

Chapter 4 User Manual



BRAZED PLATE HEAT EXCHANGER User Manual



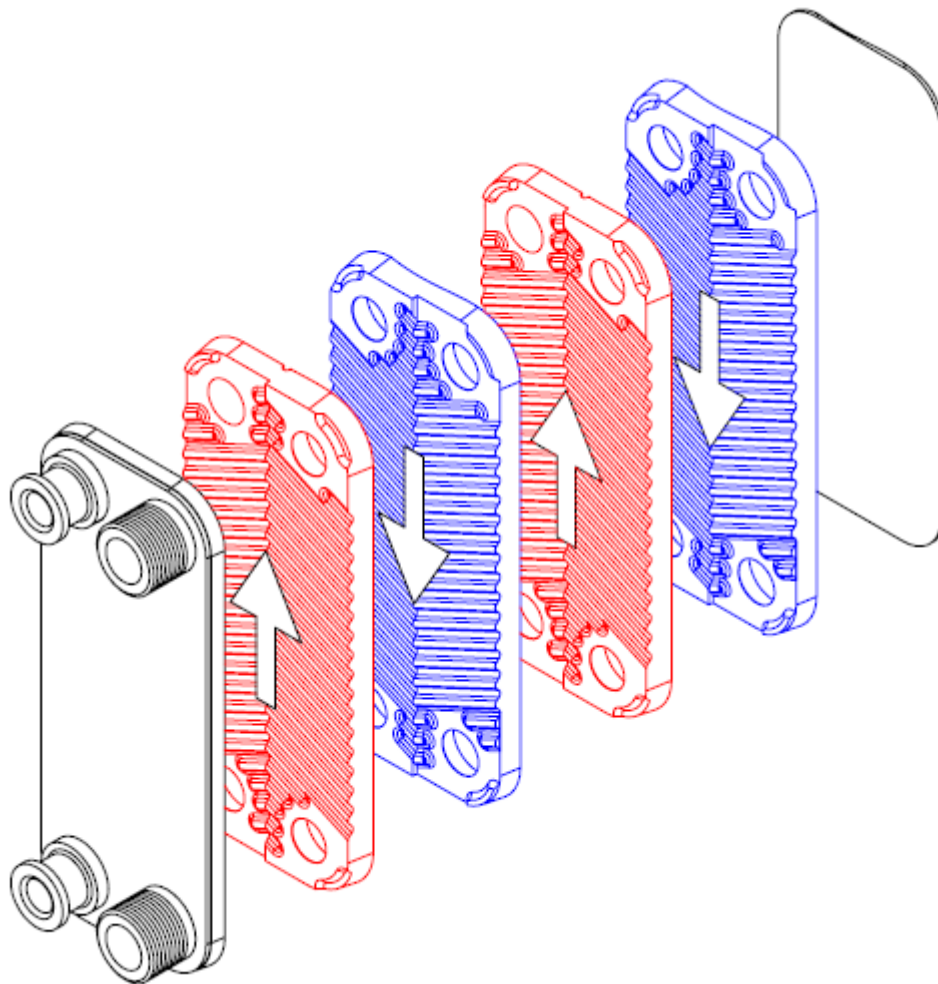
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1. Working Principle

Kaori's Brazen Plate Heat Exchanger (BPHE) consists of chevron plates of acid-resistant stainless steel. Every other plate is reversed so the ridges of the herringbone pattern intersect one another on adjacent plates forming a lattice on contact points. When these points are vacuum brazed together, two separate systems of channels for two media flow in counter-current are formed. The lattice structure causes vigorous turbulence, thus ensuring maximum heat transfer.

The BPHE is a highly efficient, corrosion-resistant, and pressure-resistant heat exchanger. The standard BPHE is designed to meet 30 bar, 200 °C, with the largest model capable of handling a maximum flow capacity of 900 liter/min.



2. Application

Kaori BPHE can be used for various mediums such as:

- All type of refrigerants
- Nickel brazed models used for Ammonia
- Organic solvents
- Water
- Oil
- Various brine solutions (glycol mixtures, CaCl_2 , alcohols etc)

Kaori BPHE can be used in:

- Heat pumps
- Industrial chiller; plastic machines, welding machines, hydraulic presses (oil), and compressor oil cooling
- Air conditioning
- Refrigeration
- Air dryer
- Water cooler; drinking water or process water for various industries
- Temperature holding for storage tanks
- Heat recovery including heat recycling from hot steam
- Indoor heating including floor heating

Refrigerant applications, BPHE function as:

- Evaporators
- Condensers
- Super-heaters for gas
- Desuper-heaters for gas
- Subcoolers for condensate
- Economizers
- Intercoolers
- Oil coolers

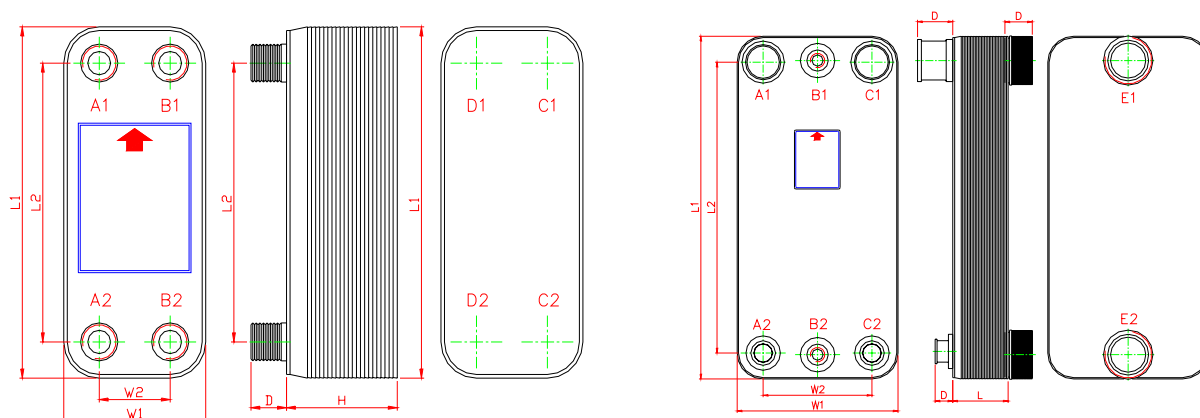
3. Advantages

Kaori BPHE provides many advantages such as:

- Highly thermal efficiency
- Compact in size and light weight
- High allowable working pressure
- High thermal resistances and high operating temperature
- Lower cost for the same performances
- Lower pressure drop and high corrosion resistance
- No gaskets required therefore no leakages
- Easy installation, easy replacement with less maintenance
- Durability

4.Specification & BPHE Dimension

Type	L1 mm	L2 mm	W1 mm	W2 mm	Weight Kg	Thickness (H) mm	Area M ² /plate	Volume Liter/Channel	Max NO. of plate
K025F	205	172	73	42	0.81+0.04(N-1)	8+2.27(N-1)	0.012	0.025	60
K025F×A	206.2	172	74.2	40	0.3+0.044(N-2)	11+2.25(N-2)	0.012	0.025	60
K025F×B	206.2	172	74.2	42	0.3+0.044(N-2)	11+2.25(N-2)	0.012	0.025	60
K030	194	154	80	40	0.8+0.05N	10+2.25N	0.0117	0.025	60
K030E	194.5	154	80.5	40	0.3+0.045N	7+2.25N	0.0117	0.025	60
K030S	194	154	80	40	1.2+0.05N	12+2.25N	0.0117	0.025	60
K040	311	278	73	40	0.84+0.07N	10+2.3N	0.01946	0.040	60
K040E	311	278	73	40	0.68+0.07N	9+2.3N	0.01946	0.040	60
K040S	311	278	73	40	1.3+0.07N	12+2.3N	0.01946	0.040	60
K050	306	250	106	50	1.5+0.135N	10+2.4N	0.0255	0.055	100
K050S	306	250	106	50	2.2+0.15N	12+2.4N	0.0255	0.055	100
K070	304	250	124	70	1.6+0.15N	10+2.4N	0.03	0.065	100
K070S	304	250	124	70	2.5+0.17N	12+2.4N	0.03	0.065	120
K095	522	466	106	50	3.1+0.22N	10+2.4N	0.0475	0.095	100
K095S	522	466	106	50	5.0+0.24N	13+2.4N	0.0475	0.095	100
K105	504	444	124	64	3.5+0.24N	10+2.4N	0.0533	0.107	120
K105S	504	444	124	64	6.2+0.27N	13+2.4N	0.0533	0.107	120
K200H	613	519	186	92	7.12+0.41N	14+2.4N	0.09446	0.206	160
K200L	613	519	186	92	7.12+0.41N	14+2.4N	0.09446	0.206	160
K200M	613	519	186	92	7.12+0.41N	14+2.4N	0.09446	0.206	160
K200S	613	519	186	92	11.88+0.47N	17+2.4N	0.09446	0.206	160
K200E	613	519	186	92	1.84+0.4N	11.5+2.4N	0.09446	0.206	160
K205	528	456	246	174	7.2+0.52N	11.5+2.4N	0.1099	0.232	200
K205S	528	456	246	174	12.9+0.59N	14.5+2.4N	0.1099	0.232	190
K210	527	430	245	148	8.5+0.490N	11+2.85N	0.1036	0.289	200
K215	529	449	247	167	7.2+0.52N	13+2.4N	0.11	0.22	200
K215D	529	449	247	167	7.2+0.52N	13+2.4N	0.11	0.22	200
K215S	529	449	247	167	13.1+0.52N	16+2.4N	0.11	0.22	200
K040C	314	275	76	40	1.98+0.137N	13+2.0N	0.01925	0.0295	60
K040C×A	314	275	76	40	2.02+0.124N	13+2.0N	0.01925	0.0295	60
K040C×B	314	275	76	40	2.06+0.124N	13+2.0N	0.01925	0.0295	60
K095C	524	466	108	50	5.0+0.37N	13.2+2.16N	0.0475	0.071	120
K095C×A	524	466	108	50	5.1+0.32N	13.2+2.16N	0.0475	0.071	120
K095C×B	524	466	108	50	5.2+0.32N	13.2+2.16N	0.0475	0.071	120



5.Design Condition for Copper Brazed PHE

Type	Max. working Pressure	Test Pressure	Max. working Temperature
K025F×A,K025F×B K030E,K040E,K200E	10 Bar	15 Bar	−160~+200
K210	16 Bar	23 Bar	−160~+200
K025F,K030,K040 K050,K070,K095 K105,K200H,K200L K200M,K205,K215 K215D	30 Bar	43 Bar	−160~+200
K215S	30 Bar	43 Bar	−160~+200
K030S,K040S,K050S K070S,K095S,K105S K200S,K205S	45 Bar	65 Bar	−160~+200

Type	Max. working Pressure		Test Pressure		Max. working Temperature
	Side 1	Side 2	Side 1	Side 2	
K040C,K095C	140 Bar	30 Bar	200 Bar	43 Bar	−160~+200
K040C×A,K095C×A	70 Bar	30 Bar	100 Bar	43 Bar	−160~+200
K095C×B,K095C×B	100 Bar	30 Bar	143 Bar	43 Bar	−160~+200

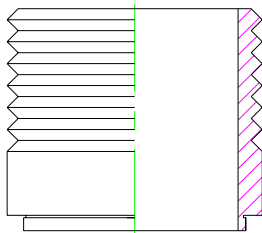
6. Standardized Connections

*Connections for fluid applications are threaded connectors.

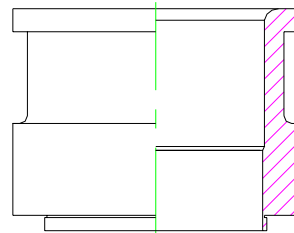
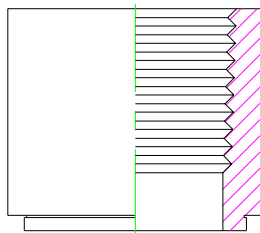
*Connections for refrigerant units are soldered/sweat connectors.

Type	Threaded Connections														
	PT/NPT/GB – Male								PT/NPT/G – Female						
	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"
K025F															
K030															
K040															
K050															
K070															
K095															
K105															
K200															
K205															
K210															
K215															

Type	Soldered Connections										
	1/4"	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-3/8"	1-5/8"	2-1/8"
	ψ 6.60 mm	ψ 9.73 mm	ψ 12.90 mm	ψ 16.15 mm	ψ 19.25 mm	ψ 22.36 mm	ψ 25.60 mm	ψ 28.80 mm	ψ 35.25 mm	ψ 41.50 mm	ψ 54.30 mm
K025F											
K030											
K040											
K050											
K070											
K095											
K105											
K200											
K205											
K210											
K215											



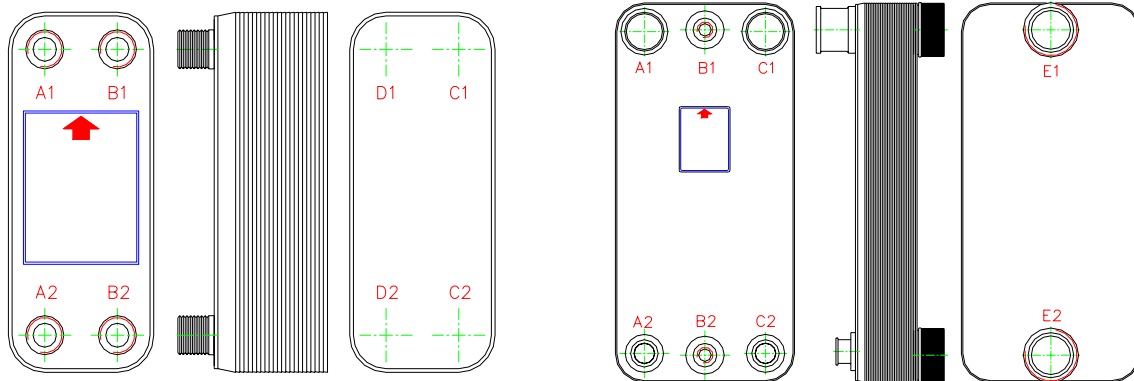
Threaded Connections



Soldered Connections

7. Installation Guide

- Illustration of
- 1 : General purpose of BPHE
 - 2 : Types of fluid applied
 - 3 : Arrangements of fluids directions



Application	Fluid 1	Fluid 2	Fluid 3
Evaporator (single refrigerant)	Refrigerant A2 → A1	Chiller water B1 → B2	
Evaporator (dual refrigerant)	Refrigerant 1 A2 → A1	Chiller water B1 → B2	Refrigerant 2 C2 → C1
Condenser	Refrigerant A1 → A2	Cooling water B2 → B1	
Heating , Cooling	Cold water A2 → A1	Hot water B1 → B2	
Oil cooler	Cooling water A2 → A1	Oil B1 → B2	
Air Dryer (Refrigerant)	Refrigerant A2 → A1	Air D2 → (D1) → (B1) → B2 → Separator → C1 → C2	
Air & Oil cooling (Air compressor)	Oil A2 → A1	Cooling water D2 → (D1) → (B1) → B2	Air C1 → C2

Always install your BPHE vertically especially for a refrigerant system. This is done to secure the BPHE and keep minimum amount of water below the connector.

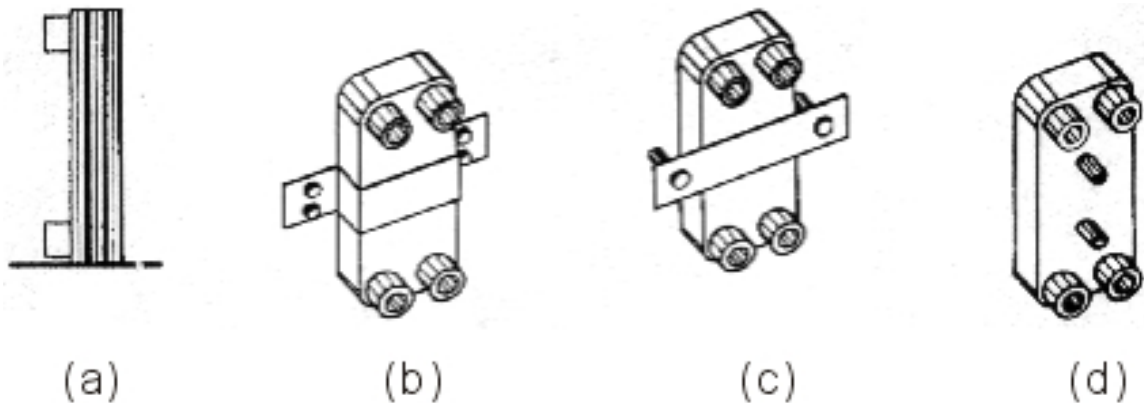
In order to achieve high thermal efficiency and high heat transfer rates, BPHE has to be installed in a counter flow direction.

When BPHE works as an Evaporator, the two-phased (liquid and gas) refrigerant enters the evaporator at the bottom left connector and the single-phased (gas) refrigerant leaves the evaporator from the top left connector after the heat transfer process. The water enters at the top right connector and leaves from the bottom right. In the case of evaporator, heat is transferred from water to refrigerant and both fluids are in counter flow direction.

When BPHE works as a condenser, the single-phased (gas) refrigerant enters the condenser at top left connector and the single-phased (liquid) refrigerant leaves the condenser from the bottom left connector. The water enters the condenser at bottom right and leaves the condenser from top right. In the case of condenser, heat is transferred from refrigerant to water and both fluids are in counter flow direction.

Mounting suggestions: There are four different ways to mount the BPHE:

(a) Bottom support (b) Sheet metal bracket, (c) Crossbar & bolts, (d) Stud bolts



- All items should be supported independently.
- Do not apply excessive forces to the fittings.
- Except for small sized K030 model, our BPHE cannot be fastened directly to the fittings/piping.
- Using flexible hoses or vibration dampers to reduce pulsation, shock or vibrations that are caused by the operating system.

8. Anti-Freezing Protection Methods for BPHE:

Any formation of freezing or icing will damage BPHE and the refrigeration system. The following methods will prevent BPHE from freezing:

- Use brine (e.g. glycol) when evaporation temperature is close to the freezing point.
- Low working pressure will cause low evaporation temperature. If the evaporation temperature is below 0 °C, it will cause water to freeze. Since the bottom portion has the lowest temperature, it is the most likely spot for the BPHE to crack.
- To start the refrigeration system, always start the water pump for a few minutes and then start the compressor. To stop the system, always stop the compressor first and then stop the water pump.

(1) Low Pressure Cut-off Switch (LP)

A low-pressure cut-off switch should be installed with properly set values. When the actual evaporation pressure is lower than the setting value, the compressor will be cut off automatically.

(2) Low Temperature Thermostat (LT)

The function of the thermostat is to prevent evaporation temperature going under 0 °C. If evaporation temperature is always above 0 °C; then water has no chance to freeze and expand.

(3) Water Temperature Sensor

Installation of an anti-freezing temperature sensor near the water outlet is another method to prevent the water from freezing. The setting temperature is suggested at 4 °C for buffering purposes.

(4) Water Flow Switch

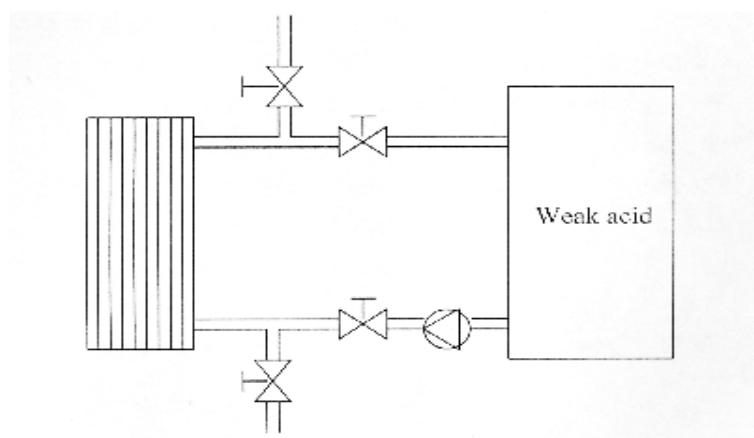
Installation of a water flow switch in the water circuit can prevent possible BPHE freezing up due to low water flow rate. Usually, low water flow rate may be caused by malfunction of water pump, leaking pipes, pipe blockage due to pipe contamination or dirty filter.

9. Soldering Instruction

Cleaning and degreasing the surface of copper pipes and PHE connectors before soldering is important. To avoid the inside of copper pipes and BPHE from oxidation, protect the inside with N₂-gas. Place the BPHE on a flat surface and wrap a wet rag around the connectors to protect the BPHE from excessive heating. Use a 40~45% silver alloy soldering rod to weld the copper pipe into the connector at a maximum temperature of 800 °C. After soldering, clean and dry the connection and BPHE.

10. Cleaning

Cleaning of fouled plate heat exchangers by back flushing will remove most of the soft debris that is blocked the inside. The solution used for back flushing shall be weak acids with concentration less than 5%; one example the citric acid. If the acidity is too high, the copper and stainless steel inside the PHE may be etched or corroded. Before restarting the system, flush the plate heat exchanger with large amounts of fresh water to purge any remaining acid solution.



11. Warning

- Fluid that is explosive, extremely flammable, highly toxic, highly corrosive, hazardous in nature cannot be used with the BPHE. Examples are nitric acid, sulfuric acid, ammonia (for copper models)etc.
- When unknown quality of water is applied to BPHE, filter and strainer should be placed at the water inlet of BPHE to filter out the dirt or large particles. Mesh size of around 20 is suitable for most cases. Blockage of evaporator due to dirt or large particles will reduce the flow rate of water which might cause freezing effect and consequently damage the integrity of the BPHE.
- Chlorinated water, seawater, etc. are not suitable for BPHE due to their corrosive nature on regular stainless steel and copper. For example, swimming pool water.

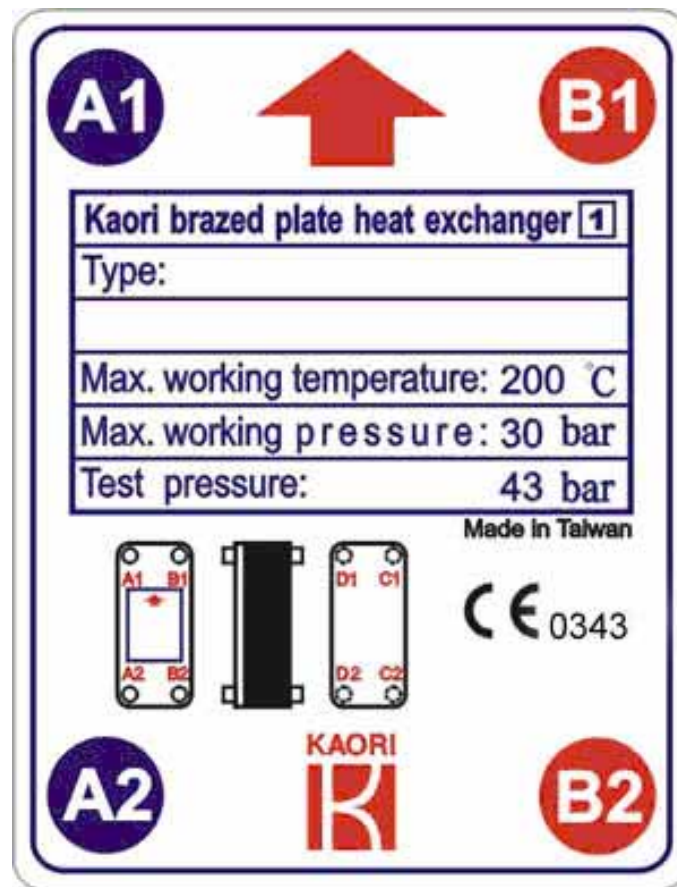
- Solution which applied to BPHE shall have PH values ranging between 6 ~ 8.
- Ground water with high sulfuric compound, sulfuric acid, low PH value, may cause gradual copper corrosion and damage the BPHE in a few years.
- Rubber strips always cover the bottom edge of the BPHE in order to protect the hand and wrist against the sharp metal edges. If the rubber strip is not a required part of your order, be careful of the sharp metal edge.
- When moving the BPHE, always wear gloves and pay attention to the sharp edges around the bottom of BPHE. Our BPHE can come without the rubber protective strip at your request.

12. Warranty Terms

- Free replacement of the defective unit if the defect is found to be caused by manufacturing material or manufacturing workmanship.
- Warranty period is standard 12 months after delivery date or according to the period listed on the official proforma invoice.
- Exceptions are:
 - (1) The failure or malfunction of BPHE is caused by improper or negligent usage of BPHE.
 - (2) Malfunctions from freezing or icing, flood, fire, any natural disaster or accident.
 - (3) Damages caused by improper or faulty installation or product exposed to corrosive elements harmful to the structure.

13. Label and Marking

The following nameplate is an example of KAORI BPHE K205 type:



Model name K205-26-26D-S9 will be shown on the label attached.
For tracking purposes, a serial no. 09052121019-26-26D-S9 will be carved on the front cover plate and below the two upper connectors of the BPHE.