## HISAKA Global Network


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challenge for innovation

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URL: http://www.hisaka.co.jp/english/phe/

Hisaka Works, Ltd., Heat Exchanger Division, are ISO9001 certified for its quality management system for all products including plate type heat exchangers.

Hisaka Works, Ltd., is ISO14001 certified for its environmental management system.



Agent

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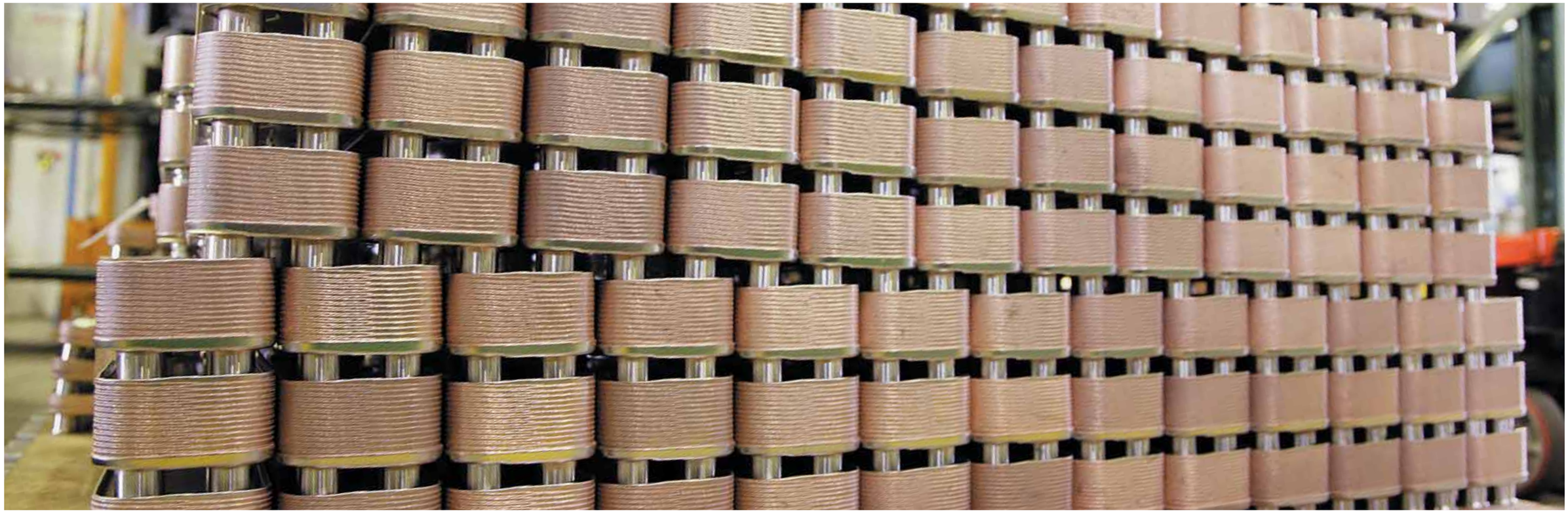
challenge for innovation

# BRAZED PLATE HEAT EXCHANGER

HISAKA

# HISAKA Brazed Plate Heat Exchangers - Cutting-edge brazing technology contributing to the global environment

As measures against global warming increase in factories and offices, and are even spreading to homes, not only are energy-saving specifications required, of course, but also there is need of space-saving for equipment and systems so that they can meet tight space in all kinds of locations. HISAKA's Brazed Plate Heat exchangers (BHE) realize even greater compactness and light weight with the same high performance as Gasketed Plate Heat Exchangers (PHE), and thus can contribute to downsizing of the units. One example of HISAKA BHEs in action is in the "Eco Cute" heat-pumped hot water supply systems. Our BHEs have enabled these systems to be installed on the balconies of apartment buildings. Demand for BHEs is set to grow rapidly in the future, and HISAKA will be meeting customers' demand.



## Features of Brazed Plate Heat Exchangers (BHE)

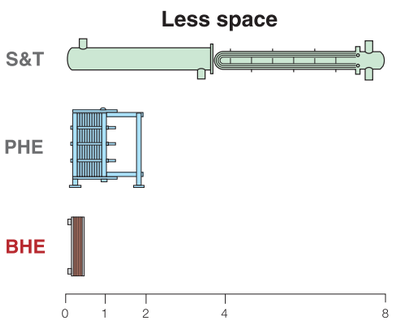
Brazed plate heat exchanger (BHE) retains the high economy and performance of "Gasketed plate heat exchanger", while adding even greater lightness, compactness, durability and economy by brazed construction. BHE can also be used with refrigerant such as ammonia and Freon due to the above features.

**◆High performance**

Through adopting herringbone plates, a higher heat transfer coefficient leads smaller heat transfer area than shell and tube heat exchangers.

**◆Low weight and compact**

Since the brazed structure enables thinner material to be used, the PHE is more compact and lighter than a shell and tube heat exchanger of similar capacity. However, the BHE is more compact and lighter than the PHE.




**◆Two fluids temperature difference up to its extremely close**

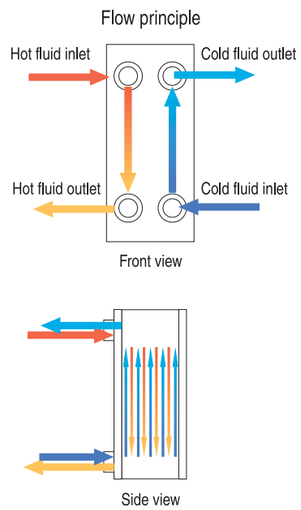
Perfect counter-current flow with very high heat transfer efficiency makes it possible to utilize the temperature difference between hot and cold fluid up to 1˚C and less.

**◆Withstand high temperature and pressure durability**

A tough brazed structure makes high sealing performance, excellent heat resistance and pressure resistance.

**◆Excellent cost performance**

The excellent cost performance due to minimizing number of the component parts and adopting high volume production.



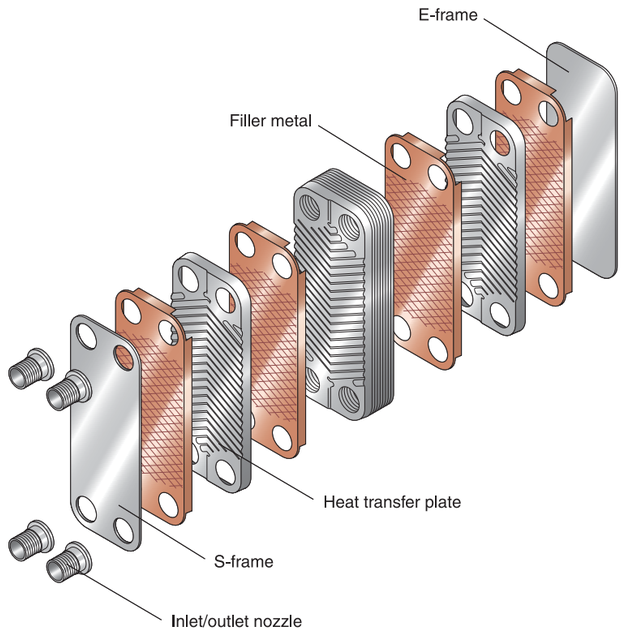



## Structure of the Brazed Plate Heat Exchanger (BHE)

With a simple structure made up of just heat transfer plates, an E-frame and an S-frame that reinforce those plates, and inlet/outlet nozzles that guide the fluids in and out of the exchanger - all made of stainless steel - the BHE uses few materials and so can be produced in high volumes.

Compared to other welding methods, with a low heating temperature for bonding and good workability mean that it can bond thin plates and parts that are required precision. Because the filler metal penetrates into gaps, brazing can be used for bonding complex-shape parts and for multipoint bonds. With certain bonding designs, brazing can provide bonds of strength equaling or higher than that of the base material.

It has now become indispensable not only for ordinary industrial products but also for industries on the cutting edge - electronics, aeronautics, and the space industry.



Continuous-vacuum heating furnace

Ready for brazing

## Manufacturing of BHEs

To manufacture BHEs, stainless steel plates and copper, nickel or other filler metals are laid over each other and heated to a temperature exceeding 1,100˚C in a continuous-vacuum heating furnace, in order to bond them together.

**Stacking of plates** → **Assembly** → **Preparation for brazing** → **Brazing** → **Inspection** → **Shipping**

The plates are stacked in the specified quantity with filler metals, which serve as brazing material, inserted between them. The filler metals can be copper or nickel, each of which is used for its own applications.

Frames and nozzles are fitted to each plate stack. There are various different types of nozzle depending on the BHE model.

The plate assemblies are mounted into fixing tools to be correctly positioned all the parts. Then the assemblies are clamped firmly.

Brazing is carried out in a vacuum heating furnace. In order to make the plates adhere solidly together, the filler metal has to be melted under vacuum condition.

After Brazing, the pressure test and dimensional test are made for all BHEs.

After inspection, BHEs are packaged and then shipping.

### Copper-brazed type BXC Series

The copper brazing widely used in the production of automobile parts and refrigerators, and this method is applied to the plate heat exchanger. The brazed plate heat exchanger developed by HISAKA's press technology and brazing technology is superior in economy due to robust and compact body. It is widely used for evaporation of refrigerant, condenser and water heating.

### Nickel-brazed type BXN Series

Nickel offers high corrosion resistance. Therefore the high quality brazed plate heat exchanger using nickel brazing material is appropriate for applications that are required better corrosion resistance than copper brazed. It is used in many cases such as pure water that refuses elution of impurity, lithium-bromide solution of absorption type refrigeration and ammonia refrigerant.

# Possible Applications of Brazed Plate Heat Exchangers (BHE)

## Refrigeration

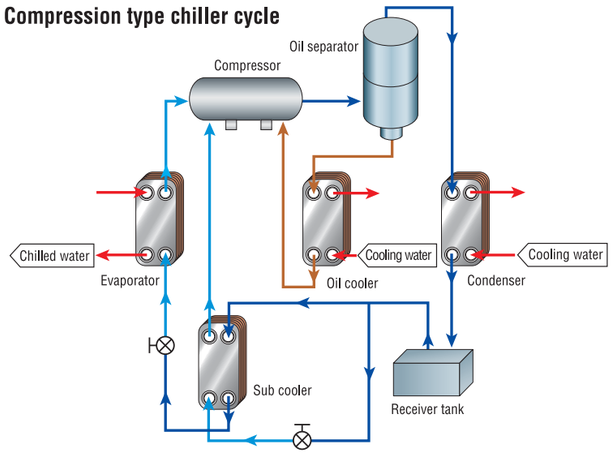
There are two types in refrigeration cycle. One is "compression type" using an electric or engine driven compressor and the other is "absorption type" driven by heat from steam or combustion of gas.

The vaporized refrigerant in an evaporator are compressed into a superheated high pressure vapor by a compressor (or a regenerator in the case of absorption type). This superheated high pressure vapor is condensed by the cooling water in a condenser.

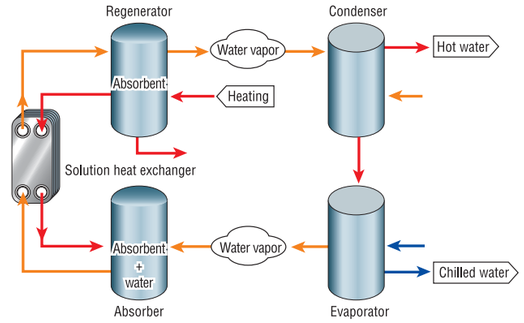
The condensed refrigerant is sent to evaporator to reduce its pressure through an expansion valve. By vaporizing of low pressure refrigerant in evaporator, hot side fluid is cooled down. Such refrigeration cycle is then repeated.

HISAKA BHEs are used for the evaporator, condenser, sub cooler, oil cooler in refrigeration cycle.

### Compression type chiller cycle



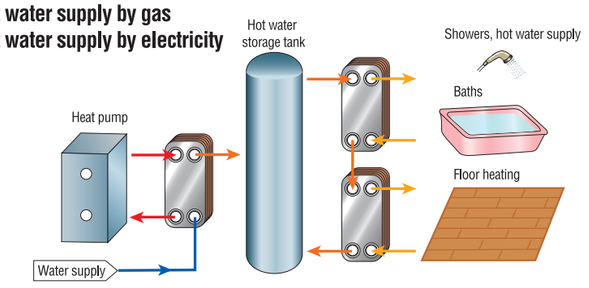

### Absorption type chiller cycle




## Hot water supply

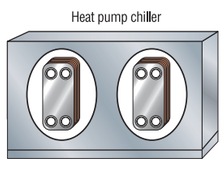
Hot water produced by a heat pump in storage tank is used in applications such as heating of tap water, heating of hot water for floor heating and panel heaters, and reheating of bathwater. In such applications, BHEs can work better under a small temperature difference than conventional tubular heat exchanger.

### Hot water supply by gas
### Hot water supply by electricity

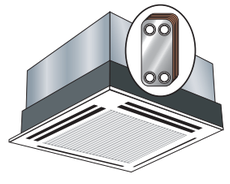



## Air conditioning

District cooling uses heat pump chiller as the central cooling source and BHEs are used for evaporators and condensers in the chiller units. Compact and high performance BHEs are also used in air conditioners of the ceiling-mounted cassette type.




Central type cooling



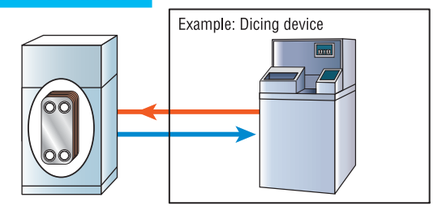
Ceiling-mounted cassette type



# Possible Applications of Brazed Plate Heat Exchanger (BHE)

### Cooling of pure water

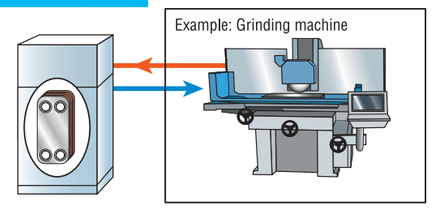
**Semiconductor**




●Etching device ●Coating device
●Spattering device ●Dicing device
●Cleaning device ●Tester, etc.

### Cooling of pure water

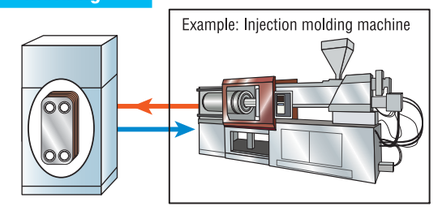
**Machine tool**




●Wire cutting ●Grinding machine
●Spot welding ●Plasma welding machine
●Laser machine tool, etc.

### Cooling of water/oil

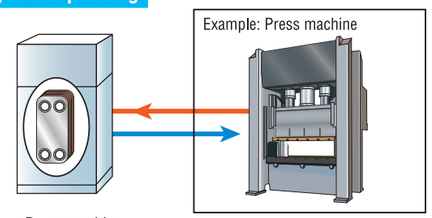
**Molding**




●Plastic molding machine
●Rubber molding machine
●Wire coating machine ●Injection molding machine, etc.

### Cooling of hydraulic oil

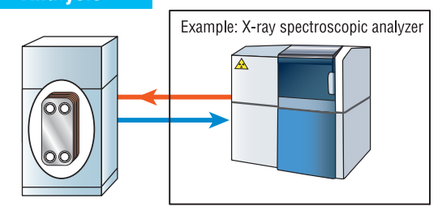
**Hydraulic pressing**




●Press machine

### Cooling of pure water

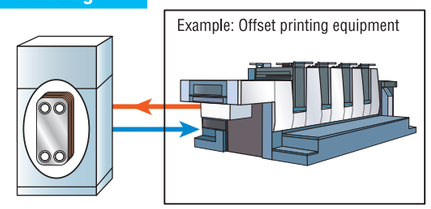
**Analysis**




●Electron microscope ●X-ray spectroscopic analyzer
●Gas chromatograph
●Sugar content analyzer, etc.

### Cooling of water

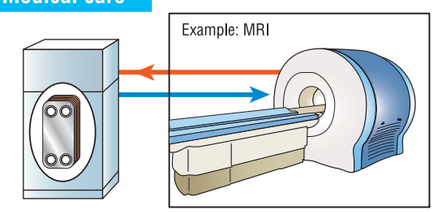
**Printing**




●Offset printing equipment
●Automatic developer
●UV device, etc.

### Cooling of purified water

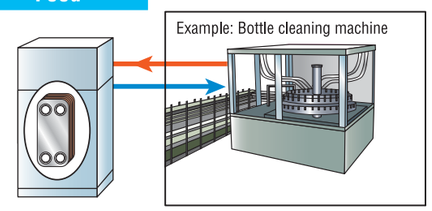
**Medical care**




●X-ray device
●MRI
●Blood refrigerated equipment

### Heading of water

**Food**




●Bottle cleaning machine
●Tofu production system
●Noodle making machine, etc.

## Product Lineup

Wide variety of product size

The table below shows data according to HISAKA standard specification products.

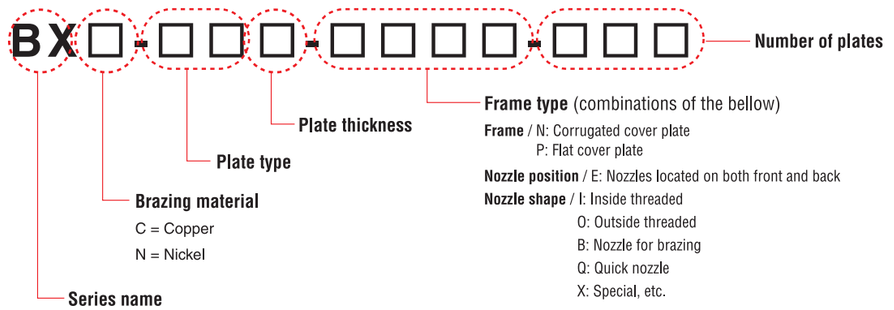
| Model | | BX-02 | BX-05 | BX-006 | BX-08 | BX-15 | BX-016 |
|---|---|---|---|---|---|---|---|
| Size (numerals listed after BX represent plate type(s)) | |  BX-024 |  BX-054 |  BX-006 |  BX-08 |  BX-154 |  BX-016 |
| Flow type | | Parallel flow (↓↑) | Diagonal flow (⤭) | Parallel flow (↓↑) | Parallel flow (↓↑) | Diagonal flow (⤭) | Diagonal flow (⤭) |
| Max. design pressure *1) (MPa) | Cu brazed | 4.2 | 4.2 | 4.5 | 1.0 | 3.0 | 1.0 |
| | Ni brazed | 1.5 | 3.0 | 1.0 | — | 1.0 | — |
| Max. design temperature *2) (℃) | Cu brazed | 200 | 200 | 200 | 99 | 200 | 99 |
| | Ni brazed | 200 | 200 | 200 | — | 200 | — |
| Standard inlet/outlet diameter (A) | | 10 | 15 | 10 | $\phi$ 18 Quick nozzle | 15 | $\phi$ 20 Quick nozzle |
| Max. heat transfer area ($m^2$/unit) | | 0.3 | 0.5 | 0.5 | 0.9 | 0.9 | 0.9 |
| Max. dimensions [w x h x $\ell$] (mm) | | 68 × 170 × 61 | 81 × 236 × 97 | 69 × 249 × 81 | 80 × 289 × 100 | 82 × 362 × 97 | 83 × 363 × 85 |
| Plate material | | SUS316 | SUS316 | SUS316 | SUS316 | SUS316 | SUS316 |
| Main applications | Refrigeration (water, brine) | ○ | ○ | ○ | | ○ | |
| | Condensers | ○ | ○ | ○ | | ○ | |
| | Hot water/heating/baths | ○ | ○ | ○ | ○ | ○ | ○ |
| | Gas coolers | ○ | ○ | ○ | | ○ | |
| | Liquid vs liquid | ○ | ○ | ○ | ○ | ○ | ○ |
| | Solvent coolers | ○ | ○ | ○ | | ○ | |
| Code/Standards *3) | | | | | | | |

| BX-20 | BX-30 | BX-50 | BX-70Ⅱ | BX-70X | BX-90 |
|---|---|---|---|---|---|
|  BX-214 BX-224 BX-244 |  BX-314 |  BX-514 BX-524*) BX-594*) |  BX-714 BX-724 |  BX-734 BX-754 BX-764 BX-774 BX-784 |  BX-936M |
| Parallel flow (↓↑) | Parallel flow (↓↑) | Parallel flow (↓↑) | Parallel flow (↓↑) | Diagonal flow (⤭) | Diagonal flow (⤭) |
| 4.2 | 4.2 | 4.2 (3.3) *) | 3.3 | 3.3 | 2.8 |
| 2.0 | 2.3 | 2.3 (1.6) *) | 1.3 | 1.3 | — |
| 200 | 200 | 200 | 200 | 200 | 200 |
| 200 | 200 | 200 | 200 | 200 | — |
| 25 | 25 | 50 | 65 | 65 | 125 |
| 2.5 | 6.2 | 20 | 52 | 52 | 98 |
| 103 × 303 × 260 | 125 × 532 × 267 | 183 × 610 × 458 | 254 × 844 × 672 | 254 × 844 × 672 | 422 × 1,458 × 613 |
| SUS316 | SUS316 | SUS316 | SUS316 | SUS316 | SUS316 |
| ○ | ○ | ○ | ○ | ○ | ○ |
| ○ | ○ | ○ | ○ | ○ | ○ |
| ○ | ○ | ○ | ○ | ○ | ○ |
| ○ | ○ | ○ | ○ | ○ | ○ |
| ○ | ○ | ○ | ○ | ○ | ○ |
| ○ | ○ | ○ | ○ | ○ | ○ |
| | | | | | |

*1) Maximum design pressure may vary with frame type.
Confirm HISAKA about the design pressure, before selecting the BHEs.

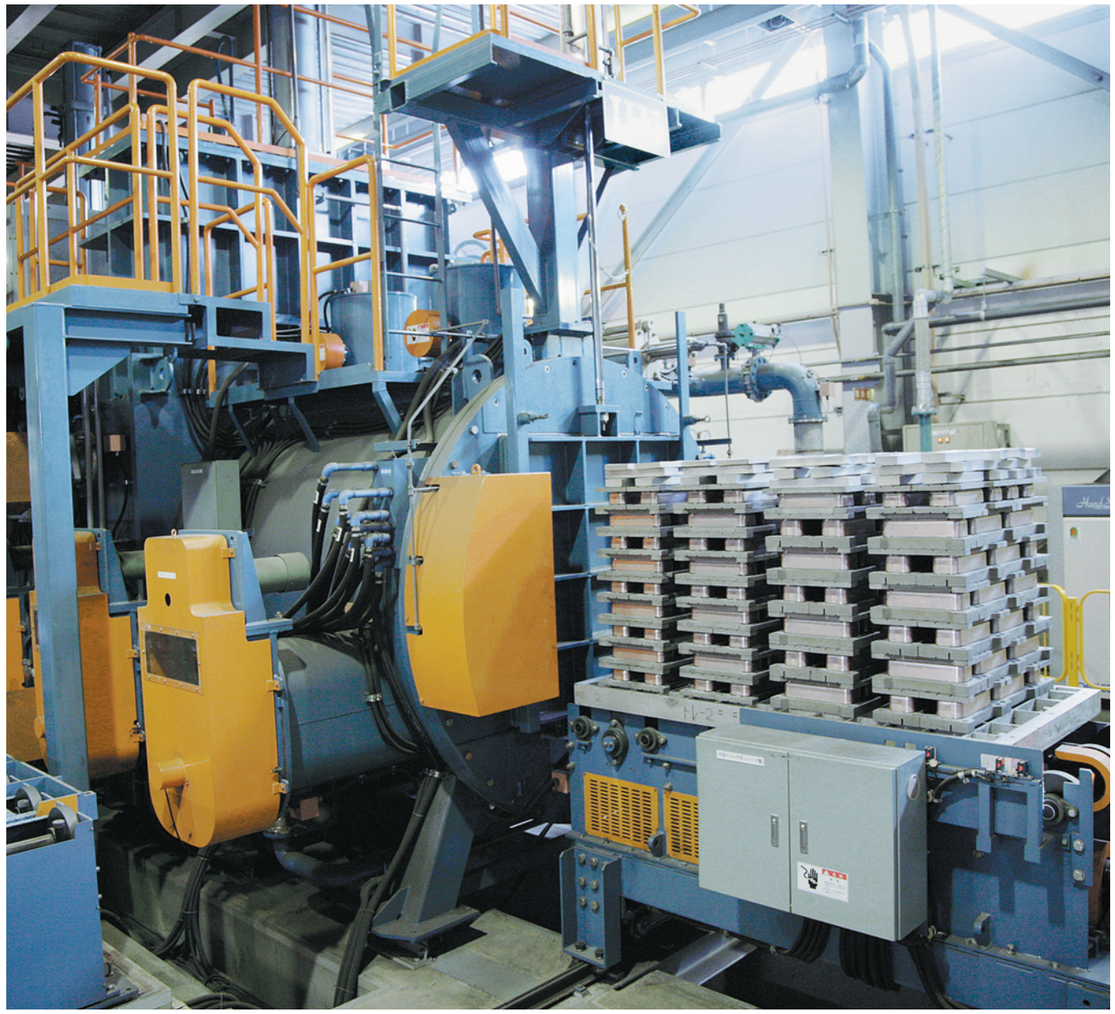
*2) Maximum design temperature will vary with operating conditions. Confirm HISAKA about the design temperature for the operating condition.

*3) Confirm HISAKA, when the code & standard are required.



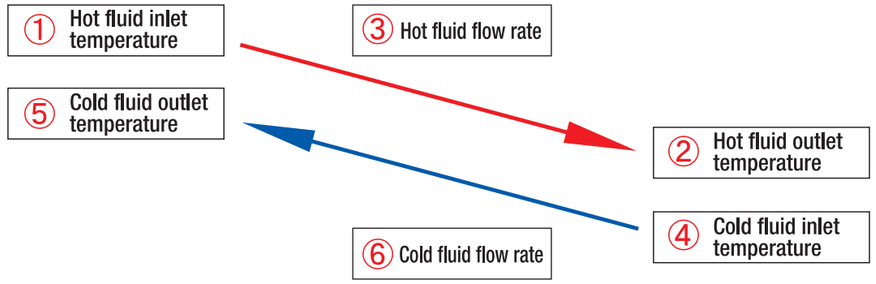
## HISAKA's Total Quality Management

Brazed plate heat exchangers (BHE) are used for many applications closer to daily life, such as in Eco Cute and other domestic units and in industrial refrigeration facilities.
Further, they are used in other industrial application as the temperature control system in semiconductor manufacturing which is required ultraprecise technology are highly demanded.
In our R&D departments, we are not only proceeding with product and technology development to match the rapidly evolving needs of the age, but have also improved reliability of "brazing" through repeated severe durability test.
In our production process, we meet expanding demand through efficient manufacturing by advanced high-speed automatic press machines and vacuum furnaces.
By stringently checking each and every product with exacting quality control techniques conforming to ISO9001, we achieve "high quality".
Our sales departments find customers' needs and give them to our R&D and production departments in a collaborative effort to realize customer satisfaction.
Diligent endeavors have made a good reputation in the world.



## Design of Brazed Heat Exchanger

### To design BHEs, 6 values are needed.




6 numerical value for BHE design: inlet/outlet temperatures and flow rate of hot side, and inlet/outlet temperatures and flow rate of cold side.

Please send a copy sheet by FAX for quotation request. We will give you a prompt response. If you can provide any other information, we will be able to make a more optimal design.
Please feel free to contact us or the nearest HISAKA agents.

**OSAKA FAX: 81-72-966-9602　　TOKYO FAX: 81-3-3562-2759**

| | | Hot side | | Cold side | |
|---|---|---|---|---|---|
| Fluid name | | | | | |
| Flow rate | $m^3/hr$ | | | | |
| Temperature | ℃ | Inlet | Outlet | Inlet | Outlet |
| Evaporating temperature | ℃ | ——— | | | |
| Condensing temperature | ℃ | | | ——— | |
| Heat Duty | kW | | | | |
| Allowable pressure drop | MPa | | | | |
| Design pressure | MPa | | | | |
| Physical properties of fluid (Please fill in other than water) | Specific gravity | | | | |
| | Specific heat | KJ/kg℃ | | KJ/kg℃ | |
| | Thermal conductivity | W/m℃ | | W/m℃ | |
| | Viscosity 1 | mPa・s(at ℃) | | mPa・s(at ℃) | |
| | Viscosity 2 | mPa・s(at ℃) | | mPa・s(at ℃) | |
| Materials | Plates | SUS316 | | | |
| | Filler metal | ☐Copper・☐Nickel | | | |

SI unit conversion table

| | | | |
|---|---|---|---|
| Heat duty | 1kcal/hr = $\frac{1}{860}$ kW | Pressure | 1kg/cm² = 0.098MPa |
| 1UST (U.S. refrigeration ton) = 3.516kW | | Specific heat | 1kcal/kg℃ = 4.186KJ/kg℃ |
| 1JRT (Japanese refrigeration ton) = 3.860kW | | Thermal conductivity | 1kcal/m・hr℃ = 1.163W/m℃ |
| 1RT (Refrigeration ton) = 4.535kW | | Viscosity | 1cP = 1mPa・s |

## Precaution for BHE

❶Use strainer on the inlet side in order to prevent clogging within this unit because of being unable to disassemble.
- ●Use compressed air to blow out any foreign material causing blockage.
  (Periodical bubbling can prevent decreasing performance.)
- ●Periodically flush to wash away foreign material.
  (This can be made even more effective if used in conjunction with bubbling.)

❷Frequent rapid temperature change of the fluids can damage this unit.

❸Freezing of fluid within this unit or sudden temperature change can result in damage to BHEs by volume expansion of internal fluids (especially liquid).

❹Watch/control the operating condition to avoid the scalling on the plates by high wall temperature.

## Maintenance

### Cleaning

Due to integrated structure, Hisaka Works does not recommend using in any applications where maintenance such as interior cleaning of this unit is necessary. However, in case that this unit becomes soiled or clogged with foreign material, the Cleaning In Place by chemical detergents can be performed to restore the unit to better condition.
BHEs use SUS316 as plate material, but use either copper or nickel as the filler metal to braze the plates. As the copper might dissolve into the detergent thereby reducing durability, be careful for copper brazing unit.
Please confirm the filler metal material before cleaning.

| | Type of scale | Solvent | Temperature | Circulation time | Circulation flow rate |
|---|---|---|---|---|---|
| ① | Organic | 5% caustic soda aqueous solution | Not more than 60˚C | 30 min | Use as much circulating flow rate as possible when cleaning in order to improve the physical cleaning effects. |
| ② | Inorganic | 5% citric acid aqueous solution or 5% oxalic acid aqueous solution | Not more than 60˚C | 30 min | |

* If using this unit for liquid food application, after performing of cleaning, circulate water at 80˚C for 30 minutes or more, and sterilize the unit.

**Basically, implement rinsing in the following sequence: ①→rinse→②→rinse.**
**After chemical cleaning, flush out all the chemicals thoroughly.**

## Warning

❶Do NOT use a BHEs under frequent pressure fluctuation circumstance, even if at a pressure within the design pressure.
Avoid process where there are frequent sudden pressure fluctuations due to plunger pump or opening/closing by direct-drive solenoid valve. If using a solenoid valve, install at the fluid inlet side in order to prevent pressure shock from the unit.

❷Confirm with Hisaka Works, if using BHEs at the temperature difference more than 80 ˚C between the hot fluid inlet and cold fluid inlet even if within design temperature.

❸Avoid any loads on the nozzles.

❹Take preventive measure against freezing.
Freezing of fluid within BHEs can result in damage to the unit and the leakage of fluids can be occurred. If there is risk of freezing while operation is stopped, drain off the fluid.

❺Avoid the damage by volume expansion of internal liquid with shutting up.

❻When carrying out chemical cleaning, do not use a detergent that could corrode the plates and/or the filler metal.
Chlorine-based detergent is particularly liable to corrode the plates.
Confirm HISAKA WORKS, if using the detergent other than the above.

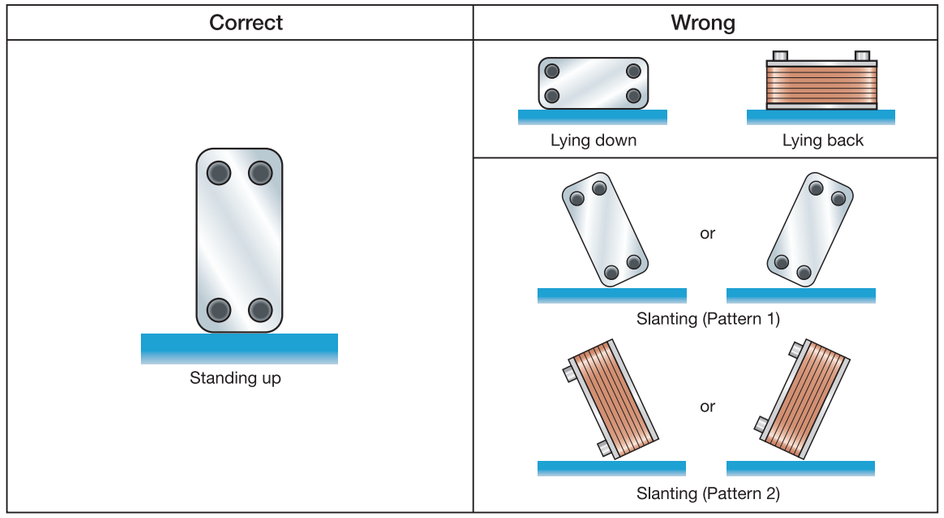


## Installation

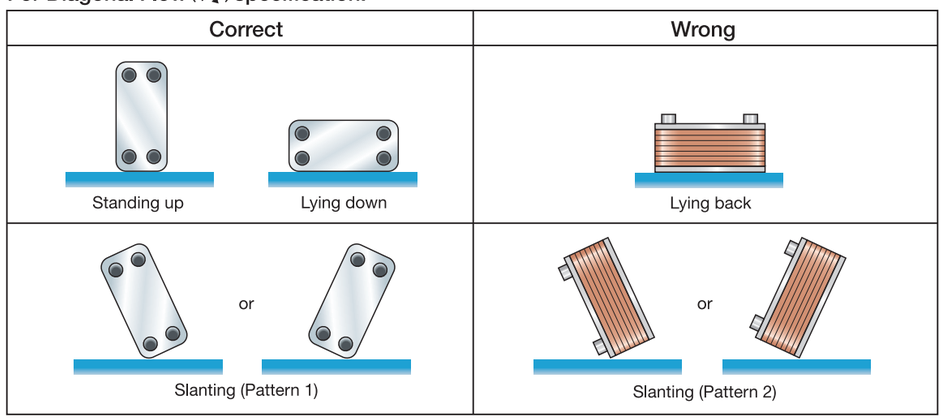
### Setting

●Use this unit in the "Correct" installation as below.
If used in an "Wrong" installation, problems such as fluid accumulation or maldistribution can occur.

For parallel flow( ↓↑ )specification:



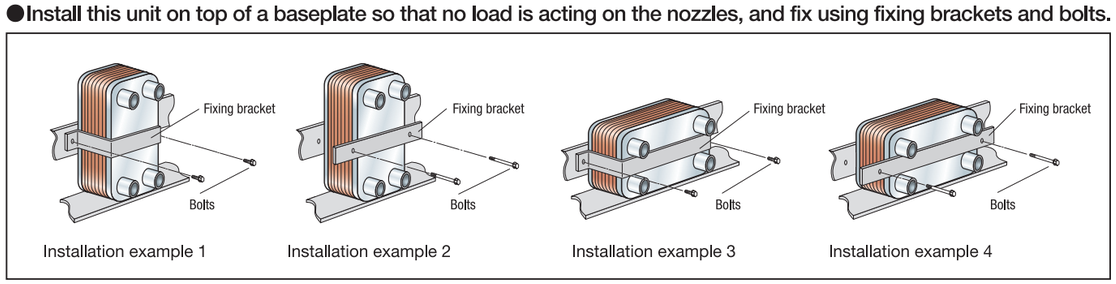

For Diagonal Flow( ⤭ )specification:




Always install the BHE standing up when it is used as an evaporator or a condenser.

### Fixing method

●Install this unit on top of a baseplate so that no load is acting on the nozzles, and fix using fixing brackets and bolts.




If using parallel flow( ↓↑ )unit, do not install as shown in installation examples -3 and 4. (Only diagonal flow cases can be used.)