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Reviewing Key Safety Measures for Mobile Home HVAC Work Understanding PPE Guidelines for Mobile Home Furnace Repair Following OSHA Standards During Mobile Home AC Installations Noting Electrical Hazard Precautions in Mobile Home HVAC Projects Planning Lockout Procedures for Mobile Home Heating Maintenance Checking for Proper Ventilation in Mobile Home HVAC Crawl Spaces Confirming Compliance with HUD Requirements for Mobile Home Ducts Conducting On Site Safety Assessments Before Mobile Home AC Repairs Checking Gas Line Integrity in Mobile Home Heating Systems Identifying Combustion Clearance Issues in Mobile Home Furnaces Monitoring Air Quality Factors During Mobile Home HVAC Upkeep Coordinating Exit Strategies for Emergencies in Mobile Home HVAC Work
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In the realm of modern building management, the significance of proper airflow in ensuring efficient HVAC performance cannot be overstated. Heating, Ventilation, and Air Conditioning (HVAC) systems are integral to maintaining comfortable indoor environments, but their efficiency hinges on a delicate balance that is often overlooked: airflow. Implementing airflow balancing techniques stands as a cornerstone for optimizing these systems, promising not only enhanced comfort but also substantial energy savings.

At its core, airflow balancing involves adjusting and fine-tuning the distribution of air throughout a building to ensure uniform temperature control and air quality. This process includes measuring the volume of air being delivered to different areas and making necessary adjustments through dampers or other control mechanisms. The goal is to achieve an equilibrium where each room receives precisely the amount of conditioned air it requires to maintain desired conditions.

The importance of proper airflow cannot be underestimated given its direct impact on system performance and energy consumption. When airflow is imbalanced, some areas may experience excessive heating or cooling while others remain uncomfortably warm or cold. Mobile home HVAC systems must comply with local building codes **mobile home hvac ductwork** inventory. Such disparities lead to increased workload on HVAC equipment as it struggles to meet inconsistent demands across different zones. This not only accelerates wear and tear but also results in higher energy bills due to inefficient operation.

Moreover, proper airflow enhances indoor air quality by ensuring that fresh air circulates adequately throughout the space. Stagnant zones with poor ventilation can become breeding grounds for pollutants and allergens, compromising occupant health and well-being. Balancing techniques help mitigate these risks by promoting consistent ventilation rates, thus reducing concentrations of indoor pollutants.

Implementing airflow balancing techniques begins with a comprehensive assessment of existing conditions. Technicians measure the current flow rates in various parts of the system using specialized tools such as anemometers or balometers. These measurements inform necessary adjustments; for instance, dampers can be modulated to redirect excess air from over-served areas to those requiring more supply.

Additionally, regular maintenance plays a pivotal role in sustaining balanced airflow. Filters must be cleaned or replaced routinely to prevent blockages that could disrupt flow patterns. Likewise, ductwork should be inspected for leaks or obstructions that might impede effective distribution.

Beyond technical adjustments, technology offers advanced solutions for maintaining optimal balance within HVAC systems. Smart thermostats and sensors provide real-time data on environmental conditions and system performance, enabling automated adjustments that keep airflow finely tuned without manual intervention.

In summary, understanding and implementing effective airflow balancing techniques is essential for maximizing HVAC efficiency. By ensuring equitable distribution of conditioned air throughout spaces, we not only enhance comfort levels but also achieve significant energy savings while safeguarding indoor air quality. As we continue advancing towards more sustainable building practices, embracing such strategies will undoubtedly play an instrumental role in shaping our approach to efficient climate control solutions.

Balancing airflow in mobile homes presents a unique set of challenges that are often more pronounced than those encountered in traditional housing. Mobile homes, by design, have distinct structural and spatial characteristics that necessitate a tailored approach to HVAC (heating, ventilation, and air conditioning) management. Implementing effective airflow balancing techniques within these spaces is crucial for ensuring comfort, energy efficiency, and the longevity of the HVAC systems.

One of the primary challenges in balancing airflow in mobile homes is their compact size and layout. Unlike conventional houses with attics or basements that can house extensive ductwork systems, mobile homes have limited space for such installations. This often results in shorter and more compact duct systems where airflow resistance can be higher. Additionally, due to the narrow hallways and rooms typically found in mobile homes, achieving an even distribution of air throughout the interior can be difficult. It requires careful planning and precise calculations to ensure that each room receives adequate airflow without encountering hot or cold spots.

Another significant challenge is related to the construction materials used in mobile homes. These structures often utilize lightweight materials that may not provide as much thermal insulation as those used in permanent residences. As a result, they are more susceptible to external temperature variations, which can affect indoor climate control. Properly balancing airflow becomes essential not only for maintaining a comfortable environment but also for

reducing strain on HVAC systems trying to compensate for rapid temperature changes.

Furthermore, older mobile homes might still use outdated heating or cooling technologies that are less efficient than modern solutions. In such cases, upgrading these systems while implementing new airflow balancing techniques can be financially daunting for homeowners. Nonetheless, it's important to consider these upgrades because they offer long-term benefits like reduced energy consumption and lower utility bills.

In addressing these challenges, several techniques prove beneficial for improving airflow balance within mobile homes. One effective strategy involves conducting regular maintenance checks on ductwork to identify any leaks or blockages that could impede air distribution. Ensuring ducts are properly sealed prevents loss of conditioned air and enhances system efficiency.

Moreover, utilizing adjustable vents or dampers can help direct airflow precisely where it's needed most within the home. By modifying vent settings seasonally or based on occupancy patterns, homeowners can optimize comfort levels while conserving energy.

For newer models equipped with advanced technology options like variable speed fans or zoned HVAC systems, leveraging these features allows even greater control over indoor climates by adjusting fan speeds according to specific area demands.

Ultimately though overcoming common challenges associated with managing balanced airflow involves identifying potential issues early-whether through professional inspections or attentive DIY observation-and employing targeted solutions tailored specifically toward individual needs present within varying types/styles/models found across this diverse housing category known as mobile living quarters today!

Posted by on

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Essential Safety Gear and Equipment for Technicians

Airflow balancing is an essential process in ensuring that heating, ventilation, and air conditioning (HVAC) systems operate efficiently and effectively. It involves adjusting the airflow within a building to achieve a desired balance, ensuring each room receives the right amount of air for optimal comfort and energy efficiency. Implementing airflow balancing techniques requires not only expertise but also a set of specialized tools and equipment.

Foremost among these tools is the anemometer, which measures air velocity. This device is crucial in assessing the current state of airflow within ducts and vents. By accurately gauging the speed at which air travels through the system, technicians can identify areas where adjustments are needed. Anemometers come in various forms, including vane and hot-wire types, each suited to specific scenarios and measurement needs.

Another indispensable tool in the arsenal is the manometer. This instrument measures pressure differences within the HVAC system. Understanding pressure variations helps technicians pinpoint imbalances that may cause inefficient airflow distribution or undesirable noise levels in ductwork. The data collected from manometers guide adjustments to dampers or fan speeds to equalize pressures across different zones.

Balancing hoods are also pivotal in this process. These devices capture air from diffusers or grilles and measure its volume flow rate directly. The use of balancing hoods allows for precise calibration of airflow entering individual rooms or spaces, facilitating adjustments that

ensure consistent comfort levels throughout a building.

In addition to these primary instruments, temperature sensors play a critical role in airflow balancing. They help monitor temperature variations across different areas served by an HVAC system, enabling technicians to adjust settings so that all spaces maintain uniform thermal conditions.

Furthermore, implementing effective airflow balancing techniques often requires sophisticated software for data analysis and simulation. These digital tools allow technicians to visualize airflow patterns and predict outcomes of various adjustments before physically making changes. Such foresight minimizes trial-and-error efforts while optimizing resource allocation during maintenance procedures.

Complementing these technical instruments are basic yet vital tools such as screwdrivers, wrenches, pliers, tape measures, and flashlights-each serving its purpose during installation or adjustment tasks within HVAC systems.

In conclusion, successful implementation of airflow balancing techniques hinges on a combination of skilled expertise and appropriate tools. Anemometers provide velocity readings; manometers offer pressure insights; balancing hoods ensure volumetric accuracy; temperature sensors facilitate thermal consistency-all supported by advanced software for comprehensive analysis-and bolstered by essential hand tools for hands-on work. Together they form an integrated toolkit indispensable for achieving efficient HVAC performance tailored precisely to occupants' comfort needs while conserving energy resources sustainably over time.



Proper Procedures for Handling Refrigerants and Chemicals

Implementing Airflow Balancing Techniques: A Step-by-Step Guide

Airflow balancing is a crucial aspect of maintaining an efficient and comfortable indoor environment. Proper airflow ensures that heating, ventilation, and air conditioning (HVAC) systems operate effectively, providing optimal temperature control while reducing energy consumption. Implementing airflow balancing techniques requires a systematic approach to ensure each space within a building receives the appropriate amount of air. This guide outlines the key steps involved in implementing these techniques.

The first step in achieving balanced airflow is conducting a thorough assessment of the existing HVAC system. This involves examining ductwork, vents, and registers to identify any blockages or leaks that may impede airflow. It's important to measure the current airflow at different points throughout the system using anemometers or similar instruments. By comparing these measurements with the designed specifications, one can pinpoint discrepancies that need addressing.

Once the assessment is complete, it's time to address any identified issues. Sealing leaks in ductwork is paramount as it prevents unnecessary loss of conditioned air, which can significantly affect efficiency and comfort levels. Additionally, cleaning ducts and filters will help remove any obstructions that might hinder airflow. Ensuring that all components are free from dirt and debris facilitates smoother passage of air through the system.

After resolving physical impediments within the HVAC system, focus shifts towards adjusting dampers and registers to fine-tune airflow distribution throughout the space. Dampers are critical components that allow for controlling airflow volume within ducts; thus, proper adjustment ensures even distribution across different zones in a building. It's essential to balance dampers systematically by starting with rooms farthest from the air handler unit and working towards those closest to it.

Beyond manual adjustments, employing advanced technology can further enhance precision in airflow balancing efforts. Variable Air Volume (VAV) systems offer dynamic control over airflow rates by automatically adjusting according to real-time demand changes across various zones within a building-this not only optimizes comfort but also contributes significantly towards energy savings.

Finally, ongoing monitoring and maintenance are vital for sustaining balanced airflow over time. Regular inspections should be scheduled periodically along with necessary recalibrations if needed due to seasonal variations or changes in occupancy patterns within different areas of a building structure.

In conclusion, implementing effective airflow balancing techniques requires meticulous attention coupled with systematic execution at every stage—from initial assessments through adjustments till continuous monitoring post-implementation phase—all aimed at achieving optimal indoor climate conditions aligned with energy efficiency goals simultaneously enhancing overall occupant satisfaction levels indoors alike!

Electrical Safety Protocols for Mobile Home HVAC Work

Maintaining balanced airflow over time is crucial in ensuring efficient heating, ventilation, and air conditioning (HVAC) systems. Proper airflow balancing not only enhances comfort within a building but also promotes energy efficiency, extending the lifespan of HVAC equipment. Implementing effective airflow balancing techniques requires a strategic approach to achieve optimal conditions and consistent performance.

One fundamental aspect of maintaining balanced airflow is understanding the importance of regular system assessments. Over time, various factors such as dust accumulation, changes in building occupancy, or modifications to space layouts can disrupt airflow balance. Therefore, conducting periodic inspections helps identify potential issues before they escalate into significant problems. During these assessments, it's essential to check for blockages in vents and ductwork. Cleaning or replacing filters regularly can prevent obstructions that hinder proper air distribution.

Another critical technique involves adjusting dampers within the HVAC system. Dampers are adjustable plates located within ducts that regulate air flow by opening or closing to varying degrees. By fine-tuning these dampers, one can ensure that air is evenly distributed throughout different areas of a building. This process might require some trial and error initially but ultimately leads to improved comfort levels and efficiency.

Utilizing advanced technology can also aid in achieving balanced airflow over time. Modern HVAC systems often come equipped with variable speed motors and smart thermostats that

allow for more precise control of airflow rates. These technologies automatically adjust fan speeds based on real-time temperature readings and usage patterns, ensuring that airflow remains consistent regardless of external conditions or internal changes.

Moreover, addressing any structural inefficiencies within the building itself can significantly impact airflow balance. For instance, sealing gaps around windows and doors prevents unwanted drafts that could disrupt the intended flow of conditioned air. Additionally, ensuring that insulation is adequate helps maintain desired temperatures while reducing the workload on HVAC systems.

Training maintenance personnel on the principles of airflow balancing is another vital component in sustaining long-term equilibrium. Educating staff about how different elements interact within an HVAC system empowers them to make informed decisions when troubleshooting issues or making adjustments.

Finally, collaboration between all stakeholders involved—engineers, technicians, property managers—is essential for successful implementation and maintenance of balanced airflow practices over time. Open communication channels facilitate quick identification and resolution of any disruptions affecting indoor climate control.

In conclusion, maintaining balanced airflow over time necessitates a combination of regular assessments, strategic adjustments using available tools like dampers and smart technology integration alongside addressing structural inefficiencies ensures optimal performance from your HVAC system year-round while promoting both comfortability indoors along with energy conservation efforts across spaces being managed effectively through collaborative approaches among key individuals responsible for overseeing these processes efficiently overall!





Best Practices for Ensuring Structural Integrity During Installation and Maintenance

Troubleshooting common issues with HVAC airflow in mobile homes can be a challenging yet rewarding endeavor. Mobile homes, by their very nature, present unique challenges due to their compact size and often less robust construction compared to traditional houses. Ensuring proper airflow is essential for maintaining comfort and efficiency in these living spaces. One of the most effective ways to address HVAC airflow problems is by implementing airflow balancing techniques.

Airflow balancing involves adjusting the amount of air distributed through each room or area to ensure consistent temperature and comfort levels throughout the home. In mobile homes, this process becomes crucial due to their typically smaller ductwork systems and limited space for air circulation. Common issues such as uneven heating or cooling, higher energy bills, and increased wear on HVAC components can often be traced back to imbalanced airflow.

To begin addressing these issues, one must first conduct a thorough assessment of the current airflow distribution within the mobile home. This involves checking for any obstructions in vents or ducts, ensuring that all registers are open and unobstructed by furniture or other items, and inspecting the ductwork for leaks or damage. Leaky ducts are a common problem that can significantly hinder efficient airflow and should be repaired promptly.

Once potential obstructions have been cleared, homeowners can start implementing specific techniques to balance their system effectively. One such technique is adjusting the dampers within the ductwork. Dampers are adjustable plates located inside the ducts that help control the volume of air flowing into different areas of the home. By partially closing dampers in areas that receive too much air while opening those in under-conditioned spaces, one can achieve a more even distribution of airflow.

Another useful technique is zoning, which involves dividing the home into different zones with separate thermostats controlling each area's temperature independently. This allows for more tailored climate control based on individual preferences and usage patterns across different parts of the home. However, zoning systems may require professional installation if not already present in your HVAC setup.

Moreover, regular maintenance plays an integral role in achieving balanced airflow within a mobile home's HVAC system. Regularly replacing air filters ensures that dust and debris do not accumulate within ducts or impede air movement through them-this simple act alone can significantly improve system performance over time.

Finally, it is essential to consider professional assistance when necessary; sometimes DIY fixes may not suffice due to complex underlying issues requiring expert intervention like recalibrating blower motors or resizing ductwork entirely-a task best left handled by trained technicians familiar with intricacies involved therein.

In conclusion, troubleshooting common issues related specifically towards improving overall quality concerning how heat/air conditioning circulates efficiently throughout entire dwelling remains paramount especially considering smaller confines found typically associated amongst various types/models representing modern-day manufactured housing options available today! Through diligent efforts encompassing everything from basic inspections/cleaning routines alongside strategic implementation involving advanced methodologies designed precisely around needs/preferences occupants therein-optimal results ultimately become achievable thereby ensuring maximum comfort coupled alongside minimized operational costs long-term basis alike!

In today's world, where efficiency and sustainability are more important than ever, maintaining optimal performance in heating, ventilation, and air conditioning (HVAC) systems is crucial. One key aspect of achieving this is through regularly scheduled airflow balancing maintenance. Implementing airflow balancing techniques not only improves the comfort levels within a building but also enhances energy efficiency and extends the lifespan of HVAC systems.

Airflow balancing refers to the process of adjusting and optimizing the distribution of air throughout a building's ductwork system. This ensures that each room receives the correct amount of air, leading to consistent temperatures and improved indoor air quality. The benefits of regular airflow balancing maintenance are multifaceted.

Firstly, regular maintenance helps in identifying and rectifying any imbalances in the system before they escalate into major issues. Over time, changes in occupancy or building

modifications can lead to uneven airflow distribution. By conducting routine checks, HVAC professionals can detect these discrepancies early on and make necessary adjustments. This proactive approach prevents discomfort for occupants caused by hot or cold spots within a building.

Secondly, implementing airflow balancing techniques significantly enhances energy efficiency. When an HVAC system is properly balanced, it operates at its optimum capacity without overworking any particular component. This leads to reduced energy consumption as the system does not need to compensate for imbalances by working harder than necessary. Lower energy usage translates into cost savings on utility bills, making it an economically savvy choice for both residential and commercial property owners.

Additionally, regular airflow balancing maintenance contributes to extending the lifespan of HVAC components. Systems that are forced to operate under unbalanced conditions experience increased wear and tear due to uneven pressure loads on motors and fans. Over time, this can lead to premature equipment failure and expensive repairs or replacements. By ensuring that all components function harmoniously through scheduled maintenance, property owners can protect their investment and avoid unnecessary expenses.

Furthermore, maintaining proper airflow balance plays a vital role in enhancing indoor air quality. Poorly balanced systems may lead to inadequate ventilation or excessive recirculation of stale air within certain areas of a building. This can result in increased levels of indoor pollutants such as dust, allergens, and volatile organic compounds (VOCs), ultimately affecting occupant health and well-being. Regularly scheduled maintenance ensures that fresh air is distributed efficiently throughout the space while minimizing potential health risks associated with poor IAQ.

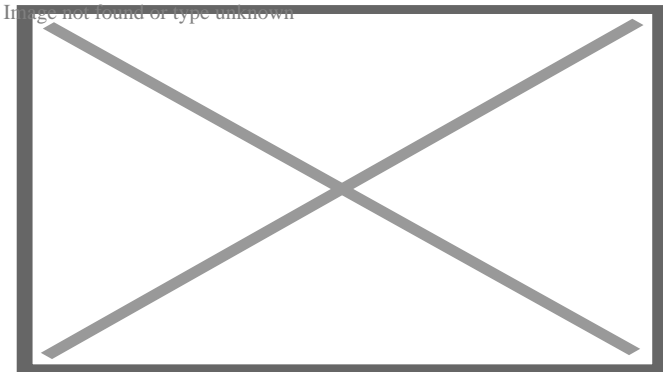
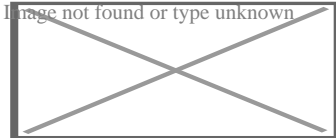
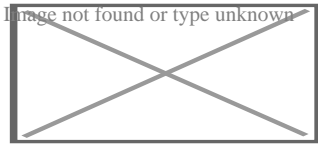
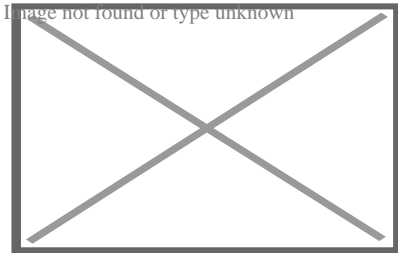
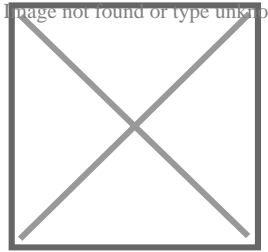
In conclusion, regularly scheduled airflow balancing maintenance provides numerous benefits for both residential homes and commercial buildings alike: improved comfort levels through consistent temperature control; enhanced energy efficiency resulting in cost savings; extended equipment lifespan due to reduced wear-and-tear; better indoor air quality promoting occupant health all contributing towards creating sustainable environments where people thrive effortlessly amidst optimal conditions year-round!



About Air conditioning

This article is about cooling of air. For the Curved Air album, see [Air Conditioning \(album\)](#). For a similar device capable of both cooling and heating, see [heat pump](#).

"a/c" redirects here. For the abbreviation used in banking and book-keeping, see [Account \(disambiguation\)](#). For other uses, see [AC](#).



There are various types of air conditioners. Popular examples include: Window-mounted air conditioner (Suriname, 1955); Ceiling-mounted cassette air conditioner (China, 2023); Wall-mounted air conditioner (Japan, 2020); Ceiling-mounted console (Also called ceiling suspended) air conditioner (China, 2023); and portable air conditioner (Vatican City, 2018).

Air conditioning, often abbreviated as **A/C** (US) or **air con** (UK),^[1] is the process of removing heat from an enclosed space to achieve a more comfortable interior temperature (sometimes referred to as 'comfort cooling') and in some cases also strictly controlling the humidity of internal air. Air conditioning can be achieved using a mechanical 'air

conditioner' or by other methods, including passive cooling and ventilative cooling.^{[2][3]} Air conditioning is a member of a family of systems and techniques that provide heating, ventilation, and air conditioning (HVAC).^[4] Heat pumps are similar in many ways to air conditioners, but use a reversing valve to allow them both to heat and to cool an enclosed space.^[5]

Air conditioners, which typically use vapor-compression refrigeration, range in size from small units used in vehicles or single rooms to massive units that can cool large buildings.^[6] Air source heat pumps, which can be used for heating as well as cooling, are becoming increasingly common in cooler climates.

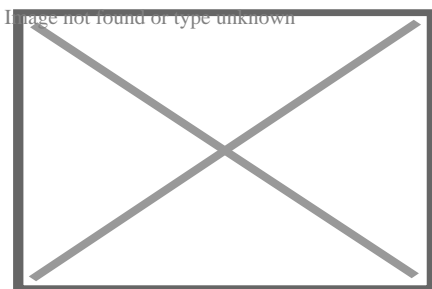
Air conditioners can reduce mortality rates due to higher temperature.^[7] According to the International Energy Agency (IEA) 1.6 billion air conditioning units were used globally in 2016.^[8] The United Nations called for the technology to be made more sustainable to mitigate climate change and for the use of alternatives, like passive cooling, evaporative cooling, selective shading, windcatchers, and better thermal insulation.

History

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Air conditioning dates back to prehistory.^[9] Double-walled living quarters, with a gap between the two walls to encourage air flow, were found in the ancient city of Hamoukar, in modern Syria.^[10] Ancient Egyptian buildings also used a wide variety of passive air-conditioning techniques.^[11] These became widespread from the Iberian Peninsula through North Africa, the Middle East, and Northern India.^[12]

Passive techniques remained widespread until the 20th century when they fell out of fashion and were replaced by powered air conditioning. Using information from engineering studies of traditional buildings, passive techniques are being revived and modified for 21st-century architectural designs.^{[13][12]}



An array of air conditioner condenser units outside a commercial office building

Air conditioners allow the building's indoor environment to remain relatively constant, largely independent of changes in external weather conditions and internal heat loads. They also enable deep plan buildings to be created and have allowed people to live comfortably in hotter parts of the world.^[14]

Development

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Preceding discoveries

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In 1558, Giambattista della Porta described a method of chilling ice to temperatures far below its freezing point by mixing it with potassium nitrate (then called "nitre") in his popular science book *Natural Magic*.^{[15][16][17]} In 1620, Cornelis Drebbel demonstrated "Turning Summer into Winter" for James I of England, chilling part of the Great Hall of Westminster Abbey with an apparatus of troughs and vats.^[18] Drebbel's contemporary Francis Bacon, like della Porta a believer in science communication, may not have been present at the demonstration, but in a book published later the same year, he described it as "experiment of artificial freezing" and said that "Nitre (or rather its spirit) is very cold, and hence nitre or salt when added to snow or ice intensifies the cold of the latter, the nitre by adding to its cold, but the salt by supplying activity to the cold of the snow."^[15]

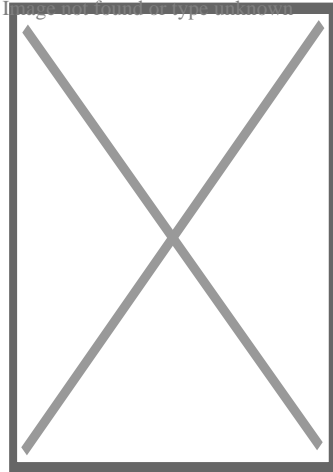
In 1758, Benjamin Franklin and John Hadley, a chemistry professor at the University of Cambridge, conducted experiments applying the principle of evaporation as a means to cool an object rapidly. Franklin and Hadley confirmed that the evaporation of highly volatile liquids (such as alcohol and ether) could be used to drive down the temperature of an object past the freezing point of water. They experimented with the bulb of a mercury-in-glass thermometer as their object. They used a bellows to speed up the evaporation. They lowered the temperature of the thermometer bulb down to $-14\text{ }^{\circ}\text{C}$ ($7\text{ }^{\circ}\text{F}$) while the ambient temperature was $18\text{ }^{\circ}\text{C}$ ($64\text{ }^{\circ}\text{F}$). Franklin noted that soon after they passed the freezing point of water $0\text{ }^{\circ}\text{C}$ ($32\text{ }^{\circ}\text{F}$), a thin film of ice formed on the surface of the thermometer's bulb and that the ice mass was about 6 mm (1/4 in) thick when they stopped the experiment upon reaching $-14\text{ }^{\circ}\text{C}$ ($7\text{ }^{\circ}\text{F}$). Franklin concluded: "From this experiment, one may see the possibility of freezing a man to death on a warm summer's day."^[19]

The 19th century included many developments in compression technology. In 1820, English scientist and inventor Michael Faraday discovered that compressing and liquefying ammonia could chill air when the liquefied ammonia was allowed to evaporate.^[20] In 1842, Florida physician John Gorrie used compressor technology to create ice, which he used to cool air for his patients in his hospital in Apalachicola, Florida. He hoped to eventually use his ice-making machine to regulate the temperature of buildings.^{[20][21]} He envisioned centralized air conditioning that could cool entire cities. Gorrie was granted a patent in 1851,^[22] but following the death of his main backer, he was not able to realize his invention.^[23] In 1851, James Harrison created the first mechanical ice-making machine in Geelong, Australia, and was granted a patent for an ether vapor-compression refrigeration system in 1855 that produced three tons of ice per day.^[24] In 1860, Harrison established a second ice company. He later entered the debate over competing against

the American advantage of ice-refrigerated beef sales to the United Kingdom.[²⁴]

First devices

[edit]



Willis Carrier, who is credited with building the first modern electrical air conditioning unit

Electricity made the development of effective units possible. In 1901, American inventor Willis H. Carrier built what is considered the first modern electrical air conditioning unit.[²⁵][²⁶][²⁷][²⁸] In 1902, he installed his first air-conditioning system, in the Sackett-Wilhelms Lithographing & Publishing Company in Brooklyn, New York.[²⁹] His invention controlled both the temperature and humidity, which helped maintain consistent paper dimensions and ink alignment at the printing plant. Later, together with six other employees, Carrier formed The Carrier Air Conditioning Company of America, a business that in 2020 employed 53,000 people and was valued at \$18.6 billion.[³⁰][³¹]

In 1906, Stuart W. Cramer of Charlotte, North Carolina, was exploring ways to add moisture to the air in his textile mill. Cramer coined the term "air conditioning" in a patent claim which he filed that year, where he suggested that air conditioning was analogous to "water conditioning", then a well-known process for making textiles easier to process.[³²] He combined moisture with ventilation to "condition" and change the air in the factories; thus, controlling the humidity that is necessary in textile plants. Willis Carrier adopted the term and incorporated it into the name of his company.[³³]

Domestic air conditioning soon took off. In 1914, the first domestic air conditioning was installed in Minneapolis in the home of Charles Gilbert Gates. It is, however, possible that the considerable device (c. 2.1 m × 1.8 m × 6.1 m; 7 ft × 6 ft × 20 ft) was never used, as the house remained uninhabited[²⁰] (Gates had already died in October 1913.)

In 1931, H.H. Schultz and J.Q. Sherman developed what would become the most common type of individual room air conditioner: one designed to sit on a window ledge. The units went on sale in 1932 at US\$10,000 to \$50,000 (the equivalent of \$200,000 to \$1,100,000 in 2023.)^[20] A year later, the first air conditioning systems for cars were offered for sale.^[34] Chrysler Motors introduced the first practical semi-portable air conditioning unit in 1935,^[35] and Packard became the first automobile manufacturer to offer an air conditioning unit in its cars in 1939.^[36]

Further development

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Innovations in the latter half of the 20th century allowed more ubiquitous air conditioner use. In 1945, Robert Sherman of Lynn, Massachusetts, invented a portable, in-window air conditioner that cooled, heated, humidified, dehumidified, and filtered the air.^[37] The first inverter air conditioners were released in 1980–1981.^[38]^[39]

In 1954, Ned Cole, a 1939 architecture graduate from the University of Texas at Austin, developed the first experimental "suburb" with inbuilt air conditioning in each house. 22 homes were developed on a flat, treeless track in northwest Austin, Texas, and the community was christened the 'Austin Air-Conditioned Village.' The residents were subjected to a year-long study of the effects of air conditioning led by the nation's premier air conditioning companies, builders, and social scientists. In addition, researchers from UT's Health Service and Psychology Department studied the effects on the "artificially cooled humans." One of the more amusing discoveries was that each family reported being troubled with scorpions, the leading theory being that scorpions sought cool, shady places. Other reported changes in lifestyle were that mothers baked more, families ate heavier foods, and they were more apt to choose hot drinks.^[40]^[41]

Air conditioner adoption tends to increase above around \$10,000 annual household income in warmer areas.^[42] Global GDP growth explains around 85% of increased air condition adoption by 2050, while the remaining 15% can be explained by climate change.^[42]

As of 2016 an estimated 1.6 billion air conditioning units were used worldwide, with over half of them in China and USA, and a total cooling capacity of 11,675 gigawatts.^[8]^[43] The International Energy Agency predicted in 2018 that the number of air conditioning units would grow to around 4 billion units by 2050 and that the total cooling capacity would grow to around 23,000 GW, with the biggest increases in India and China.^[8] Between 1995 and 2004, the proportion of urban households in China with air conditioners increased from 8% to 70%.^[44] As of 2015, nearly 100 million homes, or about 87% of US households, had air conditioning systems.^[45] In 2019, it was estimated that 90% of new single-family homes constructed in the US included air conditioning (ranging from 99% in the South to 62% in the West).^[46]^[47]

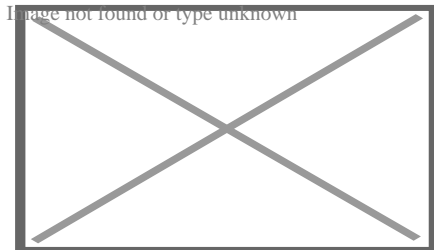
Operation

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Operating principles

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Main article: Vapor-compression refrigeration



A simple stylized diagram of the refrigeration cycle: 1) condensing coil, 2) expansion valve, 3) evaporator coil, 4) compressor

Cooling in traditional air conditioner systems is accomplished using the vapor-compression cycle, which uses a refrigerant's forced circulation and phase change between gas and liquid to transfer heat.^{[48][49]} The vapor-compression cycle can occur within a unitary, or packaged piece of equipment; or within a chiller that is connected to terminal cooling equipment (such as a fan coil unit in an air handler) on its evaporator side and heat rejection equipment such as a cooling tower on its condenser side. An air source heat pump shares many components with an air conditioning system, but includes a reversing valve, which allows the unit to be used to heat as well as cool a space.^[50]

Air conditioning equipment will reduce the absolute humidity of the air processed by the system if the surface of the evaporator coil is significantly cooler than the dew point of the surrounding air. An air conditioner designed for an occupied space will typically achieve a 30% to 60% relative humidity in the occupied space.^[51]

Most modern air-conditioning systems feature a dehumidification cycle during which the compressor runs. At the same time, the fan is slowed to reduce the evaporator temperature and condense more water. A dehumidifier uses the same refrigeration cycle but incorporates both the evaporator and the condenser into the same air path; the air first passes over the evaporator coil, where it is cooled^[52] and dehumidified before passing over the condenser coil, where it is warmed again before it is released back into the room.^[citation needed]

Free cooling can sometimes be selected when the external air is cooler than the internal air. Therefore, the compressor does not need to be used, resulting in high cooling efficiencies for these times. This may also be combined with seasonal thermal energy storage.^[53]

Heating

[edit]

Main article: Heat pump

Some air conditioning systems can reverse the refrigeration cycle and act as an air source heat pump, thus heating instead of cooling the indoor environment. They are also commonly referred to as "reverse cycle air conditioners". The heat pump is significantly more energy-efficient than electric resistance heating, because it moves energy from air or groundwater to the heated space and the heat from purchased electrical energy. When the heat pump is in heating mode, the indoor evaporator coil switches roles and becomes the condenser coil, producing heat. The outdoor condenser unit also switches roles to serve as the evaporator and discharges cold air (colder than the ambient outdoor air).

Most air source heat pumps become less efficient in outdoor temperatures lower than 4 °C or 40 °F.^[54] This is partly because ice forms on the outdoor unit's heat exchanger coil, which blocks air flow over the coil. To compensate for this, the heat pump system must temporarily switch back into the regular air conditioning mode to switch the outdoor evaporator coil *back* to the condenser coil, to heat up and defrost. Therefore, some heat pump systems will have electric resistance heating in the indoor air path that is activated only in this mode to compensate for the temporary indoor air cooling, which would otherwise be uncomfortable in the winter.

Newer models have improved cold-weather performance, with efficient heating capacity down to 14 °F (−10 °C).^[55]^[54]^[56] However, there is always a chance that the humidity that condenses on the heat exchanger of the outdoor unit could freeze, even in models that have improved cold-weather performance, requiring a defrosting cycle to be performed.

The icing problem becomes much more severe with lower outdoor temperatures, so heat pumps are sometimes installed in tandem with a more conventional form of heating, such as an electrical heater, a natural gas, heating oil, or wood-burning fireplace or central heating, which is used instead of or in addition to the heat pump during harsher winter temperatures. In this case, the heat pump is used efficiently during milder temperatures, and the system is switched to the conventional heat source when the outdoor temperature is lower.

Performance

[edit]

Main articles: coefficient of performance, Seasonal energy efficiency ratio, and European seasonal energy efficiency ratio

The coefficient of performance (COP) of an air conditioning system is a ratio of useful heating or cooling provided to the work required.^{[57][58]} Higher COPs equate to lower operating costs. The COP usually exceeds 1; however, the exact value is highly dependent on operating conditions, especially absolute temperature and relative temperature between sink and system, and is often graphed or averaged against expected conditions.^[59] Air conditioner equipment power in the U.S. is often described in terms of "tons of refrigeration", with each approximately equal to the cooling power of one short ton (2,000 pounds (910 kg) of ice melting in a 24-hour period. The value is equal to 12,000 BTU_{IT} per hour, or 3,517 watts.^[60] Residential central air systems are usually from 1 to 5 tons (3.5 to 18 kW) in capacity.^[citation needed]

The efficiency of air conditioners is often rated by the seasonal energy efficiency ratio (SEER), which is defined by the Air Conditioning, Heating and Refrigeration Institute in its 2008 standard AHRI 210/240, *Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment*.^[61] A similar standard is the European seasonal energy efficiency ratio (ESEER).^[citation needed]

Efficiency is strongly affected by the humidity of the air to be cooled. Dehumidifying the air before attempting to cool it can reduce subsequent cooling costs by as much as 90 percent. Thus, reducing dehumidifying costs can materially affect overall air conditioning costs.^[62]

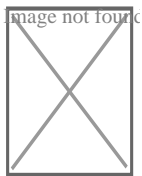
Control system

[edit]

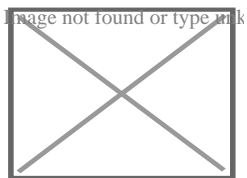
Wireless remote control

[edit]

Main articles: Remote control and Infrared blaster

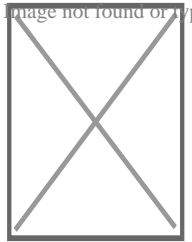
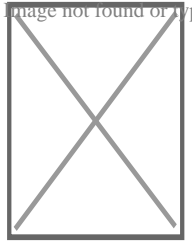


A wireless remote controller



The infrared transmitting

LED on the remote



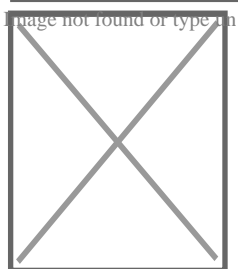
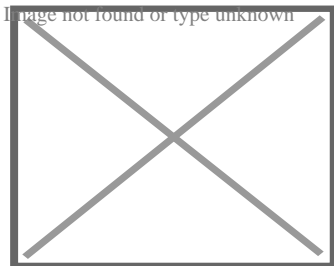
The infrared receiver on the air conditioner

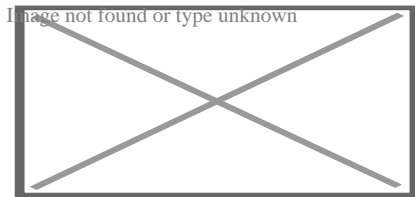
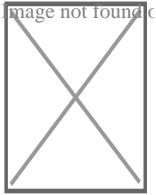
This type of controller uses an infrared LED to relay commands from a remote control to the air conditioner. The output of the infrared LED (like that of any infrared remote) is invisible to the human eye because its wavelength is beyond the range of visible light (940 nm). This system is commonly used on mini-split air conditioners because it is simple and portable. Some window and ducted central air conditioners uses it as well.

Wired controller

[edit]

Main article: Thermostat





Several wired controllers (Indonesia, 2024)

A wired controller, also called a "wired thermostat," is a device that controls an air conditioner by switching heating or cooling on or off. It uses different sensors to measure temperatures and actuate control operations. Mechanical thermostats commonly use bimetallic strips, converting a temperature change into mechanical displacement, to actuate control of the air conditioner. Electronic thermostats, instead, use a thermistor or other semiconductor sensor, processing temperature change as electronic signals to control the air conditioner.

These controllers are usually used in hotel rooms because they are permanently installed into a wall and hard-wired directly into the air conditioner unit, eliminating the need for batteries.

Types

[edit]

Types	Typical Capacity*	Air supply	Mounting	Typical application
Mini-split	small – large	Direct	Wall	Residential
Window	very small – small	Direct	Window	Residential
Portable	very small – small	Direct / Ducted	Floor	Residential, remote areas
Ducted (individual)	small – very large	Ducted	Ceiling	Residential, commercial
Ducted (central)	medium – very large	Ducted	Ceiling	Residential, commercial
Ceiling suspended	medium – large	Direct	Ceiling	Commercial
Cassette	medium – large	Direct / Ducted	Ceiling	Commercial

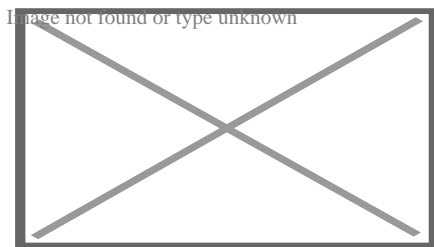
Floor standing	medium – large	Direct / Ducted	Floor	Commercial
Packaged	very large	Direct / Ducted	Floor	Commercial
Packaged RTU (Rooftop Unit)	very large	Ducted	Rooftop	Commercial

* where the typical capacity is in kilowatt as follows:

- very small: <1.5 kW
- small: 1.5–3.5 kW
- medium: 4.2–7.1 kW
- large: 7.2–14 kW
- very large: >14 kW

Mini-split and multi-split systems

[edit]



Evaporator, indoor unit, or terminal, side of a ductless split-type air conditioner

Ductless systems (often mini-split, though there are now ducted mini-split) typically supply conditioned and heated air to a single or a few rooms of a building, without ducts and in a decentralized manner.^[63] Multi-zone or multi-split systems are a common application of ductless systems and allow up to eight rooms (zones or locations) to be conditioned independently from each other, each with its indoor unit and simultaneously from a single outdoor unit.

The first mini-split system was sold in 1961 by Toshiba in Japan, and the first wall-mounted mini-split air conditioner was sold in 1968 in Japan by Mitsubishi Electric, where small home sizes motivated their development. The Mitsubishi model was the first air conditioner with a cross-flow fan.^{[64][65][66]} In 1969, the first mini-split air conditioner was sold in the US.^[67] Multi-zone ductless systems were invented by Daikin in 1973, and variable refrigerant flow systems (which can be thought of as larger multi-split systems) were also invented by Daikin in 1982. Both were first sold in Japan.^[68] Variable refrigerant flow systems when compared with central plant cooling from an air handler, eliminate the need for large cool air ducts, air handlers, and chillers; instead cool refrigerant is transported through much smaller pipes to the indoor units in the spaces to be conditioned, thus allowing for less space above dropped ceilings and a lower structural

impact, while also allowing for more individual and independent temperature control of spaces. The outdoor and indoor units can be spread across the building.^[69] Variable refrigerant flow indoor units can also be turned off individually in unused spaces.^[citation needed] The lower start-up power of VRF's DC inverter compressors and their inherent DC power requirements also allow VRF solar-powered heat pumps to be run using DC-providing solar panels.

Ducted central systems

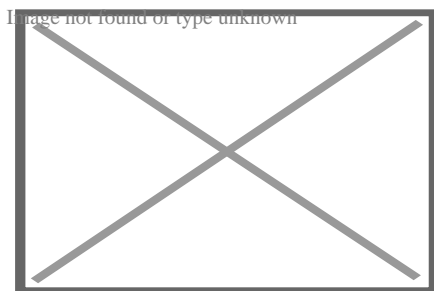
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Split-system central air conditioners consist of two heat exchangers, an outside unit (the condenser) from which heat is rejected to the environment and an internal heat exchanger (the evaporator, or Fan Coil Unit, FCU) with the piped refrigerant being circulated between the two. The FCU is then connected to the spaces to be cooled by ventilation ducts.^[70] Floor standing air conditioners are similar to this type of air conditioner but sit within spaces that need cooling.

Central plant cooling

[edit]

See also: Chiller



Industrial air conditioners on top of the shopping mall *Passage* in Linz, Austria

Large central cooling plants may use intermediate coolant such as chilled water pumped into air handlers or fan coil units near or in the spaces to be cooled which then duct or deliver cold air into the spaces to be conditioned, rather than ducting cold air directly to these spaces from the plant, which is not done due to the low density and heat capacity of air, which would require impractically large ducts. The chilled water is cooled by chillers in the plant, which uses a refrigeration cycle to cool water, often transferring its heat to the atmosphere even in liquid-cooled chillers through the use of cooling towers. Chillers may be air- or liquid-cooled.^[71]^[72]

Portable units

[edit]

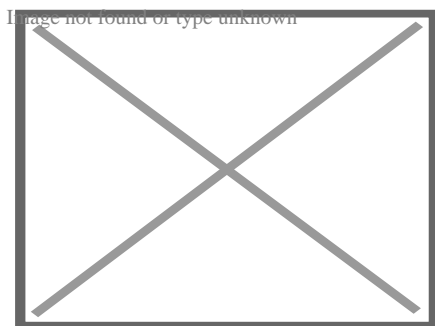
A portable system has an indoor unit on wheels connected to an outdoor unit via flexible pipes, similar to a permanently fixed installed unit (such as a ductless split air conditioner).

Hose systems, which can be *monoblock* or *air-to-air*, are vented to the outside via air ducts. The *monoblock* type collects the water in a bucket or tray and stops when full. The *air-to-air* type re-evaporates the water, discharges it through the ducted hose, and can run continuously. Many but not all portable units draw indoor air and expel it outdoors through a single duct, negatively impacting their overall cooling efficiency.

Many portable air conditioners come with heat as well as a dehumidification function.^[73]

Window unit and packaged terminal

[edit]



Through-the-wall PTAC units, University Motor Inn, Philadelphia

Main article: Packaged terminal air conditioner

The packaged terminal air conditioner (PTAC), through-the-wall, and window air conditioners are similar. These units are installed on a window frame or on a wall opening. The unit usually has an internal partition separating its indoor and outdoor sides, which contain the unit's condenser and evaporator, respectively. PTAC systems may be adapted to provide heating in cold weather, either directly by using an electric strip, gas, or other heaters, or by reversing the refrigerant flow to heat the interior and draw heat from the exterior air, converting the air conditioner into a heat pump. They may be installed in a wall opening with the help of a special sleeve on the wall and a custom grill that is flush with the wall and window air conditioners can also be installed in a window, but without a custom grill.^[74]

Packaged air conditioner

[edit]

Packaged air conditioners (also known as self-contained units)^{[75][76]} are central systems that integrate into a single housing all the components of a split central system, and deliver air, possibly through ducts, to the spaces to be cooled. Depending on their construction they may be outdoors or indoors, on roofs (rooftop units),^{[77][78]} draw the air to be conditioned from inside or outside a building and be water or air-cooled. Often, outdoor units are air-cooled while indoor units are liquid-cooled using a cooling tower.^{[70][79][80][81][82][83]}

Types of compressors

[edit]

Compressor types	Common applications	Typical capacity	Efficiency	Durability	Repairability
Reciprocating	Refrigerator, Walk-in freezer, portable air conditioners	small – large	very low (small capacity) medium (large capacity)	very low	medium
Rotary vane	Residential mini splits	small	low	low	easy
Scroll	Commercial and central systems, VRF	medium	medium	medium	easy
Rotary screw	Commercial chiller	medium – large	medium	medium	hard
Centrifugal	Commercial chiller	very large	medium	high	hard
Maglev Centrifugal	Commercial chiller	very large	high	very high	very hard

Reciprocating

[edit]

Main article: Reciprocating compressor

This compressor consists of a crankcase, crankshaft, piston rod, piston, piston ring, cylinder head and valves. ^[*citation needed*]

Scroll

[edit]

Main article: Scroll compressor

This compressor uses two interleaving scrolls to compress the refrigerant.^[84] It consists of one fixed and one orbiting scrolls. This type of compressor is more efficient because it has 70 percent less moving parts than a reciprocating compressor. *[citation needed]*

Screw

[edit]

Main article: Rotary-screw compressor

This compressor use two very closely meshing spiral rotors to compress the gas. The gas enters at the suction side and moves through the threads as the screws rotate. The meshing rotors force the gas through the compressor, and the gas exits at the end of the screws. The working area is the inter-lobe volume between the male and female rotors. It is larger at the intake end, and decreases along the length of the rotors until the exhaust port. This change in volume is the compression. *[citation needed]*

Capacity modulation technologies

[edit]

There are several ways to modulate the cooling capacity in refrigeration or air conditioning and heating systems. The most common in air conditioning are: on-off cycling, hot gas bypass, use or not of liquid injection, manifold configurations of multiple compressors, mechanical modulation (also called digital), and inverter technology. *[citation needed]*

Hot gas bypass

[edit]

Hot gas bypass involves injecting a quantity of gas from discharge to the suction side. The compressor will keep operating at the same speed, but due to the bypass, the refrigerant mass flow circulating with the system is reduced, and thus the cooling capacity. This naturally causes the compressor to run uselessly during the periods when the bypass is operating. The turn down capacity varies between 0 and 100%.^[85]

Manifold configurations

[edit]

Several compressors can be installed in the system to provide the peak cooling capacity. Each compressor can run or not in order to stage the cooling capacity of the unit. The turn down capacity is either 0/33/66 or 100% for a trio configuration and either 0/50 or 100% for a tandem. *[citation needed]*

Mechanically modulated compressor

[edit]

This internal mechanical capacity modulation is based on periodic compression process with a control valve, the two scroll set move apart stopping the compression for a given time period. This method varies refrigerant flow by changing the average time of compression, but not the actual speed of the motor. Despite an excellent turndown ratio – from 10 to 100% of the cooling capacity, mechanically modulated scrolls have high energy consumption as the motor continuously runs.^[*citation needed*]

Variable-speed compressor

[edit]

Main article: Inverter compressor

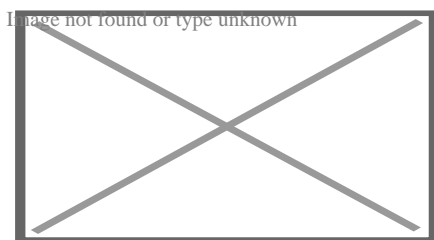
This system uses a variable-frequency drive (also called an Inverter) to control the speed of the compressor. The refrigerant flow rate is changed by the change in the speed of the compressor. The turn down ratio depends on the system configuration and manufacturer. It modulates from 15 or 25% up to 100% at full capacity with a single inverter from 12 to 100% with a hybrid tandem. This method is the most efficient way to modulate an air conditioner's capacity. It is up to 58% more efficient than a fixed speed system.^[*citation needed*]

Impact

[edit]

Health effects

[edit]



Rooftop condenser unit fitted on top of an Osaka Municipal Subway 10 series subway carriage. Air conditioning has become increasingly prevalent on public transport vehicles as a form of climate control, and to ensure passenger comfort and drivers' occupational safety and health.

In hot weather, air conditioning can prevent heat stroke, dehydration due to excessive sweating, electrolyte imbalance, kidney failure, and other issues due to hyperthermia.^[⁸]

^{86]} Heat waves are the most lethal type of weather phenomenon in the United States.^[87]
^{88]} A 2020 study found that areas with lower use of air conditioning correlated with higher rates of heat-related mortality and hospitalizations.^[89] The August 2003 France heatwave resulted in approximately 15,000 deaths, where 80% of the victims were over 75 years old. In response, the French government required all retirement homes to have at least one air-conditioned room at 25 °C (77 °F) per floor during heatwaves.^[8]

Air conditioning (including filtration, humidification, cooling and disinfection) can be used to provide a clean, safe, hypoallergenic atmosphere in hospital operating rooms and other environments where proper atmosphere is critical to patient safety and well-being. It is sometimes recommended for home use by people with allergies, especially mold.^[90]^[91] However, poorly maintained water cooling towers can promote the growth and spread of microorganisms such as *Legionella pneumophila*, the infectious agent responsible for Legionnaires' disease. As long as the cooling tower is kept clean (usually by means of a chlorine treatment), these health hazards can be avoided or reduced. The state of New York has codified requirements for registration, maintenance, and testing of cooling towers to protect against Legionella.^[92]

Economic effects

[edit]

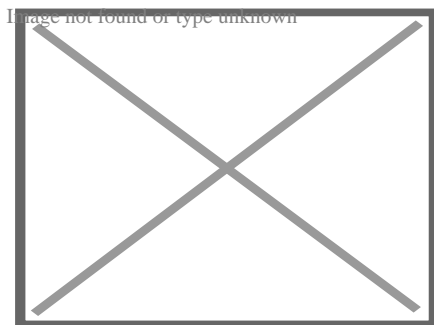
First designed to benefit targeted industries such as the press as well as large factories, the invention quickly spread to public agencies and administrations with studies with claims of increased productivity close to 24% in places equipped with air conditioning.^[93]

Air conditioning caused various shifts in demography, notably that of the United States starting from the 1970s. In the US, the birth rate was lower in the spring than during other seasons until the 1970s but this difference then declined since then.^[94] As of 2007, the Sun Belt contained 30% of the total US population while it was inhabited by 24% of Americans at the beginning of the 20th century.^[95] Moreover, the summer mortality rate in the US, which had been higher in regions subject to a heat wave during the summer, also evened out.^[7]

The spread of the use of air conditioning acts as a main driver for the growth of global demand of electricity.^[96] According to a 2018 report from the International Energy Agency (IEA), it was revealed that the energy consumption for cooling in the United States, involving 328 million Americans, surpasses the combined energy consumption of 4.4 billion people in Africa, Latin America, the Middle East, and Asia (excluding China).^[8] A 2020 survey found that an estimated 88% of all US households use AC, increasing to 93% when solely looking at homes built between 2010 and 2020.^[97]

Environmental effects

[edit]



Air conditioner farm in the facade of a building in Singapore

Space cooling including air conditioning accounted globally for 2021 terawatt-hours of energy usage in 2016 with around 99% in the form of electricity, according to a 2018 report on air-conditioning efficiency by the International Energy Agency.^[8] The report predicts an increase of electricity usage due to space cooling to around 6200 TWh by 2050,^{[8][98]} and that with the progress currently seen, greenhouse gas emissions attributable to space cooling will double: 1,135 million tons (2016) to 2,070 million tons.^[8] There is some push to increase the energy efficiency of air conditioners. United Nations Environment Programme (UNEP) and the IEA found that if air conditioners could be twice as effective as now, 460 billion tons of GHG could be cut over 40 years.^[99] The UNEP and IEA also recommended legislation to decrease the use of hydrofluorocarbons, better building insulation, and more sustainable temperature-controlled food supply chains going forward.^[99]

Refrigerants have also caused and continue to cause serious environmental issues, including ozone depletion and climate change, as several countries have not yet ratified the Kigali Amendment to reduce the consumption and production of hydrofluorocarbons.^[100] CFCs and HCFCs refrigerants such as R-12 and R-22, respectively, used within air conditioners have caused damage to the ozone layer,^[101] and hydrofluorocarbon refrigerants such as R-410A and R-404A, which were designed to replace CFCs and HCFCs, are instead exacerbating climate change.^[102] Both issues happen due to the venting of refrigerant to the atmosphere, such as during repairs. HFO refrigerants, used in some if not most new equipment, solve both issues with an ozone damage potential (ODP) of zero and a much lower global warming potential (GWP) in the single or double digits vs. the three or four digits of hydrofluorocarbons.^[103]

Hydrofluorocarbons would have raised global temperatures by around 0.3–0.5 °C (0.5–0.9 °F) by 2100 without the Kigali Amendment. With the Kigali Amendment, the increase of global temperatures by 2100 due to hydrofluorocarbons is predicted to be around 0.06 °C (0.1 °F).^[104]

Alternatives to continual air conditioning include passive cooling, passive solar cooling, natural ventilation, operating shades to reduce solar gain, using trees, architectural shades, windows (and using window coatings) to reduce solar gain.^[citation needed]

Social effects

[edit]

Socioeconomic groups with a household income below around \$10,000 tend to have a low air conditioning adoption,^[42] which worsens heat-related mortality.^[7] The lack of cooling can be hazardous, as areas with lower use of air conditioning correlate with higher rates of heat-related mortality and hospitalizations.^[89] Premature mortality in NYC is projected to grow between 47% and 95% in 30 years, with lower-income and vulnerable populations most at risk.^[89] Studies on the correlation between heat-related mortality and hospitalizations and living in low socioeconomic locations can be traced in Phoenix, Arizona,^[105] Hong Kong,^[106] China,^[106] Japan,^[107] and Italy.^{[108][109]} Additionally, costs concerning health care can act as another barrier, as the lack of private health insurance during a 2009 heat wave in Australia, was associated with heat-related hospitalization.^[109]

Disparities in socioeconomic status and access to air conditioning are connected by some to institutionalized racism, which leads to the association of specific marginalized communities with lower economic status, poorer health, residing in hotter neighborhoods, engaging in physically demanding labor, and experiencing limited access to cooling technologies such as air conditioning.^[109] A study overlooking Chicago, Illinois, Detroit, and Michigan found that black households were half as likely to have central air conditioning units when compared to their white counterparts.^[110] Especially in cities, Redlining creates heat islands, increasing temperatures in certain parts of the city.^[109] This is due to materials heat-absorbing building materials and pavements and lack of vegetation and shade coverage.^[111] There have been initiatives that provide cooling solutions to low-income communities, such as public cooling spaces.^{[8][111]}

Other techniques

[edit]

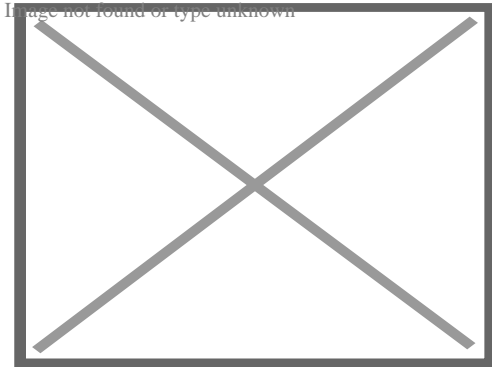
Buildings designed with passive air conditioning are generally less expensive to construct and maintain than buildings with conventional HVAC systems with lower energy demands.^[112] While tens of air changes per hour, and cooling of tens of degrees, can be achieved with passive methods, site-specific microclimate must be taken into account, complicating building design.^[12]

Many techniques can be used to increase comfort and reduce the temperature in buildings. These include evaporative cooling, selective shading, wind, thermal convection, and heat storage.^[113]

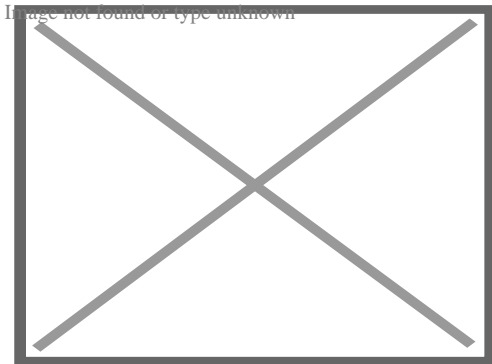
Passive ventilation

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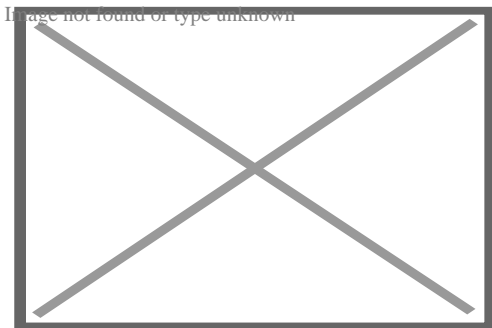
This section is an excerpt from Passive ventilation.[edit]



The ventilation system of a regular earthship



Dogtrot houses are designed to maximise natural ventilation.



A roof turbine ventilator, colloquially known as a 'Whirly Bird' is an application of wind driven ventilation.

Passive ventilation is the process of supplying air to and removing air from an indoor space without using mechanical systems. It refers to the flow of external air to an indoor space as a result of pressure differences arising from natural forces.

There are two types of natural ventilation occurring in buildings: *wind driven ventilation* and *buoyancy-driven ventilation*. Wind driven ventilation arises from the different pressures created by wind around a building or structure, and openings being formed on the perimeter which then permit flow through the building. Buoyancy-driven ventilation occurs as a result of the directional buoyancy force that results from temperature

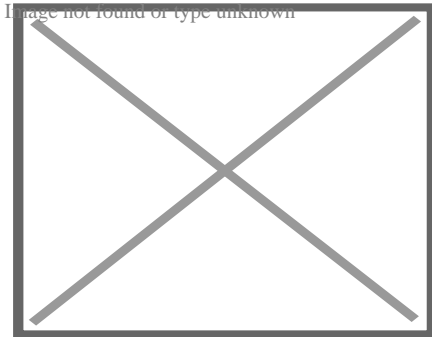
differences between the interior and exterior.[¹¹⁴]

Since the internal heat gains which create temperature differences between the interior and exterior are created by natural processes, including the heat from people, and wind effects are variable, naturally ventilated buildings are sometimes called "breathing buildings".

Passive cooling

[edit]

This section is an excerpt from Passive cooling.[edit]

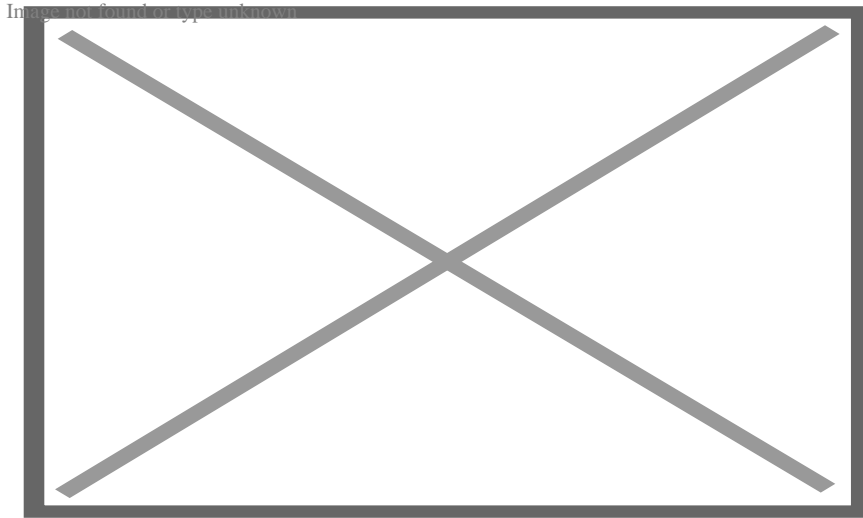


A traditional Iranian solar cooling design using a wind tower

Passive cooling is a building design approach that focuses on heat gain control and heat dissipation in a building in order to improve the indoor thermal comfort with low or no energy consumption.[¹¹⁵][¹¹⁶] This approach works either by preventing heat from entering the interior (heat gain prevention) or by removing heat from the building (natural cooling).[¹¹⁷]

Natural cooling utilizes on-site energy, available from the natural environment, combined with the architectural design of building components (e.g. building envelope), rather than mechanical systems to dissipate heat.[¹¹⁸] Therefore, natural cooling depends not only on the architectural design of the building but on how the site's natural resources are used as heat sinks (i.e. everything that absorbs or dissipates heat). Examples of on-site heat sinks are the upper atmosphere (night sky), the outdoor air (wind), and the earth/soil.

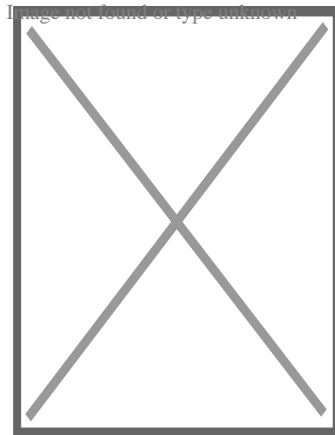
Passive cooling is an important tool for design of buildings for climate change adaptation – reducing dependency on energy-intensive air conditioning in warming environments.[¹¹⁹][¹²⁰]



A pair of short windcatchers (*malqaʿ*) used in traditional architecture; wind is forced down on the windward side and leaves on the leeward side (*cross-ventilation*). In the absence of wind, the circulation can be driven with evaporative cooling in the inlet (which is also designed to catch dust). In the center, a *shuksheika* (roof lantern vent), used to shade the qa'a below while allowing hot air rise out of it (*stack effect*).^[11]

Daytime radiative cooling

[edit]



Passive daytime radiative cooling (PDRC) surfaces are high in solar reflectance and heat emittance, cooling with zero energy use or pollution.^[121]

Passive daytime radiative cooling (PDRC) surfaces reflect incoming solar radiation and heat back into outer space through the infrared window for cooling during the daytime. Daytime radiative cooling became possible with the ability to suppress solar heating using photonic structures, which emerged through a study by Raman et al. (2014).^[122] PDRCs can come in a variety of forms, including paint coatings and films, that are designed to be high in solar reflectance and thermal emittance.^{[121][123]}

PDRC applications on building roofs and envelopes have demonstrated significant decreases in energy consumption and costs.^[123] In suburban single-family residential areas, PDRC application on roofs can potentially lower energy costs by 26% to 46%.^[124] PDRCs are predicted to show a market size of ~\$27 billion for indoor space cooling by 2025 and have undergone a surge in research and development since the 2010s.^[125]^[126]

Fans

[edit]

Main article: Ceiling fan

Hand fans have existed since prehistory. Large human-powered fans built into buildings include the punkah.

The 2nd-century Chinese inventor Ding Huan of the Han dynasty invented a rotary fan for air conditioning, with seven wheels 3 m (10 ft) in diameter and manually powered by prisoners.^[127]

:*ĀfĀĀ*†â€™*Āfâ€* Āĉâ,-â,,*ĉĀfĀĀ*Āĉâ,-Ā ĀfĀĉĀĉâ€šĀ-Āĉâ€žĀĉĀfĀĀ†â€™*ĀfĀĉĀĉâ€šĀ-Ā,*

In 747, Emperor Xuanzong (r. 712–762) of the Tang dynasty (618–907) had the Cool Hall (*Liang Dian*

ĀfĀĀ†â€™*Āfâ€* Āĉâ,-â,,*ĉĀfĀĀ*Āĉâ,-Ā ĀfĀĉĀĉâ€šĀ-Āĉâ€žĀĉĀfĀĀ†â€™*ĀfĀĉĀĉâ€šĀ-Ā,*

) built in the imperial palace, which the *Tang Yulin* describes as having water-powered fan wheels for air conditioning as well as rising jet streams of water from fountains. During the subsequent Song dynasty (960–1279), written sources mentioned the air conditioning rotary fan as even more widely used.^[127]

:*ĀfĀĀ*†â€™*Āfâ€* Āĉâ,-â,,*ĉĀfĀĀ*Āĉâ,-Ā ĀfĀĉĀĉâ€šĀ-Āĉâ€žĀĉĀfĀĀ†â€™*ĀfĀĉĀĉâ€šĀ-Ā,*

Thermal buffering

[edit]

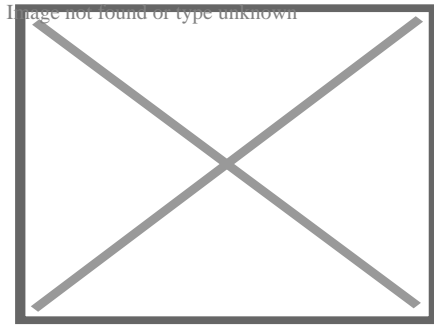
In areas that are cold at night or in winter, heat storage is used. Heat may be stored in earth or masonry; air is drawn past the masonry to heat or cool it.^[13]

In areas that are below freezing at night in winter, snow and ice can be collected and stored in ice houses for later use in cooling.^[13] This technique is over 3,700 years old in the Middle East.^[128] Harvesting outdoor ice during winter and transporting and storing for use in summer was practiced by wealthy Europeans in the early 1600s.^[15] and became popular in Europe and the Americas towards the end of the 1600s.^[129] This practice was replaced by mechanical compression-cycle icemakers.

Evaporative cooling

[edit]

Main article: Evaporative cooler



An evaporative cooler

In dry, hot climates, the evaporative cooling effect may be used by placing water at the air intake, such that the draft draws air over water and then into the house. For this reason, it is sometimes said that the fountain, in the architecture of hot, arid climates, is like the fireplace in the architecture of cold climates.^[11] Evaporative cooling also makes the air more humid, which can be beneficial in a dry desert climate.^[130]

Evaporative coolers tend to feel as if they are not working during times of high humidity, when there is not much dry air with which the coolers can work to make the air as cool as possible for dwelling occupants. Unlike other types of air conditioners, evaporative coolers rely on the outside air to be channeled through cooler pads that cool the air before it reaches the inside of a house through its air duct system; this cooled outside air must be allowed to push the warmer air within the house out through an exhaust opening such as an open door or window.^[131]

See also

[edit]

- Air filter
- Air purifier
- Cleanroom
- Crankcase heater
- Energy recovery ventilation
- Indoor air quality
- Particulates

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[edit]

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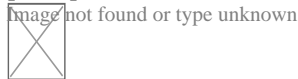
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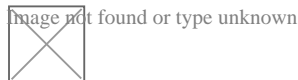
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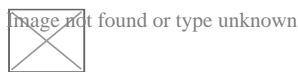
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Look up **Cassette air conditioner** in Wiktionary, the free dictionary.



Wikiversity has learning resources about **Refrigeration and air conditioning**

- U.S. patent 808,897 Carrier's original patent
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- *Scientific American*, "Artificial Cold", 28 August 1880, p. 138
- *Scientific American*, "The Presidential Cold Air Machine", 6 August 1881, p. 84
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Heating, ventilation, and air conditioning

**Fundamental
concepts**

- Air changes per hour
- Bake-out
- Building envelope
- Convection
- Dilution
- Domestic energy consumption
- Enthalpy
- Fluid dynamics
- Gas compressor
- Heat pump and refrigeration cycle
- Heat transfer
- Humidity
- Infiltration
- Latent heat
- Noise control
- Outgassing
- Particulates
- Psychrometrics
- Sensible heat
- Stack effect
- Thermal comfort
- Thermal destratification
- Thermal mass
- Thermodynamics
- Vapour pressure of water

Technology

- Absorption-compression heat pump
- Absorption refrigerator
- Air barrier
- Air conditioning
- Antifreeze
- Automobile air conditioning
- Autonomous building
- Building insulation materials
- Central heating
- Central solar heating
- Chilled beam
- Chilled water
- Constant air volume (CAV)
- Coolant
- Cross ventilation
- Dedicated outdoor air system (DOAS)
- Deep water source cooling
- Demand controlled ventilation (DCV)
- Displacement ventilation
- District cooling
- District heating
- Electric heating
- Energy recovery ventilation (ERV)
- Firestop
- Forced-air
- Forced-air gas
- Free cooling
- Heat recovery ventilation (HRV)
- Hybrid heat
- Hydronics
- Ice storage air conditioning
- Kitchen ventilation
- Mixed-mode ventilation
- Microgeneration
- Passive cooling
- Passive daytime radiative cooling
- Passive house
- Passive ventilation
- Radiant heating and cooling
- Radiant cooling
- Radiant heating
- Radon mitigation
- Refrigeration
- Renewable heat
- Room air distribution
- Solar air heat
- Solar combisystem
- Solar cooling
- Solar heating
- Thermal insulation

- Air conditioner inverter
- Air door
- Air filter
- Air handler
- Air ionizer
- Air-mixing plenum
- Air purifier
- Air source heat pump
- Attic fan
- Automatic balancing valve
- Back boiler
- Barrier pipe
- Blast damper
- Boiler
- Centrifugal fan
- Ceramic heater
- Chiller
- Condensate pump
- Condenser
- Condensing boiler
- Convection heater
- Compressor
- Cooling tower
- Damper
- Dehumidifier
- Duct
- Economizer
- Electrostatic precipitator
- Evaporative cooler
- Evaporator
- Exhaust hood
- Expansion tank
- Fan
- Fan coil unit
- Fan filter unit
- Fan heater
- Fire damper
- Fireplace
- Fireplace insert
- Freeze stat
- Flue
- Freon
- Fume hood
- Furnace
- Gas compressor
- Gas heater
- Gasoline heater
- Grease duct
- Grille
- Ground-coupled heat exchanger

Components

**Measurement
and control**

- Air flow meter
- Aquastat
- BACnet
- Blower door
- Building automation
- Carbon dioxide sensor
- Clean air delivery rate (CADR)
- Control valve
- Gas detector
- Home energy monitor
- Humidistat
- HVAC control system
- Infrared thermometer
- Intelligent buildings
- LonWorks
- Minimum efficiency reporting value (MERV)
- Normal temperature and pressure (NTP)
- OpenTherm
- Programmable communicating thermostat
- Programmable thermostat
- Psychrometrics
- Room temperature
- Smart thermostat
- Standard temperature and pressure (STP)
- Thermographic camera
- Thermostat
- Thermostatic radiator valve
- Architectural acoustics
- Architectural engineering
- Architectural technologist
- Building services engineering
- Building information modeling (BIM)
- Deep energy retrofit

**Professions,
trades,
and services**

- Duct cleaning
- Duct leakage testing
- Environmental engineering
- Hydronic balancing
- Kitchen exhaust cleaning
- Mechanical engineering
- Mechanical, electrical, and plumbing
- Mold growth, assessment, and remediation
- Refrigerant reclamation
- Testing, adjusting, balancing

Industry organizations

- AHRI
- AMCA
- ASHRAE
- ASTM International
- BRE
- BSRIA
- CIBSE
- Institute of Refrigeration
- IIR
- LEED
- SMACNA
- UMC
- Indoor air quality (IAQ)
- Passive smoking
- Sick building syndrome (SBS)
- Volatile organic compound (VOC)
- ASHRAE Handbook
- Building science
- Fireproofing
- Glossary of HVAC terms
- Warm Spaces
- World Refrigeration Day
- Template:Home automation
- Template:Solar energy

Health and safety

See also

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Home appliances

- Air conditioner
- Air fryer
- Air ioniser
- Air purifier
- Barbecue grill
- Blender
 - Immersion blender
- Bread machine
- Bug zapper
- Coffee percolator
- Clothes dryer
 - combo
- Clothes iron
- Coffeemaker
- Dehumidifier
- Dishwasher
 - drying cabinet
- Domestic robot
 - comparison
- Deep fryer
- Electric blanket
- Electric drill
- Electric kettle
- Electric knife
- Electric water boiler
- Electric heater
- Electric shaver
- Electric toothbrush
- Epilator
- Espresso machine
- Evaporative cooler
- Food processor
- Fan
 - attic
 - bladeless
 - ceiling
 - Fan heater
 - window
- Freezer
- Garbage disposer
- Hair dryer
- Hair iron
- Humidifier
- Icemaker
- Ice cream maker
- Induction cooker
- Instant hot water dispenser
- Juicer
- Kitchen hood
- Kitchen stove

Types

- See also**
- Appliance plug
 - Appliance recycling

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Roofs

Roof shapes

- Arched roof
- Barrel roof
- Board roof
- Bochka roof
- Bow roof
- Butterfly roof
- Clerestory
- Conical roof
- Dome
- Flat roof
- Gable roof
- Gablet roof
- Gambrel roof
- Half-hipped roof
- Hip roof
- Onion dome
- Mansard roof
- Pavilion roof
- Rhombic roof
- Ridged roof
- Saddle roof
- Sawtooth roof
- Shed roof
- Tented roof

Cross-gabled roof

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Roof elements

- Air conditioning unit
- Attic
- Catslide
- Chimney
- Collar beam
- Dormer
- Eaves
- Flashing
- Gable
- Green roof
- Gutter
- Hanging beam
- Joist
- Lightning rod
- Loft
- Purlin
- Rafter
- Ridge vent
- Roof batten
- Roof garden
- Roofline
- Roof ridge
- Roof sheeting
- Roof tiles
- Roof truss
- Roof window
- Skylight
- Soffit
- Solar panels
- Spire
- Weathervane
- Wind brace

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Electronics

Branches

- Analogue electronics
- Digital electronics
- Electronic engineering
- Instrumentation
- Microelectronics
- Optoelectronics
- Power electronics
- Printed electronics
- Semiconductor
- Schematic capture
- Thermal management
- 2020s in computing
- Atomtronics
- Bioelectronics
- List of emerging electronics
- Failure of electronic components

Advanced topics

- Flexible electronics
- Low-power electronics
- Molecular electronics
- Nanoelectronics
- Organic electronics
- Photonics
- Piezotronics
- Quantum electronics
- Spintronics

**Electronic
equipment**

- Air conditioner
- Central heating
- Clothes dryer
- Computer/Notebook
- Camera
- Dishwasher
- Freezer
- Home robot
- Home cinema
- Home theater PC
- Information technology
- Cooker
- Microwave oven
- Mobile phone
- Networking hardware
- Portable media player
- Radio
- Refrigerator
- Robotic vacuum cleaner
- Tablet
- Telephone
- Television
- Water heater
- Video game console
- Washing machine

Applications

- Audio equipment
- Automotive electronics
- Avionics
- Control system
- Data acquisition
- e-book
- e-health
- Electromagnetic warfare
- Electronics industry
- Embedded system
- Home appliance
- Home automation
- Integrated circuit
- Home appliance
 - Consumer electronics
 - Major appliance
 - Small appliance
- Marine electronics
- Microwave technology
- Military electronics
- Multimedia
- Nuclear electronics
- Open-source hardware
- Radar and Radio navigation
- Radio electronics
- Terahertz technology
- Wired and Wireless Communications

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Things To Do in Tulsa County

Photo

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Tours of Tulsa

4.9 (291)

Photo

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The Cave House

4.6 (249)

Photo

Gathering Place

4.8 (12116)

Photo

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Golden Driller Statue

4.6 (1935)

Photo

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Guthrie Green

4.7 (3055)

Photo

The Blue Dome

4.5 (60)

Driving Directions in Tulsa County

Driving Directions From Oakwood Homes to Durham Supply Inc

Driving Directions From Reception Jehovah's Witnesses to Durham Supply Inc

Driving Directions From Country Inn & Suites by Radisson, Tulsa, OK to Durham Supply Inc

Driving Directions From Lincoln Christian School to Durham Supply Inc

Driving Directions From Tulsa VA Behavioral Medicine Clinic to Durham Supply Inc

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Driving Directions From Tulsa Air and Space Museum & Planetarium to Durham Supply Inc

Driving Directions From OkieTundra to Durham Supply Inc

Driving Directions From Gathering Place to Durham Supply Inc

Driving Directions From Tulsa Botanic Garden to Durham Supply Inc

Driving Directions From Tulsa Air and Space Museum & Planetarium to Durham Supply Inc

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Reviews for Durham Supply Inc

Durham Supply Inc

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B Mann

(5)

I was in need of some items for a double wide that I am remodeling and this place is the only place in town that had what I needed (I didn't even try the other rude place)while I was there I learned the other place that was in Tulsa that also sold mobile home supplies went out of business (no wonder the last time I was in there they were VERY RUDE and high priced) I like the way Dunham does business they answered all my questions and got me the supplies I needed, very friendly, I will be back to purchase the rest of my items when the time comes.

Durham Supply Inc

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Dennis Champion

(5)

Durham supply and Royal supply seems to find the most helpful and friendly people to work in their stores, we are based out of Kansas City out here for a few remodels and these guys treated us like we've gone there for years.

Durham Supply Inc

Image not found or type unknown

Ty Spears

(5)

Bought a door/storm door combo. Turns out it was the wrong size. They swapped it out, quick and easy no problems. Very helpful in explaining the size differences from standard door sizes.

Durham Supply Inc

Image not found or type unknown

Gerald Clifford Brewster

(5)

We will see, the storm door I bought says on the tag it's 36x80, but it's 34x80. If they return it.....they had no problems returning it. And it was no fault of there's, you measure a mobile home door different than a standard door!

Durham Supply Inc

Image not found or type unknown

Ethel Schiller

(5)

This place is really neat, if they don't have it they can order it from another of their stores and have it there overnight in most cases. Even hard to find items for a trailer! I definitely recommend this place to everyone! O and the prices is awesome too!

Implementing Airflow Balancing Techniques [View GBP](#)

Royal Supply Inc

Phone : +16362969959

City : Oklahoma City

State : OK

Zip : 73149

Address : Unknown Address

Google Business Profile

Company Website : <https://royal-durhamsupply.com/locations/oklahoma-city-oklahoma/>

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