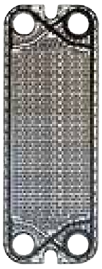
Plate Element Types

The plates are specially selected from various patterns so as to achieve optimum heat transfer area and cost effective heat exchanger type for each requirement. These plates include the corrugated pattern EX and FX series, the herringbone pattern RX, UX, LX, SX, and CX series, and the specific pattern GX and YX series.

Corrugated Pattern

The corrugated pattern is also called the wash board pattern. It has less metal contact points between plates and allows for even liquids with fiber or sludge contents to flow easily without blockage. The FX series was developed exclusively for food application even beyond the conventional corrugated pattern. (Refer to P16)

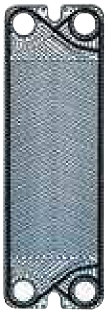

Corrugated

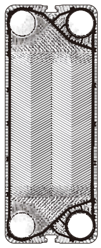
Herringbone Pattern

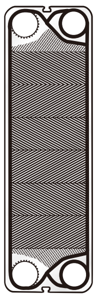
The "herringbone" pattern was named as the V-shaped press grooves resemble the bones of a herring. There are numerous contact points by pilling the V-shaped pressed plates, turning them 180° in an alternating pattern. This ensures high pressure resistance, and also the complex flow channels formed by the V-shaped press grooves get high heat transfer performance. Furthermore, including the decreased heat transfer resistance due to the thinner plate results in heat transfer performance three to five times higher than that of S&T heat exchangers.

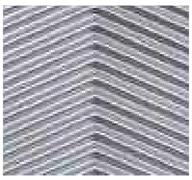
A herringbone pattern with a W-shaped press groove is called a "double herringbone" and is an improved version of the V-shaped herringbone.

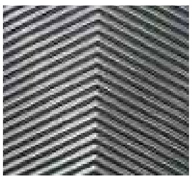
The "lightning herringbone" is a herringbone for higher NTU duty.

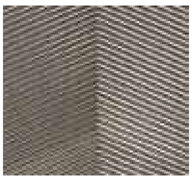

Single herringbone


Double herringbone


Lightning herringbone


LX series


RX, UX series


SX series

Pressing depth	Deep	↔	Shallow
Pressing pitch	Big	↔	Small
NTU	Low	↔	High

Specific Patterns

In addition to the above plates, we also develop high-functionality plate patterns, such as multi-gap, exclusive condensation use.

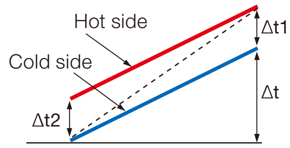
NTU (θ)

NTU = 3 is heat recovery performance of 75%

The heat transfer characteristic of each plate are expressed using NTU (Number of Transfer Unit, θ) and are defined as follows.

$$\theta = U \cdot A / G \cdot C_p = \Delta t / \Delta tlm$$

U: Overall heat transfer coefficient
A: Heat transfer area
G: Flow rate of the fluid
Cp: Specific heat of the fluid
Δt: Temperature change of one fluid
Δtlm: Logarithmic mean temperature difference between Δt1 and Δt2



As heat recovery ratio η is expressed as $\eta = \dfrac{\Delta t}{\Delta t + \Delta tlm}$

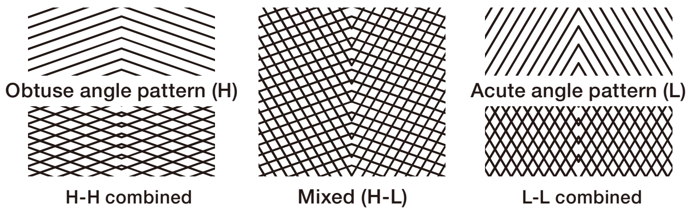
when Δt1 = Δt2 (= Δtlm), θ is $\eta = \dfrac{\theta}{\theta + 1}$.

Therefore, for a plate where $\theta = 3$, $\eta = \dfrac{3}{3+1} = 0.75$,

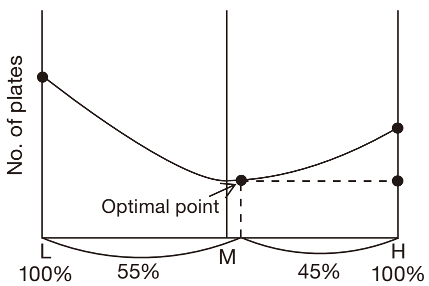
which means it has the performance of 75% heat recovery.

Plate Patterns and NTU

There are two types of herringbone pattern plates; one where the V (W) angle is obtuse (H-plate), and one where it is acute (L-plate). Combining H-plates and L-plates can allow for three types of different flow channels; H-H, H-L, and L-L. Our optimal design method which combines plates, known as the "mixed arrangement," can decrease the heat transfer area by approx. 25% compared to designs with a single plate.

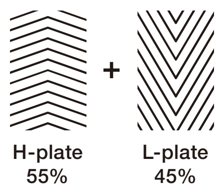


NTU	High	↔	Moderate ↔	Low
Pressure loss	Big	↔	Moderate ↔	Small



Example optimal design by mixed arrangement

The figure (left) shows that the heat transfer area is reduced by the mixed arrangement.



This case shows a mixed arrangement wherein there are 55 H-plates and 45 L-plates for a total of 100 plates.

Two plates form one channel, so there are 45 M channels (H-L) and 5 H channels (H-H). The number of plates is significantly reduced compared to a case with only H channels case.