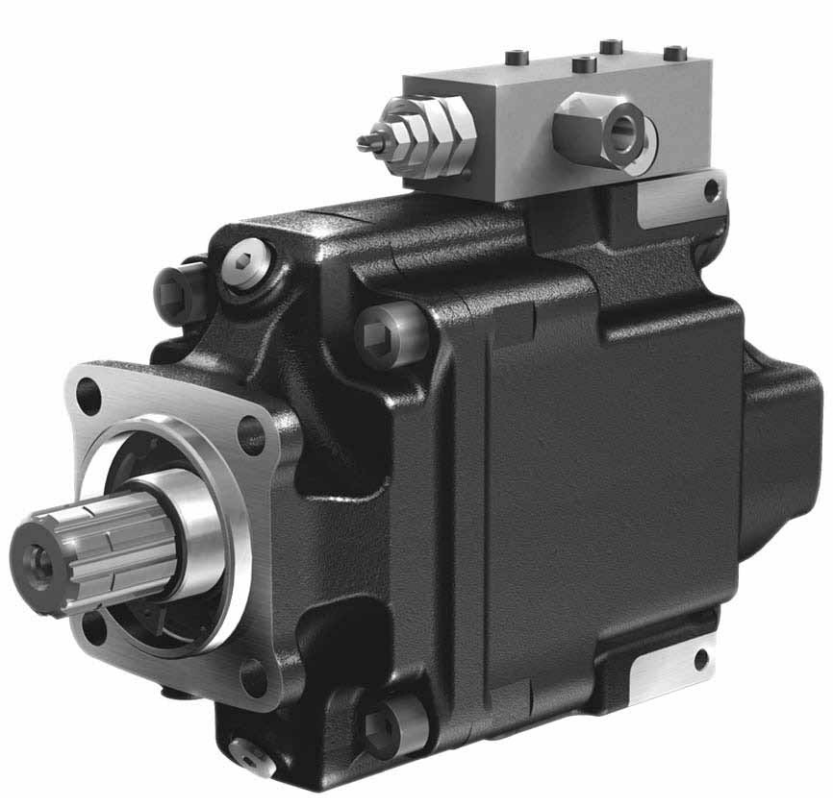


Truck Hydraulics

Serie VP1
Variable Displacement Pumps

aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

Parker

ENGINEERING YOUR SUCCESS.

Conversion factors

1 kg ..... 2.20 lb
1 N ..... 0.225 lbf
1 Nm ..... 0.738 lbf ft
1 bar ..... 14.5 psi
1 l ..... 0.264 US gallon
1 cm^3 ..... 0.061 cu in
1 mm ..... 0.039 in
$^9/_5$ °C + 32 ..... 1°F
1 kW ..... 1.34 hp

A suitable pump size for a truck application can be selected as follows:

Operating conditions

As an example, a cargo crane specifies:

- Flow: 60-80 l/min
  Pressure: 230 bar
  Diesel engine speed ≈ 800 rpm

Determine pump speed

As example a PTO with a Gear Ratio of 1:1.54.

The pump speed will be:

- 800 x 1.54 ≈ 1200 rpm

Select a suitable pump size

Use diagram 1 and select a pump that will provide 60 - 80 l/min at 1200 rpm.

Follow line 'a' (1200 rpm) until it crosses line 'b' (70 l/min).

- F1-61 is a suitable choice

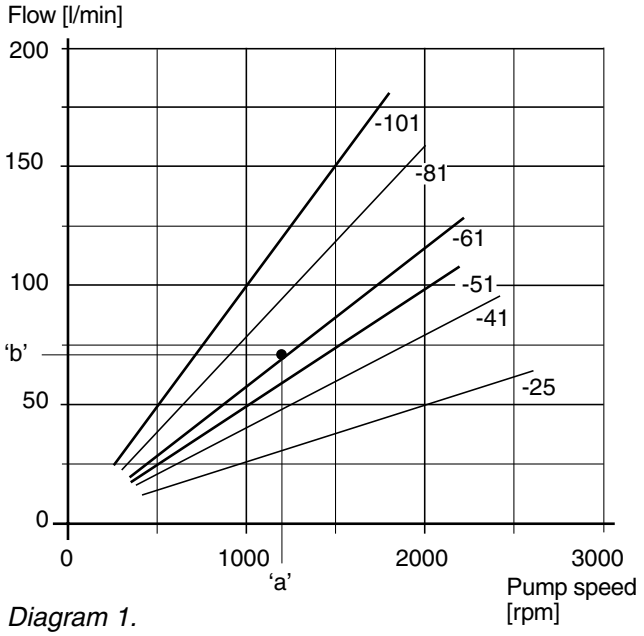


Diagram 1.

Required input torque

Make sure the PTO and the gear-box tolerates the pump torque. Use diagram 2 to obtain the required pump torque.

Follow a line from 'c' (230 bar) until it crosses the F1-61 line (the selected pump).

- Read 220 Nm (at 'd')

NOTE: A rule-of-thumb is to select the highest PTO ratio and the smallest pump size that meets the crane specification without exceeding the pump speed, pressure, and power limitations.

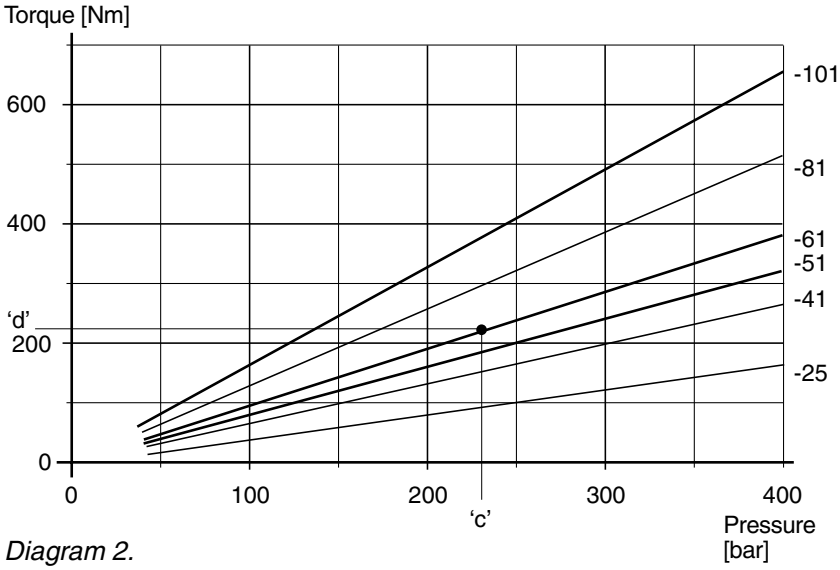


Diagram 2.

Line selection

all pumps

Line type	Flow velocity [m/s]
Inlet (suction)	max 1.0
Outlet (pressure)	max 5.0

Flow velocity [m/s] at selected line sizes [mm/inches]

Flow rate [l/min]	19 / $^3/_4$"	25 / 1"	32 / $1^1/_4$"	38 / $1^1/_2$"	51 / 2"	64 / $2^1/_2$"	75 / 3"
25	1.5	*0.8*	*0.5*	*0.4*	*0.2*	*0.1*	*0.1*
50	2.9	1.7	*1.0*	*0.7*	*0.4*	*0.3*	*0.2*
75	4.4	2.5	1.6	1.1	*0.6*	*0.4*	*0.3*
100	5.9	3.4	2.1	1.5	*0.8*	*0.5*	*0.4*
150	8.8	5.1	3.1	2.2	1.3	*0.8*	*0.5*
200	-	-	4.1	2.9	1.6	1.1	*0.7*
250	-	-	5.3	3.7	2.1	1.3	*0.9*

Inlet (suction) line

Table 1.

Outlet (pressure) line

In order to obtain sufficient inlet (suction) pressure to the pump, low noise level and low heat generation, flow speeds shown in table 2, right, should not be exceeded.

From table 1 (page 13), select the smallest line dimension that meets the flow speed recommendation; example:

- At 100 l/min, a 50 mm suction line and a 25 mm pressure line is needed.

NOTE: Long inlet (suction) lines, low inlet pressure (caused by e.g. a reservoir positioned below the pump) and/or low temperatures may require larger line dimensions.

Alternatively, the pump speed will have to be lowered to avoid pump cavitation (which may cause noise, deteriorating performance and pump damage).

Line type	Flow velocity [m/s]
Inlet (suction)	max 1.0
Outlet (pressure)	max 5.0

Table 2.

Nomogram

Flow - Line dimension - Flow velocity

Example 1
Pressure line
Q = 65 l/min
d = 3/4"
v = 3.8 m/s

Example 2
Suction line
Q = 50 l/min
v = 0.8 m/s
d = 1 1/2"

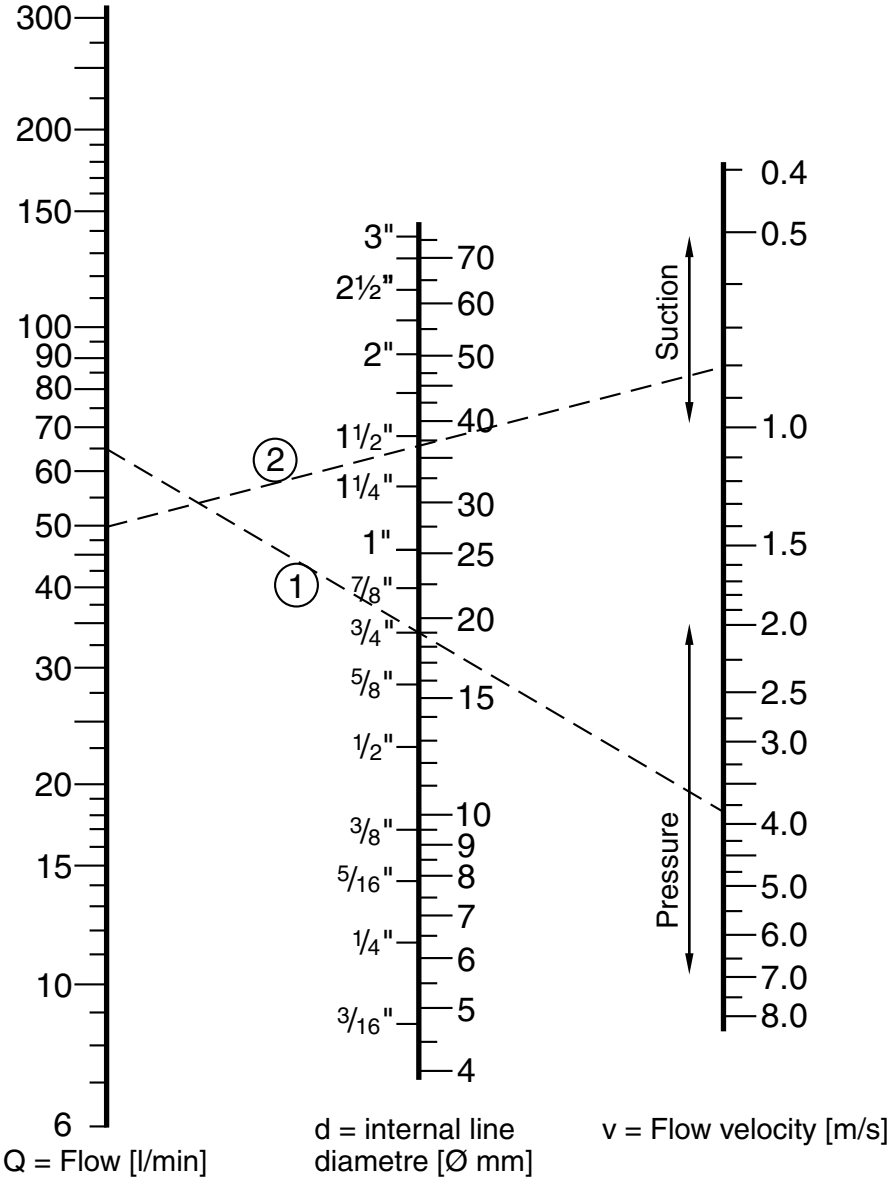
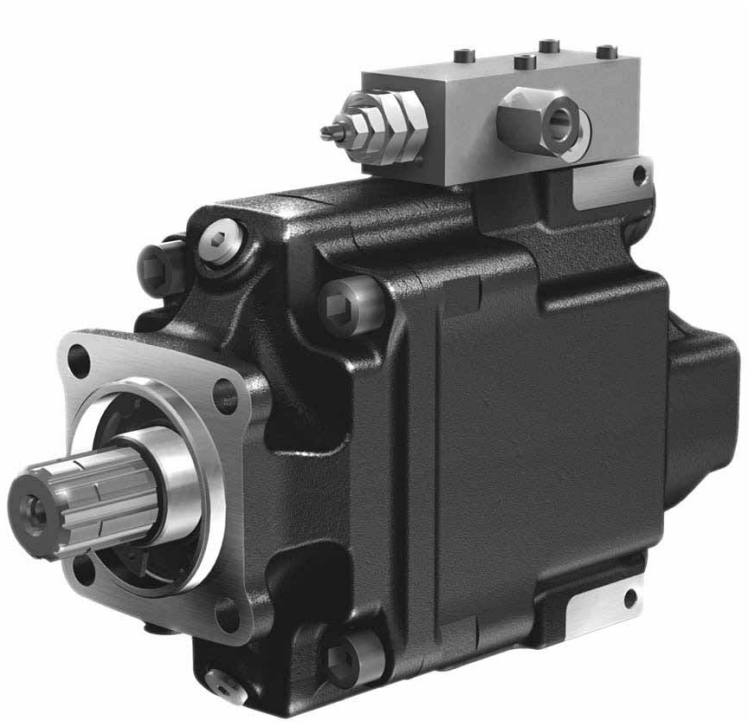


Table 3.

VP1 Pump



5

Contents **Page 5-4-**

VP1 Pump

The VP1 is a variable displacement pump for truck applications. It can be close-coupled to a gearbox PTO (power take-off) or to a coupling independent PTO (e.g. an engine PTO) which meets ISO standard 7653-1985.

An application that makes full use of all the features of the VP1 is truck cranes with a load sensing system. The complex systems of refuse collection vehicles and sewage trucks as well as various combinations of tippers, cranes, snow ploughs, and salt/sand spreaders can also be greatly simplified and optimised with the VP1 pump.

The VP1 provides the hydraulic system with the correct amount of fluid at precisely the right moment, effectively reducing energy consumption and heat generation. This means a smoother and quieter hydraulic system with much reduced impact on the environment.

The VP1 is highly efficient and extremely light. It is reliable, economical and easy to install.

The four frame sizes, VP1-045, -075, -095 and -120 have small installation dimensions.

The VP1 is suitable for all load sensing systems, regardless of make.

Design

Large angle - compact design
The pump design permits a large angle, 20°, between piston and slipper shoe/swashplate, providing compactness and small outer dimensions.

Tandem coupling
The through-shaft on VP1-45/-75 permits tandem coupling of an additional pump, such as a series F1 fixed displacement pump.

Long life
The VP1 is designed for trucks with hydraulic load sensing systems. It is sturdy, yet simple, with few moving parts. The result is a reliable pump with long service life.

Features
- Variable displacement
- Low noise level
- High power-to-weight ratio
- Compact and light
- Highly efficient
- Sturdy design
- Withstands low temperatures
- Can be close coupled and tandem mounted.
  (tandem coupling only for VP1-45/-75)

Retainer plate
The retainer plate is of a heavy duty design which makes the pump withstand high shaft speeds and fast speed changes.(e. g. engine PTO).

Specifications

Frame size	VP1–045	VP1–075	VP1-095	VP1-120
Max displacement [cm^3/rev]	45	75	95	120
Max pressure [bar]				
continuous	350	350	400	380
intermittent [1)]	400	400	420	400
Response time [ms]				
max-to-min	20-30	20-40	20-40	20-40
min-to-max	90-120	100-140	100-140	100-140
Selfpriming speed[2)] [rpm]				
2" suction line, max	2200	1700	-	-
$2^1/_2$" suction line, max	2400	2100	1750	1400
3" suction line, max	-	-	2200	1900
Control type	LS			
Shaft end spline	DIN 5462			
Mounting flange	ISO 7653-1985			
Weight (with control) [kg]	27			

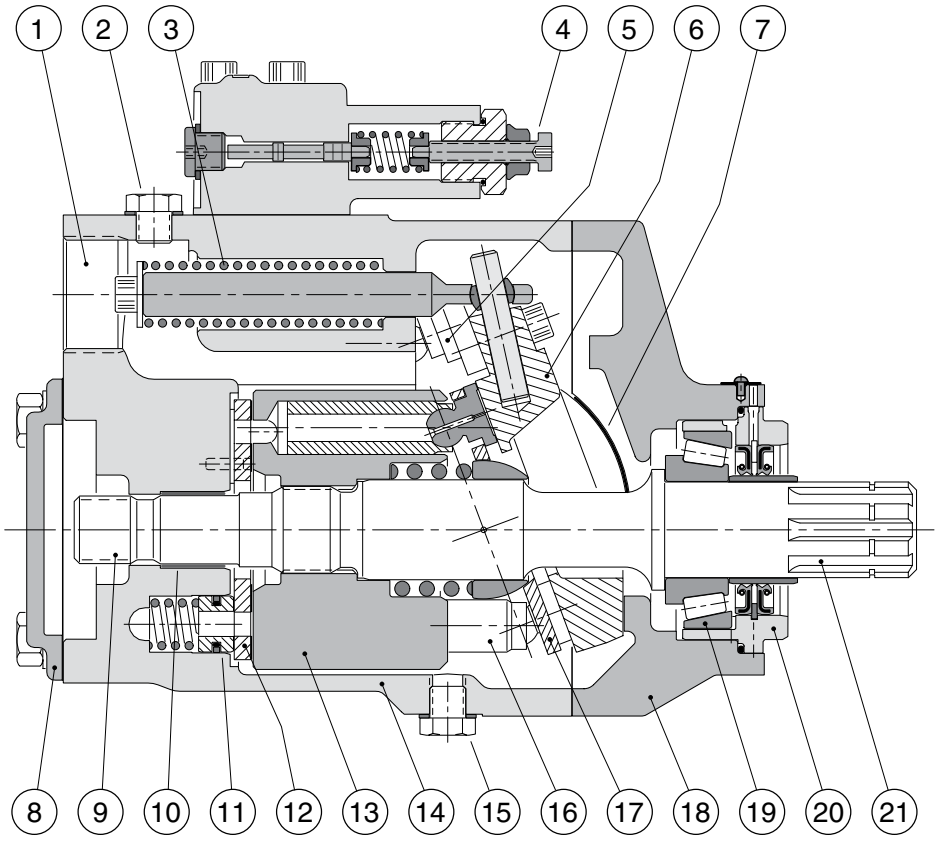
1) Max 6 seconds in any one minute.

2) At an inlet pressure of 1.0 bar (abs.) with mineral oil at a viscosity of 30 mm^2/s (cSt).

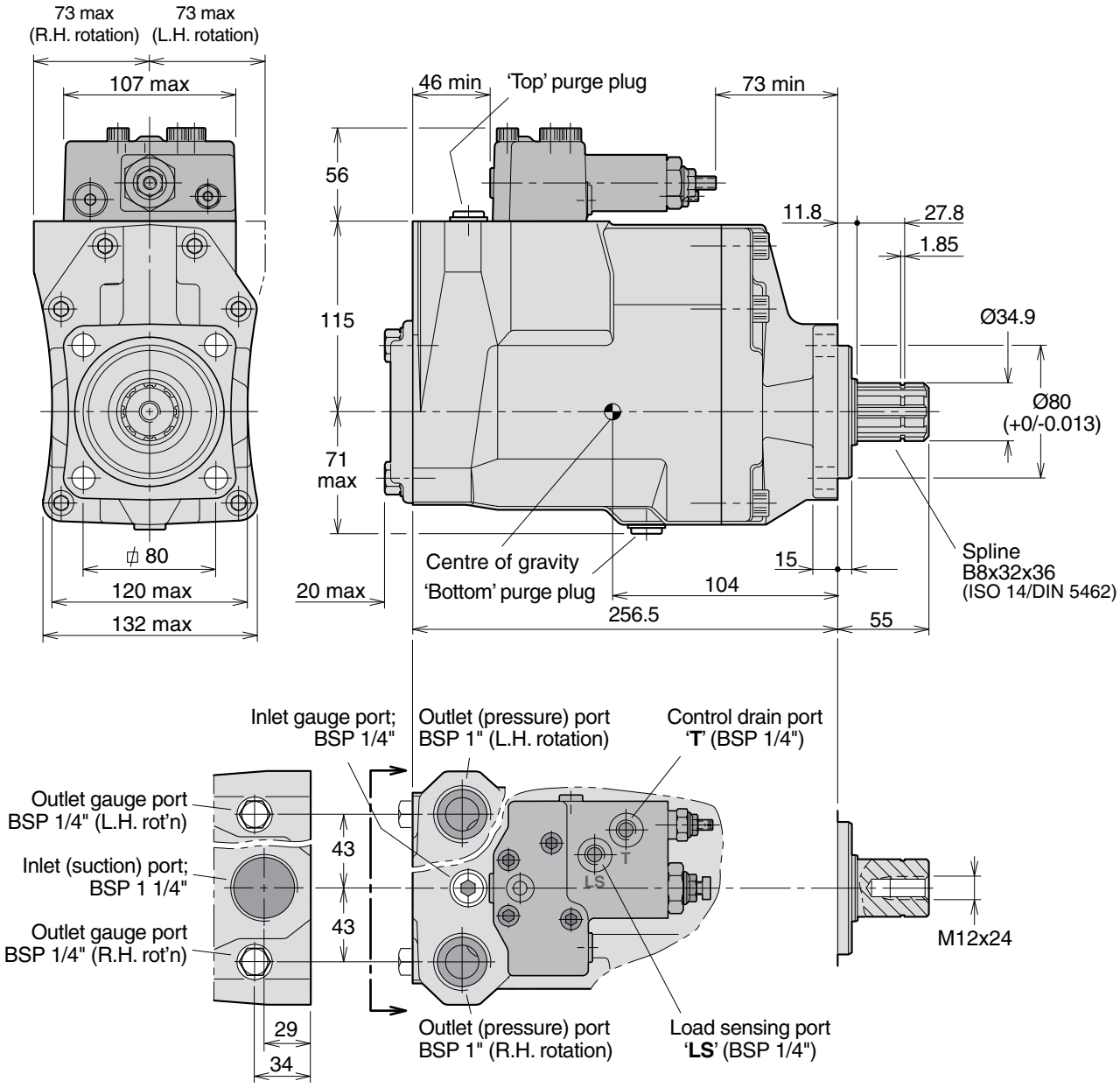
5

VP1-045/-075 cross section

1. Inlet port
2. 'Top' purge plug
3. Return spring
4. Control
5. Setting piston (one of two)
6. Swash plate
7. Bearing shell
8. End cover
9. Spline (for mounting an auxiliary pump)
10. Bearing sleeve
11. Hold-down plunger
12. Valve plate
13. Cylinder barrel
14. Barrel housing
15. 'Bottom' purge plug
16. Piston with piston shoe
17. Retainer plate
18. Bearing housing
19. Roller bearing
20. Shaft seals with carrier
21. Input shaft



VP1-045 and -075



IMPORTANT
The control is *not* drained through the pump case. An external line *must be installed* between the control drain port 'T' and the reservoir.

NOTE: The pump **does not** include a suction fitting; it must be ordered separately. See chapter 10-3.

LS valve block VP1-045/075

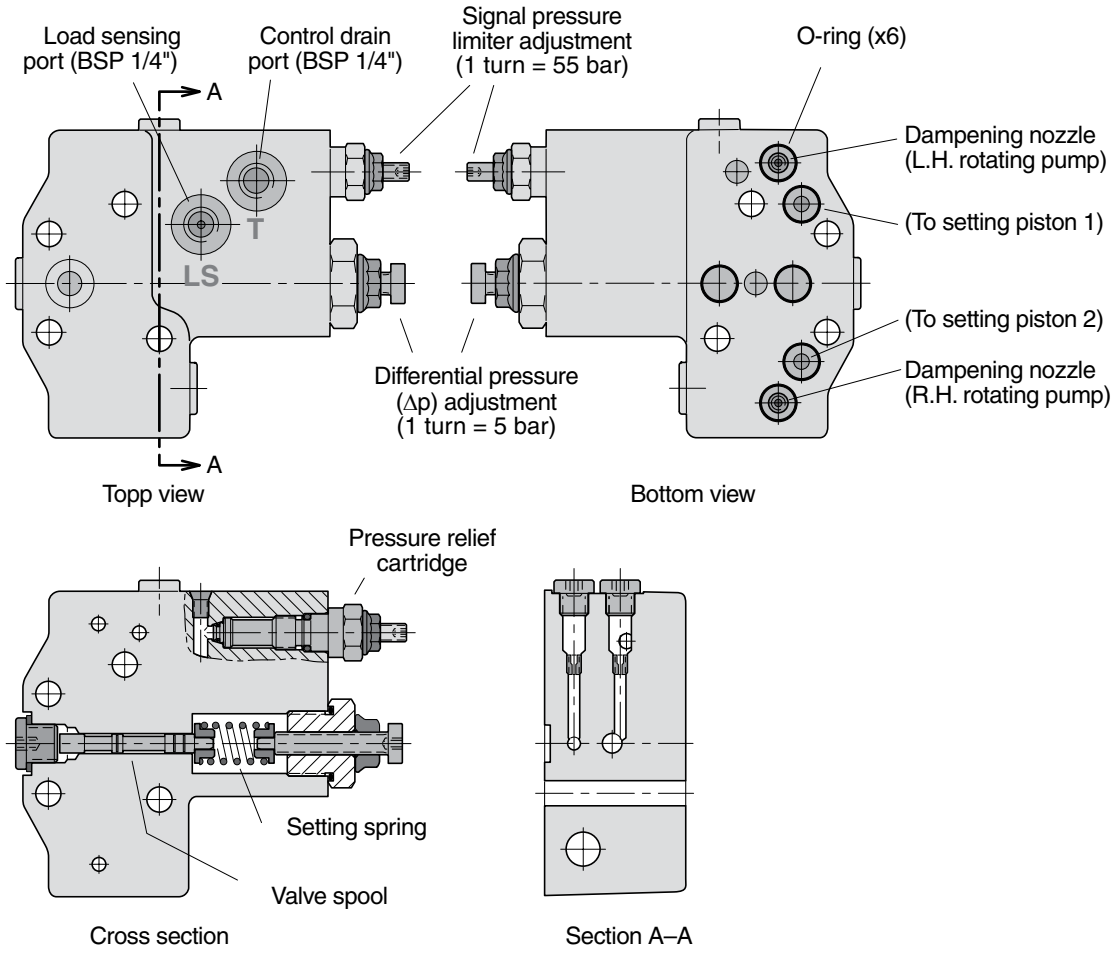


Fig. 2. LS valve block.

Through-shaft coupling VP1-045/075

The VP1 pump has a through-shaft which means that an additional pump, such as a fixed displacement F1, can be installed in tandem with the VP1 by means of an adaptor kit (fig. 3).

NOTE: The bending moment caused by the weight of a tandem assembly normally exceeds that allowed by the PTO.
To prevent damage, the auxiliary pump should be supported by a bracket attached to the gearbox; it *must not* be fastened to the truck chassis.
Likewise, when the tandem assembly is installed on a separate bracket and driven by a cardan shaft, the auxiliary pump should have a support attached to the pump bracket.

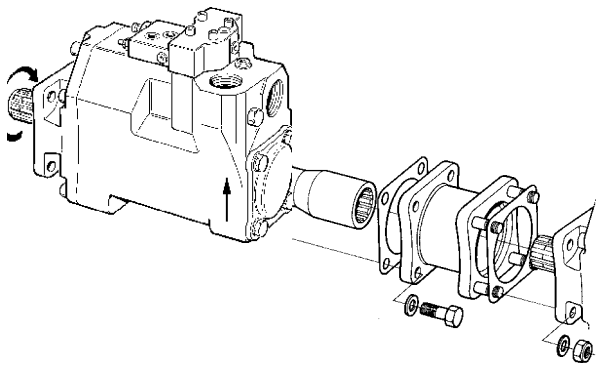
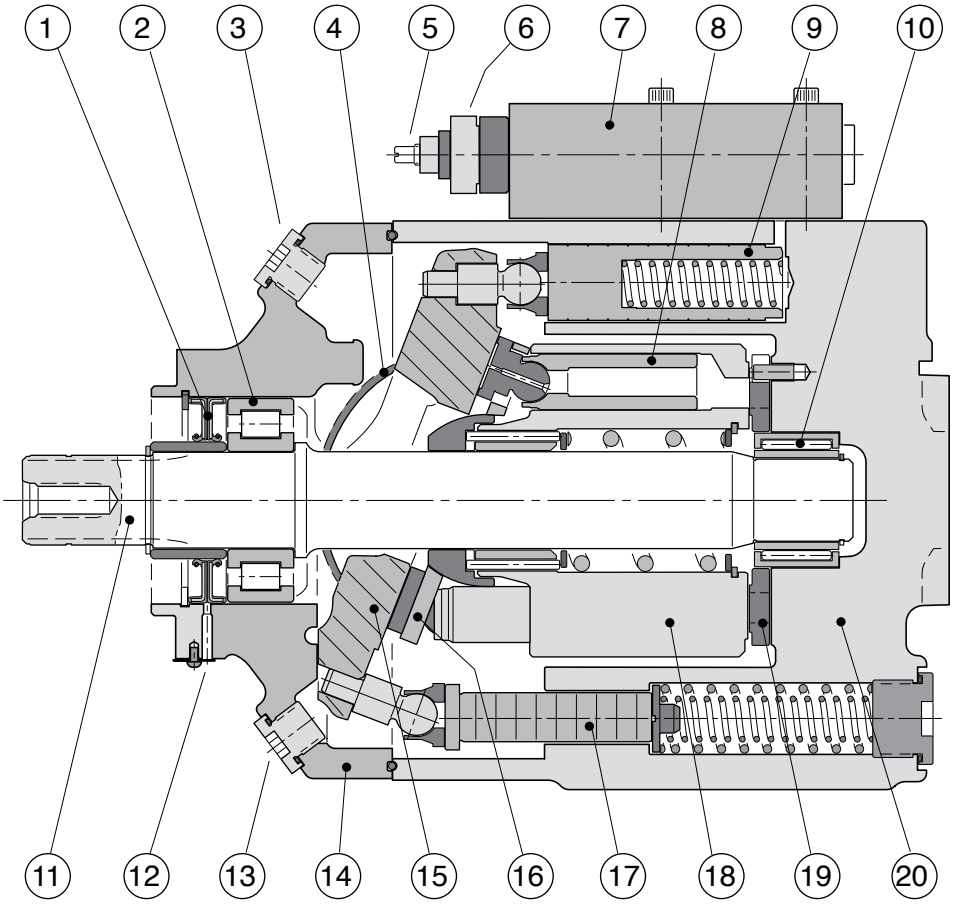


Fig. 3. Adaptor kit (P/N 379 7795) for tandem coupling.

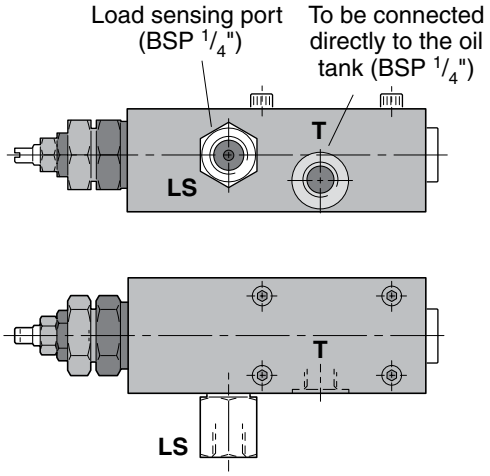
IMPORTANT
Contact Parker Hannifin for additional information when considering tandem mounting a second VP1 pump.

VP1-095 cross section

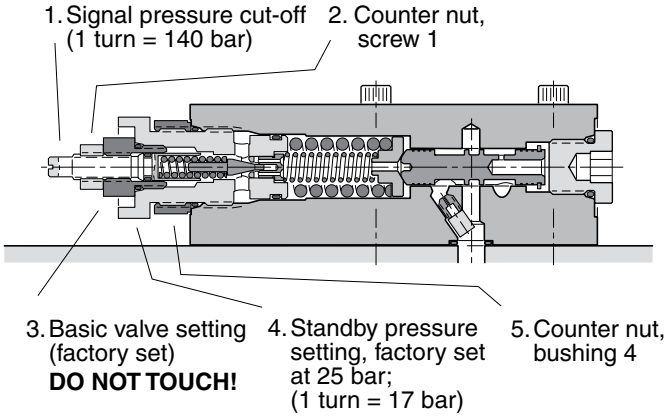
1. Shaft seal
2. Roller bearing
3. 'Upper' purge plug
4. Bearing shell
5. Setting screw (pressure relief valve)
6. Setting bushing (standby pressure)
7. Control
8. Piston with piston shoe
9. 'Upper' setting piston (control pressure
10. Needle bearing
11. Shaft
12. Drain hole, shaft seals
13. 'Lower' purge plug
14. Bearing housing
15. Swash plate
16. Retainer plate
17. 'Lower' setting piston (pump pressure)
18. Cylinder barrel
19. Valve plate
20. Barrel housing



LS control (for VP1-095)

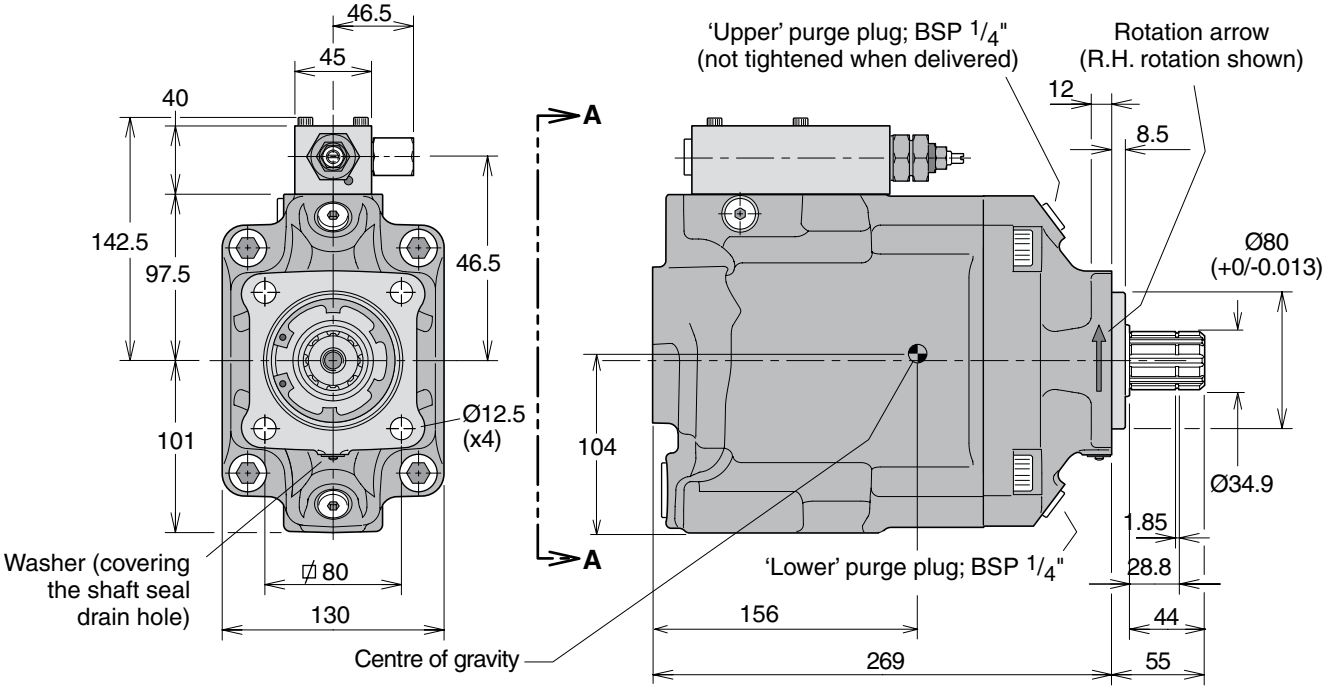


LS control ports.



LS control cross section.

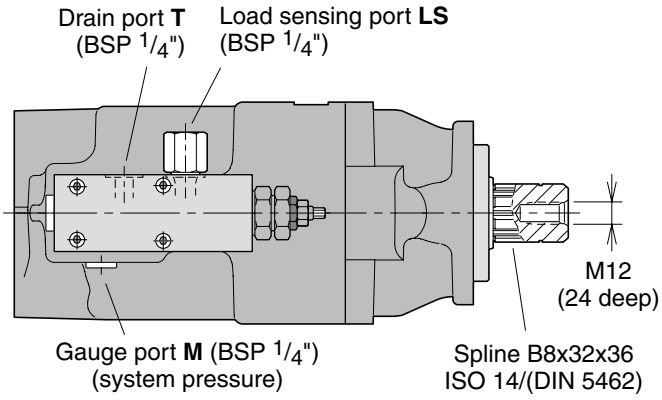
VP1-095

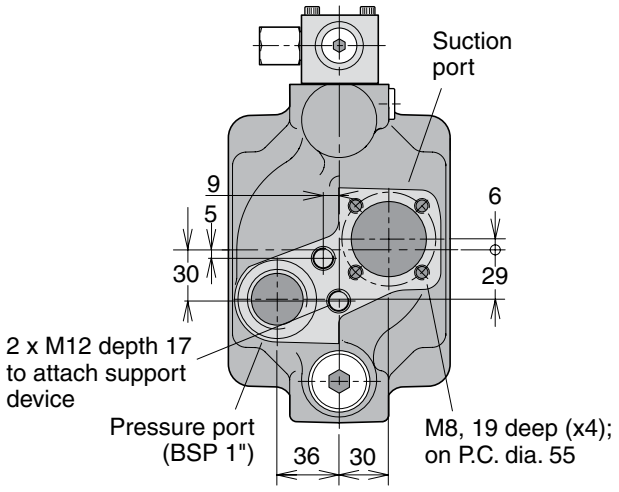


NOTE: The pump **does not** include a suction fitting; it must be ordered separately. See chapter 10-3.

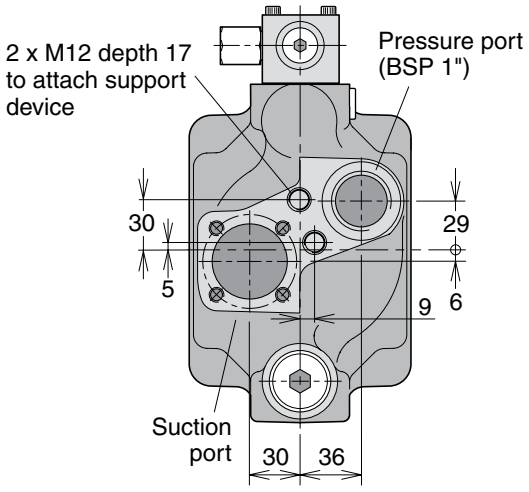
IMPORTANT!

The control is **not** drained through the pump case; an external drain line must be installed from control port T and, directly, to the oil tank.





View A–A
Left hand rotating pump

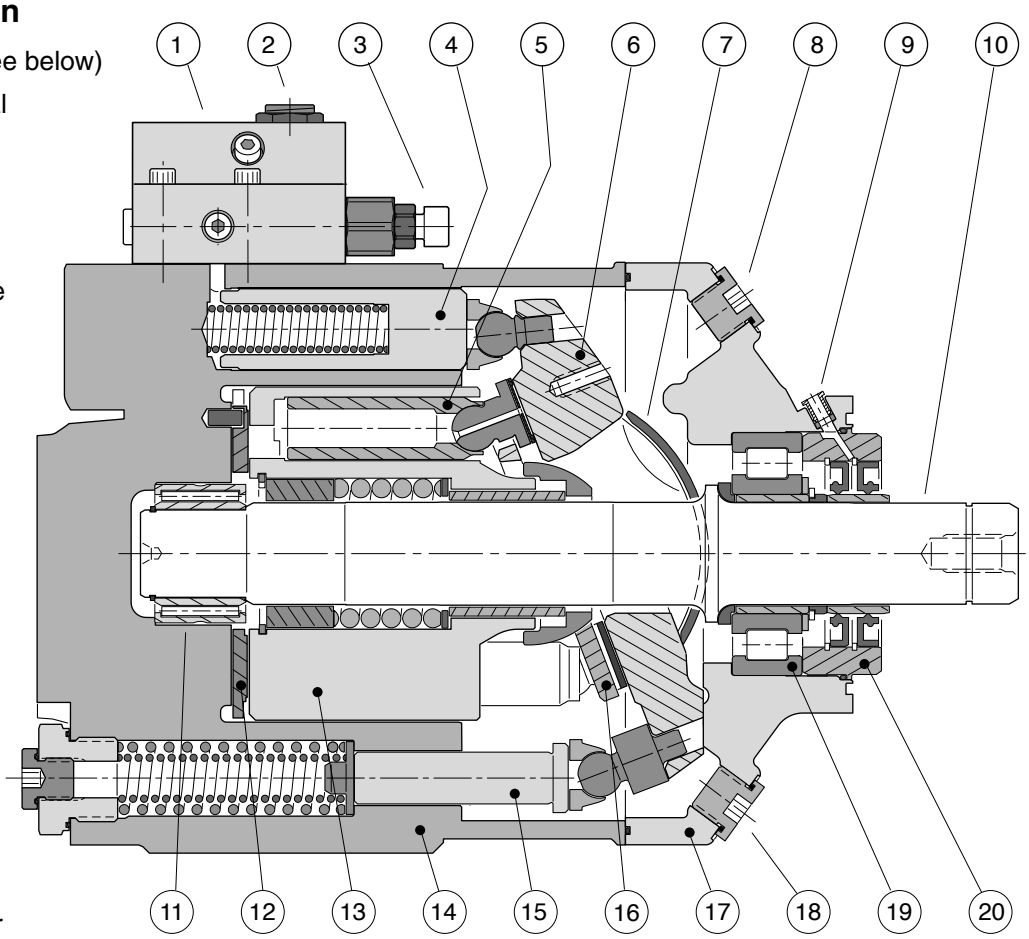


View A–A
Right hand rotating pump

5

VP1-120 cross section

1. Pump control valve (see below)
2. Setting screw for signal pressure limiter
3. Setting screw for stand-by pressure
4. Setting piston
5. Piston with piston shoe
6. Swash plate
7. Bearing shell
8. Purge plug
9. Shaft seal drain
10. Input shaft
11. Needle bearing
12. Valve plate
13. Cylinder barrel
14. Barrel housing
15. Setting piston
16. Retainer plate
17. Bearing housing
18. Purge plug
19. Roller bearing
20. Shaft seals with carrier

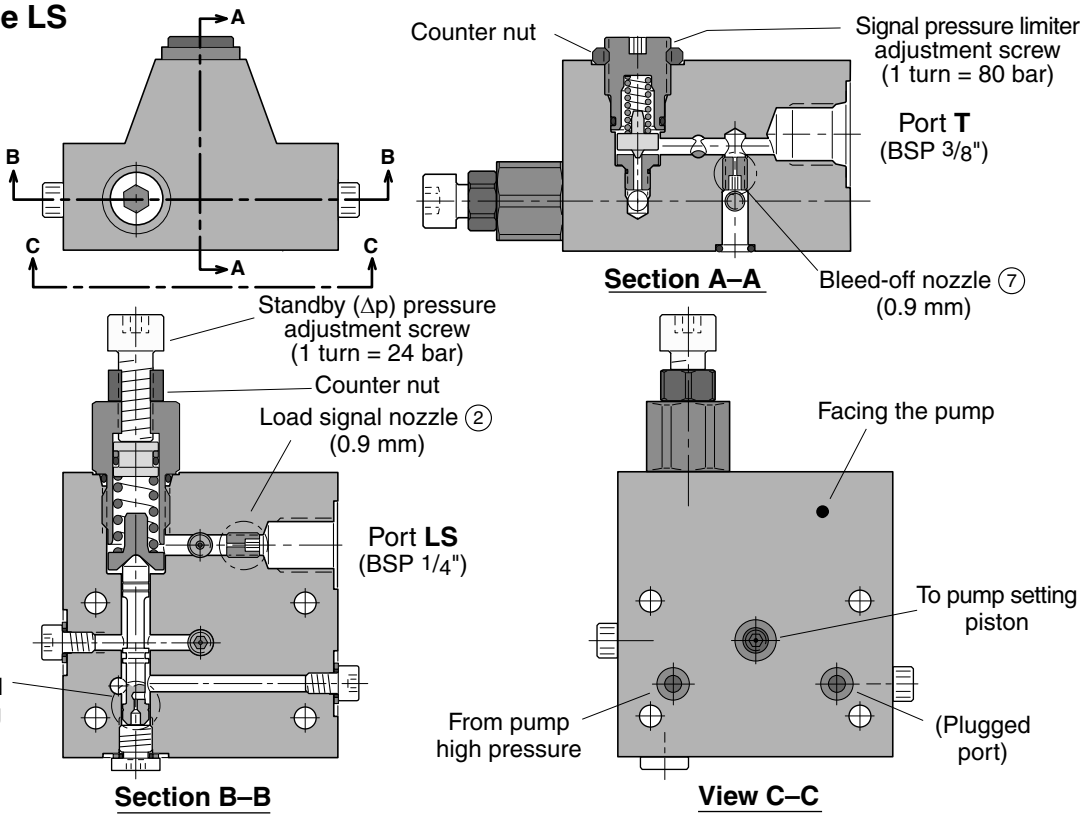


Control valve type LS

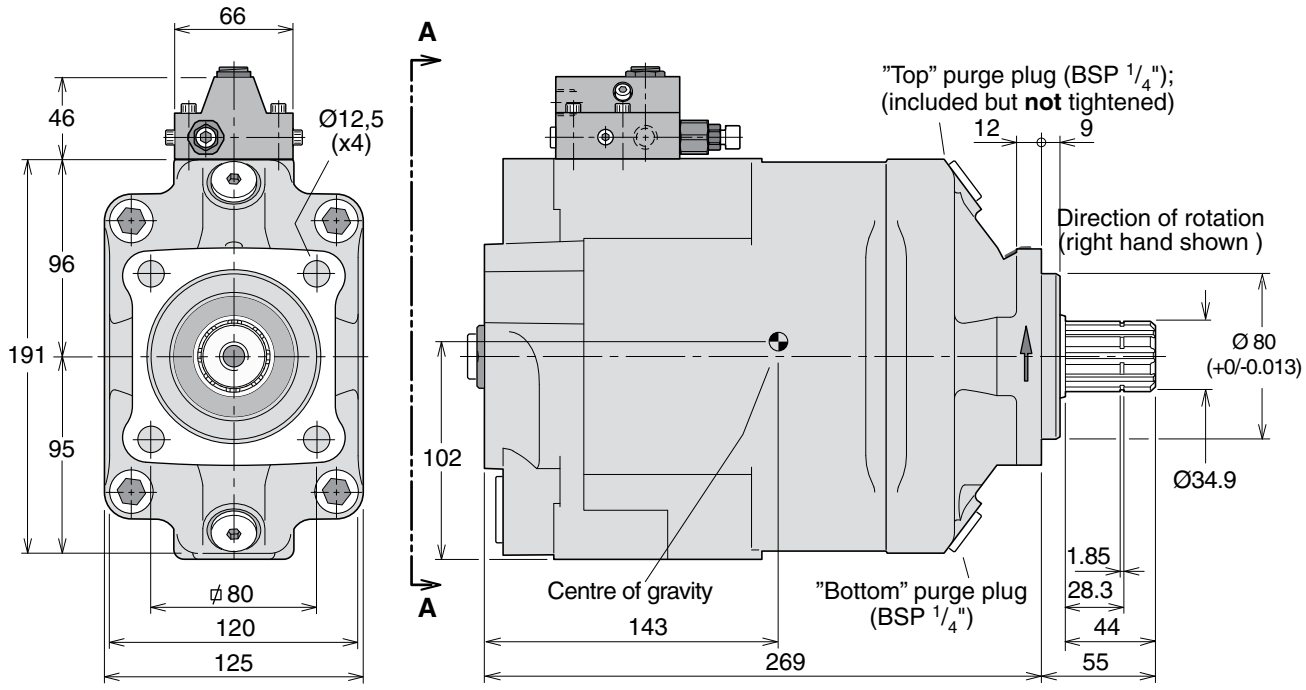
(VP1-120)

NOTE:

Hydraulic schematic, see page 5-4-15.



VP1-120

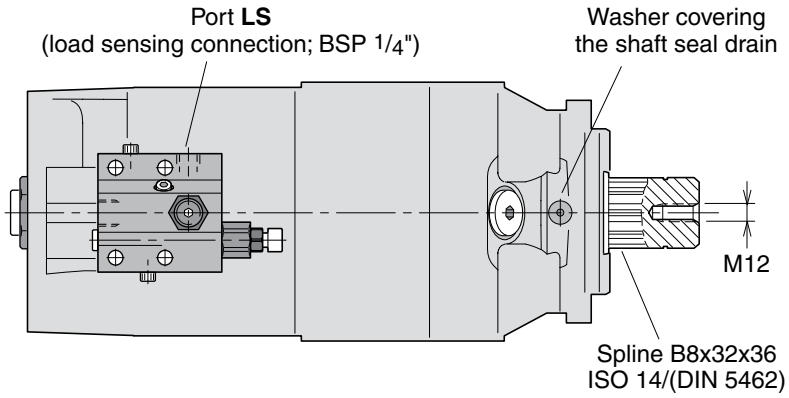


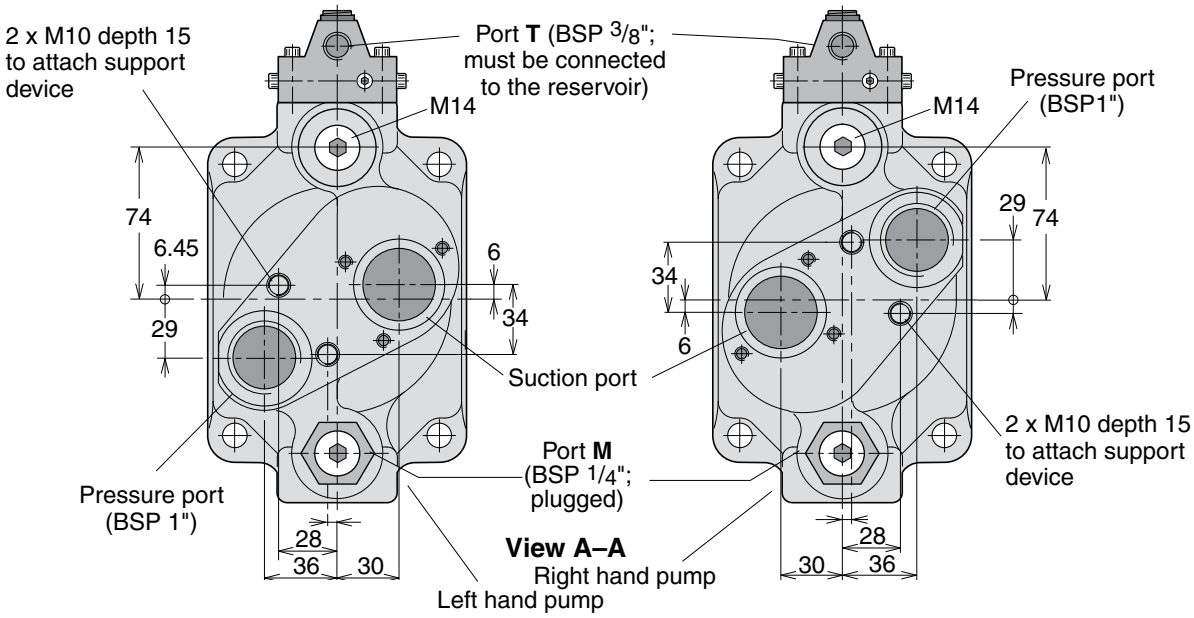
IMPORTANT

The control is **not** drained through the pump case. An external line must be installed between the control drain port 'T' and the reservoir.

NOTE: The pump **does not** include a suction fitting; it must be ordered separately.

See chapter 10-3.





Ordering information

Example: **VP1 - 045 - L**

Frame size

045, 075, 095 or 120

Direction of rotation

L Left hand
R Right hand

NOTE:
The VP1 is uni-directional. Consequently, the desired direction of rotation must be stated *when ordering*.

Standard model numbers

Designation	Ordering no.
VP1-045-R	378 0334
VP1-045-L	378 0335
VP1-075-R	378 0336
VP1-075-L	378 0337
VP1-095-R	378 6000
VP1-095-L	378 6001
VP1-120-R	378 6848
VP1-120-L	378 6849

VP1 in load sensing systems

When installed in a load sensing system, the VP1 supplies the correct amount of flow required by the various work functions currently engaged.

This means that energy consumption and heat generation are minimised and much reduced in comparison with a fixed displacement pump used in the same system.

Diagram 1 shows the required power (flow times pressure) in a constant flow system with a fixed displacement pump.

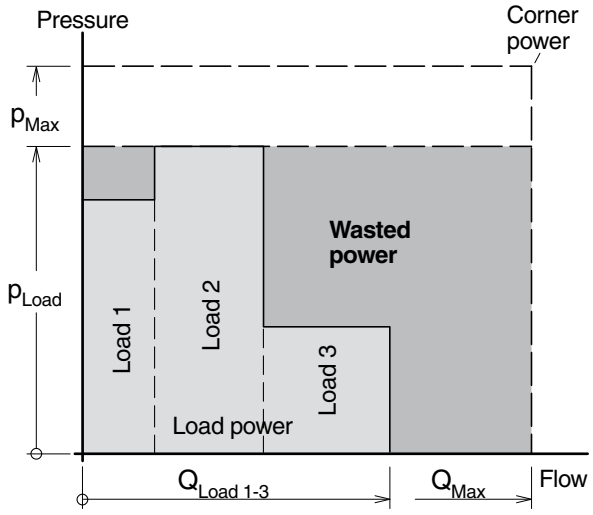


Diagram 1. Constant flow system with a fixed displacement pump.

Diagram 2 shows the sharply reduced power requirement in a load sensing system with a variable displacement pump such as the VP1.

In both cases the pump pressure is slightly higher than what is required by the heaviest load (’Load 2’) but the VP1, because of the much smaller flow being delivered, needs only the power indicated by the shaded area ’Load power’.

In a constant flow system, on the other hand, excess fluid is shunted to tank and the corresponding power, ’Wasted power’ (shown in diagram 1), is a heat loss.

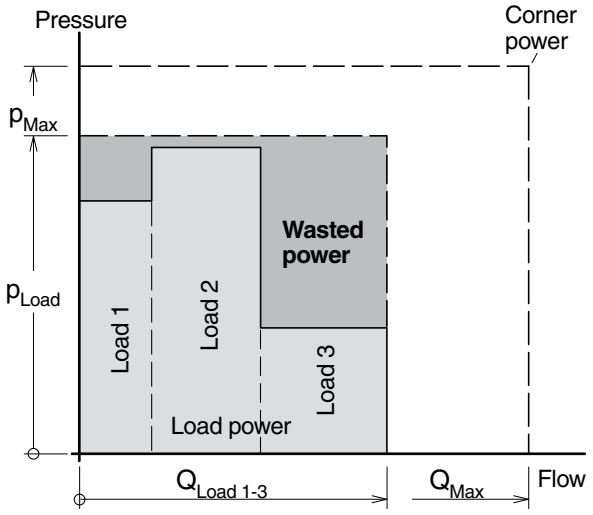


Diagram 2. Constant flow system with a variable displacement pump (e.g. VP1).

Systems comparison

System	Constant flow	Load-sensing
Pump	Fixed displ.	VP1 variable displ.
Pump adjustments	Pressure only	Pressure and flow
Load *	Some influence	Some influence
Energy consumption	High	Low
Heat generation	High	Low

***** Simultaneous operation of loads with non-equal flows and pressures; refer to the above diagrams.

LS load sensing control function

Refer to corresponding hydraulic schematic below.

A selected 'opening' of the directional control valve spool corresponds to a certain flow to the work function. This flow, in turn, creates a pressure differential over the spool and, consequently, also a ∆p between the pump outlet and the LS port.

When the differential pressure decreases (e.g. the directional valve is 'opened' further) the ∆p also decreases and the LS valve spool moves to the left. The pressure to the setting pistons then decreases and the pump displacement increases.

The increase in pump displacement stops when the ∆p finally reaches the setting (e.g. 25 bar) and the forces acting on the valve spool are equal.

If there is no LS signal pressure (e.g. when the directional valve is in the neutral, no-flow position) the pump only delivers sufficient flow to maintain the standby pressure as determined by the ∆p setting.

LS control adjustments

Pressure limiter

Pump size	Factory setting [bar]	Max pressure intermittent [bar]
VP1-045/075	350	400
VP1- 095	350	420
VP1-120	300	400

LS load sensing valve

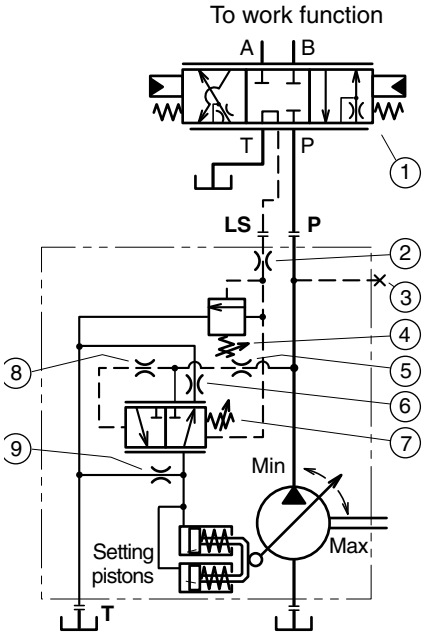
Pump size	Factory setting [bar]	Min pressure [bar]	Max pressure [bar]
VP1-045/075	25	20	35
VP1- 095	25	15	40
VP1-120	35	25	40

The factory setting, and the standard orifice sizes shown in the corresponding schematic below, will usually provide an acceptable directional valve characteristic as well as system stability.

For additional information, contact Parker Hannifin.

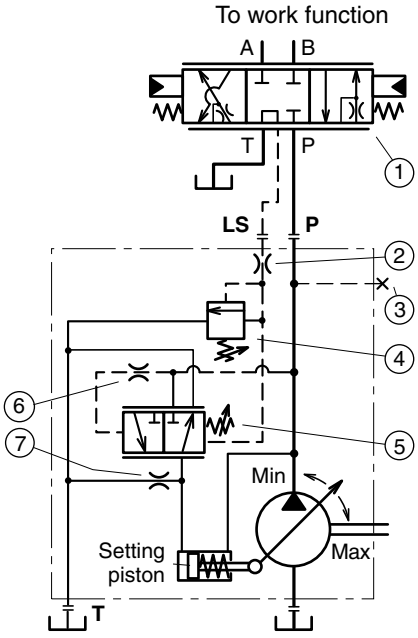
5

Hydraulic schematic for VP1-45/75



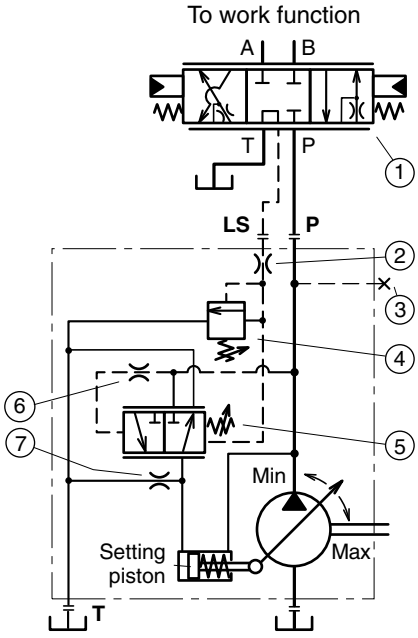
1. Directional, load sensing control valve
2. Load signal orifice (1.0 mm; fixed)
3. Gauge port
4. Signal pressure limiter adjustment
5. System pressure dampening nozzle (2.0 mm)
6. Return line nozzle (0.6 mm)
7. Standby (∆p) pressure adjustment
8. System pressure dampening orifice (fixed)
9. Bleed-off nozzle (0.6 mm).

Hydraulic schematic for VP1-095



1. Directional, load sensing control valve
2. Load signal orifice (0.8 mm)
3. Gauge port
4. Signal pressure limiter adjustment
5. Standby (∆p) pressure adjustment
6. System pressure dampening orifice (fixed)
7. Bleed-off nozzle (1.2 mm)

Hydraulic schematic for VP1-120



1. Directional, load sensing control valve
2. Load signal orifice (0.9 mm)
3. Gauge port
4. Signal pressure limiter adjustment
5. Standby (∆p) pressure adjustment
6. System pressure dampening orifice (fixed)
7. Bleed-off nozzle (0.9 mm)

Installation and start-up for VP1

Direction of rotation

The basic VP1 pump is uni-directional; there is a left hand and a right hand version (indicated by the arrow on the side of the VP1 pump (fig. 4 and 5).

Consequently, the required direction of rotation must be stated when ordering the pump.

Installation

The VP1 can be installed (close-coupled) directly on a PTO (which meets ISO DIN 5462).

Before start-up, the pump must be filled with hydraulic fluid and purged. Utilise the uppermost purge plug (refer to the installation drawing on pages 5-6-8, -11 and -13.

Figure 6 shows two ways of installing a gear on the VP1 shaft. On a non-geared or a geared PTO with support bearings, the pump shaft is usually installed directly in the internally splined PTO output shaft.

Make sure max torque and bending moment (due to the weight of the pump) of the utilised PTO are not exceeded. (The approx. center of gravity of the various pump sizes are shown in the installation drawings).

Hydraulic fluids

The VP1 data shown in the specifications on

page 5-6-7 are valid when operating on a high quality, mineral based fluid.

Hydraulic fluids type HLP (DIN 51524), ATF (auto- matic transmission fluids), and API type CD engine oils are suitable.

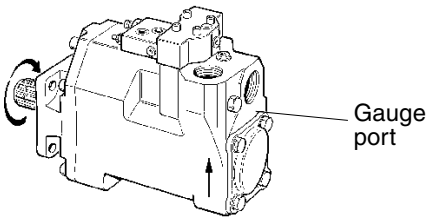


Fig. 4. Left hand rotating pump.

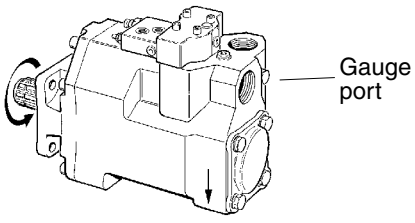


Fig. 5. Right hand rotating pump.

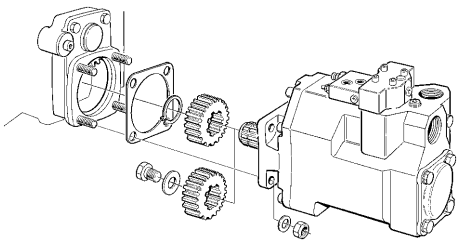


Fig. 6. VP1-to-PTO installation.

Fluid temperature

Main circuit: Max 75 °C.

Viscosity

Recommended viscosity: 20 to 30 mm^2/s (cSt).
Operating viscosity limits: 10 to 400 mm^2/s.
At start-up: Max 1000 mm^2/s.

Filtration

To obtain long VP1 life, we recommend a filtration level of:

- 25 µm (absolute) in clean environment or at low pressures.
- 10 µm (absolute) in contaminated environment or at high pressures.

Filtration should meet ISO standard 4406: 1987, code 18/13.

Drain line

The LS valve *requires a separate drain line;* it should be routed directly to the reservoir (refer to fig. 8).

Start-up

Make sure the entire hydraulic system is clean before filling it with a recommended fluid.
In addition, the VP1 pump must be purged to remove any entrapped air in the pump housing; utilise the uppermost purge port (fig. 8).

IMPORTANT

As shown in fig. 8, the pump inlet must always be below the lowest reservoir oil level.

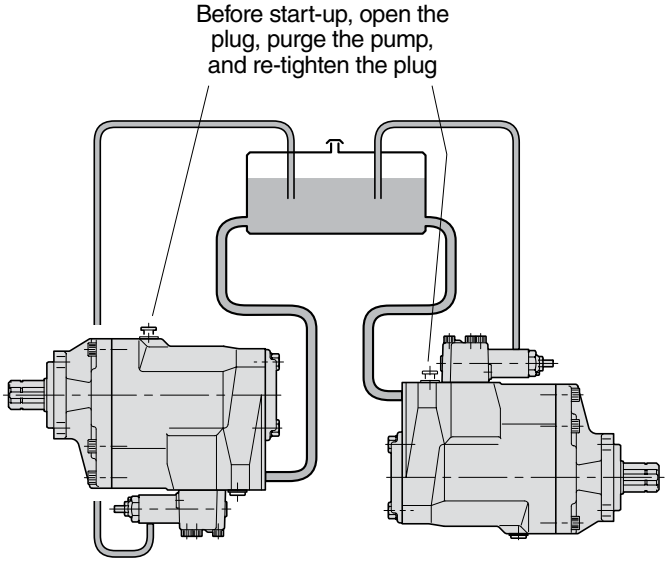


Fig. 8. VP1 should be installed below the reservoir fluid level.

Purging should be performed when the pump is connected to the reservoir and the system is filled with fluid.