

ENGINEERING  
TOMORROW

*Danfoss*

# Immediate and steady savings With **MPHE** for heat pumps

Micro Plate Heat Exchangers

A close-up photograph of two metal fittings on a heat exchanger plate. The fittings are cylindrical and have a threaded section. They are mounted on a reflective surface, creating a clear reflection. The background is dark, making the metallic components stand out.

**\$161**

**Savings per  
heat pump**

Using MPHEs in a typical  
17 Rt Brine-Water heat  
pump.

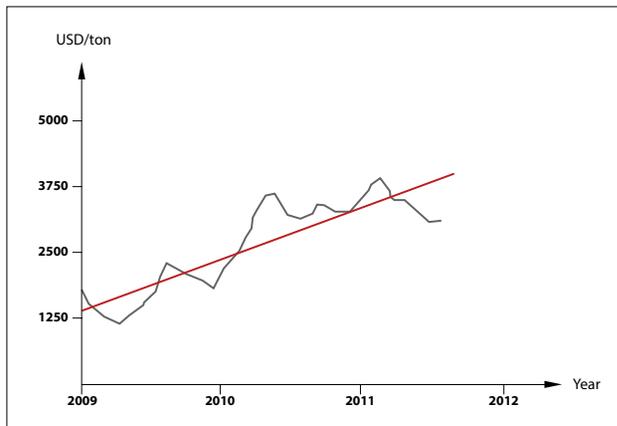


# CONTENTS

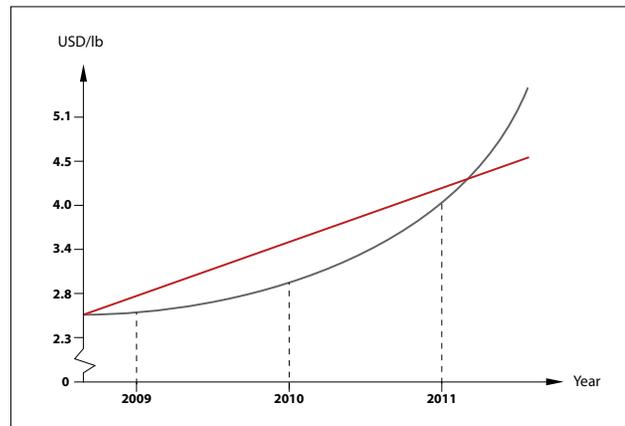
NEW WORLD, NEW CHALLENGES	4
SMARTER HEAT TRANSFER WITH MPHEs	6
SAVE \$161 PER HEAT PUMP!	7
FLEXIBLE AND INNOVATIVE DESIGN	11
PUT IT ALL TOGETHER, AND WHAT DO YOU GET?	12
MPHEs GO ASYMMETRIC	14
A WHOLE PRODUCT FAMILY	16
WE'RE ALWAYS ON YOUR SIDE	18



## NEW WORLD, NEW CHALLENGES



The price of stainless steel has risen steeply over the last three years and this trend is predicted to continue. This has a dramatic effect on chiller production costs.



This graph shows the rising purchase price (excluding taxes) of the refrigerant R410A over the last three years.

Heat pump technology answers modern society's urgent need for efficient, environmentally friendly heating systems. And as our efforts to save energy intensify, the demand for heat pumps just keeps on growing.

This situation means new challenges for heat pump manufacturers. Competition is fiercer than ever, raw material prices fluctuate, customers want lighter, slimmer products, and increasingly strict environmental legislation drives the need to reduce the refrigerant charge.

Now, Danfoss brings you a heat exchanger concept that addresses all these needs, starting with heat transfer itself. Find out how we can help you develop tomorrow's heat pumps, to keep your customers comfortable and your business competitive in the future.

A landscape photograph showing a bright green grassy hill in the foreground, a single tree on the crest of the hill, and a clear blue sky above. The text is overlaid on the top left of the image.

**35%**

**Lower hold-up  
volume**

Enables significant  
reduction in refrigerant  
charge.

# SMARTER HEAT TRANSFER WITH MPHEs



To help our customers meet the challenges of today's heat pump business, Danfoss introduces the innovative Micro Plate Heat Exchanger (MPHE) with its revolutionary plate design.

## **New plate design**

In place of the traditional BPHE herringbone pattern, our new MPHEs have an indented surface. This apparently minor change leads to a major improvement in heat transfer. And as we shall see, it enables a series of other important efficiency gains, which result in significant and steady savings for you. How is this possible?

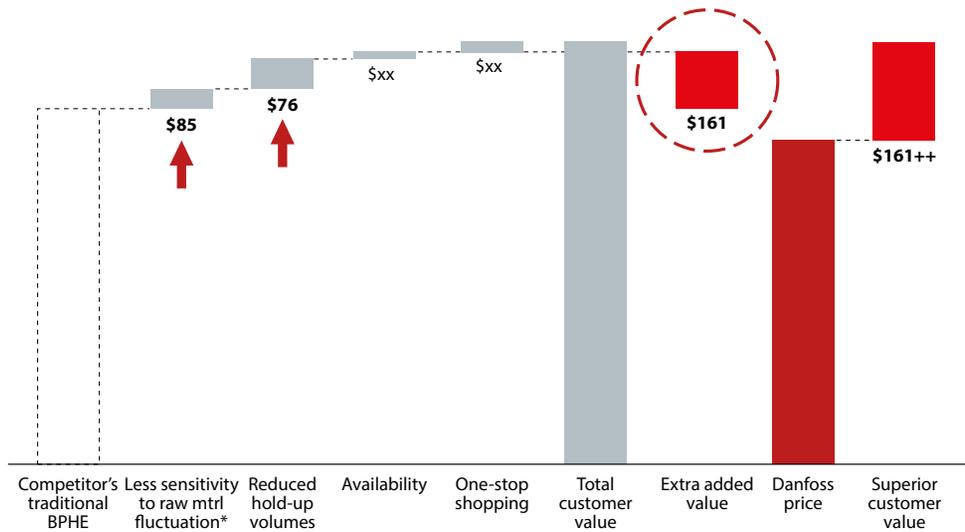
## **Resource efficiency**

For a start, MPHEs can be made smaller and more compact. This means they use less raw material, which not only lowers initial costs but also makes your business less sensitive to raw material price fluctuations. Secondly, MPHEs require a smaller refrigerant charge. Besides the obvious environmental benefits, this cuts costs and, once again, reduces sensitivity to changes in price.

## **Steady savings in an unpredictable world**

By minimising the use of raw materials and refrigerants, while maximising efficiency, our MPHEs save you money right away and, at the same time, they protect your business from the worst effects of future price rises. For these and many other reasons, using Danfoss MPHEs in your air and ground source heat pump applications helps to stabilize your business and facilitates the development of more efficient and environmentally friendly heat pump systems.

# SAVE \$161 PER HEAT PUMP!



Your MPHE savings, your profit – Per 17 Rt B/W R410A Heat Pump. \*Based on increase in alloy adjustment factor (AAF316) in 2010-2011

To find out exactly how much you can save by using MPHEs instead of BPHEs, we took a closer look at one sample product: a ground source heat pump with 17 Rt heating capacity using R410A refrigerant, standard B32/W95 °F temperatures, and a pressure loss of 2.9 psi. Starting with a BPHE and an MPHE with the same purchase prices, we examined how raw material price rises between 2010 and 2011 affected the manufacturer's costs. Our calculations were based on the assumption that heat exchangers were purchased continually.

## Impact on manufacturing costs

With raw material prices rising fast, how would the raw material surcharge affect you as a manufacturer during this period? We discovered that by buying our compact, lightweight MPHEs instead of BPHEs, you could have saved \$85 per heat pump.

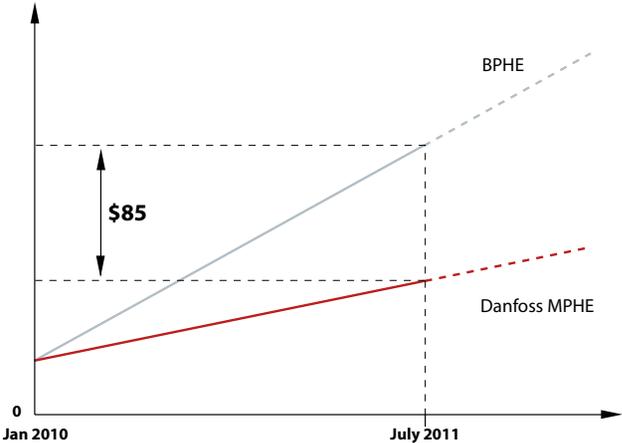
But that's not all. Reducing refrigerant hold-up volumes by 35% also greatly reduces the cost of filling your heat exchanger with refrigerant. Using MPHEs instead of BPHEs you would save \$76 per unit, based on current prices. In the future, refrigerant prices may have an even greater impact on your total costs, and the savings potential may be even greater.

Today, the total cost advantage of using MPHEs instead of BPHEs adds up to an astonishing \$161 per unit! This calculation does not take carbon and other environmental taxes into account, so, in reality, your savings could be even higher. We recommend that you investigate the environmental taxes in the countries where you do business and factor these into your own calculations.

See how costs are reduced by using the new MPHE technology instead of traditional BPHEs in your heat pumps. We made a direct comparison and here are the results.

Results overview	BPHE	MPHE	DIFFERENCE ABSOLUTE	DIFFERENCE RELATIVE
Weight, lbs	324.5	195.3	-129.2	<b>-40%</b>
Refrigerant hold-up volume, oz	987.3	649.2	-338.1	<b>-35%</b>

HEX price/heat pump



40% lower weight reduces purchase costs and gives greater price stability so you save \$85.

**Raw material savings (lb)**

BPHE SS316	265.2
MPHE SS316	137.6
Difference, lb	127.6

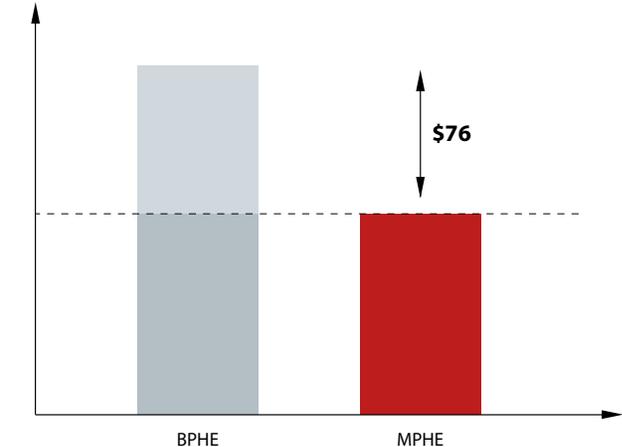
**Price increase/lb (USD)**

Alloy Adjustment Factor (AAF316)	
Jan 2010	1986
July 2011	3399
USD/ton increase	1412
USD/lb increase	0.64

**Total savings per heat pump (USD/heat pump)**

(Weight difference) x Price increase 127.6 lb x USD 0.64/lb = **\$ 85.00**

Refrigerant cost USD/heat pump



35% lower hold-up volume reduces purchase costs and gives greater price stability so you save \$76.

**Refrigerant purchase savings (lb/USD)**

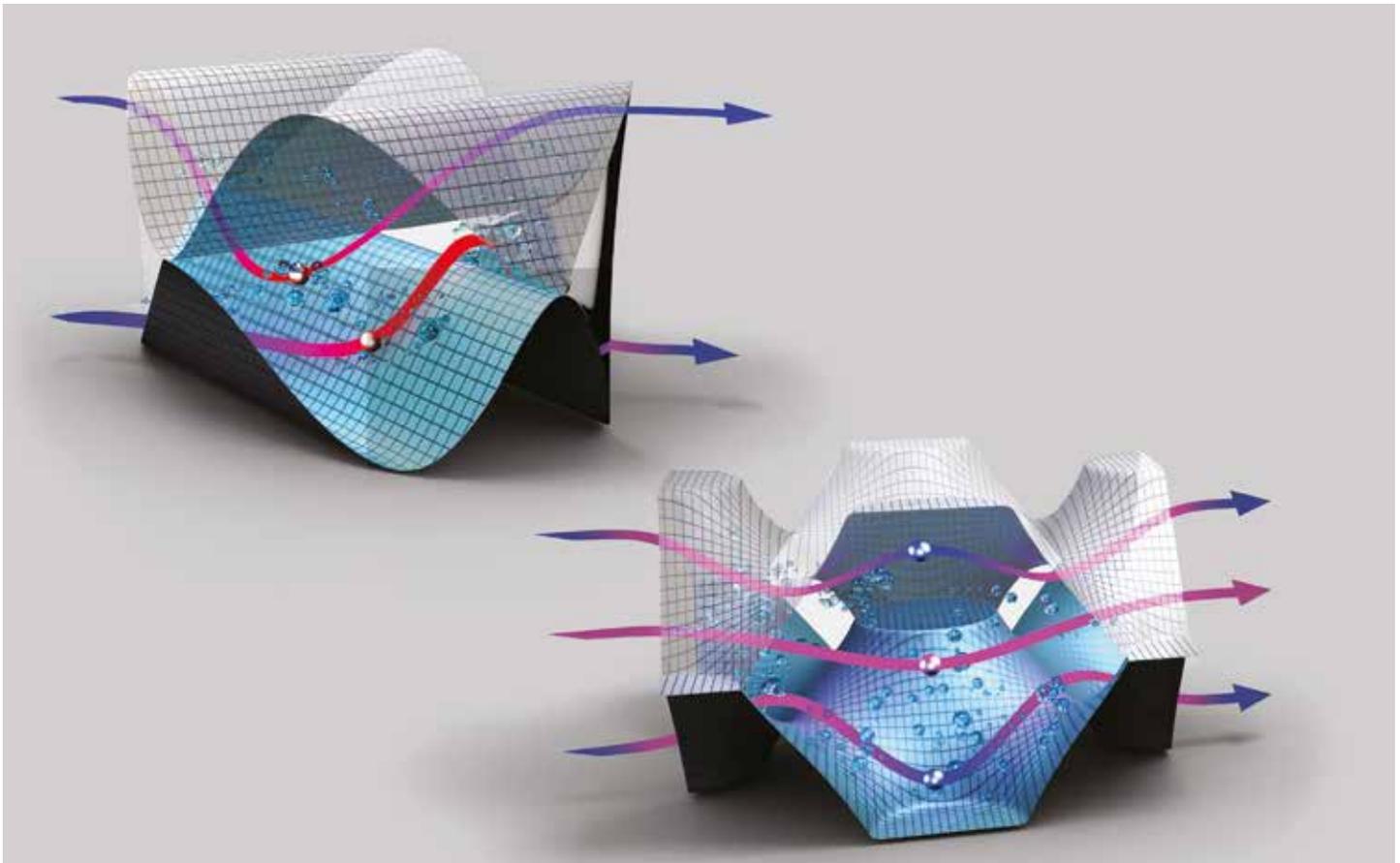
BPHE system	1047 oz
MPHE system	677 oz
Difference, l	370 oz
Difference, kg (R410A)	12.7 lb
Cost R410A	USD 5.7/lb
Saving 5.80 x 10 =	<b>\$ 76.00</b>

**Additional savings**

Cost of CO <sub>2</sub> compliance	0
Refrigerant taxes	0

Environmental taxes are not included in our calculation (figures based on purchase price only). To factor in further savings from a smaller refrigerant charge, consider the legislation which applies in your market.

\$85 plus \$76 means a total saving per chiller of \$161.



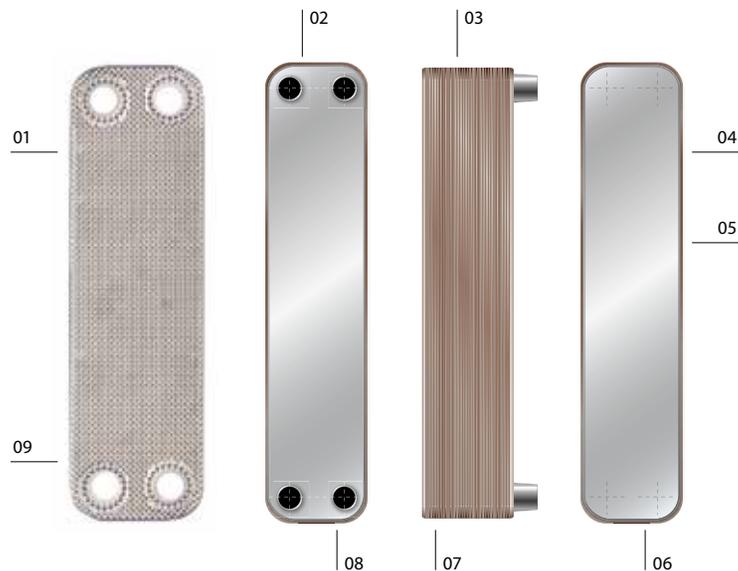
Compared with a traditional BPHE, with its three-dimensional flow, the innovative MPHE has a two-dimensional flow with a more uniform velocity which enhances heat transfer.



Overview of MPHE plates with the new channel pattern. The construction is based on existing heat exchanger technology and well-proven production methods.

# FLEXIBLE AND INNOVATIVE DESIGN

A quantum leap in heat exchanger design



- |    |                                  |    |                          |
|----|----------------------------------|----|--------------------------|
| 01 | Enhanced heat transfer           | 06 | Verified strong design   |
| 02 | High seasonal performance factor | 07 | Compact design           |
| 03 | Stronger, lighter and slimmer    | 08 | Higher working pressures |
| 04 | Small carbon footprint           | 09 | Focus on heat pumps      |
| 05 | Five-product platform            |    |                          |

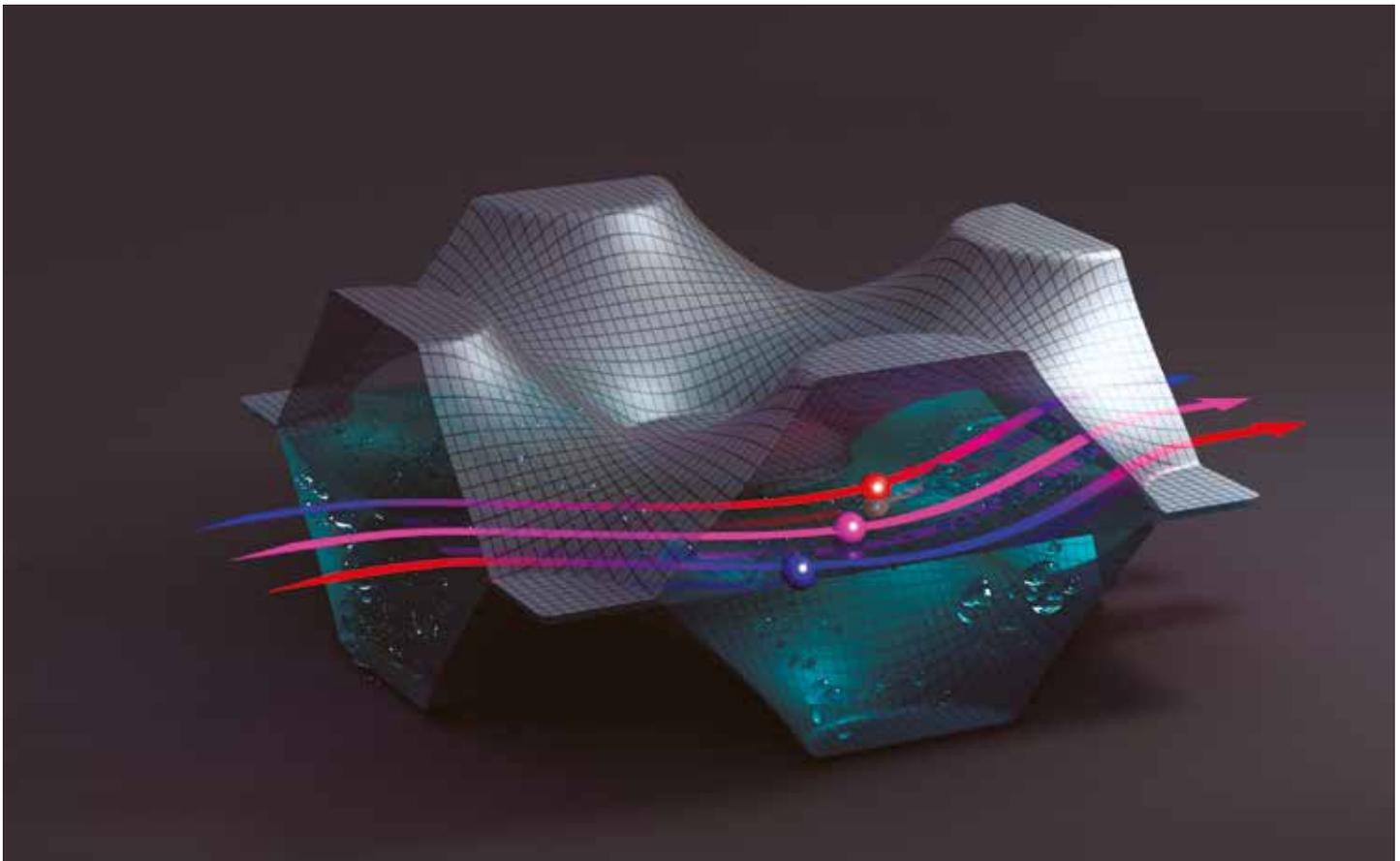
How often do you see a quantum leap in industrial design? It's certainly not every day. In the world of heat exchangers, it's not even every decade. The same basic heat exchanger model has been in use since the 1970s.

Now, thanks to Danfoss' revolutionary MPHE, things are changing fast. The new channel geometry of our MPHEs improves the flow across the plate and the utilization of the surface area, leading to a more uniform flow velocity. This enhances heat transfer and enables greater efficiency in heat pump applications with a narrow temperature approach.

Enhanced heat transfer combined with a highly resource-efficient design (economical use of raw materials and low refrigerant charge) makes our MPHE technology an excellent route to improved heat pump performance and lower environmental impact.



New channel plate pattern – verified technology.

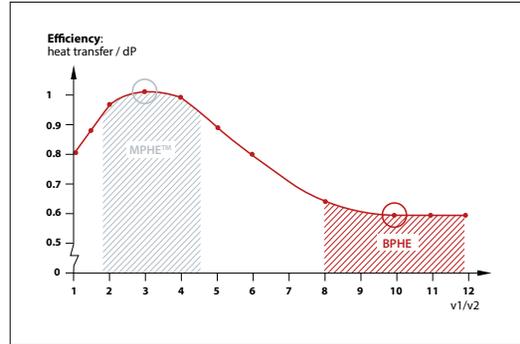
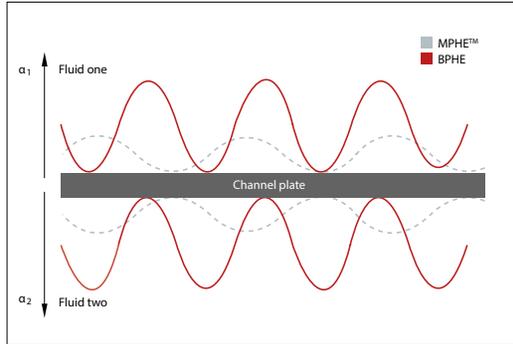


In close-up, we can see how the MPHE design gives a more uniform channel velocity. Additionally, the plates have a broad, flat brazing area compared with BPHEs, which reduces stress and gives you a more robust heat exchanger.

# PUT IT ALL TOGETHER, AND WHAT DO YOU GET?

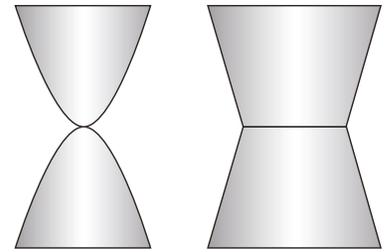
## ENHANCED HEAT TRANSFER

The enhanced heat transfer of our H-range MPHEs leads to an increase in efficiency in your heat pump systems, which in turn leads to a reduction in energy consumption and accompanying cost savings. And of course, the more efficient your heat pumps are, the more attractive they will be to your customers.



## LIGHTWEIGHT BUT STRONG

Our new MPHEs are 40% lighter than traditional BPHEs. However, thanks to their innovative design and broad flat brazing surfaces, this weight reduction has been achieved without compromising on strength.



## PLATE DESIGN FREEDOM

The MPHE channel plate pattern allows greater flexibility in application design. Varying the number, size and placement of indentations enables MPHEs to be fine-tuned to provide optimal heat transfer and minimal pressure loss in all kinds of heat pump applications.

## IMPROVED UTILIZATION OF RAW MATERIALS

Since MPHEs transfer heat more efficiently, a more compact model gives you the same performance compared with other technologies. The result is better utilization of raw materials, which reduces costs and improves price stability over time.

## WELL-KNOWN PRODUCTION METHODS

The new MPHEs are based on proven technology and manufactured using reliable, well-known production methods.

## REDUCED HOLD-UP VOLUMES

MPHEs have a small hold-up volume, which means cost savings, better price stability and a greener product profile. Furthermore, the minimal use of refrigerants reduces the need for F-gas inspections and in some cases eliminates it completely.

## SMALLER CARBON FOOTPRINT

Compared with herringbone BPHEs, MPHEs have a 40% lower CO<sub>2</sub> footprint. This is in part due to the efficient use of raw materials in their construction, but also to the lower refrigerant charge.





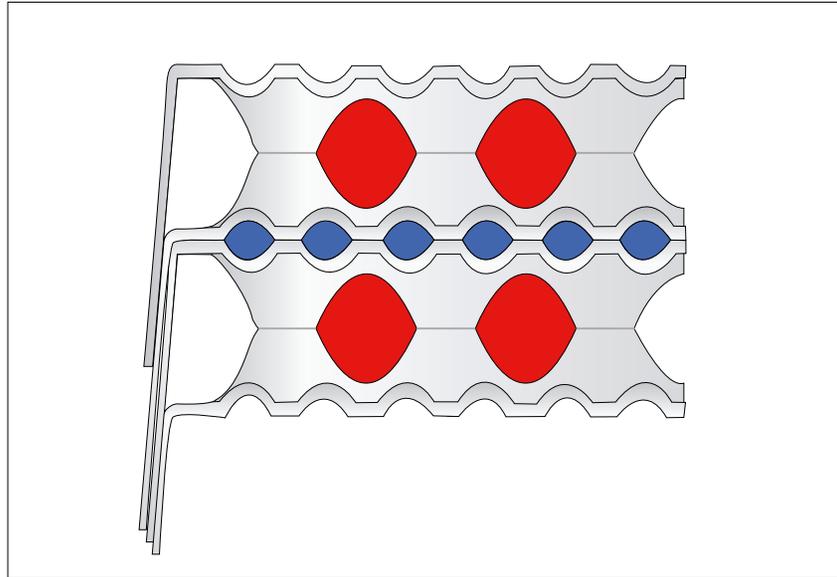
With new asymmetric X-products from Danfoss, the heat exchanger channel proportions are optimised for the application.



You can find an MPHE for nearly every application, across the 1 Rt to 155 Rt capacity range. Our MPHE products are all based on our new product platform, which is designed to make your product development and production leaner.

## MPHEs GO ASYMMETRIC

X-range – our new range heat exchangers



In heat pump applications, the natural proportion of brine to refrigerant is approximately 10:1. This means that traditional heat exchangers with channels equivalent to a 1:1 proportion do not correspond to actual operating conditions. With new asymmetric X-products from Danfoss, the heat exchanger channel proportions are optimised for the application.

Our new X-range heat exchangers are based on an ingeniously simple idea. Rather than being identical in size, the channels for transporting brine (or water) and refrigerant inside the heat exchanger have different dimensions. They therefore reflect the reality in which brine and refrigerant flow rates are not, and should not be, equal. In other words, we match the heat exchanger to the application – with optimised channel geometries – rather than the other way round! It's so simple, yet it delivers so many savings!

Relatively narrow refrigerant channels reduce the amount of refrigerant required. This delivers immediate savings to the manufacturer as well as improving the environmental profile of the product and reducing the cost of ownership for the user.

Wider brine channels allow the brine to flow more easily. This reduces the need for pump power, which implies savings for both manufacturers and system owners. While existing pumps consume less energy, future systems can be built using smaller and more cost-effective pumps. Keeping the same pump envelope, the new asymmetric heat exchanger will reduce the power needed, hence contributing to an overall increase of system COP.

As a global company with many years of experience to draw on, we continually push back the boundaries of technology to deliver new and innovative solutions: more cost-effective for you; greener for the planet. Based on our well-proven MPHE technology, the simple, practical design of the new X-range is one more example of smart, reality-adapted innovation from Danfoss.

## A WHOLE **PRODUCT** FAMILY

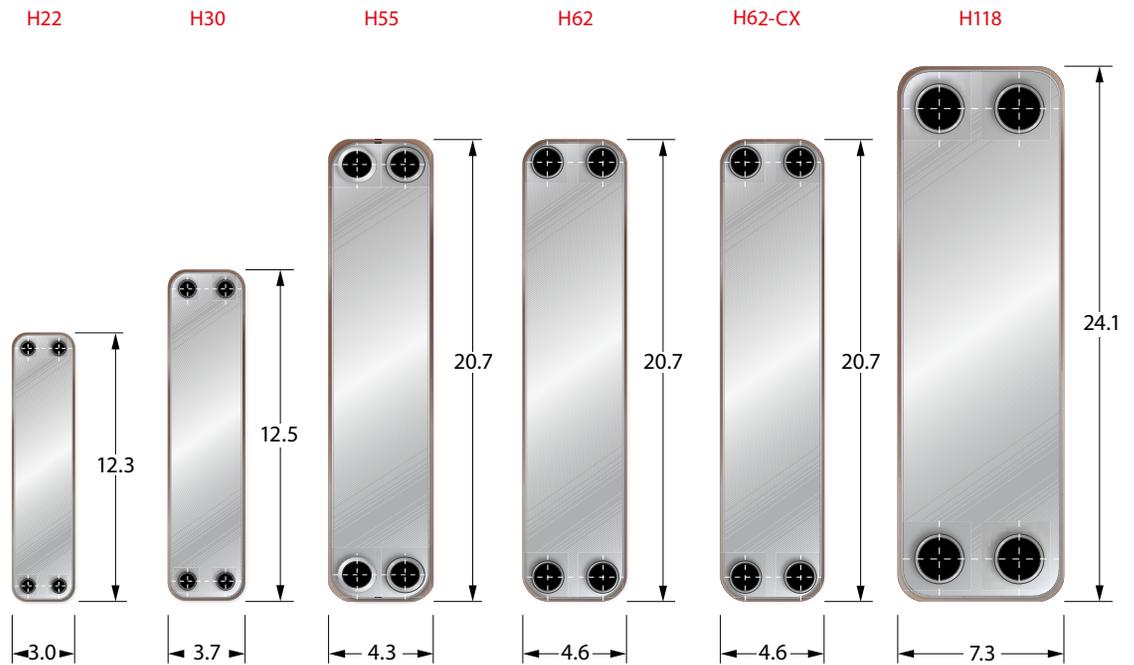


You can find an MPHE for nearly every application across the 1 Rt to 43 Rt capacity range. Our MPHE products are all based on our new product platform, which is designed to make your product development and production leaner.

### **Fully tested and certified**

All the MPHEs showcased in this brochure are thoroughly tested and verified in our fully equipped laboratories in Asia and Europe, which enable us to challenge the boundaries and establish innovative new trends. They are also fully compliant with regulations such as PED and UL, guaranteeing consistently high performance, reliability and safety.

Our production plants are ISO 9000/14000 certified, enabling us to guarantee the durability, sustainability and safety of all our products.



**BASELINE**

<b>Evaporators</b>	H22-E				H62-CX	H118-E
Capacity, Rt	1-3					5-34
Design pressure, max	435 psi					435 psi
<b>Condensers</b>	H22-C	H30-C	H55-C	H62-C		H118-C
Capacity, Rt	1-4	1-7	1-16	1-18		6-43
Design pressure, max	30 bar	435 psi	435 psi	435 psi		435 psi

**L-LINE  
FOR R410A**

<b>Evaporators</b>	H22 L-E					H118 L-E
Capacity, Rt	1-3					5-34
Design pressure, max	652 psi					652 psi
<b>Condensers</b>	H22 L-C	H30 L-C	H55 L-C	H62 L-C		H118 L-C
Capacity, Rt	1-4	1-7	1-16	1-18		6-43
Design pressure, max	696 psi	696 psi	696 psi	696 psi		696 psi



## WE'RE **ALWAYS** ON YOUR SIDE

We stand by the efficiency, quality and reliability of all our heat exchanger products, MPHEs included. And we're always available to explore their integration into a new customer's products. By offering you the lowest costs and the greatest possible price stability we make it easier for you to focus on the vital task of developing and producing tomorrow's energy-efficient chillers.

And remember, Danfoss has all the components you need. Consider buying one other component from us, besides MPHEs, and you can enjoy numerous cost efficiencies. One less order to place, one less delivery to manage – all these advantages combine to give an impressive reduction in your overall costs, and, at the same time, reduce the carbon footprint of your product.

Let's sit down together and look at all the savings that working with Danfoss can bring to your business!

**\$12,500**

**Annual savings**

When you reduce the number of suppliers by just one.





## CHANGING AN INDUSTRY

We offer the heat exchangers our customers have always asked for. Danfoss' Micro Plate technology, along with our market-oriented approach, simplifies life for every customer. At the same time, our innovative technology promises clear, core savings and a cleaner environment. Our sharp focus on customer solutions means we can help our customers grow, and make a difference in situations where energy efficiency and the climate challenge are critical issues.

Address