

SATURN
RESOURCE MANAGEMENT

◆ Air Conditioners

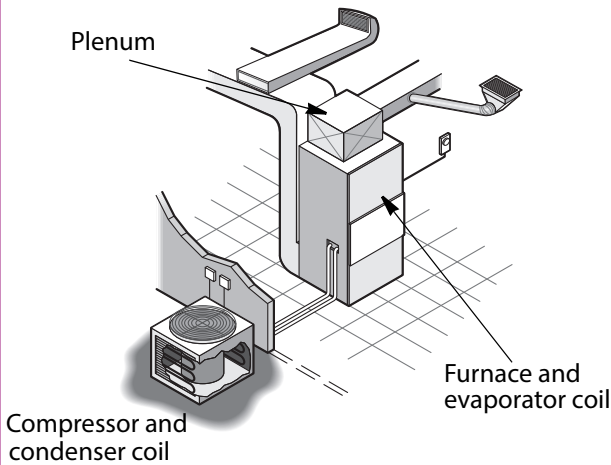
Air conditioners employ the same principles as your home refrigerator. An air conditioner cools your home with a cold indoor coil, called the *evaporator*. A hot outdoor coil, called the *condenser*, releases the collected heat outdoors. The evaporator and condenser coils are actually serpentine copper pipes surrounded by aluminum fins, similar to a car radiator. Fans move air through these coils.

A fluid, called the *refrigerant*, collects heat at the evaporator coil and releases it at the condenser coil. The compressor forces the refrigerant through the circuit of coils and pipes. Heat pumps and air conditioners are almost identical in operation except that heat pumps are reversible for winter heating.

Types of Air Conditioners

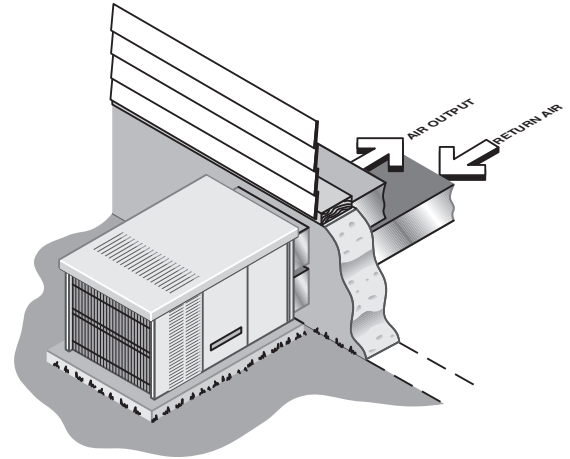
Central air conditioners have supply and return ducts that connect to a central air handler. The condenser unit is outside and releases heat collected from inside the house. Most central air conditioners are *split-systems*—that is, they have the evaporator coil indoors and the condenser coil outdoors. *Packaged air conditioners* have both coils outdoors.

Split-System Air Conditioner



This upflow furnace has the evaporator coil in its plenum (main supply duct). The condenser and compressor are outdoors. Split system air conditioners can be a part of combustion furnaces, electric furnaces, or heat pumps.

Packaged Air Conditioner

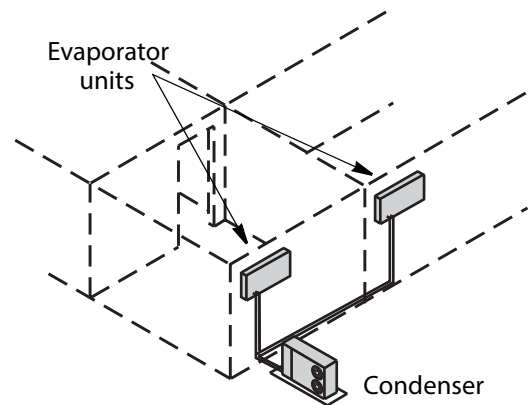


The packaged air conditioner contains an evaporator, condenser, compressor, and all the other parts in a single cabinet located outdoors. Indoor air is circulated through the evaporator and cooled, while the outdoor air absorbs the heat collected indoors.

Room air conditioners work well for smaller homes or homes in mild climates, where residents use air conditioning occasionally. Room air conditioners install in a window or a hole in the wall—wall installations being preferable for appearance. Room air conditioners save energy by cooling only the home's occupied areas, rather than the entire house.

Mini-split system air conditioners combine features of room air conditioners and central split-system air conditioners. Mini-splits, as they are called, use an evaporator coil and fan in each room with a single condensing unit outdoors. They have no ducts. This new type of air conditioner is more expensive than standard room air conditioners, and may even cost more than a conventional central air-conditioning system. Designers and contractors use them when there is no space to install ducts. Mini-splits can save energy over central air conditioners when used for spot cooling occupied rooms instead of the whole house—a conservation measure not practical with conventional central air conditioners.

Mini-Split Air Conditioning System



Mini-split systems employ a cooling unit—with an evaporator coil and fan—in each room. The condensing unit serves up to four indoor units.

Each of these types may be purely an air conditioner or a heat pump. Heat pumps are reversible air conditioners that move heat in or out of the home, depending on the season.

Air-conditioner Efficiency

The energy ratings of air conditioners are based on how many BTUs (heat) per hour the unit can remove for each watt of power it draws.

For central air conditioners, the efficiency rating is called the *Seasonal Energy Efficiency Ratio*, or SEER. For room air conditioners, it is called *Energy Efficiency Ratio*, or EER.

$$\text{SEER or EER} = \frac{\text{BTUs per hour heat removed}}{\text{Watts of electrical power drawn}}$$

Air conditioners with higher EER or SEER generally cost more, but the energy savings will return the higher initial investment several times during the air conditioner's life. The Energy Guide Label, listing EER or SEER, must remain on the air conditioner until it is sold.

The most efficient air conditioners are listed by size and efficiency in the *Consumer Guide to Home Energy Savings*, published by the American Council for an Energy-Efficient Economy. See Bibliography.

Buy the most efficient air conditioner you can afford, especially if you live in a hot climate, or if your air-conditioning costs are high.

Room air conditioner sizes range from 5500 BTUH to 14,000 BTUH. National appliance standards require room air conditioners built after January 1, 1990, to have an EER of 8.5 or greater. An EER of 10 is considered very energy-efficient. If you live in a mild cooling climate, select a room air conditioner with an EER of at least 9.0. Select one with an EER over 10 if you live in a hot climate.

Cooling Device	Watts	Cost (¢/Hour)
Central air conditioner	2000–5000	16–40
Room air conditioner	500–3000	4–24
Evaporative Cooler	400–1800	3–15
Whole-House Fan	300–600	2–5
Circulating/Exhaust Fan	25–200	0.2–1.6
The ranges of watts and hourly cost represent the different sizes of the cooling devices. The hourly cost assumes 8¢ per kilowatt-hour.		

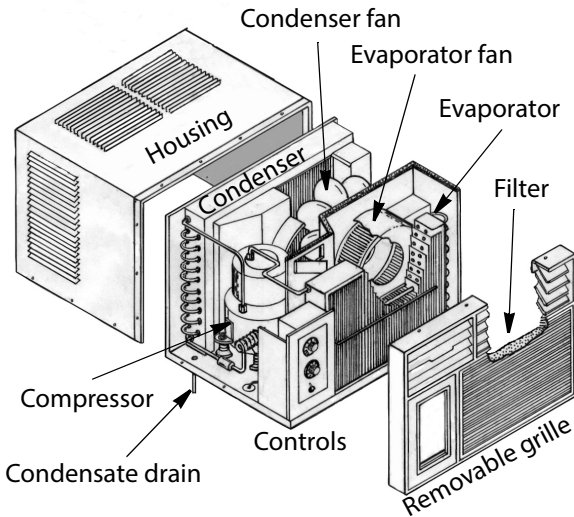
National appliance minimum standards for central air conditioners require a SEER between 8.9 and 10.0, depending on when the unit was manufactured. There is a wide selection of units available with SEERs up to almost 17. Before 1979, the SEERs of central air conditioners ranged from 4.5 to 8.0. Replacing a 1970's vintage central air conditioner that has a SEER of 6 with a new unit that has a SEER of 12 will cut air-conditioning costs in half.

To determine the approximate SEER of an existing central air conditioner, find the model number and manufacturer from the nameplate on the outdoor unit. Contact a local dealer of that manufacturer's equipment and ask them to look up the efficiency rating for you. If they can't give you the efficiency rating, ask them if they know of a local manufacturer's representative who can estimate the efficiency.

New Energy-efficient Air Conditioners

The efficiency of today's air conditioners is one-and-a-half to two times greater than air conditioners made in the mid-1970s. This improvement in efficiency has resulted from technical advances such as:

Room Air Conditioners



Room air conditioner performance deteriorates as it accumulates dirt. The air conditioner will eventually break down or fail to cool the room unless it is cleaned.

- ◆ Variable-speed or two-speed blowers.
- ◆ Copper tubing grooved inside to increase surface area.
- ◆ Aluminum fins spaced closer together and perforated to improve heat transfer to air.
- ◆ Improved electric motor design.
- ◆ Dual-speed compressors.
- ◆ Time-delay relays controlling evaporator fans.

Sizing and Selecting Air Conditioners

Size is a very important consideration to achieve comfort and minimize energy cost when selecting new air-conditioning equipment. Oversized air conditioners cycle more than correctly sized ones. With each cycle, the air conditioner has to heat the condenser, cool the evaporator, and cool the ductwork before beginning to cool the home. This start-up energy is wasted at the end of the cycle, so more cycles waste more energy.

When selecting air conditioners, consider cooling, moisture removal, and energy efficiency. The amount of heat gain during the hottest (and most humid) weather is used to determine the air conditioner's *capacity*. This capacity is measured in BTUs per hour, or "tons" of cooling. Each ton equals 12,000 BTUs per hour (1 ton = 12,000 BTUs/hour).

Reputable contractors size air-conditioning systems accurately, using hand calculations or computer programs. The Air Conditioning Contractors of America publishes a calculation procedure called Manual J, the standard method for sizing central air conditioners. Several air-conditioning manufacturers and others have developed computer programs based on Manual J or on other calculation methods.

"One ton per 400 square feet of floor space" is an archaic rule-of-thumb used to estimate the size of central air conditioners in older, less efficient homes. However, sizing the system smaller to provide one ton per 700 to 1200 square feet of floor space will provide better efficiency and humidity control in energy-efficient homes.

Contractors normally oversize air conditioners by 30% to 100% to ensure they are big enough to cool the home. However, properly sized air-conditioning systems are more efficient and more effective at removing moisture than oversized systems.

Moisture removal capacity of the system—measured by *sensible heat factor (SHF)*—is an important consideration for selecting a central air-conditioning system. The SHF rates the air conditioner on its ability to remove moisture. The SHF is a decimal number between 0.5 and 1.0. The lower the SHF, the more moisture the unit will remove from the air. The SHF depends on the size and construction of the evaporator coil, and on the fan speed.