Mobile Home Owners

- Choosing Appropriate Units for Mobile Home HVAC Upgrades
  Choosing Appropriate Units for Mobile Home HVAC Upgrades Steps for Removing Outdated AC Systems in Mobile Homes Evaluating Space Requirements for Mobile Home Heating Installation Wiring Considerations for Mobile Home HVAC Retrofits Overcoming Structural Challenges in Mobile Home AC Replacement Aligning Duct Modifications with Mobile Home Layout Configuring Vent Placement in Mobile Home Retrofit Projects Minimizing Air Leaks During Mobile Home HVAC Installation Using Modern Components for Efficient Mobile Home Heating Adapting Mobile Home Interiors for New AC Systems Verifying Proper Refrigerant Levels in Mobile Home Retrofitting Evaluating Permits and Rules for Mobile Home HVAC Changes
- Estimating Service Life of Mobile Home Heating Units
  Estimating Service Life of Mobile Home Heating Units Signs that Indicate Need for Mobile Home HVAC Replacement Evaluating Costs of Upgrading Mobile Home AC Systems Planning a Timely Furnace Upgrade in Mobile Home Settings Comparing Electric and Gas Options for Mobile Home Heating Understanding Lifespan Variations in Mobile Home Air Handlers Identifying Worn Components in Mobile Home HVAC Equipment Matching Mobile Home Dimensions to Suitable AC Units Selecting Replacement Filters for Aging Mobile Home Furnaces Predicting Maintenance Needs in Older Mobile Home HVAC Systems Preparing a Budget for Future Mobile Home HVAC Upgrades Exploring Extended Service Agreements for Mobile Home AC Units
- About Us

Projects

Importance of Selecting the Right Units for Upgrades

When configuring vent placement in mobile home retrofit projects, understanding the key factors influencing this process is crucial for ensuring efficient air circulation and maintaining optimal indoor air quality. Mobile homes, often characterized by their compact size and unique structural designs, require a tailored approach to HVAC system modifications. Several critical factors must be considered when planning vent placement to enhance both comfort and energy efficiency.

Firstly, the layout of the mobile home plays a pivotal role in determining vent placement. Mobile home owners should consider financing options for HVAC upgrades **mobile home hvac** expert. Unlike traditional homes, mobile homes typically have a more linear design with limited space. This requires careful consideration of how air will flow throughout each room to avoid areas of stagnant air or inconsistent temperatures. Properly placed vents should facilitate even distribution of conditioned air across living spaces, minimizing hot and cold spots.

Additionally, the insulation level of the mobile home influences vent placement decisions. Many older mobile homes have subpar insulation compared to newer models, which can affect how effectively air circulates within the space. In such cases, strategic vent placement can compensate for inadequate insulation by directing airflow toward areas that typically lose heat or gain excessive warmth quickly.

Another significant factor is the existing ductwork configuration. Retrofitting projects often involve working with pre-existing systems that may not align with current best practices for HVAC efficiency. Evaluating the state and layout of existing ducts can help identify opportunities for improvement without extensive renovation work. Where possible, aligning new vents with existing duct pathways reduces installation costs and complexity while enhancing system performance.

Moreover, external environmental conditions play an essential role in configuring vent placements. Mobile homes are frequently situated in diverse climates ranging from arid deserts to humid coastal regions. Each environment presents its own challenges regarding temperature regulation and humidity control inside the home. Vent placement strategies should account for these regional differences to optimize indoor comfort regardless of outside weather conditions.

Lastly, occupant needs and preferences cannot be overlooked when planning vent configurations in retrofits. Understanding how residents use different spaces within their mobile home provides valuable insights into where additional ventilation might be needed or where it could potentially disrupt daily activities if poorly placed-such as near seating areas prone to drafts or noise disturbances from airflow.

In conclusion, configuring vent placement during mobile home retrofit projects involves balancing various factors including spatial layout considerations; insulation levels; existing ductwork configurations; external climate conditions; along with resident preferences-all aimed at achieving improved thermal comfort alongside greater energy efficiency outcomes overall.

Assessing existing ventilation systems in mobile home retrofit projects is a critical component of ensuring that the living environment is both healthy and energy-efficient. Mobile homes, often characterized by their compact design and limited space, present unique challenges when it comes to configuring vent placement. Retrofitting these homes requires careful consideration of the existing infrastructure and an understanding of how to optimize airflow while maintaining structural integrity.

Firstly, it is essential to evaluate the current state of the ventilation system. Many older mobile homes were constructed with minimal attention to efficient airflow, leading to issues such as poor indoor air quality and increased susceptibility to mold and mildew. An assessment should include a thorough inspection of all vents, ductwork, and any mechanical ventilation devices currently in place. This evaluation will help identify any deficiencies or areas where improvements are necessary.

Once the assessment is complete, the next step involves designing a new ventilation strategy that addresses these deficiencies while accommodating the unique layout of a mobile home. Unlike traditional houses, mobile homes have limited wall space for additional vents or ductwork, making strategic planning crucial. One approach is to utilize existing ducts more efficiently or integrate new technologies like energy recovery ventilators (ERVs) that can improve air exchange without extensive remodeling.

Vent placement itself requires careful thought. Ideally, vents should be positioned in a way that maximizes cross-ventilation, allowing fresh air to circulate through every room evenly. In many cases, this means placing intake vents at lower positions where cooler air can enter and exhaust vents higher up where warmer air naturally rises. However, individual layouts may necessitate custom solutions.

Moreover, consideration must be given to how external factors such as local climate conditions impact airflow within a mobile home. For instance, in humid regions, dehumidification might need integration into the ventilation system design to prevent moisture buildup that could lead to health hazards or structural damage.

Finally, it's important not just to configure but also maintain these systems regularly post-retrofit. Filters should be changed routinely; ducts require periodic cleaning; mechanical components need checking for wear and tear-all these ensure long-term efficiency and functionality.

In conclusion, assessing existing ventilation systems during retrofit projects in mobile homes demands meticulous planning tailored specifically towards optimizing available resources while overcoming inherent limitations posed by their construction style. By focusing on strategic vent placement informed by thorough initial evaluations coupled with ongoing maintenance practices-residents can enjoy improved indoor environments conducive both comfort-wise as well as health-wise-a goal worth striving toward amidst modern energy-conscious architectural trends today!

Posted by on

Posted by on

Posted by on

Posted by on

Energy Efficiency and Environmental Impact

In the realm of mobile home retrofit projects, achieving optimal airflow through strategic vent placement is both an art and a science. The unique construction characteristics of mobile homes present particular challenges and opportunities when it comes to enhancing air circulation. As we explore best practices for configuring vent placement, it becomes clear that careful consideration must be given to both the existing structure and the desired outcomes of improved air quality, energy efficiency, and occupant comfort.

One fundamental aspect of optimizing airflow in mobile homes is understanding the underlying principles of ventilation. Effective vent placement is not just about ensuring air enters and exits a space; it's about creating a balanced system where fresh air is distributed evenly throughout. In mobile homes, which often have limited space and unique layouts, this balance can be achieved by strategically placing vents to facilitate cross-ventilation - allowing air to flow naturally from one side of the home to the other.

A critical first step in this process involves assessing the current state of airflow within the mobile home. This includes identifying areas where stale air tends to accumulate or where temperature variations are most pronounced. Using tools such as smoke tests or digital anemometers can help pinpoint these problem areas. Once identified, strategic vent placement can address these issues by introducing new pathways for air movement.

In retrofitting projects, it's essential to consider both intake and exhaust vents. Intake vents should be placed in locations that allow for effective capture of prevailing winds or cooler ambient air - typically on lower walls or near shaded areas outside. Exhaust vents, on the other hand, should be located at points where hot or stale air naturally rises - such as ceilings or high walls - enabling its efficient expulsion from the living spaces.

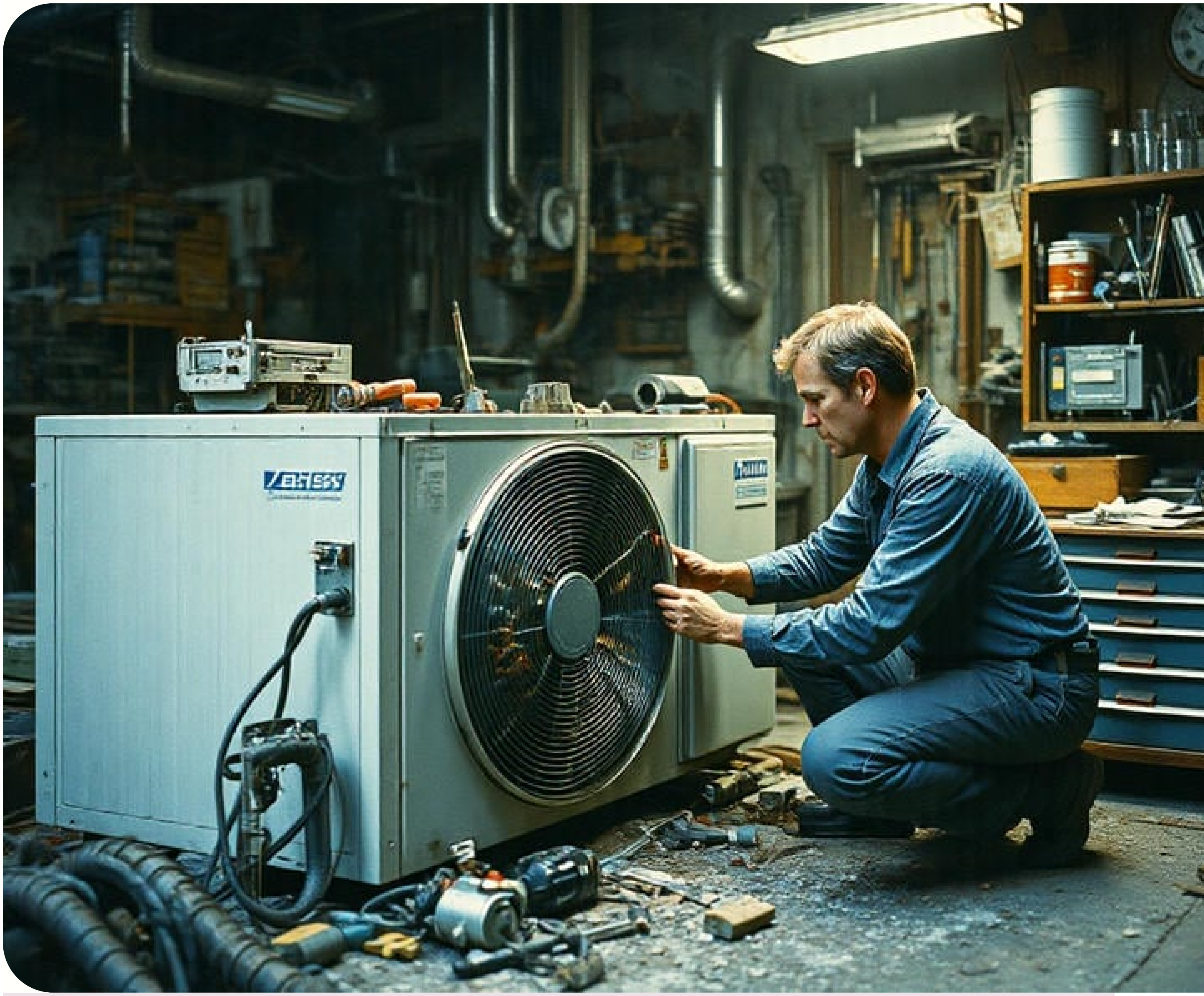
Moreover, attention should be paid to obstacles that may impede airflow within a mobile home. Interior partitions, furniture arrangements, and even decorative elements can disrupt intended airflow patterns if not thoughtfully considered during planning stages. Ensuring unobstructed paths between intake and exhaust points will significantly enhance overall ventilation efficacy.

Another best practice involves leveraging technology where possible. Modern advances in smart ventilation systems offer opportunities for real-time monitoring and automatic adjustments based on temperature changes or humidity levels within different zones of a mobile home. These systems can optimize energy use while maintaining consistent indoor climate conditions without requiring constant manual intervention.

It's also crucial to keep environmental factors in mind when configuring vent placements during retrofits. Seasonal wind patterns, local climate conditions, and potential sources of outdoor pollutants should influence decisions regarding which areas are ideal for drawing in fresh air versus those better suited for exhausting indoor contaminants.

Finally, collaboration with professionals who specialize in HVAC systems tailored specifically for manufactured housing can provide invaluable insights into making informed choices about vent materials (such as insulated ducts) that suit specific needs while complying with regulatory standards.

In conclusion, optimizing airflow in mobile home retrofit projects through strategic vent placement demands an integrative approach encompassing both technical knowledge and practical application skills. By adhering to best practices focused on enhancing natural ventilation mechanisms alongside modern technological solutions-and factoring external environmental considerations-homeowners stand poised not only improve their living environments but also contribute positively towards sustainable building practices overall.



Cost-Effectiveness and Budget Considerations

Configuring vent placement in mobile home retrofit projects presents a unique set of challenges, each demanding careful consideration and strategic solutions to ensure optimal functionality and efficiency. As mobile homes are typically characterized by their compact size and specific structural requirements, retrofitting them with an effective ventilation system can be quite complex. However, understanding the common challenges that arise during this process allows for the development of strategies to overcome them effectively.

One primary challenge in configuring vent placement is the restricted space available within mobile homes. Unlike traditional houses, mobile homes have a limited area to work with, which can complicate the installation of necessary ductwork and vents. To address this issue, it's crucial to conduct a thorough assessment of the available space before beginning any modifications. By identifying areas where vents can be inconspicuously integrated without compromising living space or aesthetic appeal, homeowners can achieve effective ventilation without significant sacrifices.

Another prevalent challenge is ensuring adequate airflow throughout the home. Mobile homes often suffer from poor air circulation due to their compact design and lack of built-in ventilation systems. This can lead to issues such as moisture buildup and poor indoor air quality. To overcome this obstacle, it is essential to strategically place vents in locations that promote cross-ventilation and efficient air distribution. Installing vents near heat-producing appliances or at opposite ends of a room can facilitate better airflow dynamics.

Furthermore, structural limitations pose another significant challenge when retrofitting vent systems in mobile homes. The materials used in constructing these dwellings may not always support extensive modifications without risking damage or compromising structural integrity. Therefore, selecting appropriate vent materials that are lightweight yet durable is vital for ensuring successful integration into existing structures.

In addition to spatial constraints and structural considerations, energy efficiency must also be prioritized during vent configuration in retrofit projects for mobile homes. Traditional HVAC systems might not suit these smaller spaces efficiently; hence exploring alternative options becomes imperative.

Implementing energy-efficient solutions like passive ventilation techniques or incorporating smart technology into existing systems ensures optimal performance while minimizing energy consumption-a win-win scenario for both comfort-conscious residents seeking lower utility bills as well as environmentally conscious individuals striving towards sustainable living practices.

Lastly but importantly-compliance with local building codes cannot be overlooked when undertaking any retrofitting project involving vent placements within mobile homes since regulations vary from jurisdiction-to-jurisdiction depending upon factors such as climate conditions etcetera; therefore consulting professionals who specialize within this niche field could save time money avoid potential legal hassles down line!

In conclusion-though there certainly exist numerous hurdles associated configuring proper ventilation setups specifically tailored towards accommodating complexities inherent structure mobility these types dwellings-by addressing issues head-on through proactive planning coupled innovative solutions informed decision-making processes homeowners stand good chance overcoming obstacles achieving desired outcomes improved comfort levels healthier environments all round!

Sizing and Compatibility with Mobile Home Structures

In recent years, the importance of proper ventilation in mobile homes has gained significant attention. As these homes become more popular due to their affordability and flexibility, ensuring a healthy indoor environment is paramount. Effective vent configuration is crucial for maintaining air quality, managing moisture levels, and ensuring energy efficiency. In retrofit projects, where older mobile homes are updated with modern amenities and systems, configuring vent placement becomes a critical aspect of the renovation process.

The first step in configuring vent placement in retrofit projects is understanding the unique challenges posed by mobile homes. Unlike traditional houses, mobile homes often have less space for ductwork and ventilation systems, necessitating innovative solutions. Tools such as advanced design software can help homeowners and contractors visualize potential configurations before implementation. These programs allow users to simulate airflow patterns and identify optimal locations for vents based on the home's layout.

Another vital technology in this domain is smart home integration. Modern HVAC systems equipped with smart thermostats can be programmed to optimize airflow based on occupancy patterns and external weather conditions. This not only enhances comfort but also contributes to energy efficiency by reducing unnecessary heating or cooling when spaces are unoccupied.

Moreover, new materials and technologies offer improved options for retrofitting existing structures. For instance, insulated ductwork can minimize thermal loss, which is particularly beneficial in mobile homes where maintaining a consistent internal temperature can be challenging. Additionally, variable-speed fans provide greater control over airflow rates, allowing for more precise adjustments according to specific needs.

When it comes to actual vent placement during retrofits, strategic consideration must be given to both supply and return vents. Supply vents should ideally be placed near windows or doors where drafts may occur; this helps distribute conditioned air effectively throughout the space. Meanwhile, return vents should be located centrally or near areas prone to higher humidity or heat buildup-such as kitchens or bathrooms-to ensure efficient circulation back into the system.

One must also consider integrating passive ventilation techniques alongside mechanical systems. Techniques like cross-ventilation leverage natural breezes by strategically placing windows or louvered vents across from each other-a method that can significantly enhance air movement without additional energy costs.

Finally, regular maintenance post-retrofit cannot be overlooked; even the most well-planned vent configurations require periodic inspection to ensure they function optimally over time. Routine cleaning of ducts and filters helps maintain good airflow while preventing pollutants from accumulating within living spaces.

In conclusion, effective vent configuration in mobile home retrofit projects requires a blend of innovative tools and technologies alongside practical knowledge about air movement principles within confined spaces like those found in mobile homes. By embracing both modern advancements like smart HVAC systems along with timeless strategies such as passive ventilation methods-homeowners stand poised not only improve their indoor environments but also achieve greater long-term sustainability benefits from their investments into these versatile dwellings.

Installation Challenges and Solutions

In recent years, the conversation around sustainable living and energy efficiency has gained significant momentum. Among the various housing solutions, mobile homes have become a focal point for retrofitting projects aimed at enhancing HVAC efficiency. The importance of configuring vent placement in such endeavors cannot be overstated, as it plays a critical role in ensuring optimal airflow and temperature regulation within these compact living spaces.

Mobile homes often present unique challenges when it comes to heating, ventilation, and air conditioning (HVAC) systems due to their structural characteristics and limited space. Traditional HVAC systems may not always translate effectively into these settings, necessitating innovative retrofit strategies. Successful case studies have demonstrated that strategic vent placement can significantly improve energy efficiency by minimizing energy loss and enhancing indoor comfort.

One exemplary project involved a mobile home community in the Pacific Northwest that sought to reduce energy consumption while improving resident comfort during harsh winter months. The project team conducted a thorough assessment of existing HVAC systems and identified inefficiencies primarily linked to poorly placed vents that caused uneven heating throughout the homes. By leveraging advanced computational fluid dynamics (CFD) modeling, they were able to simulate different vent configurations before implementing changes on-site.

The results were transformative: repositioning vents closer to floors rather than ceilings helped distribute heat more evenly throughout rooms, significantly reducing reliance on auxiliary heating sources. Additionally, installing adjustable vent grilles allowed residents to control airflow direction based on seasonal needs, further optimizing climate control within each unit.

Another notable case study focused on a mobile home park located in Arizona's desert climate. Here, cooling rather than heating was the primary concern due to sweltering summer temperatures. Retrofits centered around redirecting cool air from window-mounted air conditioners using strategically placed vents towards high-traffic areas such as living rooms and kitchens while diverting excess heat outside through roof vents equipped with automatic fans.

This configuration not only improved indoor comfort but also resulted in substantial reductions in electricity bills as less energy was needed for cooling purposes. Residents reported feeling more comfortable despite external temperatures soaring above 100 degrees Fahrenheit - showcasing how thoughtful vent placement can make an impactful difference even under extreme conditions.

These successful case studies underscore key insights into configuring vent placement during mobile home retrofits aimed at improving HVAC efficiency:

1. **Assessment is Critical**: A comprehensive evaluation of existing systems helps identify specific inefficiencies related to current vent placements.

2. **Simulation Tools Offer Insight**: Utilizing tools like CFD modeling allows teams to explore multiple configurations virtually before making physical changes.

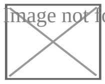
3. **Customization Enhances Efficiency**: Tailoring solutions based on climate considerations ensures maximum benefit from any retrofit efforts undertaken.

4. **Resident Feedback Matters**: Involving residents throughout planning stages provides valuable input regarding personal comfort preferences which may influence final design decisions.

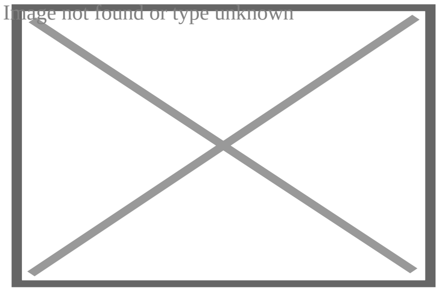
Ultimately, these projects highlight how innovative approaches toward configuring vent placement hold immense potential for boosting both environmental sustainability and quality-of-life standards within mobile home communities nationwide-demonstrating once again that small changes can yield big results when thoughtfully applied across diverse contexts!

About Modular building

For the Lego series, see Lego Modular Buildings.



This article **needs additional citations for verification**. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed.
Find sources: "Modular building" – news · newspapers · books · scholar · JSTOR *(January 2024) (Learn how and when to remove this message)*

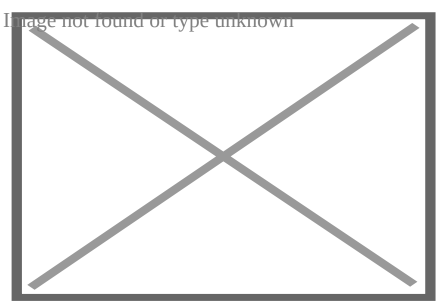


Prefabricated house in Valencia, Spain.

A **modular building** is a prefabricated building that consists of repeated sections called modules.[1] Modularity involves constructing sections away from the building site, then delivering them to the intended site. Installation of the prefabricated sections is completed on site. Prefabricated sections are sometimes placed using a crane. The modules can be placed side-by-side, end-to-end, or stacked, allowing for a variety of configurations and styles. After placement, the modules are joined together using inter-module connections, also known as inter-connections. The inter-connections tie the individual modules together to form the overall building structure.[2]

Uses

[edit]



Modular home prefab sections to be placed on the foundation

Modular buildings may be used for long-term, temporary or permanent facilities, such as construction camps, schools and classrooms, civilian and military housing, and industrial facilities. Modular buildings are used in remote and rural areas where conventional construction may not be reasonable or possible, for example, the Halley VI accommodation pods used for a BAS Antarctic expedition.[3] Other uses have included churches, health care facilities, sales and retail offices, fast food restaurants and cruise ship construction. They can also be used in areas that have weather concerns, such as hurricanes. Modular buildings are often used to provide temporary facilities, including toilets and ablutions at events. The portability of the buildings makes them popular with hire companies and clients alike. The use of modular buildings enables events to be held at locations where existing facilities are unavailable, or unable to support the number of event attendees.

Construction process

[edit]

Construction is offsite, using lean manufacturing techniques to prefabricate single or multi-story buildings in deliverable module sections. Often, modules are based around standard 20 foot containers, using the same dimensions, structures, building and stacking/placing techniques, but with smooth (instead of corrugated) walls, glossy white paint, and provisions for windows, power, potable water, sewage lines, telecommunications and air conditioning. Permanent Modular Construction (PMC) buildings are manufactured in a controlled setting and can be constructed of wood, steel, or concrete. Modular components are typically constructed indoors on assembly lines. Modules' construction may take as little as ten days but more often one to three months. PMC modules can be integrated into site built projects or stand alone and can be delivered with MEP, fixtures and interior finishes.

The buildings are 60% to 90% completed offsite in a factory-controlled environment, and transported and assembled at the final building site. This can comprise the entire building or be components or subassemblies of larger structures. In many cases, modular contractors work with traditional general contractors to exploit the resources and advantages of each type of construction. Completed modules are transported to the building site and assembled by a crane.[4] Placement of the modules may take from several hours to several days. Off-site construction running in parallel to site preparation providing a shorter time to project completion is one of the common selling points of modular construction. Modular construction timeline

Permanent modular buildings are built to meet or exceed the same building codes and standards as site-built structures and the same architect-specified materials used in conventionally constructed buildings are used in modular construction projects. PMC can have as many stories as building codes allow. Unlike relocatable buildings, PMC structures are intended to remain in one location for the duration of their useful life.

Manufacturing considerations

[edit]

The entire process of modular construction places significance on the design stage. This is where practices such as Design for Manufacture and Assembly (DfMA) are used to ensure that assembly tolerances are controlled throughout manufacture and assembly on site. It is vital that there is enough allowance in the design to allow the assembly to take up any "slack" or misalignment of components. The use of advanced CAD systems, 3D printing and manufacturing control systems are important for modular construction to be successful. This is quite unlike on-site construction where the tradesman can often make the part to suit any particular installation.

Bulk materials

- Image not found or type unknown
  Bulk
  materials
  Walls attached to floor

- Image not found or type unknown
  Walls attached to
  floor
  Ceiling drywalled in spray booth

- Image not found or type unknown
  Ceiling drywalled in
  spray booth
  Roof set in place

- Image not found or type unknown
  Roof set in place

Roof shingled and siding installed

- Image not found or type unknown
  Roof shingled and
  siding installed
  Ready for delivery to site

- Image not found or type unknown
  Ready for delivery to
  site
  Two-story modular dwelling

- Image not found or type unknown
  Two-story modular dwelling
  Pratt Modular Home in Tyler Texas

- Image not found or type unknown
  Pratt Modular Home in
  Tyler Texas
  Pratt Modular Home kitchen

- Image not found or type unknown
  Pratt Modular Home
  kitchen
  Pratt Modular Home in Tyler Texas

- Image not found or type unknown

Pratt Modular Home in
Tyler Texas

Upfront production investment

[edit]

The development of factory facilities for modular homes requires significant upfront investment. To help address housing shortages in the 2010s, the United Kingdom Government (via Homes England) invested in modular housing initiatives. Several UK companies (for example, Ilke Homes, L&G Modular Homes, House by Urban Splash, Modulous, TopHat and Lighthouse) were established to develop modular homes as an alternative to traditionally-built residences, but failed as they could not book revenues quickly enough to cover the costs of establishing manufacturing facilities.

Ilke Homes opened a factory in Knaresborough, Yorkshire in 2018, and Homes England invested £30m in November 2019,[5] and a further £30m in September 2021.[6] Despite a further fund-raising round, raising £100m in December 2022,[7][8] Ilke Homes went into administration on 30 June 2023,[9][10] with most of the company's 1,150 staff made redundant,[11] and debts of £320m,[12] including £68m owed to Homes England.[13]

In 2015 Legal & General launched a modular homes operation, L&G Modular Homes, opening a 550,000 sq ft factory in Sherburn-in-Elmet, near Selby in Yorkshire.[14] The company incurred large losses as it invested in its factory before earning any revenues; by 2019, it had lost over £100m.[15] Sales revenues from a Selby project, plus schemes in Kent and West Sussex, started to flow in 2022, by which time the business's total losses had grown to £174m.[16] Production was halted in May 2023, with L&G blaming local planning delays and the COVID-19 pandemic for its failure to grow its sales pipeline.[17][18] The enterprise incurred total losses over seven years of £295m.[19]

Market acceptance

[edit]

Image not found or type unknown

Raines Court is a multi-story modular housing block in Stoke Newington, London, one of the first two residential buildings in Britain of this type. (December 2005)

Some home buyers and some lending institutions resist consideration of modular homes as equivalent in value to site-built homes.[*citation needed*] While the homes themselves may be of equivalent quality, entrenched zoning regulations and psychological marketplace factors may create hurdles for buyers or builders of modular homes and should be considered as part of the decision-making process when exploring this type of home as a living and/or investment option. In the UK and Australia, modular homes have become accepted in some regional areas; however, they are not commonly built in major cities. Modular homes are becoming increasingly common in Japanese urban areas, due to improvements in design and quality, speed and compactness of onsite assembly, as well as due to lowering costs and ease of repair after earthquakes. Recent innovations allow modular buildings to be indistinguishable from site-built structures.[20] Surveys have shown that individuals can rarely tell the difference between a modular home and a site-built home.[21]

Modular homes vs. mobile homes

[edit]

Differences include the building codes that govern the construction, types of material used and how they are appraised by banks for lending purposes. Modular homes are built to either local or state building codes as opposed to manufactured homes, which are also built in a factory but are governed by a federal building code.[22] The codes that govern the construction of modular homes are exactly the same codes that govern the construction of site-constructed homes.[*citation needed*] In the United States, all modular homes are constructed according to the International Building Code (IBC), IRC, BOCA or the code that has been adopted by the local jurisdiction.[*citation needed*] In some states, such as California, mobile homes must still be registered yearly, like vehicles or standard trailers, with the Department of Motor Vehicles or other state agency. This is true even if the owners remove the axles and place it on a permanent foundation.[23]

Recognizing a mobile or manufactured home

[edit]

A mobile home should have a small metal tag on the outside of each section. If a tag cannot be located, details about the home can be found in the electrical panel box. This tag should also reveal a manufacturing date.[*citation needed*] Modular homes do not have metal tags on the outside but will have a dataplate installed inside the home, usually under the kitchen sink or in a closet. The dataplate will provide information such as the manufacturer, third party inspection agency, appliance information, and manufacture date.

Materials

[edit]

The materials used in modular buildings are of the same quality and durability as those used in traditional construction, preserving characteristics such as acoustic insulation and energy efficiency, as well as allowing for attractive and innovative designs thanks to their versatility.[24] Most commonly used are steel, wood and concrete.[25]

- Steel: Because it is easily moldable, it allows for innovation in design and aesthetics.
- Wood: Wood is an essential part of most modular buildings. Thanks to its lightness, it facilitates the work of assembling and moving the prefabricated modules.
- Concrete: Concrete offers a solid structure that is ideal for the structural reinforcement of permanent modular buildings. It is increasingly being used as a base material in this type of building, thanks to its various characteristics such as fire resistance, energy savings, greater acoustic insulation, and durability.[26]

Wood-frame floors, walls and roof are often utilized. Some modular homes include brick or stone exteriors, granite counters and steeply pitched roofs. Modulars can be designed to sit on a perimeter foundation or basement. In contrast, mobile homes are constructed with a steel chassis that is integral to the integrity of the floor system. Modular buildings can be custom built to a client's specifications. Current designs include multi-story units, multi-family units and entire apartment complexes. The negative stereotype commonly associated with mobile homes has prompted some manufacturers to start using the term "off-site construction."

New modular offerings include other construction methods such as cross-laminated timber frames.[27]

Financing

[edit]

Mobile homes often require special lenders.[28]

Modular homes on the other hand are financed as site built homes with a construction loan

Standards and zoning considerations

[edit]

Typically, modular dwellings are built to local, state or council code, resulting in dwellings from a given manufacturing facility having differing construction standards depending on the final destination of the modules.[29] The most important zones that manufacturers have to take into consideration are local wind, heat, and snow load zones.[*citation needed*] For example, homes built for final assembly in a hurricane-prone, earthquake or flooding area may include additional bracing to meet local building codes. Steel and/or wood framing are common options for building a modular home.

Some US courts have ruled that zoning restrictions applicable to mobile homes do not apply to modular homes since modular homes are designed to have a permanent foundation.[*citation needed*] Additionally, in the US, valuation differences between modular homes and site-built homes are often negligible in real estate appraisal practice; modular homes can, in some market areas, (depending on local appraisal practices per Uniform Standards of Professional Appraisal Practice) be evaluated the same way as site-built dwellings of similar quality. In Australia, manufactured home parks are governed by additional legislation that does not apply to permanent modular homes. Possible developments in equivalence between modular and site-built housing types for the purposes of real estate appraisals, financing and zoning may increase the sales of modular homes over time.[30]

CLASP (Consortium of Local Authorities Special Programme)

[edit]

The Consortium of Local Authorities Special Programme (abbreviated and more commonly referred to as CLASP) was formed in England in 1957 to combine the resources of local authorities with the purpose of developing a prefabricated school building programme. Initially developed by Charles Herbert Aslin, the county architect for Hertfordshire, the system was used as a model for several other counties, most notably Nottinghamshire and Derbyshire. CLASP's popularity in these coal mining areas was in part because the system permitted fairly straightforward replacement of subsidence-damaged sections of building.

Building strength

[edit]

Modular Home being built in Vermont photo by Josh Vignona

Image not found or type unknown
Modular home in Vermont

Modular homes are designed to be stronger than traditional homes by, for example, replacing nails with screws, adding glue to joints, and using 8–10% more lumber than conventional housing.[31] This is to help the modules maintain their structural integrity as they are transported on trucks to the construction site. However, there are few studies on the response of modular buildings to transport and handling stresses. It is therefore presently difficult to predict transport induced damage.[1]

When FEMA studied the destruction wrought by Hurricane Andrew in Dade County Florida, they concluded that modular and masonry homes fared best compared to other construction.[32]

CE marking

[edit]

The CE mark is a construction norm that guarantees the user of mechanical resistance and strength of the structure. It is a label given by European community empowered authorities for end-to-end process mastering and traceability.[*citation needed*]

All manufacturing operations are being monitored and recorded:

- Suppliers have to be known and certified,
- Raw materials and goods being sourced are to be recorded by batch used,
- Elementary products are recorded and their quality is monitored,
- Assembly quality is managed and assessed on a step by step basis,
- When a modular unit is finished, a whole set of tests are performed and if quality standards are met, a unique number and EC stamp is attached to and on the unit.

This ID and all the details are recorded in a database, At any time, the producer has to be able to answer and provide all the information from each step of the production of a single unit, The EC certification guaranties standards in terms of durability, resistance against wind and earthquakes.[*citation needed*]

Open modular building

[edit]
See also: Green building

The term Modularity can be perceived in different ways. It can even be extended to building P2P (peer-to-peer) applications; where a tailored use of the P2P technology is with the aid of a modular paradigm. Here, well-understood components with clean interfaces can be combined to implement arbitrarily complex functions in the hopes of further proliferating self-organising P2P technology. Open modular buildings are an excellent example of this. Modular building can also be open source and green. Bauwens, Kostakis and Pazaitis[33] elaborate on this kind of modularity. They link modularity to the construction of houses.

This commons-based activity is geared towards modularity. The construction of modular buildings enables a community to share designs and tools related to all the different parts of house construction. A socially-oriented endeavour that deals with the external architecture of buildings and the internal dynamics of open source commons. People are thus provided with the tools to reconfigure the public sphere in the area where they live, especially in urban environments. There is a robust socializing element that is reminiscent of pre-industrial vernacular architecture and community-based building.[34]

Some organisations already provide modular housing. Such organisations are relevant as they allow for the online sharing of construction plans and tools. These plans can be then assembled, through either digital fabrication like 3D printing or even sourcing low-cost materials from local communities. It has been noticed that given how easy it is to use these low-cost materials are (for example: plywood), it can help increase the permeation of these open buildings to areas or communities that lack the know-how or abilities of conventional architectural or construction firms. Ergo, it allows for a fundamentally more standardised way of constructing houses and buildings. The overarching idea behind it remains key - to allow for easy access to user-friendly layouts which anyone can use to build in a more sustainable and affordable way.

Modularity in this sense is building a house from different standardised parts, like solving a jigsaw puzzle.

3D printing can be used to build the house.

The main standard is OpenStructures and its derivative Autarkytecture.[35]

Research and development

[edit]

Modular construction is the subject of continued research and development worldwide as the technology is applied to taller and taller buildings. Research and development is carried out by modular building companies and also research institutes such as the Modular Building Institute[36] and the Steel Construction Institute.[37]

See also

[edit]

- Image not found or type unknown Housing portal
- Affordable housing
- Alternative housing
- Commercial modular construction
- Construction 3D printing
- Container home
- Kit house
- MAN steel house
- Manufactured housing
- Modern methods of construction
- Modular design
- Portable building
- Prefabrication
- Open-source architecture
- Open source hardware
- OpenStructures
- Prefabricated home
- Relocatable buildings
- Recreational vehicles
- Shipping container architecture
- Stick-built home
- Tiny house movement
- Toter

References

[edit]

1. ^ ***a*** ***b*** *Lacey, Andrew William; Chen, Wensu; Hao, Hong; Bi, Kaiming (2018). "Structural Response of Modular Buildings – An Overview". Journal of Building Engineering.* ***16****: 45–56. doi:10.1016/j.jobe.2017.12.008. hdl:20.500.11937/60087.*
2. **^** *Lacey, Andrew William; Chen, Wensu; Hao, Hong; Bi, Kaiming (2019). "Review of bolted inter-module connections in modular steel buildings". Journal of Building Engineering.* ***23****: 207–219. doi:10.1016/j.jobe.2019.01.035. S2CID 86540434.*

3. **^** *"Halley VI Research Station – British Antarctic Survey". Bas.ac.uk. Retrieved 2016-05-03.*
4. **^** *"Why Build Modular?". Modular.org. Retrieved 2016-05-03.*
5. **^** *Morby, Aaron (4 November 2019). "Government pumps £30m into modular house builder". Construction Enquirer. Retrieved 14 March 2024.*
6. **^** *Morby, Aaron (27 September 2021). "Ilke Homes raises £60m for top 10 house builder plan". Construction Enquirer. Retrieved 14 March 2024.*
7. **^** *Morby, Aaron (6 December 2022). "Ilke Homes pulls off £100m record-breaking fund raise". Construction Enquirer. Retrieved 14 March 2024.*
8. **^** *O'Connor, Rob (6 December 2022). "ilke Homes announces new £100m investment". Infrastructure Intelligence. Retrieved 14 March 2024.*
9. **^** *Gardiner, Joey (30 June 2023). "Ilke Homes sinks into administration with most of firm's 1,100 staff set to lose their jobs". Building. Retrieved 14 March 2024.*
10. **^** *Riding, James (30 June 2023). "Modular house builder Ilke Homes enters administration with majority of staff to be made redundant". Inside Housing. Retrieved 14 March 2024.*
11. **^** *Morby, Aaron (30 June 2023). "Ilke Homes falls into administration". Construction Enquirer. Retrieved 14 March 2024.*
12. **^** *Prior, Grant (25 August 2023). "Ilke Homes went under owing £320m". Construction Enquirer. Retrieved 14 March 2024.*
13. **^** *Willmore, James (14 February 2024). "Homes England to lose most of £68.8m it is owed from Ilke Homes following collapse". Inside Housing. Retrieved 14 March 2024.*
14. **^** *Dale, Sharon (11 May 2020). "Head of Legal & General modular homes factory reveals plans for its future". Yorkshire Post. Retrieved 20 March 2024.*
15. **^** *Morby, Aaron (30 November 2020). "L&G modular homes losses exceed £100m". Construction Enquirer. Retrieved 20 March 2024.*
16. **^** *Morby, Aaron (3 October 2022). "L&G modular homes amassed loss deepens to £174m". Construction Enquirer. Retrieved 20 March 2024.*
17. **^** *Prior, Grant (4 May 2023). "L&G halts production at modular homes factory". Construction Enquirer. Retrieved 20 March 2024.*
18. **^** *Kollewe, Julia (4 May 2023). "Legal & General halts new production at modular homes factory near Leeds". The Guardian.*
19. **^** *Morby, Aaron (6 November 2023). "L&G modular homes foray amassed £295m of losses". Construction Enquirer. Retrieved 20 March 2024.*
20. **^** *fab, ukporta (19 August 2020). "prefabricated structures". ukportaprefab. Retrieved 4 September 2020.*
21. **^** *"Factory-Built Construction and the American Homebuyer: Perceptions and Opportunities" (PDF). Huduser.gov. p. 9. Retrieved 2017-09-10.*
22. **^** *Solutions, Dryside Property – Jennifer Mitchell and Magic Web. "Mobile homes vs Manufactured homes vs Modular homes". Drysideproperty.com. Retrieved 2018-03-09.*
23. **^** *"HCD Manufactured and Mobile Homes". Hcd.ca.gov.*

24. **^** Métodos modernos de construcción (MMC): Fabricación modular. Upv.es. 2020-10-02 Retrieved 2022-09-08
25. **^** A guide to the latest modular building construction materials. Hydrodiseno.com. 2021-12-14 Retrieved 2022-09-05
26. **^** Construcción modular en hormigón: una tendencia al alza (PDF). Andece.org. p. 53. Retrieved 2022-07-06
27. **^** *"Prefabricated Housing Module Advances Wood Research at the University of British Columbia | 2017-05-15T00:00:00 | Perkins + Will News". Archived from the original on 2019-03-31. Retrieved 2019-03-31.*
28. **^** *"HUD Financing Manufactured (Mobile) Homes". Portal.hud.gov. Archived from the original on 2016-05-03. Retrieved 2016-05-03.*
29. **^** *"Australian Government modular home regulations". Austlii.edu.au. Retrieved 2007-10-21.*
30. **^** *"Building Codes for Modular Homes". Modularhomesnetwork.com. Retrieved 2010-08-06.*
31. **^** *"Disruptive Development: Modular Manufacturing In Multifamily Housing" (PDF). p. 35. Retrieved 10 September 2017.*
32. **^** *"FIA 22, Mitigation Assessment Team Report: Hurricane Andrew in Florida (1993)". Fema.gov.*
33. **^** Bouwens, M., Kostakis, V., & Pazaitis, A. 2019. The Commons Manifesto. University of Westminster Press, London, pg. 24
34. **^** Bouwens, M., Kostakis, V., & Pazaitis, A. 2019. The Commons Manifesto. University of Westminster Press, London, pg. 25
35. **^** *"Thomas Lommée & Christiane Hoegner - Autarkytecture | z33". Archived from the original on 2014-12-31. Retrieved 2015-01-01.*
36. **^** *"Modular Building Institute". Modular.org.*
37. **^** *"The Steel Construction Institute (SCI) UK Global Steel Expertise". Steel-sci.com.*

34 - "Volumetric modular construction trend gaining groun d". https://www.aa.com.tr/en/corporate-news/volumetric-modular-construction-trend-gaining-ground/2357158 06.09.2021

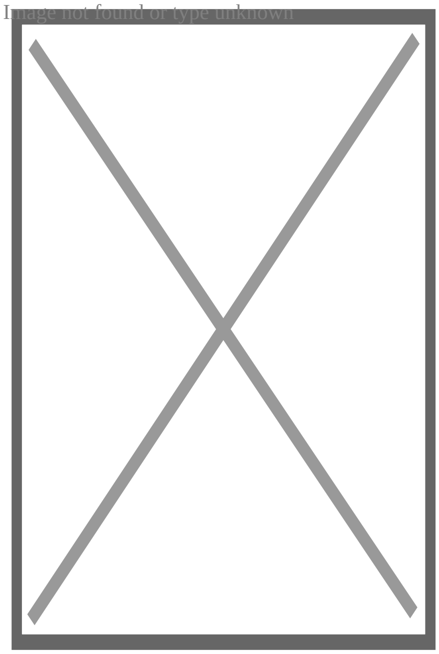
Portal:

- Image not found or type unknown housing

About Refrigerant

Image not found or type unknown This article's lead section **may be too short to adequately summarize the key points**. Please consider expanding the lead to provide an accessible overview of all important aspects of the article. *(March 2021)*

Image not found or type unknown



A DuPont R-134a refrigerant

A **refrigerant** is a working fluid used in cooling, heating or reverse cooling and heating of air conditioning systems and heat pumps where they undergo a repeated phase transition from a liquid to a gas and back again. Refrigerants are heavily regulated because of their toxicity and flammability[1] and the contribution of CFC and HCFC refrigerants to ozone depletion[2] and that of HFC refrigerants to climate change.[3]

Refrigerants are used in a direct expansion (DX- Direct Expansion) system (circulating system)to transfer energy from one environment to another, typically from inside a building to outside (or vice versa) commonly known as an air conditioner cooling only or cooling & heating reverse DX system or heat pump a heating only DX cycle. Refrigerants can carry 10 times more energy per kg than water, and 50 times more than air.

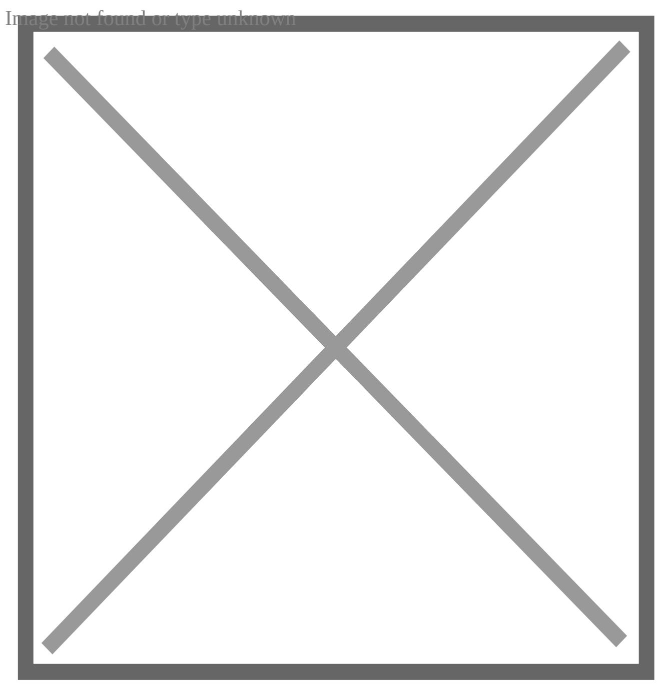
Refrigerants are controlled substances and classified by International safety regulations ISO 817/5149, AHRAE 34/15 & BS EN 378 due to high pressures (700–1,000 kPa (100–150 psi)), extreme temperatures (?50 °C [?58 °F] to over 100 °C [212 °F]), flammability (A1 class non-flammable, A2/A2L class flammable and A3 class extremely flammable/explosive) and toxicity (B1-low, B2-medium & B3-high). The regulations relate to situations when these refrigerants are released into the atmosphere in the event of an accidental leak not while circulated.

Refrigerants (controlled substances) must only be handled by qualified/certified engineers for the relevant classes (in the UK, C&G 2079 for A1-class and C&G 6187-2 for A2/A2L & A3-class refrigerants).

Refrigerants (A1 class only) Due to their non-flammability, A1 class non-flammability, non-explosivity, and non-toxicity, non-explosivity they have been used in open systems (consumed when used) like fire extinguishers, inhalers, computer rooms fire extinguishing and insulation, etc.) since 1928.

History

[edit]



The observed stabilization of HCFC concentrations (left graphs) and the growth of HFCs (right graphs) in earth's atmosphere.

The first air conditioners and refrigerators employed toxic or flammable gases, such as ammonia, sulfur dioxide, methyl chloride, or propane, that could result in fatal accidents when they leaked.[4]

In 1928 Thomas Midgley Jr. created the first non-flammable, non-toxic chlorofluorocarbon gas, *Freon* (R-12). The name is a trademark name owned by DuPont (now Chemours) for any chlorofluorocarbon (CFC), hydrochlorofluorocarbon (HCFC), or hydrofluorocarbon (HFC) refrigerant. Following the discovery of better synthesis methods, CFCs such as R-11,[5] R-12,[6] R-123[5] and R-502[7] dominated the market.

Phasing out of CFCs

[edit]
See also: Montreal Protocol

In the mid-1970s, scientists discovered that CFCs were causing major damage to the ozone layer that protects the earth from ultraviolet radiation, and to the ozone holes over polar regions.[8][9] This led to the signing of the Montreal Protocol in 1987 which aimed to phase out CFCs and HCFC[10] but did not address the contributions that HFCs made to climate change. The adoption of HCFCs such as R-22,[11][12][13] and R-123[5] was accelerated and so were used in most U.S. homes in air conditioners and in chillers[14] from the 1980s as they have a dramatically lower Ozone Depletion Potential (ODP) than CFCs, but their ODP was still not zero which led to their eventual phase-out.

Hydrofluorocarbons (HFCs) such as R-134a,[15][16] R-407A,[17] R-407C,[18] R-404A,[7] R-410A[19] (a 50/50 blend of R-125/R-32) and R-507[20][21] were promoted as replacements for CFCs and HCFCs in the 1990s and 2000s. HFCs were not ozone-depleting but did have global warming potentials (GWPs) thousands of times greater than CO_2 with atmospheric lifetimes that can extend for decades. This in turn, starting from the 2010s, led to the adoption in new equipment of Hydrocarbon and HFO (hydrofluoroolefin) refrigerants R-32,[22] R-290,[23] R-600a,[23] R-454B,[24] R-1234yf,[25][26] R-514A,[27] R-744 (CO_2),[28] R-1234ze(E)[29] and R-1233zd(E),[30] which have both an ODP of zero and a lower GWP. Hydrocarbons and CO_2 are sometimes called natural refrigerants because they can be found in nature.

The environmental organization Greenpeace provided funding to a former East German refrigerator company to research alternative ozone- and climate-safe refrigerants in 1992. The company developed a hydrocarbon mixture of propane and isobutane, or pure isobutane,[31] called "Greenfreeze", but as a condition of the contract with Greenpeace could not patent the technology, which led to widespread adoption by other firms.[32][33][34] Policy and political influence by corporate executives resisted change however,[35][36] citing the flammability and explosive properties of the refrigerants,[37] and DuPont together with other companies blocked them in the U.S. with the U.S. EPA.[38][39]

Beginning on 14 November 1994, the U.S. Environmental Protection Agency restricted the sale, possession and use of refrigerants to only licensed technicians, per rules under sections 608 and 609 of the Clean Air Act.[40] In 1995, Germany made CFC refrigerators illegal.[41]

In 1996 Eurammon, a European non-profit initiative for natural refrigerants, was established and comprises European companies, institutions, and industry experts.[42][

43][44]

In 1997, FCs and HFCs were included in the Kyoto Protocol to the Framework Convention on Climate Change.

In 2000 in the UK, the Ozone Regulations[45] came into force which banned the use of ozone-depleting HCFC refrigerants such as R22 in new systems. The Regulation banned the use of R22 as a "top-up" fluid for maintenance from 2010 for virgin fluid and from 2015 for recycled fluid.[*citation needed*]

Addressing greenhouse gases

[edit]

With growing interest in natural refrigerants as alternatives to synthetic refrigerants such as CFCs, HCFCs and HFCs, in 2004, Greenpeace worked with multinational corporations like Coca-Cola and Unilever, and later Pepsico and others, to create a corporate coalition called Refrigerants Naturally!.[41][46] Four years later, Ben & Jerry's of Unilever and General Electric began to take steps to support production and use in the U.S.[47] It is estimated that almost 75 percent of the refrigeration and air conditioning sector has the potential to be converted to natural refrigerants.[48]

In 2006, the EU adopted a Regulation on fluorinated greenhouse gases (FCs and HFCs) to encourage to transition to natural refrigerants (such as hydrocarbons). It was reported in 2010 that some refrigerants are being used as recreational drugs, leading to an extremely dangerous phenomenon known as inhalant abuse.[49]

From 2011 the European Union started to phase out refrigerants with a global warming potential (GWP) of more than 150 in automotive air conditioning (GWP = 100-year warming potential of one kilogram of a gas relative to one kilogram of CO_2) such as the refrigerant HFC-134a (known as R-134a in North America) which has a GWP of 1526.[50] In the same year the EPA decided in favour of the ozone- and climate-safe refrigerant for U.S. manufacture.[32][51][52]

A 2018 study by the nonprofit organization "Drawdown" put proper refrigerant management and disposal at the very top of the list of climate impact solutions, with an impact equivalent to eliminating over 17 years of US carbon dioxide emissions.[53]

In 2019 it was estimated that CFCs, HCFCs, and HFCs were responsible for about 10% of direct radiative forcing from all long-lived anthropogenic greenhouse gases.[54] and in the same year the UNEP published new voluntary guidelines,[55] however many countries have not yet ratified the Kigali Amendment.

From early 2020 HFCs (including R-404A, R-134a and R-410A) are being superseded: Residential air-conditioning systems and heat pumps are increasingly using R-32. This still has a GWP of more than 600. Progressive devices use refrigerants with almost no climate impact, namely R-290 (propane), R-600a (isobutane) or R-1234yf (less flammable, in cars). In commercial refrigeration also CO_2 (R-744) can be used.

Requirements and desirable properties

[edit]

A refrigerant needs to have: a boiling point that is somewhat below the target temperature (although boiling point can be adjusted by adjusting the pressure appropriately), a high heat of vaporization, a moderate density in liquid form, a relatively high density in gaseous form (which can also be adjusted by setting pressure appropriately), and a high critical temperature. Working pressures should ideally be containable by copper tubing, a commonly available material. Extremely high pressures should be avoided.[*citation needed*]

The ideal refrigerant would be: non-corrosive, non-toxic, non-flammable, with no ozone depletion and global warming potential. It should preferably be natural with well-studied and low environmental impact. Newer refrigerants address the issue of the damage that CFCs caused to the ozone layer and the contribution that HCFCs make to climate change, but some do raise issues relating to toxicity and/or flammability.[56]

Common refrigerants

[edit]

Refrigerants with very low climate impact

[edit]

With increasing regulations, refrigerants with a very low global warming potential are expected to play a dominant role in the 21st century,[57] in particular, R-290 and R-1234yf. Starting from almost no market share in 2018,[58] low GWPO devices are gaining market share in 2022.

Code	Chemical	Name	GWP 20yr[59]	GWP 100yr[59]	Status	Commentary

R-290	C_3H_8	Propane		3.3[60]	Increasing use	Low cost, widely available and efficient. They also have zero ozone depletion potential. Despite their flammability, they are increasingly used in domestic refrigerators and heat pumps. In 2010, about one-third of all household refrigerators and freezers manufactured globally used isobutane or an isobutane/propane blend, and this was expected to increase to 75% by 2020.[61]
R-600a	$HC(CH_3)_3$	Isobutane		3.3	Widely used	See R-290.
R-717	NH_3	Ammonia	0	0[62]	Widely used	Commonly used before the popularisation of CFCs, it is again being considered but does suffer from the disadvantage of toxicity, and it requires corrosion-resistant components, which restricts its domestic and small-scale use. Anhydrous ammonia is widely used in industrial refrigeration applications and hockey rinks because of its high energy efficiency and low cost.

R-1234yf HFO-1234yf	$C_3H_2F_4$	2,3,3,3-Tetrafluoropropene		<1		Less performance but also less flammable than R-290.[57] GM announced that it would start using "hydro-fluoro olefin", HFO-1234yf, in all of its brands by 2013.[63]
R-744	CO_2	Carbon dioxide	1	1	In use	Was used as a refrigerant prior to the discovery of CFCs (this was also the case for propane)[4] and now having a renaissance due to it being non-ozone depleting, non-toxic and non-flammable. It may become the working fluid of choice to replace current HFCs in cars, supermarkets, and heat pumps. Coca-Cola has fielded CO_2-based beverage coolers and the U.S. Army is considering CO_2 refrigeration.[64][65] Due to the need to operate at pressures of up to 130 bars (1,900 psi; 13,000 kPa), CO_2 systems require highly resistant components, however these have already been developed for mass production in many sectors.

Most used

[edit]

Code	Chemical	Name	Global warming potential 20yr[59]	GWP 100yr [59]	Status	Commentary
R-32 HFC-32	CH_2F_2	Difluoromethane	2430	677	Widely used	Promoted as climate-friendly substitute for R-134a and R-410A, but still with high climate impact. Has excellent heat transfer and pressure drop performance, both in condensation and vaporisation.[66] It has an atmospheric lifetime of nearly 5 years.[67] Currently used in residential and commercial air-conditioners and heat pumps.
R-134a HFC-134a	CH_2FCF_3	1,1,1,2-Tetrafluoroethane	3790	1550	Widely used	Most used in 2020 for hydronic heat pumps in Europe and the United States in spite of high GWP.[58] Commonly used in automotive air conditioners prior to phase out which began in 2012.
R-410A		50% R-32 / 50% R-125 (pentafluoroethane)	Between 2430 (R-32) and 6350 (R-125)	> 677	Widely Used	Most used in split heat pumps / AC by 2018. Almost 100% share in the USA.[58] Being phased out in the US starting in 2022.[68][69]

Banned / Phased out

[edit]

Code	Chemical	Name	Global warming potential 20yr[59]	GWP 100yr [59]	Status	Commentary
R-11 CFC-11	CCl_3F	Trichlorofluoromethane	6900	4660	Banned	Production was banned in developed countries by Montreal Protocol in 1996
R-12 CFC-12	CCl_2F_2	Dichlorodifluoromethane	10800	10200	Banned	Also known as Freon, a widely used chlorofluorocarbon halomethane (CFC). Production was banned in developed countries by Montreal Protocol in 1996, and in developing countries (article 5 countries) in 2010.[70]
R-22 HCFC-22	$CHClF_2$	Chlorodifluoromethane	5280	1760	Being phased out	A widely used hydrochlorofluorocarbon (HCFC) and powerful greenhouse gas with a GWP equal to 1810. Worldwide production of R-22 in 2008 was about 800 Gg per year, up from about 450 Gg per year in 1998. R-438A (MO-99) is a R-22 replacement.[71]

R-123 HCFC-123	$CHCl_2CF_3$	2,2-Dichloro-1,1,1-trifluoroethane	292	79	US phase-out	Used in large tonnage centrifugal chiller applications. All U.S. production and import of virgin HCFCs will be phased out by 2030, with limited exceptions.[72] R-123 refrigerant was used to retrofit some chiller that used R-11 refrigerant Trichlorofluoromethane. The production of R-11 was banned in developed countries by Montreal Protocol in 1996.[73]

Other

[edit]

Code	Chemical	Name	Global warming potential 20yr[59]	GWP 100yr [59]	Commentary
R-152a HFC-152a	CH_3CHF_2	1,1-Difluoroethane	506	138	As a compressed air duster
R-407C		Mixture of difluoromethane and pentafluoroethane and 1,1,1,2-tetrafluoroethane			A mixture of R-32, R-125, and R-134a
R-454B		Difluoromethane and 2,3,3,3-Tetrafluoropropene			HFOs blend of refrigerants Difluoromethane (R-32) and 2,3,3,3-Tetrafluoropropene (R-1234yf).[74][75][76][77]
R-513A		An HFO/HFC blend (56% R-1234yf/44%R-134a)			May replace R-134a as an interim alternative[78]

R-514A	HFO-1336mzz-Z/trans-1,2-dichloroethylene (t-DCE)	An hydrofluoroolefin (HFO)-based refrigerant to replace R-123 in low pressure centrifugal chillers for commercial and industrial applications.[79][80]

Refrigerant reclamation and disposal

[edit]
Main article: Refrigerant reclamation

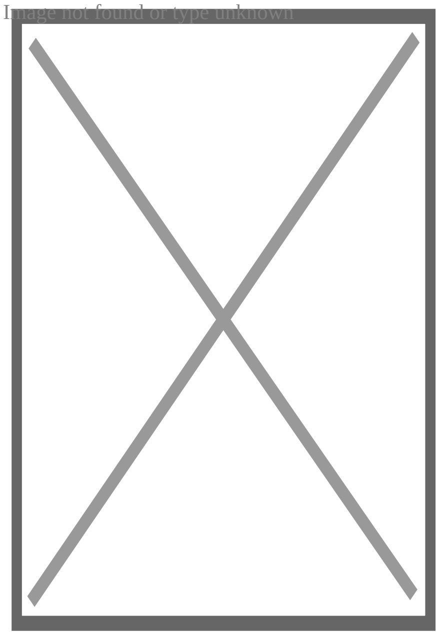
Coolant and refrigerants are found throughout the industrialized world, in homes, offices, and factories, in devices such as refrigerators, air conditioners, central air conditioning systems (HVAC), freezers, and dehumidifiers. When these units are serviced, there is a risk that refrigerant gas will be vented into the atmosphere either accidentally or intentionally, hence the creation of technician training and certification programs in order to ensure that the material is conserved and managed safely. Mistreatment of these gases has been shown to deplete the ozone layer and is suspected to contribute to global warming.[81]

With the exception of isobutane and propane (R600a, R441A and R290), ammonia and CO_2 under Section 608 of the United States' Clean Air Act it is illegal to knowingly release any refrigerants into the atmosphere.[82][83]

Refrigerant reclamation is the act of processing used refrigerant gas which has previously been used in some type of refrigeration loop such that it meets specifications for new refrigerant gas. In the United States, the Clean Air Act of 1990 requires that used refrigerant be processed by a certified reclaimer, which must be licensed by the United States Environmental Protection Agency (EPA), and the material must be recovered and delivered to the reclaimer by EPA-certified technicians.[84]

Classification of refrigerants

[edit]



R407C pressure-enthalpy diagram, isotherms between the two saturation lines

Main article: List of refrigerants

Refrigerants may be divided into three classes according to their manner of absorption or extraction of heat from the substances to be refrigerated:[*citation needed*]

- Class 1: This class includes refrigerants that cool by phase change (typically boiling), using the refrigerant's latent heat.
- Class 2: These refrigerants cool by temperature change or 'sensible heat', the quantity of heat being the specific heat capacity x the temperature change. They are air, calcium chloride brine, sodium chloride brine, alcohol, and similar nonfreezing solutions. The purpose of Class 2 refrigerants is to receive a reduction of temperature from Class 1 refrigerants and convey this lower temperature to the area to be cooled.
- Class 3: This group consists of solutions that contain absorbed vapors of liquefiable agents or refrigerating media. These solutions function by nature of their ability to carry liquefiable vapors, which produce a cooling effect by the absorption of their heat of solution. They can also be classified into many categories.

R numbering system

[edit]

The R- numbering system was developed by DuPont (which owned the Freon trademark), and systematically identifies the molecular structure of refrigerants made with a single halogenated hydrocarbon. ASHRAE has since set guidelines for the numbering system as follows:[85]

R-$X_1X_2X_3X_4$

- **X_1** = Number of unsaturated carbon-carbon bonds (omit if zero)
- **X_2** = Number of carbon atoms minus 1 (omit if zero)
- **X_3** = Number of hydrogen atoms plus 1
- **X_4** = Number of fluorine atoms

Series

[edit]

- **R-xx** Methane Series
- **R-1xx** Ethane Series
- **R-2xx** Propane Series
- **R-4xx** Zeotropic blend
- **R-5xx** Azeotropic blend
- **R-6xx** Saturated hydrocarbons (except for propane which is R-290)
- **R-7xx** Inorganic Compounds with a molar mass < 100
- **R-7xxx** Inorganic Compounds with a molar mass ? 100

Ethane Derived Chains

[edit]

- **Number Only** Most symmetrical isomer
- **Lower Case Suffix (a, b, c, etc.)** indicates increasingly unsymmetrical isomers

Propane Derived Chains

[edit]

- **Number Only** If only one isomer exists; otherwise:
- **First lower case suffix (a-f):**
  - **a Suffix** Cl_2 central carbon substitution
  - **b Suffix** Cl, F central carbon substitution
  - **c Suffix** F_2 central carbon substitution
  - **d Suffix** Cl, H central carbon substitution
  - **e Suffix** F, H central carbon substitution
  - **f Suffix** H_2 central carbon substitution
- **2nd Lower Case Suffix (a, b, c, etc.)** Indicates increasingly unsymmetrical isomers

Propene derivatives

[edit]

- **First lower case suffix (x, y, z)**:
  - **x Suffix** Cl substitution on central atom
  - **y Suffix** F substitution on central atom
  - **z Suffix** H substitution on central atom
- **Second lower case suffix (a-f)**:
  - **a Suffix** $=CCl_2$ methylene substitution
  - **b Suffix** =CClF methylene substitution
  - **c Suffix** $=CF_2$ methylene substitution
  - **d Suffix** =CHCl methylene substitution
  - **e Suffix** =CHF methylene substitution
  - **f Suffix** $=CH_2$ methylene substitution

Blends

[edit]

- **Upper Case Suffix (A, B, C, etc.)** Same blend with different compositions of refrigerants

Miscellaneous

[edit]

- **R-Cxxx** Cyclic compound
- **R-Exxx** Ether group is present
- **R-CExxx** Cyclic compound with an ether group
- **R-4xx/5xx + Upper Case Suffix (A, B, C, etc.)** Same blend with different composition of refrigerants
- **R-6xx + Lower Case Letter** Indicates increasingly unsymmetrical isomers
- **7xx/7xxx + Upper Case Letter** Same molar mass, different compound
- **R-xxxxB#** Bromine is present with the number after B indicating how many bromine atoms
- **R-xxxxI#** Iodine is present with the number after I indicating how many iodine atoms
- **R-xxx(E)** Trans Molecule
- **R-xxx(Z)** Cis Molecule

For example, R-134a has 2 carbon atoms, 2 hydrogen atoms, and 4 fluorine atoms, an empirical formula of tetrafluoroethane. The "a" suffix indicates that the isomer is unbalanced by one atom, giving 1,1,1,2-Tetrafluoroethane. R-134 (without the "a" suffix) would have a molecular structure of 1,1,2,2-Tetrafluoroethane.

The same numbers are used with an R- prefix for generic refrigerants, with a "Propellant" prefix (e.g., "Propellant 12") for the same chemical used as a propellant for an aerosol spray, and with trade names for the compounds, such as "**Freon** 12". Recently, a practice of using abbreviations HFC- for hydrofluorocarbons, CFC- for chlorofluorocarbons, and HCFC- for hydrochlorofluorocarbons has arisen, because of the regulatory differences among these groups.[*citation needed*]

Refrigerant safety

[edit]

ASHRAE Standard 34, *Designation and Safety Classification of Refrigerants*, assigns safety classifications to refrigerants based upon toxicity and flammability.

Using safety information provided by producers, ASHRAE assigns a capital letter to indicate toxicity and a number to indicate flammability. The letter "A" is the least toxic and the number 1 is the least flammable.[86]

See also

[edit]
- Brine (Refrigerant)
- Section 608
- List of Refrigerants

References

[edit]

1. **^** *United Nations Environment Programme (UNEP). "Update on New Refrigerants Designations and Safety Classifications" (PDF). ASHRAE. Retrieved 6 October 2024.*
2. **^** *"Phaseout of Class II Ozone-Depleting Substances". US Environmental Protection Agency. 22 July 2015. Retrieved October 6, 2024.*
3. **^** *"Protecting Our Climate by Reducing Use of HFCs". United States Environmental Protection Agency. 8 February 2021. Retrieved 6 October 2024.*
4. ^ ***a b*** *Pearson, S. Forbes. "Refrigerants Past, Present and Future" (PDF). R744. Archived from the original (PDF) on 2018-07-13. Retrieved 2021-03-30.*
5. ^ ***a b c*** *"Finally, a replacement for R123?". Cooling Post. 17 October 2013.*
6. **^** https://asrjetsjournal.org/index.php/American_Scientific_Journal/article/download/3297/12
7. ^ ***a b*** *Tomczyk, John (1 May 2017). "What's the Latest with R-404A?". achrnews.com.*
8. **^** *Molina, Mario J.; Rowland, F. S (28 June 1974). "Stratospheric sink for chlorofluoromethanes: chlorine catalysed destruction of ozone" (PDF). Nature.* ***249*** *: 810–812. doi:10.1038/249810a0. Retrieved October 6, 2024.*

9. **^** *National Research Council (1976). Halocarbons: Effects on Stratospheric Ozone . Washington, DC: The National Academies Press. doi:10.17226/19978. ISBN 978-0-309-02532-4. Retrieved October 6, 2024.*
10. **^** *"Air Conditioners, Dehumidifiers, and R-410A Refrigerant". Sylvane. 1 July 2011. Retrieved 27 July 2023.*
11. **^** *Protection, United States Congress Senate Committee on Environment and Public Works Subcommittee on Environmental (May 14, 1987). "Clean Air Act Amendments of 1987: Hearings Before the Subcommittee on Environmental Protection of the Committee on Environment and Public Works, United States Senate, One Hundredth Congress, First Session, on S. 300, S. 321, S. 1351, and S. 1384 ..." U.S. Government Printing Office – via Google Books.*
12. **^** *Fluorinated Hydrocarbons—Advances in Research and Application (2013 ed.). ScholarlyEditions. June 21, 2013. p. 179. ISBN 9781481675703 – via Google Books.*
13. **^** *Whitman, Bill; Johnson, Bill; Tomczyk, John; Silberstein, Eugene (February 25, 2008). Refrigeration and Air Conditioning Technology. Cengage Learning. p. 171. ISBN 978-1111803223 – via Google Books.*
14. **^** *"Scroll Chillers: Conversion from HCFC-22 to HFC-410A and HFC-407C" (PDF). Archived from the original (PDF) on 2021-07-20. Retrieved 2021-03-29.*
15. **^** *"What's Happening With R-134a? | 2017-06-05 | ACHRNEWS | ACHR News". achrnews.com.*
16. **^** *"Conversion R12/R134a" (PDF). Behr Hella Service GmbH. 1 October 2005. Retrieved 27 July 2023.*
17. **^** *"R-407A Gains SNAP OK". achrnews.com (Press release). 22 June 2009.*
18. **^** *"June 26, 2009: Emerson Approves R-407A, R-407C for Copeland Discus Compressors". achrnews.com.*
19. **^** *"Taking New Refrigerants to the Peak". achrnews.com.*
20. **^** *Koenig, H. (31 December 1995). "R502/R22 - replacement refrigerant R507 in commercial refrigeration; R502/R22 - Ersatzkaeltemittel R507 in der Gewerbekuehlung. Anwendungstechnik - Kaeltemittel".*
21. **^** *Linton, J. W.; Snelson, W. K.; Triebe, A. R.; Hearty, P. F. (31 December 1995). "System performance comparison of R-507 with R-502". OSTI 211821.*
22. **^** *"Daikin reveals details of R32 VRV air conditioner". Cooling Post. 6 February 2020.*
23. ^ ***a b*** *"Refrigerant blends to challenge hydrocarbon efficiencies". Cooling Post. 22 December 2019.*
24. **^** *"An HVAC Technician's Guide to R-454B". achrnews.com.*
25. **^** *"The truth about new automotive A/C refrigerant R1234YF". 25 July 2018.*
26. **^** *Kontomaris, Konstantinos (2014). "HFO-1336mzz-Z: High Temperature Chemical Stability and Use as A Working Fluid in Organic Rankine Cycles". International Refrigeration and Air Conditioning Conference. "Paper 1525"*
27. **^** *"Trane adopts new low GWP refrigerant R514A". Cooling Post. 15 June 2016.*
28. **^** *"R404A – the alternatives". Cooling Post. 26 February 2014.*
29. **^** *"Carrier expands R1234ze chiller range". Cooling Post. 20 May 2020.*

30. **^** *"Carrier confirms an HFO refrigerant future". Cooling Post. 5 June 2019.*
31. **^** *"Greenfreeze: A revolution in domestic refrigeration". ecomall.com. Retrieved 2022-07-04.*
32. ^ ***a b*** *"Happy birthday, Greenfreeze!". Greenpeace. 25 March 2013. Archived from the original on 2020-04-08. Retrieved 8 June 2015.*
33. **^** *"Ozone Secretariat". United Nations Environment Programme. Archived from the original on 12 April 2015.*
34. **^** *Gunkel, Christoph (13 September 2013). "Öko-Coup aus Ostdeutschland". Der Spiegel (in German). Retrieved 4 September 2015.*
35. **^** *Maté, John (2001). "Making a Difference: A Case Study of the Greenpeace Ozone Campaign". Review of European Community & International Environmental Law.* ***10*** *(2): 190–198. doi:10.1111/1467-9388.00275.*
36. **^** Benedick, Richard Elliot Ozone Diplomacy Cambridge, MA: Harvard University 1991.
37. **^** *Honeywell International, Inc. (2010-07-09). "Comment on EPA Proposed Rule Office of Air and Radiation Proposed Significant New Alternatives Policy (SNAP) Protection of Stratospheric Ozone: Listing of Substitutes for Ozone-Depleting Substances – Hydrocarbon Refrigerants" (PDF).*
38. **^** *"Discurso de Frank Guggenheim no lançamento do Greenfreeze | Brasil". Greenpeace.org. Archived from the original on 24 September 2015. Retrieved 10 June 2015.*
39. **^** *"Der Greenfreeze - endlich in den USA angekommen". Greenpeace.de (in German). 28 December 2011. Retrieved 10 June 2015.*
40. **^** *"Complying With The Section 608 Refrigerant Recycling Rule | Ozone Layer Protection - Regulatory Programs". Epa.gov. 21 April 2015. Retrieved 10 June 2015.*
41. ^ ***a b*** *"Greenfreeze: a Revolution in Domestic Refrigeration". ecomall.com. Retrieved 8 June 2015.*
42. **^** *"Company background". Archived from the original on 2020-02-20. Retrieved 2021-03-15.*
43. **^** *Safeguarding the ozone layer and the global climate System: issues related to Hydrofluorocarbons and Perfluorocarbons (Report). IPCC/TEAP. 2005.*
44. **^** *Crowley, Thomas J. (2000). "Causes of Climate Change over the Past 1000 Years". Science.* ***289*** *(5477): 270–277. Bibcode:2000Sci...289..270C. doi:10.1126/science.289.5477.270. PMID 10894770.*
45. **^** *"2010 to 2015 government policy: environmental quality". GOV.UK. 8 May 2015. Retrieved 10 June 2015.*
46. **^** *"PepsiCo Brings First Climate-Friendly Vending Machines to the U.S." phx.corporate-ir.net. Retrieved 8 June 2015.*
47. **^** *"Climate-Friendly Greenfreezers Come to the United States". WNBC. 2 October 2008. Retrieved 8 June 2015.*
48. **^** *Data, Reports and (7 August 2020). "Natural Refrigerants Market To Reach USD 2.88 Billion By 2027 | Reports and Data". GlobeNewswire News Room (Press release). Retrieved 17 December 2020.*

49. **^** Harris, Catharine. "Anti-inhalant Abuse Campaign Targets Building Codes: 'Huffing' of Air Conditioning Refrigerant a Dangerous Risk." The Nation's Health. American Public Health Association, 2010. Web. 5 December 2010. https://www.thenationshealth.org/content/39/4/20
50. **^** IPCC AR6 WG1 Ch7 2021
51. **^** *"GreenFreeze". Greenpeace.*
52. **^** *"Significant New Alternatives Program: Substitutes in Household Refrigerators and Freezers". Epa.gov. 13 November 2014. Retrieved 4 June 2018.*
53. **^** *Berwald, Juli (29 April 2019). "One overlooked way to fight climate change? Dispose of old CFCs". National Geographic - Environment. Archived from the original on April 29, 2019. Retrieved 30 April 2019.*
54. **^** *Butler J. and Montzka S. (2020). "The NOAA Annual Greenhouse Gas Index (AGGI)". NOAA Global Monitoring Laboratory/Earth System Research Laboratories.*
55. **^** *Environment, U. N. (31 October 2019). "New guidelines for air conditioners and refrigerators set to tackle climate change". UN Environment. Retrieved 30 March 2020.*
56. **^** *Rosenthal, Elisabeth; Lehren, Andrew (20 June 2011). "Relief in Every Window, but Global Worry Too". The New York Times. Retrieved 21 June 2012.*
57. ^ ***a b*** Yadav et al 2022
58. ^ ***a b c*** BSRIA 2020
59. ^ ***a b c d e f g h*** IPCC AR5 WG1 Ch8 2013, pp. 714, 731–737
60. **^** *"European Commission on retrofit refrigerants for stationary applications" (PDF). Archived from the original on August 5, 2009. Retrieved 2010-10-29.*cite web: CS1 maint: unfit URL (link)
61. **^** *"Protection of Stratospheric Ozone: Hydrocarbon Refrigerants" (PDF). Environment Protection Agency. Retrieved 5 August 2018.*
62. **^** ARB 2022
63. **^** GM to Introduce HFO-1234yf AC Refrigerant in 2013 US Models
64. **^** *"The Coca-Cola Company Announces Adoption of HFC-Free Insulation in Refrigeration Units to Combat Global Warming". The Coca-Cola Company. 5 June 2006. Archived from the original on 1 November 2013. Retrieved 11 October 2007 .*
65. **^** *"Modine reinforces its CO_2 research efforts". R744.com. 28 June 2007. Archived from the original on 10 February 2008.*
66. **^** *Longo, Giovanni A.; Mancin, Simone; Righetti, Giulia; Zilio, Claudio (2015). "HFC32 vaporisation inside a Brazed Plate Heat Exchanger (BPHE): Experimental measurements and IR thermography analysis". International Journal of Refrigeration. **57**: 77–86. doi:10.1016/j.ijrefrig.2015.04.017.*
67. **^** May 2010 TEAP XXI/9 Task Force Report
68. **^** *"Protecting Our Climate by Reducing Use of HFCs". US Environmental Protection Agency. 8 February 2021. Retrieved 25 August 2022.*
69. **^** *"Background on HFCs and the AIM Act". www.usepa.gov. US EPA. March 2021. Retrieved 27 June 2024.*

70. **^** *"1:Update on Ozone-Depleting Substances (ODSs) and Other Gases of Interest to the Montreal Protocol". Scientific assessment of ozone depletion: 2018 (PDF) (Global Ozone Research and Monitoring Project–Report No. 58 ed.). Geneva, Switzerland: World Meteorological Organization. 2018. p. 1.10. ISBN 978-1-7329317-1-8. Retrieved 22 November 2020.*
71. **^** [1] Chemours M099 as R22 Replacement
72. **^** [2] Management of HCFC-123 through the Phaseout and Beyond | EPA | Published August 2020 | Retrieved Dec. 18, 2021
73. **^** [3] Refrigerant R11 (R-11), Freon 11 (Freon R-11) Properties & Replacement
74. **^** [4] R-454B XL41 refrigerant fact & info sheet
75. **^** [5] R-454B emerges as a replacement for R-410A | ACHR News (Air Conditioning, Heating, Refrigeration News)
76. **^** [6] Ccarrier introduces [R-454B] Puron Advance™ as the next generation refrigerant for ducted residential, light commercial products in North America | Indianapolis - 19 December 2018
77. **^** [7] Johnson Controls selects R-454B as future refrigerant for new HVAC equipment | 27 May 2021
78. **^** [8] A conversation on refrigerants | ASHRAE Journal, March 2021 | page 30, column 1, paragraph 2
79. **^** [9] Opteon™ XP30 (R-514A) refrigerant
80. **^** [10] Trane adopts new low GWP refrigerant R514A | 15 June 2016
81. **^** *"Emissions of Greenhouse Gases in the United States 1998 - Executive Summary". 18 August 2000. Archived from the original on 18 August 2000.*
82. **^** *"Frequently Asked Questions on Section 608". Environment Protection Agency. Retrieved 20 December 2013.*
83. **^** *"US hydrocarbons". Retrieved 5 August 2018.*
84. **^** *"42 U.S. Code § 7671g - National recycling and emission reduction program". LII / Legal Information Institute.*
85. **^** *ASHRAE; UNEP (Nov 2022). "Designation and Safety Classification of Refrigerants" (PDF). ASHRAE. Retrieved 1 July 2023.*
86. **^** *"Update on New Refrigerants Designations and Safety Classifications" (PDF). American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). April 2020. Archived from the original (PDF) on February 13, 2023. Retrieved October 22, 2022.*

Sources

[edit]

IPCC reports

[edit]

- *IPCC (2013). Stocker, T. F.; Qin, D.; Plattner, G.-K.; Tignor, M.; et al. (eds.). Climate Change 2013: The Physical Science Basis (PDF). Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press. ISBN 978-1-107-05799-9.* (pb: 978-1-107-66182-0). Fifth Assessment Report - Climate Change 2013
  - *Myhre, G.; Shindell, D.; Bréon, F.-M.; Collins, W.; et al. (2013). "Chapter 8: Anthropogenic and Natural Radiative Forcing" (PDF). Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. pp. 659–740.*
- *IPCC (2021). Masson-Delmotte, V.; Zhai, P.; Pirani, A.; Connors, S. L.; et al. (eds.). Climate Change 2021: The Physical Science Basis (PDF). Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press (In Press).*
- *Forster, Piers; Storelvmo, Trude (2021). "Chapter 7: The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity" (PDF). IPCC AR6 WG1 2021.*

Other

[edit]

- *"High GWP refrigerants". California Air Resources Board. Retrieved 13 February 2022.*
- *"BSRIA's view on refrigerant trends in AC and Heat Pump segments". 2020. Retrieved 2022-02-14.*
- *Yadav, Saurabh; Liu, Jie; Kim, Sung Chul (2022). "A comprehensive study on 21st-century refrigerants - R290 and R1234yf: A review". International Journal of Heat and Mass Transfer.* ***122****: 121947. Bibcode:2022IJHMT.18221947Y. doi:10.1016/j.ijheatmasstransfer.2021.121947. S2CID 240534198.*

External links

[edit]

- US Environmental Protection Agency page on the GWPs of various substances
- Green Cooling Initiative on alternative natural refrigerants cooling technologies
- International Institute of Refrigeration Archived 2018-09-25 at the Wayback Machine

- v
- t
- e

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

- 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

Measurement and control	○ Air flow meter ○ Aquastat ○ BACnet ○ Blower door ○ Building automation ○ Carbon dioxide sensor ○ Clean air delivery rate (CADR) ○ Control valve ○ Gas detector ○ Home energy monitor ○ Humidistat ○ HVAC control system ○ Infrared thermometer ○ Intelligent buildings ○ LonWorks ○ Minimum efficiency reporting value (MERV) ○ Normal temperature and pressure (NTP) ○ OpenTherm ○ Programmable communicating thermostat ○ Programmable thermostat ○ Psychrometrics ○ Room temperature ○ Smart thermostat ○ Standard temperature and pressure (STP) ○ Thermographic camera ○ Thermostat ○ Thermostatic radiator valve
Professions, trades, and services	○ Architectural acoustics ○ Architectural engineering ○ Architectural technologist ○ Building services engineering ○ Building information modeling (BIM) ○ Deep energy retrofit ○ Duct cleaning ○ Duct leakage testing ○ Environmental engineering ○ Hydronic balancing ○ Kitchen exhaust cleaning ○ Mechanical engineering ○ Mechanical, electrical, and plumbing ○ Mold growth, assessment, and remediation ○ Refrigerant reclamation ○ Testing, adjusting, balancing

Industry organizations

- AHRI
- AMCA
- ASHRAE
- ASTM International
- BRE
- BSRIA
- CIBSE
- Institute of Refrigeration
- IIR
- LEED
- SMACNA
- UMC

Health and safety

- Indoor air quality (IAQ)
- Passive smoking
- Sick building syndrome (SBS)
- Volatile organic compound (VOC)

See also

- ASHRAE Handbook
- Building science
- Fireproofing
- Glossary of HVAC terms
- Warm Spaces
- World Refrigeration Day
- Template:Home automation
- Template:Solar energy

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

- United States
- France
- BnF data
- Japan
- Israel

About Durham Supply Inc

Photo

Image not found or type unknown

Photo

Image not found or type unknown

Photo

Image not found or type unknown
Photo

Image not found or type unknown
Photo

Image not found or type unknown

Things To Do in Oklahoma County

Photo

Image not found or type unknown

Stockyards City Main Street

4.6 (256)

Photo

Image not found or type unknown

Oklahoma City's Adventure District

4.2 (37)

Photo

Image not found or type unknown

Beavers Bend State Park and Nature Center

4.7 (4483)

Photo

Image not found or type unknown

Route 66 Park

4.6 (756)

Photo

Oklahoma City Museum of Art

4.7 (2241)

Photo

Image not found or type unknown

OKC Underground

4.1 (136)

Driving Directions in Oklahoma County

Driving Directions From Oklahoma City to Durham Supply Inc

Driving Directions From Orr Nissan Central to Durham Supply Inc

Driving Directions From Texas Roadhouse to Durham Supply Inc

Driving Directions From Burlington to Durham Supply Inc

https://www.google.com/maps/dir/Burlington/Durham+Supply+Inc/@35.3932991,-97.5096817,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJpZ837WsUsocRoduRUD 97.5096817!2d35.3932991!1m5!1m1!1sChIJCUnZ1UoUsocRpJXqm8cX514!2m2!1d-97.4774449!2d35.3963954!3e0

https://www.google.com/maps/dir/Helmerich+%26+Payne/Durham+Supply+Inc/@35.4
97.489937,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJ714Z1i8UsocRphJjY9iB9E
97.489937!2d35.410201!1m5!1m1!1sChIJCUnZ1UoUsocRpJXqm8cX514!2m2!1d-
97.4774449!2d35.3963954!3e2

https://www.google.com/maps/dir/Santa+Fe+South+High+School/Durham+Supply+In
97.4875762,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sChIJWbmJPqIWsocRZUD09i5
97.4875762!2d35.3961122!1m5!1m1!1sChIJCUnZ1UoUsocRpJXqm8cX514!2m2!1d-
97.4774449!2d35.3963954!3e1

Driving Directions From Oklahoma National Guard Museum to Durham Supply Inc

Driving Directions From National Cowboy & Western Heritage Museum to Durham Supply Inc

Driving Directions From National Cowboy & Western Heritage Museum to Durham Supply Inc

Driving Directions From Oklahoma State Capitol to Durham Supply Inc

Driving Directions From Museum of Osteology to Durham Supply Inc

Driving Directions From Route 66 Park to Durham Supply Inc

https://www.google.com/maps/dir/Bricktown+Water+Taxi/Durham+Supply+Inc/@35.4
97.5092944,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sunknown!2m2!1d-
97.5092944!2d35.4652226!1m5!1m1!1sChIJCUnZ1UoUsocRpJXqm8cX514!2m2!1d-
97.4774449!2d35.3963954!3e0

https://www.google.com/maps/dir/Centennial+Land+Run+Monument/Durham+Supply
97.5051775,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sunknown!2m2!1d-
97.5051775!2d35.4611333!1m5!1m1!1sChIJCUnZ1UoUsocRpJXqm8cX514!2m2!1d-

97.4774449!2d35.3963954!3e2

**https://www.google.com/maps/dir/Museum+of+Osteology/Durham+Supply+Inc/@35.3
97.4418414,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sunknown!2m2!1d-
97.4418414!2d35.3648349!1m5!1m1!1sChIJCUnZ1UoUsocRpJXqm8cX514!2m2!1d-
97.4774449!2d35.3963954!3e1**

**https://www.google.com/maps/dir/Oklahoma+City+Museum+of+Art/Durham+Supply+
97.5205029,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sunknown!2m2!1d-
97.5205029!2d35.4695638!1m5!1m1!1sChIJCUnZ1UoUsocRpJXqm8cX514!2m2!1d-
97.4774449!2d35.3963954!3e3**

**https://www.google.com/maps/dir/National+Cowboy+%26+Western+Heritage+Museu
97.4831286,14z/data=!3m1!4b1!4m14!4m13!1m5!1m1!1sunknown!2m2!1d-
97.4831286!2d35.5356997!1m5!1m1!1sChIJCUnZ1UoUsocRpJXqm8cX514!2m2!1d-
97.4774449!2d35.3963954!3e0**

Reviews for Durham Supply Inc

Durham Supply Inc

Image not found or type unknown

Crystal Dawn

(1)

I would give 0 stars. This isnTHE WORST company for heating and air. I purchased a home less than one year ago and my ac has gone out twice and these people refuse to repair it although I AM UNDER WARRANTY!!!! They say it’s an environmental issue and they can’t fix it or even try to or replace my warrantied air conditioning system.

Durham Supply Inc

Image not found or type unknown

Jennifer Williamson

(5)

First we would like to thank you for installing our air conditioning unit! I’d like to really brag about our technician, Mack, that came to our home to install our unit in our new home. Mack was here for most of the day and throughly explained everything we had a question about. By the late afternoon, we had cold air pumping through our vents and we couldn’t have been more thankful. I can tell you, I would be very lucky to have a technician like Mack if this were my company. He was very very professional, kind, and courteous. Please give Mack a pat on the back and stay rest assured that Mack is doing a great job and upholding your company name! Mack, if you see this, great job!! Thanks for everything you did!! We now have a new HVAC company in the event we need one. We will also spread the word to others!!

Durham Supply Inc

Image not found or type unknown

Salest

(5)

Had to make a quick run for 2 sets of ?? door locks for front and back door.. In/ out in a quick minute! They helped me right away. ?? Made sure the 2 sets had the same ? keys. The ? bathroom was clean and had everything I needed. ? ?. Made a quick inquiry about a random item... they quickly looked it up and gave me pricing. Great ? job ?

Durham Supply Inc

Image not found or type unknown

K Moore

(1)

No service after the sale. I purchased a sliding patio door and was given the wrong size sliding screen door. After speaking with the salesman and manager several times the issue is still not resolved and, I was charged full price for an incomplete door. They blamed the supplier for all the issues…and have offered me nothing to resolve this.

Durham Supply Inc

Image not found or type unknown

Noel Vandy

(5)

Thanks to the hard work of Randy our AC finally got the service it needed. These 100 degree days definitely feel long when your house isn't getting cool anymore. We were so glad when Randy came to work on the unit, he had all the tools and products he needed with him and it was all good and running well when he left. With a long drive to get here and only few opportunities to do so, we are glad he got it done in 1 visit. Now let us hope it will keep running well for a good while.

Configuring Vent Placement in Mobile Home Retrofit Projects**View GBP**

Check our other pages :

- **Predicting Maintenance Needs in Older Mobile Home HVAC Systems**
- **Comparing Electric and Gas Options for Mobile Home Heating**
- **Using Modern Components for Efficient Mobile Home Heating**

Frequently Asked Questions

What factors should be considered when determining the optimal placement of vents in a mobile home retrofit project?

When determining vent placement, consider factors such as the layout and size of each room, existing ductwork infrastructure, airflow requirements for efficient heating and cooling, potential obstructions like furniture or structural elements, and areas prone to temperature variations that may need additional ventilation.

How does proper vent placement impact the efficiency of an HVAC system in a mobile home?

Proper vent placement is crucial for maximizing HVAC efficiency. It ensures even distribution of air throughout the space, minimizes energy consumption by reducing the workload on the system, prevents hot or cold spots that can lead to discomfort or increased thermostat adjustments, and helps maintain consistent indoor air quality.

Are there specific guidelines or best practices for installing vents in different types of rooms within a mobile home?

Yes, specific guidelines include placing supply vents near windows or exterior walls to combat heat loss/gain effectively; ensuring return vents are unobstructed and centrally located for balanced airflow; adjusting vent sizes based on room size (e.g., larger vents for bigger rooms); and considering ceiling height variations by possibly using floor-level vents for better circulation.

Royal Supply Inc

Phone : +16362969959

City : Oklahoma City

State : OK

Zip : 73149

Address : Unknown Address

Google Business Profile

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