Mobile Homes

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  Considering Weight Distribution on Mobile Home Roofs Analyzing Space Limitations for Duct Installation Minimizing Vibrations through Effective Mounting Checking for Clearances near Windows and Doors Verifying Electrical Capacity for New Units Inspecting Crawl Spaces before Major Installations Protecting Exterior Components from Windy Conditions Resolving Access Issues in Narrow Hallways Planning Around Existing Plumbing or Gas Lines Prioritizing Safety in Confined Work Areas Ensuring Adequate Ventilation for Heat Pumps Mitigating Moisture Risks in Humid Climates
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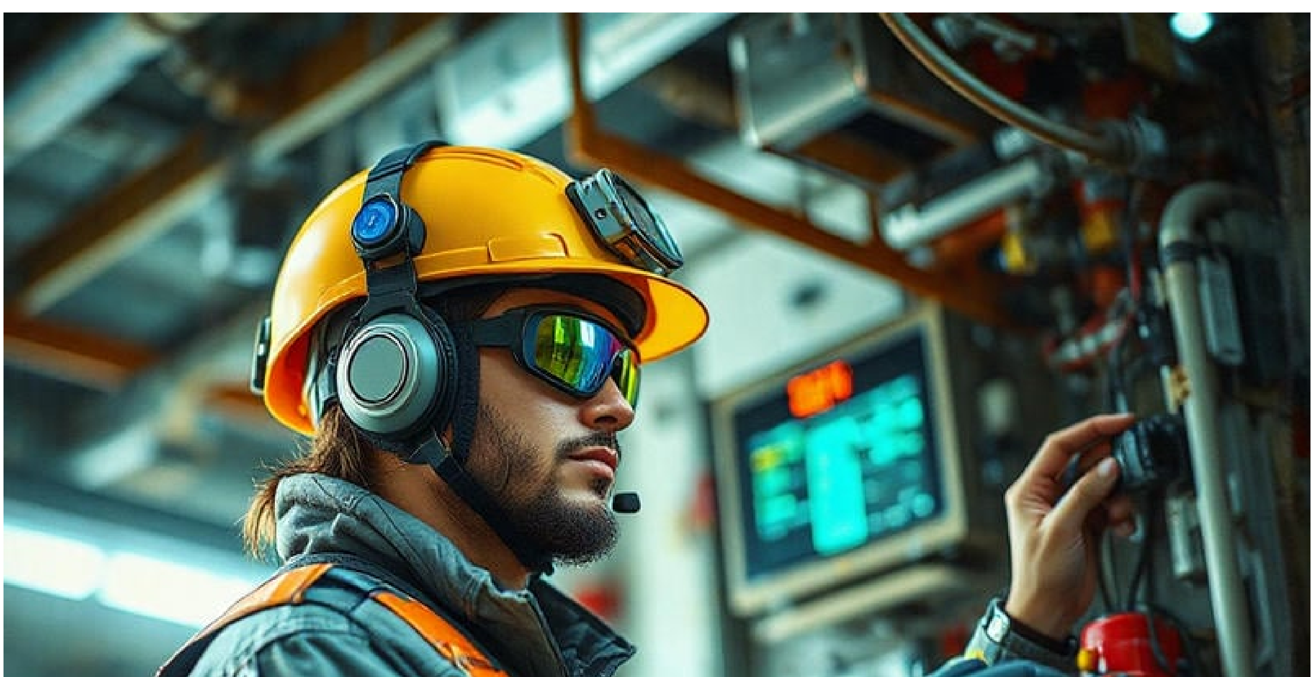

When it comes to maintaining a comfortable living environment within a mobile home, the importance of seasonal tune-ups for HVAC systems cannot be overstated. These compact and efficient homes demand special attention to their heating, ventilation, and air conditioning units due to space constraints and unique construction features. Regular maintenance not only ensures efficiency but significantly contributes to the longevity of these critical systems.

Firstly, seasonal tune-ups are essential in enhancing the efficiency of an HVAC system. Mobile homes often face challenges with insulation and airtightness, which can lead to higher energy consumption if the HVAC system is not functioning optimally. During a seasonal tune-up, professionals clean and inspect various components of the system such as filters, coils, and ductwork. Clean filters improve airflow and reduce strain on the unit, while well-maintained coils allow for better heat exchange. Mobile home owners should explore financing options for energy-efficient upgrades **mobile home hvac system** energy conservation. As a result, homeowners enjoy a more consistent climate control experience without unnecessarily inflated energy bills.

Moreover, routine maintenance can preemptively address potential issues that could compromise system performance or safety. For instance, inspecting electrical connections during tune-ups helps prevent problems like short circuits or fires caused by faulty wiring. Additionally, checking refrigerant levels ensures that there are no leaks that could diminish cooling capabilities or harm the environment. By identifying and rectifying these issues early on, homeowners can avoid costly repairs or complete system failures in peak seasons.

In terms of extending longevity, regular tune-ups play a pivotal role by minimizing wear and tear on HVAC components. Just like any mechanical system, prolonged use without proper care can lead to premature breakdowns. Parts such as belts and motors benefit from being lubricated regularly; this reduces friction and prolongs their lifespan. By scheduling bi-annual inspections-typically in spring before cooling season kicks off and fall ahead of heating needs-homeowners ensure their systems are prepared for changing weather conditions year-round.

Furthermore, manufacturers often stipulate regular maintenance as part of warranty agreements for new HVAC units installed in mobile homes. Failing to adhere to these guidelines might void warranties, leaving homeowners vulnerable to covering repair costs out-of-pocket if problems arise prematurely.

In conclusion, investing in seasonal tune-ups for mobile home HVAC systems is an integral part of responsible homeownership that offers both immediate benefits in terms of efficiency savings as well as long-term advantages through extended equipment lifespan. By prioritizing this preventative measure twice a year-springtime before summer heatwaves arrive and autumn prior to winter chills setting in-residents can maintain comfort without unexpected interruptions while also safeguarding their investment against unnecessary expenses down the line.

Impact of HVAC system installation on roof weight distribution —

When drafting a maintenance agreement for seasonal tune-ups, selecting the right clauses is crucial to ensure that both parties' expectations and responsibilities are clearly defined. A well-structured agreement not only protects against potential disputes but also lays the foundation for a successful ongoing service relationship. Here, we delve into the essential clauses to consider in such agreements, emphasizing their importance and how they contribute to a seamless maintenance experience.

First and foremost, the **Scope of Services** clause is pivotal. This section should clearly outline what services are included in the seasonal tune-up. Whether it's inspecting heating systems before winter or checking cooling units as summer approaches, detailing these services prevents misunderstandings. By specifying tasks like filter replacements, system diagnostics, and efficiency evaluations, both parties understand exactly what will be done during each visit.

Equally important is the **Frequency of Visits** clause. Seasonal tune-ups typically occur biannually; however, it's beneficial to specify exact times of year or conditions under which additional visits might be necessary. This ensures that clients know when to expect service and can plan accordingly. It also helps service providers manage their schedules effectively.

The **Pricing and Payment Terms** clause must be transparent and detailed. This includes not just the cost of each tune-up but also any additional fees that may arise from unexpected repairs or parts replacement. Outlining payment methods and due dates further clarifies financial obligations, reducing potential conflicts over billing issues.

Another critical element is the **Duration and Termination** clause. Clearly stating how long the agreement lasts-whether it's annually renewable or set for multiple years-provides security for both parties. Additionally, outlining conditions under which either party can terminate the agreement helps manage expectations if circumstances change unexpectedly.

A comprehensive **Liability and Warranty** clause offers protection to both client and provider by defining who is responsible for damages or failures post-service. Including warranties on parts replaced or guarantees on workmanship can enhance client trust while delineating boundaries of responsibility for unforeseen problems.

Moreover, an effective agreement should include a **Force Majeure** clause to address situations beyond anyone's control that might prevent fulfilling agreed terms, such as extreme weather events or supply chain disruptions affecting parts availability.

Finally, incorporating an **Amendments** clause allows flexibility within the contract by providing a framework for making changes collaboratively as needs evolve over time without invalidating existing terms.

In conclusion, crafting a maintenance agreement with these key clauses ensures clarity and mutual understanding between service providers and clients engaging in seasonal tune-ups. By addressing all relevant aspects-from scope to liability-a well-thought-out contract minimizes risks while fostering trustful working relationships built on clear communication and shared goals.

Posted by on

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Considerations for maintaining structural integrity during HVAC installation

When it comes to maintaining heating, ventilation, and air conditioning (HVAC) systems, seasonal tune-ups are an essential service that ensures efficiency and longevity. However, the effectiveness of these tune-ups often depends on the scope of services included in contractual agreements, particularly when they are part of a broader HVAC maintenance plan. Evaluating the scope of services included in seasonal tune-up clauses becomes crucial for both property owners and service providers.

Firstly, it is important to understand what typically constitutes a seasonal tune-up. Generally, this includes checking system controls, tightening electrical connections, lubricating moving parts, inspecting condensate drains in cooling equipment, and ensuring thermostat accuracy. In heating systems, it might also involve examining fuel connections and burner combustion. While these tasks seem straightforward, the specific services covered can vary significantly depending on the contract.

To ensure comprehensive coverage during seasonal tune-ups, one must carefully select clauses that explicitly detail the services provided. A well-defined clause will not only list each service but also specify any additional checks or repairs that may be necessary based on the system's condition at the time of inspection. This level of specificity helps prevent misunderstandings between service providers and clients regarding what is considered routine maintenance versus what incurs additional costs.

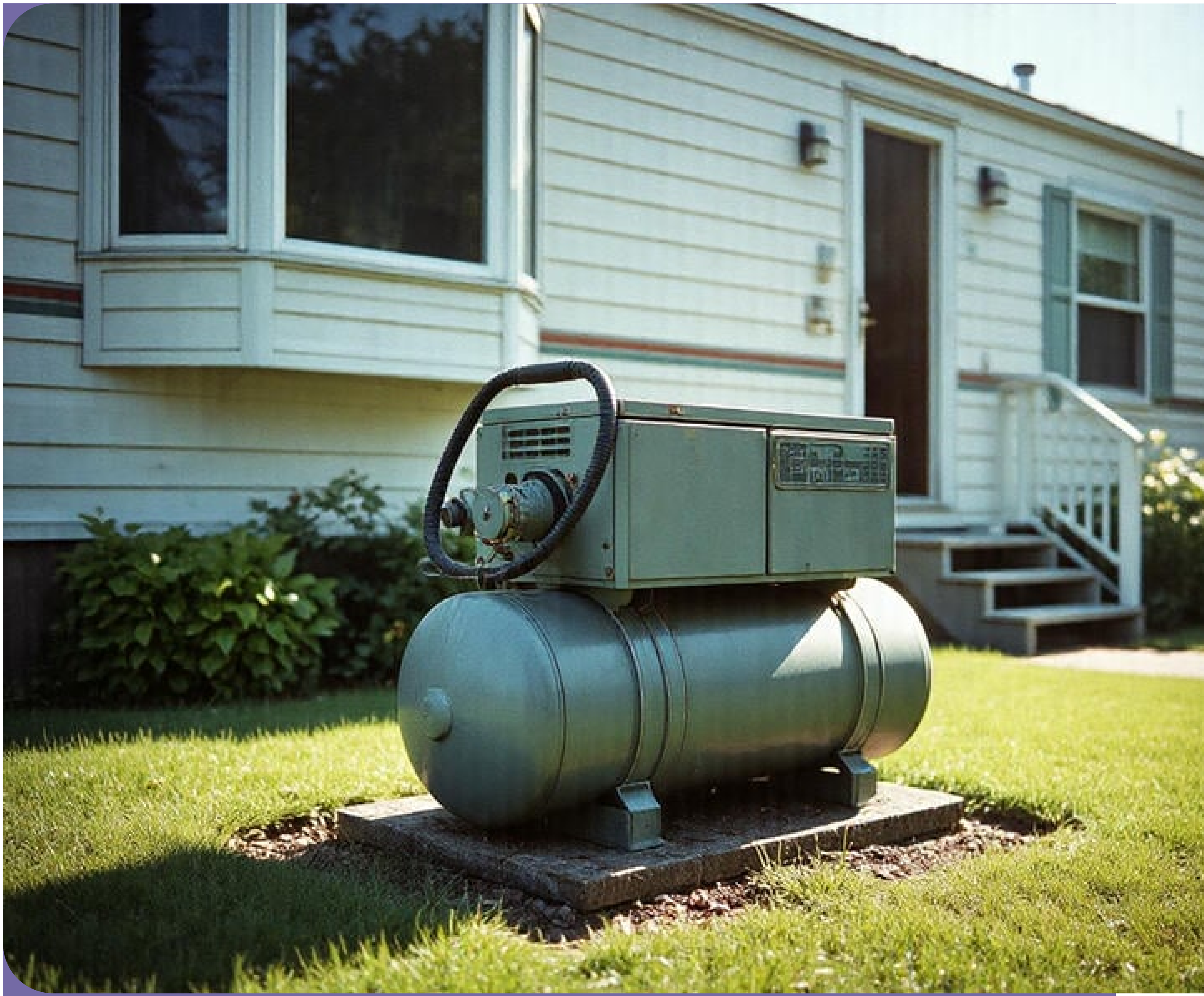
Moreover, evaluating these clauses requires considering how they align with industry standards and manufacturer recommendations. Contracts should reflect best practices within HVAC maintenance to ensure systems operate efficiently throughout their lifespan. For example, manufacturers might recommend specific procedures or intervals for servicing particular components; a robust seasonal tune-up clause would incorporate these guidelines.

Another key aspect is flexibility within the clause to accommodate unique system needs or unforeseen issues discovered during initial inspections. While basic services should be standard across contracts, allowing room for tailored solutions ensures that all potential problems are addressed promptly rather than deferred until they escalate into more significant issues.

Cost transparency is another critical factor when selecting clauses covering seasonal tune-ups. Clients need assurance that there will be no hidden fees beyond what has been agreed upon unless explicitly stated within the contract as optional or emergency repairs. Clear communication about pricing structures fosters trust between parties involved.

Finally yet importantly is customer support following a service call integral yet often overlooked in many agreements' scopes! Quality after-service care should form part of any reputable company's offering: providing follow-up consultations either remotely via phone/email/video chat platforms if necessary so customers feel supported even post-inspection day itself!

In conclusion then: assessing which elements comprise effective seasonal-tuneup' provisions requires diligence combined with insight into current market norms alongside careful consideration given towards tailoring language according both individual client/system specifications as well those laid out by respective manufacturers themselves wherever applicable too! By doing so properly from outset thus minimizes risk future disputes whilst simultaneously maximizing value derived through seamless operational continuity maintained year-round thanks proactive preventative measures implemented early-on therein instead waiting until later stages where potentially costlier interventions might otherwise prove necessary further down line altogether unnecessarily perhaps entirely avoidably too ultimately speaking overall here today now indeed...



Strategies for evenly distributing weight across the roof when adding or upgrading HVAC systems

When purchasing any product, especially those with significant financial investment like vehicles or home appliances, warranties offer peace of mind by promising repairs or replacements under certain conditions. However, the devil is in the details, and one must thoroughly understand the implications of a warranty's regular maintenance clauses to ensure coverage remains intact. Among these clauses, those related to seasonal tune-ups warrant particular attention.

At its core, a warranty is a contract between the manufacturer and the consumer that outlines what is covered and what isn't. Regular maintenance clauses are prevalent in many warranties as they stipulate that for coverage to remain valid, the owner must adhere to specified upkeep routines. This requirement serves dual purposes: it ensures that the product performs optimally throughout its lifespan and it helps manufacturers avoid liability for damages resulting from neglect.

Seasonal tune-ups are often included within these regular maintenance clauses because they address issues specific to changing environmental conditions. Whether it's ensuring an air conditioning unit is ready for summer heat or preparing a vehicle for winter's cold temperatures, these tune-ups are critical for maintaining optimal performance. They can prevent minor issues from escalating into major problems that would otherwise void a warranty if attributed to neglect.

Understanding these clauses requires careful reading of the warranty documentation. Many consumers overlook this step, only to face unexpected out-of-pocket expenses later on when their claims are denied due to non-compliance with maintenance requirements. It's essential for consumers not only to know which specific services need performing but also how frequently they should be done-and by whom. Some warranties require that maintenance be conducted by authorized service providers; using unauthorized providers could nullify your coverage.

Moreover, keeping meticulous records of all maintenance activities is equally important. In case of a dispute over whether proper care was taken as stipulated by the warranty terms, having documented proof can make one's claim substantially stronger. Receipts, detailed service logs, and even visual documentation can serve as valuable evidence supporting compliance with regular maintenance obligations.

The importance of selecting appropriate clauses cannot be overstated when discussing seasonal tune-ups in relation to warranty implications. Consumers should seek warranties that clearly outline required seasonal checks while providing flexibility regarding who can perform them without compromising coverage integrity. Additionally, some advanced products come equipped with self-diagnostic features indicating necessary service intervals-choosing such products could simplify adherence to regular maintenance commitments.

In conclusion, while warranties provide considerable comfort against unforeseen failures or defects in purchased products, understanding their limitations through careful examination of regular maintenance clauses is vital-especially those concerning seasonal tune-ups. By ensuring full compliance with these stipulations-via timely service interventions performed preferably by authorized technicians-consumers protect themselves against potential denials of legitimate claims down the line due simply because they didn't follow prescribed care procedures adequately enough according their contract agreement terms set forth initially upon purchase transaction completion date itself!

Potential risks of improper weight distribution on mobile home roofs and HVAC efficiency

When it comes to selecting service providers for essential home maintenance tasks, such as seasonal tune-ups for HVAC systems or other appliances, discerning homeowners must weigh the costs against the benefits of different contract clauses. The decision-making process involves an evaluation of not just the immediate financial outlay but also long-term value and peace of mind that these contracts can provide.

Seasonal tune-ups are vital to ensure that systems operate efficiently and effectively throughout their service lives. Regular maintenance helps prevent unexpected breakdowns and costly repairs while ensuring energy efficiency, which can lead to significant savings over time. However, the key to maximizing these benefits lies in choosing the right service provider contract.

The first step in this comparison is a detailed understanding of what each service provider offers. Contracts may vary significantly; some may include comprehensive coverage for parts and labor during tune-ups, while others might only offer basic inspections with additional charges for any necessary repairs. It's crucial to examine whether the contract covers critical components like filters, belts, and refrigerant levels or if these will incur extra costs.

Another important consideration is the frequency of tune-ups included in the contract. Some providers may offer bi-annual checkups as part of their package, which can be beneficial in regions with extreme seasonal changes requiring more frequent system adjustments. In contrast, other contracts might only include a single annual visit, which could suffice in milder climates but may leave certain needs unmet elsewhere.

Moreover, the terms regarding emergency services should be scrutinized closely. A valuable contract will often include priority scheduling or discounted rates for emergency calls outside of regular maintenance visits. This feature can be particularly advantageous if a sudden malfunction occurs during peak seasons when service requests surge.

Customer reviews and reputation also play a pivotal role in evaluating service providers' reliability and quality. Testimonials from other homeowners can provide insights into how effectively companies honor their contractual promises and handle customer complaints or disputes.

Price remains a significant factor but should not overshadow these qualitative aspects. While it might be tempting to opt for a cheaper contract upfront, it's imperative to consider potential hidden costs down the line due to inadequate coverage or poor service quality.

Finally, flexibility within a contract is worth noting-some agreements allow adjustments based on changing homeowner needs or technological advancements in equipment maintenance protocols.

In conclusion, selecting clauses that cover seasonal tune-ups requires a careful balance between cost considerations and comprehensive coverage benefits offered by different service provider contracts. By diligently reviewing what each agreement entails-beyond just price-homeowners can secure not only financial savings but also dependable support for maintaining their household systems efficiently year-round.

Guidelines for professional assessment and installation to ensure balanced weight distribution

When selecting clauses for seasonal tune-ups, legal considerations and consumer rights play a pivotal role in shaping the terms of service and ensuring that both parties-service providers and consumers-are protected and fairly represented. This delicate balance is crucial not only for fostering trust but also for maintaining compliance with overarching legal standards.

To begin with, it is essential that any clause related to seasonal tune-ups be crafted with transparency in mind. Consumers have a right to understand what services are being offered, the associated costs, and any potential liabilities. This means that service agreements should clearly outline the scope of the tune-up services provided. For instance, will the service include inspection only, or will it extend to repairs if necessary? Such distinctions must be unambiguously stated to avoid misunderstandings.

Another critical legal consideration is warranty coverage. Clauses should specify whether seasonal tune-ups are covered under existing warranties or if they require separate provisions. Many consumers assume that routine maintenance checks might void their warranties if performed outside authorized centers; therefore, such concerns need addressing within the clauses. Service providers should ensure that their terms align with federal regulations such as the Magnuson-Moss Warranty Act in the United States, which protects consumers against deceptive warranty practices.

Furthermore, liability clauses must be carefully considered. While it's reasonable for service providers to limit liability for unforeseeable issues arising during a tune-up, these clauses shouldn't overreach in a manner that absolves them of all responsibility even when negligence is apparent. Courts often scrutinize overly broad disclaimers; hence, crafting balanced liability terms can prevent potential disputes while safeguarding consumer rights.

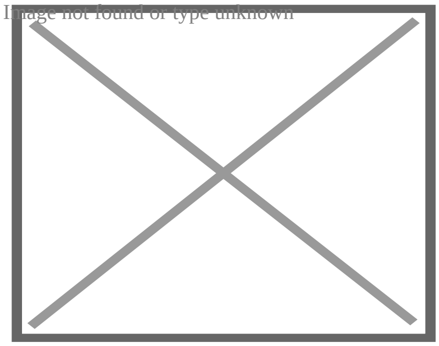
Additionally, cancellation and refund policies form another cornerstone of consumer rights within these clauses. Given the seasonality of tune-ups-often coinciding with specific weather changes-unexpected scheduling conflicts may arise for consumers. Clear policies regarding cancellations and refunds ensure fairness and flexibility without compromising business stability.

From a regulatory perspective, adherence to consumer protection laws cannot be overstressed. These laws vary by jurisdiction but generally aim to prevent unfair trade practices and ensure truthful representation of services offered. Service providers must remain vigilant about complying with local laws related to advertising claims about energy savings or environmental benefits resulting from regular maintenance.

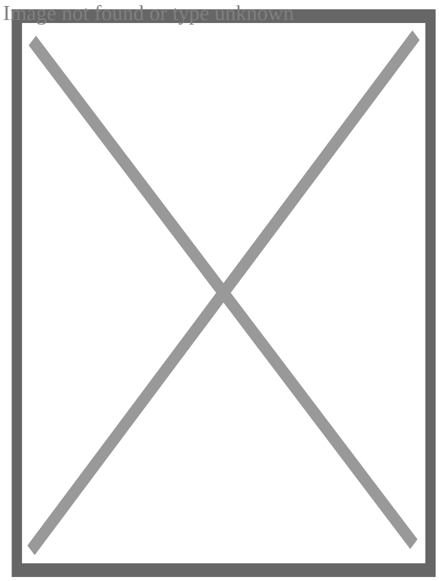
Lastly, privacy considerations are increasingly important in an era where data collection accompanies many service transactions. If personal data is collected during scheduling or billing processes, clauses should adhere to relevant data protection regulations like GDPR or CCPA depending on geographical location.

In conclusion, when drafting clauses covering seasonal tune-ups, integrating robust legal frameworks alongside respect for consumer rights ensures mutually beneficial agreements between service providers and consumers alike. By embedding clarity, fairness, and compliance into these contractual terms from the outset, businesses not only uphold ethical standards but also strengthen their reputation as trustworthy partners committed to customer satisfaction and legal integrity.

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

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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)

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.

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)

Types

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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

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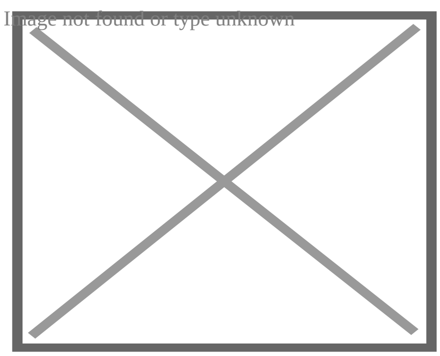
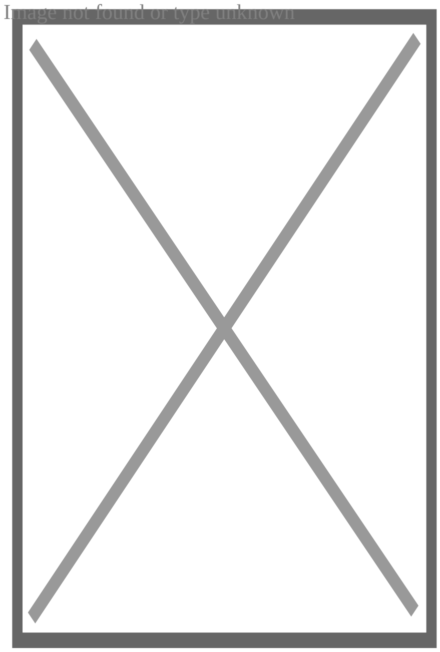
Main article: Shell and tube heat exchanger



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

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Main article: Plate heat exchanger

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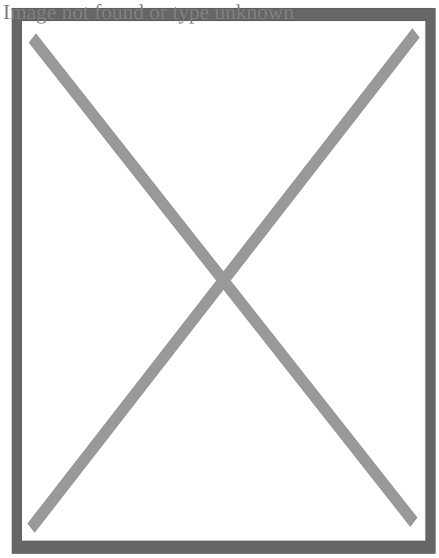

Conceptual diagram of a plate and frame heat exchanger

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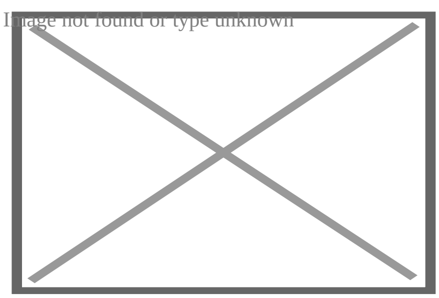

A single plate heat exchanger

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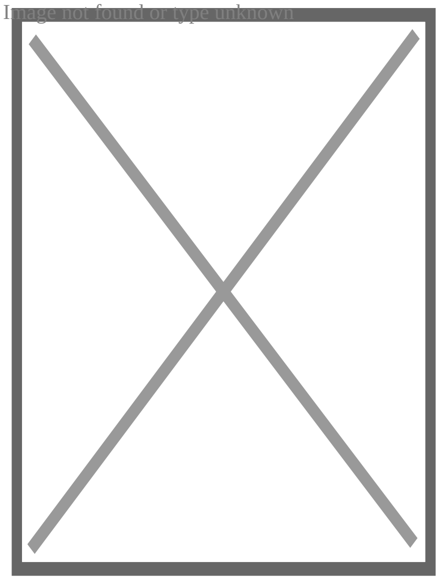

An interchangeable plate heat exchanger directly applied to the system of a swimming pool

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 n*

- 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.

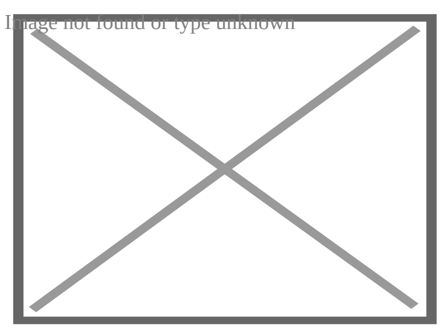
Dynamic scraped surface

[edit]

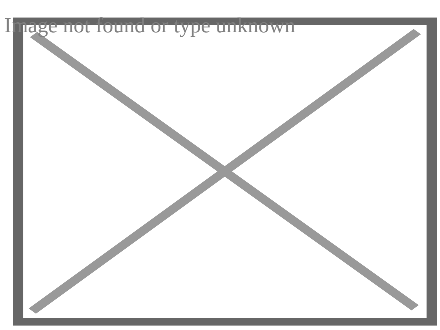
Another type of heat exchanger is called "(dynamic) scraped surface heat exchanger". This is mainly used for heating or cooling with high-viscosity products, crystallization processes, evaporation and high-fouling applications. Long running times are achieved due to the continuous scraping of the surface,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

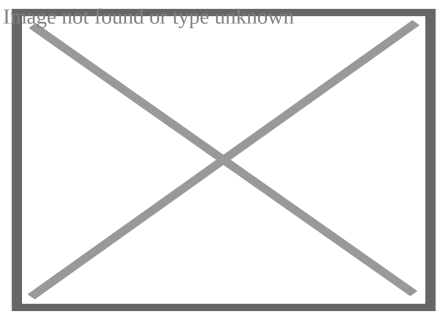
For many climates, water or steam HVAC coils can be exposed to freezing conditions. Because water expands upon freezing, these somewhat expensive and difficult to replace thin-walled heat exchangers can easily be damaged or destroyed by just one freeze. As such, freeze protection of coils is a major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

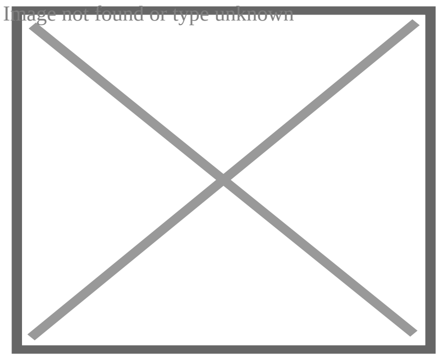
- The main advantage of the HCHE, like that for the Spiral heat exchanger (SHE), is its highly efficient use of space, especially when it's limited and not enough straight pipe can be laid.[19]
- Under conditions of low flowrates (or laminar flow), such that the typical shell-and-tube exchangers have 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

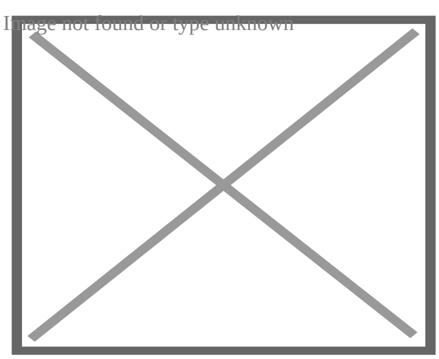
[edit]

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.

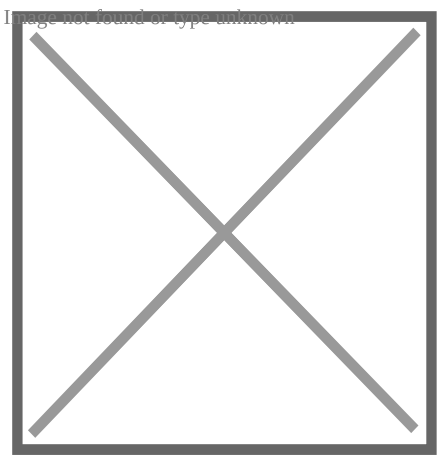
By periodically calculating the overall heat transfer coefficient from exchanger flow rates and temperatures, the owner of the heat exchanger can estimate when cleaning the heat exchanger is economically attractive.

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

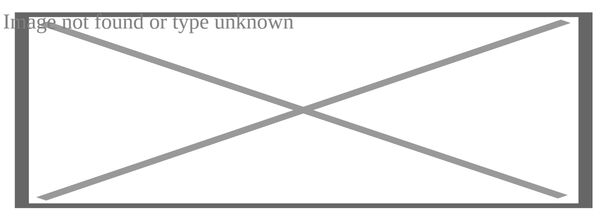
[edit]

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 $\displaystyle C_i$ (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 $\displaystyle J_i$ (mass per unit time), where the subscript *i* applies to pipe 1 or pipe 2.

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

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

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

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(this is for parallel flow in the same direction and opposite temperature gradients, but for counter-flow heat exchange countercurrent exchange the sign is opposite in the second equation in front of $\displaystyle \gamma (T_1-T_2)$), where $\displaystyle u_i(x)$ is the thermal energy per unit length and ? 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:

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

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

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

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

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

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:

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

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

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

$$k=k_1+k_2$$

(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:

$$\overline{T}_1=\frac{1}{L}\int_0^L T_1(x)dx$$

$$\overline{T}_2=\frac{1}{L}\int_0^L T_2(x)dx.$$

Using the solutions above, these temperatures are:

\displaystyle T_10=A-\frac Bk_1k

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

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

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\displaystyle T_20=A+\frac Bk_2k

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

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

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

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

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

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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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External links

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- Shell and Tube Heat Exchanger Design Software for Educational Applications (PDF)
- EU Pressure Equipment Guideline
- A Thermal Management Concept For More Electric Aircraft Power System Application (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
- Passive ventilation
- Radiant heating and cooling
- Radiant cooling
- Radiant heating
- Radon mitigation
- Refrigeration
- Renewable heat
- Room air distribution
- Solar air heat
- Solar combisystem
- Solar cooling
- Solar heating

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

Components

- Grille

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 Prefabrication

Not to be confused with Preproduction.
"Prefab" redirects here. For other uses, see Prefab (disambiguation).

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Find sources: "Prefabrication" – news · newspapers · books · scholar · JSTOR *(September 2014) (Learn how and when to remove this message)*

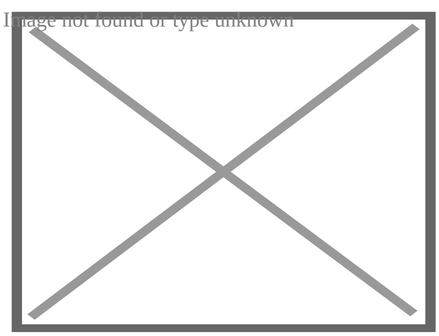
Prefabrication is the practice of assembling components of a structure in a factory or other manufacturing site, and transporting complete assemblies or sub-assemblies to the construction site where the structure is to be located. Some researchers refer it to “various materials joined together to form a component of the final installation procedure“.

The most commonly cited definition is by Goodier and Gibb in 2007, which described the process of manufacturing and preassembly of a certain number of building components, modules, and elements before their shipment and installation on construction sites.[1]

The term *prefabrication* also applies to the manufacturing of things other than structures at a fixed site. It is frequently used when fabrication of a section of a machine or any movable structure is shifted from the main manufacturing site to another location, and the section is supplied assembled and ready to fit. It is not generally used to refer to electrical or electronic components of a machine, or mechanical parts such as pumps, gearboxes and compressors which are usually supplied as separate items, but to sections of the body of the machine which in the past were fabricated with the whole machine. Prefabricated parts of the body of the machine may be called 'sub-assemblies' to distinguish them from the other components.

Process and theory

[edit]



Levittown, Puerto Rico

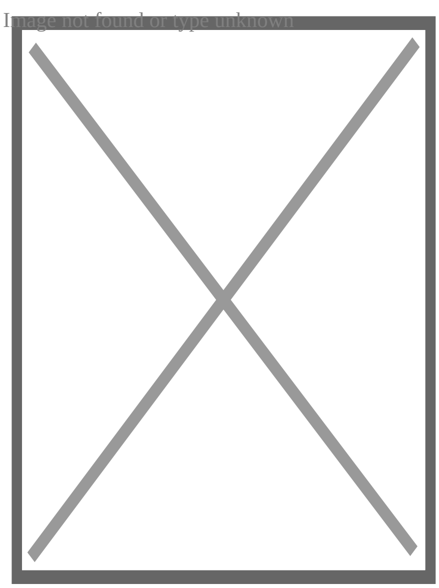
An example from house-building illustrates the process of prefabrication. The conventional method of building a house is to transport bricks, timber, cement, sand, steel and construction aggregate, etc. to the site, and to construct the house on site from these materials. In prefabricated construction, only the foundations are constructed in this way, while sections of walls, floors and roof are prefabricated (assembled) in a factory (possibly with window and door frames included), transported to the site, lifted into place by a crane and bolted together.

Prefabrication is used in the manufacture of ships, aircraft and all kinds of vehicles and machines where sections previously assembled at the final point of manufacture are assembled elsewhere instead, before being delivered for final assembly.

The theory behind the method is that time and cost is saved if similar construction tasks can be grouped, and assembly line techniques can be employed in prefabrication at a location where skilled labour is available, while congestion at the assembly site, which wastes time, can be reduced. The method finds application particularly where the structure is composed of repeating units or forms, or where multiple copies of the same basic structure are being constructed. Prefabrication avoids the need to transport so many skilled workers to the construction site, and other restricting conditions such as a lack of power, lack of water, exposure to harsh weather or a hazardous environment are avoided. Against these advantages must be weighed the cost of transporting prefabricated sections and lifting them into position as they will usually be larger, more fragile and more difficult to handle than the materials and components of which they are made.

History

[edit]



"Loren" Iron House, at Old Gippstown in Moe, Australia

Prefabrication has been used since ancient times. For example, it is claimed that the world's oldest known engineered roadway, the Sweet Track constructed in England around 3800 BC, employed prefabricated timber sections brought to the site rather than assembled on-site.[*citation needed*]

Sinhalese kings of ancient Sri Lanka have used prefabricated buildings technology to erect giant structures, which dates back as far as 2000 years, where some sections were prepared separately and then fitted together, specially in the Kingdom of Anuradhapura and Polonnaruwa.

After the great Lisbon earthquake of 1755, the Portuguese capital, especially the Baixa district, was rebuilt by using prefabrication on an unprecedented scale. Under the guidance of Sebastião José de Carvalho e Melo, popularly known as the Marquis de Pombal, the most powerful royal minister of D. Jose I, a new Pombaline style of architecture and urban planning arose, which introduced early anti-seismic design features and innovative prefabricated construction methods, according to which large multistory buildings were entirely manufactured outside the city, transported in pieces and then assembled on site. The process, which lasted into the nineteenth century, lodged the city's residents in safe new structures unheard-of before the quake.

Also in Portugal, the town of Vila Real de Santo António in the Algarve, founded on 30 December 1773, was quickly erected through the use of prefabricated materials en masse. The first of the prefabricated stones was laid in March 1774. By 13 May 1776, the centre of the town had been finished and was officially opened.

In 19th century Australia a large number of prefabricated houses were imported from the United Kingdom.

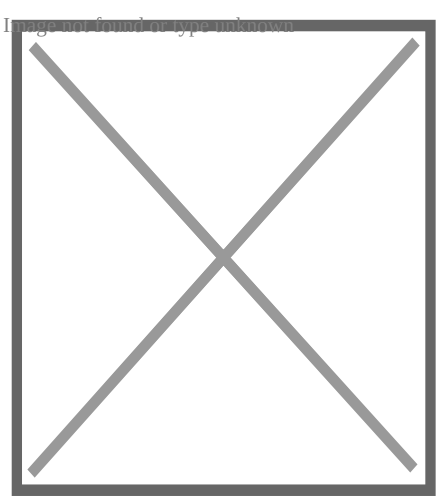
The method was widely used in the construction of prefabricated housing in the 20th century, such as in the United Kingdom as temporary housing for thousands of urban families "bombed out" during World War II. Assembling sections in factories saved time on-site and the lightness of the panels reduced the cost of foundations and assembly on site. Coloured concrete grey and with flat roofs, prefab houses were uninsulated and cold and life in a prefab acquired a certain stigma, but some London prefabs were occupied for much longer than the projected 10 years.[2]

The Crystal Palace, erected in London in 1851, was a highly visible example of iron and glass prefabricated construction; it was followed on a smaller scale by Oxford Rewley Road railway station.

During World War II, prefabricated Cargo ships, designed to quickly replace ships sunk by Nazi U-boats became increasingly common. The most ubiquitous of these ships was the American Liberty ship, which reached production of over 2,000 units, averaging 3 per day.

Current uses

[edit]



A house being built with prefabricated concrete panels.

The most widely used form of prefabrication in building and civil engineering is the use of prefabricated concrete and prefabricated steel sections in structures where a particular part or form is repeated many times. It can be difficult to construct the formwork required to mould concrete components on site, and delivering wet concrete to the site before it starts to set requires precise time management. Pouring concrete sections in a factory brings the advantages of being able to re-use moulds and the concrete can be mixed on the spot without having to be transported to and pumped wet on a congested construction site. Prefabricating steel sections reduces on-site cutting and welding costs as well as the associated hazards.

Prefabrication techniques are used in the construction of apartment blocks, and housing developments with repeated housing units. Prefabrication is an essential part of the industrialization of construction.[3] The quality of prefabricated housing units had increased to the point that they may not be distinguishable from traditionally built units to those that live in them. The technique is also used in office blocks, warehouses and factory buildings. Prefabricated steel and glass sections are widely used for the exterior of large buildings.

Detached houses, cottages, log cabin, saunas, etc. are also sold with prefabricated elements. Prefabrication of modular wall elements allows building of complex thermal insulation, window frame components, etc. on an assembly line, which tends to improve quality over on-site construction of each individual wall or frame. Wood construction in particular benefits from the improved quality. However, tradition often favors building by hand in many countries, and the image of prefab as a "cheap" method only slows its adoption. However, current practice already allows the modifying the floor plan according to the customer's requirements and selecting the surfacing material, e.g. a personalized brick facade can be masoned even if the load-supporting elements are timber.

Today, prefabrication is used in various industries and construction sectors such as healthcare, retail, hospitality, education, and public administration, due to its many advantages and benefits over traditional on-site construction, such as reduced installation time and cost savings.[4] Being used in single-story buildings as well as in multi-story projects and constructions. Providing the possibility of applying it to a specific part of the project or to the whole of it.

The efficiency and speed in the execution times of these works offer that, for example, in the case of the educational sector, it is possible to execute the projects without the cessation of the operations of the educational facilities during the development of the same.

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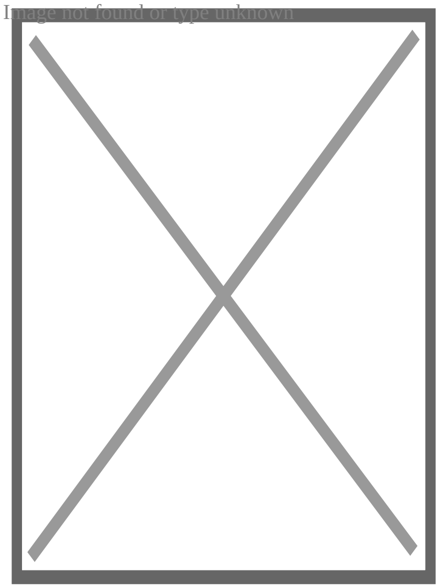

Transportation of prefabricated Airbus wing assembly

Prefabrication saves engineering time on the construction site in civil engineering projects. This can be vital to the success of projects such as bridges and avalanche galleries, where weather conditions may only allow brief periods of construction. Prefabricated bridge elements and systems offer bridge designers and contractors significant advantages in terms of construction time, safety, environmental impact, constructibility, and cost. Prefabrication can also help minimize the impact on traffic from bridge building. Additionally, small, commonly used structures such as concrete pylons are in most cases prefabricated.

Radio towers for mobile phone and other services often consist of multiple prefabricated sections. Modern lattice towers and guyed masts are also commonly assembled of prefabricated elements.

Prefabrication has become widely used in the assembly of aircraft and spacecraft, with components such as wings and fuselage sections often being manufactured in different countries or states from the final assembly site. However, this is sometimes for political rather than commercial reasons, such as for Airbus.

Advantages

[edit]

- Moving partial assemblies from a factory often costs less than moving pre-production resources to each site
- Deploying resources on-site can add costs; prefabricating assemblies can save costs by reducing on-site work
- Factory tools - jigs, cranes, conveyors, etc. - can make production faster and more precise
- Factory tools - shake tables, hydraulic testers, etc. - can offer added quality assurance

- Consistent indoor environments of factories eliminate most impacts of weather on production
- Cranes and reusable factory supports can allow shapes and sequences without expensive on-site falsework
- Higher-precision factory tools can aid more controlled movement of building heat and air, for lower energy consumption and healthier buildings
- Factory production can facilitate more optimal materials usage, recycling, noise capture, dust capture, etc.
- Machine-mediated parts movement, and freedom from wind and rain can improve construction safety
- Homogeneous manufacturing allows high standardization and quality control, ensuring quality requirements subject to performance and resistance tests, which also facilitate high scalability of construction projects. [5]
- The specific production processes in industrial assembly lines allow high sustainability, which enables savings of up to 20% of the total final cost, as well as considerable savings in indirect costs. [6]

Disadvantages

[edit]

- Transportation costs may be higher for voluminous prefabricated sections (especially sections so big that they constitute oversize loads requiring special signage, escort vehicles, and temporary road closures) than for their constituent materials, which can often be packed more densely and are more likely to fit onto standard-sized vehicles.
- Large prefabricated sections may require heavy-duty cranes and precision measurement and handling to place in position.

Off-site fabrication

[edit]

Off-site fabrication is a process that incorporates prefabrication and pre-assembly. The process involves the design and manufacture of units or modules, usually remote from the work site, and the installation at the site to form the permanent works at the site. In its fullest sense, off-site fabrication requires a project strategy that will change the orientation of the project process from construction to manufacture to installation. Examples of off-site fabrication are wall panels for homes, wooden truss bridge spans, airport control stations.

There are four main categories of off-site fabrication, which is often also referred to as off-site construction. These can be described as component (or sub-assembly) systems, panelised systems, volumetric systems, and modular systems. Below these categories different branches, or technologies are being developed. There are a vast number of different systems on the market which fall into these categories and with recent advances in digital design such as building information modeling (BIM), the task of integrating these different systems into a construction project is becoming increasingly a "digital" management proposition.

The prefabricated construction market is booming. It is growing at an accelerated pace both in more established markets such as North America and Europe and in emerging economies such as the Asia-Pacific region (mainly China and India). Considerable growth is expected in the coming years, with the prefabricated modular construction market expected to grow at a CAGR (compound annual growth rate) of 8% between 2022 and 2030. It is expected to reach USD 271 billion by 2030. [7]

See also

[edit]

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Wikimedia Commons has media related to ***Prefabrication***.

- Prefabricated home
- Prefabricated buildings
- Concrete perpend
- Panelák
- Tower block
- St Crispin's School — an example of a prefabricated school building
- Nonsuch House, first prefabricated building
- Agile construction
- Intermediate good

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[edit]

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7. **^** Modular Construction Market Size is projected to reach USD 271 Billion by 2030, growing at a CAGR of 8%: Straits Research. Globenewswire.com. 2022-06-18. Retrieved 2023-02-16

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About Royal Supply South

Things To Do in Arapahoe County

Photo

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Clock Tower Tours

4.1 (7)

Photo

Aurora Reservoir

4.6 (1770)

Photo

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History Colorado Center

4.6 (2666)

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Cherry Creek State Park

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Molly Brown House Museum

4.7 (2528)

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Four Mile Historic Park

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Driving Directions in Arapahoe County

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

Driving Directions From Walmart Supercenter to Royal Supply South

Driving Directions From Littleton to Royal Supply South

Driving Directions From King Soopers Pharmacy to Royal Supply South

Driving Directions From Wells Fargo ATM to Royal Supply South

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Driving Directions From Molly Brown House Museum to Royal Supply South

Driving Directions From Clock Tower Tours to Royal Supply South

Driving Directions From Four Mile Historic Park to Royal Supply South

Driving Directions From Blue Grama Grass Park to Royal Supply South

Driving Directions From Molly Brown House Museum to Royal Supply South

Driving Directions From Four Mile Historic Park to Royal Supply South

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105.0233105!2d39.6435918!3e0**

Reviews for Royal Supply South

Selecting Clauses that Cover Seasonal Tuneups**View GBP**

Check our other pages :

- **Planning Budget Strategies for Contract Renewals**

- Checking Deductible Requirements for Repairs
- Inspecting Crawl Spaces before Major Installations

Frequently Asked Questions

What specific components should be covered in a seasonal tune-up clause for a mobile home HVAC system?

A seasonal tune-up clause should cover inspection and cleaning of filters, coils, and blower components; checking refrigerant levels; testing thermostat calibration; inspecting ductwork for leaks or damage; and ensuring electrical connections are secure.

How often should a seasonal tune-up be conducted on a mobile home HVAC system according to standard clauses?

Standard clauses typically recommend conducting a seasonal tune-up twice a year, ideally before the start of the heating and cooling seasons, such as in spring and fall.

Are there any exclusions commonly found in clauses covering seasonal HVAC tune-ups for mobile homes?

Yes, exclusions may include costs related to major repairs or replacement of parts not related to routine maintenance, such as compressors or heat exchangers. These would require separate service agreements.

Why is it important to have coverage for seasonal tune-ups in an HVAC service agreement for mobile homes?

Coverage for seasonal tune-ups helps ensure that the HVAC system operates efficiently throughout the year, reduces the risk of unexpected breakdowns, extends the life span of the unit, and can lower energy costs by maintaining optimal performance.

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