



IDC Cooling



Hofmann

Specialist in

Plate heat exchanger

Greeting, a person pursuing fashion stem from personality, an enterprise pursuing new trend is derived from market demand, we believe so, and this is our way.

Professional design solution:

Our technical department dealt with various application year after year, the accumulative experience forged a special team with exploring spirit and critical spirit.

Service is our cornerstone:

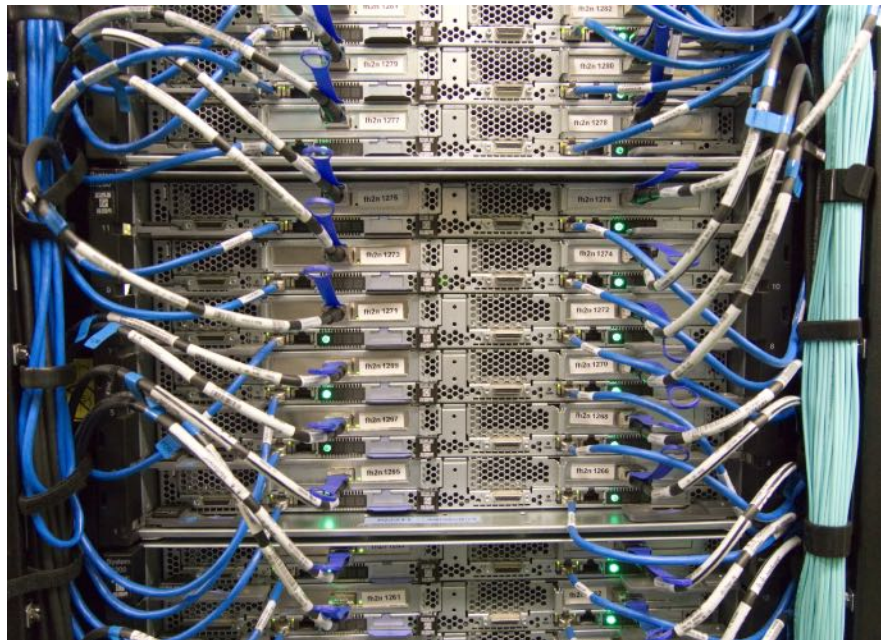
We consider customer as our priority, understanding customers' real needs and rapid feedback are the basics. We and customers are bound to each other for learning and developing, sharing knowledge keeps us growing, which makes accomplishing projects easier and faster.



New era

In the era of 5G, the industries of APP, AI, blockchain, mobile remote control and so on are going to flourish. The number of infrastructure like data center rapid increase predictably, not mention refurbishing and extension.

Assuming self-driving autonomous cars flood onto the roads, Bitcoin becomes the official currency in countries, the power load of communication and process data will increase geometrically, better cooling efficiency is going to be needed.



It produce **value**
and **heat**



73 TWH
in 2019

Based on the research from Uptime Intelligence, Bitcoin mining is reliably estimated to have consumed over 73 terawatt-hour of energy in 2019, and this is only one cryptocurrency - of over 1,500 - and just one application area of blockchains.



Instagram

24 MWH
Per Pic

Every time an image is posted on Instagram by the Portuguese soccer star Cristiano Ronaldo, his more than 188 million followers consume over 24 megawatt-hours of energy to view it.

Server **performance** is dependent on **cooling system**

If you have tried to run multiple or high demanding software on your computer, you must have encountered slow-running or even downtime. In terms of these kinds of situation, on one hand, your request overrun what it could bear, on the other hand, the electronic components like CPU, GPU, memory bar, BGA swiftly heat up, the cooling system (fans) inside your computer keeps running, a large number of hot air emitted from the air outlet, if you keep running the programs, to combat damaging the components, the onboard logic will degrade its performance. However, if you use high-performance cooling system to decrease the temperature of these components, at least the working performance maintains one hundred percent.

The data center is similar but more complex and the number of components is much more, and we are not allowed to bring a data center crash, furthermore, HFM is dedicated to keep the inlet temperature based on your demand and extend the lifespan of electronics.





legendary Data center

The development of electronics cooling has never stalled. There are two impressive tags in the traditional air cooling data center room, first is the chilling temperature, second is the raised floor. The cooled air is produced by air-conditioners and pressurized to the raised floor, then delivered to the server rack through layers of array cabinets and enter the hot pipe, circled to the cooling part. The disadvantage is uneven heat dissipation, to keep the end gas cooling enough, the air-conditioner and compressor must work really hard, which leads to huge power consumption, and poor efficiency.



Google data center in Hamina, Finland
Source: www.google.com/about/datacenters/locations/hamina

Nature cooling

Lots of large businesses draw support from nature, someone builds data center into a gulf, undersea, around the lake, etc. maximizing the utilization of geography and climate, yet we have to admit they really dealt with the power consumption of cooling with great performance. However the initial investment in conquering the trouble from nature sometimes costs a lot, for example, seawater, the pipe is the fiberglass-reinforced pipe, the plate from the plate heat exchanger is made of titanium, which in order to resist the corrosion of seawater. The lake is full of impurity, the cooling water has to be going through multiple filters before entering the system. Not mention the container designs to be waterproof and high-pressure bare capability.

$$\text{PUE} = \frac{\text{(Total Facility Energy)}}{\text{(IT Equipment Energy)}}$$

(Power usage effectiveness)



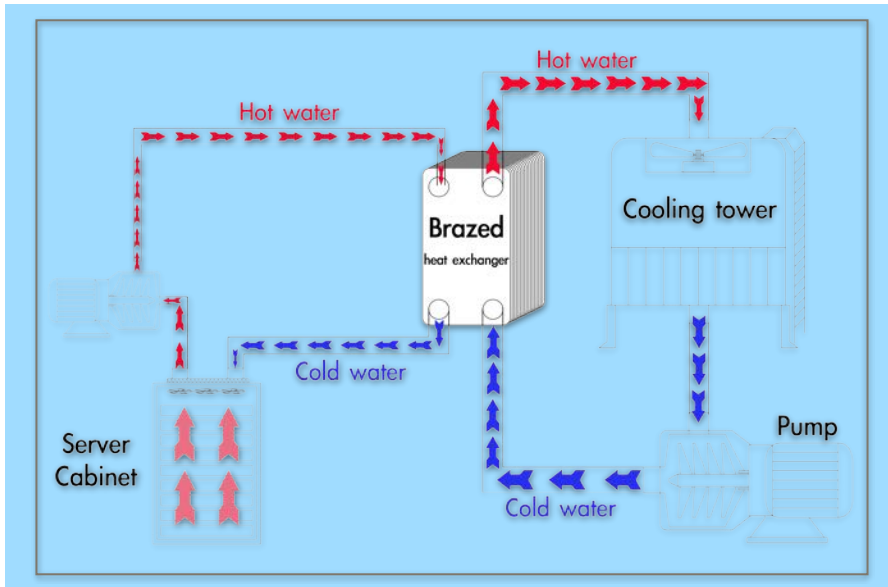
Liquid cooling

The heat we are talking about is due to electric resistance and electromagnetic induction from the electronic components in the server, why do we choose to chill the cabinet or the whole room by air rather than these heat sources directly by using higher specific heat capacity and heat transfer capacity- fluid. Water as the most common refrigerant is 40- 50 times more cooling effectiveness than air, and fluid phase transition makes heat transferring more efficient. Evaporation of 1 KG of water into water vapor can absorb 2501 KJ of heat, which is a significant cooling effect compared to air cooling. For example, a 10,000 KW capacity data center can do the chilling by hypothetically evaporating 4 KG water per second, only 12.6144 ten thousands ton of water per year and almost zero power consumption on cooling system compared to conventional data center air cooling system.

Fluid like water can better carry heat than air, but at first, using it on electronic devices cooling system was not popular due to two reasons, air cooling was qualified enough, second, most of the fluid are not insulating, leaking caused irreversible damage. Now we are facing tons of CPU and hard disk arrays operating 7/24 with high density, people figured out many creative

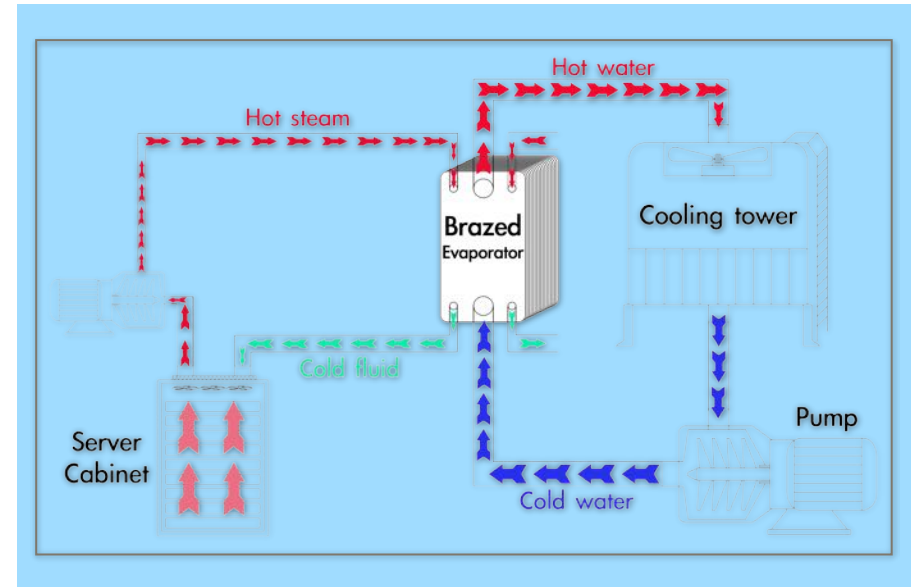
Let me use two graphic model to demonstrate:

Single-phase cooling



In the first graphic, the hot air within the cabinet is delivered to the radiator, thermal energy is transmitted to the water, in this circle, the brazed heat exchanger keeps chilling hot water. On the other side, thermal energy passes through plates to the water of the other circle. There is few state transform of the fluid due to its high boiling point under proper design, which is called "Single-phase cooling".

Two-phase cooling

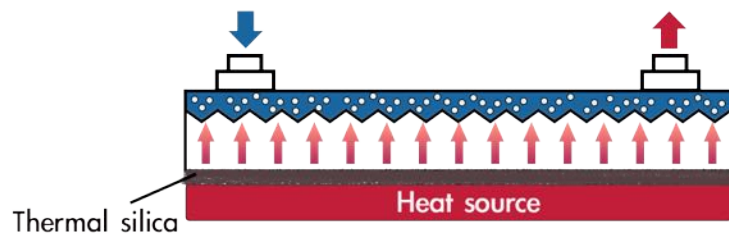


The second graphic reveals the process of "Two-phase cooling" in the server cooling system, which is similar to the "Single-phase cooling". However, owing to the low-boiling of the fluid, thermal energy leads to state transform, fluid like 3M™ Novec™ 7000 is vaporized into steam by the heat from the hot air and condensed into water in brazed evaporator over and over again, on the other side water keeps on transporting heat to cooling tower with extremely few power consumption compared to traditional air cooling system in data center.

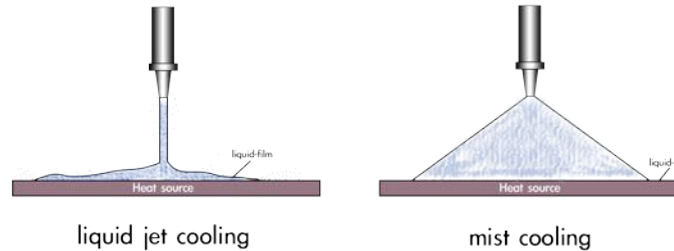
Cold plate cooling

There are three common liquid cooling methods in the data center, cold plate cooling, liquid spray cooling and immersion cooling, which all use specific liquid transferring heat from the core components.

Cold plate cooling, as the name implied, a metal plate as a thermal media transferring the heat from the heat source to the refrigerant, so the fluid does not contact the electronic component directly and achieving thermal transferring. Here is one type of cold plate and its framework for drawing, distinguish from the heat sink, cold plate are finless and made of a thicker metal plate which normal is made of high thermal conductivity material like copper and aluminum alloy. The various corrugation shapes increase fluid resistance and heat transfer efficiency. The colloid between the heat source and cold plate is thermal silica. The advantage of the cold plate cooling is that there is no need for adjusting the circuit structure so much and expensive dielectric coolant is unnecessary.



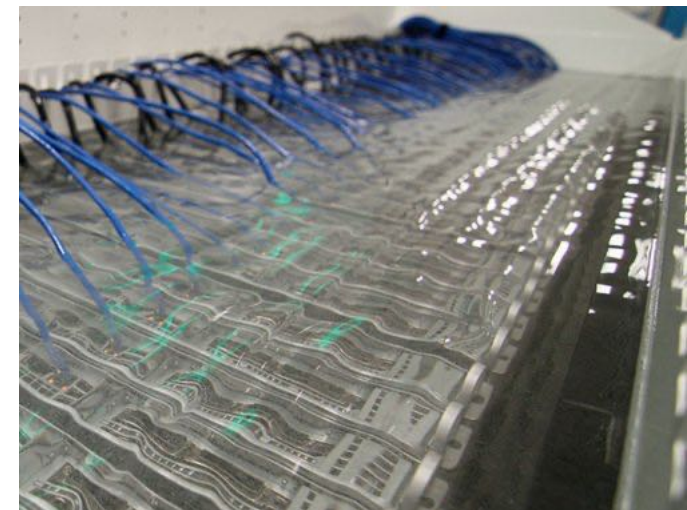
Spray cooling



Spray cooling can be divided into liquid jet cooling and mist cooling, which are all using dielectric fluid- fluorocarbon as the refrigerant. Usually, there is a liquid storage tank above cabinets, pipeline connects to spray nozzles which point to every electronic component, fluid's potential energy converts to kinetic energy, and dashes to the surface components. Meanwhile, the heat from the surface is taken away due to the refrigerant jet impact, strong convection, and phase transition. Even though it has so many advantages, remarkable chilling efficiency, low modification requirements, low noise, and vibration, etc. It demands high tightness against gas dispersion, moisture control is very necessary, mechanical hard disks have to be changed to helium type or completely isolated, the corrosive elements within the dielectric refrigerant have to meet the standard. HFM is keeping studying the feasibility plan.

Immersion cooling

Immersion cooling looks like more simple and direct, just soak servers into tons of refrigerant. The key point is what kind of refrigerant should we use, considering the compatibility between the coolant, server components, seal ring, welding flux, adhesive and etc., considering the boiling points has to below 90°C and not difficult to condense, considering the dielectric affects signal transmission, the permittivity of refrigerant should be lower than $2(C^2)$. Further more, unlike the traditional computer, the immersion cooling server case need to be built like a sealed container. However it is worth, based on the public information from several data enters using immersion cooling system, like Shanghai Supercomputing Center, Alibaba Zhangbei data center and Vienna Scientific Cluster, there PUE are 1.04(2018), 1.07(2018), and 1.033(2019). The refrigerant protects the electronics from contamination, no fans no vibration, which extended service life. The immersion cooling system allow high density layout compare to air-cooling system and less space demand, which is friendly to high price area.

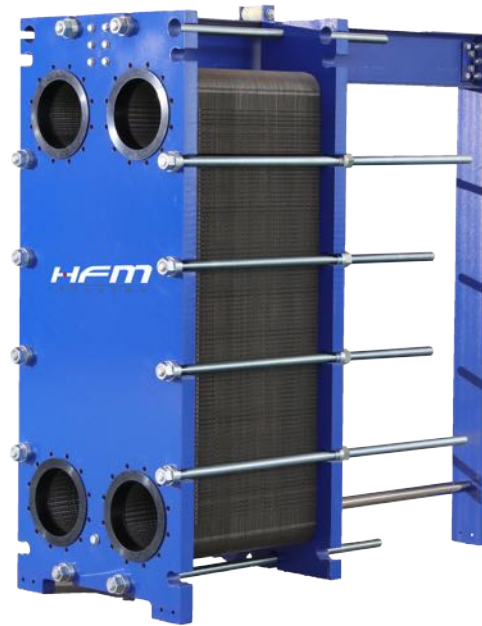


What products we could supply
for data centers

HFM is at your
disposal to offer
any kinds of heat
exchanger for any
circumstances
wherever you are

Based on several years experience on different application areas for heat exchanger, HFM will be your best consuler for thermal management.

HFM is dedicated to supply gasket heat exchanger, semi-welded, full-welded and brazed heat exchanger. Different sizes of evaporators and condensers are perfectly suitable for different working conditions.



Gasket plate heat exchanger's temperature bearing range is between $-40-180^{\circ}\text{C}$, which is depending on gasket material. It's qualified of the process of heat exchanging and waste heat recovery in data center. Its volume capability is variable by simple increase or decrease the number of the plates.



Brazed heat exchanger is commonly be used inside of a CDU (Cooling capacity distribution unit), its lightweight design and small size make it easily distribute into any area of a data center. Furthermore, brazed could be evaporator, condenser and normal heat exchanger.



Our **service** is
better than you
expected

HFM group has contracts with our partners for service and after-sales around the world, which is fully under our supervision. Manufacturing is merely one part of our business, knowing our customers requirements and acknowledge various kinds of working conditions is our daily life.

1, Inventory management

In order to ensuring delivery effectiveness, based on the acknowledge of PHE market and supply chain management, HFM has distributed the warehouses around the world.

2, Spares replacement

HFM has the full range of plate heat exchanger spares, our service engineers could either travel to the scene or remote guid your team to replace.

3, Cleaning service

HFM can provide both CIP(cleaning in place) and disassembling cleaning services depending on your circumstances.



Professional design solution:

Our technical department dealt with various application year after year, the accumulative experience forged a special team with exploring spirit and critical spirit. The gasket plate heat exchanger is our core business, thousands of units have been in services for many years in different fields.

Service is our cornerstone:

We consider customer as our priority, understanding customers' real needs and rapid feedback are the basics.

We and customers are bound to each other for learning and developing, sharing knowledge keeps us growing, which makes accomplishing projects easier and faster.

www.hofmann-heatexchanger.com



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