Top Ten Things Consumers Should Know About Air Conditioning

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Most homes in warm climates have air conditioning. For some, air conditioning may be a luxury, but for many, it is a necessity. Given the expense of the equipment and the power to run it, ASHRAE wants consumers to be informed about their air conditioning systems. These ten points should make a consumer more aware of the air conditioning system and better able to care for it and use it well. Should it become necessary to replace that system, seek out a qualified HVAC professional.

What is Air Conditioning?

The first functional definition of air-conditioning was created in 1908 and is credited to G. B. Wilson. It is the definition that Willis Carrier, the "father of air conditioning" subscribed to:

- Maintain suitable humidity in all parts of a building
- Free the air from excessive humidity during certain seasons
- Supply a constant and adequate supply of ventilation
- Efficiently remove from the air micro-organisms, dust, soot, and other foreign bodies
- Efficiently cool room air during certain seasons
- Heat or help heat the rooms in winter
- An apparatus that is not cost-prohibitive in purchase or maintenance

HOW AN AIR CONDITIONER WORKS

The job of your home air conditioner is move heat from inside your home to the outside, thereby cooling you and your home. Air conditioners blow cool air into your home by pulling the heat out of that air. The air is cooled by blowing it over a set of cold pipes called an evaporator coil. This works just like the cooling that happens when water evaporates from your skin. The evaporator coil is filled with a special liquid called a refrigerant, which changes from a liquid to a gas as it absorbs heat from the air. The refrigerant is pumped outside the house to another coil where it gives up its heat and changes back into a liquid. This outside coil is called the condenser because the refrigerant is condensing from a gas back to a fluid just like moisture on a cold window. A pump, called a compressor, is used to move the refrigerant between the two coils and to change the pressure of the refrigerant so that all the refrigerant evaporates or condenses in the appropriate coils.

The energy to do all of this is used by the motor that runs the compressor. The entire system will normally give about three times the cooling energy that the compressor uses. This odd fact happens because the changing of refrigerant from a liquid to a gas and back again lets the system move much more energy than the compressor uses.

WHAT A 'TON' OF COOLING IS

Before refrigeration air conditioning was invented, cooling was done by saving big blocks of ice. When cooling machines started to get used, they rated their capacity by the equivalent amount of ice melted in a day, which is where the term "ton"

came from sizing air conditioning.

A ton of cooling is now defined as delivering 12,000 BTU/hour of cooling. BTU is short for British Thermal Unit (and is a unit that the British do not use) The BTU is a unit of heating - or in this case, cooling - energy. It's more important, however, to keep in perspective that a window air conditioner is usually less than one ton. A small home central air conditioner would be about two tons and a large one about five tons.

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WHAT GOES WRONG

Unlike most furnaces, air conditioners are complex mechanical systems that depend on a wide variety of conditions to work correctly. They are sized to meet a certain "load" on the house. They are designed to have certain amount of refrigerant, known as the "charge". They are designed to have a certain amount of air flow across the coils. When any of these things changes, the system will have problems.
If you produce more heat indoors either from having more people or appliances or because of changes in the house, the air conditioning may not be able to keep up.

If the refrigerant charge on the system leaks out, it lowers the capacity of the system. You will simply get less cooling and system will not be able to keep up when the load gets high.

If airflow across the outdoor (condenser) coil is reduced, the ability to reject heat outdoors is reduced and the again the capacity of the system may go down, especially at higher outdoor temperatures.

In dry climates such as the Southwest United States, the same issues happen with regard to the indoor (evaporator) coil: higher airflow helps, lower airflow hurts. In humid climates, the situation is more complex. At higher airflows, there will be less dehumidification, leading to high indoor humidities. If the airflow gets too low, however, the evaporator coil may freeze. This makes performance worse and can damage the compressor until it fails - leaving you with an expensive repair bill and no cooling!

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WHAT THOSE FILTERS DO

Almost every air conditioning system has a filter upstream of the evaporator coil. This can be in the return grille or in special slots in the duct system and can be a fuzzy-looking or a folded paper filter. This filter removes particles from the air stream to both keep the air conditioning system clean and to remove particles from the air.

As the filter does its job, it gets loaded with more and more particles. This actually has the effect of making it more efficient, but it also increases resistance and reducing airflow. When this happens, it is time to change the filter. How long it will take to happen depends on how dirty the air is and how big the filter is.

If you don't change the filter, the air flow will go down, and the system will not perform well. Not only that, but if the filter is too dirty, it starts to become a source or air pollution itself.
If you take the filter out completely, you would solve the low air flow problem, but this victory would be short lived. The particles that the filter would have taken out will now build up on your evaporator coil and eventually cause it to fail. A new filter is a lot cheaper.

When you do buy a new filter, ASHRAE recommends getting one with a Minimum Efficiency Rating Value of MERV 6 or higher.

MAINTAIN THE SYSTEM

Routine maintenance such as changing filters can be handled by most consumers, but others require professional service.

It's a good idea to brush dirt and obstructions from the coils and the drains at the start of each cooling season. Depending on the system and the consumer, this may require a service call from a professional.

If the system is not producing as much cold air as is normal, it could also be an indication of a refrigerant charge or airflow problems. These

be an indication of a refrigerant charge or airflow problems. These problems may require servicing.

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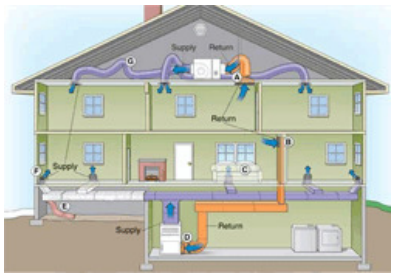
DUCTS MATTER - A LOT

Another reason systems may appear not to be producing enough cold air is because of duct leakage. Duct leakage can sap 20 to 40% of the energy out of even a well-operating air conditioner, if the ducts pass outside the cooled space (this includes attics, crawlspaces and garages). Ducts outside need to be well insulated. Various products exist specifically for insulating ducts that can be installed by a keen home owner or a professional contractor.



You might be able to get an extra half ton of air conditioner capacity for free, if you seal your leaky ducts. If the ducts are accessible, handy consumers can seal ducts with mastic—that white sticky stuff you can paint on the ducts. Otherwise you would need a professional to seal the ducts.

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HOW TO INCREASE ENERGY EFFICIENCY

Sealing leaky ducts may be the biggest single thing you can do to improve efficiency, but a lot of the issues mentioned about will help as well: replace dirty filters, keep the right charge and airflow, clean the coils.

Another thing to do is to make sure the outdoor (condenser) unit is not so hidden from sight that its air flow is blocked or that leaves or other matter are not clogging it.

If you are replacing the air conditioner, look to buy high efficiency equipment. The most generally known efficiency rating is Seasonal Energy Efficiency Rating (SEER). SEER 13 is the minimum efficiency you should consider, but higher efficiencies are likely to be quite cost effective.

Depending on your climate, you may wish to consider other efficiency numbers as well. For example, in hot, dry climates you should look at the Energy Efficiency Rating (EER) which says how well the system will work at peak conditions. If you live in a hot, humid climate you need to consider how well the unit can dehumidify.

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LIGHTEN YOUR LOAD

You can make your air conditioner work better by reducing the size of the job it has to do. You can do this by improving the building or reducing the internally generated loads that your air conditioner must deal with.

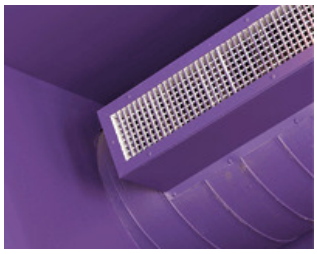
Improving the building "envelope" includes things such increasing insulation levels or shading windows or reducing air leakage. Such improvements will reduce energy spent on heating and cooling, but may require substantial time or investment. When putting in a new roof or new windows, it is usually cost effective to use high-efficiency products. "Cool" roofing, for example, can save half a ton of cooling and a lot of energy over the year.

Reducing internal loads can be simpler. Shut off unneeded electrical appliances, lights and equipment. Shift appliance use (such as washers and dryers) to cooler times of the day. Use local exhaust fans to remove heat and humidity from kitchens and baths. Buying Energy Star or similarly efficiency appliances helps as well.

In some climates other techniques can be used to reduce the load on the air conditioner. In dry climates evaporative air conditions (the modern version of what used to be called "swamp coolers") can provide substantial cooling. In climates with large temperature swings, such as the hot, dry climates, you can reduce the load by bringing in large amounts of cool outdoor air. Such systems can be called "night cooling" "ventilative cooling" or "residential economizers".

VENTILATE

The previous points have focused on cooling, but the original definition of air conditioning contains more than that; an ideal air conditioner should heat, cool, clean, ventilate, humidify and dehumidify as needed to provide health and comfort. In fact the second most important objective of the original definition is to provide ventilation. Whether or not the piece of equipment we call an air conditioner provides it, ventilation is needed.



Without adequate ventilation, contaminants generated indoors will can lead to significant health and comfort problems. ASHRAE recommends that there be at least enough ventilation to exchange the air inside house once every four hours, depending on house design.
Older homes tend to have leakier walls and leakier ducts and mostly get sufficient ventilation through such leakage. Such leakage and infiltration may not be the most energy efficient approach to ventilation and is an opportunity for savings.

Most new homes and some existing homes are relatively tight and thus require mechanical ventilation to meet minimum ventilation requirements.

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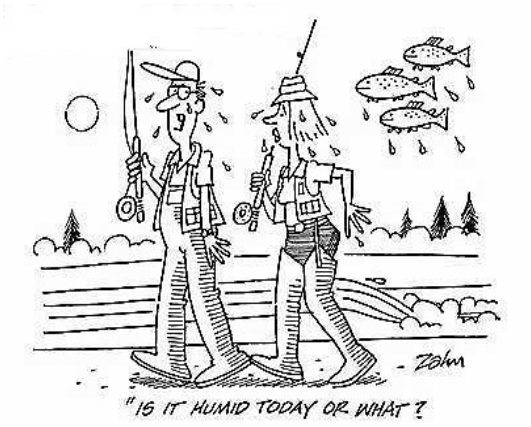
IT'S NOT THE HEAT, IT'S THE HUMIDITY

Humidity control was the problem that originally spurred the need for air conditioning. Lack of humidity control in hot, humid climates, in particular, can lead to mold growth and other moisture-related problems. High indoor humidities can lead to health and comfort problems.
Modern air conditioners dehumidify as they cool; you can see that by the water that drains away, but this dehumidification is incidental to their main job of controlling temperature. They cannot independently control both temperature and humidity.



In hot, humid climates the incidental dehumidification that occurs may not always be enough to keep the indoor humidity conditions acceptable. (ASHRAE recommends roughly a 60% relative humidity maximum at 78F.) The maximum dehumidification happens not at the hot times of the year—when the air conditioner is running a lot—but at mild times of the year when the air conditioner runs very little.

Although there are some leading edge air conditioning systems that promise to independently control humidity, conventional systems may not be able to sufficiently control the problem and

can cause comfort or mold problems in certain situations. Some current high-end systems have enhanced dehumidification, but when the existing system cannot sufficiently dehumidify, it may be necessary to buy a stand-alone dehumidifier.

There are things that consumers can do to lessen the need for dehumidification:

Do not set your thermostat to the "fan on" position. In this position the fan blows air all the time whether your cooling system is running or not and one key impact is that a lot of the moisture your system just took out of the air, will be blown back into the house before it can drain way.

Use exhaust fans during moisture-producing activities. Cooking, bathing, washing, and similar activities produce a lot of moisture inside the home. Exhaust that moisture directly outdoors using a fan. Similarly, avoid drying clothes indoors except with a clothes dryer that is exhausted directly outdoors.

Do not open windows or use ventilative cooling when it is too humid outside.

These 10 points will help consumers more aware of their air-conditioning systems and better able to care for them and use them well. Should it become necessary to replace that system seek out a qualified HVAC professional, preferably, of course, a member of ASHRAE.

ASHRAE is the world's foremost technical society in the fields of heating, ventilation, air conditioning and refrigeration. The Society helps keep indoor environments comfortable and productive, deliver healthy food to consumers and preserve the outdoor environment. ASHRAE's technical foundation is built by some 50,000 volunteer members, including consulting

engineers, contractors, manufacturers, manufacturing representatives/sales, and architects.

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