What is the ideal pressure drop to specify for gasketed plate heat exchangers in HVAC applications?

Save now, save later

Why allow more pressure drop across the gasketed plate heat exchanger?

Pressure drop is the fuel/cost for heat transfer and is created by using electricity in pumps. How to use the available pressure in the most optimum way is the challenge for designers and consultants.

The dilemma is between OPEX and CAPEX, balance for a low lifecycle cost.

- Specify a pump with **low head** = increased cost for the plate heat exchanger
- Specify a pump with **higher head** = reduced cost for the plate heat exchanger

Benefits with a higher pressure drop, 50 kPa instead of 20 kPa

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- Pressure drop
- Higher velocity in channel
- More turbulence
- Better self-cleaning effect

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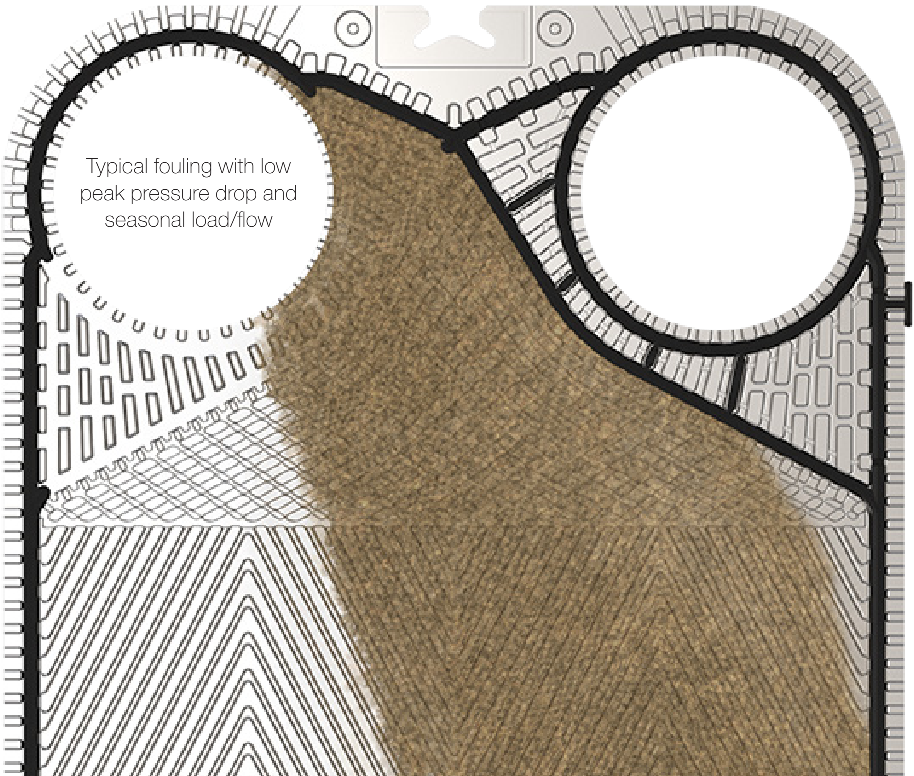
- Reduced capital investment cost
- Less number of plates needed
- Lower heat transfer area
- Decreased risk of fouling and OPEX



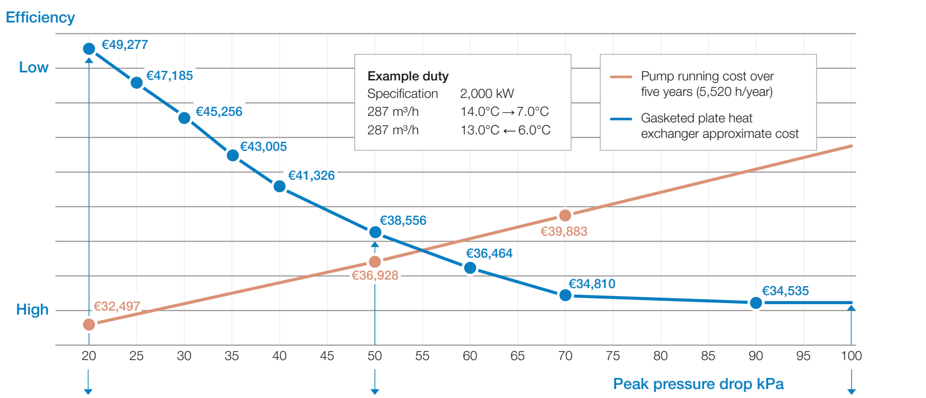
How does pressure drop effect the total cost of ownership?

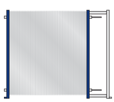
Extremely low pressure drop, 20 kPa, has a profound effect on the gasketed plate heat exchanger. In the example below, you can save up to 10% on CAPEX, by specifying the pressure drop as 50 kPa instead of 20 kPa. This will generate a gasketed plate heat exchanger with less plates and hence a lower cost/CAPEX. With higher pressure drop, the pumping cost will increase but as shown below, the impact is not substantial.

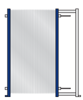
$$\text{Pump power (kW)} = \frac{\text{m (m}^3\text{/h)} \cdot \text{H (m water)}}{367 \cdot \eta \text{ (pump efficiency, 0.8)}}$$

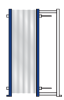
Plate heat exchanger pressure drop	20 kPa	50 kPa	70 kPa
Pump head (m water)	22	25	27
One season pump energy with variable flow (kWh) *	64,994	73,857	79,765
Pump running cost over 5 years (0.10 €/kWh)	€32,497	€36,928	€39,883
Estimated PHE maintenance over 5 years **	€13,551	€10,603	***
Gasketed plate heat exchanger cost (€)	€49,277	€38,556	€34,810
Total	**€95,325**	**€86,087**	**€74,693**

* Based on pump operation at seasonal load, 5,520 h/HVAC season, with flow and time according to graph on next page.
** Includes open, clean, close and hydraulic test one time in five years
*** Due to high velocities and self-cleaning effect, maintenance is not expected.









- More heat transfer area
- Low velocities and turbulence
- Faster fouling

- Less heat transfer area
- High velocities and turbulence
- Less fouling

The decision is with the designer or consultant

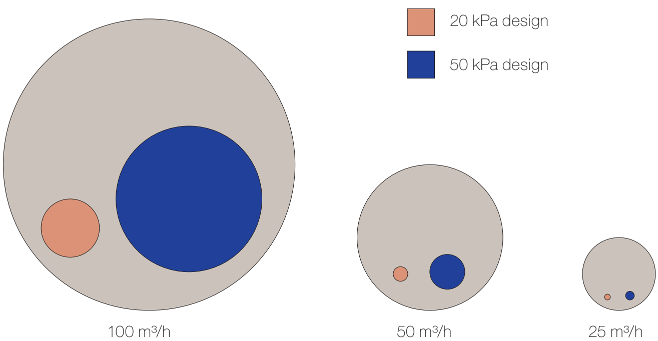
Allow more pressure drop across the gasketed plate heat exchanger for sustainability, better efficiency, and savings. The effect on the pump running costs is minimal compared to the high initial cost and fouling risks of the gasketed plate heat exchanger. Please ask for alternatives in pressure drop.

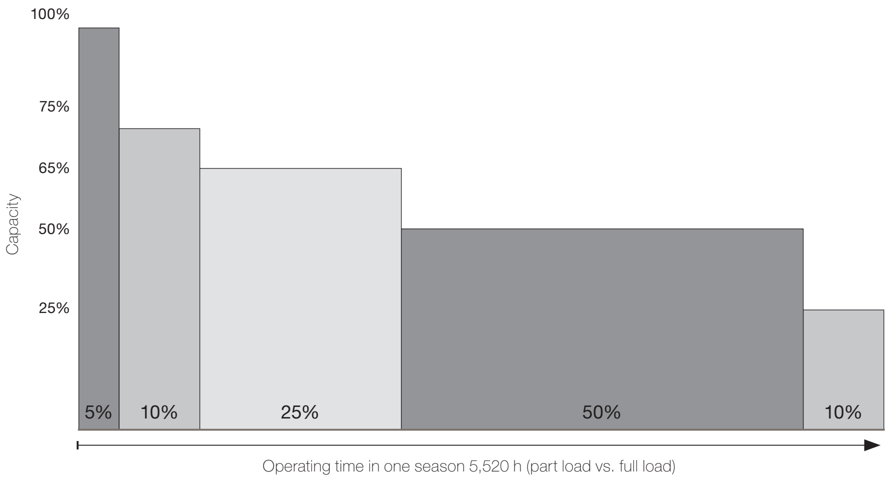
Risk of increased fouling with seasonal/part load

If the nature of the application is to run with seasonal load, the actual flow will be less than 50% of the design flow most of the time. As a consequence the actual pressure drop will be 25% of the design pressure drop, so the risk of fouling is high and the OPEX will increase.

Specifying with 50 kPa pressure drop instead of 20 kPa will reduce the risk of fouling.

	Flow m³/hr	Load Factor	Exponentional dP Effect (square)	Case 1 Pressure drop	Case 2 Pressure drop
Peak	**100**			**20 kPa**	**50 kPa**
	90	0.90	$0.90^2 = 0.81$	16.2	45.0
¾	75	0.75	$0.75^2 = 0.56$	11.2	28.0
½	50	0.50	$0.50^2 = 0.25$	5.0	12.5
	33	0.33	$0.33^2 = 0.11$	2.2	5.0
¼	25	0.25	$0.25^2 = 0.06$	2.0	3.0

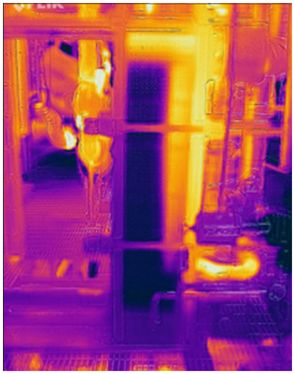




Cost of dirty gasketed plate heat exchangers on the OPEX

When operating at lower than design flowrates, there will be low shear stress in the channels which means the risk of fouling, leading to reduced efficiency/performance and demand for service. Also there will be increased pressure drop when there is a build-up of fouling, which will have an adverse effect on OPEX.

Effect on pumping costs	
Installation phase power consumption	10.0 kW
After one year because of fouling	14.0 kW
Calculated average difference	2.0 kW
Annual running time (h)	6,000
Cost of electricity (€/kWh)	0.10
Calculated extra annual running cost	**€1,200**



Lower velocities, less turbulance, faster fouling and less performance in a district heating application.

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AHRI Standard 400

Specify what you need – get what you have specified, one sentence is enough:

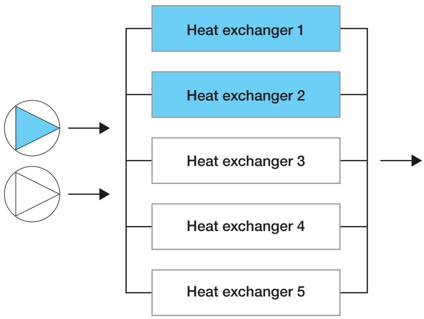
"Heat exchangers shall be performance certified in the AHRI Liquid to Liquid Heat Exchangers Certification Program."

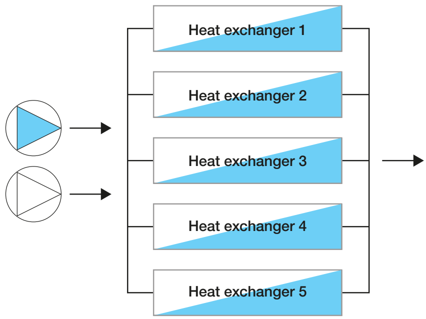
Save now with lower capital costs and save later with reduced cleaning costs. *

* With 50 kPa instead of 20 kPa pressure drop, the gasketed plate heat exchanger will cost less to buy and require less maintenance, as it will stay clean longer.

Recommendations

Recommendation for part load operation for gasketed plate heat exchangers connected in parallel, to stay clean longer. Non-operating plate hat exchangers should be flushed and filled with fresh water. Rotate between units in operation.





Correct operation

- High channel velocities
- More turbulent flow
- Stays clean longer
- Higher efficiency

Incorrect operation

- Low channel velocities
- More laminar flow
- Faster fouling
- Reduced efficiency

Rule of thumb – Pressure drop

Recommended pressure drop for various applications, for maximum efficiency, considering seasonal/part load. Check with your local Alfa Laval for optimum lifecycle cost.

Application	Design pressure drop at peak load
HVAC cooling pressure breaker	50-70 kPa
HVAC boiler interchange	50-70 kPa
HVAC cooling tower interchanger	80-100 kPa
Geothermal heating	80-160 kPa
Sea water cooling	80-100 kPa

Challenges with plate heat exchangers

Benefits of CurveFlow™, OmegaPort™ and FlexFlow™

www.youtube.com/watch?v=pkiJI8jPcJg

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