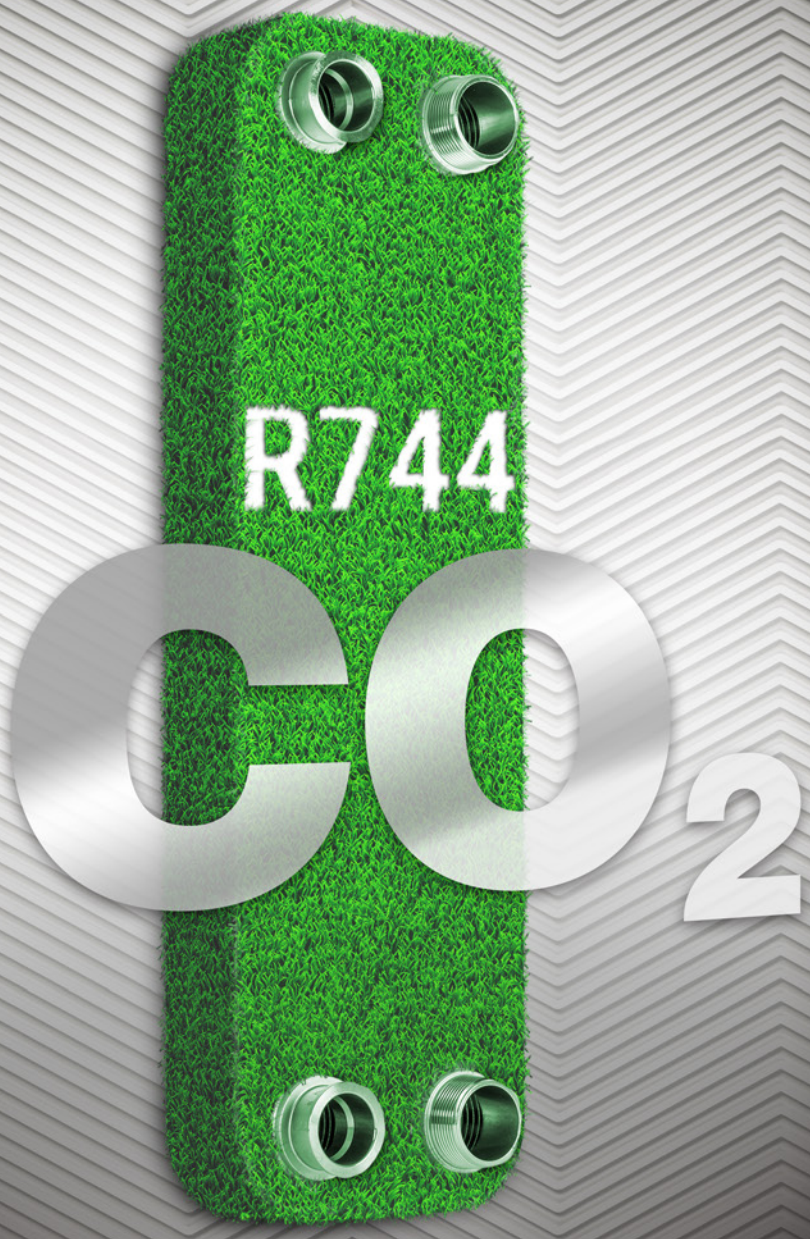
KAORI

Brazed Plate Heat Exchanger for CO_2 Applications



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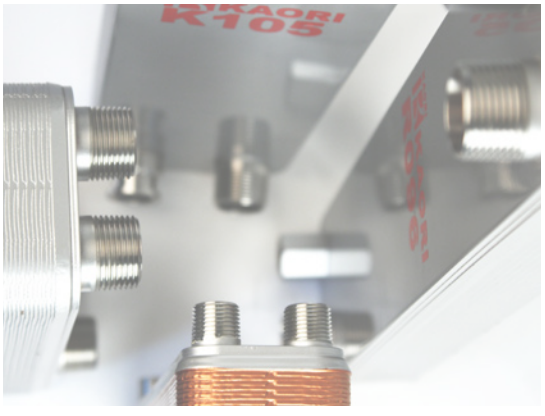
CO_2 (R744)

Due to global warming, climate change phenomenon, and rising restriction on the use of high GWP synthetic refrigerant; replacing HCFC and HFC by natural refrigerants has gained importance. HVAC system manufacturers are using natural refrigerant instead of HCFC and HFC in their latest products, in order to take a part in slowing global warming. The environment-friendly CO_2 HVAC is growing in the vehicle air conditioning systems, heat pumps HVAC and house heating markets.

Hydrocarbon refrigerants are usually composed of flammable substances with high potential risk. In contrary CO_2 (R744) is classified as non-flammable and non-toxic fluid, having zero ODP (Ozone Depletion Potential) and minimal GWP (Global Warming Potential) of 1. It also has excellent thermodynamic properties making it one of the most popular natural refrigerants to replace HCFC and CFC.
CO_2 (R744) is suitable for range of application such as industrial heat extraction, modern heating or refrigeration technologies, and as well biotechnology industry such as supercritical extraction, with the environment-friendly characteristic of supercritical CO_2.

Brazed Plate Heat Exchanger

Brazed Plate heat exchangers are compact designed with high efficiency, size only 1/3 of shell and tube heat exchanger, made by stainless steel with high pressure strength, higher corrosion resistance, and most importantly with longer usage life. Brazed plate heat exchangers are now the most preferred engineering design of various system manufacturers, such as refrigeration, air conditioning, heat pump system, hydraulic cooling, industrial processes and other industries can be seen on the application of brazed plate heat exchanger.
KAORI High-pressure C series brazed plate heat exchanger is dedicatedly designed for various uses of CO_2 systems. KAORI has successfully developed our latest C series exchanger to a high pressure resistance, higher heat transfer performance and smaller size heat exchanger, with all its advantages, C series heat exchanger not only breakthrough the restrictions of traditional heat exchanger , but also enlarge the benefits of R744 (CO_2), and fulfill various CO_2 system applications and designs.

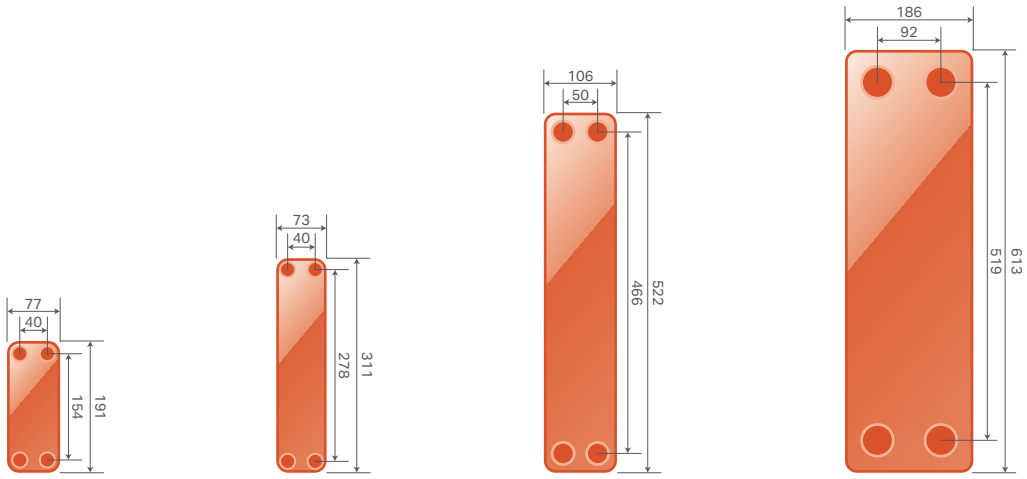


Super High Pressure BPHE

KAORI C series is specially designed for R744 (CO_2), in supercritical, transcritical and subcritical system applications, can be used as gas cooler, condenser, evaporator ,economizer, cascade, heat recovery, SLHE (suction line heat exchanger), and intercooler of heat pump in refrigeration, and supercritical extraction industries. Designed with different maximum working pressure resistance, at 70 bar, 100 bar and 140 bar, available for various duties and different performance specifications, with compact size, outstanding heat transfer efficiency and low pressure drop are the three key features of KAORI C series. The quality and the durability of C series is proved by field tests, achieving the burst test pressure up to 650 bar and cycle test over 100,000 cycles.

C Series Specifications

Unit: mm



C020/C021/C022 C040/C041/C042 C095/C096/C097 C200/C201/C202

Model	Thickness (mm)	Weight*(kg) Without Connection	Heat Transfer Area/ Plate (m^2)	Total Heat Transfer Area (m^2)	Volume/ Channel (liter)	Total Volume (liter)	Max. Working Pressure (bar)	Min. Test Pressure (bar)	Max. Working Temperature (°C)
C020	9.5+1.10*N	1.12+0.042*N	0.01109	(N-2)*0.01109	0.009	(N-1)*0.009	70/30	100/43	200
C021	9.5+1.10*N	1.14+0.042*N	0.01109	(N-2)*0.01109	0.009	(N-1)*0.009	100/30	143/43	
C022	9.5+1.10*N	1.126+0.042*N	0.01109	(N-6)*0.01109	0.009	(N-5)*0.009	140/30	200/43	
C040	13.0+2.00*N	1.74+0.145*N	0.0193	(N-2)*0.0193	0.03	(N-1)*0.030	70/30	100/43	
C041	13.0+2.00*N	1.83+0.145*N	0.0193	(N-2)*0.0193	0.03	(N-1)*0.030	100/30	143/43	
C042	13.0+2.00*N	1.75+0.152*N	0.0193	(N-2)*0.0193	0.03	(N-1)*0.030	140/30	200/43	
C095	13.2+2.16*N	5.52+0.320*N	0.0475	(N-2)*0.0475	0.071	(N-1)*0.071	70/30	100/43	
C096	13.2+2.16*N	5.68+0.320*N	0.0475	(N-2)*0.0475	0.071	(N-1)*0.071	100/30	143/43	
C097	13.2+2.16*N	5.90+0.346*N	0.0475	(N-2)*0.0475	0.071	(N-1)*0.071	140/30	200/43	
C200	14.0+2.15*N	12.39+0.603*N	0.095	(N-2)*0.0950	0.156	(N-1)*0.156	70/30	100/43	
C201	14.0+2.15*N	12.56+0.631*N	0.095	(N-2)*0.0950	0.156	(N-1)*0.156	100/30	143/43	
C202	14.0+2.15*N	12.41+0.755*N	0.095	(N-2)*0.0950	0.156	(N-1)*0.156	140/30	200/43	

*Kaori reserves the right to make changes without prior notice.

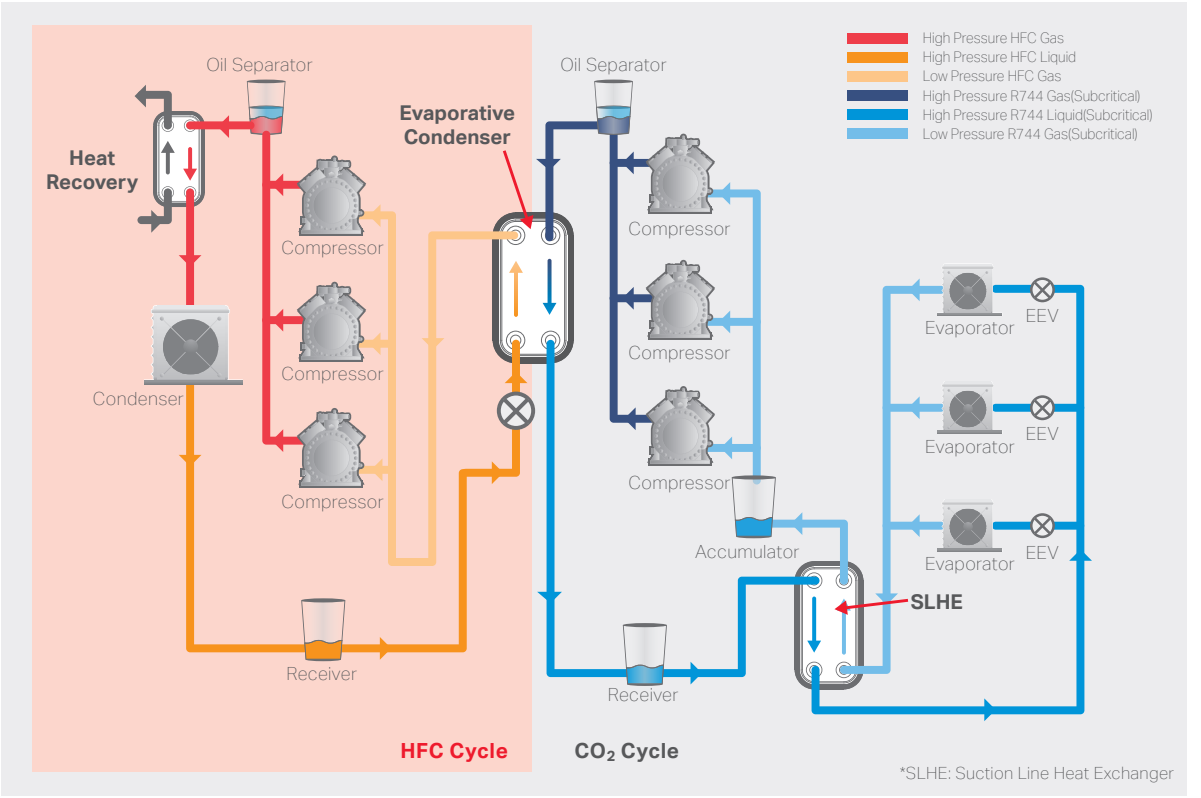
CO_2 Refrigeration System

Subcritical Cascade system

Cascade refrigeration system is a good solution for low-temperature refrigeration system that can not be achieved by single-stage refrigeration systems, enabling optimum compressor efficiency, and reduce compressor exhaust temperature and its compression ratio.

In the cascade refrigeration system, the system of HFC refrigerant is applied to the main circuit (mid-high temperature), and R744 (CO_2) refrigeration system is applied to the low temperature overlay circuit, two individual circuits exchange heat through a cascade heat exchanger. Furthermore, SLHE (suction line heat exchanger) are commonly designed in R744 (CO_2) refrigeration system, which increases subcooling and superheating of R744(CO_2), improve the efficiency of evaporator, and reduce the risk of compressor failure (refrigerant will be completely evaporated before entering refrigerant compressor). KAORI C series high pressure BPHE is the best solution for such a system design, with the advantage of high heat transfer, compact size, and light weight.

*KAORI K Series and R Series standard plate heat exchangers could be applied as economizer, SLHE, and heat recovery BPHE of the HFC refrigerant system.



Model Selection Chart for Evaporative Condenser

Model	Capacity	Primary Side			Secondary Side		
	kW	Type	Max. Working Pressure (bar)	Evaporation Temp. (°C)	Type	Max. Working Pressure (bar)	Condensation Temp. (°C)
C095-70	30	R404A	30	-20	R744 (CO_2)	70	-10
C095-100	40						
C200M-50	50						
C200M-60	60						
C200M-70	70						

*Suction line heat exchanger could be designed according to different working conditions.
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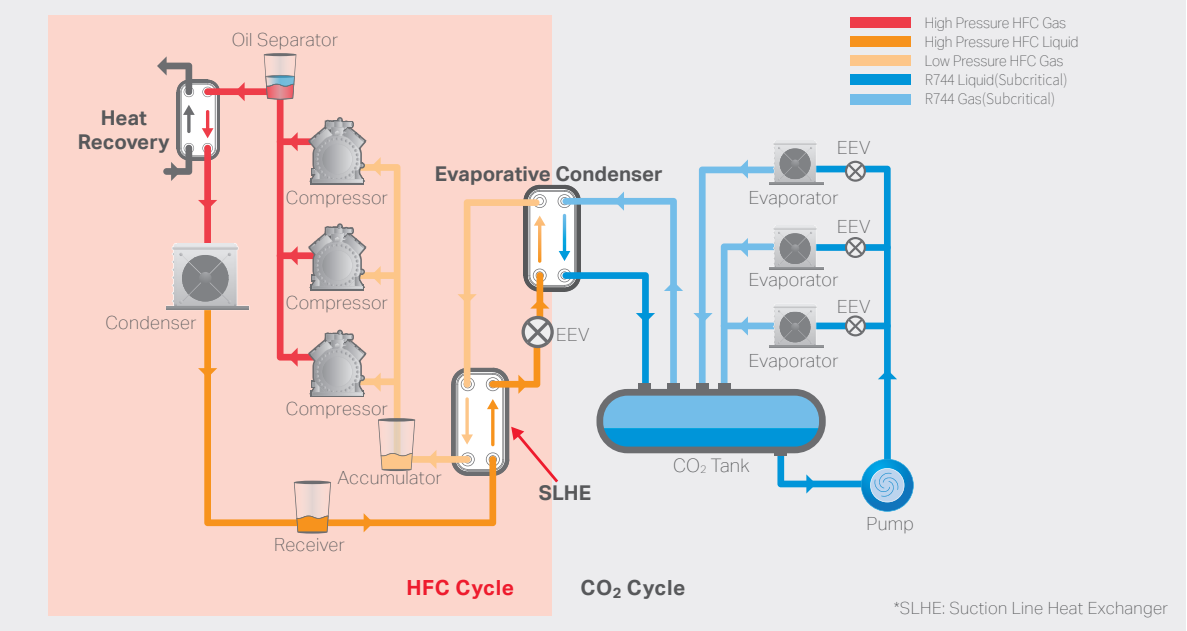
Subcritical Secondary Coolant System

Usually, secondary coolant system uses brine circulation system as the refrigeration medium, but through the high density characteristic of liquid CO_2, and its better thermodynamic property during medium temperature refrigeration process, R744 (CO_2) is very suitable for replacing the original E.G, P.G secondary refrigerant.

This refrigeration system first works with HFC refrigerant compressor to start cooling process, and through evaporator, it cools down (condense) R744 (CO_2) on the secondary side, then a pump will distribute low temperature R744 (CO_2) through whole system.

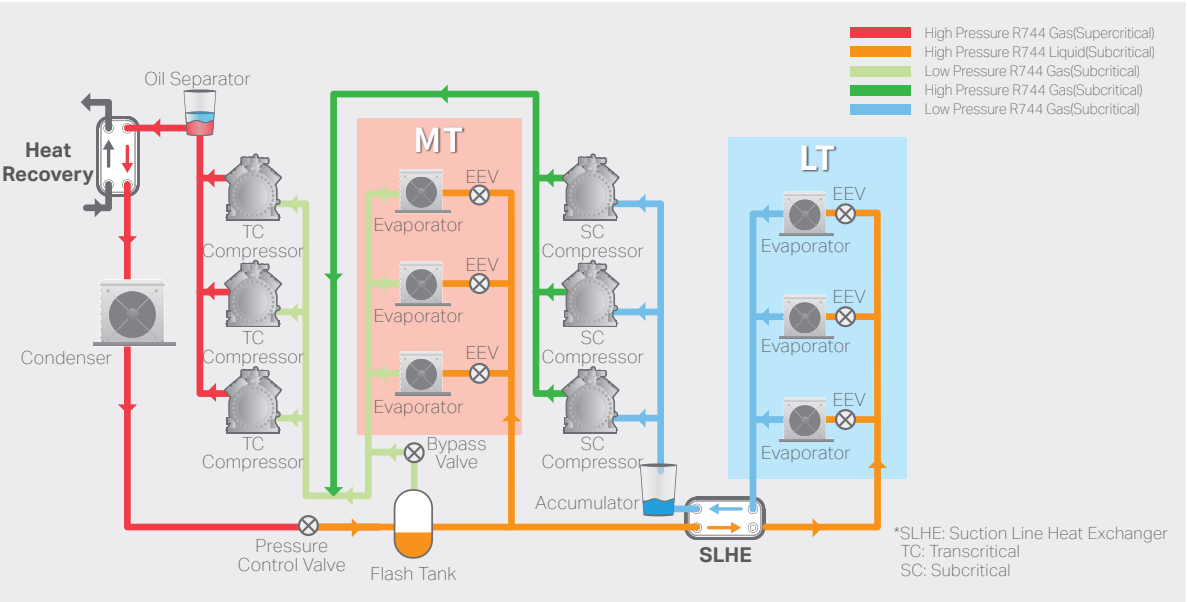
KAORI C series is suitable to be the evaporator of this system, in addition of increasing thermal conductivity, KAORI C series are also smaller model size, and higher and safer pressure resistance. To satisfy customers in different industries, KAORI provides various kinds of connectors for customization, at a reasonable price which benefits customers to attain lower assembling costs.



Transcritical Booster System

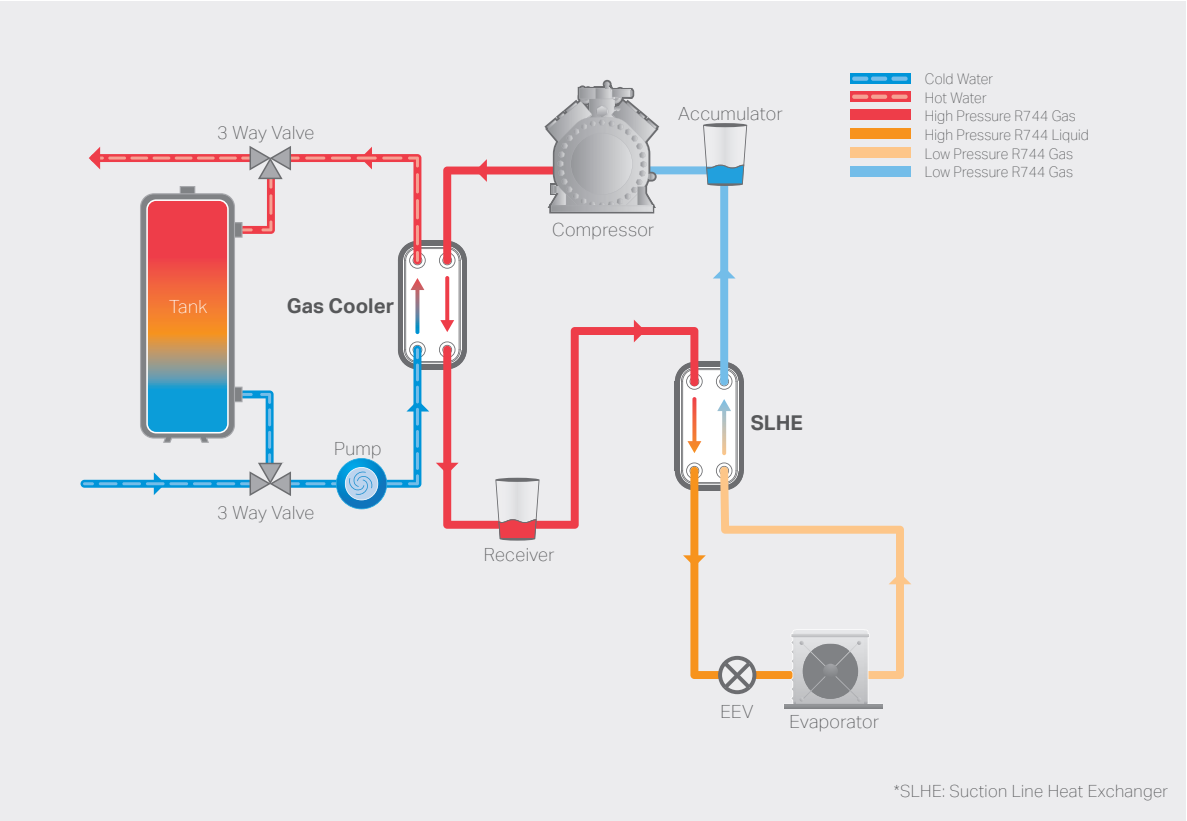
Two stage compression system pertains to a single R744 (CO_2) circuit, by connection two R744 (CO_2) compressor in series, provide mid-temperature and low temperature refrigeration applications in a single system, and includes tanscritical, subcritical, and supercritical characteristics of R744 (CO_2).

KAORI C series high pressure heat exchanger could be used/Installed for several different applications, such as gas cooler, economizer, SLHE (suction line heat exchanger) and intercooler, KAORI C series is the best solution for R744 (CO_2) applications.



Transcritical CO_2 Heat Pump System

CO_2 heating system, as known as CO_2 heat pump system, could be divided into two categories, air and water source heat pump. Both has mainly the same concept, but different heat sources. Air source heat pump is very suitable in the frigid zones, with high COP (Coefficient of performance) efficiency for hot consumption water or bath water applications. KAORI C series plate heat exchanger could be used as the gas-cooler in heat pump system, in this system, water could be heated up to maximum 90°C, at this temperature, it is also suitable for cleaning and other industrial process applications.



*SLHE: Suction Line Heat Exchanger

Model Selection Chart for Suction Line Heat Exchanger(SLHE)

Model	Capacity	Primary Side					Secondary Side				
	kW	Type	Max. Working Pressure (bar)	Working Pressure (bar)	Inlet Temp. (°C)	Outlet Temp. (°C)	Type	Max. Working Pressure (bar)	Working Pressure (bar)	Inlet Temp. (°C)	Outlet Temp. (°C)
C022M-14	0.5	R744 (CO_2)	140	100	25	16	R744 (CO_2)	70	19	-20	0
C022M-18	1										
C022M-22	1.5										
C022M-48	3										
C097-26	8										
C097-30	10										

Model Selection Chart for Gas Cooler

Model	Capacity	Primary Side					Secondary Side				
	kW	Type	Max. Working Pressure (bar)	Working Pressure (bar)	Inlet Temp. (°C)	Outlet Temp. (°C)	Type	Max. Working Pressure (bar)	Flow Rate (L/H)	Inlet Temp. (°C)	Outlet Temp. (°C)
C022HP3-28	5	R744 (CO_2)	140	100	90	25	Water	70	90	17	65
C022HP3-40	10								179		
C022HP3-58	15								269		
C042P2-60	30								538		
C097P3-102	80								1433		
C202HP2-48	100								1792		

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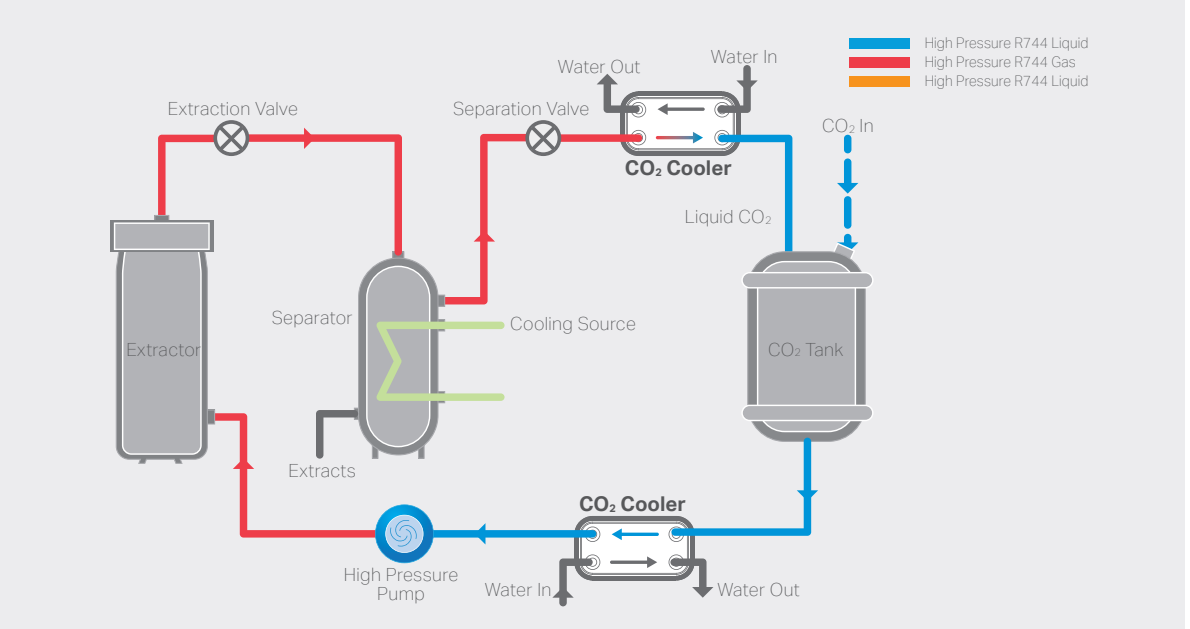
Supercritical CO_2 Extraction

The extraction technology in food and pharmaceutical industries are commonly using organic solvent as the extraction agent. But in recent years, many advanced technologies have begun to replace organic solvent with supercritical R744, due to the higher solubility and higher permeability, R744 critical temperature is closer to the ambient temperature (31.7°C), and rare chemical reaction with the extraction substances. With all the above mentioned advantages, supercritical CO2 is one of the most important developments in many industries and countries.

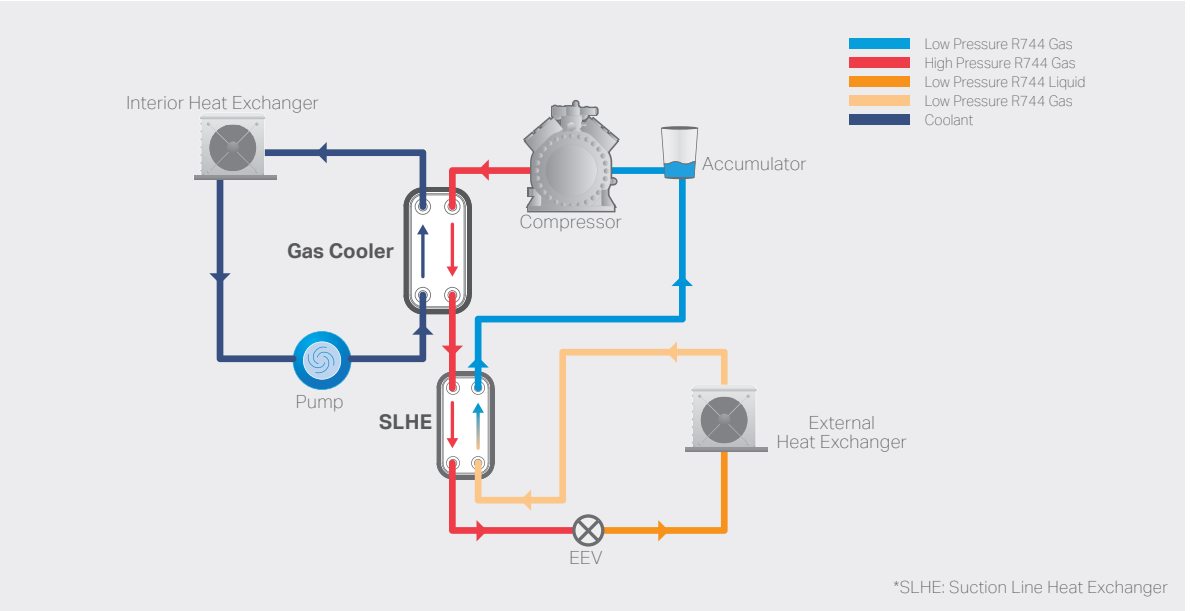
KAORI latest high pressure C series plate heat exchanger is the best solution for supercritical extraction, as a gas-cooler or sub-cooler. Comparing to traditional heat exchangers, KAORI C series has smaller model size, higher heat transfer performance, and easier installation. Hence KAORI C series is chosen by manufacturers of CO_2 Extraction technology system.



Automobile CO_2 Air Conditioning System

Due to the phenomenon of global warming, and flammable characteristics of HFO refrigerants, for the environment and for driving safety, HFO-1234yf has been banned in most of European countries. To find an alternative and environmentally friendly medium, many car dealers are gradually introducing R744 (CO_2) into their new vehicle air conditioning system for replacing HFO. Non-flammable characteristics, with only 1 GWP value, R744 (CO_2) is more environmentally friendly and a safer refrigerant for vehicle air conditioning system.

KAORI C series plate heat exchangers are dedicated for R744 (CO_2) applications. C series working pressure could be customized up to max. 140 bar, with advantages of high thermal efficiency, and compact and lighter model, it is truly the best component for vehicle CO_2 refrigeration system.



KAORI

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2017.09/1,000

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