Alfa Laval DIABON®

Graphite plate heat exchanger

Applications
Heaters, coolers, interchangers, condensers and evaporators for corrosive media, especially in the treatment of:

- Hydrochloric acid (HCl)
- Sulfuric acid (H₂SO₄)
- Hydrofluoric acid (HF)
- Mixed Acids (HNO₃/HF)
- Phosphoric acid (H₃PO₄/P₂O₅)
- Other organic and inorganic media

Standard design
The graphite plate heat exchanger consists of a pack of corrugated graphite plates with portholes for the passage of the two fluids between which heat transfer will take place.

The plate pack is assembled between a carbon steel fixed frame plate and movable pressure plate and compressed by tightening bolts. The difference in coefficients of expansion of carbon steel and graphite is compensated for by means of helical springs.

The plates are fitted with a film type PTFE gasket of 0.2 mm thickness after tightening, which seals the interplate channel and directs the fluids into alternate channels. The number of plates is determined by the flow rate, pressure drop and temperature program. The plate corrugations promote fluid turbulence and minimize fouling.

The frame plate and pressure plates are suspended from an upper carrying bar and located by a lower guiding bar, both of which are fixed to a support column. Connections are located in the frame plate or, if either or both fluids make more than a single pass within the unit, in the frame and pressure plates.

The frame and pressure plates are protected from the corrosive media by means of a PTFE lining.

Typical capacities
Max flow rate of 250 m³/h, depending on media, permitted pressure drop and temperature program.

Plate types: S1, M10-G, S10, S15.

Frame types: One standard frame available that can be modified to higher design pressures.

Working principle
Channels are formed between the plates and the corner ports are arranged so that the two media flow through alternate channels. The heat is transferred through the plate between the channels, and complete counter current flow is created for the highest possible efficiency. The corrugation of the plates provides the passage between the plates, supports each plate against the adjacent one and enhances the turbulence, resulting in efficient heat transfer.

Standard materials
Plates: F100, NS1/NS2
DIABON® F100 plates are suitable for operations where fouling can be a problem as well as for oxidising environments.

The DIABON® F100 plates are pressure moulded with a herringbone plate pattern on both sides which gives rise to very efficient turbulence. Erosion risk is minimized due to a hard plate surface. The PVDF encapsulating of the graphite grains yields plates with a very smooth, non-porous and anti-adhesive surface and provides more resistance against oxidising media.

**F100**

- **Plate material**
  - Graphite + PVDF
  - Graphite encapsulated in a fluoroplastic binder
  - Pressure-moulded
  - Herringbone pattern
  - Smooth surface
  - Good against erosion
  - Anti fouling surface

  - $T_{des} = 140 \, ^\circ C$
  - $P_{test} = 9.1 \, \text{barg}$, $P_{des} = \text{approximately} \, 7 \, \text{barg}$

- **Application**
  - Better with oxidizing media
  - PVDF not good with
    - amines & NaOH
    - organic chem. (case to case basis)

- **S1, M10-G, S10**
  - Thermal fatigue
  - Lower max. temperature

- **Plate Gaskets**
  - PTFE, plastic

- **Frame plate**
  - Carbon Steel, P265GH or SA516 Gr. 60

- **Guide bars**
  - 1.4301 (SS grade)

- **Compression springs**
  - 51CrV4

- **Nozzels**
  - Lining of frame/pressure plates and connections: PTFE (Licuflon)

**NS1/NS2**

NS1 and NS2 grade plates are preferred for 2 phase applications and/or duties with higher variations in temperature.

The NS1 and NS2 plate pattern is machined from blocks of resin impregnated material. The plates are flat on one side and have a fin-plate pattern on the side facing the pressure plate. The plate pattern has very few contact points which makes the plates more suitable for fluids containing fibres. The resin impregnated graphite in these plates is less sensitive to thermal fatigue and can handle high temperature differences. These plates are not suitable for oxidising media.

**NS1 (NS2)**

- **Plate material**
  - Resin impregnated graphite
  - Same material as used in S&T and block heat exchangers
  - Machined plates
  - Plate fin type
    - "If touched - you’re black"

  - $T_{des} = 200 \, ^\circ C$
  - $P_{test} = 9.1 \, \text{barg}$, $P_{des} = \text{approximately} \, 7 \, \text{barg}$

- **Application**
  - No nitric acid
  - DIABON® NS2 better than NS1
    - organic chem. (case to case basis)

- **S1-N, M10-GN, S10-N, S15-N**
  - + Steam heating
  - + Higher max. temperature
### Technical Data

#### Plates

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>DIABON® F100</th>
<th>DIABON® NS1 (NS2)</th>
<th>DIABON® F100</th>
<th>DIABON® NS1 (NS2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrugation pattern</td>
<td></td>
<td>turbulent flow</td>
<td>free flow</td>
<td>turbulent flow</td>
<td>free flow</td>
</tr>
<tr>
<td>Typical heat transition coefficients</td>
<td>W/K·m²</td>
<td>2000</td>
<td>4500</td>
<td>2200</td>
<td>4500</td>
</tr>
<tr>
<td>Exchange area per plate</td>
<td>m²</td>
<td>0.05</td>
<td>0.03</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>Max. no. of plates per frame</td>
<td></td>
<td>80</td>
<td>64</td>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>Plate thickness</td>
<td>mm</td>
<td>8</td>
<td>10</td>
<td>6.5</td>
<td>10</td>
</tr>
<tr>
<td>Liquid capacity</td>
<td>l</td>
<td>0.18</td>
<td>0.12</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Weight of a plate</td>
<td>kg</td>
<td>0.75</td>
<td>0.95</td>
<td>2.7</td>
<td>4.2</td>
</tr>
<tr>
<td>Plate Seals</td>
<td></td>
<td>SIGRAFLEX® graphite</td>
<td>SIGRAFLEX® graphite</td>
<td>PTFE, plastic</td>
<td>PTFE, plastic</td>
</tr>
</tbody>
</table>

#### Frame

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>DIABON® F100</th>
<th>DIABON® NS1 (NS2)</th>
<th>DIABON® F100</th>
<th>DIABON® NS1 (NS2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width x height</td>
<td>mm</td>
<td>230 x 620</td>
<td>512 x 1170</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length L</td>
<td>mm</td>
<td>350/450/550/650/750/850</td>
<td>912/1162/1512/1762</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. no. of plates for length L</td>
<td></td>
<td>18/30/43/55/68/80</td>
<td>14/24/34/45/55/64</td>
<td>32/70/125/160</td>
<td>20/45/80/100</td>
</tr>
<tr>
<td>Weight excl. DIABON® graphite</td>
<td>kg</td>
<td>105-125</td>
<td>610-650</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connections – frame plate</td>
<td>S1-S4</td>
<td>DN 100 (DN 80)</td>
<td>DN 1092-1 PN16</td>
<td>DN 25 (DN 1092-1 PN16)</td>
<td></td>
</tr>
<tr>
<td>or pressure plate</td>
<td>T1-T4</td>
<td>or DN 1” ANSI 150 lbs</td>
<td>or DN 4” (DN 3”) ANSI 150 lbs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test pressure with water</td>
<td>bar</td>
<td>standard: 9.1/special design: 10.4</td>
<td>standard: 9.1/special design: 10.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design temperature</td>
<td>ºC</td>
<td>140</td>
<td>200</td>
<td>140</td>
<td>200</td>
</tr>
</tbody>
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<td>Typical heat transition coefficients</td>
<td>W/K·m²</td>
<td>2000</td>
<td>4000</td>
<td>4000</td>
</tr>
<tr>
<td>Exchange area per plate</td>
<td>m²</td>
<td>0.4</td>
<td>0.30</td>
<td>0.63</td>
</tr>
<tr>
<td>Max. no. of plates per frame</td>
<td></td>
<td>130</td>
<td>96</td>
<td>90</td>
</tr>
<tr>
<td>Plate thickness</td>
<td>mm</td>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Liquid capacity</td>
<td>l</td>
<td>1.5</td>
<td>1.4</td>
<td>2.6</td>
</tr>
<tr>
<td>Weight of a plate</td>
<td>kg</td>
<td>6.1</td>
<td>7.1</td>
<td>15.3</td>
</tr>
<tr>
<td>Plate seals</td>
<td></td>
<td>PTFE, plastic</td>
<td>PTFE, plastic</td>
<td>PTFE, plastic</td>
</tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Width x height</td>
<td>mm</td>
<td>570 x 1473</td>
<td>570 x 1473</td>
<td>675 x 2245</td>
</tr>
<tr>
<td>Length L</td>
<td>mm</td>
<td>912/1162/1512/1762</td>
<td>912/1162/1512/1762</td>
<td>942/1150/1542/1792</td>
</tr>
<tr>
<td>Max. no. of plates for length L</td>
<td></td>
<td>25/55/100/130</td>
<td>18/40/72/96</td>
<td>16/32/66/90</td>
</tr>
<tr>
<td>Weight excl. DIABON® graphite</td>
<td>kg</td>
<td>900-940</td>
<td>900-940</td>
<td>1500-2300</td>
</tr>
<tr>
<td>Connections – frame plate</td>
<td></td>
<td>S1-S4</td>
<td>DN 100 DIN EN 1092-1 PN16</td>
<td>DN 150 DIN EN1092-1 PN16</td>
</tr>
<tr>
<td>or pressure plate</td>
<td></td>
<td></td>
<td>or DN 4” ANSI 150 lbs</td>
<td>or DN 6” ANSI 150 lbs</td>
</tr>
<tr>
<td>Test pressure with water</td>
<td>bar</td>
<td>140</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Design temperature</td>
<td>°C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Materials

- **Frame and pressure plates**: P265GH or SA516 Gr. 60
- **Tie rods and stud bolts**: 21CrMoV57 alt. SA190 Gr. B7
- **Nuts**: 25CrMo4 alt. SA194 2H
- **Compression springs**: 51CrV4
- **Guide bars**: 1.4301 (stainless steel grade)
- **Lining of frame/pressure plates and connections**: PTFE (LICUFLON)
- **Painting**: 2-component epoxy paint
  - 1 priming coat of Hempadur 15570, 100 μm
  - 1 intermediate coat of Hempadur 15570, 100 μm
  - 1 top coat of Hempathane 55210, 60 μm
  - shade: similar to RAL 5002

**DIABON® graphite plate heat exchangers are manufactured in accordance with Pressure Equipment Directive 97/23/EC, categories I to III, module B (EC type testing of series-produced pressure vessels) and C1 (conformity to design). The design calculations for our plate heat exchangers are based on specifications AD 2000-Regelwerk.**

How to contact Alfa Laval

Up-to-date Alfa Laval contact details for all countries are always available on our website at www.alfalaval.com.