Sponsored by the ACCA
Code Committee

Air Conditioning
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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.

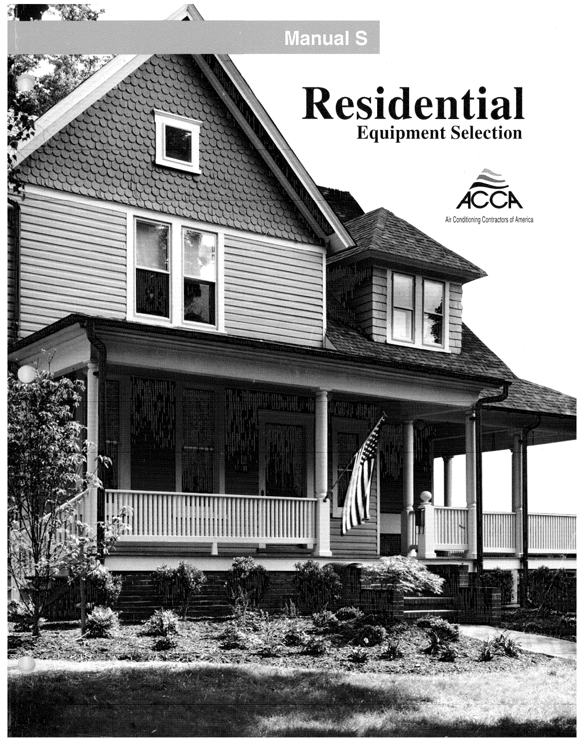
For a more detailed analysis on the design process

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

AIR CONDITIONING CONTRACTORS OF AMERICA®

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

Load Calculation	ACCA Manual J
Equipment Selection	**ACCA Manual S**
Duct Design	ACCA Manual D
Air Distribution	ACCA Manual T
Test, Adjust, and Balance	Residential Duct Diagnostic and Repair

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?
3	Equipment Performance	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)
		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

Winter Design Conditions		
Outdoor °F:	27°F (A)	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 (B)	Determined by Manual J8 load calculation

Summer Design Conditions		
Outdoor°F:	85°F (A)	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 (B)	Determined by Manual J8 load calculation
Sensible Heat Gain	23,321Btu/h (G)	
Latent Heat Gain	4,222Btu/h (G)	
Sensible Heat Ratio (SHR)	85% (C)	See formula below
Design Air Flow	400cfm/ton (D)	See Chart below, nominally CFM is 350-450 CFM/Ton depending on design conditions

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

$$85\% = \frac{23{,}321\text{Btu/h}}{27{,}543\text{Btu/h}}$$

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

(D) 85% ≈ 400cfm/ton

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 (E)	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 (F)	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 (G)	
Latent Cooling Capacity (≈ Latent Gain)	6,800Btu/h (G)	
Indoor Unit Model Number:	AH-030	Fictitious air handler
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
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.
Auxiliary Heat (Circle): Electric Gas Oil	10 KW (H)	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 Equipment Performance Data