

# Heat Exchanger Solution Partner Fresh Water Generator

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to develop new products  
and for quality improvement

**D**ongHwa Entec Fresh Water Generators are the equipment that convert sea water or exhausted dirty water to pure water for drinking, boiler make-up, domestic use on ship and small power station. At that time, sea water is evaporated at about 45°C ~50°C as it passed the inside of heater under the high vacuum condition and the separated pure vapor is converted to fresh water on condenser.



Plate Type



Tubular Type

# Fresh Water Generator

## Plate Type



### ● Working Principle

The DongHwa Entec DF Series Fresh Water Generator utilizes the heat from diesel engine jacket cooling water to produce pure drinkable water by evaporating sea water under high vacuum enabling the feed water to evaporate at temperatures below 48°C. Steam can also be used as the heat source instead of the hot jacket water.

The DongHwa Entec DF Series Fresh Water Generator is based on 2 titanium plate heat exchangers acting as an evaporator and a condenser respectively.

The evaporation chamber is kept under vacuum by a water ejector driven by the sea water outlet from condenser. A part of this heated sea water is used as feed water for the evaporator. The feed water evaporates when entering the evaporating chamber due to the vacuum condition. Water spray and droplets are partly removed from the vapour by the deflector mounted on top of the evaporator and partly by a build-in demister. The separated water droplets fall back into the brine, which is extracted from the sump by means of the ejector pump.

The desalted vapour passing through the demister will be sucked into the plate condenser where it will be condensed by means of cold incoming salt water.

The pure distilled water will be taken out by means of an integral fresh water pump. The pure water taken out from the condenser will be controlled by a salinometer to supervise that the pre-set salinity(1~10ppm) will be reached. If the salinity exceeds the specified level, the solenoid valve in the discharge line of the distillate pump is automatically activated and the faulty distillate is returned to the feed line.

### ● Technical Specification of DF Type

| Capacity             | Type         | Connection | Jacket water flow(m <sup>3</sup> /24hr) |       |       | Heat consumption | Ejector pump capacity | Ejector pump consumption(60Hz) |     | FW pump consumption(60Hz) |  |
|----------------------|--------------|------------|---|-------|-------|------------------|-----------------------|--------------------------------|-----|---------------------------|--|
|                      |              |            | 80 °C                                   | 85 °C | 90 °C |                  |                       | KW                             | bar | KW                        |  |
| m <sup>3</sup> /24hr | Single stage | JIS        |   |       |       | KW               | m <sup>3</sup> × bar  | KW                             | bar | KW                        |  |
| 3                    | DF3          | 40         | 8                                       | 6     | 5     | 110              | 8 × 4.0               | 3.6                            | 3.0 | 0.75                      |  |
| 5                    | DF3          | 40         | 10                                      | 8     | 6     | 160              | 13 × 4.0              | 4.8                            | 3.0 | 0.75                      |  |
| 7                    | DF7          | 40         | 12                                      | 10    | 8     | 220              | 18 × 4.0              | 6.6                            | 3.0 | 0.75                      |  |
| 10                   | DF7          | 65         | 24                                      | 20    | 15    | 310              | 24 × 4.0              | 6.6                            | 3.0 | 0.75                      |  |
| 12                   | DF7          | 65         | 26                                      | 23    | 16    | 360              | 29 × 4.0              | 11.0                           | 3.0 | 0.75                      |  |
| 15                   | DF13         | 65         | 34                                      | 30    | 22    | 460              | 35 × 4.0              | 11.0                           | 3.0 | 0.75                      |  |
| 18                   | DF13         | 65         | 38                                      | 35    | 25    | 540              | 40 × 4.0              | 11.0                           | 3.0 | 0.75                      |  |
| 20                   | DF13         | 65         | 44                                      | 40    | 30    | 600              | 44 × 4.0              | 11.0                           | 3.0 | 0.75                      |  |
| 25                   | DF13         | 80         | 54                                      | 48    | 35    | 750              | 58 × 4.0              | 15.0                           | 3.0 | 0.75                      |  |
| 30                   | DF23         | 100        | 75                                      | 67    | 50    | 910              | 75 × 4.0              | 18.5                           | 3.0 | 1.5                       |  |
| 35                   | DF23         | 100        | 80                                      | 75    | 55    | 1080             | 88 × 4.0              | 22.0                           | 3.0 | 1.5                       |  |
| 40                   | DF35         | 125        | 86                                      | 80    | 60    | 1220             | 92 × 4.0              | 22.0                           | 3.0 | 1.5                       |  |
| 45                   | DF35         | 125        | 100                                     | 90    | 68    | 1360             | 95 × 4.0              | 22.0                           | 3.0 | 1.5                       |  |
| 50                   | DF35         | 150        | 112                                     | 100   | 74    | 1520             | 120 × 4.0             | 22.2                           | 3.0 | 1.5                       |  |
| 60                   | DF35         | 200        | 132                                     | 118   | 90    | 1850             | 140 × 4.0             | 24.0                           | 3.0 | 1.5                       |  |

## Tubular Type



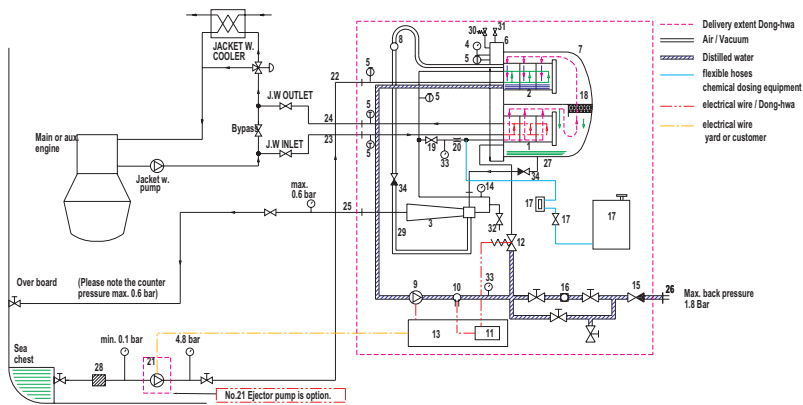
### ● Working Principle

The main engine jacket cooling water circulates the outside of the vertical tube in heating section and the sea water to be distilled is sent to the bottom cover of this section. Then some of the sea water is converted into vapour when it goes up through the heated tubes. The vapour, through the demisters, is condensed on the outer surface of the tubes of the distilling condenser and the resultant distillate is led to the suction of the distillate pump. In the meantime the non-condensable gases and brine are extracted and discharged to overboard by the combination ejector.

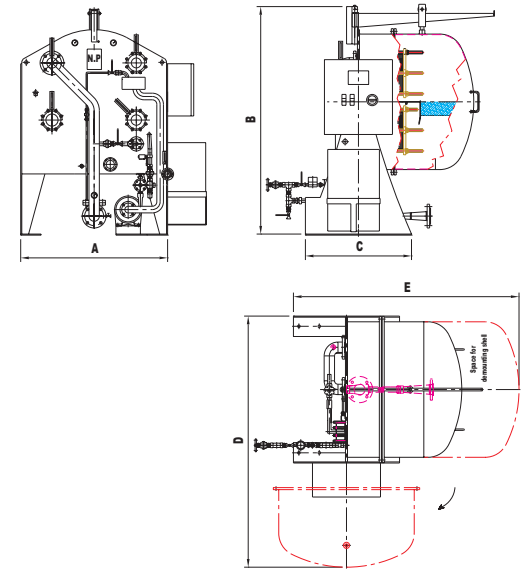
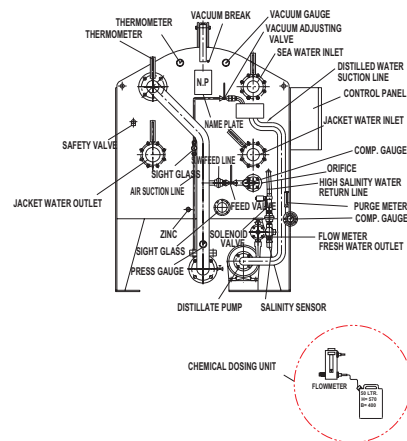
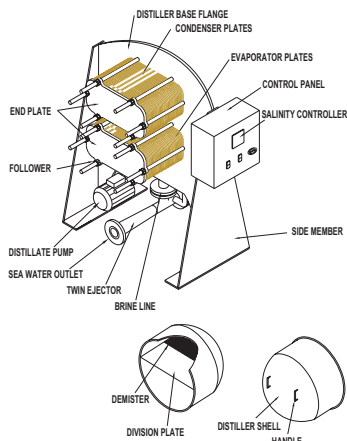
### ● Technical Specification of DX- α Type

| Capacity             | Type         | Connection | Jacket water flow    | Heat consumption | Ejector pump capacity | Ejector pump consumption(60Hz) |     | FW pump consumption(60Hz) |  |
|----------------------|--------------|------------|----------------------|------------------|-----------------------|--------------------------------|-----|---------------------------|--|
|                      |              |            | 80 °C                |                  |                       | KW                             | bar | KW                        |  |
| m <sup>3</sup> /24hr | Single stage | JIS        | m <sup>3</sup> /24hr | KW               | m <sup>3</sup> × bar  | KW                             | bar | KW                        |  |
| 5                    | DX- α-5      | 65         | 13                   | 141              | 13 × 4.8              | 5.5                            | 2   | 0.4                       |  |
| 10                   | DX- α-10     | 80         | 26                   | 282              | 24 × 4.8              | 6.6                            | 3   | 1.5                       |  |
| 15                   | DX- α-15     | 80         | 37                   | 423              | 35 × 4.8              | 11                             | 3   | 1.5                       |  |
| 20                   | DX- α-20     | 100        | 54                   | 564              | 44 × 4.8              | 11                             | 3   | 1.5                       |  |
| 25                   | DX- α-25     | 100        | 56                   | 705              | 61 × 4.8              | 15                             | 3   | 1.5                       |  |
| 30                   | DX- α-30     | 125        | 69                   | 846              | 75 × 4.8              | 18.5                           | 3   | 1.5                       |  |
| 35                   | DX- α-35     | 125        | 80                   | 987              | 75 × 4.8              | 18.5                           | 3   | 1.5                       |  |
| 40                   | DX- α-40     | 125        | 85                   | 1128             | 90 × 4.8              | 22                             | 3   | 1.5                       |  |

## ● Installation sketch of Freshwater Generator

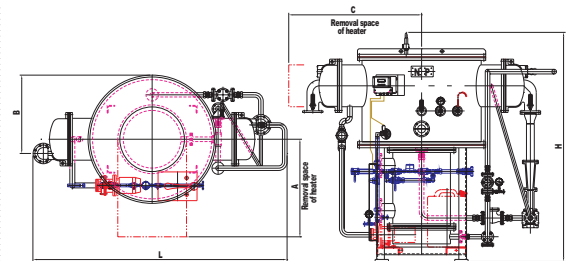
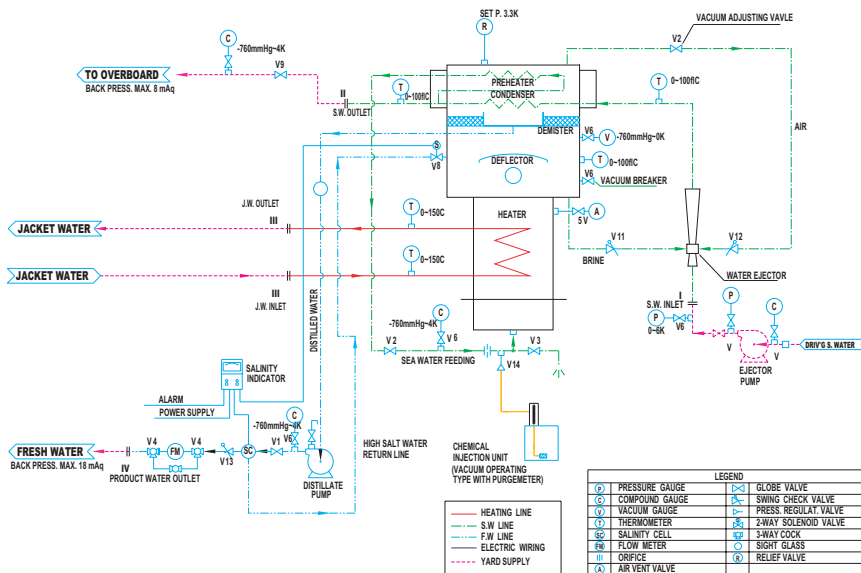


| NO. | DESCRIPTION           | NO. | DESCRIPTION                    | NO. | DESCRIPTION                    | NO. | DESCRIPTION                 |
|-----|-----------------------|-----|--------------------------------|-----|--------------------------------|-----|-----------------------------|
| 1   | EVAPORATOR            | 8   | FLOW SIGHT GLASS               | 15  | PAN CHECK VALVE                | 22  | SEA WATER INLET             |
| 2   | CONDENSER             | 9   | FRESH WATER PUMP               | 16  | FLOW METER FOR DISTILLED WATER | 23  | JACKET WATER INLET          |
| 3   | TWIN EJECTOR          | 10  | SALINITY SENSOR                | 17  | CHEMICAL DOSING UNIT           | 24  | JACKET WATER OUTLET         |
| 4   | VACUUM GAUGE          | 11  | SALINITY INDICATOR(controller) | 18  | DEMISTER                       | 25  | SEA WATER OUTLET            |
| 5   | THERMOMETER           | 12  | SOLENOID V/V                   | 19  | FEED VALVE                     | 26  | DISTILLED WATER OUTLET      |
| 6   | DISTILLER BASE FLANGE | 13  | CONTROL PANEL                  | 20  | ORIFICE                        | 27  | BRINE OUTLET                |
| 7   | DISTILLER COVER       | 14  | PRESSURE GAUGE                 | 21  | EJECTOR PUMP(Optional)         | 28  | SEA WATER FILTER (Max. 5mm) |



## ● Dimension List

| Type    | A    | B    | C    | D    | E    | Approx. Weight(kg) |           |
|---------|------|------|------|------|------|--------------------|-----------|
|         |      |      |      |      |      | Empty              | Operation |
| DF3/5   | 610  | 1013 | 810  | 935  | 1460 | 310                | 400       |
| DF7/10  | 1020 | 1400 | 808  | 1042 | 1500 | 400                | 550       |
| DF13/15 | 1020 | 1550 | 625  | 1065 | 1435 | 430                | 580       |
| DF13/20 | 1080 | 1660 | 780  | 1280 | 1550 | 450                | 600       |
| DF13/25 | 1080 | 1660 | 780  | 1450 | 1820 | 640                | 850       |
| DF23/30 | 1276 | 1838 | 1210 | 1785 | 2255 | 675                | 900       |
| DF23/35 | 1276 | 2100 | 900  | 1440 | 1710 | 700                | 950       |
| DF35/40 | 1276 | 2200 | 900  | 1590 | 1810 | 850                | 1100      |
| DF35/45 | 1276 | 2200 | 900  | 1700 | 2000 | 890                | 1200      |
| DF35/50 | 1276 | 2200 | 900  | 1750 | 2100 | 910                | 1250      |
| DF35/60 | 1276 | 2200 | 900  | 1800 | 2200 | 1130               | 1500      |



## ● Dimension List

| Type             | L    | B    | H    | C    | A    | Approx. Weight(kg) |           |             |
|------------------|------|------|------|------|------|--------------------|-----------|-------------|
|                  |      |      |      |      |      | Empty              | Operation | Ejector P/P |
| DX- $\alpha$ -5  | 1480 | 820  | 1430 | 1655 | 650  | 680                | 780       | 120         |
| DX- $\alpha$ -10 | 1680 | 980  | 2005 | 1840 | 830  | 750                | 900       | 120         |
| DX- $\alpha$ -15 | 1835 | 1030 | 1975 | 2030 | 850  | 850                | 1000      | 128         |
| DX- $\alpha$ -20 | 1880 | 1060 | 1680 | 2250 | 990  | 1140               | 1350      | 140         |
| DX- $\alpha$ -25 | 2050 | 1150 | 1850 | 2310 | 1200 | 1145               | 1370      | 175         |
| DX- $\alpha$ -30 | 2250 | 1330 | 2080 | 2470 | 1500 | 1150               | 1400      | 175         |
| DX- $\alpha$ -35 | 2400 | 1380 | 2100 | 2510 | 1500 | 1200               | 1570      | 175         |
| DX- $\alpha$ -40 | 2500 | 1400 | 2205 | 2550 | 1500 | 1320               | 1650      | 187         |

## ■ Steam Injection System



### ● Heating Source

Diesel engine jacket cooling water which otherwise would be lost to the sea is used for heating source. And if it is used with mixing injector, the boiler steam also can be used for the purpose when anchoring at harbour where jacket cooling water is not available.

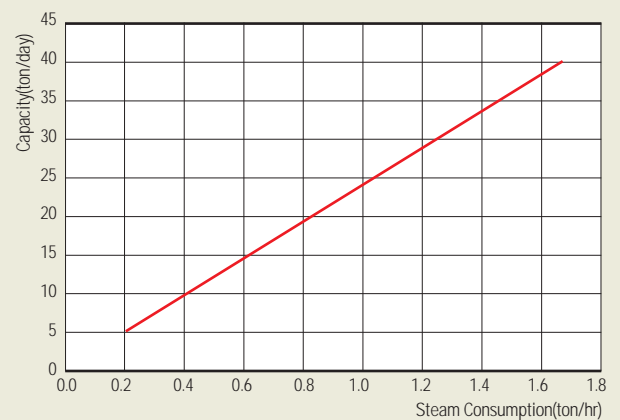
### ● Additional equipment necessary for operation

- Combined cooling and ejector water pump with electric motor.
- Control panel with motor starters and salinometer.
- Feed water anti-scale chemical dosing unit.

### ● Optional equipment

- Hot water loop module for steam boosting of jacket water.
- Extended control panel with motor starters and salinometer.
- Individual single motor starters and salinometer.
- Fresh water pH adjustment filter.
- Fresh water disinfection equipment.

### ● Steam Consumption of Steam Injector



※ NOTE : The allowable range of the driving steam pressure is 3kg/cm<sup>2</sup>g minimum and 9kg/cm<sup>2</sup>g maximum

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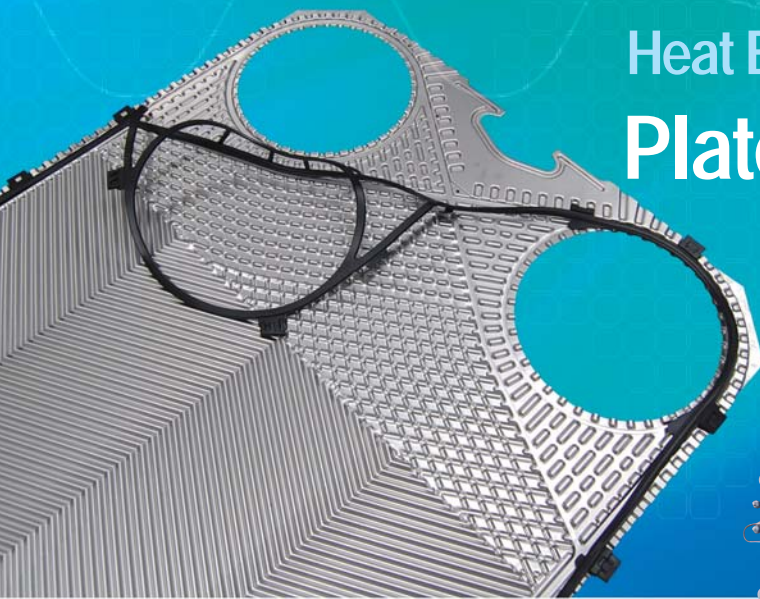
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# Heat Exchanger Solution Partner Plate Heat Exchangers

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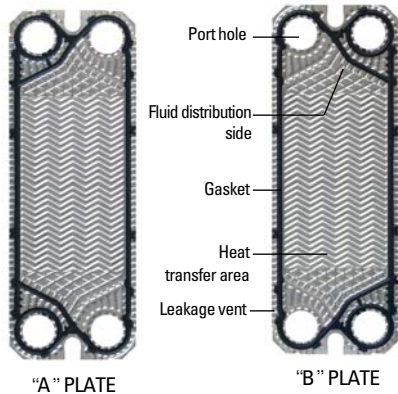
**D**ongHwa Plate Heat Exchangers are used in the industrial, marine, food and dairy sectors. DongHwa works at high quality level, based on an experienced staff, with regards to both production and calculation of Plate Heat Exchangers.

DongHwa can, with the help of specially developed computer programs, quickly calculate an optimal solution to any plate heat exchanger application, based on the customer's demands.

The calculated Plate Heat Exchanger is documented for the customer on a well-arranged and easily read data list.

# Plate Heat Exchangers

## Working Principle

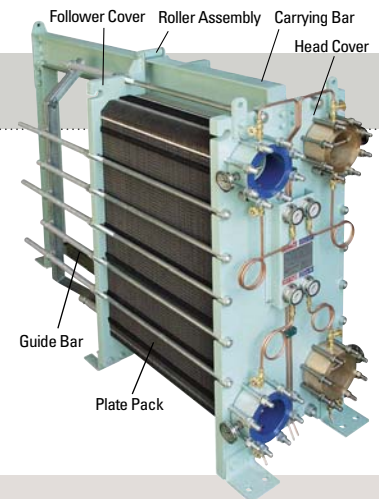


Gasket is attached to the heat plate which forms flow channel and acts seal up the fluid not to leak to the outside. The number of the heat plate is determined according to the amount of fluid, physical properties of fluid, the pressure drop and thermal condition. The covers prevent the plates bended from the difference of pressure. In the assembly of plate, the surface with gasket is directed to the fixed cover and each plate is hanged in opposite direction alternately. And two fluids cannot be mixed and separated by a thin plate. One fluid always flows in "A" channel and the other fluid always flow in "B" channel.

## The Design and Function of DongHwa Plate Heat Exchanger

The plate heat exchanger consists of a frame, which in turn consists of a Head cover, a Follower cover, a support pillar, a carrying bar, a guiding bar and a number of tightening bolts. In between the head and the follower cover a varying number of pressed plates are clamped together.

Each plate is supplied with a gasket, so that the plates form a closed system of parallel flow channels. through which the medias flow alternately at every second interval.



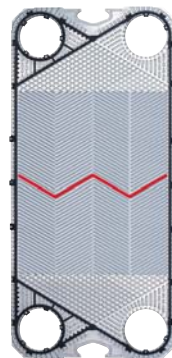
## Type of Heat Plate

### HIGH -THETA PLATE

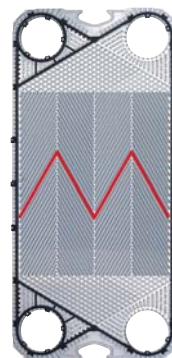
- High turbulent flow
- High heat transfer coefficient
- Perfect temperature approach
- High pressure drop

### LOW -THETA PLATE

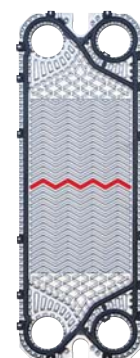
- Low turbulent flow
- Low heat transfer coefficient
- High temperature approach
- Low pressure drop



High-theta Plate



Low-theta Plate



High-theta Plate



Low-theta Plate

## Plate Design

The construction of the inlet part makes a perfect distribution of the liquids across the heating surface.

The inlet part is increased and supplied with grooves preventing "dead spots" which may cause the growth of bacteria or seaweeds in the plate heat exchanger.

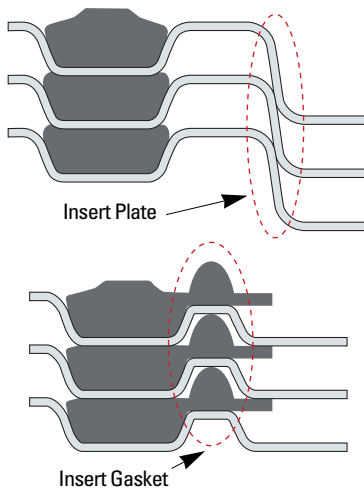
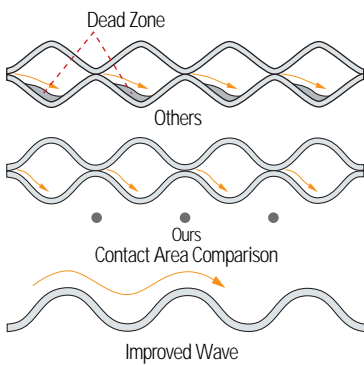
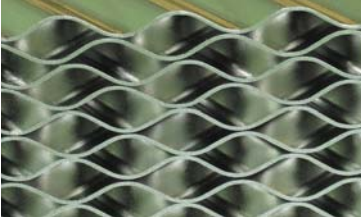
The inlet with grooves secures a strong inlet part with a minimum of contact points.

The inlet parts are constructed with a leakage drained zone fulfilling the 3A specifications.

The plate pattern is constructed to obtain a high thermal efficiency. The pattern is available in two designs with different angle sizes giving high respectively low turbulent flow. Combining these in a plate pack and optimal plate composition can be calculated.

The angle and fishbone pattern has appeared to male the best heat transmission by a given pressure drop.

## ● Characteristics



### Wide contact area

The strength of the plate is excellent, compared with other companies' products with the point contact type, as the metal contact point has the surface contact feature when the plates are assembled. And the durability and corrosion resistance are greatly improved by minimizing deformation and stress concentration.

Besides, the section of the gasket is designed and manufactured to have a pressure-resistant structure that enables the minimum contact area with the fluid, and thus to withstand a high pressure.



### Clip Gasket

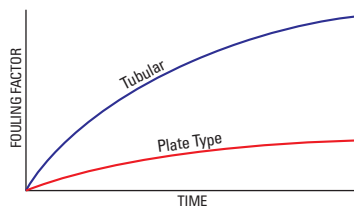
The gasket can be fixed tightly and quickly on the heat plate in the optimum condition with the dual fixing device (snap on type), and is designed and manufactured to have the glue type and non-glue type so that it can be selected according to the usage.

### Anti Vibration Design

Designed to prevent loosening the tightening bolts and nuts during continuing operation which secure to prolong the equipment's operation lifetime and prevent leakages.

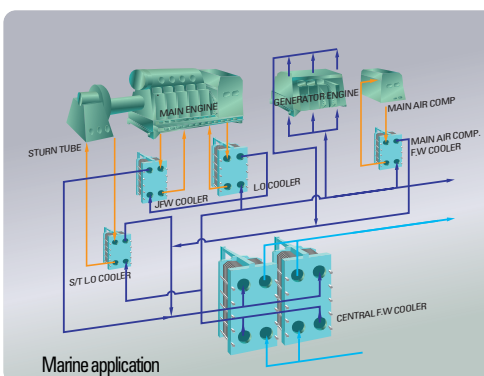
### Easy disassembly and assembly

Even the biggest model also can be assembled or disassembled by 1 or 2 persons. As it is designed to have a dual fixing method of the insert-typed plate and insert-typed gasket, there is no sliding on the plates. It prevents sliding and an assembling failure even when a non-skilled novice disassemble or assemble the device. (Excellent maintenance against materials with high viscosity such as oils for LO cooler or oil heater)



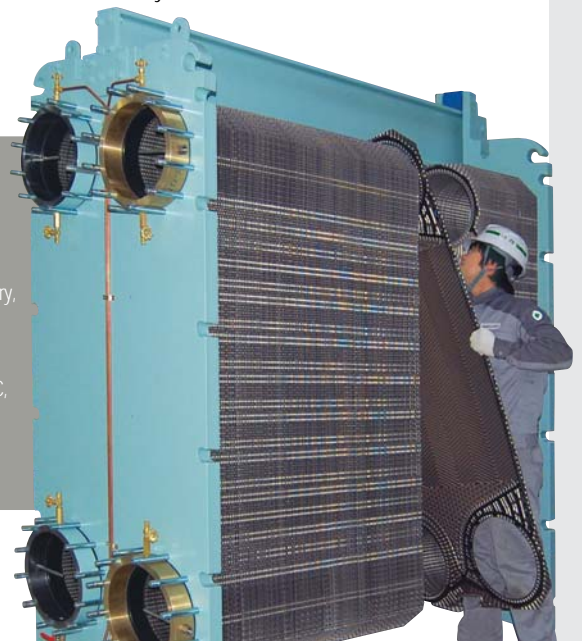
### Temperature Approach

The turbulent flow, promoted by the wave pattern of the heat plates, enables a very high heat transfer coefficient. Proximity Limit: 1 °C



### Application

Marine Application and Engines, Architecture Industry, Automobiles Industry, Textile Industry, Pulp and Paper Industry, Chemical Industry, Steel Industry, Mechanical Industry, Food Industry, HVAC, Power Stations, Surface Treatment



## Plate Heat Exchanger Technical Data

| Model                 |                    | HT03        | HT061        | HT062        | HT064        | HT081         | HT082         | HT083         | HT101       | HT102       | HT103       | HT104       |
|-----------------------|--------------------|-------------|--------------|--------------|--------------|---------------|---------------|---------------|-------------|-------------|-------------|-------------|
| Max. Flow             | m <sup>3</sup> /hr | 17          | 80           | 80           | 80           | 140           | 140           | 140           | 200         | 200         | 200         | 200         |
| Area of Plate         | m <sup>2</sup>     | 0.03        | 0.08         | 0.12         | 0.23         | 0.25          | 0.35          | 0.5           | 0.16        | 0.26        | 0.36        | 0.46        |
| Plate Hole Dia.       | mm                 | 18.4        | 65           | 65           | 65           | 85            | 85            | 85            | 105         | 105         | 105         | 105         |
| Max.Conn.Dia.         | mm                 | 40          | 65           | 65           | 65           | 100           | 100           | 100           | 100         | 100         | 100         | 100         |
| Dimension - A         | mm                 | 180         | 328          | 328          | 328          | 456           | 456           | 456           | 464         | 464         | 464         | 464         |
| Dimension - B         | mm                 | 490         | 668          | 823          | 1223         | 1158          | 1485          | 1899          | 880         | 1120        | 1409        | 1649        |
| Dimension - C (±1.5%) | mm                 | (2.5+t) x n | (3.05+t) x n | (3.05+t) x n | (3.05+t) x n | (2.7+0.5) x n | (2.7+0.5) x n | (2.7+0.5) x n | (3.3+t) x n | (3.3+t) x n | (3.3+t) x n | (3.3+t) x n |

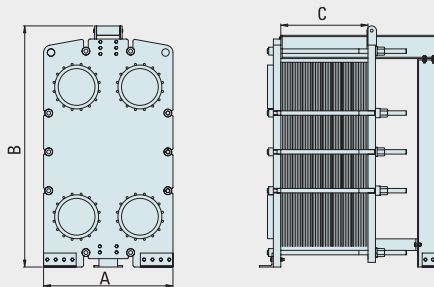
| Model                 |                    | HT121       | HT122       | HT123       | HT150        | HT151        | HT152        | HT153        | HT154        | HT200        | HT201        | HT202        |
|-----------------------|--------------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Max. Flow             | m <sup>3</sup> /hr | 250         | 250         | 250         | 420          | 420          | 420          | 420          | 420          | 730          | 730          | 730          |
| Area of Plate         | m <sup>2</sup>     | 0.34        | 0.55        | 0.71        | 0.25         | 0.55         | 0.85         | 1.15         | 1.45         | 0.2          | 0.5          | 0.8          |
| Plate Hole Dia.       | mm                 | 115         | 115         | 115         | 150          | 150          | 150          | 150          | 150          | 200          | 200          | 200          |
| Max.Conn.Dia.         | mm                 | 125         | 125         | 125         | 150          | 150          | 150          | 150          | 150          | 200          | 200          | 200          |
| Dimension - A         | mm                 | 614         | 614         | 614         | 720          | 720          | 720          | 720          | 720          | 720          | 720          | 720          |
| Dimension - B         | mm                 | 1399        | 1805        | 2119        | 1189         | 1663         | 2137         | 2611         | 3085         | 1189         | 1663         | 2137         |
| Dimension - C (±1.5%) | mm                 | (3.9+t) x n | (3.9+t) x n | (3.9+t) x n | (2.95+t) x n | (2.95+t) x n | (2.95+t) x n | (2.95+t) x n | (2.95+t) x n | (2.95+t) x n | (2.95+t) x n | (2.95+t) x n |

| Model                 |                    | HT203        | HT204        | HT231        | HT232        | HT233        | HT234        | HT235        | HT301        | HT302        | HT303        | HT304        |
|-----------------------|--------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Max. Flow             | m <sup>3</sup> /hr | 730          | 730          | 950          | 950          | 950          | 950          | 950          | 1700         | 1700         | 1700         | 1700         |
| Area of Plate         | m <sup>2</sup>     | 1.1          | 1.4          | 0.55         | 0.86         | 1.02         | 1.35         | 1.85         | 0.63         | 1.1          | 1.34         | 1.58         |
| Plate Hole Dia.       | mm                 | 200          | 200          | 224          | 224          | 224          | 224          | 224          | 300          | 300          | 300          | 300          |
| Max.Conn.Dia.         | mm                 | 200          | 200          | 250          | 250          | 250          | 250          | 250          | 300          | 300          | 300          | 300          |
| Dimension - A         | mm                 | 720          | 720          | 886          | 886          | 886          | 886          | 886          | 998          | 998          | 998          | 998          |
| Dimension - B         | mm                 | 2611         | 3085         | 1605         | 1980         | 2168         | 2543         | 3105         | 1925         | 2405         | 2645         | 2885         |
| Dimension - C (±1.5%) | mm                 | (2.95+t) x n | (2.95+t) x n | (3.05+t) x n | (3.05+t) x n | (3.05+t) x n | (3.05+t) x n | (3.05+t) x n | (3.05+t) x n | (3.05+t) x n | (3.05+t) x n | (3.05+t) x n |

| Model                 |                    | HT305        | HT351        | HT352        | HT353        | HT354        | HT451       | HT452       | HT453       | HT454       | HT501       | HT502       |
|-----------------------|--------------------|--------------|--------------|--------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Max. Flow             | m <sup>3</sup> /hr | 1700         | 2400         | 2400         | 2400         | 2400         | 3400        | 3400        | 3400        | 3400        | 4000        | 4000        |
| Area of Plate         | m <sup>2</sup>     | 2.05         | 1.09         | 1.75         | 2.45         | 3.15         | 1.23        | 2.0         | 2.15        | 2.8         | 2.38        | 3.36        |
| Plate Hole Dia.       | mm                 | 300          | 355          | 355          | 355          | 355          | 430         | 430         | 430         | 430         | 485         | 485         |
| Max.Conn.Dia.         | mm                 | 300          | 400          | 400          | 400          | 400          | 500         | 500         | 500         | 500         | 550         | 550         |
| Dimension - A         | mm                 | 998          | 1115         | 1115         | 1115         | 1115         | 1390        | 1390        | 1390        | 1390        | 1540        | 1540        |
| Dimension - B         | mm                 | 3347         | 2292         | 2912         | 3532         | 4152         | 2698        | 3264        | 3373        | 3830        | 3230        | 3950        |
| Dimension - C (±1.5%) | mm                 | (3.05+t) x n | (3.35+t) x n | (3.35+t) x n | (3.35+t) x n | (3.35+t) x n | (3.7+t) x n | (3.7+t) x n | (3.7+t) x n | (3.7+t) x n | (3.6+t) x n | (3.6+t) x n |

| Model                 |                    | HT503       |
|-----------------------|--------------------|-------------|
| Max. Flow             | m <sup>3</sup> /hr | 4000        |
| Area of Plate         | m <sup>2</sup>     | 4.02        |
| Plate Hole Dia.       | mm                 | 485         |
| Max.Conn.Dia.         | mm                 | 550         |
| Dimension - A         | mm                 | 1540        |
| Dimension - B         | mm                 | 4310        |
| Dimension - C (±1.5%) | mm                 | (3.6+t) x n |

t : Heat Plate Thickness



■ 10,000ton hydraulic press

Max. operation temp. 180°C  
 Heat transfer area 0.1 ~ 2,400m<sup>2</sup>/set\*  
 Max. operation press. 25 kg/cm<sup>2</sup>g  
 Max. flow rate 4000m<sup>3</sup>/hr.set

The following materials can be applied to plates : SS304 and 316, Avesta 254SMO, Titanium, Ti-Pd, Nickel, Hastelloy-B & C276, Zirconium etc.  
 The following materials can be applied to gaskets : NBR, EPDM, FPM, Neoprene, IIR, Butyle, Silicone, Viton, Teflon Envelope (Special)

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 Heat Exchanger Solutions

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