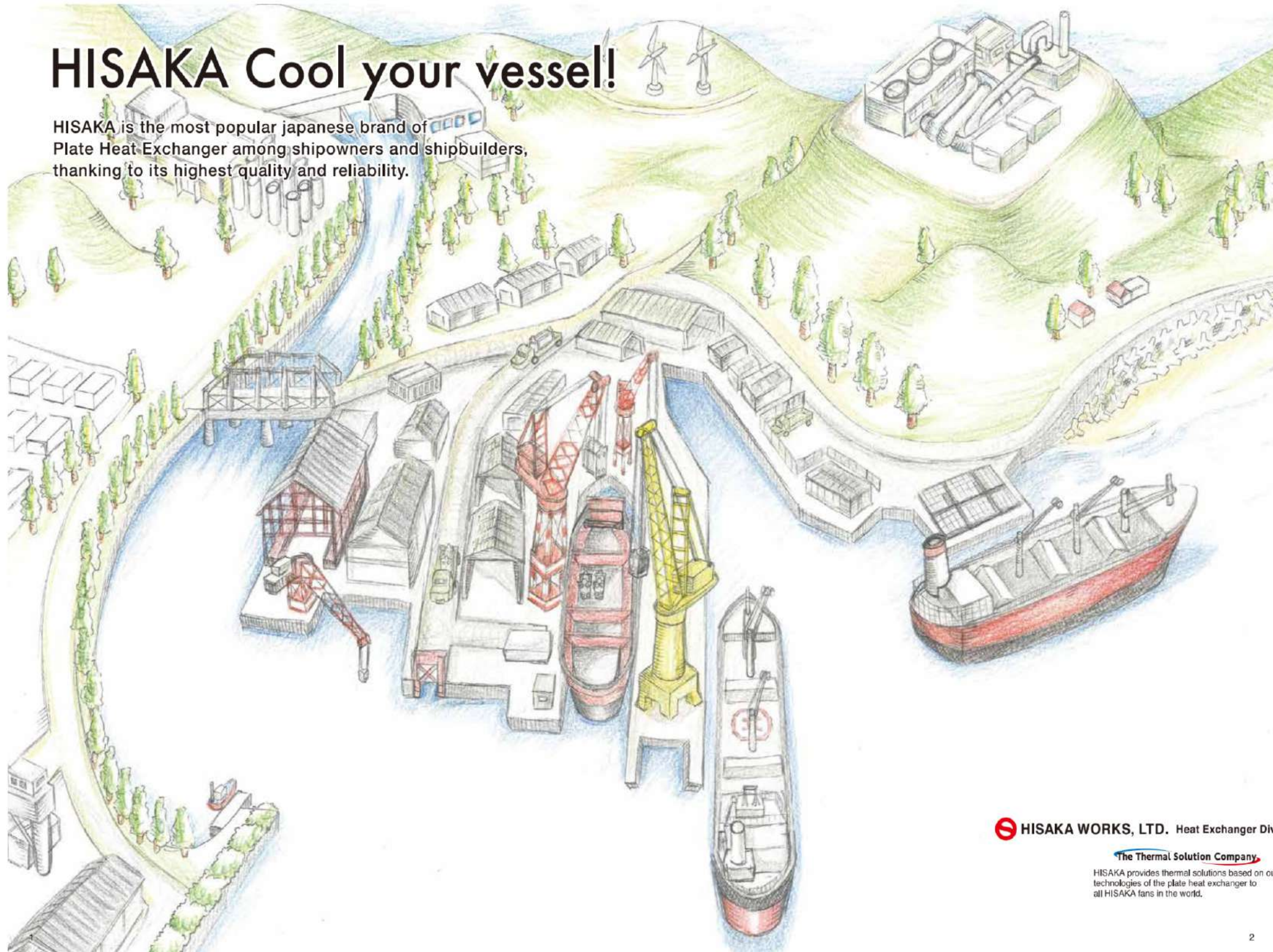


HISAKA Cool your vessel!

HISAKA is the most popular Japanese brand of Plate Heat Exchanger among shipowners and shipbuilders, thanks to its highest quality and reliability.



 **HISAKA WORKS, LTD.** Heat Exchanger Div.

The Thermal Solution Company

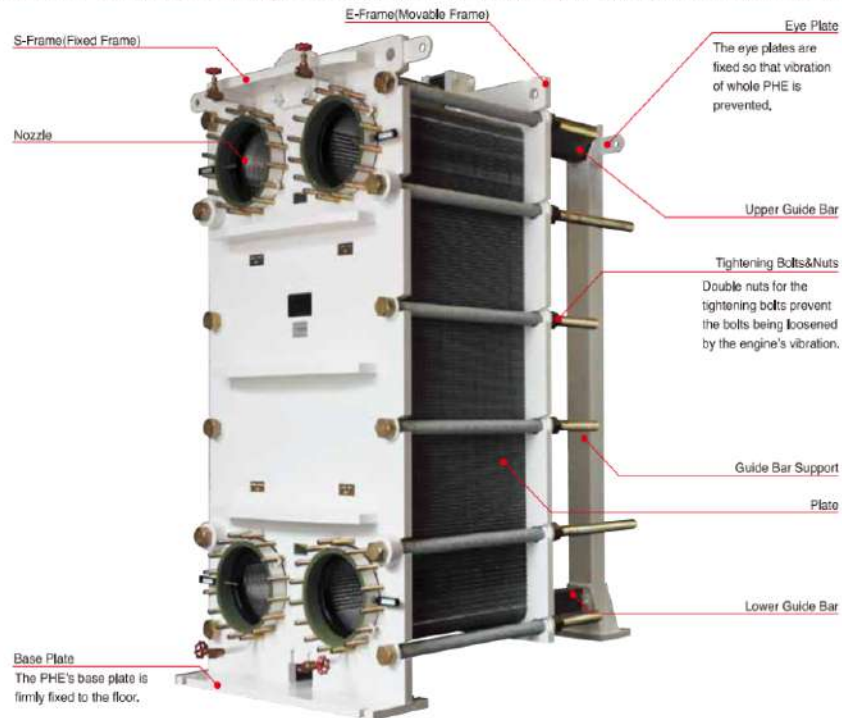
HISAKA provides thermal solutions based on our technologies of the plate heat exchanger to all HISAKA fans in the world.

Marine Plate Heat Exchangers(PHEs)

Structure of PHEs

The heat-transfer plates are thin sheets of corrosion-resistant metal, such as stainless steel or titanium. The plates are press-formed with a concavo-convex corrugated pattern on their surface, and their peripheries are sealed with molded synthetic rubber gaskets. The plates are suspended from guide bars in a line, and are fixed by clamping bolts and nuts between a fixed(S-Frame) and a movable(E-Frame) frame. A PHE has as many of these plates as it needs for the required heat-exchange duty. The plates are fitted with gaskets which seal the flow channels and direct the fluids into alternate channels.

Suited to ship operating conditions such as eye-plate and double nuts



Marine Plate Heat Exchangers(PHEs)

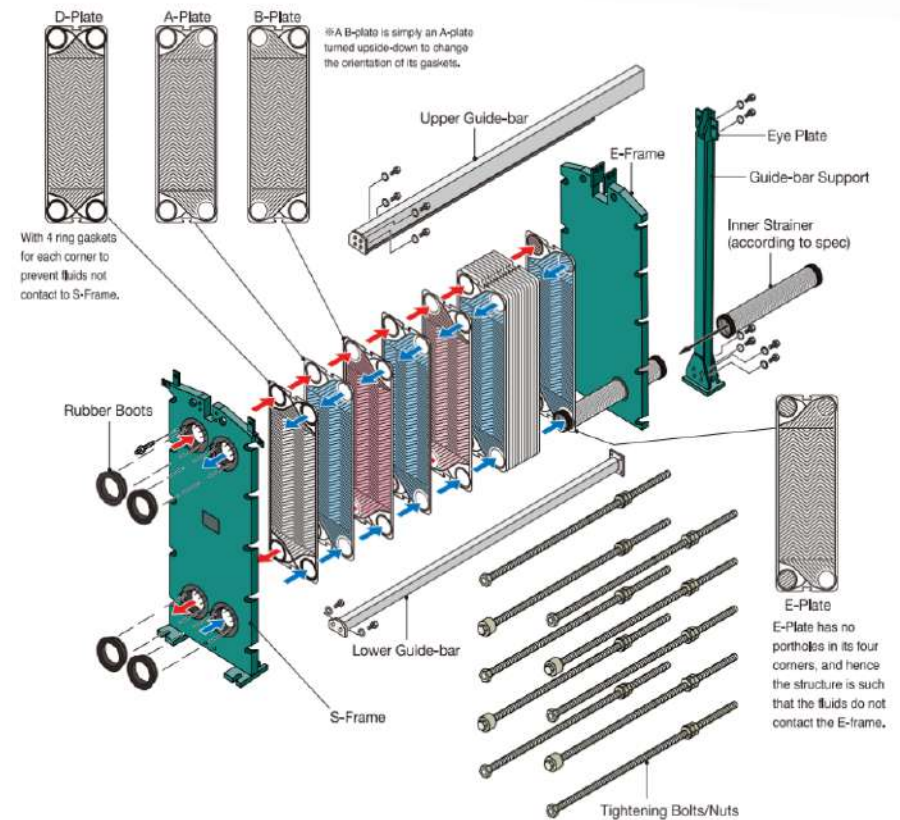
Explanation of Model Symbols ※Above PHE case

Type of Plate

UX-995-NHPM-233

- Plate Type
LX·UX·RX·SX
- Plate Size
00 (Small) — 10 (Large)
- Plate Thickness
5.0, 5mm, 6.0, 6mm, 8.0, 8mm, 0: 1.0mm
- Frame Model
"M" for marine use
- Number of Plate

Basic construction of PHE



Option



Inner Strainer

This 2-3mm diameter perforated strainer is inserted into the PHE's seawater inlet, where it removes trash and other foreign objects.



Instrument Ring

We have an instrument ring available for when you install a thermometer, air vent, drain and differential manometer to your PHE.

Features of PHEs

High performance

Plate patterns formed from pressing provide heat transferring properties that are 3 to 5 times greater than tubular heat exchangers, allowing for a smaller heat transfer area.

Lightweight and compact

The use of thin heat transfer plates allows the use of only a low volume of fluid inside the equipment. Combined with the small heat transfer area, the result is a weight and size that are 1/4 that of tubular heat exchangers. Installation is simple, and space is conserved, even when taking maintenance space into consideration.

Easy maintenance

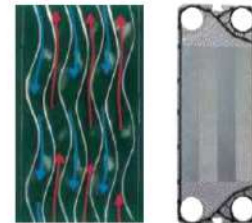
The equipment can be easily disassembled by simply loosening tightening bolts. This allows easy visual inspection and cleaning. Assembly can also be performed simply and easily.

Prevention of Liquid Inter-mixing

Special consideration is taken into the gasket so to protect it from direct attack by liquid. Furthermore, the gasket is of double-seal type so as to permit liquid draining outside the exchanger in a case of liquid leak caused by its deterioration.

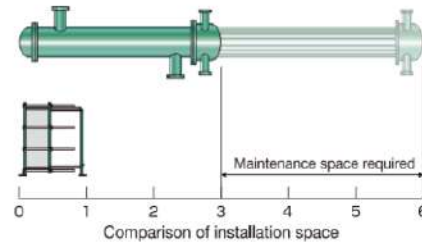
Speedy startup

A low volume of fluid inside the equipment allows a speedy startup, so that changes in operation conditions can be handled with high precision.



High turbulent flow

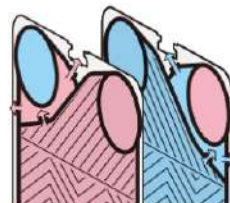
Plate



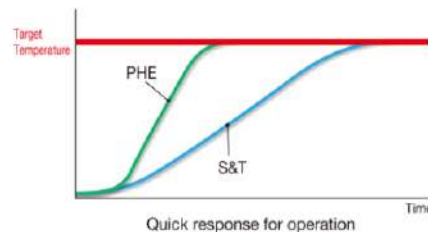
Comparison of installation space



Easy cleaning



Double seal gasket



Quick response for operation

Application of the Plate Heat Exchanger for Ships

Central Cooler

The plate heat exchanger is used as the central cooler to remove heat from the central cooling system, in which circulating fresh water is cooler by sea water.

Lubricating Oil Cooler

The lubricating oil cooler is used to cool the lubricating oil by sea water directly or by fresh water from the central cooling system.

Generator engine fresh water Cooler

The Generator engine fresh water Cooler is used to cool fresh water to remove heat from the onboard electrical power generator.

MGO Cooler

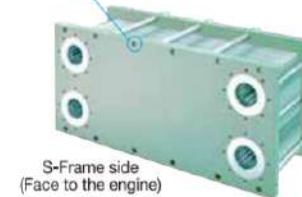
By environmental regulation for exhaust gas from diesel engines, low-sulfur content fuel like MGO is used for heavy fuel oil. However As less viscosity and lubricity of MGO will affect for combustion of engines, MGO COOLERS are used in order to its viscosity. Plate Heat Exchanger with Pressure Buffer device has excellent performance for pulsation from the engines.



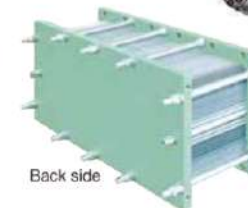
Plate cooler for Engine

This type of Plate Heat Exchanger is used for COOLER which is integrated to the engine directly by fixed bolts & nuts. PHE without guide bar and shorter tightening bolts & nuts is more compact than traditional PHE and makes less space solution for engine room.

Hole for fixed bolt and nut



S-Frame side (Face to the engine)



Back side

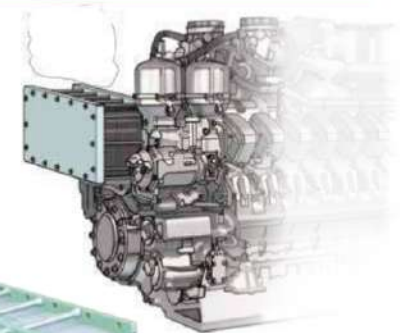
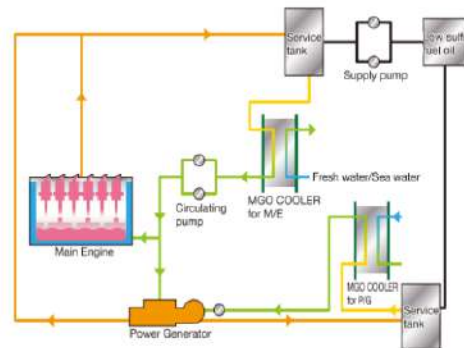


Plate Heat Exchanger for MGO COOLER

For diesel engines in which the use of low sulfur content fuel was not expected, there has been concern regarding abnormal wear on flanges/barrels in fuel injection pumps with low lubrication. Therefore, it has been necessary to add cooling equipment to increase the viscosity of the fuel. Hisaka PHE which is high performance, compact and lightweight is the best solution for MGO COOLERS.



Example of Fuel System in MGO Plant

1. Plate Heat Exchanger with Pressure Buffer Device

By the repeat of fatigue test to find the limit values for plate cracking due to pulsation, Hisaka developed the optimal buffer device. This device brings strongly resistant to pulsation cracking of plates. The optimal specifications for the buffer device will vary with the required plate type, heat transfer surface area and so on, so please inquire Hisaka when selecting.

Hisaka offers two solutions.

Lightweight and compactness can be the best solution for MGO COOLER. But cracking of plates due to engine pulsation might be anticipated.



Features of MGO COOLER with Pressure Buffer Device

Free from plate cracking trouble

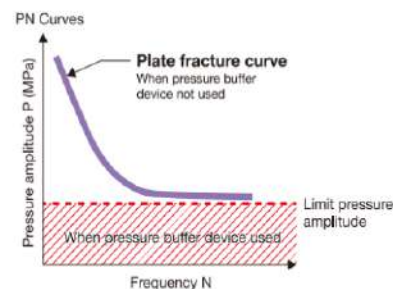
The Pressure Buffer Device protects the PHE from severe pulsation.

Select optimal thickness of PHE for the operating conditions

HISAKA can give excellent PHE solutions based on our durability test data.

Optimal sizing of Pressure Buffer Device

HISAKA can also give optimal solutions for Pressure Buffer Device based on our durability test data.



2. Dual Wall Plate Heat Exchanger to prevent intermixing fluids by dual wall construction

Due to crack by engine pulsation, if any one of the two fluids would leak through the first plate it would be prevented from going any further due to the air gap and the second plate. The leak would show up as a peripheral leak to atmosphere.

Features of Dual Wall Plate Heat Exchanger

Free from trouble of plate crack

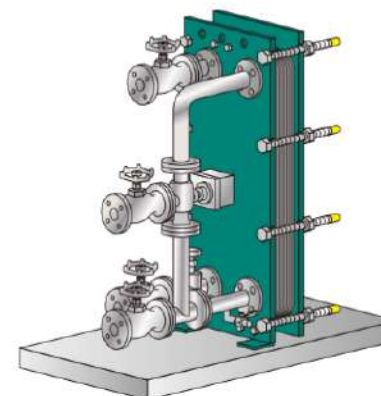
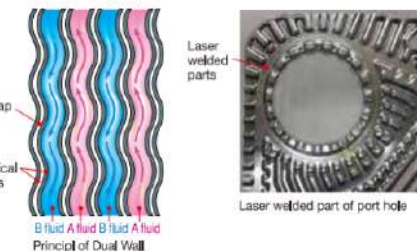
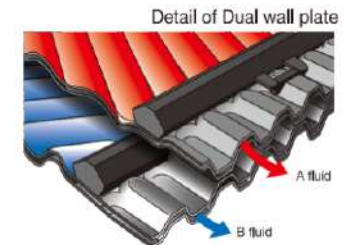
No risk for intermixing of two fluids because of dual wall construction.

Prevention from fluids intermixing

Double seal gasket system prevents intermixing of the fluids by gasket deterioration.

In case plates failure

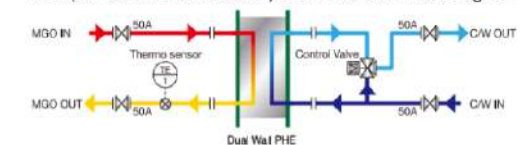
In case any one of plates were to fail, the leak can be detected from outside because of leaking through the gap of two plates.



MGO COOLING UNIT

The use of low sulfur fuel oil will be increased in the general sea area as strongly regulating for exhaust gas from vessels. Cooling of low sulfur fuel oil other than MGO is required, but the viscosity curve varies depending on the grade of fuel oil. Hisaka proposes "the MGO (low sulfur fuel oil) cooling unit" which is combined "temperature control device" with PHE. The MGO (low sulfur fuel oil) will be cooled at the programed outlet MGO temperature corresponding to the requested viscosity. "MGO Cooling Unit" using "Dual Wall" PHEs or PHEs with "Pressure Buffer Device" can be cooled safely and efficiently various low sulfur fuel oils.

MGO(low sulfur content fuel oil) COOLING UNIT flow diagram



The world largest class, super jumbo size plate with 600mm dia port hole

SUPER JUMBO PHEs have 1.5 times larger capacity than JUMBO size PHEs, achieving 7,300m³/h flow rate and 4,300m² heat transfer area per unit.



Higher performance, Higher flow rate and Space saving

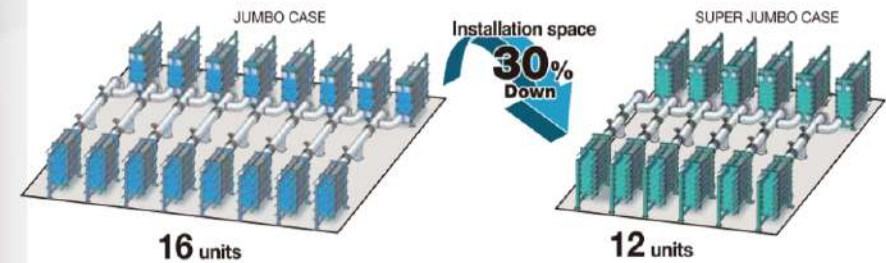
SUPER JUMBO PHEs assist less installation space and works, maintenance works and initial cost saving for the equipment itself as piping, pumps, valves and instruments.

High performance

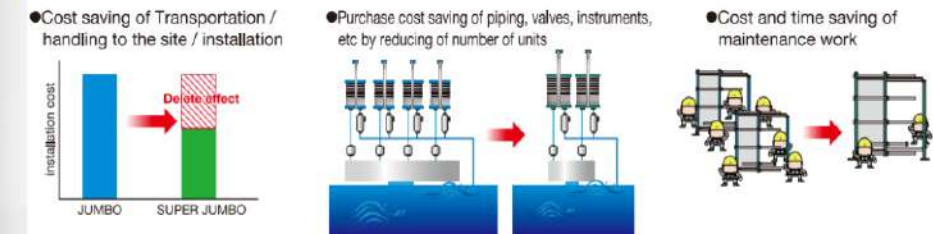
- Large connection size, up to 7,300m³/h
- Max heat transfer area up to 4,300m²/unit
- High heat transfer performance
- Thin plate thickness due to high pressure resistance pattern

Space Saving

Reducing no of installation units, and space saving about 30%.



Benefits in less number of units ?

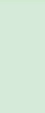
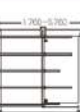
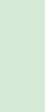


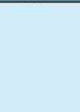
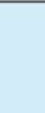
Offshore plant

Suitable for vessels, offshore plants, FLNG plants, and other facilities with limited installation space.



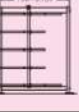
Plate Heat Exchanger Variation

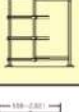
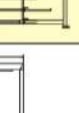
RX	Specification		Frame type		
			Width,Height	N J	N P
RX-10	Max. Flow rate / unit.	197m³/h			
	Max. Operating pressure	2.7MPaG			
	Max. Operating temperature	180°C			
	Max. Heat Transfer Area / unit.	30m²			
	Port hole Dia.	100mm			
	Connection Dia.	100A			
RX-30	Max. Flow rate / unit.	445m³/h			
	Max. Operating pressure	1.8MPaG			
	Max. Operating temperature	180°C			
	Max. Heat Transfer Area / unit.	200m²			
	Port hole Dia.	150mm			
	Connection Dia.	150A			
RX-50	Max. Flow rate / unit.	923m³/h			
	Max. Operating pressure	2.1MPaG			
	Max. Operating temperature	180°C			
	Max. Heat Transfer Area / unit.	500m²			
	Port hole Dia.	216mm			
	Connection Dia.	200A			
RX-70	Max. Flow rate / unit.	1,286m³/h			
	Max. Operating pressure	1.3MPaG			
	Max. Operating temperature	150°C			
	Max. Heat Transfer Area / unit.	500m²			
	Port hole Dia.	255mm			
	Connection Dia.	250A			
RX-90	Max. Flow rate / unit.	3,167m³/h			
	Max. Operating pressure	1.6MPaG			
	Max. Operating temperature	130°C			
	Max. Heat Transfer Area / unit.	1,600m²			
	Port hole Dia.	400mm			
	Connection Dia.	400A			

LX	Specification		Frame type		
			Width,Height	N J	N P
LX-00	Max. Flow rate / unit.	69m³/h			
	Max. Operating pressure	1.8MPaG			
	Max. Operating temperature	180°C			
	Max. Heat Transfer Area / unit.	5m²			
	Port hole Dia.	59mm			
	Connection Dia.	50A			
LX-10	Max. Flow rate / unit.	197m³/h			
	Max. Operating pressure	1.6MPaG			
	Max. Operating temperature	180°C			
	Max. Heat Transfer Area / unit.	15m²			
	Port hole Dia.	100mm			
	Connection Dia.	100A			
LX-30	Max. Flow rate / unit.	481m³/h			
	Max. Operating pressure	1.25MPaG			
	Max. Operating temperature	180°C			
	Max. Heat Transfer Area / unit.	100m²			
	Port hole Dia.	156mm			
	Connection Dia.	150A			
LX-50	Max. Flow rate / unit.	791m³/h			
	Max. Operating pressure	1.25MPaG			
	Max. Operating temperature	180°C			
	Max. Heat Transfer Area / unit.	200m²			
	Port hole Dia.	200mm			
	Connection Dia.	200A			

Max. Operating Pressure, Temperature, Heat Transfer area/unit and Dimension may vary depending on the operating/design conditions.

CX	Specification		Frame type		
			Width,Height	N J	N P
CX-10 Vertical	Max. Flow rate / unit.	108m³/h			
	Max. Operating pressure	1.9MPaG			
	Max. Operating temperature	150°C			
	Max. Heat Transfer Area / unit.	15m²			
	Port hole Dia.	74mm			
	Connection Dia.	50A			
CX-10 Horizontal	Max. Flow rate / unit.	108m³/h			
	Max. Operating pressure	1.9MPaG			
	Max. Operating temperature	150°C			
	Max. Heat Transfer Area / unit.	15m²			
	Port hole Dia.	74mm			
	Connection Dia.	50A			
CXW-01	Max. Flow rate / unit.	80m³/h			
	Max. Operating pressure	1.9MPaG			
	Max. Operating temperature	150°C			
	Max. Heat Transfer Area / unit.	15m²			
	Port hole Dia.	64mm			
	Connection Dia.	50A			

SX	Specification		Frame type		
			Width,Height	N J	N P
SX-40	Max. Flow rate / unit.	940m³/h			
	Max. Operating pressure	2.4MPaG			
	Max. Operating temperature	110°C			
	Max. Heat Transfer Area / unit.	500m²			
	Port hole Dia.	218mm			
	Connection Dia.	200A			
SX-80	Max. Flow rate / unit.	2,424m³/h			
	Max. Operating pressure	2.0MPaG			
	Max. Operating temperature	180°C			
	Max. Heat Transfer Area / unit.	1,600m²			
	Port hole Dia.	350mm			
	Connection Dia.	350A			

UX	Specification		Frame type		
			Width,Height	N J	N P
UX-10	Max. Flow rate / unit.	97m³/h			
	Max. Operating pressure	2.5MPaG			
	Max. Operating temperature	150°C			
	Max. Heat Transfer Area / unit.	30m²			
	Port hole Dia.	70mm			
	Connection Dia.	50A			
UX-30	Max. Flow rate / unit.	285m³/h			
	Max. Operating pressure	2.2MPaG			
	Max. Operating temperature	180°C			
	Max. Heat Transfer Area / unit.	200m²			
	Port hole Dia.	120mm			
	Connection Dia.	100A			
UX-90	Max. Flow rate / unit.	2,314m³/h			
	Max. Operating pressure	1.7MPaG			
	Max. Operating temperature	150°C			
	Max. Heat Transfer Area / unit.	800m²			
	Port hole Dia.	342mm			
	Connection Dia.	350A			
UX-100	Max. Flow rate / unit.	4,948m³/h			
	Max. Operating pressure	1.3MPaG			
	Max. Operating temperature	100°C			
	Max. Heat Transfer Area / unit.	1,600m²			
	Port hole Dia.	500mm			
	Connection Dia.	500A			
UX-160	Max. Flow rate / unit.	7,300m³/h			
	Max. Operating pressure	2.3MPaG			
	Max. Operating temperature	100°C			
	Max. Heat Transfer Area / unit.	4,300m²			
	Port hole Dia.	600mm			
	Connection Dia.	600A			

Max. Operating Pressure, Temperature, Heat Transfer area/unit and Dimension may vary depending on the operating/design conditions.

MAINTENANCE SUPPORT PROGRAM



Plate heat exchangers need maintenance for long voyages, as there might be concerns that are decreased the performance due to scaling on plates or leakage from plate pack by deterioration of gasket. Plate heat exchangers are easier to maintain compared to Shell & Tube heat exchangers due to their compactness, but maintenance work couldn't be easy within limited spaces such as ships. Hisaka offers the optimal maintenance support program for Plate heat exchangers on the vessels.

1. What is "Trade service Package"?

Simply replacing with new plates

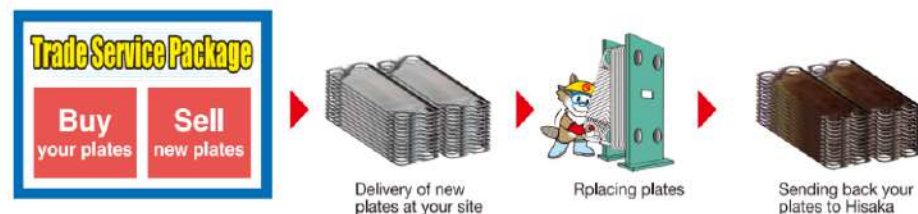
Plates on the vessels for a long time may have a hard scale that cannot be cleaned, or may be deformed by repeated maintenance work imperceptibly. In such cases, the plates must be replaced.

When you need to replace the plates you are using, Hisaka offers "Trade Service Package" program which is traded in your plates for new plates. On contracting "Trade Service Package", new plates will be delivered your site. Maintenance can be completed by simply replacing your plates with new plates and send your plates to Hisaka then.



From the contract to completion of maintenance of "Trade Service Package"

Maintenance can be completed by simply replacing your plates with new plates in your units.



Advantages of Plate Rotation

① Shorter maintenance time

HISAKA simply replaces the plates you are currently using with your plates that we keep in storage. We also provide on-site maintenance by our service engineers for plate disassembly, removal, assembly, and tightening.

② Less Space and Fewer Personnel for Cleaning and Regasketing

As removed plates are sent to a HISAKA service center for maintenance, there is no need for space and personnel to perform maintenance on site. When maintenance is complete, the plates are stored at our service center until the next maintenance request.

③ Replacing new plates

Maintenance is performed by skilled professionals, and therefore pinholes and cracks are not missed. When defects are found on plates, not only gaskets but also plates can be easily replaced when necessary.

④ Replacing at any port

Plates in storage can be sent to anywhere according to the maintenance location and schedule even such as to ships/vessels.

"Plate Rotation" which is provided by maintenance menu of Hisaka may be convenient for the same Plate model and specification.

2. Full Service Package for whole units

The Full Service Package is a total maintenance service in HISAKA. PHE disassembly, visual checks of plates, cleaning, regasketing, frame repairs, assembly, and final inspection are all performed by service centers, for the best possible performance and a long operating life time for PHEs.



3. Full Service Package for plate pack

If a unit is installed in a location where it cannot be moved, HISAKA also provides a Full Service Package for the plates only. After maintenance is performed on the plates, a pressure test using a frame is performed to confirm that the plates do not leak before they are shipped back.

Return container

Return containers that precisely fit the plates that are currently in use are provided upon customers' requests. Simply send us the plates in the return containers, and we will send back cleaned plates.



Return Containers for plate pack

Plate pack Disassembly and Pickup Service

We disassemble your PHE on site, and then reassemble it on site after maintenance.



Service Truck

Description of Full Service Package



4. Plate Rotation

Based on the contract with customer, the serviced plates of customer are kept in Hisaka and sent to the customer site on PHE maintenance.

The returned plates from customer site are serviced and stocked in Hisaka until next maintenance. Plate rotation is convenient in the case of the same plate type is used in your vessels, not only the series vessels but another type vessels.



MAINTENANCE PROGRAM

Trust and Performance

On-Site Maintenance

HISAKA will send our skilled maintenance partners who are specialized in advance technologies to perform maintenance work, including PHE disassembly, cleaning, and gasket replacement, at the customer's site. We use specialized maintenance tools, such as automatic tightening machines to efficiently disassemble and tighten plates and hot water jet cleaning to remove stubborn oil stains, to provide this service at the customer's plant.

Application	Guideline for regasketing
LO/MGO cooler	5 to 7 years
Central cooler	7 to 10 years
Jacket cooler	3 to 7 years
Steam Heater	1 to 3 years

Regasketing of the plates once in 5 years is recommended.



Use of an automatic tightening machine allows PHEs to be assembled in a short time with the ideal balance of tightening pressure without the need for specialized technology.

Cleaning in Place

Disassembling and cleaning a PHE makes it possible to remove stubborn scale and interior contaminants and to return performance to nearly the same level as new. However, if disassembly and cleaning are not possible, HISAKA also provides disassembly-free cleaning. We offer a PHE cleaning service using Plate-Clean at the customer's site. Before stubborn contaminants adhere, circulation cleaning with Plate-Clean can restore performance by removing scale through washing and dissolving. This is effective in prolonging the disassembly cleaning cycle of the PHE.

Cleaning Effect Examples 1

As shown in the photo below, we conducted a test in which a plate with seawater scale underwent circulation cleaning with Plate-Clean. As a result of cleaning with Plate-Clean, the scale was satisfactorily removed through washing and dissolving.



Cleaning Effect Examples 2

The data below was taken from an example of cleaning work performed using Plate-Clean in a PHE that used seawater as the coolant. Before cleaning, the plates tubes had narrowed and pressure loss increased due to scale growing inside the equipment. Also, the cooling effect had diminished. After cleaning, the seawater-side pressure loss diminished, and the cooling effect recovered by 43%.

	Pressure Loss (Mpa)	Temp Ctrl Valve Opening (%)	Heat Transfer Performance * 100 = Before cleaning
Before Cleaning	0.11	100	100
After Cleaning	0.06	70	143

* Complete cleaning is not guaranteed.

Plate-Clean

Plate-Clean is a special cleaner for PHEs. By circulating the cleaner inside the PHE, stubborn scale that forms on the cooling water, warm water, and steam sides can be easily removed by cleaning and dissolving without disassembling the unit. Customers are no longer required to perform the hard work of removing scale.

Cleaner and Target Scale

	Product Name	Target Scale
Cleaner	Plate-Clean C	Calcium carbonate
	Plate-Clean S	Slime, mud
	Plate-Clean F	Iron rust

Plate-Clean Series



Plate-Clean C Plate-Clean S Plate-Clean F

* Each type of Plate-Clean is also sold separately.

HISAKA PHEs support safe voyaging in ships of all kinds, from LNG tankers to luxury liners. This widespread use is itself proof of the trust we enjoy and of our performance results. We will be continuing as before to support with all our capability the global business expansion of our customer companies.

