



## Building Safety

Community Development  
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# HVAC System Guidelines

Properly sizing, selecting, and installing HVAC equipment is critical to ensuring energy efficiency and comfort. The old “rule of thumb” for sizing was 1 Ton for every 500 square feet to 1,200 square feet of living space. This is **not** allowed under the Washington State Energy Code.

### HVAC – BTU Conversions

1 British Thermal Unit (BTU) = 3.41 Watts  
3,516 Watts = 12,000 BTUs  
12,000 BTUs = 1 Ton  
3.516 KiloWatts = 1 Ton

HVAC systems now come with higher efficiencies, including air-source cooling equipment surpassing 25 – SEER and gas furnaces achieving more than 98% AFUE. Appropriate installation is vital to maximize efficiencies. This includes mastic sealing all ductwork, sizing of ducts, duct run length, minimum bends, and locations of ductwork. Quality thermostat controls also aids efficiency.

Furnaces need long run cycles to maximize efficiency. Short cycles use more energy, reduce the removal of excess humidity, and burn the system out sooner.

Without using the required WSEC BTU size calculations, heating systems are typically oversized between 75% and 115%. Cooling systems are often oversized between 143% and 322%.

ACCA Manual J establishes the base criteria for sizing and installation practices.

### Tips

- Verify all construction details prior to calculating Manual J.
- Use actual building and window orientation. For instance, a large bank of glazing on south and west sides contribute to cooling loads. Orientation matters.
- Apply full credit for insulation improvements to the building, air sealing, sealed and insulated ductwork (R-8 minimum), and documented window performance data.
- Follow the Manual J procedures for calculating ventilation and infiltration.
- Use the outdoor design temperatures from Manual J or ASHRAE Handbook of Fundamentals, in addition to documentation for Washington state.
- Use the indoor design temperatures from the ASHRAE Comfort Chart.
- Size ductwork to ACCA, Manual D standards. Efficient duct systems often reduce equipment size.
- Match ductwork to the actual location and duct system geometry as much as possible.
- Provide hard ducted and sealed return air systems. Building cavities should not be used as return ducts.

- Calculate the number of occupants as the number of bedrooms plus one.
- Consider variable speed fans and two-stage systems for improved efficiency and airflow.
- Limit the number of appliances to those that would be on during peak loads, usually during the evening. Lighting, fixtures, and appliances impact heat load. Energy efficiency is required in 75% of all new construction spaces.
- Locate ducts in conditioned spaces whenever possible.

### Important considerations

- Latitude and the sun's angle matter. Use them when designing for outdoor temperatures.
- Most homes have blinds. Consider internal shade devices.
- Eaves of 2 to 3 feet are most beneficial.
- Intermittent fans from bathrooms, kitchens, and utility rooms are not ventilation.
- Air leakage rate matters. A leaky house and leaky ductwork do not make-up air and ventilation.
- Code ventilation rates are not default infiltration rates.
- Worst-case scenarios should not be a design factor, as well as record-breaking weather conditions, such as abnormally low or high outdoor temperatures or humidity.
- Calculations should not include safety factors.
- Known insulations levels should not be reduced to be "safe."
- Entertaining groups of people and special events do not require additional internal loads.
- "Rule of thumb" based on square footage ignores many of the factors listed above.

In addition to the extra cost of purchasing and operating oversized HVAC systems, there is increased potential for mold growth and poor comfort due to mixing conditioned air with room air. This also results in increases in the peak demand for electricity. An air conditioner sized correctly runs 100% of the time on the hottest afternoon of the year.

### References

- International Residential Code (IRC)
- International Mechanical Code (IMC)
- International Energy Conservation Code, (IECC)
- Air Conditioning Contractors of America (ACCA)
- American Society of Heating / Refrigeration / Air Conditioning Engineers (ASHRAE)
- Washington State Energy Code (WSEC)

