Oil diffusion pumps

DIP 3 000
DIP 8 000
DIP 12 000
DIP 20 000
DIP 30 000
DIP 50 000

Part No.
222 10 /20 /25 /30 /35 /40

Operating instructions
Description

Contents

1 Description ........................................... 3
1.1 Design ............................................. 4
1.2 Standard equipment .................................. 4
1.3 Technical specifications .............................. 5
1.4 Order data .......................................... 6
1.5 Survey of pump fluids ............................... 6
1.6 Dimensions ......................................... 7
1.7 Connections ......................................... 8
2.1 Unpacking and moving .............................. 8
2.2 High-vacuum connection ............................ 9
2.3 Forevacuum connection ............................. 10
2.4 Coolant connections ................................ 10
2.5 Electrical connections ............................. 11
2.6 Pump fluid .......................................... 15
3 Operation ............................................. 16
3.1 Switching on ........................................ 16
3.2 Running the pump ................................... 16
3.3 Shutting down ....................................... 17
3.4 Air inrush ........................................... 17
3.5 Regular checks ...................................... 17
3.6 Detaching the pump from the system .............. 18
4 Maintenance ............................................ 19
4.1 Checking the pump fluid level ..................... 19
4.2 Topping up pump fluid .............................. 20
4.3 Exchanging the pump fluid ......................... 20
4.4 Cleaning the pump .................................. 21
4.5 Service by LEYBOLD ............................... 22
5 Troubleshooting ....................................... 24
6 Replacement parts .................................... 26
7 Terminal diagrams .................................... 30

EC Manufacturer’s Declaration ....................... 37
Index ....................................................... 38

Illustrations

The references to diagrams, e.g. (2/10), consist of the figure number and the item number, in that order.

Warning

This indicates procedures and operations which must be strictly observed to prevent hazard to persons.

Caution

This indicates procedures and operations which must be strictly observed to prevent damage to or destruction of the unit.

LEYBOLD service

Whenever you send a pump to LEYBOLD, indicate whether the pump is contaminated or is free of substances which could pose a health hazard. If it is contaminated, specify exactly which substances are involved. LEYBOLD must return to the sender any pumps which are not accompanied by a contamination statement.
The pumps in the DIP series are high-vacuum pumps. They are always operated in conjunction with forevacuum pumps.

The DIP series pumps are water cooled and utilize the oil diffusion principle in their operation. They are employed in high-vacuum technology to evacuate vacuum chambers.

Above and beyond this, they can also achieve high pumping speeds in pressure ranges of from $10^{-3}$ to $10^{-2}$ mbar.

### Caution

The pump is not suitable for handling oxygen above normal atmospheric concentration. Kindly contact the manufacturer whenever gases with high hydrogen content are to be pumped.
1.1 Design

The diffusion pumps in the DIP series comprise the following component assemblies:

- Water-cooled pump housing with high-vacuum and forevacuum connection flange
- Nozzle assembly
- Vaporization chamber with heating elements
- Cold cap baffle
- Forevacuum baffle

The DIP pumps are fitted with a four-stage nozzle system made of light-alloy metal and with an internal heating system comprising heating cartridges and mounting wells to which heat diffusion fins are soldered. The mounting wells are made of stainless steel and are welded vacuum-tight in the pump body, in a horizontal position.

The housing for the DIP pump is made of standard grade steel; the high-vacuum connection flange and the forevacuum connection are made of stainless steel (alloy 1.4301), the cooling coils of copper, and the cold cap baffle of nickel-plated copper.

The heat diffusion fins are made of copper and are only partially immersed in the pump fluid in the vaporization chamber.

The section of the heat diffusion fins immersed in the pump fluid is dimensioned so that intense but surge-free vaporization of the pump fluid is achieved.

The sections of the heat dissipation fins located above the level of the pump fluid apply additional energy to the pumping vapor.

To protect the heating element, a thermostat is attached to a part of the heat diffusion fin which protrudes from the fluid; this will switch off the pump’s heaters as soon as the temperature set at the thermostat is exceeded.

The heating cartridges can be easily replaced when required. It is not necessary to dismantle the pump to do so.

To prevent fluid from flowing back into the vacuum vessel, the DIP series pumps are fitted with a water-cooled cold cap baffle in the area of the intake port.

A water-cooled forevacuum baffle located on the forevacuum side effectively prevents fluid being swept into the forevacuum unit.

1.2 Standard equipment

All DIP pumps are shipped from the factory without pump fluid installed.

Included as standard equipment with the pump are

- centering ring with centering star, O-ring and outer ring for the high-vacuum flange,
- centering ring with insert for forevacuum baffle, O-ring and outer ring for the forevacuum flange.

The high-vacuum and forevacuum flanges are closed with shipping flanges and claws. The insides of the pumps have been cleaned; they are evacuated prior to shipment.

Warning

Shipping flanges (blank flanges) and claws are suitable only for shipping purposes; they may not be used to mount the pumps in systems.
1.3 Technical specifications

<table>
<thead>
<tr>
<th>High-vacuum/forevacuum connection</th>
<th>DIP 3 000</th>
<th>DIP 8 000</th>
<th>DIP 12 000</th>
<th>DIP 20 000</th>
<th>DIP 30 000</th>
<th>DIP 50 000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pumping speed for air 1) below 1·10⁻⁴ mbar</td>
<td>3 000</td>
<td>8 000</td>
<td>12 000</td>
<td>20 000</td>
<td>30 000</td>
<td>50 000</td>
</tr>
<tr>
<td>Working range mbar</td>
<td>&lt; 10⁻² - 10⁻⁷</td>
<td>&lt; 10⁻² - 10⁻⁷</td>
<td>&lt; 10⁻² - 10⁻⁷</td>
<td>&lt; 10⁻² - 10⁻⁷</td>
<td>&lt; 10⁻² - 10⁻⁷</td>
<td>&lt; 10⁻² - 10⁻⁷</td>
</tr>
<tr>
<td>Ultimate total pressure 2) mbar</td>
<td>&lt; 5·10⁻⁷</td>
<td>&lt; 5·10⁻⁷</td>
<td>&lt; 5·10⁻⁷</td>
<td>&lt; 5·10⁻⁷</td>
<td>&lt; 5·10⁻⁷</td>
<td>&lt; 5·10⁻⁷</td>
</tr>
<tr>
<td>Max. permissible forevacuum pressure mbar</td>
<td>6·10⁻¹</td>
<td>6·10⁻¹</td>
<td>6·10⁻¹</td>
<td>6·10⁻¹</td>
<td>6·10⁻¹</td>
<td>6·10⁻¹</td>
</tr>
<tr>
<td>Pump fluid fill, min./max. l</td>
<td>1.0 / 1.4</td>
<td>2 / 3.5</td>
<td>3 / 5.5</td>
<td>6 / 9</td>
<td>10 / 15</td>
<td>15 / 25</td>
</tr>
<tr>
<td>Line power supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard, 50/60 Hz V</td>
<td>230 – 1 Ph</td>
<td>230/400 – 3 Ph ΔY 460 – 3 Ph Δ</td>
<td>400 – 3 Ph Y</td>
<td>230/400 – 3 Ph ΔY 460 – 3 Ph Δ</td>
<td>230/400 – 3 Ph ΔY 460 – 3 Ph Δ</td>
<td>230/400 – 3 Ph ΔY 460 – 3 Ph Δ</td>
</tr>
<tr>
<td>Special, 50/60 Hz V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Heating power kW</td>
<td>2.4</td>
<td>4.8</td>
<td>7.2</td>
<td>12</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Number of heating cartridges</td>
<td>2</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Warm-up period min</td>
<td>&lt; 25</td>
<td>&lt; 25</td>
<td>&lt; 25</td>
<td>&lt; 25</td>
<td>&lt; 30</td>
<td>&lt; 30</td>
</tr>
<tr>
<td>Coolant (minimum)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for the pump 3) l · h⁻¹</td>
<td>160</td>
<td>290</td>
<td>500</td>
<td>800</td>
<td>900</td>
<td>1500</td>
</tr>
<tr>
<td>for the cold cap baffle l · h⁻¹</td>
<td>20</td>
<td>40</td>
<td>50</td>
<td>80</td>
<td>80</td>
<td>150</td>
</tr>
<tr>
<td>Number of cooling circuits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(including cold cap baffle)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Coolant connection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump G</td>
<td>3/8”</td>
<td>1/2”</td>
<td>1/2”</td>
<td>1/2”</td>
<td>1/2”</td>
<td>1/2”</td>
</tr>
<tr>
<td>Cold cap baffle G</td>
<td>1/4”</td>
<td>3/8”</td>
<td>3/8”</td>
<td>3/8”</td>
<td>3/8”</td>
<td>3/8”</td>
</tr>
<tr>
<td>Weight, approx. kg</td>
<td>29</td>
<td>70</td>
<td>102</td>
<td>172</td>
<td>296</td>
<td>560</td>
</tr>
<tr>
<td>Recommended forevacuum pumps 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>at working pressures &gt; 10⁻⁴ mbar</td>
<td>DK 100 + W 151</td>
<td>TRIVAC D 25 B</td>
<td>TRIVAC D 65 B + W 251</td>
<td>DK 200 + W 501</td>
<td>SV 200 + W 501</td>
<td>SV 300 + W 1001</td>
</tr>
<tr>
<td>at working pressures &lt; 10⁻⁴ mbar</td>
<td>TRIVAC D 25 B</td>
<td>TRIVAC D 65 B + W 251</td>
<td>DK 200 + W 501</td>
<td>TRIVAC D 65 B + W 251</td>
<td>DK 100 + W 251</td>
<td>DK 200 + W 501</td>
</tr>
</tbody>
</table>

1) Measured as per DIN 28 427 using DIFFELEN normal as the pump fluid.
2) Measured as per DIN 28 427 using DIFFELEN normal as the pump fluid. When using the DC 705 pump fluid and FPM (fluoroelastomer) gaskets, the DIP pumps with water-cooled baffles will achieve pressures below 1·10⁻⁸ mbar following suitable bake-out procedures.
3) The coolant water volume is referenced to ΔT = 10 K. The discharge temperature should not exceed 30°C.
4) Single- and two-stage rotary vane pumps (TRIVAC; SV) or rotary piston pumps (E/DK) from our line of forevacuum pumps in conjunction with roots pumps (RUVAC) in pumping systems.
### 1.4 Order data

<table>
<thead>
<tr>
<th>Oil diffusion pump</th>
<th>DIP 3 000</th>
<th>Part No. 222 10</th>
<th>DIP 8 000</th>
<th>Part No. 222 20</th>
<th>DIP 12 000</th>
<th>Part No. 222 25</th>
<th>DIP 20 000</th>
<th>Part No. 222 30</th>
<th>DIP 30 000</th>
<th>Part No. 222 35</th>
<th>DIP 50 000</th>
<th>Part No. 222 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astrotorus vapor baffle</td>
<td>Part No. 227 50</td>
<td>Part No. 227 60</td>
<td>Part No. 227 65</td>
<td>Part No. 227 70</td>
<td>Part No. 227 75</td>
<td>Part No. 227 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water-flow monitor, LR 10</td>
<td>Part No. 122 82</td>
<td>Part No. 122 82</td>
<td>-</td>
<td>-</td>
<td>Part No. 122 83</td>
<td>Part No. 122 83</td>
<td>Part No. 122 83</td>
<td>Part No. 122 83</td>
<td>Part No. 122 83</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LR 20</td>
<td>-</td>
<td>-</td>
<td>Part No. 122 83</td>
<td>Part No. 122 83</td>
<td>Part No. 122 83</td>
<td>Part No. 122 83</td>
<td>Part No. 122 83</td>
<td>Part No. 122 83</td>
<td>Part No. 122 83</td>
<td>Part No. 122 83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermostatic safety switch</td>
<td>Part No. 122 84</td>
<td>Part No. 122 84</td>
<td>Part No. 122 84</td>
<td>Part No. 122 84</td>
<td>Part No. 122 84</td>
<td>Part No. 122 84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact thermometer</td>
<td>Part No. 218 81</td>
<td>Part No. 218 81</td>
<td>Part No. 218 81</td>
<td>Part No. 218 81</td>
<td>Part No. 218 81</td>
<td>Part No. 218 81</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Thermoelement Pt 100 sensor</td>
<td>Part No. 200 02 958</td>
<td>Part No. 200 02 958</td>
<td>Part No. 200 02 958</td>
<td>Part No. 200 02 958</td>
<td>Part No. 200 02 958</td>
<td>Part No. 200 02 958</td>
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<td></td>
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</table>

Pump fluid (see below)

### 1.5 Survey of pump fluids

#### Technical data

<table>
<thead>
<tr>
<th>Petroleum-based oils/DIFFELEN</th>
<th>Light</th>
<th>Standard</th>
<th>Ultra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapor pressure at 20 °C mbar</td>
<td>$1 \cdot 10^{-8}$</td>
<td>$1.5 \cdot 10^{-9}$</td>
<td>$2.7 \cdot 10^{-11}$</td>
</tr>
<tr>
<td>Relative molecular mass g · mol⁻¹</td>
<td>500</td>
<td>570</td>
<td>600</td>
</tr>
<tr>
<td>Flash point (DIN ISO 2592) °C</td>
<td>&gt; 240</td>
<td>&gt; 255</td>
<td>&gt; 270</td>
</tr>
<tr>
<td>Viscosity at 25 °C mm² · s⁻¹</td>
<td>115</td>
<td>165</td>
<td>200</td>
</tr>
<tr>
<td>Density at 20 °C g · cm⁻³</td>
<td>0.862</td>
<td>0.862</td>
<td>0.864</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Petroleum-based oils/DIFFELEN</th>
<th>Light</th>
<th>Standard</th>
<th>Ultra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicone-based oils DC 704</td>
<td>$2.6 \cdot 10^{-8}$</td>
<td>$4 \cdot 10^{-10}$</td>
<td></td>
</tr>
<tr>
<td>Silicone-based oils DC 705</td>
<td>484</td>
<td>546</td>
<td></td>
</tr>
<tr>
<td>1) At 25 °C</td>
<td></td>
<td></td>
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#### Order data

<table>
<thead>
<tr>
<th>Petroleum-based oils/DIFFELEN</th>
<th>Light</th>
<th>Standard</th>
<th>Ultra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump fluid / oils 5 kg</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5 l</td>
<td>Part No. 176 68</td>
<td>Part No. 176 72</td>
<td>-</td>
</tr>
<tr>
<td>0.5 l</td>
<td>Part No. 176 69</td>
<td>Part No. 176 73</td>
<td>Part No. 176 71</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Petroleum-based oils/DIFFELEN</th>
<th>Light</th>
<th>Standard</th>
<th>Ultra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicone-based oils DC 704</td>
<td>Part No. 500 600</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Silicone-based oils DC 705</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Petroleum-based oils/DIFFELEN</th>
<th>Light</th>
<th>Standard</th>
<th>Ultra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicone-based oils DC 704</td>
<td>Part No. 176 94</td>
<td>Part No. 176 96</td>
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</table>
## 1.6 Dimensions

![Dimensional drawing of DIP models](image-url)

<table>
<thead>
<tr>
<th>DIP</th>
<th>3 000</th>
<th>8 000</th>
<th>12 000</th>
<th>20 000</th>
<th>30 000</th>
<th>50 000</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>290</td>
<td>450</td>
<td>550</td>
<td>750</td>
<td>920</td>
<td>1120</td>
</tr>
<tr>
<td>d₁</td>
<td>261</td>
<td>400</td>
<td>501</td>
<td>651</td>
<td>800</td>
<td>1000</td>
</tr>
<tr>
<td>d₂</td>
<td>–</td>
<td>405</td>
<td>506</td>
<td>636</td>
<td>716</td>
<td>916</td>
</tr>
<tr>
<td>d₃</td>
<td>278</td>
<td>530</td>
<td>630</td>
<td>760</td>
<td>840</td>
<td>1040</td>
</tr>
<tr>
<td>d₄</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>720</td>
<td>890</td>
<td>1090</td>
</tr>
<tr>
<td>d₅</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Number (d₅)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>20</td>
<td>24</td>
<td>32</td>
</tr>
<tr>
<td>a</td>
<td>240</td>
<td>350</td>
<td>420</td>
<td>540</td>
<td>600</td>
<td>800</td>
</tr>
<tr>
<td>a₁</td>
<td>250,5</td>
<td>375,5</td>
<td>432</td>
<td>496</td>
<td>536</td>
<td>636</td>
</tr>
<tr>
<td>b</td>
<td>443</td>
<td>643</td>
<td>775</td>
<td>920</td>
<td>1090</td>
<td>1290</td>
</tr>
<tr>
<td>b₁</td>
<td>276</td>
<td>373</td>
<td>460</td>
<td>540</td>
<td>630</td>
<td>730</td>
</tr>
<tr>
<td>h</td>
<td>560</td>
<td>785</td>
<td>940</td>
<td>1130</td>
<td>1450</td>
<td>1880</td>
</tr>
<tr>
<td>h₁</td>
<td>250</td>
<td>400</td>
<td>470</td>
<td>620</td>
<td>870</td>
<td>1275</td>
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<td>h₂</td>
<td>68</td>
<td>88</td>
<td>92</td>
<td>97</td>
<td>102</td>
<td>102</td>
</tr>
<tr>
<td>h₃</td>
<td>75</td>
<td>102</td>
<td>106</td>
<td>110</td>
<td>116</td>
<td>116</td>
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<tr>
<td>h₄</td>
<td>45</td>
<td>68</td>
<td>68</td>
<td>74</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>α</td>
<td>45°</td>
<td>30°</td>
<td>30°</td>
<td>30°</td>
<td>20°</td>
<td>25°</td>
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<td>α₂</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>α₃</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>15°</td>
</tr>
</tbody>
</table>

Fig. 3 Dimensional drawing for the DIP 3000 (left), the DIP 8000 to 30 000 (middle) and the DIP 50 000 models (right)
2 Connections

2.1 Unpacking and moving

The DIP pump is shipped upright on a pallet and packed in a wooden crate. Proceed as follows to unpack the unit; see Figure 4.

1) Remove the shipping papers from the pocket (4/4)
2) Position the pallet on a flat and level surface.
3) Unscrew the 4 bolts (4/6) from under the wooden box and/or remove the tightening straps (4/2).
4) Loosen the 4 bolts at the upper part of the wooden crate and turn the brackets (4/4) up. Then tighten the bolts once more. Affix the lifting gear at the brackets and lift the wooden crate up and away.

Warning

Lift the wooden crate up slowly and with care so that it passes the pump without causing it to topple over.

5) Remove the plastic wrapper.
6) The DIP pump is now freely accessible on the pallet on the floor.
7) Remove the linen bag containing the desiccant.

The DIP pump may be moved only when it is standing upright on a pallet or suspended from the lifting eyes. After unpacking the unit, examine the shipment for completeness and any possible shipping damage (see Section 1.2, “Standard equipment”).

Warning

Protect the pump against tipping when moving it on the pallet.

The pumps are shipped evacuated (corrosion protection). Do not air the pumps until immediately before installation.

To vent the pump, pull the closure plug out of the hose nozzle in the forevacuum shipping flange (5/5).
2.2 High-vacuum connection

The DIP pumps are shipped evacuated. Do not air the pump until immediately before it is installed; to do so, open the closure plug at the forevacuum shipping flange.

Remove the high-vacuum shipping flange (5/10).

The pump must be standing flat and level or suspended from the high-vacuum connection flange when installed in the system.

We recommend maintaining a clearance of 500 mm between the sheet metal cladding at the heating unit (5/14) and other system components. This facilitates maintenance work on the pump’s heating unit with the pump left in place in the system.

Check to ensure that the centering ring (14/16), together with the O-ring (14/17) and the outer ring (14/18) are seated securely in the high-vacuum flange (14/15).

DIP 3000, 8000, 12000: Use clips to join the ISO-K flange.

DIP 20 000, 30 000, 50 000: Use M12x60 bolts and matching nuts to join the ISO-F flange; see Section 1.6 for the number required.

Warning

The shipping flange (blank flange) and claws may be used only for shipping purposes; they are not suitable for mounting the pumps in systems.

Where maintaining uniform pressure is of special importance, and particularly when working in pressure ranges of less than $10^{-6}$ mbar, we recommend using at all flange connections at the high-vacuum side the “ultra” sealing plate instead of the centering ring with an O-ring.

Necessary to achieve maximum conductance at the high-vacuum line is that it exhibit the largest possible nominal diameter and be as short as possible. The DIP pump must be suspended vertically.
2.3 Forevacuum connection

A forevacuum system is required for operating the DIP pumps. We recommend our TRIVAC or SOGEVAC pumps in conjunction with roots booster pumps.

Remove the forevacuum shipping flange (5/5).

Connect the forevacuum line with the centering ring, O-ring and outer ring (5/4) at the forevacuum port (5/3).

The centering ring also serves at the same time as the attachment point for the water-cooled baffle (14/3) in the forevacuum port.

**Warning**

The shipping flange (blank flange) and claws may be used only for shipping purposes; they are not suitable for mounting the pumps in systems.

The diameter of the forevacuum line should be at least as large as the forevacuum flange nominal diameter; the line should be as short as possible in order to achieve the maximum conductance value.

2.4 Coolant connections

The coolant should exhibit the following qualities:

- **pH value**: 7.0 to 8.5
- **Chloride content (Cl⁻)**: \( \leq 75 \text{ mg/l} = 2.1 \text{ mmol/l} \)
- **Sulfate content (SO₄²⁻)**: \( \leq 70 \text{ mg/l} = 2.1 \text{ mmol/l} \)
- **Calcium ions**: > 1.0 mmol/l = 5.6°dH, \( \leq 2.7 \text{ mmol/l} = 5.6°dH \)
- **Hydrogen carbonate hardness**: 7 to 10°dH
- **Particle size**: \( \leq 150 \mu m \)

Coolant pressure should not exceed 6 bar.

Significant deviations from the recommended values can result in premature corrosion or deposit build-up. Kindly consult the manufacturer if there are any questions.

It is necessary to connect the coolant system prior to operating the DIP pump.
The DIP 3000 to 20 000 have two coolant circuits which can be connected in series.

1. Cold cap baffle: coolant inlet and outlet: (5/6)
2. Pump: coolant inlet: (5/7)
   Coolant outlet: (5/2)

Important is that the coolant flow first into the cold cap baffle.

We recommend coolant feed temperatures of between 15°C and 20°C.

Coolant return temperature should not exceed 30°C at the outlet. It is important to pay attention to this in particular where the DIP pump is connected to a closed coolant circuit. We recommend using conditioned water to avoid the formation of scale deposits (which would impair cooling performance).

The DIP 30 000 and 50 000 have three coolant circuits:

1. Cold cap baffle: coolant inlet and outlet: (6/1)
2. Pump: upper coolant circuit: (6/2) and (6/3)
3. Pump: lower coolant circuit: (6/4) and (6/5)

The pump’s upper and lower coolant circuits may be joined one with the other: connect the outlet (6/3) to the inlet (6/4). In this operating mode the discharge temperature at the outlet (6/5) should not exceed 30°C. If the coolant return temperature should rise above 30°C, then we recommend operating the pump with separate coolant circuits.

2.5 Electrical connections

Please also refer to the wiring diagrams in Section 7.

2.5.1 Connecting the heaters

Warning
The electrical connection is to be made by a licensed electrician in compliance with VDE regulations and in accordance with the harmonized or national codes and regulations for the country in which the unit is being operated. High fault currents may appear at the insulation for the heating elements due to exceptional amounts of moisture absorption.

Warning
The DIP pump will get hot in the marked area during operation:
Burn hazard!
Be sure to observe the cool-down time after the system is shut off.

Warning
Do not use any easily flammable materials near the hot area of the pump.

General installation notes

Information on the internal wiring of the DIP pump will be found in the schematic diagrams.

In all the DIP pumps, with the exception of DIP 3000, the heating cartridges are normally wired in a “star” (Y) circuit; this means that they are prepared for connection to a 400 V, 3-phase, 50/60 Hz, power source.

If the DIP pumps are to be operated on a network in which the current deviates from 400 V, 3-phase, 50/60 Hz (e.g. 230 V, 3-phase or 460 V, 3-phase), then the pump will have to be rewired internally. Kindly inquire at the factory for details.

A supply cable sized to correspond to the amount of power drawn or the connected load is to be used when making the connection. The parameters which affect dimensioning include current load, ambient temperature, how the cable is laid and type of cable and conductors. Local codes shall be observed when sizing the connection cable.

The power consumption figures required to make this selection are given in the following table. The appropriate circuit breakers shall be installed during installation; their specifications are also given in the following table.
Connections

Legend for Fig. 7
1 Electrical terminal box with circuit breakers for heating cartridges and thermostat switching devices
2 Contact plate for thermal safety switch
3 PG type threaded fitting for electrical connection
4 Connection for dial-type thermometer (optional)

<table>
<thead>
<tr>
<th>DIP</th>
<th>Connection voltage</th>
<th>Main fuse</th>
<th>Individual fuses</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000</td>
<td>230 V, single-phase</td>
<td>16 A</td>
<td>6 A 2</td>
</tr>
<tr>
<td>8000</td>
<td>230 V, 3-phase</td>
<td>16 A</td>
<td>10 A 6</td>
</tr>
<tr>
<td>400 V, 3-phase</td>
<td>16 A</td>
<td>6 A 6</td>
<td></td>
</tr>
<tr>
<td>460 V, 3-phase</td>
<td>16 A</td>
<td>10 A 3</td>
<td></td>
</tr>
<tr>
<td>12000</td>
<td>230 V, 3-phase</td>
<td>25 A</td>
<td>10 A 9</td>
</tr>
<tr>
<td>400 V, 3-phase</td>
<td>16 A</td>
<td>6 A 9</td>
<td></td>
</tr>
<tr>
<td>460 V, 3-phase</td>
<td>16 A</td>
<td>6 A 9</td>
<td></td>
</tr>
<tr>
<td>20000</td>
<td>230 V, 3-phase</td>
<td>40 A</td>
<td>10 A 12</td>
</tr>
<tr>
<td>400 V, 3-phase</td>
<td>25 A</td>
<td>6 A 12</td>
<td></td>
</tr>
<tr>
<td>460 V, 3-phase</td>
<td>25 A</td>
<td>10 A 6</td>
<td></td>
</tr>
<tr>
<td>30000</td>
<td>230 V, 3-phase</td>
<td>63 A</td>
<td>10 A 18</td>
</tr>
<tr>
<td>400 V, 3-phase</td>
<td>40 A</td>
<td>6 A 18</td>
<td></td>
</tr>
<tr>
<td>460 V, 3-phase</td>
<td>32 A</td>
<td>10 A 9</td>
<td></td>
</tr>
<tr>
<td>50000</td>
<td>230 V, 3-phase</td>
<td>100 A</td>
<td>10 A 24</td>
</tr>
<tr>
<td>400 V, 3-phase</td>
<td>50 A</td>
<td>6 A 24</td>
<td></td>
</tr>
<tr>
<td>460 V, 3-phase</td>
<td>40 A</td>
<td>10 A 12</td>
<td></td>
</tr>
</tbody>
</table>

Safety interlock
Operation of the pump heaters at the DIP type pump is monitored with a thermostat. Where there is a loss of pump liquid and an unacceptable temperature rise in the vaporization chamber, the heating will be switched off, keeping the cartridges from being overheated.

The thermostat is engineered as a fail-safe temperature monitoring unit which means that if the connection line between the measurement sensor (14/44) and the switching device (14/21) is broken the built-in contact will open, reporting a “fault” as would be the case for unacceptable temperature rise.

<table>
<thead>
<tr>
<th>DIP</th>
<th>Number of thermostats</th>
<th>Temperature setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000</td>
<td>1</td>
<td>320 °C</td>
</tr>
<tr>
<td>8000</td>
<td>1</td>
<td>320 °C</td>
</tr>
<tr>
<td>12000</td>
<td>1</td>
<td>320 °C</td>
</tr>
<tr>
<td>20000</td>
<td>1</td>
<td>360 °C</td>
</tr>
<tr>
<td>30000</td>
<td>2</td>
<td>360 °C</td>
</tr>
<tr>
<td>50000</td>
<td>2</td>
<td>360 °C</td>
</tr>
</tbody>
</table>

The insulation for the lines from the junction boxes to the fuse boxes shall be resistant to temperatures of up to 200 °C.
Caution

Switching the heating cartridge on and off repeatedly will result in its premature failure.

The connection for the DIP pump must be via a power relay of appropriate capacity (not included as standard equipment). The control circuit for the relay coil is to interface with the switching contact for the thermostat in such a way that the relay will separate the pump from the power supply if unacceptably high temperatures are detected. Use terminals 1 and 2 at the thermostat for this purpose; see the schematic diagram for details.

Caution

Connect the thermostat in such a way that, after the thermostat has disabled the system, the pump cannot start again spontaneously once the system has cooled down again.

Electrical connection at the thermostat

To set up the protective interlock system connect the switching contact for the thermostat with the appropriate power circuit to control the relay coil.

Remove the cover at the electrical junction box. Pass the end of the supply line through the type PG threaded fitting and connect the conductors with the connector contacts at the thermostat (see the schematic for the wiring scheme). Attach the ground conductor in the supply lead to the central grounding point on the backing plate (PE bus). Then connect the supply line with the system control unit in order to ensure that this protective interlock is set up properly.

Caution

Missing or wrong connections for the thermostat can cause the pump to overheat.
Connections

Connect the supply line with the electrical junction box

Pass the end of the supply lead through the type PG threaded fitting.

Attach the ground and neutral conductors at the appropriate PE and N buses inside the fuse box. Connect the neutral conductor only after determining that it can carry a load.

Then connect the hot conductor(s) (L1 in the DIP 1000; L1, L2 and L3 in the other models) at the appropriate connection strips for the fuse groups. Tighten down the PG threaded fitting to activate the strain relief feature and then reinstall the cover on the electrical junction box.

2.5.2 Connect monitoring components (options)

Overheating switch

We recommend installing a thermostatic safety switch. This switch monitors the coolant temperature and is located in the immediate vicinity of the coolant pipe (7/2). The contacts are closed at temperatures below 50°C during normal operations. If the temperature at the sensor rises above 50°C (in case the coolant circulation should fail, for example), then the contacts will open and shut down the DIP pump heating by way of a relay (to be provided by owner).

Route one phase of the relay in the power supply through the overheating protection switch.

Caution

Connect the pump in such a way that it will not start again spontaneously once a monitoring component (thermostat, overheating protection switch, coolant flow monitor) has been tripped and the operating parameters have returned from the unacceptable to the normal status.

Use four cap screws, M3 x 6 to mount the thermal protection switch (7/2).

Coolant flow monitor

The coolant flow monitor is installed in the outlet port of the coolant circuit for the series DIP pump.

If coolant circulation fails the flow monitor can, for example, be used to drive a relay which will switch off the pump heating, activate an alarm system or carry out another suitable switching function. The minimum coolant volumes are given in Section 1.3, “Technical Data”.

Dial-type thermometer

The dial-type thermometer is inserted at the base of the vaporization chamber, in the opening (7/4) provided for this purpose. Remove the threaded plug to do so.

The dial thermometer has two switching points which can be set independent one of another.

We recommend setting the lower switching point at < 100°C (pump can be aired) and the upper switching point at > 200°C (pump is ready for operation).

The contacts for the switching points are connected to leads which terminate outside the thermometer. The signals can be interpreted by an external pump system control unit.

Alternatively also a Pt 100 temperature sensor may be inserted into the bore (7/4).
2.6 Pump fluid

The series DIP pumps are shipped without pump fluid installed.

We recommend using either our DIFFELEN pump fluid or silicone oil. These compounds are particularly suitable because of their high thermal and chemical stability.

Use DIFFELEN LEICHT where great throughput is to be achieved in a range of $10^{-3}$ to $10^{-2}$ mbar.

We recommend using DIFFELEN NORMAL for pressure reaching down to $10^{-2}$ mbar.

DIFFELEN ULTRA is used to achieve extremely low pressures (ultra-high vacuum).

Silicone oils are distinguished by their very low vapor pressure and great resistance to oxidation and decomposition. We recommend using type DC 704 silicone oil.

We recommend using type DC 705 silicone oil where particularly low ultimate pressures are to be attained.

Caution

All the pump’s interior surfaces must be carefully cleaned before filling the pump with a different oil compound (e.g. from mineral oil DIFFELEN to silicone oil).

Install the pump fluid through the pump fluid filler port (11/1).

The quantities of fluid required will be found in Section 1.3, “Technical Data”.

Use a litre gauge to measure the quantity of pump fluid and fill the pump fluid into the pump. When filling the pump for the first time or when filling it after cleaning, we recommend to fill the pump up to its maximum.

After having filled in the pump fluid, wait a few minutes for the pump fluid to spread and then read off the oil level at the oil level sight glass. In order to correctly determine the oil level, read off the filling level at eye level.

Disposing of spent fluid

The owners of used fluid are responsible for its proper disposal.

Spent fluid from vacuum pumps may not be mixed with other substances.

Spent fluids from vacuum pumps (Leybold’s petroleum-based oils) which are contaminated only as a result of normal wear and tear due to the effects of atmospheric oxygen, elevated temperature and mechanical strain can be disposed of in the same way as used motor oils.

Spent oils from vacuum pumps which were contaminated with other substances will have to be marked to identify the contaminant and stored and disposed of as toxic wastes.

European, national and local regulations concerning the disposal of waste need to be observed. The waste must only be handled and disposed of through an approved waste disposal vendor.
3 Operation

The pumping speed attained by diffusion pumps is constant between about $10^{-3}$ mbar and very low pressure since in this pressure range the stream of vapor will not be affected by the pressure level prevailing in the vacuum chamber.

We recommend joining the vacuum chamber direct to the forevacuum pump via a valve (9/3) and a roughing line. A high-vacuum valve (9/4) and a forevacuum valve (9/2) are required for proper functioning of the roughing line.

The vacuum chamber is evacuated down to the transfer pressure via the roughing line. The diffusion pump and pump fluid are protected when the high-vacuum valve (9/4) is opened. Close the forevacuum valve (9/2) and the high-vacuum valve (9/4) prior to venting the vacuum chamber; the diffusion pump will remain in a state of operational readiness.

3.1 Switching on

All the connections and preparations for operation have been made properly and in accordance with Sections 2.2 to 2.6.

Switch on the roughing pump and evacuate the DIP pump down to forevacuum pressure $< 5 \cdot 10^{-1}$ mbar; open the coolant supply valve and then switch on the pump heaters. The DIP pump will begin functioning after a certain period of time (see Section 1.3, “Technical Data”).

If a high-vacuum valve has been installed between the diffusion pump and the vacuum chamber, then this should be opened when the DIP pump is hot only if the pressure in the vacuum chamber is below $1 \cdot 10^{-1}$ mbar.

3.2 Running the pump

Warning

Operating the DIP pump with the high-vacuum and forevacuum sections closed off and with the coolant supply shut down at the same time represents a hazardous situation and is to be reliably excluded (e.g. by way of interlock circuitry).

Warning

Do not use any easily flammable materials near the hot pump section.

When inlet and forevacuum temperatures are above the maximum permissible levels as specified in the tables at “Technical Data” (see Section 1.3) it is possible for pump fluid to pass into other parts of the vacuum system. Unrestricted coolant flow and satisfactory temperature and the quantity and temperature of the pump fluid have to be monitored while the DIP pump is in operation.

For this refer to Sections 3.5 Regular checks and 4 Maintenance.
Where there is an unacceptable rise in temperature caused, for instance, by failure of the coolant circuit, the built-in thermostat will switch off the heating cartridges at the DIP pump; see Section 2.5 “Electrical connection at the thermostat”. If you have installed a thermostatic safety switch and/or a coolant flow monitor unit these will also switch off.

### 3.3 Shutting down

Close the high-vacuum valve (9/4).

Switch off the pump heating and wait until the DIP pump has cooled down sufficiently.

**Warning**

Danger of scalding by the pump fluid vapor when the hot DIP pump is opened.

Close the forevacuum valve (9/2).

Shut off the coolant supply.

**Caution**

The DIP may be vented only after the pump fluid temperature has fallen to below 100°C. With the optionally built-in pointer thermometer (see Section 2.5.2) the temperature may be checked. At 100 °C the lower switching threshold is tripped. Ventilation should preferably be from the high-vacuum side, into the cool pump.

Switch off and vent the forevacuum pump.

Shut off coolant supply only after the DIP pump has cooled down to below 100°C.

### 3.4 Air inrush

Brief, intermittent ingress of air will not affect functioning of the DIP pump since the pump fluid is self-cleaning.

We recommend using a silicone-based oil if air inrush is to be expected more frequently, since such compounds exhibit greater resistance to oxidation and de-composition.

### 3.5 Regular checks

In order to ensure trouble-free operation of the DIP pump we recommend in the case of normal operation the following regular checks:

<table>
<thead>
<tr>
<th>Check</th>
<th>Interval</th>
<th>Action</th>
<th>Chapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filling level of the pump fluid</td>
<td>1 week</td>
<td>If required top up oil, be sure to use the same grade of oil</td>
<td>4.1, 4.2</td>
</tr>
<tr>
<td>Condition of the pump fluid</td>
<td>1 month</td>
<td>If required change the oil</td>
<td>4.3</td>
</tr>
<tr>
<td>Cleaning of the nozzle assembly</td>
<td>1 year</td>
<td>Use suitable solvents, for example, petroleum ether or acetone</td>
<td>4.4</td>
</tr>
<tr>
<td>Cleaning the heat conducting plates of the heater cartridges</td>
<td>1 year</td>
<td>Use a commercial high-pressure cleaner, 2 bar overpressure max.</td>
<td>4.4</td>
</tr>
<tr>
<td>Cooling water flow</td>
<td>1 year</td>
<td>If required clean the cooling coils</td>
<td>4.4.5</td>
</tr>
</tbody>
</table>
3.6 Detaching the pump from the system

Switch off and vent the DIP pump in a planned fashion and as described in Section 3.3.

Isolate the DIP pump from the power supply and detach at the electrical connection terminals.

Disconnect the coolant system and use compressed air to blow out the piping network.

Lift the DIP pump only at the lifting eyes.

**Warning**

If the pump had previously handled hazardous gases or if toxic products of pump fluid decomposition generated due to overheating might be present, then all the appropriate precautionary measures will have to be undertaken.

Use gloves, a respirator and protective clothing as required and work under a suitable fume extraction hood.

Open the pump fluid outlet ports (11/5) and drain the pump fluid into a suitable container.

**Caution**

Dispose of the pump fluid properly (may possibly have to be handled as toxic waste).

Separate the pump’s forevacuum and high-vacuum flanges from the system and remove the DIP pump.

Pack the pump so that it cannot be damaged during shipment.

Protect the flanges and the coolant connections in particular.

Please observe the precautions set forth in Section 4.5 if you send a pump to Leybold.

**Maintaining in stock**

Maintain the pump in stock so that it is dry and not exposed to frost. The cooling coils need to be blown out and must be dry.

Keep the pump in stock standing upright.
4 Maintenance

Warning
If the pump had previously handled hazardous gases or if toxic products of pump fluid decomposition generated due to overheating might be present, then all the appropriate precautionary measures will have to be undertaken. Use gloves, a respirator and protective clothing as required and work under a suitable fume extraction hood.

4.1 Checking the pump fluid level

The fluid fill level can be read at the sight glass on the DIP pump. There are markings for the minimum and maximum levels at the sight glass. When the DIP pump is running the fill level should be at the center of the sight glass.

The oil fill level can be checked exactly only when the pump is cold and vented. In order to correctly determine the oil level, read off the filling level at eye level.

The fill level will fluctuate hardly at all during normal operation. If the DIP pump has to be aired frequently (batch operation), then we recommend keeping the fluid level at the maximum level.
4.2 Topping up pump fluid

The level of the pump fluid must not be allowed to drop below the minimum mark. Top up as required.

Caution

Open the inlet port for the pump fluid only after having vented the pump and while cold.

• Switch the pump off, wait for it to cool down and vent it.
• Read off the filling level at eye level. Be sure to use the same grade of pump fluid.

Open the inlet port (11/1) and fill in the pump fluid ensuring that the maximum mark is not exceeded.
• We recommend that you replace the gasket at the inlet port (14/43).
• Close the inlet port.

4.3 Exchanging the pump fluid

Normally the pump fluid (mineral oil and silicone oil) is as clear as water. When it changes its colour to “honey yellow” it will have to be exchanged.

Caution

Open the pump fluid drain port or the inlet port only after the pump has been vented and while cold.

• Switch the pump off, wait for it to cool down and vent.
• Open the drain port and drain the pump fluid into a suitable vessel. Leave the drain port open for at least 30 minutes so that as much pump fluid as possible can drain out.
• Each time when exchanging the pump fluid we recommend that you replace the two gaskets at the filling port (14/43) and the drain port (14/42).
• Close the drain port.
• Open the inlet port and fill in the pump fluid ensuring that the maximum mark is not exceeded. Read off the filling level at eye level.
• Close the inlet port.

For disposing of waste oil refer to Section 2.6.
4.4 Cleaning the pump

The inner surfaces of the pump should be cleaned at least once a year. Moreover, they must be cleaned when filling in a different grade of pump fluid.

The pump will have to be dismantled to do so.

4.4.1 Dismantle pump

Disconnect the power supply and coolant circuit (see Section 3.6, “Detaching the pump from the system”).

Open the pump fluid outlet port (14/42) and allow the pump fluid to drain.

Separate the pump’s forevacuum and high-vacuum flanges from the system.

Remove the cold cap baffle (14/19).

Unscrew the nut (14/31) and remove the washer (14/32).

Unscrew the mounting bolt (14/35).

Carefully lift the cold cap baffle and pull it out of the pump housing.

Loosen the connection ports (14/30) with by tapping lightly with a rubber hammer or wooden mallet if necessary.

When removing the baffle carefully remove the two insulating washers (14/34) and the spacer (14/36).

DIP 3000 to 20 000: Grasp the nozzle assembly at the first stage (12/6) and lift it out of the pump housing.

DIP 30 000 and 50 000: Lift out the nozzle assembly using the lifting eyes at the second stage.

4.4.2 Cleaning the pump

The nozzle assembly and the inner parts of the pump may be cleaned with a commercial steam cleaner.

Caution The pressure of the steam cleaner may
• only amount to 2 bar when cleaning the heat conducting panels of the heater inserts (risk of breaking the copper lamellae)
• only amount to 10 bar for the remainder of the pump.

Stubborn dirt (burnt-in residues of the pump fluid) may be removed with a suitable solvent or with fine grain detergents or fine emery paper.

Place the pump at a slight angle (ensure that it can not topple over) so that the cleaning fluid can run out. At the end of the cleaning process clean all inner surfaces with a commercial hot air fan.

4.4.3 Oil level sight glass

Remove the screws at the flange mount (14/39) to clean the oil level sight glass (14/41) in the assembly (14/29).

We recommend replacing the two O-rings (14/38) in front of and behind the sight glass during assembly.

Pay attention to correct positioning of the marking at the sight glass cover. The marking line indicating the upper level for the pump fluid must be located above the middle of the oil level sight glass.

If arrows are present on the cover frame, these must point downwards.

4.4.4 Assembling the pump

When assembling the pump ensure that the individual components are again mounted in the correct order (see Fig. 14).

Caution The nozzle assembly may not be dismantled. It will be necessary to change out the complete nozzle assembly if the dimensions at the gaps (see Fig. 12) deviate from the specified values. Deformations at the nozzle assembly are an indicator for serious air ingress during pump operation.

Install the nozzle assembly centered in the pump housing. Check to ensure that it is seated in the center of the high-vacuum flange (14/15).

Mount the cold cap baffle (14/19), paying particular attention to correct seating of the gasket rings (14/33) for the coolant liquid port.

Close the pump fluid outlet port (14/42) and reinstall the DIP pump in the system, being sure that it is vacuum-tight.

Caution Pay attention to correct positioning, properties and cleanliness for all gaskets; use new gaskets if appropriate.

Install new pump fluid at the pump fluid filling port (14/43). See Section 1.3, “Technical Data”, for specifications on the amount of pump fluid required.
4.4.5 Cleaning the cooling coils

Clean the cooling coils with a commercial decalcifier based on formic acid or ethanoic acid.

Caution

Do not use any chlorine based decalcifier since this will damage the cooling coils due to crevice corrosion.

4.5 Service by LEYBOLD

Whenever you send a pump to Leybold, indicate whether the pump is contaminated or is free of substances which could pose a health hazard. If it is contaminated, specify exactly which substances are involved. You must use the form we have prepared for this purpose; we will forward the form on request.

A copy of the form is printed at the end of these operating instructions: „Declaration of contamination of vacuum equipment and components“. Another suitable form is available from the Leybold homepage: http://www.leyboldvac.de under the headline “customer service”.

Attach the form to the pump or enclose it with the pump.

This statement detailing the contamination is required to satisfy legal requirements and for the protection of our employees.

Pumps which are not accompanied by a contamination statement will be returned to the sender.
Legend for Fig. 12
1 Nozzle assembly housing
2 4th stage
3 Spacer bushing
4 3rd stage
5 2nd stage
6 1st stage

Specified dimensions for nozzle gap

<table>
<thead>
<tr>
<th></th>
<th>a (1st stage)</th>
<th>b (2nd stage)</th>
<th>c (3rd stage)</th>
<th>d (4th stage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP 3000</td>
<td>1.5 ± 0.1</td>
<td>1.2 ± 0.2</td>
<td>1.3 ± 0.2</td>
<td>3.5 ± 0.2</td>
</tr>
<tr>
<td>DIP 8000</td>
<td>0.8 ± 0.1</td>
<td>1.2 ± 0.2</td>
<td>2.0 ± 0.2</td>
<td>2.5 ± 0.2</td>
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Fig. 12. Nozzle assembly for the DIP 20 000; other models are similar.
5 Troubleshooting

The ultimate total pressure specified in Section 1.3, "Technical Data", will be attained under the following conditions:

The chamber must be leak-tight and bake-out procedures should be possible, if this is at all feasible. The interior surfaces must be clean.

The gases liberated by the sealing elements used in the unit are to be kept to a minimum, which means that FPM gaskets are to be used instead of NBR or silicone sealing rings. If very low working pressures are required, then metal seals will preferably be installed.

If the ultimate pressure is obviously not attained although the conditions given here are all satisfied, then the following defects may be present:

**Insufficient pump fluid**

*Cause:* Heating units switch off and on at insufficient pump fluid level.

*Remedy:* Top up with pump fluid.

**Pump fluid contaminated**

*Cause:* Pump fluid has decomposed as a result of frequent air ingress or there are contaminants originating from the apparatus.

*Remedy:* Clean the DIP pump; replace the pump fluid.

**Insufficient heater output**

*Warning* Have these repairs carried out (in accordance with VDE and local codes) only by a qualified, licensed electrician.

*Cause:* Line voltage too low; heating cartridge defective.

*Remedy:* Check the heating units; replace the defective heating cartridge.

The heating cartridges contain magnesium oxide (MgO) and thus attract humidity. For this reason keep the replacement heater cartridges in dry rooms only or in plastic bags which are sealed air-tight. If the heater cartridges have attracted humidity, they may be dried in a drying oven for 8 hours at 180 °C.

*Caution* Only install heater cartridges which are dry.

Switch off the DIP pump in preparation for replacing the heating cartridge; remove the sheet metal cladding at the base of the pump (14/27) by loosening the fixing screws. Disconnect the leads for the defective heating cartridge (14/45) and pull the heating cartridge straight out of the heater well, **without** rotating it.

If the heater cartridge can not be pulled out manually, use the withdrawal sleeve; see Fig. 13.

For this remove the clamp holding the heater cartridge (13/4) and cut off the electric cables.

Drill a hole (5 mm dia.) into the side of the heater cartridge.

Fit the withdrawal sleeve and affix it with the pin.

Screw the withdrawing hammer in and pull the heater cartridge out.

Before installing the heater cartridge widen the heating pipe by 20\(^{\text{H7}}\) mm with a reamer and then clean it.

The replacement heating cartridge will have to be sprayed with a temperature-resistant lubricating substance ("Never Seez" brand; see Section 6, “Replacement Parts”).

*Caution* In order to avoid any danger of electrical problems, **do not** apply the spray to a 20 mm length of the cylindrical section of the cartridge at the connection end.

The spray film which is applied must be distributed evenly and should fill the entire air gap between the cartridge and the inside of the heater well. The lubrication substance enhances protection against the cartridge seizing during installation and removal and promotes heat transfer from the heating cartridge to the heater well.

Rotate and slide the heating cartridge (13/5) to insert it into the heater tube. When inserting the heater cartridge there must be no mechanical resistance. If necessary once more widen the heating pipe by 20\(^{\text{H7}}\) mm with a reamer and then clean it. Finally provide the electrical connections.

Subsequent assembly is in the reverse order to that described above. The inside of the heater well must not be damaged. Notify our Customer Service Department if the heater well should suffer serious damage.
**Insufficient cooling; pump runs too hot**

**Cause:** Coolant circuits connected incorrectly, insufficient coolant pressure, clogged lines, scale deposits.

**Remedy:** Connect the coolant circuits as described in Section 2.3. Raise the coolant pressure to a maximum of 6 bar, clean the lines, run water through the system in the reverse direction.

Do not use any de-scaling products containing chlorine compounds; use commercially available products based on formic or acetic acid.

---

**Pump achieves neither full pumping speed nor satisfactory ultimate pressure**

**Possible causes:**

a) Nozzle assembly assembly improperly mounted.

b) Insufficient forevacuum.

c) Device leaking or soiled.

d) Oil contaminated or aged.

**Remedy:**

a) Remove and clean the nozzle assembly and then carefully reinstall (see Section 4.4). Ensure that the nozzle assembly is centered in the DIP pump.

b) Examine the forevacuum line for potential leaks and seal where needed. The required forevacuum pressure upline from the diffusion pump must be ensured.

c) Use a leak tester to examine the apparatus; clean thoroughly, dry and bake out if indicated.

d) Change the oil.
## 6 Replacement parts

<table>
<thead>
<tr>
<th>Item in Fig. 14</th>
<th>DIP 3,000</th>
<th>DIP 8,000</th>
<th>DIP 12,000</th>
<th>DIP 20,000</th>
<th>DIP 30,000</th>
<th>DIP 50,000</th>
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Legend for Fig. 14

1 Shielding plate, ring insert
2 Fixing pins, ring insert
3 Insert, forevacuum baffle
4 Cooling, forevacuum baffle
5 Coolant outlet, pump
6 Forevacuum connection flange
7 Outer ring
8 O-ring
9 Centering ring with baffle insert
10 Nozzle assembly, 4-stage
11 Pump housing
12 Coolant line
13 Coolant inlet, pump
14 Coolant connection, cold cap baffle
15 High-vacuum connection flange
16 Centering ring with centering star
17 O-ring
18 Outer ring
19 Cold cap baffle
20 Outer ring for cold cap baffle
21 Electrical junction box with circuit breakers for heating cartridges and switching devices for thermostats
22 Threaded fitting (PG) for electrical connection
23 Contact plate for thermostatic safety switch
24 Switching device, thermostat
25 Warning label
26 Sheet metal cladding, heating
27 Installation location for dial-type thermometer
28 Fluid fill level sight glass with pump fluid inlet and outlet ports

Fig. 14a Overall view of the DIP 20 000; other models are similar
30 Connection ports, water cooling, cold cap baffle
31 Nut
32 Washer
33 Gasket ring
34 Ceramic washer
35 Bolt
36 Centering ring
37 Tightening screw
38 O-ring
39 Flange
40 Spacer sleeve
41 Fluid fill level sight glass
42 Pump fluid outlet port
43 Pump fluid inlet port
44 Capillary tube, thermostat
45 Heating cartridge
46 Mounting well for heating cartridge
47 Fixing clamp
48 Heat diffusion fin
49 Pump base
50 Thermal protection jacket
51 Vaporization chamber

Section A-A  Heater well with heating rod
Section B-B  Fluid fill level sight glass with pump fluid inlet and outlet ports
Section C-C  Arrangement of the heating rods
Section X  Connection port, water cooling, cold cap baffle
Section Z  Attachment, cold cap baffle

Min./Max. position on the cover frame for the oil level sight glass

Fig. 14b  Overall view of the DIP 20 000; other models are similar
Fig. 15 Terminal diagram, DIP 3000 — 230 V AC, 50/60 Hz

- 2 heating elements 1200 W, 230 V, P = 2.4 kW
- 2 circuit breakers 6 A, line protection
- Neutral bus
- PE bus
- Switching capacity 16 A / 400 V AC
- Built-in thermostat
- Safety temperature monitor
- Set at 320 °C
- Contact open at ≥ 320 °C
- Safety temperature monitor
- Switching capacity 16 A / 400 V AC
- Built-in thermostat
- Safety temperature monitor
- Set at 320 °C
- Contact open at ≥ 320 °C
Terminal diagrams

Fig. 17 Terminal diagram, DIP 12 000 — 400 V, 3-phase, star connection, 50/60 Hz

9 heating elements, approx. 800 W, 230 V, P = 7.2 kW

9 circuit breakers 6 A, line protection

Fuse box

Thermostat

Neutral bus

PE bus

To relay coil

Built-in thermostat
Safety temperature monitor
Switching capacity 16 A / 400 V AC
Contact temperature at ≥ 320 °C

Contacts open at ‡ 320 °C

To relay coil

Contact temperature

9 heating elements, approx. 800 W, 230 V, P = 7.2 kW

Terminal strips
Fig. 18 Terminal diagram, DIP 20 000 — 400 V, 3-phase, star connection, 50/60 Hz
Terminal diagrams

Fig. 19 Terminal diagram, DIP 30 000 — 400 V, 3-phase, star connection, 50/60 Hz

18 heating elements, 1000 W, 230 V, P = 18 kW

2 x Built-in thermostat
Safety temperature monitor
Set at 360° C
Contacts open at ≥ 360° C

Fuse box
18 circuit breakers 6 A, line protection
Neutral bus
PE bus

To relay coil

Pump base
Cover plate
Thermostat 1
Thermostat 2

Switching capacity 16 A / 400 V AC
Set at 360° C
Contacts open at

2 x Built-in thermostat
Safety temperature monitor
Set at 360° C
Contacts open at ≥ 360° C
2 x Built-in thermostat
Safety temperature monitor
Switching capacity 16 A / 400 V AC
Set at 360 °C
Contacts open at ≥ 360 °C

To relay coil

Fig. 20  Terminal diagram , DIP 50 000 — 400 V, 3-phase, star connection, 50/60 Hz
Declaration of Contamination of Vacuum Equipment and Components

The repair and/or service of vacuum equipment and components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay. The manufacturer could refuse to accept any equipment without a declaration.

This declaration can only be completed and signed by authorized and qualified staff.

1. Description of Vacuum Equipment and Components
   - Equipment type/model: _________________________________
   - Code No.: _________________________________
   - Serial No.: _________________________________
   - Invoice No.: _________________________________
   - Delivery date: __________________________

2. Reason for Return
   ______________________________________________
   ______________________________________________
   ______________________________________________
   ______________________________________________
   ______________________________________________
   ______________________________________________

3. Condition of the Vacuum Equipment and Components
   - Has the equipment been used? yes □ no □
   - What type of pump oil/liquid was used? _________
   - Is the equipment free from potentially harmful substances? yes □ (go to Section 5) no □ (go to Section 4)

4. Process related Contamination of Vacuum Equipment and Components:
   - toxic yes □ no □
   - corrosive yes □ no □
   - explosive*) yes □ no □
   - biological hazard*) yes □ no □
   - radioactive*) yes □ no □
   - other harmful substances yes □ no □

*) Vacuum equipment and components which have been contaminated by biological explosive or radioactive substances, will not accepted without written evidence of decontamination!

Please list all substances, gases and by-products which may have come into contact with the equipment:

<table>
<thead>
<tr>
<th>Trade name</th>
<th>Product name</th>
<th>Chemical name (or Symbol)</th>
<th>Dangerous material class</th>
<th>Measures if spillage</th>
<th>First aid in case of human contact</th>
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5. Legally Binding Declaration

I hereby declare that the information supplied on this form is complete and accurate. The despatch of the contaminated vacuum equipment and components will be in accordance with the appropriate regulations covering Packaging, Transportation and Labelling of Dangerous Substances.

Name of organisation or company: _______________________________________________________

Address: ____________________________ Post code: _______________________

Tel.: _______________________________ Fax: ___________________________

Name: _______________________________ Job title: ___________________________

Date: _______________________________ Company stamp: _______________________

Legally binding signature: ____________________________________________________________
We, the Leybold Vakuum GmbH, declare herewith that the commissioning of the incomplete machine designated below is prohibited until such time as it has been determined that the system in which this incomplete machine is to be installed complies with the EC Machinery Directive.

**Product designation:**
Oil diffusion pumps

**Models:**
- DIP 3 000
- DIP 8 000
- DIP 12 000
- DIP 20 000
- DIP 30 000
- DIP 50 000

**Catalog numbers:**
222 10 /20 /25 /30 /35 /40

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**The products comply with the following directives:**
- EC Low-Voltage Directive (73/23/EEC)

**Applicable, harmonized standards:**
- EN 292
- EN 1012, Part 2
- EN 50081-2
- EN 50082-1
- EN 60204
- EN 61010

**Applied national standards and technical specifications:**
- DIN 28400
- DIN 28403
- DIN 2501
- ISO 1609

Cologne, 5 September 1996

Beeck, Diffusion Pump Division Manager

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Kersken, Diffusion Pump Development Section
Index

A
Air inrush 2, 17

B
Baffle 3-6, 9-11, 16, 21, 26, 28, 29

C
Cold cap baffle 3-5, 9-11, 16, 21, 26, 28, 29
Contamination 2, 22, 36
Coolant 2, 3, 5, 9-11, 14, 16-18, 21, 25, 26, 28
Coolant flow monitor 14, 17
Cooling coils 4, 17, 18, 22

D
De-scaling 25
Dial thermometer 14

E
Electrical connections 2, 11, 12, 24
Electrical junction box 3, 13, 14, 28

F
Filling level 15, 17, 19, 20
Forevacuum connection flange 3, 4, 9, 28
Forevacuum valve 16, 17

H
Hazardous gases 18, 19
Heat conducting plate 13
Heat diffusion fin 4, 29
Heating 3-5, 9, 11-14, 17, 24, 27-35
Heating cartridge 13, 24, 27, 29
High-vacuum connection flange 3, 4, 9, 28
High-vacuum valve 16, 17

M
Mineral oil 15, 20

N
Nozzle assembly 3, 4, 17, 21, 23, 25, 26, 28

O
Oil level 9, 13, 15, 19-21, 29
Oil level sight glass 9, 15, 20, 21, 29
Overheating protection switch 14
Oxygen 3, 15

P
Pump fluid 2, 4, 5, 6, 9, 15-21, 24, 28, 29
Pumping speed 4, 5, 16, 25

R
Roughing line 16

S
Silicone oil 15, 20
Sorption trap 16
Spent fluids 15

T
Temperature 4, 5, 11, 12, 14-17, 24, 27, 30-35
Terminal diagram 30-35
Thermostat 4, 9, 12-14, 17, 26, 28-35
Thermostatic safety switch 6, 14, 17, 28

U
Used fluid 15

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