Air Quality

- Mapping Duct Layouts for Cleaner Airflow in Mobile Homes
  Mapping Duct Layouts for Cleaner Airflow in Mobile Homes Inspecting Vent Connections for Improved Air Quality Minimizing Drafts Through Sealed Mobile Home Duct Systems Scheduling Regular Cleanings for Mobile Home Ventilation Evaluating Filter Efficiency for Enhanced Mobile Home Air Quality Addressing Mold Risks in Mobile Home Ductwork Installing Air Purification Systems in Mobile Homes Checking Air Pressure to Reduce Allergens in Mobile Home Interiors Identifying Common Leaks in Flexible Mobile Home Ducts Balancing Humidity Levels for Healthier Mobile Home Air Considering UV Technology for Mobile Home Air Treatment Using Diagnostic Tools to Assess Air Quality in Mobile Homes
- Preparing Mobile Home HVAC Units for Intense Summer Heat
  Preparing Mobile Home HVAC Units for Intense Summer Heat Protecting Mobile Home Furnaces During Low Temperature Periods Coping with Storm Related Damage to Mobile Home Air Conditioners Adjusting Climate Control in Mobile Homes for Coastal Humidity Handling Power Outages in Mobile Home Heating Systems Planning Winterization Steps for Mobile Home HVAC Equipment Adapting Mobile Homes to Rapid Seasonal Swings in Temperature Evaluating Wind Exposure Factors for Mobile Home AC Placement Addressing Extended Rainy Periods in Mobile Home Ventilation Considering Local Building Codes for Mobile Home Climate Adaptations Balancing Heat Needs in Mobile Homes Across Different Regions Checking Insurance Coverage for Storm Damaged Mobile Home AC Units
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Considering Local Building Codes for Mobile Home Climate Adaptations

Importance of Efficient Duct Layouts for Airflow

Mobile homes, often seen as a cost-effective and flexible housing solution, are increasingly facing a multitude of climate challenges that necessitate thoughtful adaptations. As the impacts of climate change become more pronounced, these structures are subjected to weather extremes like hurricanes, tornadoes, wildfires, and flooding. In this context, considering local building codes becomes crucial for ensuring the resilience and safety of mobile homes.

One primary challenge is the vulnerability of mobile homes to severe weather events. Their lightweight construction makes them particularly susceptible to high winds and storms. Refrigerant levels should be checked regularly in mobile home systems **mobile home hvac units** energy. Hurricanes can cause devastating damage, stripping away roofs or even overturning entire units. Similarly, tornadoes pose a significant threat due to their powerful winds that can easily dismantle these structures. Therefore, adapting mobile homes to withstand such forces is imperative.

Local building codes play a pivotal role in fortifying mobile homes against these environmental threats. By enforcing standards that emphasize structural integrity and resilience, building codes can mandate the use of reinforced materials or require anchoring systems that secure the home more effectively to its foundation. These measures are essential not only for protecting property but also for safeguarding lives during extreme weather events.

Another pressing issue is temperature regulation within mobile homes amidst rising global temperatures. Mobile homes often lack the insulation found in traditional houses, leading to inefficient heating and cooling which can exacerbate health risks during heatwaves or cold spells. Building codes could encourage or require improvements in thermal insulation and energy efficiency standards, promoting the use of better insulating materials and energy-efficient appliances.

Furthermore, water management presents another hurdle as climate change intensifies rainfall patterns leading to increased flooding incidents. Mobile homes situated in flood-prone areas face heightened risk unless proper drainage systems are implemented. Local building codes could address this by specifying elevation requirements above expected flood levels or mandating flood-proofing measures like waterproof barriers.

Wildfire exposure represents yet another critical concern for mobile home communities located near forested regions or wildfire-prone areas. The flammable nature of materials traditionally used in mobile home construction increases vulnerability during fires. To mitigate this risk, local building codes might require fire-resistant materials for roofing and siding or create defensible space around properties through strategic landscaping practices.

Adapting mobile homes to meet these diverse climate challenges requires collaboration between policymakers, builders, community members, and environmental experts who understand both regional climatic conditions and innovative design solutions available today. It demands an integrated approach where local building codes reflect current scientific understanding while remaining adaptable enough to evolve alongside ongoing changes in our environment.

In conclusion, as climate change continues posing complex challenges across various sectors globally-housing being no exception-it becomes increasingly evident how vital it is for mobile home owners/operators/local authorities alike engage actively with evolving local building regulations aimed at enhancing overall resilience against future uncertainties posed by changing climates worldwide thereby ensuring safer living environments now into foreseeable future generations alike!

When considering local building codes for mobile home climate adaptations, it is essential to address the specific HVAC (Heating, Ventilation, and Air Conditioning) requirements for different climates. Mobile homes, often more susceptible to environmental conditions due to their construction and location flexibility, must be equipped with HVAC systems tailored to the unique demands of their surroundings.

In colder climates, such as those found in northern regions, mobile homes require robust heating solutions. This need arises from both the severity and duration of cold weather, which can lead to increased energy consumption if not properly addressed. Building codes in these areas often mandate higher insulation standards, ensuring that heat is retained effectively within the structure. It is common for mobile homes in these climates to utilize high-efficiency furnaces or heat pumps designed to operate efficiently at lower temperatures. Additionally, proper sealing and the use of double-glazed windows can significantly reduce heat loss.

Conversely, in warmer climates like those prevalent in southern states or desert regions, air conditioning becomes a priority. The intense heat necessitates an HVAC system capable of maintaining a comfortable indoor environment despite soaring outdoor temperatures. Local building codes may require reflective roofing materials or additional ventilation options such as attic fans to mitigate thermal load on the structure. High-efficiency air conditioning units are crucial here and should be paired with programmable thermostats that optimize cooling schedules according to occupancy patterns.

Humid climates present another set of challenges where moisture control becomes paramount. This requirement is typical in coastal or tropical areas where high humidity can lead to mold growth and structural damage if not managed correctly. Building codes often emphasize effective ventilation strategies combined with dehumidification capabilities integrated into HVAC systems. Ensuring adequate airflow through strategically placed vents helps maintain indoor air quality while preventing excessive moisture accumulation.

Finally, arid climates demand specialized considerations for dust management alongside temperature regulation. In these environments, filtration systems play a pivotal role in maintaining air quality by capturing fine particulates that might otherwise infiltrate living spaces through open windows or doors.

Understanding these diverse climatic demands underscores the importance of aligning mobile home climate adaptations with local building codes focusing on specific HVAC requirements. By doing so, occupants not only ensure compliance but also enhance comfort and efficiency within their living spaces regardless of external environmental conditions.

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Techniques for Mapping Duct Layouts

When considering the installation and modification of HVAC systems in mobile homes, one cannot overlook the critical role local building codes play. These regulations are designed to ensure safety, efficiency, and environmental sustainability in residential construction and renovation projects. For mobile homes, which often face unique challenges due to their size and design, adhering to these codes is particularly essential to create a comfortable and safe living environment.

Local building codes provide a framework that governs how HVAC systems should be installed or modified within any dwelling, including mobile homes. These codes take into account factors such as climate conditions, energy efficiency standards, and safety requirements specific to each region. For instance, in areas with extreme temperatures, whether scorching summers or frigid winters, there may be stricter guidelines on insulation levels and system capacities to ensure adequate climate control.

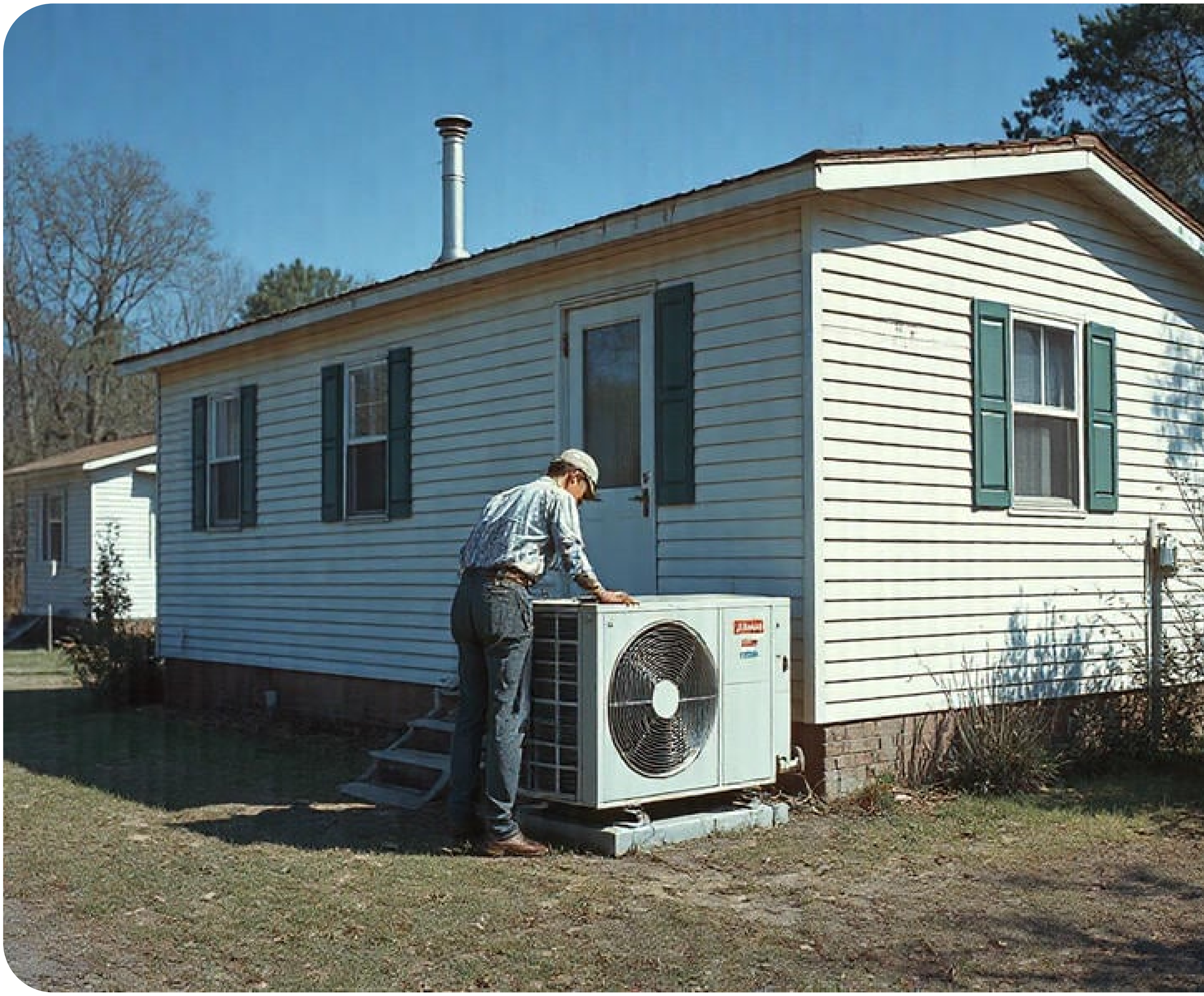
One of the primary considerations under local building codes is the energy efficiency of HVAC systems. Regulations may require installations that meet certain Seasonal Energy Efficiency Ratio (SEER) ratings or Heating Seasonal Performance Factor (HSPF) for heating units. These criteria not only help reduce environmental impact but also lower energy costs for homeowners-a crucial benefit given the typically smaller budgets associated with mobile home ownership.

Another significant aspect influenced by local building codes is safety. Proper ventilation is mandated to prevent issues like carbon monoxide buildup or moisture accumulation that could lead to mold growth. Building codes typically specify minimum ventilation rates and require particular materials or installation techniques to mitigate such risks effectively.

Moreover, structural limitations inherent in mobile homes can also dictate specific considerations when installing or modifying HVAC systems. Building codes often address these constraints by providing guidance on unit sizing and placement to avoid overloading the home's structure while ensuring optimal performance of the system.

Compliance with these regulations not only guarantees adherence to legal standards but also enhances the long-term viability of the investment made in upgrading a mobile home's HVAC system. By following local building codes during installation or modifications, homeowners can ensure their systems operate safely and efficiently while maintaining indoor comfort across varying external weather conditions.

In conclusion, understanding and considering local building codes is indispensable when dealing with HVAC installations in mobile homes. These regulations safeguard both occupants' well-being and financial investment by ensuring installations meet necessary performance metrics while complying with regional safety norms. As such, engaging knowledgeable professionals familiar with local regulations becomes paramount for successful implementation of climate adaptations in mobile home settings.



Tools and Technologies for Accurate Duct Mapping

Evaluating energy efficiency standards in local regulations is a crucial step when considering local building codes for mobile home climate adaptations. As climate change continues to impact weather patterns and intensify environmental conditions, it becomes increasingly important to ensure that mobile homes, often more vulnerable to such changes, are equipped with the necessary adaptations to maintain energy efficiency and resilience.

Mobile homes, traditionally known for their affordability and quick assembly, are often less insulated and more susceptible to extreme temperatures compared to conventional housing. This makes them particularly sensitive to shifts in climate, which can lead to increased energy consumption for heating or cooling purposes. Therefore, evaluating the energy efficiency standards embedded within local building codes becomes essential not only for reducing utility costs for residents but also for minimizing the carbon footprint associated with these dwellings.

Local regulations play a pivotal role in setting the baseline requirements for construction and retrofitting of mobile homes. These standards ensure that new constructions meet specific criteria that can withstand local climatic conditions. By integrating enhanced insulation materials, advanced HVAC systems, and renewable energy sources such as solar panels into these regulations, local authorities can significantly improve the energy performance of mobile homes.

However, merely having these standards is not enough; they need continuous evaluation and updating to keep pace with technological advancements and emerging climate data. For instance, regions experiencing increased frequency of heatwaves may need stricter insulation requirements or incentives for installing reflective roofing materials that can mitigate heat absorption.

Moreover, evaluating these standards offers an opportunity to address disparities in living conditions among different communities. Often, low-income populations are disproportionately affected by inefficient housing due to financial constraints limiting access to newer or upgraded units. Ensuring robust energy efficiency standards within local building codes could help bridge this gap by making it mandatory for all new developments or retrofits to comply with sustainable practices.

In conclusion, evaluating energy efficiency standards within the framework of local building codes is vital when adapting mobile homes for changing climates. It requires a collaborative approach involving policymakers, industry experts, and community stakeholders to develop comprehensive strategies that enhance resilience while promoting sustainability. By prioritizing energy-efficient adaptations today, we pave the way towards a more equitable and environmentally conscious future for all residents living in mobile homes.

Best Practices for Cleaner Airflow

In the ever-evolving landscape of climate change, successful HVAC adaptations in mobile homes have become crucial for ensuring comfort and safety. As temperatures rise and weather patterns shift, mobile homes-often considered more vulnerable to extreme weather conditions-require innovative heating, ventilation, and air conditioning solutions that comply with local building codes. Examining case studies of successful HVAC adaptations provides valuable insights into achieving these objectives.

One notable case study is from Arizona, where a community of mobile homes faced scorching summer heat compounded by outdated cooling systems. Local building codes emphasized energy efficiency to mitigate environmental impact, prompting residents to explore sustainable HVAC solutions. The adaptation involved the installation of energy-efficient ductless mini-split systems that provided precise temperature control while consuming less electricity. By adhering to local codes mandating energy conservation and efficiency standards, residents not only reduced their carbon footprint but also significantly lowered utility costs.

Similarly, in Florida's hurricane-prone regions, mobile home communities confronted challenges posed by high humidity levels and frequent storms. Here, compliance with local building codes required robust ventilation systems capable of withstanding harsh weather conditions. A successful project involved retrofitting mobile homes with advanced dehumidification units integrated into the existing HVAC systems. This adaptation improved indoor air quality and prevented mold growth-a common issue in humid climates-while meeting stringent code requirements for moisture control.

In colder climates like Michigan, where winter temperatures can plummet dramatically, ensuring adequate insulation alongside efficient heating is paramount. A case study from this region highlighted a collaboration between mobile home owners and local authorities to upgrade insulation materials while installing modern heat pump systems. These efforts were guided by building codes focused on reducing heat loss and promoting efficient energy use during harsh winters. The result was a dramatic increase in thermal comfort within these homes without incurring excessive heating costs.

These case studies underscore the importance of considering local building codes when adapting HVAC systems in mobile homes for climate resilience. By doing so, communities can achieve a balance between regulatory compliance and practical solutions tailored to their unique environmental challenges. Moreover, these adaptations serve as blueprints for other regions facing similar issues, illustrating how thoughtful integration of technology and regulation can lead to substantial improvements in living conditions.

In conclusion, addressing climate-related challenges in mobile homes through successful HVAC adaptations requires an understanding of both technological advancements and regulatory frameworks. As demonstrated by these case studies from diverse climates across the United States, aligning adaptation strategies with local building codes not only ensures compliance but also fosters sustainability and economic benefits for residents. Through continued innovation and cooperation among stakeholders, it is possible to create safer and more comfortable living environments despite the unpredictability of our changing climate.

Case Studies of Improved Air Quality in Mobile Homes

Navigating the intricate web of building code requirements for HVAC systems can be a daunting task for any homeowner, particularly those living in mobile homes. The unique structure and mobility of these homes necessitate careful consideration and adaptation to ensure compliance with local codes while optimizing climate control. Understanding these requirements is essential not only for legal compliance but also for the safety, efficiency, and comfort of your home.

First and foremost, homeowners must familiarize themselves with the specific building codes applicable to their region. These codes are designed to ensure safety standards are met and often vary significantly from one locality to another. For mobile homes, which are inherently different from traditional houses, these differences can be even more pronounced. It's crucial to consult with local building authorities or a knowledgeable professional who can provide insights into regional regulations pertaining to HVAC installations.

One key aspect of adapting mobile homes for climate control involves understanding the limitations and capabilities of the existing structure. Mobile homes typically have less insulation compared to traditional homes, which can affect how heating and cooling systems perform. When considering upgrades or new installations, selecting an HVAC system that matches your home's size and insulation properties is important. This ensures energy efficiency while maintaining a comfortable indoor environment.

Moreover, it is essential to consider the environmental conditions specific to your location. For instance, a mobile home situated in a region with extreme temperatures will require an HVAC system capable of handling such conditions efficiently without overburdening energy resources or violating local energy consumption regulations. Researching energy-efficient models that comply with both federal standards and local ordinances can lead to significant cost savings in the long run.

Another critical factor is ensuring proper installation by certified professionals who understand both mobile home construction nuances and local building codes. Poor installation not only risks non-compliance but also jeopardizes safety and performance. Hiring experienced contractors who adhere strictly to code requirements minimizes potential pitfalls such as leaks or improper ventilation.

Finally, regular maintenance cannot be overstated when it comes to keeping your HVAC system within regulatory standards post-installation. Routine checks help detect issues early on before they escalate into costly repairs or non-compliance problems during inspections by authorities.

In conclusion, navigating building code requirements for HVAC systems in mobile homes demands thorough research into local regulations combined with strategic planning tailored specifically towards your home's needs and environmental conditions. By taking proactive steps-from consulting experts during setup stages through committing diligently towards ongoing maintenance-you pave way not only towards regulatory compliance but also enhance overall living comfort within this distinctive housing environment.

As climate change continues to reshape our environment, the need for more resilient and adaptable housing solutions becomes increasingly critical. Mobile homes, often seen as affordable and flexible living options, are not exempt from this necessity. Building codes play a crucial role in ensuring that mobile homes can withstand extreme weather conditions while also contributing to sustainability goals. As we look into the future, it is essential to consider how evolving building codes will influence mobile home climate adaptation.

One of the anticipated trends in building codes is the integration of climate resilience measures specific to local environmental challenges. This means that areas prone to hurricanes might see stricter requirements for anchoring systems and wind resistance in mobile homes, while regions with high temperatures could require enhanced insulation or reflective roofing materials. By tailoring building codes to address local climatic conditions, communities can ensure that their housing stock is better prepared for the adverse effects of climate change.

Another trend likely to gain traction is the emphasis on energy efficiency within building codes. As energy costs rise and environmental concerns mount, there is a growing push towards reducing the carbon footprint of residential buildings. For mobile homes, which are traditionally less energy-efficient than conventional houses, updated codes may mandate more stringent standards for insulation, window glazing, and HVAC systems. These enhancements not only reduce energy consumption but also improve comfort levels for residents living in fluctuating climates.

The focus on sustainable materials and construction practices is another area where future building codes may evolve. Renewable resources such as bamboo or recycled steel might become standard in mobile home construction guidelines. Additionally, incorporating green technologies like solar panels or rainwater harvesting systems could be incentivized through updated regulations. These changes would not only promote environmental stewardship but also increase the self-sufficiency of mobile homes during extreme weather events when utilities may be disrupted.

Moreover, digital technology's role in monitoring and maintaining compliance with building codes cannot be overlooked. Future codes might incorporate smart home technologies that provide real-time data on structural integrity or energy usage patterns. Such innovations would allow homeowners to make proactive adjustments before minor issues escalate into significant problems due to climatic pressures.

While these potential changes represent positive steps towards creating safer and more sustainable mobile homes, they also come with challenges. Implementing new code requirements can lead to increased costs for manufacturers and consumers alike. Ensuring affordability remains a priority will require careful balancing between necessary improvements and financial accessibility.

In conclusion, as we navigate an era marked by unprecedented environmental shifts, future trends in building codes will undoubtedly shape how mobile homes adapt to climate challenges. By prioritizing local resilience measures, enhancing energy efficiency standards, promoting sustainable practices, and leveraging digital innovations-building codes have the power not only to safeguard vulnerable communities but also contribute positively towards global sustainability efforts. It is imperative that stakeholders collaborate closely during this transformative period-to ensure equitable access across all socioeconomic strata without compromising on safety or quality standards-and ultimately pave the way for resilient futures built upon adaptive foundations tailored specifically against localized threats posed by our changing world dynamics.

About Fan coil unit

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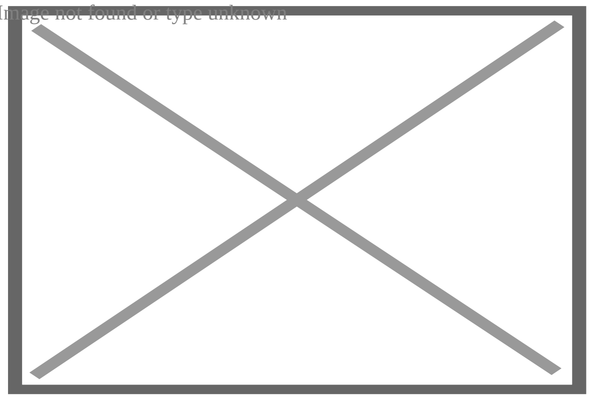

Refrigerant based Fan-Coil Unit. Other variants utilize a chilled, or heated water loop for space cooling, or heating, respectively.

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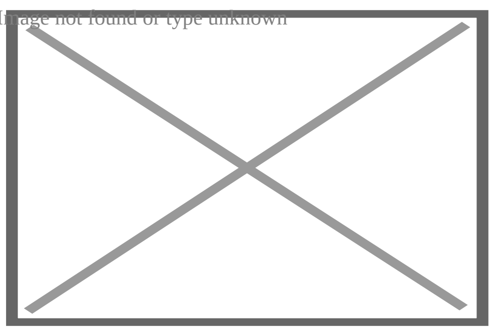

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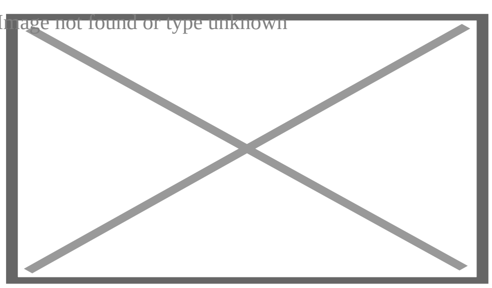

A **fan coil unit** (**FCU**), also known as a **Vertical Fan Coil Unit** (**VFCU**), is a device consisting of a heat exchanger (coil) and a fan. FCUs are commonly used in HVAC systems of residential, commercial, and industrial buildings that use ducted split air conditioning or central plant cooling. FCUs are typically connected to ductwork and a thermostat to regulate the temperature of one or more spaces and to assist the main air handling unit for each space if used with chillers. The thermostat controls the fan speed and/or the flow of water or refrigerant to the heat exchanger using a control valve.

Due to their simplicity, flexibility, and easy maintenance, fan coil units can be more economical to install than ducted 100% fresh air systems (VAV) or central heating systems with air handling units or chilled beams. FCUs come in various configurations, including horizontal (ceiling-mounted) and vertical (floor-mounted), and can be used in a wide range of applications, from small residential units to large commercial and industrial buildings.

Noise output from FCUs, like any other form of air conditioning, depends on the design of the unit and the building materials surrounding it. Some FCUs offer noise levels as low as NR25 or NC25.

The output from an FCU can be established by looking at the temperature of the air entering the unit and the temperature of the air leaving the unit, coupled with the volume of air being moved through the unit. This is a simplistic statement, and there is further reading on sensible heat ratios and the specific heat capacity of air, both of which have an effect on thermal performance.

Design and operation

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Fan Coil Unit covers a range of products and will mean different things to users, specifiers, and installers in different countries and regions, particularly in relation to product size and output capability.

Fan Coil Unit falls principally into two main types: blow through and draw through. As the names suggest, in the first type the fans are fitted behind the heat exchanger, and in the other type the fans are fitted in front the coil such that they draw air through it. Draw through units are considered thermally superior, as ordinarily they make better use of the heat exchanger. However they are more expensive, as they require a chassis to hold the fans whereas a blow-through unit typically consists of a set of fans bolted straight to a coil.

A fan coil unit may be concealed or exposed within the room or area that it serves.

An exposed fan coil unit may be wall-mounted, freestanding or ceiling mounted, and will typically include an appropriate enclosure to protect and conceal the fan coil unit itself, with return air grille and supply air diffuser set into that enclosure to distribute the air.

A concealed fan coil unit will typically be installed within an accessible ceiling void or services zone. The return air grille and supply air diffuser, typically set flush into the ceiling, will be ducted to and from the fan coil unit and thus allows a great degree of flexibility for locating the grilles to suit the ceiling layout and/or the partition layout within a space. It is quite common for the return air not to be ducted and to use the ceiling void as a return air plenum.

The coil receives hot or cold water from a central plant, and removes heat from or adds heat to the air through heat transfer. Traditionally fan coil units can contain their own internal thermostat, or can be wired to operate with a remote thermostat. However, and as is common in most modern buildings with a Building Energy Management System (BEMS), the control of the fan coil unit will be by a local digital controller or outstation (along with associated room temperature sensor and control valve actuators) linked to the BEMS via a communication network, and therefore adjustable and controllable from a central point, such as a supervisors head end computer.

Fan coil units circulate hot or cold water through a coil in order to condition a space. The unit gets its hot or cold water from a central plant, or mechanical room containing equipment for removing heat from the central building's closed-loop. The equipment used can consist of machines used to remove heat such as a chiller or a cooling tower and equipment for adding heat to the building's water such as a boiler or a commercial water heater.

Hydronic fan coil units can be generally divided into two types: Two-pipe fan coil units or four-pipe fan coil units. Two-pipe fan coil units have one supply and one return pipe. The supply pipe supplies either cold or hot water to the unit depending on the time of year. Four-pipe fan coil units have two supply pipes and two return pipes. This allows either hot or cold water to enter the unit at any given time. Since it is often necessary to heat and cool different areas of a building at the same time, due to differences in internal heat loss or heat gains, the four-pipe fan coil unit is most commonly used.

Fan coil units may be connected to piping networks using various topology designs, such as "direct return", "reverse return", or "series decoupled". See ASHRAE Handbook "2008 Systems & Equipment", Chapter 12.

Depending upon the selected chilled water temperatures and the relative humidity of the space, it's likely that the cooling coil will dehumidify the entering air stream, and as a by product of this process, it will at times produce a condensate which will need to be carried to drain. The fan coil unit will contain a purpose designed drip tray with drain connection for this purpose. The simplest means to drain the condensate from multiple fan coil units will be by a network of pipework laid to falls to a suitable point. Alternatively a condensate pump may be employed where space for such gravity pipework is limited.

The fan motors within a fan coil unit are responsible for regulating the desired heating and cooling output of the unit. Different manufacturers employ various methods for controlling the motor speed. Some utilize an AC transformer, adjusting the taps to modulate the power supplied to the fan motor. This adjustment is typically performed during the commissioning stage of building construction and remains fixed for the lifespan of the unit.

Alternatively, certain manufacturers employ custom-wound Permanent Split Capacitor (PSC) motors with speed taps in the windings. These taps are set to the desired speed levels for the specific design of the fan coil unit. To enable local control, a simple speed selector switch (Off-High-Medium-Low) is provided for the occupants of the room. This switch is often integrated into the room thermostat and can be manually set or automatically controlled by a digital room thermostat.

For automatic fan speed and temperature control, Building Energy Management Systems are employed. The fan motors commonly used in these units are typically AC Shaded Pole or Permanent Split Capacitor motors. Recent advancements include the use of brushless DC designs with electronic commutation. Compared to units equipped with asynchronous 3-speed motors, fan coil units utilizing brushless motors can reduce power consumption by up to 70%.[1]

Fan coil units linked to ducted split air conditioning units use refrigerant in the cooling coil instead of chilled coolant and linked to a large condenser unit instead of a chiller. They might also be linked to liquid-cooled condenser units which use an intermediate coolant to cool the condenser using cooling towers.

DC/EC motor powered units

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These motors are sometimes called DC motors, sometimes EC motors and occasionally DC/EC motors. DC stands for direct current and EC stands for electronically commutated.

DC motors allow the speed of the fans within a fan coil unit to be controlled by means of a 0-10 Volt input control signal to the motor/s, the transformers and speed switches associated with AC fan coils are not required. Up to a signal voltage of 2.5 Volts (which may vary with different fan/motor manufacturers) the fan will be in a stopped condition but as the signal voltage is increased, the fan will seamlessly increase in speed until the maximum is reached at a signal Voltage of 10 Volts. fan coils will generally operate between approximately 4 Volts and 7.5 Volts because below 4 Volts the air volumes are ineffective and above 7.5 Volts the fan coil is likely to be too noisy for most commercial applications.

The 0-10 Volt signal voltage can be set via a simple potentiometer and left or the 0-10 Volt signal voltage can be delivered to the fan motors by the terminal controller on each of the Fan Coil Units. The former is very simple and cheap but the latter opens up the opportunity to continuously alter the fan speed depending on various external conditions/influences. These conditions/criteria could be the 'real time' demand for either heating or cooling, occupancy levels, window switches, time clocks or any number of other inputs from either the unit itself, the Building Management System or both.

The reason that these DC Fan Coil Units are, despite their apparent relative complexity, becoming more popular is their improved energy efficiency levels compared to their AC motor-driven counterparts of only a few years ago. A straight swap, AC to DC, will reduce electrical consumption by 50% but applying Demand and Occupancy dependent fan speed control can take the savings to as much as 80%. In areas of the world where there are legally enforceable energy efficiency requirements for fan coils (such as the UK), DC Fan Coil Units are rapidly becoming the only choice.

Areas of use

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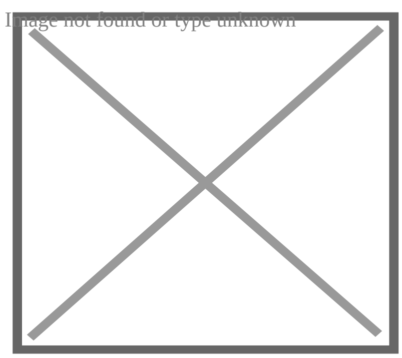

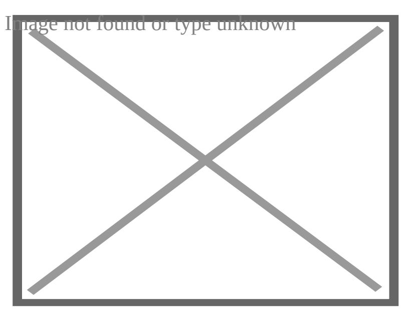

In high-rise buildings, fan coils may be vertically stacked, located one above the other from floor to floor and all interconnected by the same piping loop.

Fan coil units are an excellent delivery mechanism for hydronic chiller boiler systems in large residential and light commercial applications. In these applications the fan coil units are mounted in bathroom ceilings and can be used to provide unlimited comfort zones - with the ability to turn off unused areas of the structure to save energy.

Installation

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In high-rise residential construction, typically each fan coil unit requires a rectangular through-penetration in the concrete slab on top of which it sits. Usually, there are either 2 or 4 pipes made of ABS, steel or copper that go through the floor. The pipes are usually insulated with refrigeration insulation, such as acrylonitrile butadiene/polyvinyl chloride (AB/PVC) flexible foam (Rubatex or Armaflex brands) on all pipes, or at least on the chilled water lines to prevent condensate from forming.

Unit ventilator

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A unit ventilator is a fan coil unit that is used mainly in classrooms, hotels, apartments and condominium applications. A unit ventilator can be a wall mounted or ceiling hung cabinet, and is designed to use a fan to blow outside air across a coil, thus conditioning and ventilating the space which it is serving.

European market

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The Fan Coil is composed of one quarter of 2-pipe-units and three quarters of 4-pipe-units, and the most sold products are "with casing" (35%), "without casing" (28%), "cassette" (18%) and "ducted" (16%).[2]

The market by region was split in 2010 as follows:

Region	Sales Volume in units[2]	Share
Benelux	33 725	2.6%

France	168 028	13.2%
Germany	63 256	5.0%
Greece	33 292	2.6%
Italy	409 830	32.1%
Poland	32 987	2.6%
Portugal	22 957	1.8%
Russia, Ukraine and CIS countries	87 054	6.8%
Scandinavia and Baltic countries	39 124	3.1%
Spain	91 575	7.2%
Turkey	70 682	5.5%
UK and Ireland	69 169	5.4%
Eastern Europe	153 847	12.1%

See also

[edit]

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Wikimedia Commons has media related to ***Fan coil units***.

- Thermal insulation
- HVAC
- Construction
- Intumescent
- Firestop

References

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1. **^** *"Fan Coil Unit". Heinen & Hopman. Retrieved 2023-08-30.*
2. ^ ***a b*** *"Home". Eurovent Market Intelligence.*

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Heating, ventilation, and air conditioning

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

Technology

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

- 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

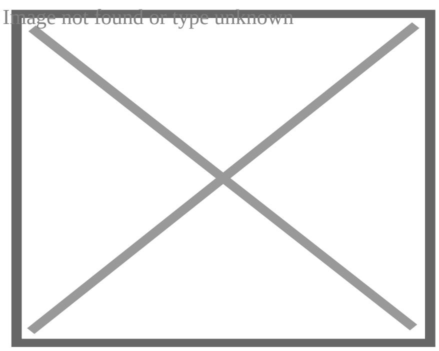
Measurement and control	◦ Air flow meter ◦ Aquastat ◦ BACnet ◦ Blower door ◦ Building automation ◦ Carbon dioxide sensor ◦ Clean air delivery rate (CADR) ◦ Control valve ◦ Gas detector ◦ Home energy monitor ◦ Humidistat ◦ HVAC control system ◦ Infrared thermometer ◦ Intelligent buildings ◦ LonWorks ◦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

Professions, trades, and services	◦ Architectural acoustics ◦ Architectural engineering ◦ Architectural technologist ◦ Building services engineering ◦ Building information modeling (BIM) ◦ Deep energy retrofit ◦ Duct cleaning ◦ Duct leakage testing ◦ Environmental engineering ◦ Hydronic balancing ◦ Kitchen exhaust cleaning ◦ Mechanical engineering ◦ Mechanical, electrical, and plumbing ◦ Mold growth, assessment, and remediation ◦ Refrigerant reclamation ◦ Testing, adjusting, balancing
Industry organizations	◦ AHRI ◦ AMCA ◦ ASHRAE ◦ ASTM International ◦ BRE ◦ BSRIA ◦ CIBSE ◦ Institute of Refrigeration ◦ IIR ◦ LEED ◦ SMACNA ◦ UMC
Health and safety	◦ Indoor air quality (IAQ) ◦ Passive smoking ◦ Sick building syndrome (SBS) ◦ Volatile organic compound (VOC)

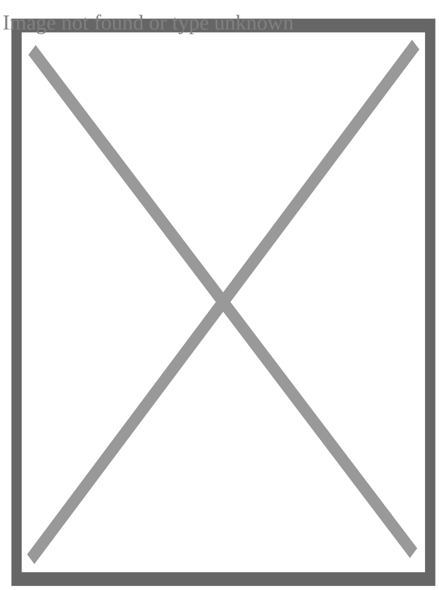
See also

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

About Heat exchanger



Tubular heat exchanger

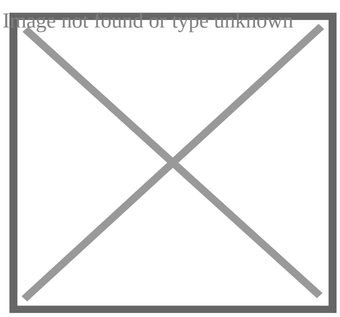


Partial view into inlet plenum of shell and tube heat exchanger of a refrigerant based chiller for providing air-conditioning to a building

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 e

◦

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

Fig. 2: Shell and tube heat e

◦

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

Fig. 3: Shell and tube heat e

◦

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

countercurrent)

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 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.

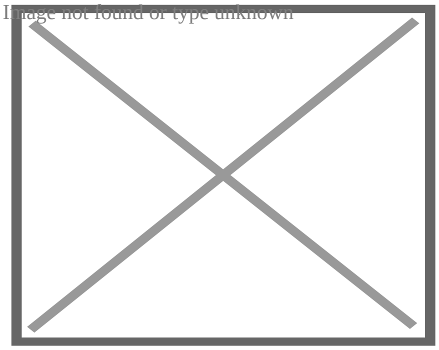
In single channels the configuration of the gaskets enables flow through. Thus, this allows the main and secondary media in counter-current flow. A gasket plate heat exchanger has a heat region from corrugated plates. The gasket function as seal between plates and they are located between frame and pressure 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.

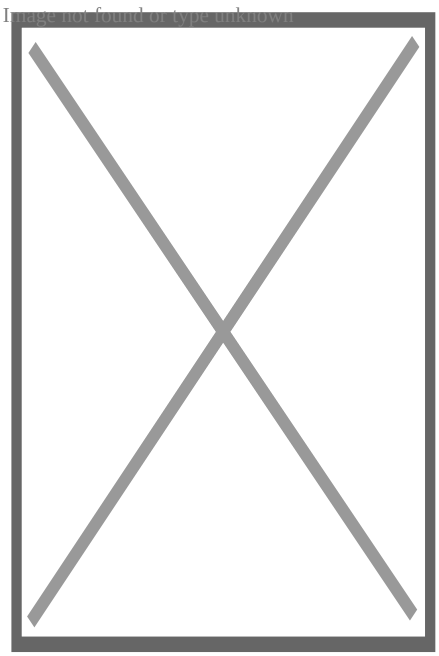
The pressure of steam at the turbine outlet is low where the steam density is very low where the flow rate is very high. To prevent a decrease in pressure in the movement of steam from the turbine to condenser, the condenser unit is placed underneath and connected to the turbine. Inside the tubes the 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 degrees 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

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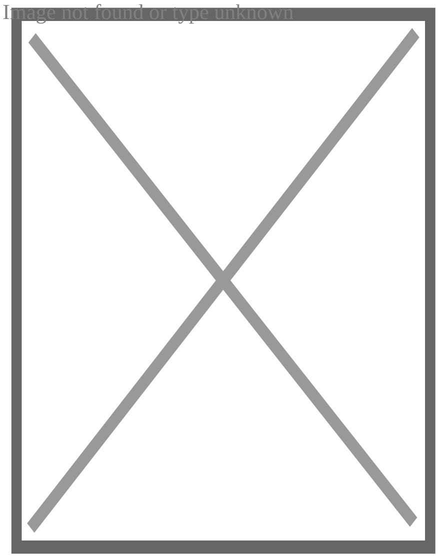

Conceptual diagram of a plate and frame heat exchanger

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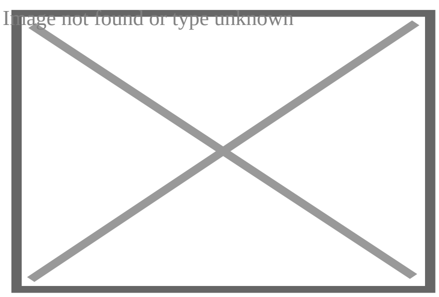
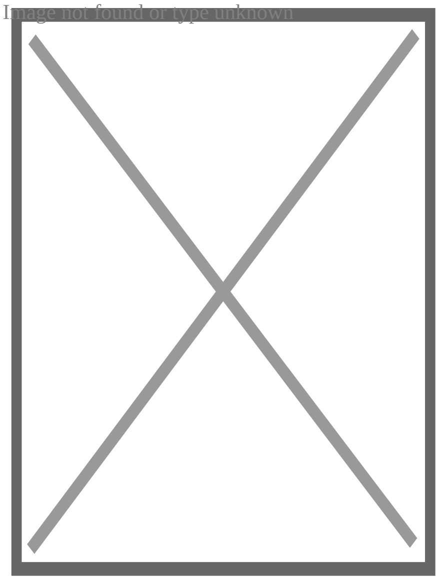


A single plate heat exchanger



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.

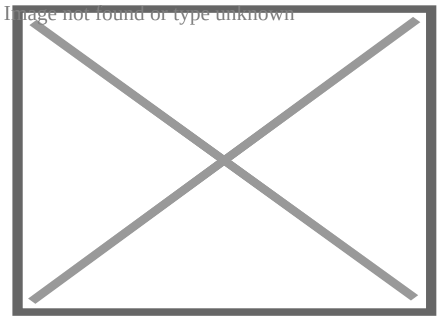
Dynamic scraped surface

[edit]

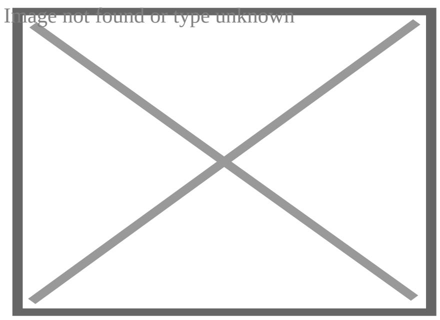
Another type of heat exchanger is called "(dynamic) scraped surface heat exchanger". This is mainly used for heating or cooling with high-viscosity products, crystallization processes, evaporation and high-fouling applications. Long running times are achieved due to the continuous scraping of the surface, 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	No	Spray coolers/quenchers
		Liquid flow	Yes	Spray condensers/evaporation, jet condensers
	Liquid	Gravity	No	Bubble columns, perforated tray columns
			Yes	Bubble column condensers
		Forced	No	Gas spargers
		Gas flow	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*.

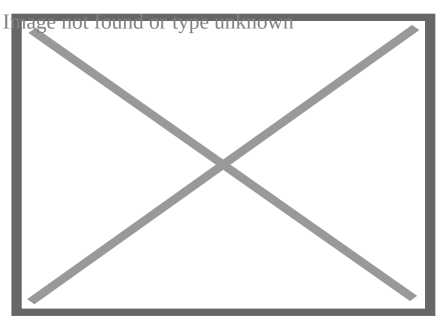
For many climates, water or steam HVAC coils can be exposed to freezing conditions. Because water expands upon freezing, these somewhat expensive and difficult to replace thin-walled heat exchangers can easily be damaged or destroyed by just one freeze. As such, freeze protection of coils is a major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

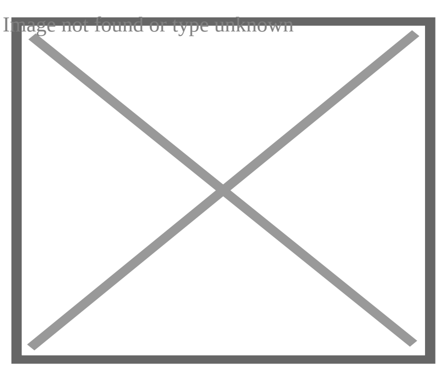
- Under conditions of low flowrates (or laminar flow), such that the typical shell-and-tube exchangers have low heat-transfer coefficients and becoming uneconomical.[19]
- When there is low pressure in one of the fluids, usually from accumulated pressure drops in other process equipment.[19]
- When one 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

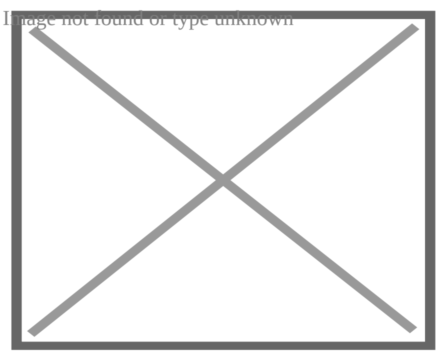
[edit]

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 needed*] 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.

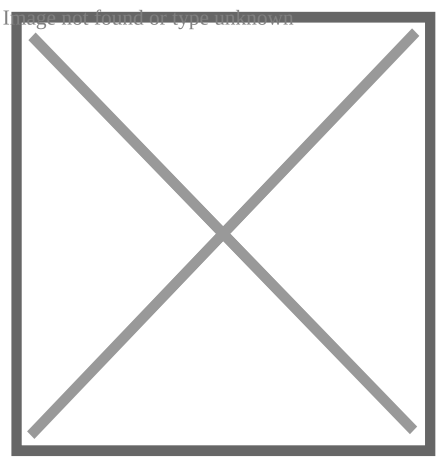
By periodically calculating the overall heat transfer coefficient from exchanger flow rates and temperatures, the owner of the heat exchanger can estimate when cleaning the heat exchanger is economically attractive.

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); NORSOK (Norwegian); TEMA;[33] API 12; and API 560.[*citation needed*]

In nature

[edit]

Humans

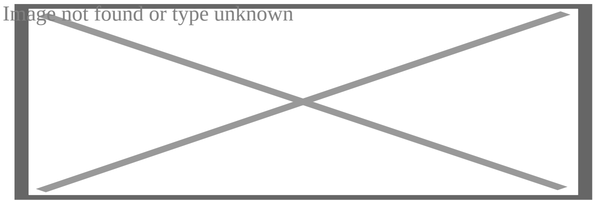
[edit]

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_i Image not found or type unknown (energy per 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 j_i Image not found or type unknown (mass per unit time), where the subscript *i* applies to pipe 1 or pipe 2.

Temperature profiles for the pipes are $T_1(x)$ Image not found or type unknown and $T_2(x)$ Image not found or type unknown 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:

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

Image not found or type unknown

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

Image not found or type unknown

(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 $\gamma (T_1-T_2)$ Image not found or type unknown), where $u_i(x)$ Image not found or type unknown 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:

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

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

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

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

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

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:

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

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

where $k_1=\gamma /J_1$, $k_2=\gamma /J_2$

$$\displaystyle k=k_1+k_2$$

(this is for parallel-flow, but for counter-flow the sign in front of k_2 is negative, so that if $k_2=k_1$ for 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_{10} and T_{20} be the temperatures at x=0 and let T_{1L} and T_{2L} be the temperatures at the end of the pipe at x=L. Define the average temperatures in each pipe as:

$$\displaystyle \overline T_1=\frac 1L\int _0^LT_1(x)dx$$

Image not found or type unknown

$$\displaystyle \overline T_2=\frac 1L\int _0^LT_2(x)dx.$$

Image not found or type unknown

Using the solutions above, these temperatures are:

$$\displaystyle T_10=A-\frac Bk_1k$$

Image not found or type unknown

$$\displaystyle T_1L=A-\frac Bk_1ke^-kL$$

Image not found or type unknown

$$\displaystyle \overline T_1=A-\frac Bk_1k^2L(1-e^-kL)$$

Image not found or type unknown

$$\displaystyle T_20=A+\frac Bk_2k$$

Image not found or type unknown

$$\displaystyle T_2L=A+\frac Bk_2ke^-kL$$

Image not found or type unknown

$$\displaystyle \overline T_2=A+\frac Bk_2k^2L(1-e^$$

Image not found or type unknown

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:

$$\displaystyle \frac dU_1dt=\int _0^L\frac du_1dt\,dx=J_1(T_1L-T_10)=\gamma L(\overline$$

Image not found or type unknown

$$\displaystyle \frac dU_2dt=\int _0^L\frac du_2dt\,dx=J_2(T_2L-T_20)=\gamma L(\overl$$

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By the conservation of energy, the sum of the two energies is zero. The quantity $\displaystyle \overline T_2-\overline T_1$ Image not found or type unknown 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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- Shell and Tube Heat Exchanger Design Software for Educational Applications (PDF)
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Heating, ventilation, and air conditioning

Fundamental concepts

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

Technology

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

- 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

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

Professions, trades, and services	Architectural acoustics
	Architectural engineering
	Architectural technologist
	Building services engineering
	Building information modeling (BIM)
	Deep energy retrofit
	Duct cleaning
	Duct leakage testing
	Environmental engineering
	Hydronic balancing
	Kitchen exhaust cleaning
	Mechanical engineering
	Mechanical, electrical, and plumbing
	Mold growth, assessment, and remediation
	Refrigerant reclamation
	Testing, adjusting, balancing
Industry organizations	AHRI
	AMCA
	ASHRAE
	ASTM International
	BRE
	BSRIA
	CIBSE
	Institute of Refrigeration
	IIR
	LEED
	SMACNA
	UMC
Health and safety	Indoor air quality (IAQ)
	Passive smoking
	Sick building syndrome (SBS)
	Volatile organic compound (VOC)

See also

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

About Durham Supply Inc

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Things To Do in Tulsa County

Photo

Bob Dylan Center

4.9 (245)

Photo

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Gathering Place

4.8 (12116)

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The Tulsa Arts District

4.7 (22)

Photo

Guthrie Green

4.7 (3055)

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Golden Driller Statue

4.6 (1935)

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Tulsa Zoo

4.5 (10481)

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Driving Directions From Catoosa to Durham Supply Inc

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Driving Directions From Philbrook Museum of Art to Durham Supply Inc

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Reviews for Durham Supply Inc

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.

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!

Considering Local Building Codes for Mobile Home Climate Adaptations**View GBP**

Check our other pages :

- **Considering UV Technology for Mobile Home Air Treatment**
- **Evaluating Filter Efficiency for Enhanced Mobile Home Air Quality**
- **Adapting Mobile Homes to Rapid Seasonal Swings in Temperature**
- **Coping with Storm Related Damage to Mobile Home Air Conditioners**

Frequently Asked Questions

What are the key local building code requirements for installing an HVAC system in a mobile home?

Local building codes typically require that HVAC systems in mobile homes be installed by licensed professionals to ensure safety and compliance. The system must meet specific efficiency standards, be appropriately sized for the space, and adhere to guidelines concerning ventilation and ductwork. It is essential to check with your local building authority for any additional requirements or permits needed.

How do local climate considerations affect building code requirements for mobile home HVAC systems?

Local climates influence building codes by dictating insulation standards, energy efficiency ratings (like SEER or EER), and ventilation needs to ensure adequate heating or cooling while minimizing energy use. Areas prone to extreme temperatures may have stricter regulations on insulation materials and HVAC system performance to maintain comfort and safety.

Are there exemptions or special considerations in local building codes for upgrading existing mobile home HVAC systems?

Yes, some jurisdictions offer exemptions or simplified processes when upgrading existing systems rather than installing new ones. These may include grandfathering clauses that allow older units to remain if certain conditions are met. However, upgrades often still need to comply with current efficiency standards. Its crucial to consult local authorities as policies can vary significantly between regions.

Royal Supply Inc

Phone : +16362969959

City : Oklahoma City

State : OK

Zip : 73149

Address : Unknown Address

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