Hydro-Pneumatic Cylinder
HPL-B / HPL-C
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1. Specifications

- **Operating pressure**: 3 to 10 bar
- **Compensation pressure (DK model)**: max. 6 bar
- **Compressed air**: filtered, lubricated or not lubricated
- **Hydraulic medium**: slide oils of viscosity class ISO VG 32 (32 mm²/s at 40°C). Supplied cylinders filled with hydraulic oil Mobil Vactra No. 1 (see Section 9)
- **Operating temperature**: 15 °C to 80 °C (HPL-B max. +50 °C)
- **Function mode**: double-acting
- **Cushioning**: for back stroke only (adjustable)
- **Stroke speeds**: Depending on operating pressure, oil volume flow, load, function mode and size of cylinder. Stroke speed of the different speed regulation valves see HPL catalogue

**Intended use**

Hydropneumatic cylinders HPL are driving elements which serve to perform uniform linear motion in alternating direction and within a limited stroke. Employment of the unit for any other purpose shall not be deemed the intended use. The manufacturers will not assume any liability for damage resulting from any other use than the intended use.

2. Safety

**Safety symbol**

This **Caution !** symbol is included in the Operating Instructions wherever special care must be exercised. **Operational safety**

- The hydropneumatic cylinder HPL designed and manufactured according to the state of the art, and is operationally safe when properly installed. The operational safety of the overall system is subject to the assessment of the manufacturer of the overall system.
- Any person involved with the installation of the HPL must have read and understood the Operation Instructions and, in particular, these safety instructions.
- The manufacturers will not assume any liability for arbitrary alterations and modifications to the unit.
- Hydropneumatic cylinders HPL are driving elements which serve to perform uniform linear motion in alternating direction and within a limited stroke.
- For units with pressure compensation, for any piston rod motion, whether through applying pressure to the piston or moving the rod from outside, under the condition of pressure compensation connected, the compensation tank must be filled with hydraulic pressure medium ensuring a pneumatic pressure equivalent to the working pressure

Employment of the unit for any other purpose shall not be deemed the intended use. The manufacturers will not assume any liability for damage resulting from any other use than the intended use.
3. General

Basic information

The EU machine directive 2006/42/EC does not apply to this device. Therefore, it is also not provided with the CE marking according to the machine guideline.

These operating instructions are intended to enable the manufacturer of the overall operational system to properly install the device and instruct the user about any necessary maintenance.

These operating instructions are intended for engineers of the manufacturer providing the overall system, and not for the user of the system.

It is assumed that the fundamentals of pneumatics and hydraulics are known.

Only if these operating instructions are understood and complied with can installation mistakes be avoided and trouble-free operation be guaranteed.

However, if you do encounter problems please contact our company, field staff or agencies.

We reserve the right to make technical modifications

Copyright

The copyright of these Operating Instructions shall remain with SPECKEN-DRUMAG.

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4. Design and operation

4.1 General description

The Hydropneumatic cylinder HPL converts the energy from processed compressed air into a steady linear movement. The internal hydraulic cycle is regulated using control elements.

The working energy is supplied through an external air power supply system. The internal closed hydraulic circuit can be precisely regulated using control units. This enables the piston rod, whose feed rate can be controlled separately, to move in a steady linear fashion.

4.2 Design

Due to the nature of the appliance, it is helpful to divide the hydropneumatic drives into two main areas. Depicted below is a longitudinal section through the drive which is generally designed as a fluid cylinder. The possible control features will be shown and described further down.

![Diagram of hydropneumatic cylinder]

2.1 Front plate
2.11 Air connection (Back stroke)
2.12 Rod bearing
2.13 Fastening nut
2.2 Front cap
2.21 Cushioning
2.22 Seal element for cushioning
2.23 Cushioning regulator
2.24 Air connection (Forward stroke)
2.3 Piston
2.31 Hydraulic seal
2.32 Pneumatic seal
2.4 Compensation and Backstroke piston
2.5 Rod
2.6 / 2.7 Hydraulic pressure medium
2.8 Spring compensation (only HPL-B)
2.81 Pressure compensation system (only HPL-C; with HPL-B: Oil refilling fitting)
2.9 Function control unit (see section 4.3 ff)
4.2.1 Hydro-control units

The hydro-control equipment is located between the two oil chambers (2.6 and 2.7) (with dotted frame in picture 2). The main features can be found under point 4.3.

4.3 Function modes

4.3.1 Basic design

You can select whatever hydropneumatic drive functions you require by combining several basic control elements. These could be:

- Throttle valve
- Fine throttle valve
- Throttle check valve
- Stop-valve normally closed or normally open
- Check valve

There are two different basic types for accommodating the control elements:

**Basic type 1: cylinder centrepiece for directly incorporating a throttle / fine throttle / throttle check valve**

This basic type allows you to perform control functions 21, 2L1, 23 and 32 (see HPL catalogue), i.e. functions with just one adjustable speed and no stop function.

**Basic type 2: Cylinder centrepiece with mounted valve block**

All functions not stated under basic type 1 can be performed with this assembly and all necessary basic control elements can be combined in the valve block. The valve block has two parallel, mutually independent oil ducts, which are each be fitted with the basic control elements required for the control procedure. One or more of these elements can be replaced with blank panels or plugs for specific control procedures.
4.3.2 Basic control elements

**Throttle valve**
The throttle valve determines the volume flow rate for the desired feed rate, which is identical in both feed directions.

**Fine throttle valve**
The fine throttle valve determines the volume flow rate for the desired feed rate, which is identical in both feed directions. It is used in particular for low feed rates when the resolution of the standard throttle is insufficient.

**Throttle check valve**
The throttle check valve determines the volume flow rate for the desired feed rate in one feed direction; it allows free through-flow in the opposite direction.

**Stop/fast-feed valve (NC/NO)**
This valve stops the volume flow rate of the respective oil duct and thereby allows the throttle in the series connection to be switched on or off. If both oil ducts are closed, the cylinder will stop, even when the mains pressure has been switched on. If there is no throttle or if there is a throttle check valve connected in series to the open valve, this produces a fast-feed function at maximum speed.

The stop-valve (NC; normally closed) is spring-loaded and stops the oil flow. In order to open the valve, there must be a control signal on the side connection. The back connection must be vented.

The stop-valve (NO; normally open) allows the oil to flow through freely when inactive. In order to stop the oil flow, there must be a control signal on the back connection. The side connection must be vented.

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**Caution !**
For safety reasons it is better to use the NC variant as the cylinder stops if the network air supply fails, thus ensuring that no uncontrolled movements can occur.
Check valve
The check valve enables free through-flow in one direction and blocks the flow in the other direction.

4.3.3 Functions
The functions are defined by two digits; the first digit describes the outward stroke function, the second digit describes the back stroke function (see HPL catalogue). You can find out which basic control elements are used for the respective operation in the circuit plan, which is available for every type of control.

4.4 Cushioning
The cylinder features an integrated pneumatic cushioning for the end positions (HPL-B: only back stroke). The cushioning rate can be set reasonably accurately by means of the throttle (6.3). A toothed ring (6.4) is provided to prevent the throttle from being accidentally removed.

Caution! HPL-B: Forward stroke without cushioning!

4.5 Pneumatic pressure compensation
The HPL-C cylinders are pressure-compensated (DK). The hydraulic part is filled and topped up via the compensator (9.3 with 9.2).
A check valve which is integrated into a differential piston enables the pressure medium to flow from the tank to the drive in all of the system's operating states.
When the hydraulic pressure in the drive increases, for example, because of heat influences, the check valve opens to allow the medium to flow back to the tank at an overpressure of approx. 50% in the drive.
Pressure compensation is an important element of self-contained hydropneumatic systems. The compensation tank to be filled with Mobil Vactra No. 1 or a similar slide oil to a level of about 70%, serves to compensate for hydraulic pressure medium differences in the cylinder which occur during operation. In addition the reserve oil volume serves to compensate for losses at sealing points with the compressed-air unit and casing.

During operation and also when turning the piston rod from outside, the compensation tank must be kept under pneumatic pressure equal to the operating pressure, but not more than 6 bar.

Caution!

5. Installation

5.1 Mechanical Installation

Due to the fact that hydropneumatic cylinders are some flexible in design you must be particularly careful when selecting the assembly method. For best results, secure directly at the cylinder head. In the case of long-stroke cylinders use the cover centring support. If pivoting is required, this can be best achieved using spherical bearings at the cover and at the piston rod.

Caution!

Avoid stress through transverse forces as this can impair the smooth operation of the cylinder. It also can cause greater leakage.

5.2 Pneumatical Installation

Caution!
6. Putting into service

Before putting into service, ensure that the HPL hydropneumatic cylinder is properly installed in the overall system. It is important to make sure that the hydraulic unit has been properly vented (the hydraulic unit comes filled and vented with the HPL). When using the pressure compensation you must also ensure that the compensation tank is filled with hydraulic fluid.

7. Maintenance

7.1 Maintenance

For the cylinders of the HPL-C series, maintenance is limited to checking the hydraulic medium level in the compensation tank. On cylinders of the HPL-B series (spring-compensated), a non-uniform motion behaviour indicates a possible loss of pressure medium. Refilling using different hydraulic pressure media is not permitted. Before any refilling, stop the cylinder, disconnect the compensation pressure and vent the compensation tank. The tank should be filled to a level of about 70% with hydraulic pressure medium.

7.2 Venting the hydraulic system

Usually air can only get into the hydraulic system if the piston rod is turned from the outside without the compensation valve or compensating pressure, the cylinder is operated with inadequate compensating pressure or the gaskets and seals are worn or defective. If there is no or not enough compensating pressure, the hydraulic pressure medium is pushed back into the compensation tank, causing a negative pressure in the hydraulic system and a take-in of air through the gaskets.

If larger volumes of air have been trapped, it is recommended to drain the oil completely and refill.

Prerequisites

- The cylinder must be horizontal (the ventilation screws (pos. 3.7 and 3.8) are on top of the cylinder centrepiece or valve block)
- Both of the cylinder's compressed-air connections (pos. 2.11 and 2.24) must be unpressurised.
- The adjusting screw(s) on the throttle(s) should be fully open (max. speed)

Filling

- Connect the compensation tank at the compensation connection (pos. 3.6) and fill with oil.
- Remove the ventilation screws, insert the union pieces incl. plastic tube into the screw thread of the ventilation screws to collect the oil that flows out during the venting and/or filling process in a tank.
- Create an overpressure of approx. 0.5 to 1 bar at the compensation tank until oil leaks out of the ventilation screw connections, then depressurise the compensation tank again.

Caution ! Ensure that the compensation tank is topped up in due time.
Close the ventilation screws again (remove the union pieces and plastic tube) and move the cylinder backwards and forwards approx. five times. Generate an operating pressure in the cylinder and compensation tank when moving backwards and forwards. Once this process is complete, the operating pressure must be switched off again.

Remove ventilation screws, insert union piece incl. plastic tube and create an overpressure of approx. 0.5 to 1 bar at the compensation tank again until oil without bubbles leaks out of the ventilation screw connections. Raise the cylinder at each side alternately to allow any air present through to the ventilation screw.

Once the filling pressure of 0.5 to 1 bar overpressure at the compensation tank has been switched off, no more oil should leak out of the cylinder. If there were any more air pockets in the cylinder, the expanding air would continue to push oil out of the cylinder (only applies to pressure-compensated cylinders).

Remove union pieces incl. plastic tube and close the ventilating unions. The compensation tank should be filled to about 70% with hydraulic pressure medium.

On cylinders of the HPL-B series (with internal spring compensating feature) the compensation tank must then be pressurised with operating pressure (6 bar), in order to completely fill the internal compensation area and counter the spring pressure. Once the filling procedure is complete, it is necessary to drain the following amounts of oil at the oil filling screw, depending on the stroke.

<table>
<thead>
<tr>
<th>HPL - 40</th>
<th>Reserve oil</th>
<th>up to stroke 200</th>
<th>amount to be discharged</th>
<th>up to stroke 300</th>
<th>up to stroke 400</th>
<th>up to stroke 500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 cm³</td>
<td>4 cm³</td>
<td>6 cm³</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HPL - 50</td>
<td>40 cm³</td>
<td>6 cm³</td>
<td>10 cm³</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HPL - 63</td>
<td>70 cm³</td>
<td>11 cm³</td>
<td>16 cm³</td>
<td>32 cm³</td>
<td>27 cm³</td>
<td>-</td>
</tr>
<tr>
<td>HPL - 80</td>
<td>110 cm³</td>
<td>17 cm³</td>
<td>25 cm³</td>
<td>35 cm³</td>
<td>44 cm³</td>
<td>-</td>
</tr>
</tbody>
</table>

**Caution !** The filling pressure for the spring-compensated cylinders of the HPL-B series must be 6 bar. The quantities of oil stated above must be drained in order to compensate for the change in volume of the hydraulic oil caused by the temperature changes. The maximum operating temperature for the HPL-B series is 50°C.

### 7.3 Replacement of seals and gaskets

In general, replacement of seals and gaskets is not necessary if the pressure media are used and filtered as specified. However, if a replacement does become necessary, it is recommended to have this done by the manufacturers.

**Caution !** All piston gaskets should be changed when performing replacement operations on the spot. It is important to adhere to the relevant tightening torques of the thread when assembling. The hydraulic system must be carefully vented in order to maintain an even motion. Always check the condition of the sliding faces and replace worn parts when changing the seals and gaskets.
7.4 Assembly lubrication

"Autol TOP 2000" is used for assembly lubrication purposes. To ensure the unit's operational safety the above-mentioned grease or compatible greases should be used for maintenance work which requires relubrication.

8. Trouble shooting

<table>
<thead>
<tr>
<th>Fault</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive medium losses at the compensation tank</td>
<td>Hydraulic gasket leaks</td>
<td>Refer to Section 7.3</td>
</tr>
<tr>
<td>Nonuniform motion behaviour</td>
<td>Air in the hydraulic system</td>
<td>Refer to Section 7.2</td>
</tr>
<tr>
<td>Excessive wear at front plate bearing and rod</td>
<td>radial forces</td>
<td>Refer to Section 5 Contact manufacturer</td>
</tr>
</tbody>
</table>

9. Spare parts

When ordering spare parts please indicate the model designation and part number of the desired unit. Seals and gaskets are available in complete sets only. The hydraulic medium Mobil Vactra No. 1 is available at SPECKEN DRUMAG.

10. Waste Disposal

Caution! Any left lubricants and parts such as seals, cleaning materials etc. must be disposed of in compliance with the local requirements.