



- **News**
- **Evaluating Different Financing Packages for Mobile Home HVAC**
Evaluating Different Financing Packages for Mobile Home HVAC **Budgeting Monthly Payments for Mobile Home Heating Projects** **Reviewing Interest Options for Mobile Home AC Installations** **Setting Up Installment Plans for Mobile Home Furnace Upgrades** **Comparing Credit Requirements for Mobile Home HVAC Financing** **Investigating No Payment Period Deals for Mobile Home Cooling** **Combining Rebates with Financing for Mobile Home AC Purchases** **Checking Eligibility for Income Based Mobile Home HVAC Loans** **Aligning Payment Strategies with Seasonal Needs in Mobile Home Heating** **Exploring Collaboration with Utility Incentive Programs for Mobile Homes** **Scheduling Payments for Large Scale Mobile Home HVAC Replacements** **Simplifying Approval Steps for Mobile Home HVAC Financing**
- **Exploring Major Brands for Mobile Home Furnace Installations**
Exploring Major Brands for Mobile Home Furnace Installations **Aligning System Specifications with Mobile Home AC Requirements** **Evaluating Carrier Options for Mobile Home Air Conditioning** **Navigating Trane Models for Mobile Home Heating** **Selecting Goodman Units for Reliable Mobile Home Climate Control** **Verifying Rheem Specifications in Mobile Home HVAC Retrofits** **Identifying Compatible Parts Across Multiple Mobile Home Brands** **Adapting Different Brand Coils and Compressors for Mobile Home Use** **Maintaining Uniform Performance with Mixed Brand Components** **Comparing Equipment Sizes to Mobile Home Square Footage** **Assessing Future Upgrade Paths for Mobile Home AC Brand Choices** **Checking Warranties Offered by Various Mobile Home HVAC Brands**
- **About Us**



Checking Warranties Offered by Various Mobile Home HVAC Brands

Overview of HVAC needs specific to mobile homes

Understanding HVAC warranties is crucial, especially when it comes to mobile homes, where the heating, ventilation, and air conditioning system plays a pivotal role in maintaining comfort. As you explore different HVAC brands for your mobile home, paying close attention to the warranties they offer can make a significant difference in your overall satisfaction and long-term financial investment.

First and foremost, an HVAC warranty provides peace of mind. It ensures that if something goes wrong with your system within a specified period, you're protected against unexpected repair costs. This financial safety net is particularly important in mobile homes, where space constraints often require specialized equipment that can be expensive to repair or replace.

Different HVAC brands offer varying types of warranties. Mobile home owners should explore financing options for energy-efficient upgrades **hvac mobile home** condenser. Some might provide a comprehensive coverage that includes parts and labor for several years, while others might only cover specific components like the compressor or heat exchanger. It's crucial to understand the scope of the warranty being offered. Reading the fine print will help you distinguish between what is covered fully and what might incur additional charges.

Additionally, understanding warranty terms can inform your maintenance practices. Many warranties require regular maintenance by certified technicians to remain valid. Knowing these requirements ahead of time helps ensure compliance and keeps your warranty intact.

Regular maintenance not only satisfies warranty conditions but also optimizes system performance and extends its lifespan.

Comparing warranties from various brands also gives insight into their confidence in product durability. A brand offering a longer or more comprehensive warranty may suggest higher reliability in their products compared to one with minimal coverage. However, it's essential not just to rely on warranty length as an indicator of quality-consider user reviews and expert opinions as well.

Moreover, some manufacturers offer extended warranty options at an additional cost. While these might seem like an unnecessary expense upfront, they could be prudent investments based on your long-term plans for your mobile home or if you reside in regions with extreme climate conditions that put extra strain on HVAC systems.

In conclusion, understanding HVAC warranties is integral when selecting a system for your mobile home. It protects you financially while providing assurance about product quality and longevity. By thoroughly comparing offerings from various brands and comprehending the intricacies of their warranties, you empower yourself to make informed decisions that enhance comfort without unforeseen expenses down the line. Always remember: investing time now in understanding warranties can save considerable stress and money in the future.

When it comes to selecting the perfect HVAC system for a mobile home, one cannot underestimate the importance of a solid warranty. Just as you would scrutinize the specifications and capabilities of various models, it's crucial to pay equal attention to the warranties offered by different mobile home HVAC brands. A well-structured warranty not only provides peace of mind but also ensures long-term reliability and protection against unforeseen issues that may arise with your heating and cooling system.

First and foremost, one key feature to look for in an HVAC warranty is its duration. Typically, warranties vary from brand to brand, with some offering coverage for as little as a year and others extending up to ten years or more. Longer warranty periods often indicate the manufacturer's confidence in their product's durability and performance. For mobile homeowners who may face unique challenges due to space constraints or environmental factors, having an extended warranty can be particularly reassuring.

Another critical aspect is the comprehensiveness of coverage provided under the warranty terms. It's essential to understand what components are included-does it cover just parts, or does it extend to labor costs as well? Ideally, you want a warranty that encompasses both parts and labor since repair costs can quickly add up if you're required to pay out-of-pocket for service calls or replacements. Additionally, some warranties might exclude certain parts like

thermostats or ductwork, so reading the fine print is crucial.

Transferability is another significant factor when evaluating HVAC warranties. If you plan on selling your mobile home in the future, a transferable warranty can be an attractive selling point for potential buyers. It demonstrates that they will receive continued protection without additional costs or hassle, thus adding value to your property.

Furthermore, consider any stipulations regarding maintenance requirements outlined in the warranty agreement. Many manufacturers require regular maintenance checks by certified professionals as a condition for keeping the warranty valid. While this might seem like an added responsibility, routine maintenance helps prolong the life of your HVAC system while ensuring optimal performance.

Lastly, it's worth investigating whether there are any customer-friendly features within the warranty terms-such as no-hassle claims processes or access to 24/7 customer support lines. These can make all the difference when dealing with unexpected breakdowns during extreme weather conditions.

In conclusion, when checking warranties offered by various mobile home HVAC brands, take time to evaluate each option thoroughly based on these key features: duration of coverage; comprehensiveness (including both parts & labor); transferability; maintenance requirements; and ease-of-use/customer service aspects embedded within policies themselves! Doing so will empower informed decisions leading towards enhanced satisfaction levels over time spent enjoying comfortable living spaces free from worries about costly repairs down line thanks largely due diligence exercised upfront during purchase phase itself!

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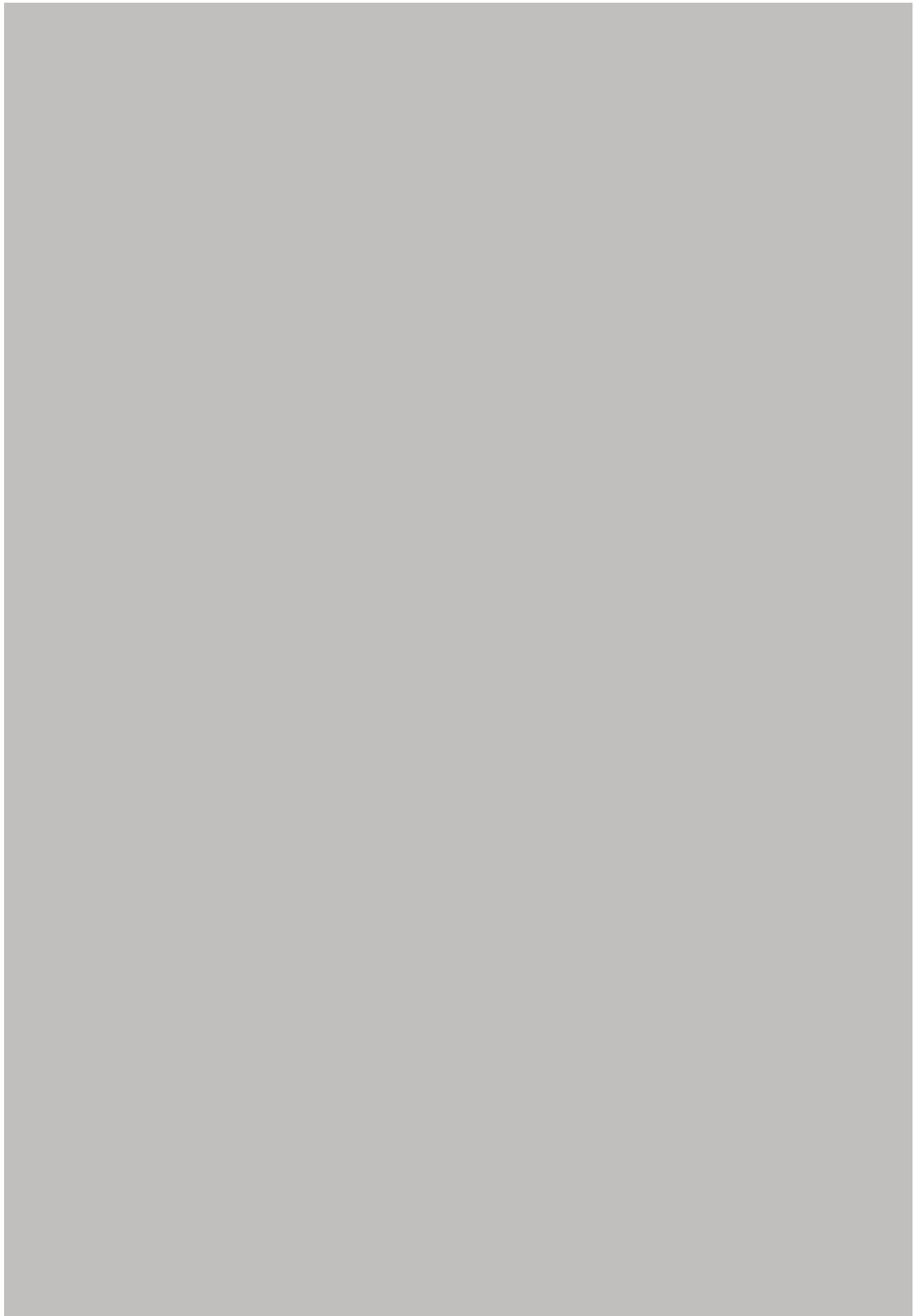
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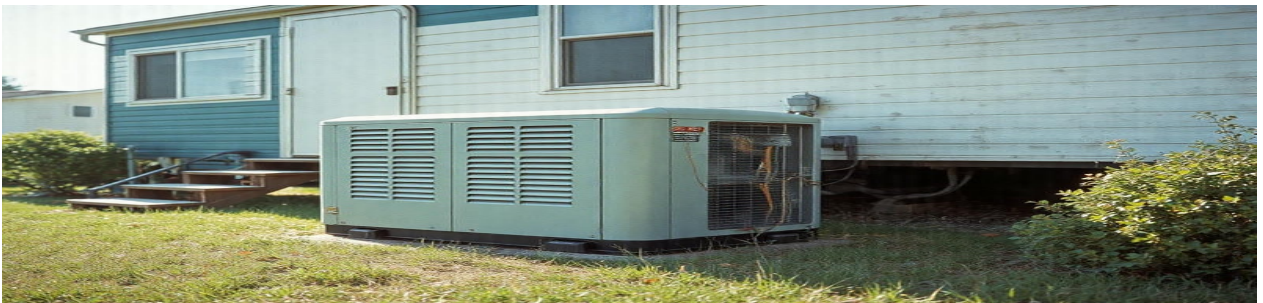
Affordable Payment Plans for Upgrading Mobile Home AC Systems



Choosing the right payment plan for upgrading your mobile home AC system is a crucial decision that can significantly impact your financial stability and comfort at home.. With numerous options available, it's essential to consider several factors to ensure you select a plan that aligns with your needs and budget. Firstly, assess your financial situation.

Posted by on 2024-12-30

Aligning Equipment Compatibility with Financing Options in Mobile Homes



In the dynamic world of mobile homes, aligning equipment compatibility with financing options is a crucial element that can significantly impact the success of any project.. The process involves ensuring that the equipment used in mobile home construction or renovation is not only technically suitable but also financially feasible.

Posted by on 2024-12-30

Benefits of Payment Plans Tailored for Mobile Home HVAC Upgrades



When contemplating upgrades to your mobile home's HVAC system, choosing the right payment plan is as crucial as selecting the equipment itself.. As energy efficiency and comfort become increasingly important, many homeowners are considering tailored payment plans that make these enhancements more accessible.

Posted by on 2024-12-30

Best Practices for Financing Energy-Efficient HVAC Systems in Mobile Homes



In recent years, the push towards sustainability has gained significant momentum, with energy-efficient HVAC systems emerging as a critical component in reducing energy consumption and emissions.. Mobile homes, often overlooked in conversations about sustainable living, present unique challenges and opportunities in implementing these systems.

Posted by on 2024-12-30

Understanding Financing Options for Mobile Home HVAC

When considering the purchase of a mobile home HVAC system, one crucial factor that often influences decision-making is the warranty terms offered by leading brands. A warranty not only provides peace of mind but also reflects a manufacturer's confidence in their product's reliability and durability. Let's explore how some of the top mobile home HVAC brands compare in this regard.

First on our list is Carrier, a brand renowned for its innovation and quality. Carrier typically offers a 10-year limited parts warranty on many of their systems, provided that the owner registers the product within 90 days of installation. This warranty covers functional components such as compressors, coils, and internal functional parts. However, labor costs are usually not included unless an extended service plan is purchased separately.

Trane, another heavyweight in the HVAC industry, provides similar warranty terms with a 10-year coverage on parts if registered timely. What sets Trane apart is their promise of reliable operation under even extreme conditions, which adds an unspoken assurance beyond what's documented in their warranties.

Lennox offers slightly different terms. Their standard warranty for most models includes a 5-year coverage for parts and optional extensions up to 10 years if registration requirements are met. Lennox emphasizes energy efficiency in its products, which could mean fewer breakdowns over time—a valuable trait when combined with solid warranty protection.

Goodman stands out by offering one of the best warranties available: they extend limited lifetime warranties on compressors for select high-efficiency models and up to 10 years on unit replacement or major components. Goodman's robust coverage can be particularly appealing

to those seeking long-term security without additional financial strain.

Lastly, Rheem's approach to warranties combines standard industry practices with unique customer-focused options. Their typical offer includes a 10-year limited parts warranty; however, they also have special programs like Protection Plus® that allow customers to extend original terms and include labor coverage-providing comprehensive protection against potential future expenses.

In conclusion, while all these brands provide competitive warranties aimed at safeguarding consumer investment, differences lie in specific details such as registration requirements, component coverage length, and additional service plans availability. When choosing an HVAC system for your mobile home, it is essential to consider not just the initial cost but also these nuanced warranty provisions alongside each brand's reputation for reliability and support service quality. Doing so ensures that you choose a system that meets both your immediate comfort needs and long-term peace of mind expectations.



Explanation of common financing packages available

When considering the purchase of an HVAC system for a mobile home, it's crucial to delve into the warranties offered by various brands. These warranties can provide peace of mind and financial protection in case of unexpected malfunctions or defects. However, understanding the common exclusions and limitations within these warranties is essential to

make an informed decision.

Firstly, it's important to recognize that not all components of an HVAC system may be covered under warranty. Typically, major parts such as compressors or heat exchangers have longer coverage periods than smaller parts like thermostats or filters. This distinction is critical because it affects potential repair costs down the line. Consumers should carefully review which components are included in their warranty coverage.

Another common exclusion found in many HVAC warranties pertains to improper installation. If the system is not installed by a certified professional according to manufacturer specifications, any resulting damage might not be covered. This condition underscores the importance of hiring experienced technicians for installation to ensure both optimal performance and warranty compliance.

Furthermore, regular maintenance plays a significant role in upholding warranty validity. Most manufacturers require routine servicing to keep the warranty active. Failure to adhere to recommended maintenance schedules could void the warranty altogether. Therefore, keeping detailed service records becomes imperative for homeowners who wish to claim repairs under warranty.

It's also worth noting that some warranties exclude damages caused by external factors such as weather events, power surges, or misuse of the equipment. Understanding these exclusions helps consumers set realistic expectations regarding what scenarios are considered eligible for coverage.

Lastly, time limitations are inherent in most warranties; they often range from one year for basic parts and labor coverage up to ten years for certain components with extended protection plans available at additional costs. As these timeframes vary across brands and models, prospective buyers should weigh how long they plan to own their mobile home against the duration of available warranty coverage.

In conclusion, while HVAC warranties offer valuable security against malfunctions and defects, it's vital for consumers to thoroughly examine each policy's exclusions and limitations before making a purchase decision. By doing so, mobile home owners can better prepare themselves financially and ensure their systems remain protected under their chosen brand's terms and conditions.

Key factors to consider when choosing a financing option

When considering the purchase of a mobile home HVAC system, understanding and evaluating the warranty options available is crucial. A warranty is not just a safety net; it is an indicator of the manufacturer's confidence in their product. Here are some tips to help you navigate through the various warranties offered by different mobile home HVAC brands and choose the best one for your needs.

Firstly, it's essential to understand what a warranty typically covers. Most warranties include parts and sometimes labor for repairs within a specified period. However, these can vary significantly between manufacturers, so reading the fine print is imperative. Look beyond just the coverage duration and focus on what specific components are covered. Some brands might offer extensive coverage on critical parts like compressors or heat exchangers, which could save you significant costs down the line.

Secondly, consider the length of the warranty. While longer warranties often seem more appealing, they may come with strings attached. Some manufacturers require regular maintenance checks to keep warranties valid, which could entail additional costs over time. Ensure you're clear about maintenance requirements and assess whether adhering to them fits within your budget and schedule.

Another factor to evaluate is transferability. If you plan on selling your mobile home in the future, having a transferable warranty could add value to potential buyers. Check if the warranty allows this option and any associated fees or conditions that might be involved in transferring it.

Customer service should also play a role in your decision-making process. Research how responsive and helpful each brand's customer support team is when dealing with warranty

claims or inquiries. You can gain insights from online reviews or forums where other customers share their experiences with different HVAC manufacturers.

Moreover, consider any additional services that come with the warranty package. Some companies provide added benefits such as extended customer support hours or priority service for repairs under warranty claims. These extras can enhance overall satisfaction with your purchase and provide peace of mind.

Finally, compare costs associated with each warranty option against its benefits. Sometimes premium warranties may appear costly upfront but could lead to substantial savings in repair expenses over time due to comprehensive coverage.

In conclusion, choosing an HVAC system involves more than just selecting based on price or brand reputation-warranty considerations are equally important in ensuring long-term satisfaction with your investment. By carefully assessing coverage details, terms of service agreements including transferability options along with evaluating customer service quality among various brands offering mobile home HVAC systems-you'll be better equipped at making informed decisions tailored specifically towards securing reliable comfort solutions backed by robust protections suited precisely around individual needs/preferences while staying mindful about financial constraints/limitations too!





Personal Loans for HVAC Systems

When purchasing a mobile home HVAC system, one of the most critical considerations for homeowners is the warranty offered by various brands. A warranty serves as a promise from the manufacturer, assuring customers that they will stand behind their product in the case of defects or malfunctions. However, these warranties come with stipulations, one of the most significant being the requirement for proper maintenance. Understanding and fulfilling this role is essential to keeping warranties valid and ensuring long-term satisfaction with your HVAC investment.

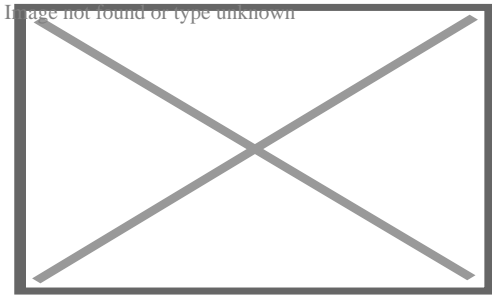
Proper maintenance involves regular check-ups and servicing by qualified professionals who can identify potential issues before they escalate into costly repairs. Most manufacturers outline specific maintenance tasks that must be completed at certain intervals to keep the warranty intact. These tasks often include cleaning filters, checking refrigerant levels, inspecting electrical connections, and ensuring all components are functioning correctly. By adhering to these requirements, homeowners not only prevent voiding their warranties but also enhance the efficiency and longevity of their HVAC systems.

Failure to perform these necessary maintenance activities can lead to several problems. First and foremost, neglecting regular upkeep may result in reduced performance of the HVAC system, leading to higher energy bills and discomfort within the home. Additionally, if a problem arises that could have been prevented through routine maintenance, manufacturers may refuse to honor warranty claims. This could leave homeowners shouldering substantial repair costs that would otherwise have been covered under warranty.

Moreover, keeping a detailed record of all maintenance performed can be invaluable when making a warranty claim. Many companies require proof that proper care has been taken before agreeing to cover repairs or replacements under warranty terms. By documenting every service visit and retaining receipts or reports from technicians, homeowners provide clear evidence that they have fulfilled their responsibilities in maintaining their equipment.

In conclusion, while warranties provide peace of mind when investing in an HVAC system for your mobile home, they also place an obligation on owners to maintain their equipment properly. Regular servicing not only preserves the validity of these warranties but also ensures optimal performance and extended lifespan of the systems themselves. As such, understanding and adhering to maintenance requirements is crucial for any homeowner seeking to protect both their financial investment and comfort at home. Checking warranties offered by various mobile home HVAC brands should always involve a careful review of maintenance obligations so that you can enjoy uninterrupted support throughout your system's lifecycle.

About Ventilation (architecture)



An ab anbar (water reservoir) with double domes and windcatchers (openings near the top of the towers) in the central desert city of Naeen, Iran. Windcatchers are a form of natural ventilation.^[1]

Ventilation is the intentional introduction of outdoor air into a space. Ventilation is mainly used to control indoor air quality by diluting and displacing indoor pollutants; it can also be used to control indoor temperature, humidity, and air motion to benefit thermal comfort, satisfaction with other aspects of the indoor environment, or other objectives.

The intentional introduction of outdoor air is usually categorized as either mechanical ventilation, natural ventilation, or mixed-mode ventilation.^[2]

- Mechanical ventilation is the intentional fan-driven flow of outdoor air into and/or out from a building. Mechanical ventilation systems may include supply fans (which push outdoor air into a building), exhaust^[3] fans (which draw air out of a building and thereby cause equal ventilation flow into a building), or a combination of both (called balanced ventilation if it neither pressurizes nor depressurizes the inside air,^[3] or only slightly depressurizes it). Mechanical ventilation is often provided by equipment that is also used to heat and cool a space.
- Natural ventilation is the intentional passive flow of outdoor air into a building through planned openings (such as louvers, doors, and windows). Natural ventilation does not require mechanical systems to move outdoor air. Instead, it relies entirely on passive physical phenomena, such as wind pressure, or the stack effect. Natural ventilation openings may be fixed, or adjustable. Adjustable openings may be controlled automatically (automated), owned by occupants (operable), or a combination of both. Cross ventilation is a phenomenon of natural ventilation.

- Mixed-mode ventilation systems use both mechanical and natural processes. The mechanical and natural components may be used at the same time, at different times of day, or in different seasons of the year.^[4] Since natural ventilation flow depends on environmental conditions, it may not always provide an appropriate amount of ventilation. In this case, mechanical systems may be used to supplement or regulate the naturally driven flow.

Ventilation is typically described as separate from infiltration.

- Infiltration is the circumstantial flow of air from outdoors to indoors through leaks (unplanned openings) in a building envelope. When a building design relies on infiltration to maintain indoor air quality, this flow has been referred to as adventitious ventilation.^[5]

The design of buildings that promote occupant health and well-being requires a clear understanding of the ways that ventilation airflow interacts with, dilutes, displaces, or introduces pollutants within the occupied space. Although ventilation is an integral component of maintaining good indoor air quality, it may not be satisfactory alone.^[6] A clear understanding of both indoor and outdoor air quality parameters is needed to improve the performance of ventilation in terms of occupant health and energy.^[7] In scenarios where outdoor pollution would deteriorate indoor air quality, other treatment devices such as filtration may also be necessary.^[8] In kitchen ventilation systems, or for laboratory fume hoods, the design of effective effluent capture can be more important than the bulk amount of ventilation in a space. More generally, the way that an air distribution system causes ventilation to flow into and out of a space impacts the ability of a particular ventilation rate to remove internally generated pollutants. The ability of a system to reduce pollution in space is described as its "ventilation effectiveness". However, the overall impacts of ventilation on indoor air quality can depend on more complex factors such as the sources of pollution, and the ways that activities and airflow interact to affect occupant exposure.

An array of factors related to the design and operation of ventilation systems are regulated by various codes and standards. Standards dealing with the design and operation of ventilation systems to achieve acceptable indoor air quality include the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards 62.1 and 62.2, the International Residential Code, the International Mechanical Code, and the United Kingdom Building Regulations Part F. Other standards that focus on energy conservation also impact the design and operation of ventilation systems, including ASHRAE Standard 90.1, and the International Energy Conservation Code.

When indoor and outdoor conditions are favorable, increasing ventilation beyond the minimum required for indoor air quality can significantly improve both indoor air quality

and thermal comfort through ventilative cooling, which also helps reduce the energy demand of buildings.^{[9][10]} During these times, higher ventilation rates, achieved through passive or mechanical means (air-side economizer, ventilative pre-cooling), can be particularly beneficial for enhancing people's physical health.^[11] Conversely, when conditions are less favorable, maintaining or improving indoor air quality through ventilation may require increased use of mechanical heating or cooling, leading to higher energy consumption.

Ventilation should be considered for its relationship to "venting" for appliances and combustion equipment such as water heaters, furnaces, boilers, and wood stoves. Most importantly, building ventilation design must be careful to avoid the backdraft of combustion products from "naturally vented" appliances into the occupied space. This issue is of greater importance for buildings with more air-tight envelopes. To avoid the hazard, many modern combustion appliances utilize "direct venting" which draws combustion air directly from outdoors, instead of from the indoor environment.

Design of air flow in rooms

[edit]

The air in a room can be supplied and removed in several ways, for example via ceiling ventilation, cross ventilation, floor ventilation or displacement ventilation.^[citation needed]

Ceiling ventilation

○

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Ceiling ventilation Cross ventilation

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Cross ventilation

Floor ventilation

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Floor ventilation Displacement ventilation

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Displacement ventilation

Furthermore, the air can be circulated in the room using vortexes which can be initiated in various ways:

Tangential flow vortexes, initiated horizontally

○

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Tangential flow
vortexes, initiated
horizontally
Tangential flow vortexes, initiated vertically

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Tangential flow
vortexes, initiated
vertically

Diffused flow vortices from air nozzles

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Diffused flow
vortices from air
nozzles
Diffused flow vortices due to roof vortices

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Diffused flow
vortices due to roof
vortices

Ventilation rates for indoor air quality

[edit]

The examples and perspective in this article **deal primarily with the United States and do not represent a worldwide view of the subject**. You may **improve this article**, discuss the issue on the talk page, or create a new article, as appropriate. *(April 2024) (Learn how and when to remove this message)*

The ventilation rate, for commercial, industrial, and institutional (CII) buildings, is normally expressed by the volumetric flow rate of outdoor air, introduced to the building. The typical units used are cubic feet per minute (CFM) in the imperial system, or liters per second (L/s) in the metric system (even though cubic meter per second is the preferred unit for volumetric flow rate in the SI system of units). The ventilation rate can also be expressed on a per person or per unit floor area basis, such as CFM/p or CFM/ft², or as air changes per hour (ACH).

Standards for residential buildings

[edit]

For residential buildings, which mostly rely on infiltration for meeting their ventilation needs, a common ventilation rate measure is the air change rate (or air changes per hour): the hourly ventilation rate divided by the volume of the space (*V* or *ACH*; units of 1/h). During the winter, ACH may range from 0.50 to 0.41 in a tightly air-sealed house to 1.11 to 1.47 in a loosely air-sealed house.^[12]

ASHRAE now recommends ventilation rates dependent upon floor area, as a revision to the 62-2001 standard, in which the minimum ACH was 0.35, but no less than 15 CFM/person (7.1 L/s/person). As of 2003, the standard has been changed to 3 CFM/100 sq. ft. (15 L/s/100 sq. m.) plus 7.5 CFM/person (3.5 L/s/person).^[13]

Standards for commercial buildings

[edit]

Ventilation rate procedure

[edit]

Ventilation Rate Procedure is rate based on standard and prescribes the rate at which ventilation air must be delivered to space and various means to the condition that air.^[14] Air quality is assessed (through CO₂ measurement) and ventilation rates are mathematically derived using constants. Indoor Air Quality Procedure uses one or more guidelines for the specification of acceptable concentrations of certain contaminants in indoor air but does not prescribe ventilation rates or air treatment methods.^[14] This addresses both quantitative and subjective evaluations and is based on the Ventilation Rate Procedure. It also accounts for potential contaminants that may have no measured limits, or for which no limits are not set (such as formaldehyde off-gassing from carpet and furniture).

Natural ventilation

[edit]

Main article: Natural ventilation

Natural ventilation harnesses naturally available forces to supply and remove air in an enclosed space. Poor ventilation in rooms is identified to significantly increase the localized moldy smell in specific places of the room including room corners.^[11] There are three types of natural ventilation occurring in buildings: wind-driven ventilation, pressure-driven flows, and stack ventilation.^[15] The pressures generated by 'the stack effect' rely upon the buoyancy of heated or rising air. Wind-driven ventilation relies upon the force of the prevailing wind to pull and push air through the enclosed

space as well as through breaches in the building's envelope.

Almost all historic buildings were ventilated naturally.^[16] The technique was generally abandoned in larger US buildings during the late 20th century as the use of air conditioning became more widespread. However, with the advent of advanced Building Performance Simulation (BPS) software, improved Building Automation Systems (BAS), Leadership in Energy and Environmental Design (LEED) design requirements, and improved window manufacturing techniques; natural ventilation has made a resurgence in commercial buildings both globally and throughout the US.^[17]

The benefits of natural ventilation include:

- Improved indoor air quality (IAQ)
- Energy savings
- Reduction of greenhouse gas emissions
- Occupant control
- Reduction in occupant illness associated with sick building syndrome
- Increased worker productivity

Techniques and architectural features used to ventilate buildings and structures naturally include, but are not limited to:

- Operable windows
- Clerestory windows and vented skylights
- Lev/convection doors
- Night purge ventilation
- Building orientation
- Wind capture façades

Airborne diseases

[edit]

Natural ventilation is a key factor in reducing the spread of airborne illnesses such as tuberculosis, the common cold, influenza, meningitis or COVID-19.^[18] Opening doors and windows are good ways to maximize natural ventilation, which would make the risk of airborne contagion much lower than with costly and maintenance-requiring mechanical systems. Old-fashioned clinical areas with high ceilings and large windows provide the greatest protection. Natural ventilation costs little and is maintenance-free, and is particularly suited to limited-resource settings and tropical climates, where the burden of TB and institutional TB transmission is highest. In settings where respiratory isolation is difficult and climate permits, windows and doors should be opened to reduce the risk of airborne contagion. Natural ventilation requires little maintenance and is inexpensive.^[19]

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

Ventilation is measured in terms of air changes per hour (ACH). As of 2023, the CDC recommends that all spaces have a minimum of 5 ACH.^[20] For hospital rooms with airborne contagions the CDC recommends a minimum of 12 ACH.^[21] Challenges in facility ventilation are public unawareness,^[22]^[23] ineffective government oversight, poor building codes that are based on comfort levels, poor system operations, poor maintenance, and lack of transparency.^[24]

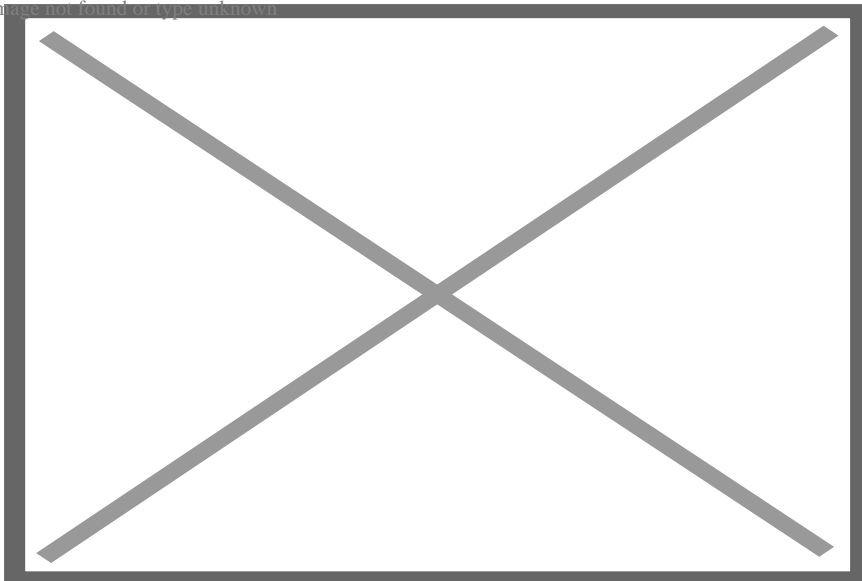
Pressure, both political and economic, to improve energy conservation has led to decreased ventilation rates. Heating, ventilation, and air conditioning rates have dropped since the energy crisis in the 1970s and the banning of cigarette smoke in the 1980s and 1990s.^[25]^[26]^[better source needed]

Mechanical ventilation

[edit]

Main article: HVAC

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

Mechanical ventilation of buildings and structures can be achieved by the use of the following techniques:

- Whole-house ventilation
- Mixing ventilation

- Displacement ventilation
- Dedicated subaerial air supply

Demand-controlled ventilation (DCV)

[edit]

Demand-controlled ventilation (**DCV**, also known as Demand Control Ventilation) makes it possible to maintain air quality while conserving energy.^{[27][28]} ASHRAE has determined that "It is consistent with the ventilation rate procedure that demand control be permitted for use to reduce the total outdoor air supply during periods of less occupancy."^[29] In a DCV system, CO₂ sensors control the amount of ventilation.^{[30][31]} During peak occupancy, CO₂ levels rise, and the system adjusts to deliver the same amount of outdoor air as would be used by the ventilation-rate procedure.^[32] However, when spaces are less occupied, CO₂ levels reduce, and the system reduces ventilation to conserve energy. DCV is a well-established practice,^[33] and is required in high occupancy spaces by building energy standards such as ASHRAE 90.1.^[34]

Personalized ventilation

[edit]



This section needs to be **updated**. Please help update this article to reflect recent events or newly available information. (*September 2024*)

Personalized ventilation is an air distribution strategy that allows individuals to control the amount of ventilation received. The approach delivers fresh air more directly to the breathing zone and aims to improve the air quality of inhaled air. Personalized ventilation provides much higher ventilation effectiveness than conventional mixing ventilation systems by displacing pollution from the breathing zone with far less air volume. Beyond improved air quality benefits, the strategy can also improve occupants' thermal comfort, perceived air quality, and overall satisfaction with the indoor environment. Individuals' preferences for temperature and air movement are not equal, and so traditional approaches to homogeneous environmental control have failed to achieve high occupant satisfaction. Techniques such as personalized ventilation facilitate control of a more diverse thermal environment that can improve thermal satisfaction for most occupants.

Local exhaust ventilation

[edit]

See also: Power tool

Local exhaust ventilation addresses the issue of avoiding the contamination of indoor air by specific high-emission sources by capturing airborne contaminants before they are spread into the environment. This can include water vapor control, lavatory effluent control, solvent vapors from industrial processes, and dust from wood- and metal-working machinery. Air can be exhausted through pressurized hoods or the use of fans and pressurizing a specific area.^[35]

A local exhaust system is composed of five basic parts:

1. A hood that captures the contaminant at its source
2. Ducts for transporting the air
3. An air-cleaning device that removes/minimizes the contaminant
4. A fan that moves the air through the system
5. An exhaust stack through which the contaminated air is discharged^[35]

In the UK, the use of LEV systems has regulations set out by the Health and Safety Executive (HSE) which are referred to as the Control of Substances Hazardous to Health (CoSHH). Under CoSHH, legislation is set to protect users of LEV systems by ensuring that all equipment is tested at least every fourteen months to ensure the LEV systems are performing adequately. All parts of the system must be visually inspected and thoroughly tested and where any parts are found to be defective, the inspector must issue a red label to identify the defective part and the issue.

The owner of the LEV system must then have the defective parts repaired or replaced before the system can be used.

Smart ventilation

[edit]

Smart ventilation is a process of continually adjusting the ventilation system in time, and optionally by location, to provide the desired IAQ benefits while minimizing energy consumption, utility bills, and other non-IAQ costs (such as thermal discomfort or noise). A smart ventilation system adjusts ventilation rates in time or by location in a building to be responsive to one or more of the following: occupancy, outdoor thermal and air quality conditions, electricity grid needs, direct sensing of contaminants, operation of other air moving and air cleaning systems. In addition, smart ventilation systems can provide information to building owners, occupants, and managers on operational energy consumption and indoor air quality as well as a signal when systems need maintenance or repair. Being responsive to occupancy means that a smart ventilation system can adjust ventilation depending on demand such as reducing ventilation if the building is unoccupied. Smart ventilation can time-shift ventilation to periods when a) indoor-outdoor temperature differences are smaller (and away from peak outdoor temperatures and humidity), b) when indoor-outdoor

temperatures are appropriate for ventilative cooling, or c) when outdoor air quality is acceptable. Being responsive to electricity grid needs means providing flexibility to electricity demand (including direct signals from utilities) and integration with electric grid control strategies. Smart ventilation systems can have sensors to detect airflow, systems pressures, or fan energy use in such a way that systems failures can be detected and repaired, as well as when system components need maintenance, such as filter replacement.^[36]

Ventilation and combustion

[edit]

Combustion (in a fireplace, gas heater, candle, oil lamp, etc.) consumes oxygen while producing carbon dioxide and other unhealthy gases and smoke, requiring ventilation air. An open chimney promotes infiltration (i.e. natural ventilation) because of the negative pressure change induced by the buoyant, warmer air leaving through the chimney. The warm air is typically replaced by heavier, cold air.

Ventilation in a structure is also needed for removing water vapor produced by respiration, burning, and cooking, and for removing odors. If water vapor is permitted to accumulate, it may damage the structure, insulation, or finishes. *[citation needed]* When operating, an air conditioner usually removes excess moisture from the air. A dehumidifier may also be appropriate for removing airborne moisture.

Calculation for acceptable ventilation rate

[edit]

Ventilation guidelines are based on the minimum ventilation rate required to maintain acceptable levels of effluents. Carbon dioxide is used as a reference point, as it is the gas of highest emission at a relatively constant value of 0.005 L/s. The mass balance equation is:

$$Q = G / (C_i - C_a)$$

- Q = ventilation rate (L/s)
- G = CO₂ generation rate
- C_i = acceptable indoor CO₂ concentration
- C_a = ambient CO₂ concentration^[37]

Smoking and ventilation

[edit]

ASHRAE standard 62 states that air removed from an area with environmental tobacco smoke shall not be recirculated into ETS-free air. A space with ETS requires more ventilation to achieve similar perceived air quality to that of a non-smoking environment.

The amount of ventilation in an ETS area is equal to the amount of an ETS-free area plus the amount V , where:

$$V = DSD \times VA \times A/60E$$

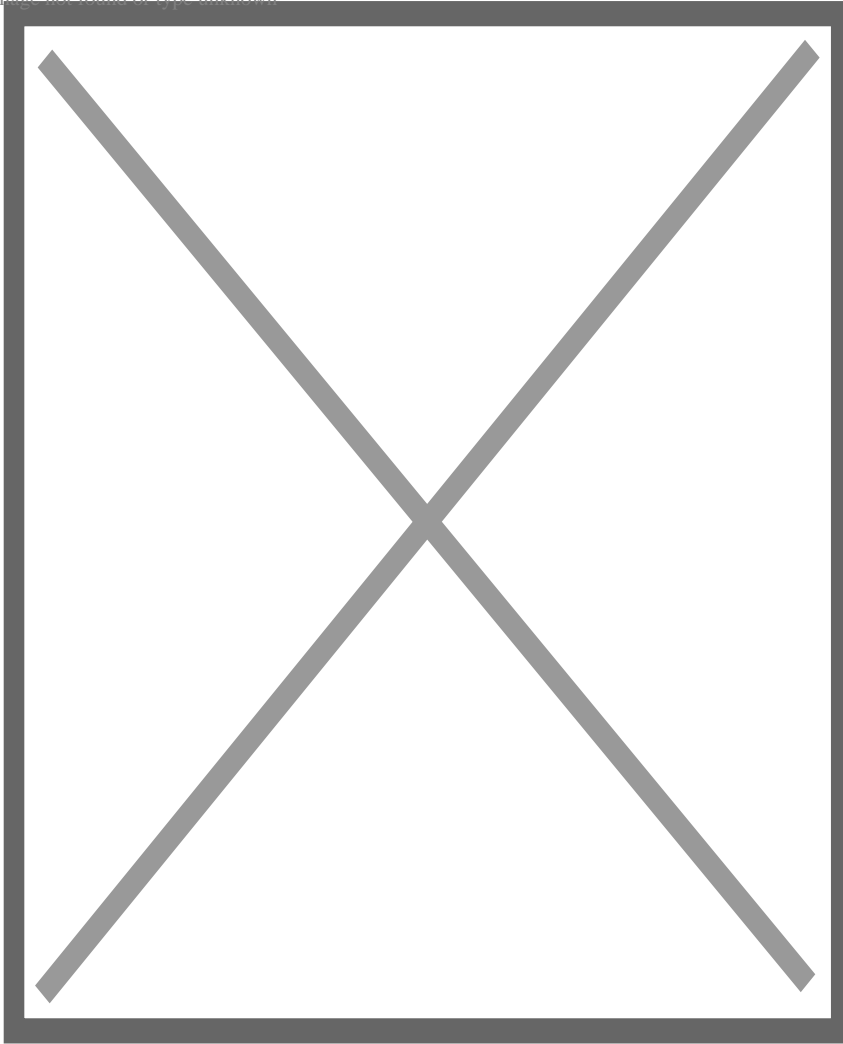
- V = recommended extra flow rate in CFM (L/s)
- DSD = design smoking density (estimated number of cigarettes smoked per hour per unit area)
- VA = volume of ventilation air per cigarette for the room being designed (ft³/cig)
- E = contaminant removal effectiveness^[38]

History

[edit]

[icon] **This section needs expansion.** You can help by adding to it. *(August 2020)*

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This ancient Roman house uses a variety of passive cooling and passive ventilation techniques. Heavy masonry walls, small exterior windows, and a narrow walled garden oriented N-S shade the house, preventing heat gain. The house opens onto a central atrium with an impluvium (open to the sky); the evaporative cooling of the water causes a cross-draft from atrium to garden.

Primitive ventilation systems were found at the Pločnik archaeological site (belonging to the Vinča culture) in Serbia and were built into early copper smelting furnaces. The furnace, built on the outside of the workshop, featured earthen pipe-like air vents with hundreds of tiny holes in them and a prototype chimney to ensure air goes into the furnace to feed the fire and smoke comes out safely.^[39]

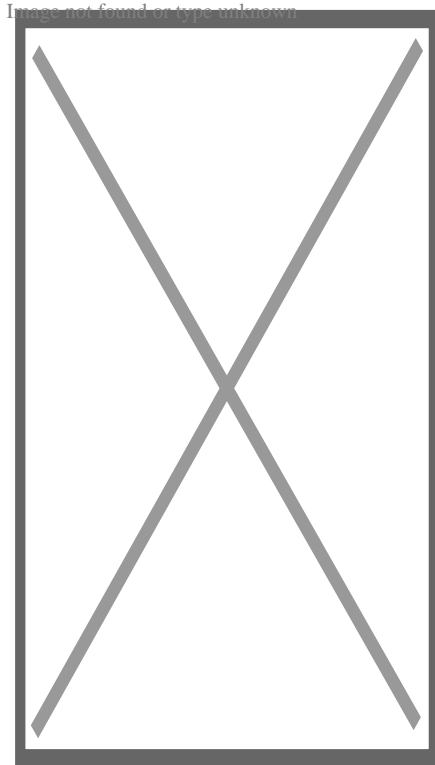
Passive ventilation and passive cooling systems were widely written about around the Mediterranean by Classical times. Both sources of heat and sources of cooling (such as fountains and subterranean heat reservoirs) were used to drive air circulation, and buildings were designed to encourage or exclude drafts, according to climate and function. Public bathhouses were often particularly sophisticated in their heating and cooling. Icehouses are some millennia old, and were part of a well-developed ice industry by classical times.

The development of forced ventilation was spurred by the common belief in the late 18th and early 19th century in the miasma theory of disease, where stagnant 'airs' were thought to spread illness. An early method of ventilation was the use of a ventilating fire near an air vent which would forcibly cause the air in the building to circulate. English engineer John Theophilus Desaguliers provided an early example of this when he installed ventilating fires in the air tubes on the roof of the House of Commons. Starting with the Covent Garden Theatre, gas burning chandeliers on the ceiling were often specially designed to perform a ventilating role.

Mechanical systems

[edit]

Further information: Heating, ventilation, and air conditioning § Mechanical or forced ventilation



The Central Tower of the Palace of Westminster. This octagonal spire was for ventilation purposes, in the more complex system imposed by Reid on Barry, in which it was to draw air out of the Palace. The design was for the aesthetic disguise of its function.^[40]^[41]

A more sophisticated system involving the use of mechanical equipment to circulate the air was developed in the mid-19th century. A basic system of bellows was put in place to ventilate Newgate Prison and outlying buildings, by the engineer Stephen Hales in the mid-1700s. The problem with these early devices was that they required constant human labor to operate. David Boswell Reid was called to testify before a Parliamentary committee on proposed architectural designs for the new House of Commons, after the old one burned down in a fire in 1834.^[40] In January 1840 Reid was appointed by the committee for the House of Lords dealing with the construction of the replacement for the Houses of Parliament. The post was in the capacity of ventilation engineer, in effect; and with its creation there began a long series of quarrels between Reid and Charles Barry, the architect.^[42]

Reid advocated the installation of a very advanced ventilation system in the new House. His design had air being drawn into an underground chamber, where it would undergo either heating or cooling. It would then ascend into the chamber through thousands of small holes drilled into the floor, and would be extracted through the ceiling by a special ventilation fire within a great stack.^[43]

Reid's reputation was made by his work in Westminster. He was commissioned for an air quality survey in 1837 by the Leeds and Selby Railway in their tunnel.^[44] The steam vessels built for the Niger expedition of 1841 were fitted with ventilation systems based on Reid's Westminster model.^[45] Air was dried, filtered and passed over charcoal.^[46]^[47] Reid's ventilation method was also applied more fully to St. George's Hall, Liverpool, where the architect, Harvey Lonsdale Elmes, requested that Reid should be involved in ventilation design.^[48] Reid considered this the only building in which his system was completely carried out.^[49]

Fans

[edit]

With the advent of practical steam power, ceiling fans could finally be used for ventilation. Reid installed four steam-powered fans in the ceiling of St George's Hospital in Liverpool, so that the pressure produced by the fans would force the incoming air upward and through vents in the ceiling. Reid's pioneering work provides the basis for ventilation systems to this day.^[43] He was remembered as "Dr. Reid the ventilator" in the twenty-first century in discussions of energy efficiency, by Lord Wade

of Chorlton.^[50]

History and development of ventilation rate standards

[edit]

Ventilating a space with fresh air aims to avoid "bad air". The study of what constitutes bad air dates back to the 1600s when the scientist Mayow studied asphyxia of animals in confined bottles.^[51] The poisonous component of air was later identified as carbon dioxide (CO₂), by Lavoisier in the very late 1700s, starting a debate as to the nature of "bad air" which humans perceive to be stuffy or unpleasant. Early hypotheses included excess concentrations of CO₂ and oxygen depletion. However, by the late 1800s, scientists thought biological contamination, not oxygen or CO₂, was the primary component of unacceptable indoor air. However, it was noted as early as 1872 that CO₂ concentration closely correlates to perceived air quality.

The first estimate of minimum ventilation rates was developed by Tredgold in 1836.^[52] This was followed by subsequent studies on the topic by Billings ^[53] in 1886 and Flugge in 1905. The recommendations of Billings and Flugge were incorporated into numerous building codes from 1900–the 1920s and published as an industry standard by ASHVE (the predecessor to ASHRAE) in 1914.^[51]

The study continued into the varied effects of thermal comfort, oxygen, carbon dioxide, and biological contaminants. The research was conducted with human subjects in controlled test chambers. Two studies, published between 1909 and 1911, showed that carbon dioxide was not the offending component. Subjects remained satisfied in chambers with high levels of CO₂, so long as the chamber remained cool.^[51] (Subsequently, it has been determined that CO₂ is, in fact, harmful at concentrations over 50,000ppm^[54])

ASHVE began a robust research effort in 1919. By 1935, ASHVE-funded research conducted by Lemberg, Brandt, and Morse – again using human subjects in test chambers – suggested the primary component of "bad air" was an odor, perceived by the human olfactory nerves.^[55] Human response to odor was found to be logarithmic to contaminant concentrations, and related to temperature. At lower, more comfortable temperatures, lower ventilation rates were satisfactory. A 1936 human test chamber study by Yaglou, Riley, and Coggins culminated much of this effort, considering odor, room volume, occupant age, cooling equipment effects, and recirculated air implications, which guided ventilation rates.^[56] The Yaglou research has been validated, and adopted into industry standards, beginning with the ASA code in 1946. From this research base, ASHRAE (having replaced ASHVE) developed space-by-space recommendations, and published them as ASHRAE Standard 62-1975:

Ventilation for acceptable indoor air quality.

As more architecture incorporated mechanical ventilation, the cost of outdoor air ventilation came under some scrutiny. In 1973, in response to the 1973 oil crisis and conservation concerns, ASHRAE Standards 62-73 and 62-81) reduced required ventilation from 10 CFM (4.76 L/s) per person to 5 CFM (2.37 L/s) per person. In cold, warm, humid, or dusty climates, it is preferable to minimize ventilation with outdoor air to conserve energy, cost, or filtration. This critique (e.g. Tiller^[57]) led ASHRAE to reduce outdoor ventilation rates in 1981, particularly in non-smoking areas. However subsequent research by Fanger,^[58] W. Cain, and Janssen validated the Yaglou model. The reduced ventilation rates were found to be a contributing factor to sick building syndrome.^[59]

The 1989 ASHRAE standard (Standard 62-89) states that appropriate ventilation guidelines are 20 CFM (9.2 L/s) per person in an office building, and 15 CFM (7.1 L/s) per person for schools, while 2004 Standard 62.1-2004 has lower recommendations again (see tables below). ANSI/ASHRAE (Standard 62-89) speculated that "comfort (odor) criteria are likely to be satisfied if the ventilation rate is set so that 1,000 ppm CO₂ is not exceeded"^[60] while OSHA has set a limit of 5000 ppm over 8 hours.^[61]

Historical ventilation rates

Author or source	Year	Ventilation rate (IP)	Ventilation rate (SI)	Basis or rationale
Tredgold	1836	4 CFM per person	2 L/s per person	Basic metabolic needs, breathing rate, and candle burning
Billings	1895	30 CFM per person	15 L/s per person	Indoor air hygiene, preventing spread of disease
Flugge	1905	30 CFM per person	15 L/s per person	Excessive temperature or unpleasant odor
ASHVE	1914	30 CFM per person	15 L/s per person	Based on Billings, Flugge and contemporaries
Early US Codes	1925	30 CFM per person	15 L/s per person	Same as above
Yaglou	1936	15 CFM per person	7.5 L/s per person	Odor control, outdoor air as a fraction of total air
ASA	1946	15 CFM per person	7.5 L/s per person	Based on Yahlou and contemporaries
ASHRAE	1975	15 CFM per person	7.5 L/s per person	Same as above

ASHRAE	1981	10 CFM per person	5 L/s per person	For non-smoking areas, reduced.
ASHRAE	1989	15 CFM per person	7.5 L/s per person	Based on Fanger, W. Cain, and Janssen

ASHRAE continues to publish space-by-space ventilation rate recommendations, which are decided by a consensus committee of industry experts. The modern descendants of ASHRAE standard 62-1975 are ASHRAE Standard 62.1, for non-residential spaces, and ASHRAE 62.2 for residences.

In 2004, the calculation method was revised to include both an occupant-based contamination component and an area-based contamination component.^[62] These two components are additive, to arrive at an overall ventilation rate. The change was made to recognize that densely populated areas were sometimes overventilated (leading to higher energy and cost) using a per-person methodology.

Occupant Based Ventilation Rates,^[62] ANSI/ASHRAE Standard 62.1-2004

IP Units	SI Units	Category	Examples
0 cfm/person	0 L/s/person	Spaces where ventilation requirements are primarily associated with building elements, not occupants.	Storage Rooms, Warehouses
5 cfm/person	2.5 L/s/person	Spaces occupied by adults, engaged in low levels of activity	Office space
7.5 cfm/person	3.5 L/s/person	Spaces where occupants are engaged in higher levels of activity, but not strenuous, or activities generating more contaminants	Retail spaces, lobbies
10 cfm/person	5 L/s/person	Spaces where occupants are engaged in more strenuous activity, but not exercise, or activities generating more contaminants	Classrooms, school settings
20 cfm/person	10 L/s/person	Spaces where occupants are engaged in exercise, or activities generating many contaminants	dance floors, exercise rooms

Area-based ventilation rates,^[62] ANSI/ASHRAE Standard 62.1-2004

IP Units	SI Units	Category	Examples
0.06 cfm/ft ²	0.30 L/s/m ²	Spaces where space contamination is normal, or similar to an office environment	Conference rooms, lobbies
0.12 cfm/ft ²	0.60 L/s/m ²	Spaces where space contamination is significantly higher than an office environment	Classrooms, museums

0.18 cfm/ft ²	0.90 L/s/m ²	Spaces where space contamination is even higher than the previous category	Laboratories, art classrooms
0.30 cfm/ft ²	1.5 L/s/m ²	Specific spaces in sports or entertainment where contaminants are released	Sports, entertainment
0.48 cfm/ft ²	2.4 L/s/m ²	Reserved for indoor swimming areas, where chemical concentrations are high	Indoor swimming areas

The addition of occupant- and area-based ventilation rates found in the tables above often results in significantly reduced rates compared to the former standard. This is compensated in other sections of the standard which require that this minimum amount of air is delivered to the breathing zone of the individual occupant at all times. The total outdoor air intake of the ventilation system (in multiple-zone variable air volume (VAV) systems) might therefore be similar to the airflow required by the 1989 standard.

From 1999 to 2010, there was considerable development of the application protocol for ventilation rates. These advancements address occupant- and process-based ventilation rates, room ventilation effectiveness, and system ventilation effectiveness [63]

Problems

[edit]

- In hot, humid climates, unconditioned ventilation air can daily deliver approximately 260 milliliters of water for each cubic meters per hour (m³/h) of outdoor air (or one pound of water each day for each cubic feet per minute of outdoor air per day), annual average. ^[citation needed] This is a great deal of moisture and can create serious indoor moisture and mold problems. For example, given a 150 m² building with an airflow of 180 m³/h this could result in about 47 liters of water accumulated per day.
- Ventilation efficiency is determined by design and layout, and is dependent upon the placement and proximity of diffusers and return air outlets. If they are located closely together, supply air may mix with stale air, decreasing the efficiency of the HVAC system, and creating air quality problems.
- System imbalances occur when components of the HVAC system are improperly adjusted or installed and can create pressure differences (too much-circulating air creating a draft or too little circulating air creating stagnancy).
- Cross-contamination occurs when pressure differences arise, forcing potentially contaminated air from one zone to an uncontaminated zone. This often involves undesired odors or VOCs.
- Re-entry of exhaust air occurs when exhaust outlets and fresh air intakes are either too close, prevailing winds change exhaust patterns or infiltration between intake and exhaust air flows.

- Entrainment of contaminated outdoor air through intake flows will result in indoor air contamination. There are a variety of contaminated air sources, ranging from industrial effluent to VOCs put off by nearby construction work.^[64] A recent study revealed that in urban European buildings equipped with ventilation systems lacking outdoor air filtration, the exposure to outdoor-originating pollutants indoors resulted in more Disability-Adjusted Life Years (DALYs) than exposure to indoor-emitted pollutants.^[65]

See also

[edit]

- Architectural engineering
- Biological safety
- Cleanroom
- Environmental tobacco smoke
- Fume hood
- Head-end power
- Heating, ventilation, and air conditioning
- Heat recovery ventilation
- Mechanical engineering
- Room air distribution
- Sick building syndrome
- Siheyuan
- Solar chimney
- Tulou
- Windcatcher

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- Publications from the International Energy Agency (IEA) Energy in Buildings and Communities Programme (EBC) ventilation-related research projects-annexes:
 - EBC Annex 9 Minimum Ventilation Rates
 - EBC Annex 18 Demand Controlled Ventilation Systems
 - EBC Annex 26 Energy Efficient Ventilation of Large Enclosures
 - EBC Annex 27 Evaluation and Demonstration of Domestic Ventilation Systems
 - EBC Annex 35 Control Strategies for Hybrid Ventilation in New and Retrofitted Office Buildings (HYBVENT)
 - EBC Annex 62 Ventilative Cooling

International Society of Indoor Air Quality and Climate

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- Indoor Air Journal
- Indoor Air Conference Proceedings

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

[edit]

- ASHRAE Standard 62.1 – Ventilation for Acceptable Indoor Air Quality
 - ASHRAE Standard 62.2 – Ventilation for Acceptable Indoor Air Quality in Residential Buildings
 - v
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 - 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

- 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

Technology

- 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

**Measurement
and control**

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

**Professions,
trades,
and services**

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)
- ASHRAE Handbook
- Building science
- Fireproofing

See also

- Glossary of HVAC terms
- Warm Spaces
- World Refrigeration Day
- Template:Home automation
- Template:Solar energy

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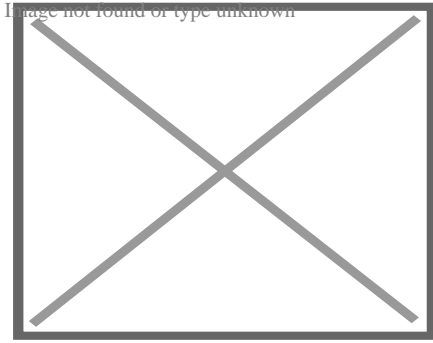
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- Czech Republic

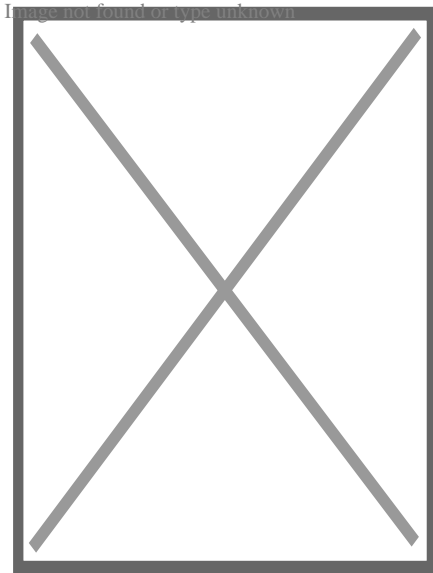
Other

- NARA

About Heat exchanger



Tubular heat exchanger

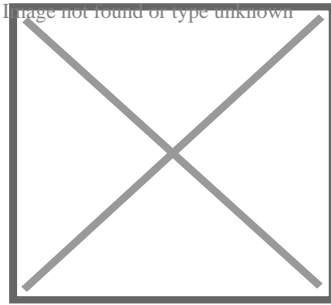


Partial view into inlet plenum of shell and tube heat exchanger of a refrigerant based chiller for providing air-conditioning to a building

A **heat exchanger** is a system used to transfer heat between a source and a working fluid. Heat exchangers are used in both cooling and heating processes.^[1] The fluids may be separated by a solid wall to prevent mixing or they may be in direct contact.^[2] They are widely used in space heating, refrigeration, air conditioning, power stations, chemical plants, petrochemical plants, petroleum refineries, natural-gas processing, and sewage treatment. The classic example of a heat exchanger is found in an internal combustion engine in which a circulating fluid known as engine coolant flows through radiator coils and air flows past the coils, which cools the coolant and heats the incoming air. Another example is the heat sink, which is a passive heat exchanger that transfers the heat generated by an electronic or a mechanical device to a fluid medium, often air or a liquid coolant.^[3]

Flow arrangement

[edit]



Countercurrent (A) and parallel (B) flows

There are three primary classifications of heat exchangers according to their flow arrangement. In *parallel-flow* heat exchangers, the two fluids enter the exchanger at the same end, and travel in parallel to one another to the other side. In *counter-flow* heat exchangers the fluids enter the exchanger from opposite ends. The counter current design is the most efficient, in that it can transfer the most heat from the heat (transfer) medium per unit mass due to the fact that the average temperature difference along any unit length is *higher*. See countercurrent exchange. In a *cross-flow* heat exchanger, the fluids travel roughly perpendicular to one another through the exchanger.

Fig. 1: Shell and tube heat

○

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Fig. 1: Shell and tube heat exchanger, single pass (1-1 parallel flow)

Fig. 2: Shell and tube heat

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Fig. 2: Shell and tube heat exchanger, 2-pass tube side (1-2)

For efficiency, heat exchangers are designed to maximize the surface area of the wall between the two fluids, while minimizing resistance to fluid flow through the exchanger. The exchanger's performance can also be affected by the addition of fins or corrugations in one or both directions, which increase surface area and may channel fluid flow or induce turbulence.

The driving temperature across the heat transfer surface varies with position, but an appropriate mean temperature can be defined. In most simple systems this is the "log mean temperature difference" (LMTD). Sometimes direct knowledge of the LMTD is not available and the NTU method is used.

Types

[edit]

Double pipe heat exchangers are the simplest exchangers used in industries. On one hand, these heat exchangers are cheap for both design and maintenance, making them a good choice for small industries. On the other hand, their low efficiency coupled with the high space occupied in large scales, has led modern industries to use more efficient heat exchangers like shell and tube or plate. However, since double pipe heat exchangers are simple, they are used to teach heat exchanger design basics to students as the fundamental rules for all heat exchangers are the same.

1. Double-pipe heat exchanger

When one fluid flows through the smaller pipe, the other flows through the annular gap between the two pipes. These flows may be parallel or counter-flows in a double pipe heat exchanger.

(a) Parallel flow, where both hot and cold liquids enter the heat exchanger from the same side, flow in the same direction and exit at the same end. This configuration is preferable when the two fluids are intended to reach exactly the same temperature, as it reduces thermal stress and produces a more uniform rate of heat transfer.

(b) Counter-flow, where hot and cold fluids enter opposite sides of the heat exchanger, flow in opposite directions, and exit at opposite ends. This configuration is preferable when the objective is to maximize heat transfer between the fluids, as it creates a larger temperature differential when used under otherwise similar

crossflow)

Fig. 3: Shell and tube heat

○

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Fig. 3: Shell and tube heat exchanger, 2-pass shell side, 2-pass tube side (2-2 countercurrent)

conditions. [citation needed]

The figure above illustrates the parallel and counter-flow flow directions of the fluid exchanger.

2. Shell-and-tube heat exchanger

In a shell-and-tube heat exchanger, two fluids at different temperatures flow through the heat exchanger. One of the fluids flows through the tube side and the other fluid flows outside the tubes, but inside the shell (shell side).

Baffles are used to support the tubes, direct the fluid flow to the tubes in an approximately natural manner, and maximize the turbulence of the shell fluid. There are many various kinds of baffles, and the choice of baffle form, spacing, and geometry depends on the allowable flow rate of the drop in shell-side force, the need for tube support, and the flow-induced vibrations. There are several variations of shell-and-tube exchangers available; the differences lie in the arrangement of flow configurations and details of construction.

In application to cool air with shell-and-tube technology (such as intercooler / charge air cooler for combustion engines), fins can be added on the tubes to increase heat transfer area on air side and create a tubes & fins configuration.

3. Plate Heat Exchanger

A plate heat exchanger contains an amount of thin shaped heat transfer plates bundled together. The gasket arrangement of each pair of plates provides two separate channel system. Each pair of plates form a channel where the fluid can flow through. The pairs are attached by welding and bolting methods. The following shows the components in the heat exchanger.

In single channels the configuration of the gaskets enables flow through. Thus, this allows the main and secondary media in counter-current flow. A gasket plate heat exchanger has a heat region from corrugated plates. The gasket function as seal between plates and they are located between frame and pressure plates. Fluid flows in a counter current direction throughout the heat exchanger. An efficient thermal performance is produced. Plates are produced in different depths, sizes and corrugated shapes. There are different types of plates available including plate and frame, plate and shell and spiral plate heat exchangers. The distribution area guarantees the flow of fluid to the whole heat transfer surface. This helps to prevent stagnant area that can cause accumulation of unwanted material on solid surfaces. High flow turbulence between plates results in a greater transfer of heat and a decrease in pressure.

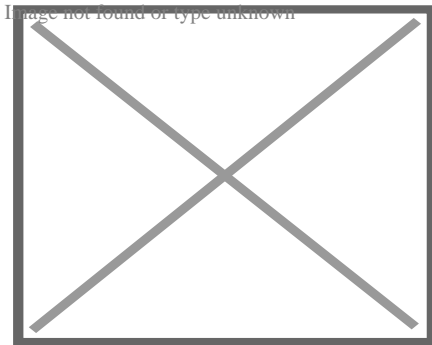
4. Condensers and Boilers Heat exchangers using a two-phase heat transfer system are condensers, boilers and evaporators. Condensers are instruments that take and cool hot gas or vapor to the point of condensation and transform the gas into a liquid form. The point at which liquid transforms to gas is called vaporization and vice versa is called condensation. Surface condenser is the most common type of condenser where it includes a water supply device. Figure 5 below displays a two-pass surface condenser.

The pressure of steam at the turbine outlet is low where the steam density is very low where the flow rate is very high. To prevent a decrease in pressure in the movement of steam from the turbine to condenser, the condenser unit is placed underneath and connected to the turbine. Inside the tubes the cooling water runs in a parallel way, while steam moves in a vertical downward position from the wide opening at the top and travel through the tube. Furthermore, boilers are categorized as initial application of heat exchangers. The word steam generator was regularly used to describe a boiler unit where a hot liquid stream is the source of heat rather than the combustion products. Depending on the dimensions and configurations the boilers are manufactured. Several boilers are only able to produce hot fluid while on the other hand the others are manufactured for steam production.

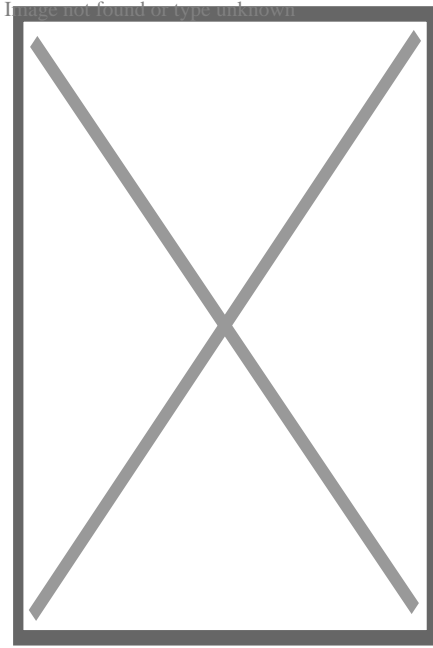
Shell and tube

[edit]

Main article: Shell and tube heat exchanger



A shell and tube heat exchanger



Shell and tube heat exchanger

Shell and tube heat exchangers consist of a series of tubes which contain fluid that must be either heated or cooled. A second fluid runs over the tubes that are being heated or cooled so that it can either provide the heat or absorb the heat required. A set of tubes is called the tube bundle and can be made up of several types of tubes: plain, longitudinally finned, etc. Shell and tube heat exchangers are typically used for high-pressure applications (with pressures greater than 30 bar and temperatures greater than 260 °C).^[4] This is because the shell and tube heat exchangers are robust due to their shape.

Several thermal design features must be considered when designing the tubes in the shell and tube heat exchangers: There can be many variations on the shell and tube design. Typically, the ends of each tube are connected to plenums (sometimes called water boxes) through holes in tubesheets. The tubes may be straight or bent in the shape of a U, called U-tubes.

- Tube diameter: Using a small tube diameter makes the heat exchanger both economical and compact. However, it is more likely for the heat exchanger to foul up faster and the small size makes mechanical cleaning of the fouling difficult. To prevail over the fouling and cleaning problems, larger tube diameters can be used. Thus to determine the tube diameter, the available space, cost and fouling nature of the fluids must be considered.
- Tube thickness: The thickness of the wall of the tubes is usually determined to ensure:
 - There is enough room for corrosion
 - That flow-induced vibration has resistance
 - Axial strength

- Availability of spare parts
- Hoop strength (to withstand internal tube pressure)
- Buckling strength (to withstand overpressure in the shell)
- Tube length: heat exchangers are usually cheaper when they have a smaller shell diameter and a long tube length. Thus, typically there is an aim to make the heat exchanger as long as physically possible whilst not exceeding production capabilities. However, there are many limitations for this, including space available at the installation site and the need to ensure tubes are available in lengths that are twice the required length (so they can be withdrawn and replaced). Also, long, thin tubes are difficult to take out and replace.
- Tube pitch: when designing the tubes, it is practical to ensure that the tube pitch (i.e., the centre-centre distance of adjoining tubes) is not less than 1.25 times the tubes' outside diameter. A larger tube pitch leads to a larger overall shell diameter, which leads to a more expensive heat exchanger.
- Tube corrugation: this type of tubes, mainly used for the inner tubes, increases the turbulence of the fluids and the effect is very important in the heat transfer giving a better performance.
- Tube Layout: refers to how tubes are positioned within the shell. There are four main types of tube layout, which are, triangular (30°), rotated triangular (60°), square (90°) and rotated square (45°). The triangular patterns are employed to give greater heat transfer as they force the fluid to flow in a more turbulent fashion around the piping. Square patterns are employed where high fouling is experienced and cleaning is more regular.
- Baffle Design: baffles are used in shell and tube heat exchangers to direct fluid across the tube bundle. They run perpendicularly to the shell and hold the bundle, preventing the tubes from sagging over a long length. They can also prevent the tubes from vibrating. The most common type of baffle is the segmental baffle. The semicircular segmental baffles are oriented at 180° to the adjacent baffles forcing the fluid to flow upward and downwards between the tube bundle. Baffle spacing is of large thermodynamic concern when designing shell and tube heat exchangers. Baffles must be spaced with consideration for the conversion of pressure drop and heat transfer. For thermo economic optimization it is suggested that the baffles be spaced no closer than 20% of the shell's inner diameter. Having baffles spaced too closely causes a greater pressure drop because of flow redirection. Consequently, having the baffles spaced too far apart means that there may be cooler spots in the corners between baffles. It is also important to ensure the baffles are spaced close enough that the tubes do not sag. The other main type of baffle is the disc and doughnut baffle, which consists of two concentric baffles. An outer, wider baffle looks like a doughnut, whilst the inner baffle is shaped like a disk. This type of baffle forces the fluid to pass around each side of the disk then through the doughnut baffle generating a different type of fluid flow.

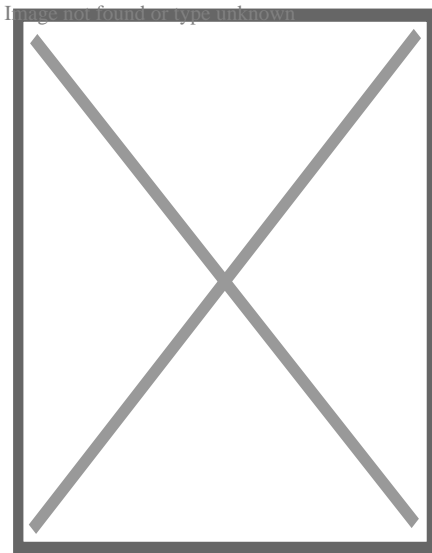
- Tubes & fins Design: in application to cool air with shell-and-tube technology (such as intercooler / charge air cooler for combustion engines), the difference in heat transfer between air and cold fluid can be such that there is a need to increase heat transfer area on air side. For this function fins can be added on the tubes to increase heat transfer area on air side and create a tubes & fins configuration.

Fixed tube liquid-cooled heat exchangers especially suitable for marine and harsh applications can be assembled with brass shells, copper tubes, brass baffles, and forged brass integral end hubs.^[*citation needed*] (See: *Copper in heat exchangers*).

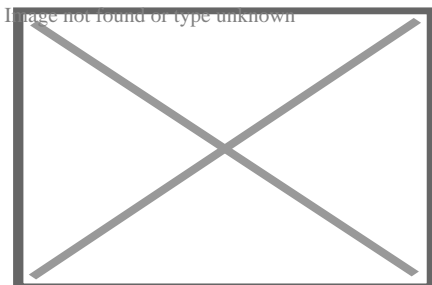
Plate

[edit]

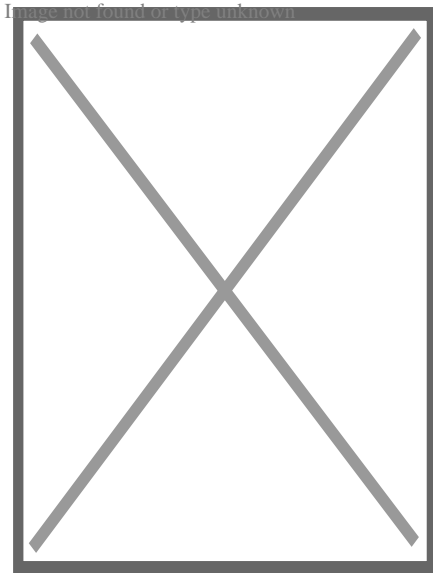
Main article: Plate heat exchanger



Conceptual diagram of a plate and frame heat exchanger



A single plate heat exchanger



An interchangeable plate heat exchanger directly applied to the system of a swimming pool

Another type of heat exchanger is the plate heat exchanger. These exchangers are composed of many thin, slightly separated plates that have very large surface areas and small fluid flow passages for heat transfer. Advances in gasket and brazing technology have made the plate-type heat exchanger increasingly practical. In HVAC applications, large heat exchangers of this type are called *plate-and-frame*; when used in open loops, these heat exchangers are normally of the gasket type to allow periodic disassembly, cleaning, and inspection. There are many types of permanently bonded plate heat exchangers, such as dip-brazed, vacuum-brazed, and welded plate varieties, and they are often specified for closed-loop applications such as refrigeration. Plate heat exchangers also differ in the types of plates that are used, and in the configurations of those plates. Some plates may be stamped with "chevron", dimpled, or other patterns, where others may have machined fins and/or grooves.

When compared to shell and tube exchangers, the stacked-plate arrangement typically has lower volume and cost. Another difference between the two is that plate exchangers typically serve low to medium pressure fluids, compared to medium and high pressures of shell and tube. A third and important difference is that plate exchangers employ more countercurrent flow rather than cross current flow, which allows lower approach temperature differences, high temperature changes, and increased efficiencies.

Plate and shell

[edit]

A third type of heat exchanger is a plate and shell heat exchanger, which combines plate heat exchanger with shell and tube heat exchanger technologies. The heart of the heat exchanger contains a fully welded circular plate pack made by pressing and cutting round plates and welding them together. Nozzles carry flow in and out of the platepack (the 'Plate side' flowpath). The fully welded platepack is assembled into an outer shell that creates a second flowpath (the 'Shell side'). Plate and shell technology offers high heat transfer, high pressure, high operating temperature, compact size, low fouling and close approach temperature. In particular, it does completely without gaskets, which provides security against leakage at high pressures and temperatures.

Adiabatic wheel

[edit]

A fourth type of heat exchanger uses an intermediate fluid or solid store to hold heat, which is then moved to the other side of the heat exchanger to be released. Two examples of this are adiabatic wheels, which consist of a large wheel with fine threads rotating through the hot and cold fluids, and fluid heat exchangers.

Plate fin

[edit]

Main article: Plate fin heat exchanger

This type of heat exchanger uses "sandwiched" passages containing fins to increase the effectiveness of the unit. The designs include crossflow and counterflow coupled with various fin configurations such as straight fins, offset fins and wavy fins.

Plate and fin heat exchangers are usually made of aluminum alloys, which provide high heat transfer efficiency. The material enables the system to operate at a lower temperature difference and reduce the weight of the equipment. Plate and fin heat exchangers are mostly used for low temperature services such as natural gas, helium and oxygen liquefaction plants, air separation plants and transport industries such as motor and aircraft engines.

Advantages of plate and fin heat exchangers:

- High heat transfer efficiency especially in gas treatment
- Larger heat transfer area
- Approximately 5 times lighter in weight than that of shell and tube heat exchanger. ^[*citation needed*]

- Able to withstand high pressure

Disadvantages of plate and fin heat exchangers:

- Might cause clogging as the pathways are very narrow
- Difficult to clean the pathways
- Aluminium alloys are susceptible to Mercury Liquid Embrittlement Failure

Finned tube

[edit]

The usage of fins in a tube-based heat exchanger is common when one of the working fluids is a low-pressure gas, and is typical for heat exchangers that operate using ambient air, such as automotive radiators and HVAC air condensers. Fins dramatically increase the surface area with which heat can be exchanged, which improves the efficiency of conducting heat to a fluid with very low thermal conductivity, such as air. The fins are typically made from aluminium or copper since they must conduct heat from the tube along the length of the fins, which are usually very thin.

The main construction types of finned tube exchangers are:

- A stack of evenly-spaced metal plates act as the fins and the tubes are pressed through pre-cut holes in the fins, good thermal contact usually being achieved by deformation of the fins around the tube. This is typical construction for HVAC air coils and large refrigeration condensers.
- Fins are spiral-wound onto individual tubes as a continuous strip, the tubes can then be assembled in banks, bent in a serpentine pattern, or wound into large spirals.
- Zig-zag metal strips are sandwiched between flat rectangular tubes, often being soldered or brazed together for good thermal and mechanical strength. This is common in low-pressure heat exchangers such as water-cooling radiators. Regular flat tubes will expand and deform if exposed to high pressures but flat microchannel tubes allow this construction to be used for high pressures.^[5]

Stacked-fin or spiral-wound construction can be used for the tubes inside shell-and-tube heat exchangers when high efficiency thermal transfer to a gas is required.

In electronics cooling, heat sinks, particularly those using heat pipes, can have a stacked-fin construction.

Pillow plate

[edit]

A pillow plate heat exchanger is commonly used in the dairy industry for cooling milk in large direct-expansion stainless steel bulk tanks. Nearly the entire surface area of a tank can be integrated with this heat exchanger, without gaps that would occur between pipes welded to the exterior of the tank. Pillow plates can also be constructed as flat plates that are stacked inside a tank. The relatively flat surface of the plates allows easy cleaning, especially in sterile applications.

The pillow plate can be constructed using either a thin sheet of metal welded to the thicker surface of a tank or vessel, or two thin sheets welded together. The surface of the plate is welded with a regular pattern of dots or a serpentine pattern of weld lines. After welding the enclosed space is pressurised with sufficient force to cause the thin metal to bulge out around the welds, providing a space for heat exchanger liquids to flow, and creating a characteristic appearance of a swelled pillow formed out of metal.

Waste heat recovery units

[edit]



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A waste heat recovery unit (WHRU) is a heat exchanger that recovers heat from a hot gas stream while transferring it to a working medium, typically water or oils. The hot gas stream can be the exhaust gas from a gas turbine or a diesel engine or a waste gas from industry or refinery.

Large systems with high volume and temperature gas streams, typical in industry, can benefit from steam Rankine cycle (SRC) in a waste heat recovery unit, but these cycles are too expensive for small systems. The recovery of heat from low temperature systems requires different working fluids than steam.

An organic Rankine cycle (ORC) waste heat recovery unit can be more efficient at low temperature range using refrigerants that boil at lower temperatures than water. Typical organic refrigerants are ammonia, pentafluoropropane (R-245fa and R-245ca), and toluene.

The refrigerant is boiled by the heat source in the evaporator to produce super-heated vapor. This fluid is expanded in the turbine to convert thermal energy to kinetic energy, that is converted to electricity in the electrical generator. This energy transfer process decreases the temperature of the refrigerant that, in turn, condenses. The

cycle is closed and completed using a pump to send the fluid back to the evaporator.

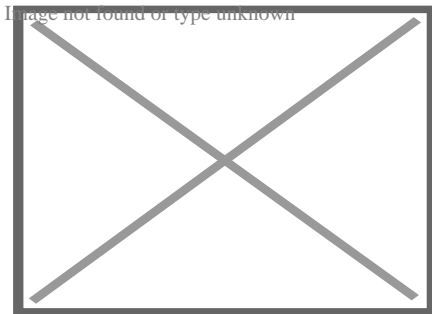
Dynamic scraped surface

[edit]

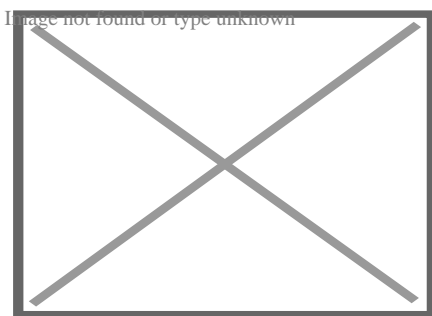
Another type of heat exchanger is called "(dynamic) scraped surface heat exchanger". This is mainly used for heating or cooling with high-viscosity products, crystallization processes, evaporation and high-fouling applications. Long running times are achieved due to the continuous scraping of the surface, thus avoiding fouling and achieving a sustainable heat transfer rate during the process.

Phase-change

[edit]



Typical kettle reboiler used for industrial distillation towers



Typical water-cooled surface condenser

In addition to heating up or cooling down fluids in just a single phase, heat exchangers can be used either to heat a liquid to evaporate (or boil) it or used as condensers to cool a vapor and condense it to a liquid. In chemical plants and refineries, reboilers used to heat incoming feed for distillation towers are often heat exchangers.^{[6][7]}

Distillation set-ups typically use condensers to condense distillate vapors back into liquid.

Power plants that use steam-driven turbines commonly use heat exchangers to boil water into steam. Heat exchangers or similar units for producing steam from water are often called boilers or steam generators.

In the nuclear power plants called pressurized water reactors, special large heat exchangers pass heat from the primary (reactor plant) system to the secondary (steam plant) system, producing steam from water in the process. These are called steam generators. All fossil-fueled and nuclear power plants using steam-driven turbines have surface condensers to convert the exhaust steam from the turbines into condensate (water) for re-use.^{[8][9]}

To conserve energy and cooling capacity in chemical and other plants, regenerative heat exchangers can transfer heat from a stream that must be cooled to another stream that must be heated, such as distillate cooling and reboiler feed pre-heating.

This term can also refer to heat exchangers that contain a material within their structure that has a change of phase. This is usually a solid to liquid phase due to the small volume difference between these states. This change of phase effectively acts as a buffer because it occurs at a constant temperature but still allows for the heat exchanger to accept additional heat. One example where this has been investigated is for use in high power aircraft electronics.

Heat exchangers functioning in multiphase flow regimes may be subject to the Ledinegg instability.

Direct contact

[edit]

Direct contact heat exchangers involve heat transfer between hot and cold streams of two phases in the absence of a separating wall.^[10] Thus such heat exchangers can be classified as:

- Gas – liquid
- Immiscible liquid – liquid
- Solid-liquid or solid – gas

Most direct contact heat exchangers fall under the Gas – Liquid category, where heat is transferred between a gas and liquid in the form of drops, films or sprays.^[4]

Such types of heat exchangers are used predominantly in air conditioning, humidification, industrial hot water heating, water cooling and condensing plants.^[11]

Phases[^{12]}]	Continuous phase	Driving force	Change of phase	Examples
Gas – Liquid	Gas	Gravity	No	Spray columns, packed columns
			Yes	Cooling towers, falling droplet evaporators
		Forced Liquid flow	No	Spray coolers/quenchers
			Yes	Spray condensers/evaporation, jet condensers
	Liquid	Gravity	No	Bubble columns, perforated tray columns
			Yes	Bubble column condensers
		Forced Gas flow	No	Gas spargers
			Yes	Direct contact evaporators, submerged combustion

Microchannel

[edit]

Microchannel heat exchangers are multi-pass parallel flow heat exchangers consisting of three main elements: manifolds (inlet and outlet), multi-port tubes with the hydraulic diameters smaller than 1mm, and fins. All the elements usually brazed together using controllable atmosphere brazing process. Microchannel heat exchangers are characterized by high heat transfer ratio, low refrigerant charges, compact size, and lower airside pressure drops compared to finned tube heat exchangers.^[*citation needed*] Microchannel heat exchangers are widely used in automotive industry as the car radiators, and as condenser, evaporator, and cooling/heating coils in HVAC industry.

Main article: Micro heat exchanger

Micro heat exchangers, **Micro-scale heat exchangers**, or **microstructured heat exchangers** are heat exchangers in which (at least one) fluid flows in lateral confinements with typical dimensions below 1 mm. The most typical such confinement are microchannels, which are channels with a hydraulic diameter below 1 mm.

Microchannel heat exchangers can be made from metal or ceramics.^[¹³]

Microchannel heat exchangers can be used for many applications including:

- high-performance aircraft gas turbine engines^[¹⁴]
- heat pumps^[¹⁵]
- Microprocessor and microchip cooling^[¹⁶]
- air conditioning^[¹⁷]

HVAC and refrigeration air coils

[edit]

One of the widest uses of heat exchangers is for refrigeration and air conditioning. This class of heat exchangers is commonly called *air coils*, or just *coils* due to their often-serpentine internal tubing, or condensers in the case of refrigeration, and are typically of the finned tube type. Liquid-to-air, or air-to-liquid HVAC coils are typically of modified crossflow arrangement. In vehicles, heat coils are often called heater cores.

On the liquid side of these heat exchangers, the common fluids are water, a water-glycol solution, steam, or a refrigerant. For *heating coils*, hot water and steam are the most common, and this heated fluid is supplied by boilers, for example. For *cooling coils*, chilled water and refrigerant are most common. Chilled water is supplied from a chiller that is potentially located very far away, but refrigerant must come from a nearby condensing unit. When a refrigerant is used, the cooling coil is the evaporator, and the heating coil is the condenser in the vapor-compression refrigeration cycle. HVAC coils that use this direct-expansion of refrigerants are commonly called *DX coils*. Some *DX coils* are "microchannel" type.^[5]

On the air side of HVAC coils a significant difference exists between those used for heating, and those for cooling. Due to psychrometrics, air that is cooled often has moisture condensing out of it, except with extremely dry air flows. Heating some air increases that airflow's capacity to hold water. So heating coils need not consider moisture condensation on their air-side, but cooling coils *must* be adequately designed and selected to handle their particular *latent* (moisture) as well as the *sensible* (cooling) loads. The water that is removed is called *condensate*.

For many climates, water or steam HVAC coils can be exposed to freezing conditions. Because water expands upon freezing, these somewhat expensive and difficult to replace thin-walled heat exchangers can easily be damaged or destroyed by just one freeze. As such, freeze protection of coils is a major concern of HVAC designers, installers, and operators.

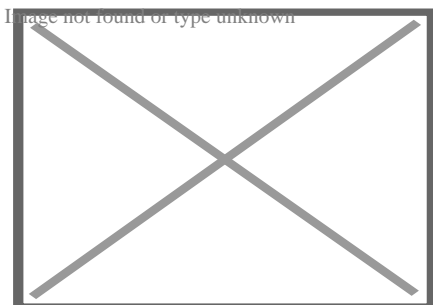
The introduction of indentations placed within the heat exchange fins controlled condensation, allowing water molecules to remain in the cooled air.^[18]

The heat exchangers in direct-combustion furnaces, typical in many residences, are not 'coils'. They are, instead, gas-to-air heat exchangers that are typically made of stamped steel sheet metal. The combustion products pass on one side of these heat exchangers, and air to heat on the other. A *cracked heat exchanger* is therefore a dangerous situation that requires immediate attention because combustion products

may enter living space.

Helical-coil

[edit]



Helical-Coil Heat Exchanger sketch, which consists of a shell, core, and tubes (Scott S. Haraburda design)

Although double-pipe heat exchangers are the simplest to design, the better choice in the following cases would be the helical-coil heat exchanger (HCHE):

- The main advantage of the HCHE, like that for the Spiral heat exchanger (SHE), is its highly efficient use of space, especially when it's limited and not enough straight pipe can be laid.^[19]
- Under conditions of low flowrates (or laminar flow), such that the typical shell-and-tube exchangers have low heat-transfer coefficients and becoming uneconomical.^[19]
- When there is low pressure in one of the fluids, usually from accumulated pressure drops in other process equipment.^[19]
- When one of the fluids has components in multiple phases (solids, liquids, and gases), which tends to create mechanical problems during operations, such as plugging of small-diameter tubes.^[20] Cleaning of helical coils for these multiple-phase fluids can prove to be more difficult than its shell and tube counterpart; however the helical coil unit would require cleaning less often.

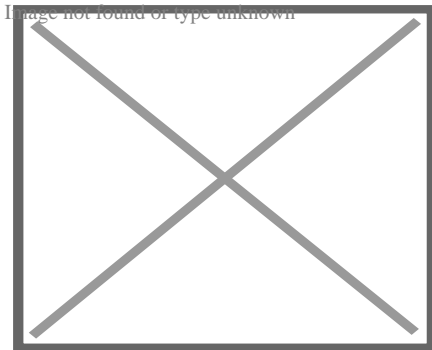
These have been used in the nuclear industry as a method for exchanging heat in a sodium system for large liquid metal fast breeder reactors since the early 1970s, using an HCHE device invented by Charles E. Boardman and John H. Germer.^[21] There are several simple methods for designing HCHE for all types of manufacturing industries, such as using the Ramachandra K. Patil (et al.) method from India and the Scott S. Haraburda method from the United States.^{[19][20]}

However, these are based upon assumptions of estimating inside heat transfer coefficient, predicting flow around the outside of the coil, and upon constant heat flux. [

22]

Spiral

[edit]



Schematic drawing of a spiral heat exchanger

A modification to the perpendicular flow of the typical HCHE involves the replacement of shell with another coiled tube, allowing the two fluids to flow parallel to one another, and which requires the use of different design calculations.^[23] These are the Spiral Heat Exchangers (SHE), which may refer to a helical (coiled) tube configuration, more generally, the term refers to a pair of flat surfaces that are coiled to form the two channels in a counter-flow arrangement. Each of the two channels has one long curved path. A pair of fluid ports are connected tangentially to the outer arms of the spiral, and axial ports are common, but optional.^[24]

The main advantage of the SHE is its highly efficient use of space. This attribute is often leveraged and partially reallocated to gain other improvements in performance, according to well known tradeoffs in heat exchanger design. (A notable tradeoff is capital cost vs operating cost.) A compact SHE may be used to have a smaller footprint and thus lower all-around capital costs, or an oversized SHE may be used to have less pressure drop, less pumping energy, higher thermal efficiency, and lower energy costs.

Construction

[edit]

The distance between the sheets in the spiral channels is maintained by using spacer studs that were welded prior to rolling. Once the main spiral pack has been rolled, alternate top and bottom edges are welded and each end closed by a gasketed flat or conical cover bolted to the body. This ensures no mixing of the two fluids occurs. Any leakage is from the periphery cover to the atmosphere, or to a passage that contains

the same fluid.[²⁵]

Self cleaning

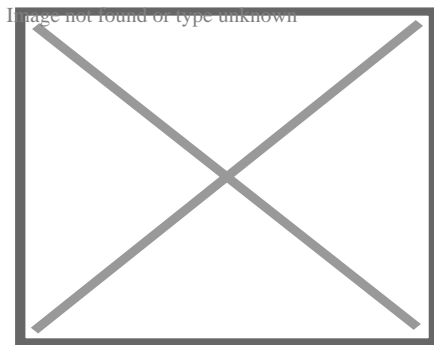
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Spiral heat exchangers are often used in the heating of fluids that contain solids and thus tend to foul the inside of the heat exchanger. The low pressure drop lets the SHE handle fouling more easily. The SHE uses a “self cleaning” mechanism, whereby fouled surfaces cause a localized increase in fluid velocity, thus increasing the drag (or fluid friction) on the fouled surface, thus helping to dislodge the blockage and keep the heat exchanger clean. "The internal walls that make up the heat transfer surface are often rather thick, which makes the SHE very robust, and able to last a long time in demanding environments."^[citation needed] They are also easily cleaned, opening out like an oven where any buildup of foulant can be removed by pressure washing.

Self-cleaning water filters are used to keep the system clean and running without the need to shut down or replace cartridges and bags.

Flow arrangements

[edit]



A comparison between the operations and effects of a **cocurrent and a countercurrent flow exchange system** is depicted by the upper and lower diagrams respectively. In both it is assumed (and indicated) that red has a higher value (e.g. of temperature) than blue and that the property being transported in the channels therefore flows from red to blue. Channels are contiguous if effective exchange is to occur (i.e. there can be no gap between the channels).

There are three main types of flows in a spiral heat exchanger:

- **Counter-current Flow:** Fluids flow in opposite directions. These are used for liquid-liquid, condensing and gas cooling applications. Units are usually mounted

vertically when condensing vapour and mounted horizontally when handling high concentrations of solids.

- **Spiral Flow/Cross Flow:** One fluid is in spiral flow and the other in a cross flow. Spiral flow passages are welded at each side for this type of spiral heat exchanger. This type of flow is suitable for handling low density gas, which passes through the cross flow, avoiding pressure loss. It can be used for liquid-liquid applications if one liquid has a considerably greater flow rate than the other.
- **Distributed Vapour/Spiral flow:** This design is that of a condenser, and is usually mounted vertically. It is designed to cater for the sub-cooling of both condensate and non-condensables. The coolant moves in a spiral and leaves via the top. Hot gases that enter leave as condensate via the bottom outlet.

Applications

[edit]

The Spiral heat exchanger is good for applications such as pasteurization, digester heating, heat recovery, pre-heating (see: recuperator), and effluent cooling. For sludge treatment, SHEs are generally smaller than other types of heat exchangers. ^{[citation ne} These are used to transfer the heat.

Selection

[edit]

Due to the many variables involved, selecting optimal heat exchangers is challenging. Hand calculations are possible, but many iterations are typically needed. As such, heat exchangers are most often selected via computer programs, either by system designers, who are typically engineers, or by equipment vendors.

To select an appropriate heat exchanger, the system designers (or equipment vendors) would firstly consider the design limitations for each heat exchanger type. Though cost is often the primary criterion, several other selection criteria are important:

- High/low pressure limits
- Thermal performance
- Temperature ranges
- Product mix (liquid/liquid, particulates or high-solids liquid)
- Pressure drops across the exchanger
- Fluid flow capacity
- Cleanability, maintenance and repair

- Materials required for construction
- Ability and ease of future expansion
- Material selection, such as copper, aluminium, carbon steel, stainless steel, nickel alloys, ceramic, polymer, and titanium.[²⁶][²⁷]

Small-diameter coil technologies are becoming more popular in modern air conditioning and refrigeration systems because they have better rates of heat transfer than conventional sized condenser and evaporator coils with round copper tubes and aluminum or copper fin that have been the standard in the HVAC industry. Small diameter coils can withstand the higher pressures required by the new generation of environmentally friendlier refrigerants. Two small diameter coil technologies are currently available for air conditioning and refrigeration products: copper microgroove [²⁸] and brazed aluminum microchannel. [*citation needed*]

Choosing the right heat exchanger (HX) requires some knowledge of the different heat exchanger types, as well as the environment where the unit must operate. Typically in the manufacturing industry, several differing types of heat exchangers are used for just one process or system to derive the final product. For example, a kettle HX for pre-heating, a double pipe HX for the 'carrier' fluid and a plate and frame HX for final cooling. With sufficient knowledge of heat exchanger types and operating requirements, an appropriate selection can be made to optimise the process.[²⁹]

Monitoring and maintenance

[edit]

Online monitoring of commercial heat exchangers is done by tracking the overall heat transfer coefficient. The overall heat transfer coefficient tends to decline over time due to fouling.

By periodically calculating the overall heat transfer coefficient from exchanger flow rates and temperatures, the owner of the heat exchanger can estimate when cleaning the heat exchanger is economically attractive.

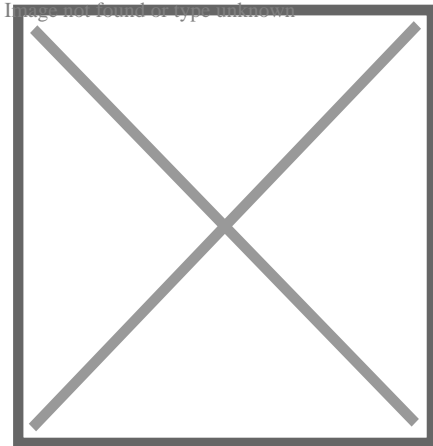
Integrity inspection of plate and tubular heat exchanger can be tested in situ by the conductivity or helium gas methods. These methods confirm the integrity of the plates or tubes to prevent any cross contamination and the condition of the gaskets.

Mechanical integrity monitoring of heat exchanger tubes may be conducted through Nondestructive methods such as eddy current testing.

Fouling

[edit]

Main article: Fouling



A heat exchanger in a steam power station contaminated with macrofouling

Fouling occurs when impurities deposit on the heat exchange surface. Deposition of these impurities can decrease heat transfer effectiveness significantly over time and are caused by:

- Low wall shear stress
- Low fluid velocities
- High fluid velocities
- Reaction product solid precipitation
- Precipitation of dissolved impurities due to elevated wall temperatures

The rate of heat exchanger fouling is determined by the rate of particle deposition less re-entrainment/suppression. This model was originally proposed in 1959 by Kern and Seaton.

Crude Oil Exchanger Fouling. In commercial crude oil refining, crude oil is heated from 21 °C (70 °F) to 343 °C (649 °F) prior to entering the distillation column. A series of shell and tube heat exchangers typically exchange heat between crude oil and other oil streams to heat the crude to 260 °C (500 °F) prior to heating in a furnace. Fouling occurs on the crude side of these exchangers due to asphaltene insolubility. The nature of asphaltene solubility in crude oil was successfully modeled by Wiehe and Kennedy.^[30] The precipitation of insoluble asphaltenes in crude preheat trains has been successfully modeled as a first order reaction by Ebert and Panchal^[31] who expanded on the work of Kern and Seaton.

Cooling Water Fouling. Cooling water systems are susceptible to fouling. Cooling water typically has a high total dissolved solids content and suspended colloidal solids. Localized precipitation of dissolved solids occurs at the heat exchange surface

due to wall temperatures higher than bulk fluid temperature. Low fluid velocities (less than 3 ft/s) allow suspended solids to settle on the heat exchange surface. Cooling water is typically on the tube side of a shell and tube exchanger because it's easy to clean. To prevent fouling, designers typically ensure that cooling water velocity is greater than 0.9 m/s and bulk fluid temperature is maintained less than 60 °C (140 °F). Other approaches to control fouling control combine the "blind" application of biocides and anti-scale chemicals with periodic lab testing.

Maintenance

[edit]

Plate and frame heat exchangers can be disassembled and cleaned periodically. Tubular heat exchangers can be cleaned by such methods as acid cleaning, sandblasting, high-pressure water jet, bullet cleaning, or drill rods.

In large-scale cooling water systems for heat exchangers, water treatment such as purification, addition of chemicals, and testing, is used to minimize fouling of the heat exchange equipment. Other water treatment is also used in steam systems for power plants, etc. to minimize fouling and corrosion of the heat exchange and other equipment.

A variety of companies have started using water borne oscillations technology to prevent biofouling. Without the use of chemicals, this type of technology has helped in providing a low-pressure drop in heat exchangers.

Design and manufacturing regulations

[edit]

The design and manufacturing of heat exchangers has numerous regulations, which vary according to the region in which they will be used.

Design and manufacturing codes include: ASME Boiler and Pressure Vessel Code (US); PD 5500 (UK); BS 1566 (UK);^[32] EN 13445 (EU); CODAP (French); Pressure Equipment Safety Regulations 2016 (PER) (UK); Pressure Equipment Directive (EU); NOROK (Norwegian); TEMA;^[33] API 12; and API 560.^[*citation needed*]

In nature

[edit]

Humans

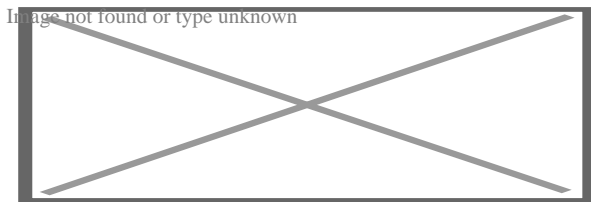
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The human nasal passages serve as a heat exchanger, with cool air being inhaled and warm air being exhaled. Its effectiveness can be demonstrated by putting the hand in front of the face and exhaling, first through the nose and then through the mouth. Air exhaled through the nose is substantially cooler.^{[34][35]} This effect can be enhanced with clothing, by, for example, wearing a scarf over the face while breathing in cold weather.

In species that have external testes (such as human), the artery to the testis is surrounded by a mesh of veins called the pampiniform plexus. This cools the blood heading to the testes, while reheating the returning blood.

Birds, fish, marine mammals

[edit]



Counter-current exchange conservation circuit

Further information: Counter-current exchange in biological systems

"Countercurrent" heat exchangers occur naturally in the circulatory systems of fish, whales and other marine mammals. Arteries to the skin carrying warm blood are intertwined with veins from the skin carrying cold blood, causing the warm arterial blood to exchange heat with the cold venous blood. This reduces the overall heat loss in cold water. Heat exchangers are also present in the tongues of baleen whales as large volumes of water flow through their mouths.^{[36][37]} Wading birds use a similar system to limit heat losses from their body through their legs into the water.

Carotid rete

[edit]

Carotid rete is a counter-current heat exchanging organ in some ungulates. The blood ascending the carotid arteries on its way to the brain, flows via a network of vessels

where heat is discharged to the veins of cooler blood descending from the nasal passages. The carotid rete allows Thomson's gazelle to maintain its brain almost 3 °C (5.4 °F) cooler than the rest of the body, and therefore aids in tolerating bursts in metabolic heat production such as associated with outrunning cheetahs (during which the body temperature exceeds the maximum temperature at which the brain could function).[³⁸] Humans with other primates lack a carotid rete.[³⁹]

In industry

[edit]

Heat exchangers are widely used in industry both for cooling and heating large scale industrial processes. The type and size of heat exchanger used can be tailored to suit a process depending on the type of fluid, its phase, temperature, density, viscosity, pressures, chemical composition and various other thermodynamic properties.

In many industrial processes there is waste of energy or a heat stream that is being exhausted, heat exchangers can be used to recover this heat and put it to use by heating a different stream in the process. This practice saves a lot of money in industry, as the heat supplied to other streams from the heat exchangers would otherwise come from an external source that is more expensive and more harmful to the environment.

Heat exchangers are used in many industries, including:

- Waste water treatment
- Refrigeration
- Wine and beer making
- Petroleum refining
- Nuclear power

In waste water treatment, heat exchangers play a vital role in maintaining optimal temperatures within anaerobic digesters to promote the growth of microbes that remove pollutants. Common types of heat exchangers used in this application are the double pipe heat exchanger as well as the plate and frame heat exchanger.

In aircraft

[edit]

In commercial aircraft heat exchangers are used to take heat from the engine's oil system to heat cold fuel.[⁴⁰] This improves fuel efficiency, as well as reduces the possibility of water entrapped in the fuel freezing in components.[⁴¹]

Current market and forecast

[edit]

Estimated at US\$17.5 billion in 2021, the global demand of heat exchangers is expected to experience robust growth of about 5% annually over the next years. The market value is expected to reach US\$27 billion by 2030. With an expanding desire for environmentally friendly options and increased development of offices, retail sectors, and public buildings, market expansion is due to grow.^[42]

A model of a simple heat exchanger

[edit]

A simple heat exchange ^[43]^[44] might be thought of as two straight pipes with fluid flow, which are thermally connected. Let the pipes be of equal length L , carrying fluids with heat capacity c (unit mass per unit change in temperature) and let the mass flow rate of the fluids through the pipes, both in the same direction, be \dot{m}_i (mass per unit time), where the subscript i applies to pipe 1 or pipe 2.

Temperature profiles for the pipes are $T_1(x)$ and $T_2(x)$ where x is the distance along the pipe. Assume a steady state, so that the temperature profiles are not functions of time. Assume also that the only transfer of heat from a small volume of fluid in one pipe is to the fluid element in the other pipe at the same position, i.e., there is no transfer of heat along a pipe due to temperature differences in that pipe. By Newton's law of cooling the rate of change in energy of a small volume of fluid is proportional to the difference in temperatures between it and the corresponding element in the other pipe:

$$\frac{du_1}{dt} = \gamma (T_2 - T_1)$$

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$$\frac{du_2}{dt} = \gamma (T_1 - T_2)$$

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(this is for parallel flow in the same direction and opposite temperature gradients, but for counter-flow heat exchange countercurrent exchange the sign is opposite in the second equation in front of γ) where $u_i(x)$ is the thermal energy per unit length and γ is the thermal connection constant per unit length between the two pipes. This change in internal energy results in a change in the temperature of the fluid element. The time rate of change for the fluid element being carried along by the flow is:

$$\frac{du_1}{dt} = J_1 \frac{dT_1}{dx}$$

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$$\frac{du_2}{dt} = J_2 \frac{dT_2}{dx}$$

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where J_1 is the "thermal mass flow rate". The differential equations governing the heat exchanger may now be written as:

$$J_1 \frac{\partial T_1}{\partial x} = \gamma (T_2 - T_1)$$

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$$J_2 \frac{\partial T_2}{\partial x} = \gamma (T_1 - T_2).$$

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Since the system is in a steady state, there are no partial derivatives of temperature with respect to time, and since there is no heat transfer along the pipe, there are no second derivatives in x as is found in the heat equation. These two coupled first-order differential equations may be solved to yield:

$$T_1 = A - \frac{Bk_1}{k}, e^{-kx}$$

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$$T_2 = A + \frac{Bk_2}{k}, e^{-kx}$$

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where $k = \frac{\gamma(J_1 + J_2)}{k_1 + k_2}$

$$k = k_1 + k_2$$

(this is for parallel-flow, but for counter-flow the sign in front of k_2 that if J_1 and J_2 are the same "thermal mass flow rate" in both opposite directions, the gradient of temperature is constant and the temperatures linear in position x with a constant difference $(T_2 - T_1)$ along the exchanger, explaining why the counter current design countercurrent exchange is the most efficient)

and A and B are two as yet undetermined constants of integration. Let T_1 and T_2 be the temperatures at $x=0$ and let T_1 and T_2 be the temperatures at the end of the pipe at $x=L$. Define the average temperatures in each pipe as:

$$\overline{T_1} = \frac{1}{L} \int_0^L T_1(x) dx$$

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$$\overline{T_2} = \frac{1}{L} \int_0^L T_2(x) dx.$$

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Using the solutions above, these temperatures are:

$$T_{10} = A - \frac{Bk_1}{k} \quad T_{20} = A + \frac{Bk_2}{k}$$

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$$T_{1L} = A - \frac{Bk_1}{k} e^{-kL} \quad T_{2L} = A + \frac{Bk_2}{k} e^{-kL}$$

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$$\overline{T}_1 = A - \frac{Bk_1}{k} \frac{1 - e^{-kL}}{2L} \quad \overline{T}_2 = A + \frac{Bk_2}{k} \frac{1 - e^{-kL}}{2L}$$

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Choosing any two of the temperatures above eliminates the constants of integration, letting us find the other four temperatures. We find the total energy transferred by integrating the expressions for the time rate of change of internal energy per unit length:

$$\frac{dU_1}{dt} = \int_0^L \frac{du_1}{dt} dx = J_1 (T_{1L} - T_{10}) = \gamma L (\overline{T}_2 - \overline{T}_1)$$

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$$\frac{dU_2}{dt} = \int_0^L \frac{du_2}{dt} dx = J_2 (T_{2L} - T_{20}) = \gamma L (\overline{T}_1 - \overline{T}_2)$$

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By the conservation of energy, the sum of the two energies is zero. The quantity $\frac{\overline{T}_2 - \overline{T}_1}{\overline{T}_2 + \overline{T}_1}$ is known as the *Log mean temperature difference*, and is a measure of the effectiveness of the heat exchanger in transferring heat energy.

See also

[edit]

- Architectural engineering
- Chemical engineering
- Cooling tower
- Copper in heat exchangers
- Heat pipe
- Heat pump
- Heat recovery ventilation
- Jacketed vessel
- Log mean temperature difference (LMTD)
- Marine heat exchangers
- Mechanical engineering
- Micro heat exchanger
- Moving bed heat exchanger
- Packed bed and in particular Packed columns

- Pumpable ice technology
- Reboiler
- Recuperator, or cross plate heat exchanger
- Regenerator
- Run around coil
- Steam generator (nuclear power)
- Surface condenser
- Toroidal expansion joint
- Thermosiphon
- Thermal wheel, or rotary heat exchanger (including enthalpy wheel and desiccant wheel)
- Tube tool
- Waste heat

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Heating, ventilation, and air conditioning

Fundamental concepts

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

- 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

Technology

- 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

**Measurement
and control**

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

**Professions,
trades,
and services**

Industry organizations

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

Health and safety

See also

About Durham Supply Inc

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Things To Do in Tulsa County

Photo

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Blue Whale of Catoosa

4.5 (3899)

Photo

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Bob Dylan Center

4.9 (245)

Photo

Oxley Nature Center

4.8 (563)

Photo

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The Outsiders House Museum

4.7 (885)

Photo

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Gathering Place

4.8 (12116)

Photo

Tours of Tulsa

4.9 (291)

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Mobile home supply store

Air conditioning repair service

Air conditioning store

Air conditioning system supplier

Reviews for Durham Supply Inc

Durham Supply Inc

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Ty Spears

(5)

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

Durham Supply Inc

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Ethel Schiller

(5)

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

Durham Supply Inc

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Gerald Clifford Brewster

(5)

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

Durham Supply Inc

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B Mann

(5)

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

Durham Supply Inc

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Dennis Champion

(5)

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

Checking Warranties Offered by Various Mobile Home HVAC Brands [View GBP](#)

Check our other pages :

- [Identifying Compatible Parts Across Multiple Mobile Home Brands](#)
- [Navigating Trane Models for Mobile Home Heating](#)
- [Setting Up Installment Plans for Mobile Home Furnace Upgrades](#)
- [Adapting Different Brand Coils and Compressors for Mobile Home Use](#)
- [Assessing Future Upgrade Paths for Mobile Home AC Brand Choices](#)

Frequently Asked Questions

What is the typical warranty duration offered by mobile home HVAC brands for new installations?

The typical warranty duration for mobile home HVAC systems varies by brand, but it generally ranges from 5 to 10 years for parts, with some manufacturers offering extended warranties on components like compressors or heat exchangers.

Do warranties on mobile home HVAC systems cover both parts and labor?

Most standard warranties cover parts only. Labor coverage can vary significantly; some brands offer limited labor coverage in the first year, while others may require purchasing an extended service plan for labor costs.

Are there specific maintenance requirements needed to keep a mobile home HVAC systems warranty valid?

Yes, most warranties require regular maintenance checks by certified technicians to remain valid. This typically includes annual inspections and servicing such as filter replacements and system cleanings as specified in the warranty terms.

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

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