Performance certification – a *necessity* in today’s plate heat exchanger market

How AHRI performance certification of plate heat exchangers protects you and your clients.
Agenda

- Parameters that effect the sizing of a plate heat exchanger
  - Approach temperature
  - Pressure drop
- Evaluation of heat transfer area (m²)
  - Pressing depth / Channel gap
- Performance certification
  - Air Conditioning Heating and Refrigeration Institute (AHRI)
    - Energy savings
    - Protection and security
  - Why? What? How…?
The competitive market for plate heat exchangers

Specification: 1,000 kW
35°C → 30°C  50 kPa
34°C ← 29°C  50 kPa

- 1,000 kW – 200 m²
- 1,000 kW – 150 m²
- 1,000 kW – 100 m²
Which parameters have the biggest influence in sizing of a plate heat exchanger?

Heat transfer equations

\[ Q_{\text{hot}} = m \cdot c \cdot \Delta T_{\text{hot}} \]
\[ Q_{\text{cold}} = m \cdot c \cdot \Delta T_{\text{cold}} \]
\[ Q = k \cdot A \cdot \text{LMTD} \]

1. LMTD (approach temperature)
2. Pressure drop
Effect of approach temperature LMTD

**Specification:** 1,000 kW
35°C → 30°C  50 kPa
34°C ← 29°C  50 kPa

- **1°C LMTD**
  - 1,000 kW – 200 m²

- **1.5°C LMTD**
  - 1,000 kW – 150 m²

- **2°C LMTD**
  - 1,000 kW – 100 m²
LMTD steps of 0.1°C

**Specification:** 1,000 kW
35°C → 30°C 50 kPa
34°C ← 29°C 50 kPa

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**LMTD of 0.2°C can impact:**
- Heat transfer area: >16%
- Price: >12%

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Price EUR vs. LMTD °C graph: 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0

<table>
<thead>
<tr>
<th>LMTD °C</th>
<th>Price EUR</th>
<th>Water 173 m³/hr</th>
<th>Hot side 5</th>
<th>Cold side 5</th>
<th>M15-B FG</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>€56,812</td>
<td>35°C → 30°C</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>€56,812</td>
</tr>
<tr>
<td>1.1</td>
<td>€53,559</td>
<td>34°C ← 29°C</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>€53,559</td>
</tr>
<tr>
<td>1.2</td>
<td>€50,539</td>
<td>35°C → 30°C</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>€50,539</td>
</tr>
<tr>
<td>1.3</td>
<td>€46,286</td>
<td>34°C ← 29°C</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>€46,286</td>
</tr>
<tr>
<td>1.4</td>
<td>€44,266</td>
<td>35°C → 30°C</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>€44,266</td>
</tr>
<tr>
<td>1.5</td>
<td>€41,246</td>
<td>34°C ← 29°C</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>€41,246</td>
</tr>
<tr>
<td>1.6</td>
<td>€39,852</td>
<td>35°C → 30°C</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>€39,852</td>
</tr>
<tr>
<td>1.7</td>
<td>€38,690</td>
<td>34°C ← 29°C</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>€38,690</td>
</tr>
<tr>
<td>1.8</td>
<td>€37,529</td>
<td>35°C → 30°C</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>€37,529</td>
</tr>
<tr>
<td>1.9</td>
<td>€36,599</td>
<td>34°C ← 29°C</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>€36,599</td>
</tr>
<tr>
<td>2.0</td>
<td>€35,438</td>
<td>35°C → 30°C</td>
<td>1.0</td>
<td>1.0</td>
<td>5.0</td>
<td>€35,438</td>
</tr>
</tbody>
</table>

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LMTD ˚C

- LMTD of 0.1°C can impact:
  - Heat transfer area: >16%
  - Price: >12%

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Energy Division:
- €56,812
- €53,559
- €50,539
- €46,286
- €44,266
- €41,246
- €39,852
- €38,690
- €37,529
- €36,599
- €35,438

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Water 173 m³/hr
- Hot side 5
- Cold side 5
Effect of pressure drop

**Specification:** 1,000 kW
35°C → 30°C  50 kPa
34°C ← 29°C  50 kPa

<table>
<thead>
<tr>
<th>Pressure Drop</th>
<th>Temperature</th>
<th>1°C LMTD</th>
<th>1.5°C LMTD</th>
<th>2°C LMTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 kPa</td>
<td>35°C → 30°C</td>
<td>33°C ← 28°C</td>
<td>1,000 kW – 200 m²</td>
<td>1,000 kW – 150 m²</td>
</tr>
<tr>
<td>50 kPa</td>
<td>35°C → 30°C</td>
<td>33°C ← 28°C</td>
<td>1,000 kW – 225 m²</td>
<td>1,000 kW – 150 m²</td>
</tr>
<tr>
<td>100 kPa</td>
<td>35°C → 30°C</td>
<td>33°C ← 28°C</td>
<td>1,000 kW – 250 m²</td>
<td>1,000 kW – 150 m²</td>
</tr>
</tbody>
</table>
Effect of peak pressure drop on plate heat exchanger sizing

Taking a 5 kPa higher dP can reduce price by 5%

35,438 EUR – 33,812 EUR = 1,626 EUR / 33,812

<table>
<thead>
<tr>
<th>Duty kWatt</th>
<th>Temperature profile °C</th>
<th>Media &amp; Flowrate m³/hr</th>
<th>LMTD °C</th>
<th>Maximum dP at peak flow kPa</th>
<th>Alfa Laval PHE model</th>
<th>Number of plates</th>
<th>Transfer area m²</th>
<th>Price EUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000</td>
<td>35°C → 30°C, 33°C ← 28°C</td>
<td>Water 173 m³/hr</td>
<td>2.0</td>
<td>50</td>
<td>M15-B FG</td>
<td>163</td>
<td>101.1</td>
<td>€ 30,791</td>
</tr>
</tbody>
</table>
Can we compare heat transfer area like for like?

Is a $m^2 = m^2$?
Alfa Laval has a range of pressing depths from 1.9 mm up to 4.0 mm for optimal solution to any duty. There is no good or bad pressing depth – just different ones to fit various duties be it difficult or easy.

- High velocities
- Energy savings
- Efficient heat transfer
- Gentle product treatment
- Viscous products
- Clogging problems
You can never be sure…

Or you can **always** be sure!
Small change, big impact 4MW ETS

Offer version 1

14°C

13°C

7°C

6°C

LMTD ................................ 1.0°C
Heat transfer area ............ 100%
Flow rate on DC side .......... 489 m³/h
Small change, big impact 4MW ETS

Offer version 2

LMTD ...................... 1.0°C ...... +0.5°C ...... 1.5°C
Heat transfer area ..... 100% ...... -26% ....... 74%
Flow rate on DC side.. 489 m³/h ... +18.4% ..... 579 m³/h
One example where certification pays off
The operational cost in a district cooling system is to a large extent determined by the heat exchangers.
Small change, big impact

1. The temperature set point, 7°C is not met. Valve opens and flow increases.
   (from 489 to 579 m³/h)

2. Pump power consumption increases.
   (from 43 to 71 kW) +28 kW

3. Return temperature decreases.
   (from 13°C to 11.9°C)

4. Evaporation temperature decreases.
   (from 4°C to 3.5°C)

5. Compressor power increases.
   (from 1,259 kW to 1,283 kW) +24 kW

+ 28 kW pumping power
+ 24 kW chiller compressor

+ 52 kW
Extra power consumption

Under-surfaced PHE in a district cooling energy transfer station.
No buts, correctly dimensioned heat exchangers pay for themselves fast
No buts, correctly dimensioned heat exchangers pay for themselves fast

Cost of 15 kW average added power in one year running time?

Assumed power cost 0.08 €/kWh

Running time / year 24 hrs x 365 days = 8,760 hrs/yr

Annual savings 8,760 hrs/yr × 15 kW × 0.08 €/kWh = 10,512 €/y

Payback time Approx. 1 year

15 kW average whole year

www.alfalaval.com
AHRI protects you and your clients

- Non-profit trade organization
- Develops and publishes technical standards for industry products
- Establishes procedures for measuring and certifying performance
- Saves energy, improves productivity and ensures better environment
You want the AHRI certification programs – and nothing else

- Independent third-party verification of thermal performance of plate heat exchangers in the ‘AHRI Liquid to Liquid Heat Exchangers (LLHE) certification program’
- Brazed/fusion-bonded plate heat exchangers in ‘Liquid to Liquid Brazed & Fusion bonded Plate Heat Exchangers (LLBF)’
- Lab testing principles in the AHRI 400 rating standard
Supplier verification

LLHE Specification Sheet Verifications

Complete this form for each LLHE specification sheet verification request and send to AHRI Verification. A copy of the output sheet from the manufacturer’s Selection Rating Software must be submitted in conjunction with this form. All fields must be completed prior to submission. AHRI does not verify the mechanical attributes of a specification sheet; only the thermal performance is verified. Thermal performance includes Inlet Temperatures, Outlet Temperatures, Flow Rates, Pressure Drops, Heat Load, Heat Transfer Area, Density, Specific Heat Capacity, Thermal Conductivity, Viscosity, Heat Transfer Coefficient, L.M.T.D., and Channel Arrangements.

Please allow ten (10) calendar days for AHRI to conduct verification and respond to your request.
AHRI performance certification is better for everyone
# Buying a plate heat exchanger?

## Heat Transfer Area comparison

<table>
<thead>
<tr>
<th>Plate heat exchanger design criteria</th>
<th>Pressing depth (mm)</th>
<th>Channel gap (mm)</th>
<th>Height / width</th>
<th>LMTD (°C)</th>
<th>NTU (ΔT/LMTD)</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.9</td>
<td>3.8</td>
<td>&gt;2.5</td>
<td>&lt;2.0°C</td>
<td>6/2 = 2</td>
<td>Data centre, HVAC cooling, district cooling, heat recovery, pressure breakers…</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>5.0</td>
<td>&lt;= 2.5</td>
<td>2.0 – 2.5°C</td>
<td>6/5 = 1.2</td>
<td>HVAC heating, district heating, sea water, cooling tower interchanger, heat recovery…</td>
</tr>
<tr>
<td></td>
<td>4.0</td>
<td>8.0</td>
<td>&lt;2.0</td>
<td>&gt;5.0°C</td>
<td></td>
<td>Steam, oil cooling, tap water heating, swimming pool</td>
</tr>
</tbody>
</table>
How to specify?

One sentence:

”The plate heat exchangers shall be AHRI certified in accordance with the AHRI Liquid to Liquid Heat Exchangers Certification Program”
Let’s create a sound plate heat exchanger market

Specifying AHRI performance certification

- Eliminates cheating with thermal performance
- Stimulates manufacturers to develop more efficient products
- Creates a fair basis for comparisons between suppliers
- Saves natural resources as fuel, gas and electricity
- Our social responsibility
# AlfaQ™ series models

**Gasketed plate heat exchangers**

<table>
<thead>
<tr>
<th>Model</th>
<th>AQ1</th>
<th>AQ1L</th>
<th>AQ2</th>
<th>AQ2L</th>
<th>AQ2S</th>
<th>AQ4</th>
<th>AQ4L</th>
<th>AQ6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal flow rate m³/h/GPM</td>
<td>14/80</td>
<td>14/80</td>
<td>58/250</td>
<td>58/250</td>
<td>58/250</td>
<td>180/980</td>
<td>180/980</td>
<td>430/1850</td>
</tr>
<tr>
<td>Nominal design temperature °C/°F</td>
<td>180/300</td>
<td>180/300</td>
<td>180/300</td>
<td>180/300</td>
<td>180/300</td>
<td>180/300</td>
<td>180/300</td>
<td>180/300</td>
</tr>
<tr>
<td>Nominal design pressure bar/psi</td>
<td>16/150</td>
<td>16/150</td>
<td>25/300</td>
<td>25/300</td>
<td>25/300</td>
<td>25/300</td>
<td>25/400</td>
<td>30/400</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>AQ6L</th>
<th>AQ8</th>
<th>AQ8S</th>
<th>AQ10</th>
<th>AQ14</th>
<th>AQ14L</th>
<th>AQ20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal flow rate m³/h/GPM</td>
<td>430/1850</td>
<td>800/3600</td>
<td>700/3100</td>
<td>900/6000</td>
<td>1800/7900</td>
<td>2000/8000</td>
<td>3600/15500</td>
</tr>
<tr>
<td>Nominal design temperature °C/°F</td>
<td>180/300</td>
<td>180/300</td>
<td>180/300</td>
<td>180/300</td>
<td>180/300</td>
<td>180/300</td>
<td>180/300</td>
</tr>
<tr>
<td>Nominal design pressure bar/psi</td>
<td>30/460</td>
<td>30/400</td>
<td>30/400</td>
<td>30/400</td>
<td>25/300</td>
<td>30/400</td>
<td>25/300</td>
</tr>
</tbody>
</table>
Alfa Laval’s corporate mission

To optimize the performance of our customers’ processes. Time and time again.
Demand new Standards
New generation plate heat exchangers

The CurveFlow™ area
Improves media flow and minimizes risk of fouling.

The Five-point alignment system
Secures reliable performance with easy serviceability thanks to perfect positioning.

Offset gasket grooves
Ensures plate utilization for maximum heat transfer efficiency.

The ClipGrip™ gasket design
Ensures perfect seal and trouble-free maintenance.

The OmegaPort™ noncircular inlet and outlet
Enhances media flow and thermal efficiency.

The T-bar roller design
Provides a lower unit that is easy to service.

Website: Demand new Standards