic Zone Pressure Diagnostics (ZPD)

(Hole, Door, and Vent methods)

Duct Series Leakage Testing

(Add-a-Hole, Blower door subtraction,

Full-Nelson, and Nelson with NFR Twist)

September 2002 (V3.2)

INTRODUCTION

This software program, "Press," is intended to be used as a diagnostic tool for residential and commercial weatherization and new construction analysis.

Procedures included in this program are:

- 1) Calculation of CFM₅₀ for Minneapolis Blower Door®, Model 3. Can't-Reach-Fifty values and temperature adjustments are incorporated into the program.
- 2) Calculation of building CFM₅₀ zone pressure diagnostics, basic methods (the ZipTest Pro² software package also include an advanced zone pressure diagnostics program, ZPDa):
 - Hole Method.
 - Door Method.
 - Vent Method.
- 3) Calculation of Minneapolis Duct Blaster™ Flow Rates, both older (serial numbers from 0-591) and newer (serial numbers from 592 and up) models.
- 4) Calculation of Duct CFM₅₀ Series Leakage Values (Building/Duct, Duct/Outdoors, Total Path):
 - Add-a-Hole Method.
 - Blower-Door-Subtraction Method.
 - Full-Nelson Method.
 - Nelson-with-NFR-Twist Method.

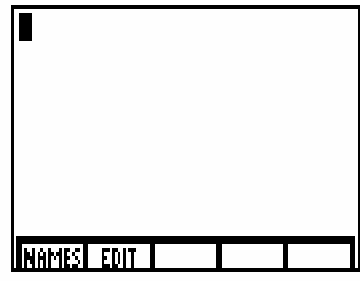
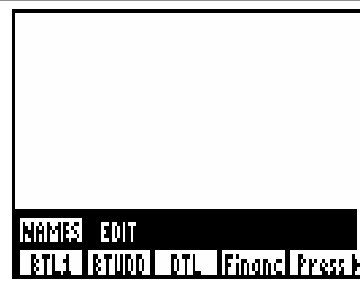
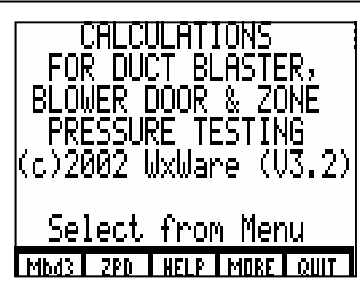
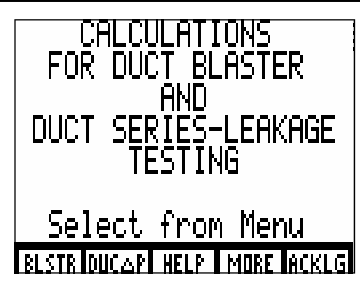
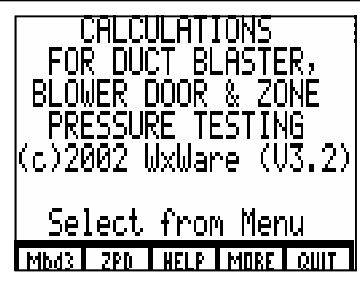
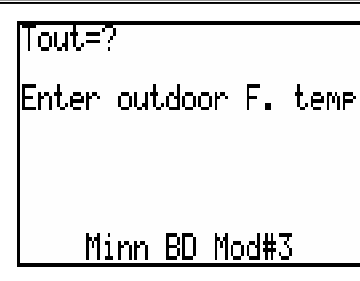
For more information about these test procedures, consult the following documents:

- *Minneapolis Blower Door® Manual, Model 3*, the Energy Conservatory.
- *Minneapolis Duct Blaster® Manual*, the Energy Conservatory.
- *Pressure Diagnostics*, Michael Blasnik and Jim Fitzgerald.
- *The Airflow Diagnostic Procedure*, John Tooley and Neil Moyer.
- "Building Tightness Guidelines: When Is a House Too Tight?" George Tsongas, *Home Energy*, March/April, 1993

PROGRAM OPERATION

Follow the instructions beginning on page 43. Pictures of the TI-86 screens appear on the left side of pages 43 through 58 with explanations at the right of each picture.

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-1		<ul style="list-style-type: none"> • Turn the TI-86 calculator on. • Press PRGM (Programs). • You will see this menu on the screen. • Press F1 for "NAMES."
Press-2		<ul style="list-style-type: none"> • You will see this menu on the screen. • Press F1, F2, F3, F4, or F5 for the program "Press." The menu key for this program will depend upon the number of programs loaded into the memory of your TI-86 calculator.
Press-3		<ul style="list-style-type: none"> • You will see this menu on the screen. • "Mbd3," F1, is for the calculation of CFM₅₀ with the Minneapolis Blower Door™, Model 3. • "ZPD," F2, is for the calculation of basic Building Zone Pressure Diagnostics. This routine includes the basic hole, door, and vent methods. For the Advanced Zone Pressure Diagnostics method, run the ZPDa program. • "HELP," F3, lists instructions for this screen.
Press-4		<ul style="list-style-type: none"> • Select "MORE," F4 and you will see this menu on the screen. • "BLSTR," F1, calculates Minneapolis Duct Blaster™ Flow Rates. • "DUCΔP," F2, is for the calculation of Duct Series Leakage Testing. • "HELP," F3, lists simple instructions. • "MORE," F4, moves you to the previous (main) screen. • "ACKLG," F5, Acknowledgments selection lists the authors of the program, etc.
Press-5		<ul style="list-style-type: none"> • Select "MORE," F4 and you will see this menu on the screen. • As a demonstration, press "Mbd3," F1, for Minneapolis Blower Door™, Model 3. • Note: This calculation procedure does not work for the Minneapolis Blower Door™, Model 2 or any other blower door brand.
Press-6		<ul style="list-style-type: none"> • You will see this on the screen. • Enter "Tout," the outdoor temperature (F^o). If the temperature is below zero, enter a negative sign in front of the temperature by using the key, (-), just to the left of the ENTER key. • Notice that there is a short instruction on the screen below the prompt line. • Notice that "Minn BD Mod#3" is at the bottom of the screen as a reminder of the routine you are calculating. • Enter "10" and press ENTER.

This is very important!

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-7	<pre>Tout=?10 Tin=? Enter indoor F. temp Minn BD Mod#3</pre>	<ul style="list-style-type: none"> • Enter "Tin," the indoor temperature (F⁰). • If the temperature is different indoors than it is outdoors, the blower door CFM₅₀ value will be influenced because of the different air densities. The magnitude of the difference is dependent on the degree of temperature difference. • Enter "70" and press ENTER.
Press-8	<pre>Tout=?10 Tin=?70 Test=? Enter Test Type: Depressurization = 1 Pressurization = 2 Minn BD Mod#3</pre>	<ul style="list-style-type: none"> • You will see this menu on the screen. • Now you must enter "1" for a depressurization blower door test or enter "2" for a pressurization blower door test. • This question is necessary because the CFM₅₀ results are temperature-corrected. See panel explanation "Press-7" just above, for a brief explanation. • Enter "1" and then press ENTER.
Press-9	<pre>BLDΔP=? Enter ACTUAL Bldg. to Outdoor ΔP in Pascals Depressurization Test</pre>	<ul style="list-style-type: none"> • Enter "BLDDP," the pressure difference between the inside and the outside of the building, in units of Pascals. Although this pressure will usually be negative, do not enter a negative sign before the pressure difference value. • If you are not able to reach 50 Pascals of depressurization difference in a building, enter the lower value. The program will automatically extrapolate the answer to a level of 50 Pascals depressurization difference. In other words, the "Can't-Reach-Fifty" multipliers are incorporated. • Enter "35" and press ENTER.
Press-10	<pre>BLDΔP=?35 FANΔP=? Enter Fan ΔP in Pascals Depressurization Test</pre>	<ul style="list-style-type: none"> • "FANΔP," fan pressure, in Pascals, is prompted next. • Enter a fan pressure of "100" and then press ENTER. • Note: If you notice you have made a mistake after you have pressed ENTER, press the "2nd" button, the "QUIT" button (next to the the "2nd" button), and then ENTER. This will return you to the main menu. • Notice that "Depressurization Test" is at the bottom of the screen as a reminder of the routine you are calculating.
Press-11	<pre>BLDΔP=?35 0=OPEN FANΔP=?100 1=A-RING CONFIG=? 2=B-RING 3=C-RING Enter Ring Config. Depressurization Test</pre>	<ul style="list-style-type: none"> • "CONFIG," the Configuration of the blower door fan must be entered now. The four choices are listed on the right side of the screen. • Enter "0" for an open fan configuration (no rings used). Note: If you cannot reach a house pressure difference of 50 Pascals, the "CONFIG" must always be "0." • Press ENTER.
Press-12	<pre>BLDΔP=?35 0=OPEN FANΔP=?100 1=A-RING CONFIG=?0 2=B-RING 3=C-RING Tin = 70 Tout = 10 CFM35 ----> 4501 CFM50 ----> 5675 Depressurization Test</pre>	<ul style="list-style-type: none"> • The Fan Flow and the CFM₅₀ answers are displayed along with all the data you entered. • The "CFM35" of 4501. The extrapolated "CFM50" displayed is 5675 (Can't-Reach-Fifty values are a part of this calculation procedure). Both of these resulting values, CFM₃₅ and CFM₅₀ are temperature-compensated. • For most purposes, the "CFM50" value is the most important result. • Press ENTER.

This is very important!

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-13		<ul style="list-style-type: none"> • After pressing ENTER you will see this display. • This is a reminder that another program included in the ZipTest Pro² software can calculate these values and others for you. To get to this program, you must exit from the “Press” program that you are now in and go to the “BTL1” program and then to the “BTLA” or the “62.2” routine. • When you press ENTER, you will be returned to the home screen of the pressure diagnostics program, “Press.”
Press-14		<p><i>[Please Note: this panel does not follow the above panel Press-13, it is a sample from the BTL1 program/BTLA routine]</i></p> <p>With the “BTL1” program/”BTLA” routine you can calculate:</p> <ol style="list-style-type: none"> 1. ELA, Effective Leakage Area in square inches (see panel BTL1-29, pg 11). 2. EqLA, Equivalent Leakage Area in square inches. (see panel BTL1-30, pg 11). 3. Estimated Natural CFM (see panel BTL1-31, pg 12). 4. Estimated Natural ACH (see panel BTL1-31, pg 12). 5. Natural CFM/occ (see panel BTL1-32, pg 12). [continued next panel]
Press-15		<p><i>[Please Note: this panel does not follow the above panel Press-13, it is a sample from the BTL1 program/BTLA routine]</i></p> <ol style="list-style-type: none"> 6. ELA minimum (see panel BTL1-33, pg 12). 7. CFM minimum (see panel BTL1-34, pg 12). 8. Ventilation CFM needed (see panels BTL1-34 & 35, pg 12). 9. Minimum CFM₅₀ value (see panel BTL1-39, pg 13). <p><i>[End of sample screens from the “BTL1” program/”BTLA” routine]</i></p>
Press-16		<ul style="list-style-type: none"> • Back to the home screen of the pressure diagnostics program, “Press.” • Now select, “ZPD,” F2 for “Building Zone Pressure Diagnostics, basic methods.”
Press-17		<ul style="list-style-type: none"> • You will see the Building Zone Pressure Diagnostics menu. • “HOLE,” F1, calculates the Hole Method (creating a measured hole between the building and the zone or between the zone and the outdoors). • “DOOR,” F2, calculates the Door Method (opening a door between the building and the zone or between the zone and the outdoors). • “VENT,” F3, calculates the Vent Method, (used primarily for attics). • Press “HOLE,” F1, for the Hole Series Leakage Method.
Press-18		<ul style="list-style-type: none"> • You will see this screen, prompting for building/zone ΔP1. The building should be at 50 Pascals of pressure while the building/zone ΔP1 is measured. • Note: If you are not able to obtain a building pressure difference of 50 Pascals, this procedure will not work (Note: the advanced zone pressure diagnosis program, ZPDa, will work). • The Building Hole Method works best when the second measured building/zone or zone/outdoors pressure is 15-35 Pascals and the pressure drop resulting from the creation of the hole is 15-25 Pascals.

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ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-19	<pre> BLD/ZONE ΔP1= 35 ZONE/OUT ΔP1= 15 HOLE METHOD </pre>	<ul style="list-style-type: none"> • Enter "35" as the "BLD/ZONE ΔP1." • Press ENTER. • Now you are prompted to enter the "Zone/Out ΔP1." Notice that the number "15" is displayed at the right. This is the value of the building/zone pressure subtracted from 50 building/outdoors pressure. • Enter "15" as "ZONE/OUT ΔP1." • "BLD/ZONE ΔP1" plus "ZONE/OUT ΔP1" should equal 50, plus or minus 2. • Press ENTER.
Press-20	<pre> BLD/ZONE ΔP1= 35 ZONE/OUT ΔP1= 15 15 LOC.= B/2=1 Z/O=2 INDICATE LOCATION OF CREATED HOLE HOLE METHOD </pre>	<ul style="list-style-type: none"> • Indicate the location of the measured hole, between the building and the zone or between the zone and the outdoors. It is a good idea to create the hole in the tightest air barrier (that between the building and zone or that between the zone and the outdoors). This is because we should drop the pressure across the barrier in which the hole is created by 15 or more Pascals. For our example, it is best to create a hole from the building to the zone where we have a ΔP1 of 35 Pascals. • Enter "1" and press ENTER.
Press-21	<pre> BLD/ZONE ΔP1= 35 ZONE/OUT ΔP1= 15 15 LOC.= 1 B/2=1 Z/O=2 ADDED HOLE, IN²= HOLE METHOD </pre>	<ul style="list-style-type: none"> • Enter the square inches of the added hole. • For our example, we will use 130 square inches. • Press ENTER.
Press-22	<pre> BLD/ZONE ΔP1= 35 ZONE/OUT ΔP1= 15 15 LOC.= 1 B/2=1 Z/O=2 ADDED HOLE, IN²= 130 BLD/ZONE ΔP2= Bldg. ΔP back to 50? HOLE METHOD </pre>	<ul style="list-style-type: none"> • Enter the new (with-hole) building to zone pressure, "BLD/ZONE ΔP2." • NOTE: It is very important that the <i>building to outdoors</i> pressure be brought back up to 50 Pascals after the creation of the hole and before the ΔP2 readings are taken. There is a reminder on the screen. • If you are not able to get the building to outside pressure back up to 50 Pascals, make the hole smaller. If you are still not able to get the building to outside pressure back to 50 Pascals, this method is not workable.
Press-23	<pre> BLD/ZONE ΔP1= 35 ZONE/OUT ΔP1= 15 15 LOC.= 1 B/2=1 Z/O=2 ADDED HOLE, IN²= 130 BLD/ZONE ΔP2= 28 ZONE/OUT ΔP2= 22 HOLE METHOD </pre>	<ul style="list-style-type: none"> • Enter the new (with-hole) zone to outdoor pressure, "ZONE/OUT ΔP2." • Notice that to the right of "ZONE/OUT ΔP2" the suggested pressure is displayed. Your measured "ZONE/OUT ΔP2" should be within 2 Pascals of this displayed number. • Enter "22" and press ENTER.
Press-24	<pre> CFM50's BLD/ZONE ----> 2205 ZONE/OUT ----> 3824 TOTAL PATH --> 1749 ENTERED DATA: 35 15 1 130 28 22 HOLE METHOD </pre>	<ul style="list-style-type: none"> • The CFM₅₀ "BLD/ZONE, ZONE/OUT," and "TOTAL PATH" values are displayed. • Notice that the "ENTERED DATA" is displayed in the order in which it was entered on the previous screen. • Dividing the "BLD/ZONE" CFM₅₀ by 10 yields the approximate square inches of leakage between the building and the zone, for this example 220 in². This may also be done for the zone-to-outdoor CFM₅₀. • The TOTAL PATH will always be less than the CFM₅₀ values of the BLD/ZONE and ZONE/OUT. Press ENTER.

This is very important!

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-25		<ul style="list-style-type: none"> The main menu is displayed. Press "ZPT," F2, for Building Zone Pressure Diagnostics.
Press-26		<ul style="list-style-type: none"> Press "DOOR," F2, for the Door Method. For this test, a door or other openable panel is closed for the first set of pressure readings and opened for the second set of pressure readings. The size of the door or openable panel does not need to be measured. If the initial, closed pressure readings are close to 50 or 0, this method may not work well.
Press-27		<ul style="list-style-type: none"> Enter the initial building CFM₅₀. This is a value that you might already know if you have done a single- or multi-point blower door test on the building. This initial CFM₅₀ should be 200 and preferably 400 or more for this test to work well. Enter "2250" and press ENTER.
Press-28		<ul style="list-style-type: none"> Measure the building-to-zone pressure, "BLD/ZONE ΔP." Enter "32" and press ENTER.
Press-29		<ul style="list-style-type: none"> Measure the zone-to-outdoors pressure, "ZONE/OUT ΔP." Notice that the suggested "ZONE/OUT ΔP" pressure is displayed at the right. Your measured "ZONE/OUT ΔP" should be within 2 Pascals of this displayed number. Enter "18" and press ENTER.
Press-30		<ul style="list-style-type: none"> Indicate the location of the opened door or panel, between the building and the zone or between the zone and the outdoors. It is a good idea to open a door, window, or panel in the tightest air barrier (that between the building and zone or that between the zone and the outdoors). For our example, it is best to create a hole from the building to the zone where we have a ΔP of 32 Pascals. Enter "1" and press ENTER.

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-31	<pre> CLOSED CFM50= 2250 BLD/ZONE ΔP= 32 ZONE/OUT ΔP= 18 18 LOC.= 1 B/Z=1 Z/O=2 OPENED CFM50= █ Bldg. ΔP back to 50? DOOR METHOD </pre>	<ul style="list-style-type: none"> • Now enter the CFM₅₀ with the door opened. • NOTE: It is very important that the building to outdoors pressure be brought back up to 50 Pascals after the door, window, or panel is opened and before the opened CFM₅₀ reading is taken. • The pressure across the barrier in which you created the opening should be less than one (1) Pascal, otherwise the method will not be accurate. • Measure the building CFM₅₀ with the door, window, or panel opened. • For the example, enter "3000" and press ENTER. 	<p><i>This is very important!</i></p>
Press-32	<pre> CFM50's BLD/ZONE ----> 1063 ZONE/OUT ----> 1545 TOTAL PATH --> 796 ENTERED DATA: 2250 32 18 1 3000 DOOR METHOD </pre>	<ul style="list-style-type: none"> • The CFM₅₀ "BLD/ZONE, ZONE/OUT," and "TOTAL PATH" values are displayed. • Notice that the "ENTERED DATA" is displayed in the order in which it was entered. See panel "Press-37" for the order of entry. • Dividing the BLD/ZONE CFM₅₀ by 10 yields the approximate square inches of leakage between the building and the zone, for this example 106 in². This may also be done for the zone-to-outdoor CFM₅₀. • The "TOTAL PATH" will always be less than the CFM₅₀ values of the "BLD/ZONE" and "ZONE/OUT." Press ENTER. 	
Press-33	<pre> CALCULATIONS FOR DUCT BLASTER, BLOWER DOOR & ZONE PRESSURE TESTING (c)2002 WxWare (V3.2) Select from Menu MWD3 ZPD HELP MORE QUIT </pre>	<ul style="list-style-type: none"> • The main menu is displayed. • Press "ZPD," F2, for Building Zone Pressure Diagnostics, basic methods. 	
Press-34	<pre> Building Zone Pressure Diagnostics Basic Methods Select from Menu HOLE DOOR VENT QUIT </pre>	<ul style="list-style-type: none"> • Press "VENT," F3, for the Vent Method. • For this test, the openings in the attic are measured or estimated. The building-to-zone and the zone-to-the outdoor pressures are measured. This method is weak because of the difficulty of measuring the openings in most attics (zone-to-outdoors). However, this method is faster than the other two—"HOLE" or "DOOR." • The pressure across the ceiling (building-to-zone) should not be much less 	
Press-35	<pre> NET VENT, IN²= ENTER NET IN² LEAKAGE AREA OF ROOF/GABLES/ VENTS VENT METHOD </pre>	<ul style="list-style-type: none"> • "Enter net square inches of leakage area of roof/gables/vents. This is often difficult to measure or estimate. Do the best you can. • For the example, enter "260" and press ENTER. 	
Press-36	<pre> NET VENT, IN²= 260 BLD/ZONE ΔP= VENT METHOD </pre>	<ul style="list-style-type: none"> • With the building to outside pressure at 50 Pascals, measure the building-to-zone pressure difference. This pressure should be close to 50 Pascals. • For the example, enter "28" and press ENTER. 	

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-37		<ul style="list-style-type: none"> • Enter the zone-to-outdoor pressure difference. • The measured zone-to-outdoor pressure should be within 2 of the pressure difference displayed at the right on the screen. • Enter “22” and press ENTER.
Press-38		<ul style="list-style-type: none"> • The CFM₅₀ values are displayed for building-to-zone, zone-to-outdoors, and total path. • The “Total Path” value for the vent method, the hole method, and the door method will always be less than the building-to-zone or the zone-to-outdoor CFM₅₀ values. The Total Path figure includes the combined air-flow resistance of the building-to-zone barrier and the zone-to-outdoor barrier. • This ends the basic zone pressure diagnostics examples.
Press-39		<ul style="list-style-type: none"> • You will see the main screen displayed. • Press “MORE,” F4, to move to the other primary menu.
Press-40		<ul style="list-style-type: none"> • Press “BLSTR,” F1, for Minneapolis Duct Blaster™ Flow Rate calculations. • The Duct Blaster is a calibrated air flow measurement system used to test the airtightness of forced air distribution systems. See the <i>Minneapolis Duct Blaster™ Operation Manual</i> for discussion of proper use of the Duct Blaster™. The Duct Blaster™ may also be used as a powered flow hood and as a small blower door. The Duct Blaster is manufactured by The Energy Conservatory.
Press-41		<ul style="list-style-type: none"> • As of March 1995, The Energy Conservatory (TEC) began producing a duct blaster with a different calibration than the original. The WxWare ZipTest Pro² software can calculate flow rates for both types. • Serial numbers 0 - 591 are designated in the ZipTest Pro² program as Type 1 (these are white in color), serial numbers from 592 and higher are Type 2 (TEC calls these “series B” duct blasters). They are black in color. • After you enter the Type number “2”, press ENTER to move to the next screen.
Press-42		<ul style="list-style-type: none"> • Now enter the duct pressure. The reference pressures for testing usually are 25 Pascals, 50 Pascals, or the average actual operating pressure of the duct system. • If you are not able to reach 25 Pascals, enter the value that was reached. The program will calculate the CFM₂₅ from the data that you provide. (The program assumes the flow exponent, n=0.65). • Enter “25” and press ENTER.


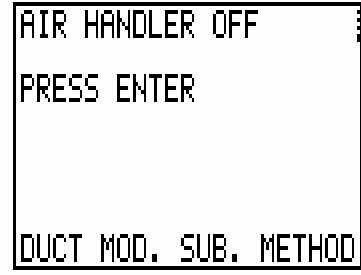
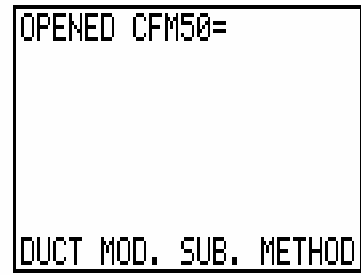
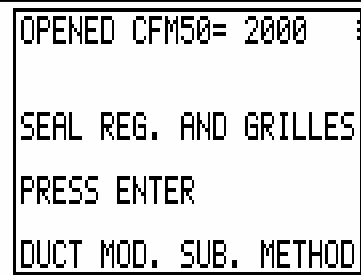
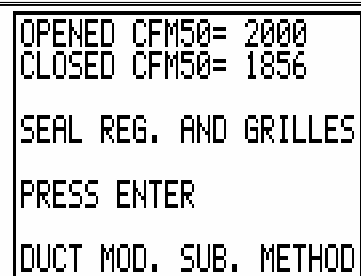
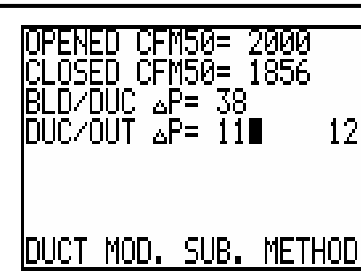
ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-43		<ul style="list-style-type: none"> • Enter the Duct Blaster™ fan pressure. • For the example, enter “100” and press ENTER.
Press-44		<ul style="list-style-type: none"> • Finally, enter the Duct Blaster™ configuration that you used. • Enter “1” for this example and press ENTER.
Press-45		<ul style="list-style-type: none"> • The flow of the Duct Blaster™ fan is given and the CFM₂₅ and CFM₅₀ of the duct system tested. If the maximum duct pressure attainable were 23 Pascals, the first “CFM25=” value would be “CFM23=” instead. Notice that the approximate leakage area — in square inches — is also listed on the screen. • Press ENTER.
Press-46		<ul style="list-style-type: none"> • Once again, back to the main menu. • Press “MORE,” F4, to go to the other primary menu.
Press-47		<ul style="list-style-type: none"> • Press “DUCΔP,” F2, for the Duct Series Leakage Tests menu.
Press-48		<ul style="list-style-type: none"> • “HOLE,” F1, calculates duct leakage using the Add-a-Hole Method. • “MODBD,” F2, calculates duct leakage using the Blower-Door-Subtraction Method. • “NELSN,” F3, calculates duct leakage using the Full-Nelson Method. • “TWIST,” F4, calculates duct leakage using the Nelson-with-NFR-Twist Method (NFR is Natural Florida Retrofit). • Press F1 for Add-a-Hole Method.

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-49	<pre>AIR HANDLER OFF SEAL REG. AND GRILLES PRESS ENTER DUCT HOLE METHOD</pre>	<ul style="list-style-type: none"> • This screen displays instructions for Add-a-Hole Method. • This method is similar to the Building Hole Method. • The method works best when the duct leakage is less than 200 CFM₅₀ and there is little leakage to the building. • The area of the added hole should be less than 50% of the cross-sectional area of the smallest duct in the path between the hole and the air handler. • Press ENTER.
Press-50	<pre>BLD/DUC ΔP1= 36 DUC/OUT ΔP1= 14 14 LOC.= ■ B/O=1 D/O=2 INDICATE LOCATION OF CREATED HOLE</pre>	<ul style="list-style-type: none"> • Enter the building-to-duct pressure difference, “36” for our example. • Enter the duct-to-outdoors pressure difference, “14” for our example. • Indicate the location of added hole, building-to-duct or duct-to-outdoor, “1” for the example.
Press-51	<pre>BLD/DUC ΔP1= 36 DUC/OUT ΔP1= 14 14 LOC.= 1 B/O=1 D/O=2 ADDED HOLE, IN²= 10 HOLE ΔP= 26 BLD/DUC ΔP2= 27 DUC/OUT ΔP2= ■ 23</pre>	<ul style="list-style-type: none"> • Enter the size of the added hole. For our example “10” square inches. The hole can be created in a seal that was applied to a register or grille. • Measure and enter the hole pressure, “26” for the example. • Measure and enter the “BLD/DUC ΔP2,” the building to duct pressure after the hole is made. For the example “27.” • Measure and enter the “DUC/OUT ΔP2,” the duct to outdoors pressure after the hole is made. For the example “23.” • Press ENTER.
Press-52	<pre>CFM50's BLD/DUCT ----> 122 DUC/OUT ----> 225 ENTERED DATA: 36 14 1 10 26 27 23 DUCT HOLE METHOD</pre>	<ul style="list-style-type: none"> • The Building to Duct CFM50 and the Duct to outdoors CFM50 are displayed. • Notice that the “ENTERED DATA” is displayed in the order in which it was entered. Refer to Panels Press-50 and Press-51 for the labels for the entered data. • Press ENTER.
Press-53	<pre>CALCULATIONS FOR DUCT BLASTER, BLOWER DOOR & ZONE PRESSURE TESTING (c)2002 WxWare (V3.2) Select from Menu Mbd3 2FD HELP MORE QUIT</pre>	<ul style="list-style-type: none"> • The main menu is displayed. • Press “MORE,” F4, for another example of Duct Series Leakage testing.
Press-54	<pre>CALCULATIONS FOR DUCT BLASTER AND DUCT SERIES-LEAKAGE TESTING Select from Menu BLSTRA DUCΔP HELP MORE BACKLG</pre>	<ul style="list-style-type: none"> • The other primary menu is displayed. • Press “DUCΔP,” F2, for the Duct Series Leakage menu.

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-55		<ul style="list-style-type: none"> • The Duct Series Leakage menu is displayed. • Press “MODSB,” F2, for the Duct Modified Subtraction Method calculation. • The method works best when the duct leakage is less than 200 CFM₅₀
Press-56		<ul style="list-style-type: none"> • Air handler should be off. • Press ENTER.
Press-57		<ul style="list-style-type: none"> • With the blower door, measure the CFM₅₀ with the duct system open to the building, i.e. not taped or sealed. • For the example, enter “2000” and press ENTER.
Press-58		<ul style="list-style-type: none"> • Now seal registers and grilles and measure the CFM₅₀ with the blower door. • Press ENTER.
Press-59		<ul style="list-style-type: none"> • Now enter the Closed CFM₅₀ (registers and grilles sealed). For the example enter “1856.” • Press ENTER.
Press-60		<ul style="list-style-type: none"> • Enter the building-to-duct pressure difference with the registers and grilles sealed. For the example, enter “38.” • Press ENTER. • Enter the duct-to-outdoor pressure difference with the registers and grilles sealed. • Press ENTER.

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-61	<pre> CFM50's BLD/DUCT ----> 103 DUCT/OUT ----> 230 ENTERED DATA: 2000 1856 38 11 DUCT MOD. SUB. METHOD </pre>	<ul style="list-style-type: none"> • The CFM₅₀ values for the building-to-duct and the duct-to-the outdoor are displayed. • Notice that the "ENTERED DATA" is displayed in the order in which it was entered. Refer to Panels Press-59 and Press-60 for the input labels. • Press ENTER.
Press-62	<pre> CALCULATIONS FOR DUCT BLASTER, BLOWER DOOR & ZONE PRESSURE TESTING (c)2002 WxWare (V3.2) Select from Menu ----- Mbd3 2FD HELP MORE QUIT </pre>	<ul style="list-style-type: none"> • Back to the main menu. • Press "MORE," F4, and we will try another example.
Press-63	<pre> CALCULATIONS FOR DUCT BLASTER AND DUCT SERIES-LEAKAGE TESTING Select from Menu ----- BLSTR DUCAP HELP MORE ACKLG </pre>	<ul style="list-style-type: none"> • Press "DUCAP," F2 for Duct Series Leakage Tests.
Press-64	<pre> DUCT SERIES-LEAKAGE TESTS Select from Menu ----- HOLE MODSR NELSN TWIST QUIT </pre>	<ul style="list-style-type: none"> • Press "NELSN," F3, for an example of the Full-Nelson Method. • This method is experimental. Act accordingly with the results. This method provides insight into the relative leakiness of the return and supply sides of the duct system in terms of CFM₅₀.
Press-65	<pre> AIR HANDLER ON SEAL REG. AND GRILLES PRESS ENTER FULL NELSON METHOD </pre>	<ul style="list-style-type: none"> • Instructions for Full-Nelson Method are displayed. • Note that high pressures may be created in the duct system. These pressures could damage the duct system. • Press ENTER.
Press-66	<pre> AVE SUPPLY ΔP1= 65 AVE RETURN ΔP1= 98 ADD A HOLE SUPPLY HOLE, IN²= 10 SUPPLY HOLE ΔP= 50 </pre>	<ul style="list-style-type: none"> • Enter the average supply duct pressure, for the example, "65" Pascals. • Enter the average return duct pressure, for the example, "98" Pascals. • Add a hole to either the supply side or the return side. • Enter the Supply Hole size, for the example, "10" square inches. • Enter the Supply Hole Pressure Difference, for the example, "50" Pascals.

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-67	<pre> AVE RETURN ΔP1= 98 ADD A HOLE SUPPLY HOLE, INΔ= 10 SUPPLY HOLE ΔP= 50 RETURN HOLE, INΔ= 0 RETURN HOLE ΔP= 0 AVE SUPPLY ΔP2= 55 AVE RETURN ΔP2= 102 </pre>	<ul style="list-style-type: none"> • Enter the return hole size, for the example, no return hole is made, so "0" is entered. • Enter the return hole pressure difference. If no return hole is added, the return hole pressure difference will be "0." • Enter the average supply pressure, "AVE SUPPLY ΔP2" after the hole is made. For the example enter "55." • Enter the average return pressure, "AVE RETURN ΔP2" after the hole is made. For the example enter "102." Press ENTER.
Press-68	<pre> CFM50's RETURN ----> 375 SUPPLY ----> 490 TOTAL ----> 865 FULL NELSON METHOD </pre>	<ul style="list-style-type: none"> • The return duct CFM₅₀, supply duct CFM₅₀, and the total CFM₅₀ are displayed. • Press ENTER.
Press-69	<pre> CALCULATIONS FOR DUCT BLASTER, BLOWER DOOR & ZONE PRESSURE TESTING (c)2002 WxWare (V3.2) Select from Menu MND3 2FD HELP MORE QUIT </pre>	<ul style="list-style-type: none"> • Back to the main menu. • Press "MORE," F4, for one last example.
Press-70	<pre> CALCULATIONS FOR DUCT BLASTER AND DUCT SERIES-LEAKAGE TESTING Select from Menu BLSTR DUCΔP HELP MORE ACKLG </pre>	<ul style="list-style-type: none"> • The other primary menu is displayed. • Press "DUCΔP," F2, for Duct Series Leakage Tests.
Press-71	<pre> DUCT SERIES-LEAKAGE TESTS Select from Menu HOLE MODSR NELSN TWIST QUIT </pre>	<ul style="list-style-type: none"> • Press "TWIST," F4, for an example of the Nelson-with-NFR-Twist Method (NFR is Natural Florida Retrofit). • Note: If you make a mistake while entering data before you press ENTER, use the arrow buttons to move the cursor over the erroneous entry and type the correct entry. If you notice you have made a mistake after you have pressed ENTER, press the "2nd" button, the "QUIT" button (next to the "2nd" button), and then ENTER. This will return you to the main menu.
Press-72	<pre> AIR HANDLER ON SEAL REG. AND GRILLES PRESS ENTER NFR TWIST METHOD </pre>	<ul style="list-style-type: none"> • Instructions for the Nelson-with-NFR-Twist Method are displayed. • Note that high pressures may be created in the duct system. These pressure could damage the duct system. • This method is similar to the Full-Nelson method, except a hole is added to relieve pressure in the ducts. • Press ENTER.

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-73	<pre>SUPPLY HOLE, IN²= 10 SUPPLY HOLE ΔP= 20 RETURN HOLE, IN²= 0 RETURN HOLE ΔP= 0</pre>	<ul style="list-style-type: none"> • Enter the initial added supply hole. For the example, enter “10” square inches. • Enter the pressure across the supply hole. For the example, enter “20.” • Enter the return hole. In the example, a return hole is not added, so enter “0.” • Enter the return hole pressure difference. If no return hole is added, the pressure difference across the hold is “0.”
Press-74	<pre>SUPPLY HOLE, IN²= 10 SUPPLY HOLE ΔP= 20 RETURN HOLE, IN²= 0 RETURN HOLE ΔP= 0 AVE SUPPLY ΔP1= 50 AVE RETURN ΔP1= 58 ADD A HOLE SUPPLY HOLE, IN²= 15</pre>	<ul style="list-style-type: none"> • Enter the average supply pressure difference, “AVE SUPPLY ΔP1” for the example is “50.” • Enter the average return pressure difference, “AVE RETURN ΔP1” for the example is “58.” • Add a hole to either or both sides of the duct system. For the example a supply hole is added, “15.” Note that the supply hole went from the initial 20 square inches to 15 square inches. Use the actual hole size, not the change in hole size (in this case, a reduction of 5 square inches).
Press-75	<pre>AVE RETURN ΔP1= 58 ADD A HOLE SUPPLY HOLE, IN²= 15 SUPPLY HOLE ΔP= 18 RETURN HOLE, IN²= 0 RETURN HOLE ΔP= 0 AVE SUPPLY ΔP2= 36 AVE RETURN ΔP2= 58</pre>	<ul style="list-style-type: none"> • (The screen has been scrolled up five lines). • Enter the pressure across the supply hole, “SUPPLY HOLE ΔP.” For the example enter “18.” • Enter the return hole size. For the example, enter “0.” • Enter the return hole pressure difference. If no hole is made, the return hole pressure difference is “0.”
Press-76	<pre>AVE RETURN ΔP1= 58 ADD A HOLE SUPPLY HOLE, IN²= 15 SUPPLY HOLE ΔP= 18 RETURN HOLE, IN²= 0 RETURN HOLE ΔP= 0 AVE SUPPLY ΔP2= 36 AVE RETURN ΔP2= 58</pre>	<ul style="list-style-type: none"> • Enter the average supply pressure difference after the second hole is added, “AVE SUPPLY ΔP2.” For our example this is “36.” • Enter the average return pressure difference after the second hole is added, “AVE RETURN ΔP2.” For our example this is “58.” • Press ENTER.
Press-77	<pre>CFM50's RETURN ---> 138 SUPPLY ---> 104 TOTAL ----> 242 NFR TWIST METHOD</pre>	<ul style="list-style-type: none"> • The return duct CFM₅₀, supply duct CFM₅₀, and the total CFM₅₀ are displayed. • This ends the Duct Series Leakage Test examples. • Press ENTER.
Press-78	<pre>CALCULATIONS FOR DUCT BLASTER, BLOWER DOOR & ZONE PRESSURE TESTING (c)2002 WxWare (V3.2) Select from Menu M643 2FD HELP MORE QUIT</pre>	<ul style="list-style-type: none"> • Once again, back to the main menu. • Press “HELP,” F3. • This feature gives simple help messages for the main menu shown at the left.

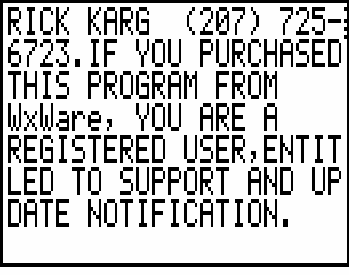
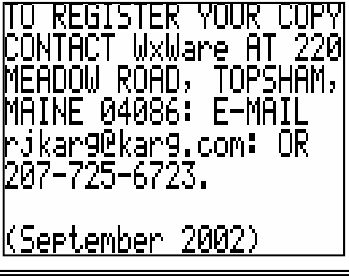
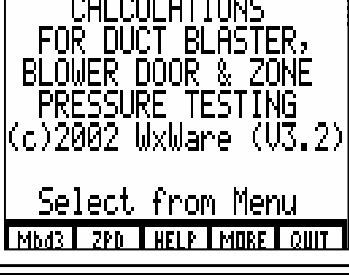
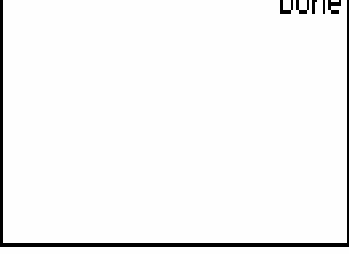

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-79	<pre>Mbd3 TEST CALCULATES CFM50 FOR MINNEAPOLIS BLOWER DOOR MODEL 3. CAN'T REACH 50 VALUES ARE INCORPORATED. Help Screen</pre>	<ul style="list-style-type: none"> • The “Mbd3,” F1, menu item. • Press ENTER.
Press-80	<pre>ZPD TESTS CALCULATES SERIES-LEAKAGE CFM50 VALUES USING HOLE, DOOR & VENT METHODS. IF YOU CAN'T REACH A BUILDING PRESSURE OF 50 Pa, THE CALCULATION IS NOT VALID.</pre>	<ul style="list-style-type: none"> • The “ZPD,” F2, menu item. • Press ENTER.
Press-81	<pre>'MORE' TAKES YOU TO THE NEXT MENU. Help Screen</pre>	<ul style="list-style-type: none"> • The “MORE,” F4, menu item. • Press ENTER.
Press-82	<pre>'QUIT' EXITS PROGRAM. Help Screen</pre>	<ul style="list-style-type: none"> • And the “QUIT,” F4, menu item. • Always exit this and other TI-86 programs by pressing the “QUIT” menu key. This resets the decimal place to “float” so that you can perform accurate calculations with the calculator functions of the TI-86. • Press ENTER.
Press-83	<pre>CALCULATIONS FOR DUCT BLASTER, BLOWER DOOR & ZONE PRESSURE TESTING (c)2002 WxWare (V3.2) Select from Menu Mbd3 ZPD HELP MORE QUIT</pre>	<ul style="list-style-type: none"> • And, back to the main menu screen. • Press “MORE,” F4, for the other primary menu screen.
Press-84	<pre>CALCULATIONS FOR DUCT BLASTER AND DUCT SERIES-LEAKAGE TESTING Select from Menu BLSTRA DUCAP HELP MORE ACKLG</pre>	<ul style="list-style-type: none"> • There is a “HELP,” F3, button on this menu also. • Go ahead, press it.

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-85	<pre>'BLSTR' TEST IS FOR CALCULATING CFM FLOW WITH THE MINNEAPOLIS DUCT BLASTER. TO FIND CFM FLOW, ENTER FAN PRESSURE, DUCT PRESSURE, & RING CONFIGURATION.</pre>	<ul style="list-style-type: none"> • The "BLSTR," F1, menu item. • Press ENTER.
Press-86	<pre>'DUCAP' TESTS ALLOW THE CALCULATION OF DUCT LEAKAGE. ADD-A- HOLE, MODIFIED SUBTRAC TION, NELSON AND NFR TWIST METHODS ARE INCLUDED. Help Screen</pre>	<ul style="list-style-type: none"> • The "DUCAP," F2, menu item. • Press ENTER.
Press-87	<pre>'MORE' TAKES YOU TO THE NEXT MENU. Help Screen</pre>	<ul style="list-style-type: none"> • The "MORE," F4, menu item. • Press ENTER.
Press-88	<pre>'ACKLG' (ACKNOWLEDG- MENTS), LISTS CREDITS, SUPPORT AND REGISTRA- TION INFORMATION. Help Screen</pre>	<ul style="list-style-type: none"> • The "ACKLG," F4, menu item. • Press Enter.
Press-89	<pre>CALCULATIONS FOR DUCT BLASTER AND DUCT SERIES-LEAKAGE TESTING Select from Menu BLSTR DUCAP HELP MORE ACKLG</pre>	<ul style="list-style-type: none"> • Now we are back to one of the primary screens. • Press "ACKLG," F5. This is the acknowledgments section.
Press-90	<pre>WELCOME TO THE WORLD OF PRESSURES & FLOWS, A GATHERING OF WORKS FROM ENERGY CONSERVA- TORY, GRASP & NATURAL FLORIDA RETROFIT. THIS PROGRAM WAS WRIT TEN BY NEIL MOYER AND</pre>	<ul style="list-style-type: none"> • This is the first acknowledgments screen. • Press ENTER.

ZipTest Pro² Building Diagnostics Software for the Texas Instruments TI-86 Graphing Calculator

Press-91		<ul style="list-style-type: none"> • This is the second acknowledgments screen. • Press ENTER.
Press-92		<ul style="list-style-type: none"> • This is the third acknowledgments screen. • Press ENTER.
Press-93		<ul style="list-style-type: none"> • Once again, back to the main menu screen. • Press "QUIT," F5. • Note: Always exit the program by pressing QUIT; this automatically resets the decimal place for calculator use.
Press-94		<ul style="list-style-type: none"> • You have now exited from the program. • If you want to get back to the program quickly after pressing "QUIT," simply press ENTER. • Note: The TI-86 automatically shuts off after two minutes of non-use. When you turn it back on, you will be able to pick up right where it shut off.
Press-95		
Press-96	