Indoor Air Quality

- **Selecting Appropriate Multimeters for HVAC Checks**
  Selecting Appropriate Multimeters for HVAC Checks Maintaining HVAC Gauges for Accurate Readings Choosing Coil Cleaners Suited to Household Needs Comparing Protective Gloves for Different Tasks Identifying Goggles Designed for Refrigerant Handling Using Screwdriver Sets for Precise Adjustments Organizing Toolkits for Efficient Site Visits Calibrating Equipment for Reliable Measurements Handling Harmful Chemicals with Proper Ventilation Safely Storing Extra HVAC Parts and Supplies Dressing for Extreme Temperatures during Repairs Assessing Essential Items for Emergency Calls
- **Examining Pollutants Affecting Air Circulation**
  Examining Pollutants Affecting Air Circulation Improving Vent Placement for Even Distribution Managing Excess Humidity with Simple Techniques Using UV Lights to Minimize Microbial Growth Testing Indoor Air Quality with Basic Tools Filtering Particulates through Electrostatic Options Checking Fan Speed for Consistent Comfort Controlling Airflow Patterns across Different Rooms Maintaining Clear Ducts for Cleaner Breathing Spaces Exploring Optional Dehumidifiers for Damp Areas Balancing Comfort and Efficiency in Vent Adjustments Assessing Long Term Effects of Poor Air Quality
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Managing humidity in mobile homes is crucial for maintaining a healthy and comfortable living environment. Mobile homes, by their very nature, can be more susceptible to moisture-related issues compared to traditional houses due to their design and construction materials. Excessive humidity in these homes can lead to a host of problems, ranging from structural damage to health concerns for the inhabitants.

One of the primary reasons humidity management is vital is its impact on the structure of the mobile home. High levels of moisture can cause wood and other building materials to warp or rot over time. This not only affects the aesthetic appeal of the home but also its structural integrity. Moreover, excessive dampness can lead to mold growth, which poses significant health risks including respiratory issues and allergic reactions.

Energy audits can identify ways to improve HVAC efficiency in mobile homes **mobile home hvac repair near me** flat roof.

In addition to structural concerns, high humidity levels can also affect indoor air quality. A damp environment encourages the proliferation of dust mites and mold spores, both common allergens that can exacerbate existing conditions such as asthma or trigger new allergic responses in sensitive individuals.

Given these potential issues, exploring optional dehumidifiers for damp areas in mobile homes becomes an essential consideration. Dehumidifiers work by drawing excess moisture from the air, thus reducing overall humidity levels. This helps create a healthier living space by minimizing mold growth and improving air quality.

When selecting a dehumidifier for a mobile home, several factors should be considered. The size of the area needing dehumidification is paramount; choosing a unit that is appropriately sized ensures efficient operation and energy use. Additionally, features such as auto-shutoff when the water reservoir is full or continuous drain options can enhance convenience and prevent overflow mishaps.

Energy efficiency is another critical consideration when choosing dehumidifiers. Opting for Energy Star-rated models not only reduces utility bills but also lessens environmental impact-a growing concern for many homeowners today.

Furthermore, modern dehumidifiers often come with additional features such as digital displays showing current humidity levels or built-in hygrometers that automatically adjust settings based on real-time data. These advancements make it easier than ever to maintain optimal conditions within your mobile home without constant manual adjustments.

In conclusion, managing humidity in mobile homes through effective use of dehumidifiers is essential for preserving both property value and occupant health. By understanding the importance of controlling moisture levels and investing in suitable equipment tailored specifically for your needs, you are taking proactive steps towards ensuring your home remains safe, comfortable, and welcoming all year round.

In today's world, maintaining a comfortable and healthy home environment is more important than ever. One crucial aspect of this is managing humidity levels, particularly in damp areas such as basements, bathrooms, or laundry rooms. Excessive moisture can lead to various issues, including mold growth, musty odors, and even structural damage. This is where dehumidifiers come into play. These devices are designed to remove excess moisture from the air, creating a more comfortable living space and protecting your home from potential damage.

When exploring dehumidifier options for damp areas, it's essential to consider several factors to ensure you select the most suitable model for your needs. Firstly, think about the size of the area you need to dehumidify. Dehumidifiers come in different capacities measured in pints per day-the amount of moisture they can remove within 24 hours. For small spaces or mildly damp conditions, a smaller capacity unit might suffice. However, larger or severely damp areas will require a more robust machine.

Energy efficiency is another critical consideration when choosing a dehumidifier. Since these devices may need to operate continuously or for extended periods in particularly humid environments, selecting an energy-efficient model can significantly reduce electricity consumption and lower utility bills over time.

Noise level is also an important aspect to consider if the dehumidifier will be used in living areas where silence is golden. While most modern units are designed with quieter operation in mind, there still exists a range of noise outputs among different models.

Additionally, features such as automatic humidity control settings can enhance convenience by allowing users to set desired humidity levels that the unit maintains automatically without constant monitoring and adjustment.

For those dealing with severe humidity issues or needing rapid results after water damage incidents like flooding or leaks-commercial-grade dehumidifiers could be worth investigating despite their higher cost compared to residential units due primarily because they offer greater power output along with robust construction meant specifically handling heavy-duty tasks effectively making them suitable choice situations requiring rapid drying times large-scale applications alike

Finally don't overlook aspects portability ease-of-use including things like caster wheels carrying handles because depending location purpose might find yourself moving device frequently between different rooms floors house apartment building thus having lightweight easy maneuver design feature could prove invaluable effort-saving future endeavors

In conclusion finding right option involves balancing specific requirements against available features budget constraints remember investing good quality product not only ensures better performance longevity but ultimately contributes maintaining healthier environment safeguarding property well-being family members occupants alike

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Types of Measurements Required in Mobile Home HVAC Checks

Mobile homes, often cherished for their affordability and flexibility, can sometimes face unique challenges when it comes to maintaining ideal indoor air quality. One such challenge is managing humidity levels, which can fluctuate due to varying weather conditions and the specific construction of mobile homes. This is where optional dehumidifiers, integrated with HVAC systems, come into play as a valuable solution.

The primary benefit of incorporating an optional dehumidifier in a mobile home's HVAC system is its ability to regulate moisture levels effectively. Mobile homes are particularly susceptible to high humidity due to their compact size and the materials used in their construction. Excessive moisture inside a home can lead to a host of problems, including mold growth, structural damage, and discomfort for the occupants. By installing a dehumidifier, homeowners can maintain optimal humidity levels that reduce these risks significantly.

Furthermore, controlling indoor humidity has direct implications for health and comfort. High humidity creates an environment conducive to dust mites and other allergens that thrive in moist conditions. By reducing the moisture content in the air, dehumidifiers help minimize the presence of these allergens, contributing to better respiratory health for residents. Additionally, lower humidity levels make temperatures feel cooler during warm months because less moisture in the air means sweat evaporates more efficiently from our skin.

Energy efficiency is another compelling reason to consider this addition to your mobile home's HVAC system. When humidity levels are high, it often feels warmer than it actually is; as a result, residents may be tempted to crank up the air conditioning unit to achieve comfort. A dehumidifier helps by removing excess moisture without overworking the AC system-leading not only to enhanced comfort but also potentially lower energy bills.

Moreover, incorporating a dehumidifier into your HVAC setup is typically straightforward and user-friendly. Many modern systems are designed for easy integration and operation alongside existing heating and cooling units. Homeowners can set desired humidity levels using intuitive controls or even smart home technology that adjusts settings automatically based on environmental conditions.

In summary, optional dehumidifiers offer numerous benefits when paired with mobile home HVAC systems-ranging from improved health outcomes due to reduced allergens and mold risk; increased comfort through efficient temperature management; cost savings via enhanced energy efficiency; and ease of use with modern technological solutions. For those living in damp-prone areas or seeking better control over their indoor environment's quality year-round within their mobile homes-the investment in an optional dehumidifier proves both practical and wise.

Comparing Digital vs Analog Multimeters for HVAC Use

Selecting the right dehumidifier for your mobile home is crucial to maintaining a comfortable and healthy living environment, especially if you live in damp areas. Dehumidifiers play an essential role in controlling humidity levels, preventing mold growth, and improving air quality. Given the compact nature of mobile homes, choosing an appropriate dehumidifier requires careful consideration of several key criteria.

First and foremost, consider the size of your mobile home. The dehumidifier's capacity should match the square footage it needs to cover. Small-capacity units are suitable for smaller spaces but may struggle in larger or more humid environments. On the other hand, a unit with too high a capacity might consume unnecessary energy and space. It's important to strike a balance by selecting a unit that efficiently manages moisture without being excessive.

Energy efficiency is another critical factor. Mobile homes often have limited power resources, so opting for an energy-efficient model can save on utility costs while providing effective humidity control. Look for dehumidifiers with energy-saving features such as programmable timers or auto-shutoff functions which help minimize power consumption during operation.

Noise level is also an important consideration when selecting a dehumidifier for a mobile home. Due to limited space, noise from appliances can be more noticeable compared to traditional homes. Choose models designed to operate quietly so they do not disrupt daily activities or rest periods within your cozy living space.

Additionally, consider the ease of maintenance when selecting your dehumidifier. Units with removable filters that are easy to clean can help ensure long-term performance and efficiency without requiring frequent replacements or complicated procedures. Also, check whether the water reservoir is easily accessible and offers sufficient capacity; this will reduce the frequency of emptying it.

Finally, look into additional features that could enhance convenience and functionality in your specific situation. For instance, some models offer built-in hygrometers that measure real-time humidity levels or continuous drainage options that eliminate manual emptying altogether-ideal for those who spend significant time away from their mobile homes.

In conclusion, choosing the right dehumidifier involves assessing factors like size compatibility, energy efficiency, noise levels, maintenance requirements, and extra features tailored specifically for mobile living conditions in damp areas. By carefully evaluating these aspects before purchasing one suited perfectly to meet all needs related directly towards creating healthier indoor air quality through optimal moisture management-your investment promises comfort along with peace-of-mind knowing each breath taken inside remains pure regardless outside weather patterns prevailing at any given time!

Safety Considerations When Using Multimeters in Mobile Homes

Exploring optional dehumidifiers for damp areas can be an enlightening journey into improving home comfort and safeguarding your living space from the adverse effects of excess moisture. Whether you're dealing with a musty basement or a humid laundry room, installing a dehumidifier can significantly enhance your environment's air quality and prevent mold growth. To ensure optimal performance, it's crucial to follow some installation tips and best practices.

First and foremost, selecting the right size dehumidifier is essential. A unit that's too small may struggle to handle the moisture in larger areas, while an oversized one might cycle on and off too frequently, which could reduce its lifespan. Assess the square footage of the area you intend to manage and choose a model that matches those dimensions. Most manufacturers provide sizing charts that are invaluable in this process.

Once you've chosen your dehumidifier, placement plays a pivotal role in its effectiveness. Position it centrally within the room if possible, ensuring there's ample space around it for proper air circulation-ideally about 6-12 inches from walls or furniture. This allows for efficient intake and exhaust of air. Avoid placing it near sources of dust or debris, such as open windows or doors leading outside.

Humidity control settings are another critical aspect of optimal performance. Dehumidifiers often come with adjustable humidity levels; setting them between 30-50% is generally ideal for most homes. This range helps maintain comfort without drying out the air excessively, which could lead to other issues like static electricity or respiratory discomfort.

Regular maintenance is key to longevity and efficiency. Clean the filter every few weeks to prevent dust accumulation that could impede airflow or harbor allergens. If your dehumidifier has an automatic drainage option, ensure that hoses remain unobstructed and check for leaks periodically to avoid water damage.

Additionally, consider energy efficiency when running your dehumidifier continuously in particularly damp conditions. Look for models with Energy Star certification-they tend to use less electricity without compromising performance.

Lastly, monitor environmental changes over time as seasons shift or weather patterns fluctuate. The demand for moisture control can vary throughout the year; being attentive allows you to adjust settings accordingly while maintaining consistent protection against dampness.

In conclusion, enhancing your living spaces with optional dehumidifiers requires thoughtful consideration of size, placement, settings, maintenance routines, energy consumption, and adaptability to changing conditions. By adhering to these installation tips and best practices, you can achieve not only optimal performance but also contribute positively towards a healthier indoor environment free from excessive moisture challenges.

Recommended Brands and Models for HVAC Multimeters

Dehumidifiers are invaluable appliances for managing moisture levels in damp areas, playing a crucial role in maintaining a healthy and comfortable living environment. While exploring optional dehumidifiers tailored for such spaces is essential, it's equally important to understand maintenance practices and troubleshooting techniques to ensure these devices operate efficiently.

First and foremost, regular maintenance is key to prolonging the life of a dehumidifier. One of the simplest yet most effective maintenance tasks is cleaning or replacing the air filter. The filter's primary job is to trap dust, allergens, and other particulates from the air. Over time, it can become clogged, reducing the efficiency of the dehumidifier or causing it to work harder than necessary. Generally, filters should be inspected monthly and cleaned with warm water or replaced as recommended by the manufacturer.

Another critical aspect of maintenance involves emptying and cleaning the water collection tank or ensuring proper function if your unit has a continuous drainage option. A full tank will automatically shut off most dehumidifiers until emptied, which means regularly checking and emptying it is crucial for uninterrupted operation. If your model allows for continuous drainage via a hose attachment, periodically inspect this setup to prevent blockages or leaks that could cause damage over time.

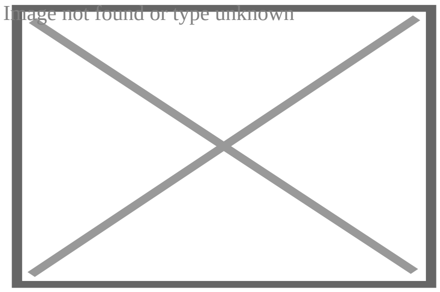
Despite diligent maintenance efforts, users might still encounter common issues that require troubleshooting. One frequent problem is inadequate moisture removal. This issue could stem from incorrect settings on the humidistat-a device within some models that controls humidity levels-or an improperly sized unit for the area it serves. It's vital to ensure that settings align with current environmental needs and that your dehumidifier's capacity matches room size.

Another common challenge is loud noise during operation, often caused by loose components or debris caught in the fan blades or motor assembly. Addressing this might involve tightening screws on panels or carefully removing any obstructions found inside.

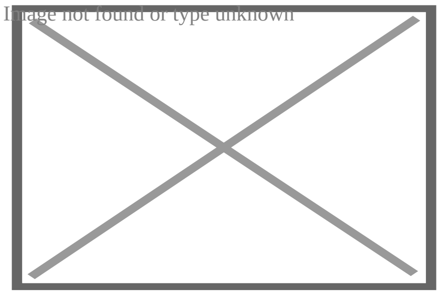
For electrical problems like failure to start or frequent cycling off-and-on, checking power connections can often resolve these issues swiftly-ensuring plugs are secure and inspecting cords for damage are simple but effective first steps.

In conclusion, while selecting an optional dehumidifier suitable for damp areas requires understanding various features such as capacity and energy efficiency ratings, maintaining them through regular care significantly enhances their longevity and performance. Moreover, knowing how to troubleshoot common issues empowers users to address minor problems independently without professional assistance unless absolutely necessary. By staying vigilant about both preventative measures and quick fixes when required, homeowners can enjoy all benefits offered by their dehumidifiers while minimizing potential disruptions caused by unforeseen malfunctions.

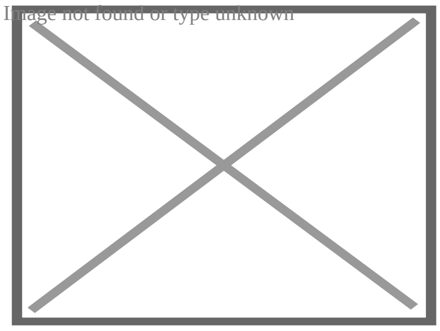
About Heating, ventilation, and air conditioning



Rooftop HVAC unit with view of fresh-air intake vent



Ventilation duct with outlet diffuser vent. These are installed throughout a building to move air in or out of rooms. In the middle is a damper to open and close the vent to allow more or less air to enter the space.



The control circuit in a household HVAC installation. The wires connecting to the blue terminal block on the upper-right of the board lead to the thermostat. The fan enclosure is directly behind the board, and the filters can be seen at the top. The safety interlock switch is at the bottom left. In the lower middle is the capacitor.

Heating, ventilation, and air conditioning (**HVAC**) is the use of various technologies to control the temperature, humidity, and purity of the air in an enclosed space. Its goal is to provide thermal comfort and acceptable indoor air quality. HVAC system design is a subdiscipline of mechanical engineering, based on the principles of thermodynamics, fluid mechanics, and heat transfer. "Refrigeration" is sometimes added to the field's abbreviation as **HVAC&R** or **HVACR**, or "ventilation" is dropped, as in **HACR** (as in the designation of HACR-rated circuit breakers).

HVAC is an important part of residential structures such as single family homes, apartment buildings, hotels, and senior living facilities; medium to large industrial and office buildings such as skyscrapers and hospitals; vehicles such as cars, trains, airplanes, ships and submarines; and in marine environments, where safe and healthy building conditions are regulated with respect to temperature and humidity, using fresh air from outdoors.

Ventilating or ventilation (the "V" in HVAC) is the process of exchanging or replacing air in any space to provide high indoor air quality which involves temperature control, oxygen replenishment, and removal of moisture, odors, smoke, heat, dust, airborne bacteria, carbon dioxide, and other gases. Ventilation removes unpleasant smells and excessive moisture, introduces outside air, keeps interior building air circulating, and prevents stagnation of the interior air. Methods for ventilating a building are divided into *mechanical/forced* and *natural* types.[1]

Overview

[edit]

The three major functions of heating, ventilation, and air conditioning are interrelated, especially with the need to provide thermal comfort and acceptable indoor air quality within reasonable installation, operation, and maintenance costs. HVAC systems can be used in both domestic and commercial environments. HVAC systems can provide ventilation, and maintain pressure relationships between spaces. The means of air delivery and removal from spaces is known as room air distribution.[2]

Individual systems

[edit]
See also: HVAC control system

In modern buildings, the design, installation, and control systems of these functions are integrated into one or more HVAC systems. For very small buildings, contractors normally estimate the capacity and type of system needed and then design the system, selecting the appropriate refrigerant and various components needed. For larger buildings, building service designers, mechanical engineers, or building services engineers analyze, design, and specify the HVAC systems. Specialty mechanical contractors and suppliers then fabricate, install and commission the systems. Building permits and code-compliance inspections of the installations are normally required for all sizes of buildings

District networks

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Although HVAC is executed in individual buildings or other enclosed spaces (like NORAD's underground headquarters), the equipment involved is in some cases an extension of a larger district heating (DH) or district cooling (DC) network, or a combined DHC network. In such cases, the operating and maintenance aspects are simplified and metering becomes necessary to bill for the energy that is consumed, and in some cases energy that is returned to the larger system. For example, at a given time one building may be utilizing chilled water for air conditioning and the warm water it returns may be used in another building for heating, or for the overall heating-portion of the DHC network (likely with energy added to boost the temperature).[3][4][5]

Basing HVAC on a larger network helps provide an economy of scale that is often not possible for individual buildings, for utilizing renewable energy sources such as solar heat,[6][7][8] winter's cold,[9][10] the cooling potential in some places of lakes or seawater for free cooling, and the enabling function of seasonal thermal energy storage. By utilizing natural sources that can be used for HVAC systems it can make a huge difference for the environment and help expand the knowledge of using different methods.

History

[edit]
See also: Air conditioning § History

HVAC is based on inventions and discoveries made by Nikolay Lvov, Michael Faraday, Rolla C. Carpenter, Willis Carrier, Edwin Ruud, Reuben Trane, James Joule, William Rankine, Sadi Carnot, Alice Parker and many others.[11]

Multiple inventions within this time frame preceded the beginnings of the first comfort air conditioning system, which was designed in 1902 by Alfred Wolff (Cooper, 2003) for the New York Stock Exchange, while Willis Carrier equipped the Sacketts-Wilhems Printing Company with the process AC unit the same year. Coyne College was the first school to offer HVAC training in 1899.[12] The first residential AC was installed by 1914, and by the 1950s there was "widespread adoption of residential AC".[13]

The invention of the components of HVAC systems went hand-in-hand with the Industrial Revolution, and new methods of modernization, higher efficiency, and system control are constantly being introduced by companies and inventors worldwide.

Heating

[edit]
"Heater" redirects here. For other uses, see Heater (disambiguation).
Main article: Central heating

Heaters are appliances whose purpose is to generate heat (i.e. warmth) for the building. This can be done via central heating. Such a system contains a boiler, furnace, or heat pump to heat water, steam, or air in a central location such as a furnace room in a home, or a mechanical room in a large building. The heat can be transferred by convection, conduction, or radiation. Space heaters are used to heat single rooms and only consist of a single unit.

Generation

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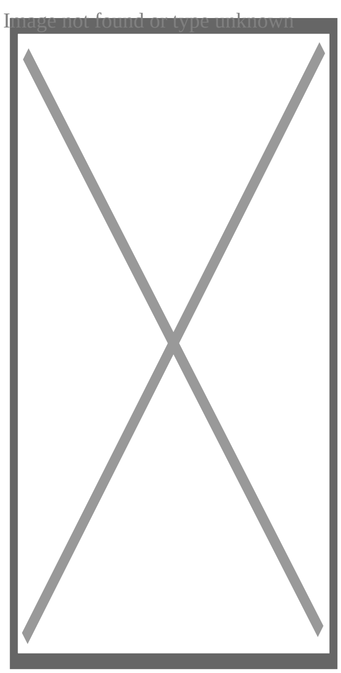

Central heating unit

Heaters exist for various types of fuel, including solid fuels, liquids, and gases. Another type of heat source is electricity, normally heating ribbons composed of high resistance wire (see Nichrome). This principle is also used for baseboard heaters and portable heaters. Electrical heaters are often used as backup or supplemental heat for heat pump systems.

The heat pump gained popularity in the 1950s in Japan and the United States.[14] Heat pumps can extract heat from various sources, such as environmental air, exhaust air from a building, or from the ground. Heat pumps transfer heat from outside the structure into the air inside. Initially, heat pump HVAC systems were only used in moderate climates, but with improvements in low temperature operation and reduced loads due to more efficient homes, they are increasing in popularity in cooler climates. They can also operate in reverse to cool an interior.

Distribution

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Water/steam

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In the case of heated water or steam, piping is used to transport the heat to the rooms. Most modern hot water boiler heating systems have a circulator, which is a pump, to move hot water through the distribution system (as opposed to older gravity-fed systems). The heat can be transferred to the surrounding air using radiators, hot water coils (hydro-air), or other heat exchangers. The radiators may be mounted on walls or installed within the floor to produce floor heat.

The use of water as the heat transfer medium is known as hydronics. The heated water can also supply an auxiliary heat exchanger to supply hot water for bathing and washing.

Air

[edit]
Main articles: Room air distribution and Underfloor air distribution

Warm air systems distribute the heated air through ductwork systems of supply and return air through metal or fiberglass ducts. Many systems use the same ducts to distribute air cooled by an evaporator coil for air conditioning. The air supply is normally filtered through air filters[*dubious – discuss*] to remove dust and pollen particles.[15]

Dangers

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The use of furnaces, space heaters, and boilers as a method of indoor heating could result in incomplete combustion and the emission of carbon monoxide, nitrogen oxides, formaldehyde, volatile organic compounds, and other combustion byproducts. Incomplete combustion occurs when there is insufficient oxygen; the inputs are fuels containing various contaminants and the outputs are harmful byproducts, most dangerously carbon monoxide, which is a tasteless and odorless gas with serious adverse health effects.[16]

Without proper ventilation, carbon monoxide can be lethal at concentrations of 1000 ppm (0.1%). However, at several hundred ppm, carbon monoxide exposure induces headaches, fatigue, nausea, and vomiting. Carbon monoxide binds with hemoglobin in the blood, forming carboxyhemoglobin, reducing the blood's ability to transport oxygen. The primary health concerns associated with carbon monoxide exposure are its cardiovascular and neurobehavioral effects. Carbon monoxide can cause atherosclerosis (the hardening of arteries) and can also trigger heart attacks. Neurologically, carbon monoxide exposure reduces hand to eye coordination, vigilance, and continuous performance. It can also affect time discrimination.[17]

Ventilation

[edit]
Main article: Ventilation (architecture)
See also: Duct (flow)

Ventilation is the process of changing or replacing air in any space to control the temperature or remove any combination of moisture, odors, smoke, heat, dust, airborne bacteria, or carbon dioxide, and to replenish oxygen. It plays a critical role in maintaining a healthy indoor environment by preventing the buildup of harmful pollutants and ensuring the circulation of fresh air. Different methods, such as natural ventilation through windows and mechanical ventilation systems, can be used depending on the building design and air quality needs. Ventilation often refers to the intentional delivery of the outside air to the building indoor space. It is one of the most important factors for maintaining acceptable indoor air quality in buildings.

Although ventilation is an integral component of maintaining good indoor air quality, it may not be satisfactory alone.[18] A clear understanding of both indoor and outdoor air quality parameters is needed to improve the performance of ventilation in terms of ...[19] In scenarios where outdoor pollution would deteriorate indoor air quality, other treatment devices such as filtration may also be necessary.[20]

Methods for ventilating a building may be divided into *mechanical/forced* and *natural* types.[21]

Mechanical or forced

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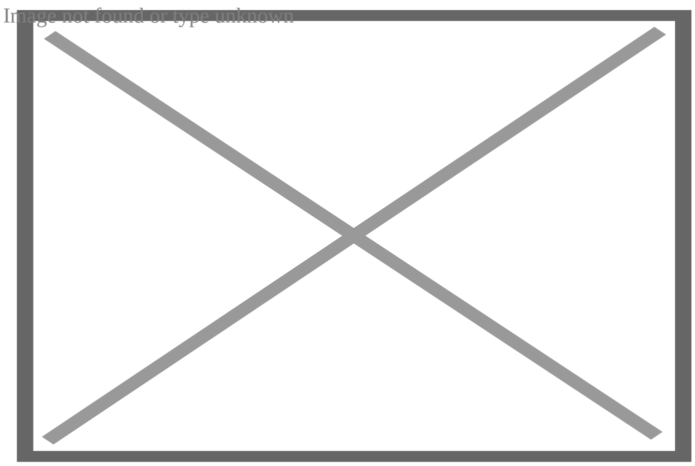
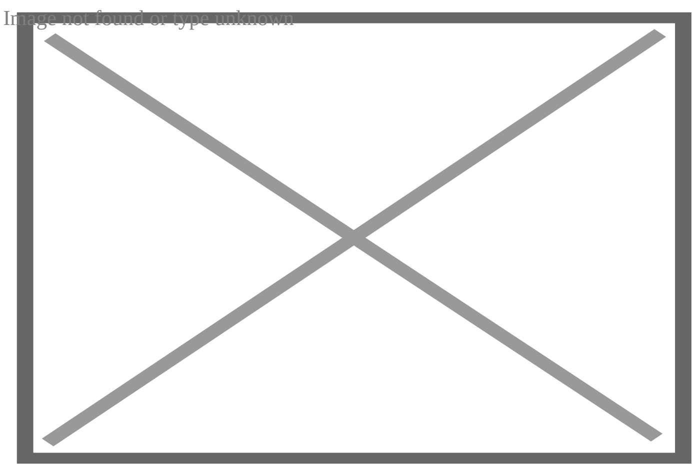
Further information: Ventilation (architecture) § Mechanical systems



HVAC ventilation exhaust for a 12-story building



An axial belt-drive exhaust fan serving an underground car park. This exhaust fan's operation is interlocked with the concentration of contaminants emitted by internal combustion engines.

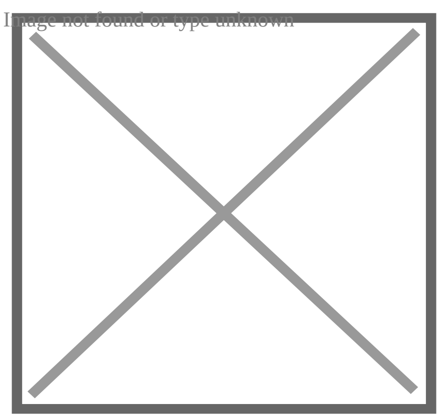
Mechanical, or forced, ventilation is provided by an air handler (AHU) and used to control indoor air quality. Excess humidity, odors, and contaminants can often be controlled via dilution or replacement with outside air. However, in humid climates more energy is required to remove excess moisture from ventilation air.

Kitchens and bathrooms typically have mechanical exhausts to control odors and sometimes humidity. Factors in the design of such systems include the flow rate (which is a function of the fan speed and exhaust vent size) and noise level. Direct drive fans are available for many applications and can reduce maintenance needs.

In summer, ceiling fans and table/floor fans circulate air within a room for the purpose of reducing the perceived temperature by increasing evaporation of perspiration on the skin of the occupants. Because hot air rises, ceiling fans may be used to keep a room warmer in the winter by circulating the warm stratified air from the ceiling to the floor.

Passive

[edit]
Main article: Passive ventilation



Ventilation on the downdraught system, by impulsion, or the 'plenum' principle, applied to schoolrooms (1899)

Natural ventilation is the ventilation of a building with outside air without using fans or other mechanical systems. It can be via operable windows, louvers, or trickle vents when spaces are small and the architecture permits. ASHRAE defined Natural ventilation as the flow of air through open windows, doors, grilles, and other planned building envelope penetrations, and as being driven by natural and/or artificially produced pressure differentials.[1]

Natural ventilation strategies also include cross ventilation, which relies on wind pressure differences on opposite sides of a building. By strategically placing openings, such as windows or vents, on opposing walls, air is channeled through the space to enhance cooling and ventilation. Cross ventilation is most effective when there are clear, unobstructed paths for airflow within the building.

In more complex schemes, warm air is allowed to rise and flow out high building openings to the outside (stack effect), causing cool outside air to be drawn into low building openings. Natural ventilation schemes can use very little energy, but care must be taken to ensure comfort. In warm or humid climates, maintaining thermal comfort solely via natural ventilation might not be possible. Air conditioning systems are used, either as backups or supplements. Air-side economizers also use outside air to condition spaces, but do so using fans, ducts, dampers, and control systems to introduce and distribute cool outdoor air when appropriate.

An important component of natural ventilation is air change rate or air changes per hour: the hourly rate of ventilation divided by the volume of the space. For example, six air changes per hour means an amount of new air, equal to the volume of the space, is added every ten minutes. For human comfort, a minimum of four air changes per hour is typical, though warehouses might have only two. Too high of an air change rate may be uncomfortable, akin to a wind tunnel which has thousands of changes per hour. The highest air change rates are for crowded spaces, bars, night clubs, commercial kitchens at around 30 to 50 air changes per hour.[22]

Room pressure can be either positive or negative with respect to outside the room. Positive pressure occurs when there is more air being supplied than exhausted, and is common to reduce the infiltration of outside contaminants.[23]

Airborne diseases

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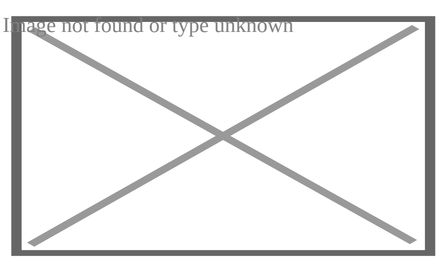
Natural ventilation [24] is a key factor in reducing the spread of airborne illnesses such as tuberculosis, the common cold, influenza, meningitis or COVID-19. Opening doors and windows are good ways to maximize natural ventilation, which would make the risk of airborne contagion much lower than with costly and maintenance-requiring mechanical systems. Old-fashioned clinical areas with high ceilings and large windows provide the greatest protection. Natural ventilation costs little and is maintenance free, and is particularly suited to limited-resource settings and tropical climates, where the burden of TB and institutional TB transmission is highest. In settings where respiratory isolation is difficult and climate permits, windows and doors should be opened to reduce the risk of airborne contagion. Natural ventilation requires little maintenance and is inexpensive.[25]

Natural ventilation is not practical in much of the infrastructure because of climate. This means that the facilities need to have effective mechanical ventilation systems and or use Ceiling Level UV or FAR UV ventilation systems.



Alpha Black Edition - Sirair Air conditioner with UVC (Ultraviolet Germicidal Irradiation)

Ventilation is measured in terms of Air Changes Per Hour (ACH). As of 2023, the CDC recommends that all spaces have a minimum of 5 ACH.[26] For hospital rooms with airborne contagions the CDC recommends a minimum of 12 ACH.[27] The challenges in facility ventilation are public unawareness,[28][29] ineffective government oversight, poor building codes that are based on comfort levels, poor system operations, poor maintenance, and lack of transparency.[30]

UVC or Ultraviolet Germicidal Irradiation is a function used in modern air conditioners which reduces airborne viruses, bacteria, and fungi, through the use of a built-in LED UV light that emits a gentle glow across the evaporator. As the cross-flow fan circulates the room air, any viruses are guided through the sterilization module's irradiation range, rendering them instantly inactive.[31]

Air conditioning

[edit]
Main article: Air conditioning

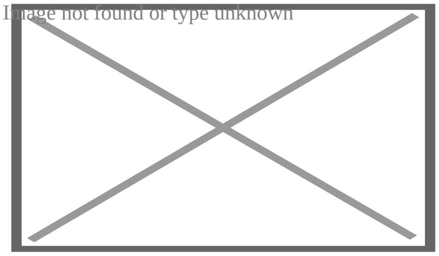
An air conditioning system, or a standalone air conditioner, provides cooling and/or humidity control for all or part of a building. Air conditioned buildings often have sealed windows, because open windows would work against the system intended to maintain constant indoor air conditions. Outside, fresh air is generally drawn into the system by a vent into a mix air chamber for mixing with the space return air. Then the mixture air enters an indoor or outdoor heat exchanger section where the air is to be cooled down, then be guided to the space creating positive air pressure. The percentage of return air made up of fresh air can usually be manipulated by adjusting the opening of this vent. Typical fresh air intake is about 10% of the total supply air.[*citation needed*]

Air conditioning and refrigeration are provided through the removal of heat. Heat can be removed through radiation, convection, or conduction. The heat transfer medium is a refrigeration system, such as water, air, ice, and chemicals are referred to as refrigerants. A refrigerant is employed either in a heat pump system in which a compressor is used to drive thermodynamic refrigeration cycle, or in a free cooling system that uses pumps to circulate a cool refrigerant (typically water or a glycol mix).

It is imperative that the air conditioning horsepower is sufficient for the area being cooled. Underpowered air conditioning systems will lead to power wastage and inefficient usage. Adequate horsepower is required for any air conditioner installed.

Refrigeration cycle

[edit]
Main article: Heat pump and refrigeration cycle



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

The refrigeration cycle uses four essential elements to cool, which are compressor, condenser, metering device, and evaporator.

- At the inlet of a compressor, the refrigerant inside the system is in a low pressure, low temperature, gaseous state. The **compressor** pumps the refrigerant gas up to high pressure and temperature.
- From there it enters a heat exchanger (sometimes called a **condensing coil** or condenser) where it loses heat to the outside, cools, and condenses into its liquid phase.
- An **expansion valve** (also called metering device) regulates the refrigerant liquid to flow at the proper rate.
- The liquid refrigerant is returned to another heat exchanger where it is allowed to evaporate, hence the heat exchanger is often called an **evaporating coil** or evaporator. As the liquid refrigerant evaporates it absorbs heat from the inside air, returns to the compressor, and repeats the cycle. In the process, heat is absorbed from indoors and transferred outdoors, resulting in cooling of the building.

In variable climates, the system may include a reversing valve that switches from heating in winter to cooling in summer. By reversing the flow of refrigerant, the heat pump refrigeration cycle is changed from cooling to heating or vice versa. This allows a facility to be heated and cooled by a single piece of equipment by the same means, and with the same hardware.

Free cooling

[edit]
Main article: Free cooling

Free cooling systems can have very high efficiencies, and are sometimes combined with seasonal thermal energy storage so that the cold of winter can be used for summer air conditioning. Common storage mediums are deep aquifers or a natural underground rock mass accessed via a cluster of small-diameter, heat-exchanger-equipped boreholes. Some systems with small storages are hybrids, using free cooling early in the cooling season, and later employing a heat pump to chill the circulation coming from the storage. The heat pump is added-in because the storage acts as a heat sink when the system is in cooling (as opposed to charging) mode, causing the temperature to gradually increase during the cooling season.

Some systems include an "economizer mode", which is sometimes called a "free-cooling mode". When economizing, the control system will open (fully or partially) the outside air damper and close (fully or partially) the return air damper. This will cause fresh, outside air to be supplied to the system. When the outside air is cooler than the demanded cool air, this will allow the demand to be met without using the mechanical supply of cooling (typically chilled water or a direct expansion "DX" unit), thus saving energy. The control system can compare the temperature of the outside air vs. return air, or it can compare the enthalpy of the air, as is frequently done in climates where humidity is more of an issue. In both cases, the outside air must be less energetic than the return air for the system to enter the economizer mode.

Packaged split system

[edit]

Central, "all-air" air-conditioning systems (or package systems) with a combined outdoor condenser/evaporator unit are often installed in North American residences, offices, and public buildings, but are difficult to retrofit (install in a building that was not designed to receive it) because of the bulky air ducts required.[32] (Minisplit ductless systems are used in these situations.) Outside of North America, packaged systems are only used in limited applications involving large indoor space such as stadiums, theatres or exhibition halls.

An alternative to packaged systems is the use of separate indoor and outdoor coils in split systems. Split systems are preferred and widely used worldwide except in North America. In North America, split systems are most often seen in residential applications, but they are gaining popularity in small commercial buildings. Split systems are used where ductwork is not feasible or where the space conditioning efficiency is of prime concern.[33] The benefits of ductless air conditioning systems include easy installation, no ductwork, greater zonal control, flexibility of control, and quiet operation.[34] In space conditioning, the duct losses can account for 30% of energy consumption.[35] The use of minisplits can result in energy savings in space conditioning as there are no losses associated with ducting.

With the split system, the evaporator coil is connected to a remote condenser unit using refrigerant piping between an indoor and outdoor unit instead of ducting air directly from the outdoor unit. Indoor units with directional vents mount onto walls, suspended from ceilings, or fit into the ceiling. Other indoor units mount inside the ceiling cavity so that short lengths of duct handle air from the indoor unit to vents or diffusers around the rooms.

Split systems are more efficient and the footprint is typically smaller than the package systems. On the other hand, package systems tend to have a slightly lower indoor noise level compared to split systems since the fan motor is located outside.

Dehumidification

[edit]

Dehumidification (air drying) in an air conditioning system is provided by the evaporator. Since the evaporator operates at a temperature below the dew point, moisture in the air condenses on the evaporator coil tubes. This moisture is collected at the bottom of the evaporator in a pan and removed by piping to a central drain or onto the ground outside.

A dehumidifier is an air-conditioner-like device that controls the humidity of a room or building. It is often employed in basements that have a higher relative humidity because of their lower temperature (and propensity for damp floors and walls). In food retailing establishments, large open chiller cabinets are highly effective at dehumidifying the internal air. Conversely, a humidifier increases the humidity of a building.

The HVAC components that dehumidify the ventilation air deserve careful attention because outdoor air constitutes most of the annual humidity load for nearly all buildings.[36]

Humidification

[edit]
Main article: Humidifier

Maintenance

[edit]

All modern air conditioning systems, even small window package units, are equipped with internal air filters.[*citation needed*] These are generally of a lightweight gauze-like material, and must be replaced or washed as conditions warrant. For example, a building in a high dust environment, or a home with furry pets, will need to have the filters changed more often than buildings without these dirt loads. Failure to replace these filters as needed will contribute to a lower heat exchange rate, resulting in wasted energy, shortened equipment life, and higher energy bills; low air flow can result in iced-over evaporator coils, which can completely stop airflow. Additionally, very dirty or plugged filters can cause overheating during a heating cycle, which can result in damage to the system or even fire.

Because an air conditioner moves heat between the indoor coil and the outdoor coil, both must be kept clean. This means that, in addition to replacing the air filter at the evaporator coil, it is also necessary to regularly clean the condenser coil. Failure to keep the condenser clean will eventually result in harm to the compressor because the condenser coil is responsible for discharging both the indoor heat (as picked up by the evaporator) and the heat generated by the electric motor driving the compressor.

Energy efficiency

[edit]

HVAC is significantly responsible for promoting energy efficiency of buildings as the building sector consumes the largest percentage of global energy.[37] Since the 1980s, manufacturers of HVAC equipment have been making an effort to make the systems they manufacture more efficient. This was originally driven by rising energy costs, and has more recently been driven by increased awareness of environmental issues. Additionally, improvements to the HVAC system efficiency can also help increase occupant health and productivity.[38] In the US, the EPA has imposed tighter restrictions over the years. There are several methods for making HVAC systems more efficient.

Heating energy

[edit]

In the past, water heating was more efficient for heating buildings and was the standard in the United States. Today, forced air systems can double for air conditioning and are more popular.

Some benefits of forced air systems, which are now widely used in churches, schools, and high-end residences, are

- Better air conditioning effects
- Energy savings of up to 15–20%
- Even conditioning[*citation needed*]

A drawback is the installation cost, which can be slightly higher than traditional HVAC systems.

Energy efficiency can be improved even more in central heating systems by introducing zoned heating. This allows a more granular application of heat, similar to non-central heating systems. Zones are controlled by multiple thermostats. In water heating systems the thermostats control zone valves, and in forced air systems they control zone dampers inside the vents which selectively block the flow of air. In this case, the control system is very critical to maintaining a proper temperature.

Forecasting is another method of controlling building heating by calculating the demand for heating energy that should be supplied to the building in each time unit.

Ground source heat pump

[edit]
Main article: Geothermal heat pump

Ground source, or geothermal, heat pumps are similar to ordinary heat pumps, but instead of transferring heat to or from outside air, they rely on the stable, even temperature of the earth to provide heating and air conditioning. Many regions experience seasonal temperature extremes, which would require large-capacity heating and cooling equipment to heat or cool buildings. For example, a conventional heat pump system used to heat a building in Montana's ?57 °C (?70 °F) low temperature or cool a building in the highest temperature ever recorded in the US—57 °C (134 °F) in Death Valley, California, in 1913 would require a large amount of energy due to the extreme difference between inside and outside air temperatures. A metre below the earth's surface, however, the ground remains at a relatively constant temperature. Utilizing this large source of relatively moderate temperature earth, a heating or cooling system's capacity can often be significantly reduced. Although ground temperatures vary according to latitude, at 1.8 metres (6 ft) underground, temperatures generally only range from 7 to 24 °C (45 to 75 °F).

Solar air conditioning

[edit]
Main article: Solar air conditioning

Photovoltaic solar panels offer a new way to potentially decrease the operating cost of air conditioning. Traditional air conditioners run using alternating current, and hence, any direct-current solar power needs to be inverted to be compatible with these units. New variable-speed DC-motor units allow solar power to more easily run them since this conversion is unnecessary, and since the motors are tolerant of voltage fluctuations associated with variance in supplied solar power (e.g., due to cloud cover).

Ventilation energy recovery

[edit]

Energy recovery systems sometimes utilize heat recovery ventilation or energy recovery ventilation systems that employ heat exchangers or enthalpy wheels to recover sensible or latent heat from exhausted air. This is done by transfer of energy from the stale air inside the home to the incoming fresh air from outside.

Air conditioning energy

[edit]

The performance of vapor compression refrigeration cycles is limited by thermodynamics.[39] These air conditioning and heat pump devices *move* heat rather than convert it from one form to another, so *thermal efficiencies* do not appropriately describe the performance of these devices. The Coefficient of performance (COP) measures performance, but this dimensionless measure has not been adopted. Instead, the Energy Efficiency Ratio (*EER*) has traditionally been used to characterize the performance of many HVAC systems. EER is the Energy Efficiency Ratio based on a 35 °C (95 °F) outdoor temperature. To more accurately describe the performance of air conditioning equipment over a typical cooling season a modified version of the EER, the Seasonal Energy Efficiency Ratio (*SEER*), or in Europe the ESEER, is used. SEER ratings are based on seasonal temperature averages instead of a constant 35 °C (95 °F) outdoor temperature. The current industry minimum SEER rating is 14 SEER. Engineers have pointed out some areas where efficiency of the existing hardware could be improved. For example, the fan blades used to move the air are usually stamped from sheet metal, an economical method of manufacture, but as a result they are not aerodynamically efficient. A well-designed blade could reduce the electrical power required to move the air by a third.[40]

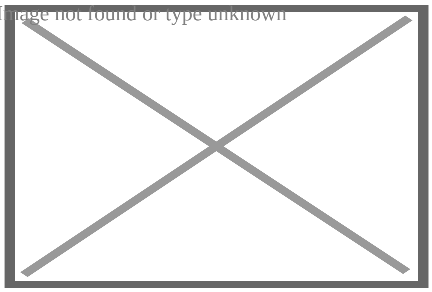
Demand-controlled kitchen ventilation

[edit]
Main article: Demand controlled ventilation

Demand-controlled kitchen ventilation (DCKV) is a building controls approach to controlling the volume of kitchen exhaust and supply air in response to the actual cooking loads in a commercial kitchen. Traditional commercial kitchen ventilation systems operate at 100% fan speed independent of the volume of cooking activity and DCKV technology changes that to provide significant fan energy and conditioned air savings. By deploying smart sensing technology, both the exhaust and supply fans can be controlled to capitalize on the affinity laws for motor energy savings, reduce makeup air heating and cooling energy, increasing safety, and reducing ambient kitchen noise levels.[41]

Air filtration and cleaning

[edit]
Main article: Air filter



Air handling unit, used for heating, cooling, and filtering the air

Air cleaning and filtration removes particles, contaminants, vapors and gases from the air. The filtered and cleaned air then is used in heating, ventilation, and air conditioning. Air cleaning and filtration should be taken in account when protecting our building environments.[42] If present, contaminants can come out from the HVAC systems if not removed or filtered properly.

Clean air delivery rate (CADR) is the amount of clean air an air cleaner provides to a room or space. When determining CADR, the amount of airflow in a space is taken into account. For example, an air cleaner with a flow rate of 30 cubic metres (1,000 cu ft) per minute and an efficiency of 50% has a CADR of 15 cubic metres (500 cu ft) per minute. Along with CADR, filtration performance is very important when it comes to the air in our indoor environment. This depends on the size of the particle or fiber, the filter packing density and depth, and the airflow rate.[42]

Circulation of harmful substances

[edit]
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Poorly maintained air conditioners/ventilation systems can harbor mold, bacteria, and other contaminants, which are then circulated throughout indoor spaces, contributing to ...[43]

Industry and standards

[edit]

The HVAC industry is a worldwide enterprise, with roles including operation and maintenance, system design and construction, equipment manufacturing and sales, and in education and research. The HVAC industry was historically regulated by the manufacturers of HVAC equipment, but regulating and standards organizations such as HARDI (Heating, Air-conditioning and Refrigeration Distributors International), ASHRAE, SMACNA, ACCA (Air Conditioning Contractors of America), Uniform Mechanical Code, International Mechanical Code, and AMCA have been established to support the industry and encourage high standards and achievement. (UL as an omnibus agency is not specific to the HVAC industry.)

The starting point in carrying out an estimate both for cooling and heating depends on the exterior climate and interior specified conditions. However, before taking up the heat load calculation, it is necessary to find fresh air requirements for each area in detail, as pressurization is an important consideration.

International

[edit]

ISO 16813:2006 is one of the ISO building environment standards.[44] It establishes the general principles of building environment design. It takes into account the need to provide a healthy indoor environment for the occupants as well as the need to protect the environment for future generations and promote collaboration among the various parties involved in building environmental design for sustainability. ISO16813 is applicable to new construction and the retrofit of existing buildings.[45]

The building environmental design standard aims to:[45]

- provide the constraints concerning sustainability issues from the initial stage of the design process, with building and plant life cycle to be considered together with owning and operating costs from the beginning of the design process;
- assess the proposed design with rational criteria for indoor air quality, thermal comfort, acoustical comfort, visual comfort, energy efficiency, and HVAC system controls at every stage of the design process;
- iterate decisions and evaluations of the design throughout the design process.

United States

[edit]

Licensing

[edit]
Main article: Section 608 EPA Certification

In the United States, federal licensure is generally handled by EPA certified (for installation and service of HVAC devices).

Many U.S. states have licensing for boiler operation. Some of these are listed as follows:

- Arkansas [46]
- Georgia [47]
- Michigan [48]
- Minnesota [49]
- Montana [50]
- New Jersey [51]
- North Dakota [52]
- Ohio [53]
- Oklahoma [54]
- Oregon [55]

Finally, some U.S. cities may have additional labor laws that apply to HVAC professionals.

Societies

[edit]
See also: American Society of Heating, Refrigerating and Air-Conditioning Engineers
See also: Air Conditioning, Heating and Refrigeration Institute

Many HVAC engineers are members of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). ASHRAE regularly organizes two annual technical committees and publishes recognized standards for HVAC design, which are updated every four years.[56]

Another popular society is AHRI, which provides regular information on new refrigeration technology, and publishes relevant standards and codes.

Codes

[edit]

Codes such as the UMC and IMC do include much detail on installation requirements, however. Other useful reference materials include items from SMACNA, ACGIH, and technical trade journals.

American design standards are legislated in the Uniform Mechanical Code or International Mechanical Code. In certain states, counties, or cities, either of these codes may be adopted and amended via various legislative processes. These codes are updated and published by the International Association of Plumbing and Mechanical Officials (IAPMO) or the International Code Council (ICC) respectively, on a 3-year code development cycle. Typically, local building permit departments are charged with enforcement of these standards on private and certain public properties.

Technicians

[edit]

HVAC Technician	
Occupation	
Occupation type	Vocational
Activity sectors	Construction
Description	
Education required	Apprenticeship
Related jobs	Carpenter, electrician, plumber, welder

An **HVAC technician** is a tradesman who specializes in heating, ventilation, air conditioning, and refrigeration. HVAC technicians in the US can receive training through formal training institutions, where most earn associate degrees. Training for HVAC technicians includes classroom lectures and hands-on tasks, and can be followed by an apprenticeship wherein the recent graduate works alongside a professional HVAC technician for a temporary period.[57] HVAC techs who have been trained can also be certified in areas such as air conditioning, heat pumps, gas heating, and commercial refrigeration.

United Kingdom

[edit]

The Chartered Institution of Building Services Engineers is a body that covers the essential Service (systems architecture) that allow buildings to operate. It includes the electrotechnical, heating, ventilating, air conditioning, refrigeration and plumbing industries. To train as a building services engineer, the academic requirements are GCSEs (A-C) /

Standard Grades (1-3) in Maths and Science, which are important in measurements, planning and theory. Employers will often want a degree in a branch of engineering, such as building environment engineering, electrical engineering or mechanical engineering. To become a full member of CIBSE, and so also to be registered by the Engineering Council UK as a chartered engineer, engineers must also attain an Honours Degree and a master's degree in a relevant engineering subject.[*citation needed*] CIBSE publishes several guides to HVAC design relevant to the UK market, and also the Republic of Ireland, Australia, New Zealand and Hong Kong. These guides include various recommended design criteria and standards, some of which are cited within the UK building regulations, and therefore form a legislative requirement for major building services works. The main guides are:

- Guide A: Environmental Design
- Guide B: Heating, Ventilating, Air Conditioning and Refrigeration
- Guide C: Reference Data
- Guide D: Transportation systems in Buildings
- Guide E: Fire Safety Engineering
- Guide F: Energy Efficiency in Buildings
- Guide G: Public Health Engineering
- Guide H: Building Control Systems
- Guide J: Weather, Solar and Illuminance Data
- Guide K: Electricity in Buildings
- Guide L: Sustainability
- Guide M: Maintenance Engineering and Management

Within the construction sector, it is the job of the building services engineer to design and oversee the installation and maintenance of the essential services such as gas, electricity, water, heating and lighting, as well as many others. These all help to make buildings comfortable and healthy places to live and work in. Building Services is part of a sector that has over 51,000 businesses and employs represents 2–3% of the GDP.

Australia

[edit]

The Air Conditioning and Mechanical Contractors Association of Australia (AMCA), Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH), Australian Refrigeration Mechanical Association and CIBSE are responsible.

Asia

[edit]

Asian architectural temperature-control have different priorities than European methods. For example, Asian heating traditionally focuses on maintaining temperatures of objects such as the floor or furnishings such as Kotatsu tables and directly warming people, as opposed to the Western focus, in modern periods, on designing air systems.

Philippines

[edit]

The Philippine Society of Ventilating, Air Conditioning and Refrigerating Engineers (PSVARE) along with Philippine Society of Mechanical Engineers (PSME) govern on the codes and standards for HVAC / MVAC (MVAC means "mechanical ventilation and air conditioning") in the Philippines.

India

[edit]

The Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE) was established to promote the HVAC industry in India. ISHRAE is an associate of ASHRAE. ISHRAE was founded at New Delhi[58] in 1981 and a chapter was started in Bangalore in 1989. Between 1989 & 1993, ISHRAE chapters were formed in all major cities in India.[*citation nee*

See also

[edit]

- Air speed (HVAC)
- Architectural engineering
- ASHRAE Handbook
- Auxiliary power unit
- Cleanroom
- Electric heating
- Fan coil unit
- Glossary of HVAC terms
- Head-end power
- Hotel electric power
- Mechanical engineering
- Outdoor wood-fired boiler
- Radiant cooling
- Sick building syndrome
- Uniform Codes
- Uniform Mechanical Code

- Ventilation (architecture)
- World Refrigeration Day
- Wrightsoft

References

[edit]

1. ^ ***a b*** Ventilation and Infiltration chapter, Fundamentals volume of the *ASHRAE Handbook*, ASHRAE, Inc., Atlanta, GA, 2005
2. **^** *Designer's Guide to Ceiling-Based Air Diffusion*, Rock and Zhu, ASHRAE, Inc., New York, 2002
3. **^** *Rezaie, Behnaz; Rosen, Marc A. (2012). "District heating and cooling: Review of technology and potential enhancements". Applied Energy.* ***93****: 2–10. Bibcode:2012ApEn...93....2R. doi:10.1016/j.apenergy.2011.04.020.*
4. **^** Werner S. (2006). ECOHEATCOOL (WP4) Possibilities with more district heating in Europe. Euroheat & Power, Brussels. Archived 2015-09-24 at the Wayback Machine
5. **^** Dalin P., Rubenhag A. (2006). ECOHEATCOOL (WP5) Possibilities with more district cooling in Europe, final report from the project. Final Rep. Brussels: Euroheat & Power. Archived 2012-10-15 at the Wayback Machine
6. **^** Nielsen, Jan Erik (2014). Solar District Heating Experiences from Denmark. Energy Systems in the Alps - storage and distribution … Energy Platform Workshop 3, Zurich - 13/2 2014
7. **^** Wong B., Thornton J. (2013). Integrating Solar & Heat Pumps. Renewable Heat Workshop.
8. **^** Pauschinger T. (2012). Solar District Heating with Seasonal Thermal Energy Storage in Germany Archived 2016-10-18 at the Wayback Machine. European Sustainable Energy Week, Brussels. 18–22 June 2012.
9. **^** *"How Renewable Energy Is Redefining HVAC | AltEnergyMag". www.altenergymag.com. Retrieved 2020-09-29.*
10. **^** *""Lake Source" Heat Pump System". HVAC-Talk: Heating, Air & Refrigeration Discussion. Retrieved 2020-09-29.*
11. **^** *Swenson, S. Don (1995). HVAC: heating, ventilating, and air conditioning. Homewood, Illinois: American Technical Publishers. ISBN 978-0-8269-0675-5.*
12. **^** *"History of Heating, Air Conditioning & Refrigeration". Coyne College. Archived from the original on August 28, 2016.*
13. **^** *"What is HVAC? A Comprehensive Guide".*
14. **^** *Staffell, Iain; Brett, Dan; Brandon, Nigel; Hawkes, Adam (30 May 2014). "A review of domestic heat pumps".*
15. **^** *(Alta.), Edmonton. Edmonton's green home guide : you're gonna love green. OCLC 884861834.*
16. **^** *Bearg, David W. (1993). Indoor Air Quality and HVAC Systems. New York: Lewis Publishers. pp. 107–112.*
17. **^** *Dianat, I.; Nazari, I. "Characteristic of unintentional carbon monoxide poisoning in Northwest Iran-Tabriz". International Journal of Injury Control and Promotion. Retrieved 2011-11-15.*

18. **^** *ANSI/ASHRAE Standard 62.1, Ventilation for Acceptable Indoor Air Quality*, ASHRAE, Inc., Atlanta, GA, US
19. **^** *Belias, Evangelos; Licina, Dusan (2024). "European residential ventilation: Investigating the impact on health and energy demand". Energy and Buildings. **304**. Bibcode:2024EneBu.30413839B. doi:10.1016/j.enbuild.2023.113839.*
20. **^** *Belias, Evangelos; Licina, Dusan (2022). "Outdoor PM2. 5 air filtration: optimising indoor air quality and energy". Building & Cities. **3** (1): 186–203. doi:10.5334/bc.153.*
21. **^** Ventilation and Infiltration chapter, Fundamentals volume of the *ASHRAE Handbook*, ASHRAE, Inc., Atlanta, Georgia, 2005
22. **^** *"Air Change Rates for typical Rooms and Buildings". The Engineering ToolBox. Retrieved 2012-12-12.*
23. **^** *Bell, Geoffrey. "Room Air Change Rate". A Design Guide for Energy-Efficient Research Laboratories. Archived from the original on 2011-11-17. Retrieved 2011-11-15.*
24. **^** *"Natural Ventilation for Infection Control in Health-Care Settings" (PDF). World Health Organization (WHO), 2009. Retrieved 2021-07-05.*
25. **^** *Escombe, A. R.; Oeser, C. C.; Gilman, R. H.; et al. (2007). "Natural ventilation for the prevention of airborne contagion". PLOS Med. **4** (68): e68. doi: 10.1371/journal.pmed.0040068. PMC 1808096. PMID 17326709.*
26. **^** Centers For Disease Control and Prevention (CDC) *"Improving Ventilation In Buildings". 11 February 2020.*
27. **^** Centers For Disease Control and Prevention (CDC) *"Guidelines for Environmental Infection Control in Health-Care Facilities". 22 July 2019.*
28. **^** Dr. Edward A. Nardell Professor of Global Health and Social Medicine, Harvard Medical School *"If We're Going to Live With COVID-19, It's Time to Clean Our Indoor Air Properly". Time. February 2022.*
29. **^** *"A Paradigm Shift to Combat Indoor Respiratory Infection - 21st century" (PDF). University of Leeds.*, Morawska, L, Allen, J, Bahnfleth, W et al. (36 more authors) (2021) A paradigm shift to combat indoor respiratory infection. Science, 372 (6543). pp. 689-691. ISSN 0036-8075
30. **^** Video *"Building Ventilation What Everyone Should Know". YouTube. 17 June 2022.*
31. **^** *CDC (June 1, 2020). "Center for Disease Control and Prevention, Decontamination and Reuse of Filtering Facepiece Respirators". cdc.gov. Retrieved September 13, 2024.*
32. **^** *"What are Air Ducts? The Homeowner's Guide to HVAC Ductwork". Super Tech. Retrieved 2018-05-14.*
33. **^** *"Ductless Mini-Split Heat Pumps". U.S. Department of Energy.*
34. **^** *"The Pros and Cons of Ductless Mini Split Air Conditioners". Home Reference. 28 July 2018. Retrieved 9 September 2020.*
35. **^** *"Ductless Mini-Split Air Conditioners". ENERGY SAVER. Retrieved 29 November 2019.*
36. **^** *Moisture Control Guidance for Building Design, Construction and Maintenance. December 2013.*
37. **^** Chenari, B., Dias Carrilho, J. and Gameiro da Silva, M., 2016. Towards sustainable, energy-efficient and healthy ventilation strategies in buildings: A review. Renewable and Sustainable Energy Reviews, 59, pp.1426-1447.

38. **^** *"Sustainable Facilities Tool: HVAC System Overview". sftool.gov. Retrieved 2 July 2014.*
39. **^** *"Heating and Air Conditioning". www.nuclear-power.net. Retrieved 2018-02-10.*
40. **^** Keeping cool and green, *The Economist* 17 July 2010, p. 83
41. **^** *"Technology Profile: Demand Control Kitchen Ventilation (DCKV)" (PDF). Retrieved 2018-12-04.*
42. ^ ***a b*** *Howard, J (2003), Guidance for Filtration and Air-Cleaning Systems to Protect Building Environments from Airborne Chemical, Biological, or Radiological Attacks, National Institute for Occupational Safety and Health, doi: 10.26616/NIOSHPUB2003136, 2003-136*
43. **^** *"The Inside Story: A Guide to Indoor Air Quality". 28 August 2014.*
44. **^** *ISO. "Building environment standards". www.iso.org. Retrieved 2011-05-14.*
45. ^ ***a b*** *ISO. "Building environment design—Indoor environment—General principles". Retrieved 14 May 2011.*
46. **^** *"010.01.02 Ark. Code R. § 002 - Chapter 13 - Restricted Lifetime License".*
47. **^** *"Boiler Professionals Training and Licensing".*
48. **^** *"Michigan Boiler Rules".*
49. **^** *"Minn. R. 5225.0550 - EXPERIENCE REQUIREMENTS AND DOCUMENTATION FOR LICENSURE AS AN OPERATING ENGINEER".*
50. **^** *"Subchapter 24.122.5 - Licensing".*
51. **^** *"Chapter 90 - BOILERS, PRESSURE VESSELS, AND REFRIGERATION".*
52. **^** *"Article 33.1-14 - North Dakota Boiler Rules".*
53. **^** *"Ohio Admin. Code 1301:3-5-10 - Boiler operator and steam engineer experience requirements".*
54. **^** *"Subchapter 13 - Licensing of Boiler and Pressure Vessel Service, Repair and/or Installers".*
55. **^** *"Or. Admin. R. 918-225-0691 - Boiler, Pressure Vessel and Pressure Piping Installation, Alteration or Repair Licensing Requirements".*
56. **^** *"ASHRAE Handbook Online". www.ashrae.org. Retrieved 2020-06-17.*
57. **^** *"Heating, Air Conditioning, and Refrigeration Mechanics and Installers : Occupational Outlook Handbook: : U.S. Bureau of Labor Statistics". www.bls.gov. Retrieved 2023-06-22.*
58. **^** *"About ISHRAE". ISHRAE. Retrieved 2021-10-11.*

Further reading

[edit]

- *International Mechanical Code* (2012 (Second Printing)) by the International Code Council, Thomson Delmar Learning.
- *Modern Refrigeration and Air Conditioning* (August 2003) by Althouse, Turnquist, and Bracciano, Goodheart-Wilcox Publisher; 18th edition.
- *The Cost of Cool.*
- *Whai is LEV?*

External links

[edit]

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- v
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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

Components

- Grille
- Ground-coupled heat exchanger

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

Professions, trades, and services

- Architectural acoustics
- Architectural engineering
- Architectural technologist
- Building services engineering
- Building information modeling (BIM)
- Deep energy retrofit
- 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
Health and safety	◦ Indoor air quality (IAQ) ◦ Passive smoking ◦ Sick building syndrome (SBS) ◦ Volatile organic compound (VOC)
See also	◦ ASHRAE Handbook ◦ Building science ◦ Fireproofing ◦ Glossary of HVAC terms ◦ Warm Spaces ◦ World Refrigeration Day ◦ Template:Home automation ◦ Template:Solar energy

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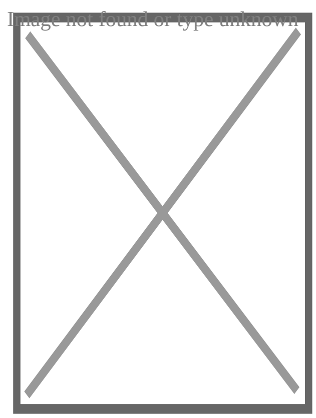
Home automation

- **System**
  - **Elements**
    - Actuators
    - Hardware controllers
    - Sensors
  - **Interconnection type**
    - **Wired**
      - Cable (xDSL)
      - Optical fiber
      - Powerline
        - PLCBUS
        - Universal powerline bus (UPB)
        - X10
    - **Wireless**
      - Radio frequency
        - Bluetooth
        - Bluetooth Low Energy
        - DECT
        - EnOcean
        - GPRS
        - MyriaNed
        - One-Net
        - Thread
        - UMTS
        - Wi-Fi
        - Zigbee
        - Z-Wave
      - Infrared (Consumer IR)
    - **Both**
      - Insteon
      - KNX
      - Matter
  - **Network technologies, by function**
    - **Device interconnection**
      - Bluetooth
      - Bluetooth Low Energy
      - FireWire
      - IrDA
      - USB
      - Zigbee
    - **Control and automation**
      - AllJoyn
      - Bus SCS with OpenWebNet
      - C-Bus (protocol)
      - CEBus
      - EnOcean
      - EHS
      - Insteon
      - IP500
      - Luxom
      - KNX
      - LonWorks



Tasks	○ Audio and video ○ Heating, ventilation, and air conditioning ○ Lighting control system ○ Other systems ○ Robotics ○ Security ○ Thermostat automation
Other	○ Gateway ○ Smart home hub ○ Costs ○ Mesh networking ○ Organizations ○ Smart grid

See also

Home of the future
Building automation
Floor plan
Home automation
Home energy monitor
Home network
Home server
House navigation system
INTEGER Millennium House
The House for the Future
Ubiquitous computing
Xanadu Houses

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About Royal Supply South

Things To Do in Arapahoe County

Photo

Meow Wolf Denver | Convergence Station

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Photo

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Wings Over the Rockies Air & Space Museum

4.7 (5324)

Photo

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Aurora Reservoir

4.6 (1770)

Photo

Cherry Creek Dam

4.3 (6)

Photo

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History Colorado Center

4.6 (2666)

Photo

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Molly Brown House Museum

4.7 (2528)

Driving Directions in Arapahoe County

Driving Directions From The Home Depot to Royal Supply South

Driving Directions From Sheridan High School to Royal Supply South

Driving Directions From Tandy Leather South Denver - 151 to Royal Supply South

Driving Directions From Walmart Supercenter to Royal Supply South

Driving Directions From St. Nicks Christmas and Collectibles to Royal Supply South

Driving Directions From Costco Wholesale to Royal Supply South

Air conditioning store

Air conditioning system supplier

Furnace repair service

Furnace store

Heating contractor

Driving Directions From Plains Conservation Center (Visitor Center) to Royal Supply South

Driving Directions From Colorado Freedom Memorial to Royal Supply South

Driving Directions From History Colorado Center to Royal Supply South

Driving Directions From The Aurora Highlands North Sculpture to Royal Supply South

Driving Directions From Wings Over the Rockies Air & Space Museum to Royal Supply South

Driving Directions From Colorado Freedom Memorial to Royal Supply South

Mobile Home Furnace Installation

Mobile Home Air Conditioning Installation Services

Mobile Home Hvac Repair

Mobile Home Hvac Service

Mobile home supply store

Reviews for Royal Supply South

Exploring Optional Dehumidifiers for Damp Areas**View GBP**

Check our other pages :

- **Identifying Goggles Designed for Refrigerant Handling**
- **Checking Fan Speed for Consistent Comfort**
- **Assessing Essential Items for Emergency Calls**
- **Handling Harmful Chemicals with Proper Ventilation**

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