

HVAC Gnome



How Does an Air Conditioner Work?

by Cecilia Acevedo | Updated: January 15, 2024

HVAC



How does an air conditioner work to turn scorching summer days into refreshing retreats? From the mysterious magic of refrigerants to the laws of thermodynamics that make your room feel like the Arctic, we'll explain the science behind keeping cool. So, if you're ready to beat the heat and satisfy your curiosity, let's discover how an air conditioner works its chilling wonders.

In this article, we'll cover the following:

- [The Basics: Thermodynamics and Your Air Conditioner](#)
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The Basics: Thermodynamics and Your Air Conditioner

Understanding how an air conditioner works involves understanding the intricacies of its operation, which can be broken down into several key stages. But first, we need to review the basic rule an air conditioner must follow: thermodynamics.

Thermodynamics is a branch of physics that involves the transfer of heat as a substance changes between a gaseous or liquid state. For instance, when liquids turn into gas, they absorb heat, which is why we feel cooler when we sweat or when we get out of a cold shower. And when a gas turns back into a liquid, it releases heat and gets colder. Air conditioners use this science to work, using a special fluid called a **refrigerant** to help cool the air and absorb heat.

The Parts of an Air Conditioner



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An air conditioner, though seemingly simple on the surface, is a complex interplay of various parts, each with a vital role in the cooling process. So, let's discover the inner workings of your air conditioner, piece by piece, so that you can better understand the cooling process.

The Air Conditioning Refrigerant

Often referred to as the coolant, the air conditioner's refrigerant plays a pivotal role in the cooling process, acting as the system's lifeblood. The fluid's primary mission is to transport heat from inside your home and release it into the outdoor environment.

There are different types of refrigerants. However, when it comes to air conditioning systems, two primary types stand out: Freon and Puron.

As the cooling cycle unfolds, this versatile substance embarks on a journey through the AC's enclosed coils, undergoing gaseous and liquid transformations along the way to regulate temperature and keep your indoor environment refreshingly cool.

The Air Conditioning Evaporator

At the heart of the **indoor unit** lies the air conditioner evaporator, a critical component responsible for one of the most crucial tasks in the cooling process: absorbing heat from within your home.

Cool refrigerant is introduced into the evaporator's coil, and it's the evaporator's job to vaporize the refrigerant. It does this by drawing in warm, indoor air through a vent and over the cold evaporator coil. The refrigerant inside the coil absorbs the heat as it vaporizes. Then, a fan inside the evaporator blows the chilled air back into the room.

To ensure its efficiency, keeping the evaporator clean and well-maintained is essential. Regularly replacing air filters is a key part of this maintenance routine, as it ensures the evaporator can perform its heat-absorbing role effectively, keeping your indoor space refreshingly cool and comfortable.

The Air Conditioning Compressor

The **compressor** takes center stage as the primary component of the **outdoor unit**, where the heat is bid adieu to the great outdoors.

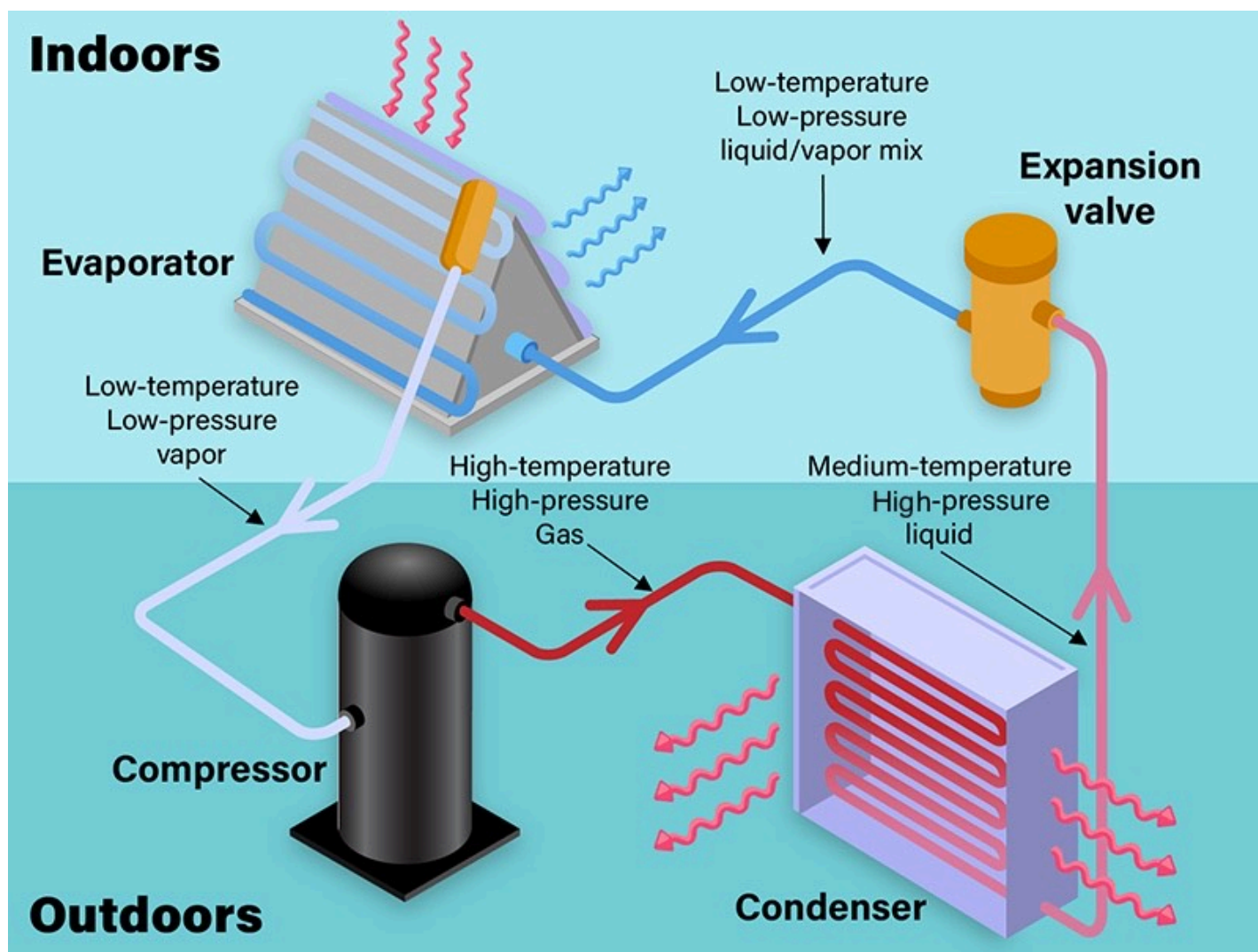
Initially, the refrigerant enters the compressor in a low-temperature, low-pressure vapor state. However, after compression, it exits as a high-temperature, high-pressure gas.

The Air Conditioning Condenser

Situated in the **outdoor unit**, the air conditioning condenser serves as the counterpart to the evaporator. While the evaporator transforms the refrigerant from liquid to vapor by absorbing heat, the condenser coils operate in reverse, turning the high-pressure vapor back into a medium-temperature, high-pressure liquid through a fascinating process known as heat transfer.

This crucial step allows the captured heat to be efficiently released into the outdoor environment. So, while the evaporator chills the indoor air, the condenser ensures that the outdoor surroundings bear the brunt of the heat, all contributing to your comfort and relaxation.

How an Air Conditioner Works Step-By-Step



Infographic by Juan Rodriguez

Stage 1: Thermostat Signal

Before the refreshing coolness of air conditioning can sweep over a room, the process begins with the thermostat. When you decide it's time to beat the heat, adjust the

thermostat to your desired temperature. Equipped with temperature sensors, this smart device constantly monitors the actual temperature in the room.

When the current temperature surpasses the threshold you've set, the thermostat springs into action. It sends a signal that kicks off the intricate cooling cycle, setting the entire air conditioner in motion to create the perfect indoor climate.

Stage 2: Evaporator Coil Absorbs Indoor Heat

Low-pressure, low-temperature refrigerant enters the evaporator coil in the indoor unit. As the warm, indoor air passes over the cold evaporator coil, the refrigerant begins to boil (because the surrounding indoor air is hotter than the cool refrigerant). The heat turns the refrigerant into a low-temperature vapor. The fans inside the evaporator blow the now cold, heat-free air back into the room.

(During this process, condensation forms on the outside of the coil and exits through a condensate drain line.)

Stage 3: Compressor Heats the Refrigerant

The refrigerant now enters the compressor as a low-temperature, low-pressure vapor. Then, after the compressor works its magic (it basically squeezes the vapor), it comes out as a high-temperature, high-pressure gas.

Stage 4: Condenser Releases the Heat Outdoors

The gaseous refrigerant then goes through a special coil called the condenser, where the gas changes back into a liquid. This is where it releases all the heat it picked up inside your house. Thanks to the compressor, the high-temperature refrigerant is now *hotter* than its outdoor surroundings. As the refrigerant loses heat to the outdoors and turns into a liquid, the fan helps to transport the heat outside of the outdoor unit.

Stage 5: Expansion Valve Lowers the Temperature

After leaving the condenser and having lost some heat, the refrigerant is now a medium-temperature, high-pressure liquid. It heads straight for something called the **expansion**

valve. This valve has a special job: it slows down the flow of refrigerant and makes the pressure and temperature drop.

As the pressure falls, the refrigerant gets even colder, turning into a low-pressure, low-temperature liquid/vapor mix. This is how we get that cold refrigerant we need for the evaporator to work.

Stage 6: The Cycle Restarts

After leaving the expansion valve, the low-pressure, low-temperature refrigerant returns to the indoor evaporator coil to absorb more heat from the home. The refrigerant goes back to the compressor and condenser to release the heat it gathered inside your house, and then the whole process begins again.

Stage 7: Thermostat Shutdown

When your home is at the right temperature, the thermostat says, “Okay, take a break.” The AC system stops, but it’s ready to start again if the temperature goes up a bit. It’s like your AC is always on standby, making sure you stay comfortable.

Moisture Mastery: AC’s Dehumidifying Feat

Air conditioners aren’t just cool; they’re also masters of moisture control. While their primary job is to keep indoor spaces comfortable by lowering the temperature, they have a hidden talent: dehumidification.

This moisture-removing occurs when the AC’s operation draws in the warm air from inside your building and guides it over the cold, frosty evaporator coils. Now, here’s where physics steps in. Warm air holds more moisture than cooler air, but it gets a chill when it encounters these frigid coils. As a result, the warm air sheds its excess moisture in the form of tiny water droplets, a process known as condensation.

These water droplets gradually accumulate and gracefully drip off the coils, where they are collected and drained away to the building’s exterior or a sewer connection. This brilliant combination of humidity removal and temperature reduction defines the

“conditioning” of the air by your trusty AC. So, while you enjoy the cool comfort, remember it’s also working tirelessly to keep the humidity levels just right, ensuring a refreshing and pleasant indoor environment.

Types of Air Conditioners

When staying cool and comfortable, the world of air conditioning offers a variety of options to suit every need and space.

From the classic window units that cool a single room to the versatile split systems that provide zonal control and the central air conditioning systems that keep entire homes chill, the array of air conditioner types is as diverse as the spaces they cool.

Each type has unique characteristics, advantages, and applications, ensuring an ideal cooling solution for every scenario. In this exploration, we’ll see the different types of air conditioners, shedding light on their features and helping you find the perfect fit to keep your indoor environment refreshingly pleasant, no matter the weather outside.

Central Air Conditioners



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Central air conditioners are the powerhouse of home cooling, utilizing a robust compressor unit located outdoors in conjunction with an indoor air handler. This dynamic duo collaborates seamlessly to deliver cool, refreshing air throughout your entire home. What sets central air conditioning systems apart is their ability to use the same air ducts as your furnace, allowing for efficient and widespread distribution of chilled air.

This makes central AC the go-to choice for larger homes, ensuring that every room enjoys the advantages of a fresh and comfortable indoor environment, regardless of the scorching temperatures outside. It's the epitome of whole-home comfort and convenience, making it a popular choice for many homeowners seeking relief from the summer heat.

Cassette Air Conditioners

Cassette air conditioners offer a unique and efficient cooling solution, as they are discreetly installed in the ceiling and designed to disperse chilled air in four distinct directions. This 360-degree airflow makes them a preferred choice for commercial settings and areas with limited wall space for traditional units.

Cassette AC systems seamlessly blend into the ceiling, making them an unobtrusive and aesthetically pleasing option while ensuring even and consistent cooling across the room.

Whether in a bustling office, a cozy restaurant, or any space where uniform cooling is essential, cassette air conditioners rise to the occasion, providing comfort and an uncluttered look to your environment.

Commercial Air Conditioners



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Commercial air conditioners are the workhorses of cooling systems, purpose-built to tackle the demands of large-scale commercial spaces. These robust systems possess the strength and capacity to efficiently cool expansive structures like department stores or towering office buildings.

With their high cooling power and performance, commercial air conditioners are engineered to maintain a comfortable and temperate indoor environment, even in the face of scorching heat and significant occupancy. They are the backbone of climate control for large-scale businesses, ensuring that employees and customers enjoy a cool and inviting atmosphere, no matter the size of the commercial space.

Window AC Units



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Window AC units are compact, self-contained air conditioning systems designed to fit snugly into the space of an open window. These handy devices are typically employed to cool individual rooms, making them particularly popular for bedrooms and smaller areas.

They offer an affordable cooling solution that can relieve the heat on a hot summer's day. However, it's worth noting that while window AC units provide effective cooling, they can be somewhat noisy compared to other air conditioners.

Despite the hum of their operation, they remain a budget-friendly and convenient choice for localized cooling needs, ensuring you can stay comfortable even when the mercury rises outside.

Ductless Mini-Split Air Conditioners

A ductless mini-split system is a versatile and highly efficient HVAC solution that can both heat and cool indoor spaces. Unlike traditional central HVAC systems that use ducts to circulate air, ductless mini-splits deliver conditioned air through individual air handlers.

What sets them apart is their ability to independently control room temperatures or zones. Each indoor unit works on its own, giving you the freedom to adjust the climate in different areas to your liking.

With their flexibility, compact design, and energy efficiency, ductless mini-splits are a great choice for various residential and commercial needs.

Health Benefits of Air Conditioning



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Air conditioners offer a multitude of health benefits that go beyond just keeping you cool on hot days. Here are some key advantages:

- **Improved Air Quality:** Air conditioners have filters that work like silent guardians, diligently removing particles and allergens like pollen and dust. This means the air you breathe inside your rooms is cleaner and healthier, making it especially beneficial for individuals with allergies.
- **Enhanced Sleep Quality:** Keeping your bedroom at a comfortable temperature through air conditioning leads to better sleep quality. When you sleep soundly, you wake up feeling rested and ready for the day ahead.
- **Dehumidification:** AC works as a dehumidifier by drawing excess moisture from the air within a room, effectively reducing humidity levels. Lower humidity not only makes the air feel more comfortable but also helps prevent mold and mildew growth.

- **Heat Stroke Prevention:** During scorching temperatures, the risk of heat-related illnesses, such as heat stroke, rises significantly. Air conditioning systems reduce this risk by maintaining a cool and comfortable indoor environment.
- **Hydration Control:** Cooler indoor temperatures mean you're less likely to sweat excessively, helping you conserve precious bodily fluids and reducing the risk of dehydration. Staying well-hydrated is vital for overall health, and air conditioning can prevent excessive fluid loss.
- **Asthma Management:** Cleaner air from the filtration system in air conditioners can significantly reduce the possibility of asthma attacks, providing relief for individuals with this condition.

In summary, air conditioners do much more than just keep you cool; they contribute to better indoor air quality, health, and overall well-being, making them a valuable addition to any living or working space.

FAQ About Air Conditioners

Can Air Conditioners Filter Out Smoke?

Air conditioners incorporate specialized filters that effectively remove dust and pollen from the air, enhancing indoor air quality. However, it's important to note that they are not specifically designed to filter out smoke particles. Nevertheless, the air quality within your space can still see an improvement when using an air conditioner compared to not having one, as it helps reduce overall particulate matter and maintains a more comfortable environment.

Does An AC Reduce Oxygen?

Air conditioners are engineered to generate and distribute cool indoor air throughout different rooms. While the air conditioning unit doesn't produce additional oxygen, it can be integrated with a dedicated duct system to bring in fresh outdoor air. This external air intake introduces supplemental oxygen into the building, ensuring a well-ventilated and oxygen-rich environment.

What is a packaged HVAC unit?

[Packaged HVAC systems](#) are like all-in-one air conditioning devices. They house everything: the evaporator coil, blower fan, compressor, and condensing coil, in a single outdoor unit. They are the right choice when space indoors is limited. They're also energy efficiency champs, with options ranging from two-stage to single-stage systems, and some even come with fancy multi-speed blower fans.

What is a ductless AC unit?

Now, onto the ductless wonders. They're not your typical central air systems because they're all about precise cooling in specific spots. No ductwork is needed! Just imagine them as cooling ninjas. You put these indoor units wherever you want coolness, and they deliver. It's like having your own temperature control for each room. So, whether you're looking for an all-in-one cooling solution or customized comfort, these ACs have got you covered.

Hire an HVAC Professional

In conclusion, understanding the inner workings of an air conditioner can demystify the cooling magic that keeps us comfortable during scorching summers. From the thermostat's command to the refrigerant's cooling journey, you now have a glimpse into the complex choreography of your AC system.

However, if you need further guidance or assistance with your air conditioner, don't hesitate to contact an [HVAC professional in your area](#). They're equipped with the expertise to keep your cooling system in top-notch condition, ensuring you stay cool and comfortable year-round.

Main Image Credit: [Pixabay](#)



Cecilia Acevedo

Cecilia is your home expert with a knack for making spaces both comfortable and efficient. Beyond her skill in transforming homes, Cecilia has a specialized focus on HVAC systems. She knows the ins and outs of heating, ventilation, and air conditioning, ensuring your home is always at the perfect temperature.

Posts by Cecilia Acevedo

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