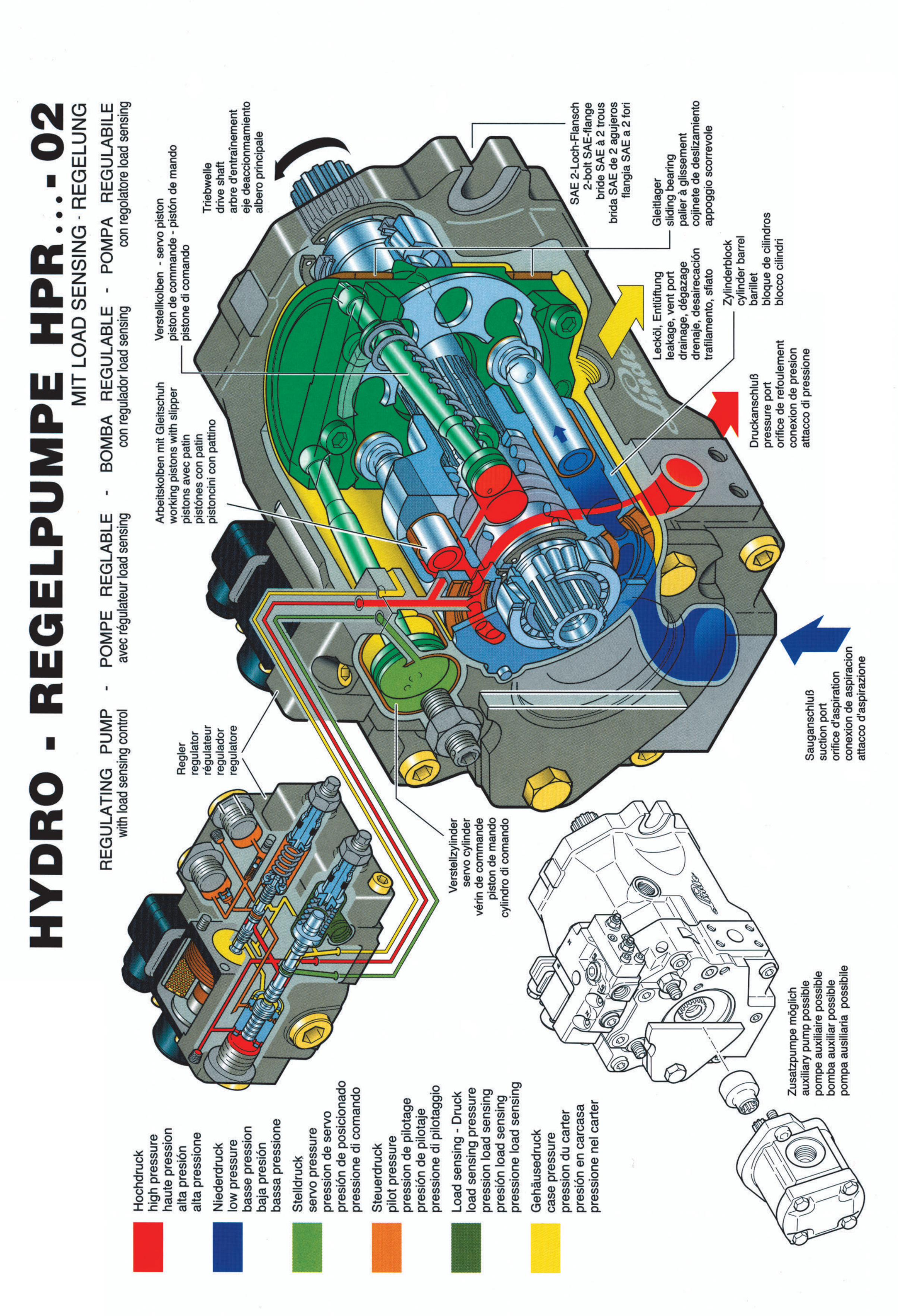
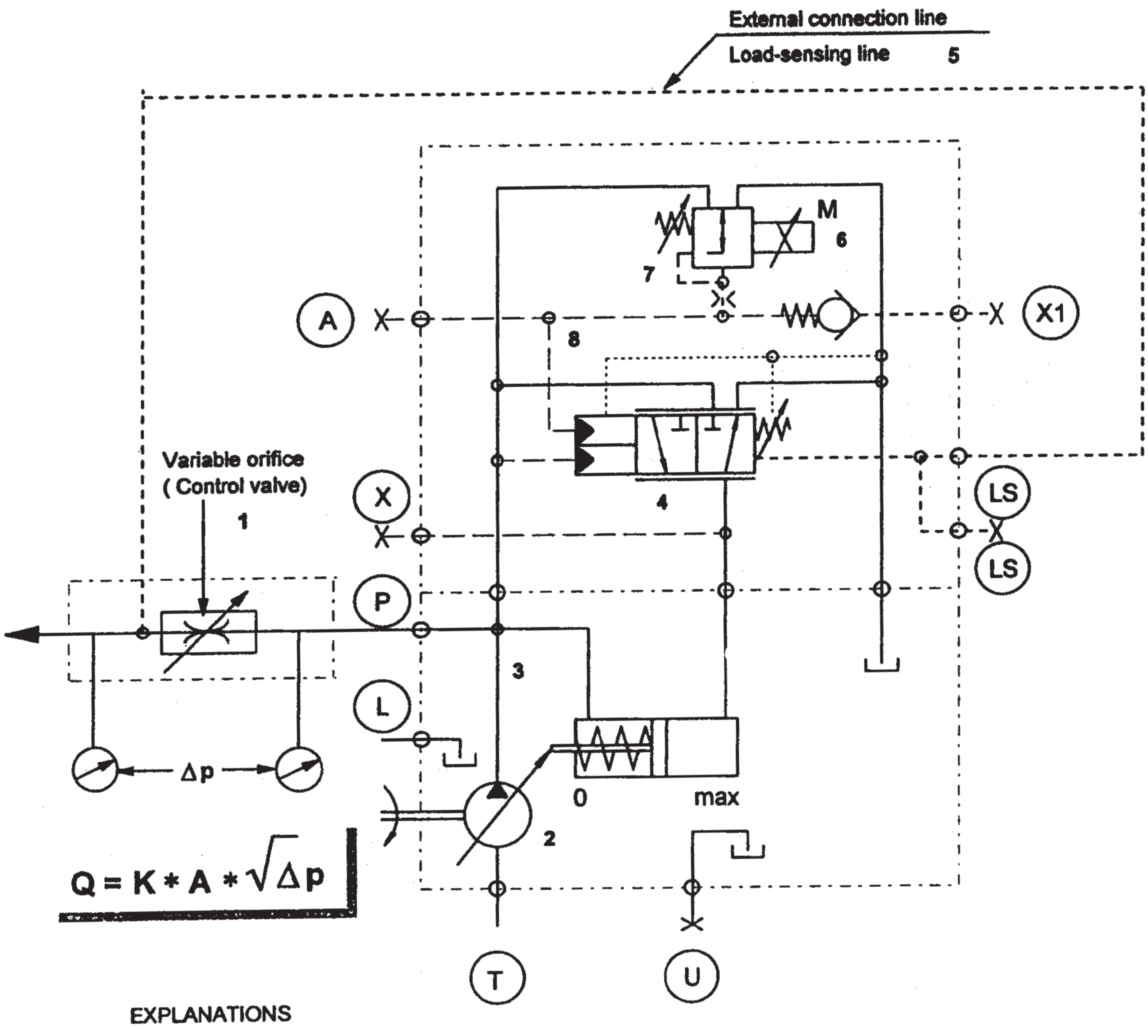
5 Variable Displacement Pump HPR 105/135-02



5.1 Circuit diagram



<u>EXPLANATIONS</u>

P	Discharge port SAE
T	Suction port SAE
X1	Control pressure port for emergency operation (max. 30 bar) M14x1.5
A	Gage port, control pressure M14 x 1.5
LS	Load-sensing connection 2x M14 x 1.5
X	Gage port, actuating pressure M14 x 1.5
L U	Drain (filling, vent) ports
	Port enabling case to be filled with oil

<u>Solenoid switching operations</u>
M d.c. proportional solenoid
12/24 V, according to specification

<u>Not component parts of HPR 02 :</u>
5 External connection line
1 Variable throttle (control valve)

5.2 Functional description

The HPR - 02 R E1 L models are self priming swash-plate type axial piston pumps with a variable displacement volume for open loops.
The controller of the HPR pump is a combination of two types of controls:

- load-sensing control
- electrical pressure control valve.

5.2.1 Load-sensing controller

The principle of the load-sensing control of the HPR pump is as follows: it controls the displacement starting from a zero pump flow condition. If no flow is demanded, only the "stand-by" pressure required by the system is maintained by the pump. When the main control valves are actuated, the load-sensing controller of the HPR automatically matches the displacement, and consequently the flow, to the "flow on demand" required by the control valves, up to the maximum available pump flow. The pump pressure is only approximately 20 bar higher than the (highest) pressure of the active loads. The load-sensing control system thus is a "flow on demand" control which matches the pump output flow to the variable metering orifice size by keeping a constant Δ p across the measuring orifice of the directional control valve.

$$\mathbf{Q} = \mathbf{K} \times \mathbf{A} \times \sqrt{\Delta \mathbf{p}}$$

5.2.2 Electrical pressure control valve

The pressure control valve is actuated via a proportional solenoid. The pressure control valve
reduces the, internally provided pump pressure in relation to the applied current.
This pressure signal changes the set pressure Δ p (reduction of the stroke volume) by means of an additional metering area on the LS control spool.
With additional components such as the Linde CEB electronic controller, the pressure control
valve can be used for anti stall control as well as for mode controls.

5.3 Technical description

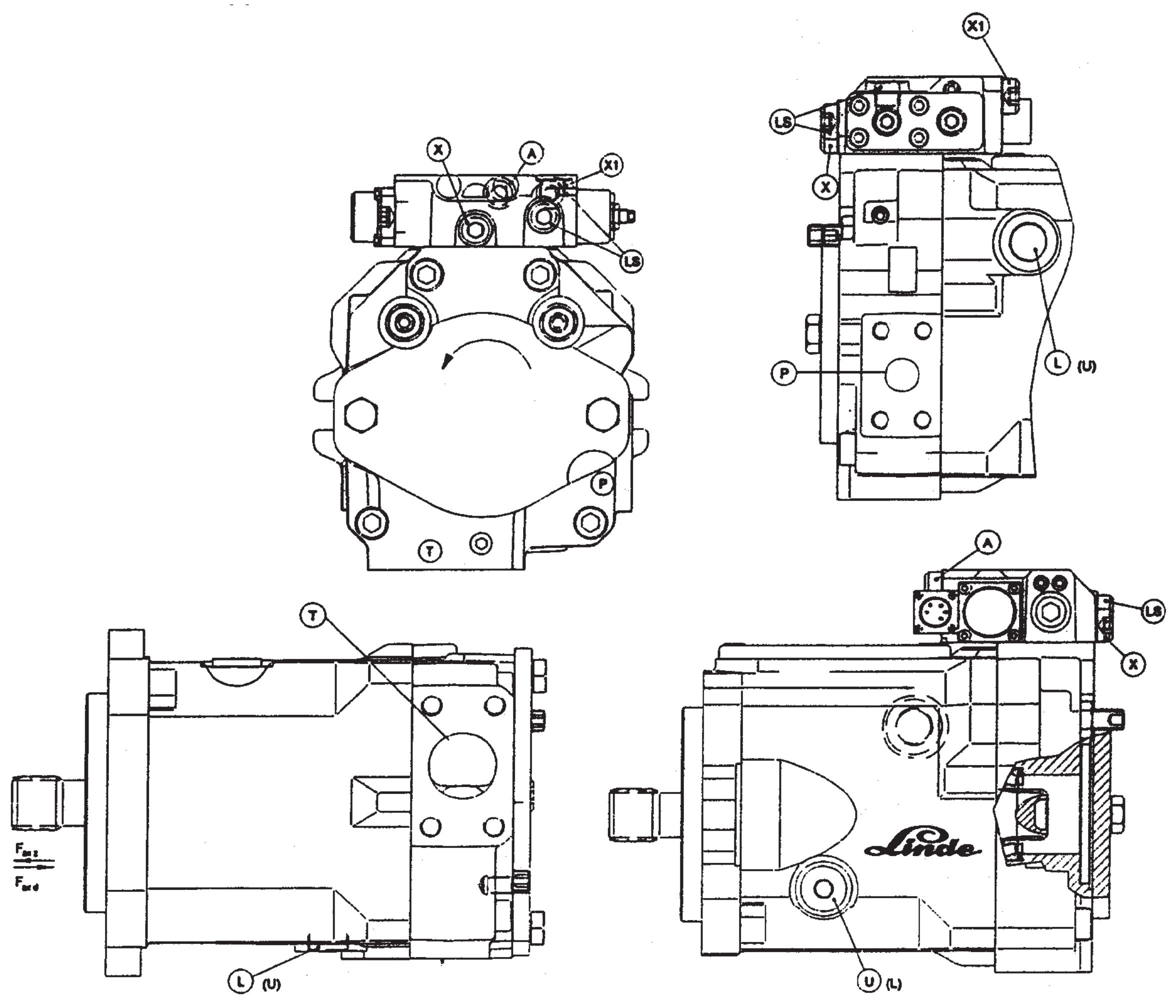
5.3.1 Load-sensing controller

When there is no function activated and when the control spool (1) is in the neutral position (see circuit diagram), then the pump (2) delivers only such a quantity of oil that the pressure in the pump line (3) which acts on the load-sensing controller (4) (LS) maintains the spring on the opposite side of the control spool and the swivel spring (on the displacement piston Vmin) in balance. Every change in pressure P and LS makes the LS spool move and leads to an immedial change of pump displacement. Upon actuation of the control piston (1) the connection from the pump output (2) to the load port is opened. Essentially, the area which is opened represents a metering orifice.
If a constant flow of oil is to flow continuously through this orifice, independent of the load pressure, then the pressure difference at this point must be kept constant. If the control spool (1) is opened, the pump pressure proceeds up to this function. At the same time, the load pressure acts upon the spring side of the LS spool (4), through the LS line (5), causing the pump (2) to go on stroke and the pressure in the P line (3) to increase.
If the pump pressure exceeds the load pressure, the load starts moving and the following oil flow produces a drop in pressure across the control edge (metering orifice). Balance is achieved when this drop in pressure corresponds to the spring preload of the LS controller (4).
The pump (2) reacts to each control spool movement because it tries to fully stabilize each variation of the metering orifice and to maintain always a constant pressure difference.

5.3.2 Electrical pressure control valve

When the solenoid (2) is in the de-energized state, the pilot spool of the pressure control valve (7) is in the position in which the connection channel (3) (pump pressure) to the channel (8) (metering area on LS pilot) is blocked. The channel (8) is released to the tank (interior of HPR pump housing). If a predetermined current exile in the solenoid (2), then the solenoid pin moves the pilot spool of the pressure control valve (7) to the position in which the channels (3) and (8) are connected. Solenoid force "Fm" is then converted into hydraulic force "Fh" proportionally in relation to the level of the applied current. This signal (control pressure) causes the set pressure difference Δ p to be reduced by means of an additional metering area on the LS control spool (4).
Result: A reduction of the displacement of the HPR pump.

5.4 Connection and gage port diagram



EXPLANATIONS

		105	135
	Nominal ratings (cm³)	105	135
P	Discharge port SAE	1“	1“
T	Suction port SAE	2“	2“
L U	Drain (filling vent) ports Port enabling case to be filled with oil	M22x1.5	M22x1.5

A Gage port, control pressure M14 x 1.5

LS Load-sensing port 2x M1 4 x 1 .5

X Gage port, actuating pressure M14 x 1.5

X1 Control pressure port for foroperation operation emergency operation (max. 30 bar) M 14 x 1.5

Solenoid switching operations
M d.c. proportional solenoid 12/24 V, according to specification

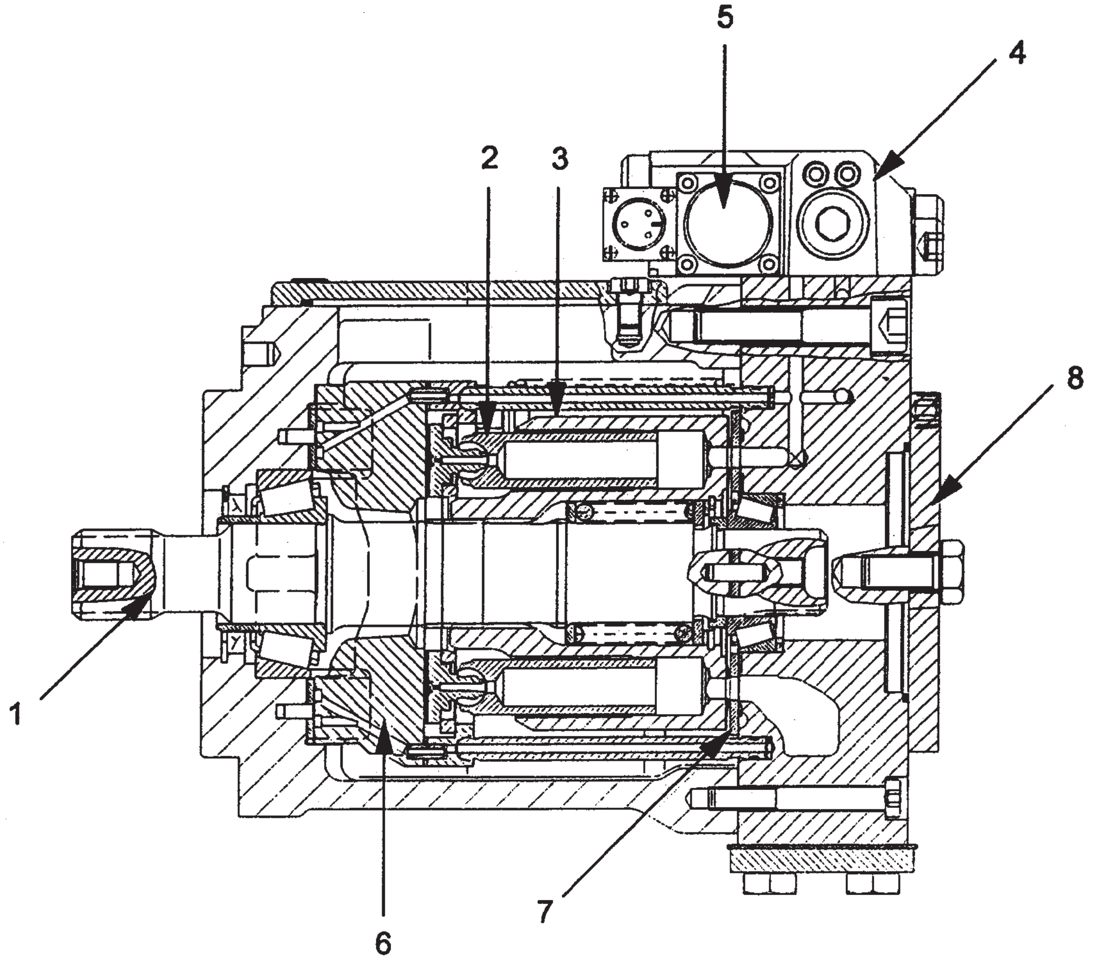
Oil type (see technical data sheet)

Permissible casing inner pressure 1,5 bar. Casing to be filled with oil and bled before start of operation observe mounting instructions !

For other specifications, see technical data sheets.

For applications involving radial shaft loadings please contact LFH.

5.5 Basic design of rotating goup



1 shaft
2 piston assembly
3 cylinder barrel
4 control
5 proportional solenoid
6 swash plate
7 port plate
8 PTO

5.6 Basic design of port

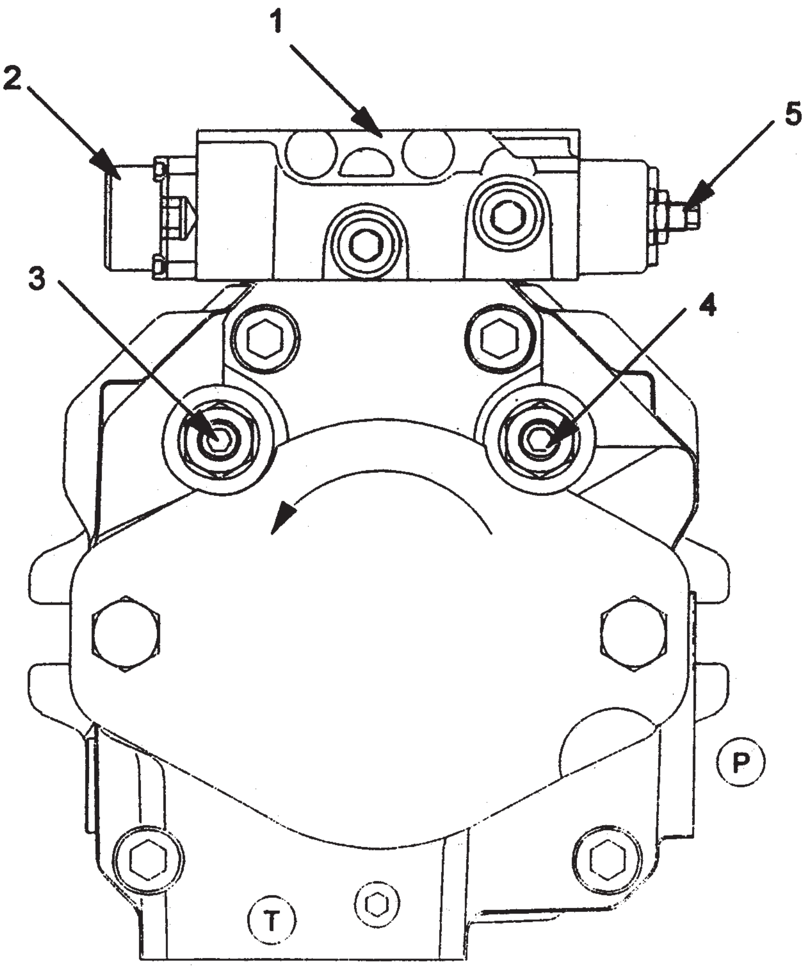
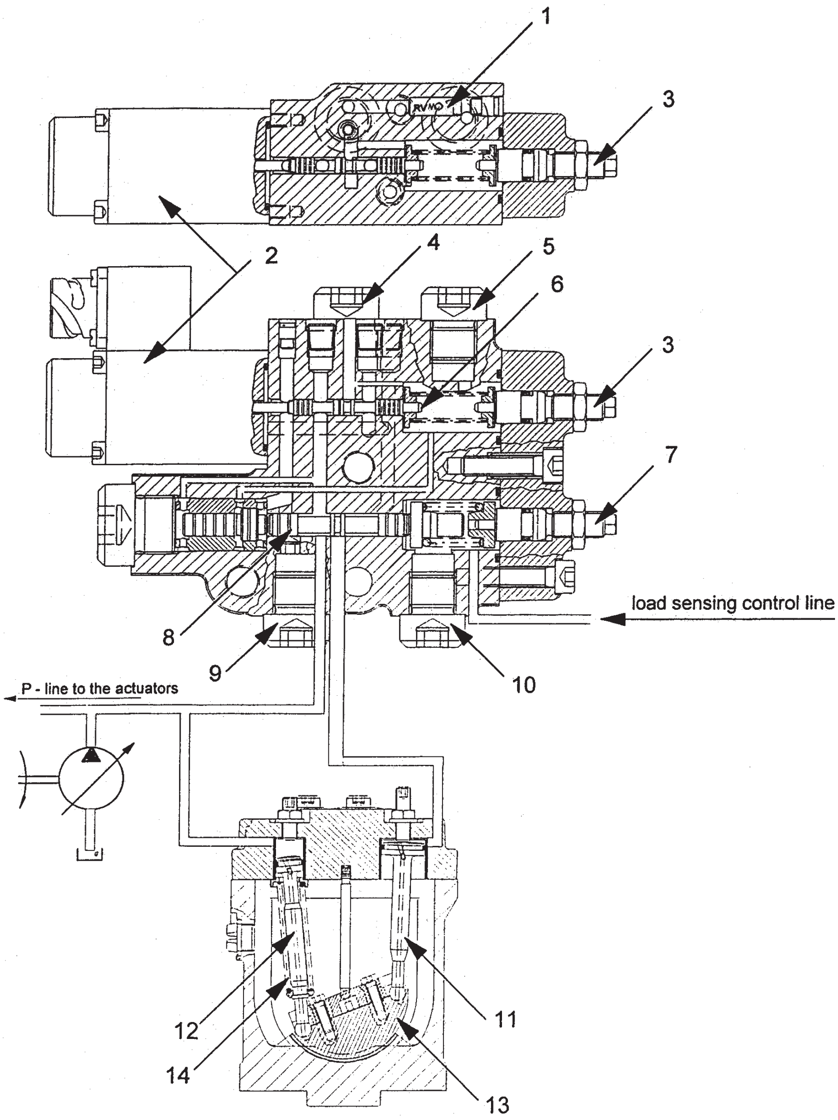


plate housing

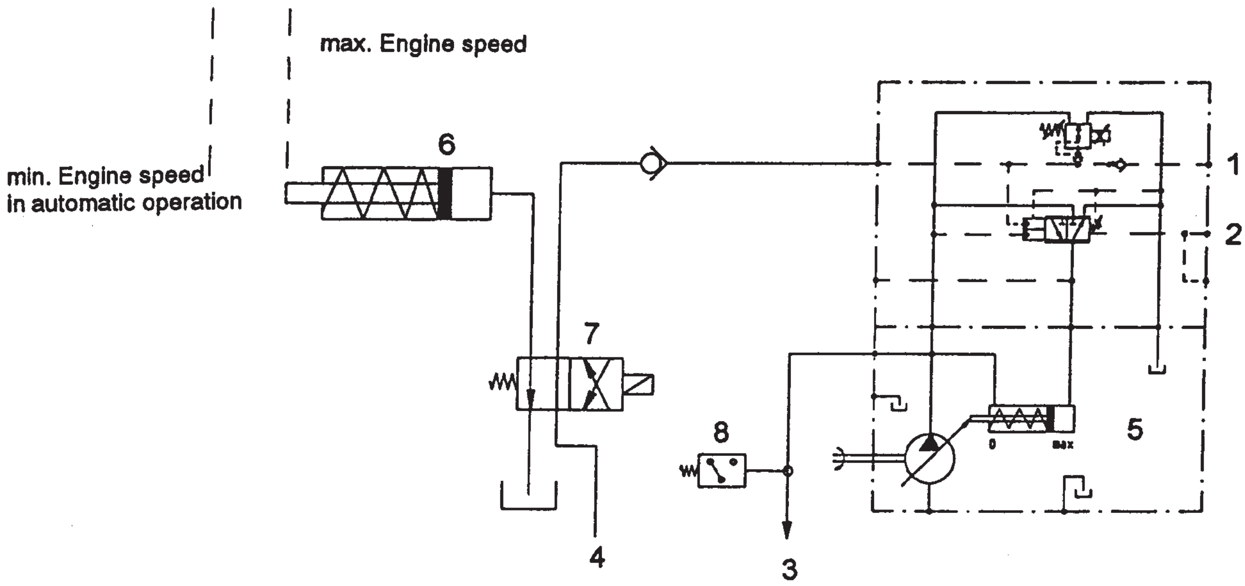
1 control
2 proportional solenoid
3 stop screw Vmax
4 stop screw Vmin
5 set screw LS - control Δ **p** = Pp - LSp

5.7 Basic design of control system

1 check valve
2 proportional solenoid
3 set screw control pressure
4 gage port A
5 control pressure port for emergency operation X1
6 pilot spool (el. pressure control valve)
7 set screw Δ **p** = Pp - LSp
8 pilot spool load sensing control
9 gage port X
10 gage port LS
11 actuator piston Vmax
12 actuator piston Vmin
13 swash plate
14 swivel spring



10 Automatic engine idle system



1 Connection - Emergency system

2 Connection - Load sensing line - Distributor valve

3 Connection - Pressure line

4 Connection - Servo pressure

5 Variable pump HPR

6 Hydraulic cylinder (build on speed adjusting device)

7 Soleniod valve (coil energized - min. engine rpm.)

8 Pressure switch (setting pressure 70 bar)