

DAS State of Connecticut
Department of Administrative Services
Division of Construction Services
Office of Education and Data
Management

Understanding Residential HVAC Equipment Sizing

*Presented by
Buck Taylor, Roltay Inc. Energy Services
for the*

*Office of Education and Data Management
Fall 2015 Career Development Series*

Objectives

1. Participants shall understand the CT code requirements for residential mechanical equipment engineering (Manual J, S & D)
2. Participants shall understand the relationship between Manual J load calculations and Manual S Equipment Selection
3. Participants shall understand the impact of duct location and integrity (leakage) on equipment sizing
4. Participants shall understand the impact of different ventilation strategies on equipment sizing
5. Participants shall understand the primary market barriers to code adoption and engineering practices by concerned market actors

Topics

1. "Limited" Code Overview
2. Design Process Overview
3. Manual S (Equipment Selection)
4. Compliance Document Review
5. Market Support

Handouts

- Copy of this presentation
- 2012 Connecticut Code Summary
- Design FAQ
- CT Code – QIV Comparison
- CT Municipal Design Table 2015
- Example OEM Engineering Data
- Example OEM Capacity Report
- Example Manual J-S Report
- Manual-S Demo Interpolation Spreadsheet

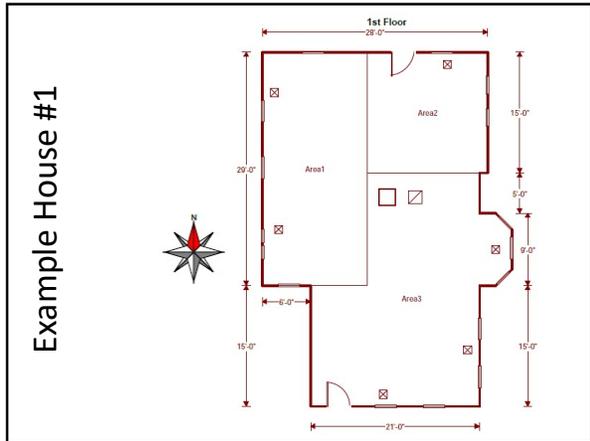
Before we get started...

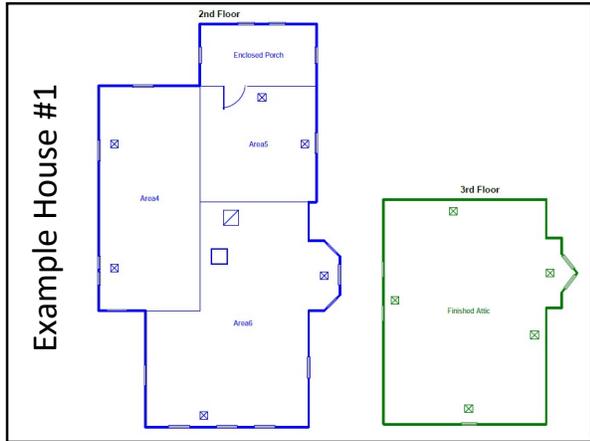
Lets look at an example house!

Example House #1



- West Haven, CT
- 2 Floors + Finished Attic
- Built 1930
- 1st Flr = 1145 sq.ft.
- 2nd Flr = 1145 sq.ft.
- Attic = 632 sq.ft.
- Total = 2922 sq.ft.
- Attic Ceilings Insulated
- Windows Updated
- New "insulated" siding





Example House #1

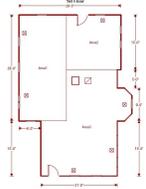


What are your gut-check estimates for heating and cooling loads for this example home?

Loads by floor (apartment)?

Entire building?

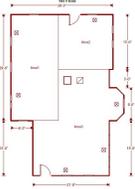
How many pieces of equipment?



Example House #1



How do we **typically** go about "Engineering" a mechanical system for this house?

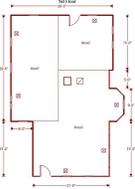


1. Determine scope of the project
 1. All problems are solved by installing new equipment (mentality).....
2. Solicit contractor quotes
3. Hire contractor
4. Install system

Example House #1



What is the **correct** way to go about "Engineering" a mechanical system for this house?



1. Perform engineering analysis
 1. Determine scope of the project
 2. Determine code requirements
 3. Inspect/test existing distribution system
 4. Calculate loads
 5. Select candidate equipment
 6. Engineer/re-engineer distribution system
2. Solicit bids
3. Hire contractor
4. Install system
5. Commission system

Code Overview



State Building Codes

2005 Connecticut Code Summary
(with 2011 Amendment)

- 2003 International Building Code. (IBC)
- 2003 International Existing Building Code (IEBC)
- 2003 International Plumbing Code. (IPC)
- 2003 International Mechanical Code. (IMC)
- 2009 International Energy Conservation Code (IECC)
- 2009 International Residential Code. (IRC)
- 2011 National Electrical Code (NFPA-70) (NEC)

2011 Connecticut Amendment

Effective: Oct 6, 2011

SECTION 29-252-1d Amended....

DELETE 2006 IECC, substitute with 2009 IECC Amendments:

403.2.1.1 Duct Insulation Values prescribed must be Installed values.
403.2.3 No building cavities may be used as supply or return "ducts". (2003 IMC/IRC allowed returns)

403.6 Equipment Sizing (*Mandatory*). Heating and cooling equipment shall be sized in accordance with ACCA Manual S, based on building loads calculated in accordance with ACCA Manual J (or other approved methods – none listed).

Referenced Standard: ACCA Manual J-02, 8th edition (not 7)
Referenced Standard: ACCA Manual S-04

2012 Connecticut Code Summary
(Proposed Adoption Fall 2015)

- 2012 International Building Code. (IBC)
- 2012 International Existing Building Code (IEBC)
- 2012 International Plumbing Code. (IPC)
- 2012 International Mechanical Code. (IMC)
- 2012 International Energy Conservation Code (IECC)
- 2012 International Residential Code. (IRC)
- 2014 National Electrical Code (NFPA-70) (NEC)

2012 International Residential Code 2012 International Energy Conservation Code

**N1103.6 (R403.6) Equipment sizing (Mandatory) & M1401.3 Sizing.
R403.6 Equipment Sizing (Mandatory).**

“Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other **approved** heating and cooling calculation methodologies.”

Acceptable Software Tools/Methods

- Manual J is too complex to perform by hand or with a spreadsheet! The design practitioner **MUST** use approved software. The software must be **Manual J 8** compliant
 - There are currently 6 software packages available for load calculations. They are NOT equal in their capabilities.



ACCA Approved Software



Software Not ACCA Approved

MrHVAC.com
HVAC-Calc
Fire Dragon Net
O'Brien Quick Loads Pro
Qwickload
Loadcalc.net

Code Officials Notes:

- 1). None of these packages will calculate duct loads or air-conditioning loads correctly. They may be close enough for hydronic heating loads, but they are not vetted by ACCA for either.
- 2). Many of these have reports stating they are "In accordance with ACCA Manual J". Needs to be in accordance with "Manual J 8".

Software Not ACCA Approved

Code Officials Advice:

DISCLOSURE: I am not a lawyer, this is my opinion only, it does not reflect the views of the DAS, nor any municipalities (anywhere). There is a significant disparity in the capabilities of many of the software solutions currently in the marketplace:

- 1). If you want to accept questionable software reports, request from the software manufacturer a certified statement from a licensed engineer stating the software is compliant with current ACCA Manual J "8" requirements.
- 2). I highly recommend the formation of a committee represented by code officials, DAS, engineers, subject matter experts, contractors, trade organizations (ACCA) and any other interested parties (software vendors, utilities) to review the currently available software and compile a list of acceptable software for dissemination across all jurisdictions.

HANDOUTS

2012 Connecticut Code Summary
(Proposed Adoption Fall 2015)

- 2012 International Building Code (IBC)
- 2012 International Existing Building Code (IEBC)
- 2012 International Plumbing Code (IPC)
- 2012 International Mechanical Code (IMC)
- 2012 International Energy Conservation Code (IECC)
- 2012 International Fire Code (IFC)
- 2014 National Electrical Code (NFPA 70) (NEC)

2015 International Residential Code

IRC602.7 (R602.7.1) Allow code program.
The building official or other authority having jurisdiction shall be permitted to deem a national, state or local energy efficiency program to exceed the energy efficiency required by this code. Building approval or rating by such an energy efficiency program shall be considered in compliance with this code. The requirements identified as "mandatory" in I202.2.2.2 and I202.2.2.3 shall, as applicable, shall be met.

IRC602.8.1 (R602.8.1) Programmable thermostat.
When the primary heating system is a forced air furnace, at least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. The thermostat shall include the capability to set back or temporarily override the system to maintain the temperature down to 55°F (13°C) or 40°F (4°C) (2°F). The thermostat shall comply in program with a heating temperature set point no higher than 70°F (21°C) and a cooling temperature set point no lower than 59°F (15°C).

IRC602.9 (R602.9.1) Heat pump supplementary heat (Mandatory).
Heat pump heating supplementary electric resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

IRC602.10 (R602.10.1) Insulation (Prescriptive).
Supply ducts in attics shall be insulated to a minimum of R-6. All other ducts shall be insulated to a minimum of R-6.

Exception: Ducts or portions thereof located completely inside the building thermal envelope.

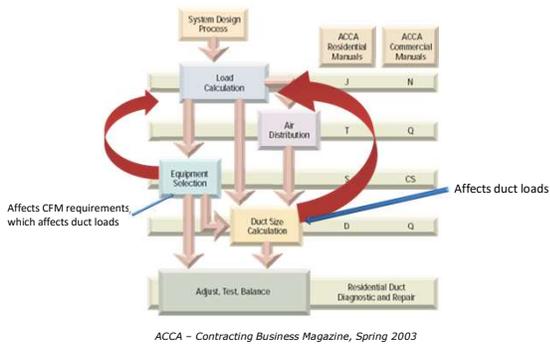
IRC602.11 (R602.11.1) Sealing (Mandatory).
Ducts, air handlers, and their boxes shall be sealed. Joints and seams shall comply with [section 602.11.1](#) of this code.

Exception:
1. An impermeable spray foam product shall be permitted to be applied without additional joint seal.

Design Process Overview

The design of residential mechanical systems is an iterative process of using Manual J, S & D.

Design Process Overview



Design Process Overview



What is Manual D?

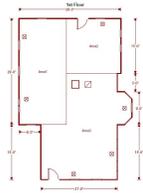
1. The process to design a ducted distribution system based on the CFM requirements determined by the Manual J and Manual S process.
2. Although re-engineering existing duct systems is not required – the designer/mechanic better be able to recognize the very common problems of insufficient return duct, grille and filter sizing.
3. If installing a hydronic only system, many of the Manual J software suites will help size baseboard lengths for the project.

Design Summary Relationship

- Manual J
 - Determined by local conditions
- Manual S
 - Select equipment with capacity adjusted for local conditions and available airflow (CFM)
- Manual D
 - Based on design CFM requirements and what equipment can deliver

Back to our example...

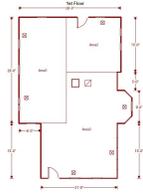
Example House #1



1. Determine scope of the project

1. Replace 1st floor furnace and Air Conditioner
2. Replace boiler that serves 2nd floor and finished attic
3. Add new air conditioner system to 2nd floor and attic

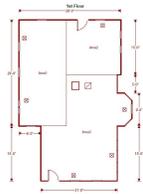
Example House #1



2. Determine code requirements

1. Manual J (Entire building)
2. Manual S (all systems)
3. Manual D – New A/C system only

Example House #1

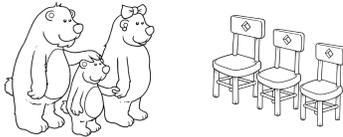


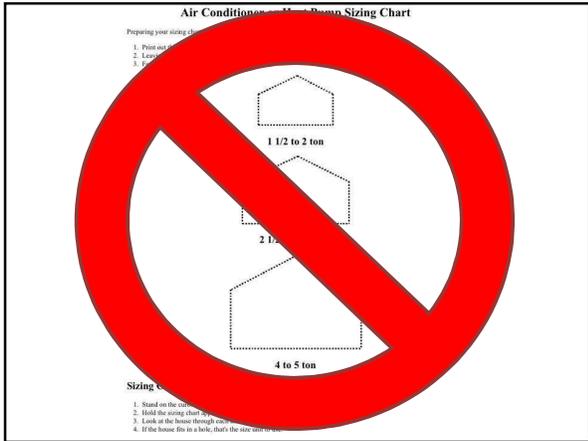
3. Perform engineering analysis

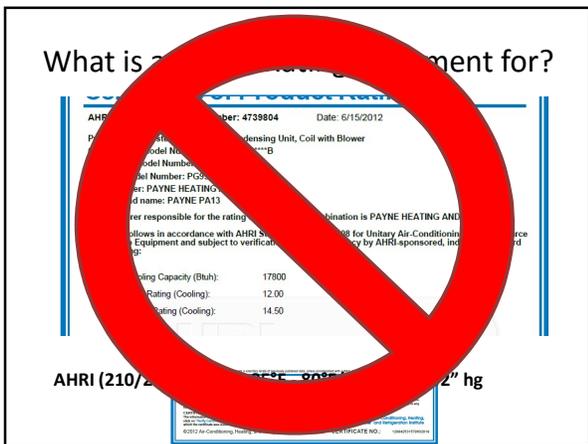
1. Manual J (Entire building)
2. Manual S (all systems)
3. Manual D – New A/C system only

Manual S Definition

- The process by which the design practitioner determines the suitability of a candidate mechanical comfort system to meet the design loads of a building.







BECAUSE

- The original system was MOST likely not properly engineered to begin with,
- Buildings change over time:
 - Weatherization
 - Improvements: Insulation, windows, etcetera...
 - Additional space: additions, finished basements, attics, etcetera.
- Modern equipment doesn't necessarily work the same as the system that is being replaced.

SO...

- Isn't equipment selection based on the loads?
- Can't I just pick a system based on the loads?
-Well not always!

Manual J ~~≠~~ Equipment Selection

Equipment capacity is rated at certain laboratory conditions. The designer needs to determine how it will operate at local climatic and building operating conditions.

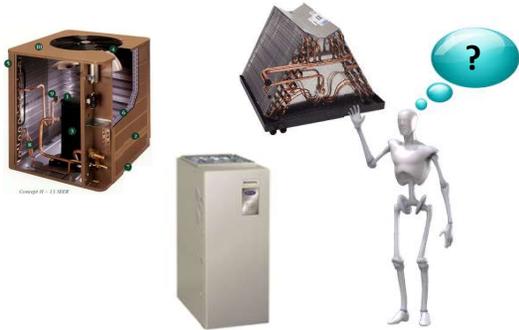
AHRI Rating – Cooling (& HP's)

- Doesn't include affects of:
 - Altitude
 - Duct thermal gains/losses
 - Duct static pressures
 - Affects fan power and heat
 - Affects airflow and actual Sensible Heat Ratio
 - Outdoor air temperature (difference)
 - Line-sets
 - Charge adjustments to compensate for length, lifts, size

AHRI Rating – Heating (Combustion)

- Doesn't include affects of:
 - Altitude
 - Duct thermal gains/losses (not significant)
 - Duct static pressures
- Affects fan power and heat (not significant)

Manual S (Equipment Selection)



Line Sets

VAPOR LINE SIZING AND COOLING CAPACITY LOSS PURON REFRIGERANT 1-STAGE AIR CONDITIONER APPLICATIONS

LONG LINE APPLICATION: An application is considered "Long Line" when the total equivalent tubing length exceeds 80 ft or when there is more than 20 ft vertical separation between indoor and outdoor units. These applications require additional accessories and system modifications for reliable system operation. The maximum allowable total equivalent length is 250ft. The maximum vertical separation is 200 Ft when outdoor

unit is above indoor unit, and 80 Ft when the outdoor unit is below the indoor unit. Refer to Accessory Usage Guideline below for required accessories. See Long Line Application Guideline for required piping and system modifications. Also, refer to the table below for the acceptable vapor tube diameters based on the total length to minimize the cooling capacity loss.

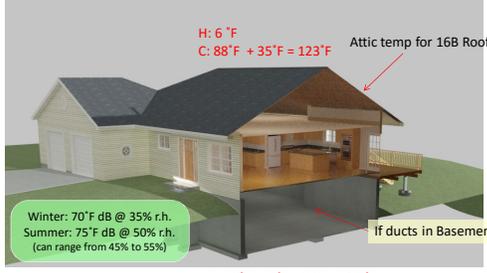
| Unit Nominal Size (Btu/h) | Acceptable Liquid Line Diameters (in. OD) | Acceptable Vapor Line Diameters (in. OD) | Standard Application | Cooling Capacity Loss (%) | | | | | | | | | | | |
|---------------------------|---|--|---------------------------|------------------------------------|-----|-----|-----|-----|-----|-----|-----|----------------------|--|--|--|
| | | | | Total Equivalent Line Length (ft.) | | | | | | | | | | | |
| | | | | 80+ | 100 | 125 | 150 | 175 | 200 | 225 | 250 | Requires Accessories | | | |
| 18000 | 3/8 | 1/2 | 1 2 3 3 4 5 6 7 8 9 10 12 | | | | | | | | | | | | |
| Puron AC | | 5/8 | 0 0 1 1 1 1 1 2 2 3 3 3 | | | | | | | | | | | | |
| 24000 | 3/8 | 5/8 | 0 1 1 1 2 3 3 4 4 5 5 6 | | | | | | | | | | | | |
| 1 Stage Puron AC | | 3/4 | 0 0 0 0 0 0 1 1 1 1 1 2 | | | | | | | | | | | | |
| 30000 | 3/8 | 7/8 | 0 0 0 0 0 0 0 0 0 0 0 0 | | | | | | | | | | | | |
| 1 Stage Puron AC | | 5/8 | 1 2 3 3 4 5 6 7 8 9 | | | | | | | | | | | | |
| 36000 | 3/8 | 3/4 | 0 0 1 1 1 1 2 2 2 3 3 3 | | | | | | | | | | | | |
| 1 Stage Puron AC | | 7/8 | 0 0 0 0 0 1 1 1 1 1 1 1 | | | | | | | | | | | | |
| 42000 | 3/8 | 5/8 | 1 2 4 4 5 6 7 9 10 11 13 | | | | | | | | | | | | |
| 1 Stage Puron AC | | 3/4 | 0 0 1 1 1 1 2 2 3 3 4 | | | | | | | | | | | | |
| 48000 | 3/8 | 7/8 | 0 0 0 0 0 0 1 1 1 1 2 2 | | | | | | | | | | | | |
| 1 Stage Puron AC | | 3/4 | 0 0 1 1 1 1 2 2 2 3 3 4 | | | | | | | | | | | | |
| 60000 | 3/8 | 1 1/8 | 0 0 0 0 0 0 0 0 0 0 1 1 | | | | | | | | | | | | |
| 1 Stage Puron AC | | 3/4 | 1 2 4 4 5 6 7 9 10 11 12 | | | | | | | | | | | | |
| 72000 | 3/8 | 1 1/8 | 0 1 2 2 2 3 4 4 5 5 6 | | | | | | | | | | | | |
| 1 Stage Puron AC | | 1 1/8 | 0 0 0 0 1 1 1 1 1 1 2 | | | | | | | | | | | | |

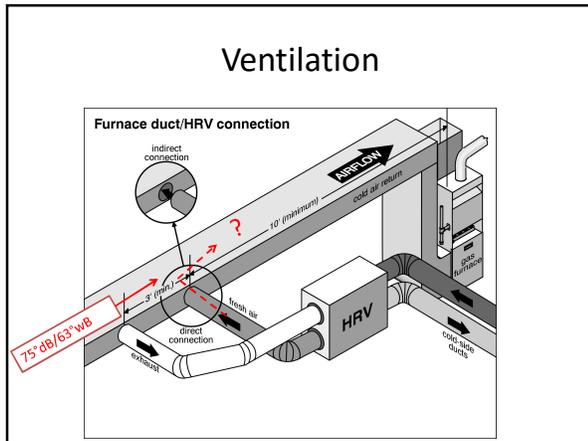
Standard Length = 80 Ft or less total equivalent length
 Applications in this area may have height restrictions that limit allowable total equivalent length, when outdoor unit is below indoor unit. See Long Line Application Guidelines.

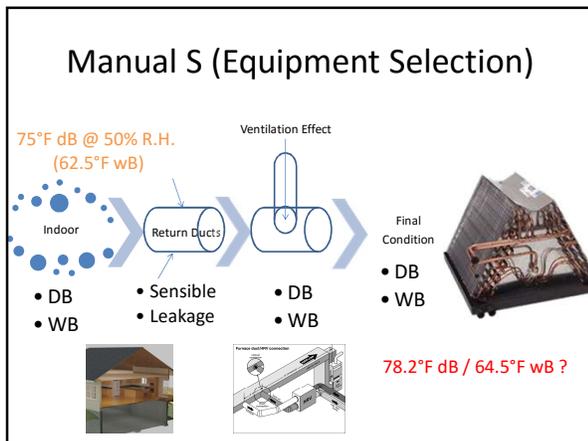
Design Conditions - Ducts

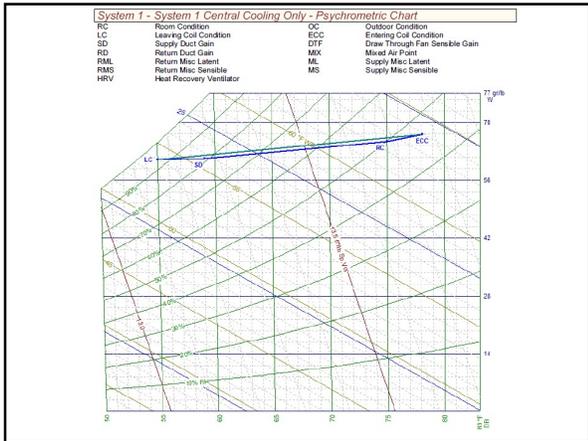
Winter: 99% dB
Hartford = 6°F dB

Summer: 1% dB and 1% (coincidence) WB
Hartford = 88°F dB, 72°F WB

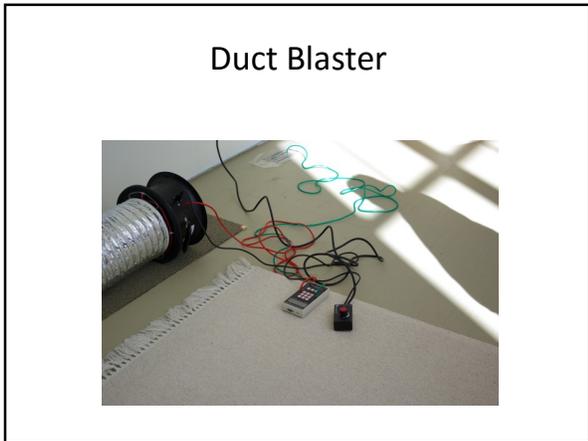








Sidebar: Infiltration & Duct Leakage



Duct Sealing Note

- Seal Duct system correctly – these are examples of thoughtlessness!



Duct Sealing Note

- Ducts get sealed first, then insulated.
– In this case, these ducts are lined.



Blower Door – Infiltration Testing



Infiltration Testing

- IECC 2009: Optional
- IECC 2012: 3 Air Changes per Hour at 50 pascals aka 3 ACH₅₀ (0.2 i.w.c.)

Infiltration Comparison

| Example Typical Infiltration Rates for Homes (Air Changes per Hour) | | |
|---|-------------|-------------|
| Type of Treatment | ACH50 | ACHnat* |
| 2012 Connecticut Code | 3.0 | 0.17 - 0.23 |
| New home with special airtight construction and a controlled ventilation system | 1.5 - 2.5 | 0.10 - 0.17 |
| Energy efficient home with continuous air barrier system | 4.0 - 6.0 | 0.27 - 0.41 |
| Earlier MEC homes (80's - 90's) | 7.0 - 15.0 | 0.47 - 1.01 |
| Standard existing home | 10.0 - 25.0 | 0.68 - 1.69 |
| Older, leaky home | 20.0 - 50.0 | 1.35 - 3.38 |

*The conversion between ACH50 and ACHnat is only an estimate for a 2-story home with normal exposures. ACHnat is used in load calculations.

Infiltration & Duct Leakage

- Both affect heat loss/gain and comfort.
- Both can cause unwanted effects to combustion appliances.
- Both affect the sizing of the A/C system and CFM requirements – which can affect duct sizing.
- Duct leakage can drive (or induce) building infiltration.

Manual S – Using available tools



Entering Air

Capacity Interpolator

Design conditions

EDB (°F) EWB (°F) ODB (°F) AVF (cfm)

Manufacturer performance data

Cooling Coil Interpolator - System 1

System 1 Design Conditions

Outdoor Dry Bulb: °F Supply Airflow: CFM Entering Wet Bulb: °F Entering Dry Bulb: °F

System 1 Loads

| Zone | Total Load (kW) | Sensible Load (kW) | Latent Load (kW) | Capacity (kW) |
|---------|-----------------|--------------------|------------------|---------------|
| Zone 1 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 2 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 3 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 4 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 5 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 6 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 7 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 8 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 9 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 10 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 11 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 12 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 13 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 14 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 15 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 16 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 17 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 18 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 19 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 20 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 21 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 22 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 23 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 24 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 25 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 26 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 27 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 28 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 29 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 30 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 31 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 32 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 33 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 34 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 35 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 36 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 37 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 38 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 39 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 40 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 41 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 42 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 43 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 44 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 45 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 46 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 47 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 48 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 49 | 10.00 | 8.00 | 2.00 | 10.00 |
| Zone 50 | 10.00 | 8.00 | 2.00 | 10.00 |



OEM Engineering Data

84°F

AHRI Condition

DETAILED COOLING CAPACITIES

CONDENSER ENTERING AIR TEMPERATURES (°F) #

| Evaporator Air | 78 | | | | 80 | | | | 82 | | | | 84 | | | | 86 | | | |
|----------------|---------------|------------|---------------|------------|---------------|------------|---------------|------------|---------------|------------|---------------|------------|---------------|------------|---------------|------------|----|--|--|--|
| | Capacity (kW) | Total (kW) | | | | |
| 100 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | | | | |
| 125 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | 12.50 | | | | |
| 150 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | 15.00 | | | | |
| 175 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | 17.50 | | | | |
| 200 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | 20.00 | | | | |
| 225 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | 22.50 | | | | |
| 250 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | | | | |
| 275 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | 27.50 | | | | |
| 300 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 | | | | |
| 325 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | 32.50 | | | | |
| 350 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | 35.00 | | | | |
| 375 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | 37.50 | | | | |
| 400 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | | | | |
| 425 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | 42.50 | | | | |
| 450 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | 45.00 | | | | |
| 475 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | 47.50 | | | | |
| 500 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | 50.00 | | | | |
| 525 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | 52.50 | | | | |
| 550 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | 55.00 | | | | |
| 575 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | 57.50 | | | | |
| 600 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | 60.00 | | | | |
| 625 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | 62.50 | | | | |
| 650 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | 65.00 | | | | |
| 675 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | 67.50 | | | | |
| 700 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | 70.00 | | | | |
| 725 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | 72.50 | | | | |
| 750 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | 75.00 | | | | |
| 775 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | 77.50 | | | | |
| 800 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | | | | |
| 825 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | 82.50 | | | | |
| 850 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | 85.00 | | | | |
| 875 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | | | | |
| 900 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | 90.00 | | | | |
| 925 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | 92.50 | | | | |
| 950 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | 95.00 | | | | |
| 975 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | 97.50 | | | | |
| 1000 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | | | | |

587 CFM
63.7°F WB



OEM Tools

Inputs

ZIP Code: 06405
Weather location: Bridgeport

Cooling ODR: 64
Heating ODR: 7.0
Air flow: 587
Cooling IDB: 75.2
Cooling IRW: 63.7
Cooling IRH: 63.5
Heating IDB: 70

Results - Selected unit

Outdoor: 123ANA018000BC
Indoor: CNPVP2414ALA
Furnace:
Type: Dom SplitAC, 208/230, 1a

| AHRI rated | Adjusted | Valid range: 525 - 675 |
|------------|----------|------------------------|
| 600 | 587 | |
| 13059 | 4295 | |
| 17500 | 17354 | |
| 13.00 | 1.38 | |
| 0.00 | 0 | |
| 0.00 | 0 | |
| 0.00 | 0.00 | |

Manufacturer: Bryant
System type: Split AC
Cooling Capacity: < 1.5 Ton
Voltage: All

| Min | Max |
|------------|-------|
| 500 | 625 |
| uh): | |
| uh): | |
| uh): 16000 | 20000 |
| EER: 13 | 15 |
| kW): 0 | 0 |
| uh): 0 | 0 |
| SPF: 0 | 0 |
| kW): 0 | 0 |

OEM Tools

Case Summary Report

Job: #Bryant1 12/13/2014

98 Overbrook Road, Madison, CT 06443 Phone: 2036721330 Email: buck@roltay.com Web: www.roltay.com

Case 1

Outdoor: 123ANA018000BC Indoor: CNPVP2414ALA

Type: Dom SplitAC, 208/230, 1a

| SODB (°F) | SIDB (°F) | SIRH | SIWB (°F) | WODB (°F) | WIDB (°F) | Elev (ft) | Suction line loss (ft) | AVF (cfm) |
|-----------|-----------|------|-----------|-----------|-----------|-----------|------------------------|-----------|
| 84.0 | 75.2 | 63.5 | 63.7 | 7.0 | 70.0 | 0 | 1.4 | 587 |

| | Unit AVF (cfm) | Net Cool Sensible (Btu/h) | Net Cool Latent (Btu/h) | Net Cool Capacity (Btu/h) | SEER | Cool kW | Net Heat Capacity (Btu/h) | HSPF | Heat kW |
|-------------|----------------|---------------------------|-------------------------|---------------------------|-------|---------|---------------------------|------|---------|
| AHRI Rated: | 600 | 0 | 0 | 17500 | 13.00 | 0.00 | 0 | 0 | 0 |
| Adjusted: | 587 | 13059 | 4295 | 17354 | | 1.38 | 0 | 0 | 0 |

Using 3rd party coils

- Manual S requires extended performance rating data.
- OEM must provide tools or custom calculations to meet the requirements for Manual S.
 - Many 3rd party coils do not currently provide such tools, or
 - 3rd party coils instructs designer to use OEM data for their products!

Sizing Heat Pumps

- Heat Pumps are sized to the **COOLING** load only.
- The balance of any heating that cannot be met by the compressors shall be provided by a supplemental system (stage)
 - Electric resistance
 - Hot water coil
 - Baseboard
 - Radiant

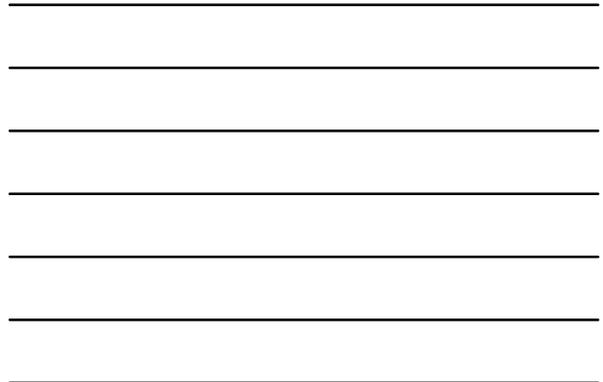
A/C Sizing Exceptions

- For cooling - multi / variable speed systems usually come only in **1-ton** increments. The latest Manual S addresses this with the higher sizing factors, however you may still end up over the maximum on smaller houses (loads).
 - Sizing factors are static and make it more difficult for smaller loads (smaller houses have a penalty versus larger houses).
 - Base/old sizing factor is 1.15, now up to 1.3 for high-end variable refrigerant flow systems

Sizing Boilers

- For heating with boilers that also serve DHW, an additional water load may be considered given that peak heating loads usually occur just before dawn, and it is possible that occupants may be using showers at the same time.
 - Manual S tries to address this with upper limit factor of 2.0 (base/old limit is 1.4).
 - Better addressed by adding storage tank (60 gal +) and sizing boiler within 1.4 factor, or
 - Use Tankless water heater!

Must Have BOTH:
Manual J
Manual S



Manual J + Manual S

Load Sheet Form
Energy Services

Project Information

Manual J Date: 08/27/2015

Design Information

Manual J Ver: 7.0
Manual S Ver: 5.0
Manual S Ver: 5.0
Manual S Ver: 5.0

Mechanical Equipment

| Zone | Area | Volume | Supply | Return |
|--------------|------------|-------------|-------------|-------------|
| Living | 140 | 1000 | 1000 | 1000 |
| Dining | 140 | 1000 | 1000 | 1000 |
| Kitchen | 140 | 1000 | 1000 | 1000 |
| Bedroom | 140 | 1000 | 1000 | 1000 |
| Bath | 140 | 1000 | 1000 | 1000 |
| Garage | 140 | 1000 | 1000 | 1000 |
| Attic | 140 | 1000 | 1000 | 1000 |
| Basement | 140 | 1000 | 1000 | 1000 |
| Unfinished | 140 | 1000 | 1000 | 1000 |
| Finished | 140 | 1000 | 1000 | 1000 |
| Other | 140 | 1000 | 1000 | 1000 |
| Total | 140 | 1000 | 1000 | 1000 |

COOLING EQUIPMENT

| Zone | Area | Volume | Supply | Return |
|--------------|------------|-------------|-------------|-------------|
| Living | 140 | 1000 | 1000 | 1000 |
| Dining | 140 | 1000 | 1000 | 1000 |
| Kitchen | 140 | 1000 | 1000 | 1000 |
| Bedroom | 140 | 1000 | 1000 | 1000 |
| Bath | 140 | 1000 | 1000 | 1000 |
| Garage | 140 | 1000 | 1000 | 1000 |
| Attic | 140 | 1000 | 1000 | 1000 |
| Basement | 140 | 1000 | 1000 | 1000 |
| Unfinished | 140 | 1000 | 1000 | 1000 |
| Finished | 140 | 1000 | 1000 | 1000 |
| Other | 140 | 1000 | 1000 | 1000 |
| Total | 140 | 1000 | 1000 | 1000 |

COOLING EQUIPMENT

| Zone | Area | Volume | Supply | Return |
|--------------|------------|-------------|-------------|-------------|
| Living | 140 | 1000 | 1000 | 1000 |
| Dining | 140 | 1000 | 1000 | 1000 |
| Kitchen | 140 | 1000 | 1000 | 1000 |
| Bedroom | 140 | 1000 | 1000 | 1000 |
| Bath | 140 | 1000 | 1000 | 1000 |
| Garage | 140 | 1000 | 1000 | 1000 |
| Attic | 140 | 1000 | 1000 | 1000 |
| Basement | 140 | 1000 | 1000 | 1000 |
| Unfinished | 140 | 1000 | 1000 | 1000 |
| Finished | 140 | 1000 | 1000 | 1000 |
| Other | 140 | 1000 | 1000 | 1000 |
| Total | 140 | 1000 | 1000 | 1000 |

Manual S Compliance Report
Energy Services

Project Information

Manual S Date: 08/27/2015

Design Information

Manual S Ver: 5.0
Manual S Ver: 5.0
Manual S Ver: 5.0
Manual S Ver: 5.0

COOLING EQUIPMENT

| Zone | Area | Volume | Supply | Return |
|--------------|------------|-------------|-------------|-------------|
| Living | 140 | 1000 | 1000 | 1000 |
| Dining | 140 | 1000 | 1000 | 1000 |
| Kitchen | 140 | 1000 | 1000 | 1000 |
| Bedroom | 140 | 1000 | 1000 | 1000 |
| Bath | 140 | 1000 | 1000 | 1000 |
| Garage | 140 | 1000 | 1000 | 1000 |
| Attic | 140 | 1000 | 1000 | 1000 |
| Basement | 140 | 1000 | 1000 | 1000 |
| Unfinished | 140 | 1000 | 1000 | 1000 |
| Finished | 140 | 1000 | 1000 | 1000 |
| Other | 140 | 1000 | 1000 | 1000 |
| Total | 140 | 1000 | 1000 | 1000 |

COOLING EQUIPMENT

| Zone | Area | Volume | Supply | Return |
|--------------|------------|-------------|-------------|-------------|
| Living | 140 | 1000 | 1000 | 1000 |
| Dining | 140 | 1000 | 1000 | 1000 |
| Kitchen | 140 | 1000 | 1000 | 1000 |
| Bedroom | 140 | 1000 | 1000 | 1000 |
| Bath | 140 | 1000 | 1000 | 1000 |
| Garage | 140 | 1000 | 1000 | 1000 |
| Attic | 140 | 1000 | 1000 | 1000 |
| Basement | 140 | 1000 | 1000 | 1000 |
| Unfinished | 140 | 1000 | 1000 | 1000 |
| Finished | 140 | 1000 | 1000 | 1000 |
| Other | 140 | 1000 | 1000 | 1000 |
| Total | 140 | 1000 | 1000 | 1000 |



Manual J - 8

Solidific values have been manually overridden
Calculations approved by ACCA to meet all requirements of Manual J 8th Ed.

htsoft Right-Soft® Universal 2015 15.0.15 RBU19562
totay Projects\Ulang\lang_wac.nip Calc = MJ8 Front Door faces: S

Residential Heat Loss and Heat Gain Calculation
In accordance with ACCA Manual J



OEM Docs with Load Calc Software

Capacity Interpolator

Design conditions:
 Outdoor design DB: 84.0 F
 Outdoor design WB: 73.0 F
 Indoor design DB: 75.0 F
 Indoor RH: 50%

Manufacturer performance data at actual design conditions:
 Equipment type: Split AC
 Manufacturer: Bryant
 Actual airflow: 567 cfm
 Sensible capacity: 13059 Btu/h
 Latent capacity: 4305 Btu/h
 Total capacity: 17365 Btu/h

Design Conditions:
 Outdoor design DB: 84.0 F
 Outdoor design WB: 73.0 F
 Indoor design DB: 75.0 F
 Indoor RH: 50%

Manufacturer's Performance Data at Actual Design Conditions:
 Equipment type: Split AC
 Manufacturer: Bryant
 Actual airflow: 567 cfm
 Sensible capacity: 13059 Btu/h
 Latent capacity: 4305 Btu/h
 Total capacity: 17365 Btu/h



OEM Docs with Load Calc Software

Manual S Compliance Report

Design Conditions:
 Outdoor design DB: 84.0 F
 Outdoor design WB: 73.0 F
 Indoor design DB: 75.0 F
 Indoor RH: 50%

Manufacturer's Performance Data at Actual Design Conditions:
 Equipment type: Split AC
 Manufacturer: Bryant
 Actual airflow: 567 cfm
 Sensible capacity: 13059 Btu/h
 Latent capacity: 4305 Btu/h
 Total capacity: 17365 Btu/h

Design Conditions:
 Outdoor design DB: 7.0 F
 Indoor design DB: 70.0 F

Manufacturer's Performance Data at Actual Design Conditions:
 Equipment type: Gas furnace
 Manufacturer: York
 Actual airflow: 1149 cfm
 Output capacity: 80000 Btu/h



OEM Docs with Load Calc Software

Cooling Equipment

Design Conditions:
 Outdoor design DB: 84.0 F
 Outdoor design WB: 73.0 F
 Indoor design DB: 75.0 F
 Indoor RH: 50%

Manufacturer's Performance Data at Actual Design Conditions:
 Equipment type: Split AC
 Manufacturer: Bryant
 Actual airflow: 567 cfm
 Sensible capacity: 13059 Btu/h
 Latent capacity: 4305 Btu/h
 Total capacity: 17365 Btu/h

Design Conditions:
 Outdoor design DB: 7.0 F
 Indoor design DB: 70.0 F

Manufacturer's Performance Data at Actual Design Conditions:
 Equipment type: Gas furnace
 Manufacturer: York
 Actual airflow: 1149 cfm
 Output capacity: 80000 Btu/h



Oversizing

Heating Equipment
 Design Conditions
 Outdoor design DB: 7.0°F Heat loss: 36351 Btu/h Entering coil DB: 68.0°F
 Indoor design DB: 70.0°F

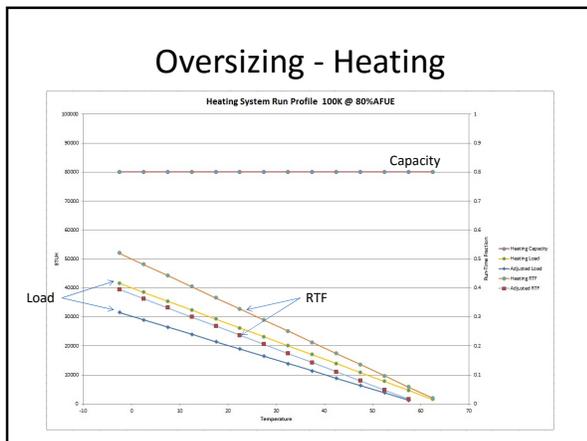
| | Gross | AFUE | Net | Δ T | CFM | Annual Run Hrs | Flue BTU | Annual Flue BTU | Fraction Flue |
|--|--------|------|-------|-----|------|----------------|----------|-----------------|---------------|
| | 70000 | 72 | 50400 | 80 | 583 | 1880 | 19600 | 36848000 | 1 |
| | 100000 | 72 | 72000 | 80 | 833 | 1316 | 28000 | 36848000 | 1 |
| | 100000 | 80 | 80000 | 70 | 1058 | 1184 | 20000 | 23680000 | 0.64264 |
| | 100000 | 86 | 86000 | 65 | 1225 | 1101 | 14000 | 15414000 | 0.41831 |
| | 100000 | 94 | 94000 | 50 | 1741 | 1008 | 6000 | 6048000 | 0.16413 |
| | 48000 | 94 | 45120 | 45 | 928 | 2100 | 2880 | 6048000 | 0.16413 |

Contractors tend to size replacements "like for like". This results in potential (significant) issues with airflow and draft (flue gasses condensing prematurely)!

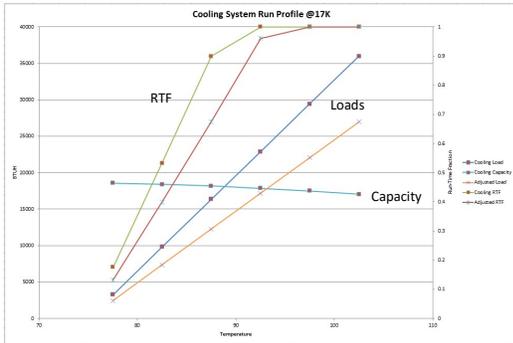


Oversizing

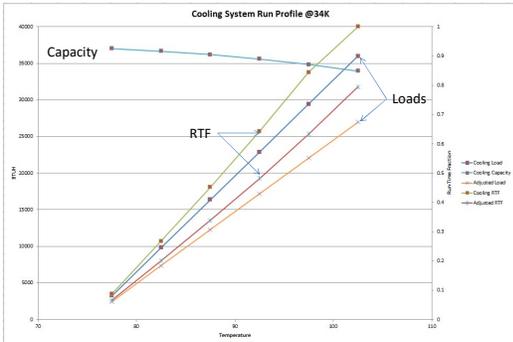
| Bin Bracket | Bin Avg | Loss/Gain | Adjusted Capacity | Sum Hrs | EER | Power | RTF | ADJ. WattHrs | Bin Power |
|-------------|---------|-----------|-------------------|---------|------|-------|---------|--------------|-----------|
| -15 to -30 | -22.5 | 60072 | 46701 | 80000 | 0 | 0 | 0.7509 | 0.583760 | 0 |
| -30 to -25 | -27.5 | 56991 | 44177 | 80000 | 0 | 0 | 0.71239 | 0.532112 | 0 |
| -25 to -20 | -22.5 | 53910 | 41652 | 80000 | 0 | 0 | 0.67387 | 0.52065 | 0 |
| -20 to -15 | -17.5 | 50830 | 39128 | 80000 | 0 | 0 | 0.63535 | 0.4891 | 0 |
| -15 to -10 | -12.5 | 47749 | 36603 | 80000 | 0 | 0 | 0.59686 | 0.457538 | 0 |
| -10 to -5 | -7.5 | 44669 | 34079 | 80000 | 0 | 0 | 0.55836 | 0.425988 | 0 |
| -5 to 0 | -2.5 | 41588 | 31555 | 80000 | 9 | 0 | 0.51985 | 0.394437 | 4.67865 |
| 0 to 5 | 2.5 | 38507 | 29030 | 80000 | 35 | 0 | 0.48134 | 0.362875 | 16.84681 |
| 5 to 10 | 7.5 | 35427 | 26506 | 80000 | 82 | 0 | 0.44284 | 0.331325 | 36.31268 |
| 10 to 15 | 12.5 | 32346 | 23982 | 80000 | 201 | 0 | 0.40433 | 0.299775 | 81.26933 |
| 15 to 20 | 17.5 | 29266 | 21457 | 80000 | 240 | 0 | 0.36582 | 0.268211 | 87.798 |
| 20 to 25 | 22.5 | 26185 | 18933 | 80000 | 382 | 0 | 0.32731 | 0.236663 | 125.0334 |
| 25 to 30 | 27.5 | 23104 | 16408 | 80000 | 466 | 0 | 0.2888 | 0.2051 | 134.5600 |
| 30 to 35 | 32.5 | 20024 | 13884 | 80000 | 848 | 0 | 0.25028 | 0.17355 | 212.2544 |
| 35 to 40 | 37.5 | 16943 | 11360 | 80000 | 724 | 0 | 0.21179 | 0.142 | 153.3342 |
| 40 to 45 | 42.5 | 13863 | 8835 | 80000 | 704 | 0 | 0.17329 | 0.110437 | 111.2844 |
| 45 to 50 | 47.5 | 10782 | 6311 | 80000 | 696 | 0 | 0.13477 | 0.078887 | 93.8034 |
| 50 to 55 | 52.5 | 7701 | 3787 | 80000 | 669 | 0 | 0.09626 | 0.047337 | 64.39961 |
| 55 to 60 | 57.5 | 4621 | 1262 | 80000 | 670 | 0 | 0.05776 | 0.015776 | 38.70687 |
| 60 to 65 | 62.5 | 1540 | 0 | 80000 | 696 | 0 | 0.01925 | 0 | 13.398 |
| 65 to 70 | 67.5 | 0 | 80000 | 714 | 0 | 0 | 0 | 0 | 0 |
| 70 to 75 | 72.5 | 0 | 18994.5 | 880 | 0 | 0 | 0 | 0 | 0 |
| 75 to 80 | 77.5 | 3271 | 2433 | 18951.2 | 434 | 13.59 | 1.96138 | 0.132586 | 76.73092 |
| 80 to 85 | 82.5 | 9813 | 7360 | 18337.9 | 343 | 13.05 | 1.4052 | 0.53512 | 183.5466 |
| 85 to 90 | 87.5 | 16358 | 12267 | 18104.7 | 169 | 12.45 | 1.03419 | 0.67359 | 152.6786 |
| 90 to 95 | 92.5 | 22898 | 17174 | 17881.6 | 94 | 11.81 | 1.00733 | 1 | 34 |
| 95 to 100 | 97.5 | 29440 | 22080 | 17428.5 | 3 | 11.15 | 1.56309 | 1 | 3 |
| 100 to 105 | 102.5 | 35983 | 26987 | 16985.6 | 0 | 10.48 | 1.62076 | 1 | 0 |
| 105 to 110 | 107.5 | 42525 | 31894 | 16472.7 | 0 | 9.83 | 1.67576 | 1 | 0 |
| 110 to 115 | 112.5 | 49067 | 36800 | 15889.8 | 0 | 9.2 | 1.72715 | 1 | 0 |
| | | | | | 8799 | 980 | | Heating | 1188.404 |
| | | | | | 8760 | 450 | | Cooling | -489.9541 |



Proper Sized - Cooling



Oversizing - Cooling



Review Example

| Whole House | 581 sq.ft. | 8,102 | 2,832 | 10,934 (1 tons) | 22,165 |
|--|-------------|-------|-------|----------------------|--------|
| Second Floor | | 8,102 | 2,832 | 10,934 | 22,165 |
| Bathroom | 40 sq.ft. | 132 | 0 | 132 | 291 |
| Infiltration | | 0 | 0 | 0 | 0 |
| - Tightness: Poor; Winter ACH: 2.01 ; Summer ACH: 8 | | | | | |
| Duct | | 6 | 0 | 6 | 38 |
| - Supply above 120; Enclosed in unheated space; R-4 | | | | | |
| Floor | 40 sq.ft. | 0 | 0 | 0 | 0 |
| - Over conditioned space | | | | | |
| Ceiling | 40 sq.ft. | 126 | 0 | 126 | 253 |
| - Under ventilated attic; R-11 (3 - 3.5 inch); Dark | | | | | |
| Bedroom | 216 sq.ft. | 2,401 | 918 | 3,319 | 8,408 |
| Infiltration | | 358 | 458 | 816 | 4,630 |
| - Tightness: Poor; Winter ACH: 2.01 ; Summer ACH: 8 | | | | | |
| Duct | | 114 | 0 | 114 | 1,067 |
| - Supply above 120; Enclosed in unheated space; R-4 | | | | | |
| People | 2 | 600 | 460 | 1,060 | 0 |
| Floor | 216 sq.ft. | 0 | 0 | 0 | 0 |
| - Over conditioned space | | | | | |
| S Wall | 72.4 sq.ft. | 115 | 0 | 115 | 469 |
| - Wood frame, with sheathing, siding or brick; R-11 3 1/2 in.; none | | | | | |
| Window | 23.6 sq.ft. | 533 | 0 | 533 | 843 |
| - Double pane; Vinyl frame; Clear glass | | | | | |
| - Draperies or blinds; Coating: None (clear glass); No outside shading | | | | | |
| Ceiling | 216 sq.ft. | 681 | 0 | 681 | 1,369 |
| - Under ventilated attic; R-11 (3 - 3.5 inch); Dark | | | | | |

Questions?

Resources

- www.ct.gov/dcs/
- publicecodes.cyberregs.com/icod/index.htm
- www.acca.org
- www.hvac-quality.com

Thank you

Buck Taylor

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(203) 672-1330
buck@roltay.com

10:00 AM
