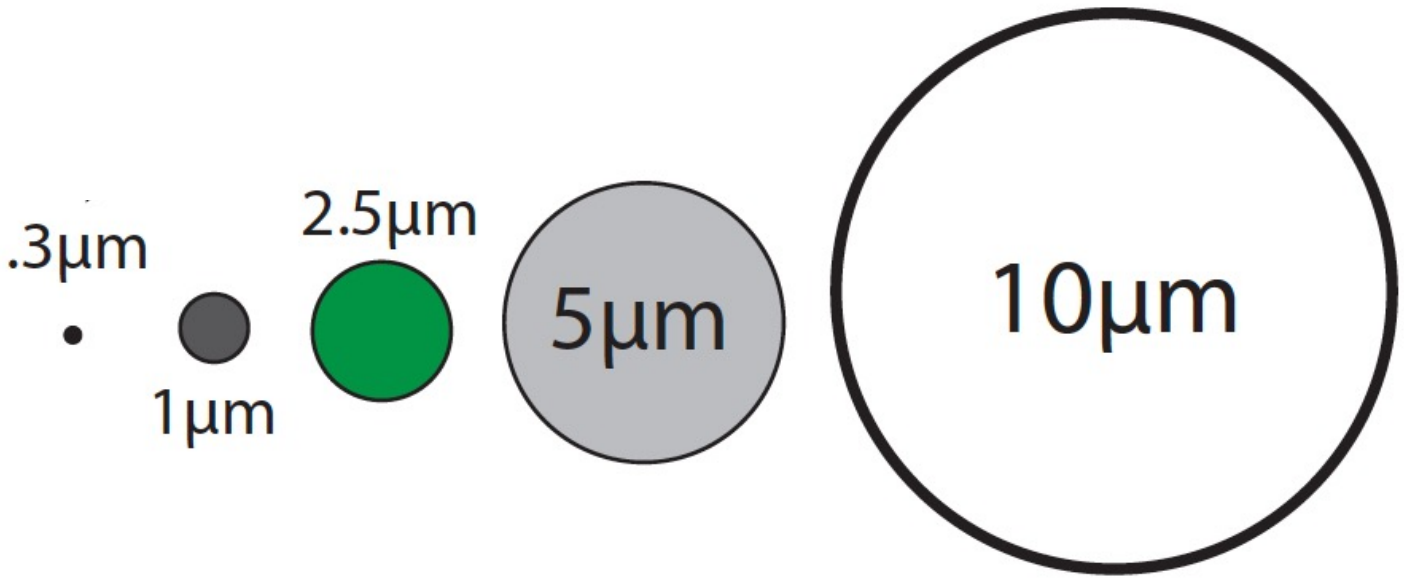
Rater Fest! 2023

Real IAQ – Particulates

Joe Medosch measureQuick joe@measurequick.com

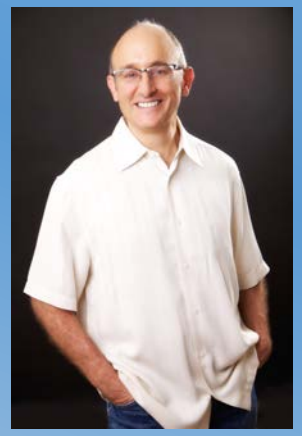
You are this particle



MERV Rating		10 to 3 microns	3.0 to 1.0 microns	1.0 to 0.03 microns	
MERV	**8**	70% - 85%	< 20 %	< 20 %	
MERV	**9**	85% or better	< 50%	< 20 %	Box Filters
MERV	**10**	85% or better	50% -64%	< 20 %	
MERV	**11**	85% or better	65% -79%	< 20 %	Lead Dust, Flour, Auto Fumes, Welding Fumes
MERV	**12**	90% or better	80% - 90%	< 20 %	
MERV	**13**	90% or better	90% or better	< 75%	Commercial Filters
MERV	**14**	90% or better	90% or better	75% -84%	
MERV	**15**	90% or better	95% or better	85% - 94%	Bacteria, Smoke, Sneezes
MERV	**16**	90% or better	95% or better	95% or better	
MERV	**17**	99.97%	99% or better	99% or better	HEPA (High-Efficiency Particulate Air filter) & ULPA (Ultra Low Particulate Air filter)
MERV	**18**	99.997%	99% or better	99% or better	
MERV	**19**	99.9997%	99% or better	99% or better	Viruses, Carbon Dust, <.30 pm
MERV	**20**	99.99997%	99% or better	99% or better	

YouTube youtu.be/El7rUiV_ZlE

IAQ Devices - Where are They Now and Who is Using Them and for What?



Les Lazareck

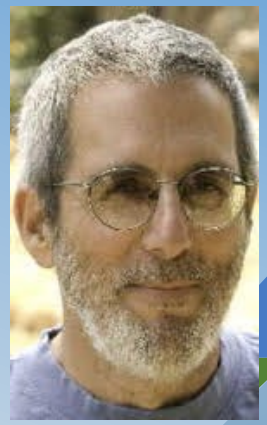
Steve Byers

Peter Troast

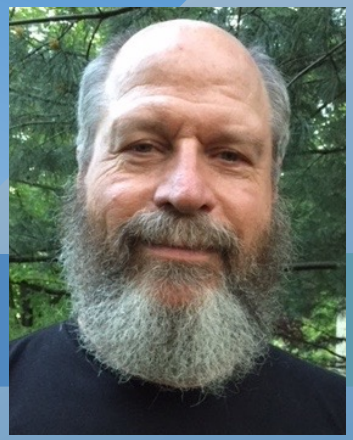
Linda Wigington

Kaleb Saleeby

Brett Singer



Steve Mann



Kevin Kennedy

Bill Spohn

All Particles Matter

µm = micron

micron = 0.001 mm

micron = 0.00003937 inch

PM 10 →

Dust, pollen, mold, etc
< 10 µm *(microns)* in diameter

Blood cell 7.5 µm →

5.0 µm →

PM 2.5 →

Combustion particles, organic compounds, metals, etc.
< 2.5 µm *(microns)* in diameter

1.0 µm →

Bacteria 0.5-2 µm →

0.3 µm →

Dime

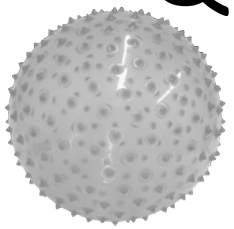
Human Hair
50-70 µm
(*microns*) in diameter

Quantity Matters

Average Particulate Count

PM 10 →

Dust, pollen, mold, etc
< 10 µm *(microns)* in diameter



20,000

Blood cell 7.5 µm →

5.0 µm →

48,000

PM 2.5 →

240,000

Combustion particles, organic compounds, metals, etc.
< 2.5 µm *(microns)* in diameter

1.0 µm →

615,000

Bacteria 0.5-2 µm →

1,690,000

0.3 µm →

Dime

7,500,000

Quantity Matters

Average Particulate Count

PM 10 →

Dust, pollen, mold, etc
< 10 µm *(microns)* in diameter

20,000 400 M

Blood cell 7.5 µm →

5.0 µm →

48,000 960 M

20,000 breaths a day

PM 2.5 →

Combustion particles, organic compounds, metals, etc.
< 2.5 µm *(microns)* in diameter

240,000 4.8 T

1.0 µm →

615,000 12.3 T

Bacteria 0.5-2 µm →

1,690,000 33.8 T

0.3 µm →

7,500,000 150 T

Dime

SiZe Matters

µm = micron

micron = 0.001 mm

micron = 0.00003937 inch

PM 10 →

Dust, pollen, mold, etc
< 10 µm *(microns)* in diameter

Blood cell 7.5 µm →

5.0 µm →

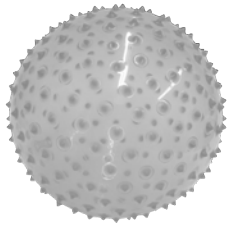
PM 2.5 →

Combustion particles, organic compounds, metals, etc.
< 2.5 µm *(microns)* in diameter

1.0 µm →

Bacteria 0.5-2 µm →

0.3 µm →



6 inches *150mm*

4.5 inches *112mm*

3 inches *75mm*

1.5 inches *37.5mm*

0.6 inches *15mm*

0.3 inches *7.5mm*

Dime

0.18 inches *4.5mm*

x15,000

14.5 miles tall

Human Hair
50-70 µm
(*microns*) in diameter

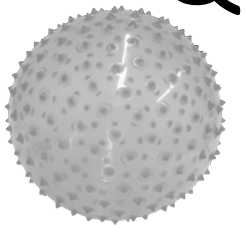
RaterFest!

MeasureQuick

Quantity Matters

PM 10

Dust, pollen, mold, etc
< 10 µm *(microns)* in diameter



6 inches

20,000

Blood cell 7.5 µm

4.5

5.0 µm

3

48,000

PM 2.5

1.5

240,000

Combustion particles, organic compounds, metals, etc.
< 2.5 µm *(microns)* in diameter

1.0 µm

0.6

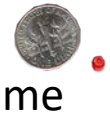
615,000

Bacteria 0.5-2 µm

0.3

1,690,000

0.3 µm



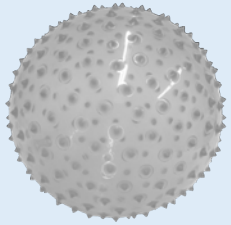
Dime

0.18

7,500,000

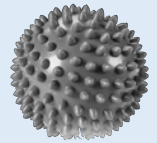
Adjusted

1



Baby Ball

3



Massage Ball

12

Ping pong balls

30

Beads

50

Beads

350

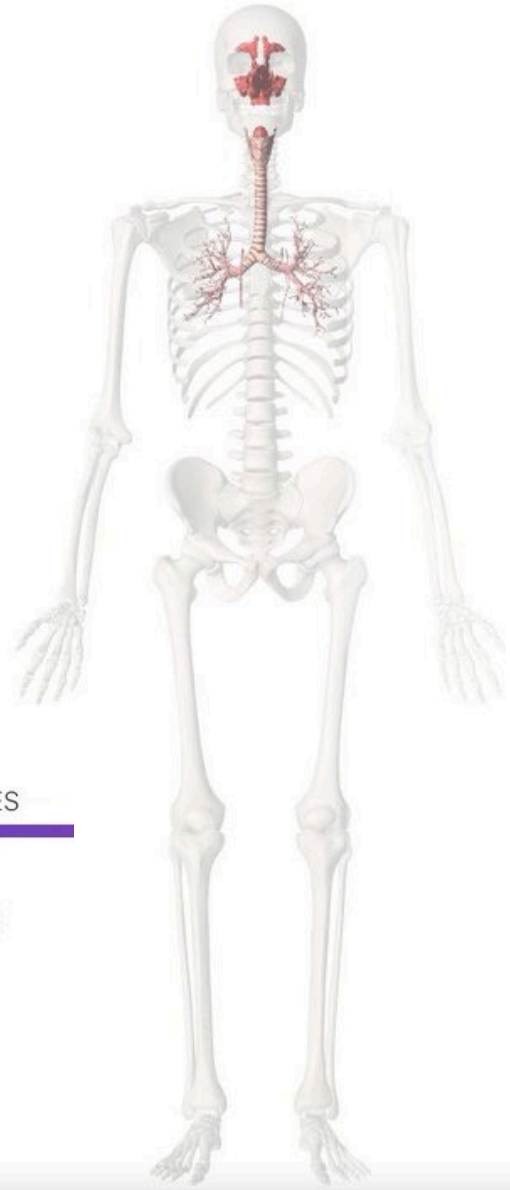
Very Small Beads

RaterFest!

#seetheair

PENETRATION OF PARTICLES INTO THE BODY

seetheair.wordpress.com/

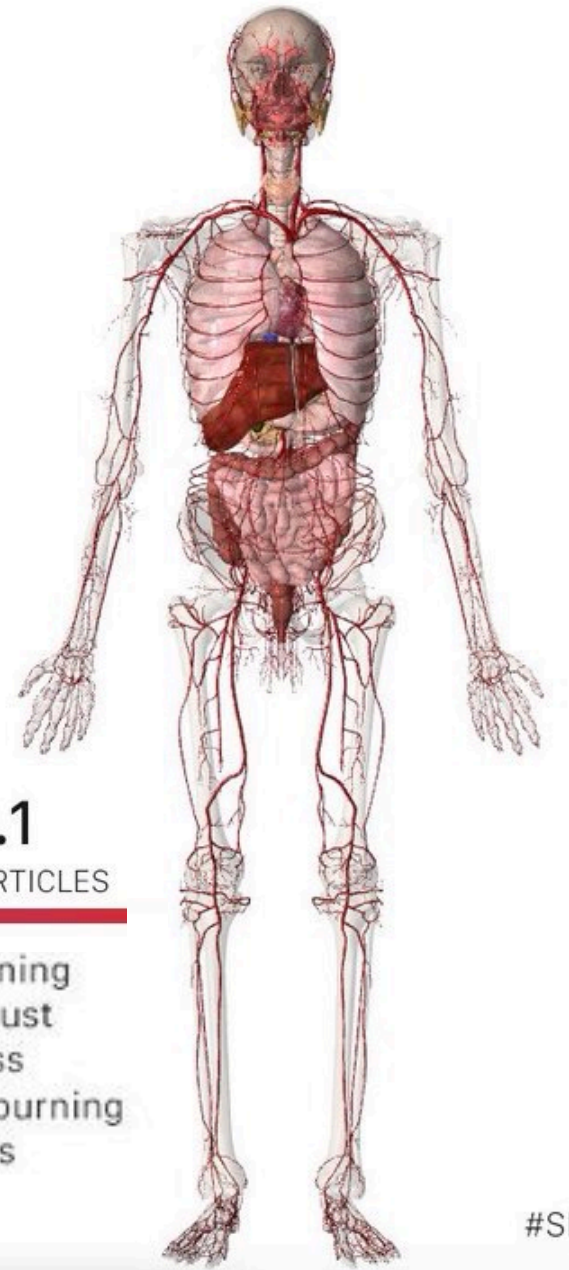


PM10
COARSE PARTICLES

Pollen
Wood burning
Dust
Constraction
Fireworks
Road traffic

PM2.5 & PM1
FINE PARTICLES

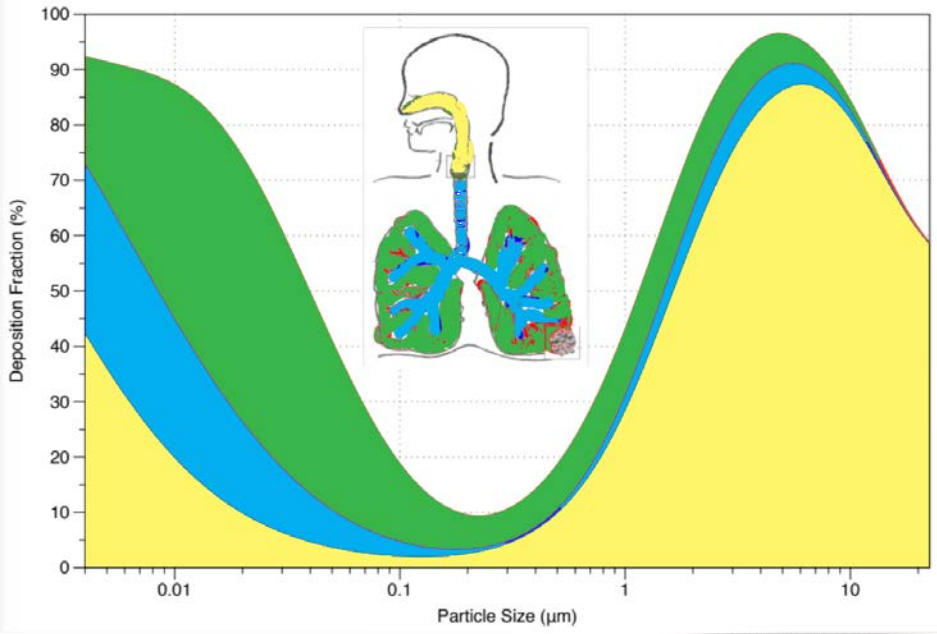
Wood burning
Car exhaust
Biomass
Agricultural burning
Fireworks
Cooking
Bacteria & Fungi



PM0.1
ULTRAFINE PARTICLES

Wood burning
Car exhaust
Biomass
Agricultural burning
Viruses

#SE

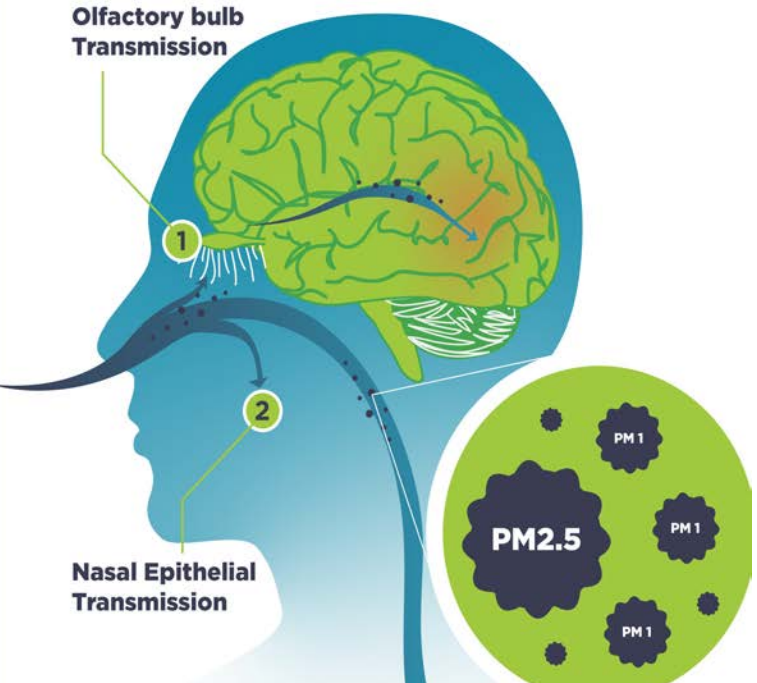


HUMAN HAIR
50-70 µm
(microns) in diameter

PM2.5
Combustion particles, organic compounds, metals, etc.
< 2.5 µm *(microns)* in diameter

← SARS-CoV-2 0.06-0.14 µm
← Bacteria 0.5-2 µm
← Blood cell 7.5 µm

PM10
Dust, pollen, mold, etc.
<10 µm *(microns)* in diameter



90 µm *(microns)* in diameter
FINE BEACH SAND

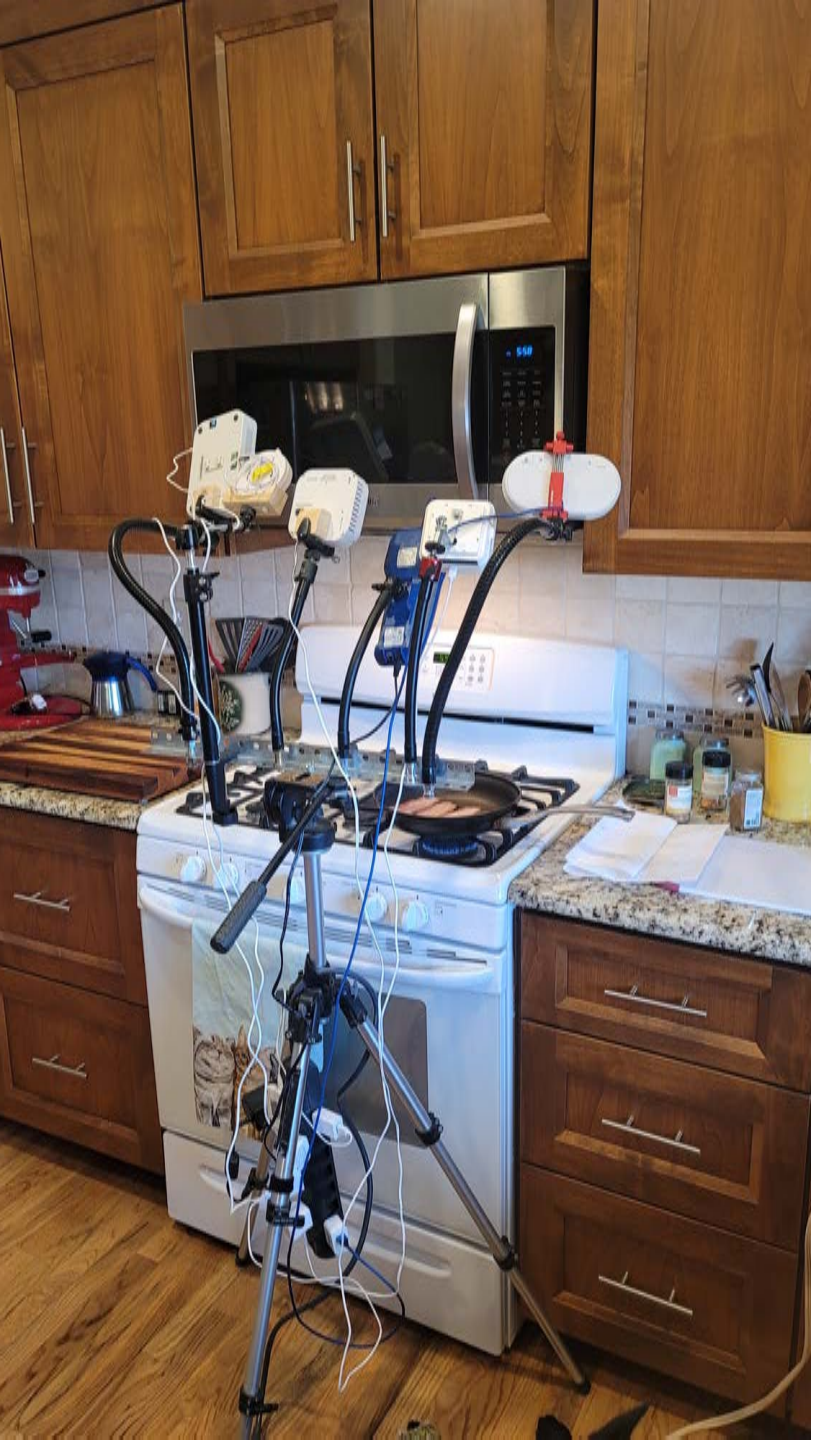
What are you breathing?

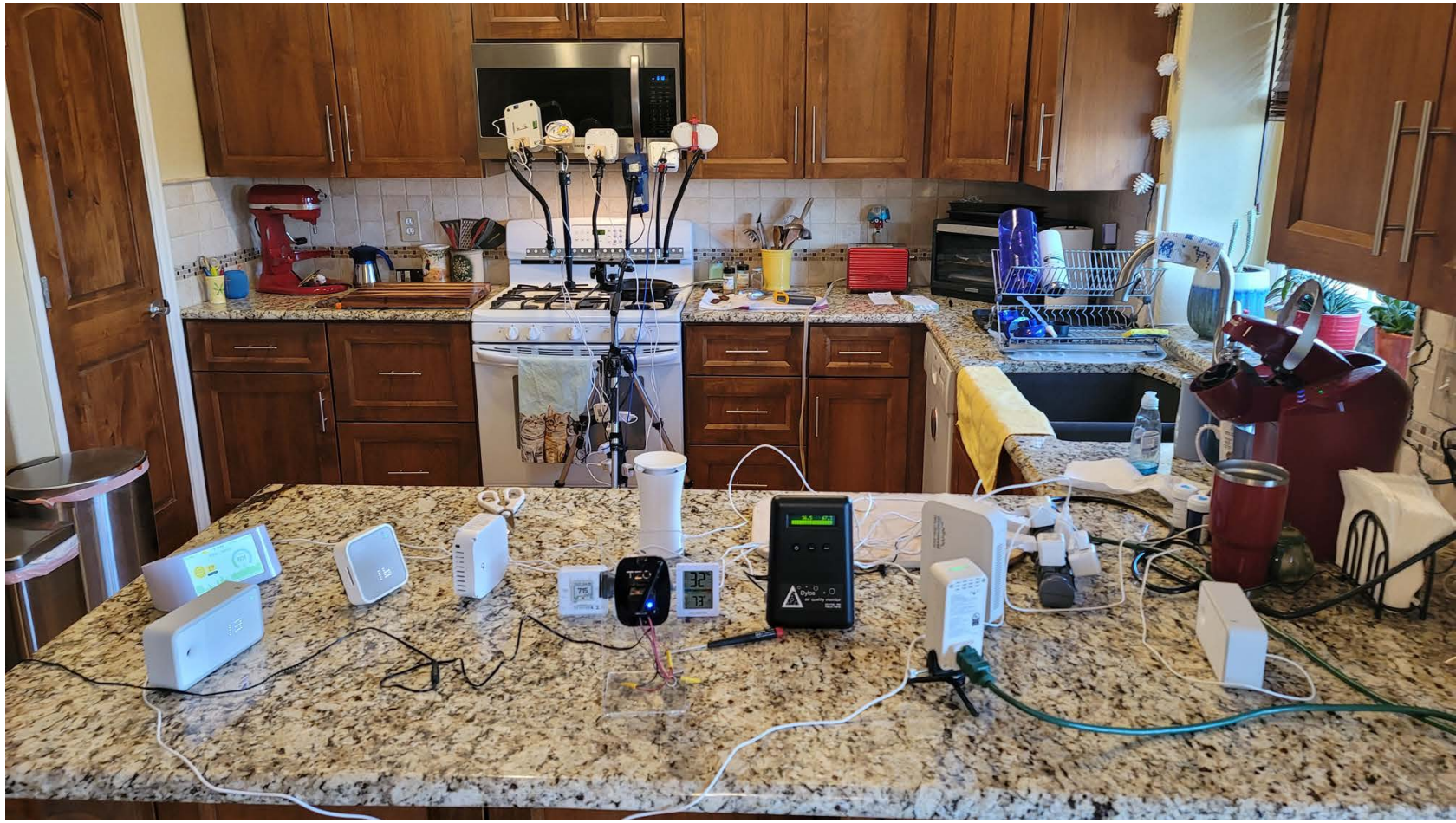
*Lawrence Berkley Labs (LBL) MERV 8-13

Air Leakage / Infiltration = Exposure pathway


Holmes
33%
64
33%
3
174
a
b
B
1651
1
4346
A
5096
2
1279

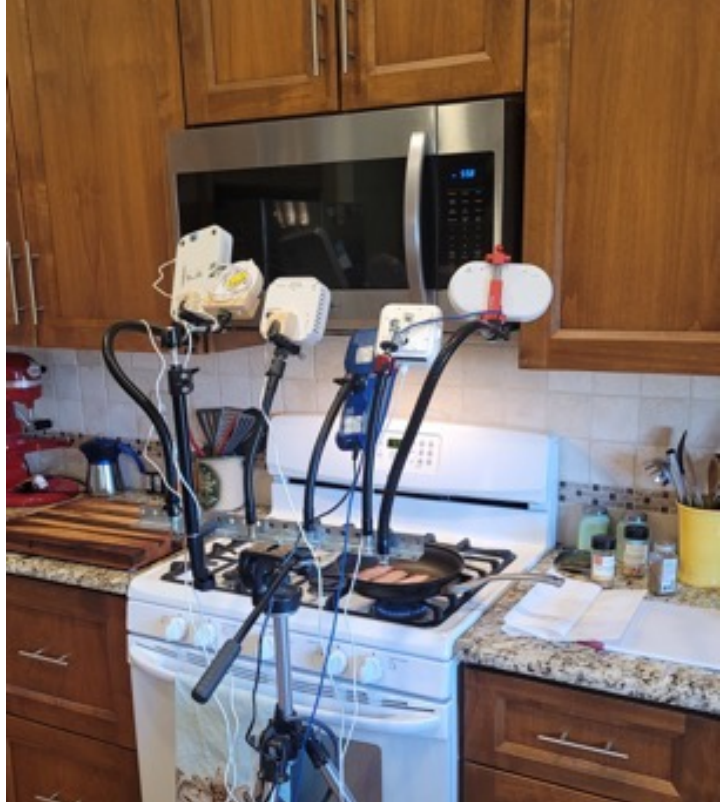
Joe’s Home Lab – Bacon Particulates

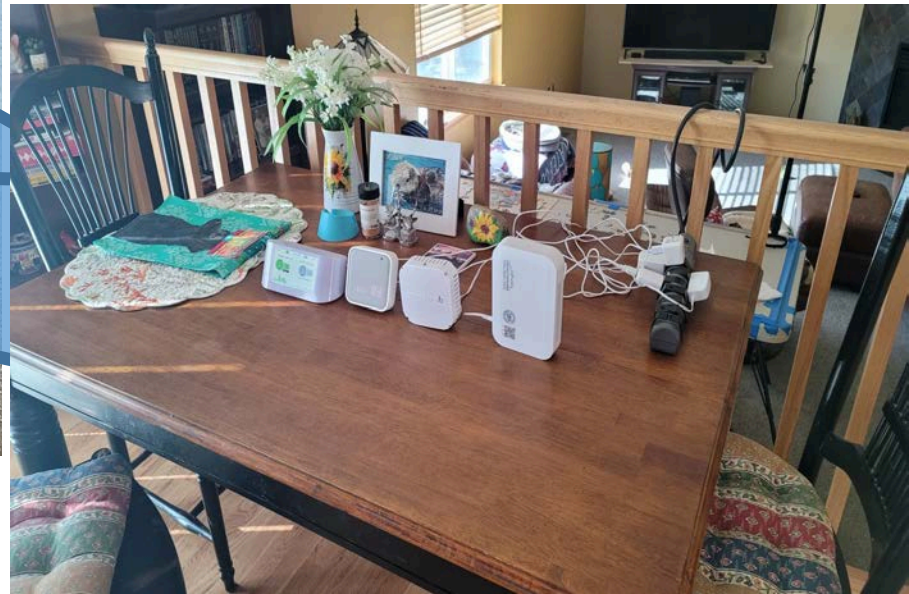


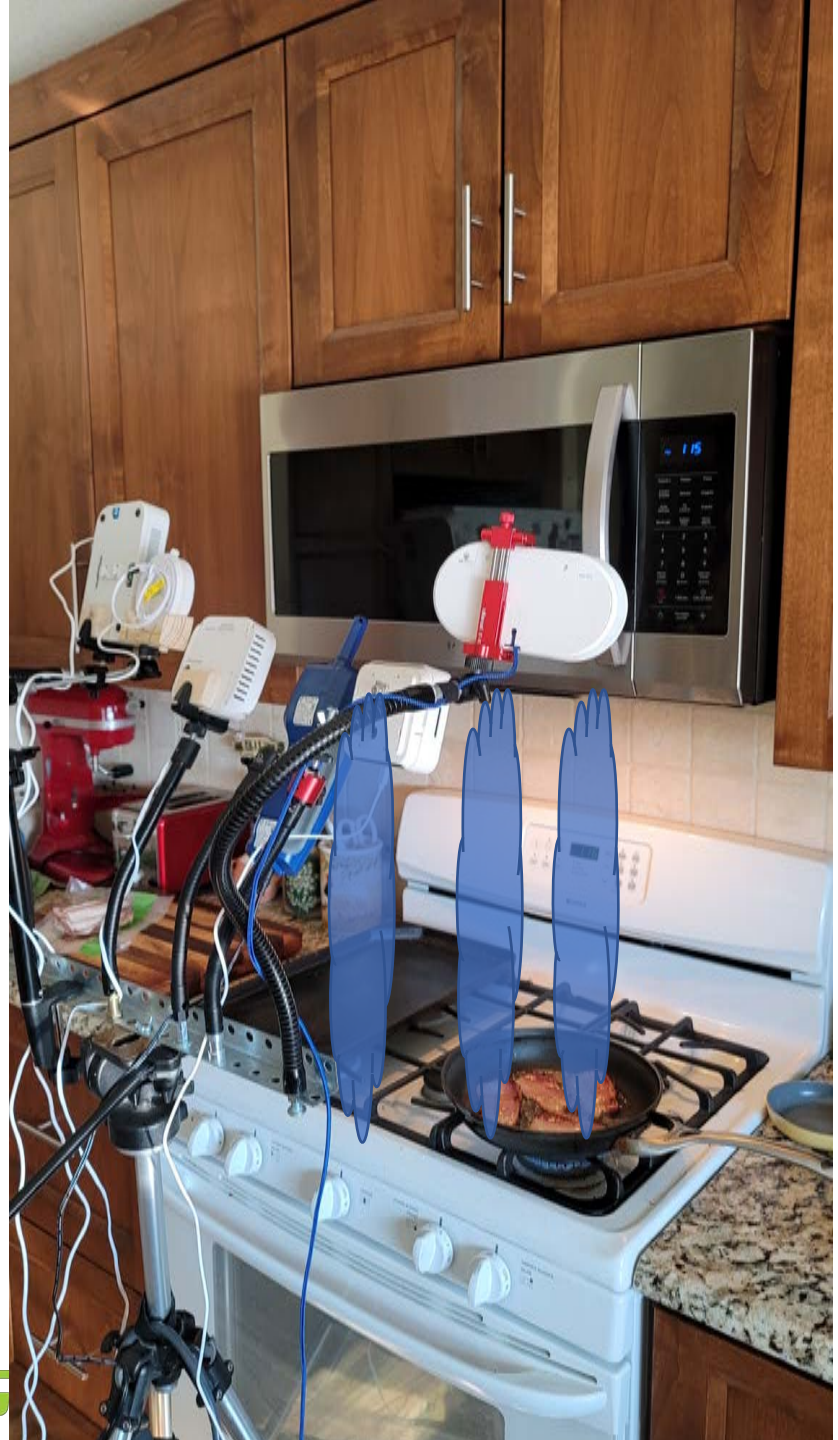


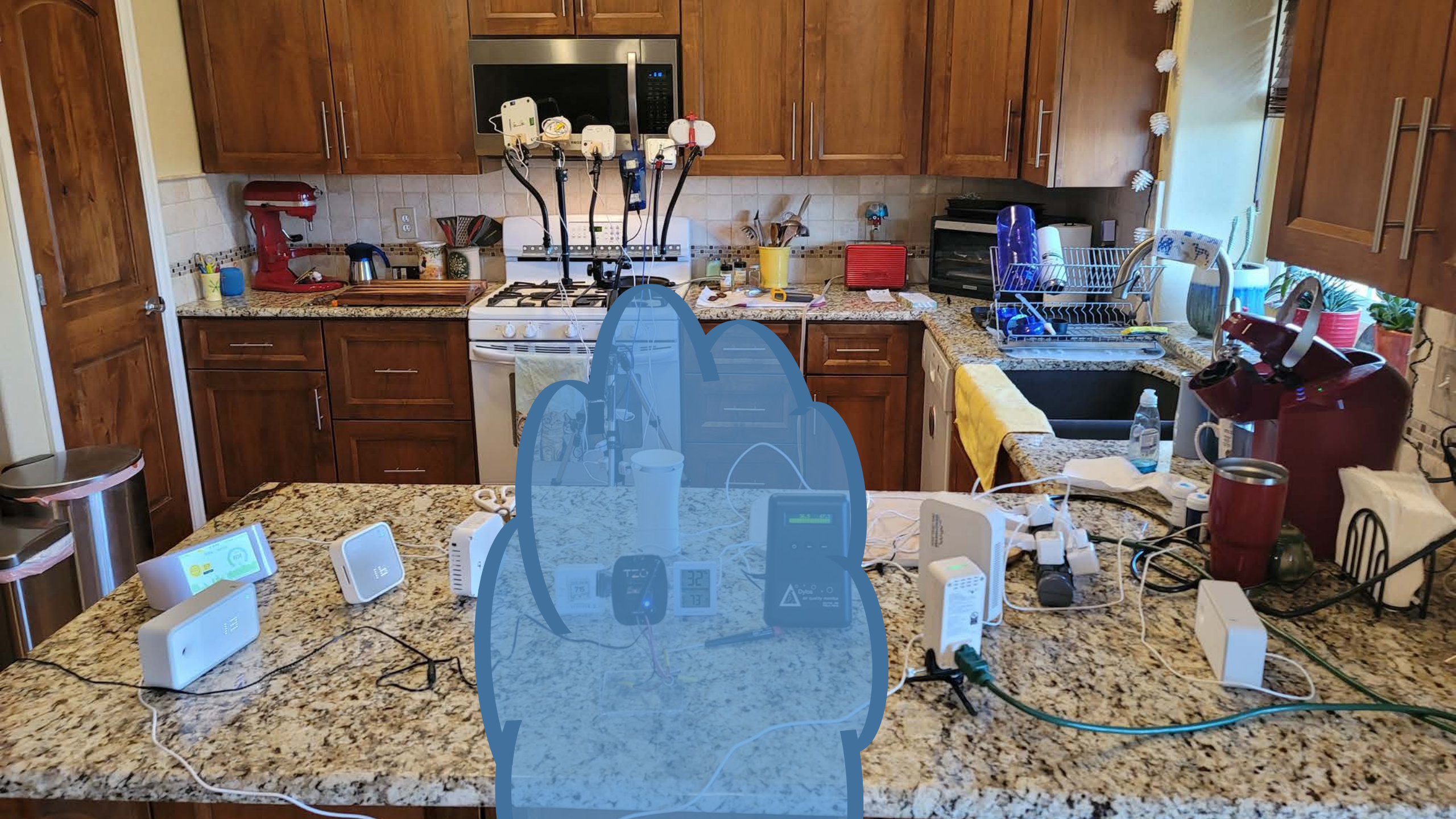

4
150
PM 2.5
VOC
Q-TRAK
HAYWARD_758
Default - Default Room
STOP
PM 2.5 (µg/m³)
Avg: 22.0
PM 1.0 (µg/m³)
Avg: 18.3
PM 10.0 (µg/m³)
Avg: 25.7
Ozone (ppm)
Avg: 0.097
iQi
VENTACITYSYSTEMS

Joe’s Home Lab – Bacon Particulates







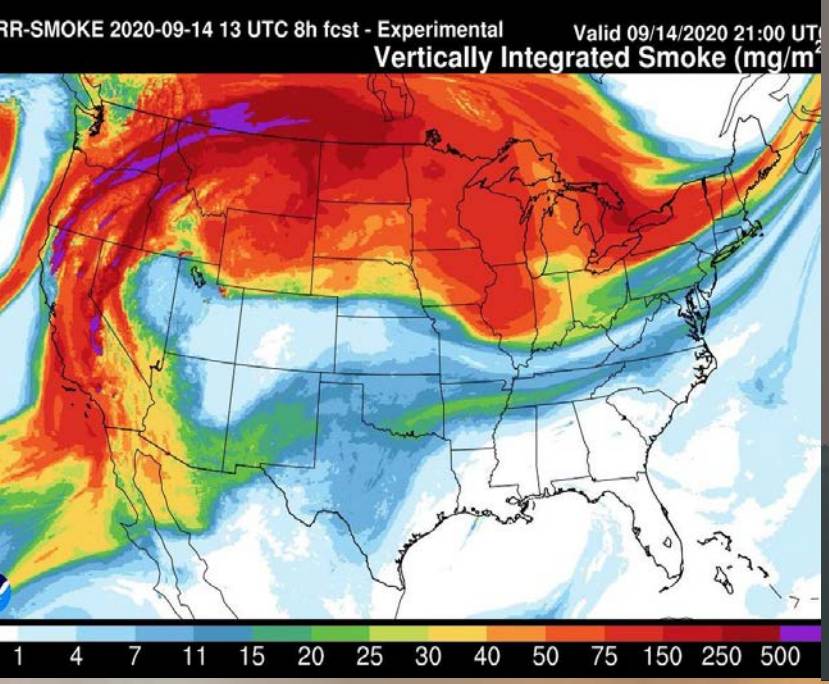


An estimated ~130,000 Deaths in 2005 in

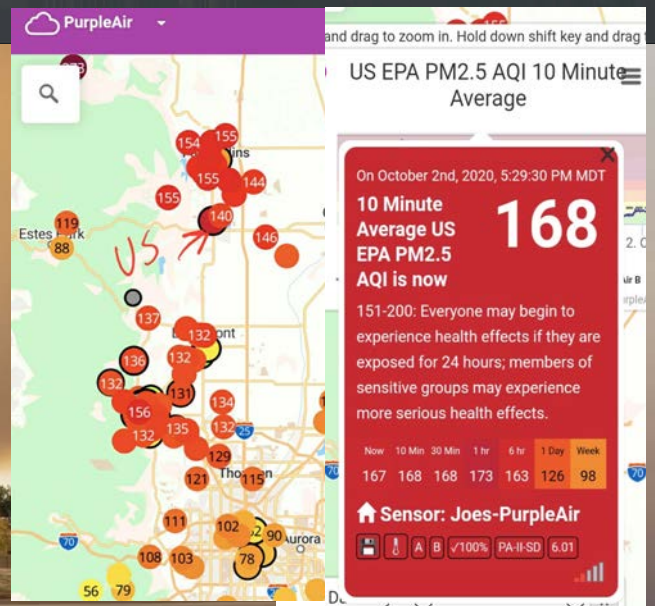
The US due to Outdoor $PM_{2.5}$

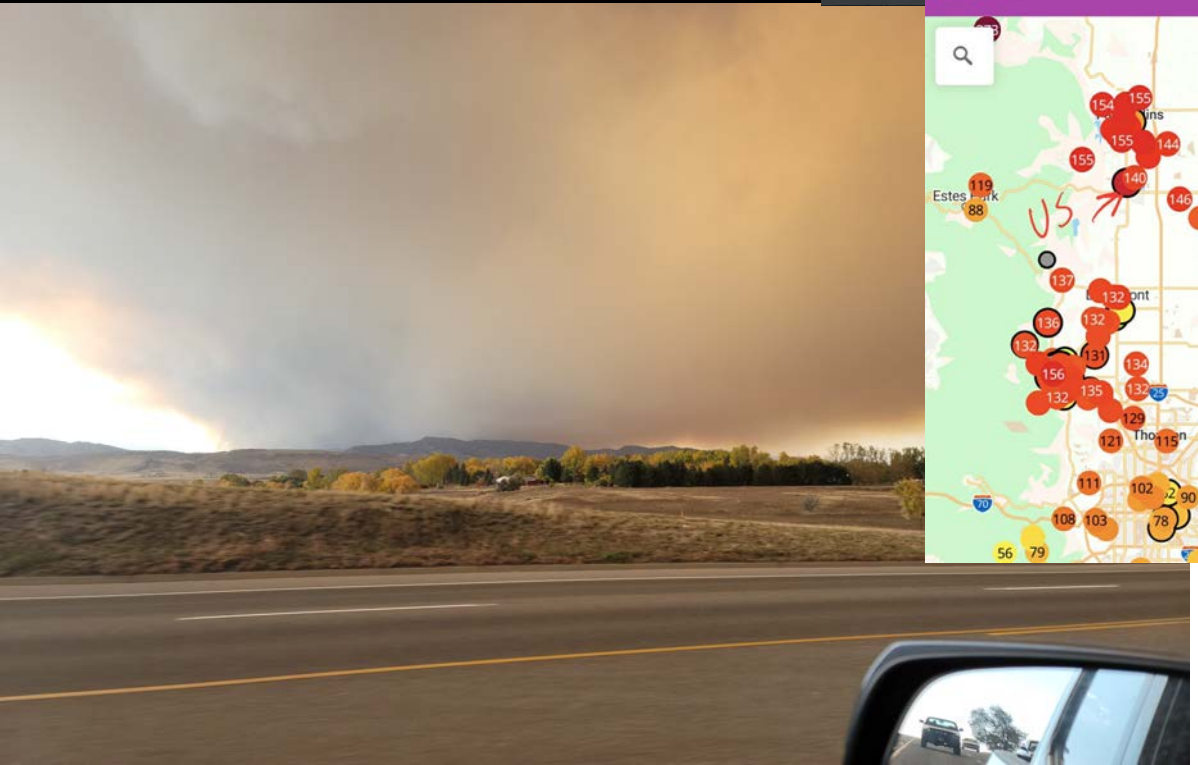
Most of this exposure occurs Indoors

https://www.built-envi.com/wp-content/uploads/stephens-UIUC-talk-indoor-exposures-to-outdoor-pollutants-feb-16-2017.pdf

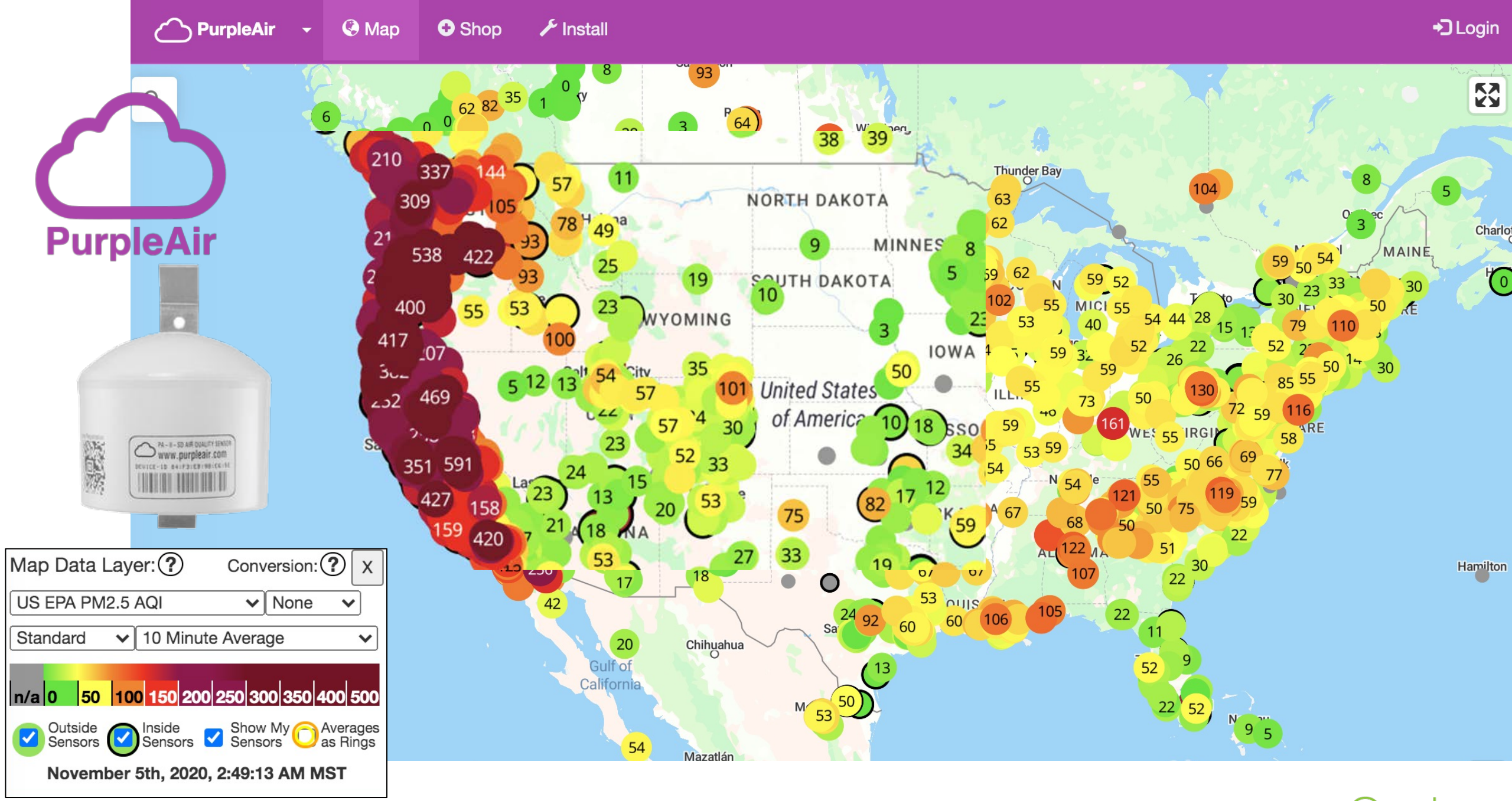


N.Y. City 2021





Loveland, CO 2020

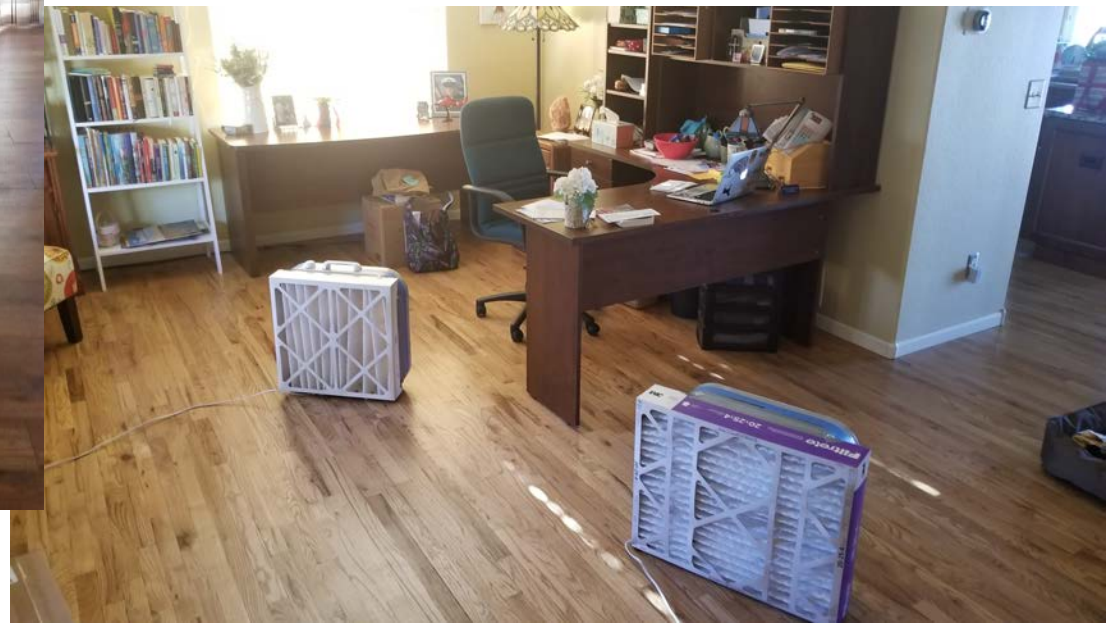


https://www.purpleair.com/map?opt=1/mAQI/a10/cC0#3.37/34.08/-100.5

MERV 13 filter


Front


Fan Speed
LOW
Air Flow
Fan Speed
LOW
Air Flow



Single 20x20x1 3M Filtrete 1900 MERV-13 and Utilitech-style fan with 13.5 in outlet shroud. Filter raised above back with additional 21 cm shroud. E1 = 0.62

Speed	Power W	Flow CFM *	Flow %	CADR CFM (Assuming 62% effectiveness)	Flow/Power CADR/W	CADR m3/h	CADR L/s	Voltage
3	52	411	100%	**255**	4.9	433	120	122
2	47	346	84%	215	4.6	365	101	122
1	40	261	64%	162	4.0	275	76	121

* Note mains voltage was 122V during measurements. Reduce by 2.5% to predict 120 V performance

Speed	dB(A) rear	dB(A) side	dB(A) front
3	58	56	59
2	55	52	56
1	49	47	50

Noise using calibrated IMM-6 microphone at 1 m from box and 73cm from floor

Tests perfomed by David Elfstrom

Twitter: @DavidElfstrom

Flow: TSI Alnor Flow capture hood. Power: Kill-A-Watt

Calculation performed by David Elfstrom

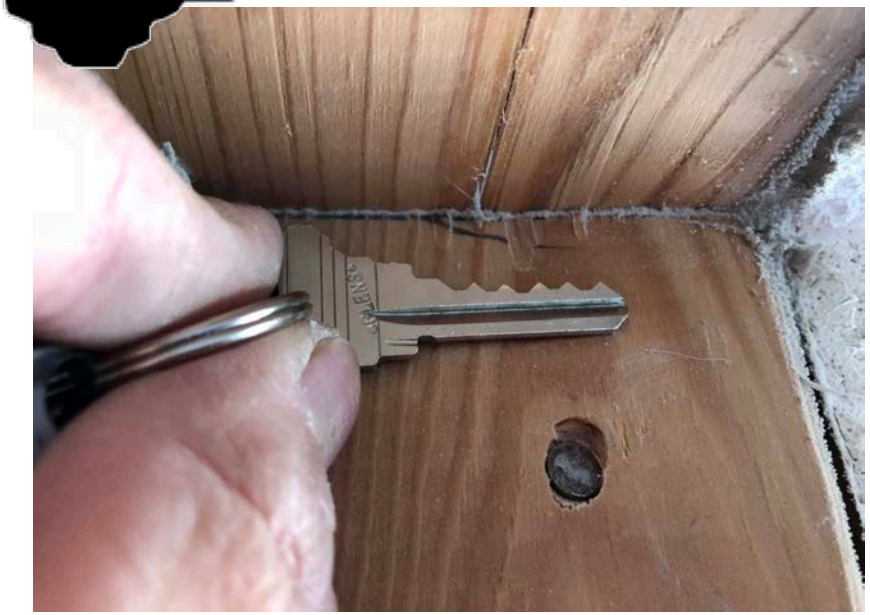
Removing the filter

Outside away from others
Wear your mask and eye protection
Put filter in a trash bag
Wash your hands

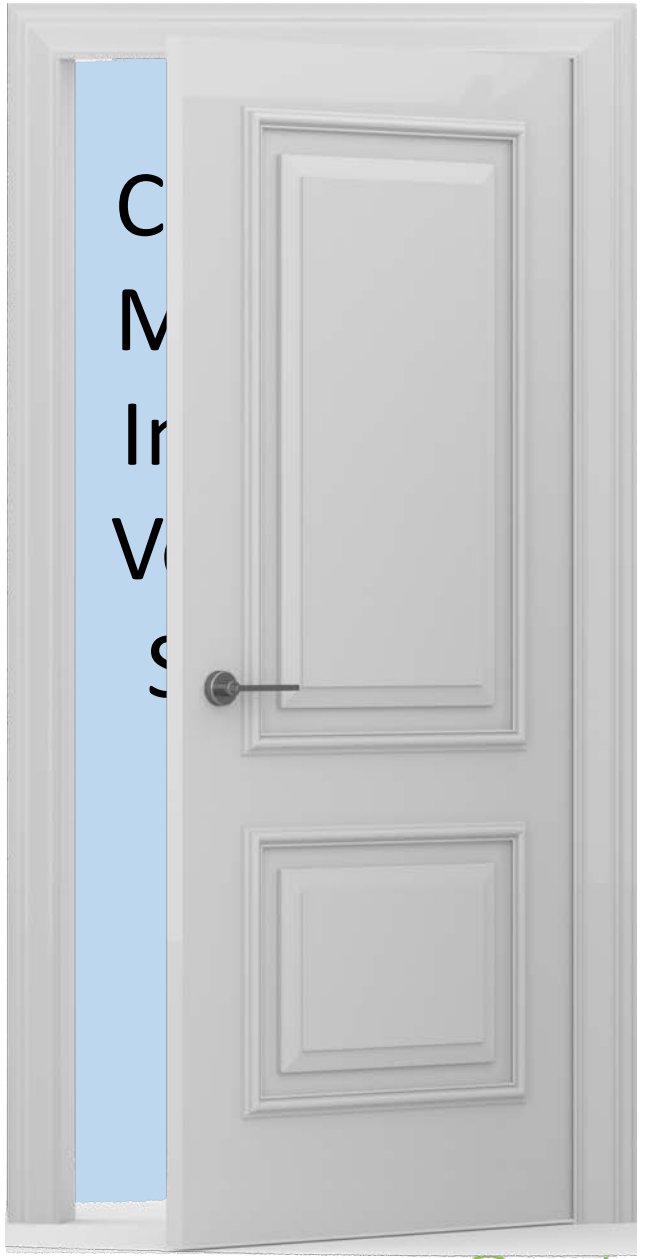
KEY MAKER

Velux

AEROBARRIER



AEROBARRIER®



measureQuick

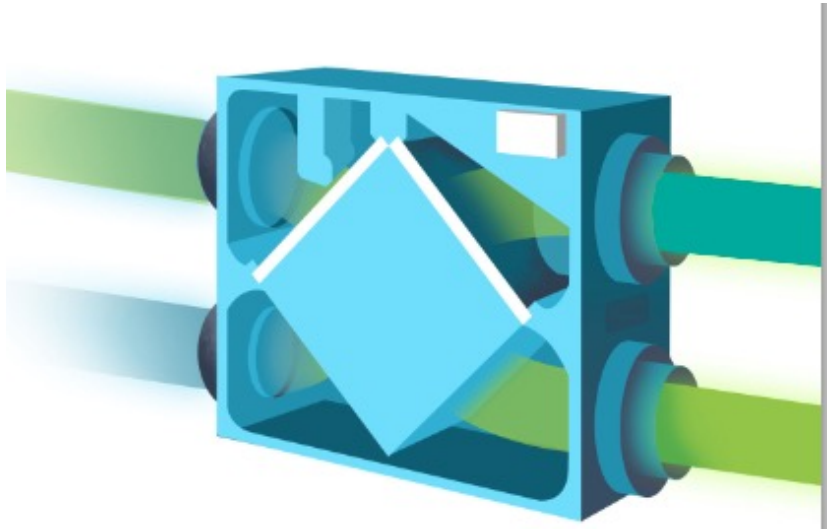
Ventilation - HRV / ERV Units

Ventilation Only

Roof top unit

There are multiple manufacturers of HRV / ERV units

Indoor unit



These systems provide outside air with little energy penalty. H/ERVs condition the air and provide occupant comfort.

EnviroSupply Premium 4x8 Virgin Coconut Shell Activated Carbon Charcoal (for Air Purification and Vapor Phase Applications) - Bulk 20 lb. Resealable Bucket

HAYWARD™ SCORE

What is Dust?

Dust is a chemical and particle history of everything that has ever happened within your house. Dust inside your home has different parts depending on the construction and age of your home, and the lifestyle and cleaning practices of the inhabitants inside it.

- Pet dander
- Human hair & skin
- Fibers from clothes & carpets
- Particulates from cooking

- Plastic and fiberglass
- Pesticides
- Chemicals from household products

- Lead
- Heavy metals
- Tobacco smoke residue
- Outdoor pollution

- Pollen
- Decomposed insects
- Mold & spores
- Dust mites

Particulates from WHERE!!

It is estimated that the entire outer layer of skin is shed every day or two at a rate of **7 million skin flakes per minute.** Tests of indoor environmental dust in homes and offices have shown it to be primarily (70-90%) composed of skin flakes.

https://www7.nau.edu/itep/main/eeop/docs/airqlty/AkIAQ_Particles.pdf

Rater Fest! 2023

Standard 310 –

Section 6. Task 3: Evaluation of the Blower Fan Volumetric Airflow.

Section 7. Task 4: Evaluation of the Blower Fan Watt Draw.

measureQuick

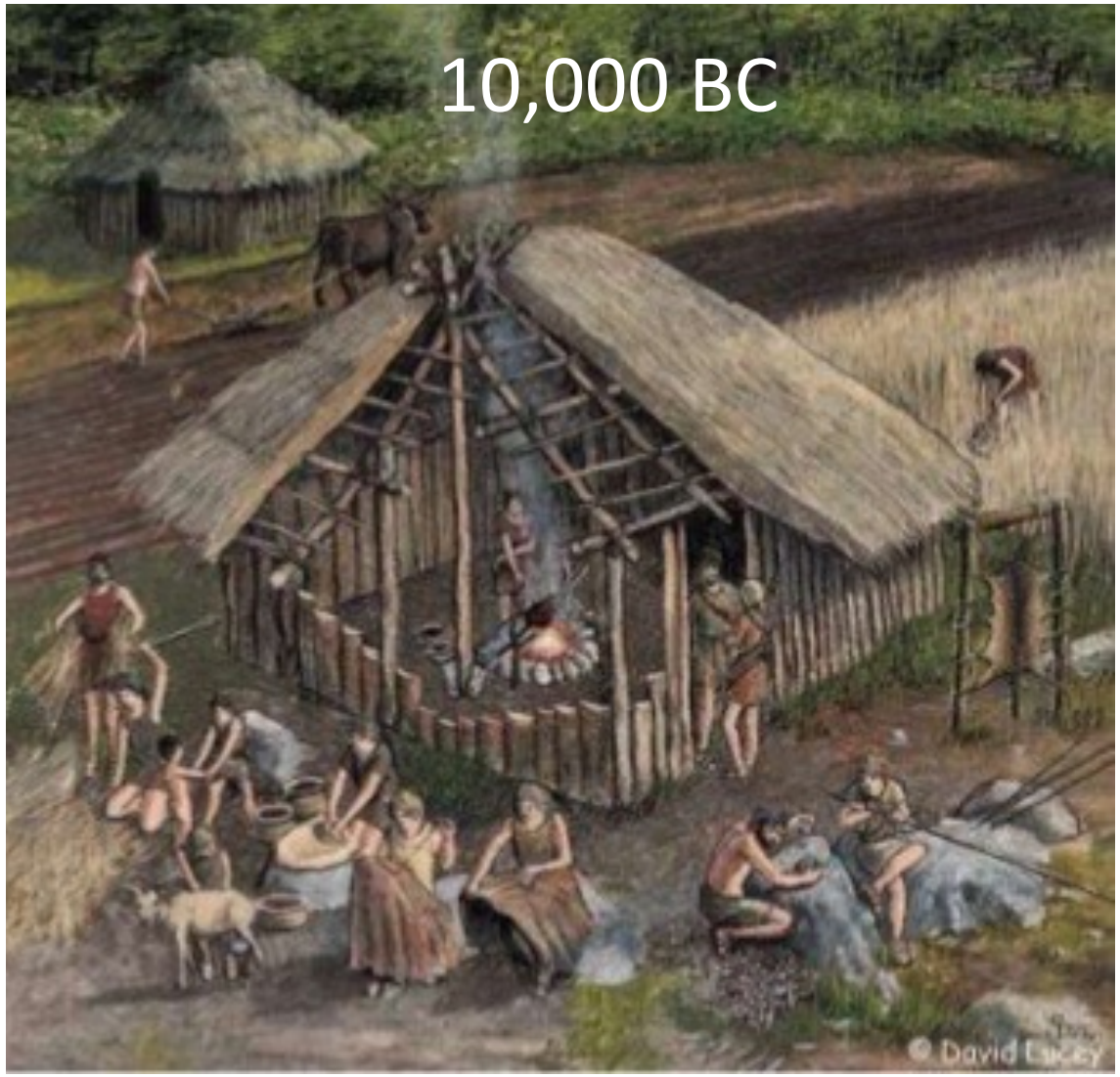
Conclusion

- Standard 310 is growing in acceptance
- Will be fully incorporated in commissioning
- Sections 2 – ~~5~~ 4 are not difficult to complete
- Systems must be fully: - Designed
  - Commissioned
- Airflow and static pressure must me measured
- The refrigerant charge is crucial

Rule of Thumbs

Joe Medosch's Rule of Thumb 2.0

Brief History of Housing



Learn by Living and Failing

measureQuick

mQ

T·E·C

Fieldpiece

testo

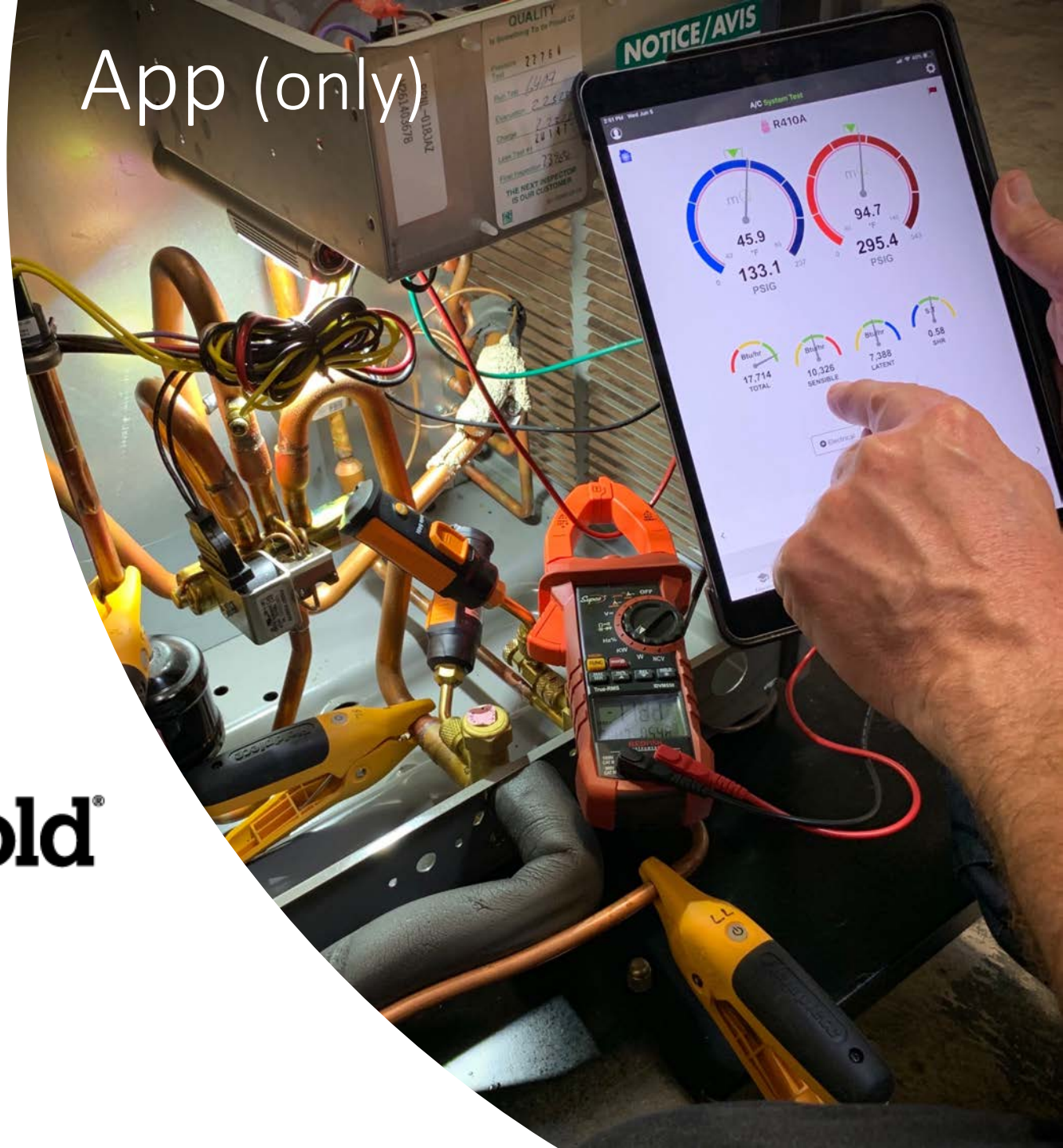
Supco

iManifold

ACCUTOOLS®

Rater Fest!

App (only)



Smart Tools and Intelligent Apps

EXIT

Indoor Workflow

- GEOLOCATE & NAME SITE
- ENTER CUSTOMER INFORMATION
- ZERO MANOMETERS
- DEPLOY INDOOR PROBES
- ENTER FILTER INFORMATION
- ENTER INSTALLATION INFO — SKIP
- HOTO DOCUMENT INDOOR ISSUE — SKIP
- ENTER AHU/FURNACE M/N & S/N

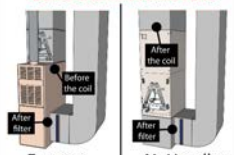
← BACK | NEXT →

45%

EXIT Indoor Workflow

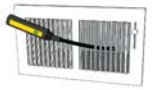
Indoor Probe Placement

Static Pressure Probes
ZERO the MANOMETERS



Furnace | Air Handler

Probe is **IN** the Supply Grill



Probe is on the Return Grill

DISMISS

53%

EXIT Outdoor Workflow

DEPLOY OUTDOOR PROBES

Outdoor Probe Placement

DISMISS

← BACK | NEXT →

66%

EXIT

Outdoor Workflow

Outdoors, before continuing, pull service disconnect to shut off outdoor condenser and remove electrical panels for service and inspection.

CONFIRM DISCONNECT IS REMOVED

← BACK

57%

ACCA
QI
QUALITY INSTALLATION
VERIFIED SYSTEM PERFORMANCE
Powered by measureQuick®

ENERGY STAR VERIFIED HVAC INSTALLATION

ACCA
QI
QUALITY INSTALLATION
VERIFIED EQUIPMENT OPERATION
Powered by measureQuick®

Rater Fest! 2023

Standard 310 –

Section 6. Task 3: Evaluation of the Blower Fan Volumetric Airflow.

Section 7. Task 4: Evaluation of the Blower Fan Watt Draw.

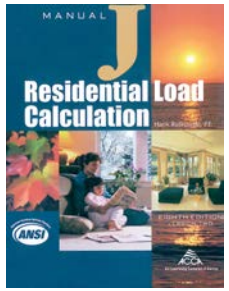
measureQuick

ANSI / RESNET / ACCA / ICC 310-2020

Must complete compliance in order of sequence.

Tolerances Met → Grade III

1 Design Review
- Tolerances Not Met
- Tolerances Met



FIELD Verified by home energy rater, energy auditor, or HVAC contractor.

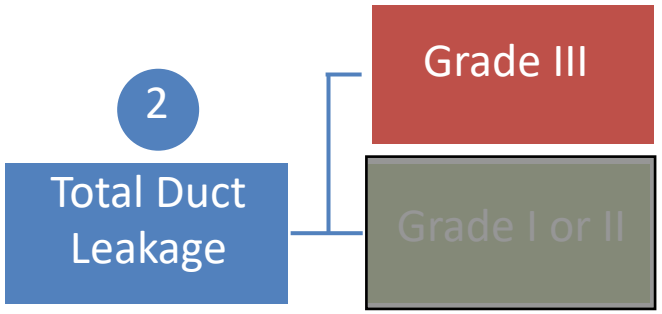
2 Total Duct Leakage
- Grade III
- Grade I or II
- ANSI / RESNET / ICC 380

3 Blower Fan Airflow
- Grade III
- Grade I or II
- Flow Grid
- Pressure Matching
- Flow Hood
- Static Press. Table

4 Blower Fan Watt Draw
- Grade III
- Grade I or II
- Plug-In Watt Meter
- Clamp-On Watt Meter
- House Utility Meter

5 Refrigerant Charge
- Grade III
- Grade I
- Non-Invasive Temp.
- Weigh-In Verification

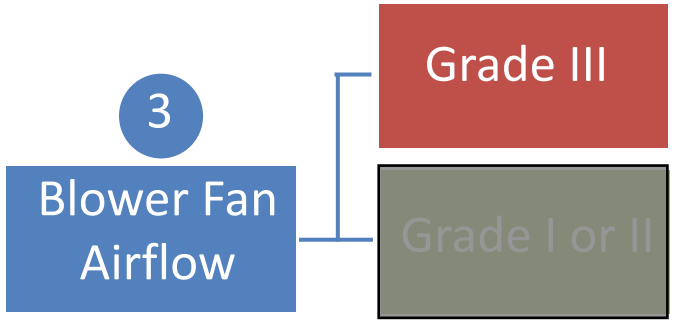
5. Task 2: Designating the Total Duct Leakage Grade



5.4.3. ... Grade III shall be designated and recorded if the total duct leakage has been measured and exceeds the limits in Section 5.4.2.

"None Shall Pass"

6. Task 3: Evaluation of the Blower Fan Volumetric Airflow.



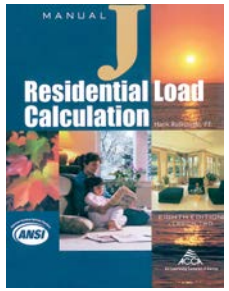
6.2.1. The total duct leakage shall have been evaluated in accordance with Section 5, ... If the total duct leakage has been designated Grade III, then the Forced-air HVAC System shall not be further evaluated using this standard, and Grade III shall be designated for Blower Fan volumetric airflow, Blower Fan watt draw, and refrigerant charge.

ANSI / RESNET / ACCA / ICC 310-2020

Must complete compliance in order of sequence.

Tolerances Met → Grade I or II

1 Design Review
- Tolerances Not Met
- Tolerances Met



FIELD Verified by home energy rater, energy auditor, or HVAC contractor.

2 Total Duct Leakage
- Grade III
- Grade I or II
- ANSI / RESNET / ICC 380

3 Blower Fan Airflow
- Grade III
- Grade I or II
- Flow Grid
- Pressure Matching
- Flow Hood
- Static Press. Table

4 Blower Fan Watt Draw
- Grade III
- Grade I or II
- Plug-In Watt Meter
- Clamp-On Watt Meter
- House Utility Meter

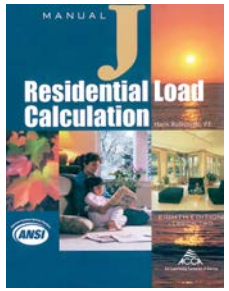
5 Refrigerant Charge
- Grade III
- Grade I
- Non-Invasive Temp.
- Weigh-In Verification

6. Task 3: 6.6. Flow Grid – 15min

ANSI / RESNET / ACCA / ICC 310-2020

Tolerances Met → Grade I or II

1 Design Review
- Tolerances Not Met
- Tolerances Met



FIELD Verified by home energy rater, energy auditor, or HVAC contractor.

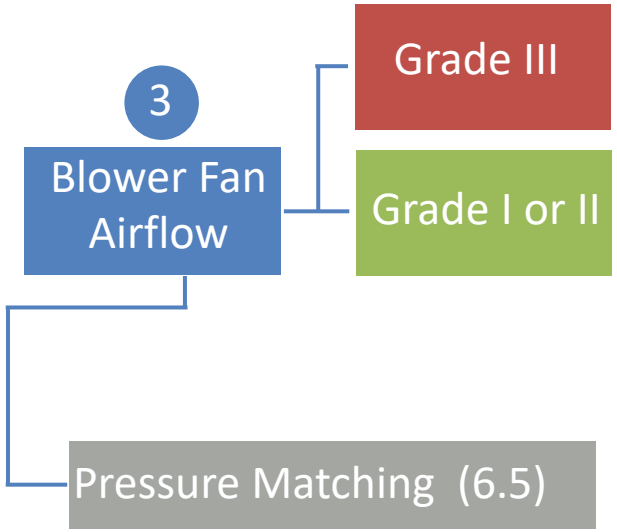
2 Total Duct Leakage
- Grade III
- Grade I or II
- ANSI / RESNET / ICC 380

3 Blower Fan Airflow
- Grade III
- Grade I or II
- Flow Grid
- Pressure Matching
- Flow Hood
- Static Press. Table

4 Blower Fan Watt Draw
- Grade III
- Grade I or II
- Plug-In Watt Meter
- Clamp-On Watt Meter
- House Utility Meter

5 Refrigerant Charge
- Grade III
- Grade I
- Non-Invasive Temp.
- Weigh-In Verification

6. Task 3: 6.5. Pressure Matching Method 6.5.2.5.2. Method 2



6.5.2.5.2. Method 2 Installation:

At the Return Grille.

The Fan Flowmeter shall be attached to the return grille.

6. Task 3: 6.7. Procedure to Conduct Flow Hood Test

3 Blower Fan Airflow

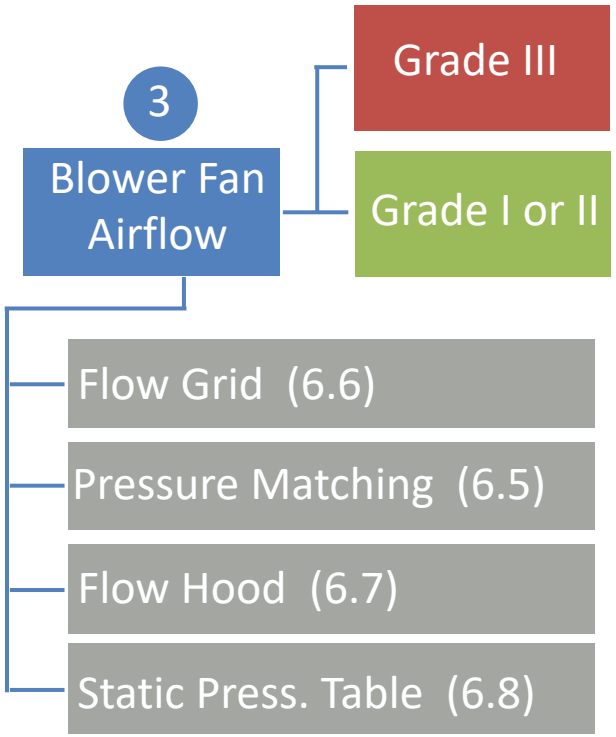
- Grade III
- Grade I ONLY

Flow Hood (6.7)

Total Duct Leakage

Grade I ONLY

6. Task 3: Evaluation of the Blower Fan Volumetric Airflow



Alternative Test Methods

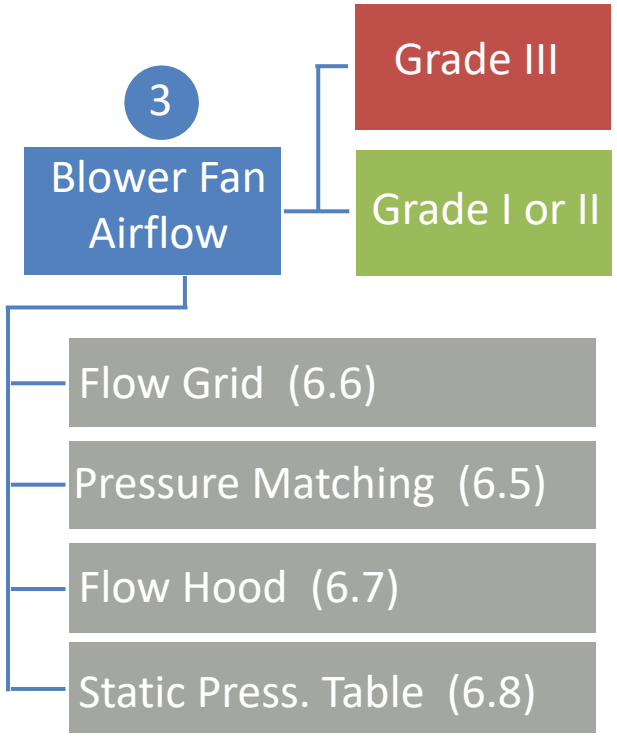
6.1. Overview. As an alternative to completing the procedures defined in Sections 6.5 through 6.8, the following are approved:

- Section 4.1.2 from ANSI/ACCA 5 QI,
- Section 8.6 from ASTM E1554-13,
- Normative Appendix A from ANSI/ASHRAE Standard 152 2004,
- Section RA3.3 from the 2016 Reference Appendices for the 2016 Building Energy Efficiency Standards of the California Energy Commission.

Exception

6.3.1.1. If the Forced-Air HVAC System has a total amount of supply ductwork or distribution building cavities that does not exceed 10 ft. in length and is entirely in Conditioned Space Volume, then measurement of the airflow shall be exempted and the volumetric airflow grade shall be Grade I

6. Task 3: Evaluation of the Blower Fan Volumetric Airflow



6.2.2. Verification of HVAC Components.

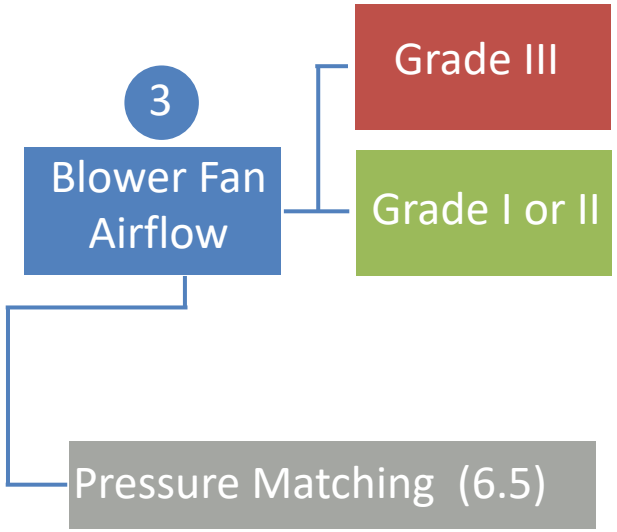
Verified 4.3.14. Each HVAC System in the Dwelling matches the equipment type specified in Section 4.2.5.3.1.

6.2.2.2. Dwelling-Unit Mechanical Ventilation Systems integrated with the HVAC System.

6.2.2.3. Distribution systems, including supply registers and return grilles.

6.2.2.4. An air filter with the same performance rating and metric as reported in Section 4.2.5.4

6. Task 3: 6.5. Pressure Matching Method



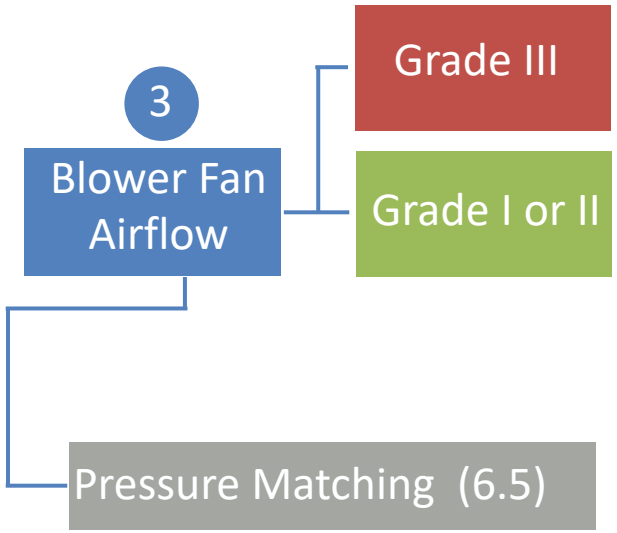
6.5.1. Equipment Needed

6.5.1.1. **Manometer.**

6.5.1.2. **Static Pressure Probe.**

6.5.1.3. **Fan Flowmeter.** A tool comprised of a variable speed fan and a Manometer (aka blower door)

6. Task 3: 6.5. Pressure Matching Method



6.5.2.5. One of two methods...

6.5.2.5.1 is permitted to be used for all Forced-Air HVAC Systems. *(single or multiple return ducts)*

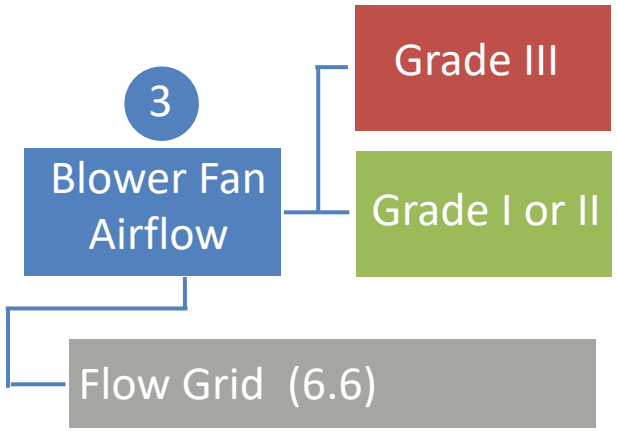
... a temporary air barrier inserted between the return duct system and the Blower Fan inlet.

... If the Fan Flowmeter will pull air from outside the Conditioned Space Volume during the test, then doors or access panels ... shall be opened.

6.5.2.5.2. Method 2 Installation: At the Return Grille.

The Fan Flowmeter shall be attached to the return grille.

6. Task 3: 6.6. Flow Grid



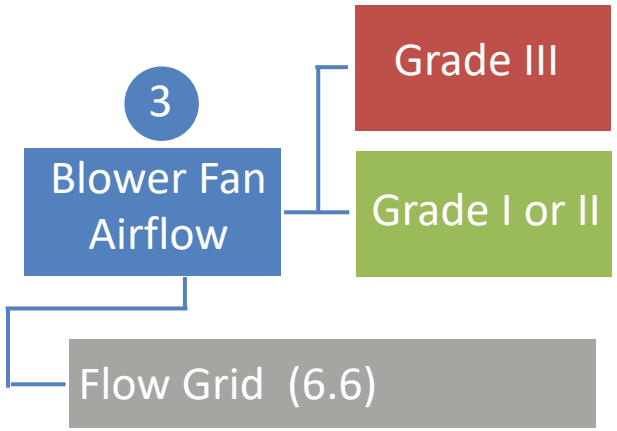
6.6.1. Equipment Needed

6.6.1.1. **Manometer.**

6.6.1.2. **Static Pressure Probe.**

6.6.1.3. **Flow Grid.** A flow measurement device designed to temporarily replace the filter in the Forced-Air HVAC System and capable of measuring the volumetric airflow through it with an accuracy equal to or better than 7% of the measured flow.

6. Task 3: 6.6. Flow Grid Procedure to Conduct Flow Grid Test



6.6.2.2. The Static Pressure Probe shall be inserted

6.6.2.3. The Forced-Air HVAC System shall run for 10 minutes continuously.

6.6.2.4. The average pressure difference between the Static Pressure Probe and the space where the Forced-Air HVAC System is located, Psop...

6.6.2.5. All filters shall be removed. Flow plate(s) shall be located so that all of the Blower Fan airflow will flow through them. If multiple locations are required multiple flow plates shall be used so that simultaneous measurements are taken, representing total system airflow.

6.6.2.6. The average static pressure at the test hole, Ptest, shall be measured

6.6.2.7. Using the pressure reading from the flow plate, the average airflow through the Flow Grid, Qtest, shall be measured

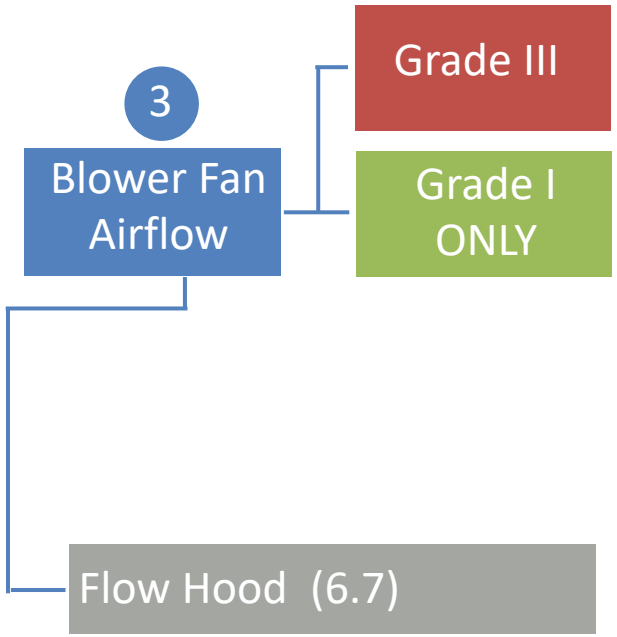
6.6.2.8. The measured airflow, Qtest, and coincident plenum pressure, Ptest, shall be used to determine the Blower Fan airflow at operating conditions, Qop, using Equation 4 and recorded:

6.6.2.9. The Flow Grid shall be removed and the filter replaced; and the supply side test hole shall be sealed

6. Task 3: 6.7. Flow Hood

Total Duct Leakage

Grade I ONLY



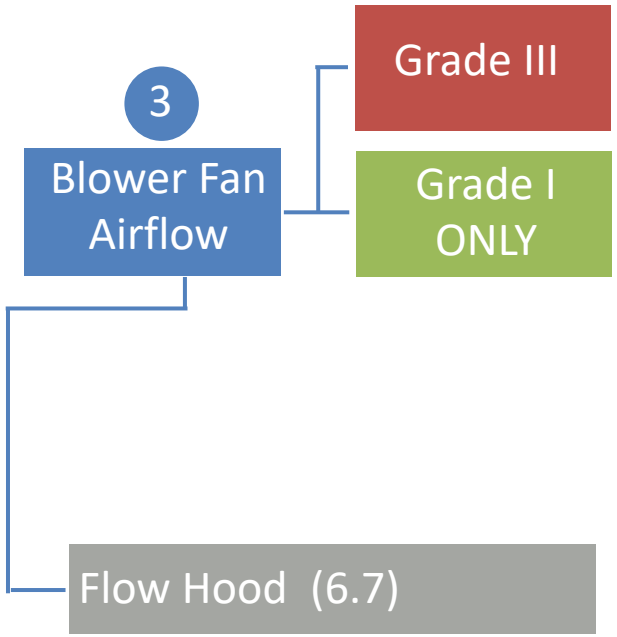
6.7.1. Equipment Needed

6.7.1.1. **Flow Hood**. A device consisting of a flow capture element capable of creating an airtight perimeter seal around the return grille, and an airflow meter capable of measuring the volumetric airflow through the flow capture element with an airflow range that that encompasses the design Blower Fan airflow, as reported in Section 4.2.5.5.1, at an accuracy equal to or better than 3% of the measured flow + 7 CFM.

6. Task 3: 6.7. Flow Hood

Total Duct Leakage

Grade I ONLY



6.7.2. Procedure to Conduct Flow Hood Airflow Test

6.7.2.1. The Forced-Air HVAC System shall run for 10 minutes continuously

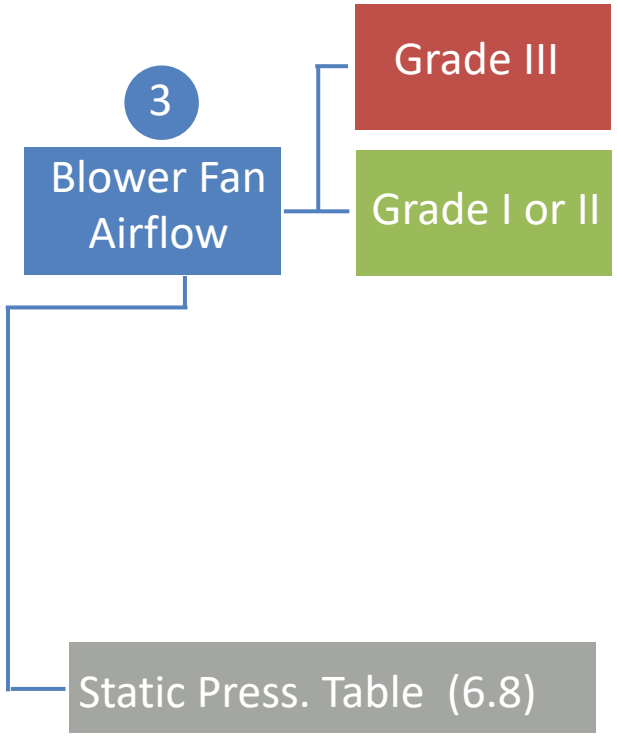
6.7.2.1.1. The flow capture element of the Flow Hood shall be placed over each return grille

6.7.2.1.2. The Flow Hood shall be turned on and the average airflow through the airflow meter, Qtest

6.7.2.1.3. For a Dwelling located at an elevation >2,500 ft., Qtest shall be corrected to equivalent airflow at sea level using the procedure specified by the airflow measurement device manufacturer

6.7.2.2. If only one return grille is present in the Forced-Air HVAC System, Qop shall equal Qtest. If multiple return grilles are present in the Forced-Air HVAC System, Qop shall be the sum of Qtest for each of the return grilles.

6. Task 3: 6.8. OEM Static Pressure Table Method



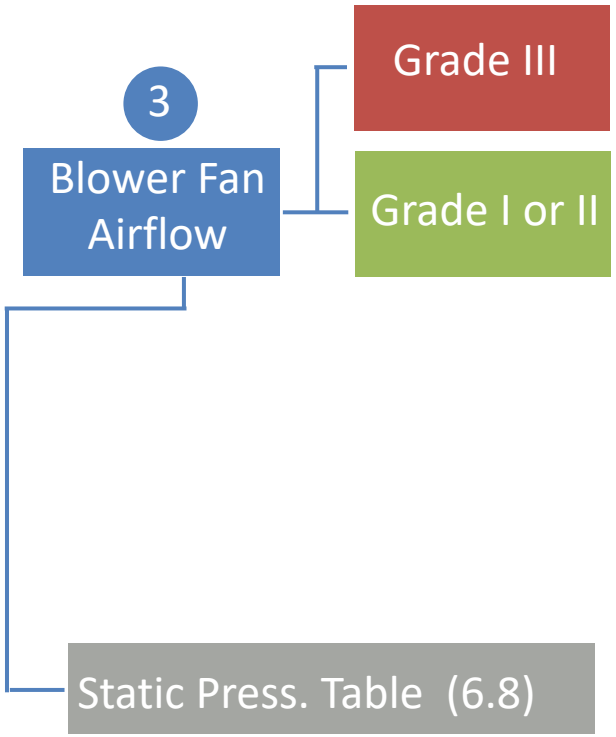
6.8.1. Equipment Needed

6.8.1.1. **Manometer.**

6.8.1.2. **Static Pressure Probe.**

6.8.1.3. **Duct plugs, UL-181 listed tape**, or other means of sealing duct holes as approved by the Authority Having Jurisdiction.

6. Task 3: 6.8. OEM Static Pressure Table Method



6.8.3. Procedure to Conduct OEM Static Pressure Airflow Test

6.8.3.1. If the Blower Fan motor type, as reported in Section 4.2.5.3.4, is ECM or Other Motor Type, then the elevation of the system shall be verified to be ≤ 2,500 ft or one of the other airflow test procedures shall be used.

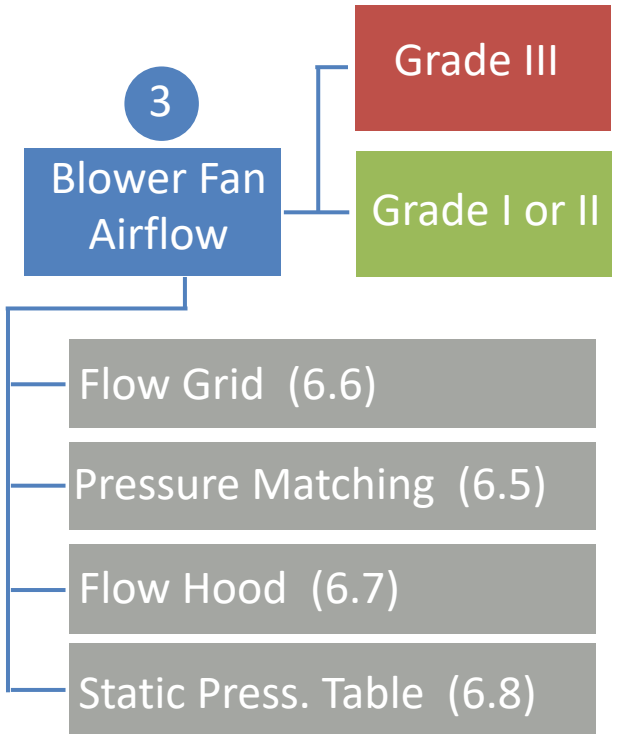
Exception: The OEM provides instructions to adjust the OEM Static Pressure Table to account for the system's elevation

6.8.3.2. The fan-speed setting of the Blower Fan shall be observed and recorded for the mode that the test will be conducted in.

6.8.3.3. A test hole shall be located or created in the return-side of the Forced-Air HVAC system for the placement of the Static Pressure Probe.

6.8.3.4. A test hole shall be located or created in the supply-side of the Forced-Air HVAC System ... Furnaces, test hole shall be located after the Furnace but before the evaporator coil. For Heat Pumps, ... the test hole shall be located after the fan-coil but before the presence of any other components not accounted for in the OEM Static Pressure Table.

6.9. Designating the Blower Fan Volumetric Airflow Grade



6.9.2. The Blower Fan volumetric airflow grade shall be designated according to the ranges in Table 4

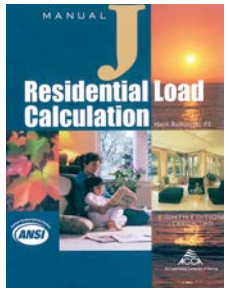
Table 4 – Grade Designations for Blower Fan Volumetric Airflow

Grade Designation	F_{AF} Range		
I	≤ 0 and > -15%	or	≥ 0 and < +15%
II	≤ -15% and > -25%	or	≥-15% and < +25%
III	≤ -25%	or	≥ +25%

ANSI / RESNET / ACCA / ICC 310-2020

Tolerances Met → Grade I or II → Grade I or II

1 Design Review
- Tolerances Not Met
- Tolerances Met



FIELD Verified by home energy rater, energy auditor, or HVAC contractor.

2 Total Duct Leakage
- Grade III
- Grade I or II
- ANSI / RESNET / ICC 380

3 Blower Fan Airflow
- Grade III
- Grade I or II
- Flow Grid
- Pressure Matching
- Flow Hood
- Static Press. Table

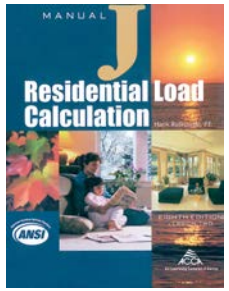
4 Blower Fan Watt Draw
- Grade III
- Grade I or II
- Plug-In Watt Meter
- Clamp-On Watt Meter
- House Utility Meter

5 Refrigerant Charge
- Grade III
- Grade I
- Non-Invasive Temp.
- Weigh-In Verification

ANSI / RESNET / ACCA / ICC 310-2020

Tolerances Met → Grade I or II → Grade I or II

1 Design Review
- Tolerances Not Met
- Tolerances Met



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2 Total Duct Leakage
- Grade III
- Grade I or II
- ANSI / RESNET / ICC 380

3 Blower Fan Airflow
- Grade III
- Grade I or II
- Flow Grid
- Pressure Matching
- Flow Hood
- Static Press. Table

Bill Go

Process and options for measuring static pressure
c) Options for location of static pressure measurements for compensating TrueFlow measurements

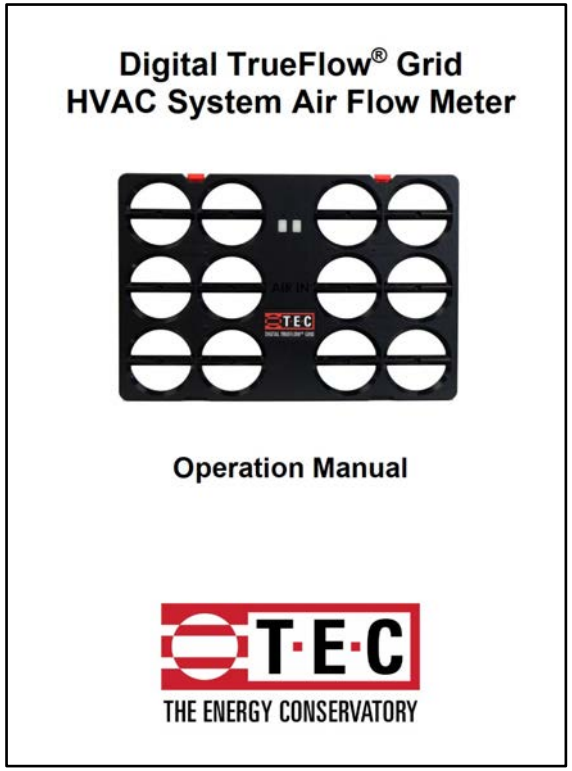
Install the static pressure probe into the ductwork according to the TrueFlow app workflow selection (the operator will typically need to drill or punch a small hole in the ductwork in order to insert the static pressure probe):

• Insert the static pressure probe into the side surface of the supply plenum. The static pressure probe should point into the airstream.

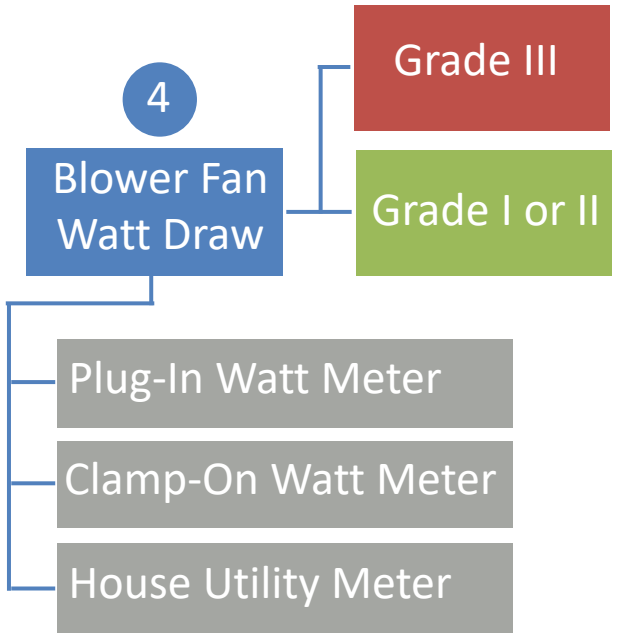
• Or, insert the static pressure probe in the side surface of the return plenum. The side of the return plenum chosen should not have a trunk line, return duct or return register connected to it. The static pressure probe should point into the airstream.

Note: If the Grid will be installed at a remote filter grille, the static pressure probe may not be installed in the return plenum (i.e. install it in the supply plenum).

• Or, insert the static or total pressure probe in the supply register approx. 2.5 inches upstream of the grille. In this mode, the app will ensure the pressure reading is high enough to provide an accurate calculation of flow to accuracy of 7% or better (vs. 5% or better for other locations). If the app is not seeing high enough pressure, it will alert the user and suggest trying
another register or measure in the supply plenum.



7. Task 4: Evaluation of the Blower Fan Watt Draw.



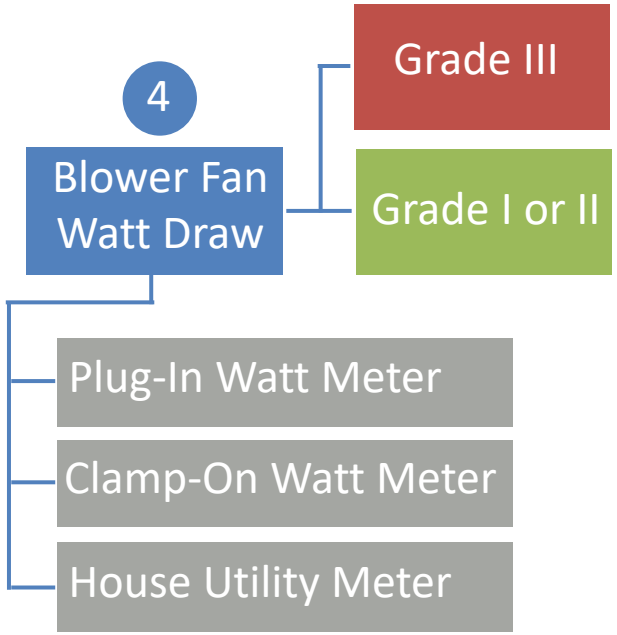
7.1. Overview ... Accepted Alternatives

- If the installed equipment contains an on-board diagnostic system that is capable of reporting the Blower Fan watt draw...

- If an Independent Verification Report is obtained containing the measured Blower Fan watt draw of the Forced-Air HVAC System under test, and the report is approved for use by an entity adopting and requiring the use of this Standard, then the reported value shall be permitted to be used.

7. Task 4: Evaluation of the Blower Fan Watt Draw.

7.3. Procedure to Prepare the Dwelling and Forced-Air HVAC System



7.3.2. Settings for HVAC System.

7.3.2.1. Cooling Mode.

7.3.2.1.1. If the outdoor temperature is < 55° F then power to the compressor shall be disconnected ....

7.3.2.2. Heating Mode.

7.3.2.2.1. If the outdoor temperature is > 60° F then power to the compressor shall be disconnected ....

Which Requires More Airflow? Air Conditioning or Furnace

$$Btuh = 1.08 \times CFM \times \Delta t$$

Solve for CFM

$$CFM = \frac{Btuh\ (output)}{1.08 \times \Delta t}$$

2 ton AC cooling = **800** CFM

3 ton AC cooling = **1200** CFM

Furnace 1 100,000 Btuh – 90%

Temp. split 60°-100°

center of the rise (80°)

$$\textbf{1041}\ CFM = \frac{90{,}000}{1.08 \times 80}$$

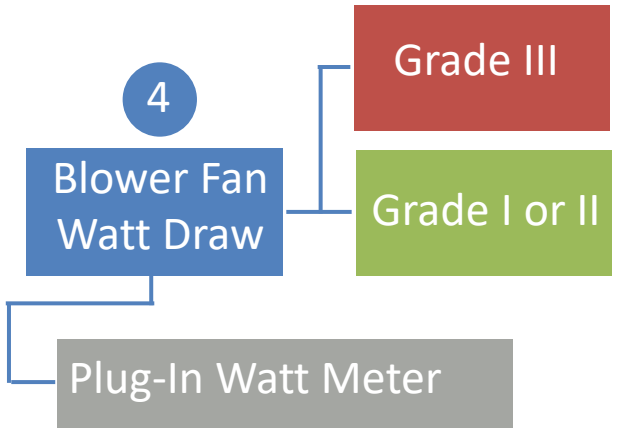
Furnace 2 70,000 Btuh – 90%

Temp. split 15°-45°

center of the rise (30°)

$$\textbf{1944}\ CFM = \frac{63{,}000}{1.08 \times 30}$$

7. Task 4: 7.4. Portable Plug-In Watt Meter

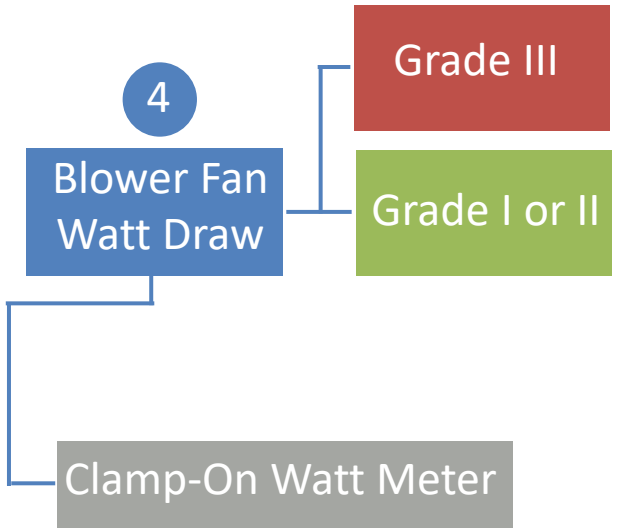


7.4.1. Equipment Needed.

7.4.1.1. **Portable Plug-In Watt Meter.** The apparatus for measuring the Blower Fan watt draw shall consist of a wattmeter capable of plugging into a standard electrical receptacle and that itself contains a receptacle for plugging devices into to measure their watt draw.
The Meter shall have a true power measurement system (i.e., sensor plus data acquisition system) having an accuracy of 2% of reading or 10 watts, whichever is greater.

7. Task 4: 7.4. Portable Plug-In Watt Meter

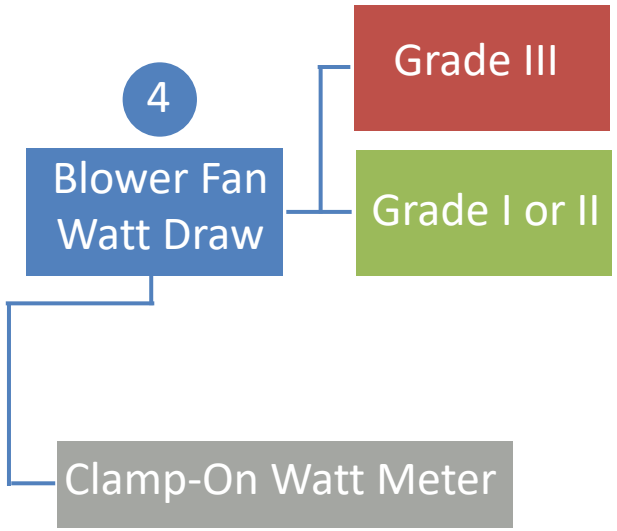
7. Task 4: 7.5. Clamp-On Watt Meter



7.5.1. Equipment Needed.

7.5.1.1. **Clamp-On Watt Meter.** The apparatus shall consist of a clamp capable of being placed around an electrical wire to measure current combined with leads capable of simultaneously measuring voltage, allowing for the measurement of the Blower Fan watt draw. The Meter shall have a true power measurement system (i.e., sensor plus data acquisition system) having an accuracy of 2% of reading or 10 watts,whichever is greater.

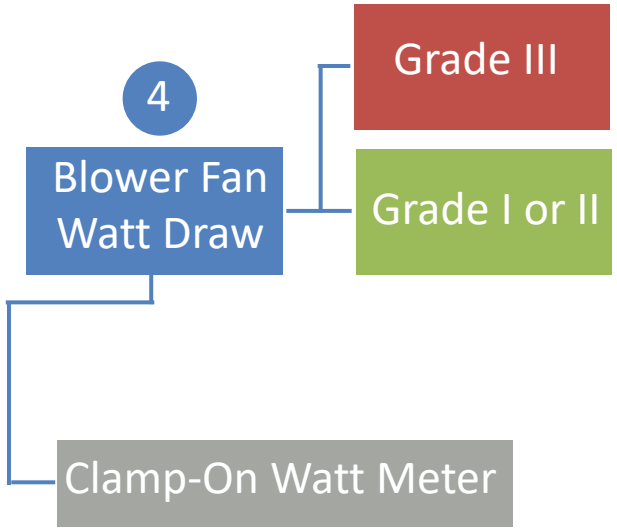
7. Task 4: 7.5. Clamp-On Watt Meter



7.5.2. Procedure to Measure Blower Fan Watt Draw

7.5.2.1. This procedure shall be performed by parties with the proper training and using appropriate safety equipment. The Clamp-On Watt Meter manufacturer's operating instructions and safety instructions shall be followed.

7. Task 4: 7.5. Clamp-On Watt Meter



7.5.2. Procedure to Measure Blower Fan Watt Draw

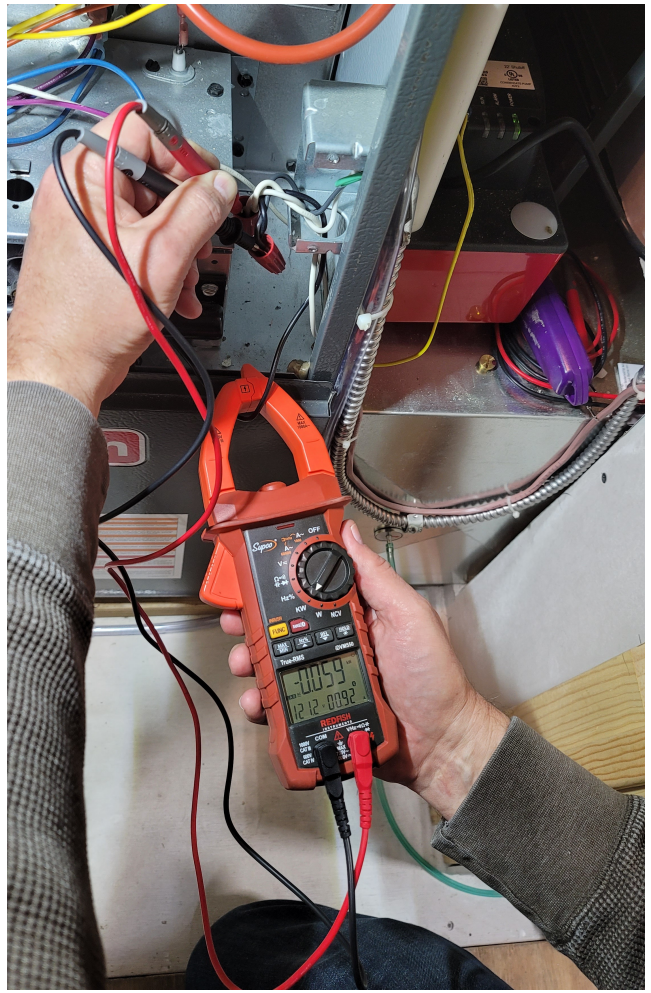
7.5.2.2. The Blower Fan watt draw shall be measured at one of the following locations.

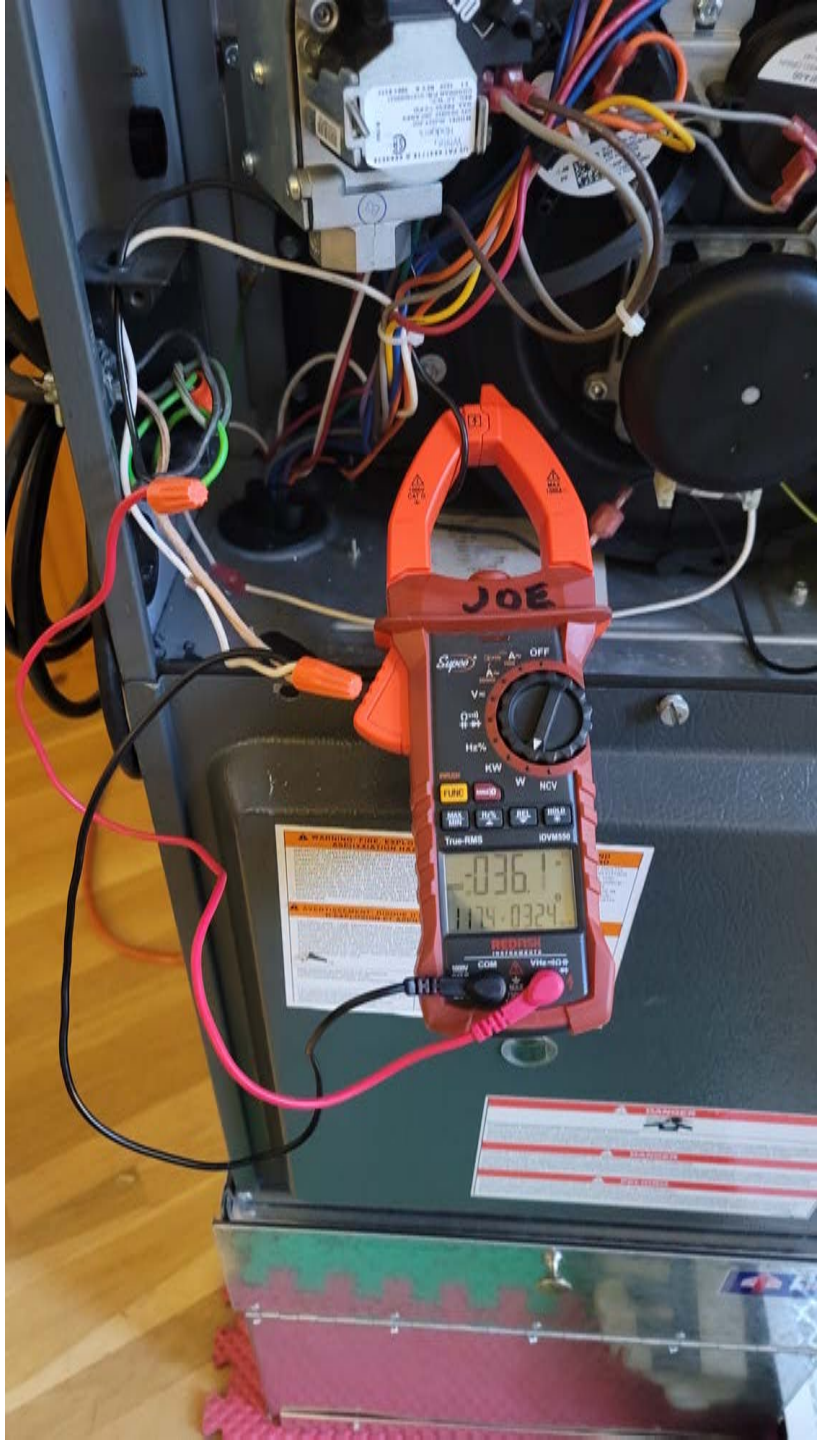
7.5.2.2.1. At the Service Disconnect.

7.5.2.2.2. At the Forced-Air HVAC System

7. Task 4: 7.5. Clamp-On Watt Meter

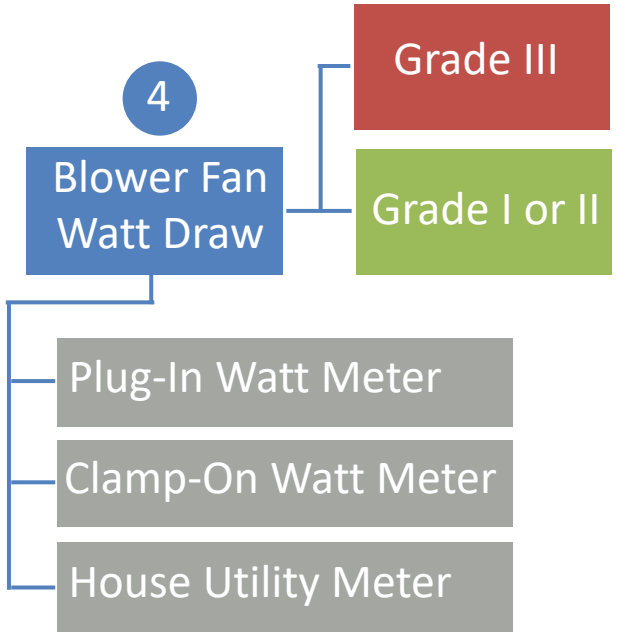
Watts = Amps x Volts




JOE


MAX MIN
Hz%
REL
HOLD
True-RMS
iDVM550
-036.2
117.6
0324
REDFISH
INSTRUMENTS
1000V CAT III
COM
VHz

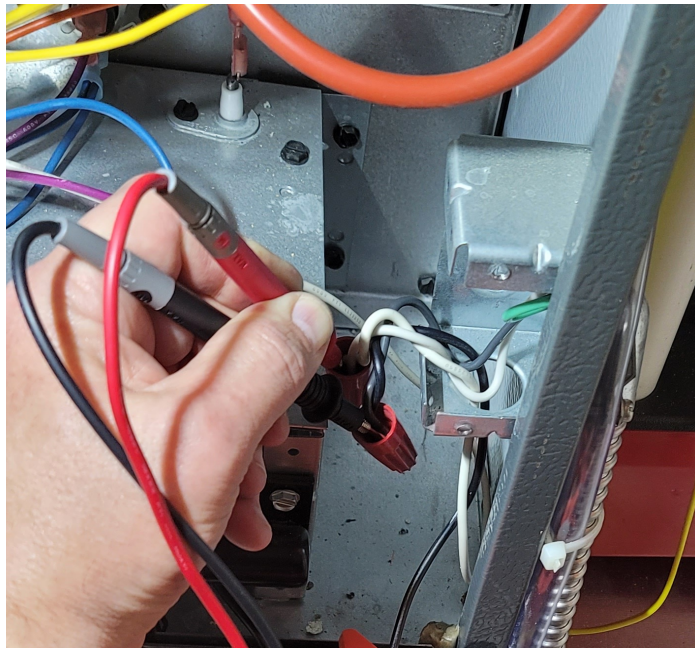
7. Task 4: 7.8. Designating the Blower Fan Watt Draw Grade

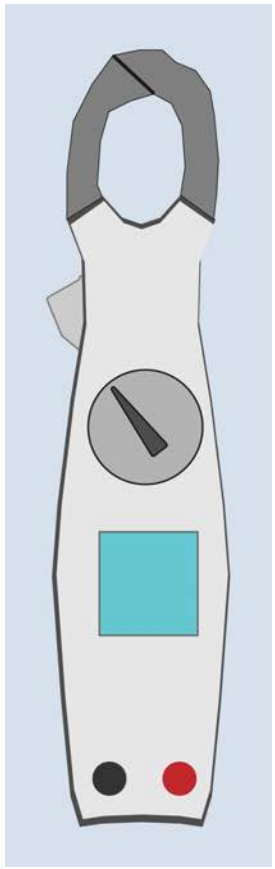


7.8.1. Blower Fan Efficiency shall be calculated using Equation 9:

$$\text{Blower Fan Efficiency} = \frac{W_{fan}}{Q_{fop}}$$

Voltage	x	Amprage	= Watts
120	x	3	= 360





7.5.1.1 Meter shall have a true power measurement system

Voltage	x	Amprage	= Watts
120	x	3	= 360

7.5.1.1 Meter shall have a true power measurement system

Example 1 SCFM = 500 ÷ 360 =

360 ÷ 500 = 0.72 Watt / CFM

Example 2 SCFM = 2400 ÷ 360 =

360 ÷ 2400 = 0.15 Watt / CFM

Grade Designation	Blower Fan Efficiency (Watts/CFM)
I	≤ 0.45
II	> 0.45 and ≤ 0.58
III	> 0.58

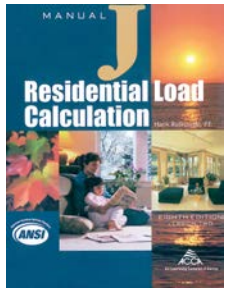
ANSI / RESNET / ACCA / ICC 310-2020

mQ BETA

- A
- B
- C

App. App. App.

1 Design Review
- Tolerances Not Met
- Tolerances Met



FIELD Verified by home energy rater, energy auditor, or HVAC contractor.

2 Total Duct Leakage
- Grade III
- Grade I or II
- ANSI / RESNET / ICC 380

3 Blower Fan Airflow
- Grade III
- Grade I or II
- Flow Grid
- Pressure Matching
- Flow Hood
- Static Press. Table

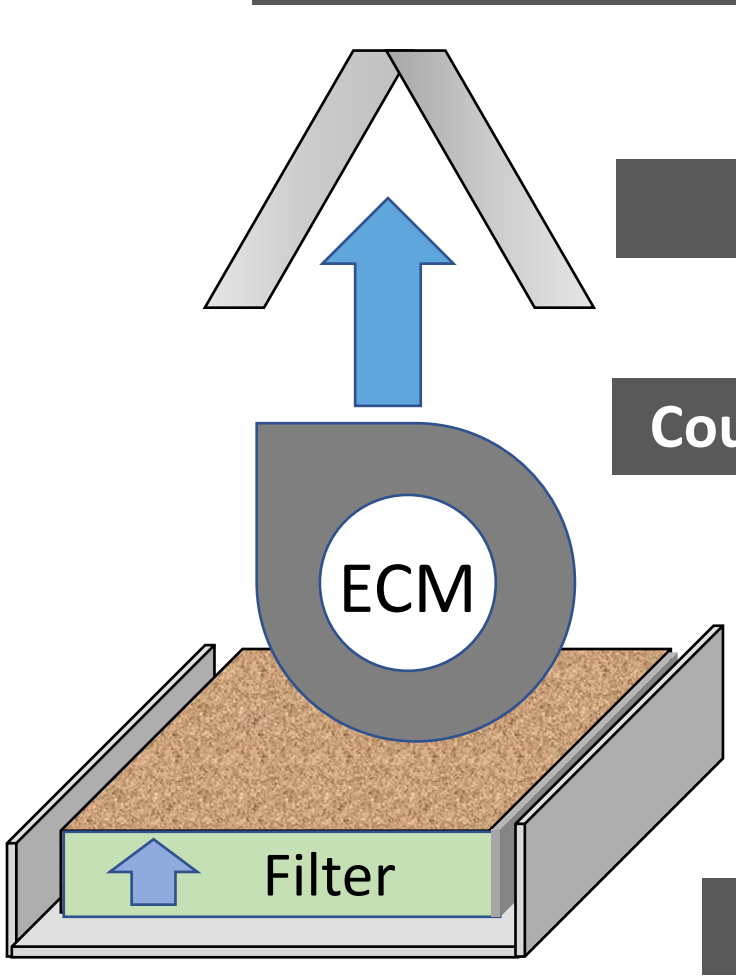
4 Blower Fan Watt Draw
- Grade III
- Grade I or II
- Plug-In Watt Meter
- Clamp-On Watt Meter
- House Utility Meter

5 Refrigerant Charge
- Grade III
- Grade I
- Non-Invasive Temp.
- Weigh-In Verification

Verification by: measureQuick Direct data capture from device

High Static Pressure

High Fan Watt Draw – Lots of Power Consumption per CFM

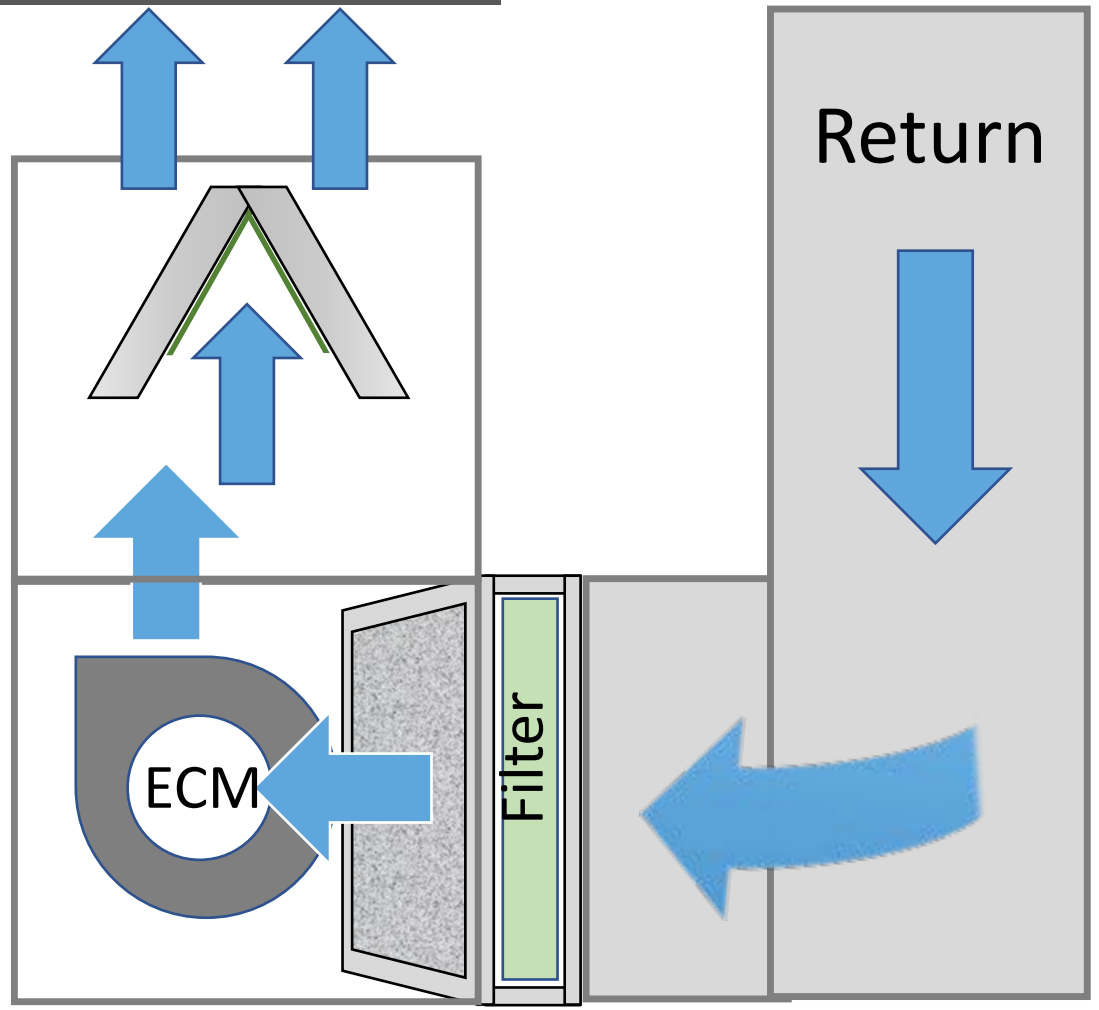


Lowering Efficiency

Could Cause Filter Bypass

Premature ECM Motor Failure

Must be at Rated TESP

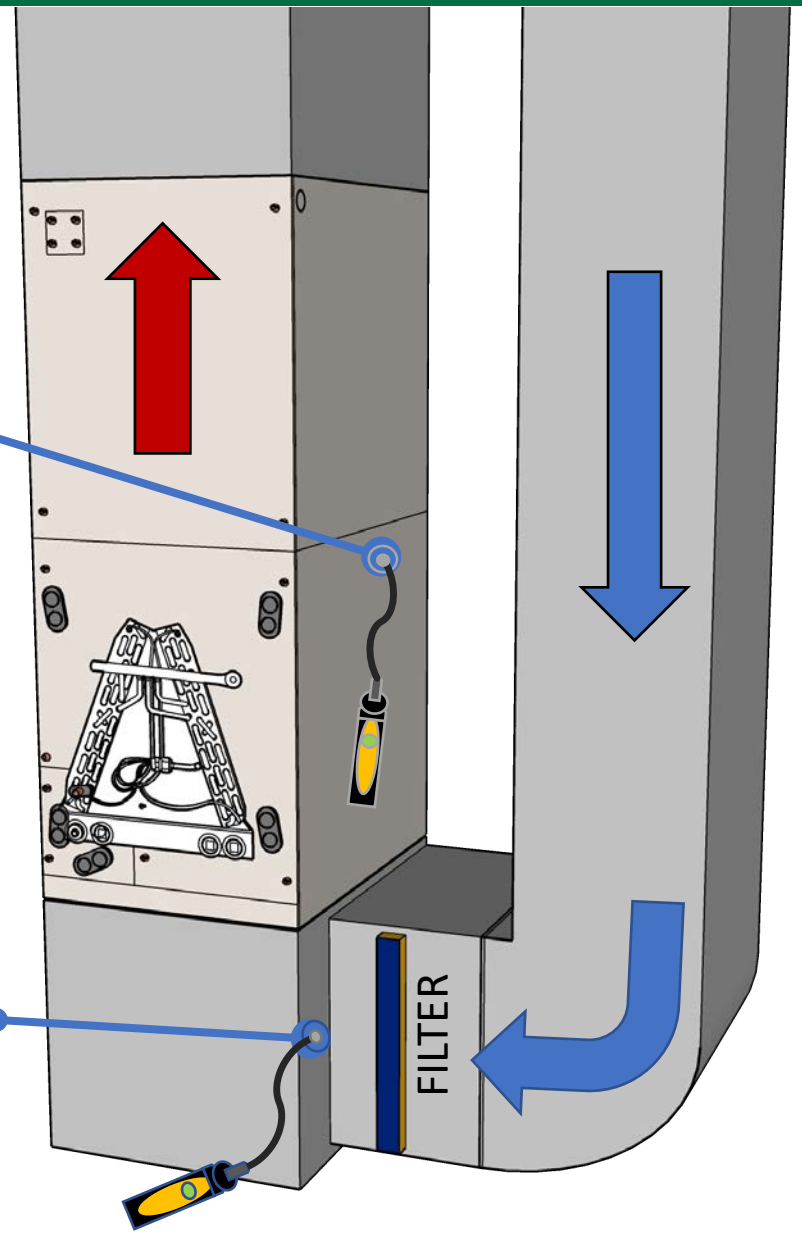


Check the Total External Static Pressure! TESP

Yes this is a furnace

Air Handler

Not a Furnace



Measured

After the Evaporator Coli

After the Filter

TESP - measured at the appliance

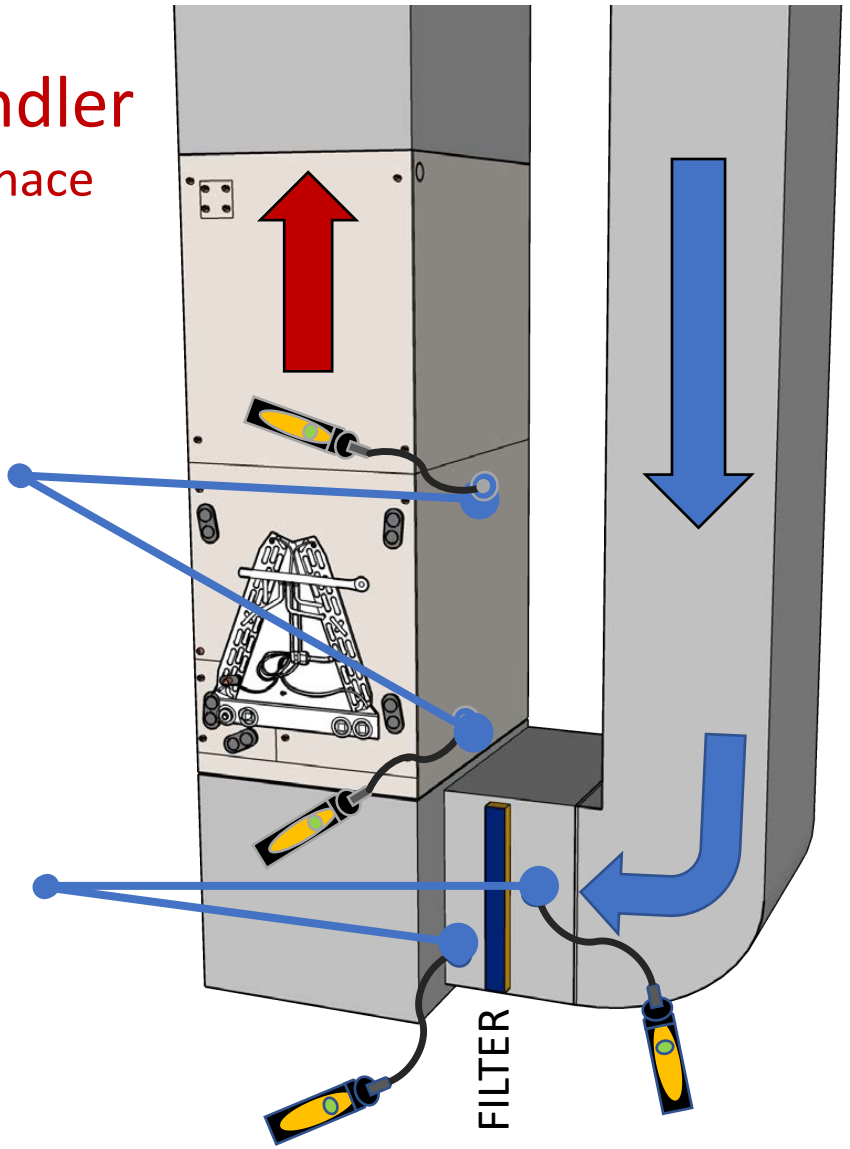
RaterFest!

Check the Components - Coil and Filter…

Checking system component pressures – individually

Air Handler

Not a Furnace



Evaporator Coil Only Static

Evaporator = 40% or .2 IWC

Filter Only Static

Filter = 20% or .50 or .1 IWC

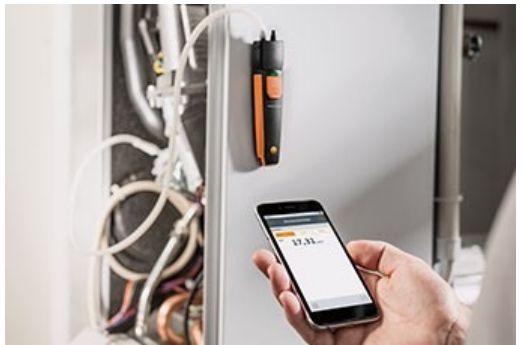
RaterFest!

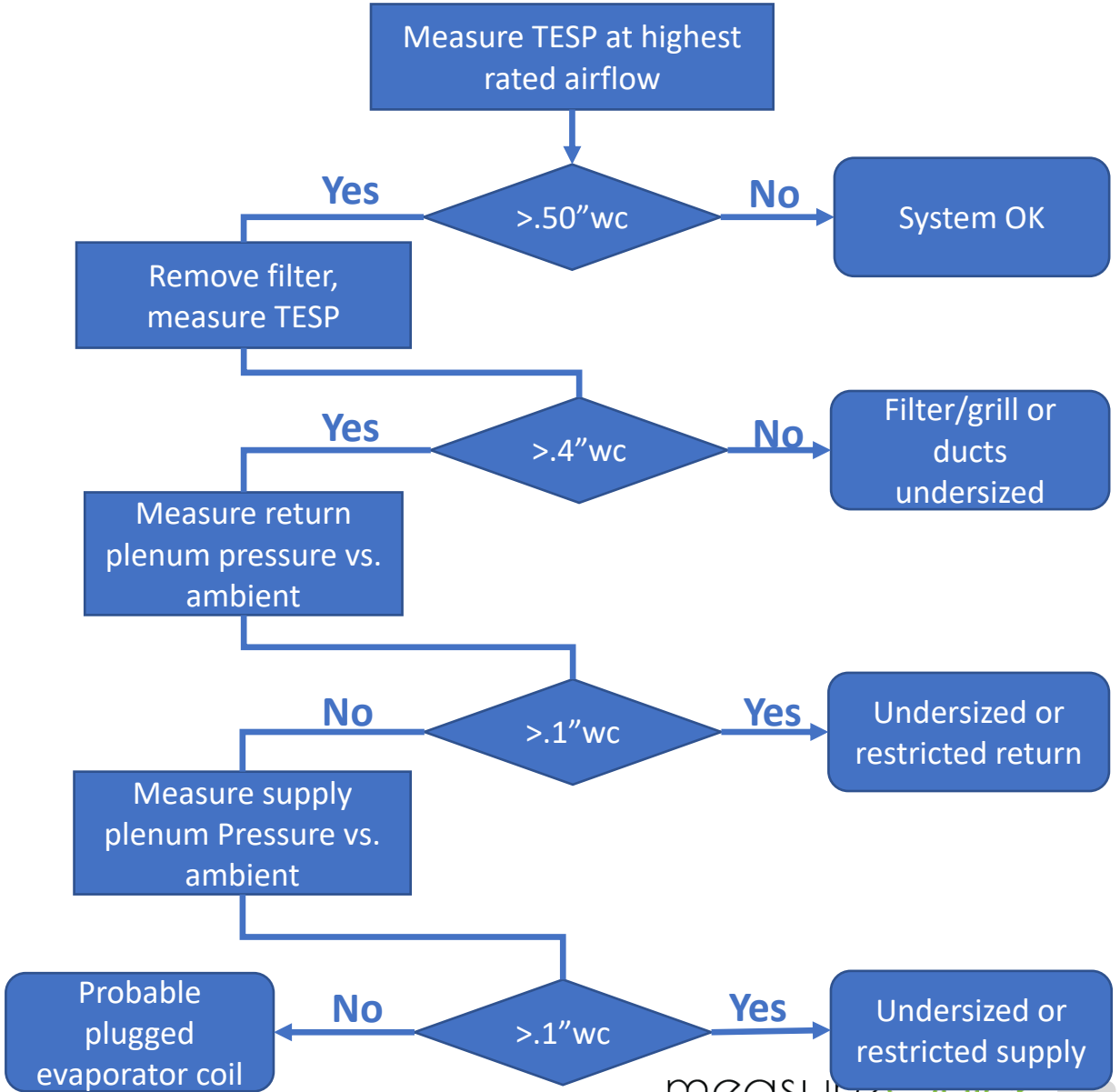
Total External Static Pressure Budget

Max recommended TESP .03 to 0.5”

Budget: (Can change, but very typical!)

Filter	20% or .50 x .2 = .1	
Ducts combined	40% or .50 x .4 = .2	
Evaporator	40% or .50 x .4 = .2	
Total	**100%**	**.5**





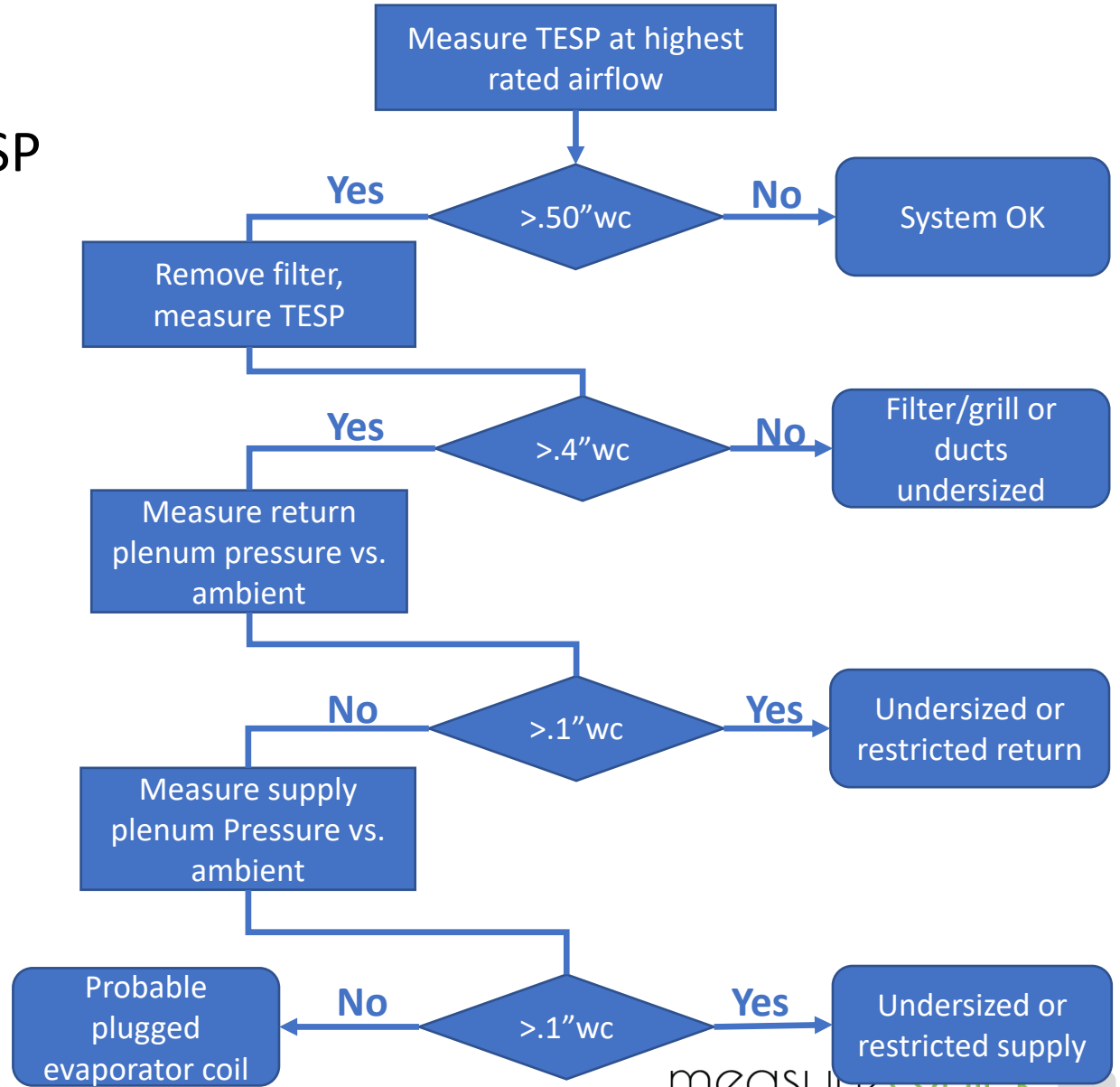
Total External Static Pressure 140%

Rated TESP x 140% = Max recommended TESP

.5” x 1.40 = .70” Max (.5” or below is ideal)

Budget: (Can change, but very typical!)

Filter	20% or .70 x .2 = .14	
Ducts combined	40% or .70 x .4 = .28	
Evaporator	40% or .70 x .4 = .28	
Total	**100%**	**.70**



THANK YOU!

Rater Fest! 2023

Joe Medosch measureQuick

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