



## WHAT IS TRUE RESIDENTIAL HVAC DESIGN & COMMISSIONING WHAT STANDARDS APPLY?

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**Jeremy Begley & Paul Yankie**

CEUS - AIA | LEED | BPI



AIA Number: 50111106



What is True  
Residential HVAC  
Design and  
Commissioning?



*What Standards Apply?*

**START**



# Partners Who We Are

1

**Paul Yankie- Partner**

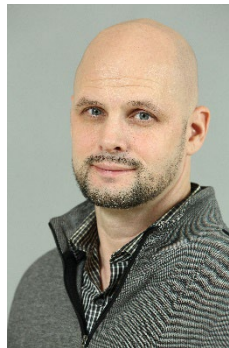
Sales/Operational Support



2

**Jeremy Begley –Partner**

Day to day Operations/Sales



# Services What WE Do



**HVAC Design Services**

Residential , Light Commercial



**Test and Balance and Functional Testing**

Residential , Light Commercial



**Commissioning**

Residential, Light Commercial





# Learning Objectives

The Stuff To Take With You



## DESIGN

Understand the basic ACCA Residential Design Process and why true HVAC Design is necessary for occupant and building health.



## COMMISSIONING

Define Commissioning as it applies to Residential HVAC.  
Learn how a design that considers occupant and building safety can fail if a true commissioning process is not used.



## STANDARDS THAT APPLY

Get to know RESNET/ACCA Standard 310 and ASHRAE 221  
Similarities and Differences



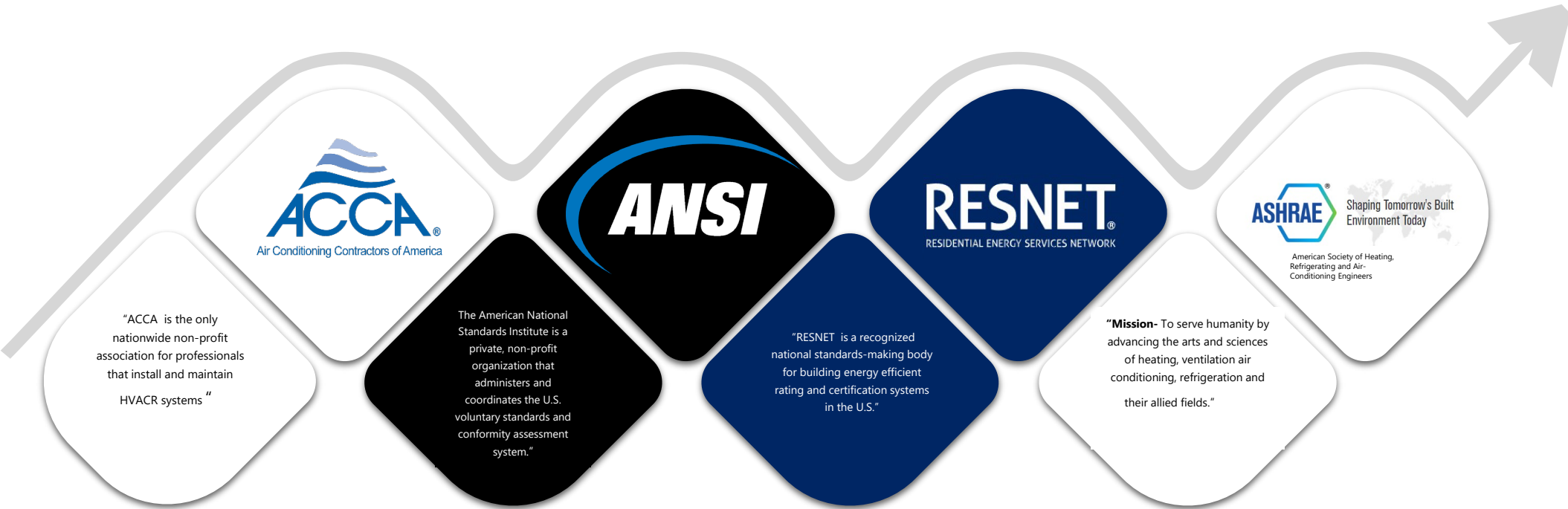
## COMMISSIONING PROCESS

Outline the full residential HVAC commissioning process necessary to ensure optimal efficiency, occupant and comfort, health, and safety and promote building durability.



ORGANIZATIONS THAT CREATED THE

STANDARDS





# The Late Rob Falke

The culmination of his work and what would become his final legacy, began in 2016 when Rob convinced ASRHAE (the American Society of Refrigeration, Heating and Air Conditioning Engineers) to let him form and chair a committee to develop a National Standard for measuring the performance of installed HVAC systems.

After four years of painstaking work, in large part due to Rob's leadership, perseverance, and great people skills, in 2020 ANSI/ASHRAE Standard 221: a ["Test Method To Field-Measure And Score The Cooling And Heating Performance Of An Installed Unitary HVAC System,"](#) was published. This standard truly embodies Rob's vision of how the industry should test and rate HVAC system performance.



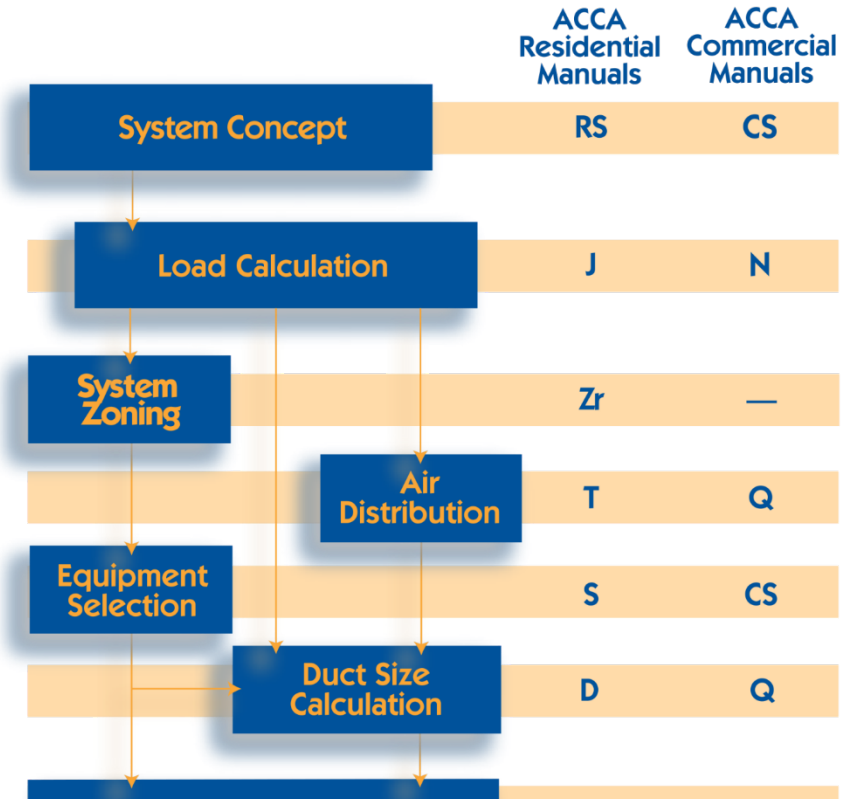


# ACCA Residential Design

Process

Overview of Residential Design Components

## System Design Process



Picture Credit: acca.org



# ACCA Mourns the Loss of Jack Rise



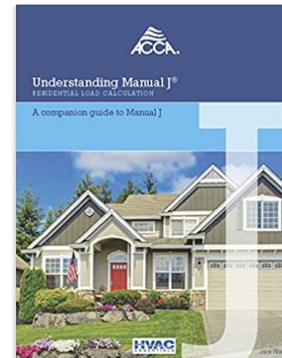
Picture and Quote Credit:  
<https://hvac-blog.acca.org/acca-mourns-the-loss-of-jack-rise>

**“The Problem with the residential HVAC industry is ANY DAMN THING WORKS”-Jack Rise**

1

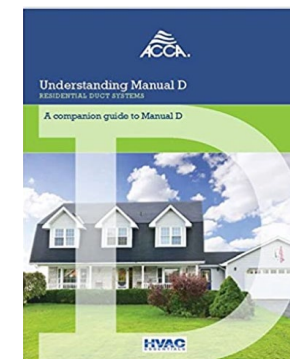
Written By Jack

## Understanding Manual J®



2

## Understanding Manual D®



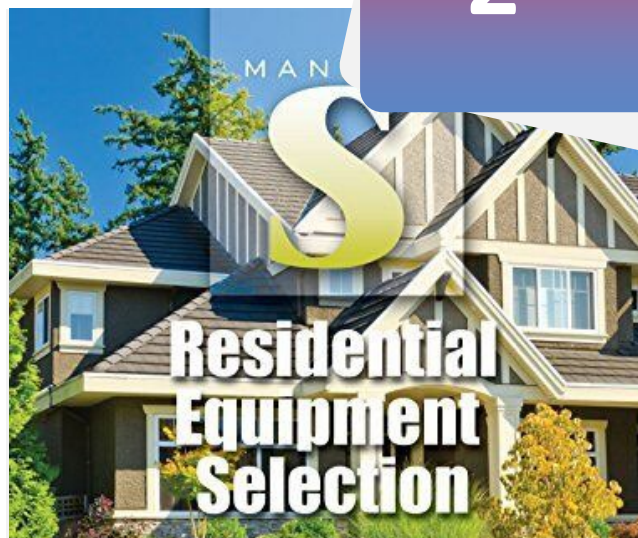
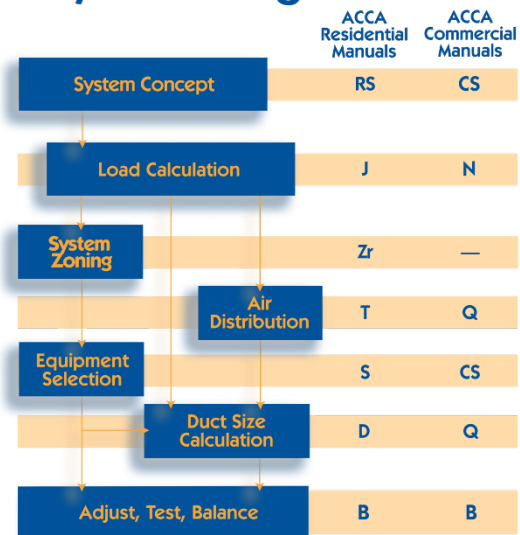
“Jack will be remembered as a dedicated contractor and champion of ACCA. His positivity, generosity, knowledge, and determination touched the entire industry” - Barton James President and CEO at ACCA

SquareBox presentation template design





## System Design Process



## ACCA DESIGN MANUALS

SquareBox presentation template design

Picture Credit :  
acca.org

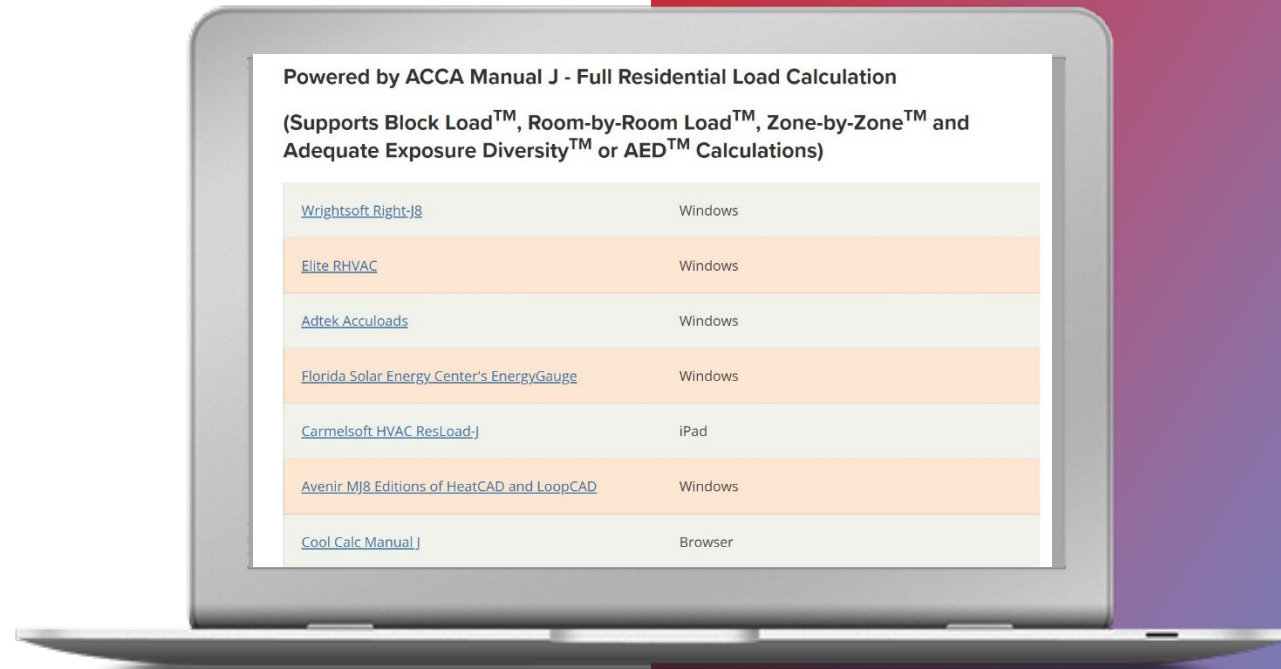


ACCA Approved Software\_

## Manual J

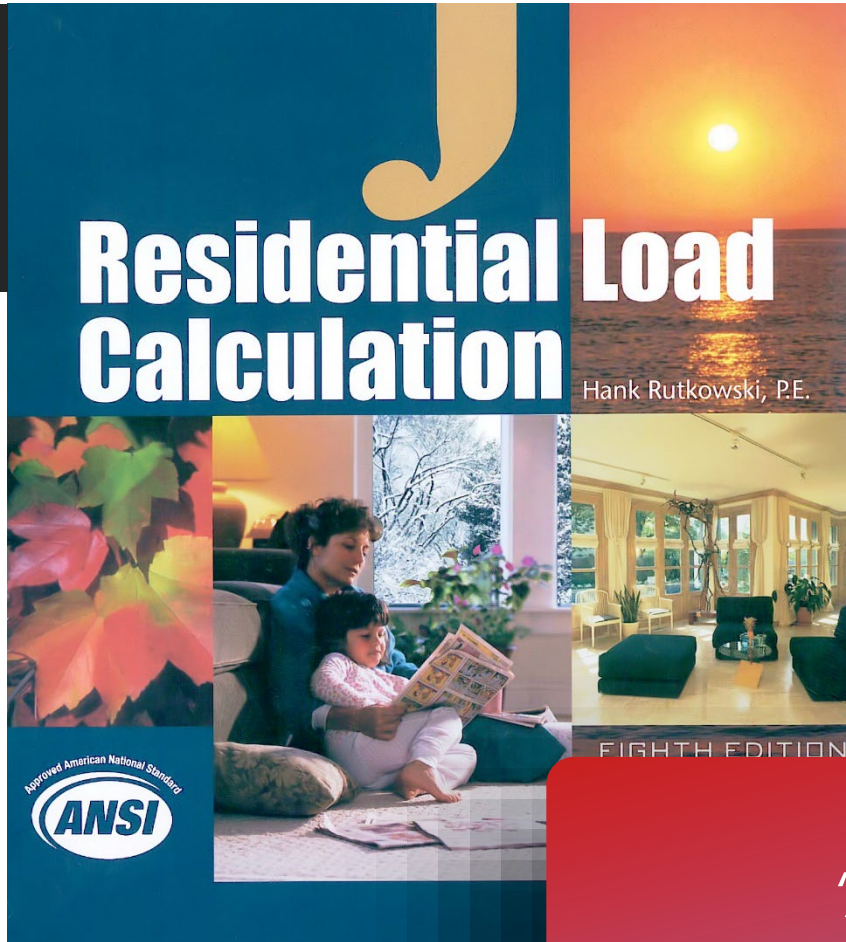
"The Eighth Edition of Manual J (MJ8) estimates heating and cooling loads for all types of residential, low rise , low rise-Structures. Computer Software(spreadsheet template, or full featured program) is required for the full Manual J procedure. " – Manual J Residential Load Calculation Eighth Edition Version Two" – "Overview of This Manual "

SOFTWARE



Picture Credit: [www.acca.org/standrds /approved-software](http://www.acca.org/standrds /approved-software)





# Garbage In Garbage Out

"Be honest and aggressive. **Manual J** is an engineering tool that has an inherent and appropriate factor of safety."

Section2-3

*"Any attempt to add other safety factors or to manipulate the result may result in unacceptable performance.(especially at part*



# MAIN MANUAL J INPUTS

THESE ITEMS HAVE THE BIGGEST AFFECT ON THE FINAL LOAD



## CFA/ Window Area

Conditioned Floor Area should be entered into the software "outside wall to outside wall". Window area should be measured "rough opening to rough opening"



## Thermal Values

Wall, ceiling and floor insulations levels as well as window U and SHGC values need to be exact



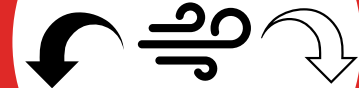
## Internal Gains/ Orientation

Internal loads should be added to areas in use during peak load times only. As built orientation should be used.



## Design Temperatures

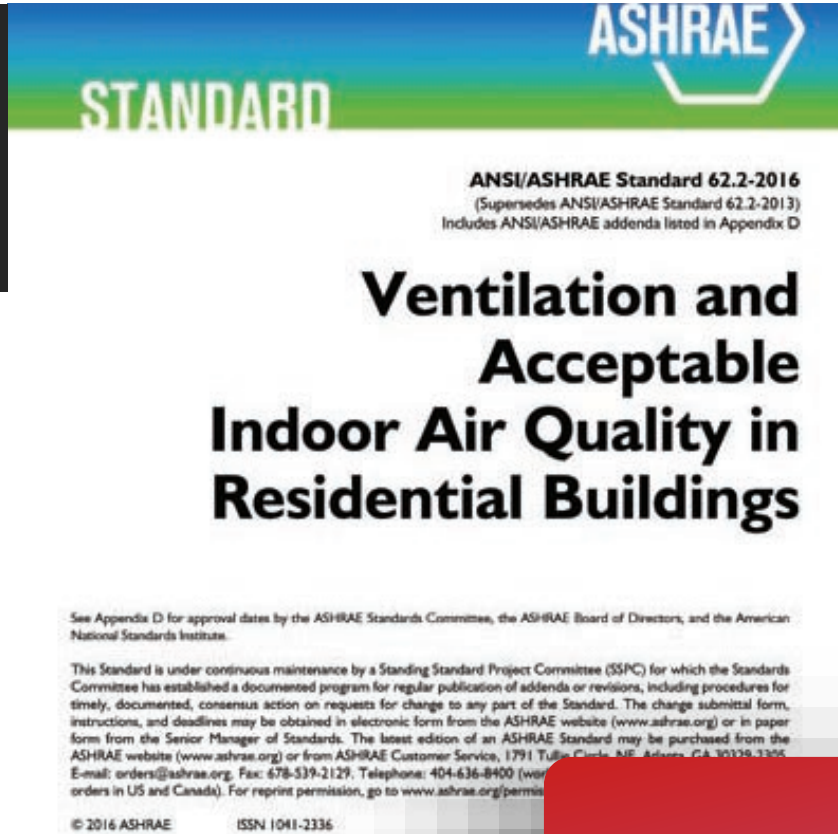
Indoor design temps should be 70° F winter and 75° F Summer and outdoor design temps Should use the ASHRAE 99% and 1% Design temps



## Ventilation/Infiltration

Ventilation should be calculated using ASHRAE 62.2 and Infiltration should be based on measured or predicted ACH 50





# Ventilation is Calculated and Accounted for in Load

"JHA or Energy Program Typically Determines Which  
Version of 62.2 is Used ."

Versions 2010-2019

*"ANSI/ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Residential Buildings, defines the roles of and minimum requirements for mechanical and natural ventilation systems and the building envelope intended to provide acceptable indoor air quality in residential buildings)"*



# CONSEQUENCES OF A BAD LOAD CACULATION

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The two direct outcomes of a bad load caculation are oversized or undersized equipment. There are then consequences of installing oversized or undersized equipment.

1

## Oversized

### Equipment:

- Short Cycling
- Increased Wear and Tear
- Lack of Dehumidification
- Poor Indoor Air Quality
- Poor Comfort
- Wet Buildings
- High Energy Bills

1

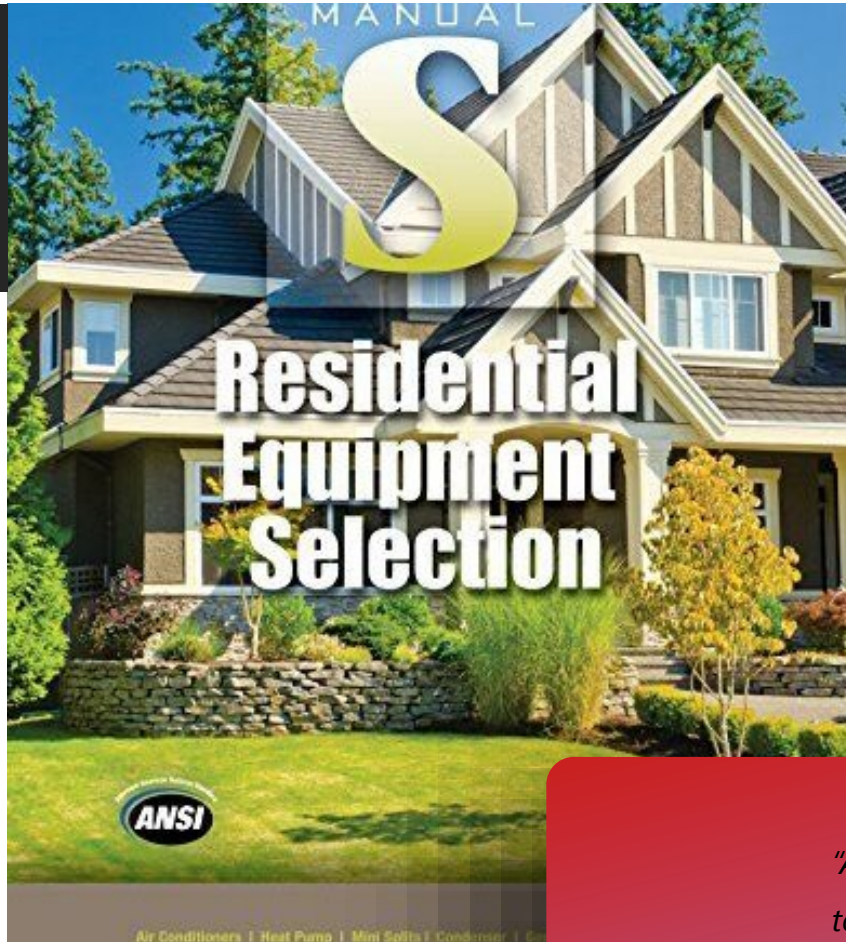
## Undersized

### Equipment :

- Poor Comfort (system can't keep up during peak heating and cooling)
- High Energy Bills
- Increased Wear and Tear
- Possibility of Unhealthily Low Humidity







# Nominal Sizing Is Garbage In

Use OEM Expanded Heating and Cooling Data at Design Conditions

Last revised 2014

*"ACCA will form a working group of industry leaders to update Manual S. ACCA is aware that today's housing stock is constructed to be more energy-efficient and requires less heating and cooling. Therefore, ACCA will consider this, along with the improved heating capacity of multi-stage and variable speed heat pumps, which may allow them to provide heat for an entire dwelling. Updates to Manual S will guide contractors to select the right equipment based on expanded performance data rather than marketing claims."- [aac.org/news/release](http://aac.org/news/release)*





# Code Built Homes Can Be Low Load

A "Low Load Home" is any home with a load of 1200sqft/Ton or smaller "

Last revised 2019

*"Manual LLH deals with the unique HVAC design issues associated with homes that exhibit low cooling and /or heating loads (per Manual J® load calculations) and identifies equipment options / approaches to address these issues. The manual augments the explicit instructions provided in the ACCA residential HVAC design process ... load calculations, duct design, equipment selection, grille/register selection and placement, zoning, and dehumidification for residential applications; per the underlying ACCA Manuals J® / D® / S® / T® / Zr® / SPS® / RS®."*



# “Making Manual S Super”

“ACCA’s Manual S: Residential Equipment Selection is under revision as part of the routine requirements set by the American National Standards Institute (ANSI). ACCA saw this as the perfect opportunity to meet the growing desire to expand the use of renewable energy, a trend some call electrification. Manual S has been a code requirement for five years. As it continues to gain recognition and is implemented by more jurisdictions, this is the perfect time to make Manual S “super.”- ACCA HVAC Blog

## Heat Pumps

- Heat Pumps that use dehumidification can be bigger
- Variable capacity heat pumps can be sized towards the heating load

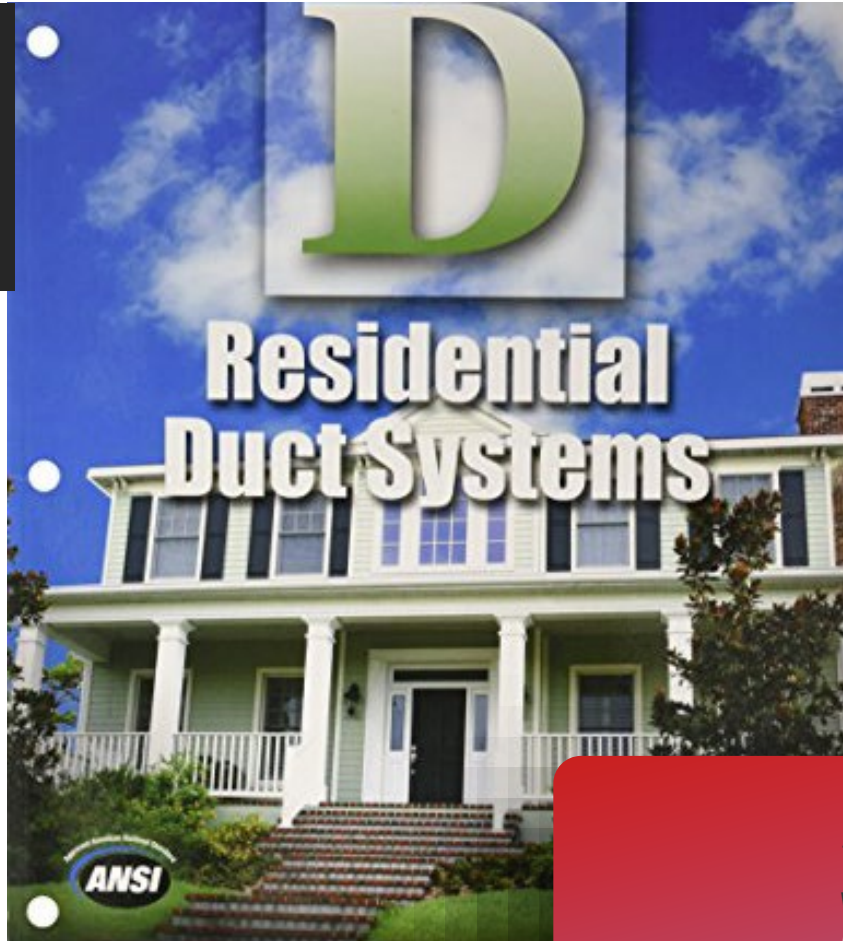
## Dehumidification

- Sizing residential dehumidifier loads
- Larger over sizing variances for projects with aux dehu

## Mandatory Language

- Refine and streamline minimum requirements
- Ensure the manual retains clear, consistent guidance.





# Keep Ducts Straight and Rigid

"Load Calculation Determines Airflow Requirements"

Equipment Performance Data Determines Blower  
Performance"

Last revised 2014

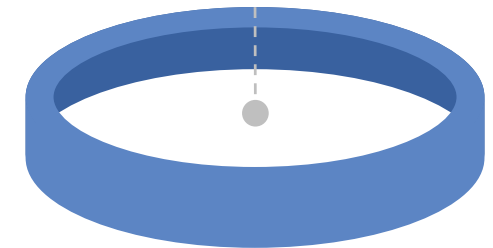
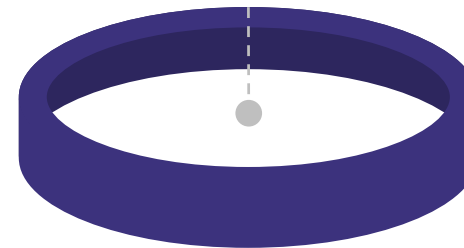
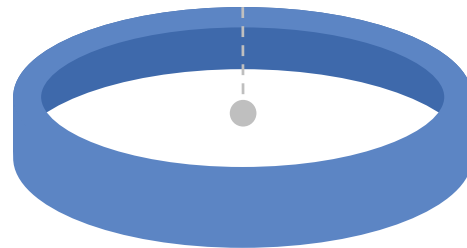
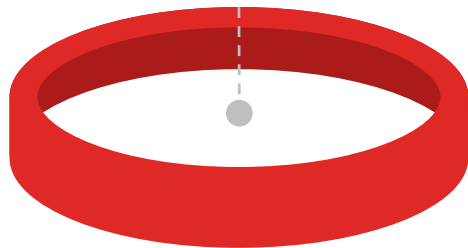
*"For a given operating condition, duct performance is summarized by a set of variables, which are : airway size(diameter or equivalent diameter),airflow rate(CFM), airflow velocity(Fpm), and friction rate(IWC/100 Ft)-these variables are interdependent."*

*"Poor heating and cooling performance is commonly attributed to inadequate equipment size when the actual problem is a restrictive or deficient duct system"*



# Deliverables

What The Client or Installing Contractor Receives



## Witten Equipment Specification Per System Instruction Duct and Equipment Layout Manual JSD Documentation

Single page that lists project parameters, equipment type and model numbers, quantity and zone served.

One page per system or zone, may contain duct fitting types, line set length, air flow settings, ventilation rates ect.

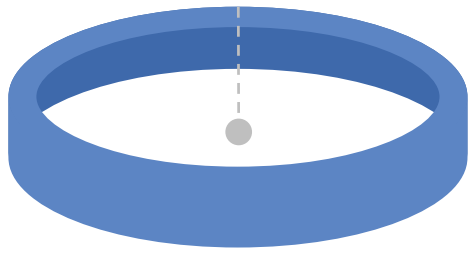
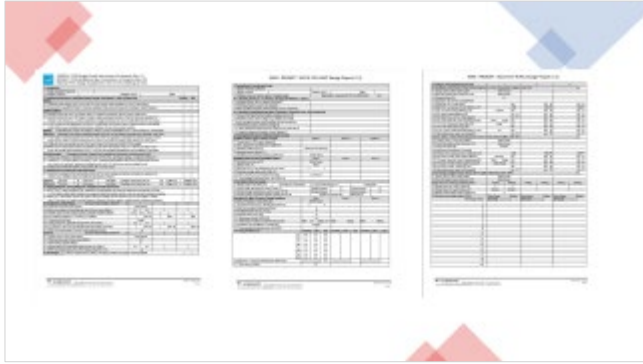
Scaled one- or two-line diagrammatic showing equipment placement, duct size and length, and register and grille size and placement.

Should Include at a minimum per system ,The Manual J Project Summary and Air Flow Detail Page, Manual S Compliance Page and Manual D System Summary and Static Pressure and Friction Rate



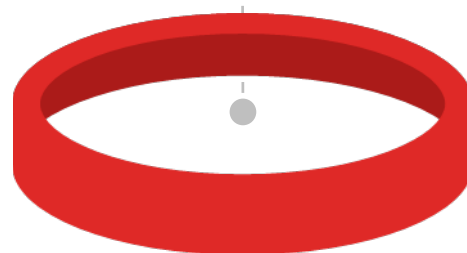
# Deliverables

What The Rater or Commissioning Agent Receives



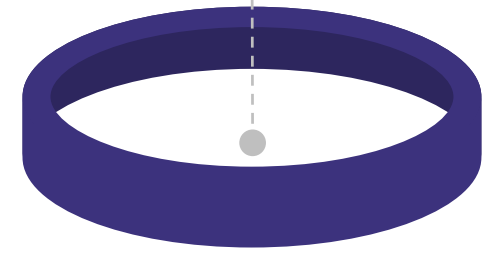
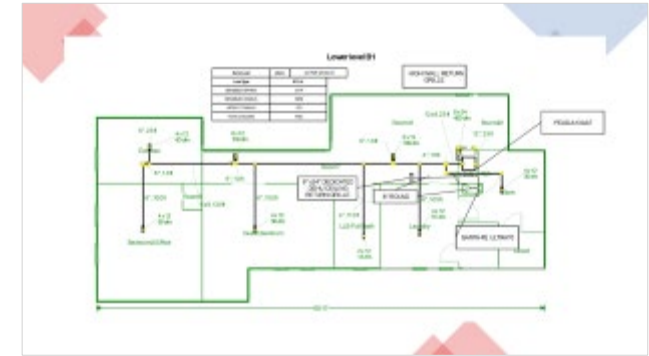
## Design Report

The design report can be in proprietary custom format, the same format you gave the client and contactor or the RESNET 310 Design Report as shown here .



## Equipment Submittals

Most current submittals for all equipment to be installed .



## Layout

Scaled one- or two-line diagrammatic showing equipment placement, duct size and length, and register and grille size and placement.

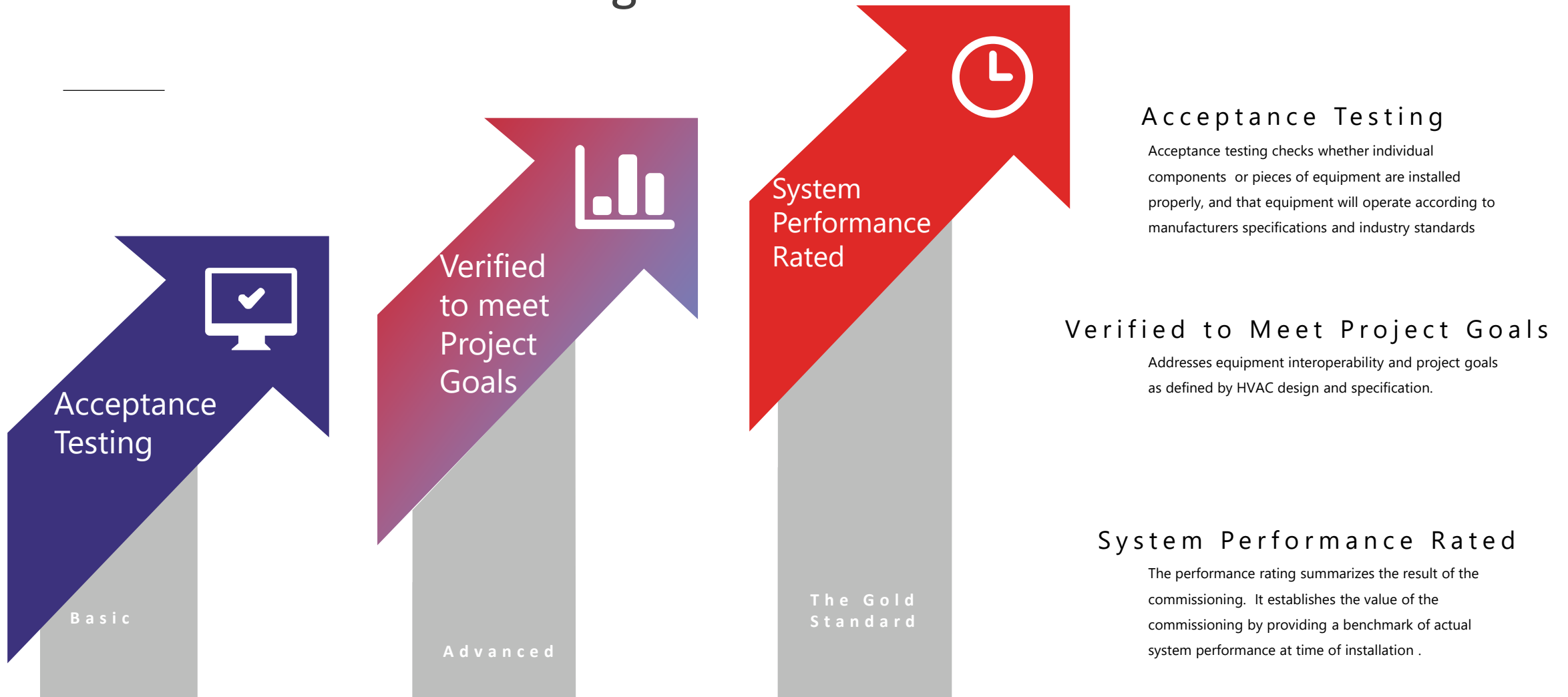


## The “Mission” of HVAC Commissioning

- HVAC commissioning is a **testing** and **reporting** process that takes place at the end of an HVAC system installation. It documents the system was installed and is performing according to designer's and manufacturer's requirements.

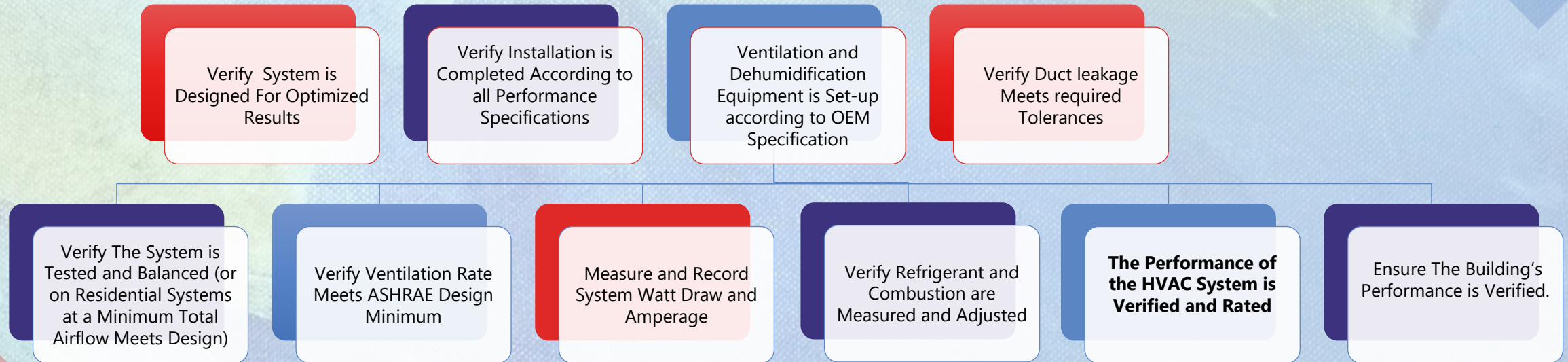


# Levels Of Commissioning





# Elements of HVAC Commissioning







# **ANSI/RESNET/ACCA 310-2020**

## **Standard for Grading the Installation of HVAC Systems**



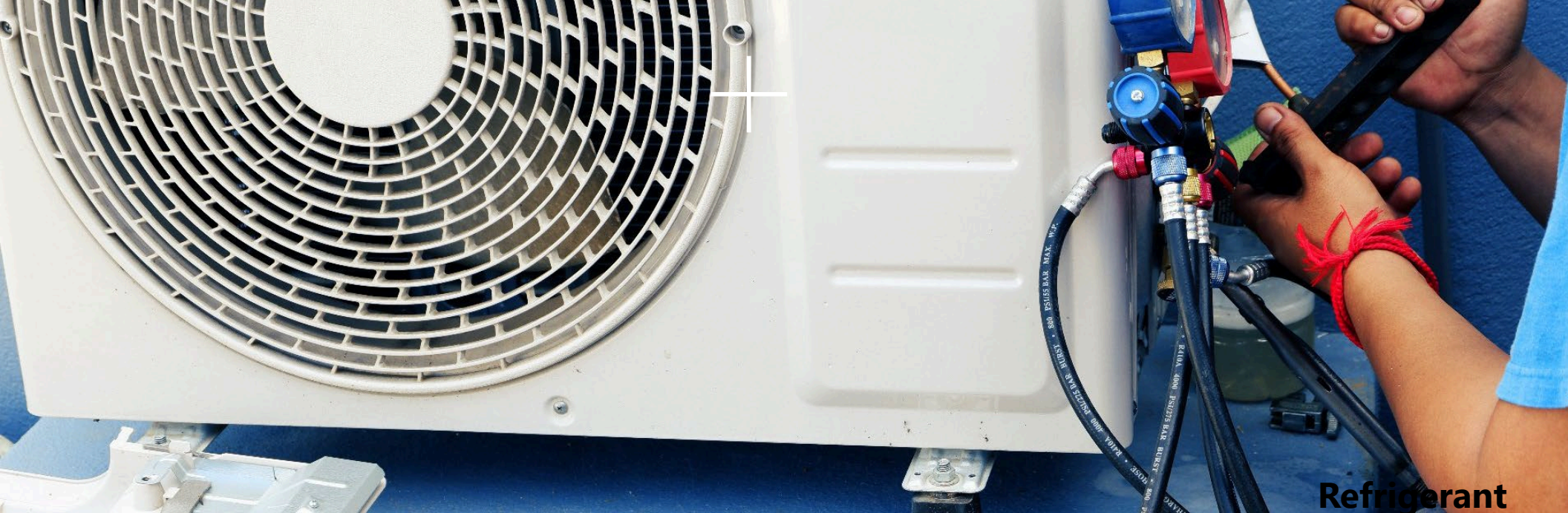
# ANSI/RESNET/ACCA 310-2020 DEFINED PURPOSE

"This Standard establishes the procedures, tolerances, and record keeping practices for evaluating and grading elements of an HVAC system's design and installation. This standard is intended to support consistency in energy ratings and labeling. It is intended for use by home energy raters, energy auditors, or HVAC contractors".

ANSI/RESNET/ACCA 310-2020







# Installation Defects In **HVAC** Systems Are Commonplace

## Airflow is Impacted By the Installation:

- ✓ Fan speed setting
- ✓ Components attached to the system
- ✓ Duct system installation quality

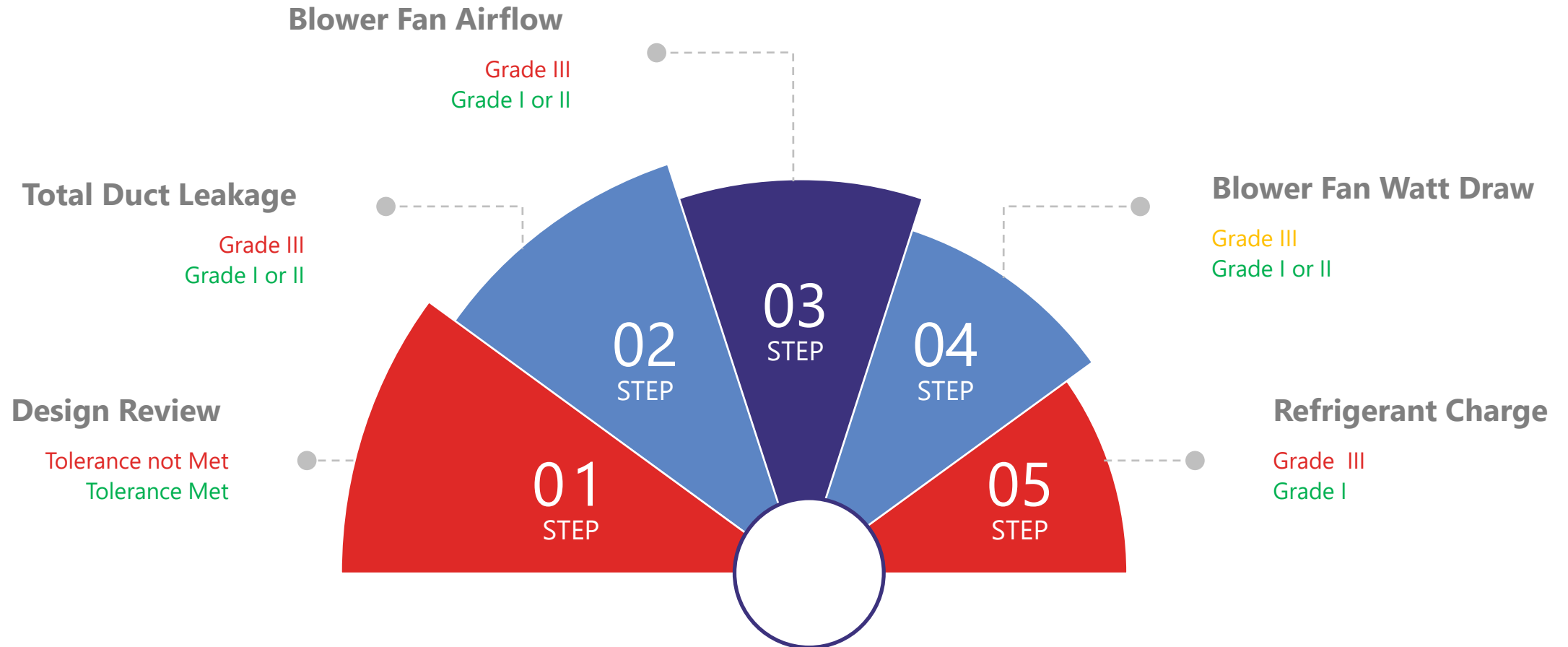
## Refrigerant Charge is Impacted By the Installation:

- ✓ Length of refrigerant line
- ✓ Change in height between indoor and outdoor section
- ✓ Initial charge
- ✓ Airflow



# The Five Tasks of Standard 310

The Five Tasks are Designed to be Completed In Sequence (*Each task tolerance must be met to move to the next task*)





# Task 1

## Evaluate the Design

Rater reviews design documentation for completeness and compares it to dwelling. The following key features must fall within defined tolerances. (If tolerances aren't met stop here)

### Floor and Window Area

#### Floor Area per Zone:

Actual (modeled home) is between 300 ft<sup>2</sup> smaller and 100 ft<sup>2</sup> larger than HVAC design

#### Window Area Per Zone:

Actual is between 60 ft<sup>2</sup> smaller and 15 ft<sup>2</sup> bigger than the HVAC design

### Internal Loads

#### # of Occupants used in HVAC

**Design:** must be within +/-2 of bedrooms +1

#### Internal Appliance Loads :

Must meet ACCA Manual J guidelines or have verified explanation for excessive internal loads

### Indoor/Outdoor Design Temps

#### Indoor Design Temp:

Winter 70° F Summer 75° F

#### Outdoor Design Temps:

Energy Star Min for Area

### Insulation and Window Values Ventilation and Infiltration Rates

#### Insulation:

Actual home predominant AGW R-value is within +/- R-2 of HVAC design; predominant ceiling insulation R-value is within +/- R-4 of HVAC

#### Window Values:

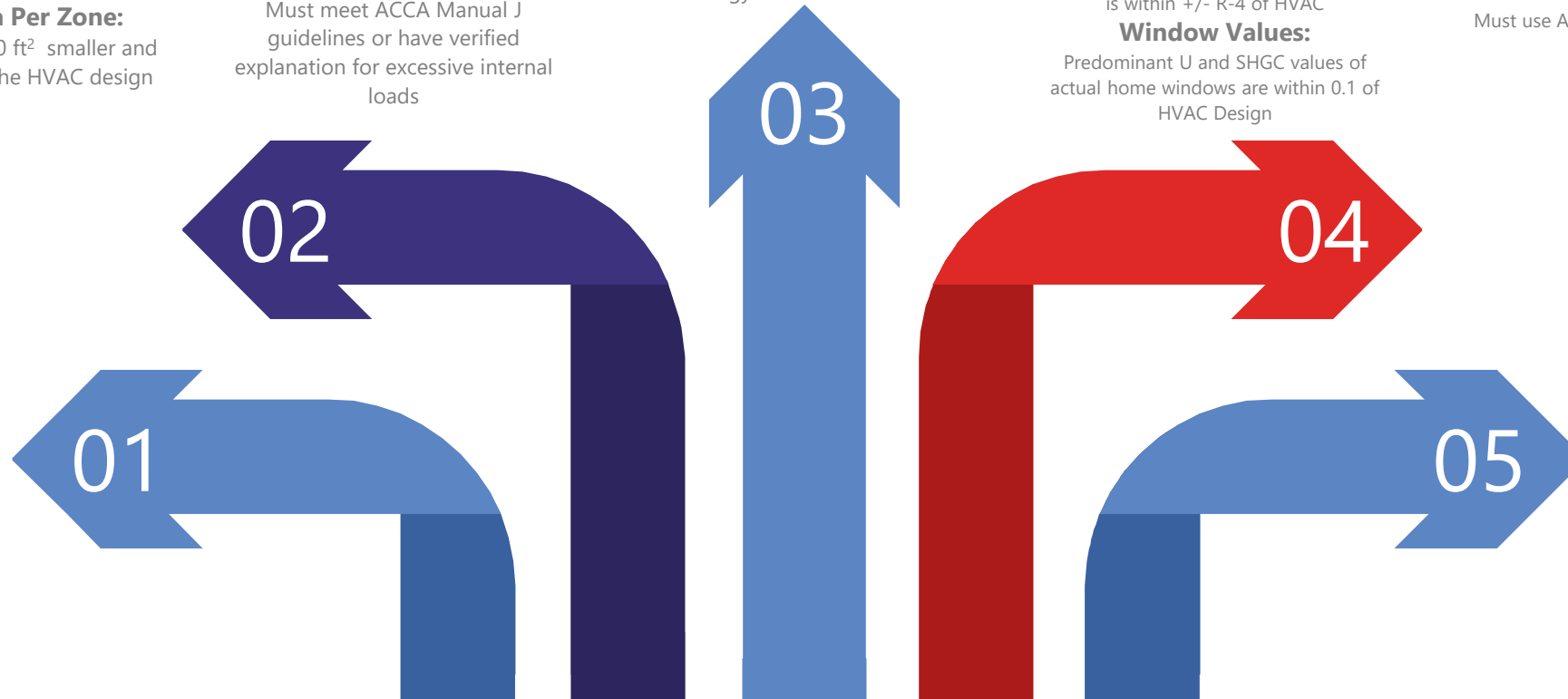
Predominant U and SHGC values of actual home windows are within 0.1 of HVAC Design

#### Ventilation :

must match ventilation rate calculated and used in energy model

#### Infiltration :

Must use ACH 50 defined in project goals





# Other Field Verification Required During Blower Airflow Evaluation Step

6.2.2.1. HVAC equipment. The specified manufacturer(s) and model number(s) of the equipment in the Forced-Air HVAC System under test matches the installed equipment or supplemental documentation has been collected as defined in Section 4.2.5 and verified in accordance with Section 4.3. If the installed equipment does not match the specified equipment in the original or supplemental documentation, 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.



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 <sup>28</sup> as reported in Section 4.2.5.4. <sup>29</sup>

6.2.2. **Verification of HVAC Components.** If the following components are included in the required design documentation for the Forced-Air HVAC System under test, they shall be verified to be present. If these components are not operational at the time of inspection, 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. The additional requirements defined in Section 6.2.2.1 shall also be met.





# Task 2

Evaluate Duct Leakage



Grade I

**Rough**

<3 Returns- 4 cfm/100sqft or 40 cfm total  
≥3 Returns -6 cfm/100sqft or 60 cfm total

**Final**

<3 Returns- 8 cfm/100sqft or 80 cfm total  
≥3 Returns -12 cfm/100sqft or 120 cfm total



Grade II

**Rough**

<3 Returns- 6 cfm/100sqft or 60 cfm total  
≥3 Returns -8 cfm/100sqft or 80 cfm total

**Final**

<3 Returns- 10 cfm/100sqft or 100cfm total  
≥3 Returns -14 cfm/100sqft or 140 cfm total



Grade III

**N/A**

Grade III is a hard stop



# Task 3

## Evaluate Blower Fan Airflow



### Flow Hood

Can only be used with 3 or less returns .



### Flow Grid

Most accurate and versatile.



### Pressure Matching

Only works with 2 tons and under.

### OEM Static Pressure Table

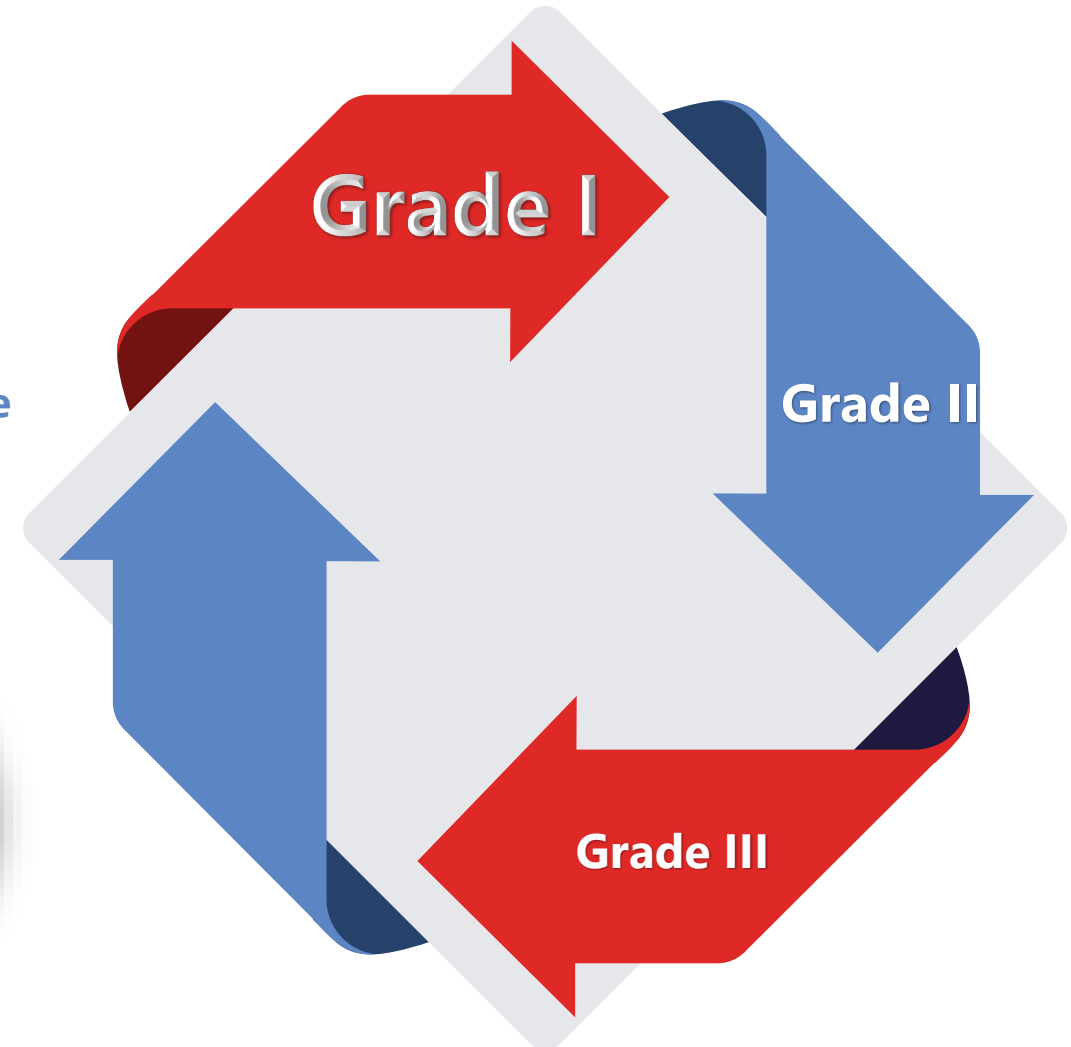
Can be very accurate, requires blower fan chart or curve.



Results are  
Compared  
To Design  
Airflow



Single  
Measurement  
(Not each  
register)





# Task 3 – Blower Fan Airflow Grading Scale

**Table 4 – Grade Designations for Blower Fan Volumetric Airflow**

| Grade Designation | $F_{AF}$ Range             |    |                            |
|-------------------|----------------------------|----|----------------------------|
| I                 | $\leq 0$ and $> -15\%$     | or | $\geq 0$ and $< +15\%$     |
| II                | $\leq -15\%$ and $> -25\%$ | or | $\geq +15\%$ and $< +25\%$ |
| III               | $\leq -25\%$               | or | $\geq +25\%$               |



# Task 4

## Blower Fan Watt Draw

### Plug in Meter

Not likely to be used in this market (some rural municipalities allow plug in AH's and furnaces.)



### Clamp On Watt Meter

Most likely to be used in this market (Most common way to take watt and amp draw professionally.)



### Utility Meter

Highly unlikely to be used (This method requires all breakers except AC and AH to be turned off)



### Grade I,II or III Allowable

Regardless of result you may move on to next step.





# Task 4- Blower fan Watt Draw Grading Scale

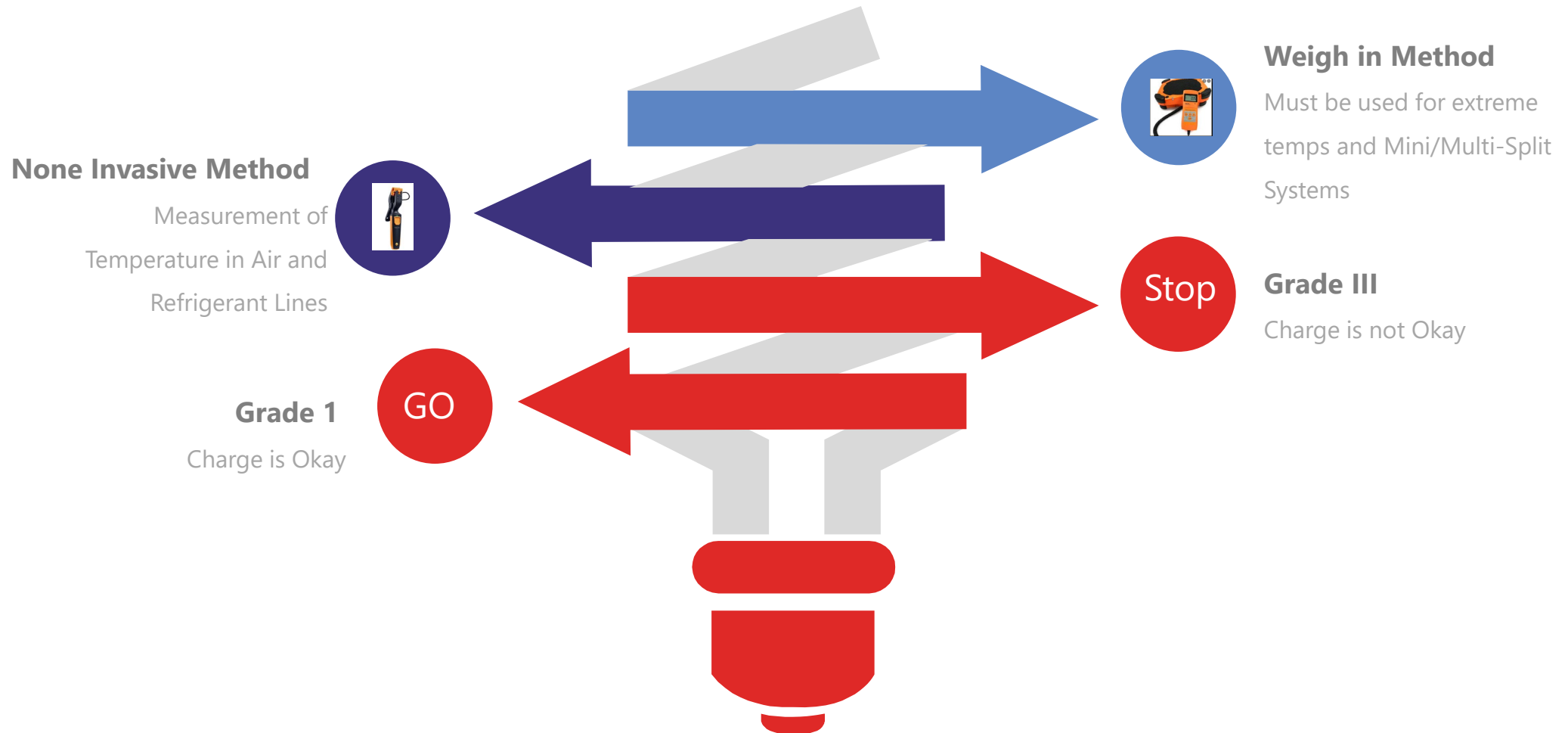
**Table 5 – Grade Designations for Blower Fan Watt Draw**

| Grade Designation | Blower Fan Efficiency (Watts/CFM) |
|-------------------|-----------------------------------|
| I                 | $\leq 0.45$                       |
| II                | $> 0.45$ and $\leq 0.58$          |
| III               | $> 0.58$                          |



# Task 5

Evaluate Refrigerant Charge





# Task 5- Refrigerant Charge Grading Scale

## Piston or Capillary Tube

8.6.2.1. If the metering device type is piston or capillary tube, per Section 4.2.5.3.9.1, then the grade for refrigerant charge shall be designated according to the ranges in Table 8, using DifferenceDTD from Equation 15.

Table 8 – Piston or Capillary Tube Metering Device  
Grade Designations for Refrigerant Charge

| Grade Designation | DifferenceDTD Range |
|-------------------|---------------------|
| I                 | > -8 °F (4 °C)      |
| III               | ≤ -8 °F (4 °C)      |

## TXV or EEV

8.6.2.2. If the metering device type is TXV or EEV, per Section 4.2.5.3.9.1, then the grade for refrigerant charge shall be designated according to the ranges in Table 9, using DifferenceCTOA from Equation 20.

Table 9 – TXV or EEV Metering Device  
Grade Designations for Refrigerant Charge

| Grade Designation | DifferenceCTOA Range |
|-------------------|----------------------|
| I                 | > -6 °F (3 °C)       |
| III               | ≤ -6 °F (3 °C)       |

8.6.3. If refrigerant charge was evaluated using the Weigh-In Method, per Section 8.5, the grade for refrigerant charge shall be designated based on the following and recorded.

8.6.3.1. Grade I shall be designated when both of the following criteria are met.

8.6.3.1.1. The absolute value of the percent deviation between the total anticipated and total reported refrigerant weight, per Equation 24, is ≤ 5%.

8.6.3.1.2. In the judgement of the party conducting the evaluation, the location of the geotagged photo provided in Section 8.5.2.1.2 matches the location of the Forced-Air HVAC System under test.

8.6.3.2. Grade III shall be designated when the criteria in Section 8.6.3.1 are not met.



**STANDARD**



**ANSI/ASHRAE Standard 221-2020**

# **Test Method to Field-Measure and Score the Cooling and Heating Performance of an Installed Unitary HVAC System**

ASHRAE 221-2020 is a copyrighted work of ASHRAE. It is not to be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage and retrieval system, without the prior written permission of ASHRAE. For more information, visit [www.ashrae.org](http://www.ashrae.org).





# ANSI/ASHRAE Standard 221-2020 DEFINED PURPOSE

- “The purpose of this standard is to prescribe a field evaluation and test method to measure and score the performance, in terms of delivered cooling or heating capacity or cooling efficiency”

ANSI/ASHRAE 221-  
2020




*The fundamental approaches described in this standard have been in regular use since at least 2001. The principles used in this test method are supported by numerous industry standards, which have been adapted for field measurement and taught to contractors and technicians by National Comfort Institute (NCI). These approaches formed the basis of the standard and were subsequently improved upon and vetted by a balanced committee to define consistent and repeatable test, measurement, and calculation procedures.*

*This test and scoring method may be used by field practitioners to score a system before and after system repairs and upgrades. The score before upgrades documents the deterioration caused by defects in the installed system and helps identify what may be done to improve the performance and efficiency of the system. The system is again tested and scored after system repairs and upgrades are completed using the same methodology. The difference between the before and after score provides an estimate of the improvement in performance and efficiency of the installed system.*

*This standard is intended for field use to estimate the capacity and efficiency of installed systems. It is written in a language of and for field practitioners, enabling HVAC contractors, technicians, design engineers, balancing and energy measurement and verification*







# Breakdown of the use of Standard 221 In Your Commissionin g Process



# Cooling System Performance Rating

## Test Procedure

1

### Prepare System for Inspection

Gather Equipment Name Plate Data  
Record required system Information  
Start system with the controls calling for max cooling  
System Must be In Steady State for 15 mins for Testing

2

### Measure , Record and Total Airflow

Std 221 Requires all Grilles to be Read and Totaled ( Total airflow is all that's needed for BTU Formula)

3


### Measure Wet Bulb

Measure wet bulb at three central supply registers and three central return grilles

4

### Calculate System Enthalpy

Convert wet bulb to enthalpy  
Avg supply enthalpy, Avg return enthalpy  
Subtract avg return enthalpy from avg supply enthalpy



5

### Calculate System Performance

Multiple conditioned space enthalpy by total airflow and Btus/hr multiplier (usually 4.5) to get total delivered Btu's

6

### Calculate System Performance Score

Divide delivered Btus/hr by design Btus/hr

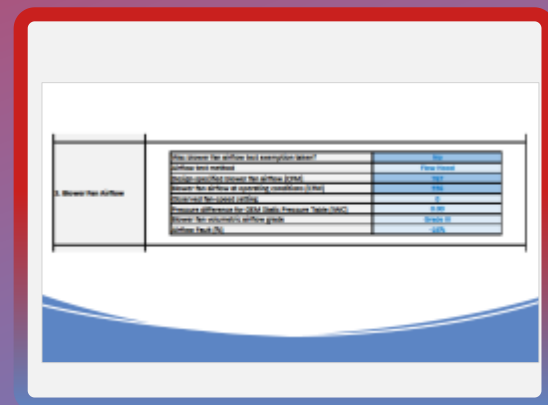
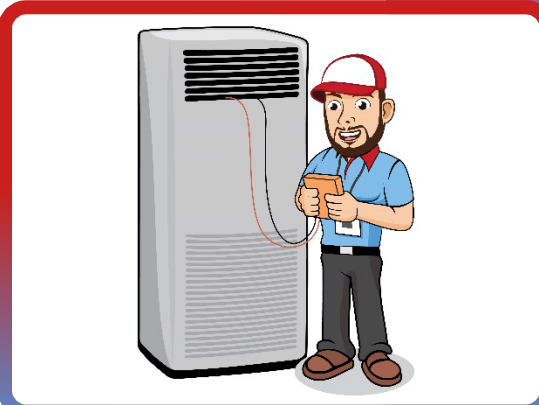
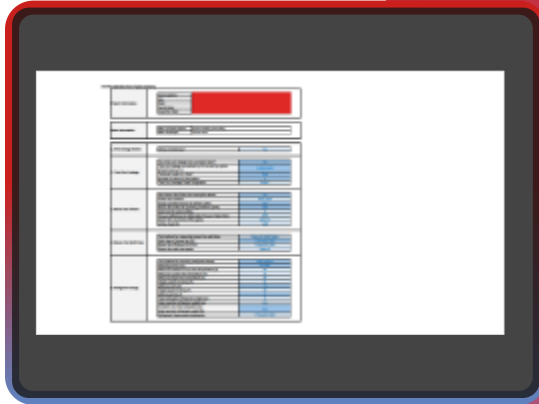




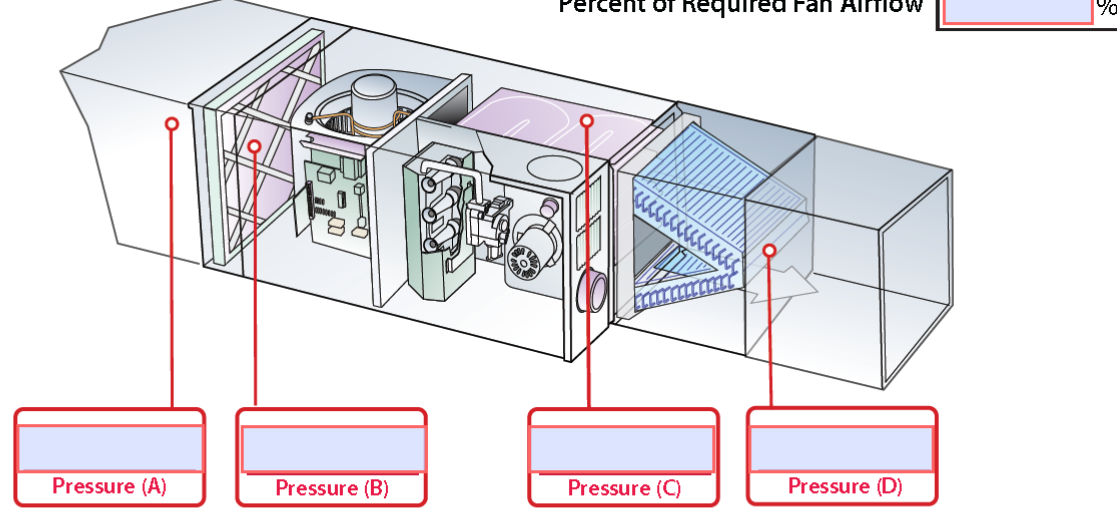
# Std 310 in Practice

*As a Diagnostic Tool*

Std 310 “Tasks” are clear indicators of where system failures are taking place







# Additional Information to be Collected

| Pressure Budgets - Residential Air Moving Equipment with an External Coil |                       |                   |                        |                        |                        |
|---|-----------------------|-------------------|------------------------|------------------------|------------------------|
|   | System Component      | Measured Pressure | .30 Fan Rated Pressure | .50 Fan Rated Pressure | .80 Fan Rated Pressure |
| A   | Return Duct           |                   | .06                    | .10                    | .16                    |
| B-A   | Filter $\Delta P$     |                   | .06                    | .10                    | .16                    |
| C-D   | Coil $\Delta P$       |                   | .12                    | .20                    | .32                    |
| D   | Supply Duct           |                   | .06                    | .10                    | .16                    |
| B+C   | Total External Static |                   | .30                    | .50                    | .80                    |

#### Typical Equipment Improvements

- ☒ Filter upgrades to reduce resistance
- ☒ Adjust fan speed setting
- ☒ Blower or Coil Cleaning
- ☒ Verify improved fan airflow

#### Typical Duct System Improvements

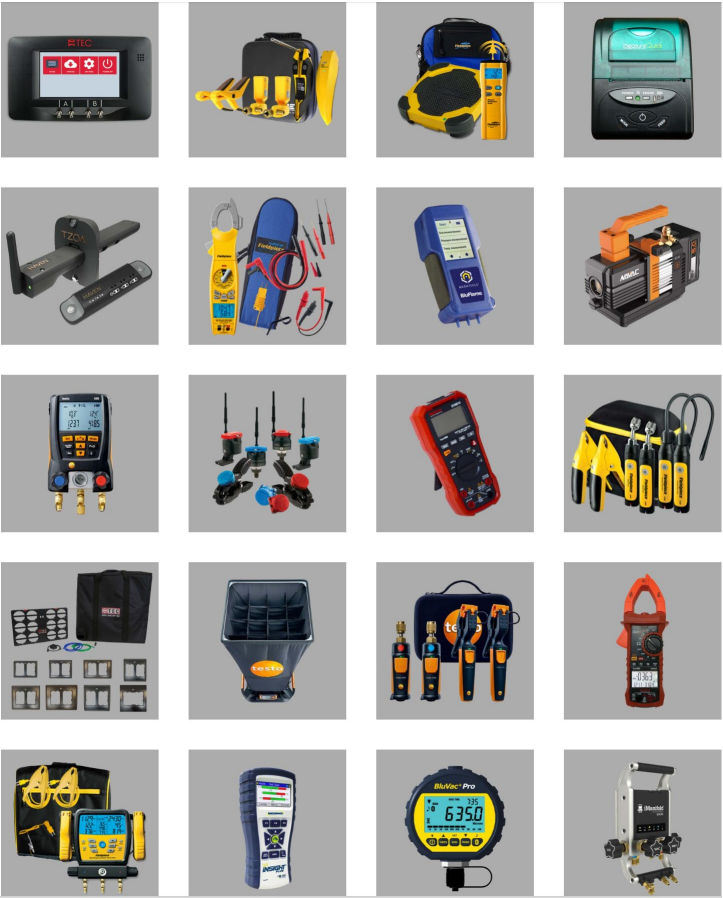
- ☒ Increase return duct capacity
- ☒ Increase supply duct capacity
- ☒ Basic duct modifications
- ☒ Reduce duct airflow loss

| Comments |
|----------|
|          |
|          |
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Measurement and Reporting Options

# Probe and App Use



Wirelessly Complete Most Tasks



Uniformed Measurement and Reporting



No Data Lost in Between Visits

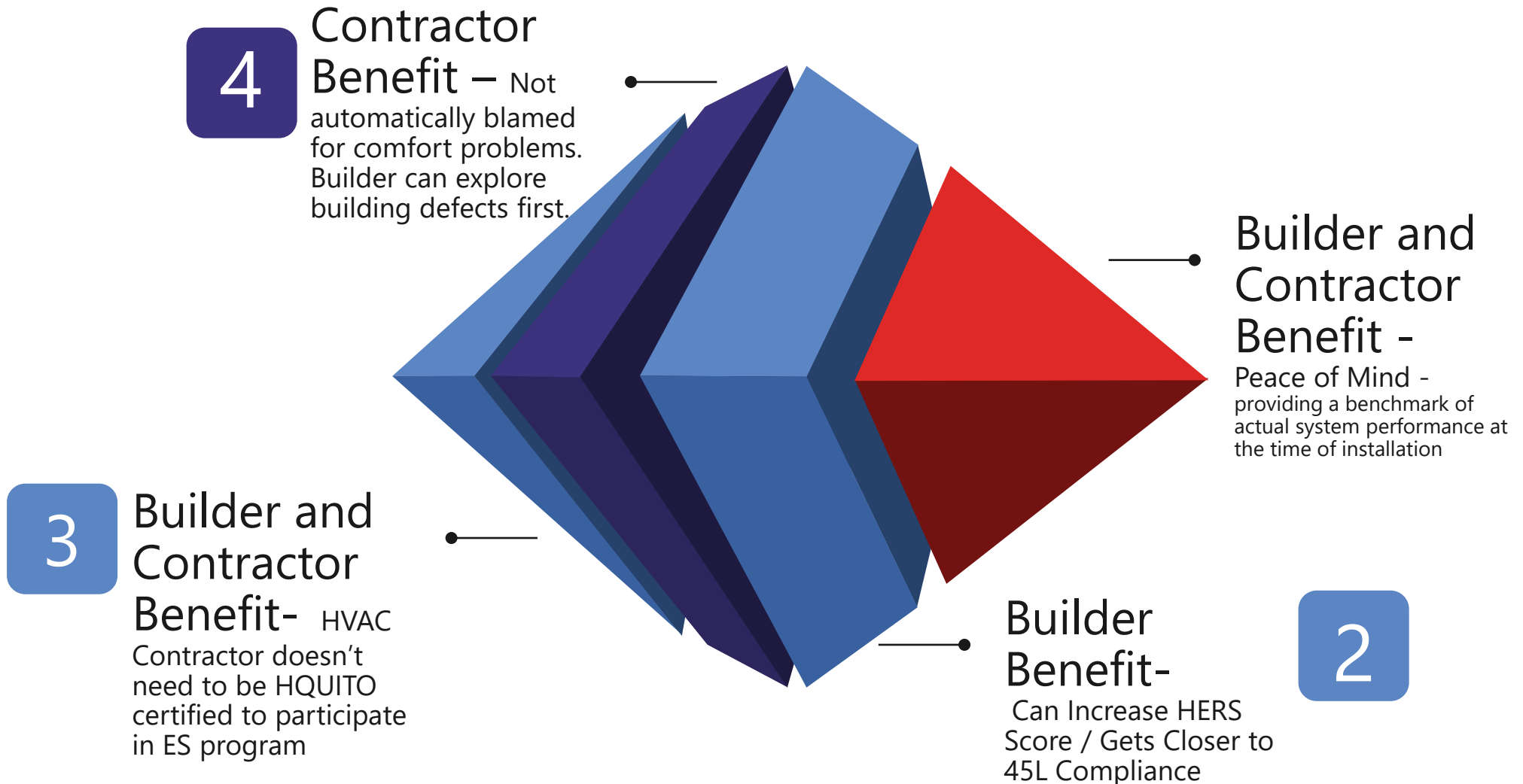


Live QA for Client or Program



# Benefits to Contractors and

What you Should Love  
**Builders**





# THANK YOU

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**FINISH**

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## WHAT IS TRUE RESIDENTIAL HVAC DESIGN & COMMISSIONING WHAT STANDARDS APPLY?

---



**Jeremy Begley & Paul Yankie**

CEUS - AIA | LEED | BPI



AIA Number: 50111106





PROJECT NAME: 501 Milton      NUMBER OF ZONES: 4

EQUIPMENT SPECIFICATION: MITSUBISHI ELECTRIC

DESIGN PARAMATERS: ENERGY STAR/LEED FOR HOMES PLATINUM

| Equipment Model Number | Quantity | Zone and Equipment Type                 |
|------------------------|----------|---|
| MXZ-8C48NAHZ2          | 1        | Level 1 AND 2 OUTDOOR CONDENSING UNIT   |
| MXZ-3C24NAHZ2          | 1        | LL B2 AND LL B1 OUTDOOR CONDENSING UNIT |
| PAC-MKA30BC            | 1        | INDOOR BRANCH BOX                       |
| SVZ-KP12NA             | 2        | LEVEL1 AND 2 INDOOR AHU                 |
| PEAD-A09AA7            | 2        | LL B2 AND LL B1 AHU                     |
| PAC-USWHS002-WF-2      | 4        | KUMO CLOUD WIRELESS INTERFACE           |
| PAC-WHS01HC-E          | 1        | KUMO STATION                            |
| PAC-USWHS003-TH-1      | 4        | WIRELESS TEMPERATURE & HUMIDITY SENSOR  |
| C7089U1006/U           | 1        | OUTDOOR AIR TEMPERATURE SENSOR          |
| SANTA FE ULTRA 70      | 4        | DEHUMIDIFIER PER ZONE                   |



## INSTALLTION INSTRUCTIONS: 1<sup>st</sup> Floor System

### Airflow Settings:

| SERVICE AND TECHNICAL SUPPORT MANUAL              |                       |              |                                    |      |      |      |      |      |      |
|---|-----------------------|--------------|------------------------------------|------|------|------|------|------|------|
| Gas Furnace: (F-G)9MXE                            |                       |              |                                    |      |      |      |      |      |      |
| Table 5 COOLING AIR DELIVERY - CFM (With Filter ) |                       |              |                                    |      |      |      |      |      |      |
| UNIT SIZE   | RETURN/AIR CONNECTION | SPEED TAP/IN | EXTERNAL STATIC PRESSURE (IN.W.C.) |      |      |      |      |      |      |
|   |                       |              | 0.1                                | 0.2  | 0.3  | 0.4  | 0.5  | 0.6  | 0.8  |
| 0401410   | SIDE/BOTTOM           | Gray         | 1120                               | 1080 | 1030 | 980  | 925  | 875  | 820  |
|   |                       | Yellow       | 880                                | 840  | 810  | 780  | 740  | 710  | 680  |
|   |                       | Blue         | 680                                | 660  | 630  | 610  | 590  | 560  | 540  |
|   |                       | Orange       | 640                                | 620  | 600  | 580  | 560  | 540  | 520  |
|   |                       | Red          | 610                                | 590  | 570  | 550  | 530  | 510  | 490  |
| 0401712   | SIDE/BOTTOM           | Gray         | 1255                               | 1220 | 1175 | 1130 | 1085 | 1040 | 990  |
|   |                       | Yellow       | 940                                | 905  | 870  | 840  | 805  | 770  | 735  |
|   |                       | Blue         | 705                                | 670  | 630  | 610  | 590  | 560  | 540  |
|   |                       | Orange       | 660                                | 635  | 600  | 575  | 550  | 525  | 500  |
|   |                       | Red          | 625                                | 600  | 575  | 550  | 525  | 500  | 475  |
| 0401412   | SIDE/BOTTOM           | Gray         | 1285                               | 1225 | 1185 | 1140 | 1090 | 1050 | 975  |
|   |                       | Yellow       | 1115                               | 1085 | 1050 | 1020 | 970  | 920  | 880  |
|   |                       | Blue         | 945                                | 915  | 885  | 855  | 820  | 785  | 745  |
|   |                       | Orange       | 910                                | 880  | 850  | 820  | 785  | 745  | 705  |
|   |                       | Red          | 875                                | 845  | 815  | 785  | 745  | 705  | 665  |
| 0401714   | SIDE/BOTTOM           | Gray         | 1720                               | 1670 | 1620 | 1565 | 1505 | 1440 | 1375 |
|   |                       | Yellow       | 1325                               | 1285 | 1255 | 1220 | 1185 | 1145 | 1105 |
|   |                       | Blue         | 1010                               | 970  | 935  | 905  | 875  | 845  | 815  |
|   |                       | Orange       | 1160                               | 1115 | 1080 | 1045 | 1000 | 960  | 920  |
|   |                       | Red          | 1120                               | 1075 | 1040 | 1000 | 960  | 920  | 880  |

Return Connection: Side Connection Filter Size: 25" x 25" x1"

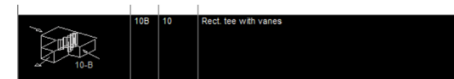
Design Static: 0.70 Design Airflow: 1115 CFM Speed Tap: Yellow

### Duct Instructions:

\*ALL DUCT TAKEOFFS FROM MAIN TRUNK LINES DESIGNED WITH TRANSITION FITTINGS TO INCREASE AIRFLOW\*



\* ALL RETURN T-FITTINGS DESIGNED WITH TURNING VANES TO INCREASE AIRFLOW\*

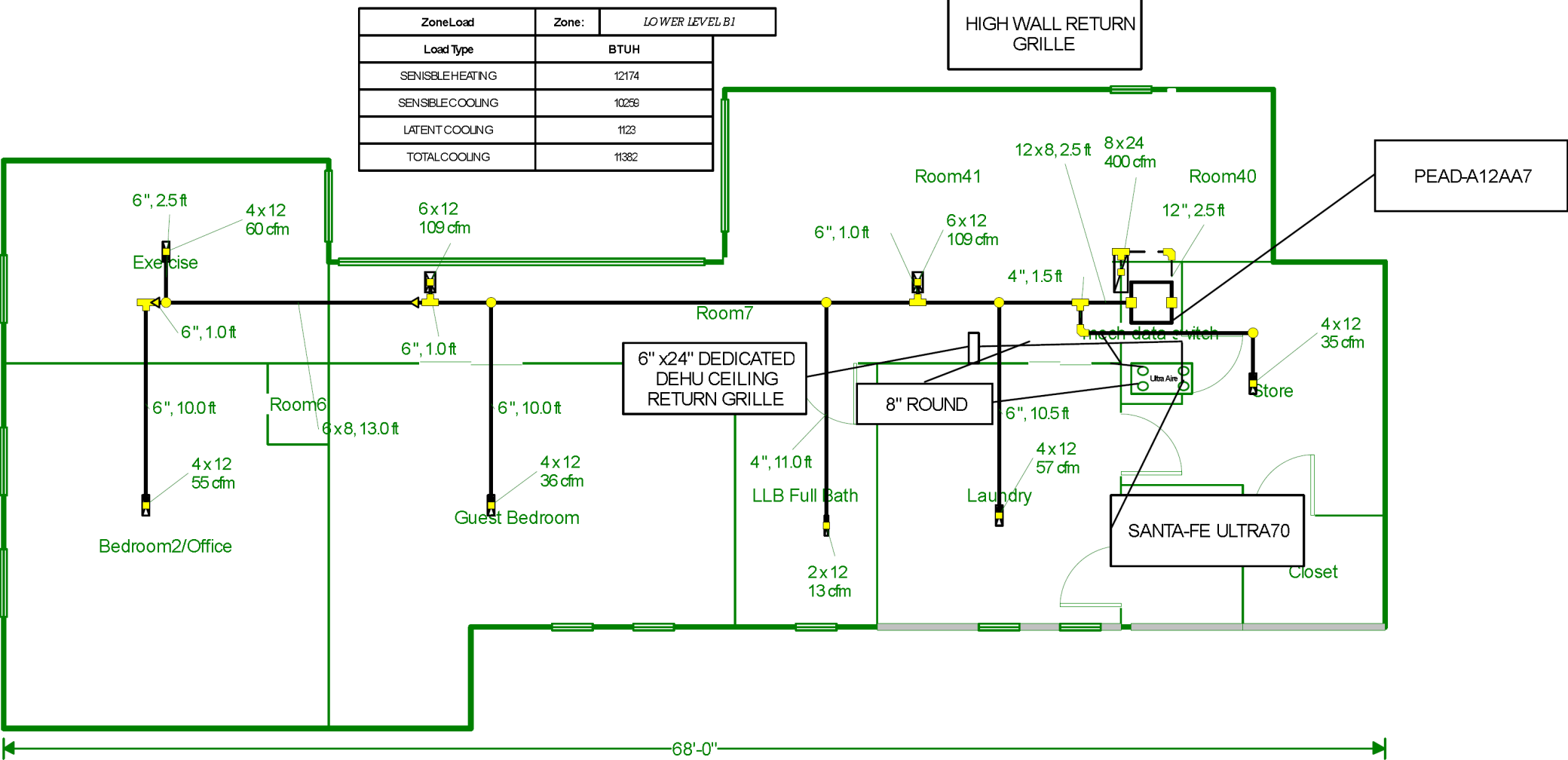


### Ventilation Settings:

ASHRAE 62.2.2019 Ventilation Rate: 91 CFM Continuous



Lower level B1







## Project Summary Entire House HVAC Design Partners

Job:  
Date: Dec 01, 2020  
By:

1401 Main, Cincinnati, OH 45202 Phone 513-455-4500 Email: jpeddy@hvacdesignpartners.com Web: www.hvacdesignpartners.com

### Project Information

Notes: 3219 Golden Single Zone Single System, Ventilating Dehumidifier, 2nd fr ducts in the attic

### Design Information

Weather: Cincinnati Municipal Lunken, OH, US

#### Winter Design Conditions

Outside db 14 °F  
Inside db 70 °F  
Design TD 56 °F

#### Summer Design Conditions

Outside db 90 °F  
Inside db 75 °F  
Design TD 15 °F  
Daily range M  
Relative humidity 50 %  
Moisture difference 38 gr/s

#### Heating Summary

Structure 20597 Btuh  
Ducts 2233 Btuh  
Central vent (88 db) 4728 Btuh  
Ventilating dehumidifier 0 Btuh  
Humidification 0 Btuh  
Piping 0 Btuh  
Equipment load 36047 Btuh

#### Sensible Cooling Equipment Load Sizing

Structure 22126 Btuh  
Ducts 2255 Btuh  
Central vent (88 db) 2210 Btuh  
Ventilating dehumidifier 0 Btuh  
Blower 0 Btuh  
Use manufacturer's data  
Rateterminator multiplier 1.00  
Equipment sensible load 26591 Btuh

#### Infiltration

Method Blower door  
Shielding / stories 3 (partial) / 3  
Pressure (AVF) 50 Pa / 1394 db

#### Latent Cooling Equipment Load Sizing

Structure 1766 Btuh  
Ducts 67 Btuh  
Central vent (88 db) 1006 Btuh  
Ventilating dehumidifier 2929 Btuh  
Equipment latent load (Sens+Lat) 28520 Btuh  
Req. total capacity at 0.50 SHR 2.5 ton

#### Heating

Area (ft²) 3028  
Volume (ft³) 27882  
Air changes/hour 0.36  
Equip. AVF (db) 0.18  
Cooling 3028  
27882  
0.36  
37

#### Heating Equipment Summary

Make Tempstar  
Trade 2 Stage Communicating Furnace  
Model 96VTN0601714A  
AHRI ref 204791506

#### Cooling Equipment Summary

Make Tempstar  
Trade 14 SEER N SERIES R410A AC  
Cond N4A3G3CKB1\*\*  
Coil END4X42L17-96VTN0601714A  
AHRI ref 204791506

Efficiency 96 AFUE  
Heating input 60000 Btuh  
Heating output 57000 Btuh  
Temperature rise 48 °F  
Actual air flow 1110 cfm  
Air flow factor 0.035 cfm/Btuh  
Static pressure 0.70 in H<sub>2</sub>O  
Load sensible heat ratio 0.90



## Load Short Form Entire House HVAC Design Partners

Job:  
Date: Dec 01, 2020  
By:

1401 Main, Cincinnati, OH 45202 Phone 513-455-4500 Email: jpeddy@hvacdesignpartners.com Web: www.hvacdesignpartners.com

### Project Information

### Design Information

|                            | Htg | Cig | Method              | Infiltration | Blower door     |
|----------------------------|-----|-----|---------------------|--------------|-----------------|
| Outside db (°F)            | 14  | 90  |                     |              | 3 (partial) / 3 |
| Inside db (°F)             | 70  | 75  | Shielding / stories |              | 50 Pa / 1394 db |
| Design TD (°F)             | 56  | 15  | Pressure / AVF      |              |                 |
| Daily range                | -   | M   |                     |              |                 |
| Inside humidity (%)        | 50  | 50  |                     |              |                 |
| Moisture difference (gr/s) | 47  | 38  |                     |              |                 |

#### HEATING EQUIPMENT

Make Tempstar  
Trade 2 Stage Communicating Furnace  
Model 96VTN0601714A  
AHRI ref 204791506

#### COOLING EQUIPMENT

Make Tempstar  
Trade 14 SEER N SERIES R410A AC  
Cond N4A3G3CKB1\*\*  
Coil END4X42L17-96VTN0601714A  
AHRI ref 204791506

Efficiency 96 AFUE  
Heating input 60000 Btuh  
Heating output 57000 Btuh  
Temperature rise 48 °F  
Actual air flow 1110 cfm  
Air flow factor 0.035 cfm/Btuh  
Static pressure 0.70 in H<sub>2</sub>O  
Space thermostat 0.90

| ROOM NAME      | Area (ft²) | Htg load (Btuh) | Cig load (Btuh) | Htg AVF (db) | Cig AVF (db) |
|----------------|------------|-----------------|-----------------|--------------|--------------|
| Closet         | 15         | 0               | 0               | 0            | 0            |
| PR             | 0          | 0               | 0               | 0            | 0            |
| Office         | 163        | 2349            | 1240            | 82           | 56           |
| Dining Room    | 162        | 709             | 111             | 25           | 5            |
| Kitchen        | 210        | 2175            | 2386            | 78           | 109          |
| Chase          | 5          | 0               | 0               | 0            | 0            |
| Living Room    | 338        | 3056            | 3787            | 106          | 172          |
| 1st stairs     | 104        | 0               | 0               | 0            | 0            |
| DS             | 5          | 0               | 0               | 0            | 0            |
| Foyer/hallway  | 102        | 2577            | 1362            | 90           | 59           |
| Master Bedroom | 223        | 2381            | 2392            | 104          | 135          |
| Master Ensuite | 169        | 2240            | 1498            | 78           | 68           |
| Master VAC     | 83         | 1382            | 979             | 48           | 45           |
| Laundry Room   | 67         | 526             | 748             | 18           | 34           |

Buildings values have been manually overridden.

Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.



RightSoft/Entire 2021 21.0.02 R5.02248  
Golden Setup-equip and ducts down to final cap. Calc = MBR. Print Door faces: N

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Page 1



## Manual S Compliance Report Entire House HVAC Design Partners

Job:  
Date: Dec 01, 2020  
By:

1401 Main, Cincinnati, OH 45202 Phone 513-455-4500 Email: jpeddy@hvacdesignpartners.com Web: www.hvacdesignpartners.com

### Project Information

### Cooling Equipment

#### Design Conditions

Outdoor design DB: 90.1°F  
Outdoor design WB: 74.3°F  
Indoor design DB: 75.0°F  
Indoor RH: 50%

Sensible gain: 26591 Btuh  
Latent gain: 2929 Btuh  
Total gain: 29520 Btuh  
Estimated airflow: 1110 cfm

Entering coil DB: 77.4°F  
Entering coil WB: 63.6°F

#### Manufacturer's Performance Data at Actual Design Conditions

Equipment type: Split AC  
Manufacturer: Tempstar  
Actual airflow: 1110 cfm  
Sensible capacity: 27390 Btuh  
Latent capacity: 5425 Btuh  
Total capacity: 32795 Btuh

Model: N4A3G3CKB1\*\*END4X42L17-96VTN0601714A  
103% of load  
185% of load  
111% of load, SHR: 84%

### Heating Equipment

#### Design Conditions

Outdoor design DB: 13.8°F  
Indoor design DB: 70.0°F

Heat loss: 36047 Btuh

Entering coil DB: 66.1°F

#### Manufacturer's Performance Data at Actual Design Conditions

Equipment type: Gas furnace  
Manufacturer: Tempstar  
Actual airflow: 1110 cfm  
Output capacity: 57000 Btuh

Model: 96VTN0601714A  
160% of load

Temp. rise: 0 °F

Meets all requirements of ACCA Manual S.



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Golden Setup-equip and ducts down to final cap. Calc = MBR. Print Door faces: N

2020 Dec 11 15:47:09  
Page 1



## Duct System Summary Entire House HVAC Design Partners

Job:  
Date: Dec 01, 2020  
By:

1401 Main, Cincinnati, OH 45202 Phone 513-455-4500 Email: jpeddy@hvacdesignpartners.com Web: www.hvacdesignpartners.com

### Project Information

### Supply Branch Detail Table

| Name            | Design (Btuh) | Htg (db) | Cig (db) | Design FR | Diam (in) | HxW (in) | Duct Mat | Actual Ln (ft) | Fig. Eqv Ln (ft) | Trunk |
|-----------------|---------------|----------|----------|-----------|-----------|----------|----------|----------------|------------------|-------|
| Bedroom 2       | h 2908        | 101      | 76       | 0.073     | 7.0       | 0x0      | Shift    | 46.0           | 115.0            | #15   |
| Bedroom 3       | h 3385        | 118      | 101      | 0.074     | 7.0       | 0x0      | Shift    | 32.5           | 125.0            | #15A  |
| Break Room      | h 2390        | 83       | 79       | 0.082     | 6.0       | 0x0      | Shift    | 27.0           | 160.0            | #5A   |
| Dining Room     | h 709         | 25       | 5        | 0.092     | 4.0       | 0x0      | Shift    | 17.0           | 110.0            | #3    |
| Fin Space       | h 3506        | 122      | 88       | 0.073     | 7.0       | 0x0      | Shift    | 31.0           | 130.0            | #5    |
| Foyer/Hallway A | h 2577        | 90       | 59       | 0.083     | 6.0       | 0x0      | Shift    | 30.5           | 110.0            | #5A   |
| Full Bath       | h 505         | 18       | 4        | 0.102     | 4.0       | 0x0      | Shift    | 15.0           | 100.0            | #5    |
| Hall/Bath       | h 1670        | 36       | 76       | 0.079     | 6.0       | 0x0      | Shift    | 23.5           | 125.0            | #15   |
| Kitchen         | c 2386        | 76       | 109      | 0.073     | 7.0       | 0x0      | Shift    | 29.0           | 130.0            | #5    |
| Laundry Room    | c 748         | 18       | 34       | 0.076     | 5.0       | 0x0      | Shift    | 29.5           | 125.0            | #14   |
| Living Room     | c 1893        | 53       | 86       | 0.092     | 7.0       | 0x0      | Shift    | 28.5           | 160.0            | #5A   |
| Living Room A   | c 1893        | 53       | 86       | 0.073     | 6.0       | 0x0      | Shift    | 31.0           | 130.0            | #5    |
| Master Bedroom  | c 1486        | 52       | 68       | 0.085     | 6.0       | 0x0      | Shift    | 29.0           | 150.0            | #14B  |
| Master Bedroom  | c 1486        | 52       | 68       | 0.084     | 6.0       | 0x0      | Shift    | 31.5           | 150.0            | #14   |
| Master Ensuite  | h 2240        | 78       | 68       | 0.081     | 6.0       | 0x0      | Shift    | 32.0           | 160.0            | #14A  |
| Master VAC      | h 1382        | 48       | 45       | 0.078     | 5.0       | 0x0      | Shift    | 20.5           | 130.0            | #14   |
| Mechanical Room | h 206         | 7        | 3        | 0.142     | 4.0       | 0x0      | Shift    | 7.5            | 75.0             | #5    |
| Office          | h 2349        | 82       | 56       | 0.091     | 6.0       | 0x0      | Shift    | 29.0           | 100.0            | #5    |

Buildings values have been manually overridden.



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Golden Setup-equip and ducts down to final cap. Calc = MBR. Print Door faces: N

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Page 1





ENERGY STAR Single-Family New Homes, All Versions (Rev. 11)  
ENERGY STAR Multifamily New Construction, All Versions (Rev. 02)  
National HVAC Design Supplement to Std. 310 for Dwellings & Units

|   |                |       |  |
|---|----------------|-------|--|
| <b>1. Design Basis</b>  |                |       |  |
| 1.1 Design description (optional):  |                |       |  |
| 1.2 Designer company:   | Designer name: | Date: |  |
| <b>2. Dwelling Unit Mechanical Ventilation System Design ("Vent System") Inlets in Return Duct</b>  |                |       |  |
| Verified <input type="checkbox"/> N/A <input type="checkbox"/>  |                |       |  |
| <b>Airflow:</b>   |                |       |  |
| 2.1 Ventilation airflow design rate & run-time for each Vent System meets ASHRAE 62.2-2010 or later edition.  |                |       |  |
| 2.2 Access point is specified for Rater to measure ventilation airflow rate and inspect any motorized / shutoff dampers.  |                |       |  |
| <b>System Controls:</b>   |                |       |  |
| 2.3 Specified controls for each Vent System allow it to operate automatically, without occupant intervention.   |                |       |  |
| 2.4 Specified controls for each Vent System include a readily-accessible override & a label has also been specified if its function is not obvious (e.g., a label is required for a toggle wall switch, but not for a switch that's on the vent, equip.). |                |       |  |
| 2.5 For any outdoor air inlet designed to connect to a ducted return of the HVAC system, specified controls automatically restrict airflow using a motorized damper during ventilation off-cycle and occupant override.                                   |                |       |  |
| Sound: 2.6 Specified fan of each Vent System is rated ≤ 3 sones if intermittent and ≤ 1 sone if continuous, or exempted.  |                |       |  |
| <b>Efficiency:</b> Complete if Vent System controller operates HVAC fan or Vent System uses both fans; otherwise, check "N/A".  |                |       |  |
| 2.7 If Vent System controller operates the HVAC fan, then HVAC fan operation is intermittent and either fan type in HVAC design report is ECM or controls will reduce the run-time by accounting for HVAC system heating or cooling hours.                |                |       |  |
| 2.8 If bathroom fans are specified as part of any Vent System, then they are ENERGY STAR certified.   |                |       |  |
| 2.9 MFNC Only: If central exhaust fans are specified as part of the Vent System, then if ≤ 1 HP, they are direct-drive, ECM, with variable speed controllers; and if > 1 HP, they are specified with NEMA Premium™ Motors or equivalent.                  |                |       |  |
| <b>Air Inlet Location:</b> Complete this section if system has a specified air inlet location; otherwise, check "N/A".  |                |       |  |
| 2.10 Inlet(s) pull ventilation air directly from outdoors and not from attic, crawlspaces, garage, or adjacent dwelling unit.   |                |       |  |
| 2.11 Inlet(s) are ≥ 2 ft. above grade or roof deck; ≥ 10 ft. of stretched-string distance from known contamination sources (e.g., stack, vent, exhaust, vehicles) not exiting the roof, and ≥ 3 ft. from known sources exiting the roof.                  |                |       |  |
| 2.12 Inlet(s) are provided with rodent / insect screen with ≤ 0.5 inch mesh.  |                |       |  |
| <b>3. Dwelling Unit Local Mechanical Exhaust Design</b>   |                |       |  |
| 3.1 System(s) are designed that mechanically exhaust air from each dwelling unit kitchen and bathroom directly to the outdoors or to ventilation fans and meet the requirements in Table 1.   |                |       |  |
| <b>Kitchens:</b> Runtime: <input type="checkbox"/> Continuous <input type="checkbox"/> Intermittent Dwelling Units Served by Fan: <input type="checkbox"/> Single Unit <input type="checkbox"/> Multiple Units  |                |       |  |
| <b>Bathrooms:</b> Runtime: <input type="checkbox"/> Continuous <input type="checkbox"/> Intermittent Dwelling Units Served by Fan: <input type="checkbox"/> Single Unit <input type="checkbox"/> Multiple Units   |                |       |  |
| <b>4. Heating Equipment, Cooling Equipment, &amp; Equipment Controls Selection</b>  |                |       |  |
| 4.1 MFNC Only: If using Prescriptive Path, equipment serving dwelling units meet the efficiency levels specified in Exhibit X of the National Rater Field Checklist; have programmable thermostatic controls, & do not use electric resistance heating.   |                |       |  |
| 4.2 MFNC Only: Thermostatic controls for systems serving a dwelling unit are within the unit and not located on exterior walls. If more than one system provides heating or cooling to the same space, controls prevent simultaneous operation.           |                |       |  |
| <b>Air Conditioners &amp; Heat Pumps</b> If none will be installed, check "N/A".  |                |       |  |
| 4.3 Unique name or ID for each system:  |                |       |  |
| 4.4 Maximum sensible and total heat gain load of zone served (kBtu/h):  |                |       |  |
| 4.5 Sensible, latent, & total cooling capacity at design conditions (kBtu/h):   |                |       |  |
| 4.6 If HP, heating capacity at 17°F and at 47°F (kBtu/h):   |                |       |  |
| 4.7 Compressor speed type:  |                |       |  |
| 4.8 Cooling sizing % & applicable sizing limit key from Table 2:  |                |       |  |
| 4.9 If C2 chosen in Item 4.8, load sensible heat ratio & HDD / CDD ratio:   |                |       |  |
| 4.10 Affirm that cooling sizing % is within cooling sizing limit (4.14):  |                |       |  |
| <b>Furnaces:</b> If none will be installed, check "N/A".  |                |       |  |
| 4.11 Unique name or ID for each system:   |                |       |  |
| 4.12 Total heat loss load of zone served (kBtu/h):  |                |       |  |
| 4.13 Total heating capacity (kBtu/h):   |                |       |  |
| 4.14 Heating sizing % & applicable sizing limit key from Table 3:   |                |       |  |
| 4.15 Affirm that heating sizing % is within heating sizing limit (4.14):  |                |       |  |
| <b>5. Duct Design</b> 5.1 All duct requirements in Table 4 have been included in the design, where applicable.  |                |       |  |



Right Suite® Universal 2022 22 0 04 RSU02248  
I:\Documents\wrightsoft\HAC3\template\data\std.ctd Calc = MJB Front Door faces N

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Page 1

## ANSI / RESNET / ACCA 310 HVAC Design Report (1,2)

|  |  |  |  |  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|--|--|--|--|
| <b>1. Design Basis &amp; Architectural Scope</b>   |  |  |  |  |  |  |  |  |  |  |  |
| 1.1 Design description (optional):   |  |  |  |  |  |  |  |  |  |  |  |
| 1.2 Design company:  |  |  |  |  |  |  |  |  |  |  |  |
| 1.3 Software name and version used to complete design:                                     |  |  |  |  |  |  |  |  |  |  |  |
| Right Suite® Universal 2022 22 0 04 RSU02248 N/A   |  |  |  |  |  |  |  |  |  |  |  |
| For a Dwelling, Townhouse, or Dwelling / Sleeping Unit Within (i.e. duplex):               |  |  |  |  |  |  |  |  |  |  |  |
| 1.4 Architectural plan name or address of property:  |  |  |  |  |  |  |  |  |  |  |  |
| 1.5 Architectural options used in the design (3):  |  |  |  |  |  |  |  |  |  |  |  |
| 1.6 Other architectural options that the design can be used with (4):                      |  |  |  |  |  |  |  |  |  |  |  |
| For a Dwelling / Sleeping Unit Not Within a Dwelling or Townhouse (e.g. condo, apartment): |  |  |  |  |  |  |  |  |  |  |  |
| 1.7 Unique ID for bldg. that the dwelling / sleeping unit is in (5):                       |  |  |  |  |  |  |  |  |  |  |  |
| 1.8 Architectural plan used in design (e.g. dwelling unit model):                          |  |  |  |  |  |  |  |  |  |  |  |
| 1.9 Other architectural plans that the design can be used with (6):                        |  |  |  |  |  |  |  |  |  |  |  |
| 1.10 Architectural options used in the design (3):   |  |  |  |  |  |  |  |  |  |  |  |
| 1.11 Other architectural options that the design can be used with (4):                     |  |  |  |  |  |  |  |  |  |  |  |
| 1.12 Dwelling / sleeping unit location used in design (7):                                 |  |  |  |  |  |  |  |  |  |  |  |
| <b>2. Dwelling Unit Mechanical Ventilation System Design</b>                               |  |  |  |  |  |  |  |  |  |  |  |
| Ventilation System Type & Control Location:  |  |  |  |  |  |  |  |  |  |  |  |
| System 1 System 2 System 3   |  |  |  |  |  |  |  |  |  |  |  |
| 2.1 Unique name or ID for each system (8):   |  |  |  |  |  |  |  |  |  |  |  |
| 2.2 Vent. equipment manufacturer & model # (9):  |  |  |  |  |  |  |  |  |  |  |  |
| 2.3 Specified system type (10):  |  |  |  |  |  |  |  |  |  |  |  |
| 2.4 Specified control location (11):   |  |  |  |  |  |  |  |  |  |  |  |
| 2.5 Ventilation zone name(s) served by system (12):  |  |  |  |  |  |  |  |  |  |  |  |
| Zone 1 Zone 2 Zone 3   |  |  |  |  |  |  |  |  |  |  |  |
| <b>Ventilation Zone Served by Ventilation System:</b>                                      |  |  |  |  |  |  |  |  |  |  |  |
| 2.6 Ventilation zone name (12):  |  |  |  |  |  |  |  |  |  |  |  |
| 2.7 Design basis (13):   |  |  |  |  |  |  |  |  |  |  |  |
| 2.8 Floor area (sq. ft.) and # bedrooms in vent. zone:                                     |  |  |  |  |  |  |  |  |  |  |  |
| 2.9 Ventilation design airflow rate (CFM) (14):  |  |  |  |  |  |  |  |  |  |  |  |
| 2.10 Vent. runtime per cycle & cycle time (mins):  |  |  |  |  |  |  |  |  |  |  |  |
| 2.11 Time-averaged mechanical vent. rate (CFM) (15):                                       |  |  |  |  |  |  |  |  |  |  |  |
| <b>3. Heat Gain &amp; Heat Loss Loads</b>  |  |  |  |  |  |  |  |  |  |  |  |
| 3.1 Design basis for the loads (16):   |  |  |  |  |  |  |  |  |  |  |  |
| 3.2 Load methodology (17):   |  |  |  |  |  |  |  |  |  |  |  |
| Single Block   |  |  |  |  |  |  |  |  |  |  |  |
| 3.3 Indoor design temperatures used in loads (°F):   |  |  |  |  |  |  |  |  |  |  |  |
| Heating Season: 70 Cooling Season: 75  |  |  |  |  |  |  |  |  |  |  |  |
| 3.4 Outdoor design temperatures used in loads (°F) (18):                                   |  |  |  |  |  |  |  |  |  |  |  |
| Heating Season: 17 Cooling Season: 81  |  |  |  |  |  |  |  |  |  |  |  |
| 3.5 Outdoor design temperature location & data source (19):                                |  |  |  |  |  |  |  |  |  |  |  |
| District of Columbia, DC Data Source:  |  |  |  |  |  |  |  |  |  |  |  |
| <b>Zone-Specific Inputs &amp; Loads at Design Conditions</b>                               |  |  |  |  |  |  |  |  |  |  |  |
| Zone 1 Zone 2 Zone 3   |  |  |  |  |  |  |  |  |  |  |  |
| 3.6 Name of heated or cooled zone (20):  |  |  |  |  |  |  |  |  |  |  |  |
| Entire House   |  |  |  |  |  |  |  |  |  |  |  |
| 3.7 Occupants & total occup. internal gains (Btu/h) (21):                                  |  |  |  |  |  |  |  |  |  |  |  |
| 0 0  |  |  |  |  |  |  |  |  |  |  |  |
| 3.8 Total non-occupant internal gains (Btu/h):   |  |  |  |  |  |  |  |  |  |  |  |
| 0  |  |  |  |  |  |  |  |  |  |  |  |
| 3.9 Conditioned floor area (sq. ft.) (22):   |  |  |  |  |  |  |  |  |  |  |  |
| 0  |  |  |  |  |  |  |  |  |  |  |  |
| 3.10 Window area (sq. ft.) (23):   |  |  |  |  |  |  |  |  |  |  |  |
| 0  |  |  |  |  |  |  |  |  |  |  |  |
| 3.11 Predominant window SHGC (24):   |  |  |  |  |  |  |  |  |  |  |  |
| 0.0  |  |  |  |  |  |  |  |  |  |  |  |
| 3.12 Predominant insulation nominal R-value (24.25):                                       |  |  |  |  |  |  |  |  |  |  |  |
| 0.0  |  |  |  |  |  |  |  |  |  |  |  |
| 3.13 Infiltration rate (Qualitative or ACH50) (26):  |  |  |  |  |  |  |  |  |  |  |  |
| Average  |  |  |  |  |  |  |  |  |  |  |  |
| 3.14 Time-averaged mechanical vent. rate (CFM):  |  |  |  |  |  |  |  |  |  |  |  |
| 0  |  |  |  |  |  |  |  |  |  |  |  |
| 3.15 Heat gain (kBtu/h) (27):  |  |  |  |  |  |  |  |  |  |  |  |
| Sensible Latent Total Sensible Latent Total Sensible Latent Total                          |  |  |  |  |  |  |  |  |  |  |  |
| N 0.0 0.0 0.0  |  |  |  |  |  |  |  |  |  |  |  |
| NE 0.0 0.0 0.0   |  |  |  |  |  |  |  |  |  |  |  |
| E 0.0 0.0 0.0  |  |  |  |  |  |  |  |  |  |  |  |
| SE 0.0 0.0 0.0   |  |  |  |  |  |  |  |  |  |  |  |
| S 0.0 0.0 0.0  |  |  |  |  |  |  |  |  |  |  |  |
| SW 0.0 0.0 0.0   |  |  |  |  |  |  |  |  |  |  |  |
| W 0.0 0.0 0.0  |  |  |  |  |  |  |  |  |  |  |  |
| NW 0.0 0.0 0.0   |  |  |  |  |  |  |  |  |  |  |  |
| 3.16 Maximum – minimum total heat gain (kBtu/h) (28):                                      |  |  |  |  |  |  |  |  |  |  |  |
| 0.0  |  |  |  |  |  |  |  |  |  |  |  |
| 3.17 Total heat loss (kBtu/h):   |  |  |  |  |  |  |  |  |  |  |  |
| 0.0  |  |  |  |  |  |  |  |  |  |  |  |



Right Suite® Universal 2022 22 0 04 RSU02248  
I:\Documents\wrightsoft\HAC3\template\data\std.ctd Calc = MJB Front Door faces N

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Page 2

## ANSI / RESNET / ACCA 310 HVAC Design Report (1,2)

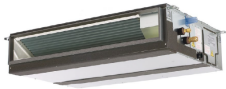
|   |  |                   |  |                   |  |                   |  |
|---|--|-------------------|--|-------------------|--|-------------------|--|
| <b>4. Heating &amp; Cooling Equipment Selection</b>   |  | 1                 |  | 2                 |  | 3                 |  |
| Air Conditioners, Heat Pumps, & Other Cooling Equipment (if none of these will be installed, check "N/A") |  | N/A               |  | N/A               |  | N/A               |  |
| 4.1 Unique name or ID for each system:  |  | Entire House      |  |                   |  |                   |  |
| 4.2 Zone that system serves (See Item 3.6):   |  | Entire House      |  |                   |  |                   |  |
| 4.3 Equipment type (29):  |  | AC                |  |                   |  |                   |  |
| 4.4 Evaporator / fan coil mfr. & model # (30):  |  |                   |  |                   |  |                   |  |
| 4.5 Condenser mfr. & model # (30):  |  | N/A               |  | N/A               |  | N/A               |  |
| 4.6 AHR ref. #, or check box for alt. OEM doc. (31):  |  | OEM               |  | OEM               |  | OEM               |  |
| 4.7 If AC / HP, rated cooling efficiency (32):  |  | 0 SEER            |  | N/A               |  | N/A               |  |
| 4.8 If HP, rated heating efficiency (33):   |  | N/A               |  | N/A               |  | N/A               |  |
| 4.9 If HP, ratio of max. to min. rated capacity:  |  | N/A               |  | N/A               |  | N/A               |  |
| 4.10 If AC / HP, blower fan motor & speed type (34):  |  | Other Single      |  | N/A               |  | N/A               |  |
| 4.11 If AC / HP, compressor speed type (35):  |  | Single            |  | N/A               |  | N/A               |  |
| 4.12 If AC / HP, meter device type (36):  |  | N/A               |  | N/A               |  | N/A               |  |
| 4.13 If TXV or EEV, OEM subcooling target (°F) (37):  |  | 0.0               |  | N/A               |  | N/A               |  |
| 4.14 Filter performance metric and rating (38):   |  | N/A               |  | N/A               |  | N/A               |  |
| Furnaces, Boilers, & Other Heating Equipment (if none of these will be installed, check "N/A")            |  | N/A               |  | N/A               |  | N/A               |  |
| 4.15 Unique name or ID for each system:   |  | Entire House      |  |                   |  |                   |  |
| 4.16 Zone that system serves (See Item 3.6):  |  | Entire House      |  |                   |  |                   |  |
| 4.17 Equipment type (39):   |  | Furnace           |  |                   |  |                   |  |
| 4.18 Equipment manufacturer & model #:  |  |                   |  |                   |  |                   |  |
| 4.19 AHR ref. #, or check box for alt. OEM doc. (31):   |  | OEM               |  | OEM               |  | OEM               |  |
| 4.20 If furnace or boiler, rated heating efficiency:  |  | 80 AFUE           |  | N/A               |  | N/A               |  |
| 4.21 If furnace, blower fan motor & speed type (34):  |  | Other Single      |  | N/A               |  | N/A               |  |
| 4.22 If furnace or boiler, heating capacity type (40):  |  | Single Stage      |  | N/A               |  | N/A               |  |
| 4.23 If furnace or boiler, venting type (41):   |  | N/A               |  | N/A               |  | N/A               |  |
| 4.24 Filter performance metric and rating (38):   |  | N/A               |  | N/A               |  | N/A               |  |
| <b>5. Duct Design (Complete if duct system will be installed; otherwise, check "N/A")</b>                 |  | N/A               |  | N/A               |  | N/A               |  |
| 5.1 Unique name or ID for each system:  |  | Entire House      |  |                   |  |                   |  |
| 5.2 Zone that system serves (See Item 3.6):   |  | Entire House      |  |                   |  |                   |  |
| Design Values for Cooling and Heating Mode  |  | Cooling Heating   |  | Cooling Heating   |  | Cooling Heating   |  |
| 5.3 Design blower fan airflow (CFM) (42):   |  | 0 0               |  |                   |  |                   |  |
| 5.4 Design blower fan speed setting (43):   |  | Medium Medium     |  |                   |  |                   |  |
| 5.5 Design external static pressure (INWG) (44):  |  | 0                 |  |                   |  |                   |  |
| 5.6 Room-by-room design airflows (CFM):   |  | Room Name Airflow |  | Room Name Airflow |  | Room Name Airflow |  |
| Total Design Airflow:   |  | [All rooms]       |  | [All rooms]       |  | [All rooms]       |  |
| 1.  |  |                   |  |                   |  |                   |  |
| 2.  |  |                   |  |                   |  |                   |  |
| 3.  |  |                   |  |                   |  |                   |  |
| 4.  |  |                   |  |                   |  |                   |  |
| 5.  |  |                   |  |                   |  |                   |  |
| 6.  |  |                   |  |                   |  |                   |  |
| 7.  |  |                   |  |                   |  |                   |  |
| 8.  |  |                   |  |                   |  |                   |  |
| 9.  |  |                   |  |                   |  |                   |  |
| 10.   |  |                   |  |                   |  |                   |  |
| 11.   |  |                   |  |                   |  |                   |  |
| 12.   |  |                   |  |                   |  |                   |  |
| 13.   |  |                   |  |                   |  |                   |  |
| 14.   |  |                   |  |                   |  |                   |  |
| 15.   |  |                   |  |                   |  |                   |  |
| 16.   |  |                   |  |                   |  |                   |  |
| 17.   |  |                   |  |                   |  |                   |  |
| 18.   |  |                   |  |                   |  |                   |  |
| 19.   |  |                   |  |                   |  |                   |  |
| 20.   |  |                   |  |                   |  |                   |  |



PEAD-A09AA7  
9,000 BTUH HORIZONTAL MID STATIC DUCTED



Job Name:  
System Reference: **LL B1,B2** Date:



- GENERAL FEATURES**
- Unobtrusive ceiling-concealed design for short-run ductwork
  - Wide ranging external static pressure (0.14-0.60 in. WDG)
  - Built-in condensate lift mechanism (up to 27'-0"16")
  - Auto fan speed mode
  - Optional F8 Series filter boxes for easy access and service
  - Ideal for residential homes, retail shopping centers, larger classrooms, office complexes, conference rooms, ballrooms, fitness centers, and more
  - Multiple control options available
    - kumo cloud\*smart device app for remote access
    - Third-party interface options
    - Wired or wireless controllers

| Specifications     |   | Unit Type          | System  |
|--------------------|---|--------------------|---|
| Cooling Capacity** |   | BTU/H              | PEAD-A09AA7                                     |
| Heating Capacity** |   | BTU/H              | 10,000  |
| Electrical         | Voltage, Phase, Frequency                   | VAC                | 208/230V, 1-Ø                                   |
|                    | Guaranteed Voltage Range                    | VAC                | 198-259V  |
|                    | Voltage: Indoor - Outdoor, S1-S2            | VAC                | 208/230   |
|                    | Voltage: Indoor - Outdoor, S2-S3            | VDC                | 24  |
|                    | Short-circuit Current Rating (SCCR)         | KA                 | 5   |
|                    | NEMA  | A                  | 1-45  |
|                    | Fan Motor Full Load Amperage                | A                  | 1.16  |
|                    | Fan Motor Output                            | W                  | 65  |
|                    | Airflow Rate at Cooling, Dry                | CFM                | 262-316-363                                     |
|                    | Airflow Rate at Cooling, Wet                | CFM                | 254-286-318                                     |
| Indoor Unit        | Airflow Rate at Heating, Dry                | CFM                | 265-315-363                                     |
|                    | Sound Pressure Level (Cooling)              | dB(A)              | 24-26-28  |
|                    | Sound Pressure Level (Heating)              | dB(A)              | 24-26-28  |
|                    | External Static Pressure                    | in.WDG             | 0.14-0.2-0.28-0.4-0.6                           |
|                    | Drain Pipe Size                             | in. (mm)           | 1/4 (32)  |
|                    | Condensate Lift Mechanism, Maximum Distance | in. (mm)           | 270 (6,905)                                     |
|                    | Coating on Heat Exchanger                   |                    | —   |
|                    | External Finish Color                       |                    | Optional  |
|                    | Unit Dimensions                             | W x D x H in. (mm) | 35-7/16 x 26-7/8 x 9-7/8 (900 x 732 x 250)      |
|                    | Package Dimensions                          | W x D x H in. (mm) | 45-5/16 x 34-11/16 x 13-7/16 (1150 x 880 x 341) |
| Refrigerant        | Unit Weight                                 | Lbs. (kg)          | 69 (31)   |
|                    | Package Weight                              | Lbs. (kg)          | 69 (31)   |
|                    | Type  |                    | R410A   |
| Piping             | Gas Pipe Size O.D. (Flare)                  | in. (mm)           | 5/8 (9.52)                                      |
|                    | Liquid Pipe Size O.D. (Flare)               | in. (mm)           | 1/4 (6.35)                                      |

NOTES:  
Conditions  
\*Capacity varies based on the number of indoor units operating and the model of the Multi-zone Outdoor Unit. For reference to connected capacity charts, please refer Multi-zone Outdoor Unit Operational Performance.

Specifications are subject to change without notice.

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► ULTRA SERIES **ULTRA120**



**PERFORMANCE**

|                       |   |
|-----------------------|---|
| Water Removal         | 121 Pints / 15.125 Gallons                                  |
| Efficiency            | 6.1 Pints/kWh   |
| Energy Factor         | 2.95 L/kWh  |
| Blower                | 350 CFM @ 0.0" WG<br>285 CFM @ 0.2" WG<br>210 CFM @ 0.4" WG |
| Operating Temperature | 49°F Min., 95°F Max.  |
| Sizing                | Up to 3,000 Sq. Ft. / 30,000 Cu. Ft.                        |

**ELECTRICAL**

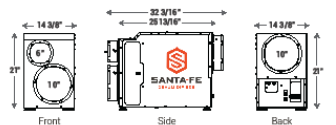
|                     |                             |
|---------------------|-----------------------------|
| Power               | 840 watts @ 80°F and 60% RH |
| Supply Voltage      | 115 volt – 1 phase – 60 Hz  |
| Current Draw        | 7.3 amps                    |
| Power Cord          | 9' 115 VAC Ground           |
| Circuit Requirement | 15 Amps                     |

**SPECIFICATIONS**

|                  |   |
|------------------|---|
| Duct Connections | 6" Round Inlet, 10" Round Inlet, 10" Round Outlet |
| Drain Connection | 3/4" Threaded Female NPT                          |
| Refrigerant      | R410A, 1 lb. 10 oz.                               |
| Unit Dimensions  | 14.375"W x 21"H x 32.1875"D                       |
| Unit Weight      | 91 lbs.   |

**SHIPPING**

|                     |                        |
|---------------------|------------------------|
| Shipping Dimensions | 18.5"W x 23.5"H x 40"D |
| Shipping Weight     | 101 lbs.               |
| Pallet Quantity     | 4 per pallet           |
| UPC Number          | 859029004656           |
| Shipping Options    | LTL                    |



Specifications are subject to change without notice. Performance is based on pints / gallons per day @ 80°F / 60% RH. Sizing is based on 15-foot ceiling height. Unit dimensions and weight are with outdoor air.

\* The Santa Fe Ultra120 was previously known as the Ultra Airc 1200.



THE **ULTRA120\***  
DELIVERS DEHUMIDIFIED  
VENTILATION AND FEATURES A  
HORIZONTAL CONFIGURATION TO  
FIT ANY ATTIC, BASEMENT OR  
CRAWL SPACE INSTALLATION.

MODEL 4031957

**FEATURES**

- + Features a horizontal configuration with optional vertical discharge
- + Designed for quiet operation
- + Engineered for low temperature operation providing comfort year round
- + Use of DEH 3000/R digital control for outdoor air ventilation and humidity control
- + Superior MERV-13 filtration to improve indoor air quality
- + Ducting option for fresh outdoor air ventilation
- + Push button reset for transformer protection



**BUILT TO LAST. BUILT TO PERFORM.**

214C  
Legacy™ Line Heat Pump  
with Puron® Refrigerant  
1 – 1/2 To 5 Nominal Tons



**Product Data**



on system for maximum reliability

**INDUSTRY LEADING  
FEATURES / BENEFITS**

**Efficiency**

- 14 SEER
- Microtune Technology™ refrigeration system
- Indoor air quality accessories available

**Sound**

- Sound level as low as 69 dBA
- Sound levels as low as 68 dBA with accessory sound blanket

**Comfort**

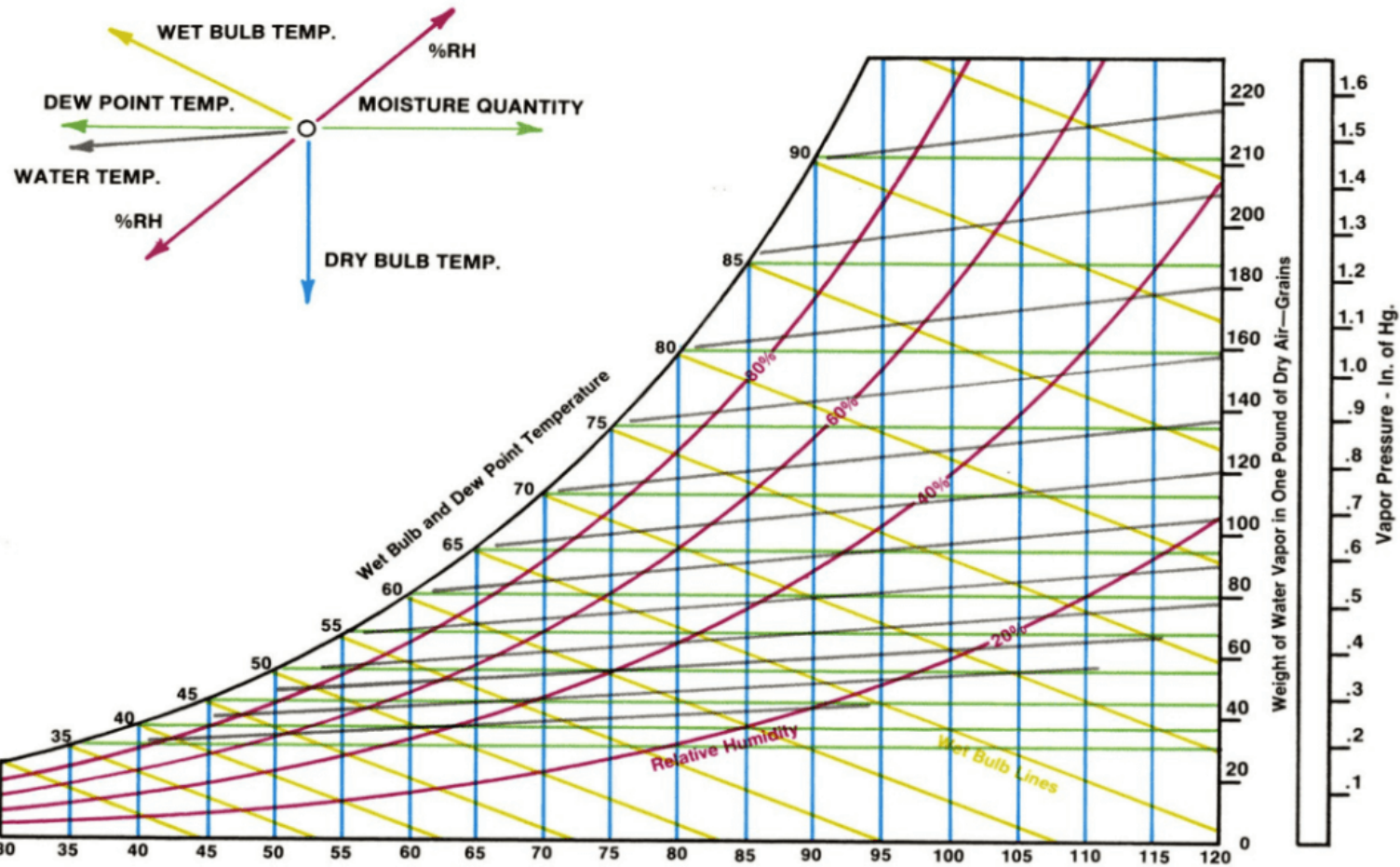
- System supports Thermostat™ or standard thermostat controls

**Reliability**

- Puron® refrigerant - environmentally sound, won't deplete the ozone layer and low lifetime service cost.
- Scroll compressor
- Internal pressure relief valve
- Internal thermal overload
- High pressure switch
- Loss of charge switch
- Filter drier

**Durability**







**Enthalpy Chart    BTU Per Pound of Air**  
**Wet Bulb to Enthalpy Conversion**  
Wet Bulb temperature in tenths of a degree Fahrenheit

| Wet Bulb Temp | 0     | 0.1   | 0.2   | 0.3   | 0.4   | 0.5   | 0.6   | 0.7   | 0.8   | 0.9   |
|---------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 52            | 21.44 | 21.49 | 21.55 | 21.60 | 21.66 | 21.72 | 21.78 | 21.83 | 21.89 | 21.95 |
| 53            | 22.02 | 22.06 | 22.12 | 22.19 | 22.24 | 22.30 | 22.36 | 22.43 | 22.49 | 22.55 |
| 54            | 22.62 | 22.68 | 22.74 | 22.80 | 22.86 | 22.92 | 22.98 | 23.04 | 23.11 | 23.16 |
| 55            | 23.22 | 23.28 | 23.34 | 23.40 | 23.46 | 23.52 | 23.58 | 23.64 | 23.71 | 23.77 |
| 56            | 23.84 | 23.90 | 23.96 | 24.03 | 24.09 | 24.15 | 24.21 | 24.28 | 24.34 | 24.40 |
| 57            | 24.48 | 24.53 | 24.59 | 24.66 | 24.72 | 24.79 | 24.85 | 24.92 | 24.99 | 25.05 |
| 58            | 25.12 | 25.18 | 25.25 | 25.32 | 25.38 | 25.45 | 25.51 | 25.58 | 25.65 | 25.71 |
| 59            | 25.78 | 25.85 | 25.91 | 25.99 | 26.06 | 26.12 | 26.19 | 26.26 | 26.33 | 26.39 |
| 60            | 26.46 | 26.53 | 26.60 | 26.67 | 26.74 | 26.81 | 26.88 | 26.94 | 27.01 | 27.08 |
| 61            | 27.15 | 27.21 | 27.28 | 27.35 | 27.42 | 27.48 | 27.55 | 27.62 | 27.69 | 27.76 |
| 62            | 27.85 | 27.92 | 28.00 | 28.07 | 28.14 | 28.21 | 28.29 | 28.36 | 28.43 | 28.50 |
| 63            | 28.57 | 28.65 | 28.72 | 28.79 | 28.86 | 28.94 | 29.01 | 29.08 | 29.16 | 29.23 |
| 64            | 29.31 | 29.38 | 29.45 | 29.53 | 29.60 | 29.68 | 29.76 | 29.83 | 29.91 | 29.98 |



## Cooling System Performance Score Report

| Equipment Information     |                |
|---------------------------|----------------|
| Manufacturer              | Bryant         |
| Model Number              | 113ANA02414ALA |
| Serial Number             |                |
| Outdoor DB Temperature    | 86             |
| Equip. Entering WB        |                |
| Mfg. Spec. Cool. Capacity | 21,740         |

### Cooling System Performance Score

79

| Supply Register Air Enthalpy Btu/lb. |           | Return Grille Air Enthalpy Btu/lb. |           |
|--------------------------------------|-----------|------------------------------------|-----------|
| Register Number/Name                 | Enthalpy  | Grille Number/Name                 | Enthalpy  |
| basement supply                      | 19.75     | basement common return             | 25.25     |
| Kitchen Supply                       | 19.53     | Foyer Return                       | 26.26     |
| Front Bath                           | 19.81     | master Return                      | 24.59     |
| Total supply register enthalpy       | 59.09     | Total return grille enthalpy       | 76.1      |
| Divided by number of readings        | 3         | Divided by number of readings      | 3         |
| Average supply register enthalpy     | 19.696667 | Average return grille enthalpy     | 25.366667 |

### Occupied Space Enthalpy Change

|   |              |        |
|---|--------------|--------|
| Average return grille enthalpy            | 25.3         | Btu/lb |
| Minus average supply register enthalpy    | <u>19.69</u> | Btu/lb |
| Equals the occupied space enthalpy change | 5.61         | Btu/lb |

### Supply Register Airflow

[illegible]

## System Delivered Total (Cooling) Btu/hr.

|  |               |                |
|--|---------------|----------------|
| Occupied space enthalpy change                     | <u>5.61</u>   | Btu/lb.        |
| Times the total supply register airflow            | <u>540</u>    | Cfm            |
| Times appropriate Btu/hr multiplier                | <u>4.5</u>    | Btu Multiplier |
| Equals the system delivered total (cooling) Btu/hr | <u>13,632</u> | Btu/hr.        |

### Cooling System Performance Score

|   |        |         |
|---|--------|---------|
| System delivered total (cooling) Btu/hr             | 13,632 | Btu/hr. |
| Divided by Manufacturers Specified Cooling Capacity | 21,740 | Btu/hr. |
| Cooling System Performance Score                    | 79     | %       |

**COMMENTS:**

Date of Test:  
6/23/22

Customer Name

System Name

Tested By:  
TP

## HVAC Design Partners

1435 Vine St Cincinnati Ohio  
phone 513.486.4908 [www.HVACdesignpartners.com](http://www.HVACdesignpartners.com)



## Standard 310 Data Tool: Project Summary

|                     |                  |  |
|---------------------|------------------|--|
| Project Information | Home Address:    |  |
|                     | City:            |  |
|                     | State:           |  |
|                     | Permit Date:     |  |
|                     | Inspection Date: |  |

|                   |                     |                           |
|-------------------|---------------------|---------------------------|
| Rater Information | Rater Company Name: | Green Building Consulting |
|                   | Rater Employee:     | Trevor Plum               |

|                       |                       |     |
|-----------------------|-----------------------|-----|
| 1. HVAC Design Review | Meets all tolerances? | Yes |
|-----------------------|-----------------------|-----|

|                       |   |             |
|-----------------------|---|-------------|
| 2. Total Duct Leakage | Was total duct leakage test exemption taken?                              | No          |
|                       | Total duct leakage normalized by CFA served by system (CFM25/100 Sq. Ft.) | 4.698412698 |
|                       | Testing at rough-in or final?   | Final       |
|                       | Number of returns in the system   | 4           |
|                       | Total Duct Leakage Grade Designation                                      | Grade I     |

|                       |   |           |
|-----------------------|---|-----------|
| 3. Blower Fan Airflow | Was blower fan airflow test exemption taken?            | No        |
|                       | Airflow test method                                     | Flow Hood |
|                       | Design-specified blower fan airflow (CFM)               | 767       |
|                       | Blower fan airflow at operating conditions (CFM)        | 336       |
|                       | Observed fan-speed setting                              | 0         |
|                       | Pressure difference for OEM Static Pressure Table (IWC) | 0.00      |
|                       | Blower fan volumetric airflow grade                     | Grade III |
|                       | Airflow Fault (%)                                       | -28%      |

|                         |  |                     |
|-------------------------|--|---------------------|
| 4. Blower Fan Watt Draw | Test method for measuring blower fan watt draw | Clamp-On Watt Meter |
|                         | Watt draw of blower fan (W)                    | Prereq Not Met      |
|                         | Blower fan efficiency (W/CFM)                  | Prereq Not Met      |
|                         | Blower fan watt draw grade                     | Grade III           |

|                       |   |                |
|-----------------------|---|----------------|
| 5. Refrigerant Charge | Test method for assessing refrigerant charge                              | Non-invasive   |
|                       | Metering device type  | TXV/EEV        |
|                       | Measured outdoor air dry-bulb temperature (F)                             | 85             |
|                       | Measured suction line temperature (F)                                     | 52             |
|                       | Measured liquid line temperature (F)                                      | 89             |
|                       | Target suction line temp (F)  | 41             |
|                       | Difference DTD (F)  | -11            |
|                       | Target liquid line temp (F)   | 95             |
|                       | Difference CTOA (F)   | 6              |
|                       | Total anticipated refrigerant weight (oz)                                 | 0              |
|                       | Total reported refrigerant weight (oz)                                    | 0.0            |
|                       | Deviation btw total anticipated and total reported refrigerant weight (%) | N/A            |
|                       | Refrigerant charge grade designation                                      | Prereq Not Met |



### 3. Blower Fan Airflow

|   |           |
|---|-----------|
| Was blower fan airflow test exemption taken?            | No        |
| Airflow test method                                     | Flow Hood |
| Design-specified blower fan airflow (CFM)               | 767       |
| Blower fan airflow at operating conditions (CFM)        | 556       |
| Observed fan-speed setting                              | 0         |
| Pressure difference for OEM Static Pressure Table (IWC) | 0.00      |
| Blower fan volumetric airflow grade                     | Grade III |
| Airflow Fault (%)                                       | -28%      |