Virginia Cooperative Extension
Virginia Tech • Virginia State University
www.ext.vt.edu

ENERGY SERIES: What about the Air Conditioning System?

As you begin the process of selecting the most efficient air conditioning system for your home, investigate the critical issues of system size, placement, installation, and contractor experience. Your goal is to obtain an efficient system by: sizing the system for the specific cooling load of your home; selecting and properly installing the thermostats or controls; designing a ductwork system to deliver the correct amount of conditioned air to each space; and sealing and insulating all ductwork.

AC Size

Heating, ventilation and air conditioning load calculations are required for new homes in many municipalities. These design loads are usually performed for each zone in a dwelling in accordance with Air Conditioning Contractors of America (ACCA) Manual J, ACCA Manual N or the ASHRAE Cooling and Heating Load Calculation Manual.

The load calculations should be based on the exact orientation, conditioned floor area (ft^2) and type of construction for each component of the building envelope, as well as the heat given off by the lights, people, and equipment inside the building. If a zoned heating and cooling system is used, the loads for each zone should be calculated. An accurate load analysis will help to prevent problems that occur when a house is equipped with an oversized, or undersized, system.

Energy Efficiency of an AC System?

The cooling efficiency of a heat pump or an air conditioning system is rated by the Seasonal Energy Efficiency Ratio (SEER), a ratio of the total cooling output to the amount of electricity used. Federal Regulation mandates a minimum SEER 14.0 for most residential air conditioners manufactured after January 1, 2015. Efficiencies of some units can be as high as SEER 26 or more. (Chances are that older homes have units with SEERs less than 10.) Note that it is important to understand that even though the SEER may be high, overall or system efficiency includes the air distribution system as well.

What about Removing Moisture?

The Sensible Heat Ratio, or SHR, describes the moisture removing capability of air conditioning systems. An SHR on HVAC equipment of 0.7 means that 70% of the air conditioning load is devoted to cooling and 30% to removing humidity. It is critical that the HVAC contractor accurately estimate the humidity, or latent load. It is important to note that many high SEER units have poor humidity removal capacity, so verify system performance before purchasing and ask the HVAC contractor to provide written confirmation.

Why are Size, SEER and SHR Important?

This is where it gets a bit complex. The SEER, the SHR, and the system tonnage must be in balance so difficulties do not occur with indoor air quality. Systems without an adequate SHR or with inaccurate tonnage, cool without removing moisture. An oversized air conditioner will "short cycle." Short cycling will cool your home too quickly to remove moisture very effectively.

This results in a home that is cool and "clammy." If units are not providing sufficient dehumidification, the typical owner response is to lower the thermostat setting. Since every degree the thermostat is lowered increases cooling bills

3% to 5%, systems that have technically high efficiencies, but inadequate dehumidification, may suffer from higher than expected cooling bills.

AC Component Locations

Central HVAC systems have a component called an air handling unit (AHU). The advantages of placing the AHU in conditioned space include: it is in a more benign environment; a central location can minimize duct lengths and optimize air flow; there is easier access for maintenance; and any leaks occur in conditioned space.

Another often-neglected area of installation concerns the placement of the outside unit (condenser). Manufacturer's recommendations for proper clearance distances should be followed to ensure there is no blockage of air flow from the unit. Also, do not vent a clothes dryer within 10 feet of the outdoor unit as dryer lint will cling to the condensing coil, lowering both the system's efficiency and service life.

Questions the HVAC Contractor Should Ask

The HVAC contractor should ask you the following questions to properly conduct a comfort analysis and system design for your family and home:

- Would you change anything about your current air conditioning and/or heating system?
- What do you like most about your present system?
- What benefits do you expect from your new system?
- Does your existing system heat and cool your home to your satisfaction?
- Are there rooms that are too hot or too cold?
- What temperature is your thermostat set on during the summer? Winter?
- Do you have a scheduled lifestyle that encourages adjusting the thermostat frequently, or while you're not at home?
- Do you set the thermostat at different temperatures for the hours that you're awake and the hours you're asleep?
- What types of heating or cooling problems have you experienced?
- Have you had any problems with condensate drainage?
- What is your average summer electric bill?
- Who performs your regular energy-savings check-ups?
- How long do you plan on residing in this home?
- Do you plan to remodel and/or expand your floor plan in the future?
- Have you made any changes to your home since the existing air conditioning and/or heating system was originally installed?
- How many people reside in your home?
- Does anyone residing in your home have allergies?
- Do you understand ratings like SEER and SHR?
- Do you understand how HVAC systems work or, more specifically, do you understand how the system I'm recommending placing in your home, works?

Many of the same questions should be asked when determining what HVAC system should go in a new home. In addition…

- **Be sure your contractor is licensed (if required in your municipality), well trained, and experienced.** Ask to see a valid license, proof of coverage for workers' compensation, and certificate of insurance coverage for liability and property damage. Inquire about references and membership in contractor associations. Ask for proof that your contractor is certified to handle refrigerant in cooling systems.
- **Request a calculation of your savings**. Heating and cooling equipment comes with two

price tags: the cost to buy the equipment and the cost to operate it. Your contractor should be able to calculate your utility bill savings and total lifetime costs.

- **Request a load calculation.** Ask your contractor to calculate equipment size using computer software or professional guidelines. This will require taking measurements in your house and asking questions. Don't use a contractor who wants to size your unit solely on the square footage of your house.
- **Inspect ducts.** Ask your contractor to inspect your ducts for leaks, incomplete connections, and compatibility with the rest of your system. Evaluate your system's performance. Ideally, your contractor should use diagnostic equipment, and, if necessary, fix leaks using a quality duct sealant. In some cases, proper duct repairs may include actual duct modifications to ensure proper supply and return airflow.
- **Consider a house pressurization test.** Test your house and appliances for "backdrafting," which occurs when the fumes from the combustion process are pulled back into the home, threatening the health and safety of occupants.
- **Replace both indoor and outdoor coils.** If you're replacing an air conditioner or heat pump, be sure to replace both indoor and outdoor coils on a matched system for maximum efficiency and reliability.
- **Obtain a written contract.** Always obtain a written contract or proposal before allowing your contractor to install a new system. Be sure to ask about warranties for labor and parts.
- **Weigh the costs.** Remember that the lowest price may not always be the best price. Carefully evaluate a contractor's proposal to ensure you get the equipment and service that best meets your needs. Paying slightly more now may get you better equipment, service and save you money in the years to come due to lower costs of ownership.
- **Install for easy maintenance.** Make sure the inside coil can be reached for its annual cleaning. The air filter(s) should also be easily removed, cleaned or changed when dirty. Check it monthly during peak season.

References and Resources

- U.S. Department of Energy (n.d.) , Building Energy Codes Program, Glossary: https://www.energycodes.gov/resource-center/glossary

Developed as part of the NASULGC/DOE Building Science Community of Practice. The factsheet editors are: Robert "Bobby" Grisso, Ph. D., Extension Engineer, Biological Systems Engineering; Martha A. Walker, Ph.D, Community Viability Specialist, Central District; Philip Agee, Ph. D., Assistant Professor, Department of Building Construction, and John Ignosh, Extension Specialist, Biological Systems Engineering, Virginia Tech.