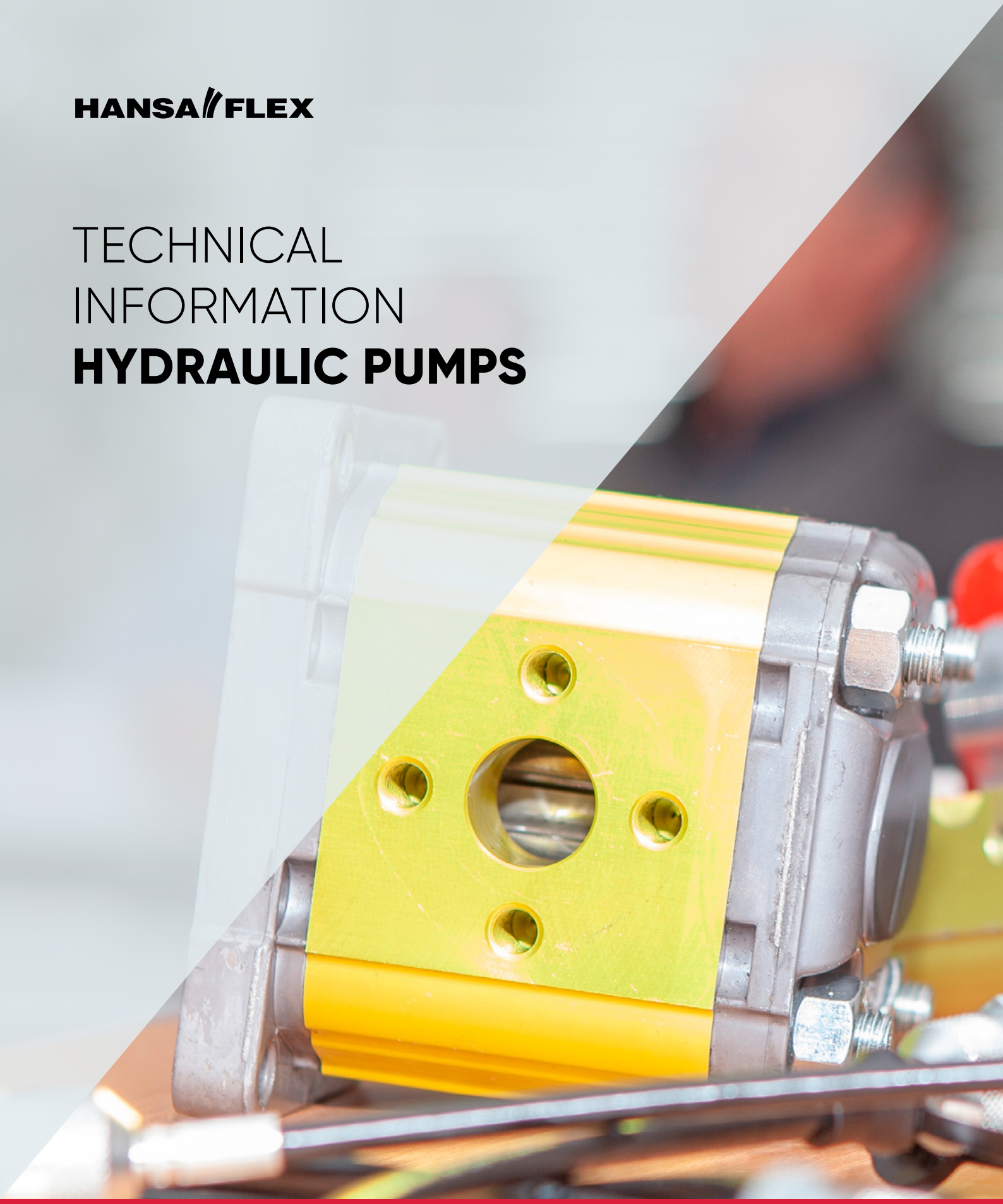
HANSA-FLEX

TECHNICAL INFORMATION
HYDRAULIC PUMPS



REV. A / 01/2025

Technical information Hydraulic pumps

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1. General

The installation, commissioning and maintenance of hydraulic systems or their components may be carried out only by suitably qualified personnel and in strict observance of all the relevant safety regulations.

The main task of the pump is to convert mechanical energy in the form of torque and rotational speed into hydraulic energy in the form of volumetric flow and pressure.

However, the requirements applying to a pump are considerably more differentiated in practice.

The following points must be considered:

- Pressure range
- Required volumetric flow
- Rotational speed range
- Operating medium
- Temperature range
- Drive type
- Attachment/installation
- Ease of maintenance
- Noise level
- Efficiency
- Cost
- Number of load cycles
- Constant or variable displacement

The list of criteria alone illustrates that not every pump can fulfil all the criteria. For this reason, there are various design principles for hydraulic pumps. However, they all work using the principle of displacement. This means that mechanically sealed chambers in a pump transport fluids from the inlet side (suction side) to the outlet side (pressure side). Pumps that work using the principle of displacement are also suitable for very high system pressures because of the lack of direct connection between the suction and pressure ports.

2. Safety instructions

The maximum loads (volumetric flows, pressures, forces, temperatures) given in the product documentation must not be exceeded.

The operator (the employer) of the system must ensure that:

- The safety instructions and operating manuals are available and complied with
- The product is used for the intended applications stated in the operating instructions and the installation instructions and on the identification plate
- The currently applicable accident prevention and installation regulations are observed

- The permissible operating data and conditions of use are complied with
- Safety devices are used and the prescribed maintenance tasks are carried out

3. Technical information

3.1. Principles of construction

The principles of construction basically depend on the way in which the pressure medium is transported and displaced in the interior of the pump. The displacement volume of the pump can be constant or adjustable (variable).

Displacement principle	Design	Variant	Displacement volume
Gear	Gear pump	External gear pump	Constant
		Internal gear pump	
		Gerotor pump	
	Screw spindle pump	Screw spindle pump	
Vane	Vane pump	Single-acting	Constant / variable
		Double-acting	Constant
Piston	Radial piston pump	Radial piston pump	Constant / variable
	Axial piston pump	Swash plate pump	
		Bent axis pump	

The following figures 1-10 made available by IHA Schulungs gGmbH give a clearer illustration of the principles of construction.

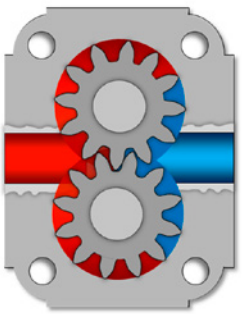

Fig. 1: External gear pump

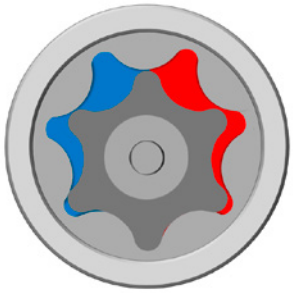

Fig. 2: Gear pump

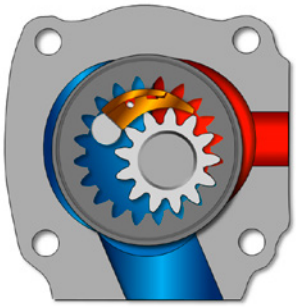

Fig. 3: Internal gear pump

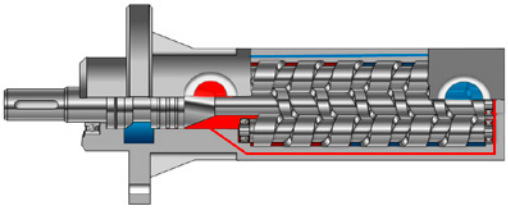

Fig. 4: Screw spindle pump

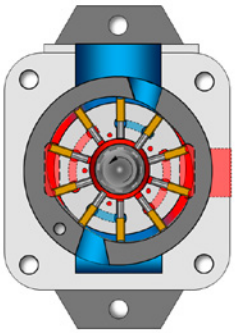

Fig. 5: Vane pump, double-acting

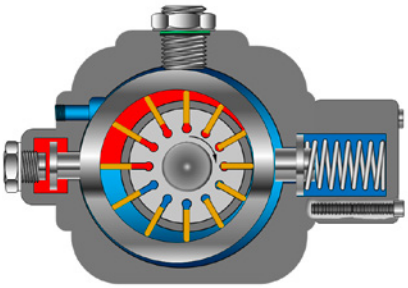

Fig. 6: Vane pump, single-acting

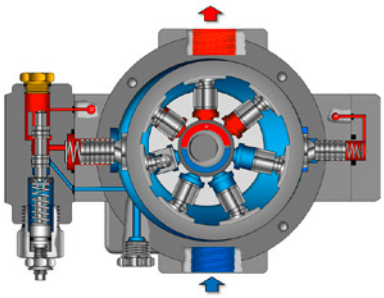

Fig. 7: Radial piston pump, pistons supported outside

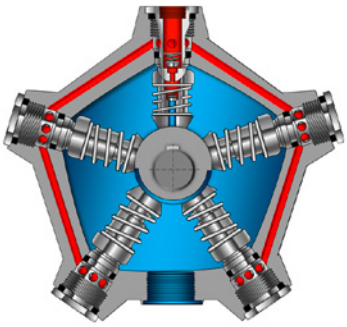

Fig. 8: Radial piston pump, pistons supported inside

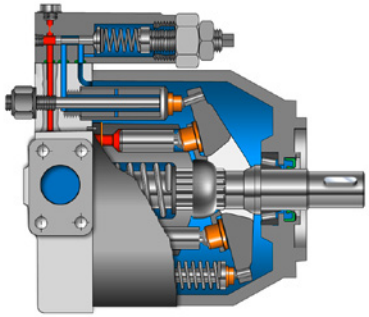

Fig. 9: Axial piston pump, swash plate

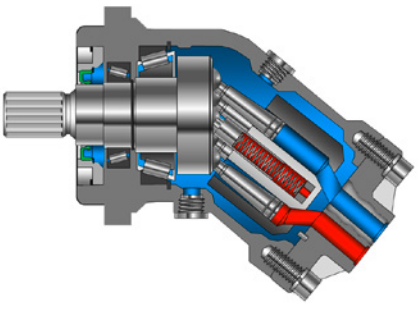

Fig. 10: Bent axis pump, constant

3.2. Hydraulic pump drives

Hydraulic pumps can be driven in various ways. As a rule, electric motors are used in the field of industrial hydraulics. A common type of drive in mobile hydraulics is the power take-off gearbox onto which the pump is bolted by a flanged connection. Internal combustion engines are also used as drives. Pumps can be driven directly from the auxiliary drive of vehicles or mobile machines.

3.3. Design of hydraulic pumps

Various factors must be taken into account when designing hydraulic pumps.

The most important parameter is the geometric displacement volume (V_g). This is a measure of the size of the pump. It describes the volume of fluid that can be delivered by the pump per revolution (or per stroke). Losses occur through the conversion of mechanical power into hydraulic power. These losses are expressed by the overall efficiency.

Overall efficiency

The overall efficiency (η_{ges}) of the hydraulic system is the product of the volumetric efficiency and the hydro-mechanical efficiency.

$$\eta_{ges} = \eta_v \times \eta_{hm}$$

η_{ges} = Overall efficiency
η_v = Volumetric efficiency
η_{hm} = Hydromechanical efficiency

Volumetric flow of the pump

The volumetric flow (Q) the hydraulic pump is the quantity of hydraulic fluid that is delivered by the pump in a specified time.

$$Q = \frac{V_g \times n \times \eta_v}{1000}$$

$$Q = \frac{600 \times P \times \eta_{ges}}{p}$$

Q = Volumetric flow (l/min)
V_g = Geometric displacement volume (cm³)
n = Rotational speed of the pump (rpm)
η_v = Volumetric efficiency
P = Power of the pump (kW)
p = Working pressure at the pump outlet (bar)
η_{ges} = Overall efficiency

Required drive power of the pump

The drive power (P) required for a hydraulic pump depends on the working pressure and the volumetric flow.

Example: In order to achieve a working pressure of p = 500 bar at a volumetric flow of Q = 1 l/min, a drive power of approximately 1 kW is required!

$$P = \frac{p \times Q}{600 \times \eta_{ges}}$$

P = Drive power (kW)
p = Working pressure at the pump outlet (bar)
Q = Volumetric flow (l/min)
η_{ges} = Overall efficiency
M = Torque (Nm)
n = Rotational speed of the pump (rpm)

Rotational speed of the hydraulic pump

The rotational speed (n) is calculated in accordance with the following formula.

$$n = \frac{Q \times 1000}{V_g \times \eta_v}$$

n	= Rotational speed of the pump (rpm)
Q	= Volumetric flow (l/min)
V_g	= Geometric displacement volume (cm^3)
η_v	= Volumetric efficiency

Torque of the hydraulic pump

The torque (M) of the pump is calculated from the geometric displacement volume and the working pressure.

$$M = \frac{V_g \times p}{20 \times \pi \times \eta_{hm}}$$

M	= Torque (Nm)
V_g	= Geometric displacement volume (cm^3)
p	= Working pressure at the pump outlet (bar)
η_{hm}	= Hydromechanical efficiency

Pressure of the pump

The pressure of the pump (p) is calculated from the drive power of the motor and the volumetric flow.

$$p = \frac{600 \times P \times \eta_{ges}}{Q}$$

p	= Working pressure at the pump outlet (bar)
P	= Drive power (kW)
η_{ges}	= Overall efficiency
Q	= Volumetric flow (l/min)

3.4. Installation instructions / assembly

The installation, filling, start-up, bleeding and setting of hydraulic pumps must always be in accordance with the information provided by the manufacturer in the operating instructions. Observe the direction of rotation of the pump. The direction of rotation is clockwise or anticlockwise when looking onto the pump shaft. Ensure that the electrical connection is correct when installing the electric motor (rotating field). Ensure that the suction line is leak-free when assembling the pump, suction line and tank. Clean or replace any existing suction filter.

Reattach the safety devices before bringing into use. Large amounts of pressure fluid can escape when installing or removing hydraulic pumps. Keep suitable collection containers ready in order to prevent the resulting slip hazard.

Disconnect ports and mountings on the depressurised hydraulic pump in accordance with the manufacturer's information. Label the ports and lines before assembly in order to avoid mix-ups.

Protect open ends of lines and the motor-side flange against contamination.

4. Maintenance

Repairs to devices may be carried out only by qualified personnel.

Alteration, maintenance or installation work must be in accordance with the instructions in the operating instructions and the installation instructions. Original replacement parts should always be used.

The relevant safety and operating regulations of the country of use must be observed when performing maintenance work of any kind.

Careful maintenance has a crucial influence on operational safety and the service life of hydraulic systems. Oils and filters must be regularly checked and replaced in accordance with the instructions of the manufacturer. Systems must be regularly checked for leaks.

5. Disposal information

Hydraulic oil, hydraulic hose lines, hydraulic components and electronic components or devices may not be thoughtlessly placed in the ordinary refuse; they must be collected and disposed of in accordance with the applicable waste disposal regulations. The national requirements of the respective country and, if appropriate, the information given in the safety data sheets must be observed.