

Sponsored by the ACCA
Code Committee



Air Conditioning
Contractors of America

2800 Shirlington Road

Phone: 703-575-4477

Fax: 703-575-9147

The Air Conditioning Contractors of America (ACCA) 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 Code 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 load calculations for an HVAC application have been correctly performed.

**For a more detailed analysis
on the design process**

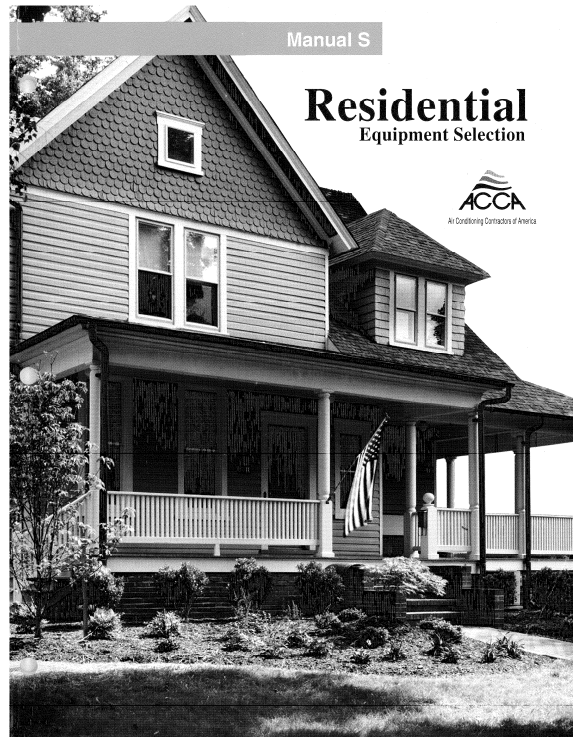
or visit

www.acca.org/tech/articles/

To order ACCA Manual S

888-290-2220

Verifying ACCA Manual S® Procedures



**Includes
Equipment
Selection
Checklist
& Example**



Verifying ACCA Manual S® Procedures

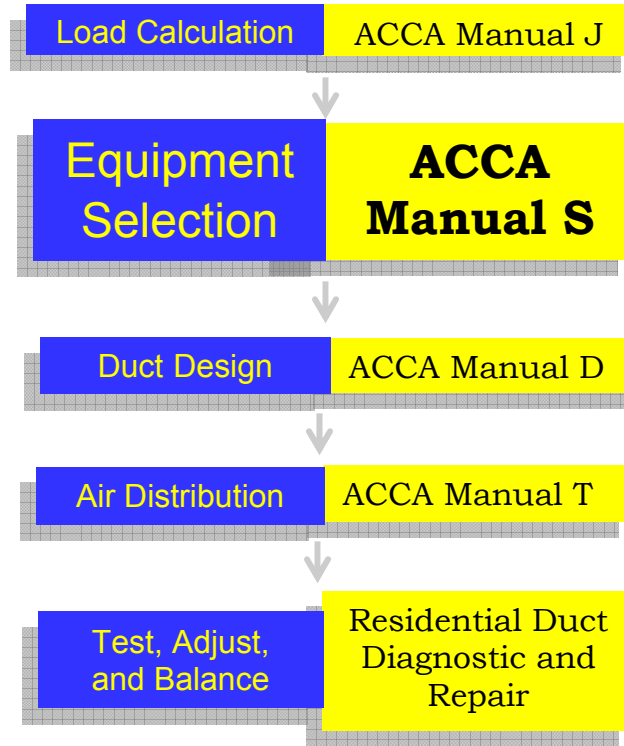
Why is proper equipment selection important?

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 Design Manuals Residential

System Process



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 more service calls.

In these unfavorable conditions occupants will experience discomfort and dissatisfaction.

What are some reasons for oversized equipment?

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) that mistakes were made in the selection process. 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.

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? (A)
		The information from the Manual J load calculation was transferred accurately.	Was the Total Heat Gain / Loss information used to evaluate equipment candidates? (B)
2	Manufacturer'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?
		Estimated Cooling – CFM based on Temperature Difference	Was the Sensible Heat Ratio calculated? (Sensible Load / Total Load)? (C) Was the SHR used to find the proper air flow? (D)
3	Equipment Performance	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 so reduce equipment size) (E)
			Is the total cooling capacity of the selected equipment ≤115% of the designed total cooling load? (If so reduce equipment size) (F)
			Does the "Sensible" and/or "Latent" capacities of the selected equipment meet the load's requirements? (G)
			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? (H)

Equipment Selection Example using the Checklist

Design			Application Data: Equipment Capacity												
Winter Design Conditions			A furnace was selected for comparing "heating only" design and performance. Other types of equipment may be used.												
Outdoor °F:	27°F (A)	From Manual J8 Table 1A or 1B				Furnace Model Number:	FU600300	Fictitious furnace							
Indoor °F:	70°F (B)	Manual J8 §3-6 defaults to 70°F				Output BTUH:	52,000Btu/h (E)	Furnace Btu/h Output: (≤ 140% of calculated loss)							
Total Calculated Heat Loss	50,981Btu/h	Determined by Manual J8 load calculation													
Summer Design Conditions			A heat pump was selected for comparing cooling and heating design and performance. Other types of equipment may be used.												
Outdoor °F:	85°F (A)	From Manual J8 Table 1A or 1B				Outdoor Unit Model Number:	HP-030	Fictitious heat pump							
Indoor °F:	75°F	Manual J8 §3-6 defaults to 75°F				Total Cooling Capacity (≤ 115%)	28,400Btu/h (F)	These capacities are from manufacturer's performance data at the DESIGN CONDITIONS: 85°F ODT, 1,000CFM, and 63°F EWB							
Entering Wet Bulb (EWB):	63°F (B)	Manual J8 §3-6 defaults to 63°F EWB (≈ 75°F / 50% RH)	Sensible Cooling Capacity (≈ Sensible Gain)	21,600Btu/h (G)											
Total Heat Gain	27,543Btu/h (B)	Determined by Manual J8 load calculation	Latent Cooling Capacity (≈ Latent Gain)	6,800Btu/h (G)											
Sensible Heat Gain	23,321Btu/h (G)		Indoor Unit Model Number:	AH-030	Fictitious air handler										
Latent Heat Gain	4,222Btu/h (G)		Indoor Blower CFM (CFM used to determine capacity in manufacturer's performance data):	1,000 (G)	Can the indoor blower deliver design airflow on Medium fan speed										
Sensible Heat Ratio (SHR)	85% (C)	See formula below	Btuh Difference between Heat Pump Balance Point and Total Heat Loss	30,281 Btu/h (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.										
Design Air Flow	400cfm/ton (D)	See Chart below, nominally CFM is 350-450 CFM/Ton depending on design conditions	Auxiliary Heat (Circle):	10 KW (H)	In this example the auxiliary heat is electric, the formula for electric heat is KW= Btu/h ÷ 3.413										
$\text{SHR} = \frac{\text{Sensible Heat}}{\text{Total Heat Gain}} = 85\% = \frac{23,321\text{Btu/h}}{27,543\text{Btu/h}}$			Electric Gas Oil												
<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th colspan="2">Sensible Heat Ratio to CFM per Ton</th> </tr> <tr> <td>SHR</td> <td>Recommended Air Flow</td> </tr> <tr> <td>Below 0.80</td> <td>350 cfm/Ton</td> </tr> <tr> <td>0.80 – 0.85</td> <td>400 cfm/Ton</td> </tr> <tr> <td>Above 0.85</td> <td>450 cfm/Ton</td> </tr> </table>		Sensible Heat Ratio to CFM per Ton		SHR	Recommended Air Flow	Below 0.80	350 cfm/Ton	0.80 – 0.85	400 cfm/Ton	Above 0.85	450 cfm/Ton	85% ≈ 400cfm/ton (D)			
Sensible Heat Ratio to CFM per Ton															
SHR	Recommended Air Flow														
Below 0.80	350 cfm/Ton														
0.80 – 0.85	400 cfm/Ton														
Above 0.85	450 cfm/Ton														
From Manual J8 Tables		From Manual J8 Load Calculation	From Equipment Performance Data												