AIR CONDITIONER BUYING GUIDE

Unless you live in a magical realm where the summer temperatures are always perfect, you have air conditioning installed in your home. In the United States, 75% of homes have at least one AC unit installed, and in new home construction, 90% include central air. It's not just here in the US. China now has the highest total number of AC units installed, and is fast catching us for the total amount of electric power dedicated to cooling homes and businesses.

Counter to the increased energy usage trend are AC units that are more efficient and better-insulated buildings that demand a lot less electricity for heating and cooling than even ten years ago. These and other factors make it necessary to know what you're facing when you consider replacing, upgrading or installing a new central air conditioning system.

It really does pay to do your homework when considering a change to your home's HVAC, so congratulations for finding and reading this article. We hope to give you the information you need to make a great decision about your home's HVAC system.

Central Air Conditioning - The Basics

How Home AC works

In 1902, engineer Willis Carrier drew up a plan for an air handling system that solved air quality problems for a New York publishing company. It included what we consider today to be the four requirements of an air conditioning system: regulate temperature and humidity while filtering and circulating conditioned air inside a enclosed space. He was later awarded a patent for his *Apparatus for Treating Air.*

While the principles haven't changed, the methods and materials have improved far beyond what Mr. Carrier could imagine. Here's how a modern air conditioning or refrigeration system works:

Air is moved through the house by way of a network of ducts and returns. As air is pulled into your central AC unit, it flows through the Evaporator- a cold "coil," of sealed, refrigerant-filled copper pipes with aluminum vanes attached (for greater surface area). How does it get so cold? In most systems, it's a frosty 40 degrees.

Evaporation. just like the chill you get when stepping out of the shower into a cool bathroom. Heat always flows from warmer to colder. When liquid water turns to a gas (vapor), it takes some heat with it leaving the wet surface cooler than it was before. Air conditioning uses special Refrigerants that evaporate easily and can then be condensed back into liquid just as easily due to their chemical makeup.

A cold spray of refrigerant enters the piping of the Evaporator coil. As warm house air blows across the aluminum vanes of the coil, its warmth transfers to the refrigerant. Fine so far, but how does the refrigerant get cold again? That happens outside your home in the exterior half of the system.

The Evaporator gets its name from the fact that it creates a change in the refrigerant from a low pressure-low temperature *liquid* to a warm, low pressure *gas* which then carries heat from inside your house to another unit just outside, usually in the backyard or sometimes on the roof. The warm-ish vapor is sucked into a Compressor that creates a high pressure by shrinking the volume of the gas inside a reinforced tank to squeeze it into a high temperature-high pressure vapor.

Why the high pressure? Because in obedience to natural law that says heat can only flow from hotter to colder, the refrigerant must be hotter than the outside air for this to work! And *pressure* is the variable that makes the difference. If you can increase the temperature (to as much as 150

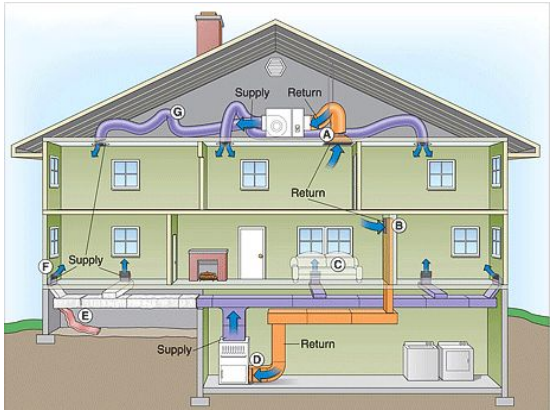
degrees) of the heat-carrying refrigerant by using pressure you can easily get a release of heat into the outside air, which might be 98 degrees on a hot day.

From the compressor with all its high energy, the refrigerant is pumped into the Condenser, a set of coils similar to the one inside the house. A blower fan moves air over the condenser and releases the built up heat energy into the outside air, like blowing on a hot cup of coffee cools it down, and the refrigerant returns (condenses) to a warm liquid state- still under high pressure.

Now the warm, high pressure refrigerant flows back into the house through special plumbing, and finally sprays into the interior coil through a small opening called an Expansion Valve, cooled back to its original starting point. It sounds like magic, but it's a simple natural principle. When the pressure of the refrigerant drops, its temperature does too, and the expansion valve creates a very large drop in pressure. Inside the indoor coil is now a low pressure, low temperature gas that is ready to cool off the air moving through the interior unit.

That's the way it works in most residential air conditioners. Window units do most of the same work, it's simply crammed into a smaller machine that will cool only one room. Large commercial AC units can work on this principle, but you'll also find an increasing number of "chiller" type coolers that work a bit differently.

Ductwork



There are quite a few variables involved in installing the perfect duct system for your home. If you already have ducts installed, there may be a case for altering the system in some ways based on the performance of the new AC unit. They may not be the right size or in the correct locations to cool at an optimal level. Undersized ductwork can create stress on the system and oversized duct volume can result in less efficient cooling.

Sealing and insulating ductwork is always a good idea! In many modern homes, even new construction, where local building codes don't require it, ducts can be left to lose up to 25% of their heat or cold into a basement or attic simply because they are not blanketed with insulation. Your heating and cooling bills are a bit higher as a result and over time it can cost you. Or, you'll notice that certain rooms are just not getting as much cooling or heating as you'd like.

Sometimes warm or cold air escapes if the joints in the system aren't sealed properly or wear over time. Duct tape has come a long way since it was first invented- foil or rubberized tapes do a much better job of making all your ducts airtight.

Dirty ducts can also present a problem. They're not as efficient and can deliver allergens and other irritants into your home as the blower forces air through the built up dust inside your ductwork.

Concepts to know when choosing your AC

Air Conditioning Unit Size

When discussing moving volumes of air around inside a building, size can be hard to conceptualize. In the HVAC world, we're talking about cooling capacity, or the ability of an AC unit to cool a certain amount of air by a certain number of degrees.

Central AC units come in a variety of sizes, based on a measurement of "tonnage." No, a "ton" in HVAC jargon refers not to a unit of 2000 pounds of weight; rather it's a reference to a unit's ability to handle a certain number of BTU's per hour. We'll come back to tonnage, but first let's understand the BTU.

BTU stands for "British Thermal Unit," shorthand for the amount of energy needed to move the temperature of one pound of water (a pint) higher or lower by one degree Fahrenheit in one hour. If you want to get really technical, one BTU is needed to heat a pint of water from exactly 39.2 degrees F to 40.2 degrees in one hour (at 39.2 degrees F, pure water is in its densest state). A single BTU isn't that much energy- about the same as a lit match.

A gallon of gasoline yields about 120,000 BTU's. Imagine a swimming pool 16 feet wide by 20 feet long and six feet deep. It would take one hour for that gallon of gasoline to heat that pool by one degree. One Watt of power (a laptop computer uses from 65-90 Watts of power to run) equals 3.4 BTUs.

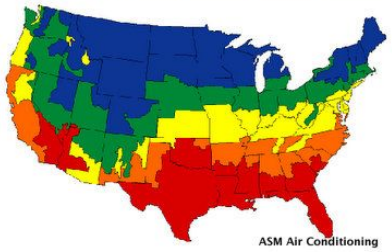
Where does the "ton" come from? It takes 12,000 BTU's to melt one ton (2,000 lbs.) of frozen 32 degree F water in 24 hours.

AC units come in a range of sizes from 1.5 tons to 5 tons. A one-ton machine can cool at a rate of 12,000 BTU's per hour, and since *air* takes only 25% of the energy needed to warm or cool *water* by one degree, that's a respectable amount of cooling ability! A two-ton unit handles 24,000 BTU's

and so on. Anything over five tons is designated as a commercial application, so if your home is super-huge, you might have two separate 3-ton units to cool it.

How to determine the size you need

Air Conditioning Square Footage Range by Climate Zone					
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
1.5 Tons	600 - 900 sf	600 - 950 sf	600 - 1000 sf	700 - 1050 sf	700 - 1100 sf
2 Tons	901-1200 sf	951 - 1250 sf	1001 - 1300 sf	1051 - 1350 sf	1101 - 1400 sf
2.5 Tons	1201 - 1500 sf	1251 - 1550 sf	1301 - 1600 sf	1351 - 1600 sf	1401 - 1650 sf
3 Tons	1501 - 1800 sf	1501 - 1850 sf	1601 - 1900 sf	1601 - 2000 sf	1651 - 2100 sf
3.5 Tons	1801 - 2100 sf	1851 - 2150 sf	1901 - 2200 sf	2001 - 2250 sf	2101 - 2300 sf
4 Tons	2101 - 2400 sf	2151 - 2500 sf	2201 - 2600 sf	2251 - 2700 sf	2301 - 2700 sf
5 Tons	2401 - 3000 sf	2501 - 3100 sf	2601 - 3200 sf	2751 - 3300 sf	2701 - 3300 sf



This is a critical step which HVAC professionals take seriously. There are published formulas and guidelines that narrow it down, but every interior space is different, requiring a careful analysis of what's needed. If your AC unit is too big, handling high BTU's for a too-small space, the AC cycles on and off too quickly resulting in temperature swings and more wear and tear on the equipment. Too small and it will run all the time trying to keep up with the heat buildup inside the house, and your electric bill will reflect the high energy use. A well-sized unit will keep indoor temperatures at a more steady level with a minimum amount of running time.

There are many ways to arrive at a beneficial size for your home. One "old school" method is to take your home's square footage, multiply by 30, divide that number by 12,000 and subtract 1. A 2000 square foot interior would need a 4-ton unit. That doesn't take into account your local climate, floor plan and design, the amount of shade you have or level of insulation you have in your home, but it does give you a rough idea.

Chart from <https://asm-air.com/airconditioning/what-size-central-air-conditioner-for-my-house/>

Your installer should be able to take many variables into account when sizing an AC unit for you. "Manual J" is a detailed approach to performing a "load calculation" on your home. It determines the size of the needed heating load on the coldest night of the year and the cooling load needed on the hottest day. Many building codes require some kind of analysis like this for new construction and there are additional detailed studies you can do- so ask your HVAC company about the ways they fine tune an exact AC size and configuration to get the maximum efficiency and comfort in your home.

Air Conditioning Unit Efficiency (SEER)

Speaking of efficiency, here are some helpful definitions that will keep you apprised of what you should expect from your AC unit. Here's what SEER means.

In any machine, some energy is lost simply in the operation of the machinery. The internal combustion gasoline engine is at best only 35-40% efficient; of the energy in the fuel, less than half actually makes the car move.

In AC equipment, efficiency is framed in terms of Watts of electric power and BTU's (see above). "EER" or "SEER" stands for Seasonal Energy Efficiency Ratio and as such , it's a number that reflects a relationship between Watts and BTU's "pulled out" of the inside air that needs cooling. It answers the question, "How many BTU's are removed per hour (another way to talk about cooling a warm room- *pulling out the heat*) per Watt of power it draws from the electrical supply?" For you mathematically-inclined people, it can be summarized this way:

$$\mathrm{EER} = \frac{\frac{\mathrm{BTUs}}{\mathrm{h}}\ \text{pulled out}}{\mathrm{Watt}}$$

In warmer climates like ours here in Georgia. A SEER of at least 10 is desired. What does that mean? Here's an example.

Suppose you have a one-ton AC unit with a SEER rating of 10. Your unit pulls out 12,000 BTU's of heat from inside your house every hour on a hot day. That's the BTU's per hour number (the little “h” in the equation stands for “hour”). We know the SEER rating is 10, with makes leaves the number of Watts as the unknown quantity. The formula gives us an answer of 1200 Watts to make the equation correct. So, to operate a one-ton AC unit removing 12,000 BTU's of heat per hour on a unit rated with a SEER of 10, you're looking at 1200 Watts of power, or 12 kWh (kilowatt hours).

As the industry innovates, the SEER numbers go up. Today's units are typically between 13 and 25, up from 8 or 9 in the recent past. Of course you'll pay more up front for a super efficient unit, but the savings over time may make up for it. It also depends on how much your unit runs every summer. There are other factors that have a bearing on the cost of your new AC unit.

Factors Affecting Cost

Of course the primary consideration for any major purchase like this is cost. Keeping the overall cost down for an installation that is going to serve you for a long time is essential to your research. As you know, sometimes the most expensive option is not the best! With and HVAC system, the variables are many and it's in your best interest to seek out an honest professional contractor to help you sort through it. Here's what's on the table when discussing how to get the best value for your money.

Factor 1- Quality

Not all units are created equal. There are at least three categories of brand quality that offer different ranges of cost and lifespan. If you're looking for a light duty AC system that doesn't need to perform at a high level year round, a budget brand might be just fine.

Only a few large corporations actually assemble all the various brands of air conditioning units. Why so many brand names then? Marketing, mostly, but there are some subtle differences in major categories here. Most of the components are very similar for the budget and middle of the road categories, with more variation in the premium brands. Here are the brands, with the parent companies.

Budget brands with a 12 to 16 year lifespan:
United Technologies Corp. - Payne
Lennox- Aire-Flo
Nortek Global- Airtemp
Goodman- Goodman
Ingersoll-Rand- Ameristar

Middle of the road brands- up to an 18 year life expectancy:
International Comfort Products Corporation- Arcoaire, Heil, ComfortMaker, KeepRite and Tempstar
Allied Air Enterprises- Armstrong and Ducane
Rheem- Rheem and Ruud
Daikin- also makes Amana
Johnson Controls- Luxaire, York and Coleman
Nortek Global- Maytag, Broan, Westinghouse, Tappan, Frigidaire, Nordyne and NuTone

Premium brands- up to 25 years of cooling:
Lennox
Ingersoll Rand- American Standard and Trane
United Technologies Corp. - Carrier and Bryant

The quality and durability of the components may be different in each category of lifespan which is reflected in the cost of the unit, but there is a quality factor that is more important- how good your HVAC service is!

Factor 2- Performance

Like brand quality, there are three general categories describing performance.

Everyone makes these as an "entry level" type of machine. They feature a SEER

of 13-15, tend to be a bit noisy, prone to higher temperature fluctuations in your home and not as fine tuned as the better ones. The compressor operates at a single setting, which means it's either on full or off.

These are installed with two-stage compressors that usually run on a low setting most of the time and are therefore quieter and more efficient. Their SEER ratings are 16-19.

The best units use compressors that are variable speed between 25% and 100% capacity depending on what's needed to cool the space. They are also much better at dehumidifying the air, much quieter and balance temperatures better than the other categories. They can have SEER numbers of up to 24.

It may be obvious that you'll pay more for a higher SEER rating, meaning a much more efficient unit. The extra cost comes from the upgrade in components and overall quality of construction. Knowing your energy cost per kilowatt hour can help you determine if the added expense up front will pay for itself over the life of the machine (it usually does).

Factor 3- Installation Costs

What's involved in placing your unit inside your home? Here's a rough idea of what each system component might cost, although the exact dollar amount depends on variables that your installer has to study to give you an exact number.

Basic installation of a new condensing unit (the outdoor part): **$3000-$4000**. If you need a new pad for it, add on another **$100**.

New insulated ductwork: **$2000- $3500**

Refrigerant lines, depending on length between your evaporator coil and condensing unit: **$500**

Evaporator Coil- depending on the type, it could cost from **$500** to **$1200**

Thermostat- these vary widely from a wall mounted non-programmable type (the ones with the dial) for **$10** up to a wi-fi-ready programmable model you can control with your phone from anywhere for **$250**.

How to get the best price on a new AC system

You can buy the highest-priced premium AC unit on the market but if you cut corners on installation, you'll never get the full benefit of the unit. Experience and expertise have no substitutes, so make sure you are using a contractor with a sterling reputation. Going with the lowest bidder is not always the wisest course of action on installation!

Get at least three bids on the work. It's easy to contact Hammock's AC here in north Atlanta. Fill out our online contact form or give us a call!

Consider the latest rebate offers and tax credits for AC units that are energy-saving. Here are a few examples of resources you can look into:

Trane's tax credit information
Database of State Incentives for Renewables & Efficiency
U.S. Department of Energy- Tax Credits, Rebates and Savings

Should I get a maintenance plan?

We might seem biased or self-serving about maintenance plans, but it is true- they will save you money and aggravation in the long run! Your HVAC system is a finely tuned machine with lots of moving parts and opportunities for wear and tear. Regular maintenance can solve a whole lot of major problems while they are still manageable. We take our cars in for oil changes because we depend on them working when we need them. Don't wait until that record cold or scorching hot summer day for major breakdown.

To run at peak efficiency and make those SEER numbers, an AC system needs checking and tuning. It could mean the difference between a summer cooling bill of $100 and $70- and that adds up quickly! Yours is among 100 million other AC units operating in the United States alone- the environmental impact of inefficient AC adds up as well.

HVAC systems have lifespans, and yours will be much shorter if you don't take care of it. The lifespan ratings and warranties on parts assume that there is regular maintenance happening, so adjust your expectations downward accordingly if you don't plan on adding in a maintenance plan.

When properly maintained, your house will simply feel better in hot or cold weather because your HVAC unit is operating the way it's supposed to. Sometimes it's simply a safety issue if there's carbon monoxide involved, a gas or refrigerant leak or extreme temperatures.

Now you know a lot more than you did before about residential HVAC and air conditioning specifically. We'd like to help you make the best possible choice for your home and family, so talk to us! We're a third generation family owned company right here in the Atlanta metro area. Visit Hammock's HVAC online for a lot more on how you can get the home comfort you need.