Why Residential Air Balancing is Being Required by Code

By Rob Falke, President, National Comfort Institute

National Comfort Institute, Inc.

2018 AHR EXPO CHICAGO JAN 22-24

National Balancing Council™

About National Balancing Council & National Comfort Institute

At National Balancing Council (NBC), we have long known that true system performance and efficiency goes beyond traditional testing and balancing. NBC trained and certified professionals specialize in comprehensive HVACR system diagnostics. Technicians have the expertise to measure and verify *actual* system operating performance.

National Comfort Institute, Inc. (NCI) is the world leader in HVAC System Performance training and Air Balancing. We created the industry's best practices, processes, and forms and have been teaching them for decades. What makes NCI's approach different? We show you how to thoroughly test and diagnose the system using practical, easy-to-follow methods so you'll know exactly what to do to provide your customers with optimum comfort and energy efficiency. During the past two decades, NCI has trained and certified more than 25,000 HVAC industry professionals.

If You Don't Measure, You're Just Guessing™

About National Balancing Council & National Comfort Institute

The parent company to NBC, NCI has offices and staff in 10 states across the USA. NBC is the *only* large commercial certification that also includes training as part of the certification process. NCI is active in HVAC utility energy savings programs as well. We hope that you enjoy this presentation, and if you want to learn more:

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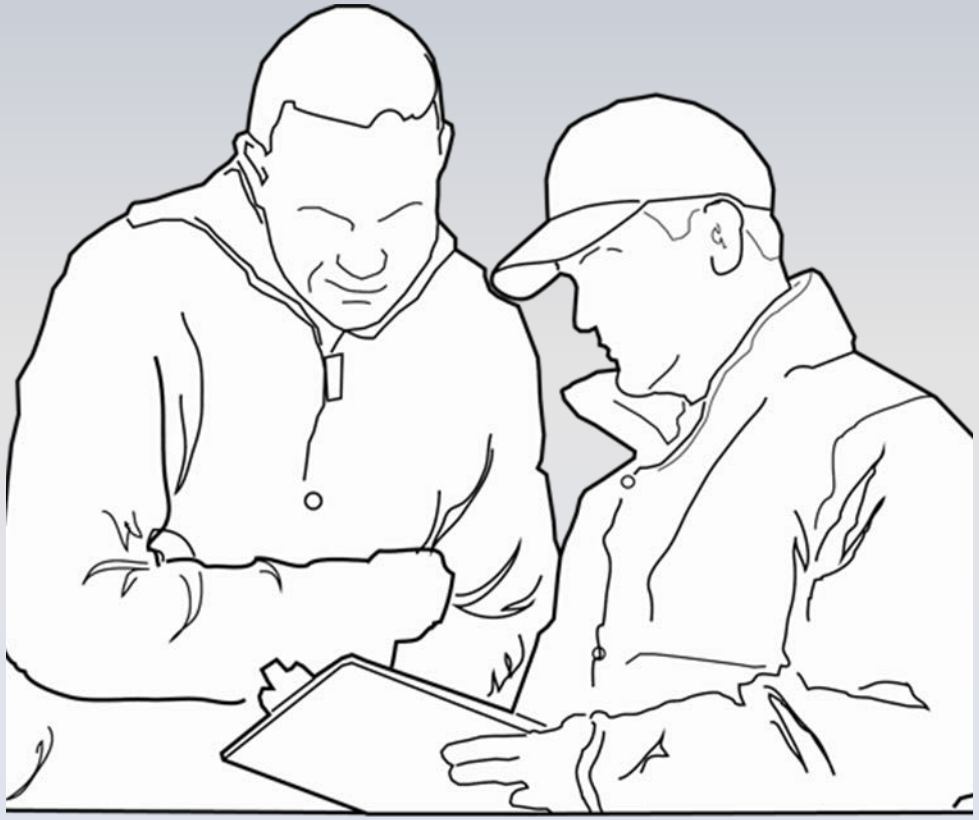
Balancing – A 50 Year Precedent

- Air Balancing has been the specified method of field measured verification for the past 50 years.
- Balancing in commercial work is the standard and habit
- Verification design intent has been met
- You can design the best HVAC system in the world and still end up with a system that doesn't perform to its rated capacity
- Air, pressure, temperature, humidity and energy are invisible, so to discover their performance, each must be measured.

Residential Balancing Code References

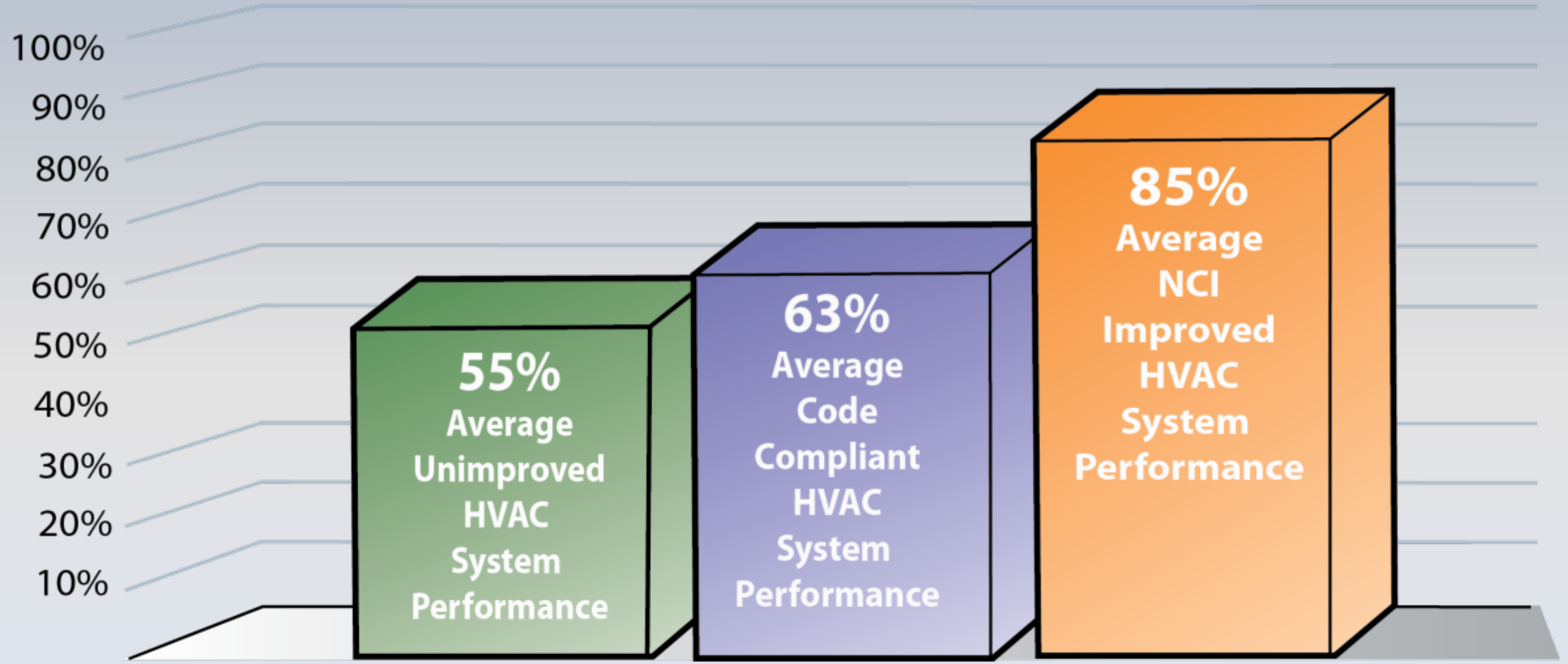
- International Energy Conservation Code 2009 to 2015
- International Residential Code 2102 to 2015
- International Mechanical Code 2015
- ACCA Manual B adopted in some regions
- Many states and municipalities requiring a balancing report be added to documentation to close permit

Benefits Hoped For in Residential Code



1. Help for building officials responsible for energy efficiency
2. Verification of design and code intent
3. Delivered efficiency matching equipment specification and savings projection estimates
4. Something measurable

The Need for Performance in Code



Average Percent of Rated System Capacity

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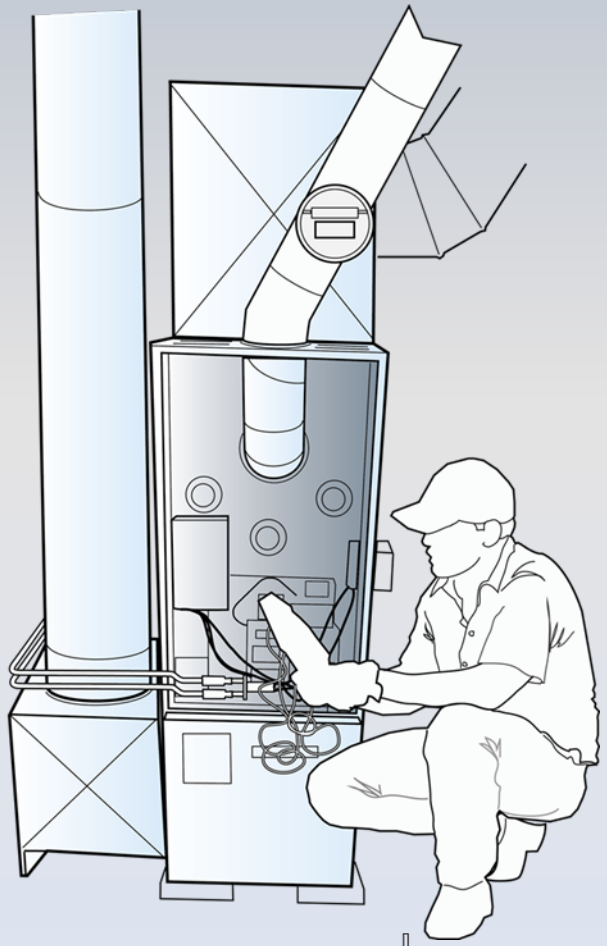
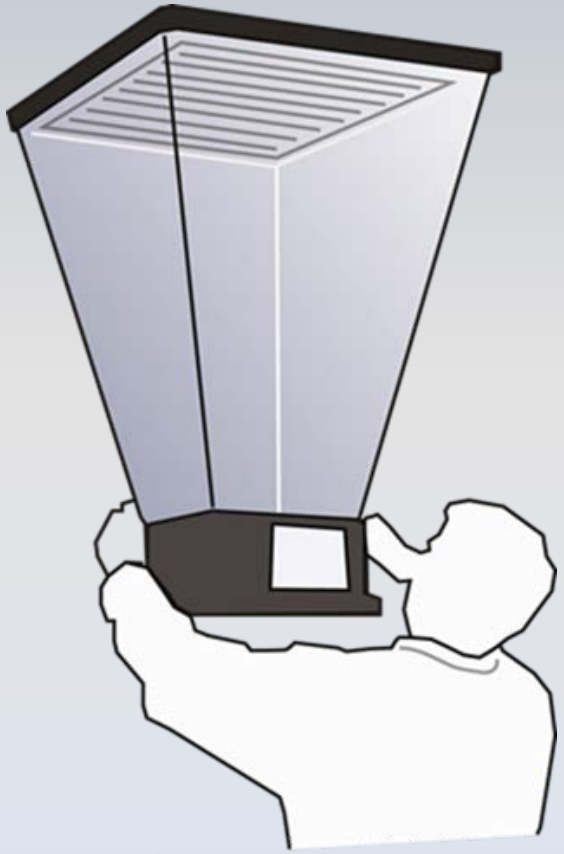
Steps for a Typical Residential Air Balance Job

1. Secure design and specifications
2. Report Preparation
3. Inspect the system to assure 100% complete
4. Gather equipment data in the field
5. Startup system
6. Set fan airflow at equipment
7. Verify and record fan speed and system static pressures



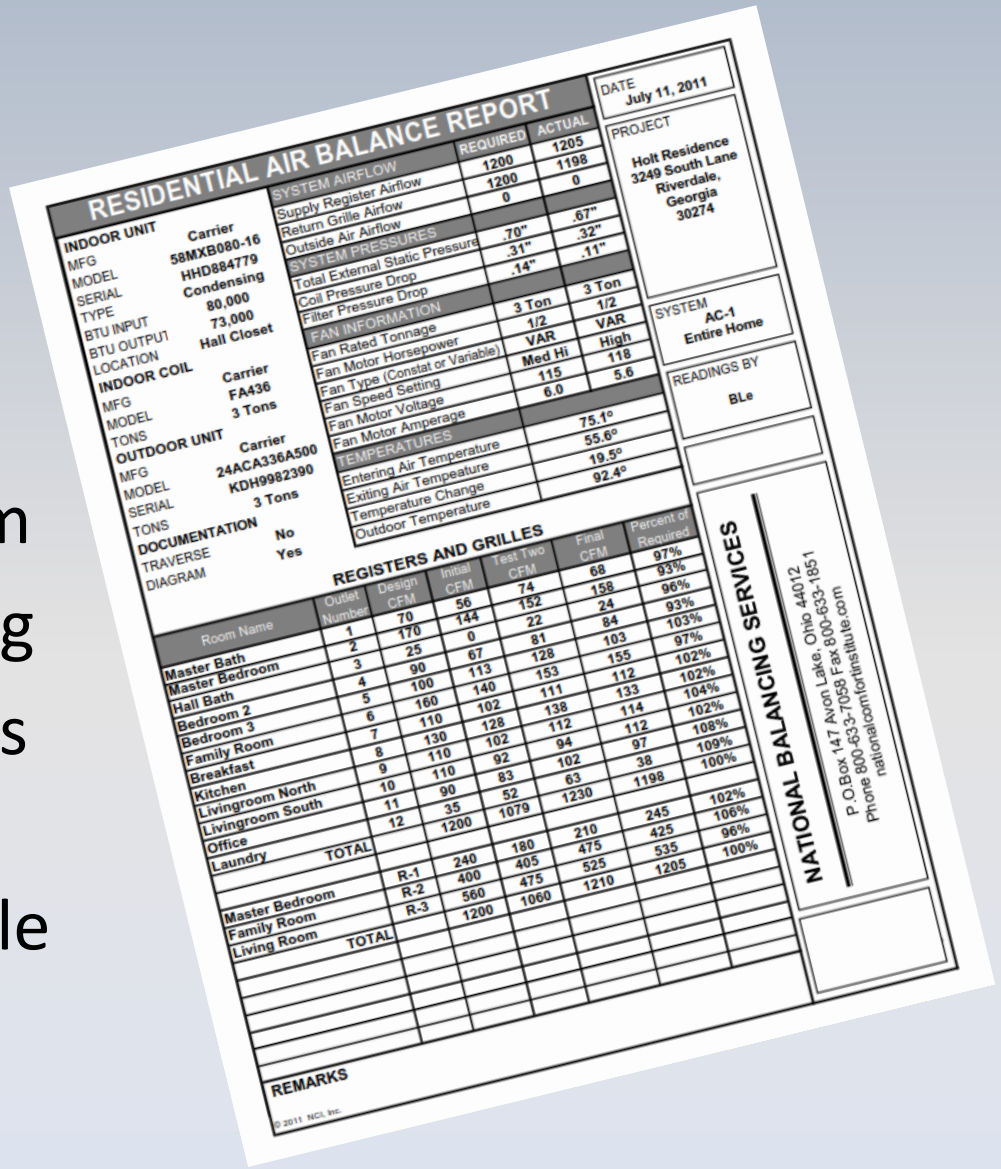
Steps for a Typical Residential Air Balance Job



8. Shoot and record each supply and return grille
9. Inspect for installation defects, readjust fan speed
10. Balance each register, beginning with lowest percent of required airflow
11. Set to plus or minus 10% of design airflow
12. Final testing of fan speed, static pressures, electrical and temperatures
13. Compare actual to design
14. Complete and publish the balancing report.

Review an Air Balance Report

- Completed by a certified professional
- Documents the air properties of the system
- Records equipment information and testing
- Verification the installation generally meets specifications
- An air balance report contents are verifiable through principles of physics



RESIDENTIAL AIR BALANCE REPORT

DATE: July 11, 2011

PROJECT: Holt Residence, 3249 South Lane, Riverdale, Georgia 30274

SYSTEM: AC-1, Entire Home

READINGS BY: BLe

INDOOR UNIT		
MFG	Carrier	
MODEL	58MXB080-16	
SERIAL	HHD884779	
TYPE	Condensing	
BTU INPUT	80,000	
BTU OUTPUT	73,000	
LOCATION	Hall Closet	
INDOOR COIL		
MFG	Carrier	
MODEL	FA436	
TONS	3 Tons	
OUTDOOR UNIT		
MFG	Carrier	
MODEL	24ACA336A500	
SERIAL	KDH9982390	
TONS	3 Tons	
DOCUMENTATION		
TRAVERSE	No	
DIAGRAM	Yes	

	REQUIRED	ACTUAL
SYSTEM AIRFLOW		
Supply Register Airflow	1200	1205
Return Grille Airflow	1200	1198
Outside Air Airflow	0	0
SYSTEM PRESSURES		
Total External Static Pressure	.70"	.67"
Coil Pressure Drop	.31"	.32"
Filter Pressure Drop	.14"	.11"
FAN INFORMATION		
Fan Rated Tonnage	3 Ton	3 Ton
Fan Motor Horsepower	1/2	1/2
Fan Type (Constat or Variable)	VAR	VAR
Fan Speed Setting	Med Hi	High
Fan Motor Voltage	115	118
Fan Motor Amperage	6.0	5.6
TEMPERATURES		
Entering Air Temperature	75.1°	
Exiting Air Tempeature	55.6°	
Temperature Change	19.5°	
Outdoor Temperature	92.4°	

REGISTERS AND GRILLES

Room Name	Outlet Number	Design CFM	Initial CFM	Test Two CFM	Final CFM	Percent of Required
Master Bath	1	70	56	74	68	97%
Master Bedroom	2	170	144	152	158	93%
Hall Bath	3	25	0	22	24	96%
Bedroom 2	4	90	67	81	84	93%
Bedroom 3	5	100	113	128	103	103%
Family Room	6	160	140	153	155	97%
Breakfast	7	110	102	111	112	102%
Kitchen	8	130	128	138	133	102%
Livingroom North	9	110	102	112	114	104%
Livingroom South	10	110	92	94	112	102%
Office	11	90	83	102	97	108%
Laundry	12	35	52	63	38	109%
TOTAL		1200	1079	1230	1198	100%
Master Bedroom	R-1	240	180	210	245	102%
Family Room	R-2	400	405	475	425	106%
Living Room	R-3	560	475	525	535	96%
TOTAL		1200	1060	1210	1205	100%

REMARKS

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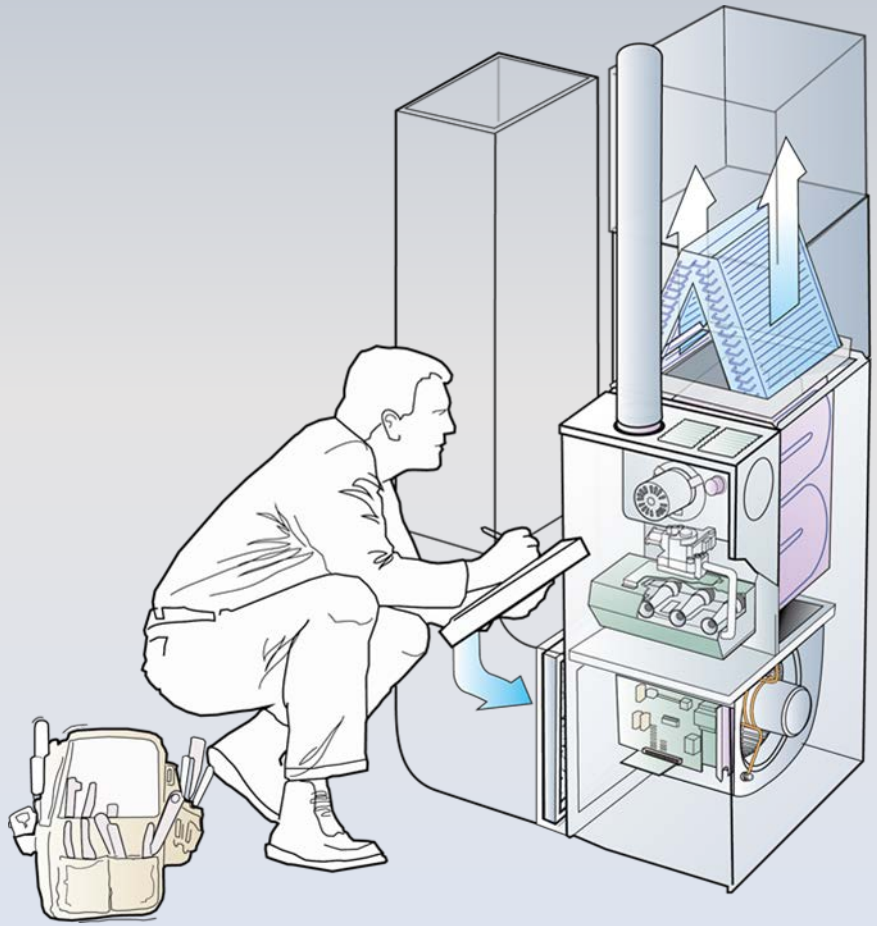
P.O.Box 147 Avon Lake, Ohio 44012
Phone 800-633-7058 Fax 800-633-1851
nationalcominstitute.com

Customer and Equipment



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SYSTEM	**AC-1 Entire Home**
READINGS BY	**BLe**

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MFG	**Carrier**
MODEL	**58MXB080-16**
SERIAL	**HHD884779**
TYPE	**Condensing**
BTU INPUT	**80,000**
BTU OUTPUT	**73,000**
LOCATION	**Hall Closet**
INDOOR COIL	
MFG	**Carrier**
MODEL	**FA436**
TONS	**3 Tons**
OUTDOOR UNIT	
MFG	**Carrier**
MODEL	**24ACA336A500**
SERIAL	**KDH9982390**
TONS	**3 Tons**
DOCUMENTATION	
TRAVERSE	**No**
DIAGRAM	**Yes**

The Balancing Report Scoreboard

FAN INFORMATION		
Fan Rated Tonnage	3 Ton	3 Ton
Fan Motor Horsepower	1/2	1/2
Fan Type (Constat or Variable)	VAR	VAR
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Total External Static Pressure	.70"	.67"
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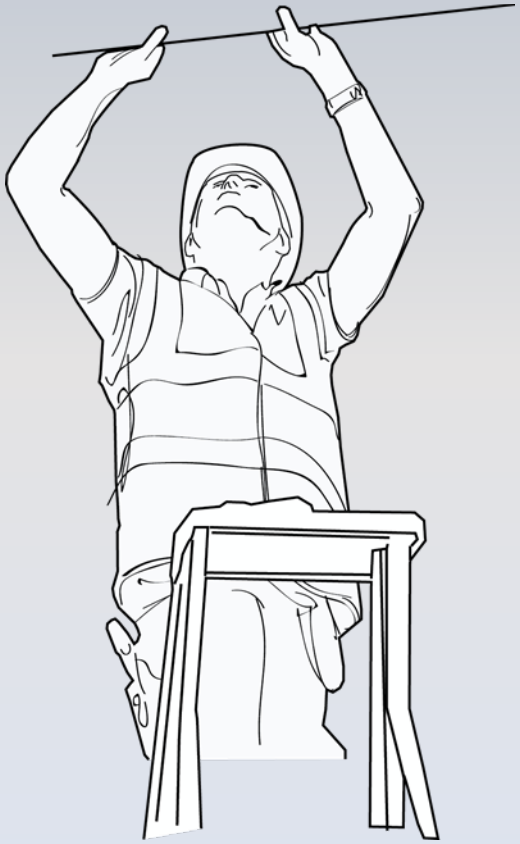
Registers and Grilles



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Code and Energy

U.S. Department Of Energy

“Heating and cooling account for 40% to 60% of energy used in residential buildings. This reveals an opportunity for significant energy savings.”

“The efficiency of air distribution systems has been found to be 60-75% or less in many houses because of insufficient and/or poorly installed duct insulation and leaks in the duct system”.

“Moreover, efficient duct system installations can (could) reduce equipment size, further saving money for new or replacement equipment”

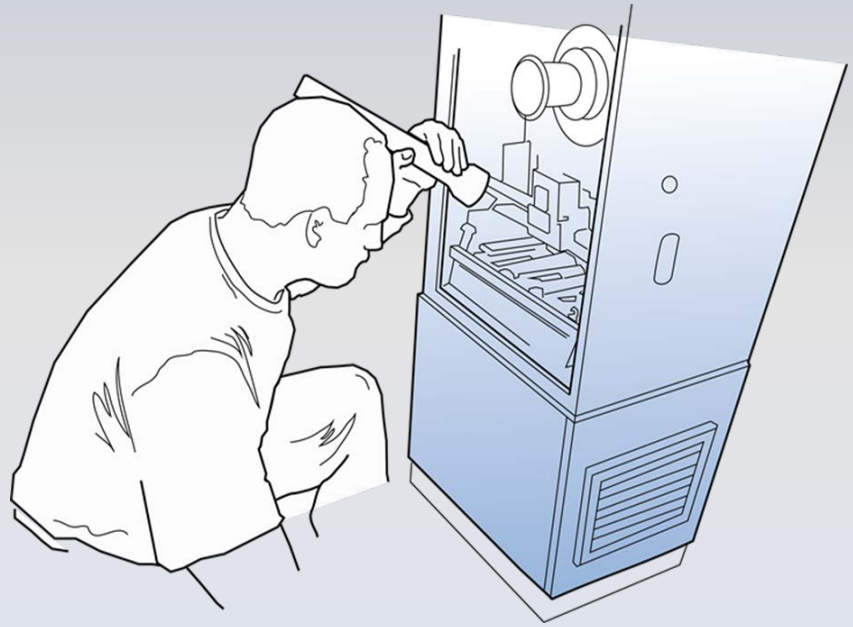
Code is Evolving

- Permitting is at an all time low in some states.
- As low as 1.5% on retrofit HVAC jobs.
- The tighter regulators squeeze, the less permits are pulled.
- HVAC professionals believe code does not save energy.
- Consumers can't justify the cost of a permit.

California - AB 802 – Savings to be verified at the meter – Like accusing someone of cheating at 5 card stud at poker. AB 350 – 50% reduction in energy use. SB 1414 - Permit must accompany utility incentives

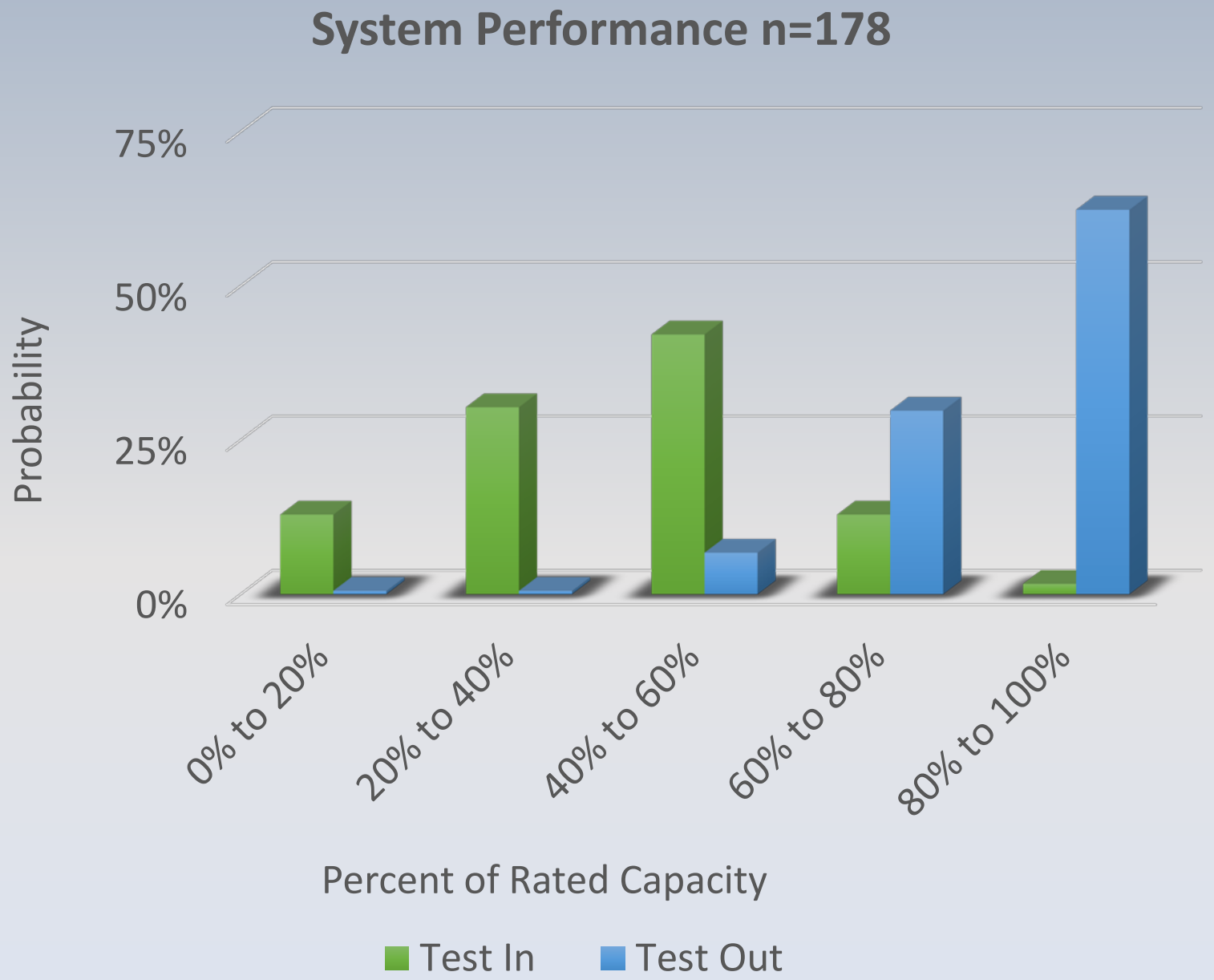
Away From Modeled Energy Savings

- Results of modeling and wish-a watt savings doesn't pencil
- Duct pressure testing, has never measured flow
- Tight ducts can reduce actual field performance 30%
- The 20 year reign of Refrigerant Charge and Adjustment is toppling
- Bottom line, code requirements have failed to produce promised energy savings in HVAC.



NCI System Performance Score Data

- **85%** of systems Test In at **less than 60%**
- After renovations, **75%** of systems Test Out at **better than 75%**



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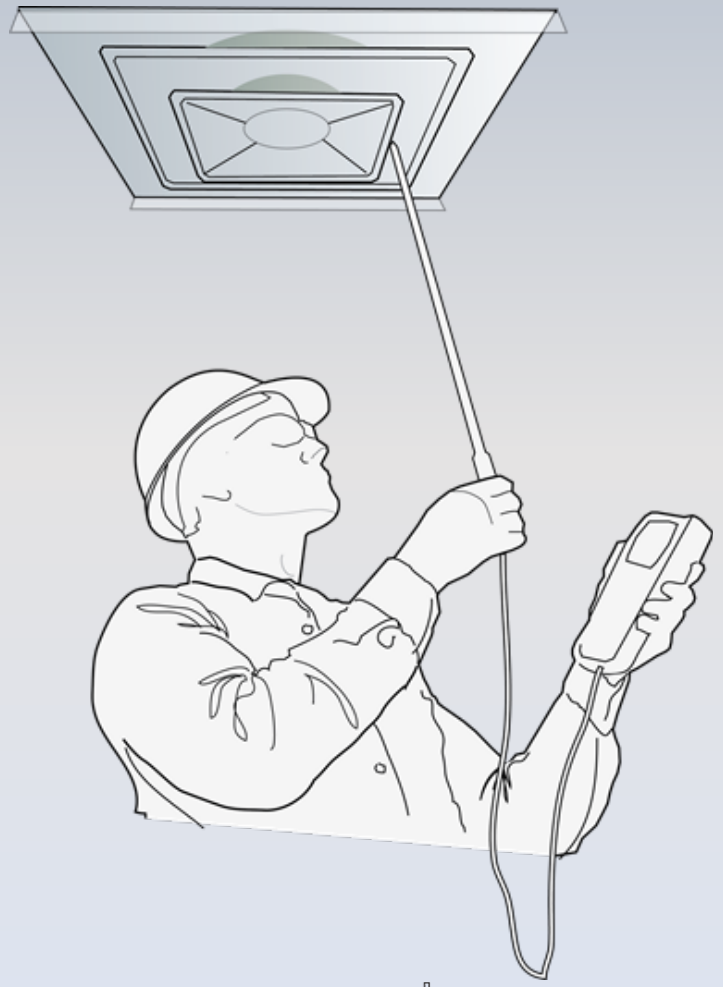
Looking Ahead, Where is Code Headed?

- Many say code needs to become more relevant and produce benefits for those expected to use it.
- Consumers often refuse to pay the cost of code compliance.
- Contractors weigh total cost with perceived benefits, and withdraw from compliance.
- Perhaps moving past checklists and measures and towards field verified efficiency.

Test Method Developing to Enhance Balancing

- Scores the performance of an installed HVAC system
- Revolutionary in its approach to efficiency
- Moves beyond balancing
- This test method has been used in Utility programs
- More than 25,000 have been trained and certified.



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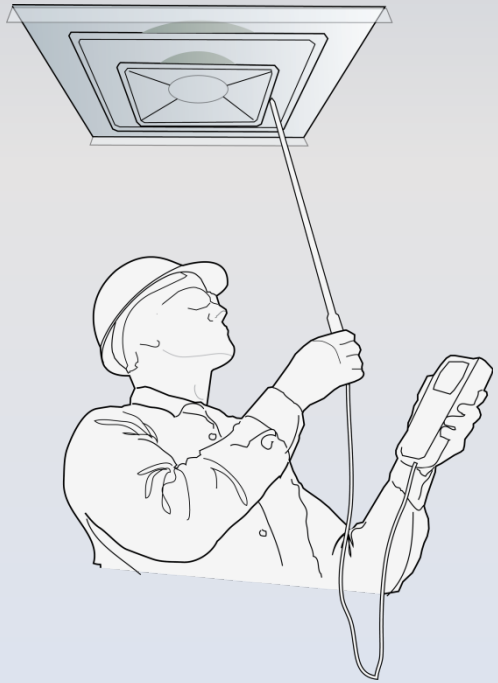
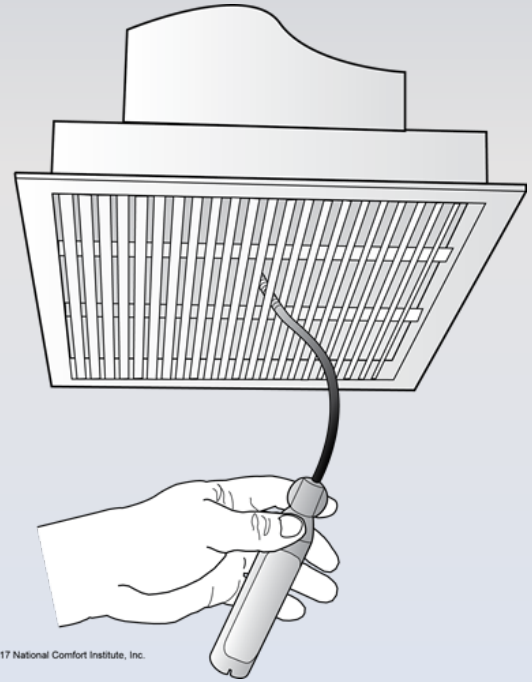
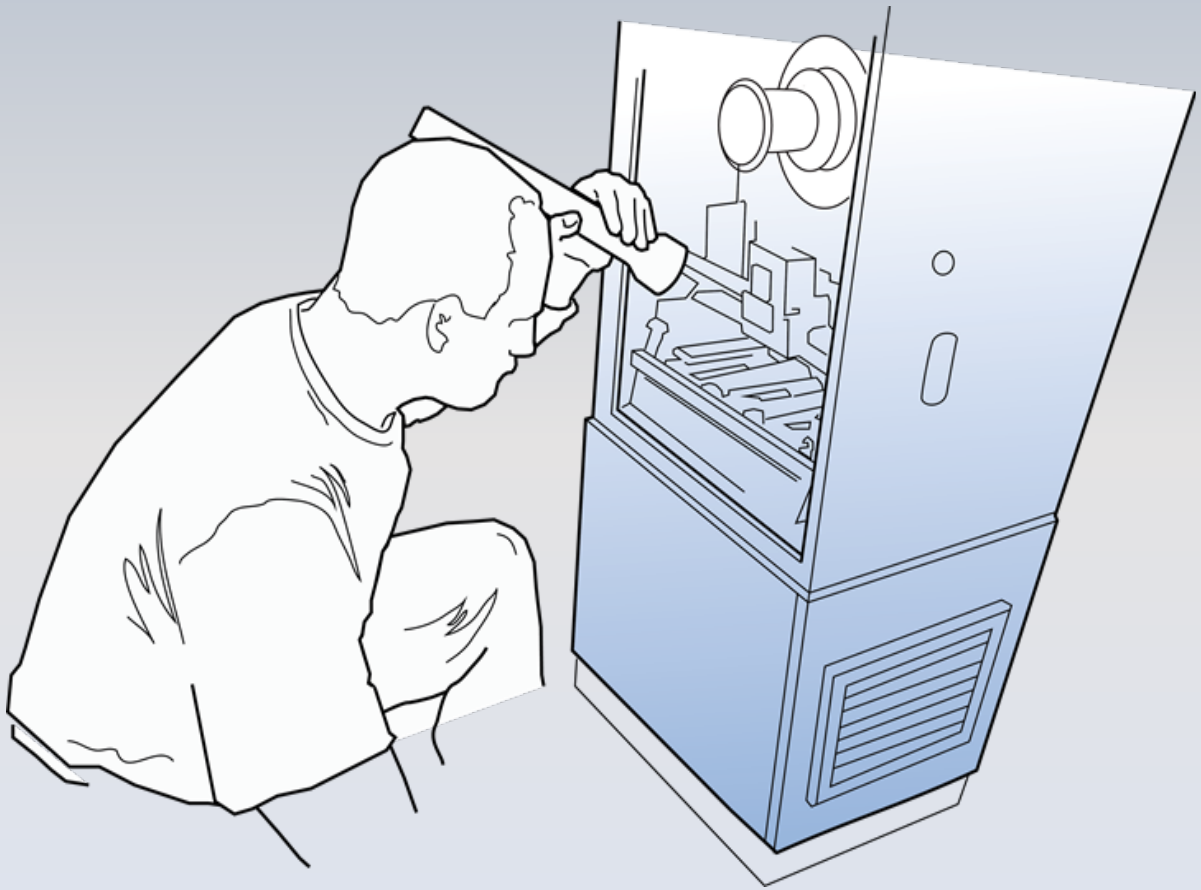
Required Test Instruments

- An commercial air balance hood
- An anemometer to traverse airflow
- A series of data capture temperature probes



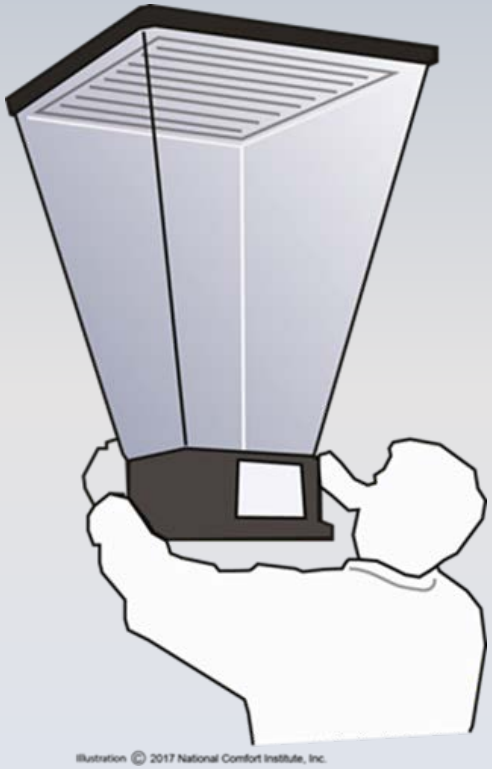


Collect Field Data and Start-up the System

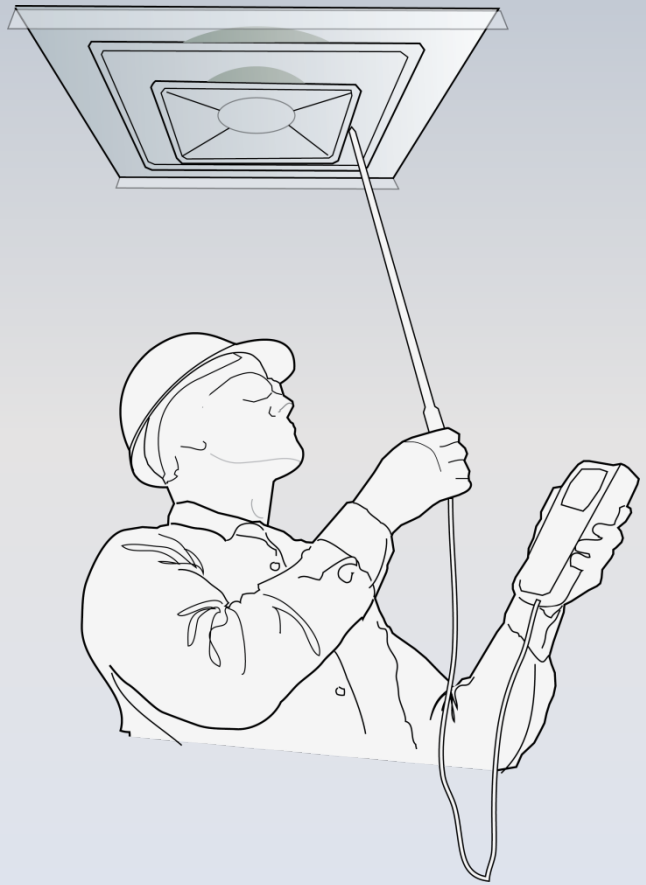


- Gather equipment specifications, nameplate data, system design information, and measure ambient temperatures.
- Start the system in heating mode and allow the system to stabilize for 15 minutes.
- Record required information on the System Performance Score Report
- Place temperature probes and allow to stabilize.

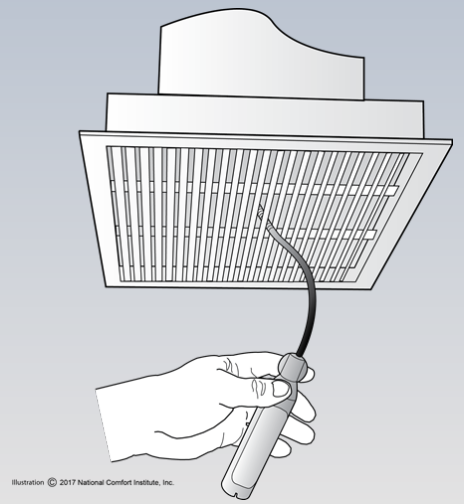
Measure Airflow From Each Supply Register

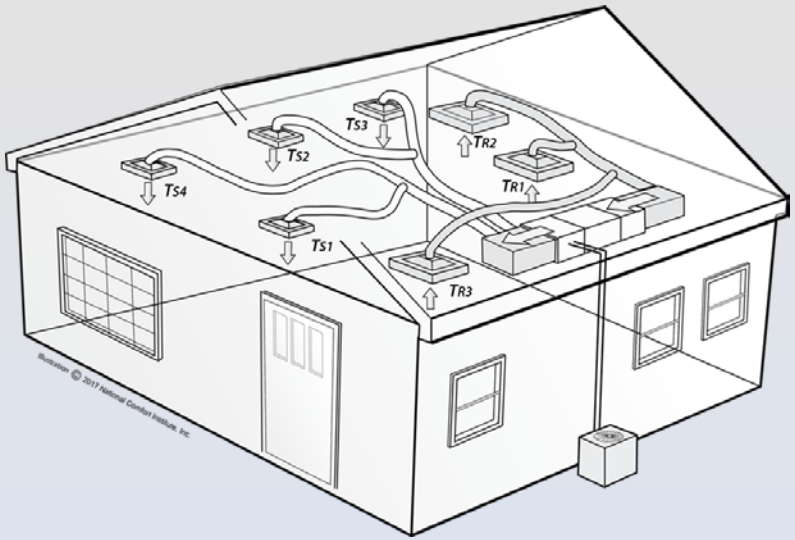


- Using a commercial air balance hood measure the airflow into the occupied space form each supply register.
- Where field conditions prohibit the use of a balancing hood, traverse the supply register to find the delivered airflow.
- Record and add together the airflow from each supply register on the System Performance Score Report. **Let's say we measured 1365 cfm.**



Find the Average Supply and Return Grille Temperatures





- Insert probes in 3 supply registers and 2 return grilles near the center of the system.
- The average supply air is 108.3º and the average return grille temperatures is 72.4º.
- Calculate the conditioned space temperature change by subtracting the average return grille temperature from the average supply register temperature.
- The conditioned space temperature is (108.3º – 72.4º = 35.9º)

Calculate the System Delivered Btu/hr.

Calculate the Btu/hour the system is delivering into the occupied space using the information gathered in the previous steps.

- Airflow into the occupied space
- The temperature difference between the average supply register and return grille.

Here's the heating formula:

Supply Register Airflow x System Temperature Change x 1.08 = System Delivered BTU/hr.

1365 Cfm x 35.9º F x 1.08 = 52,923 System Delivered BTU/hr.

Calculate the System Performance Score

To calculate the System Performance Score, we'll use the data mentioned earlier for this example system.

- The calculated system delivered Btu/hr. is 52,923
- The system equipment rated Btu/hr. **output** is 100,000.

Apply the following formula:

System Delivered Btu/hr. ÷ Equipment rated Btu/hr. Output = Heating System Performance Score

52,923 System Delivered BTU/hr. ÷ 100,000 Rated Btu/hr. = 53% Heating System Performance Score

Calculate the System Performance Loss

To discover the percent of system performance loss, use the information we previously calculated on the same example system.

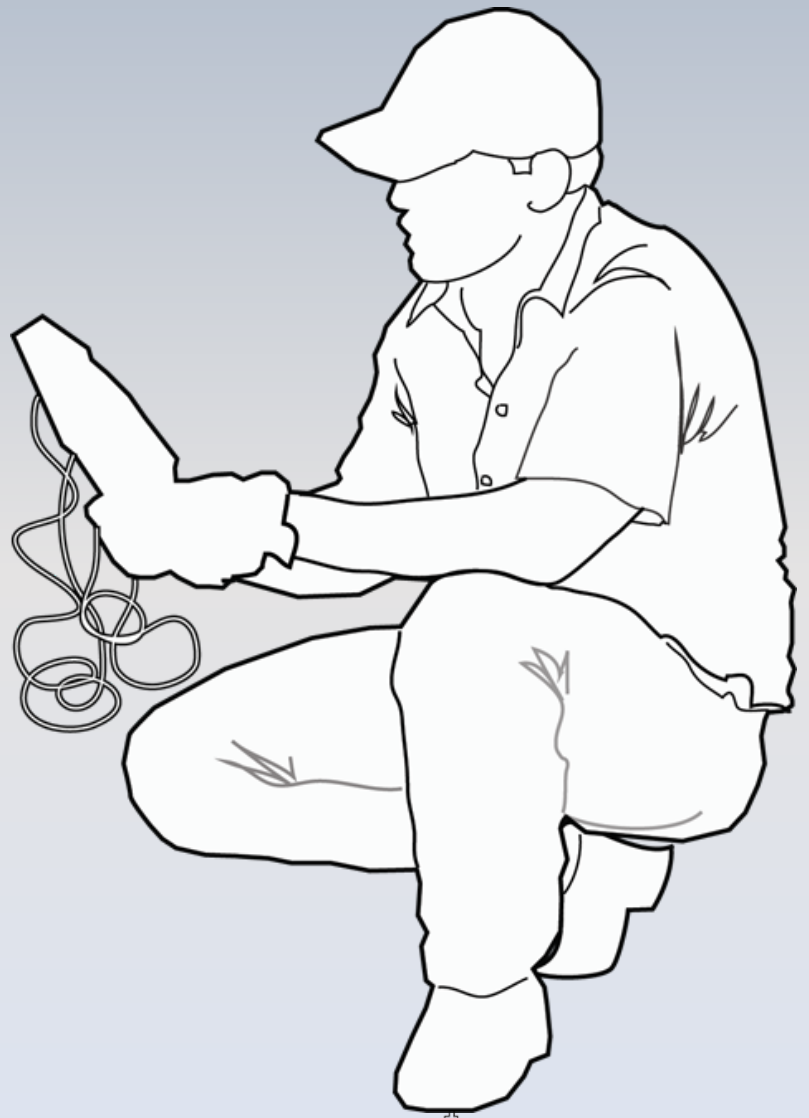
- This system is performing at 53% of rated capacity

Here's the formula:

Rated system performance of 100% - System Performance Score of 53% = 47% System Performance Loss

What You Can Do

- Understand residential balancing codes
- Study the move away from modeled savings and towards measured savings
- Get ahead of the curve
- Test or have your own systems tested
- Get educated or certified
- There is opportunity in leading the field



Depending on your role – Capitalize on balancing opportunities, specify balancing, differentiate your services.

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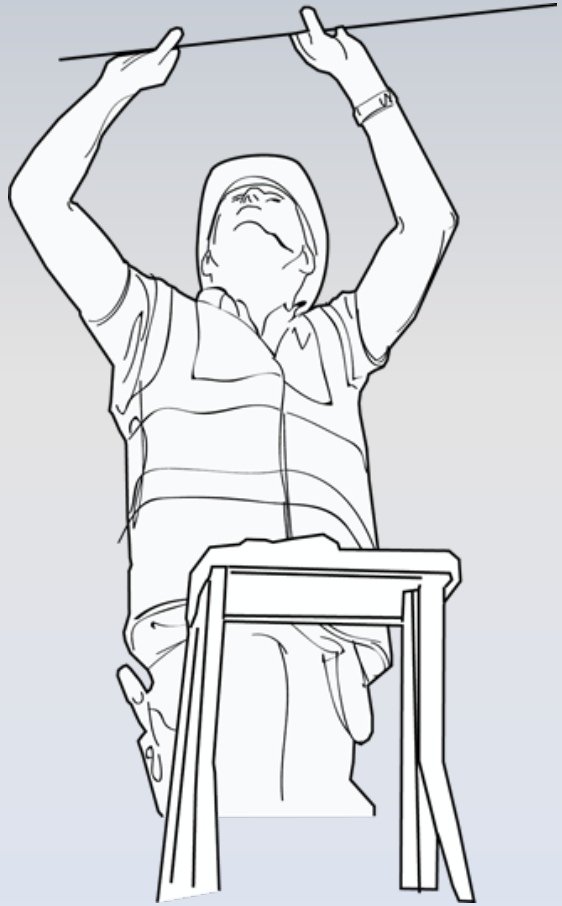
Recap - Why Residential Air Balancing is Being Required by Code



- Balancing has been used for 50 years as a verification tool
- Discussed current balancing code applications
- Balancing project steps
- Reviewed a balancing report
- Alarming field test data
- Proposed new test method to score a system's performance
- What you can do

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