

Welcome

US Heat Pump Summit

Heat Pump Commissioning: Why Cooling Mode Matters

Joe Medosch 

I will be channeling
Jim Bergmann and Ben Chouinard
who could not be here



Ben Chouinard
Vice President
Unified Comfort

Jim Bergmann
President
measureQuick



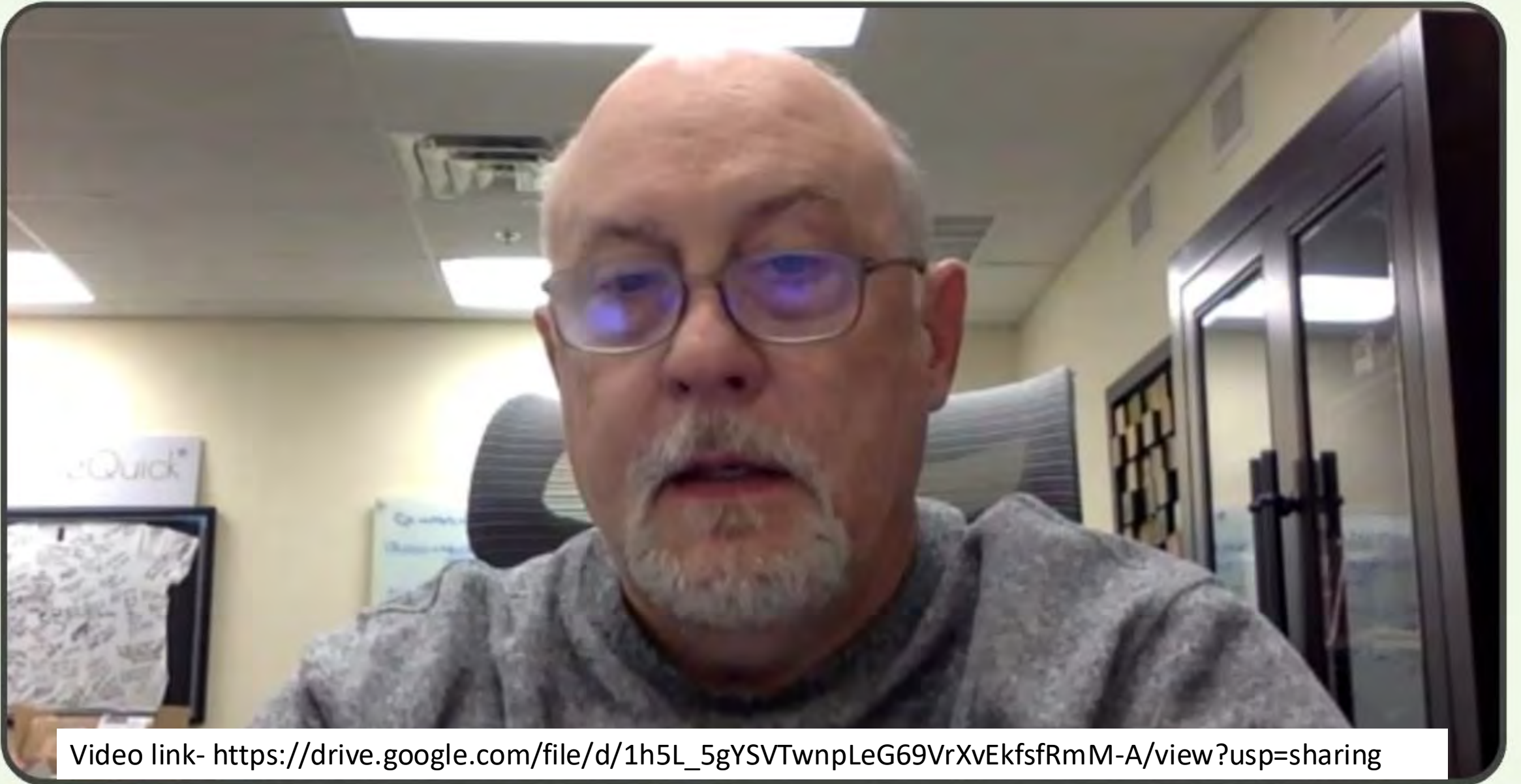
Joe Medosch
Director of Training
measureQuick

State of the Industry: Are We Ready for Heat Pumps?

Where the Industry Stands

- Equipment is ready.
- The workforce is the bottleneck.
- Homeowners expect proof, and comfort not promises.
- Design and commissioning quality is the lever.
- We must shorten time-to-competency.

Jim Bergmann



Video link- https://drive.google.com/file/d/1h5L_5gYSVTwnpLeG69VrXvEkfsfRmM-A/view?usp=sharing

Options, Options, Options



Natural Gas
Propane

Strip Heat >

Design > System type > Unitary HP > Dual fuel >

Manual J, S, D, T,RS, LLH, Zr, B

Mini-Split (ductless) Radiant

Mini-Split multi-heads

Outdoor temperature > **Cooling mode** Ground source

Heating mode

Metering device > Subcooling / Superheat

Weigh-In method

Controls > fossil fuel or electric Economic setpoint

Supplemental heat logic Auxiliary lockout

Comfort setpoint Balance point Defrost

Options, Options, Options



Design >

Testing >

System type >

Airflow >

Balancing

Manuf. Static pressure table

Terminal air flow

TEC TrueFlow Grid

Equip airflow

Pressure mapping

Static >

TESP

Metering device >

Static map

Duct Test > Total vs Leakage to Outdoors

Controls >

Blower door

Room pressures

Comfort setpoint

Balance point

Defrost

Options, Options, Options

Natural Gas
Propane

Strip Heat >



Design > System type > Unitary HP > Dual fuel >

Balancing

Testing > Airflow > Manuf. Static pressure table

Existing Replacement

Manual J, S, D, T, K, S, U, H, T, E, C, True Flow Grid, Radiant
terminal air flow, TEC True Flow Grid, Multi-heads

Equip airflow Pressure mapping

Static > TR Heating mode

OR

Metering device > Subcooling / Superheat

New Construction

Duct testing, Total Leakage to Outdoors

Controls > Comfort setpoint Economic setpoint

Blower door Room pressures

Supplemental heat logic

Heat Pump Commissioning: Why Cooling Mode Matters

Overview

Charging must always be completed in cooling mode for accuracy. This is what the manufacturer states in the install guidelines.

- **A/C** has a condenser, evaporator, liquid line and suction line
- **Heat pump** has an outdoor coil, indoor coil, liquid line, vapor line, a true suction line and discharge line.
 - The coils do both jobs of condensing and evaporating.

When the outdoor conditions are “good”, above 70° =
“easy installation”

Heat Pump Commissioning: Why Cooling Mode Matters

When the outdoor conditions are “good”, above 70° =
“easy installation”

What if they are not!

Why Cooling Mode Matters is when its “cold” outside
Like below 60°
or below 20°

Just Weigh It In – RIGHT!

Heat Pump Commissioning: Why Cooling Mode Matters

~~When the outdoor conditions are “good”, above 70° =
“easy installation”~~

Today use examples of temperatures
between 60° to 30°
and below 20°

Limitations of Charging Heat Pumps in Winter

- Variable Load Conditions
- Coil Role Reversal
- Limited Manufacturer Data
- Environmental Influences
- Weigh-In Method
- Pressure Targeting
- Simulated Load Testing
- Deferred Fine-Tuning
- Evacuation Challenges in Cold Weather

Impact of Improper Installation

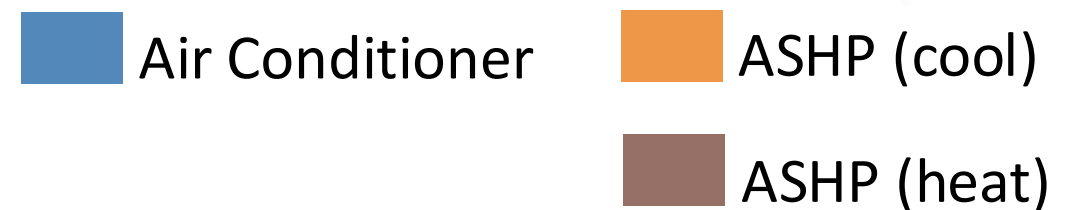
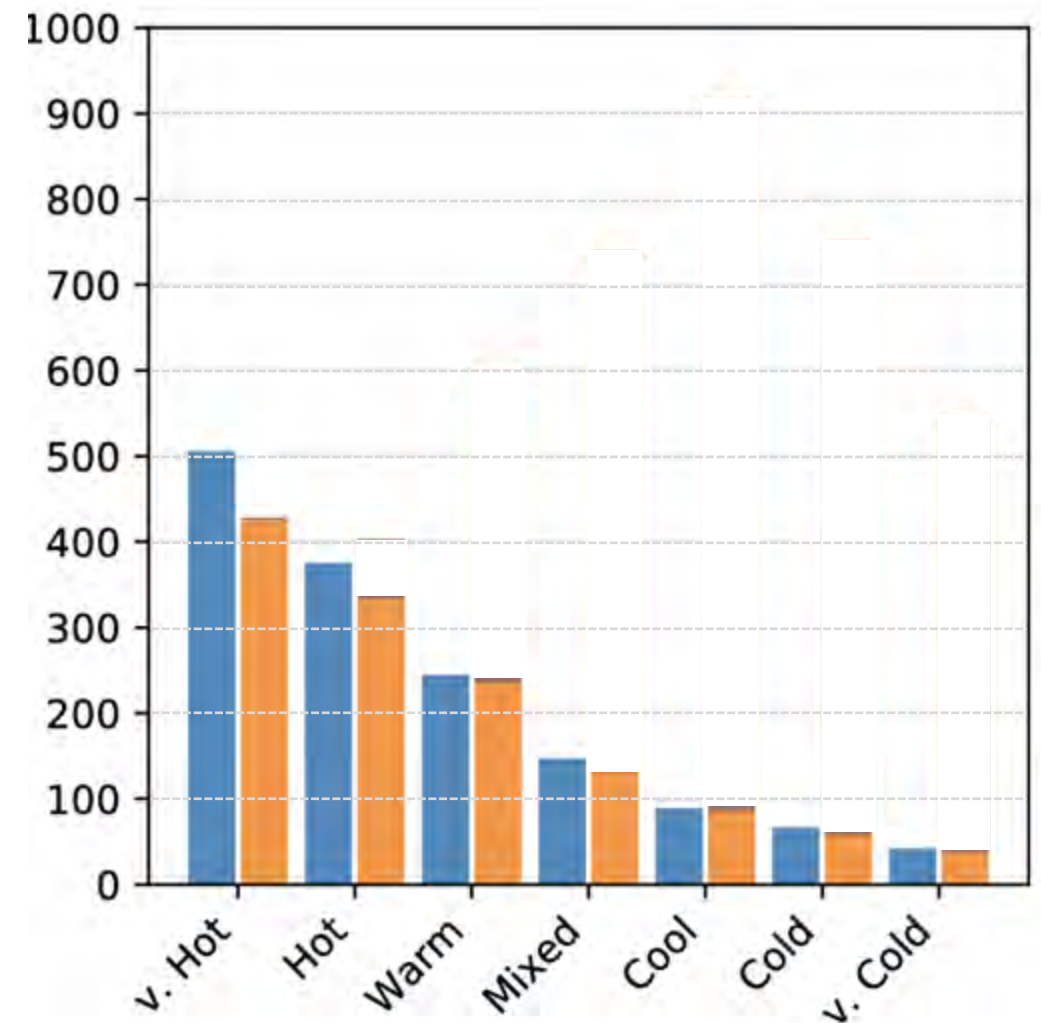
70-90% of residential HVAC systems have energy-wasting installation faults¹

9% energy waste annually²

\$2.5 billion in utility bills²

https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-30077.pdf

Fig. 8. Energy use increase per house caused by indoor airflow rate and refrigerant charge faults



Site Energy Increase Caused By Faults (kWh/y/house)

Impact of Improper Installation

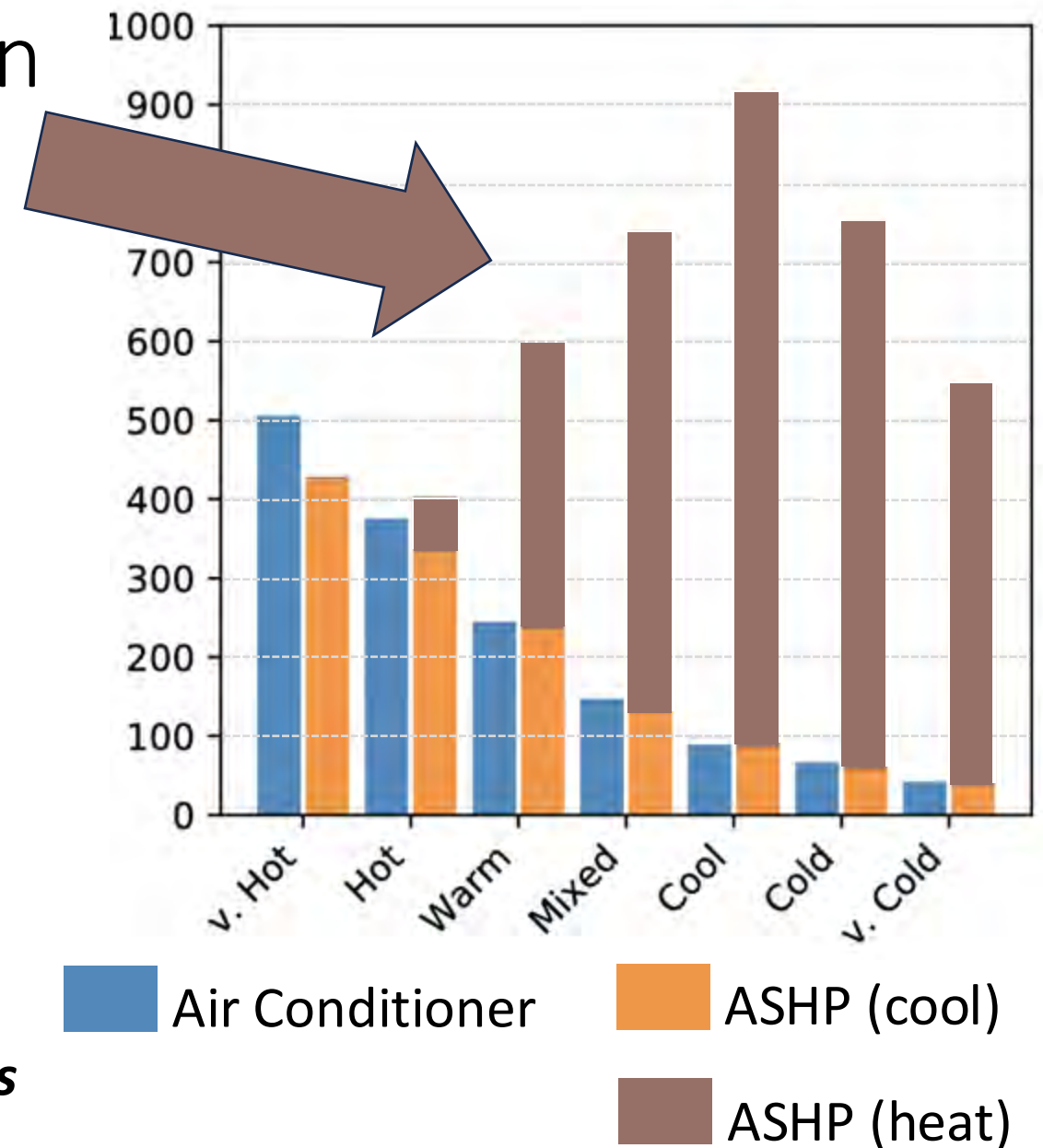
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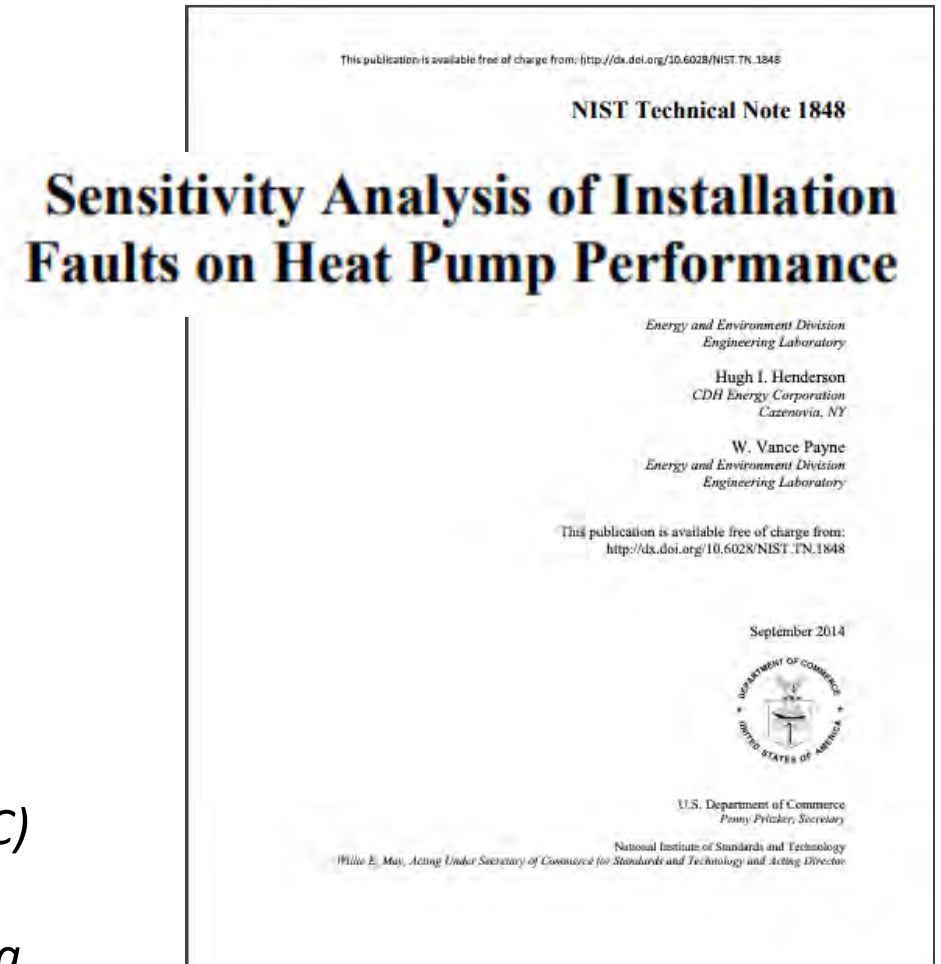
NIST Fault Study: Performance Lives in the Commissioning



As an industry we need to better understand the problem and the solutions.

1. **Duct leakage**
2. Refrigerant undercharge
3. Equipment Sizing
4. **Low airflow** (Often due to undersized ducts or filter grills)
5. Refrigerant overcharge
6. The resulting thermostat setting

For Houston, TX, lowering the thermostat setting by 2°F (1.1°C) increased the annual energy use by 20%, and the energy use increase rate is even higher due to further lowering the setting (the effect is not linear).



NIST Fault Study: Performance Lives in the Commissioning



Most heat pump performance issues
are from installations

Not a technology problem - a process
discipline problem.

Appliance Fixation



Refrigerant
Charge



Temperature Split Supply and Return



Duct Design
Duct Leakage

Charging in Cooling Mode:

- Cooling mode, we have a consistent load. Typically running a system between 68° - 85°.
- **Heat pump in heating mode**, it could be anywhere from 65° down to 0°. May get a relative target, we really can't get into an exact target.
- Additionally, manufacturers do not supply subcooling and superheat targets for a heat pump in the heating mode.

Coil Role Reversal:

- Heating mode, the evaporator and condenser switch roles.
- Outdoor ambient temperatures constantly change evaporator (outdoor coil) pressure, while indoor load varies with the building's heat loss.
- Achieving steady-state operation is nearly impossible in heating mode.
- **Manufacturers rarely provide charge targets for heating conditions.**

Pressure Targeting:

- Wind, frost, and defrost cycles introduce instability. Outdoor conditions can rapidly shift pressures, leading to false readings.
- Verify suction/discharge pressures and saturation temperatures are within expected bounds.
- This gets you at best in the ballpark.

Heat Mode is a Gut Check

Heat Mode: AHRI Match

- Common challenge is the indoor coil an AHRI match?
- **Example:** Approved AHRI match with a 2 ton outdoor unit and a 2 half ton coil.
- Run it at 400 CFM per ton vs. at 450 CFM per ton and that's going to dramatically change the pressures on the system.

Temperature Compensation Test



- Nitrogen
 - Inert gas, meaning it is nonreactive
 - No oxygen = no oxidation
 - Follows the laws of Gas
 - When Pressure changes
so does Temperature

The screenshot shows a mobile application interface for a 'Pressure Test'. The title bar at the top is dark green with a white back arrow on the left and the text 'Pressure Test' in white. Below the title bar, there is a list of test parameters and their values, each with a small blue icon to the right. The parameters are: Liquid Line Temp. (Live) at 90.3°F, High Pressure (Live) at 152 PSIG, Start Time at 5/26/2022, 2:28:13 PM, Start Temperature at 83.2°F, Start Pressure at 152 PSIG, End Time at 5/26/2022, 3:32:30 PM, End Temperature at 90.3°F, End Pressure at 152 PSIG, and Required Pressure +/- 1% at 154 PSIG. Below this list, the 'Test Result:' is shown in red text as 'FAIL'. A large, bold black number '3856.8s' is displayed in the center. At the bottom, there are two buttons: a white button with a circular refresh icon and the text 'RESET', and a green button with the text 'SAVE DATA' and a white plus sign in a green circle to its right.

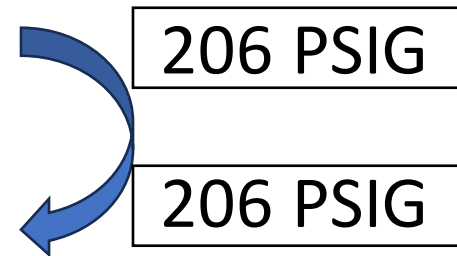
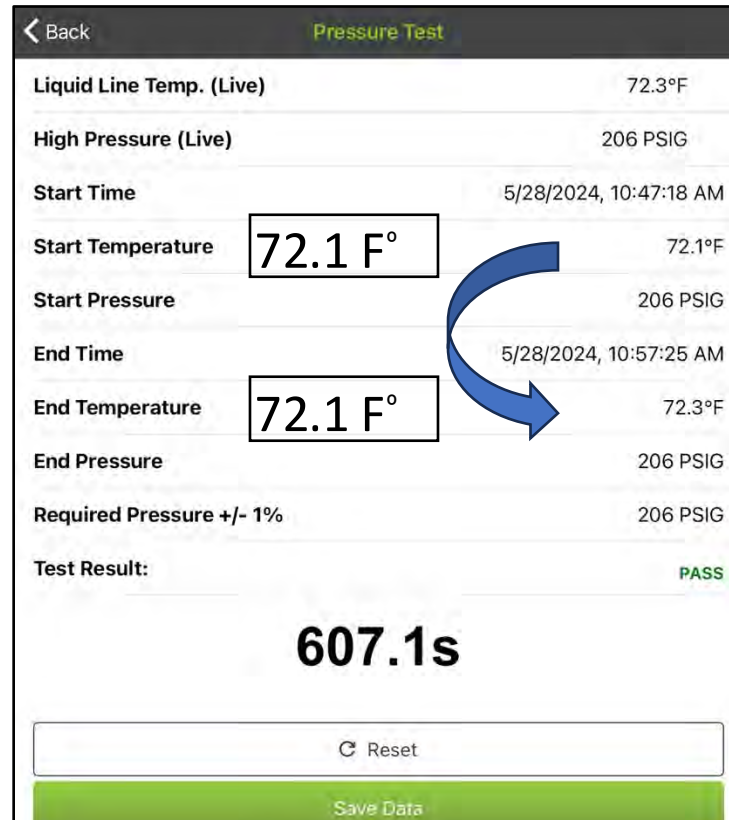
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Required Pressure +/- 1%	154 PSIG
Test Result:	FAIL
3856.8s	
RESET	
SAVE DATA	

Evacuation



Biggest Challenge, is Not Charging It's Evacuation.

- Must keep the system as dry as possible during the installation.
- Evacuation and the decay test are going to be the biggest challenge.



PASS

Temperature Compensation Test

Vacuum Pump, in cold weather evacuation

- Temperature of the vacuum pump impacts moisture removal.
- The oil and the vacuum pump has to get hot enough to release the moisture from the oil during evacuation.
- Below freezing, moisture forms ice, which must be removed by sublimation. (physical process of a solid turning directly into a gas)
- Sublimation has a dramatically higher specific volume, turning minutes of dehydration into hours or days.

Evacuation Challenges in Cold Weather

- To mitigate this, preheat the outdoor unit with a Charging Blanket and use crankcase heaters or gentle heat sources to raise metal temperature.
- Perform triple evacuation with dry nitrogen sweeps and verify stability with BluVac app. logging.



Jim Bergmann



Best Practices for Charging A System [2024 Version]

Rules Before Charging

1. Check evaporator for cleanliness
2. Check condenser for cleanliness
3. Check the filter
4. Make sure the airflow is in range
5. Know your metering device
 - TXV, charge by subcooling
 - Fixed, charge by superheat



Scenarios : Cold Conditions

Outdoor Temperature is
between 60° to 30°

What are the options?

Charge Assist Device

Weigh-In Method

Outdoor Temperature is
below 30°

What are the options?

Weigh-In Method

Use electric heat until
outdoor temperature
is acceptable

Charge Assist Device aka Charging Jacket

- Use the Charging Blanket to warm the outdoor coil in cooling mode, simulating moderate outdoor temperatures.
- This allows for more stable pressures and partial system verification.



Charge Assist Device aka Charging Jacket

Internal Load Required?

- In the cooling mode, it's not as important to have an internal load **as it is to have a pressure differential across the metering device.**
- So you need about 160 pounds of pressure drop across a typical 410A, 454B , R32 system.
- The pressure drop allows the bow to control when you have a low load inside and low outdoor air temperature.

Charging Jacket

Differential Pressure

- When the air conditioner mode is too far out of design, has NO differential pressure across it.
- It ends up wide open and it acts like a fixed metering device versus a thermal expansion valve – no ability to control.
- When the jacket raises the outdoor pressure up, it forces the valve to feed more. And the valve will then start to close down and start to control, which allows us to accurately charge it to its sub cooling requirement.

Charging Jacket

Differential Pressure

- When the air conditioning system is far out of design, it has NO differential pressure control.
- It ends up wide open, which is not a metered device versus a thermostatic device – no ability to control.
- When the jacket raises the pressure up, it forces the valve to start to close down, which allows us to accurately charge to the required requirement.



Charging Jacket Keep Coil Above the Dew Point Temp

- The load is irrelevant
- Keep the coil above the dew point temperature.
- Can even charge with a coil below freezing as long as we have enough different pressure across it.
- Example: refrigeration works, we run refrigerators with a coil below freezing. The valve will still control. and maintains super heat.
- We just need to keep the coil above the dew point temperature.

Charge Assist Device aka Turkey Blind

Larger of volume to get temperature across the coil

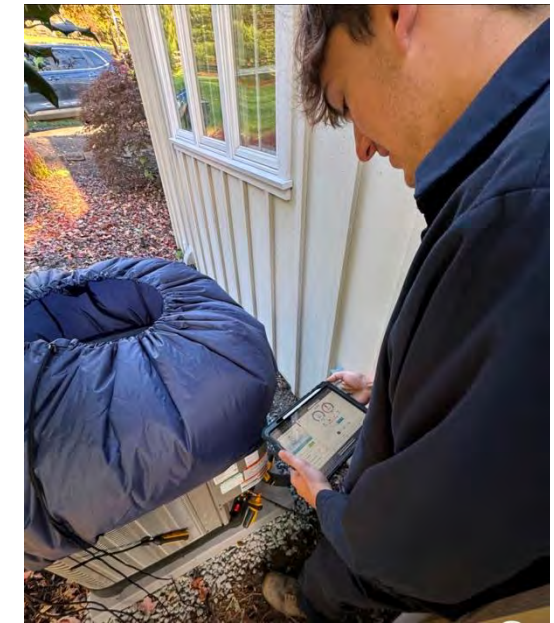


Photo credit: Mike Breen Auer Steel

Blanket, Jacket, Coat

- Fieldpiece Jacket was only approved for R22 and R410
- measureQuick, we've automated the process no matter what refrigerant you're using.
- mQ automatically calculates the pressures and temperatures that you would need to work with a charging blanket.
- Either device will work in measureQuick - when “Charging Blanket” is activated.

Charge Assist Device aka Charging Blanket



<https://youtu.be/NCsZGYYURtE?si=jAreyQzfSlqWIJZX>

Weigh-In Method:

- So charging by sub cooling on a TXV system or super heat on a non TXV system **is by far the most accurate way of making sure the right amount of refrigerant is in the indoor and outdoor coil.**
- Better off charging with the charging blanket if possible, above 35°
- Charging by weight can lead to problems

Weigh-In Method: Cold Temperatures

- Recover and weigh in the factory-specified charge. Adjust for line-set length and accessories.
- This is the most accurate method when cooling verification is not possible (no blanket).
- It is not easy though to get all of the refrigerant out of the system as it sublimates with the compressor oil.
- **Also it is almost impossible to get a good evacuation.**

Weigh-In Method:

Assuming

- **that the manufacturer got the charge right at the factory,**
- **that no charge got let out and transport**
- **that no charge got let out when you're doing your servicing.**

Below 30° - Outdoor Air Temperature

- Client's system died and it's blowing freezing, 20° outside
- They want a heat pump
- Jim's recommendations:
 - Run back up heat until you can come back and charge a system.
- Your recommendation is....

Long Term Ramifications

- So for the short term option of poor evacuation and estimated charge...
- Will cost you more in the long term in less than optimal conditions is substantial. **You just don't want to do it.**
- Just run the system on the electric heat temporarily

Long Term Ramifications

- Moisture in the system which moisture leads to
 - acid sludge,
 - copper plating, stripping the copper off the line sets
 - depositing on the bearings and compressor you're going to dramatically impact the longevity of the heat pump.

Below 30° - Outdoor Air Temperature

Use supplemental heat for 2 weeks

- Minnesota – ~\$410
- Tennessee – ~\$290

Energy used = kW × hours × duty

Cost = Energy used × \$/kWh

Cost of poorly evacuated and charged system – call backs

Moisture in the system which moisture leads to:

- acid sludge,
- copper plating, stripping the copper off the line sets AND
- depositing on the bearings and compressor

Dramatically impact the longevity of the heat pump.

Long Term Ramifications

- You perform surgery on the side of the road, if you absolutely have to!
- Prefer to being in a surgical room where we got all the surgical tools, clean and prepped – the conditions are more conducive to a successful outcome.

Heat Pumps have an Achilles Heel

- So they may have to run the backup heat for weeks in some parts of the country.
- This is actually a Achilles heel of heat pumps is you don't want to service a heat pump in the winter.
- Can't evacuate well, we can't charge well, we can't service well.

Heat Pumps have an Achilles Heel

- It is so critical that we get it right in the beginning
- When it fails in the winter time, not the ideal conditions to service in the winter it's very hard to service the refrigeration in the winter in a less than ideal conditions.
- Period.

You're Going to Need...

- Dryers to control the moisture and or use desiccant dryers to manage the moisture, you're not going to get it all out during an evacuation.
- To have to add in a liquid line site glass with a moisture indicator to make sure that moisture got out.
- To come back and check the charge, you could spend hundreds / thousands of dollars in service or you can wait and spend a few hundred dollars in electricity.

Dual Fuel vs Electric strip heat

- Cold climate- should consider dual fuel.
- Because now the backup backup heat sources is getting natural gas
- Heat pump - if the unit failed in the winter, would you rather operate off gas or electric heat

Takeaways

- Heat pumps must be charged in cooling mode for precision.
- Winter commissioning focuses on verification, not final charging.
- Charging Blanket enables winter charging down to $\sim 30^{\circ}$
- Proper evacuation is essential—sublimation slows dehydration dramatically.
- Document your measurements

Jim's Message to Technicians

- AI will not replace you.
- Techs who use AI will replace techs who do not.
- If you can prove performance, you win.
- If you guess, your falling behind.

HVAC Industry Disruption – Are You In?



1900 NY City – Where is the Horseless Carriage?

Automobile



1915 NY City – Where is the Horse and Carriage?

US Heat Pump Summit

Thanks

Joe Medosch

joe@measurequick.com

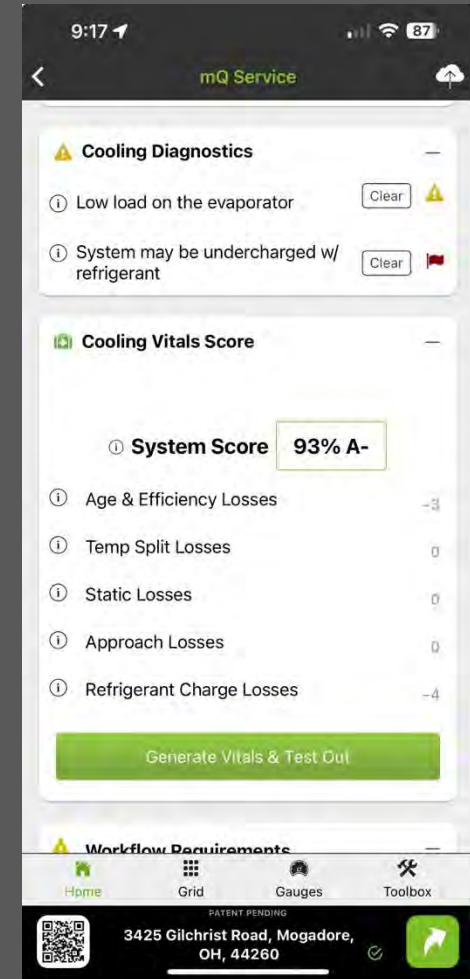
measureQuick



<https://bit.ly/4peCAFY>

Proof Beats Opinion

- System Performance
- Diagnostics
- Static Pressure
- Delivered Capacity (BTU/h)
- Vitals Score



Additional Slides Not Included in
the Live Session

Airflow Before Charge

- Total external static pressure and a manufacturer's chart on a new system
- TrueFlow[®] grid
- Manufacturer dipswitches, if it's got an airflow output.
- So setting up the air flows really, once we have a good evacuation.

Basic rules for commissioning

- Let the system run for a little while before checking anything
- Check airflow **BEFORE** the charge
 - Some of your readings will depend on airflow, so the airflow should be optimized before adding or recovering refrigerant
 - On furnaces, checking the combustion comes after airflow as well
 - Check the condensate after airflow
- Use your senses to pick up on any system abnormalities before you pick up your gauges
 - Listen to fan sounds
 - Put your hand over the condenser and in front of vents



Airflow

Before

Charging

g

System Engineering

- Airflow measured and set
- Evacuation complete
- Charging blanket by subcooling or superheat
- **Rely on the engineering of the system, assuming that it's all engineered right.**

System Engineering – Low Temp Can't Test Accurately

- Target temperature split, but we're probably outside the ideal conditions.
- It becomes harder to test the sensible and the latent capacity to make sure sensible latent splits right because we have a system that's operating with a charging blanket.

System Engineering – Low Temp Can't Test Accurately

- Not under the typical design conditions that we would use for commissioning in cooling mode.
- At that point, we're relying on the system engineering that it was done right, from the factory, which in most cases it is.
- Next service, verify performance of the system when hopefully the conditions are more conducive to doing recommended testing.

System Engineering – If a Charging Blanket is used...

- System working, providing comfort...
- Seasonal call, short trip
 - Non-Invasive test, verify the system is falling with the guide lines
 - Test with the probes on, should not have to adjust the refrigerant charge, or by much.
- If use Weigh-In or its below 30° there are risks

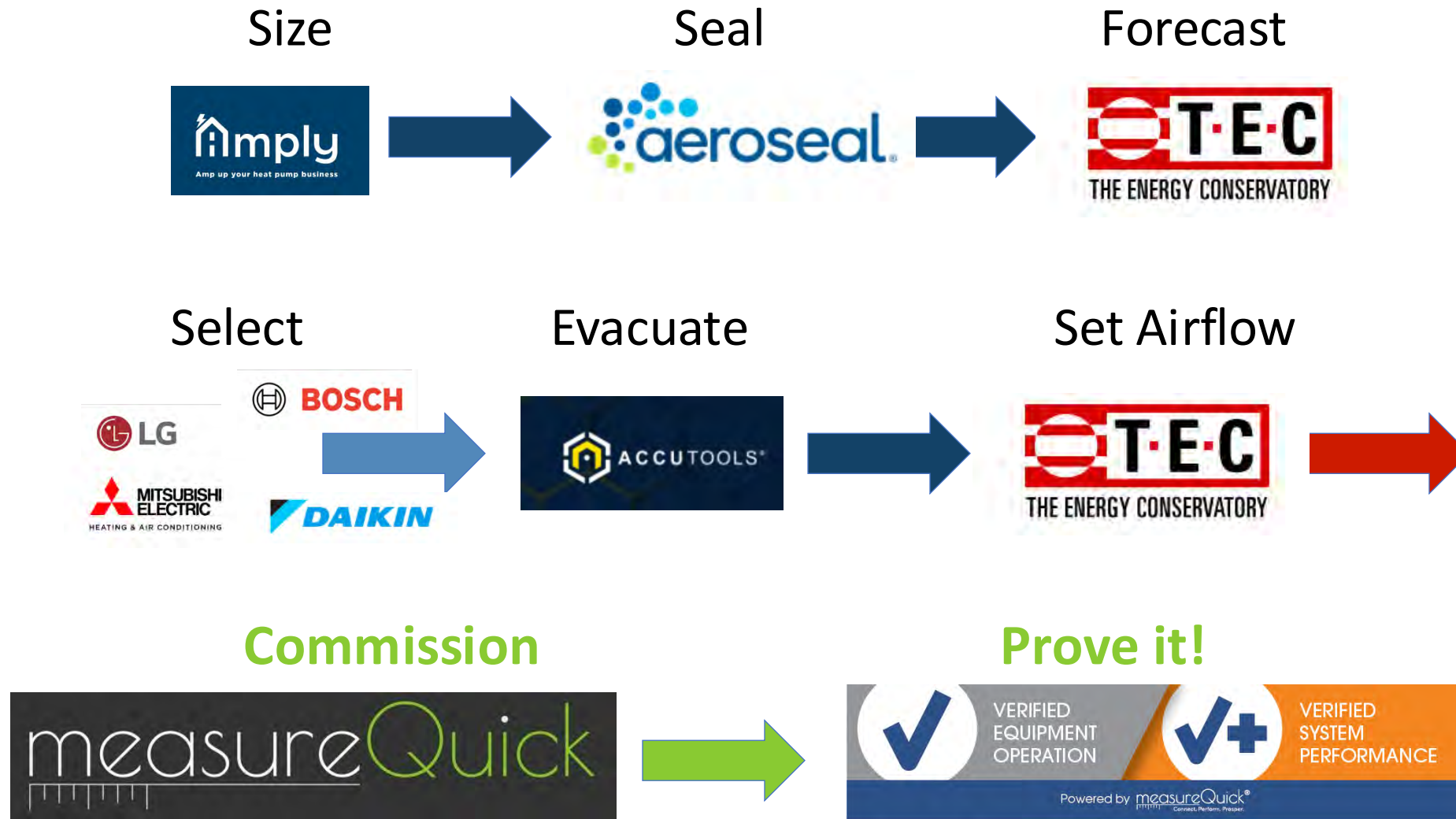
Integrated Workflow with measureQuick

- Guides technicians through heating-mode verification and simulated load testing with the charging blanket.
- Integrates BluVac data to validate system evacuation and moisture removal.
- Stores job data for deferred charge confirmation in cooling season.
- Provides visual gauges and target zones to indicate performance trends.

MeasureQuick Diagnostics:

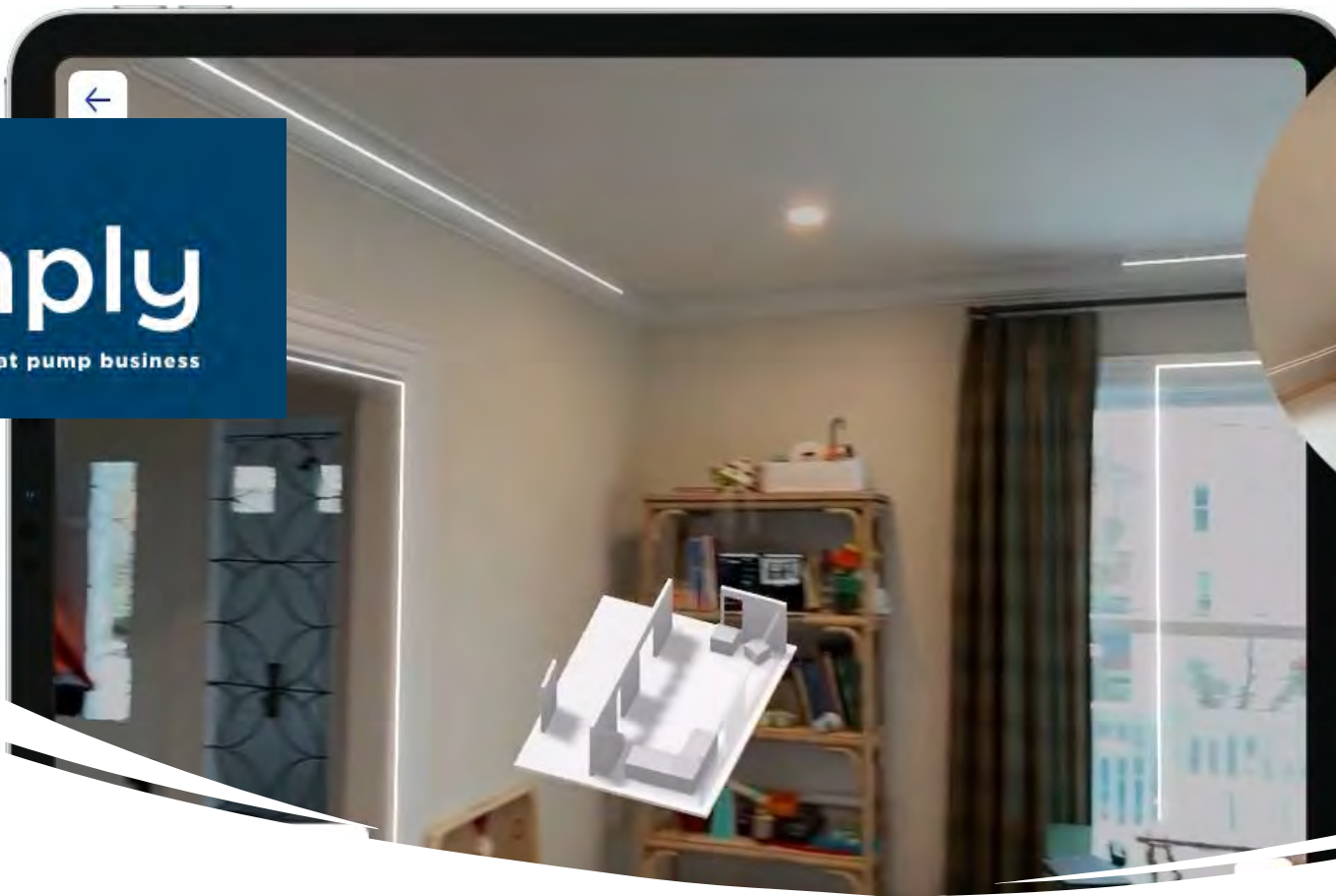
- measureQuick uses multiple data points (temperature, pressure, electrical, and airflow) to infer charge condition and system health.
- Dynamic target zones and EER impact analysis allow data-driven decisions even without precise subcooling or superheat targets.

The Fail Proof Process



The Amply logo features a stylized house icon with a lightning bolt above the letter 'i' in 'Amply'.

Amp up your heat pump business



Amply + measureQuick: From Design to Commissioning

- Amply Tech uses LiDAR-enabled scans to generate fast, accurate load calculations.
- Provides homeowner-ready visuals and AR walkthroughs that support clear decision-making.
- measureQuick verifies installation quality and delivered performance once installed.

Aeroseal Deliverable Performance

- Aeroseal seals duct leakage from the inside, reducing leakage up to ~90%.
- Reducing duct leakage assure the conditioned air gets to the envelope.
- measureQuick and TrueFlow verify airflow, static pressure, capacity, and delivered BTU/h after sealing.
- Together: Duct sealing + commissioning = proven comfort, efficiency, and system longevity.



Forecasting with TEC TrueFlow Grid: From Guess to Guarantee

- Model airflow and static pressure changes before making system modifications.
- Forecast the impact of duct resizing, filter upgrades, or equipment replacement.
- TrueFlow Grid translates complex fan law math into tech-friendly predictions.
- measureQuick verifies the delivered performance after commissioning.
- Result: No guesswork. Performance is predictable, measurable, and provable.



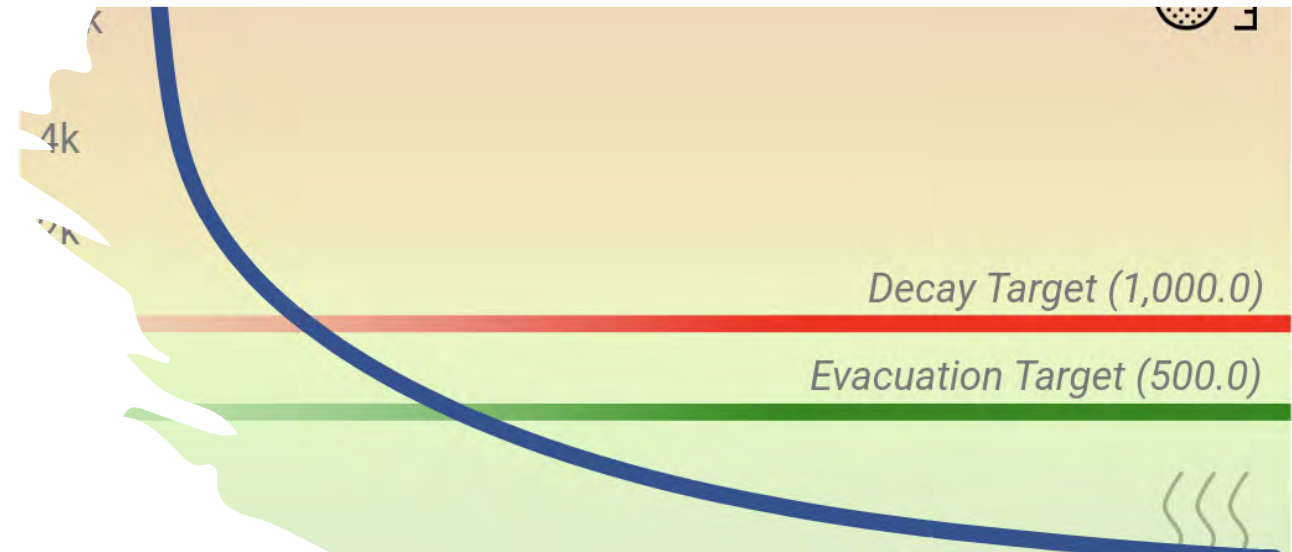
Heat Pump Commissioning

- Starts with a good installation process:
- Sweeping line-sets
- Brazing with nitrogen
- Temperature Compensated Pressure test
 - Pass / Fail criteria
- Blu vac and Tru Blue evacuation
- All documented in MQ



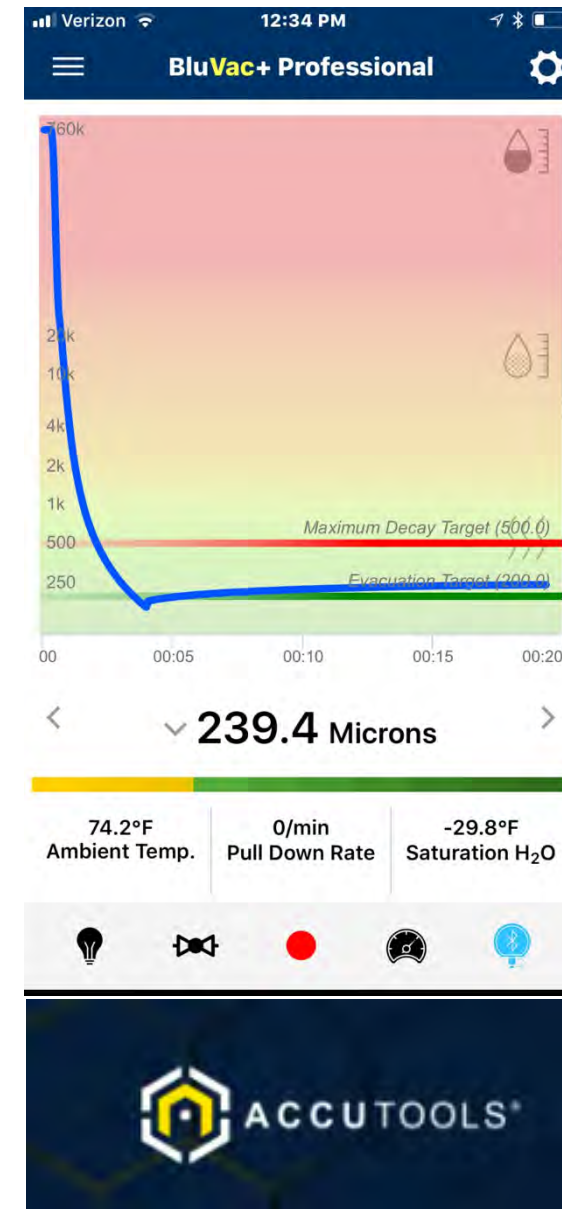
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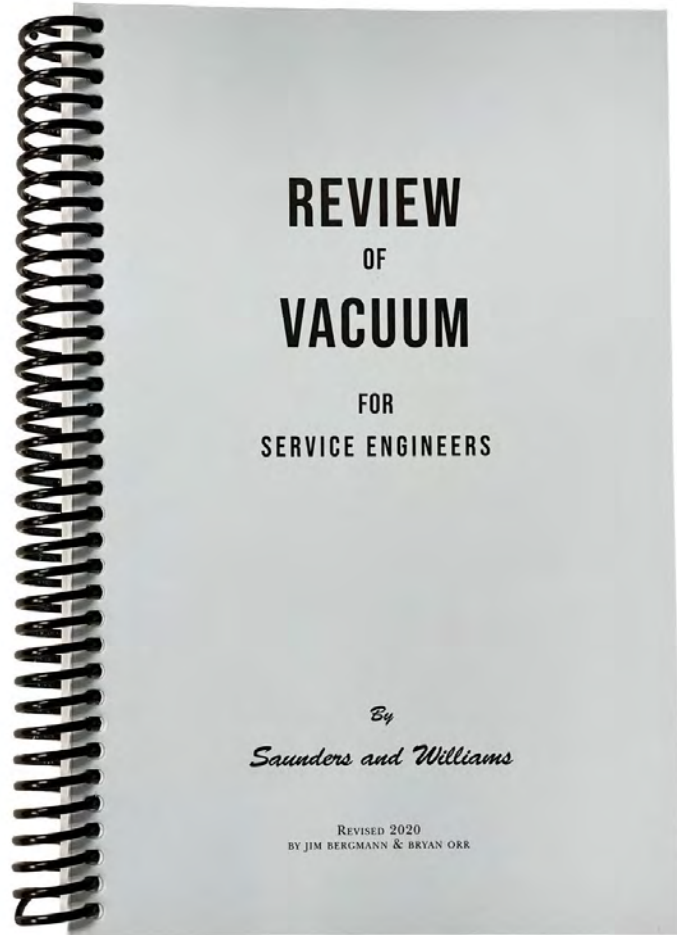


Proper Evacuation: BluVac + TruBlu Hoses

- Moisture is the enemy of compressor longevity and oil stability.
- BluVac provides precise micron measurement and decay testing for verification.
- TruBlu vacuum hoses eliminate flow restriction for faster, deeper evacuations.
- Evacuation should be measured, documented, and verified—not timed.



Evacuation



Cold Weather Installations - Down to 35°

Systems that are charged using **Subcooling** should be verified when the outdoor temperatures are warm.

Are your contractors coming back to check the charge in the spring?

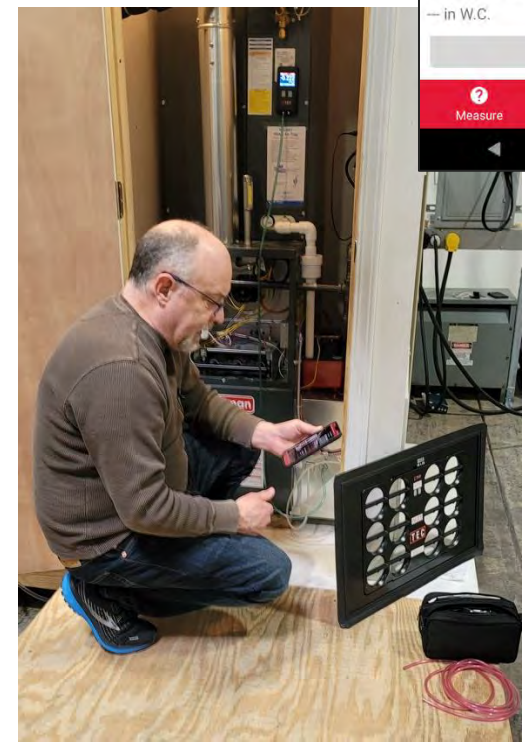
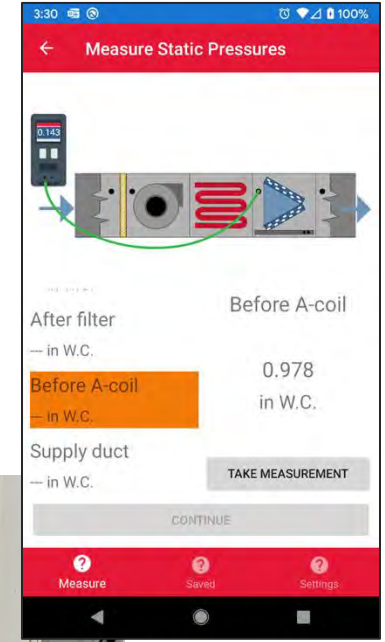


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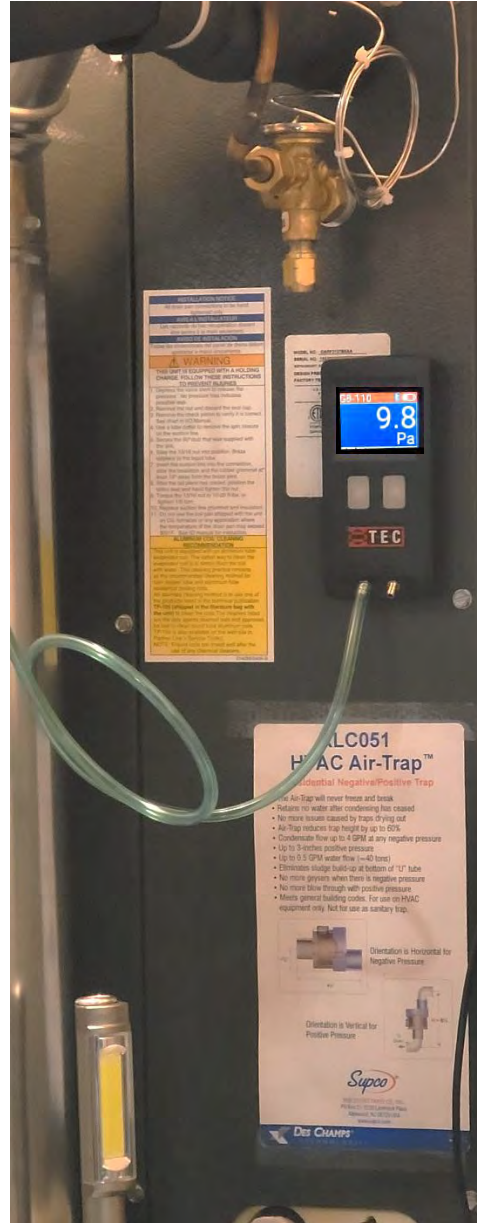
Quick

Airflow Digital TrueFlow + measureQuick

- Digital TrueFlow card provides direct airflow measurement across the air handler.
- Removes uncertainty from inferred airflow calculations and static pressure assumptionsg.
- measureQuick integrates the Digital TrueFlow reading into commissioning workflows.
- This enables rapid, repeatable, and verifiable airflow setup—critical before refrigerant charging.

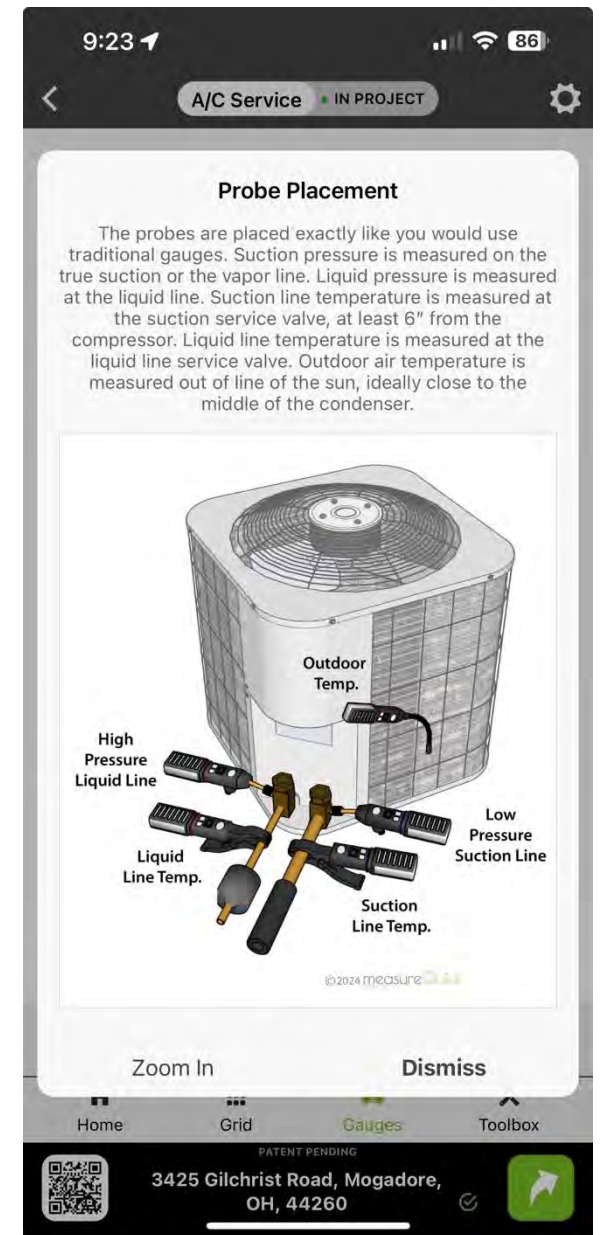


MeasureQuick & TrueFlow





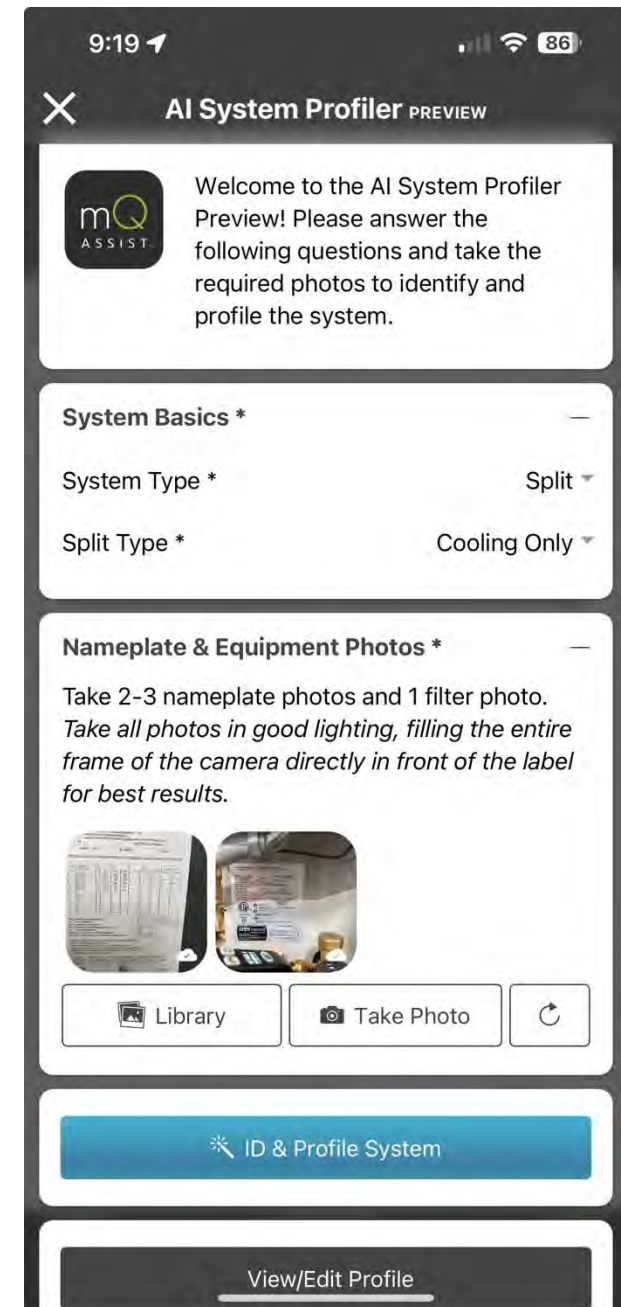
- AI-driven system profiles to speed onboarding.
- Guided commissioning with dynamic targets.
- Photo + geo data integrity and documentation.
- Remote QA/QC with live streamed system data.





What's Different Now

- Guided workflows standardize installation.
- Real-time data + photos + geotagging ensure accountability.
- AI removes guesswork so techs focus on decisions.
- The craft shifts back to skill, not trial-and-error.

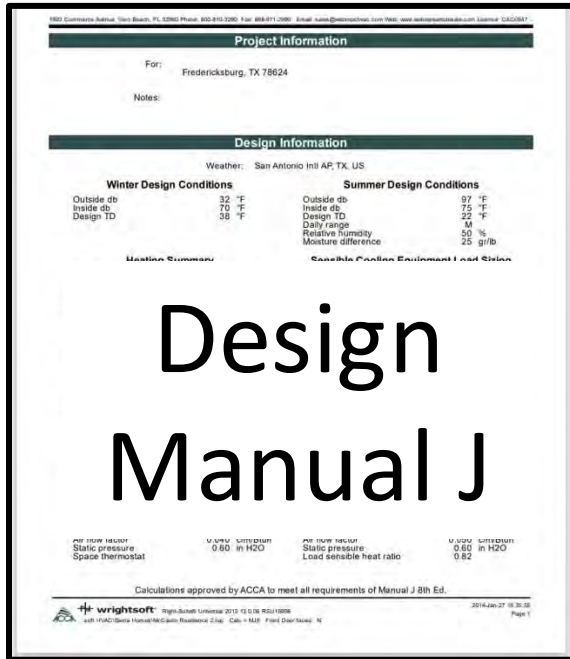




ACCA 'Prove It!' + measureQuick

- ACCA Quality Installation (QI) requires verifiable performance data.
- measureQuick is the validation and diagnostic engine behind ACCA 'Prove It!' certificates.
- This means your commissioning work produces third-party verifiable proof—not opinions.
- Contractors gain differentiation. Customers gain confidence.

ACCA QI Verified System Performance



Duct Leakage Test



System Balancing



Airflow Measurement

