**Sponsored by the ACCA
Codes Committee**

2800 Shirlington Road
Suite 300
Arlington, VA 22206

Phone: 703-575-4477
Fax: 703-575-9147

ACCA (Air Conditioning Contractors of America) is dedicated to excellence in the HVACR industry. As the largest HVACR contractor organization, ACCA is committed to helping its members succeed. Some of the fundamental ways in which our efforts are seen, are in the technical resources and industry standards, that guarantee quality HVACR design, installation and maintenance.

The ACCA Codes Committee was formed to address code issues and in particular, *to advise and assist ACCA in beneficially representing the contractors in the code processes that affect the HVAC industry*. This document has been written for code officials, seeking to verify that HVAC equipment has been selected in order to meet the home's load requirements.

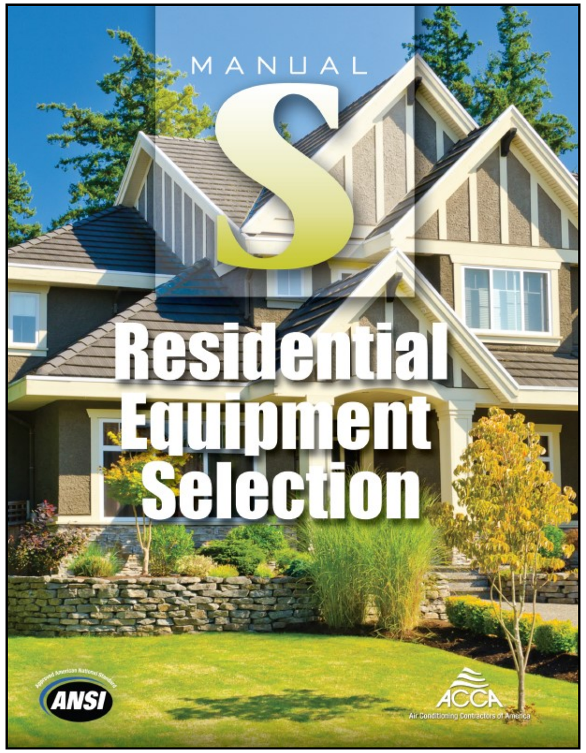
For a more detailed analysis on the design process

visit www.acca.org for

Bob's House

To order ACCA Manual S
888-290-2220

Verifying ACCA Manual S® Procedures



Includes Equipment Selection Checklist & Example

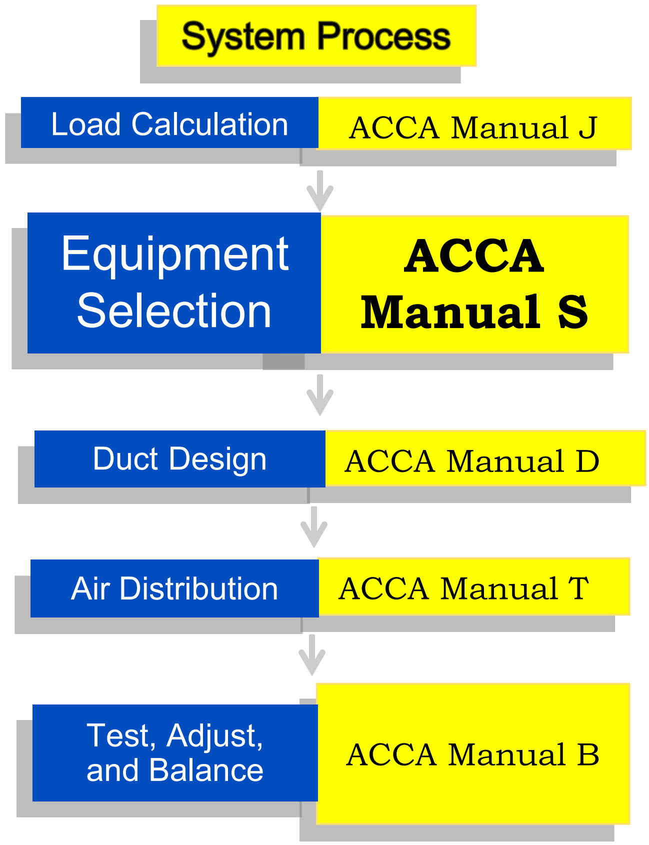
Verifying ACCA Manual S® Procedures

Why is proper equipment selection important?

Achieving occupant satisfaction is the principal goal of any HVAC design. Occupant satisfaction is maximized when the heating and cooling equipment are the correct type and size to meet the capacity requirements from the Manual J load calculation.

For residential equipment selections, ACCA's Manual S®, is the only procedure recognized by the American National Standards Institute (ANSI). If the Manual J load calculation is done then the next step is to select the equipment that will deliver the necessary heating and cooling.

ACCA'S Residential Design Manuals


System Process

Load Calculation — ACCA Manual J

Equipment Selection — ACCA Manual S

Duct Design — ACCA Manual D

Air Distribution — ACCA Manual T

Test, Adjust, and Balance — ACCA Manual B

What problems come from the wrong size equipment?

Undersized equipment will not meet the customer's comfort requirements at the design specifications.

Oversized equipment will create other problems:

- Degraded humidity control in the summer.
- Occupants may suffer the effects of an increased potential for mold growth. These same conditions also may contribute to asthma and other respiratory conditions.
- The temperature may feel right at the thermostat but the temperature in other rooms will suffer from the oversized equipment going through short operation cycles. Short cycles can cause temperature swings as the equipment over-conditions, stops, then over-conditions, etc…
- Hot and cold spots between rooms because the thermostat is satisfied but the room is not.
- Oversized equipment generally requires larger ducts, increased electrical circuit sizing and larger refrigeration tubing. These cause higher installed costs and increased operating expenses.
- The equipment starts and stops more frequently, this causes excessive wear and can increase maintenance costs / service calls.

In these unfavorable conditions occupants will experience discomfort and dissatisfaction.

What are some reasons for oversized equipment?

Manufacturers take great care in measuring and testing how well their equipment performs at different operating conditions.
When contractors use this data to select the equipment they will meet the heating and cooling needs of their customers.
Two main reasons for oversized equipment are either that: (1) a guess was made on the equipment's capacity at the design conditions or (2) mistakes were made in the selection process.

Equipment Selection Checklist

#	Key Item	Verify	Verification Questions
1	Design Conditions	The design conditions fall within specifications.	Do the design conditions fall within the minimum standards for this region as found in Manual J8 Table 1A or 1B? Ⓐ
		The information from the Manual J load calculation was transferred accurately.	Was the Total Heat Gain / Loss information used to evaluate equipment candidates? Ⓑ
2	OEM's Performance Data	The equipment manufacturer's performance parameters match the design parameters used to calculate the heat load.	Does the manufacturer's performance parameters match the design parameters used to calculate the home's heat load (i.e., outdoor dry-bulb, indoor dry-bulb, and indoor wet-bulb)?
			If the performance data parameters are more than 5% greater or less than the design parameters then did the contractor interpolate the equipment manufacturer's performance parameters to match the design parameters used to calculate the heat load?
3	Equipment Performance	Estimated Cooling – CFM based on Temperature Difference	Was the Sensible Heat Ratio calculated? (Sensible Load / Total Load)? Ⓒ
			Was the SHR used to find the proper air flow? Ⓓ
		Equipment selected satisfies Total Btus (for cooling the Sensible and **Latent** load)	Is the total heating capacity of the selected equipment ≤140% of the designed total heating load? (If not reduce equipment size) Ⓔ
			Is the total cooling capacity of the selected equipment ≤115% of the designed total cooling load ? (If not reduce equipment size) Ⓕ
			Does the "Sensible" and/or "Latent" capacities of the selected equipment meet the load's requirements? Ⓖ
			If a heat pump in a very cold climate (heating is primary concern) does the total cooling capacity of the selected equipment exceed 125% of the designed total cooling load?
4	Auxiliary Heat	Heat Pump Balance Point	Does the electric auxiliary heat provide the necessary BTUs to makeup difference in capacity from the heat pump's balance point to the design load conditions? Ⓗ

Equipment Selection using an ExampleChecklist

Design

Winter Design Conditions

Outdoor °F:	27°F Ⓐ	From Manual J8 Table 1A or 1B
Indoor °F:	70°F	Manual J8 §3-6 defaults to 70°F
Total Calculated Heat Loss	Ⓑ 50,981Btu/h	Determined by Manual J8 load calculation

Summer Design Conditions

Outdoor°F:	Ⓐ 85°F	From Manual J8 Table 1A or 1B
Indoor °F:	75°F	Manual J8 §3-6 defaults to 75°F
Entering Wet Bulb (EWB):	63°F	Manual J8 §3-6 defaults to 63°F EWB (≈ 75°F / 50% RH)
Total Heat Gain	Ⓑ 27,543Btu/h	Determined by Manual J8 load calculation
Sensible Heat Gain	Ⓖ 23,321Btu/h	
Latent Heat Gain	Ⓖ 4,222Btu/h	
Sensible Heat Ratio (SHR)	85% Ⓒ	See formula below
Design Air Flow	Ⓓ 1,116 CFM	The "*TARGET*" airflow, we look for equipment that operates in this range ($^{+}$/- 10%), on **medium** fan speed

$$SHR = \frac{\text{Sensible Heat}}{\text{Total Heat Gain}}$$

Ⓒ

85

$$\frac{23{,}321\text{Btu/h}}{27{,}543\text{Btu/h}}$$

Ⓓ

Sensible Heat Ratio versus Temperature Design Value	
SHR	Recommended Temp. Design
Below 0.80	21°F
0.80 – 0.85	19°F
Above 0.85	17°F

85% ≈ 19° Design Temp

$$CFM = \frac{\text{Sensible Heat Gain}}{\text{Design Temp x 1.1}}$$

$$1{,}116 \text{ CFM} = \frac{23{,}321 \text{ Btu/h}}{19 \text{ x } 1.1}$$

Application Data: Equipment Capacity

A furnace was selected for comparing "heating only" design and performance. Other types of equipment may be used.

Furnace Model Number:	FU600300	Fictitious furnace
Output BTUH:	Ⓔ 52,000Btu/h	Furnace Btu/h Output: (≤ 140% of calculated loss)

A heat pump was selected for comparing cooling and heating design and performance. Other types of equipment may be used.

Outdoor Unit Model Number:	HP-030	Fictitious heat pump
Total Cooling Capacity (≤ 115%)	Ⓕ 28,400Btu/h	These capacities are from manufacturer's performance data at the **DESIGN CONDITIONS:** 85°F ODT, 1,000CFM, and 63°F EWB
Sensible Cooling Capacity (≈ Sensible Gain)	Ⓖ 21,600Btu/h	
Latent Cooling Capacity (≈ Latent Gain)	Ⓖ 6,800Btu/h	
Indoor Unit Model Number:	AH-030	Fictitious air handler
Indoor Blower CFM (CFM in manufacturer's performance data at rated capacity-medium fan speed):	Ⓓ 1,000	The actual equipment rated airflow, (medium fan speed optimal) should fall within target CFM,($^{+}$/ - 15%)
Btuh Difference between Heat Pump Balance Point and Total Heat Loss	Ⓗ 30,281 Btu/h	This heat pump can only produce 20,700Btu/h at design conditions. More capacity is required. (Air Conditioners do not have a balance point.)
Auxiliary Heat (Circle): [✓ Electric] Gas Oil	10 KW Ⓗ	In this example the auxiliary heat is electric, the formula for electric heat is KW= Btu/h ÷ 3.413

From Manual J8 Tables	From Manual J8 Load Calculation	From Equip. Performance Data