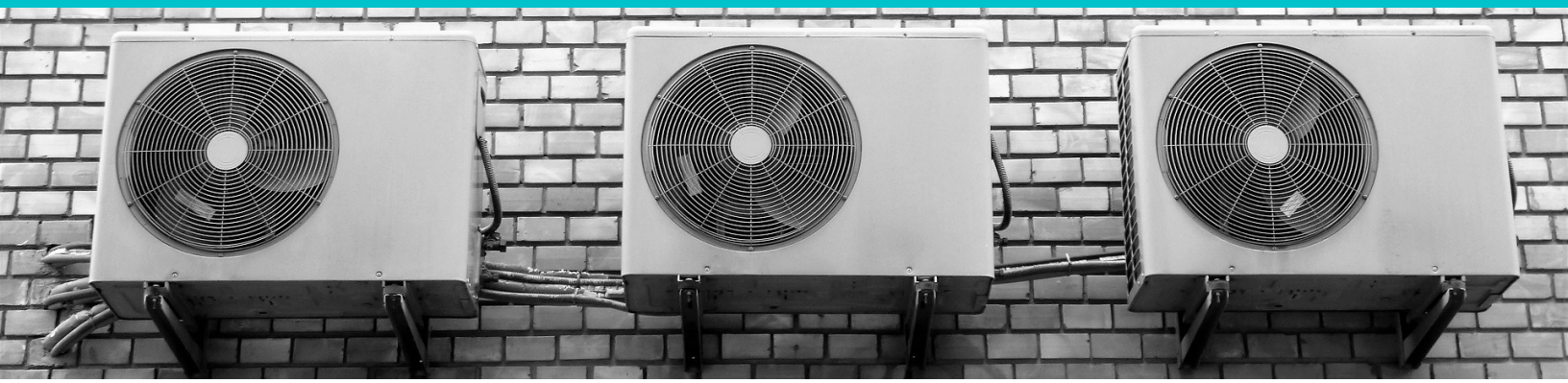
Right-Sizing of Residential HVAC Systems



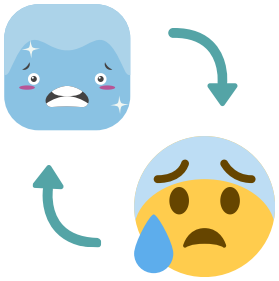
Why are HVAC systems important?

The heating, ventilation, and air conditioning (HVAC) system provides both conditioned and fresh air to help keep occupants comfortable and healthy. However, the efficiency of the HVAC system is dependent on the characteristics and quality of other building systems, including walls, windows, insulation, and air sealing. Additionally, incorrect equipment sizing negatively affects the overall performance of the HVAC system while making a home less comfortable and escalating energy costs. Understanding how the HVAC system interacts with other systems in the house, and the importance of equipment right-sizing, will help produce a healthier and more efficient indoor environment with lower maintenance costs.

An HVAC System does not Stand Alone

The HVAC system is one of the most complex systems in a house and significantly contributes to a home's total energy use. A properly designed HVAC system maintains temperature and humidity levels to improve comfort; adequately ventilates and provides fresh air; and filters air to remove pollutants. An HVAC system is required in all climates, but the ratio of cooling to heating will differ depending on geographic location. Nebraska has a mixed climate, experiencing both freezing cold and hot, humid days. Therefore, the HVAC system must be carefully designed to efficiently perform under the wide range of weather scenarios. The energy code provides guidance on how to meet these demanding requirements effectively and efficiently.

Why an Oversized HVAC System is a Bad Idea



It used to be standard practice for HVAC designers to oversize the system to compensate for unknowns like air or duct leakage, insulation levels and quality. But studies have consistently shown that new homes are generally built to a higher standard and consume far less energy than the old calculations estimated. A right-sized system will better maintain indoor temperatures and humidity, reduce energy waste, and increase occupant comfort-which is the principal goal of any HVAC system design.

But now the old unknowns can be known! A small investment in blower door and duct leakage testing will provide critical information for right-sizing equipment. The minimal cost of testing is easily offset by less expensive HVAC equipment and materials being required, fewer callbacks, and reduced contractor liability.

Despite this, studies show HVAC equipment is being consistently oversized. When a HVAC system is oversized, several negative factors arise, including increased upfront cost, decreased humidity control, the need for larger ducts, and higher energy demand. In particular, when humidity is not well controlled it can severely impact occupant health by increasing the potential for mold growth, allergic reactions and respiratory problems. Additionally, an oversized HVAC system will short-cycle, reducing the system's efficiency and allowing for more air stagnation and creating greater temperature variations throughout a home. These factors can increase the cost of running the system by 10-15%, decrease the air quality in the home, reduce the useful life of the equipment, and even compromise building materials.

Right-Sizing an HVAC System

The first step in right-sizing the HVAC system is properly calculating the cooling and heating load according to ACCA Manual J. There is no substitute – old "rules of thumb" no longer apply (and the energy code requires Manual J calculations!). ACCA Manual J calculations include a "safety factor" so there is no need to bump up the equipment size for "additional insurance." In fact, that type of oversizing often results in more callbacks, lower customer satisfaction, and increased liability. One way to reduce that liability is to submit complete and accurate Manual J calculations with every permit application.

HVAC Right-Sizing Common Issues and Resources

While each Manual J calculation is unique, there are common issues and errors that should always be double-checked for accuracy. These include:

- Building location and orientation
- Outside design dry bulb temperatures
- R-Values for walls, floors, slabs and ceiling/roof (values should match plans)
- Inside design temperatures of 72° for winter and 75° in summer
- Indoor design humidity is 30% in winter and 50% in summer
- Window U-factor and SHGC values should match plans (with appropriate credit taken for permanent shading)

Additional Resources

ACCA Manual J Brochure
https://www.acca.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=df4aaf8b-c82b-4337-bb95-081f67444222&forceDialog=0

Strategy Guideline: Accurate Heating and Cooling Load Calculations
https://www.nrel.gov/docs/fy11osti/51603.pdf

List of ACCA Approved Manual J Software
https://www.acca.org/standards/approved-software