



There's an App for That – Tips and Tricks to Use in the Field

Sam Myers

sam@retrotec.com

www.retrotec.com



- RESNET Certified HERS rater
- Trainer at Retrotec
- Conducted hundreds of blower door and duct tests in the field
- Holds an MS degree in Sustainability concentrating on the built environment



Former:

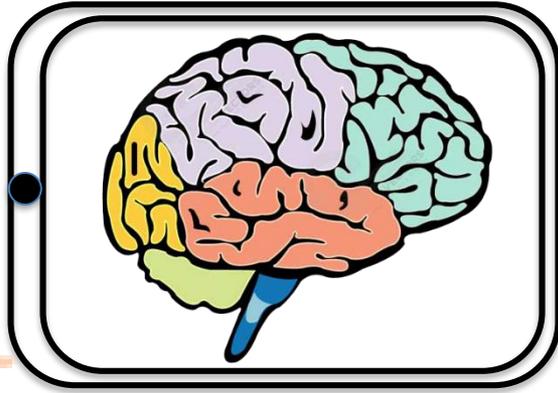
- Building Science Specialist at Advanced Energy
- Researcher at East Carolina University

General Categories

- Measurements
- Diagnostics - blower door & duct tests +
- Gadgets
- Oh that's interesting

Apps & Web-based Tools

Bring Your Own Brain Technology



Wohler VE200
Endoscope



Testo Smart Probes

RED Residential Energy Dynamics

www.residentialenergydynamics.com

RED Calc Free Tools

- Getting Started
- Tool Descriptions
- Preferences
- Ventilation
 - ASHRAE 62.2-2013**
 - ASHRAE 62.2-2010
 - ASHRAE 62.2 CA
 - Electrical Usage
 - Depressurization
 - Pitot Tube Airflow
 - Box Airflow
- Moisture
 - Moisture Metrics
 - Wood Moisture
- Air Leakage
 - Air Leakage Metrics
 - ZPD
 - Design Infiltration
 - Advanced Infiltration
- Insulation
 - Dense Pack
 - Loose Fill
 - Heat Transfer
 - Infrared R-Value
 - Parallel Path R-Value
- Domestic Hot Water
 - Systems Comparison
 - Average Daily Usage
 - First Hour Rating
 - Instantaneous Sizing
 - Volume per Use
 - Water Flow Rate

ASHRAE 62.2-2013 Ventilation

Reset Print

New or existing construction

Use infiltration credit

Closest weather station

Weather and shielding factor [1/hr] = 0.55

Floor area [] 2200

Number of occupants

Building height [] 20

Measured leakage @ 50Pa [] 1200

Use Advanced Blower Door Inputs

Blower door test type

Indoor temperature [] 75

Outdoor temperature [] 30

Altitude [] 1200

Pressure exponent 0.65

Adjusted leakage @ 50Pa [] = 1123

Whole-Bldg Ventilation Results

Effective annual avg infiltration rate [] = 46

Total required ventilation rate [] = 96

RED Residential Energy Dynamics

www.residentialenergydynamics.com

Free Building Science Calculation Tools for Energy Professionals

Ventilation

- ASHRAE 62.2- 2010, 2013, 2016
- ASHRAE 62.2 CA
- Electrical Usage
- Depressurization
- Pitot Tube Airflow
- Box Airflow

Moisture

- Moisture Metrics
- Wood Moisture
- Air Leakage
- Air Leakage Metrics
- ZPD
- Design Infiltration
- Advanced Infiltration

CI Construction Instruction

www.constructioninstruction.com

Mobile construction app has home construction videos, animated building details, building science articles, and building product & materials installation info, technical data, and other 'Best-Practices' information.



Construction Instruction®
Building Science for Everyone, Everywhere

CI Construction Instruction

www.constructioninstruction.com





SketchUp Rapid Takeoffs

www.energylogicaacademy.com/?p=5966

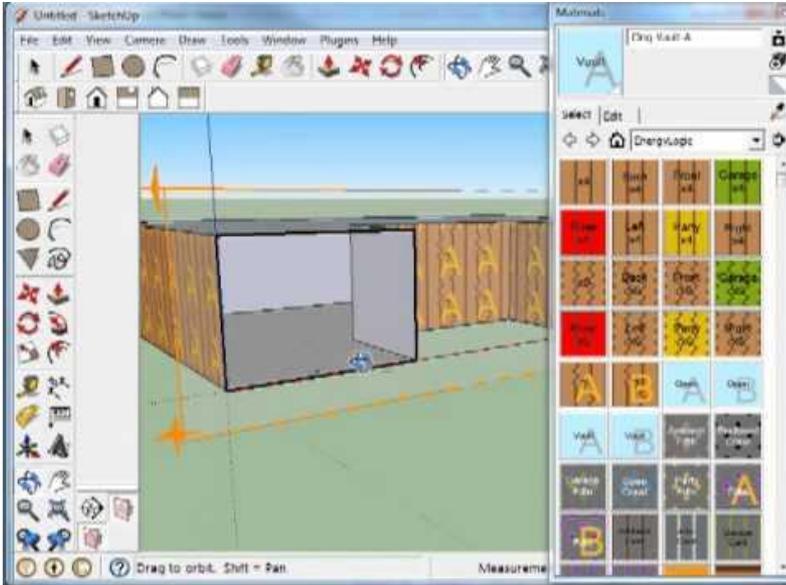
- EnergyLogic designed scripts for SketchUp to assist home energy professionals rapid and accurate takeoffs.
- This self-paced course ... designing a model from plans using SketchUp.
- Then you will use the EnergyLogic custom built scripts to create a report from the model for rapid REM/Rate input.



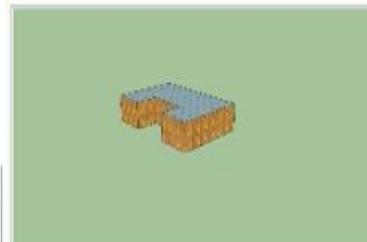


SketchUp Rapid Takeoffs

www.vimeo.com/53178648




Prob #3 Sketch.skp



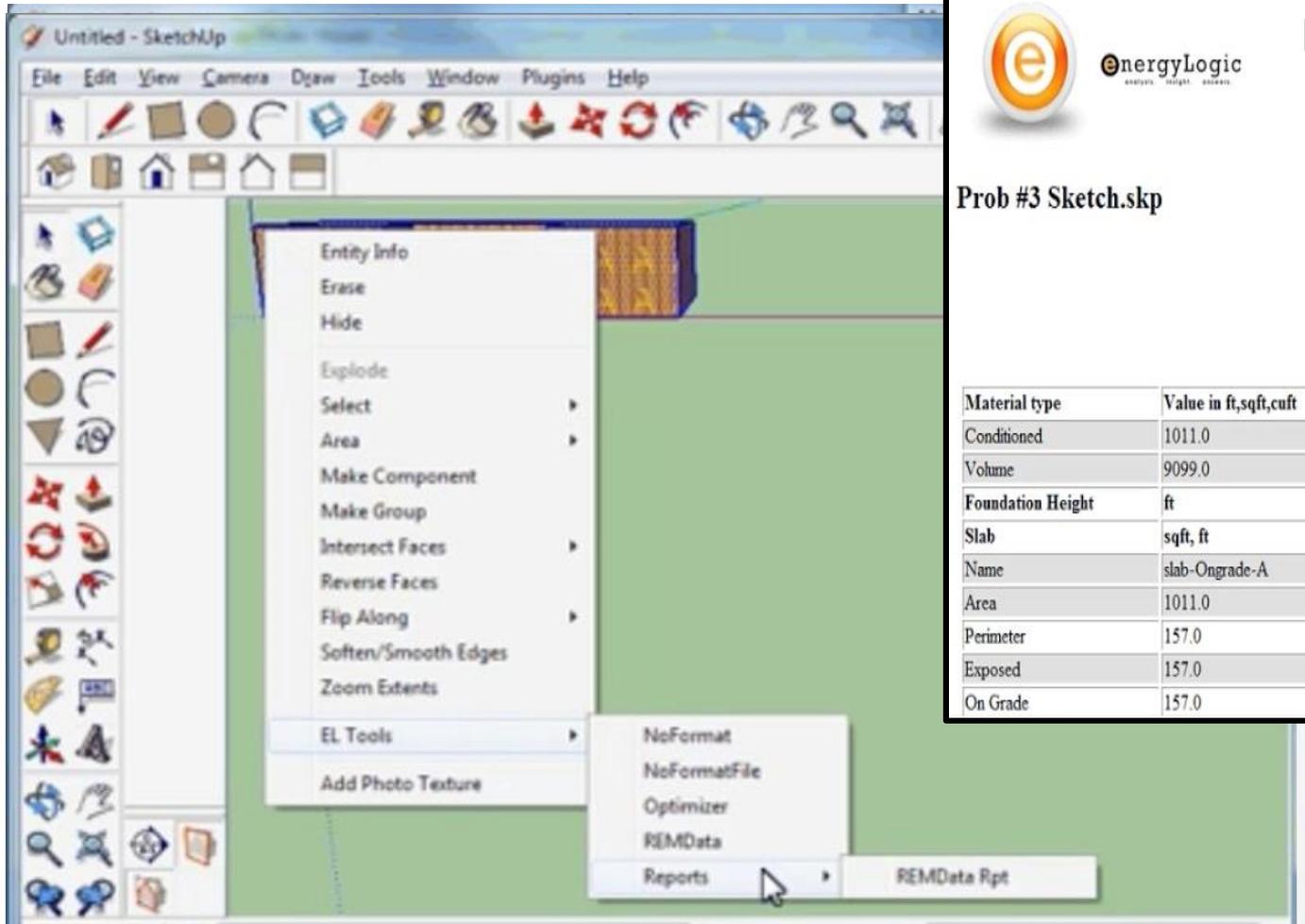
Material type	Value in ft,sqft,cuft
Conditioned	1011.0
Volume	9099.0
Foundation Height	ft
Slab	sqft, ft
Name	slab-Ongrade-A
Area	1011.0
Perimeter	157.0
Exposed	157.0
On Grade	157.0

Energy Star V3	Target
LTO 4cfm/100sqft	40
Duct Total 6cfm/100sqft	61
Blower door 7ACH50	1062
EFL	Blower door
Silver 0.5cfm/sqft	1718
Gold 0.35cfm/sqft	1202
Platinum 0.25cfm/sqft	950





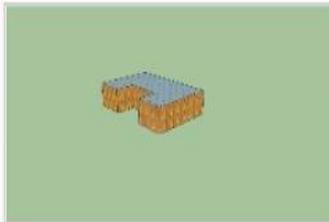
SketchUp Rapid Takeoffs





REM/Data Report

Prob #3 Sketch.skp



Material type	Value in ft,sqft,cuft
Conditioned	1011.0
Volume	9099.0
Foundation Height	ft
Slab	sqft, ft
Name	slab-Ongrade-A
Area	1011.0
Perimeter	157.0
Exposed	157.0
On Grade	157.0

Energy Star V3	Target
LTO 4cfm/100sqft	40
Duct Total 6cfm/100sqft	61
Blower door 7ACH50	1062
EFL	Blower door
Silver 0.5cfm/sqft	1718
Gold 0.35cfm/sqft	1202
Platinum 0.25cfm/sqft	850

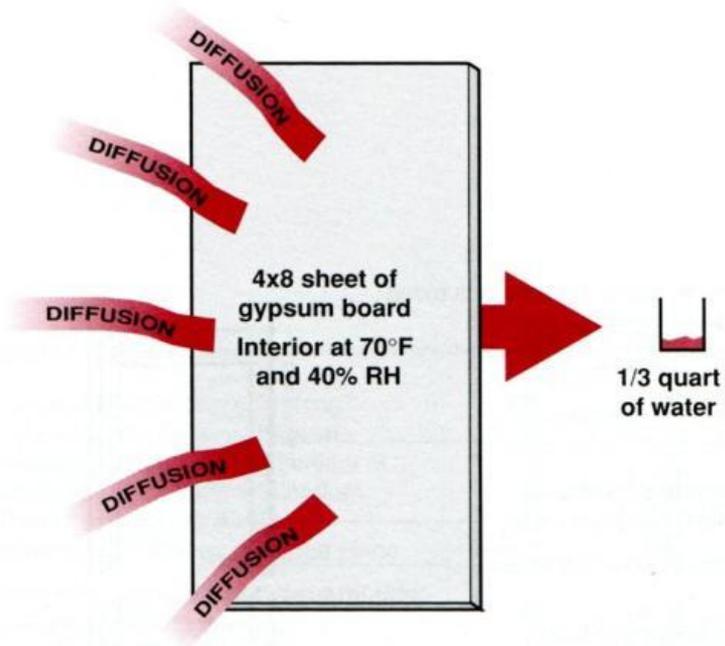
www.vimeo.com/53178648

Moisture Flow:

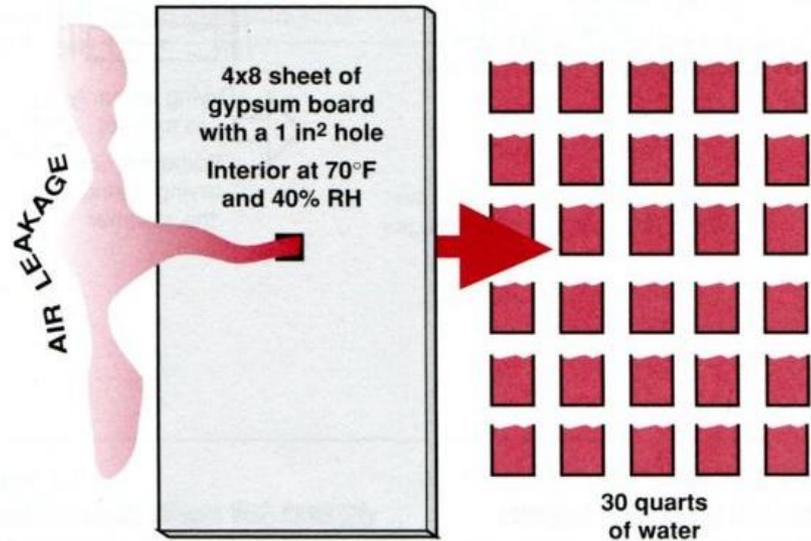
Vapor Diffusion vs. Air Leakage



1 sq inch.
hole



1/2 Quart of water

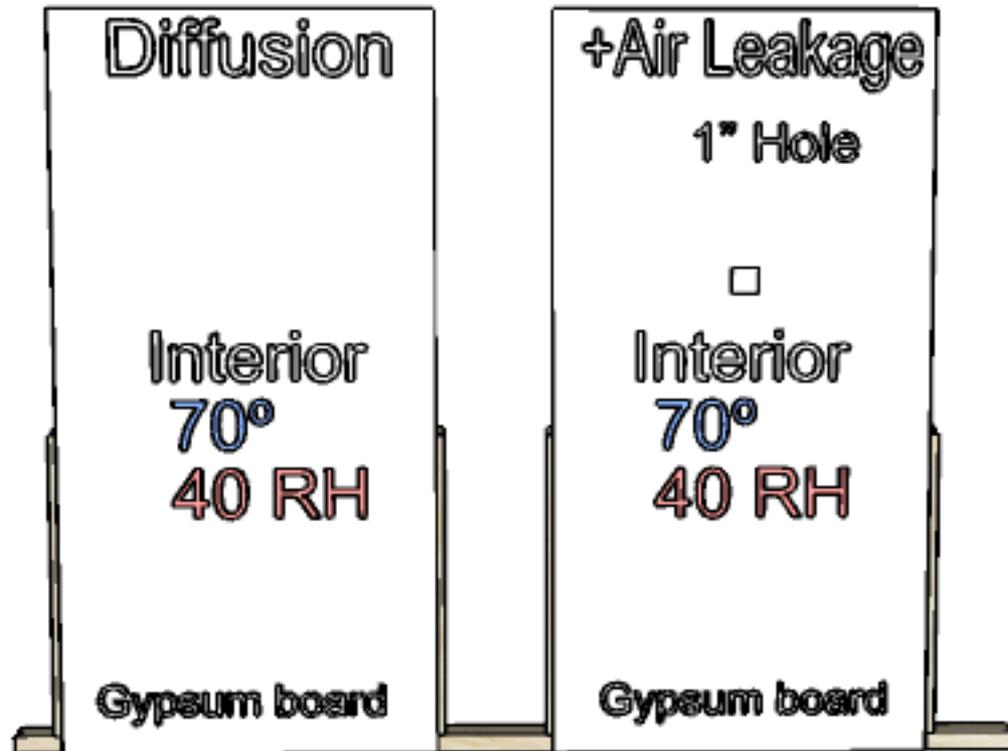


7.5 Gallons of water

30 Quarts of water

Heating Season

Mixed Climate





Pad 12:22 PM

Close Universal Work Order (Section... Send

Job Information ✓

Account Information (Bill to:) ✓

Job Location & Account Contacts ✓

Equipment Information ✓

Required Maintenance and Repairs ✓

Work Performed ✓

Materials ✓

Labor

Summary of Charges

Terms and Signature

Summary

Materials

Parts Discount (%)

10

Collect details about materials

Part Code	Part Description	Quantity	Unit Price	Subtotal
353-78000-005	Run Cap	1	9.95	9.95
373-10870-503	Wiring Harness	4	30.49	121.96
031-01264-003	Drain Pan	2	109.78	219.56
373-32099-043	Fan Limit Switch	1	4.86	4.86
Part Total				356.33
Parts Discount				35.63
Discounted Parts Subtotal				320.70

+

Add Entry View All

Site Identification

Type of Inspection

Safety Inspection

Inspection Time Stamp

2013-03-01 4:18 PM

Photo of Location



Tap to choose photo

Location (GPS)

45° 32' 27.38" N, 73° 36' 41.91" W

Tap to reacquire location

Index Next

Construction Master Pro



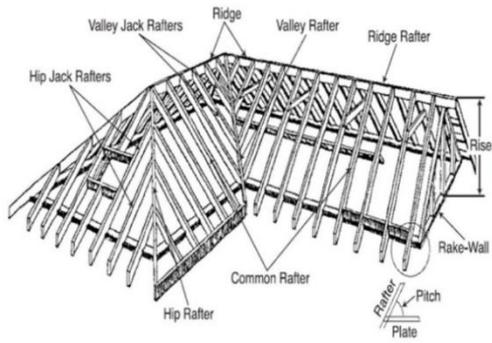
\$24.95



\$24.95

Roof Framing Definitions

The following is a listing of right triangle and roof framing terms to assist you in understanding how to use your Construction Master® roof framing functions.



Related functions:

- [Pitch](#), [Rise](#), [Run](#), [Diagonal](#), [Common Rafter](#), [Hip/Valley Rafter](#), [Jack Rafter](#)

Definitions:

- **Rise:** The vertical distance



Measurement apps



My Measures PRO



ImageMeter



RoomScan pro



Subspace



Flying Rule



CamMeasure



EasyMeasure



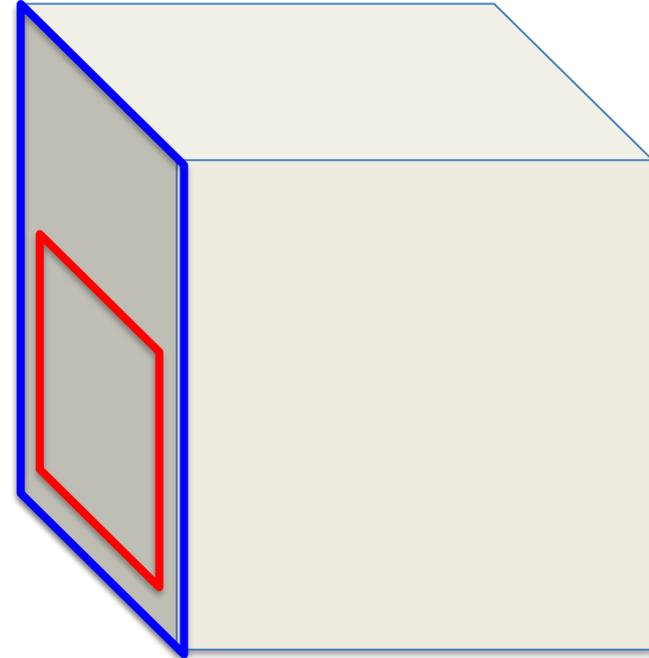
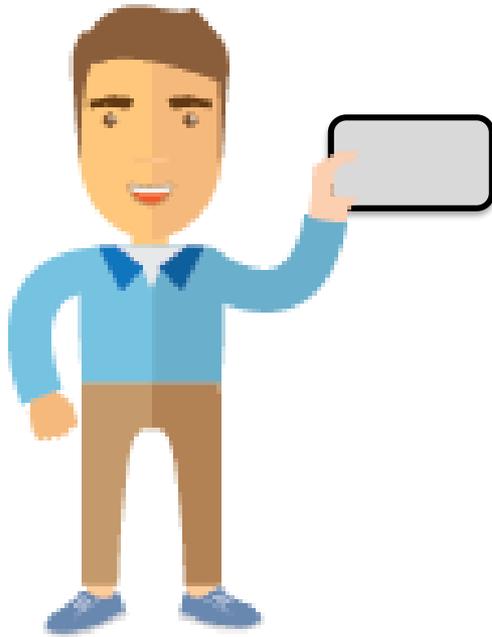
MagicPlan



Aka" STANLEY Floor Plan



Photo Measurement apps



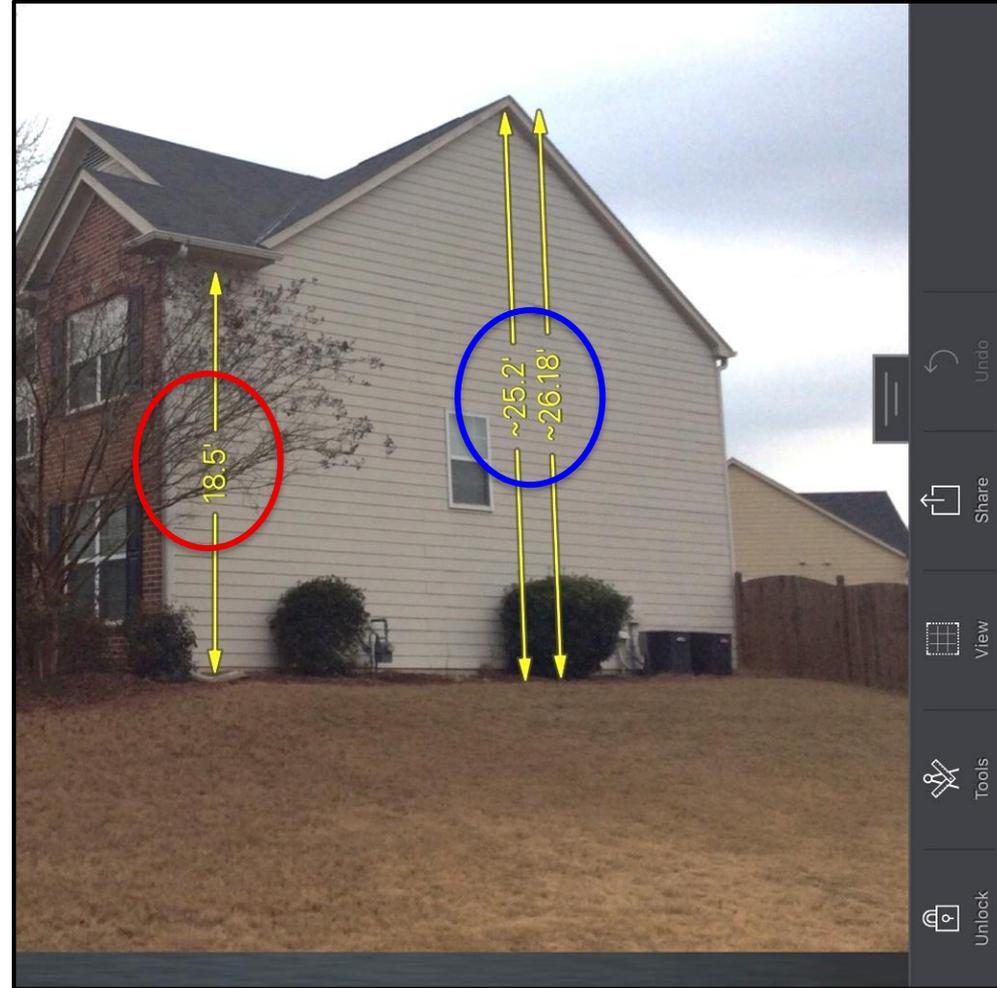
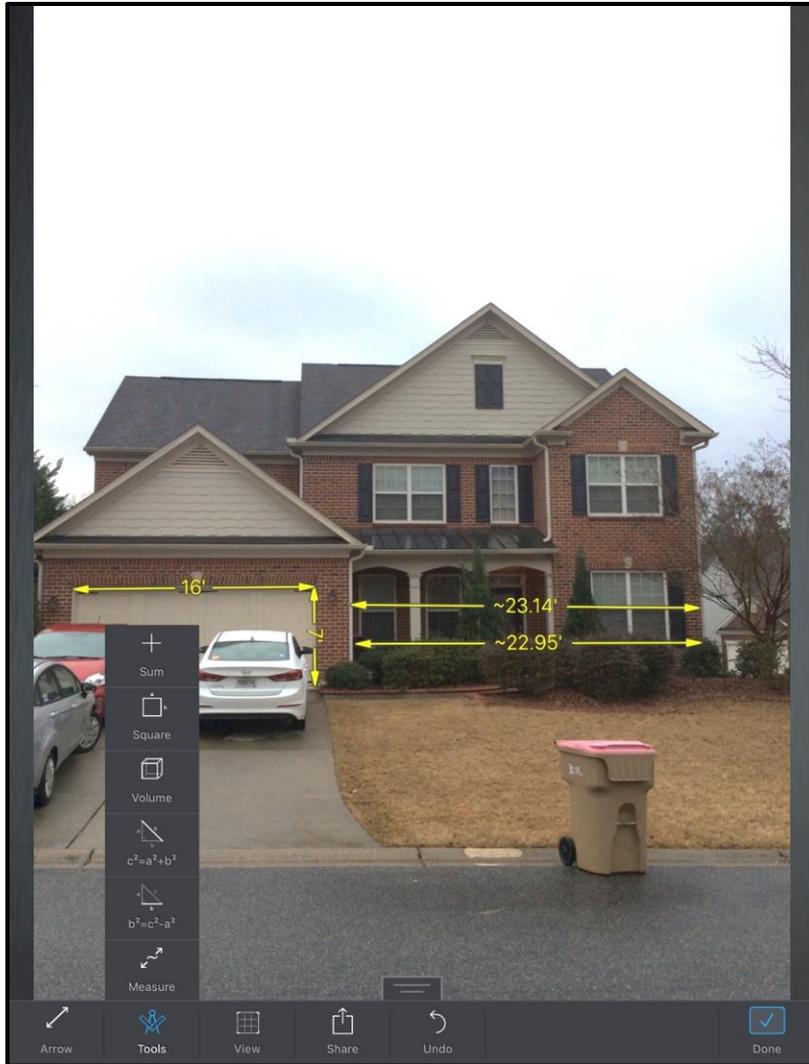
Known size reference

Calculated reference

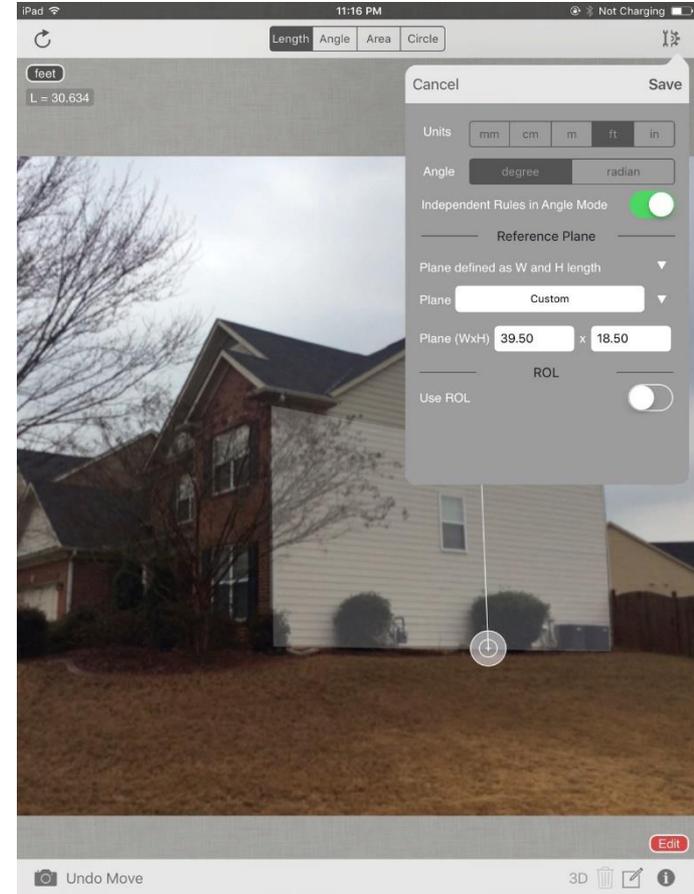
My Measures PRO



\$7.99



Partometer3D - camera measure



\$2.99

ImageMeter

Pro = \$4.99?

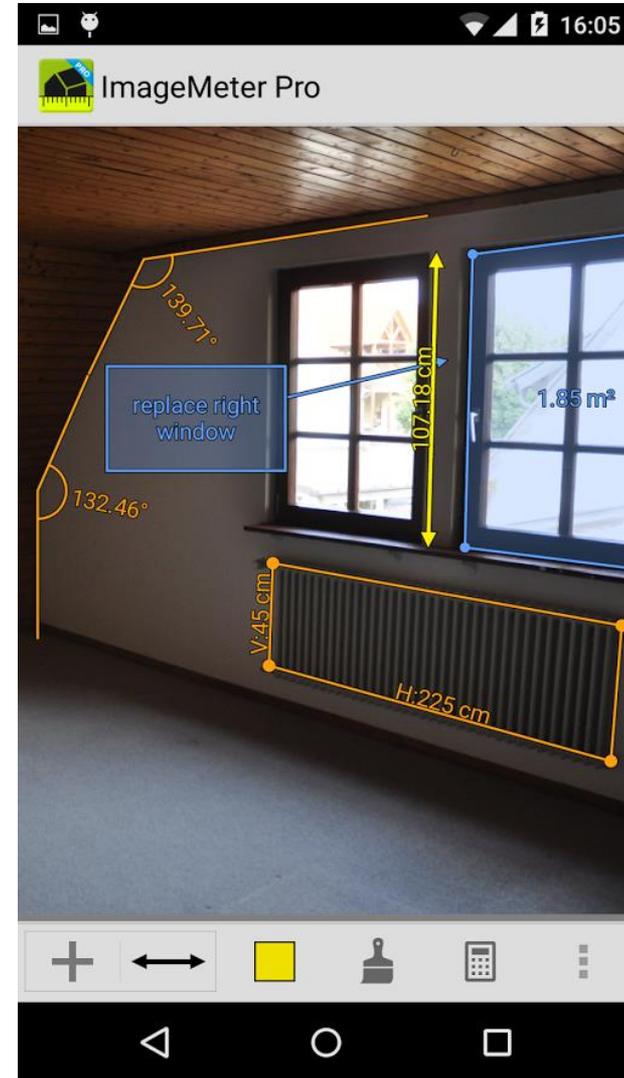
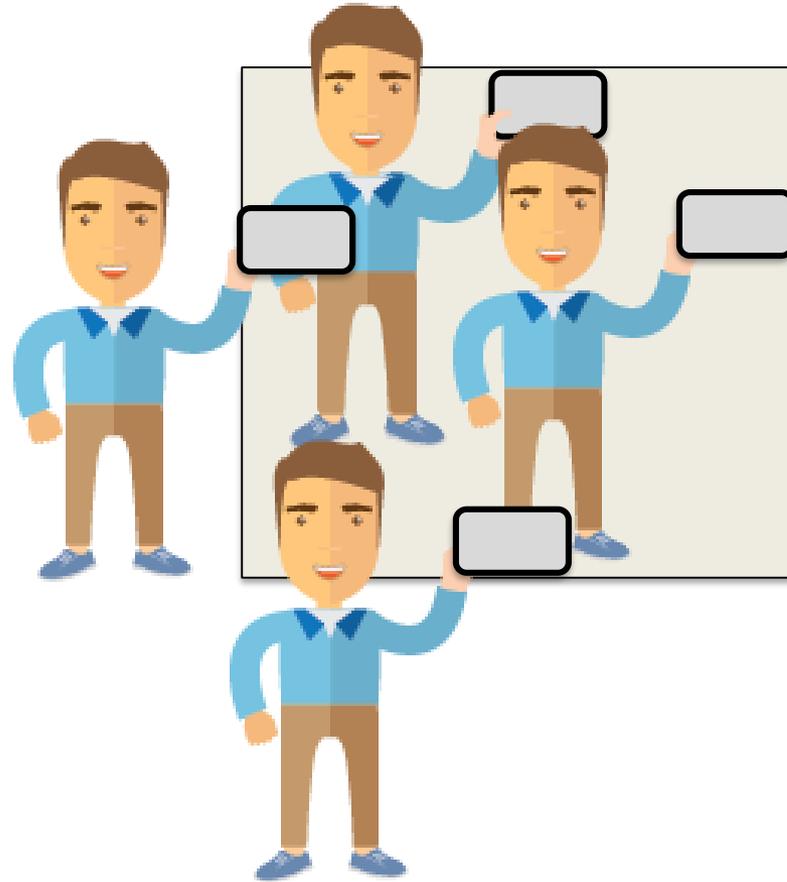


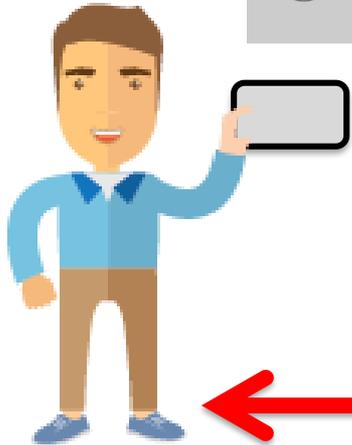
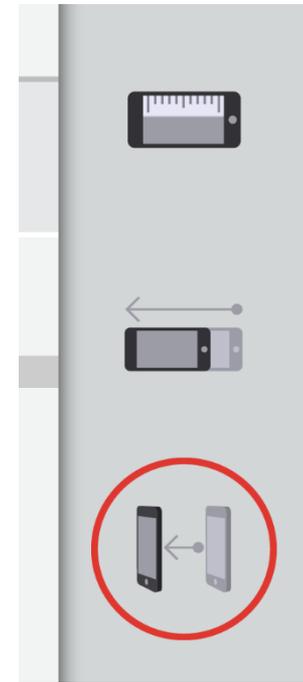
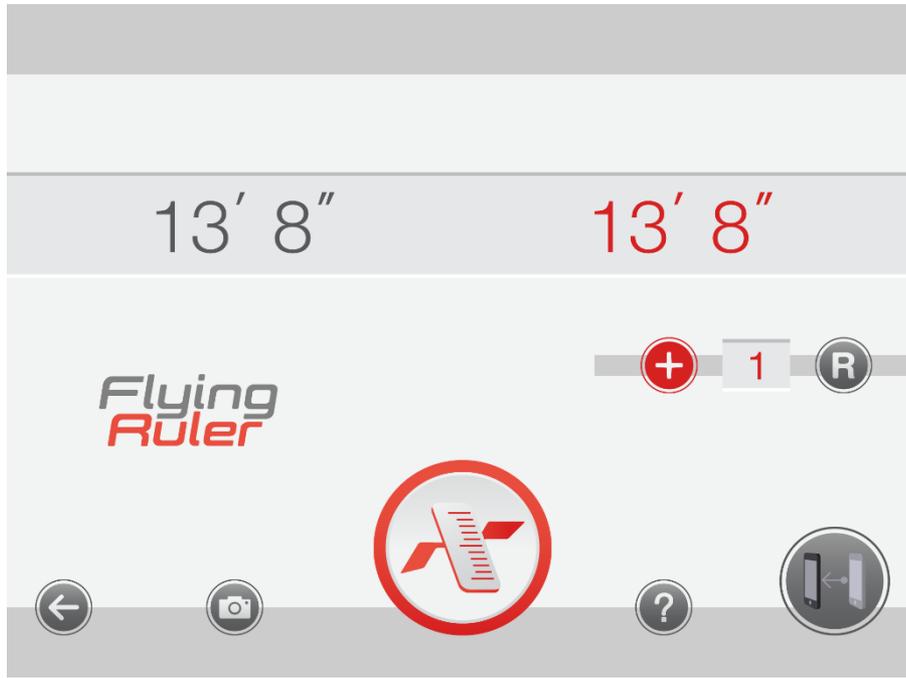
Photo Measurement apps



Flying Ruler

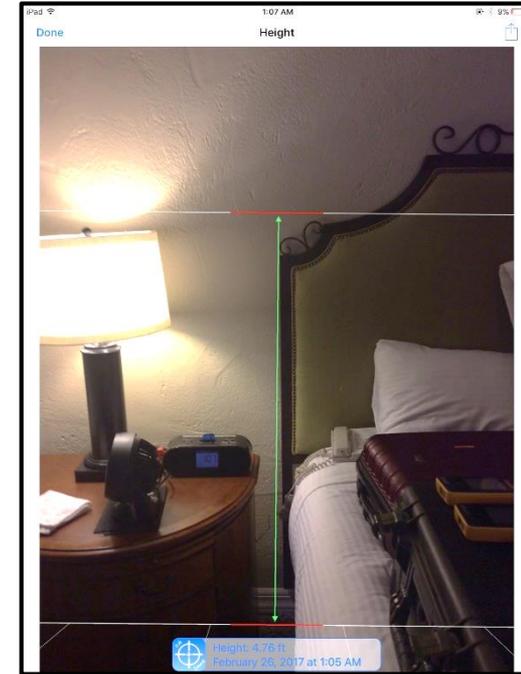
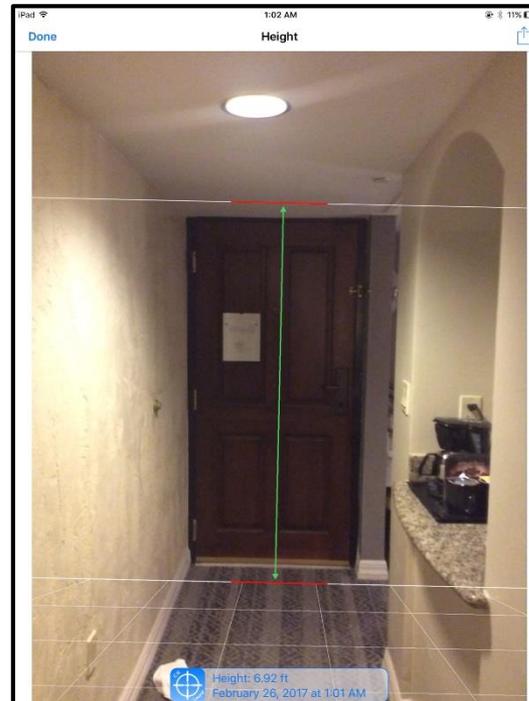
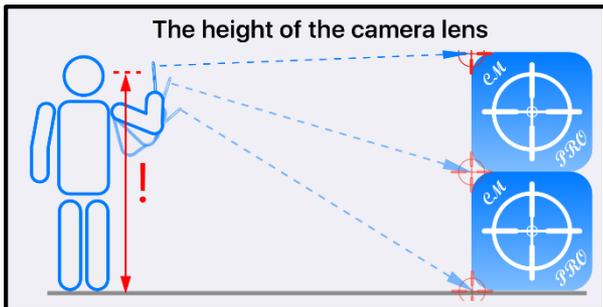
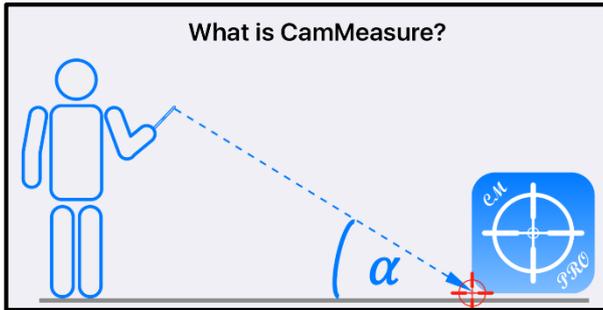
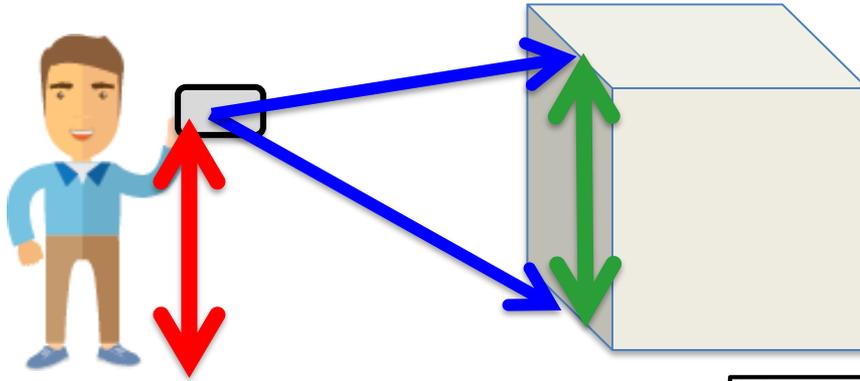


\$1.99



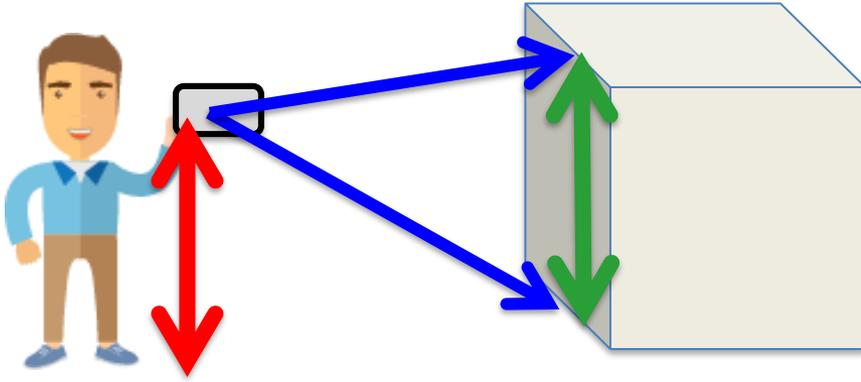
CamMeasure

Apple \$Free



Measurements <2"

Many alternatives



EasyMeasure



STANLEY Smart Measure Pro



MagicPlan

\$Free



Aka" STANLEY Floor Plan

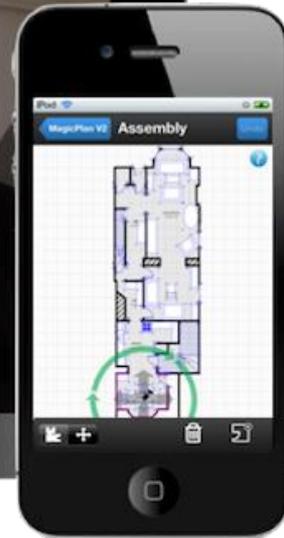
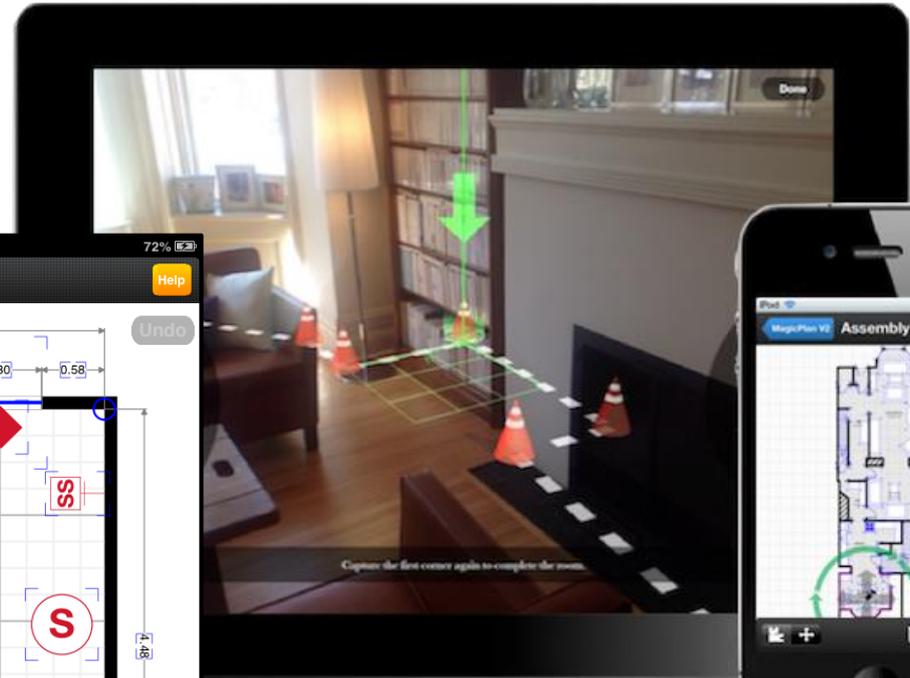


MagicPlan

\$Free



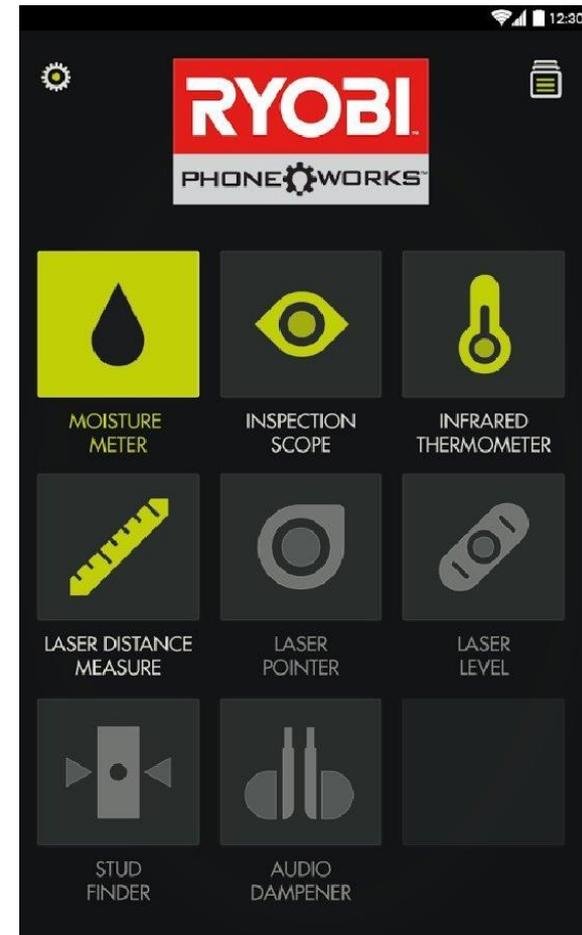
Aka" STANLEY Floor Plan



Laser Measurements



Ryobi ES1000 Phone Works Laser Distance Measurer



Laser Measurements

www.bosch-professional.com/static/specials/glm100c/gb/en/

Bosch GLM 100 Laser Tape Measure



Laser Measurements



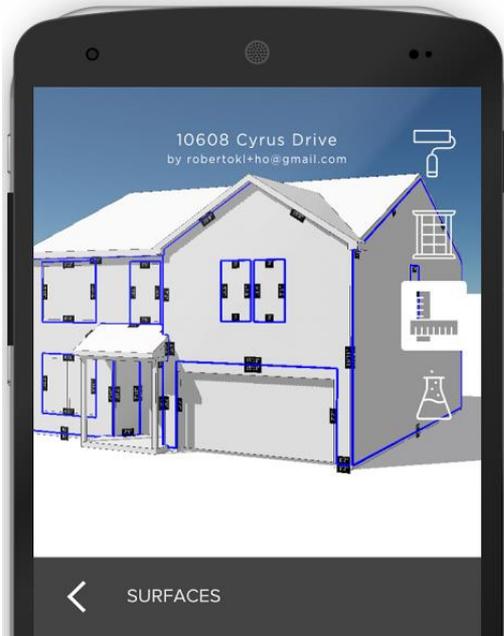
Bosch GLM 50 C Bluetooth Enabled Laser Distance Measurer with Color Backlit Display



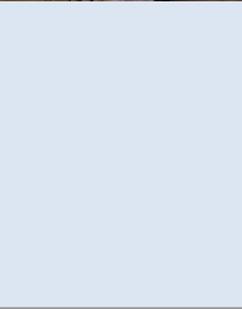
Emails



James Hardie Contractor's Eye™ 3D Estimator



James Hardie Contractor's Eye™ 3D Estimator



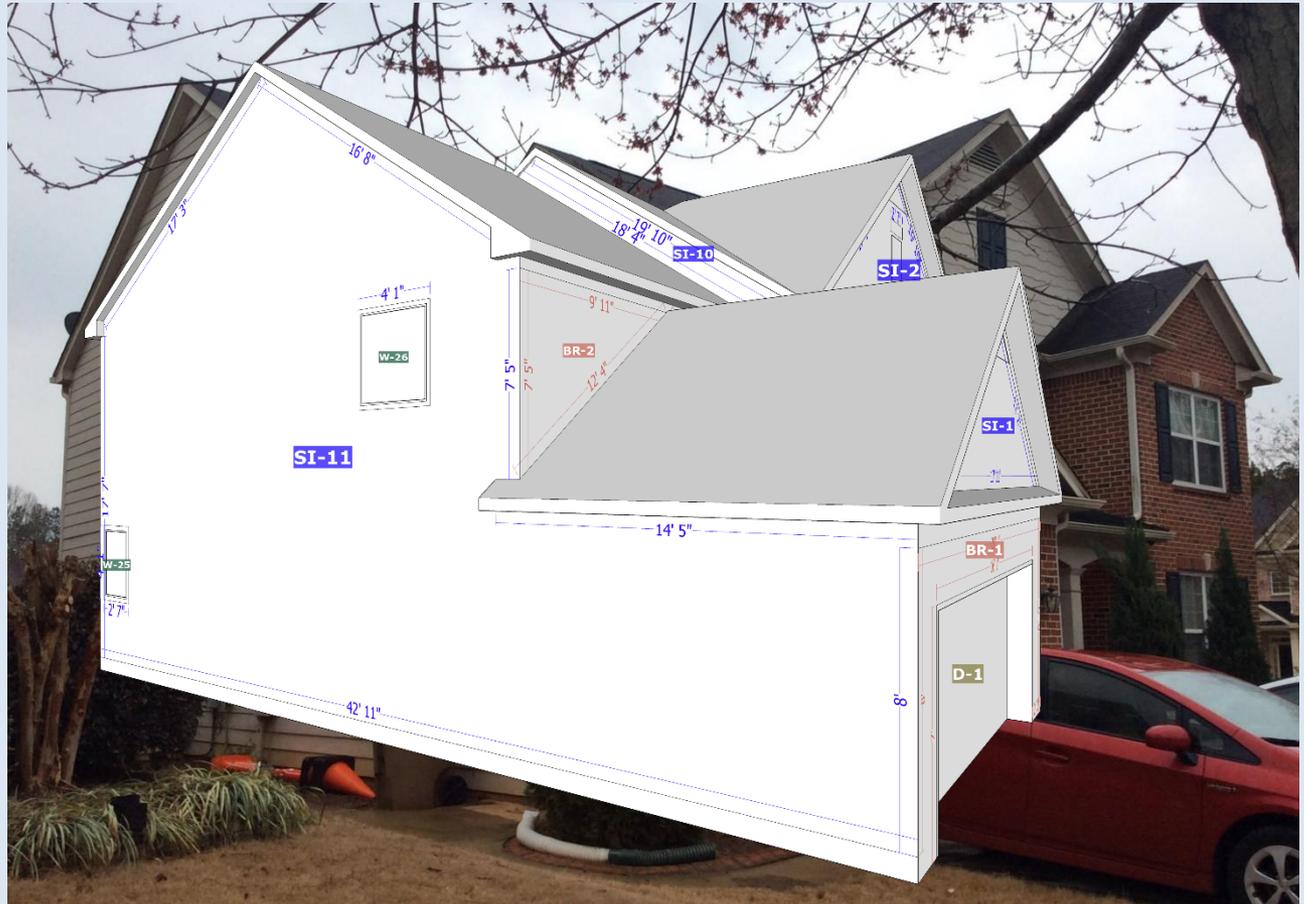
James Hardie Contractor's Eye™ 3D Estimator

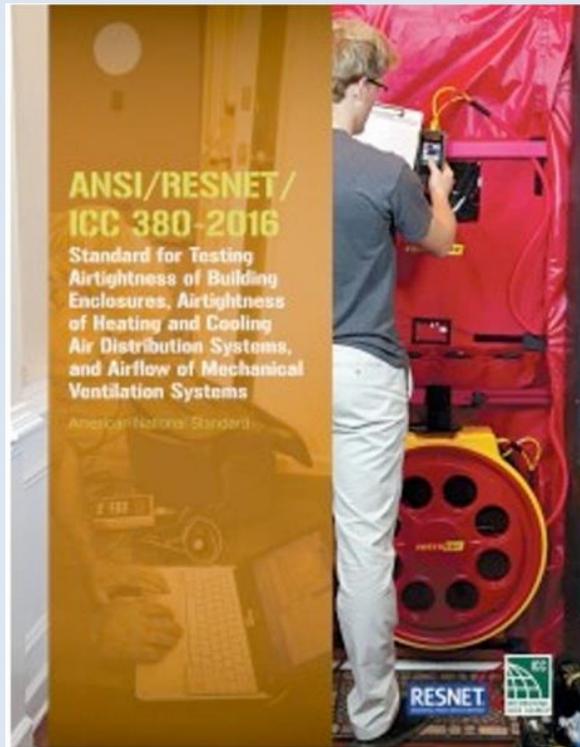


James Hardie Contractor's Eye™ 3D Estimator



 HOVER





ANSI / RESNET / ICC 380

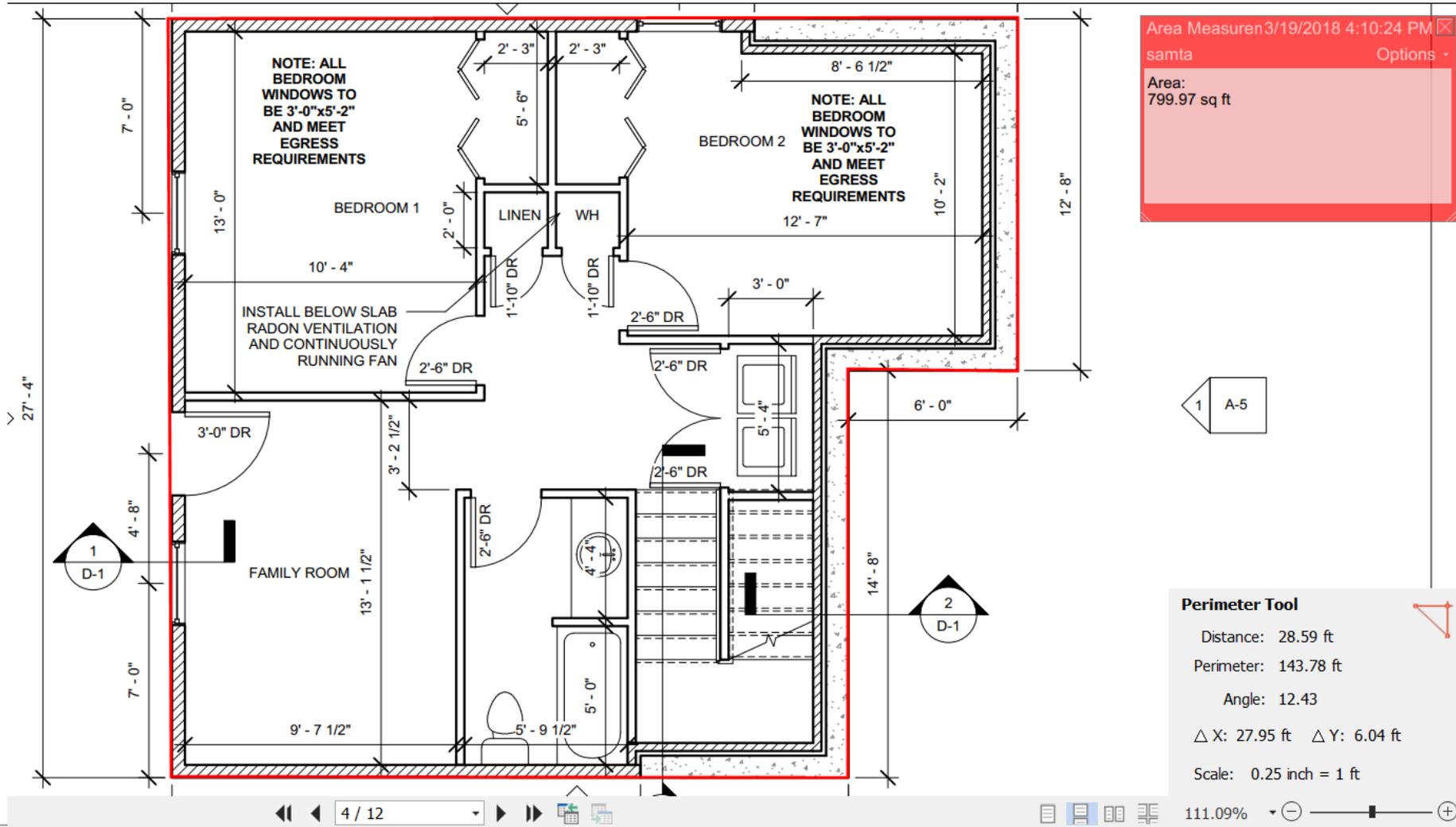
Air barrier is at the roof line ...
Attic hatch is opened and ...

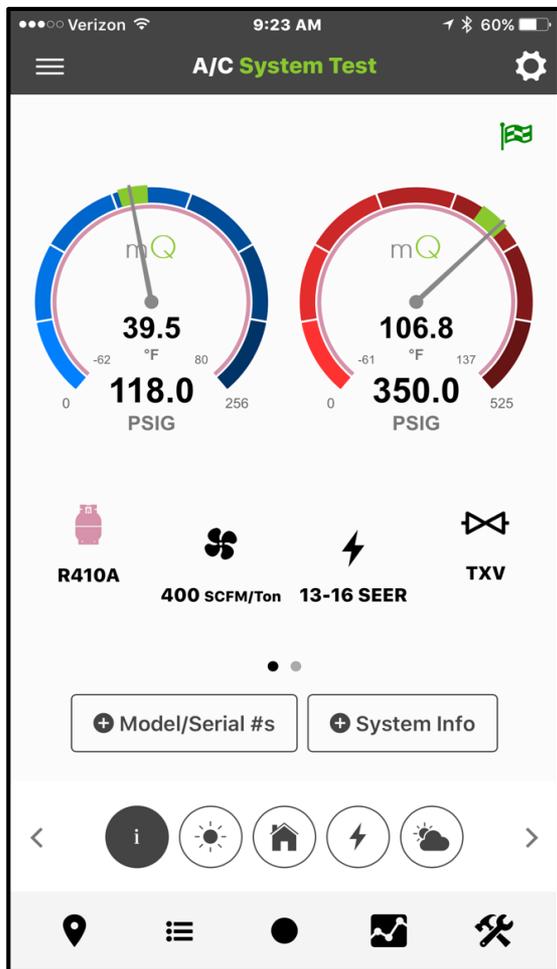


Need the volume of the attic!

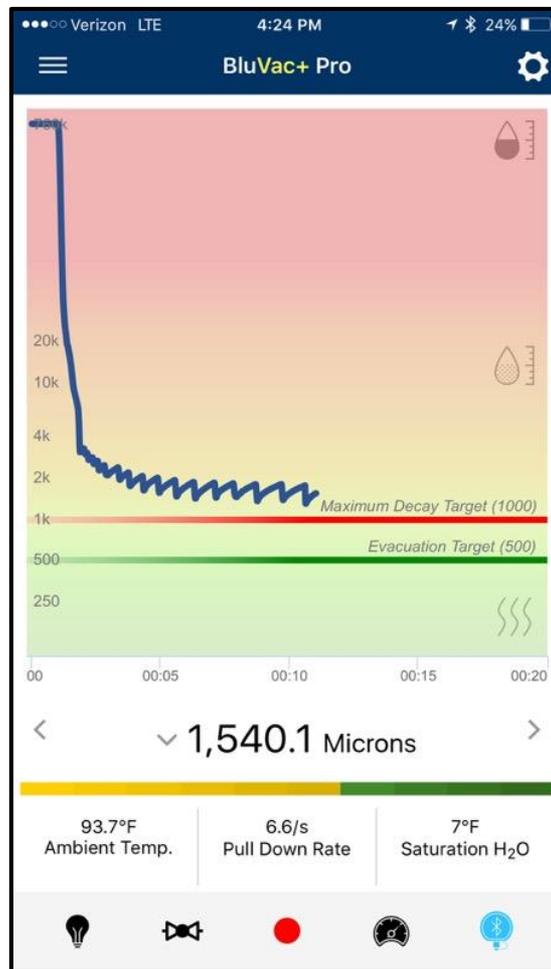
Take-offs from plans

\$Free





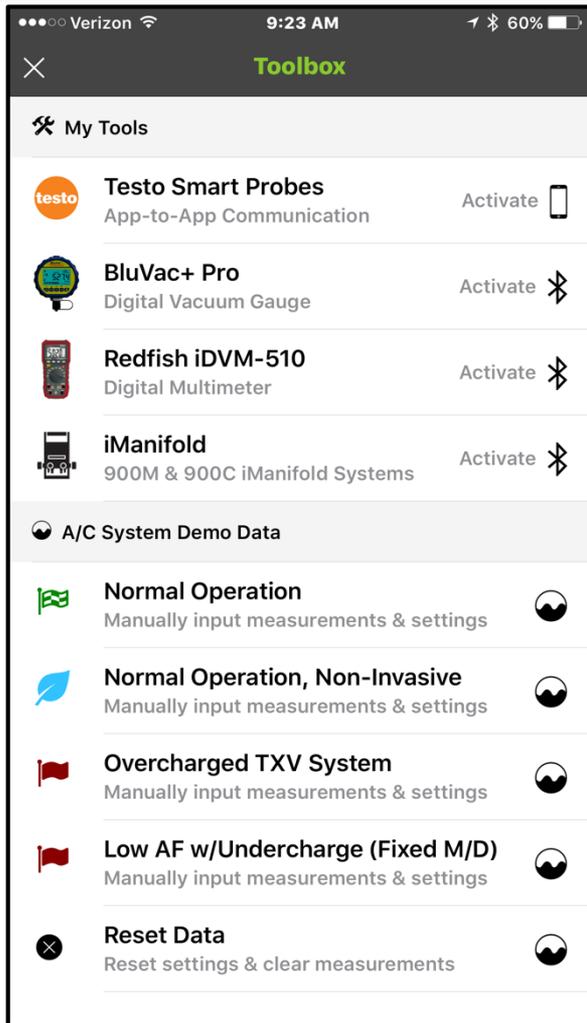
Air Conditioning/Refrigeration



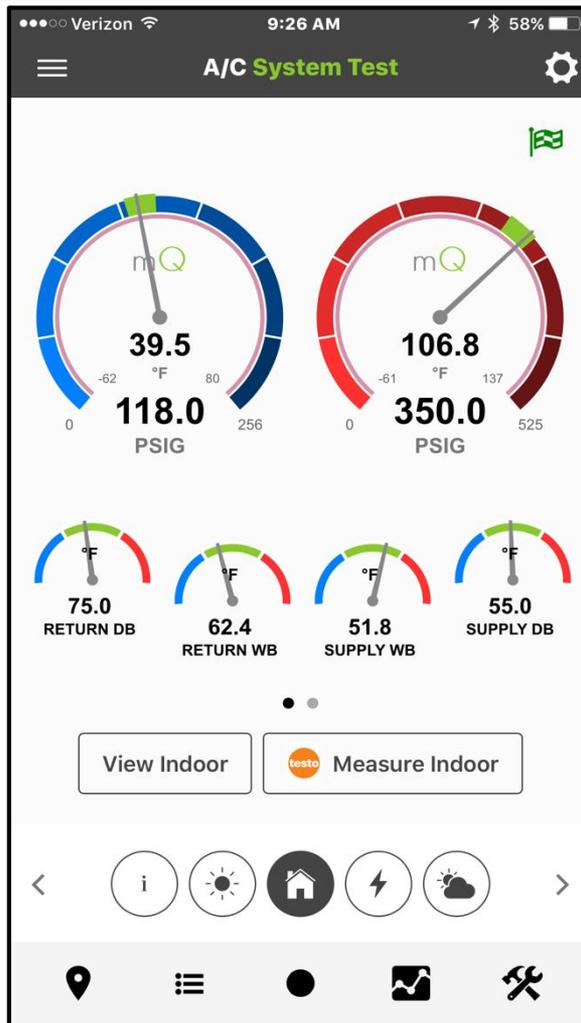
Evacuation



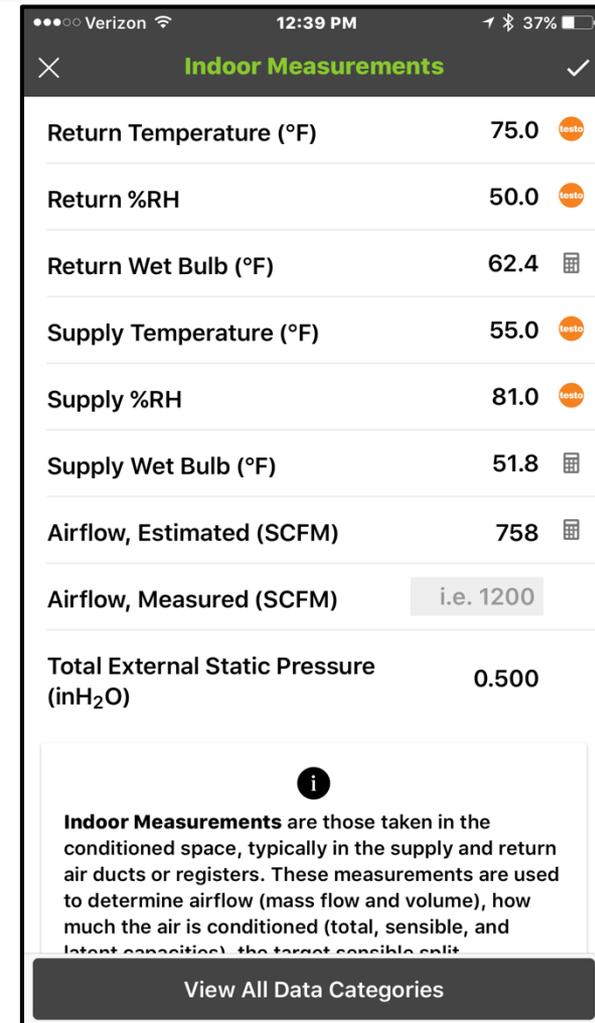
Electrical



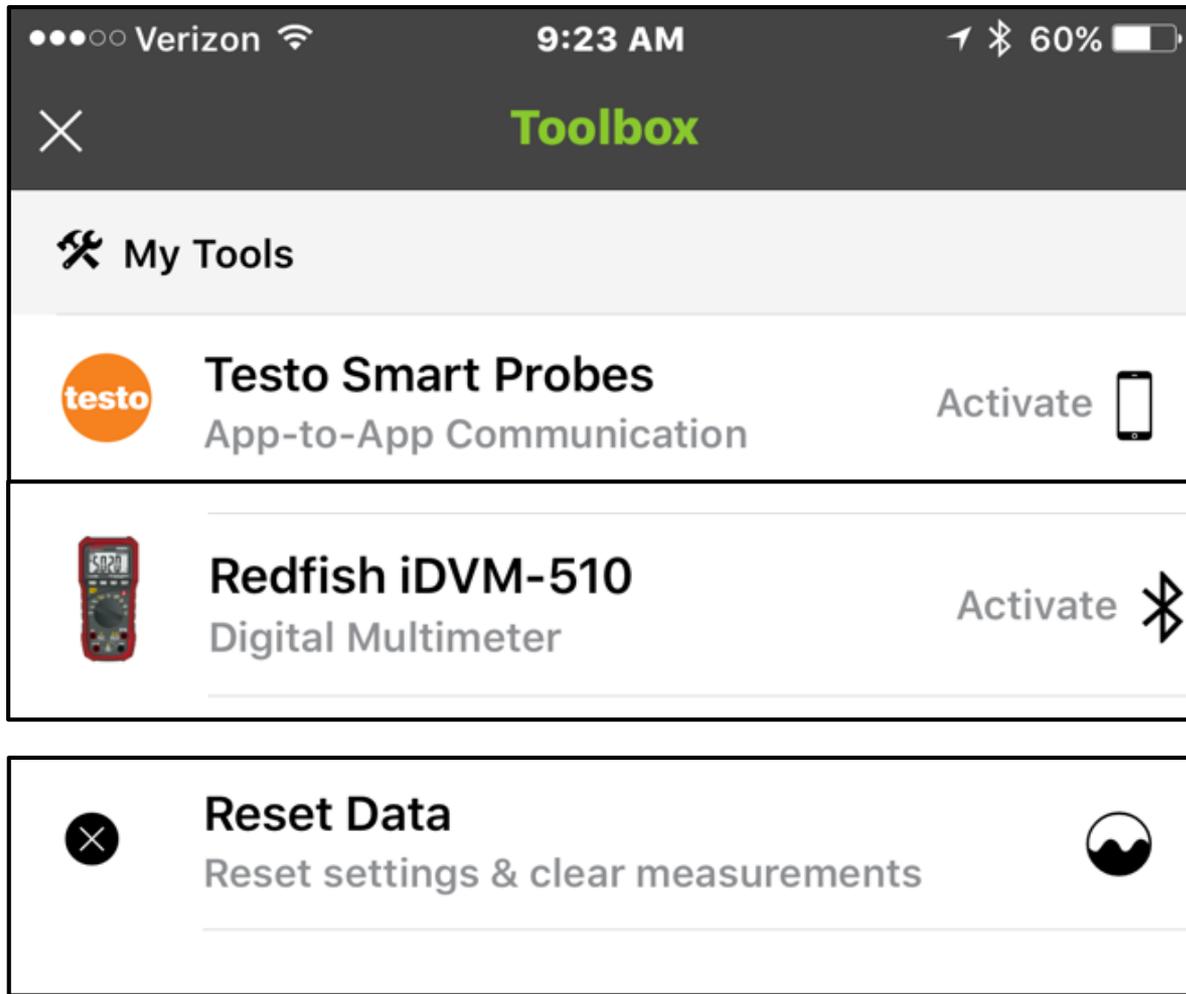
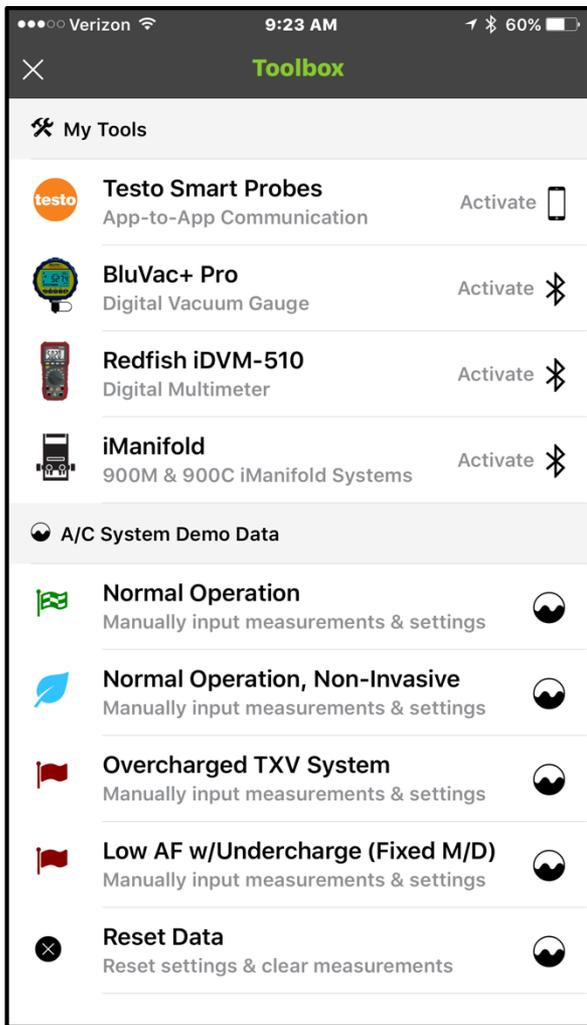
Connect your tools



Pull from the probes



Each Measurement Documented



Connect your tools



iPad 7:03 PM 100% export

HVAC Commissioning Checklist 1.2 ENERGY STAR Certified Homes, Version 3

HVAC Commissioning Contractor Responsibilities:

- The commissioning contractor must be credentialed by an HVAC oversight organization to complete this checklist.
- The completed checklist for each commissioned system, along with the corresponding HVAC Design Report, must be submitted to the contractor for quality assurance purposes. Furthermore, the contractor shall provide the builder, the Home Energy Rater responsible for certifying the home, and the HVAC oversight organization with a copy of the completed checklist.
- Visit www.energystar.gov/newhomes/hvac for information about the credential requirement and the commissioning process.

1. Commissioning Overview

1.1 Contractor name: **Jim Bergmann** Contractor company: **measureQuick**

1.2 Organization that your company is credentialed with: ACCA Advanced Energy

1.3 Builder client name: **John Smith**

1.4 Home address: **5592 Broadview Road Ohio 176** City: **Parma** State: **OH**

1.5 HVAC Design Report corresponding to this system has been collected from designer or builder.

1.6 Area that system serves, per Item 1.4 of HVAC Design Report: Whole-house Upper-level Lower-level

1.7 House plan, per Item 1.6 of HVAC Design Report: Split-level Other

2. Refrigerant Charge - Run system for 15 minutes before testing. If outdoor ambient temperature at the condenser is known, below the manufacturer-recommended minimum operating temperature for the cooling cycle, then the system shall be tested at the outdoor ambient temperature. If the outdoor ambient temperature is not known, the outdoor temperature shall be recorded in Item 2.1, and the contractor shall check "N/A" in this Section.

2.1 Outdoor ambient temperature at condenser: **85.0** °F DB

2.2 Return-side air temperature inside duct near evaporator, during cooling mode: **62.4** °F WB

2.3 Liquid line pressure: **350.0** psig

2.4 Liquid line temperature: **95.0** °F DB

2.5 Suction line pressure: **118.0** psig

2.6 Suction line temperature: **50.0** °F DB

For System with Thermal Expansion Valve (TXV):

2.7 Condenser saturation temperature: **106.8** °F DB (Using Item 2.3)

2.8 Subcooling value: **11.8** °F DB (Item 2.7 - Item 2.4)

2.9 OEM subcooling goal: **10.0** °F DB

2.10 Subcooling deviation: **1.8** °F DB (Item 2.8 - Item 2.9)

For System with Fixed Orifice:

2.11 Evaporator saturation temperature: _____ °F DB (Using Item 2.5)

2.12 Superheat value: _____ °F DB (Item 2.6 - Item 2.11)

2.13 OEM superheat goal: _____ °F DB (Using superheat tables and Items 2.1 & 2.2)

2.14 Superheat deviation: _____ °F DB (Item 2.12 - Item 2.13)

2.15 Item 2.10 is ± 3°F or Item 2.14 is ± 5°F

2.16 An OEM test procedure (e.g., as defined for a ground-source heat pump) has been used in place of the

Verizon 9:27 AM 58%

A/C Vitals 12/31/1969, 7:00:00 PM

measureQuick
www.measurequick.com

Outdoor Measurements		Indoor Measurements		System Info & Weather Data	
Low Pressure (psig):	118.0	Return Temp. (°F):	75.0	System Type:	Split
High Pressure (psig):	350.0	Return %RH:	50.0	Nominal Tonnage (tons):	2
Suction Line Temp. (°F):	50.0	Return Wet Bulb (°F):	62.4	Refrigerant:	R410A
Liquid Line Temp. (°F):	95.0	Supply Temp. (°F):	55.0	Nominal Airflow:	400
Discharge Line Temp. (°F):	170.0	Supply %RH:	81.0	SEER:	13-16
Outdoor Air Temp. (°F):	85.0	Supply Wet Bulb (°F):	51.8	Metering Device:	TXV
Superheat (°F):	10.5	Airflow, Estimated (SCFM):	758	Airflow, Estimated (scfm):	757.9
Subcooling (°F):	11.8	Airflow, Measured (SCFM):	--	Atmospheric Pressure (psia):	14.283
Compression Ratio:	2.8	Total External Static Pres (inH2O):	0.5	Elevation (ft):	786
				Temperature (°F):	85.0
				Humidity (%):	50.0
				Dew Point (°F):	55.2

Performance Calculations	
Capacity Calculations:	
Nominal:	2.0 Tons / 24,000 Btu/hr
Normalized:	1.9 Tons / 22,704 Btu/hr
Actual:	1.9 Tons / 22,519 Btu/hr (99.2% Normalized)
Sensible:	1.3 Tons / 16,037 Btu/hr (106.4% Normalized)
Latent:	0.5 Tons / 6,482 Btu/hr (84.9% Normalized)
Sensible Heat Ratio:	0.71
Air-side Performance:	
Airflow (estimated):	758 SCFM
Airflow (measured):	--
Temp. Split Target:	19.0°F
Temp. Split:	20.0°F
Dehumidification:	6.0 lb/hr
Dehumid. Gallons:	0.7 gal/hr
Energy Efficiency:	
EER:	12.68
Approx. SEER:	14.08

Send a completed Energy Star Verification!

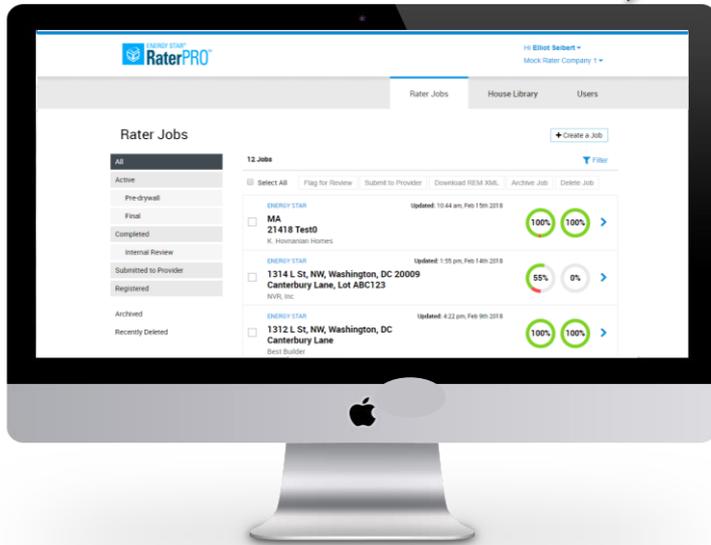
Jim Bergmann jim@measurequick.com



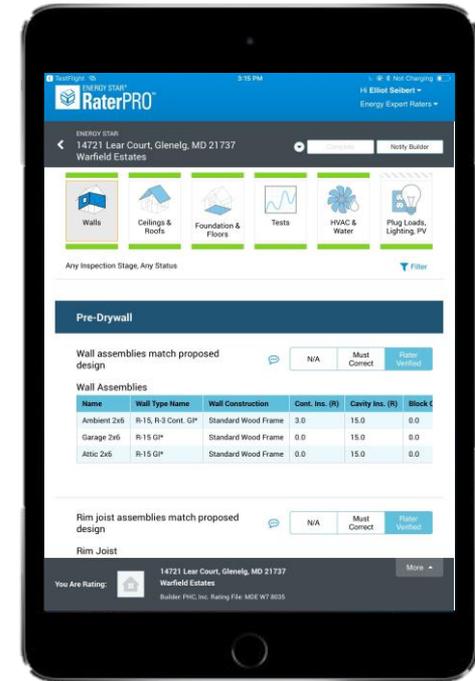
EnergyStar Rater App



Cloud
Hosted



Web-Based Admin Site



Field App



EnergyStar Rater App



ENERGY STAR RaterPRO™ Hi Dean Gamble

678 test lane, Fairfax, Va

Walls Ceilings & Roofs Foundation & Floors Tests HVAC & Water Plug Loads, Lighting, PV

21 checklist items for Any Inspection Stage, Any Status

Ceilings & Roofs - Pre-Drywall

1 Roof / ceiling assemblies match proposed design

Roof/Ceiling Assemblies

Name	Ceiling Type Name	Ceiling Type	Cont. Ins. (R)	Cavity Ins. (R)	Ins. Grad
Flat	DRH H - 2.5 Flat Cei*	Attic	0.0	30.0	I
HVAC	DRH H - 2.5 HVAC*	Attic	0.0	19.0	I
Vaulted/Cathedral	DRH H - 2.5 Vaulted *	Vaulted	0.0	19.0	I

N/A Must Correct Rater Verified

1 Insulation levels match proposed design

Builder Verified Must Correct Rater Verified

You Are Rating: 678 test lane, Fairfax, Va
Builder: House Plan: 4783 A English

ENERGY STAR RaterPRO™ Hi Dean Gamble

Jobs

Active Offline Jobs

10 Jobs

Sync Status: Last Updated Oct 10th 2017, 9:42:50 pm

Available Offline Pre-drywall Final

- 678 test lane, Fairfax, Va
Created: 5:05:33 pm, Oct 10th 2017
10% 0%
- 878 main st, Boston, MA
Created: 10:46:36 pm, Oct 9th 2017
50% 2%
- 123 Maple Lane, Alexandria, VA 22003
Created: 1:32:35 pm, Sep 27th 2017
0% 0%
- 456 Sun Street, Alexandria, VA 22031
Created: 11:48:58 am, Sep 19th 2017
0% 0%
- 8503 Test Lane, Washington, Dc 20009
Updated: 11:47:15 am, Sep 19th 2017
0% 0%
- 136 Main St, Fairfax, VA 22031
Updated: 1:50:26 pm, Sep 13th 2017
0% 5%



EnergyStar Rater App



ENERGY STAR 10:56 AM 100%

Edit Duct Systems

Cancel Save

Name: Ducts Area Served (sq. ft.): 2400

Htg. Equip Served: equip-1 Clg. Equip Served: equip-1

Leakage To Outside

Total Leakage to Outside: 79.92 CFM25

0.0333 CFM25/CFA

Leakage Test Exemption? True False

measurement type	heating season value	cooling season value	units	shelter class
Blower door test	2.65	2.65	ACH @ 50 Pascals	4

Duct systems match proposed design N/A Must Correct Rater Verified

Duct Systems

Name	Htg. Equip Served	Clg. Equip Served	Area Served (sq. ft.)	Leakage Input Type	Default
Ducts	equip-1	equip-1	2400	Total Leakage	RESNE

You Are Rating: 3970 White Sands Blvd, Orlando, FL 32789
Builder: Peninsula Homes Rating File: 3948 White Sands

ENERGY STAR 10:56 AM 100%

Edit Infiltration

Cancel Save

Infiltration Value: 901

2.65 ACH50

Shelter Class: 4

measurement type	heating season value	cooling season value	units	shelter class
Blower door test	2.65	2.65	ACH @ 50 Pascals	4

Duct systems match proposed design N/A Must Correct Rater Verified

Duct Systems

Name	Htg. Equip Served	Clg. Equip Served	Area Served (sq. ft.)	Leakage Input Type	Default
Ducts	equip-1	equip-1	2400	Total Leakage	RESNE

You Are Rating: 3970 White Sands Blvd, Orlando, FL 32789
Builder: Peninsula Homes Rating File: 3948 White Sands



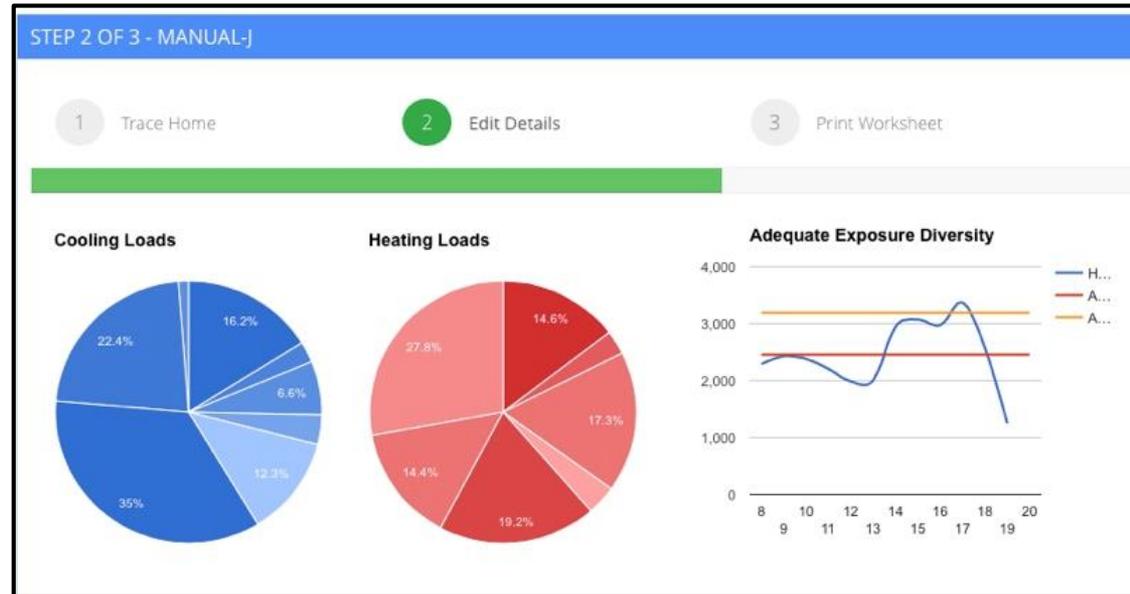
Manual J from satellite image!



1967 sq ft



1803 sq ft



Sensible Cooling Load 10856.19

Latent Cooling Load 3357.65

Heating Load 20445.47

Energy Usage and Payback Calculator

(Excel File) From Energy Star



Why this tool rocks:

- More customization than other tools
- Gives you ability to input cost of air conditioner in order to see complete life cycle savings
- Lets you add number of air conditioner units
- Lets you add electric rate per kilowatt
- Gives you option to calculate based on location
- Lets you see side by side comparisons of conventional vs Energy Star rated air conditioners

Energy Usage and Payback Calculator

Enter your own values in the gray boxes or use our default values.

Number of units
 Electric Rate (\$/kWh)

ENERGY STAR Qualified Unit

Conventional Unit

Initial Cost per Unit (estimated retail price with installation)**
 Seasonal Energy Efficiency Ratio (SEER) rating
 Cooling Capacity of Air Conditioner (Btu/hr)
 Use with programmable Thermostat (Yes/No)

Annual and Life Cycle Costs and Savings for 1 Central Air Conditioner(s)

	1 ENERGY STAR Qualified Units	1 Conventional Units	Savings with ENERGY STAR
Annual Operating Costs*			
Energy cost	\$504	\$669	\$165
<i>Energy consumption (kWh)</i>	4,465	5,929	1,464
Maintenance cost	\$0	\$0	\$0
Total	\$504	\$669	\$165
Life Cycle Costs*			
Operating costs (energy and maintenance)	\$5,320	\$7,064	\$1,744
Energy costs	\$5,320	\$7,064	\$1,744
<i>Energy consumption (kWh)</i>	62,511	83,005	20,494
Maintenance costs	\$0	\$0	\$0
Purchase price for 1 unit(s)	\$3,413	\$2,857	-\$556
Total	\$8,733	\$9,921	\$1,188

Simple payback of initial additional cost (years)[†] 3.4



House Smart Apps – Vernon House



DM32 PRESSURE PAN

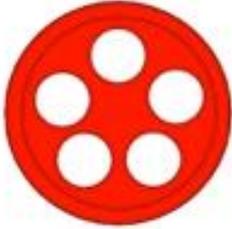


THIS TEST IS PERFORMED WITH THE BLOWER DOOR RUNNING AT 50 Pa

PRESSURE PAN SETUP

Turn the Furnace/Air Conditioning Off and remove Filter

Locate the Supply Registers in the home.



DM32
House Smart Apps
★★★★☆ FREE



QUICK ENERGY
CHECK
★★★★★ FREE

DM32 SMART GAUGE FIELD GUIDE

- QUICK GUIDE PDF
- BASIC BLOWER DOOR TEST
- ZONE TEST
- PRESSURE PAN TEST
- EXHAUST FAN FLOW TEST
- ROOM PRESSURE TEST
- DUCT BLASTER TEST
- RETROTEC WEBSITE
- RETROTEC VIDEOS
- SEND US AN EMAIL
- SHARE THIS APP



House Smart Apps – Vernon House



House Smart Apps



Building Analyst
House Smart Apps

★★★★★ FREE

cricket 91% 8:42 AM

QUICK REFERENCE TOOL



BUILDING ANALYST

The Building Analyst App is a handy quick reference tool for Professionals involved in the Building Performance and Building Diagnostics Industry.

BPI 1200-S-2015 STANDARDS PDF

NEW ONLINE - ASHRAE 62.2 FORM

NEW - ASHRAE 62.2 - 2013

MULTI-FAMILY SAMPLING PROCEDURES

48% 11:23 AM

CALCULATIONS & FORMULAS



BUILDING ANALYST

Gross Wall Area = Length x Width

Net Wall Area = Gross Wall Area with Doors and Windows Subtracted

Wall Volume = Net Wall Area x Wall Thickness
(4" wall = .333) (5" wall = .42) (6" wall = .50)

Triangle Area = .5 x base x h

Pythagorean Theorem = $A^2 + B^2 = C^2$

Volume of Angle = .5 x base x height x depth

ASHRAE 62.2 - 2013
(.03 X CFA) + 7.5 X (# Bedrooms +1)

HEAT LOSS CALCULATIONS

U - FACTOR = 1/R-VALUE

47% 11:24 AM

FURNACE FILTER MERV RATINGS



BUILDING ANALYST



BASIC FILTER = MERV 0



BASIC PLEATED = MERV 5



MICRO ALLERGEN = MERV 11



WASHABLE = MERV 8



4" PLEATED = MERV 11

Solocator – photo GPS

\$0.99



solocator™
Photos with direction

Available on the iPhone
App Store

GET IT ON
Google play

YES OPTUS 12:13 PM 78%
NW N NE
00 330 30 60
solocator™

SAMSUNG
NE E
30 90
30 60

BRG: 45°NE LAT: -36.411833 LON: 148.621667 ALT: 940.5m



Capture GPS coordinates (latitude & longitude) as well as direction. Email details and map links to crew.

Hayward Score: Measuring Home Health



[Articles](#) [Videos](#) [Ask An Expert](#) [About](#) [Contact](#)



COULD YOUR HOME BE MAKING YOU SICK?

Get your Hayward Score and personalized recommendations so you can take effective steps to start transforming your home today.

[GET YOUR SCORE NOW](#)



HOW HAYWARD SCORE HELPS YOU

Watch our video to learn more about how Hayward Score can empower you and your family.

[Find Out More.](#)



AN UNHEALTHY HOME

Just like a person, sick homes often show symptoms depending on a wide range of factors such as climate, age of the house, and occupancy.

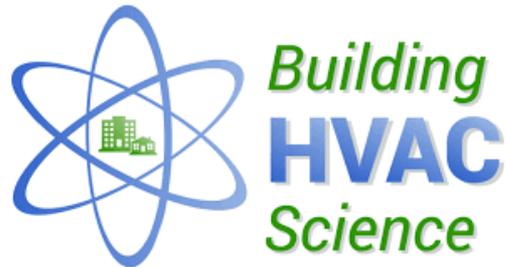
[Learn More.](#)



Podcasts to follow:



HVAC School with Bryan Orr



Building HVAC Science with Bill Spohn



RESTalk with Bill Spohn

Gauge Assistance Apps



- Remote access – 1 way > or 2 way ><
- Semi-automated tests. Data import.
- Automated tests, full control the fan.





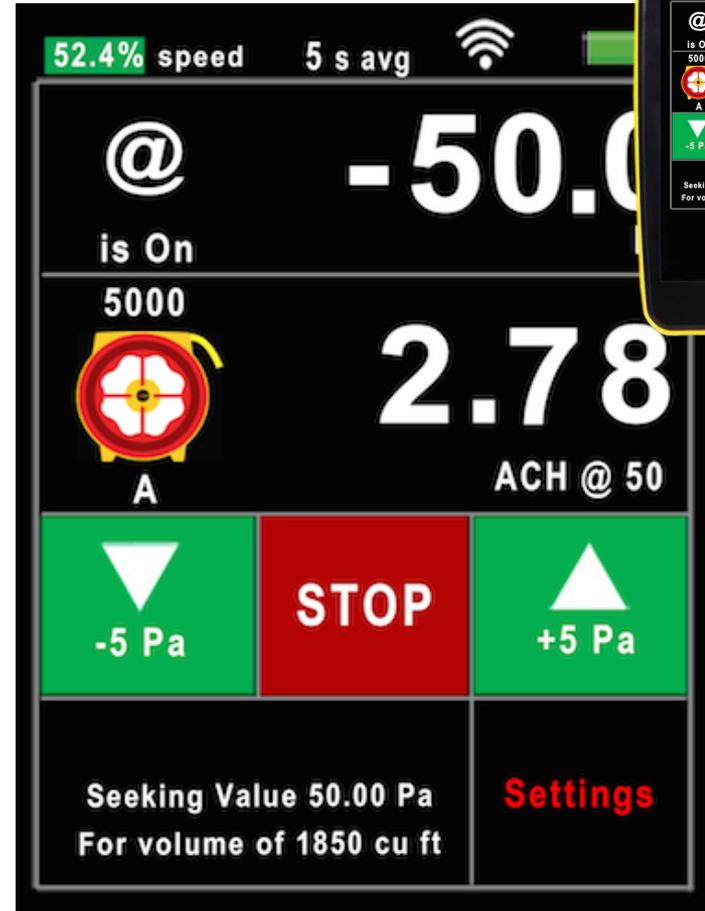
TEC Gauge



1 way control



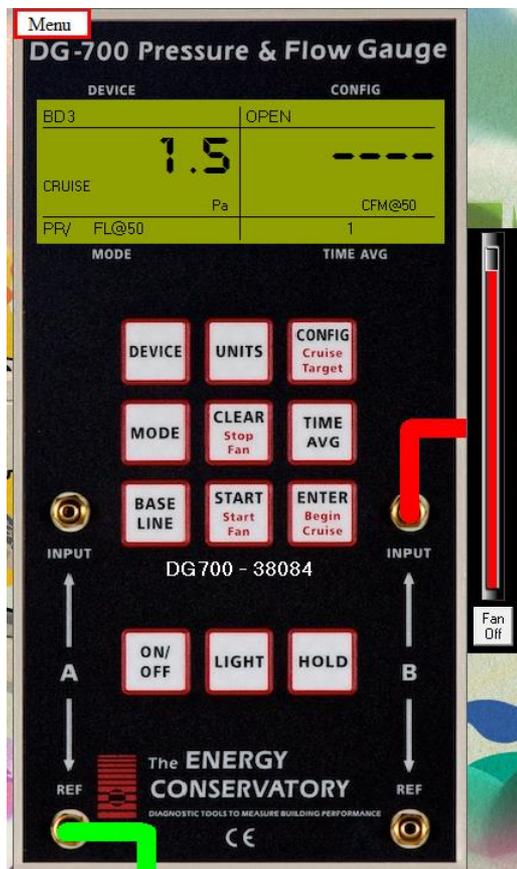
GaugeRemote



2 way control



DG-700 Connect



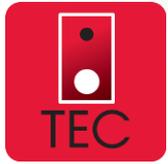
1 way control

Virtual Gauge



Multiple gauges

2 way control



TEC Resnet

Projects Example Help

Customer Info

Project Name: Example

Project Number: 1

Customer Name: Jim Smith

Customer Address: 34566 First Ave.

City: Wheaton

State/Province: IL

Zip: 60187

Phone: 333-444-5555

Email: Jim@smithco.co

Reports

Email Test File

Projects Example Help

Test Data - Manual Test

Pressurization Depressurization

Indoor Temp (F): 69.4

Outdoor Temp (F): 45.0

Site Altitude (Ft): 456.0

Time Averaging Period (s): 10.0

Test Date: 3/9/12

Baseline Readings

Average Baseline (Pa): -1.7

Baseline Range (Pa): 6.3

Test Readings

Nominal Building Press. (Pa): -18.5

Projects Example Help

Test Date: 3/9/12

Baseline Readings

Average Baseline (Pa): -1.7

Baseline Range (Pa): 6.3

Test Readings

Nominal Building Press. (Pa):

Nominal Fan Flow (CFM):

Reports

Email Test File

Reports Report View

iTEC - RESNET Test Report

Test Results		
Corrected CFM50	1,137	CFM50
Accuracy Level	Reduced	
Air Changes per Hour @ 50 Pa	3.41	ACH50
Effective Leakage Area (ELA)	62.6	Sq. in.
Test Date	3/9/12	
Customer Information		
Project Number	1	
Name	Jim Smith	
Address	34566 First Ave.	
City	Wheaton	
State/Province	IL	
Zip	60187	
Phone	333-444-5555	
Email	Jim@smithco.com	
Building Information		
Address		
City		
State/Province		
Zip		
Year Constructed		

6:53 AM

Edit Projects

Example
Project number: 1
Customer Name: Jim Smith

Default
Project number: 0
Customer Name:

New Home
Project number: 0
Customer Name:

Projects Global Settings Help



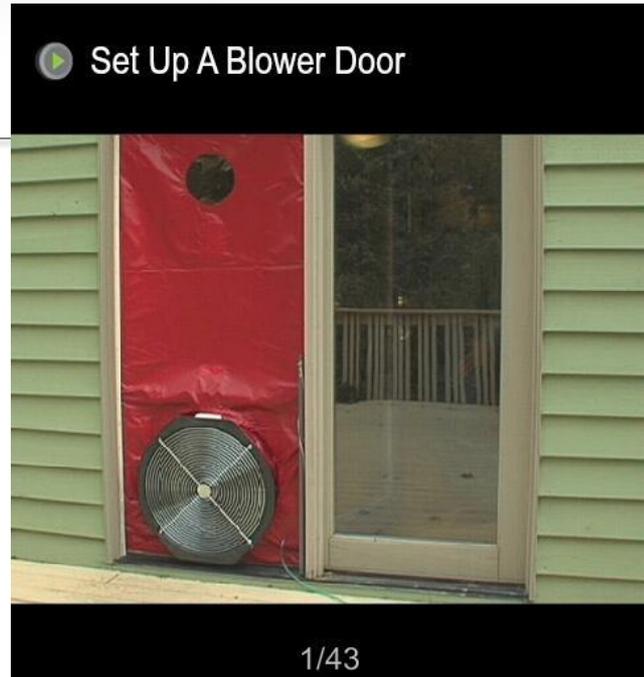
Master TEC

Master ▶ TEC Tutorials

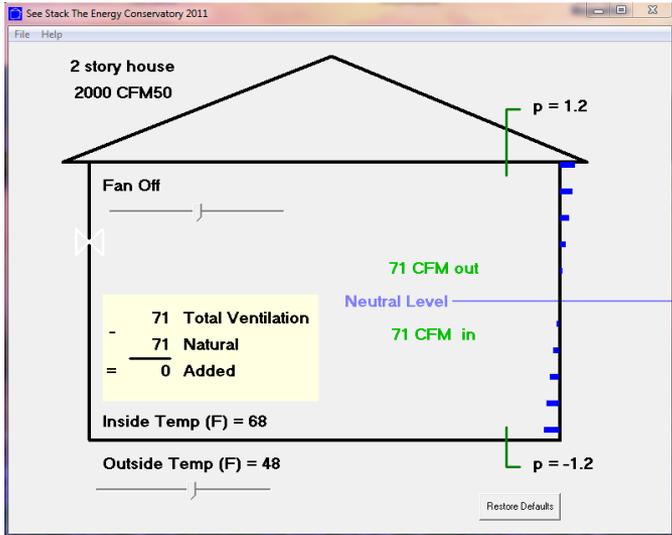
PERFORM A DEPRESSURIZATION TEST

SET UP A MINNEAPOLIS BLOWER DOOR

Sort List Find Info



See Stack Training Simulator



Virtual Gauge – simulated gauge



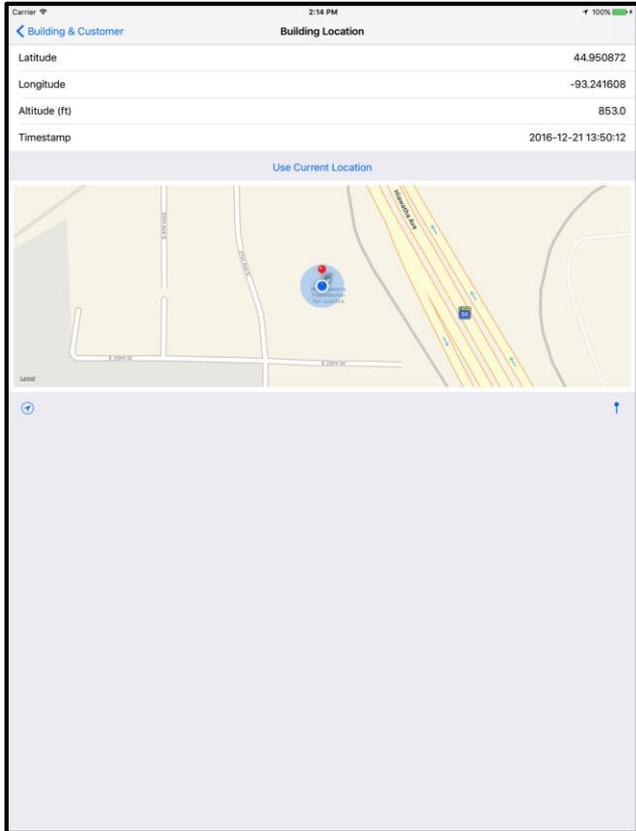
Blower Door Simulator



TEC Auto Test

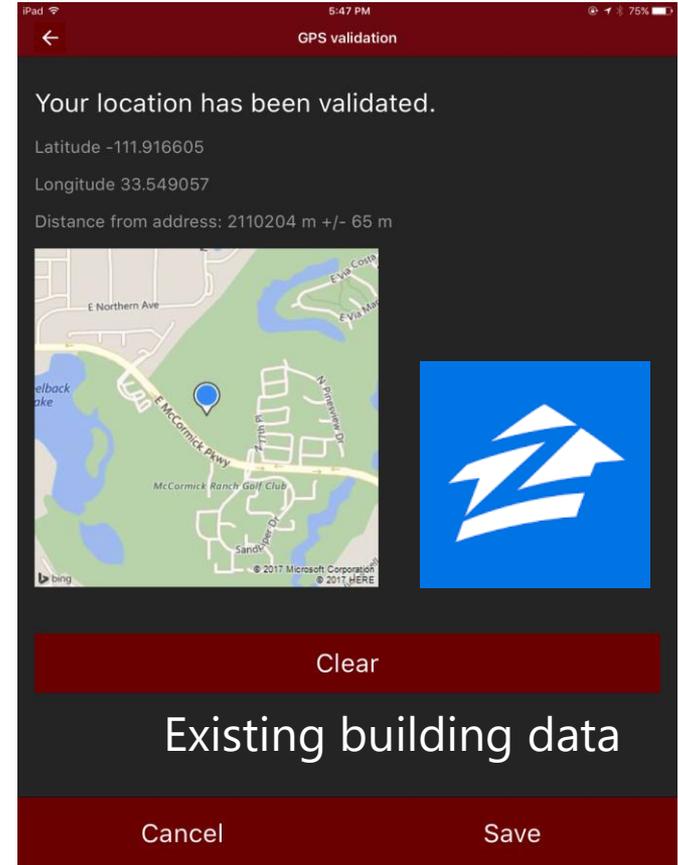
Geolocation

rCloud



Autofill
Address

Validate
Address



Get local weather



ETEC™

The Energy Conservatory

DG-1000





TEC Auto Test

Test ID & Purpose of Test

- IECC 12/15 Env. Leakage
- IECC 12/15 Duct Leakage
- CA Title 24 Duct Leakage
- IECC 12/15 Env. Leakage
- IECC 12/15 Duct Leakage
- CA Title 24 Duct Leakage
- IECC 12/15 Duct Leakage
- CA Title 24 Duct Leakage
- CFM50 Env. Leakage
- CA Title 24 Duct Leakage
- CFM50 Env. Leakage
- CFM25 Duct Leakage
- CFM50 Env. Leakage
- CFM25 Duct Leakage
- NY IECC 15 Env. Leakage
- CFM50 Env. Leakage
- CFM25 Duct Leakage
- NY IECC 15 Env. Leakage
- NY IECC 15 Env. Leakage
- EnerGuide Env. Leakage

Cancel OK

- < IECC 2012 BD >
- < IECC 2015 BD >
- Standard 380 >>
- < < CA Title 24 >
- < CFM50 BD >
- < CFM25 BD >
- < IECC NY BD
- < < Energy Guide
- Weatherization BD >
- ATTMA >>
- ISO9972 >>
- General BD/DT >>

rCloud

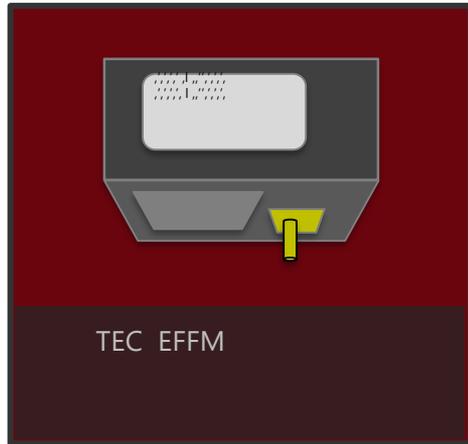
Select Test Points

RESNET Blower Door Test

- Single Point
- Multi Point
- Repeated Single Point

Cancel

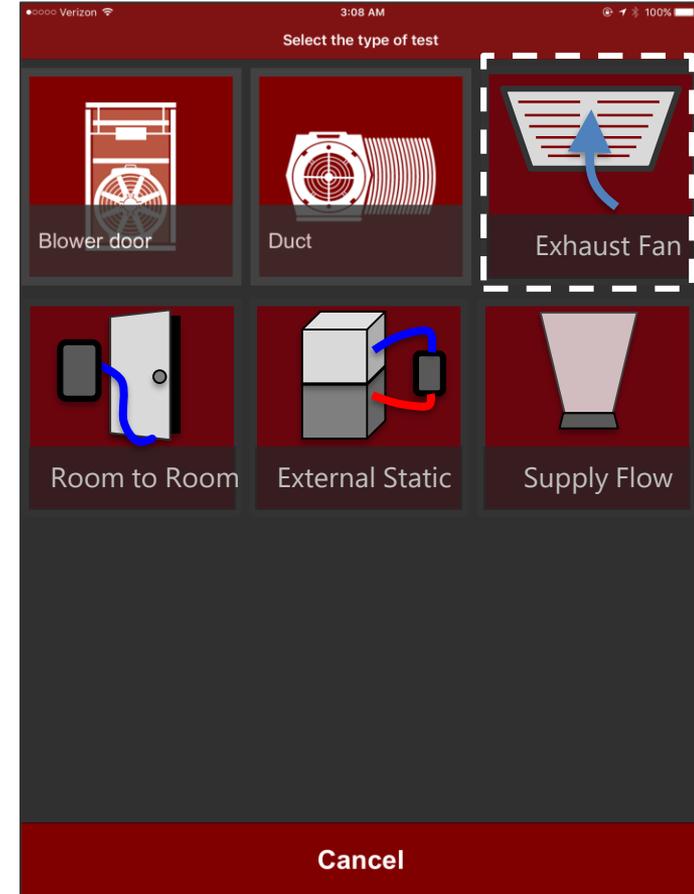




- IECC 2012 BD
- RESNET 380-2016
- CFM50 BD
- CFM25 BD
- IECC NY BD
- Energy Guide
- Weatherization BD
- ATTMA
- ISO9972
- General BD/DT



rCloud



Exhaust Fan Measurement

*Location
First floor bathroom

*Compliance
Greater than 65 CFM

Notes

Pressure Ch A 5.7 Pa

Pressure Ch B 5.7 Pa

Range E 2

Flow 68.2 CFM

Result Pass

Save

- IECC 2012 BD
- RESNET 380-2016
- CFM50 BD
- CFM25 BD
- IECC NY BD
- Energy Guide
- Weatherization BD
- ATTMA
- ISO9972
- General BD/DT

Exhaust Fan Measurement

PASS	Location	First floor bathroom	1	+
Delete	Device	TEC EFFM	Range E 2	
	Greater than	65 CFM		
	Results	68.2 CFM		
PASS	Location	Master bathroom		+
Delete	Device	TEC EFFM	Range E 2	
	Greater than	55 CFM		
	Results	71.8 CFM		
	Notes:	Fan light unit		
FAIL	Location	Master bathroom		+
Delete	Device	TEC EFFM	Range E 2	
	Greater than	55 CFM		
	Results	0.0 CFM	Entered manually	
	Notes:	Fan did not operate. No power.		

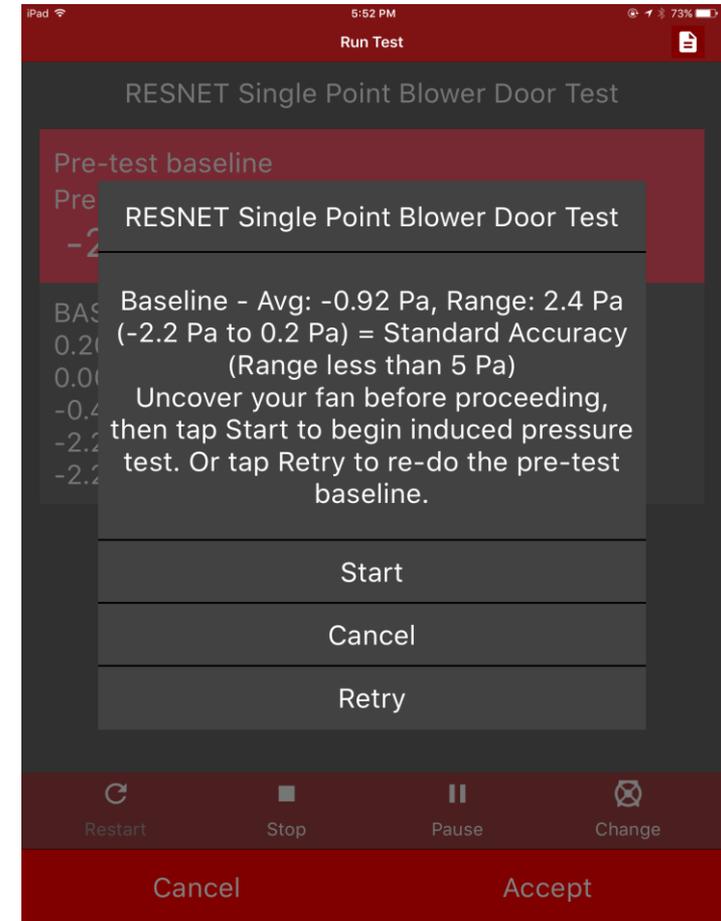


TEC Auto Test

rCloud

Baseline
Accuracy
results.

Standard
Reduced
Exceed





TEC Auto Test

Carrier 2:12 PM 100% Done

Apartment 234B - Auto Test

257 Model 3 Ring B
DG-1000 Model 3 Fan Config

-38.8 Adj Building (Pa) -46.3 Fan (Pa) 406.0 Flow (cfm)

Adjusting Fan - 36 Pa Target Pressure

Target (Pa)	Bldg (Pa)	Adj Bldg (Pa)	Fan (Pa)	Flow (cfm)	Config
Baseline	-0.8	---	---	---	---
-60.0	-61.2	-60.3	-73.1	508.7	Ring B
-54.0	-54.8	-54.0	-65.5	481.7	Ring B
-48.0	-48.7	-47.9	-57.9	453.3	Ring B
-42.0	-43.0	-42.2	-51.0	425.5	Ring B
-36.0					
-30.0					
-24.0					
-18.0					
Baseline					

Stop Stop Test Clear Sample

Live test results.

Once test starts, data cannot be changed.

- Address,
- Compliance target,
- Size of the home...

rCloud

iPad 5:55 PM 72% Run Test

RESNET Single Point Blower Door Test

-2.20 Pa
-2.20 Pa

Pressurized test set
DM32 connected. Tap 'Resume' to resume test.
50.7 Pa / 1159 CFM

Induced pressure result

Room (Pa)	Fan (Pa)	Flow (CFM)
49.00	117.30	1108.00
49.60	119.60	1125.00
50.20	121.90	1136.00
51.30	124.40	1151.00
50.90	124.70	1159.00
50.70	124.70	1157.00
50.90	124.70	1156.00
50.70	124.70	1157.00
50.70	124.70	1159.00

Restart Stop Resume Change

Cancel Accept



TEC Auto Test

Carrier 2:13 PM 100%
Final Duct Inspection Report

Duct Leakage Test

Testing Company:
Name: Smith Consulting
Address: 3446 Drew Ave.
Wheaton, IL 60187
Phone: 444-333-2222
www.smithcons.org

Technician:
Name: Erik S.
Credentials: BPI Building Analyst Certification
3/19/2015.
Email: info@energyconservatory.com

Building Information:
Project ID: Example
Address: 2801 21st Ave S
Suite 160
Minneapolis, MN 55407
Geo-Tag Data: Latitude: 44.951044
Longitude: -93.241572
Timestamp: 2016-09-02 14:04:04

Customer Information:
Name: The Energy Conservatory
Address: 2801 21st Ave. South
Suite 160
Minneapolis, MN 55407
Phone: (612) 827-1117
Email: info@energyconservatory.com

Test Results: **Measured Leakage:** **4.48 CFM25/100 ft² (floor area)**
Leakage Target: **4.00 CFM25/100 ft² (floor area)**
Compliance with Leakage Target: **Fail**

Test ID: Final Duct Inspection
Purpose of Test: IECC 12/15 Duct Leakage
Measured CFM25: 109.7
Conditioned Floor Area: 2,450.0 ft² AH Flow: 1,600.0 cfm
Flow Coefficient (C): 15.9 Exponent (n): 0.600 (assumed)
Test Standard: RESNET 380 Total Duct Leakage Test Mode: Depressurize
Test Characteristics: Time Average Period: 5 seconds
Test Date and Time: 2016-09-02 14:54:33

Test Readings:

Target (Pa)	Duct (Pa)	Fan (Pa)	Flow (cfm)	Config
-25.0	-25.1	-49.3	109.9	Ring 2

Report
with
compliance
results.

Standard 380 rCloud

Compliance Verification	
3.2.1. Fenestration. Exterior doors and windows are closed and latched.	Confirmed
3.2.2. Attached garages. If blower door is installed between the house and the garage, in which case the garage shall be opened to outside by opening at least one exterior garage door.	Confirmed
3.2.3. Crawlspace vents and hatches	Vented
3.2.4. Attic doors and hatches	Open
3.2.5. Basement doors	Open
3.2.6. Interior doors. All doors between rooms inside the Conditioned Space Volume are opened.	Confirmed
3.2.7. Chimney dampers and combustion-air inlets on solid fuel appliances are closed.	Confirmed
3.2.8. Combustion appliance flue gas vents are left in their as-found position.	Confirmed
3.2.9. Fans Turned Off - Any fan or appliance capable of inducing airflow across the building enclosure are turned off including, but not limited to, clothes dryers, attic fans, kitchen and bathroom exhaust fans, air handlers, ventilation fans used in a whole-house mechanical ventilation system (example a system intended to meet ASHRAE Standard 62.2), and crawlspace and attic ventilation fans. This requirement to turn fans off includes accessible fans in adjacent attached dwelling units.	Confirmed
3.2.10.1. Non-motorized dampers (example pressure-activated operable dampers and fixed dampers), that connect the Conditioned Space Volume to the exterior or to Unconditioned Space Volumes shall be left in their as-found positions. (example, a fixed damper in a duct supplying outdoor air for an intermittent ventilation system that utilizes the HVAC fan shall be left in its as-found position).	Confirmed
3.2.10.2. Motorized dampers that connect the conditioned space volume to the exterior or to unconditioned spaces shall be placed in their closed positions and shall not be further sealed.	Confirmed
3.2.11.1. Non-dampered ventilation openings of intermittently operating local exhaust ventilation systems (example bath fan and kitchen range fan), that connect the Conditioned Space Volume to the exterior or to Unconditioned Space	Confirmed
3.2.11.2. Non-dampered ventilation openings of intermittently operating whole-house ventilation systems, including HVAC fan-integrated outdoor air inlets, that connect the Conditioned Space Volume to the exterior or to Unconditioned Space Volume shall not be sealed.	Confirmed
3.2.11.3. Non-dampered ventilation openings of continuously operating local exhaust ventilation systems, (example bathroom or kitchen exhaust), that connect the Conditioned Space Volume to the exterior or to Unconditioned Space Volume shall be sealed, preferably at the exterior of the enclosure.	Confirmed
3.2.11.4. Non-dampered ventilation openings of continuously operating whole-house ventilation systems that connect the Conditioned Space Volume to the exterior or to Unconditioned Space Volume shall be sealed at the exterior of the enclosure where conditions allow.	Confirmed
3.2.11.5. All other Non-dampered intentional openings between Conditioned Space Volume and the exterior or Unconditioned Space Volume shall be left open. (Informative Note: For example undampered combustion air or make-up air openings shall be left in their open position).	Confirmed
3.2.12. Whole-building fan louvers and shutters shall be closed. In addition, if there is a seasonal cover present, it shall be installed.	Confirmed
3.2.13. The opening to the exterior of evaporative coolers shall be placed in its off position. In addition, if there is a seasonal cover present, it shall be installed.	Confirmed

Tools, Gadgets, Etc.

Smoke – Power Tiny S (smoke generator)



NEW PRODUCT

- Triethylene Glycol
- Monopropylene Glycol
- Dipropylene Glycol
- Demineralized Water
- Not - Neutral buoyancy smoke
- Controlled powered smoke
- Battery powered



Power Tiny S – Smoke Generator



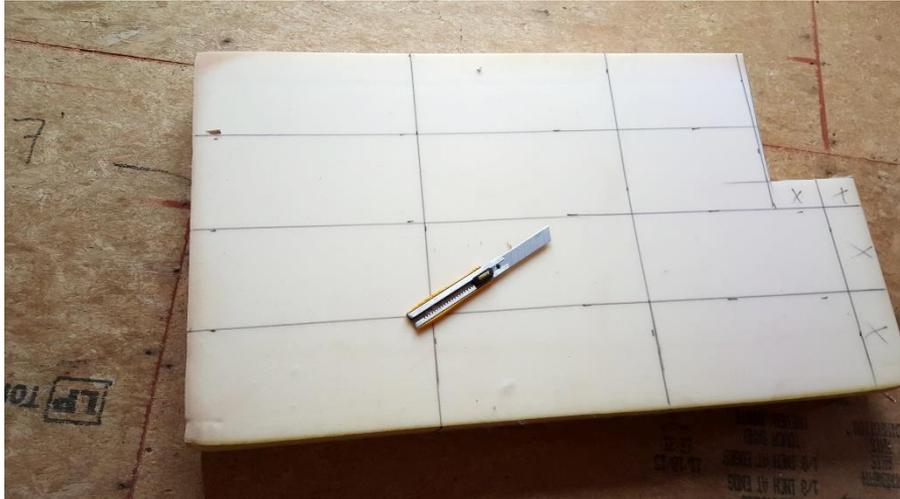
New Product



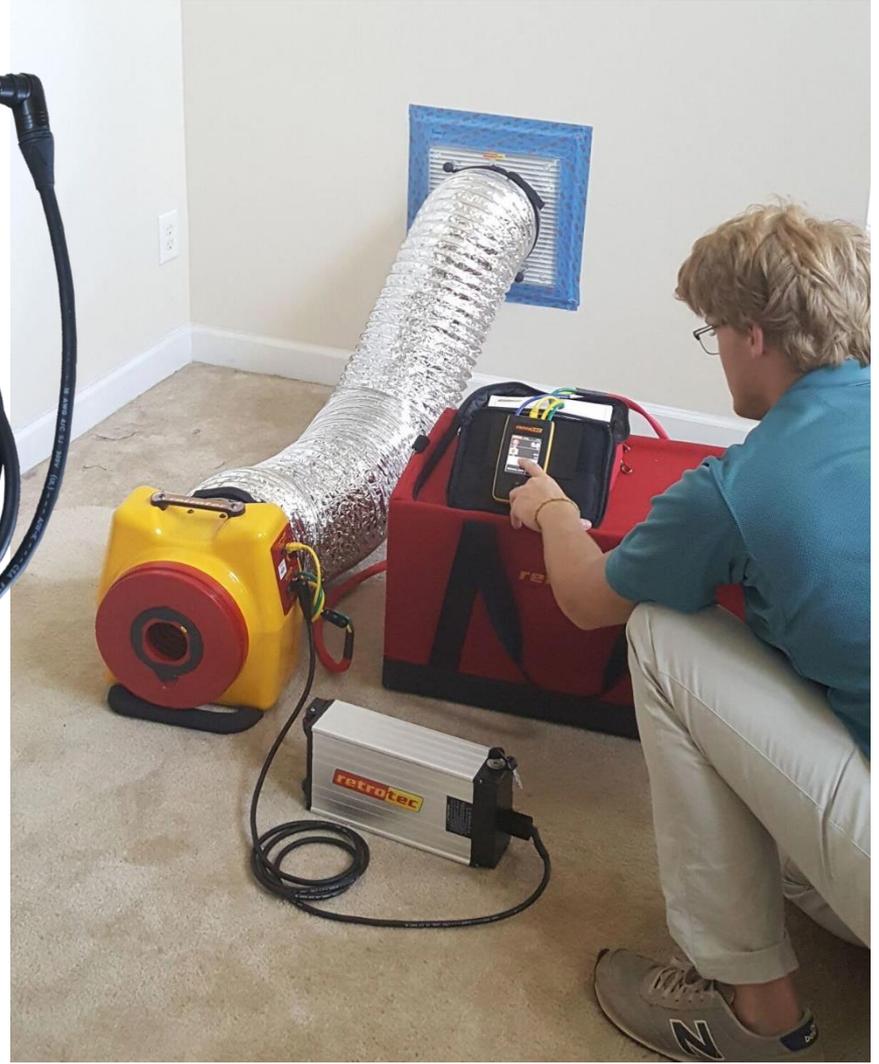




Rough In Test



Rough In Test – battery pack option!



Battery Pack

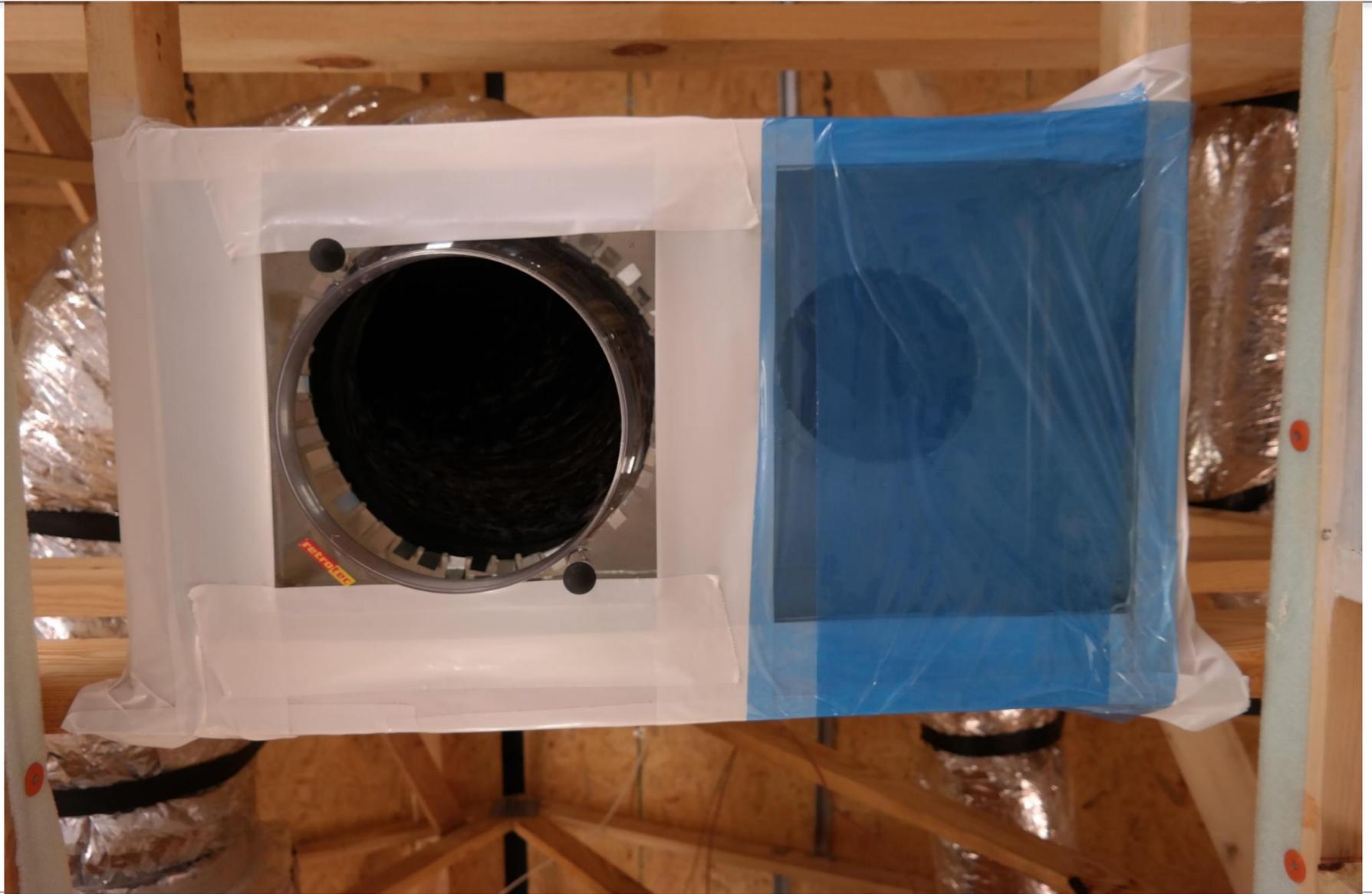
Rough In Test – crawl space tape!



Rough In Test – crawl space tape!



Rough In Test – crawl space tape!



Rough In Test – crawl space tape!



Whole House Ventilation



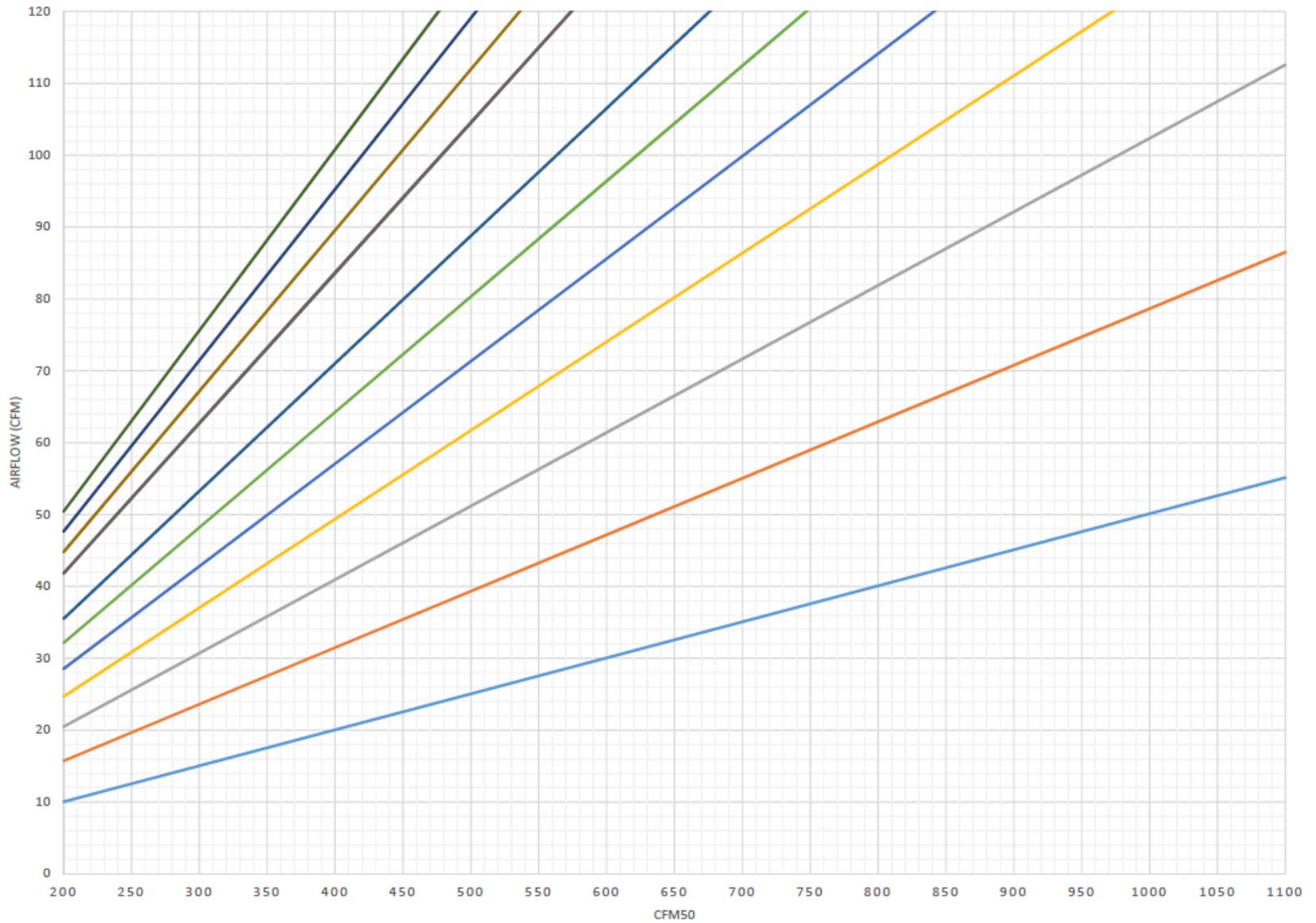
Ventilation
Duct



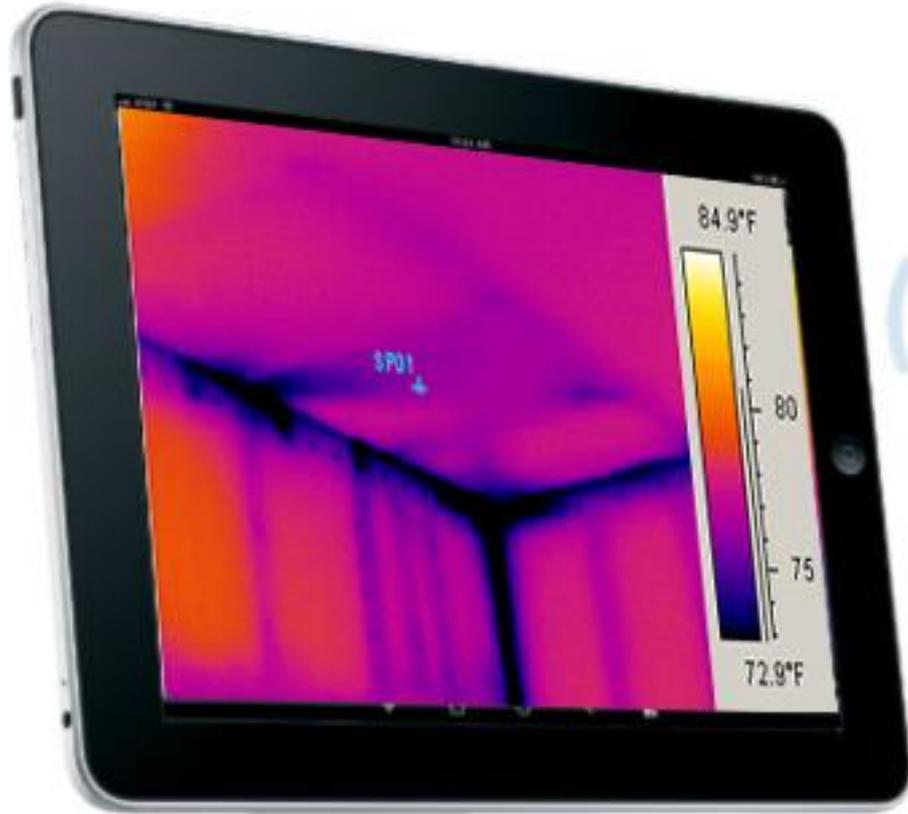
EXAMPLE OF FRESH AIR AT RETURN BOX

CFM50/AIRFLOW/PRESSURE

(Pa) 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6



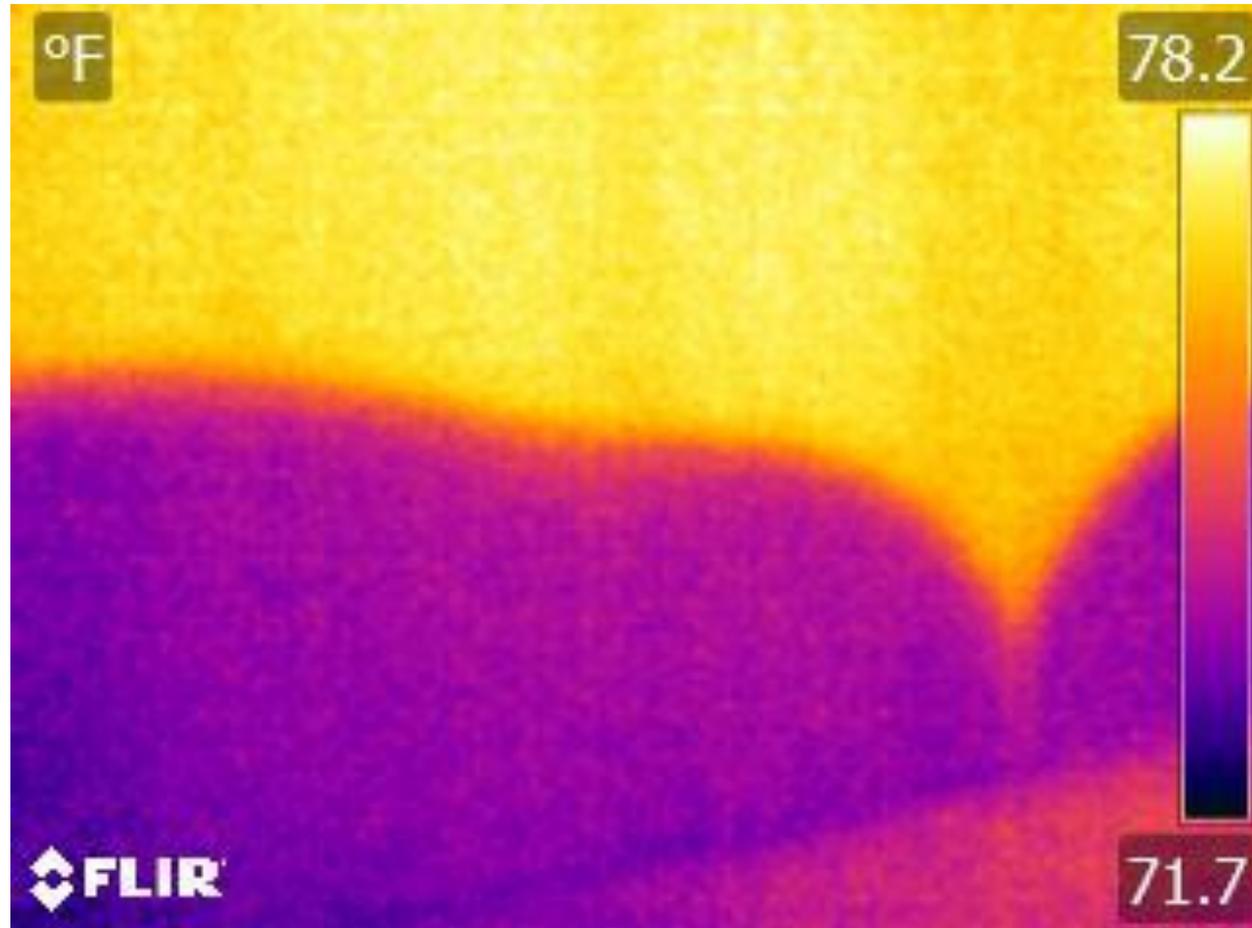
Infrared Camera



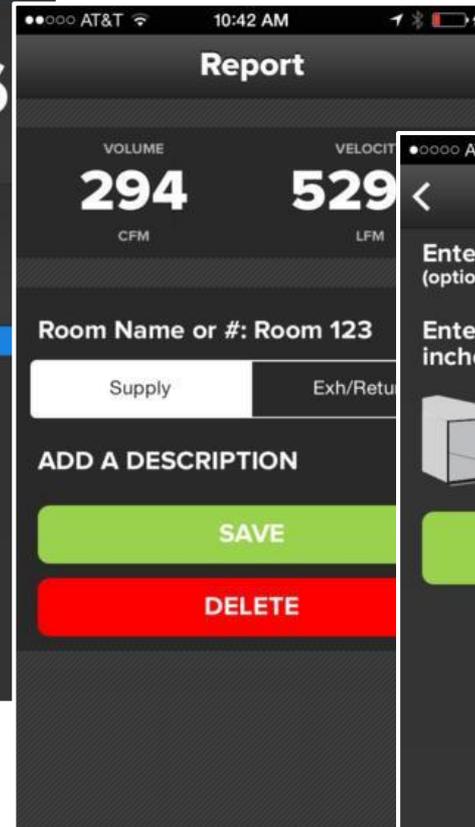
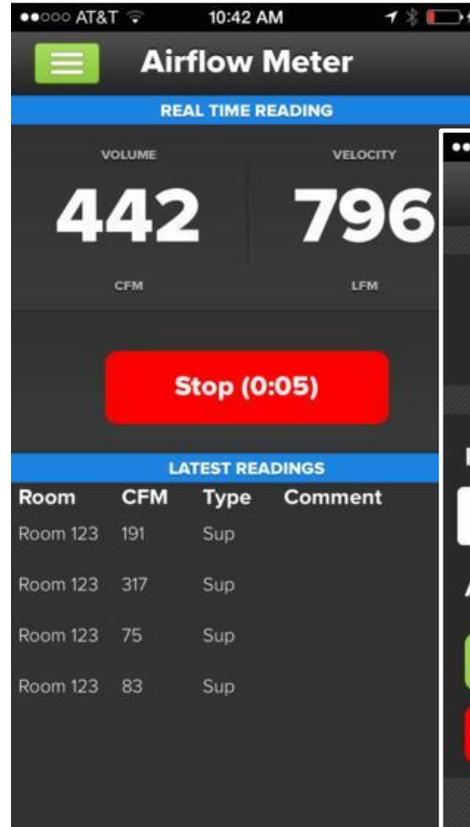
Infrared Camera



Building Moisture Incidental



Automatic Airflow Balancing \$44.95



NEWEST Capture Hood



- CPS /ABM EasyHood
- 12" x 12" unit opening
- Easily pop up frame to add 24" x 24" "skirt"
- BlueTooth readout on and data storage/reporting from your SmartDevice
- Low volume plate for 7-50 CFM sampling
- Can use your existing ABM-100 or ABM-200
- ABM-200 reads out CFM, temp, humidity, barometric pressure

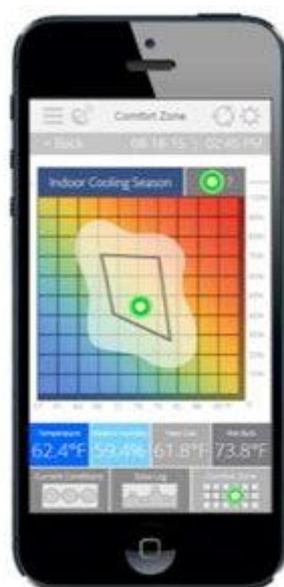
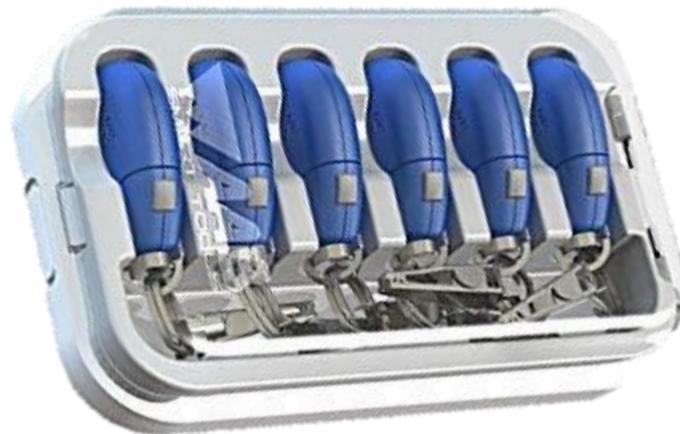


AAB Smart Tools TS-100

\$60



TempSmart Temperature and Humidity Data Logger



Testing Exhaust Fans

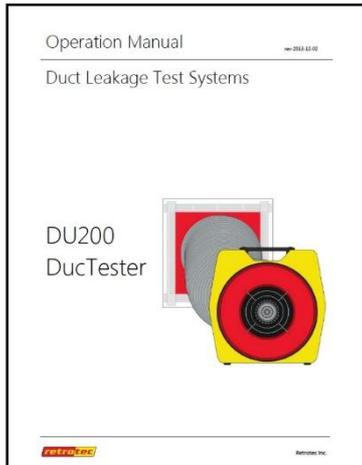


The Energy Conservatory Exhaust Fan Flow Meter



Device - Hole Flow

Cardboard box.



Appendix G: Measure Supply or Exhaust flow with a gauge and box

The Retrotec gauge can be used to measure the amount of air flowing through a hole. This feature enables the gauge to be used as an Exhaust Fan Flow Meter, by simply cutting a couple of holes in a cardboard box. The open end of the flow box should have rough dimensions which are at least two times the register dimensions, and the depth of the box should be at least the average of the other two dimensions.

Because flow through a known size hole depends on pressure across the hole, and air flow into an enclosed space will cause pressure, we can use a box with a hole in it to measure the system air flow. This method partially blocks the flow from the air handler so readings are not exact, especially if pressures in the box are above 8 Pa.

To create an Exhaust Fan Flow Meter

1. Cut a hole in one side of a medium-sized cardboard box where it is only one layer thick, and leaving about one inch of cardboard around the edge for stiffness.
2. Cut a 2" x 2" square hole in the center of the other side of the box, again where the cardboard is only one layer thick. This is the flow measuring hole. For accuracy, the small hole should be at least 1.5 inches from the edge of the box and its area should be less than half the area of the end of the box.
3. Tape any cracks in the other sides of the box to prevent air from leaking.
4. Punch a 0.25 inch diameter hole near a corner of the open end of the box for the pressure tube. Insert a tube in the hole.
5. Connect the tube to the "ref B" (yellow) and "input A" (blue) ports of the gauge using a T connector.
6. Fit the box over the exhaust fan grille while it is running, and seal in place around the box edges.
7. Observe the pressure in the box on "A". The same pressure will show on "B" if displaying pressure on "B".
8. Increase the size of the flow measuring hole in the box until the pressure is between 2 and 8 Pa.
9. The gauge will calculate the exhaust fan flow if you [Change Device] and choose "Hole Flow" from the "Generic Device" screen of choices.
10. Enter the area of the hole into the gauge when prompted by the gauge.
11. Read the Exhaust Flow in CFM directly from the gauge on "B".

Figure 73: Exhaust fan flow meter

Tip: Box pressure of 8 Pa or less is recommended because higher pressures will decrease the exhaust fan flow rate. Box pressures below 3 Pa are less accurate because small fluctuations in pressure will affect the flow a lot. One Pa is a practical limit for measuring flow, below which readings cannot be taken. Try the same fan with different holes to see the different results.

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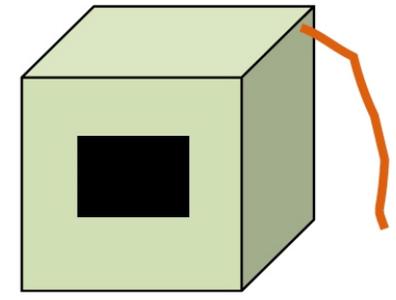
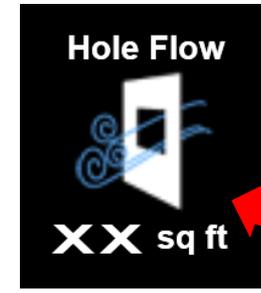
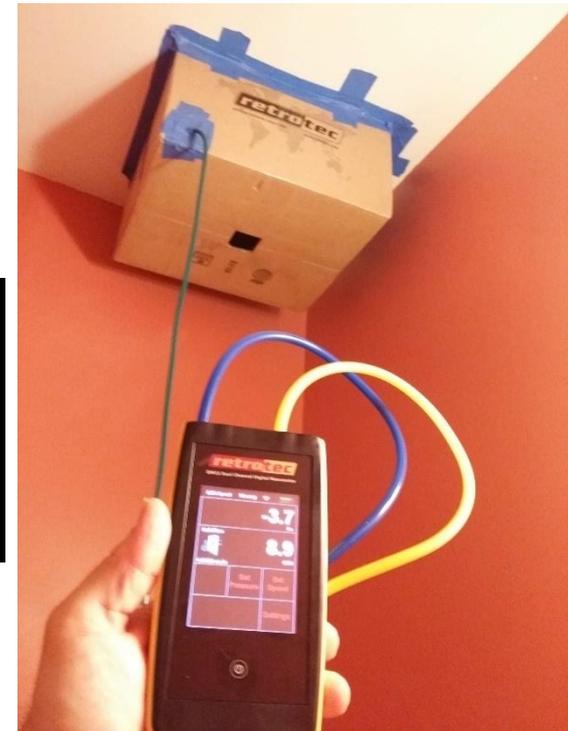
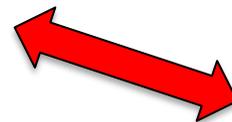
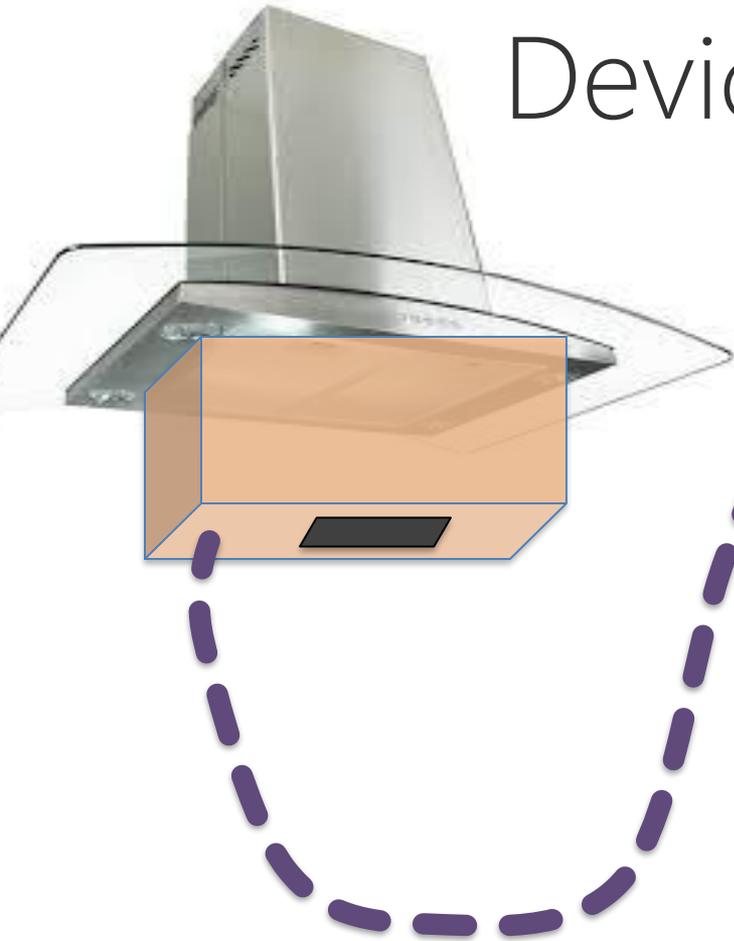


Figure 73: Exhaust fan flow meter



Device - Hole Flow



Device - Hole Flow

$$Flow = Hole Area * \sqrt{PrB} * 1.0755$$

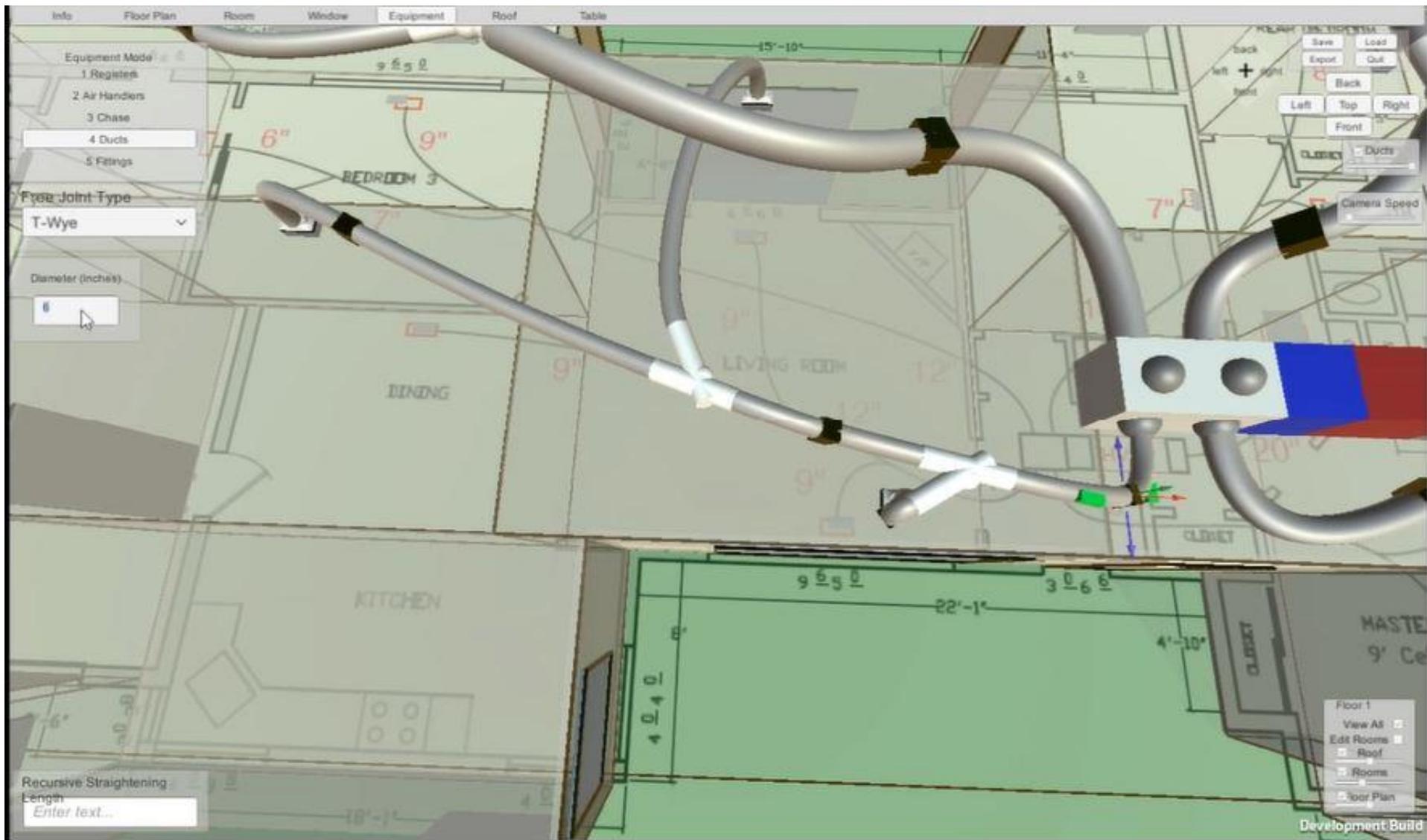
- Flow is in units of CFM
- Hole Area is in units of in²
- PrB is the Channel B pressure, is in units of Pa





Looking Forward...

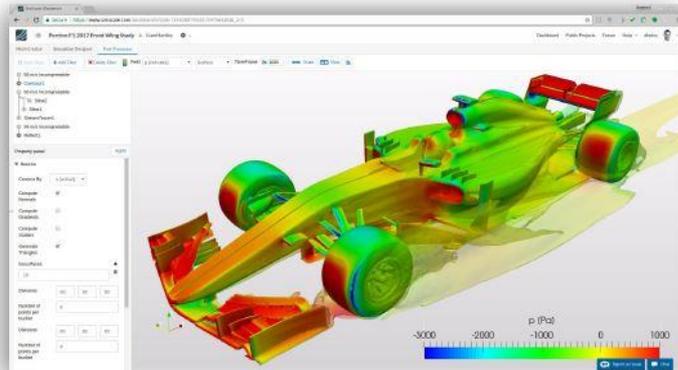
Kwik Model – 3D Duct Design



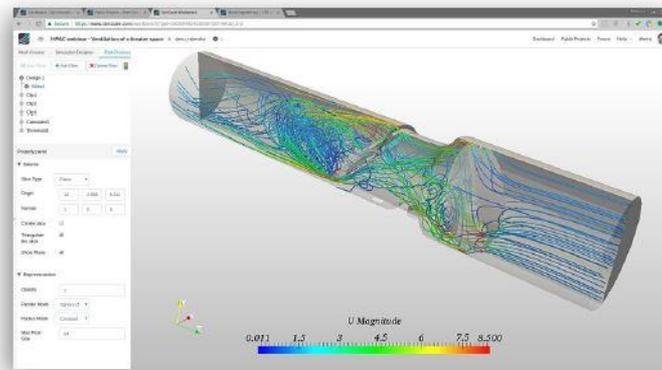
Computational Fluid Dynamics (CFD)



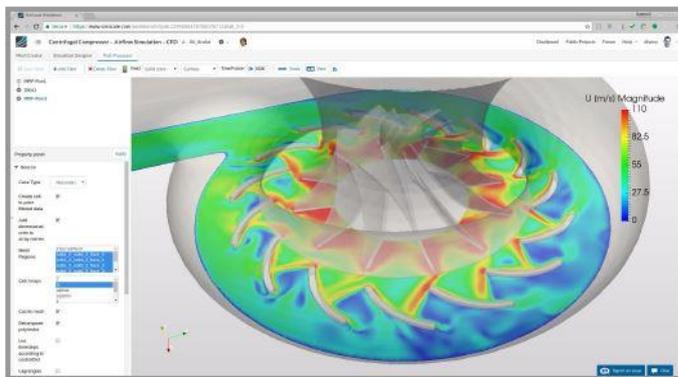
Computational Fluid Dynamics (CFD)



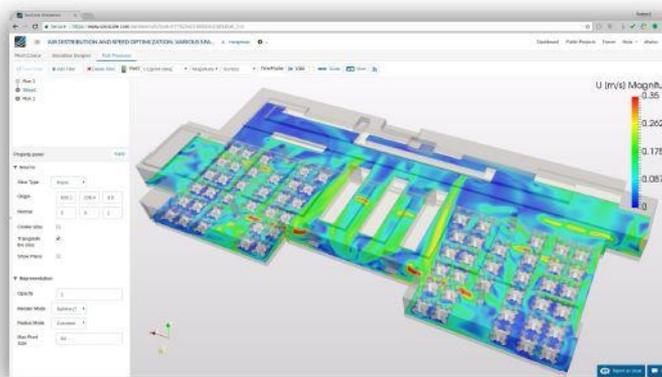
External Aerodynamic Analysis of a Race Car



Carburetor Intake Flow Analysis



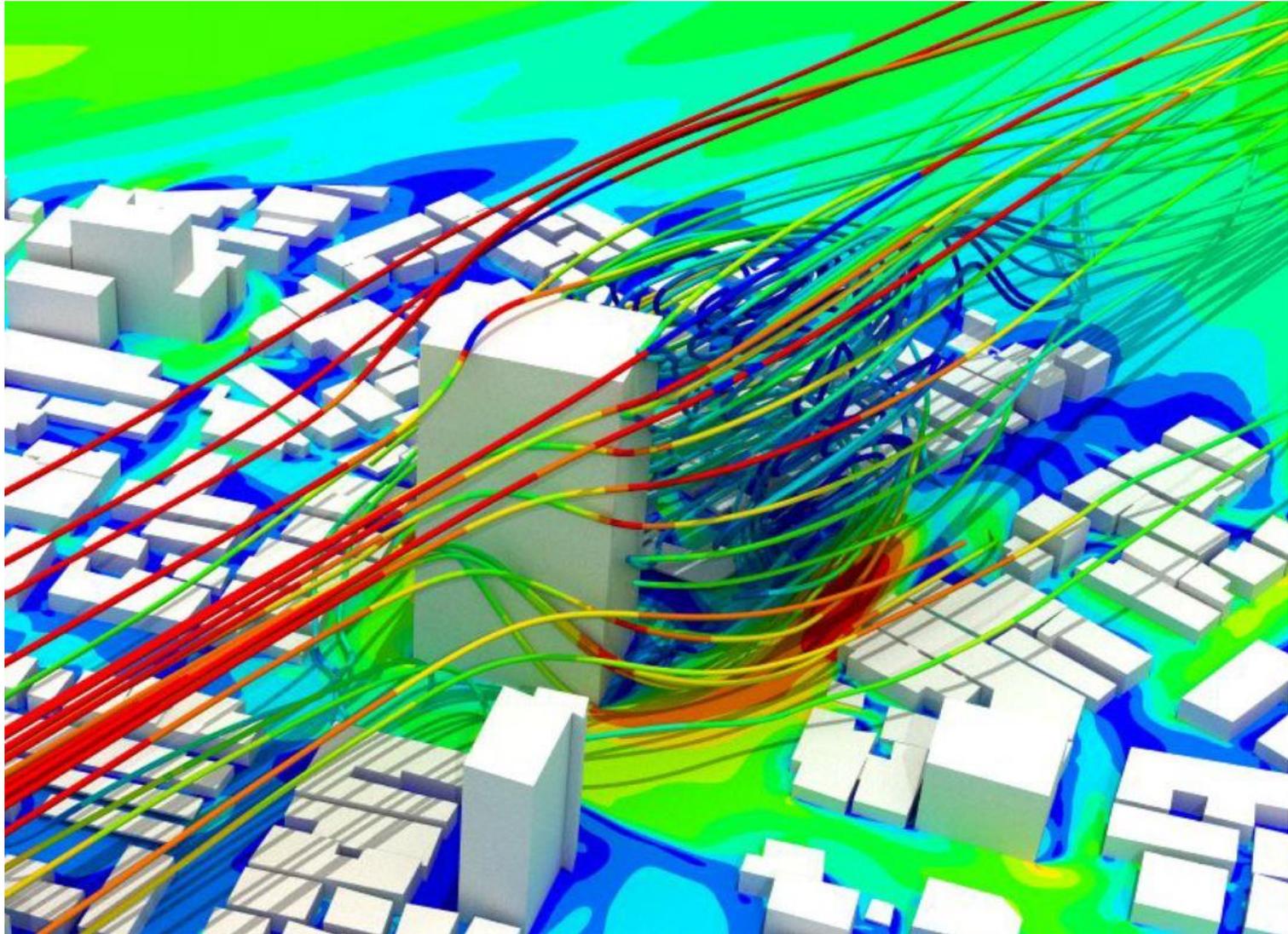
Turbulent and Compressible Flow in a compressor



Ventilation system Analysis

- Internal - External Flow
- Laminar - Turbulent
- Steady State - Transient
- In-Compressible
- Flow Heat Transport
- Single - Multiphase
- Scalar Transport
- Rotating Machinery
- Porous Media

Computational Fluid Dynamics (CFD)



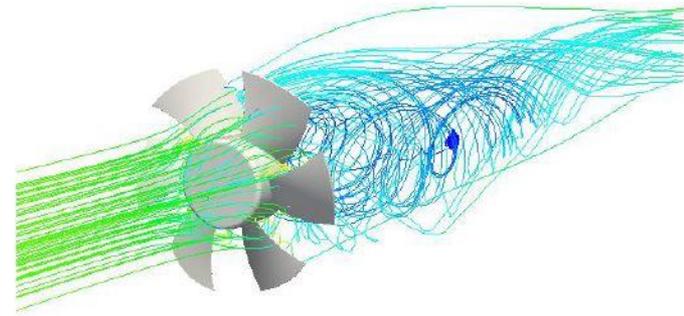
Computational Fluid Dynamics (CFD)

Analysis Overview

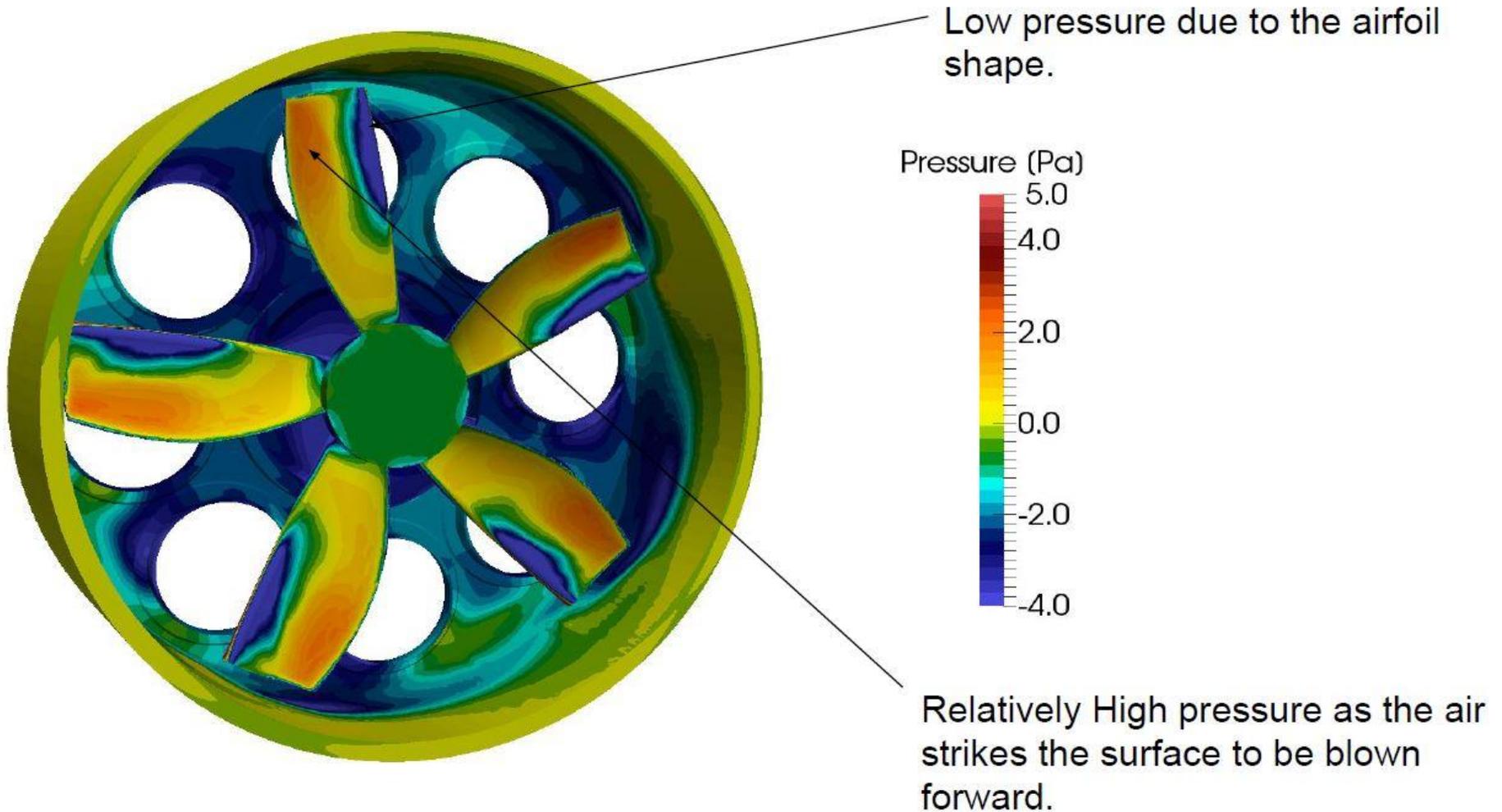
- Steady State or Transient Analysis
- Incompressible - Compressible Flow
- Turbulence modeling via RANS, URANS & LES models
- Rotating zones via Multi-Reference Frame (MRF) or Sliding Mesh Interface (AMI)

Results outputs

- 3D flow Velocity and Pressure distribution
- Forces and Torque on the Fan
- Performance Curves, Torque, Efficiency vs Flow Rate



Computational Fluid Dynamics (CFD)





Sam Myers

sam@retrotec.com

919-922-3987

www.retrotec.com

