

Load Calculation Inputs Guidelines for Residential Type Dwelling Units

The International Energy Conservation Code *and Mechanical Code* require that HVAC equipment be sized based on loads calculated by Manual J or other approved calculation software. *Manual J is the load calculation methodology developed by the Air Conditioning Contractors of America (ACCA).*

Load calculations must be submitted before the start of construction to ensure that equipment will meet requirements. All detailed loads must be submitted. Summary reports will not be accepted since they cannot be reviewed for accuracy. The calculation must be based on actual design, orientation of a project, appropriate climate data, and other project specifications.

The following items address common input questions. *The information herein is based on ACCA's Manual J and ASHRAE Handbook of Fundamentals in accordance with the ANSI/ASHRAE/ACCA standard 183-2007.*

Orientation and Unit Type

- Use the actual orientation of the dwelling unit, for which loads are being calculated, not worst case. (Depending on the design, a change in orientation can alter heating/cooling loads by a ton or more.)
- For multi-family buildings it is required to run load calculations for the first floor, a middle floor, and the top floor of each unit type.
- Similar unit types (e.g. B1, B1-A, B1-Balcony) may be considered the same unit type to reduce the number of individual load calculations. Please be aware that a change in square footage or items such as sliding doors for a balcony may be significant enough to warrant a separate load calculation.

Design Temperatures

- Indoor design temperature: 72 degrees for heating; 75 degrees for cooling (IECC; 78 degrees is Energy Star recommendation)
- Outdoor dry bulb design temperatures: 21 degrees winter; 92
- degrees summer

Construction Quality. A measure of the air infiltration rate through the thermal envelope (not a measure of ventilation).

- New conventional construction: “semi-tight”
- New alternative construction (e.g. SIPs, ICFs): “tight” or “best”
- Older conventional construction: actual infiltration rate as determined by blower door test or estimated based on age and condition.

Mechanical ventilation and occupant loads. Calculate the mechanical ventilation rate based on the size of the dwelling, the infiltration rate, and number of occupants.

- Occupants are calculated by number of bedrooms plus one.
- Please note that intermittent operation of exhaust fans is accounted for in the air-infiltration rate and is not to be counted toward the ventilation load unless fans are components of a dedicated mechanical ventilation system.
- A general rule for ventilation allotment is 15 cfm per bedroom (an efficiency counts as one bedroom), first bedroom is counted twice. Please refer to applicable codes for exact ventilation rates.

Internal loads (other than occupants). Internal loads depend on the size of the dwelling and the appliances, equipment and lighting within it. A reasonable range for an average dwelling is 1600 to 3000 sensible Btu/h. Please select internal loads through the listed methods below.

- **Speculative dwelling units**, defined as either owner occupied or rental dwelling units: Reference **Manual J Residential Load Calculations 8th ed. Version II, Section 22 Internal Loads Procedure, subsection 22-1 Default Appliance Loads**. Select Scenario 1 or 2 and add adjustment options if needed. Any additional internal load adjustment options must be clearly identified in the load calculation and submitted with the permit documentation for review.
- **Speculative dwelling units**, defined as either owner occupied or rental dwelling units: Reference **2013 ASHRAE Handbook Fundamentals I-P Edition, Section 17.10 Intern Gain formulas 30 and 31**. Calculation must be submitted with permit documentation for review.
- **Custom dwelling units**, defined as owner occupied dwelling units: Reference **Manual J Residential Load Calculations 8th ed. Version II, Section 22 Internal Load Procedures, subsection 22-2 Custom Internal Load Estimate**. A detailed occupancy time schedule that includes on-off usage, intensity and duration must be submitted with the permit documentation for review.
- **Lighting** should accurately represent the current Energy Code requirements. Do not adjust for “clients who may replace lighting with incandescent”.

Duct leakage calculation

- If available in the load calculation software: Select “extremely” or “notably” sealed. Loads resulting from duct leakage are different from those resulting from thermal loss/gain (see below).

Duct gains and losses. These are gains and losses resulting from the temperature differential between the inside and outside of the ducts and related air distribution systems. Factors influencing duct gain/loss include the surface area of supply and return ducts/plenums and the air temperature of where the ducts are located. Make sure that the correct duct/plenum insulation value is used.

- **Within the thermal envelope** (e.g. in sealed attics, insulated furred-downs, in conditioned space) should have very minimal heat gain or loss represented in the load calculation.

- **Outside the thermal envelope** should show a heat gain or loss associated with the ductwork.
- **Ductless systems will have zero duct gains/losses and zero duct leakage.**

Location of the supply registers. Duct gains and losses are influenced by the length/surface area of the ducts. Make sure that the Manual J inputs match the actual location of supply registers.

Glazing

- Use actual **SHGC** (solar heat gain coefficient) and **U-value** for specified windows. As per code, SHGC of glazing should reflect code requirements. Make sure the correct U-value is used, as this impacts both heat gain and heat loss.
- Include both **overhang size (projection) and separation** for all windows and doors with glazing. If gutters are specified, include them in the overhang calculation.
- Include **insect screens** for the operable portions of windows
- Include **interior shading** as appropriate. Most homeowners install and use interior window shading on most windows. We recommend calculating loads with 50% interior shading on all windows. Interior shading can be excluded from windows that are specifically designed to provide daylighting.

Calculating the effect of walls, floors and ceilings

- Use all relevant specified materials in calculating loads – e.g., color of roofing; wall structure (frame or mass); kind, thickness and location of insulation.
- The *type* of wall, ceiling, or floor has a big influence on heat gains/losses. Walls adjacent to garages or other unconditioned spaces (partition walls) will have smaller loads than exterior walls– the same is true for living space above a garage.

Sensible Heat Ratio (SHR). Most new construction will have a calculated or “J” SHR of between .82 and .93. Use the calculated value. The Manual J software usually has a default SHR of 0.70, which is appropriate for dwellings in very humid areas that have excessive infiltration and excessive leakage on the return side of the HVAC system. For load calculations created in software other than Manual J; you will be asked to identify this value and adjust accordingly.

Equipment selection and sizing –utilizing Manual S for residential type dwelling units

While Manual J calculates the heating and cooling loads, ACCA Manual S is used to select the equipment of appropriate capacity to satisfy those loads. It is sometimes difficult to closely match equipment capacity to loads, especially in small or very efficient structures. ACCA Quality Installation (QI) Guidelines and ACCA Manual S specify the following:

- **Single Stage:** Total equipment capacity between 90% and 115% of the calculated system load.
- **Dual Stage:** Total equipment capacity between 90% and 120% of the calculated load.
- **Variable Stage:** Total equipment capacity between 90% and 130% of the calculated load.

Match the structure’s total calculated load (sensible + latent) to the total capacity of the equipment. Matching only the building’s sensible load to the sensible capacity of the equipment ignores latent capacity that shifts to sensible capacity at higher outdoor temperatures. This can result in systems that are oversized and deliver poor comfort at slightly lower temperatures.

Additional Guidance

- Do not oversize dual capacity systems on the rationale that they “will run on the lower capacity most of the time”.
- For very small dwelling units requiring modest cooling capacity (less than 1.3 tons) consider inverter (variable load response) equipment.
- If the equipment sensible load is less than the calculated sensible load, the equipment latent load may substantially exceed the calculated latent. If so, subtract the calculated latent from the equipment latent, divide by two, and add the result to the equipment sensible capacity.
- Some manufacturers’ equipment can be more closely matched to the calculated loads than others. Additionally, some equipment can better deliver capacity at design conditions.