

HVAC cost



- **Estimating Labor Expenses for Repair Services**
Estimating Labor Expenses for Repair Services Comparing Replacement Part Prices for Various Systems Reviewing Maintenance Plan Rates in Detail Exploring Payment Arrangements for Major Overhauls Analyzing Long Term Savings with Efficient Upgrades Investigating Seasonal Discounts from Service Providers Understanding Monthly Budgeting for HVAC Projects Balancing Initial Spending with Potential Savings Evaluating Total Costs for System Retrofits Preparing for Unexpected Repair Fees Weighing Return on Investment for Modern Equipment Identifying Hidden Expenses in Older Units
- **Understanding Local Building Code Requirements**
Understanding Local Building Code Requirements Reviewing State Regulations for HVAC Installation Exploring County Permit Applications for Mobile Homes Navigating EPA 608 Certification Steps Recognizing UL Rated Components for Safety Determining Required Inspections for New Units Preparing Official Documents for System Upgrades Knowing When to Seek Professional Licensing Support Identifying Legal Mandates for Refrigerant Disposal Sorting Out Utility Guidelines for Meter Upgrades Meeting Deadlines for Permit Renewals Locating Reliable Compliance Resources for Homeowners
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When it comes to determining the required inspections for new units, a comprehensive understanding of the inspection requirements is essential. This not only ensures compliance with regulations but also guarantees the safety and functionality of the units. The process involves a systematic approach to identifying what needs to be inspected, how often these inspections should occur, and the standards that must be met.

The foundation of any effective inspection regimen is a thorough understanding of applicable regulatory requirements. Depending on the industry and jurisdiction, these can vary significantly. Mobile homes benefit from zoned HVAC systems for personalized comfort **mobile home hvac systems prices** pump. For example, in construction or manufacturing industries, there might be specific codes and standards that dictate the minimum inspection criteria for new units. These could include structural integrity assessments, electrical system checks, or environmental compliance evaluations.

In addition to regulatory requirements, industry best practices often provide valuable guidance for determining necessary inspections. These best practices are typically developed through years of experience and input from experts in the field. They offer insights into potential problem areas that may not be explicitly covered by regulations but are nonetheless critical for ensuring unit reliability and safety.

Once regulatory requirements and best practices have been reviewed, developing a detailed inspection plan is crucial. This plan should outline all required inspections along with their frequency and scope. It should also specify who will perform these inspections-whether it's an internal team or independent third-party inspectors-and detail any special equipment or procedures needed during the inspection process.

Moreover, integrating technology into inspection processes can enhance both efficiency and accuracy. Digital tools such as drones for visual inspections or software for tracking maintenance histories can help streamline operations while providing comprehensive data analysis capabilities. These technologies enable inspectors to identify trends over time, predict potential failures before they occur, and ensure corrective actions are taken promptly.

It's also important to establish clear documentation protocols as part of the inspection process. Accurate record-keeping not only provides evidence of compliance but also helps track ongoing performance issues or improvements over time. This documentation serves as a valuable resource during audits or reviews by regulatory bodies.

Finally, continuous training of personnel involved in inspections is vital to keep them updated on new technologies, revised standards, and evolving risks within their specific fields. Regular training sessions ensure that all team members remain competent in executing their duties effectively while adapting quickly to changes in regulations or industry expectations.

In conclusion, determining required inspections for new units involves more than just ticking off boxes on a checklist; it's about creating an integrated system that prioritizes safety through adherence to rigorous standards combined with innovative approaches tailored specifically towards each unit's unique characteristics and operational demands. By doing so meticulously yet flexibly enough to accommodate future developments seamlessly into existing frameworks without compromising quality assurance processes at any stage whatsoever-organizations stand poised not merely meet but exceed expectations consistently regardless ever-shifting landscapes encountered along way forward therein!

When examining new mobile home HVAC systems, it is essential to understand the key components that require thorough inspection. Mobile homes present unique challenges in heating, ventilation, and air conditioning due to their compact size and construction materials. Therefore, ensuring that each component of the HVAC system is functioning optimally is crucial for maintaining comfort and efficiency.

One of the primary components requiring inspection is the furnace. The furnace is responsible for generating heat and distributing it throughout the home. Inspectors should check for any signs of wear or damage, such as rust or cracks on the heat exchanger, which could lead to dangerous carbon monoxide leaks. Additionally, ensuring that all connections are tight and secure helps prevent gas leaks and ensures efficient operation.

Another critical component is the ductwork system. Ducts are responsible for carrying heated or cooled air from the central unit to various parts of the mobile home. Inspectors should evaluate ducts for leaks, blockages, or disconnections that can significantly reduce system efficiency and increase energy costs. Ensuring proper insulation around ducts can also help maintain consistent temperatures and enhance overall performance.

The air conditioning unit itself requires careful scrutiny as well. This includes checking refrigerant levels to ensure they are within recommended limits since low levels can impair cooling efficiency or even damage the compressor over time. Inspectors should also verify that all electrical connections are intact and free from corrosion, as faulty wiring could lead to malfunctions or pose safety hazards.

Ventilation plays a pivotal role in maintaining indoor air quality in mobile homes. The inspection process should include evaluating exhaust fans, vents, and filters to ensure they function correctly without obstruction. Clean filters are vital for optimal airflow and preventing contaminants from circulating within the living space.

Lastly, thermostats must be inspected for accuracy in temperature settings and responsiveness when adjusted by residents. An unreliable thermostat can lead to inefficient energy use and discomfort within the home environment.

In summary, inspecting these key components-furnace, ductwork system, air conditioning unit, ventilation features like fans/vents/filters-and thermostats-is essential when determining required inspections for new mobile home HVAC units. A comprehensive evaluation ensures safety standards are met while promoting operational efficiency across all seasons: ultimately benefiting both homeowners through enhanced comfort levels & reduced utility expenses alike!

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Steps to Accurately Estimate Labor Expenses for HVAC Repair Services

In the realm of mobile homes, ensuring the safety and efficiency of HVAC systems is paramount. As these units are often compact and subject to varying environmental conditions, adhering to rigorous safety standards and regulations during inspections is crucial. This becomes particularly important when considering new units, as they set the precedent for sustained safety and comfort.

The first step in determining required inspections for HVAC systems in new mobile home units involves understanding the regulatory landscape. Various agencies at both federal and state levels govern these standards to ensure that all installations meet specific safety criteria. For instance, the U.S. Department of Housing and Urban Development (HUD) outlines stringent guidelines that manufacturers must follow. These regulations are designed to protect residents from potential hazards such as carbon monoxide leaks, electrical fires, or inefficient heating and cooling which can lead to significant energy waste.

A comprehensive inspection process begins with verifying that all components of the HVAC system are installed according to manufacturer specifications and HUD requirements. Inspectors must ensure that ductwork is properly sealed and insulated to prevent air leaks, which can compromise system efficiency and indoor air quality. Additionally, inspectors check for appropriate clearance around equipment to avoid overheating or obstruction.

Inspectors also focus on evaluating the performance of each unit within a mobile home's unique layout. They assess whether the system provides adequate airflow throughout the space without creating pressure imbalances that could affect structural integrity or occupant comfort. This may involve testing thermostats for accuracy, examining filters for cleanliness, and ensuring vents are unobstructed.

Another critical aspect of these inspections is assessing compliance with environmental regulations aimed at reducing emissions. New HVAC units must not only meet current energy efficiency standards but also use refrigerants that have a lower impact on global warming potential (GWP). Inspectors play a vital role in confirming that systems utilize approved materials and technologies that align with evolving environmental mandates.

Furthermore, safety standards dictate regular maintenance checks even after initial installation inspections have been completed. Mobile homes often experience shifts due to transportation or settling over time; therefore, continuous monitoring ensures ongoing compliance with safety protocols while identifying wear-and-tear issues before they escalate into major problems.

In conclusion, determining required inspections for new HVAC units in mobile homes involves navigating a complex web of safety standards and regulations designed to protect both residents and the environment. By adhering strictly to these guidelines during every phase- from installation through ongoing maintenance-inspectors help guarantee reliable performance while mitigating risks associated with improper system operation. Ultimately this meticulous approach fosters peace-of-mind knowing one's living environment remains safe comfortable efficient year-round regardless external conditions might present themselves outside its walls



Tools and Software for Estimating Labor Costs in Mobile Home HVAC Repairs

When determining required inspections for new units, understanding common issues detected during inspections and their implications is crucial. Inspections serve as a vital tool in ensuring the safety, efficiency, and compliance of newly manufactured or constructed units with industry standards and regulations. The discovery of recurring issues during these assessments not only highlights areas for improvement but also helps in refining inspection protocols to prevent future occurrences.

One prevalent issue often identified during inspections is structural defects. These can range from minor cosmetic imperfections to significant integrity concerns that might compromise the unit's stability. Structural problems may arise from manufacturing errors, poor material quality, or subpar construction practices. The implications of such findings are profound; they can lead to costly repairs, project delays, and even pose safety risks if not addressed promptly. Understanding this pattern emphasizes the importance of robust quality control measures at every stage of production.

Another common issue involves electrical and mechanical system failures. These systems are integral to the functionality of any unit, whether it's residential buildings or industrial machinery. Faulty wiring, improper installation of components, or inadequate testing procedures often result in malfunctions that can cause operational inefficiencies or hazards like fires and equipment breakdowns. Identifying these problems early through thorough inspections allows for timely intervention, improving overall reliability and performance.

Compliance violations with regulatory standards are also frequently uncovered during inspections. These could relate to environmental guidelines, fire safety codes, or other legal requirements specific to certain industries. Non-compliance not only jeopardizes public safety but also exposes organizations to legal penalties and reputational damage. Regular inspections ensure adherence to these regulations, fostering a culture of accountability and responsibility among manufacturers and builders.

Moreover, inspections often reveal lapses in documentation and record-keeping practices. Accurate records are essential for tracking maintenance schedules, warranty claims, and past repairs or upgrades. Insufficient documentation can lead to misunderstandings about a unit's history and hinder decision-making processes regarding its upkeep or sale.

The implications of these common issues extend beyond immediate rectifications; they provide valuable insights into systemic weaknesses within production processes or design frameworks. By addressing root causes rather than symptoms alone, companies can enhance product quality and customer satisfaction while minimizing future risks.

In conclusion, identifying common issues during inspections is pivotal in shaping effective inspection strategies for new units. Recognizing patterns enables stakeholders to implement preventive measures proactively rather than reactively fixing problems after they arise. As industries evolve with technological advancements and changing regulatory landscapes continue defining new benchmarks for excellence maintaining rigorous inspection protocols remains an indispensable component towards achieving sustainable growth without compromising on safety standards.

Case Studies: Examples of Labor Cost Estimation in Various Repair Scenarios

Preparing for a successful HVAC inspection in new mobile homes is crucial to ensure the safety, efficiency, and longevity of the heating, ventilation, and air conditioning systems. As mobile homes become increasingly popular due to their affordability and flexibility, understanding how to properly prepare for these inspections is essential. By following a systematic approach, homeowners can ensure that their HVAC systems are up to standard and meet all regulatory requirements.

The first step in preparing for an HVAC inspection is understanding the specific requirements for new mobile homes. This involves familiarizing oneself with local building codes and regulations that govern HVAC installations. Each jurisdiction may have different standards, so it's important to research and comprehend what is required in your area. Consulting with professionals or local authorities can provide valuable guidance on what inspectors will be looking for during their assessments.

Once you understand the necessary regulations, conducting a pre-inspection check is crucial. Start by thoroughly examining the HVAC system yourself or hiring a professional to do so. Look for any visible signs of damage or wear, such as leaks in ductwork or corrosion on components. Ensure that all parts of the system are accessible and free from obstructions that might impede proper operation or inspection.

Next, verify that all documentation related to the HVAC installation is complete and readily available. Inspectors will likely request permits, installation manuals, and maintenance records to ensure compliance with manufacturer guidelines and building codes. Having this documentation organized not only demonstrates preparedness but also facilitates a smoother inspection process.

Another critical aspect of preparation involves testing the functionality of the HVAC system prior to inspection. Ensure that both heating and cooling functions operate correctly by running them through their full cycles. Pay attention to unusual noises or inefficiencies that could indicate underlying issues needing attention before the official inspection.

Additionally, cleanliness plays a significant role in passing an HVAC inspection successfully. Clean filters are vital for optimal performance; therefore, replace old filters with new ones before the inspector arrives. Dusting off vents and ensuring clear airflow paths can also contribute positively to the evaluation outcome.

Finally, communication between homeowners and inspectors should be open and proactive throughout this entire process. If there are any unique features about your mobile home's setup-or if certain aspects were modified post-installation-make sure these details are communicated clearly beforehand so they won't cause unnecessary confusion during an actual assessment.

In conclusion, preparing effectively for an HVAC inspection in new mobile homes requires diligent research into relevant regulations combined with thorough pre-inspection checks focusing on functionality tests along with organizing necessary documents while maintaining good communication throughout every stage involved within such processes ensures not only meeting expected standards but surpassing them where possible too!



Tips for Managing and Reducing Labor Expenses Without Compromising Quality

In the complex realm of construction and building development, ensuring safety, compliance, and efficacy is paramount. This is where the role of professional inspectors and the certification processes come into play, particularly when determining required inspections for new units. These professionals form a critical part of the regulatory framework that governs construction practices, ensuring that every aspect of a new build meets established standards before it becomes operational or inhabitable.

Professional inspectors are tasked with a multifaceted role that goes beyond mere box-checking exercises. Their expertise spans various domains including structural integrity, electrical systems, plumbing, fire safety, and environmental compliance. They act as the linchpins in bridging the gap between theoretical regulations and practical implementations on site. By conducting thorough inspections at different phases of construction—from foundation laying to final finishes—these inspectors ensure that each component meets stringent criteria set by local and national building codes.

The certification process complements these inspections by providing an official endorsement that a structure complies with all relevant regulations. This process involves meticulous documentation and reporting by inspectors who verify that all aspects of the construction adhere to specified standards. Certification serves as both a seal of approval for developers and a safeguard for future occupants or users of the building. It reassures stakeholders—be they investors, homeowners, or government bodies—that due diligence has been exercised in every phase of development.

Determining which inspections are required for new units is not a one-size-fits-all approach; it requires careful consideration of several factors such as location-specific regulations, type of structure being built (residential vs commercial), intended use, and even historical context if applicable. For example, structures in seismic zones may require additional scrutiny related to earthquake resilience compared to those in less volatile areas.

The evolving nature of construction technology also means that inspection protocols must adapt continually. With advancements such as smart buildings equipped with IoT devices or sustainable constructions using innovative materials like cross-laminated timber, inspectors must stay abreast with emerging trends to effectively assess compliance within these novel contexts.

Moreover, professional inspectors often collaborate with various stakeholders throughout this process-engineers provide technical insights while architects offer design perspectives-which underscores their pivotal role as integrators within the broader project ecosystem. Their work ensures not only compliance but also fosters innovation by validating cutting-edge techniques against regulatory benchmarks.

In summary, professional inspectors play an indispensable role in maintaining high standards across construction projects through diligent inspection routines backed by rigorous certification processes when determining required inspections for new units. Their expertise ensures safe environments conducive to living and working while aligning contemporary building practices with established codes-a task made ever more crucial amidst rapid urbanization worldwide. Their commitment safeguards public interest today while laying robust foundations for tomorrow's architectural landscapes.

About Mobile home

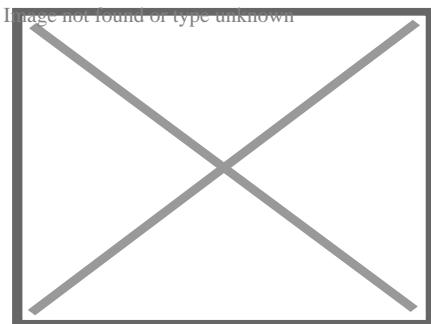
This article is about the prefabricated structure. For the vehicle, see Recreational vehicle. For other uses, see Mobile home (disambiguation).

"Static Caravan" redirects here. For the record label, see Static Caravan Recordings.

"House on wheels" redirects here. For the South Korean variety show, see House on Wheels.

The examples and perspective in this article **deal primarily with the United States and do not represent a worldwide view of the subject**. You may **improve this article**, discuss the issue on the talk page, or create a new article, as appropriate. *(April 2017)* *(Learn how and when to remove this message)*

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Mobile homes with detached single car garages

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Part of a series on

Living spaces

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Main

- House: detached
- semi-detached
- terraced
- Apartment
- Bungalow
- Cottage
- Ecohouse
- Green home
- Housing project
- Human outpost
- I-house
- Ranch
- Tenement
- Condominium
- Mixed-use development
- Hotel
- Hostel
- Castle
- Public housing
- Squat
- Flophouse
- Shack
- Slum
- Shanty town
- Villa

Issues

- Affordability
- Affordability in the United States
- Executive housing
- Environmental:
 - design
 - planning
 - racism
- Environmental security
- Eviction
- Fair housing
- Healthiness
- Homelessness
- Housing crisis
- Housing discrimination
- Housing stress
- Overpopulation
- Housing inequality
- Home ownership
- Luxury apartments
- Ownership equity
- Permit
- Rent
- Subprime lending
- Subsidized housing
- Sustainable:
 - architecture
 - development
 - living
- Sustainable city
- Toxic hotspot
- Vagrancy

Society and politics

- Housing First
- Housing subsidy
- NIMBY
- Rapid Re-Housing
- Real estate appraisal
- Real estate bubble
- Real estate economics
- Real estate investing
- Redlining
- Rent regulation
- Right to housing
- Rent control
- Rent strike
- Tenants union
- YIMBY

Other

- Alternative lifestyle
- Assisted living
- Boomtown
- Cottage homes
- Eco-cities
- Ecovillage
- Foster care
- Green building
- Group home
- Halfway house
- Healthy community design
- Homeless shelter
- Hospital
- Local community
- Log house
- Natural building
- Nursing home
- Orphanage
- Prison
- Psychiatric hospital
- Residential care
- Residential treatment center
- Retirement community
- Retirement home
- Supportive housing
- Supported living



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Housing portal

A **mobile home** (also known as a **house trailer**, **park home**, **trailer**, or **trailer home**) is a prefabricated structure, built in a factory on a permanently attached chassis before being transported to site (either by being towed or on a trailer). Used as permanent homes, or for holiday or temporary accommodation, they are often left permanently or semi-permanently in one place, but can be moved, and may be required to move from time to time for legal reasons.

Mobile homes share the same historic origins as travel trailers, but today the two are very different, with travel trailers being used primarily as temporary or vacation homes. Behind the cosmetic work fitted at installation to hide the base, mobile homes have strong trailer frames, axles, wheels, and tow-hitches.

History

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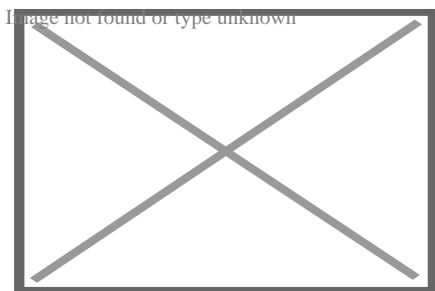
In the United States, this form of housing goes back to the early years of cars and motorized highway travel.^[1] It was derived from the travel trailer (often referred to during the early years as "house trailers" or "trailer coaches"), a small unit with wheels attached permanently, often used for camping or extended travel. The original rationale for this type of housing was its mobility. Units were initially marketed primarily to people whose lifestyle required mobility. However, in the 1950s, the homes began to be marketed primarily as an inexpensive form of housing designed to be set up and left in a location for long periods of time or even permanently installed with a masonry foundation. Previously, units had been eight feet or fewer in width, but in 1956, the 10-foot (3.0 m) wide home ("ten-wide") was introduced, along with the new term "mobile home".^[2]

The homes were given a rectangular shape, made from pre-painted aluminum panels, rather than the streamlined shape of travel trailers, which were usually painted after assembly. All of this helped increase the difference between these homes and home/travel trailers. The smaller, "eight-wide" units could be moved simply with a car, but the larger, wider units ("ten-wide", and, later, "twelve-wide") usually required the services of a professional trucking company, and, often, a special moving permit from a state highway department. During the late 1960s and early 1970s, the homes were made even longer and wider, making the mobility of the units more difficult. Nowadays, when a factory-built home is moved to a location, it is usually kept there permanently and the mobility of the units has considerably decreased. In some states, mobile homes have been taxed as personal property if the wheels remain attached, but as real estate if the wheels are removed. Removal of the tongue and axles may also be a requirement for real estate classification.

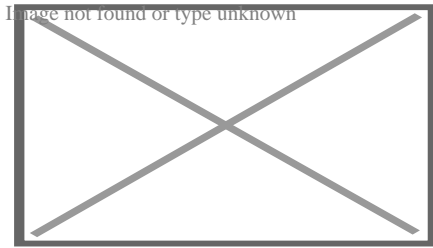
Manufactured home

[edit]

Main article: Manufactured housing



Example of a modern manufactured home in New Alexandria, Pennsylvania. 28 by 60 feet (8.5 m × 18.3 m)



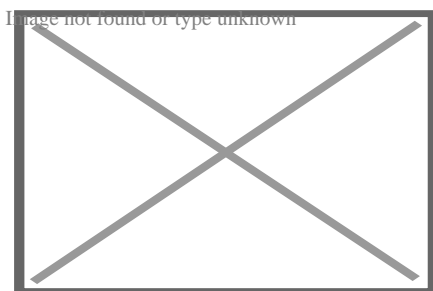
Manufactured home foundation

Mobile homes built in the United States since June 1976, legally referred to as manufactured homes, are required to meet FHA certification requirements and come with attached metal certification tags. Mobile homes permanently installed on owned land are rarely mortgageable, whereas FHA code manufactured homes are mortgageable through VA, FHA, and Fannie Mae.

Many people who could not afford a traditional site-built home, or did not desire to commit to spending a large sum of money on housing, began to see factory-built homes as a viable alternative for long-term housing needs. The units were often marketed as an alternative to apartment rental. However, the tendency of the units of this era to depreciate rapidly in resale value^[citation needed] made using them as collateral for loans much riskier than traditional home loans. Terms were usually limited to less than the thirty-year term typical of the general home-loan market, and interest rates were considerably higher.^[citation needed] In that way, mobile home loans resembled motor vehicle loans more than traditional home mortgage loans.

Construction and sizes

[edit]



Exterior wall assemblies being set in place during manufacture

Mobile homes come in two major sizes, *single-wides* and *double-wides*. Single-wides are 18 feet (5.5 m) or less in width and 90 feet (27 m) or less in length and can be towed to their site as a single unit. Double-wides are 20 feet (6.1 m) or more wide and are 90 feet (27 m) in length or less and are towed to their site in two separate units, which are then joined. *Triple-wides* and even homes with four, five, or more units are also built but less frequently.

While site-built homes are rarely moved, single-wide owners often "trade" or sell their home to a dealer in the form of the reduction of the purchase of a new home. These "used" homes are either re-sold to new owners or to park owners who use them as inexpensive rental units. Single-wides are more likely to be traded than double-wides because removing them from the site is easier. In fact, only about 5% of all double-wides will ever be moved.^[citation needed]

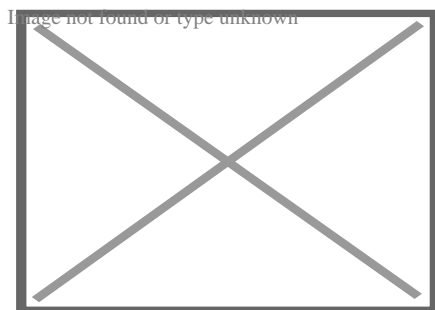
While an EF1 tornado might cause minor damage to a site-built home, it could do significant damage to a factory-built home, especially an older model or one that is not properly secured. Also, structural components (such as windows) are typically weaker than those in site-built homes.^[3] 70 miles per hour (110 km/h) winds can destroy a mobile home in a matter of minutes. Many brands offer optional hurricane straps, which can be used to tie the home to anchors embedded in the ground.

Regulations

[edit]

United States

[edit]



Home struck by tornado

In the United States, mobile homes are regulated by the US Department of Housing and Urban Development (HUD), via the Federal National Manufactured Housing Construction and Safety Standards Act of 1974. This national regulation has allowed many manufacturers to distribute nationwide because they are immune to the jurisdiction of local building authorities.^[4] ^[5] By contrast, producers of modular homes must abide by state and local building codes. There are, however, wind zones adopted by HUD that home builders must follow. For example, statewide, Florida is at least wind zone 2. South Florida is wind zone 3, the strongest wind zone. After Hurricane Andrew in 1992, new standards were adopted for home construction. The codes for building within these wind zones were significantly amended, which has greatly increased their durability. During the 2004 hurricanes in Florida, these

standards were put to the test, with great success. Yet, older models continue to face the exposed risk to high winds because of the attachments applied such as carports, porch and screen room additions. Such areas are exposed to "wind capture" which apply extreme force to the underside of the integrated roof panel systems, ripping the fasteners through the roof pan causing a series of events which destroys the main roof system and the home.

The popularity of the factory-built homes caused complications the legal system was not prepared to handle. Originally, factory-built homes tended to be taxed as vehicles rather than real estate, which resulted in very low property tax rates for their inhabitants. That caused local governments to reclassify them for taxation purposes.

However, even with that change, rapid depreciation often resulted in the home occupants paying far less in property taxes than had been anticipated and budgeted. The ability to move many factory-built homes rapidly into a relatively small area resulted in strains to the infrastructure and governmental services of the affected areas, such as inadequate water pressure and sewage disposal, and highway congestion. That led jurisdictions to begin placing limitations on the size and density of developments.

Early homes, even those that were well-maintained, tended to depreciate over time, much like motor vehicles. That is in contrast to site-built homes which include the land they are built on and tend to appreciate in value. The arrival of mobile homes in an area tended to be regarded with alarm, in part because of the devaluation of the housing potentially spreading to preexisting structures.

This combination of factors has caused most jurisdictions to place zoning regulations on the areas in which factory-built homes are placed, and limitations on the number and density of homes permitted on any given site. Other restrictions, such as minimum size requirements, limitations on exterior colors and finishes, and foundation mandates have also been enacted. There are many jurisdictions that will not allow the placement of any additional factory-built homes. Others have strongly limited or forbidden all single-wide models, which tend to depreciate more rapidly than modern double-wide models.

Apart from all the practical issues described above, there is also the constant discussion about legal fixture and chattels and so the legal status of a trailer is or could be affected by its incorporation to the land or not. This sometimes involves such factors as whether or not the wheels have been removed.

North Carolina

[edit]

The North Carolina Board of Transportation allowed 14-foot-wide homes on the state's roads, but until January 1997, 16-foot-wide homes were not allowed. 41 states allowed 16-

foot-wide homes, but they were not sold in North Carolina. Under a trial program approved January 10, 1997, the wider homes could be delivered on specific roads at certain times of day and travel 10 mph below the speed limit, with escort vehicles in front and behind.^[6]^[7] Eventually, all homes had to leave the state on interstate highways.^[8]

In December 1997, a study showed that the wider homes could be delivered safely, but some opponents still wanted the program to end.^[9] On December 2, 1999, the NC Manufactured Housing Institute asked the state Board of Transportation to expand the program to allow deliveries of 16-foot-wide homes within North Carolina.^[8] A month later, the board extended the pilot program by three months but did not vote to allow shipments within the state.^[10] In June 2000, the board voted to allow 16-foot-side homes to be shipped to other states on more two-lane roads, and to allow shipments in the state east of US 220. A third escort was required, including a law enforcement officer on two-lane roads.^[11]

New York

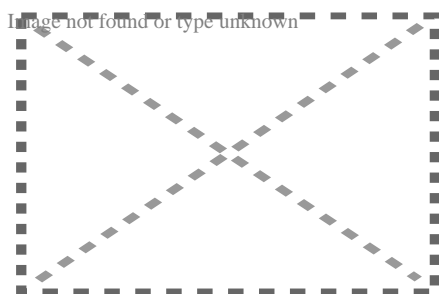
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In New York State, the Homes and Community Renewal agency tracks mobile home parks and provides regulations concerning them. For example, the agency requires park owners to provide residents with a \$15,000 grant if residents are forced to move when the land is transferred to a new owner. Residents are also granted the right of first refusal for a sale of the park, however, if the owner does not evict tenants for five years, the land sale can go ahead. State law also restricts the annual increase in land lot fee to a cap of 3 percent, unless the landowner demonstrates hardship in a local court, and can then raise the land lot fee by up to 6 percent in a year.^[12]

Mobile home parks

[edit]

Main article: Trailer park



Meadow Lanes Estates Mobile Home Park, Ames, Iowa, August 2010, during a flood

Mobile homes are often sited in land lease communities known as trailer parks (also 'trailer courts', 'mobile home parks', 'mobile home communities', 'manufactured home communities', 'factory-built home communities' etc.); these communities allow homeowners to rent space on which to place a home. In addition to providing space, the site often provides basic utilities such as water, sewer, electricity, or natural gas and other amenities such as mowing, garbage removal, community rooms, pools, and playgrounds.

There are over 38,000^[13] trailer parks in the United States ranging in size from 5 to over 1,000 home sites. Although most parks appeal to meeting basic housing needs, some communities specialize towards certain segments of the market. One subset of mobile home parks, retirement communities, restrict residents to those age 55 and older. Another subset of mobile home parks, seasonal communities, are located in popular vacation destinations or are used as a location for summer homes. In New York State, as of 2019, there were 1,811 parks with 83,929 homes.^[12]

Newer homes, particularly double-wides, tend to be built to much higher standards than their predecessors and meet the building codes applicable to most areas. That has led to a reduction in the rate of value depreciation of most used units.^[14]

Additionally, modern homes tend to be built from materials similar to those used in site-built homes rather than inferior, lighter-weight materials. They are also more likely to physically resemble site-built homes. Often, the primary differentiation in appearance is that factory-built homes tend to have less of a roof slope so that they can be readily transported underneath bridges and overpasses.^[citation needed]

The number of double-wide units sold exceeds the number of single-wides, which is due in part to the aforementioned zoning restrictions. Another reason for higher sales is the spaciousness of double-wide units, which are now comparable to site-built homes. Single-wide units are still popular primarily in rural areas, where there are fewer restrictions. They are frequently used as temporary housing in areas affected by natural disasters when restrictions are temporarily waived.^[citation needed]

Another recent trend has been parks in which the owner of the mobile home owns the lot on which their unit is parked. Some of these communities simply provide land in a homogeneous neighborhood, but others are operated more like condominiums with club homes complete with swimming pools and meeting rooms which are shared by all of the residents, who are required to pay membership fees and dues.

By country

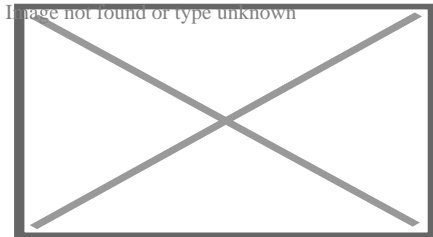
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Mobile home (or mobile-homes) are used in many European campgrounds to refer to fixed caravans, purpose-built cabins, and even large tents, which are rented by the week or even year-round as cheap accommodation, similar to the US concept of a trailer park. Like

many other US loanwords, the term is not used widely in Britain.^[*citation needed*]

United Kingdom

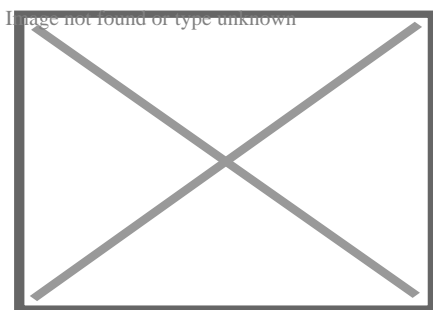
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A mobile home marketed as a holiday home

Mobile Homes or Static Caravans are popular across the United Kingdom. They are more commonly referred to as Park Homes or Leisure Lodges, depending on if they are marketed as a residential dwelling or as a second holiday home residence.

Residential Mobile homes (park homes) are built to the BS3632 standard. This standard is issued by the British Standards Institute. The institute is a UK body who produce a range of standards for businesses and products to ensure they are fit for purpose. The majority of residential parks in the UK have a minimum age limit for their residents, and are generally marketed as retirement or semi-retirement parks. Holiday Homes, static caravans or holiday lodges aren't required to be built to BS3632 standards, but many are built to the standard.



A static caravan park on the cliffs above Beer, Devon, England

In addition to mobile homes, static caravans are popular across the UK. Static caravans have wheels and a rudimentary chassis with no suspension or brakes and are therefore transported on the back of large flatbed lorries, the axle and wheels being used for movement to the final location when the static caravan is moved by tractor or 4x4. A static caravan normally stays on a single plot for many years and has many of the modern conveniences normally found in a home.

Mobile homes are designed and constructed to be transportable by road in one or two sections. Mobile homes are no larger than 20 m × 6.8 m (65 ft 7 in × 22 ft 4 in) with an internal maximum height of 3.05 m (10 ft 0 in). Legally, mobile homes can still be defined as "caravans".

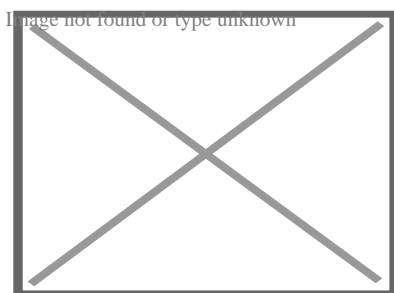
Static holiday caravans generally have sleeping accommodation for 6 to 10 people in 2, 3 or 4 bedrooms and on convertible seating in the lounge referred to as a 'pull out bed'. They tend towards a fairly "open-plan" layout, and while some units are double glazed and centrally heated for year-round use, cheaper models without double glazing or central heating are available for mainly summer use. Static caravan holiday homes are intended for leisure use and are available in 10 and 12 ft (3.0 and 3.7 m) widths, a small number in 13 and 14 ft (4.0 and 4.3 m) widths, and a few 16 ft (4.9 m) wide, consisting of two 8 ft (2.4 m) wide units joined. Generally, holiday homes are clad in painted steel panels, but can be clad in PVC, timber or composite materials. Static caravans are sited on caravan parks where the park operator of the site leases a plot to the caravan owner. There are many holiday parks in the UK in which one's own static caravan can be owned. There are a few of these parks in areas that are prone to flooding and anyone considering buying a sited static caravan needs to take particular care in checking that their site is not liable to flooding.

Static caravans can be rented on an ad-hoc basis or purchased. Purchase prices range from £25,000 to £100,000. Once purchased, static caravans have various ongoing costs including insurance, site fees, local authority rates, utility charges, winterisation and depreciation. Depending on the type of caravan and the park these costs can range from £1,000 to £40,000 per year.^[15] Some park owners used to have unfair conditions in their lease contracts but the Office of Fair Trading has produced a guidance document available for download called Unfair Terms in Holiday Caravan Agreements which aims to stop unfair practices.

Israel

[edit]

Main article: Caravan (Israel)



Posting of *caravan* in Mitzpe Hila, Israel, 1982

Many Israeli settlements and outposts are originally composed of caravans (Hebrew: *caravan*; pl.

caravanim). They are constructed of light metal, are not insulated but can be outfitted with heating and air-conditioning units, water lines, recessed lighting, and floor tiling to function in a full-service capacity. Starting in 2005, prefabricated homes, named *caravillas* (Hebrew:

), a portmanteau of the words caravan, and villa, begin to replace mobile homes in many Israeli settlements.

Difference from modular homes

[edit]

Main article: Modular home

Because of similarities in the manufacturing process, some companies build both types in their factories. Modular homes are transported on flatbed trucks rather than being towed, and lack axles and an automotive-type frame. However, some modular homes are towed behind a semi-truck or toter on a frame similar to that of a trailer. The home is usually in two pieces and is hauled by two separate trucks. Each frame has five or more axles, depending on the size of the home. Once the home has reached its location, the axles and the tongue of the frame are then removed, and the home is set on a concrete foundation by a large crane.

Both styles are commonly referred to as factory-built housing, but that term's technical use is restricted to a class of homes regulated by the Federal National Mfd. Housing Construction and Safety Standards Act of 1974.

Most zoning restrictions on the homes have been found to be inapplicable or only applicable to modular homes. That occurs often after considerable litigation on the topic by affected jurisdictions and by plaintiffs failing to ascertain the difference. Most modern modulars, once fully assembled, are indistinguishable from site-built homes. Their roofs are usually transported as separate units. Newer modulars also come with roofs that can be raised during the setting process with cranes. There are also modulars with 2 to 4 storeys.

Gallery

[edit]

Construction starts with the frame.

○

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Construction starts with the
frame.

Interior wall assemblies are attached.

○

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Interior wall assemblies are
attached.

Roof assembly is set atop home.

○

Image not found or type unknown

Roof assembly is set atop
home.

Drywall is completed.

○

Image not found or type unknown

Drywall is completed.

Home is ready for delivery to site.

○

Image not found or type unknown

Home is ready for delivery to site.

- A modern "triple wide" home, designed to look like an adobe home

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A modern "triple wide" home,
designed to look like an
adobe home

A mobile home is being moved, California.

○

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A mobile home
is being moved,
California.

- A mobile home being prepared for transport

Image not found or type unknown

A mobile home being
prepared for transport

See also

[edit]

-  not found or type unknown Housing portal
- All Parks Alliance for Change
- Campervan
- Construction trailer
- Houseboat
- Manufactured housing
- Modular home
- Motorhome
- Nomadic wagons
- Recreational vehicle
- Reefer container housing units
- Small house movement
- Trailer (vehicle)
- Trailer Park Boys
- Trailer trash
- Vardo
- Prefabricated home

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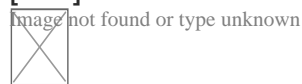
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External links

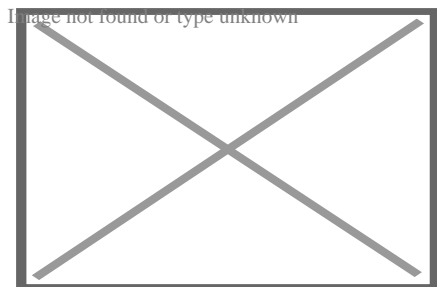
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Wikimedia Commons has media related to **Mobile homes**.

- Regulating body in the UK
- US Federal Manufactured Home Construction and Safety Standards

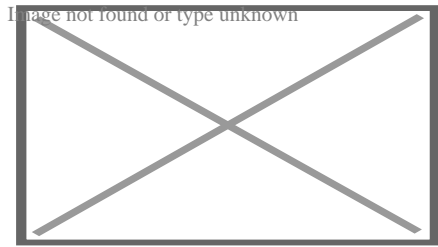
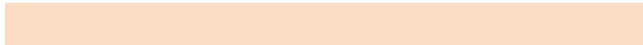
About Indoor air quality



An air filter being cleaned

- v
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Part of a series on



Air pollution from a factory

Air

- Acid rain
- Air quality index
- Atmospheric dispersion modeling
- Chlorofluorocarbon
- Combustion
- Exhaust gas
- Haze
- Global dimming
- Global distillation
- Indoor air quality
- Non-exhaust emissions
- Ozone depletion
- Particulates
- Persistent organic pollutant
- Smog
- Soot
- Volatile organic compound

Biological

- Biological hazard
- Genetic
- Illegal logging
- Introduced species
 - Invasive species

Digital

- Information

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 - Ecological
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- Soundproofing

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- Poisoning
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- Agricultural
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- Bioremediation
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- Electrical resistance heating
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Solid waste

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- Biodegradable waste
- Brown waste
- Electronic waste
- Foam food container
- Food waste
- Green waste
- Hazardous waste
- Industrial waste
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Thermal

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Visual

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- Nuclear holocaust
 - Nuclear fallout
 - Nuclear famine
 - Nuclear winter
- Scorched earth
- Unexploded ordnance
- War and environmental law

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- Biosolids
- Diseases
- Eutrophication
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- Groundwater
- Hypoxia
- Industrial wastewater
- Marine
- Monitoring
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- Ocean acidification
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- Sewage
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- Stagnation
- Sulfur water
- Surface runoff
- Turbidity
- Urban runoff
- Water quality
- Wastewater

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Indoor air quality (IAQ) is the air quality within buildings and structures. Poor indoor air quality due to **indoor air pollution** is known to affect the health, comfort, and well-being of building occupants. It has also been linked to sick building syndrome, respiratory issues, reduced productivity, and impaired learning in schools. Common pollutants of indoor air include: secondhand tobacco smoke, air pollutants from indoor combustion, radon, molds and other allergens, carbon monoxide, volatile organic compounds, legionella and other bacteria, asbestos fibers, carbon dioxide,^[1] ozone and particulates.

Source control, filtration, and the use of ventilation to dilute contaminants are the primary methods for improving indoor air quality. Although ventilation is an integral component of maintaining good indoor air quality, it may not be satisfactory alone.^[2] In scenarios where outdoor pollution would deteriorate indoor air quality, other treatment devices such as filtration may also be necessary.^[3]

IAQ is evaluated through collection of air samples, monitoring human exposure to pollutants, analysis of building surfaces, and computer modeling of air flow inside buildings. IAQ is part of indoor environmental quality (IEQ), along with other factors that exert an influence on physical and psychological aspects of life indoors (e.g., lighting, visual quality, acoustics, and thermal comfort).^[4]

Indoor air pollution is a major health hazard in developing countries and is commonly referred to as "household air pollution" in that context.^[5] It is mostly relating to cooking and heating methods by burning biomass fuel, in the form of wood, charcoal, dung, and crop residue, in indoor environments that lack proper ventilation. Millions of people, primarily women and children, face serious health risks. In total, about three billion people in developing countries are affected by this problem. The World Health Organization (WHO) estimates that cooking-related indoor air pollution causes 3.8 million annual deaths.^[6] The Global Burden of Disease study estimated the number of deaths in 2017 at 1.6 million.^[7]

Definition

[edit]

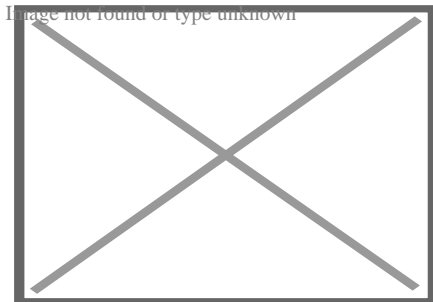
For health reasons it is crucial to breathe clean air, free from chemicals and toxicants as much as possible. It is estimated that humans spend approximately 90% of their lifetime indoors^[8] and that indoor air pollution in some places can be much worse than that of the ambient air.^[9]^[10]

Various factors contribute to high concentrations of pollutants indoors, ranging from influx of pollutants from external sources, off-gassing by furniture, furnishings including carpets, indoor activities (cooking, cleaning, painting, smoking, etc. in homes to using office equipment in offices), thermal comfort parameters such as temperature, humidity, airflow and physio-chemical properties of the indoor air.^[citation needed] Air pollutants can enter a building in many ways, including through open doors or windows. Poorly maintained air conditioners/ventilation systems can harbor mold, bacteria, and other contaminants, which are then circulated throughout indoor spaces, contributing to respiratory problems and allergies.

There have been many debates among indoor air quality specialists about the proper definition of indoor air quality and specifically what constitutes "acceptable" indoor air quality.

Health effects

[edit]



Share of deaths from indoor air pollution. Darker colors mean higher numbers.

IAQ is significant for human health as humans spend a large proportion of their time in indoor environments. Americans and Europeans on average spend approximately 90% of their time indoors.^{[11][12]}

The World Health Organization (WHO) estimates that 3.2 million people die prematurely every year from illnesses attributed to indoor air pollution caused by indoor cooking, with over 237 thousand of these being children under 5. These include around an eighth of all global ischaemic heart disease, stroke, and lung cancer deaths. Overall the WHO estimated that poor indoor air quality resulted in the loss of 86 million healthy life years in 2019.^[13]

Studies in the UK and Europe show exposure to indoor air pollutants, chemicals and biological contamination can irritate the upper airway system, trigger or exacerbate asthma and other respiratory or cardiovascular conditions, and may even have carcinogenic effects.^{[14][15][16][17][18][19]}

Poor indoor air quality can cause sick building syndrome. Symptoms include burning of the eyes, scratchy throat, blocked nose, and headaches.^[20]

Common pollutants

[edit]

Generated by indoor combustion

[edit]

Main article: Household air pollution

Further information: Energy poverty and cooking

a 3-stone stove

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A traditional wood-fired 3-stone stove in Guatemala, which causes indoor air pollution

Indoor combustion, such as for cooking or heating, is a major cause of indoor air pollution and causes significant health harms and premature deaths. Hydrocarbon fires cause air pollution. Pollution is caused by both biomass and fossil fuels of various types, but some forms of fuels are more harmful than others.

Indoor fire can produce black carbon particles, nitrogen oxides, sulfur oxides, and mercury compounds, among other emissions.^[21] Around 3 billion people cook over open fires or on rudimentary cook stoves. Cooking fuels are coal, wood, animal dung, and crop residues.^[22] IAQ is a particular concern in low and middle-income countries where such practices are common.^[23]

Cooking using natural gas (also called fossil gas, methane gas or simply gas) is associated with poorer indoor air quality. Combustion of gas produces nitrogen dioxide and carbon monoxide, and can lead to increased concentrations of nitrogen dioxide throughout the home environment which is linked to respiratory issues and diseases.^{[24][25]}

Carbon monoxide

[edit]

Main article: Carbon monoxide poisoning

One of the most acutely toxic indoor air contaminants is carbon monoxide (CO), a colourless and odourless gas that is a by-product of incomplete combustion. Carbon monoxide may be emitted from tobacco smoke and generated from malfunctioning fuel

burning stoves (wood, kerosene, natural gas, propane) and fuel burning heating systems (wood, oil, natural gas) and from blocked flues connected to these appliances.^[26] In developed countries the main sources of indoor CO emission come from cooking and heating devices that burn fossil fuels and are faulty, incorrectly installed or poorly maintained.^[27] Appliance malfunction may be due to faulty installation or lack of maintenance and proper use.^[26] In low- and middle-income countries the most common sources of CO in homes are burning biomass fuels and cigarette smoke.^[27]

Health effects of CO poisoning may be acute or chronic and can occur unintentionally or intentionally (self-harm). By depriving the brain of oxygen, acute exposure to carbon monoxide may have effects on the neurological system (headache, nausea, dizziness, alteration in consciousness and subjective weakness), the cardiovascular and respiratory systems (myocardial infarction, shortness of breath, or rapid breathing, respiratory failure). Acute exposure can also lead to long-term neurological effects such as cognitive and behavioural changes. Severe CO poisoning may lead to unconsciousness, coma and death. Chronic exposure to low concentrations of carbon monoxide may lead to lethargy, headaches, nausea, flu-like symptoms and neuropsychological and cardiovascular issues.^{[28][26]}

The WHO recommended levels of indoor CO exposure in 24 hours is 4 mg/m^3 .^[29] Acute exposure should not exceed 10 mg/m^3 in 8 hours, 35 mg/m^3 in one hour and 100 mg/m^3 in 15 minutes.^[27]

Secondhand tobacco smoke

[edit]

Main article: Passive smoking

Secondhand smoke is tobacco smoke which affects people other than the 'active' smoker. It is made up of the exhaled smoke (15%) and mostly of smoke coming from the burning end of the cigarette, known as sidestream smoke (85%).^[30]

Secondhand smoke contains more than 7000 chemicals, of which hundreds are harmful to health.^[30] Secondhand tobacco smoke includes both a gaseous and a particulate materials which, with particular hazards arising from levels of carbon monoxide and very small particulates (fine particulate matter, especially PM2.5 and PM10) which get into the bronchioles and alveoles in the lung.^[31] Inhaling secondhand smoke on multiple occasions can cause asthma, pneumonia, lung cancer, and sudden infant death syndrome, among other conditions.^[32]

Thirdhand smoke (THS) refers to chemicals that settle on objects and bodies indoors after smoking. Exposure to thirdhand smoke can happen even after the actual cigarette smoke is not present anymore and affect those entering the indoor environment much later. Toxic substances of THS can react with other chemicals in the air and produce new toxic

chemicals that are otherwise not present in cigarettes.^[33]

The only certain method to improve indoor air quality as regards secondhand smoke is to eliminate smoking indoors.^[34] Indoor e-cigarette use also increases home particulate matter concentrations.^[35]

Particulates

[edit]

Atmospheric particulate matter, also known as particulates, can be found indoors and can affect the health of occupants. Indoor particulate matter can come from different indoor sources or be created as secondary aerosols through indoor gas-to-particle reactions. They can also be outdoor particles that enter indoors. These indoor particles vary widely in size, ranging from nanomet (nanoparticles/ultrafine particles emitted from combustion sources) to micromet (resuspended dust).^[36] Particulate matter can also be produced through cooking activities. Frying produces higher concentrations than boiling or grilling and cooking meat produces higher concentrations than cooking vegetables.^[37] Preparing a Thanksgiving dinner can produce very high concentrations of particulate matter, exceeding 300 $\mu\text{g}/\text{m}^3$.^[38]

Particulates can penetrate deep into the lungs and brain from blood streams, causing health problems such as heart disease, lung disease, cancer and preterm birth.^[39]

Generated from building materials, furnishing and consumer products

[edit]

See also: Building materials and Red List building materials

Volatile organic compounds

[edit]

Volatile organic compounds (VOCs) include a variety of chemicals, some of which may have short- and long-term adverse health effects. There are numerous sources of VOCs indoors, which means that their concentrations are consistently higher indoors (up to ten times higher) than outdoors.^[40] Some VOCs are emitted directly indoors, and some are formed through the subsequent chemical reactions that can occur in the gas-phase, or on surfaces.^[41]^[42] VOCs presenting health hazards include benzene, formaldehyde,

tetrachloroethylene and trichloroethylene.[⁴³]

VOCs are emitted by thousands of indoor products. Examples include: paints, varnishes, waxes and lacquers, paint strippers, cleaning and personal care products, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions.[⁴⁴] Chlorinated drinking water releases chloroform when hot water is used in the home. Benzene is emitted from fuel stored in attached garages.

Human activities such as cooking and cleaning can also emit VOCs.[⁴⁵][⁴⁶] Cooking can release long-chain aldehydes and alkanes when oil is heated and terpenes can be released when spices are prepared and/or cooked.[⁴⁵] Leaks of natural gas from cooking appliances have been linked to elevated levels of VOCs including benzene in homes in the USA.[⁴⁷] Cleaning products contain a range of VOCs, including monoterpenes, sesquiterpenes, alcohols and esters. Once released into the air, VOCs can undergo reactions with ozone and hydroxyl radicals to produce other VOCs, such as formaldehyde.[⁴⁶]

Health effects include eye, nose, and throat irritation; headaches, loss of coordination, nausea; and damage to the liver, kidney, and central nervous system.[⁴⁸]

Testing emissions from building materials used indoors has become increasingly common for floor coverings, paints, and many other important indoor building materials and finishes.[⁴⁹] Indoor materials such as gypsum boards or carpet act as VOC 'sinks', by trapping VOC vapors for extended periods of time, and releasing them by outgassing. The VOCs can also undergo transformation at the surface through interaction with ozone.[⁴²] In both cases, these delayed emissions can result in chronic and low-level exposures to VOCs.[⁵⁰]

Several initiatives aim to reduce indoor air contamination by limiting VOC emissions from products. There are regulations in France and in Germany, and numerous voluntary ecolabels and rating systems containing low VOC emissions criteria such as EMICODE,[⁵¹] M1,[⁵²] Blue Angel[⁵³] and Indoor Air Comfort[⁵⁴] in Europe, as well as California Standard CDPH Section 01350[⁵⁵] and several others in the US. Due to these initiatives an increasing number of low-emitting products became available to purchase.

At least 18 microbial VOCs (MVOCs) have been characterised[⁵⁶][⁵⁷] including 1-octen-3-ol (mushroom alcohol), 3-Methylfuran, 2-pentanol, 2-hexanone, 2-heptanone, 3-octanone, 3-octanol, 2-octen-1-ol, 1-octene, 2-pentanone, 2-nonanone, borneol, geosmin, 1-butanol, 3-methyl-1-butanol, 3-methyl-2-butanol, and thujopsene. The last four are products of *Stachybotrys chartarum*, which has been linked with sick building syndrome.[⁵⁶]

Asbestos fibers

[edit]

Many common building materials used before 1975 contain asbestos, such as some floor tiles, ceiling tiles, shingles, fireproofing, heating systems, pipe wrap, taping muds, mastics, and other insulation materials. Normally, significant releases of asbestos fiber do not occur unless the building materials are disturbed, such as by cutting, sanding, drilling, or building remodelling. Removal of asbestos-containing materials is not always optimal because the fibers can be spread into the air during the removal process. A management program for intact asbestos-containing materials is often recommended instead.

When asbestos-containing material is damaged or disintegrates, microscopic fibers are dispersed into the air. Inhalation of asbestos fibers over long exposure times is associated with increased incidence of lung cancer, mesothelioma, and asbestosis. The risk of lung cancer from inhaling asbestos fibers is significantly greater for smokers. The symptoms of disease do not usually appear until about 20 to 30 years after the first exposure to asbestos.

Although all asbestos is hazardous, products that are friable, e.g. sprayed coatings and insulation, pose a significantly higher hazard as they are more likely to release fibers to the air.^[58]

Microplastics

[edit]

Main article: Microplastics

See also: Renovation and Particulates

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Microplastic is a type of airborne particulates and is found to prevail in air.^{[59][60][61][62]} A 2017 study found indoor airborne microfiber concentrations between 1.0 and 60.0 microfibers per cubic meter (33% of which were found to be microplastics).^[63] Airborne microplastic dust can be produced during renovation, building, bridge and road reconstruction projects^[64] and the use of power tools.^[65]

Ozone

[edit]

See also: Ground-level ozone

Indoors ozone (O_3) is produced by certain high-voltage electric devices (such as air ionizers), and as a by-product of other types of pollution. It appears in lower concentrations indoors than outdoors, usually at 0.2-0.7 of the outdoor concentration.^[66] Typically, most ozone is lost to surface reactions indoors, rather than to reactions in air, due to the large surface to volume ratios found indoors.^[67]

Outdoor air used for ventilation may have sufficient ozone to react with common indoor pollutants as well as skin oils and other common indoor air chemicals or surfaces. Particular concern is warranted when using "green" cleaning products based on citrus or terpene extracts, because these chemicals react very quickly with ozone to form toxic and irritating chemicals^[46] as well as fine and ultrafine particles.^[68] Ventilation with outdoor air containing elevated ozone concentrations may complicate remediation attempts.^[69]

The WHO standard for ozone concentration is $60 \mu\text{g}/\text{m}^3$ for long-term exposure and $100 \mu\text{g}/\text{m}^3$ as the maximum average over an 8-hour period.^[29] The EPA standard for ozone concentration is 0.07 ppm average over an 8-hour period.^[70]

Biological agents

[edit]

Mold and other allergens

[edit]

Main articles: Indoor mold and Mold health issues

Occupants in buildings can be exposed to fungal spores, cell fragments, or mycotoxins which can arise from a host of means, but there are two common classes: (a) excess moisture induced growth of mold colonies and (b) natural substances released into the air such as animal dander and plant pollen.^[71]

While mold growth is associated with high moisture levels,^[72] it is likely to grow when a combination of favorable conditions arises. As well as high moisture levels, these conditions include suitable temperatures, pH and nutrient sources.^[73] Mold grows primarily on surfaces, and it reproduces by releasing spores, which can travel and settle in different locations. When these spores experience appropriate conditions, they can germinate and lead to mycelium growth.^[74] Different mold species favor different environmental conditions to germinate and grow, some being more hydrophilic (growing at higher levels of relative humidity) and other more xerophilic (growing at levels of relative humidity as low as 75–80%).^{[74][75]}

Mold growth can be inhibited by keeping surfaces at conditions that are further from condensation, with relative humidity levels below 75%. This usually translates to a relative humidity of indoor air below 60%, in agreement with the guidelines for thermal comfort that recommend a relative humidity between 40 and 60 %. Moisture buildup in buildings may arise from water penetrating areas of the building envelope or fabric, from plumbing leaks, rainwater or groundwater penetration, or from condensation due to improper ventilation, insufficient heating or poor thermal quality of the building envelope.^[76] Even something as simple as drying clothes indoors on radiators can increase the risk of mold growth, if the humidity produced is not able to escape the building via ventilation.^[77]

Mold predominantly affects the airways and lungs. Known effects of mold on health include asthma development and exacerbation,^[78] with children and elderly at greater risk of more severe health impacts.^[79] Infants in homes with mold have a much greater risk of developing asthma and allergic rhinitis.^[80]^[71] More than half of adult workers in moldy or humid buildings suffer from nasal or sinus symptoms due to mold exposure.^[71] Some varieties of mold contain toxic compounds (mycotoxins). However, exposure to hazardous levels of mycotoxin via inhalation is not possible in most cases, as toxins are produced by the fungal body and are not at significant levels in the released spores.

Legionella

[edit]



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Legionnaires' disease is caused by a waterborne bacterium *Legionella* that grows best in slow-moving or still, warm water. The primary route of exposure is through the creation of an aerosol effect, most commonly from evaporative cooling towers or showerheads. A common source of *Legionella* in commercial buildings is from poorly placed or maintained evaporative cooling towers, which often release water in an aerosol which may enter nearby ventilation intakes. Outbreaks in medical facilities and nursing homes, where patients are immuno-suppressed and immuno-weak, are the most commonly reported cases of Legionellosis. More than one case has involved outdoor fountains at public attractions. The presence of *Legionella* in commercial building water supplies is highly under-reported, as healthy people require heavy exposure to acquire infection.

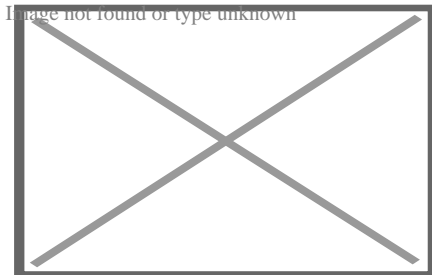
Legionella testing typically involves collecting water samples and surface swabs from evaporative cooling basins, shower heads, faucets/taps, and other locations where warm water collects. The samples are then cultured and colony forming units (cfu) of *Legionella* are quantified as cfu/liter.

Legionella is a parasite of protozoans such as amoeba, and thus requires conditions suitable for both organisms. The bacterium forms a biofilm which is resistant to chemical

and antimicrobial treatments, including chlorine. Remediation for *Legionella* outbreaks in commercial buildings vary, but often include very hot water flushes (160 °F (71 °C)), sterilisation of standing water in evaporative cooling basins, replacement of shower heads, and, in some cases, flushes of heavy metal salts. Preventive measures include adjusting normal hot water levels to allow for 120 °F (49 °C) at the tap, evaluating facility design layout, removing faucet aerators, and periodic testing in suspect areas.

Other bacteria

[edit]



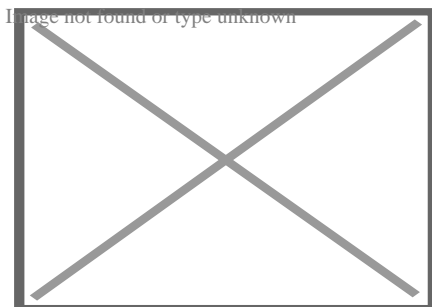
Airborne bacteria

There are many bacteria of health significance found in indoor air and on indoor surfaces. The role of microbes in the indoor environment is increasingly studied using modern gene-based analysis of environmental samples. Currently, efforts are under way to link microbial ecologists and indoor air scientists to forge new methods for analysis and to better interpret the results.^[81]

A large fraction of the bacteria found in indoor air and dust are shed from humans. Among the most important bacteria known to occur in indoor air are *Mycobacterium tuberculosis*, *Staphylococcus aureus*, *Streptococcus pneumoniae*.^[citation needed]

Virus

[edit]



Ninth floor layout of the Metropole Hotel in Hong Kong, showing where an outbreak of the severe acute respiratory syndrome (SARS) occurred

Viruses can also be a concern for indoor air quality. During the 2002–2004 SARS outbreak, virus-laden aerosols were found to have seeped into bathrooms from the bathroom floor drains, exacerbated by the draw of bathroom exhaust fans, resulting in the rapid spread of SARS in Amoy Gardens in Hong Kong.^{[82][83]} Elsewhere in Hong Kong, SARS CoV RNA was found on the carpet and in the air intake vents of the Metropole Hotel, which showed that secondary environmental contamination could generate infectious aerosols and resulted in superspreading events.^[84]

Carbon dioxide

[edit]

Humans are the main indoor source of carbon dioxide (CO₂) in most buildings. Indoor CO₂ levels are an indicator of the adequacy of outdoor air ventilation relative to indoor occupant density and metabolic activity.

Indoor CO₂ levels above 500 ppm can lead to higher blood pressure and heart rate, and increased peripheral blood circulation.^[85] With CO₂ concentrations above 1000 ppm cognitive performance might be affected, especially when doing complex tasks, making decision making and problem solving slower but not less accurate.^{[86][87]} However, evidence on the health effects of CO₂ at lower concentrations is conflicting and it is difficult to link CO₂ to health impacts at exposures below 5000 ppm – reported health outcomes may be due to the presence of human bioeffluents, and other indoor air pollutants related to inadequate ventilation.^[88]

Indoor carbon dioxide concentrations can be used to evaluate the quality of a room or a building's ventilation.^[89] To eliminate most complaints caused by CO₂, the total indoor CO₂ level should be reduced to a difference of no greater than 700 ppm above outdoor levels.^[90] The National Institute for Occupational Safety and Health (NIOSH) considers that indoor air concentrations of carbon dioxide that exceed 1000 ppm are a marker suggesting inadequate ventilation.^[91] The UK standards for schools say that carbon dioxide levels of 800 ppm or lower indicate that the room is well-ventilated.^[92] Regulations and standards from around the world show that CO₂ levels below 1000 ppm represent good IAQ, between 1000 and 1500 ppm represent moderate IAQ and greater than 1500 ppm represent poor IAQ.^[88]

Carbon dioxide concentrations in closed or confined rooms can increase to 1,000 ppm within 45 minutes of enclosure. For example, in a 3.5-by-4-metre (11 ft × 13 ft) sized office, atmospheric carbon dioxide increased from 500 ppm to over 1,000 ppm within 45

minutes of ventilation cessation and closure of windows and doors.^[93]

Radon

[edit]

Main article: Radon

Radon is an invisible, radioactive atomic gas that results from the radioactive decay of radium, which may be found in rock formations beneath buildings or in certain building materials themselves.

Radon is probably the most pervasive serious hazard for indoor air in the United States and Europe. It is a major cause of lung cancer, responsible for 3–14% of cases in countries, leading to tens of thousands of deaths.^[94]

Radon gas enters buildings as a soil gas. As it is a heavy gas it will tend to accumulate at the lowest level. Radon may also be introduced into a building through drinking water particularly from bathroom showers. Building materials can be a rare source of radon, but little testing is carried out for stone, rock or tile products brought into building sites; radon accumulation is greatest for well insulated homes.^[95] There are simple do-it-yourself kits for radon gas testing, but a licensed professional can also check homes.

The half-life for radon is 3.8 days, indicating that once the source is removed, the hazard will be greatly reduced within a few weeks. Radon mitigation methods include sealing concrete slab floors, basement foundations, water drainage systems, or by increasing ventilation.^[96] They are usually cost effective and can greatly reduce or even eliminate the contamination and the associated health risks.^[citation needed]

Radon is measured in picocuries per liter of air (pCi/L) or becquerel per cubic meter (Bq m⁻³). Both are measurements of radioactivity. The World Health Organization (WHO) sets the ideal indoor radon levels at 100 Bq/m⁻³.^[97] In the United States, it is recommend to fix homes with radon levels at or above 4 pCi/L. At the same time it is also recommends that people think about fixing their homes for radon levels between 2 pCi/L and 4 pCi/L.^[98]] In the United Kingdom the ideal is presence of radon indoors is 100 Bq/m⁻³. Action needs to be taken in homes with 200 Bq/m³ or more.^[99]

Interactive maps of radon affected areas are available for various regions and countries of the world.^{[100][101][102]}

IAQ and climate change

[edit]

See also: Effects of climate change on human health

Indoor air quality is linked inextricably to outdoor air quality. The Intergovernmental Panel on Climate Change (IPCC) has varying scenarios that predict how the climate will change in the future.^[103] Climate change can affect indoor air quality by increasing the level of outdoor air pollutants such as ozone and particulate matter, for example through emissions from wildfires caused by extreme heat and drought.^{[104][105]} Numerous predictions for how indoor air pollutants will change have been made,^{[106][107][108][109]} and models have attempted to predict how the forecasted IPCC scenarios will vary indoor air quality and indoor comfort parameters such as humidity and temperature.^[110]

The net-zero challenge requires significant changes in the performance of both new and retrofitted buildings. However, increased energy efficient housing will trap pollutants inside, whether produced indoors or outdoors, and lead to an increase in human exposure.^{[111][112]}

Indoor air quality standards and monitoring

[edit]

Quality guidelines and standards

[edit]

For occupational exposure, there are standards, which cover a wide range of chemicals, and applied to healthy adults who are exposed over time at workplaces (usually industrial environments). These are published by organisations such as Occupational Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH), the UK Health and Safety Executive (HSE).

There is no consensus globally about indoor air quality standards, or health-based guidelines. However, there are regulations from some individual countries and from health organisations. For example, the World Health Organization (WHO) has published health-based global air quality guidelines for the general population that are applicable both to outdoor and indoor air,^[29] as well as the WHO IAQ guidelines for selected compounds,^[113] whereas the UK Health Security Agency published IAQ guidelines for selected VOCs.^[114] The Scientific and Technical Committee (STC34) of the International Society of Indoor Air Quality and Climate (ISIAQ) created an open database that collects indoor environmental quality guidelines worldwide.^[115] The database is focused on indoor air quality (IAQ), but is currently extended to include standards, regulations, and guidelines related to ventilation, comfort, acoustics, and lighting.^{[116][117]}

Real-time monitoring


[edit]

Since indoor air pollutants can adversely affect human health, it is important to have real-time indoor air quality assessment/monitoring system that can help not only in the improvement of indoor air quality but also help in detection of leaks, spills in a work environment and boost energy efficiency of buildings by providing real-time feedback to the heating, ventilation, and air conditioning (HVAC) system(s).^[118] Additionally, there have been enough studies that highlight the correlation between poor indoor air quality and loss of performance and productivity of workers in an office setting.^[119]

Combining the Internet of Things (IoT) technology with real-time IAQ monitoring systems has tremendously gained momentum and popularity as interventions can be done based on the real-time sensor data and thus help in the IAQ improvement.^[120]

Improvement measures

[edit]

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See also: Air purifier, Air conditioner, Air filter, Cleanroom, Particulates § Controlling technologies and measures, Pollution control, and Ventilation (architecture)


Further information: Fan (machine), Dehumidifier, and Heater

Indoor air quality can be addressed, achieved or maintained during the design of new buildings or as mitigating measures in existing buildings. A hierarchy of measures has been proposed by the Institute of Air Quality Management. It emphasises removing pollutant sources, reducing emissions from any remaining sources, disrupting pathways between sources and the people exposed, protecting people from exposure to pollutants, and removing people from areas with poor air quality.^[121]

A report assisted by the Institute for Occupational Safety and Health of the German Social Accident Insurance can support in the systematic investigation of individual health problems arising at indoor workplaces, and in the identification of practical solutions.^[122]

Source control

[edit]

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HVAC design

[edit]

Main articles: HVAC, Air handler, and Ventilation (architecture)



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Environmentally sustainable design concepts include aspects of commercial and residential heating, ventilation and air-conditioning (HVAC) technologies. Among several considerations, one of the topics attended to is the issue of indoor air quality throughout the design and construction stages of a building's life.^[*citation needed*]

One technique to reduce energy consumption while maintaining adequate air quality, is demand-controlled ventilation. Instead of setting throughput at a fixed air replacement rate, carbon dioxide sensors are used to control the rate dynamically, based on the emissions of actual building occupants.^[*citation needed*]

One way of quantitatively ensuring the health of indoor air is by the frequency of effective turnover of interior air by replacement with outside air. In the UK, for example, classrooms are required to have 2.5 outdoor air changes per hour. In halls, gym, dining, and physiotherapy spaces, the ventilation should be sufficient to limit carbon dioxide to 1,500 ppm. In the US, ventilation in classrooms is based on the amount of outdoor air per occupant plus the amount of outdoor air per unit of floor area, not air changes per hour. Since carbon dioxide indoors comes from occupants and outdoor air, the adequacy of ventilation per occupant is indicated by the concentration indoors minus the concentration outdoors. The value of 615 ppm above the outdoor concentration indicates approximately 15 cubic feet per minute of outdoor air per adult occupant doing sedentary office work where outdoor air contains over 400 ppm^[123] (global average as of 2023). In classrooms, the requirements in the ASHRAE standard 62.1, Ventilation for Acceptable Indoor Air Quality, would typically result in about 3 air changes per hour, depending on the occupant density. As the occupants are not the only source of pollutants, outdoor air ventilation may need to be higher when unusual or strong sources of pollution exist indoors.

When outdoor air is polluted, bringing in more outdoor air can actually worsen the overall quality of the indoor air and exacerbate some occupant symptoms related to outdoor air pollution. Generally, outdoor country air is better than indoor city air.^[*citation needed*]

The use of air filters can trap some of the air pollutants. Portable room air cleaners with HEPA filters can be used if ventilation is poor or outside air has high level of PM 2.5.^[122] Air filters are used to reduce the amount of dust that reaches the wet coils.^[*citation needed*]

Dust can serve as food to grow molds on the wet coils and ducts and can reduce the efficiency of the coils. *[citation needed]*

The use of trickle vents on windows is also valuable to maintain constant ventilation. They can help prevent mold and allergen build up in the home or workplace. They can also reduce the spread of some respiratory infections. ^[124]

Moisture management and humidity control requires operating HVAC systems as designed. Moisture management and humidity control may conflict with efforts to conserve energy. For example, moisture management and humidity control requires systems to be set to supply make-up air at lower temperatures (design levels), instead of the higher temperatures sometimes used to conserve energy in cooling-dominated climate conditions. However, for most of the US and many parts of Europe and Japan, during the majority of hours of the year, outdoor air temperatures are cool enough that the air does not need further cooling to provide thermal comfort indoors. *[citation needed]* However, high humidity outdoors creates the need for careful attention to humidity levels indoors. High humidity give rise to mold growth and moisture indoors is associated with a higher prevalence of occupant respiratory problems. *[citation needed]*

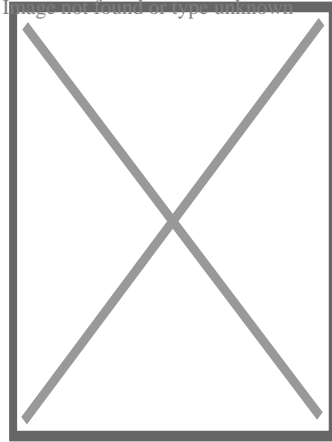
The "dew point temperature" is an absolute measure of the moisture in air. Some facilities are being designed with dew points in the lower 50s °F, and some in the upper and lower 40s °F. *[citation needed]* Some facilities are being designed using desiccant wheels with gas-fired heaters to dry out the wheel enough to get the required dew points. *[citation needed]* On those systems, after the moisture is removed from the make-up air, a cooling coil is used to lower the temperature to the desired level. *[citation needed]*

Commercial buildings, and sometimes residential, are often kept under slightly positive air pressure relative to the outdoors to reduce infiltration. Limiting infiltration helps with moisture management and humidity control.

Dilution of indoor pollutants with outdoor air is effective to the extent that outdoor air is free of harmful pollutants. Ozone in outdoor air occurs indoors at reduced concentrations because ozone is highly reactive with many chemicals found indoors. The products of the reactions between ozone and many common indoor pollutants include organic compounds that may be more odorous, irritating, or toxic than those from which they are formed. These products of ozone chemistry include formaldehyde, higher molecular weight aldehydes, acidic aerosols, and fine and ultrafine particles, among others. The higher the outdoor ventilation rate, the higher the indoor ozone concentration and the more likely the reactions will occur, but even at low levels, the reactions will take place. This suggests that ozone should be removed from ventilation air, especially in areas where outdoor ozone levels are frequently high.

Effect of indoor plants

[edit]



Spider plants (*Chlorophytum comosum*) absorb some airborne contaminants.

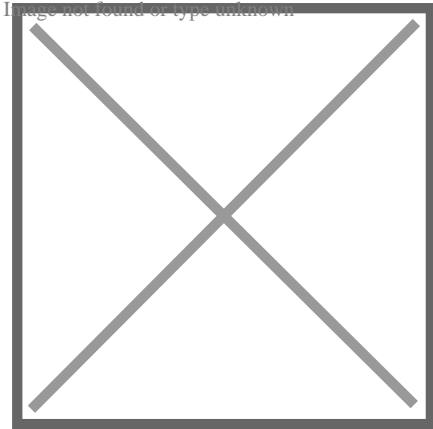
Houseplants together with the medium in which they are grown can reduce components of indoor air pollution, particularly volatile organic compounds (VOC) such as benzene, toluene, and xylene. Plants remove CO₂ and release oxygen and water, although the quantitative impact for house plants is small. The interest in using potted plants for removing VOCs was sparked by a 1989 NASA study conducted in sealed chambers designed to replicate the environment on space stations. However, these results suffered from poor replication^[125] and are not applicable to typical buildings, where outdoor-to-indoor air exchange already removes VOCs at a rate that could only be matched by the placement of 10–1000 plants/m² of a building's floor space.^[126]

Plants also appear to reduce airborne microbes and molds, and to increase humidity.^[127] However, the increased humidity can itself lead to increased levels of mold and even VOCs.^[128]

Since extremely high humidity is associated with increased mold growth, allergic responses, and respiratory responses, the presence of additional moisture from houseplants may not be desirable in all indoor settings if watering is done inappropriately.^[129]

Institutional programs

[edit]



EPA graphic about asthma triggers

The topic of IAQ has become popular due to the greater awareness of health problems caused by mold and triggers to asthma and allergies.

In the US, the Environmental Protection Agency (EPA) has developed an "IAQ Tools for Schools" program to help improve the indoor environmental conditions in educational institutions. The National Institute for Occupational Safety and Health conducts Health Hazard Evaluations (HHEs) in workplaces at the request of employees, authorized representative of employees, or employers, to determine whether any substance normally found in the place of employment has potentially toxic effects, including indoor air quality. [130]

A variety of scientists work in the field of indoor air quality, including chemists, physicists, mechanical engineers, biologists, bacteriologists, epidemiologists, and computer scientists. Some of these professionals are certified by organizations such as the American Industrial Hygiene Association, the American Indoor Air Quality Council and the Indoor Environmental Air Quality Council.

In the UK, under the Department for Environment Food and Rural Affairs, the Air Quality Expert Group considers current knowledge on indoor air quality and provides advice to government and devolved administration ministers. [131]

At the international level, the International Society of Indoor Air Quality and Climate (ISIAQ), formed in 1991, organizes two major conferences, the Indoor Air and the Healthy Buildings series. [132]

See also

[edit]

- Environmental management
- Healthy building
- Indoor bioaerosol
- Microbiomes of the built environment
- Olfactory fatigue

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[edit]

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Further reading

[edit]

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External links

[edit]

- US Environmental Protection Agency info on IAQ
- Best Practices for Indoor Air Quality when Remodeling Your Home, US EPA
- Addressing Indoor Environmental Concerns During Remodeling, US EPA
- Renovation and Repair, Part of Indoor Air Quality Design Tools for Schools, US EPA

- The 9 Foundations of a Healthy Building, Harvard T.H. Chan School of Public Health

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Pollution

History

Air

- Acid rain
- Air quality index
- Atmospheric dispersion modeling
- Chlorofluorocarbon
- Combustion
 - Biofuel
 - Biomass
 - Joss paper
 - Open burning of waste
- Construction
 - Renovation
- Demolition
- Exhaust gas
 - Diesel exhaust
- Haze
 - Smoke
- Indoor air quality
- Internal combustion engine
- Global dimming
- Global distillation
- Mining
- Ozone depletion
- Particulates
 - Asbestos
 - Metal working
 - Oil refining
 - Wood dust
 - Welding
- Persistent organic pollutant
- Smelting
- Smog
- Soot
 - Black carbon
- Volatile organic compound
- Waste

Biological

Digital

Electromagnetic

Natural

Noise

Radiation

- Biological hazard
- Genetic pollution
- Introduced species
 - Invasive species
- Information pollution
- Light
 - Ecological light pollution
 - Overillumination
- Radio spectrum pollution
- Ozone
- Radium and radon in the environment
- Volcanic ash
- Wildfire
- Transportation
 - Land
 - Water
 - Air
 - Rail
 - Sustainable transport
- Urban
- Sonar
 - Marine mammals and sonar
- Industrial
- Military
- Abstract
- Noise control
- Actinides
- Bioremediation
- Nuclear fission
- Nuclear fallout
- Plutonium
- Poisoning
- Radioactivity
- Uranium
- Electromagnetic radiation and health
- Radioactive waste

Soil

- Agricultural pollution
 - Herbicides
 - Manure waste
 - Pesticides
- Land degradation
- Bioremediation
- Open defecation
- Electrical resistance heating
- Soil guideline values
- Phytoremediation
- Advertising mail
- Biodegradable waste
- Brown waste
- Electronic waste
 - Battery recycling
- Foam food container
- Food waste
- Green waste
- Hazardous waste
 - Biomedical waste
 - Chemical waste
 - Construction waste
 - Lead poisoning
 - Mercury poisoning
 - Toxic waste
- Industrial waste
 - Lead smelting
- Litter
- Mining
 - Coal mining
 - Gold mining
 - Surface mining
 - Deep sea mining
 - Mining waste
 - Uranium mining
- Municipal solid waste
 - Garbage
- Nanomaterials
- Plastic pollution
 - Microplastics
- Packaging waste
- Post-consumer waste
- Waste management
 - Landfill
 - Thermal treatment

Solid waste

Space

- Satellite

Visual








- Air travel
- Clutter (advertising)
- Traffic signs
- Overhead power lines

War

- Vandalism
- Chemical warfare
- Herbicidal warfare (Agent Orange)
- Nuclear holocaust (Nuclear fallout - nuclear famine - nuclear winter)

Water

- Scorched earth
- Unexploded ordnance
- War and environmental law
- Agricultural wastewater
- Biological pollution
- Diseases
- Eutrophication
- Firewater
- Freshwater
- Groundwater
- Hypoxia
- Industrial wastewater
- Marine
 - debris
- Monitoring
- Nonpoint source pollution
- Nutrient pollution
- Ocean acidification
- Oil exploitation
- Oil exploration
- Oil spill
- Pharmaceuticals
- Sewage
 - Septic tanks
 - Pit latrine
- Shipping
- Stagnation
- Sulfur water
- Surface runoff
- Thermal
- Turbidity
- Urban runoff
- Water quality

Topics	<ul style="list-style-type: none"> ○ Pollutants <ul style="list-style-type: none"> ○ Heavy metals ○ Paint ○ Brain health and pollution ○ Area source ○ Debris ○ Dust
Misc	<ul style="list-style-type: none"> ○ Garbology ○ Legacy pollution ○ Midden ○ Point source ○ Waste ○ Cleaner production ○ Industrial ecology ○ Pollution haven hypothesis
Responses	<ul style="list-style-type: none"> ○ Pollutant release and transfer register ○ Polluter pays principle ○ Pollution control ○ Waste minimisation ○ Zero waste
Lists	<ul style="list-style-type: none"> ○ Diseases ○ Law by country ○ Most polluted cities ○ Least polluted cities by PM_{2.5} ○ Most polluted countries ○ Most polluted rivers ○ Treaties
<div style="display: flex; justify-content: space-between; align-items: center;"> <div data-bbox="191 1182 581 1283">  Categories (by country)  </div> <div data-bbox="581 1182 776 1283">  Commons </div> <div data-bbox="776 1182 1187 1283">  WikiProject Environment </div> <div data-bbox="1187 1182 1511 1283">  WikiProject Ecology </div> </div> <div style="display: flex; justify-content: space-between; align-items: center; margin-top: 5px;"> <div data-bbox="191 1239 386 1283">  Environment portal </div> <div data-bbox="386 1239 678 1283">  Ecology portal </div> </div>	

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Natural resources

Air

Pollution / quality

- Ambient standards (US)
- Index
- Indoor
- Law
 - Clean Air Act (US)
- Ozone depletion
- Airshed

Emissions

- Trading
- Deforestation (REDD)

Energy

- Bio
- Law
- Resources
- Fossil fuels (gas, peak coal, peak gas, peak oil)
- Geothermal
- Hydro
- Nuclear
- Solar
 - sunlight
 - shade
- Wind

Land

- Agricultural
 - arable
 - peak farmland
- Degradation
- Field
- Landscape
 - cityscape
 - seascape
 - soundscape
 - viewshed
- Law
 - property
- Management
 - habitat conservation
- Minerals
 - gemstone
 - industrial
 - ore
 - metal
 - mining
 - law
 - sand
 - peak
 - copper
 - phosphorus
 - rights
- Soil
 - conservation
 - fertility
 - health
 - resilience
- Use
 - planning
 - reserve

Life

- Biodiversity
- Bioprospecting
 - biopiracy
- Biosphere
- Bushfood
- Bushmeat
- Fisheries
 - climate change
 - law
 - management
- Forests
 - genetic resources
 - law
 - management
 - non-timber products
- Game
 - law
- Marine conservation
- Meadow
- Pasture
- Plants
 - FAO Plant Treaty
 - food
 - genetic resources
 - gene banks
 - herbal medicines
 - UPOV Convention
 - wood
- Rangeland
- Seed bank
- Wildlife
 - conservation
 - management

Water

Types / location

- Aquifer
 - storage and recovery
- Drinking
- Fresh
- Groundwater
 - pollution
 - recharge
 - remediation
- Hydrosphere
- Ice
 - bergs
 - glacial
 - polar
- Irrigation
 - *huerta*
- Marine
- Rain
 - harvesting
- Stormwater
- Surface water
- Sewage
 - reclaimed water
- Watershed
- Desalination
- Floods
- Law
- Leaching
- Sanitation
 - improved
- Scarcity
- Security
- Supply
- Efficiency
- Conflict
- Conservation
- Peak water
- Pollution
- Privatization
- Quality
- Right
- Resources
 - improved
 - policy

Aspects

- Commons
 - enclosure
 - global
 - land
 - tragedy of
- Economics
 - ecological
 - land
- Ecosystem services
- Exploitation
 - overexploitation
 - Earth Overshoot Day
- Management
 - adaptive
- Natural capital
 - accounting
 - good
- Natural heritage
- Nature reserve
 - remnant natural area
- Systems ecology
- Urban ecology
- Wilderness

Related

- Common-pool
- Conflict (perpetuation)
- Curse
- Resource
 - Depletion
 - Extraction
 - Nationalism
 - Renewable / Non-renewable
- Politics
 - Oil war
 - Petrostate
 - Resource war

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Occupational safety and health

**Occupational
diseases
and injuries**

- Acrodynia
- Asbestosis
- Asthma
- Barotrauma
- Berylliosis
- Brucellosis
- Burnout
- Byssinosis ("brown lung")
- Cardiovascular
- Chalicosis
- Chronic solvent-induced encephalopathy
- Chronic stress
- Chimney sweeps' carcinoma
- Coalworker's pneumoconiosis ("black lung")
- Concussions in sport
- Decompression sickness
- De Quervain syndrome
- Erethism
- Exposure to human nail dust
- Farmer's lung
- Fiddler's neck
- Flock worker's lung
- Glassblower's cataract
- Golfer's elbow
- Hearing loss
- Hospital-acquired infection
- Indium lung
- Laboratory animal allergy
- Lead poisoning
- Low back pain
- Mesothelioma
- Metal fume fever
- Mule spinners' cancer
- Noise-induced hearing loss
- Phossy jaw
- Pneumoconiosis
- Radium jaw
- Repetitive strain injury
- Silicosis
- Silo-filler's disease
- Sports injury
- Surfer's ear
- Tennis elbow
- Tinnitus
- Writer's cramp

- Occupational hazard
 - Biological hazard
 - Chemical hazard
 - Physical hazard
 - Psychosocial hazard
- Occupational hygiene**
 - Occupational stress
 - Hierarchy of hazard controls
 - Prevention through design
 - Exposure assessment
 - Occupational exposure limit
 - Occupational epidemiology
 - Workplace health surveillance
 - Environmental health
 - Industrial engineering
- Professions**
 - Occupational health nursing
 - Occupational health psychology
 - Occupational medicine
 - Occupational therapist
 - Safety engineering
- Agencies and organizations**
 - International**
 - European Agency for Safety and Health at Work
 - International Labour Organization
 - World Health Organization
 - Canadian Centre for Occupational Health and Safety (Canada)
 - Istituto nazionale per l'assicurazione contro gli infortuni sul lavoro (Italy)
 - National**
 - National Institute for Safety and Health at Work (Spain)
 - Health and Safety Executive (UK)
 - Occupational Safety and Health Administration
 - National Institute for Occupational Safety and Health (US)
- Standards**
 - Bangladesh Accord
 - OHSAS 18001
 - ISO 45001
 - Occupational Safety and Health Convention, 1981
 - Worker Protection Standard (US)
 - Working Environment Convention, 1977

Safety


- Checklist
- Code of practice
- Contingency plan
- Diving safety
- Emergency procedure
- Emergency evacuation
- Hazard
- Hierarchy of hazard controls
 - Hazard elimination
 - Administrative controls
 - Engineering controls
 - Hazard substitution
 - Personal protective equipment
- Job safety analysis
- Lockout-tagout
- Permit To Work
- Operations manual
- Redundancy (engineering)
- Risk assessment
- Safety culture
- Standard operating procedure
- Immediately dangerous to life or health
- Diving regulations
- Occupational Safety and Health Act (United States)

Legislation

- Potty parity (United States)
- Right to sit (United States)
- Workers' right to access the toilet

- Aerosol
- Break
- Break room
- Drug policy
- Effects of overtime
- Environment, health and safety
- Environmental toxicology
- Ergonomics
- Fire Fighter Fatality Investigation and Prevention Program
- Hawks Nest Tunnel disaster
- Health physics
- Hostile work environment
- Indoor air quality
- International Chemical Safety Card
- Job strain
- National Day of Mourning (Canada)
- NIOSH air filtration rating
- Overwork
- Process safety
- Public health
- Quality of working life
- Risk management
- Safety data sheet
- Source control
- Toxic tort
- Toxic workplace
- Workers' compensation
- Workplace hazard controls for COVID-19
- Workplace health promotion

See also

-  **Category** image not found or type unknown
 - Occupational diseases
 - Journals
 - Organizations

-  **Commons** image not found or type unknown

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Heating, ventilation, and air conditioning

**Fundamental
concepts**

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

Technology

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

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

Components

**Measurement
and control**

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

**Professions,
trades,
and services**

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

Industry organizations

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

Health and safety

See also

Authority control databases Image not found or type unknown **Edit this at Wikidata**

International

- FAST
- United States

National

- Latvia
- Israel

About Royal Supply Inc

Photo

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Things To Do in Jefferson County

Photo

Image not found or type unknown

Jefferson County Museum

4.6 (31)

Photo

Image not found or type unknown

Jefferson Barracks Park

4.8 (2321)

Photo

Image not found or type unknown

Gardens of Jefferson County

0 (0)

Photo

Image not found or type unknown

Jefferson County Historical Village

4.7 (145)

Photo

Visit Jefferson County PA

0 (0)

Photo

Image not found or type unknown

Visit Jefferson County Tennessee

5 (3)

Driving Directions in Jefferson County

Driving Directions From GameStop to Royal Supply Inc

Driving Directions From Kohl's to Royal Supply Inc

Driving Directions From Fenton Sew and Vac to Royal Supply Inc

<https://www.google.com/maps/dir/Five+Below/Royal+Supply+Inc/@38.5031445,-90.4472947,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJG4mS5uDP2lcR8cdebr1E90.4472947!2d38.5031445!1m5!1m1!1sChIJQUY-l2XQ2lcReCWJfc6UEZo!2m2!1d-90.480394!2d38.4956035!3e0>

https://www.google.com/maps/dir/AT%26T+Store/Royal+Supply+Inc/@38.5123479,-90.4445559,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJbbRvyNvP2lcR2_xVCHV

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I2XQ2IcReCWJfc6UEZo!2m2!1d-90.480394!2d38.4956035!3e2

https://www.google.com/maps/dir/Stella+Blues+Vapors/Royal+Supply+Inc/@38.5133190.4450414,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJJx_GLdrP2IcRI8Gsu7VL290.4450414!2d38.5133174!1m5!1m1!1sChIJQUY-I2XQ2IcReCWJfc6UEZo!2m2!1d-90.480394!2d38.4956035!3e1

Driving Directions From Jefferson County Museum to Royal Supply Inc

Driving Directions From Jefferson Historical Museum to Royal Supply Inc

Driving Directions From Jefferson County Area Tourism Council to Royal Supply Inc

Driving Directions From Jefferson Barracks Park to Royal Supply Inc

Driving Directions From Jefferson Barracks Park to Royal Supply Inc

Driving Directions From Cole County Historical Museum to Royal Supply Inc

<https://www.google.com/maps/dir/Jefferson+Barracks+Park/Royal+Supply+Inc/@38.5902796127,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sunknown!2m2!1d-90.2796127!2d38.5122504!1m5!1m1!1sChIJQUY-I2XQ2IcReCWJfc6UEZo!2m2!1d-90.480394!2d38.4956035!3e0>

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<https://www.google.com/maps/dir/Jefferson+County+Area+Tourism+Council/Royal+S88.819538,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sunknown!2m2!1d-88.819538!2d43.0129861!1m5!1m1!1sChIJQUY-I2XQ2IcReCWJfc6UEZo!2m2!1d-90.480394!2d38.4956035!3e3>

Reviews for Royal Supply Inc

Royal Supply Inc

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bill slayton

(1)

Went to get a deadbolt what they had was one I was told I'd have take it apart to lengthen and I said I wasn't buying something new and have to work on it. Thing of it is I didn't know if it was so that it could be lengthened said I didn't wanna buy something new I had to work on just to fit my door. He got all mad and slung the whole box with part across the room. A real business man. I guess the owner approves of his employees doing as such.

Royal Supply Inc

Image not found or type unknown

Gidget McCarthy

(5)

Very knowledgeable, friendly, helpful and don't make you feel like you're inconveniencing them. They seem willing to take all the time you need. As if you're the only thing they have to do that day. The store is clean, organized and not cluttered, symmetrical at that. Cuz I'm even and symmetricals biggest fan. It was a pleasure doing business with them and their prices are definitely reasonable. So, I'll be doing business with them in the future no doubt.

Royal Supply Inc

Image not found or type unknown

Terry Self

(1)

Horrible workmanship, horrible customer service, don't show up when they say they are. Ghosted. Was supposed to come back on Monday, no call no show. Called Tuesday and Wednesday, left messages both days. Nothing. Kinked my line, crooked to the pad and house, didn't put disconnect back on, left the trash.....

Royal Supply Inc

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Toney Dunaway

(5)

This is another amazing place where we will do much more business. They are not tyrannical about the totally useless face diapers, they have a great selection of stock, they have very knowledgeable staff, very friendly staff. We got the plumbing items we really needed and will be getting more plumbing items. They also have central units, thermostats, caulking, sealants, doors, seems everything you need for a mobile home. We've found a local treasure and will be bringing much more business. Their store is clean and tidy as well!

Royal Supply Inc

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Ae Webb

(5)

Royal installed a new furnace and air conditioner just before we got our used mobile home. Recently, the furnace stopped lighting. Jared (sp?) made THREE trips to get it back to good. He was so gracious and kind. Fortunately for us it was still under warranty. BTW, those three trips were from Fenton, Missouri to Belleville, Illinois! Thanks again, Jared!

Determining Required Inspections for New Units [View GBP](#)

Frequently Asked Questions

What are the main components of a mobile home HVAC system that require inspection?

The main components that typically require inspection include the furnace or heating unit, air conditioning unit (if applicable), ductwork, thermostat, and ventilation system. Each component should be checked for proper installation, function, and safety.

How often should a mobile homes HVAC system be inspected?

It is generally recommended to have a professional inspect the HVAC system at least once a year. This ensures optimal performance and can help identify potential issues before they become serious problems.

Are there specific regulations or codes that dictate what must be inspected in a mobile home HVAC system?

Yes, inspections must comply with local building codes and standards set by organizations such as HUD (Housing and Urban Development) for manufactured homes. These regulations ensure safety and efficiency standards are met.

What signs indicate that an immediate inspection of the HVAC system is necessary?

Immediate inspection may be required if there are unusual noises from the units, inconsistent temperatures throughout the home, higher than normal energy bills, or if you notice strange odors coming from vents. Such signs could indicate malfunctioning equipment or other issues needing urgent attention.

Royal Supply Inc

Phone : +16362969959

City : Fenton

State : MO

Zip : 63026

Address : Unknown Address

Google Business Profile

Company Website : <https://royal-durhamsupply.com/locations/lenexa-kansas/>

Sitemap

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About Us