



Danfoss Brazed Plate Heat Exchangers System Applications

Our application focus



- **Condenser**
- **Evaporator**
- **Subcooler**
- **De-super heater**
- **Air dryer**
- **Chiller**
- **Heat pump**
- **Cascade system**
- **Indirect refrigerant**

Variety of applications

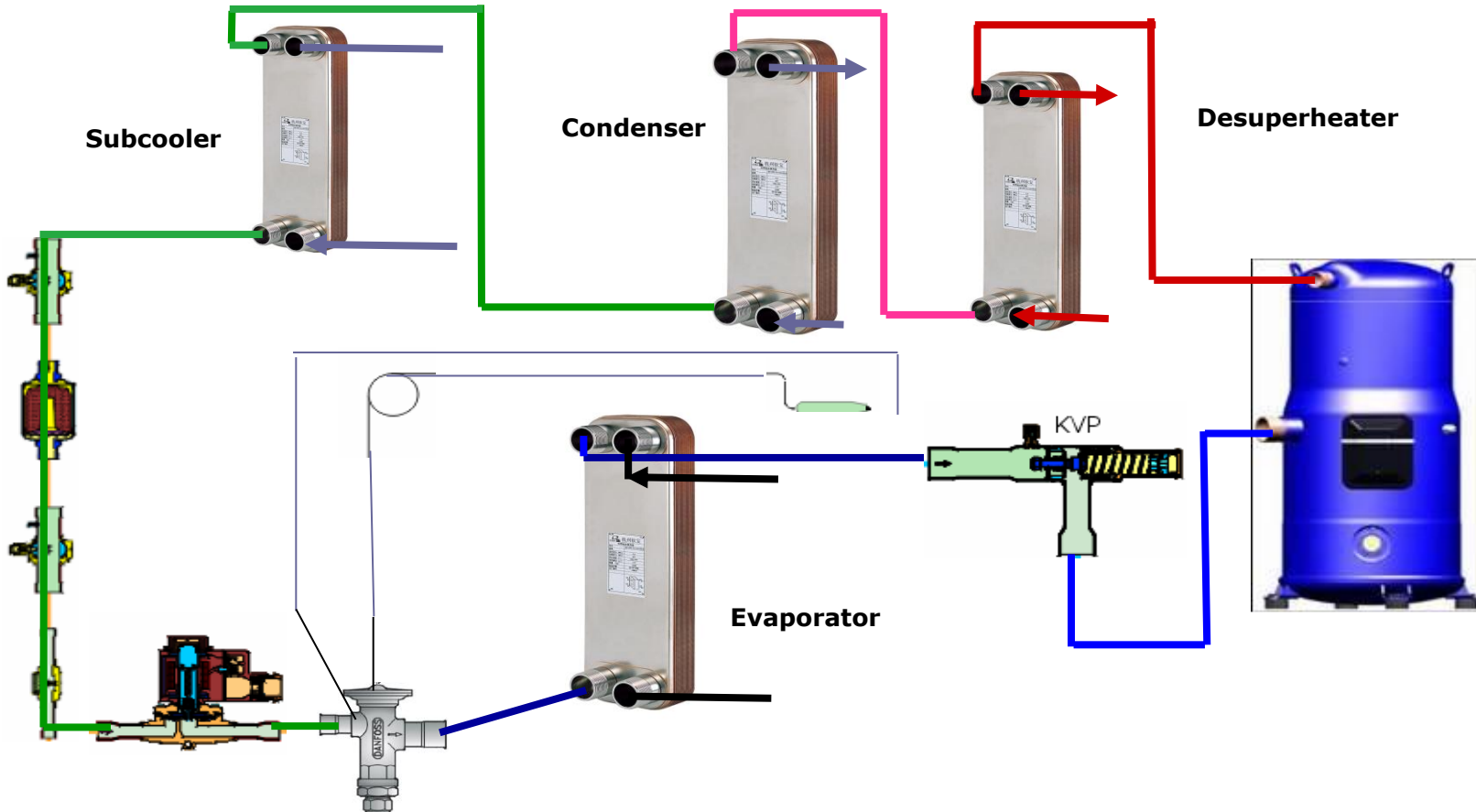


- **Power generation**
- **Mobile oil cooling**
- **Refrigeration oil cooling**
- **Cutting oils**
- **Hydraulic press**
- **CNC**
- **Laser cooling**
- **Petrochemical**
- **Industrial process**



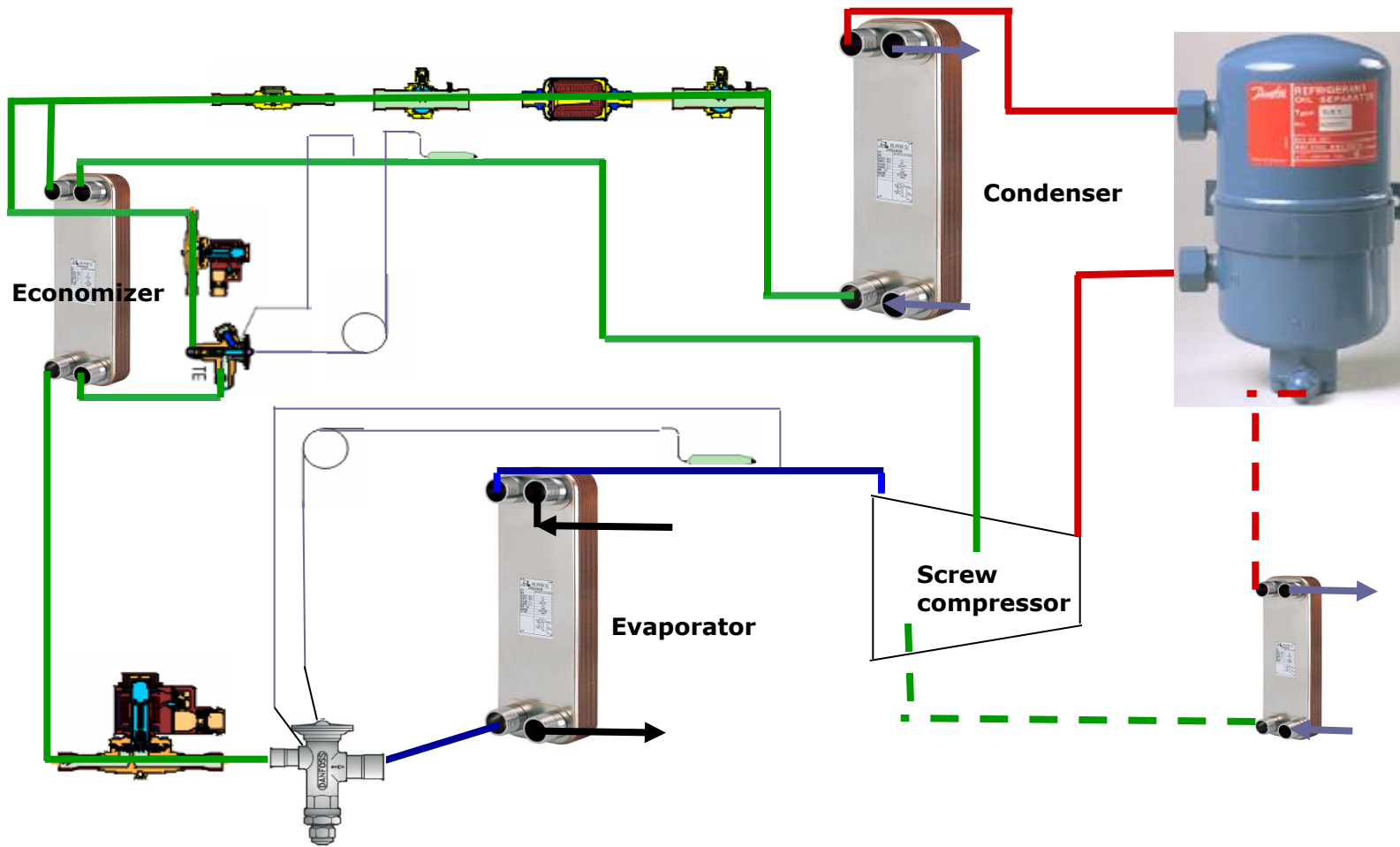
- **Beverage coolers**
- **Space heating**
- **Domestic hot water**
- **Radiant systems**
- **Heat reclaim**
- **District heating/cooling**
- **Pool heating**
- **Wall hung boilers**
- **Steam heating**

BPHE refrigeration application



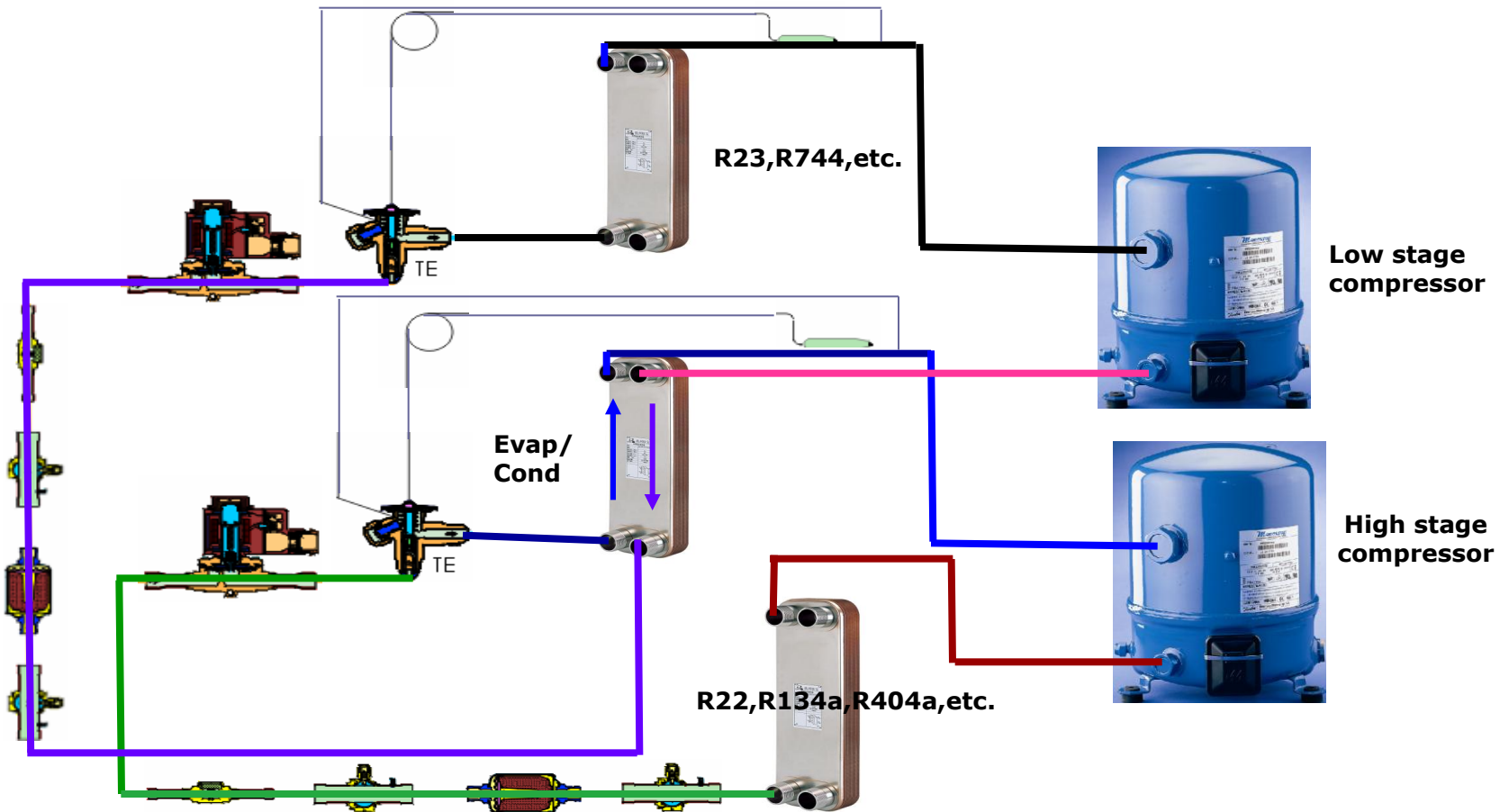


BPHE refrigeration application

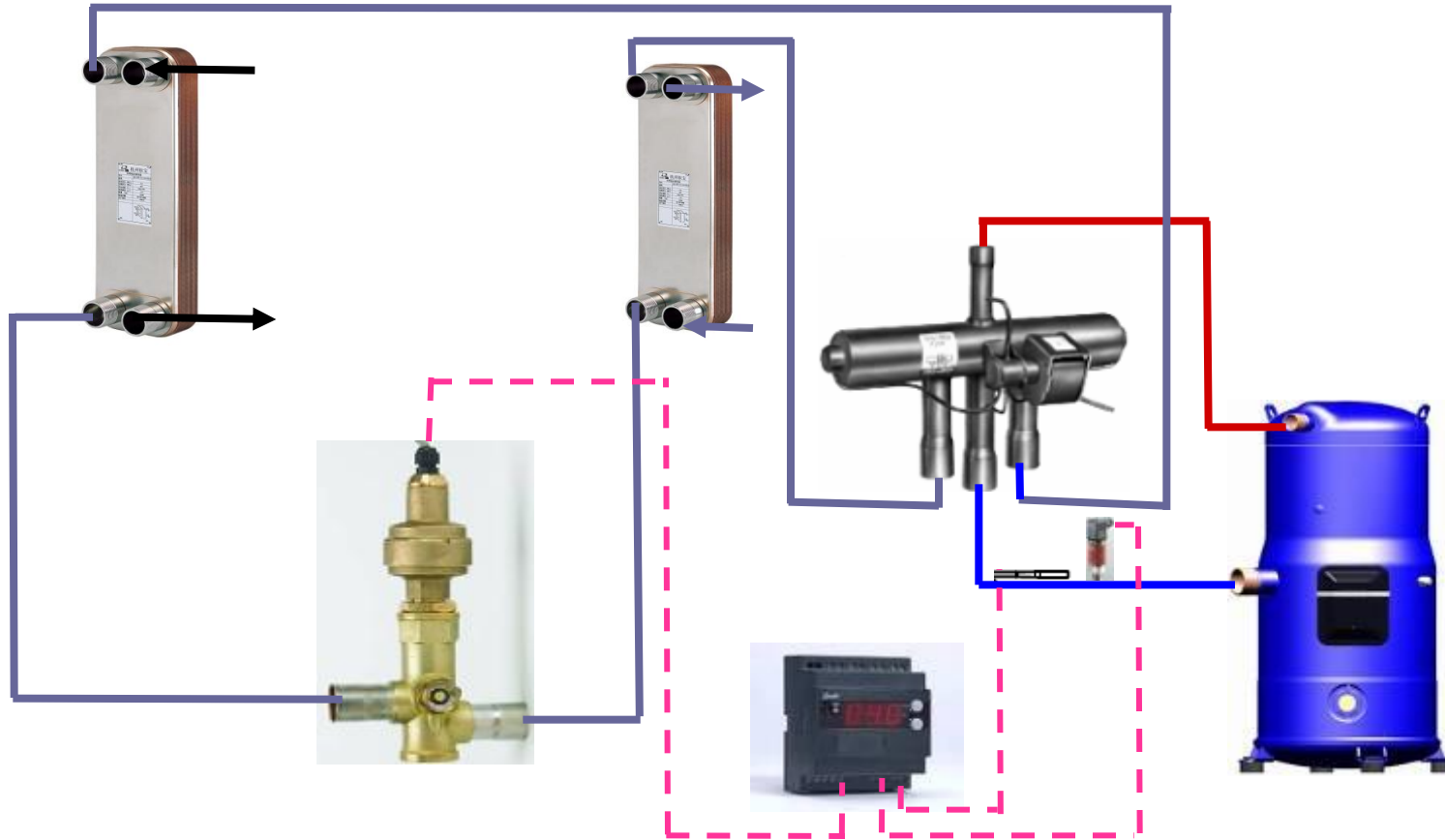




BPHE cascade application

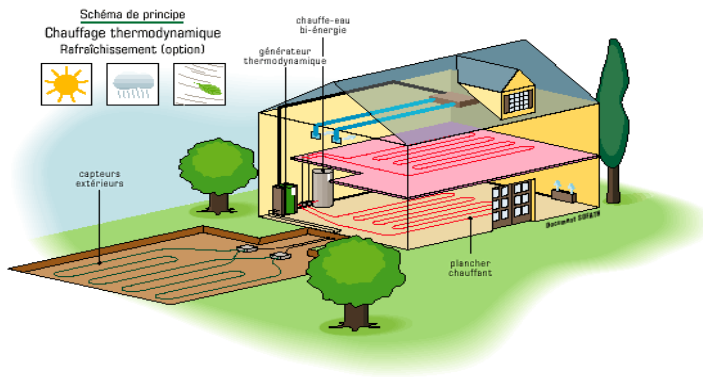


BPHE heat pump application

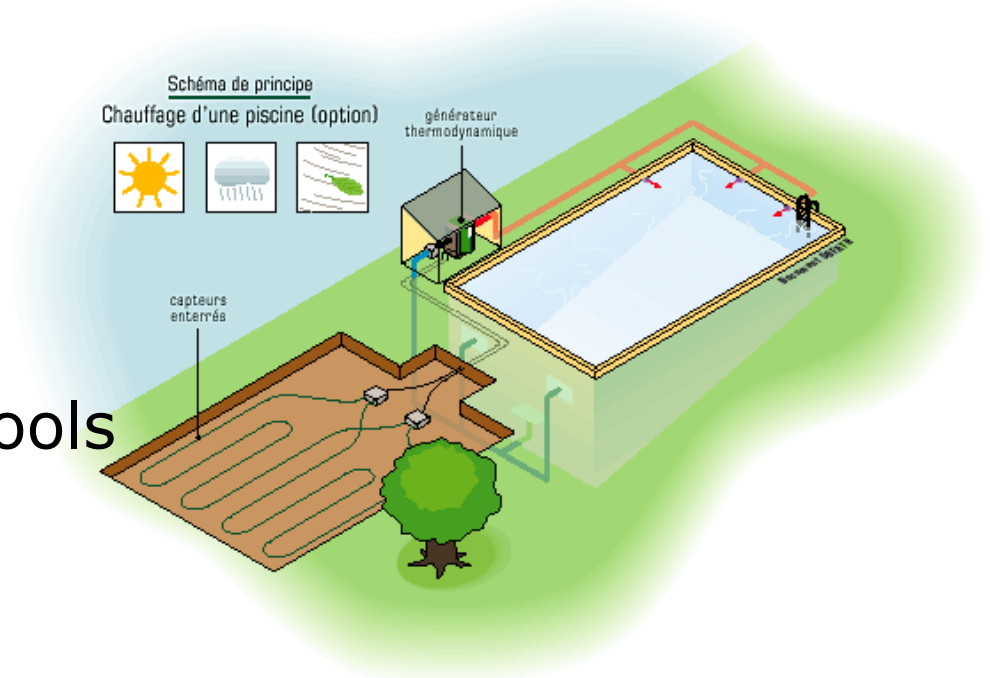


Heat Pumps (only) Application examples

Heating of single houses



Heating of swimming pools

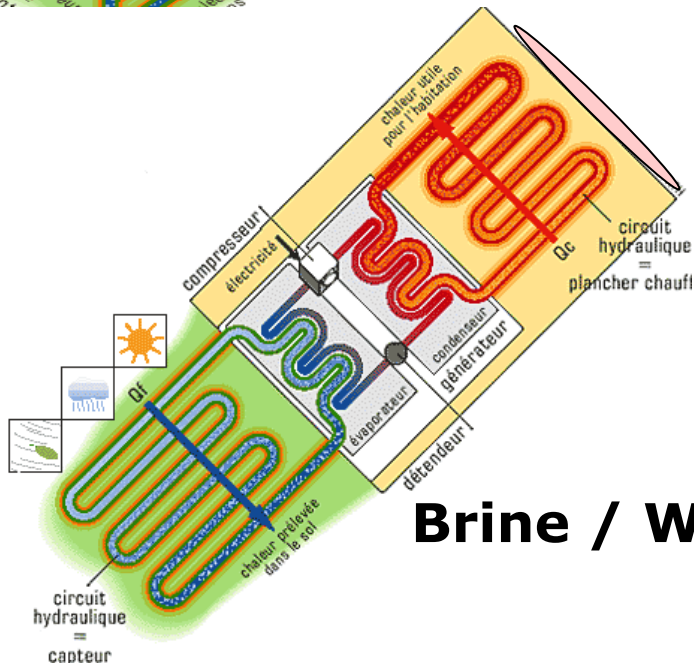
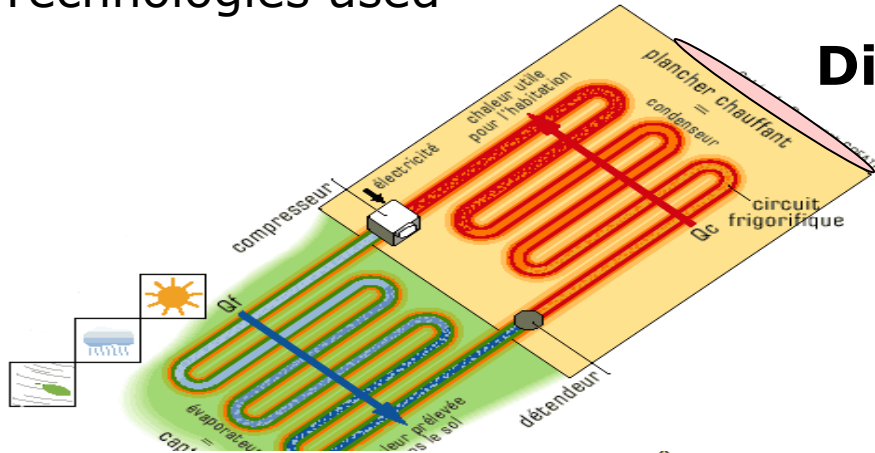




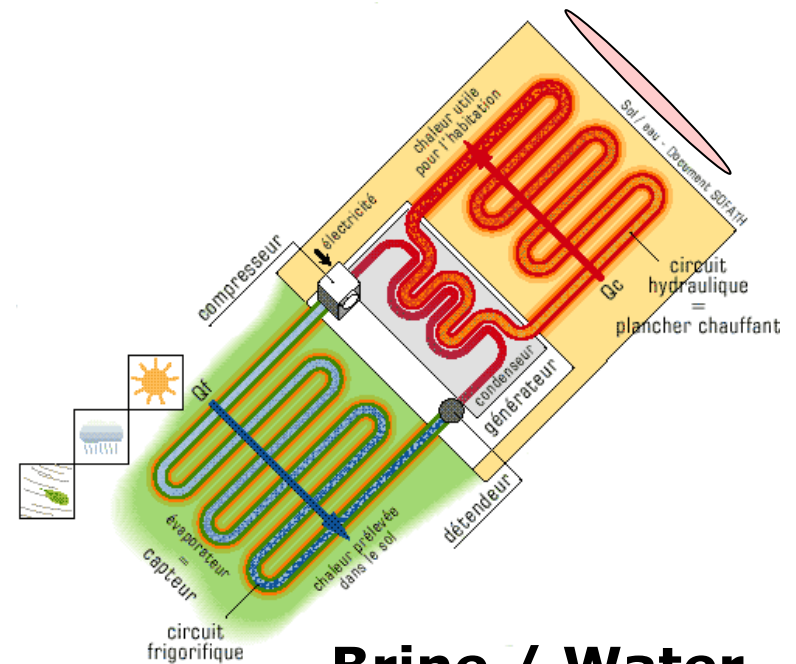
Heat Pumps

Technologies used

Direct evaporating / condensing



Brine / Water



Brine / Water and Air / Water



A word from competitors on Applications



Alfa Laval's DOC

Dedicated Oil Coolers Brazed Plate Heat Exchangers

■ General description

DOC is specially designed for hydraulic oil cooling. Low-pressure drop over the oil inlet and outlet, ensure high cooling effect in relation to flow rate.

■ Working principles

The heating surface consists of thin corrugated metal plates stacked on top of each other. Channels are formed between the plates and corner ports are arranged so that the two media flow through alternate channels, normally in full counter current flow. The media are kept in the unit by a brazed seal around the edge of the plates. The contact points of the plates are also brazed to withstand the pressure of the media handled.

■ Features

- Extremely compact and robust
- Outstanding cooling capacity
- Fast and secure installation
- Minimized risk of corrosion
- Substantial recovery of heat





Alfa Laval's DOC

Dedicated Oil Coolers Brazed Plate Heat Exchangers

- **Dedicated solution**

Alfa Laval is also the only company to offer a specially designed solution, based on the brazed technology, for cooling of oil for hydraulic systems. The unit, a dedicated oil cooler (DOC), is extremely compact and robust. A low pressure drop over the oil inlet and outlet, which enables the pressure drop to be used over the complete heat exchange surface, gives outstanding cooling capacity. The DOC has specially designed stainless steel mounting blocks brazed onto the cover plate that allow high tightening torque and good spanner grip to ensure fast and secure unit installation. The unit is also supplied with a shelf-type support bracket, which facilitates mounting. The high heat transfer capacity of the DOC allows substantial recovery of heat, which can be used for heating of tap water, for instance

- <http://here.alfalaval.com/zino.aspx?pageID=3&articleID=446>





Basic Business

Industrial applications (Ref: GEA) / I

- Plate heat exchangers are used in industrial process heating, fluid cooling, fluid heating, oil coolers, steam, and specialty applications for OEM and Industrial End Users.
- They are capable for a wide variety of Industrial fluid to fluid, gas to fluid and other applications requiring exacting heat transfer performance.
- Process Applications include:
 - Process Heating
 - Process Cooling
 - Glycol to water
 - Gas to Fluid
 - Gas to Gas
 - Close Approach applications
 - Engine Cooling
 - Oil Cooling
 - Special Fluids & Gases
 - Shell/tube Replacements



Basic Business

Industrial applications (Ref: GEA) / II

- There are literally hundreds of application possibilities for Brazed Plate Heat Exchangers being used in Industrial, Process and Manufacturing applications:
 - Radiant Floor (floor heating)
 - Snow Melt
 - Process Tank Heating/Cooling
 - Hydraulic Oil Cooling Systems
 - Process Fluid & Gases
 - Transmission Coolers
 - Engine Oil Coolers
 - Shell & Tube Replacement
 - Off shore process heating and cooling



Basic Business

Industrial applications (Ref: GEA) / III

■ Other Examples:

- CO₂ Systems
- Lasers
- Process Gas Heating/Cooling
- Cryogenic Systems
- Liquid Nitrogen Uses
- Propane/Natural Gas
- Pre-heaters
- Engine Oil & Transmission Coolers
- Machine Tool Cooling
- Pulp & Paper Processes
- Extruder Lube Cooling
- Resin Heating/Cooling
- Food Processing
- Medical Sterilizers
- Semi-conductor Processing
- Medical Sterilizers
- Semi-conductor Processing
- Fuel Cells
- MRI and X-Ray Equipment
- Solvent Heating/Cooling
- Heat Recovery
- Oven and Furnace Systems
- Steam Recovery
- Hydraulic Oil Cooling
- Petrochemical Processing
- Wine, Beer and Spirit production
- Hydrocarbon Processing
- Plastics Cooling
- Laboratory Systems
- Printing Presses

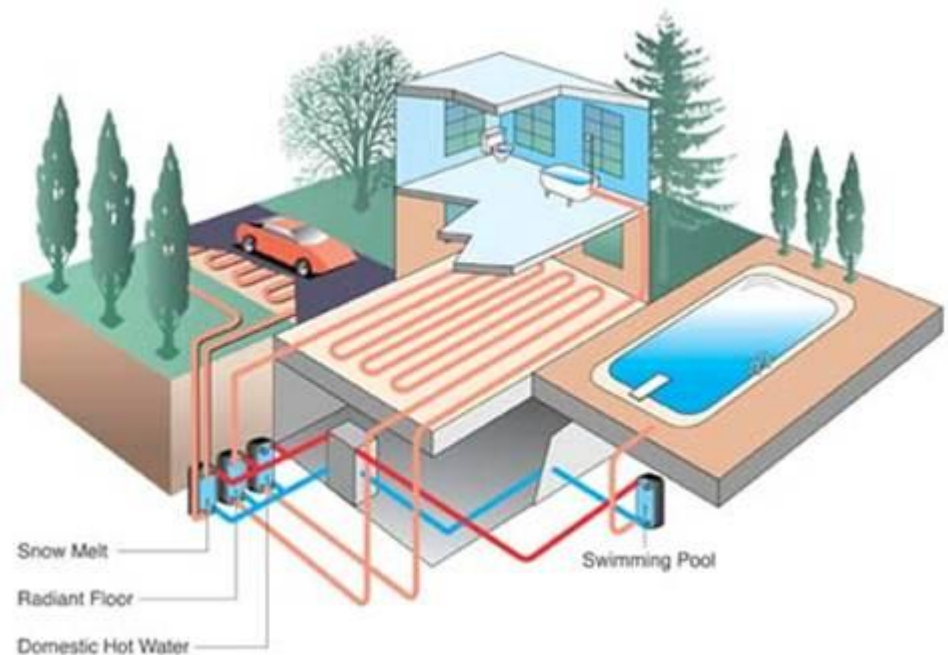
Hydronics (ref: GEA)

- **We Speak Hydronics™**

A full line of plate heat exchangers are available for boilers, hot water heating, radiant floor, snow melt systems, steam, process heating, and other hydronic heating applications.

- **Residential Applications**

GEA FlatPlate heat exchangers are typically used to efficiently heat domestic water, melt snow on sidewalks and driveways and to heat swimming pool water.



See GEA data sheet for further details on some of the applications:

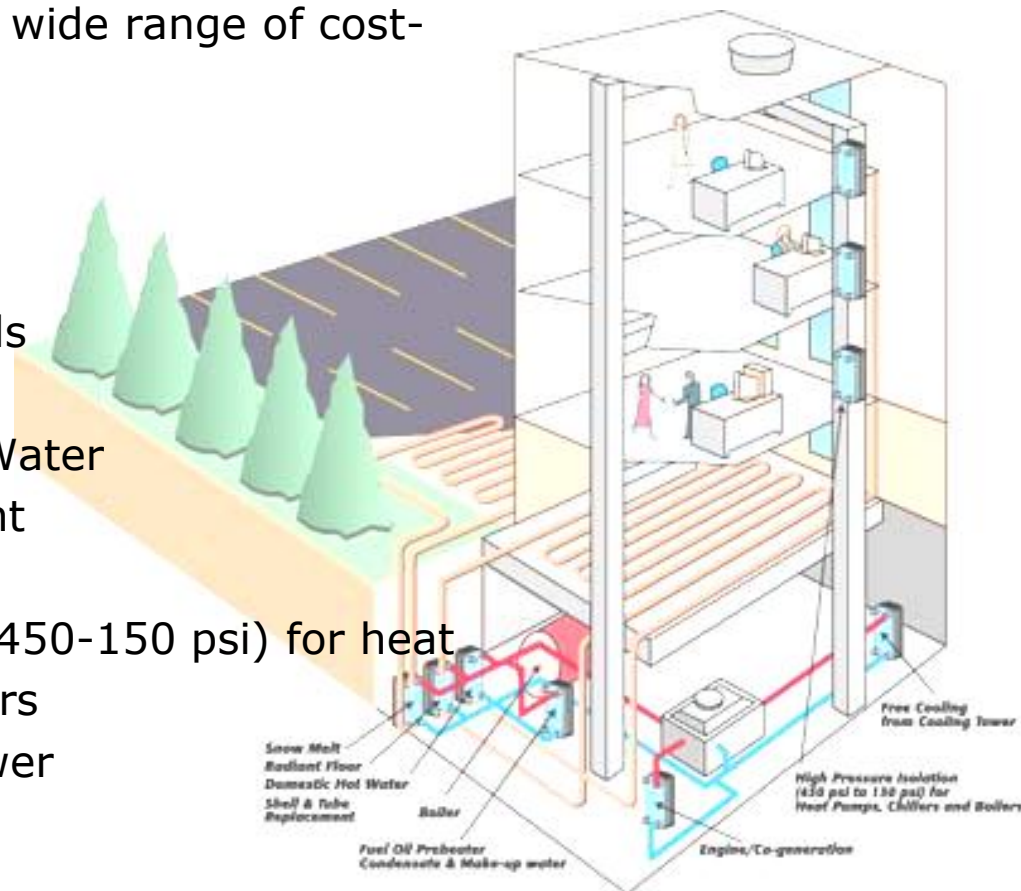
<http://www.flatplate.com/pdf/hydronic/Hydronic%20Catalog%202005.pdf>

Hydronics (ref: GEA) cont.

■ Commercial Applications

In commercial applications, GEA FlatPlate brazed plate heat exchangers are used in a wide range of cost-effective applications.

- Domestic Hot Water
- Radiant Floor
- Snow Melt
- Spas and Swimming Pools
- Fuel Oil Preheater
- Condensate & Make-up Water
- Shell & Tube Replacement
- Engine/Co-generator
- High Pressure Isolation (450-150 psi) for heat pumps, chillers and boilers
- Free Cooling/Cooling Tower



But, for the time being Our application focus is on:



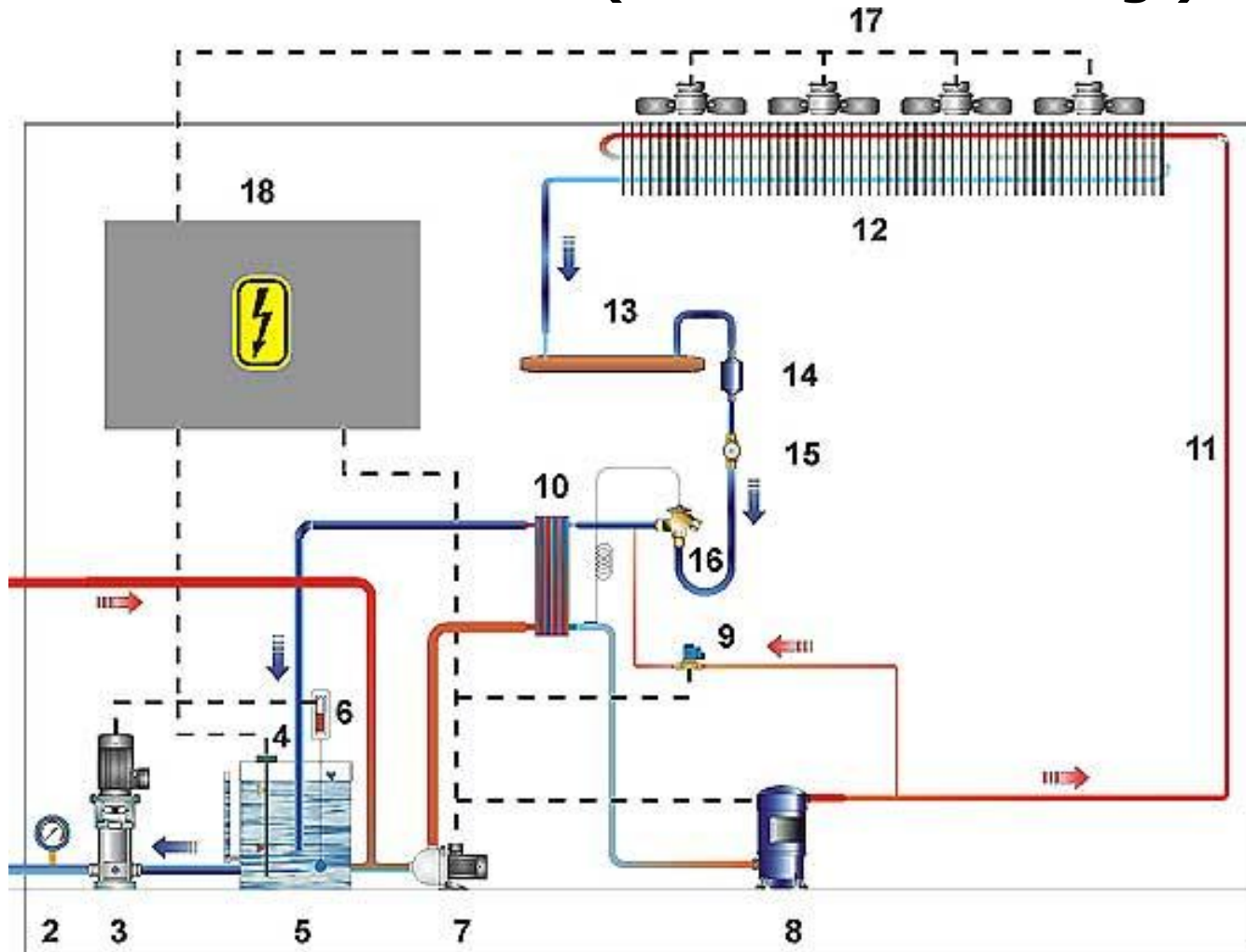
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Application Industrial Process Cooling

By Stefan Pietrek et. al.

August 2007

Functional Principle of a Universal Chiller (schematic drawing!)



Draw: Company KLH (Internet)



Industrial Process Cooling General Description I

- Designed to cool water or other fluids like re-circulated water or brine, oil, lubricating fluids.
- Factory built machine or system, incorporating compressors, controls and direct expansion or flooded evaporator → here: focus on BPHE.
- The liquid chiller can be either with built in air cooled or water cooled condenser → BPHE.
- New trend: Flow ice machines circulating ice slurry → no BPHE as evaporator.



Industrial Process Cooling General Description II

- Think about that due to medium temperature a simple oil/water cooler or water/ water, brine/water cooler could be a sales target at those customers, too!
- We are not talking about secondary cooling in supermarkets.
- We do not talk about Air Conditioning Chillers !!!



Customers Major Requirements

- Varies according to the application, for examples
 - Compact air cooled unit in the plastic industry (high evaporating temperature, capacity regulation, water used → BPHE could freeze).
 - Specifically designed to be incorporated into a machine e. g.: oil coolers for machining centres (high evaporator temperature, high condensing temperature, vibration, oil-water emulsion → freeze but later than water, viscosity changes, "Plate L-type").
 - De-ionized Water for Laser Tooling Machines (no copper, stainless steel, nickel brazed requested!!!, freezing, small temperature difference → normally water tank used; Energy consumption of cooler is no big problem).
 - Water for Medical Laser applications (see Laser Tooling Machines).
 - Dry Cleaning and Laundry Equipments (Fluid "PER", today more and more "KWL", a flammable hydrocarbon type, different additives used, → trust on customer experience, double wall exchanger needed in some cases; Chinese Star Group is the global player)



Technical Details

■ Evaporating Temperature

- Range from $-20\text{ }^{\circ}\text{C}$ (brine) to $+15\text{ (20)}\text{ }^{\circ}\text{C}$ (direct cooling)
- Secondary cooling or cascade systems could be even lower.
- $-30\text{ }^{\circ}\text{C}$ re-condensation of KWL but no BPHE used here.

■ Specific cooling process

- Either direct cooling fluid/ fluid, refrigerant/ fluid or refrigerant/ refrigerant (cascades)

■ Cooling Capacity

- 1 kW to approximately 500 kW

■ Refrigerant

- R22, R407C (glide!!!; freezing!!!), R404A / R507, R134a in special applications (high evaporating temperature)



Leading OEMs (examples)

- France → Lennox (Hyfra)
- France → Profroid
- Italy → MTA
- Germany → Glen Dimplex Deutschland
- Germany / Italy → Rittal (Kelvin)
- Germany → KLH
- China/ Germany → Star Group (Böwe)
- US/ Germany/ Spain → Donaldsen (Ultrafilter)



Product Examples End Users



Turning machines
Lubrication oil cooling



Tooling machines
Punching/
Laser Cutting machine



Printing machines



Laser machines

Plastic moulding machines





Cooling Tasks in Laser Technology



Cooling Block Systems



1 kW to 7 kW



15 kW to 75 kW



90 kW to 200 kW

The beam source, beam path and the panel of laser systems must be kept at low temperatures.

The necessary consistency of the supply temperature in most cases is $\pm 1\text{K}$ or $\pm 2\text{K}$. Some laser systems even require a consistency level of $\pm 0.5\text{K}$. The supply temperature is around $15\text{-}22^\circ\text{C}$.

Other factors that must be considered include water quality, material selection and the conductivity of the cooling water.

A variety of laser systems require a specific minimum water temperature at the start-up. An additional electrical heating system built into the water tank allows for fast heating of the circulating water. Other systems need a separate cooling circuit (optic circuit).



Cooling Tasks in Machine Design



Metal cutting machine tools

The cooling solutions are primarily used in processing centers with high-speed rotor screws that have rotation speeds up to 40,000 m-1. The main elements requiring cooling are rotor screw motors, bearings, the coolant and the panels, if applicable. The adaptation to the coolant temperature in accordance with the temperature of the machine bed and the conditions in the plant is a special challenge for cooling systems.



Non-cutting machine tools

In this sector, the cooling systems are specifically used in spark-erosion machines, in which the non-conducting material is cooled. In the case of grinders, the emphasis of effective cooling is on the coolant, which must be used to prevent sanding burns on work pieces. The cooling of lapping and polishing machines represents a special technological challenge, since the lapping granules or the polishing residue must be removed with special filters before the cooling process itself.

Cooling Block Systems



1 kW to 7 kW



15 kW to 75 kW



90 kW to 200 kW



Cooling Tasks in Machine Design



Paint lines

The cooling aggregates provide optimal temperatures for baths and coating materials in dipping baths and paint lines worldwide.

In the case of dipping machines for surface cleaning, the detergent is indirectly kept at a specific temperature with a lamella heat exchanger. The gases of solvents and other contaminants can be disposed after condensation without harming the environment. The producer also supply aggregates with very high cooling capacities for liquid paint dipping systems. While spray models for coating only require temperature-controlled paint, this technology uses high-performance lamella heat exchangers, which in addition to temperature-control also ensure the condensation of solvent gases that are dissolved in the air.

Galvanizing

In this technology, the aggregates are used to keep the galvanic bath cool. Thanks to the circulation of cold water through a lamella heat exchanger, solvents and other elements that have been absorbed in the air or in gases can condensate. The saturated gases are cooled below dew point temperature in the finned packet, where they can be collected as a liquid and disposed without harming the environment. The cooling capacity required for this application depends on the energy applications of heaters, pumps, agitators, boosters and ventilators.



Cooling Block Systems



1 kW to 7 kW



15 kW to 75 kW



90 kW to 200 kW