



**Air Conditioning
Contractors of America**

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The Air Conditioning Contractors of America (ACCA) is dedicated to excellence in the heating, ventilation, air conditioning and refrigeration (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.

Sponsored by the ACCA Code Committee

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 HVACR industry. This information has been provided for entities, seeking to verify that load calculations for an HVACR application have been correctly performed. For more information, contact:
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Verifying
ACCA Manual J®
Procedures

MANUAL **J**

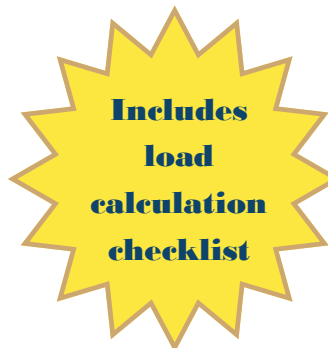
Residential Load Calculation

Hank Rutkowski, P.E.

EIGHTH EDITION

Includes demo software on CD-ROM.

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WHY ARE HEAT LOSS AND HEAT GAIN CALCULATIONS IMPORTANT

Achieving occupant satisfaction is the principal goal of any HVAC design. Primary factors impacting occupant satisfaction include: filtration, temperature and humidity control, air motion in the room, adequate ventilation, interior zoning needs and energy efficient operation. Occupant satisfaction is maximized when the heating and cooling system and equipment are the correct type and size and the air distribution system is properly designed and installed.

For residential applications, ACCA's Manual J, Eighth Edition (MJ8™) is the only procedure recognized by the American National Standards Institute (ANSI) and specifically required by residential building codes. Methods not based on actual construction details, nor founded on relevant physical laws and engineering principles, are unlikely to result in correct equipment sizing.

PROBLEMS WITH OVERSIZED EQUIPMENT

Oversized equipment results in marginal part load temperature control. While the temperature control at the thermostat may be satisfactory, equipment cycling may cause noticeable temperature swings in other rooms and larger temperature differences between rooms. Oversized equipment may cause degraded humidity control and increase the potential for mold growth, allergic reactions and respiratory problems. In these unfavorable conditions, occupants may experience additional discomfort and dissatisfaction. Other negative effects are higher installed costs, increased operating expenses, and increased maintenance costs. Furthermore, oversized equipment generally requires larger ducts, poses additional requirements on the power grid and may lead to more service calls.

REASONS FOR OVERSIZED EQUIPMENT

Three main reasons for oversized equipment are: (1) a guess is made on the load; (2) mistakes are made in the load calculation; (3) the equipment is selected for either unusual/extreme conditions such as abnormal temperatures or unusual occupancy loads (i.e. gatherings/parties). Other reasons include the use of inappropriate and inadequate "rules of thumb" such as '500ft²/ton', '400CFM/ton', or 'total cooling capacity = 1.3 x sensible cooling capacity'. Furthermore, seemingly trivial mistakes such as ignoring building efficiency upgrades and assuming that the original design and installation are correct, all contribute towards inappropriate equipment sizing.

MANUAL J® VERIFICATION

While it is not practical to verify every aspect of a submitted MJ8 calculation, it is a good practice to review key elements that indicate general integrity of the calculations i.e. the contractor has made a good faith effort to provide reasonably accurate loads.

ITEMS TO VERIFY

The key load elements, grouped in roughly decreasing levels of impact on the overall contribution to the loads, are:

IMPACT ON LOAD ↓	H I G H	<ul style="list-style-type: none"> ✓ Design Temperatures (Indoor and Outdoor) ✓ Windows, Glass Doors and Large Skylights (shading, overhangs, etc.) ✓ Ducts (location, leakage and duct wall R-values) ✓ Ceilings under an attic (R-values, roof material, roof color)
	M E D I U M	<ul style="list-style-type: none"> ✓ Small Skylights ✓ Infiltration ✓ Ventilation
	L O W	<ul style="list-style-type: none"> ✓ Appropriately Insulated Floors ✓ Appropriately Insulated Walls ✓ Internal Gains

It is also worth noting some unusual items that also contribute to the load. These include:

- Hot Tubs
- Whirlpool Tubs
- Three-season Porches

A NOTE ON UNDERSTANDING THE DESIGN PROCESS

Manual J allows contractors to perform a load calculation on a residential building/home. Apart from the load calculation being performed, the ducts must be sized and the correct size equipment must be selected. ANSI-recognized ACCA Manual D® for duct sizing and ACCA Manual S® for residential equipment selection provide guidance here.

#	KEY ITEM	CHECK	QUESTIONS TO ASK	CIRCLE ANSWER*		
1	DESIGN TEMPERATURES	✓ Indoor Design Temperatures	Is the indoor design temperature for <i>Heating</i> : per Local Code OR 70°F (21°C) at 30% RH?	YES	NO	----
			Is the indoor design temperature for <i>Cooling</i> : per Local Code OR 75°F (24°C) at 50% RH? [or 55% for humid climate, 45% for dry climate?]	YES	NO	----
		✓ Outdoor Design Temperatures	Is the outdoor design temperature per Table 1 of MJ8 or Local Code?	YES	NO	----
2	WINDOWS & GLASS DOORS	✓ U-values and SHGC values	Are the SHGC and U-values reasonable for the window types and frame constructions? (see Table 2 of MJ8)	YES	NO	----
		✓ Shading Adjustments	Have window shading (curtains, drapes, insect screens, tinting, etc.) adjustments been made?	YES	NO	----
		✓ Overhang Adjustments	Have roof overhang adjustments been made?	YES	NO	----
		✓ Total Area	Is the total area for the windows & glass doors roughly equal to the area shown on the drawing plans?	YES	NO	----
		✓ Exposure Directions	Do the exposure directions [North (N), North-East (NE), etc.] appear correct?	YES	NO	----
3	SKYLIGHTS	✓ U-values and SHGC values	Are the SHGC and U-values appropriate for the skylight types and frame constructions? (see Table 2 of MJ8)	YES	NO	N/A
		✓ Shading Adjustments	Have adjustments been made for drapes, tinting and reflective coatings?	YES	NO	N/A
		✓ Total Area	Is the total area for the skylights roughly equal to the area shown on the drawing plans?	YES	NO	N/A
		✓ Exposure Directions	Do the exposure directions [North (N), North-East (NE), etc.] appear correct?	YES	NO	N/A
4	DOORS WOOD, METAL	✓ <i>None</i>	-----	----	----	
5	WALLS ABOVE GRADE, BELOW GRADE	✓ Insulation	Are correct wall insulation R-values taken into account when the wall loads are calculated?	YES	NO	----
		✓ Total Area	Is the total area for the walls equal to the area shown on the drawing plans?	YES	NO	----
6	CEILINGS	✓ Insulation	Is correct ceiling insulation R-value taken into account when the ceiling load is calculated?	YES	NO	N/A
		✓ Radiant Barrier	If applicable, does the load calculation take credit for a radiant barrier?	YES	NO	N/A
		✓ Roof color and material	Is correct roof color and material taken into account when the ceiling load is calculated?	YES	NO	----
		✓ Total Area	Is the total area for the ceilings equal to the area shown on the drawing plans?	YES	NO	----
7	FLOORS	✓ Insulation	Is the floor insulation and type of construction representative of what is built/planned?	YES	NO	----
8	INFILTRATION	✓ Envelope Tightness	Is the listed envelope tightness (tight, semi-tight, average, semi-loose, loose) appropriate?	YES	NO	----
		✓ Above grade volume	Is the total above grade volume equal to what is shown on the drawing plans?	YES	NO	----
9	INTERNAL GAINS	✓ Appliances	Are the appliance gains 1200 Btuh, 2400 Btuh or a value recommended by MJ8?	YES	NO	----
			<i>Is Maximum Number of Occupants = Number of Bedrooms + 1?</i>	YES	NO	----
		✓ Occupants	- Is Btuh (sensible) = 230 x Number of Occupants? - Is Btuh (latent) = 200 x Number of Occupants?	YES	NO	----
10	DUCTS	✓ Duct Location	If located in an unconditioned space, are the ducts insulated (appropriate R-value)?	YES	NO	N/A
		✓ Duct Tightness	Is the duct tightness category 'average sealed' or higher (i.e. notably sealed, extremely sealed)?	YES	NO	----
11	VENTILATION	✓ Intermittent Fans	Are intermittent bathroom and kitchen fans <u>excluded</u> from the infiltration calculations?	YES	NO	N/A
		✓ Continuous Exhaust Fans	Are dedicated exhaust fans (continuous) <u>included</u> in the calculations?	YES	NO	N/A
		✓ Heat Recovery Equipment	Are the heat recovery equipment and/or a ventilating dehumidifier included in the calculations (if applicable)?	YES	NO	N/A