# A MAJOR PROJECT REPORT

**ON**

# "WINDOW AIR CONDITIONER"

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD

OF

**DIPLOMA IN MECHANICAL ENGINEERING**

## SUBMITTED TO

GALGOTIAS UNIVERSITY, UNIVERSITY POLYTECHNIC

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**Session (2021-2022)**

# CERTIFICATE

This is to certify that the project report entitled "**WINDOW AIR CONDITIONER** "was successfully completed by student of sixth semester Diploma in mechanical engineering).

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In partial fulfilment of the requirements for the award of the Diploma in mechanical engineering and submitted to the Department of Mechanical Engineering of GALGOTIAS University, University Polytechnic, work carried out during a period for the academic year 2021-22 as per curriculum.

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# ACKNOWLEDGEMENT


- This project is done as a semester project as a part of course titled WINDOW AIR CONDITIONER. We are really thankful to our Principal Mr. MOHIT GAHARWAR SIR, HOD Mr. RASHID KHAN SIR and the Project Coordinator Mr. SUSHIL SINGH SIR Mechanical Engineering Department, GALGOTIAS University, University Polytechnic for his invaluable guidance and assistance, without which the accomplishment of the task would have never been possible.
- We are also thankful to Mr. RASHID KHAN our Project Mentor for giving this opportunity to explore into the real world and realize the interrelation without which a project can never progress. In our present project we have chosen the topic “WINDOW AIR CONDITIONER”.
- We are also thankful to our present, friends and all staff of MECHANICAL ENGINEERING DEPARTMENT, for providing us relevant information and necessary clarifications, and great support.

# Abstract


- In this project all of us have repaired an air conditioner; we saw that a normal window air conditioner comes with normal cooling and fan speed in the market at a price of 30000. Now if we use an air conditioner fan motor If you change the number on rpm or watt, then it is normal that the fan speed of the air conditioner will increase and it will start covering more space, then we have put the motor of the air conditioner in it at the high rpm of the change number and secondly when we changed the motor So the cooling in the air was dull because the speed of the air has increased, then we put the compressor in the air conditioner under vacuum again, instead of R 22, we put in R 410 because R 410 cooling is very high due to high pressure compare to R 22, we have described it all well.

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# INTRODUCTION

- 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 "nit") in his popular science book Natural Magic. In 1620,Corneils 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. 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 own cold, but the salt by supplying activity to the cold of the snow.
- In 1758, Benjamin Franklin and John Hardly a chemistry professor at University of Cambridge, conducted an experiment to explore the principle of evaporation as a means to rapidly cool an object. 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 conducted their experiment with the bulb of a mercury-in-glass thermometer as their object and with a bellows used to speed up the evaporation. They lowered the temperature of the thermometer bulb down to −14 °C (7 °F) while the ambient temperature was 18 °C (64 °F). Franklin noted that soon after they passed the freezing point of water 0 °C (32 °F), a thin film of ice formed on the surface of the thermometer's bulb and that the ice mass was about 6 mm (¼ in) thick when they stopped the experiment upon reaching −14 °C (7 °F). Franklin concluded: "From this experiment one may see the possibility of freezing a man to death on a warm summer's day.

# Air conditioner

- Air conditioning, often abbreviated as A/C or AC is the process of removing heat and controlling the humidity of air in an enclosed space to achieve a more comfortable interior environment by use of powered "air conditioners" or a variety of other methods, including passing colling and ventilative. Air conditioning is a member of a family of systems and techniques that provide heating, ventilation and air conditioning (HVAC).
- Air conditioners, which typically use vapor compression refrigeration range in size from small units used within vehicles or single rooms to massive units that can cool large buildings. Air source heat pumps, which can be used for heating as well as colling are becoming increasingly common in cooler climates.
- According to the International Energy Agency (IEA), as of 2018, 1.6 billion air conditioning units were installed, which accounted for an estimated 20% of electricity usage in buildings globally with the number expected to grow to 5.6 billion by 2050. The United Nations called for the technology to be made more sustainable to using techniques including passive cooling, evaporation colling selective shading, windcatchers and better thermal insulation CFC and HCFC refrigerants such as R-12 and R-22, respectively, used within air conditioners have caused damage to the ozone layer, and HFC refrigerants such as R-410a and R-404a, which were designed to replace CFCs and HCFCs, are instead exacerbating climate change. 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 HFCs.

## History of Air Conditioner

- Air conditioning dates back to prehistory. Ancient Egyptia buildings used a wide variety of passive air-conditioning techniques. These became widespread from the Iberian Peninsula through North Africa, the Middle East, and Northern India. Similar techniques were developed in hot climates elsewhere.
- Passive techniques remained widespread until the 20th century, when they fell out of fashion, replaced by powered A/C. Using information from engineering studies of traditional buildings, passive techniques are being revived and modified for 21st-century architectural designs.
- 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 allow deep plans buildings to be created and have allowed people to live comfortably in hotter parts of the world.

## First Ac Development

Willis Carrier,

( who is credited with building the first modern electrical air conditioning unit)

- Electricity made development of effective units possible. In 1901, American inventor Willis H. Carrier built what is considered the first modern electrical air conditioning unit. In 1902, he installed his first air-conditioning system, in the Sackett-Wilhelms Lithographing & Publishing Company in Brooklyn, New York his invention controlled both the temperature and also the 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, business that in 2020 employed 53,000 employees and was valued at $18.6 billion.
- In 1906, Stuart W. Cramer of Charlotte was exploring ways to add moisture to the air in his textile mill. Cramer coined the term "air conditioning," using it in a patent claim he filed that year as analogous to "water conditioning", then a well-known process for making textiles easier to process. He combined moisture with ventilation to "condition" and change the air in the factories, controlling the humidity so necessary in textile plants. Willis Carrier adopted the term and incorporated it into the name of his company.
- 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 huge device (c. 7 x 6 x 20 ft) was never used, as the house remained uninhabited[ (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 a considerable price (the equivalent of $120,000 to $600,000 in 2015 dollars.). A year later the first air conditioning systems for cars were offered for sale. Chrysler Motors introduced the first practical semi-portable air conditioning unit in 1935, and Packerd became the first automobile manufacturer to offer an air conditioning unit in its cars in 1939.

## Further Development

- Innovations in the latter half of the 20th century allowed for much 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. By the late 1960s, most newly built residential homes in the United States had central air conditioning.

- As international development has increased wealth across countries, global use of air conditioners has increased. By 2018, an estimated 1.6 billion air conditioning units were installed worldwide, with the International Energy Agency expecting this number to grow to 5.6 billion units by 2050. Between 1995 and 2004, the proportion of urban households in China with air conditioners increased from 8% to 70%. As of 2015, nearly 100 million homes, or about 87% of US households, had air conditioning systems. In 2019, it was estimated that 90% of new single-family homes constructed in the USA included air conditioning (ranging from 99% in the South to 62% in the West).

## Types of Air Conditioner

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. 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 own indoor unit and simultaneously from a single outdoor unit. The main problem with multi-split systems is the length of the refrigerant lines for connecting the external unit to the internal ones. Though the same challenge exists for central ACs.
- The first mini-split systems were sold in 1954–1968 by Mitsubishi Electric and Toshiba in Japan, where its development was motivated by the small size of homes. 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. 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, and the outdoor and indoor units can be spread across the building. Variable refrigerant flow indoor units can also be turned off individually in unused spaces.

## Ducted Central Systems

- 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 fan coil unit, air handling unit, or evaporator) with the piped refrigerant being circulated between the two. The FCU is then connected to the spaces to be cooled by ventilation ducts.

## Central Plant Cooling

An industrial air conditioning unit 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.

## Portable Units

- 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 and discharges it through the ducted hose and can run continuously. Such portable units draw indoor air and expel it outdoors through a single duct.
- Many portable air conditioners come with heat as well as dehumidification function.

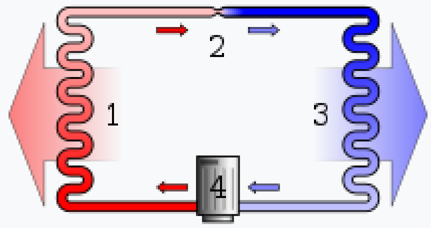
## Window Unit and Packaged Terminal

- The packaged terminal air conditioner (PTAC), through-the-wall, and window air conditioners are similar. 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.

## Packaged Air Conditioner

- Packaged air conditioners (also known as self-contained units) 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), draw the air to be conditioned from inside or outside a building and be water, refrigerant or air-cooled. Often, outdoor units are air-cooled while indoor units are liquid-cooled using a cooling tower.

## Operating Principle




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

- Cooling in traditional AC systems is accomplished using the vapor-compression cycle, which uses the forced circulation and phase change of a refrigerant between gas and liquid to transfer heat. 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.

- 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.

- Most modern air-conditioning systems feature a dehumidification cycle during which the compressor runs while the fan is slowed to reduce the evaporator temperature and therefore 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 and dehumidified before passes over the condenser coil where it is warmed again before being released back into the room again.

- Free cooling can sometimes be selected when the external air happens to be cooler than the internal air and therefore the compressor needs not be used, resulting in high cooling efficiencies for these times. This may also be combined with seasonal thermal energy storage.

## Heating

- Some air conditioning systems have the option to reverse the refrigeration cycle and act as air source heat pump, therefore producing heating instead of cooling in 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, as well as 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.
- Older generations of air source heat pumps become less efficient in outdoor temperatures lower than 4°C or 40°F; 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 being the condenser coil, so that it can heat up and defrost. Some heat pump systems will therefore have a form of electric resistance heating in the indoor air path that is activated only in this mode in order 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 (−26 °C). However there is always a chance that the humidity that condense on the heat exchanger of the outdoor unit would 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

- The coefficient of performance (COP) of a air conditioning system is a ratio of useful heating or cooling provided to work required. 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. 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 BTUIT per hour, or 3,517 watts. Residential central air systems are usually from 1 to 5 tons (3.5 to 18 kW) in capacity.
- 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. A similar standard is the European seasonal energy efficiency ratio (ESEER).

## Health Effects

- In hot weather, air conditioning can prevent heat stroke, dehydration from excessive perspiration, and other problems related to hyperthermia. Heat waves are the most lethal type of weather phenomenon in developed countries. 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.
- 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.

## Environmental Impacts

- Refrigerants have 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.
- Current air conditioning accounts for 20% of energy consumption in buildings globally, and the expected growth of the usage of air conditioning due to climate change and technology uptake will drive significant energy demand growth. 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.
- In 2018 the United Nations called for the technology to be made more sustainable to mitigate climate change.

# Economic Effects

Air conditioning caused various shifts in demography, notably that of the United States starting from the 1970s:

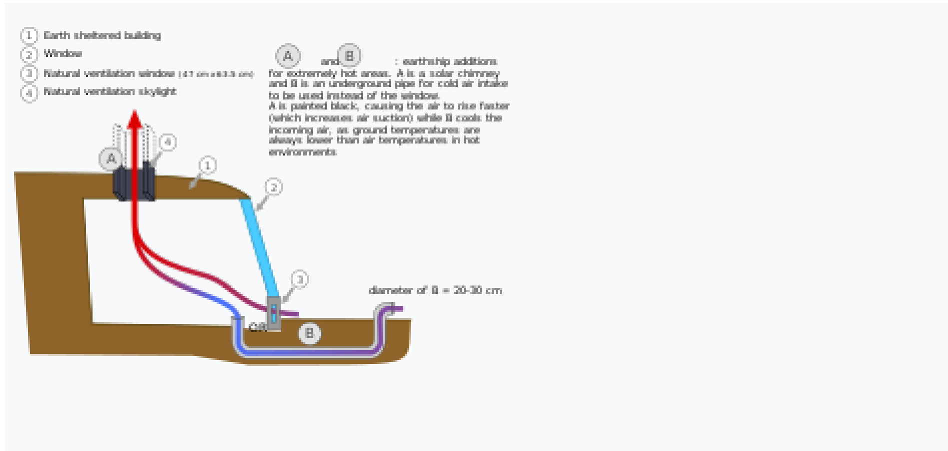
- The birth rate was lower in the spring than during other seasons until 1970s but this difference then declined over the next 30 years.
- The summer mortality rate, which had been higher in regions subject to a heatwave during the summer, also evened out.
- The Sun Belt now contains 30% of the total US population when it was inhabited by 24% of Americans at the beginning of the 20th century.

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.

## Other Techniques

- Buildings designed with passive air conditioning are generally less expensive to construct and maintain than buildings with conventional HVAC systems with lower energy demands. 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.
- 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.

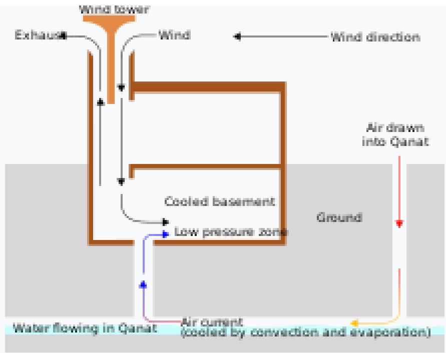
# Passive Ventilation




Dogtrot houses are designed to maximise natural 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.
- 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




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. This approach works either by preventing heat from entering the interior (heat gain prevention) or by removing heat from the building (natural cooling).

- 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. 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.

# Fans

- 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.:99,151,233 In 747, Emperor Xuanzong (r. 712–762) of the Tang Dynasty (618–907) had the Cool Hall (Liang Dian) 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.

## Thermal Buffering

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

## Evaporative Cooling

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. Evaporative cooling also makes the air more humid, which can be beneficial in a dry desert climate.
- 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.

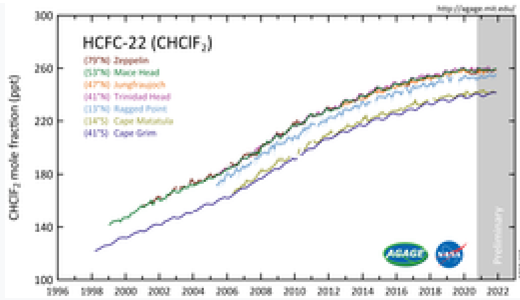
# Chlorodifluoromethane

- Chlorodifluoromethane or difluoromonochloromethane is a hydrochlorofluorocarbon (HCFC). This colorless gas is better known as HCFC-22, or R-22,or CHClF.

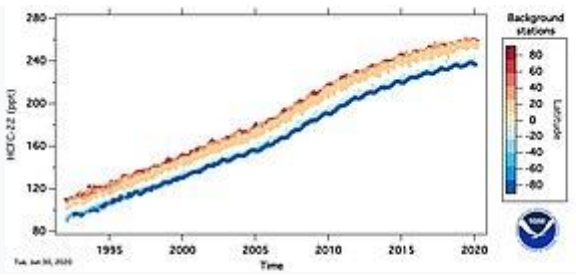
  2. It was commonly used as a propellant and refrigerant. These applications were phased out under the Montreal Protocol in developed countries in 2020 due to the compound's ozone depletion potential (ODP) and high global warming potential (GWP), and in developing countries this process will be completed by 2030. R-22 is a versatile intermediate in industrial organofluorine chemistry, e.g. as a precursor to tetrafluoroethylene.

## Production and Current Applications

- Worldwide production of R-22 in 2008 was about 800 Gg per year, up from about 450 Gg per year in 1998, with most production in developing countries. R-22 use is being phased out in developing countries, where it is largely used for air conditioning applications. Air conditioning sales are growing 20% annually in India and China.
- R-22 is prepared from chloroform:
- $HCCl_3 + 2\ HF \rightarrow HCF_2Cl + 2\ HCl$
- An important application of R-22 is as a precursor to tetrafluoroethylene. This conversion involves pyrolysis to give difluorocarbene, which dimerizes:
- $2\ CHClF_2 \rightarrow C_2F_4 + 2\ HCl$
- The compound also yields difluorocarbene upon treatment with strong base and is used in the laboratory as a source of this reactive intermediate.
- The pyrolysis of R-22 in the presence of chlorofluoromethane gives hexafluorobenzene.




- HCFC-22 measured by the Advanced Global Atmospheric Gases Experiment (AGAGE) in the lower atmosphere (troposphere) at stations around the world. Abundances are given as pollution free monthly mean mole fractions in parts-per-trillion.




Growth of R-22 (CFC-22) abundance in earth's atmosphere since year 1992.

- R-22 is often used as an alternative to the highly ozone-depleting CFC-11 and CFC-12, because of its relatively low ozone depletion potential of 0.055,[5] among the lowest for chlorine-containing haloalkanes. However, even this lower ozone depletion potential is no longer considered acceptable.

- As an additional environmental concern, R-22 is a powerful greenhouse gas with a GWP equal to 1810 (which indicates 1810 times as powerful as carbon dioxide). Hydrofluorocarbons (HFCs) are often substituted for R-22 because of their lower ozone depletion potential, but these refrigerants often have a higher GWP. R-410A, for example, is often substituted, but has a GWP of 1725. Another substitute is R-404A with a GWP of 3900. Other substitute refrigerants are available with low GWP. Ammonia (R-717), popular in the early years of refrigeration, has a GWP of

<1 and remains a popular substitute on fishing vessels. Ammonia’s toxicity and flammability limit its safe application.

- Propane (R-290), is another example, and has a GWP of 3. Propane was the de facto refrigerant in systems smaller than industrial scale before the introduction of CFCs. The reputation of propane refrigerators as a fire hazard kept delivered ice and the ice box the overwhelming consumer choice despite its inconvenience and higher cost until safe CFC systems overcame the negative perceptions of refrigerators. Illegal to use as a refrigerant in the USA for decades, propane is now permitted for use in limited mass suitable for small refrigerators. It is not lawful to use in air conditioners, or larger refrigerators because of its flammability and potential for explosion.

## Chlorodifluoromethane.

- **Names**

| | |
|---|---|
| Density | 3.66 kg/$m^3$ at 15 °C, gas |
| Melting point | −175.42 °C (−283.76 °F; 97.73 K) |
| Boiling point | −40.7 °C (−41.3 °F; 232.5 K) |
| Solubility in water | 0.7799 vol/vol at 25 °C; 3.628 g/L |

## R-410A

- R-410A, sold under the trademarked names AZ-20, EcoFluor R410, Forane 410A, Genetron R410A, Puron, and Suva 410A, is a zeotropic but near-azeotropic mixture of difluoromethane ($CH_2F_2$, called R-32) and pentafluoroethane ($CHF_2CF_3$, called R-125) that is used as a refrigerant in air conditioning and heat pump applications. R-410A cylinders are colored rose.

## History

- R-410A was invented and patented by Allied Signal (now Honeywell) in 1991. Other producers around the world have been licensed to manufacture and sell R-410A, but Honeywell continues to be the leader in capacity and sales. R-410A was successfully commercialized in the air conditioning segment by a combined effort of Carrier Corporation, Emerson Climate Technologies, Inc., Copeland Scroll Compressors (a division of Emerson Electric Company), and Allied Signal. Carrier Corporation was the first company to introduce an R-410A-based residential air conditioning unit into the market in 1996 and holds the trademark "Puron".

## Availability

- R-410A has replaced R-22 as the preferred refrigerant for use in residential and commercial air conditioners in Japan, Europe, and the United State.
- Parts designed specifically for R-410A must be used, as R-410A operates at higher pressures than other refrigerants. R-410A systems thus require service personnel to use different tools, equipment, safety standards, and techniques. Equipment manufacturers are aware of these changes and require the certification of

professionals installing R-410A systems. In addition, the AC&R Safety Coalition has been created to help educate professionals about R-410A systems.

- R-410A cannot be used in R-22 service equipment because of higher operating pressures (approximately 40 to 70% higher).
- While R-410A has negligible functional potential, it cannot be ignored when charging.
- To avoid fractionation as the system is charged and for optimum system performance, the correct type of cylinder must be used for charging. If a cylinder with dip-tubes is used, R-410A can be charged while the cylinder is upright. If the cylinder doesn't have dip-tubes, it should be kept upside-down to charge with liquid, not vapor, from the cylinder. The procedure, then, is to fill very slowly, the valve restricting output, in order to avoid slugging the compressor with liquid.

## Physical Properties

| Physical properties of R-410A refrigerant | |
|---|---|
| **Property** | **Value** |
| Formula | $CH_2F_2$ (50%)<br>$CHF_2CF_3$ (50%) |
| Molecular weight (Da) | 72.6 |
| Melting point (°C) | −155 |
| Boiling point (°C) | −48.5 |
| Liquid density (30 °C), kg/m$^3$ | 1040 |
| Vapour density (30 °C), air=1.0 | 3.0 |
| Vapour pressure at 21.1 °C (MPa) | 1.383 |
| Critical temperature (°C) | 72.8 |
| Critical pressure, MPa | 4.90 |
| Gas heat capacity (kJ/(kg·°C)) | 0.84 |
| Liquid heat capacity @ 1 atm, 30 °C, (kJ/(kg·°C)) | 1.8 |

How to Keep a Window Air Conditioner Unit Clean

Step 1: Wash the filter. A clean filter ensures that an adequate amount of room air will circulate over the evaporator coil, keeping it from freezing up. ...

Step 2: Clean the fins. ...

Step 3: Straighten bent fins. ...

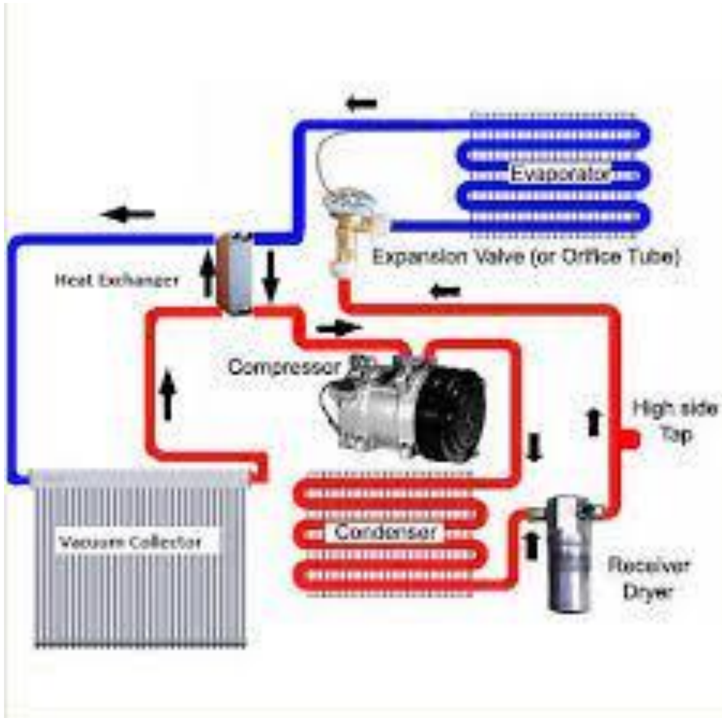
Step 4: Wash the fans and the pan. ...

Step 5: Store it in the off-season.

1. How To Clean Your Split AC Indoor Unit At Home

Step 1: Dry the Air-conditioner. ...
Step 2: Disconnect the Unit from its Power Source. ...
Step 3: Cover the Unit with a Cleaning Bag. ...
Step 4: Detach the Front Panel. ...
Step 5: Unfasten the Air Filters. ...
Step 6: Wash the Air Filters. ...
Step 7: Clean the Bacteria Filters.


# Working of air conditioner




An air conditioner in a room or a car works by absorbing hot air from a particular room, processing it into itself with the help of a refrigerant and a series of coils, and then releasing cool air into the same room where the hot air was originally collected.
This processing is mainly carried out via five components:

- Evaporator
- Compressor
- Condenser
- Expansion valve
- Refrigerants

Imagine being outside in the sweltering heat of a particularly hot summer day, doing godforsaken errands that can no longer be postponed. The heat is so unbearable that it feels like the hottest day on earth since the dawn of civilization. But one thing keeps you on your toes: the knowledge that you will be in your air-conditioned house in an hour.

The time has finally come: you open the door and enter your house. A gust of cooled air envelops every cell of your body and you immediately feel better.

## Difference Between R22 and R410a

- The HVAC industry is in the throes of a sea change, and it impacts your wallet and your comfort.
- This year put the final nail in the coffin of R22, the refrigerant that the industry has been phasing out over the past decade to comply with a federal mandate. That mandate intends to curb gas house emissions and the depletion of the ozone layer by forcing the HVAC industry to switch to a more environmentally friendly coolant.
- What does this mean for you? If your older-model AC unit requires a recharge of refrigerant due to a leak, it’s going to cost you a pretty penny. That’s because R22 — better known as Freon — is no longer legal to manufacture or import as of 2020. The coolant will become pricier as supplies dwindle.
- If, however, you’ve bought a new HVAC system within the past 10 years, you have nothing to worry about. Manufacturers stopped making systems with R22 in 2010. Today, central air systems operate with R410a.

## R410a Better

- R410a is a hydro-fluorocarbon, which means it won't contribute to the depletion of our ozone layer. R22, in contrast, is a hydrochlorofluorocarbon, which means it will.
- Beyond being the more Earth-friendly option, R410a also performs better than its now-illegal counterpart. R410a absorbs and releases more heat, so that your air conditioning compressor runs cooler and more efficiently.

## R410a in My Older AC System

- Sorry, no. Despite their names sounding like Star Wars droids, R410a and R22 are totally incompatible.
- R410a operates at a higher pressure, requiring more robust components. Today's AC systems are built to accommodate the demands of R410a. Putting this coolant into a system designed for R22 would be like putting rocket fuel in a Honda — not recommended.

## If I Still Need R22

- Your existing AC unit shouldn't require a refill of coolant unless it springs a leak. If that happens, brace yourself for an expensive repair bill. R22, while still legal for repairs, is becoming increasingly rare.
- Our advice: start budgeting for a new system now. Today's central air units are significantly more efficient and will save you money down the line on cooling costs. Meanwhile, keep your system operating at peak performance with routine maintenance.
- For all of your cooling needs this summer, depend on Black Hills Inc, Home Services. To schedule your appointment, call (360) 558-3242.

## Difference between Split AC and Window AC

- AC stands for air conditioner. It is a machine or system that is used is used to cool an enclosed space by removing heat and controlling the humidity. It is used mostly in the summer season. The user has to keep the doors and windows of the house closed while using the AC so that the cold air produced by the AC inside the house does not go out. It is also beneficial for the human body as it reduces the chances of dehydration, asthma attacks and heat stroke and improves the quality of sleep. Furthermore, it also prevents electrical equipment from overheating.
- There are two types of AC that are split air conditioner and window air conditioner. The job of both is to cool the area, but the design of both the air conditioners is different. Let us see how they differ from each other.

## Split Air Conditioner

- The air conditioner which is divided into two parts, is called a split air conditioner. This is divided into two units that are indoor unit and outdoor unit. In this type, the multi-split air conditioner is also available, which provides more than one inside unit and only one outside unit. All insides units are connected to one outside unit in the multi-split air conditioner.
- This unit is placed inside the room. It consists of a blower, capillary tube, floor, Air filter and evaporator or cooling coils and drainage system. This unit is also called an evaporator because the evaporator is the main component of this unit.

## Outdoor unit

- This unit is placed outside the room. This unit is consists of the compressor, motor, fan, discharge and condenser. This unit is also called a condenser because the condenser is the main component of this unit. Its job is to provide fresh air to the inside room and throw out the warm air outside the room.
- For connecting these two unit's Suction line and the Liquid line are used. Indoor units are well designed, and they increase the beauty of the house. The inside unit is fitted on the wall, and the outside unit is placed outside the room. The technician is required to install ac. This air conditioner requires less space, and it is easy to relocate.

## Window AC

- It is also used for cooling the room. It *has only one unit*. It is mounted in a window or cut through the wall of the size of an AC in such a way that half unit is inside the room, and the other half of the unit remains outside the room. This air conditioner requires more space and is difficult to relocate.

## Components of Window Air Conditioner:

- This air conditioner consists of a fan motor, fan condenser, compressor, condenser coils, evaporator fan, evaporator coils, and air inlet grill, filter and air outlet grill. Controls are available on the unit to change the setting of AC.
- The *popular brands of window AC* are Voltas, Whirlpool, Hitachi, Carrier and Blue star. The cost of this air conditioner is low as compared to the split AC. The installation of this air conditioner is very easy. There are fewer options of inverted type AC in window air conditioners.

## HOW I CHANGE R22 GAS TO R410A IN WINDOW AIR CONDITIONER

- FIRSTLY I STARTED TO OPEN AIR CONDITONER AND STARTS TO DISMANTLE OLD R22 COMPRESSOR TO R410A COMPRESSOR BY THIS WE CAN EASLIY CHANGE THE R22 GAS TO R410A IN TO AIR CONDITONER TO GET MORE COOLING AND AFTER BRAZZING ALL THE HOLES AND JOINTS OF THE AIR CONDITIONER AFTER THE REPLACE OLD AIR COMPRESSOR IN THE WINDOW AIR CONDITIONER I STARTED TO CHANGE FAN MOTOR OF AIR CONDITIONER FROM 1200 RPM TO 1400 RPM BY THIS FAN MOTOR GETS MORE SPEED AND COVER MORE SPACE BY THIS AIR CONDITIONER COOLS FAST.

## RESULT

- AFTER DONE ALL WORK MY AIR CONDITIONER WORK FINE AND AS I EXPECT TO THE AIR CONDITIONER IT GIVE ME MORE COOLING AND MORE AIR.

## CONCLUSION

- THE MAIN OBJECT IS COMPRESSOR AND FAN MOTOR WITHOUT THIS WE CANNOT TRANSFORM R22 AIR CONDITIONER TO R410A AIR CONDITIONER.

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