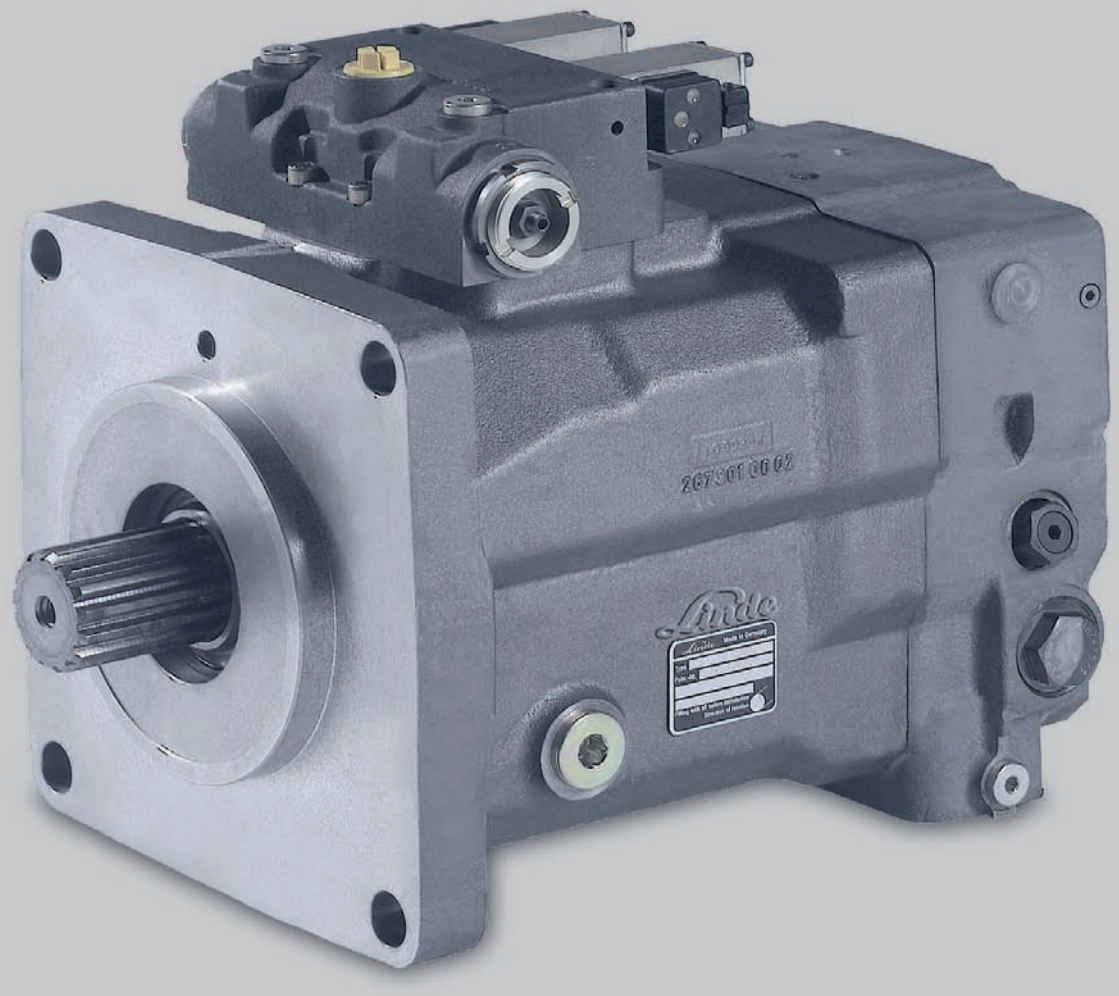
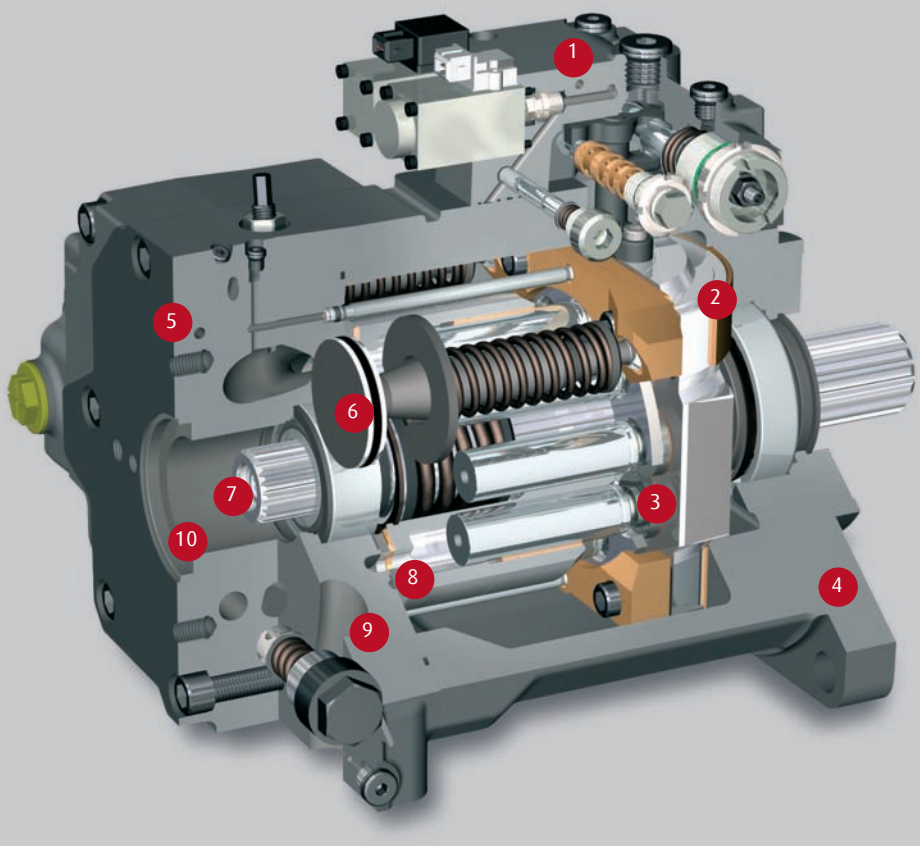
HPV-02.
Variable pumps for closed loop operation.

Linde Hydraulics





1 **control device**
modular design,
precise and load-independent

2 **swash plate**
hydrostatic bearing

3 **piston-slipper assembly**
21° swash angle

4 **housing**
monoshell for high rigidity

5 **valve plate housing**
highly integrated

6 **control piston**
integrated, hydraulically captured

7 **through shaft**
for additional pumps

8 **cylinder barrel**
compact due to 21° technology

9 **integrated pressure relief valves**
for system and boost pressure

10 **optional PTO**
pumps and motors are available
with this torque transmission

Design characteristics

>> axial piston pump in swashplate design for high pressure closed loop systems
>> clockwise or counter clockwise rotation
>> exact and rugged servo control devices (mechanical, hydraulic, electro-hydraulic)
>> integrated high pressure relief valves with make-up function
>> integrated low pressure relief valves for boost, control and cooler circuits
>> replaceable cartridge filter
>> SAE high pressure ports
>> SAE mounting flange with ANSI or SAE spline shaft
>> through shaft SAE A, B, B-B, C, D and E
>> boost pressure pumps for internal and external suction, integrated cold start relief valve optional
>> hydrostatic bearings of the rotating group compensate for axial forces
>> few sealed interfaces with O-ring seals
>> optional tandem and multiple pumps

Product advantages

>> compact design
>> high power density
>> dynamic response
>> high reliability
>> long service life
>> noise-optimized
>> precise and load-independent servo control

LinDrive = Precision x Dynamics x Reliability = Benefit^{n}

LinDrive

Data Sheets Linde Hydraulics.

Find the right products for your application.

Product range

Product		Application	Linde product name
Pump	Self-regulating pump	open loop operation	HPR-02
	Variable pump	**closed loop operation**	**HPV-02**
Motor	Variable motor	closed and open loop operation	HMV-02
	Regulating motor	closed and open loop operation	HMR-02
	Fixed motor	closed and open loop operation	HMF-02
		open loop operation	HMF-02 P
		closed and open loop operation	HMA-02
Directional control valve		open loop operation	VW
Electronics	Electronic control	open loop operation	CEB
		closed and open loop operation	CED
		closed and open loop operation	CEP
	Diagnosis software	closed and open loop operation	LinDiag®
	Peripheral equipment	closed and open loop operation	

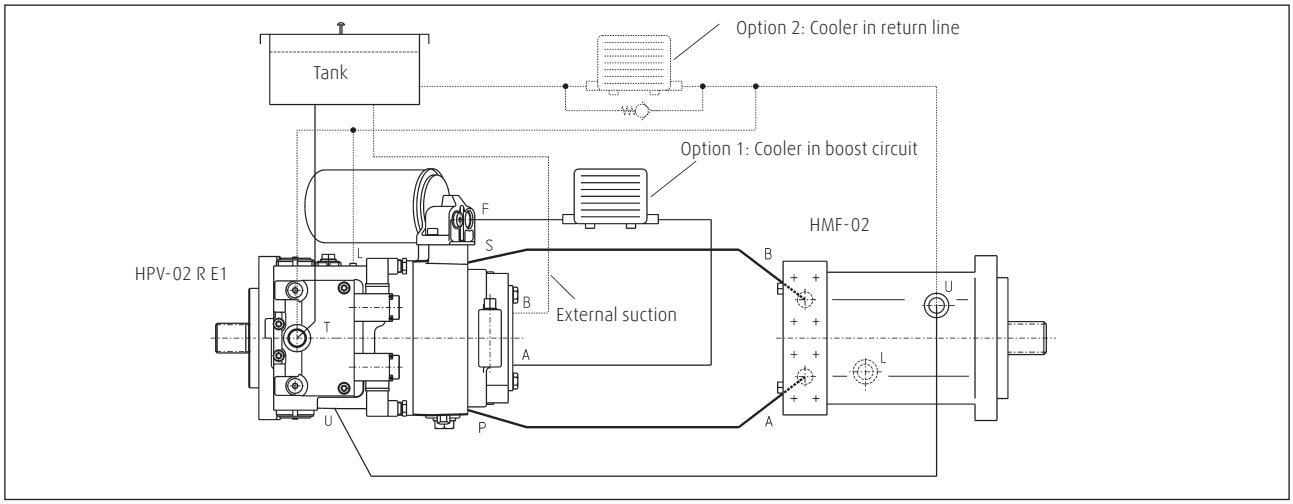
Content HPV-02.

The data on which this brochure is based correspond to the current state of development. We reserve the right to make changes in case of technical progress. The dimensions and technical data of the individual installation drawings are prevailing. The features listed in this data sheet are not available in all combinations and nominal sizes. Our sales engineers will be happy to provide advice regarding the configuration of your hydraulic system and on product selection.

The closed loop.

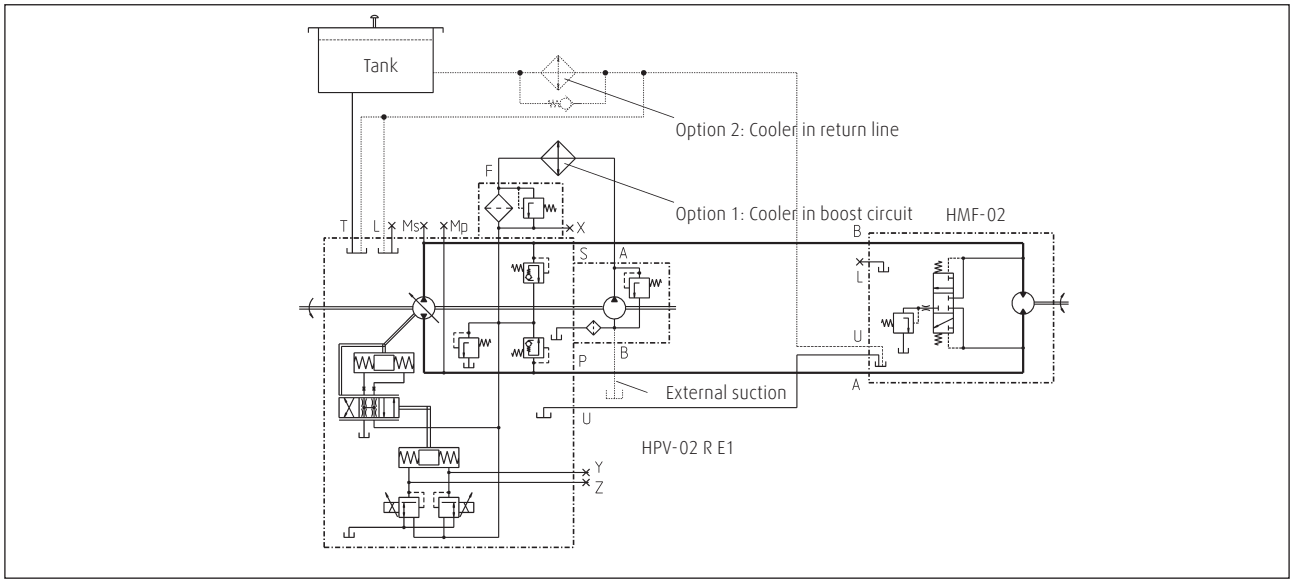
Representation of the hydraulic components of a closed loop hydrostatic drive: Variable electro-hydraulic controlled pump HPV-02 E1 and fixed displacement motor HMF-02 plus filter, cooler and oil tank. The function diagram and the circuit diagram show two types of cooling.

Function diagram



Circuit diagram

The boost pump is shown with internal and external suction.



Standard Linde name plate

Each Linde Hydraulics unit features a name plate showing the type and the serial number. For a single order via 'open variant' a customer-specific number or free text with up to 15 characters can be stamped on the name plate.

Type	HPV105-02	Series 02 variable pump with the rated size of 105
	R	Right hand rotation
	2553	the last 4 figures of the Bill of Material 2640002553
Serial-No.	H2X	
	264	Type number of HPV 105-02
	T	Letter indicating year of production
	12345	Serial number
Part No.	12345678	Free text field for up to 15 characters

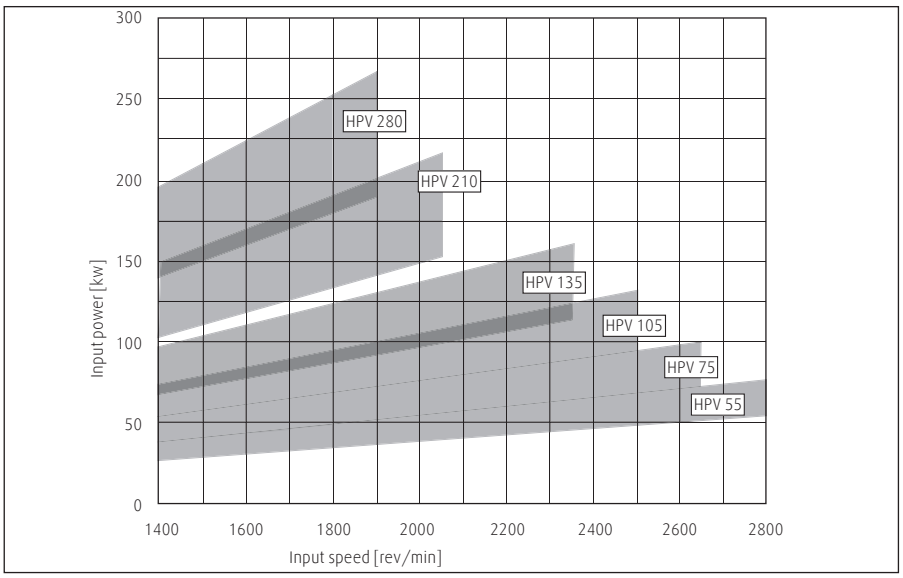
General technical data.

The table shows the complete capacity range of the pumps, while the diagram below shows the recommended practical range for the different nominal sizes of the HPV-02 pump with control limit between 200 bar Δp_{min} and 280 bar Δp_{max} . It enables initial selection of the required nominal pump size.

Overview of technical data

Rated Size			55	75	105	135	165	210	280
	Maximum displacement	cm^3/rev	54.8	75.9	105	135.6	in development	210	280
Speed	Maximum continuous speed (at 100% duty cycle)	min^{-1}	3300	3100	2900	2700		2300	2000
	Maximum speed (intermittent) higher speed on request	min^{-1}	3700	3500	3200	2900		2500	2200
	Minimum continuous speed	min^{-1}	500					500	
Pressure	Maximum operating pressure	bar	420					420	
	Maximum pressure (intermittent)	bar	500					500	
	Continuous pressure (Δp)	bar	250					250	
	Permissible housing pressure (absolute)	bar	2.5					2.5	
Torque	Continuous input torque at continuous pressure	Nm	220	305	420	540		840	1115
	Maximum input torque at max. operating pressure and 19 bar boost pressure	Nm	350	485	670	870		1340	1785
Power	Continuous power at max. continuous speed, continuous pressure	kW	75	98	127	153		201	234
	Maximum power at max. continuous speed, max. operating pressure and 19 bar boost pressure	kW	121	157	204	245		322	373
Permissible shaft loads	Axial	N	2000					2000	
	Radial	N	on request					on request	
Perm. housing temperature	Perm. housing temperature with minimum perm. viscosity > 10 cSt	°C	90					90	
Weights inclusive IGP (Size 55-135) or EGP (Size 210- 280)	HPV-02 with H1-control without oil (approx.)	kg	46	49	66	72		132	164
	Filling volume HPV-02 housing with filter	dm^3	2.1	2.8	3.4	3.8		4.8	5.5
	Maximum moment of inertia	$kgm^2 x 10^{-2}$	0.54	0.84	1.49	2.2		4.77	9.38

Recommended operating range of HPV-02



Operational parameters. Life time recommendations

Linde high pressure units are designed for excellent reliability and long service life. The actual service life of a hydraulic unit is determined by numerous factors. It can be extended significantly through proper maintenance of the hydraulic system and by using high-quality hydraulic fluid.

Beneficial conditions for long service life

>> Speed	lower continuous maximum speed
>> Operating pressure	less than 300 bar Δp on average
>> Max. pressure	only at reduced displacement
>> Viscosity	15 ... 30 cSt
>> Power	continuous power or lower
>> Purity of fluid	18/16/13 in accordance with ISO 4406 or better

Adverse factors affecting service life

>> Speed	between continuous maximum speed and intermittent maximum speed
>> Operating pressure	more than 300 bar Δp on average
>> Viscosity	less than 10 cSt
>> Power	continuous operation close to maximum power
>> Purity of fluid	lower than 18/16/13 in accordance with ISO 4406

Operational parameters. Filtration

In order to guarantee long-term proper function and high efficiency of the hydraulic pumps the purity of the pressure fluid must comply with the following criteria according to Linde Works Standard WN 51 210. High purity oil can extend the service time of the hydraulic system significantly.

>> For reliable proper function and long service life	18/ 16/ 13 in accordance with ISO 4406 or better
>>Minimum requirements	20/ 18/ 15 in accordance with ISO 4406
>> Commissioning	The minimum purity requirement for the hydraulic oil is based on the most sensitive system component. For commissioning we recommend a filtration in order to achieve the required purity.
>> Filling and operation of hydraulic systems	The required purity of the hydraulic oil must be ensured during filling or topping up. When drums, canisters or large-capacity tanks are used the oil generally has to be filtered. We recommend the implementation of suitable measures (e.g. filters) to ensure that the required minimum purity of the oil is also achieved during operation.

>> International standard	code number according to ISO 4406		purity class according to SAE AS 4059
	18/ 16/ 13	corresponds to	8A/ 7B/ 7C
	20/ 18/ 15		9A/ 8B/ 8C

Available filter sizes

Filter size	55	75	105	135	165	210	280
No. 2	x				in development		
No. 3	x	x	x	x		x	x

Operational parameters. Pressure fluids

In order to ensure the functional performance and high efficiency of the hydraulic pumps the viscosity and purity of the operating fluid should meet the different operational requirements. Linde recommends using only hydraulic fluids which are confirmed by the manufacturer as suitable for use in high pressure hydraulic installations or approved by the original equipment manufacturer.

Permitted pressure fluids

>> mineral oil HLP to DIN 51 524-2

>> biodegradable fluids in accordance with ISO 15 380 on request

>> other pressure fluids on request

Linde offers an oil testing service in accordance with VDMA 24 570 and the test apparatus required for in-house testing. Prices available on request.

Recommended viscosity ranges

Pressure fluid temperature range	[°C]	-20 to +90
Working viscosity range	[mm²/s] = [cSt]	10 to 80
Optimum working viscosity	[mm²/s] = [cSt]	15 to 30
Max. viscosity (short time start up)	[mm²/s] = [cSt]	1000

In order to be able to select the right hydraulic fluid it is necessary to know the working temperature in the hydraulic circuit. The hydraulic fluid should be selected such that its optimum viscosity is within the working temperature range (see tables).

The temperature should not exceed 90 °C in any part of the system. Due to pressure and speed influences the leakage fluid temperature is always higher than the circuit temperature. Please contact Linde if the stated conditions cannot be met in special circumstances.

Viscosity recommendations

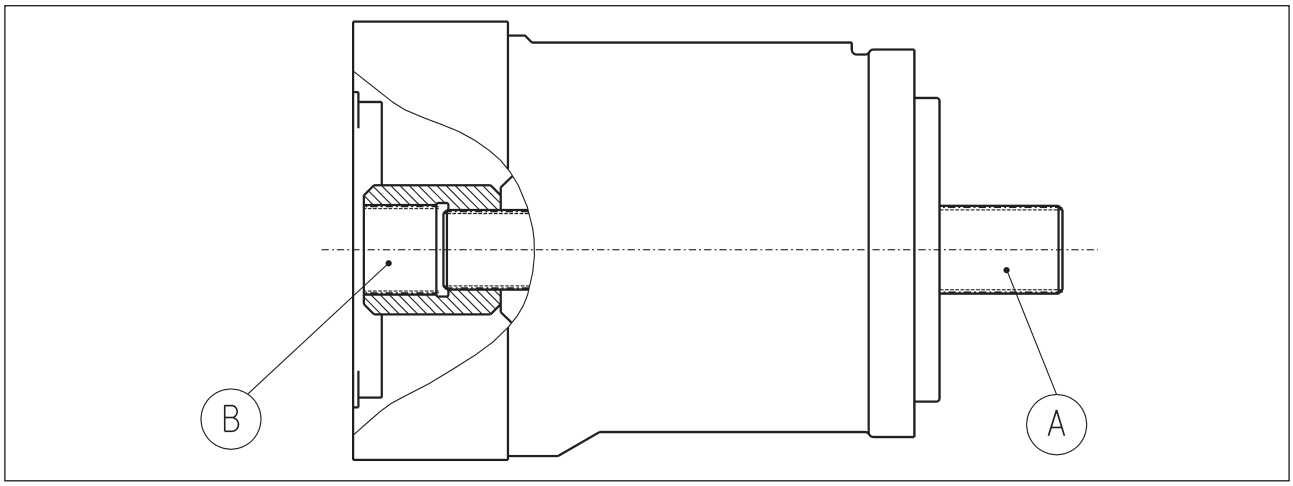
Working temperature [°C]	Viscosity class [mm²/s] = [cSt] at 40 °C
approx. 30 to 40	22
approx. 40 to 60	32
approx. 60 to 80	46 or 68

Further information regarding installation can be found in the operating instructions.

Torque transmission.

Depending on the selected components, different torques may be transferred. Please ensure that the load transfer components such as mounting flange, PTO-through shaft and additional pumps are designed adequately. Our sales engineers will be pleased to provide design advice.

Torque transmission of HPV-02



This shows the input side (A) and PTO-/output side (B) of a HPV-02 pump. The information on the following pages refers to

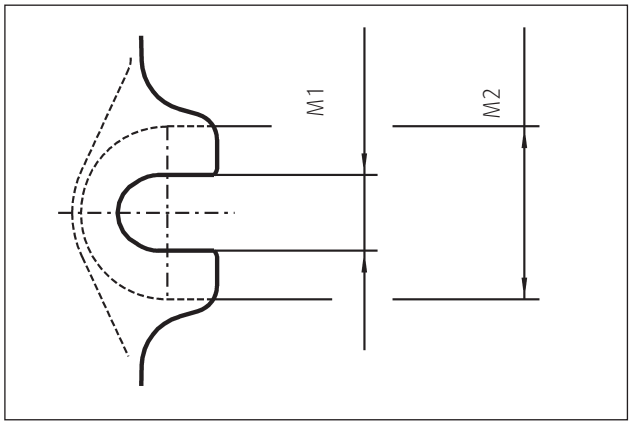
>> mounting flange and drive shaft (A)

>> PTO flange and through shaft (B).

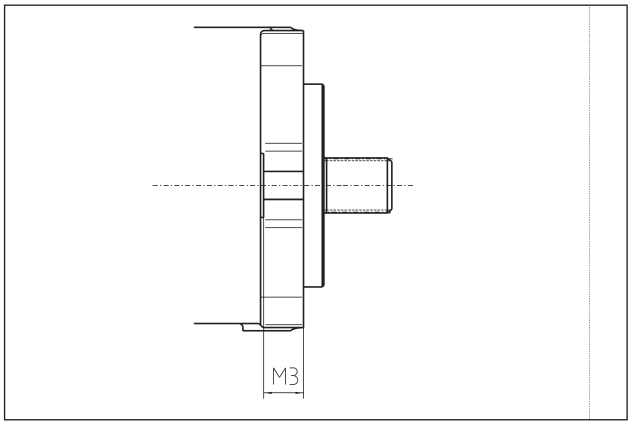
A) Flange profile

Bolt hole dimensions		Rated size HPV-02						
		55	75	105	135	165	210	280
M1 inside diameter	mm	17.5	17.5	17.5	21.5	in development	22	22
M2 outside diameter	mm	34	40	34	40		38	39
M3 length	mm	20	20	25	20		30	30
Min. plate thickness	mm	6	6	6	6		(8)	(8)

Bolt hole diameter



Bolt hole length

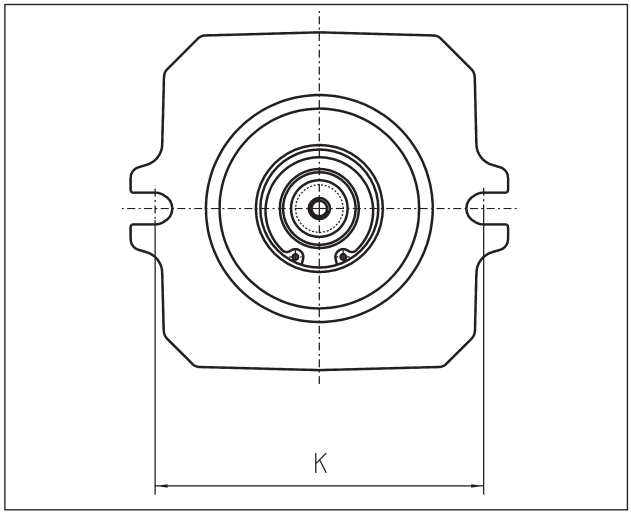


Torque transmission. Mounting flange

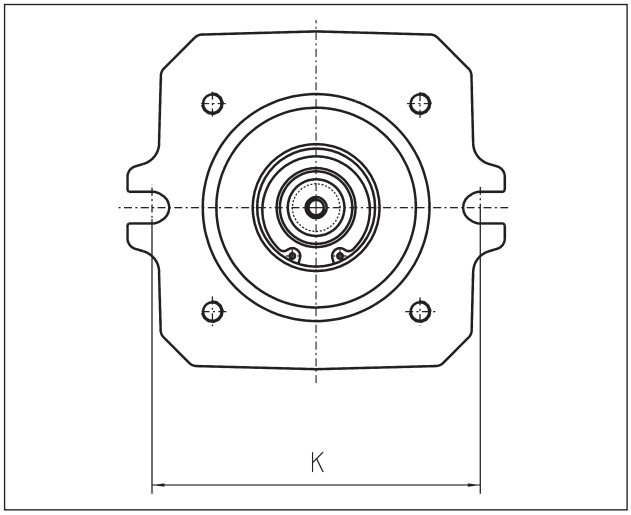
A) Mounting flange dimensions

Mounting flange dimensions in accordance with SAE J744	Dimension K [mm]	Rated size HPV-02						
		55	75	105	135	165	210	280
SAE C, C-C 2-hole	181.0	x	x	x		in development		
SAE C, C-C 2-hole with 4 additional threaded holes	181.0		x	x				
SAE D 2-hole	228.6				x			
SAE D 2-hole with 4 additional bolt holes	228.6				x			
SAE E 4-hole	224.5						x	x

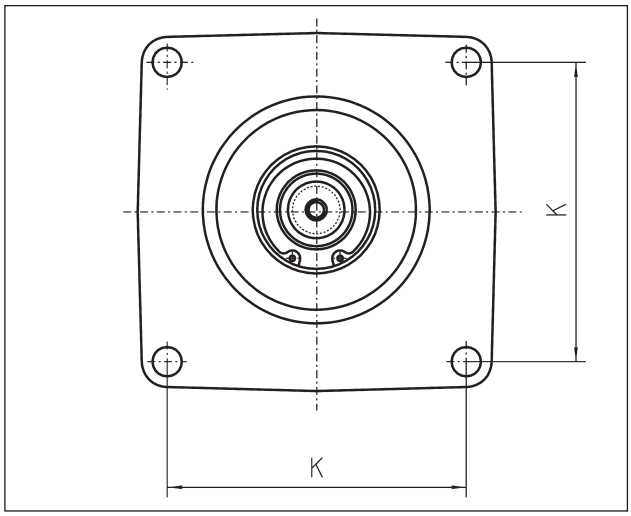
A) Fixing hole distance K 2-hole flange



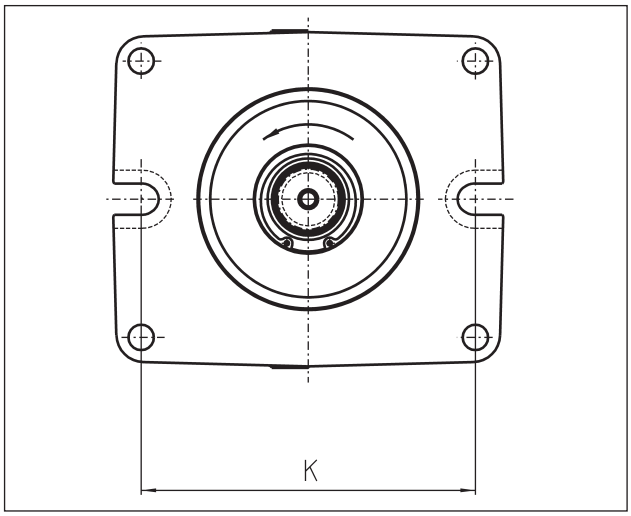
2-hole flange with 4 additional threaded holes



4-hole flange



2-hole flange with 4 additional bolt holes



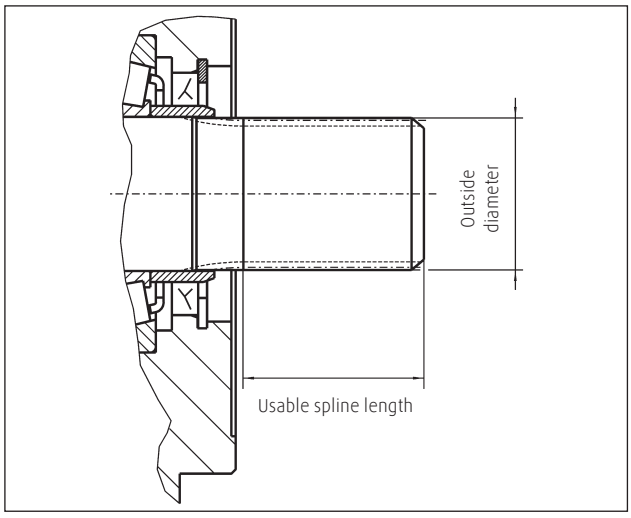
Torque transmission. Drive shaft

A) Dimensions ANSI and SAE drive shafts

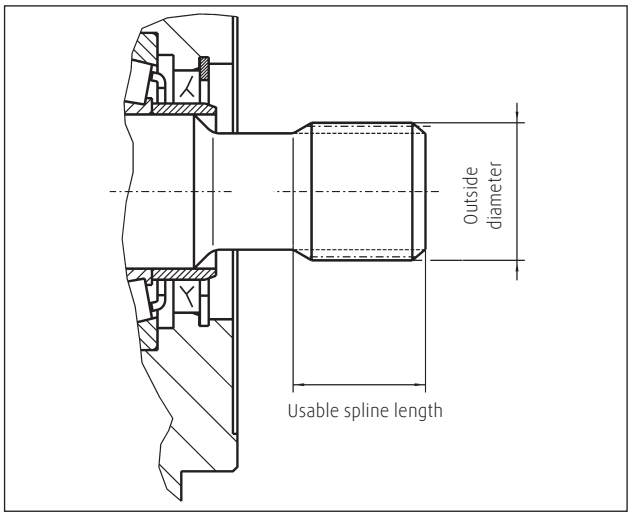
Shaft spline in accordance with ANSI B92.1	SAE J744 code for centering and shaft	Outside diameter [mm]	Usable spline length [mm]	Shaft type	Available for rated size						
					55	75	105	135	165	210	280
16/32, 21 t		34.51	39,5	1	x	x			in development		
16/32, 23 t		37.68	38,5	1			x				
16/32, 27 t		44.05	62	1				x		x	
16/32, 33 t		53.57	58	1							x
12/24, 14 t	C	31.22	30	2	x	x	x				
12/24, 17 t	C-C	37.68	30	2			x	x			
8/16, 13 t	D	43.71	50	2				x			
8/16, 15 t	F	50.06	58	1						x	

A) Linde Hydraulics shaft types

Type 1. Without undercut



Type 2. With undercut



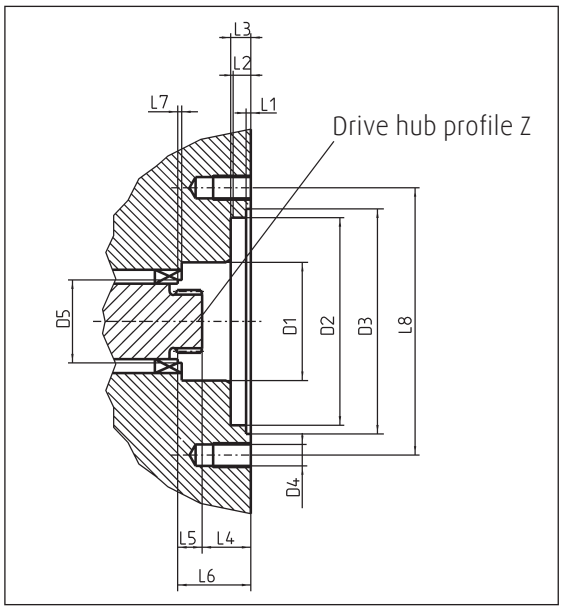
Torque transmission. PTO flange

Linde pumps can be combined into tandem and multiple pumps. The combination options are determined by the permitted transfer torque. The following data refers to the PTO (pump output side, without further attachments).

B) PTO dimensions

Rated size		55	75	105	135	165	210	280
Z Drive hub profile in accordance with ANSI B92.1		16/32, 15 t	16/32, 18 t	16/32, 19 t	16/32, 21 t	in development	16/32, 24 t	16/32, 27 t
D1	mm	40	42	48	52		63	72
D2 spigot pilot diameter	mm	82.55					82.55	
D3	mm	88					89.5	
D4	mm	M 10					M 10	M12
D5 max. bearing clearance	mm	30	35	38	43		47	49
L1	mm	1.5					1.9	
L2 adapter length	mm	7					8	
L3	mm	9					9	
L4 minimum distance	mm	35	39	33	35		38.5	50.5
L5 usable spline length	mm	14	18	19	20		29	30.6
L6 distance to bearing	mm	51	57.5	53	55.9		68.3	83
L7 min. bearing clearance	mm	3	3	3	4		3	-
L8 hole distance 2-hole	mm	106.4					106.4	146

B) PTO dimensions



Torque transmission. Output shaft

B) Output shaft transfer torque

Rated size		55	75	105	135	165	210	280
Continuous transfer torque	Nm	220	305	420	540	in develop- ment	840	1120
Max. transfer torque	Nm	350	485	670	870		1340	1800

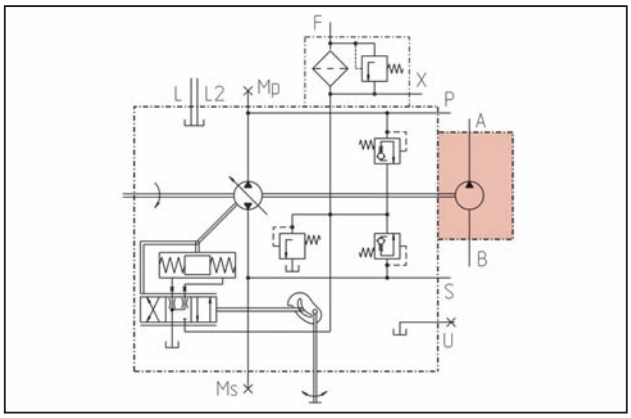
Gear pumps.

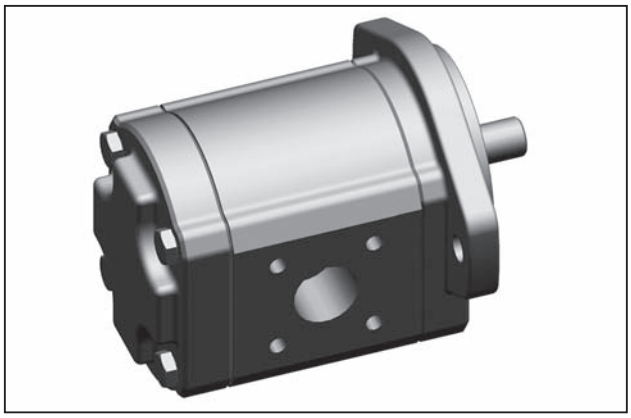
Two types of gear pumps are available: internal gear pump IGP and external gear pump EGP. The possible combinations of and with IGP and EGP are determined by the PTO option and the permitted shaft torque. Both types can be used as boost pump for the main circuit or the control and cooling circuit. The suction limit of 0.8 bar min. (absolute) must be adhered to. The boost pressure relief valves for the rated sizes 55-135 are integrated in the port plate housing, and for the rated sizes 210 and 280 in the charge pressure manifold of the HPV-02.

Technical data

Max. displacement volume	cm^3/rev	16	19	22.5	31	38	44
Standard boost pump for HPV-02	Rated size	55		75-135		210	280
Type of gear pump		IGP	EGP	IGP	EGP	EGP	EGP
Mounting flange and drive shaft profile		SAE A 16/32, 18 t	SAE A 16/32, 9 t	SAE A 16/32, 18 t	SAE A 16/32, 9 t	SAE A 16/32, 13 t	SAE A 16/32, 13 t
Type of suction		internal, external	external	internal, external	external	external	external
Max. perm. operating pressure observe max. permissible rated pressures for filter and cooler	bar	40	250	40	165	275	220
Standard PTO flange and shaft spline		SAE A 16/32, 9 t	-	SAE A 16/32, 9 t	-	-	-
Continuous output torque	Nm	175 75 Nm with SAE A	-	175 75 Nm with SAE A	-	-	-
Max. output torque	Nm	250 107Nm with SAE A	-	250 107Nm with SAE A	-	-	-
Cold start relief valve		integrated	-	integrated	-	-	-

External gear pump EGP



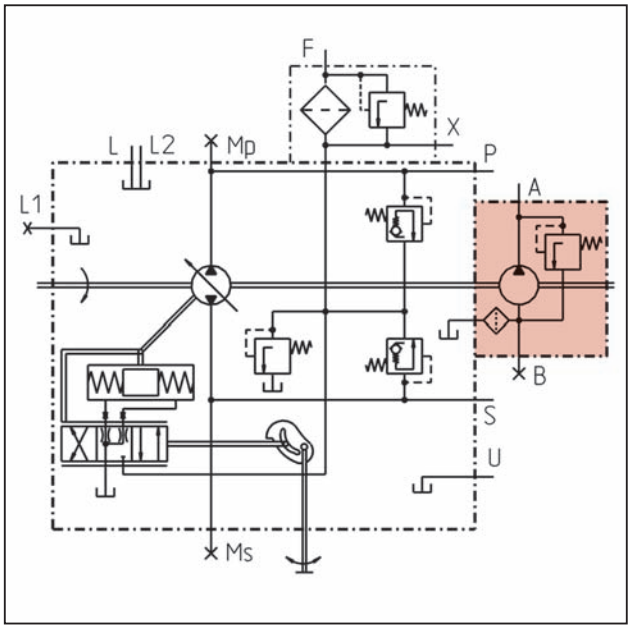


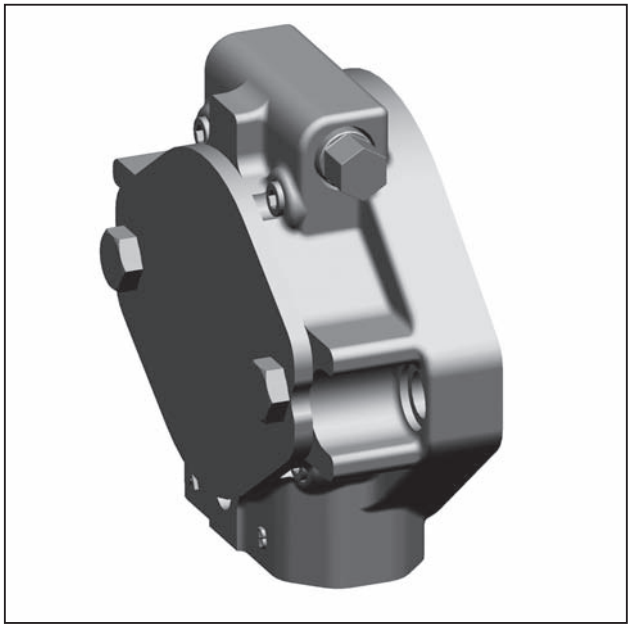
The EGP type features external suction.

Gear pumps.

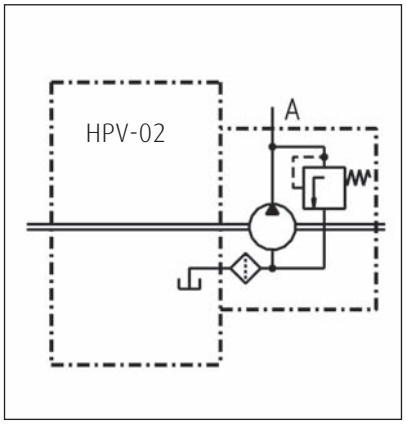
The IGP boost pumps include a cold start relief valve and a through drive for attaching additional pumps. The suction can be internal, external or combined. IGP types are available in rated sizes of 16 cm³/rev and 22.5 cm³/rev.

Internal gear pump IGP with internal suction

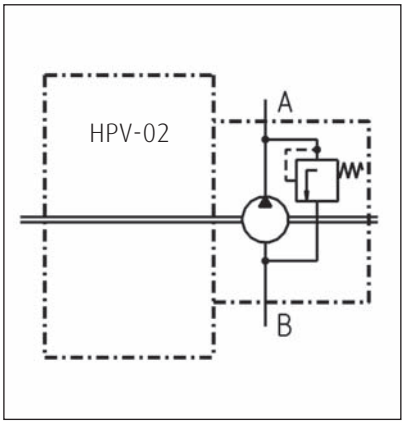




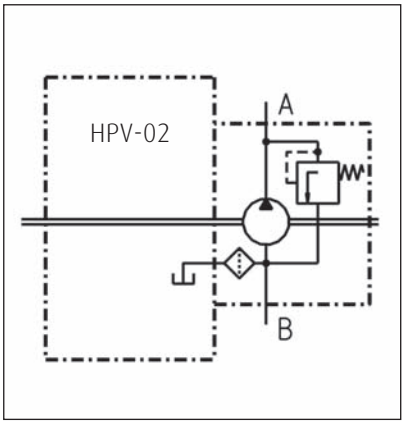
Internal suction



External suction



Combined suction



>> Internal suction

The boost pump supplies the main circuit with oil from the pump housing.
External connection B is closed.

>> External suction

The boost pump supplies the main circuit with oil from the oil tank.
The internal connection is closed.

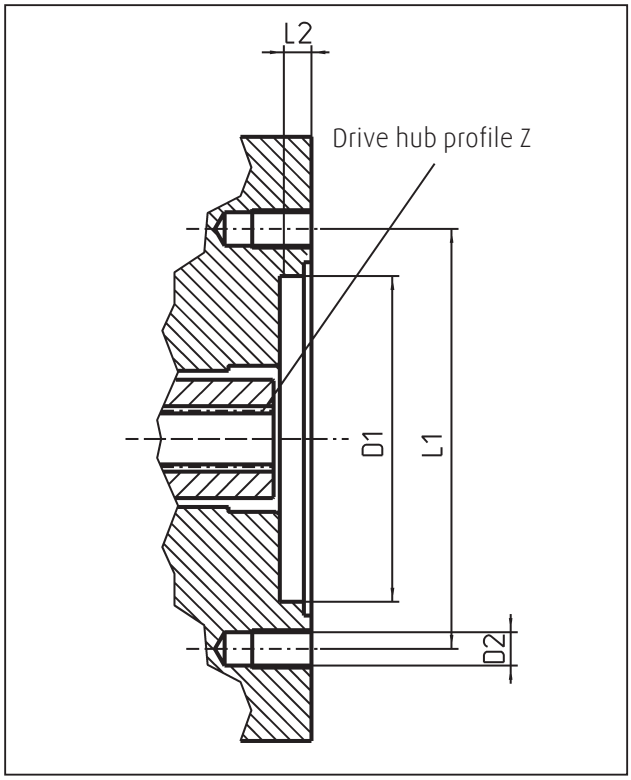
>> Combined suction

The boost pump supplies the main circuit with oil from the pump housing and oil tank.
This type of suction is a combination of internal and external suction.

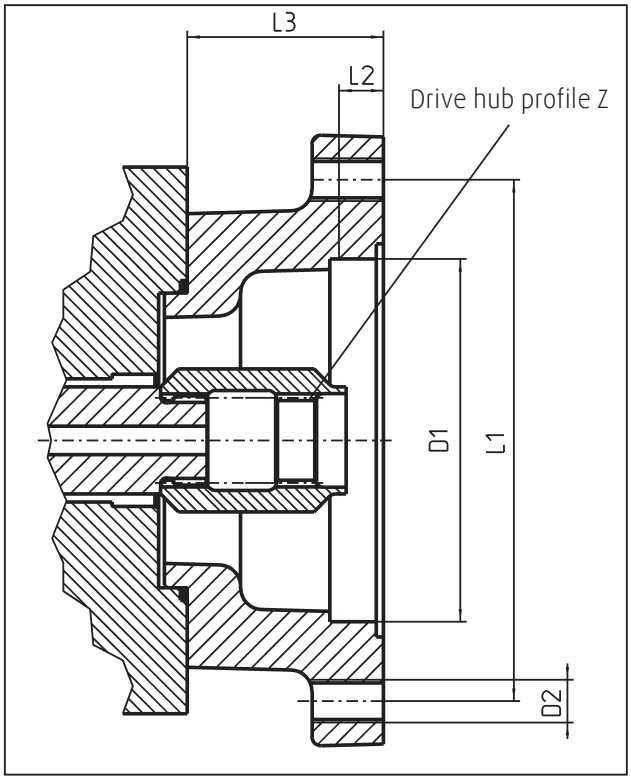
PTO flange with IGP

Flange profile 2-hole		SAE A	SAE B	SAE B-B	SAE C
Z Internal drive hub profile in according w/ ANSI B92.1		16/32, 9 t	16/32, 13 t	16/32, 15 t	12/24, 14 t
D1 Spigot pilot diameter	mm	82.55	101.6		127
D2 Thread size	mm	M 10	M 12		M 16
L1 Hole distance	mm	106.4	146		181
L2 Adapter length	mm	7	11		13
L3 Flange length	mm	-	55		72
Continuous transfer torque	Nm	75	175		
Maximum transfer torque	Nm	107	250		

PTO SAE A with IGP



PTO SAE B, B-B and C with IGP



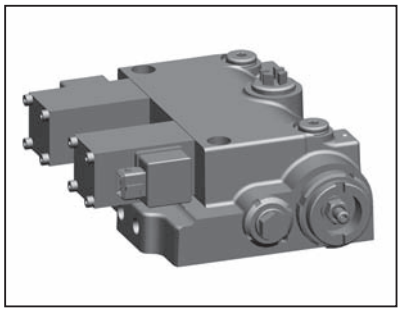
Controls.

The modular control concept with standardised interface enables quick selection and adaptation for different customer and system requirements with mechanical, hydraulic or electronic control. All Series 02-controls feature an upstream signal circuit that is adapted to the respective control, and a standardised and load-independent servo control for simple and constantly available machine or vehicle control.

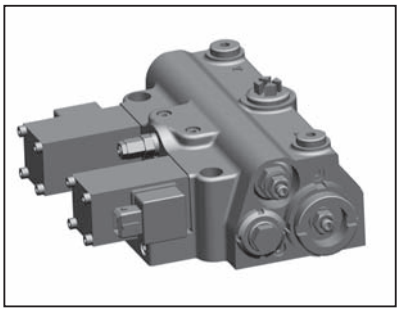
Technical data

Type of control	Additional option	Name of control
Mechanical		M1
Hydraulic		H1
	with pressure cut-off regulation	H1P
	speed dependent	CA
	torque-/ power controlled	CA
	with additional safety function	CA
Electrical		E1
	with pressure cut-off regulation	E1P
	with additional safety function	E2

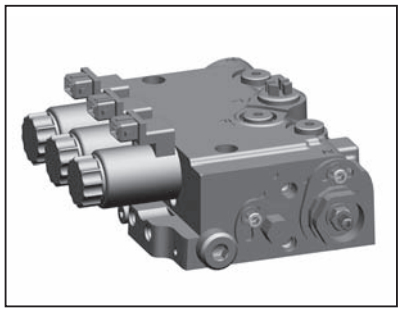
E1-control



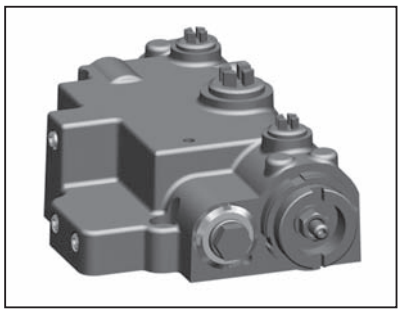
E1P-control



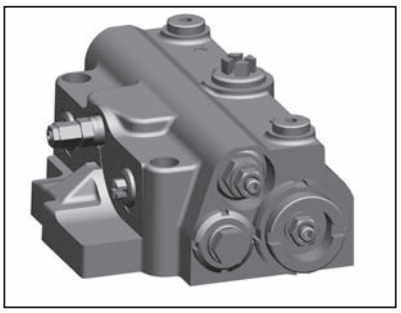
E2-control



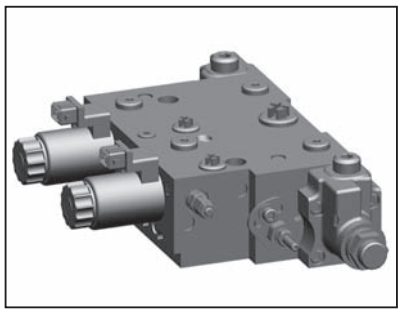
H1-control



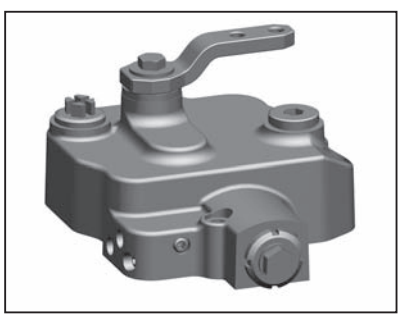
H1P-control



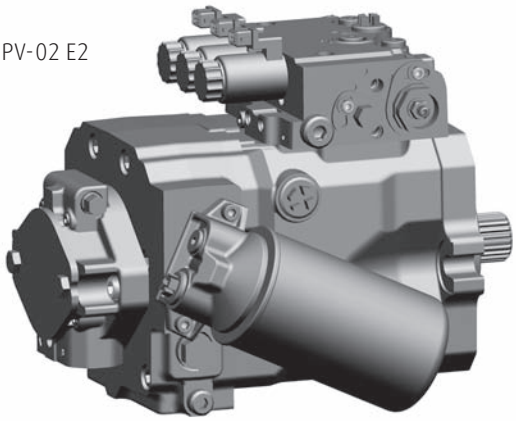
CA-control



M1-control



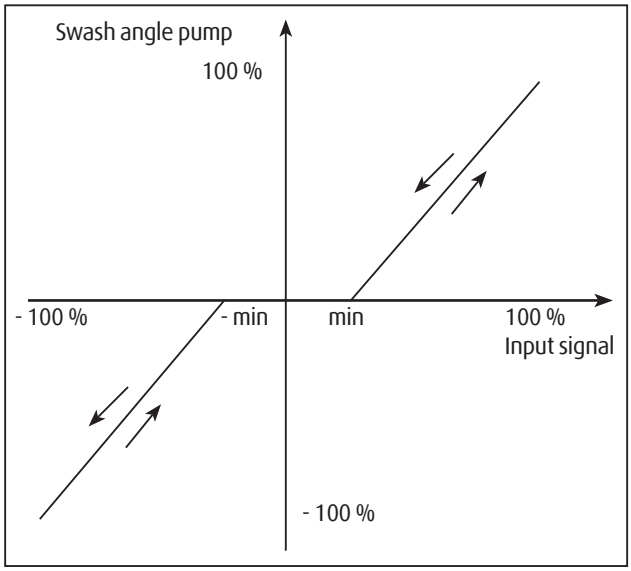
HPV-02 E2



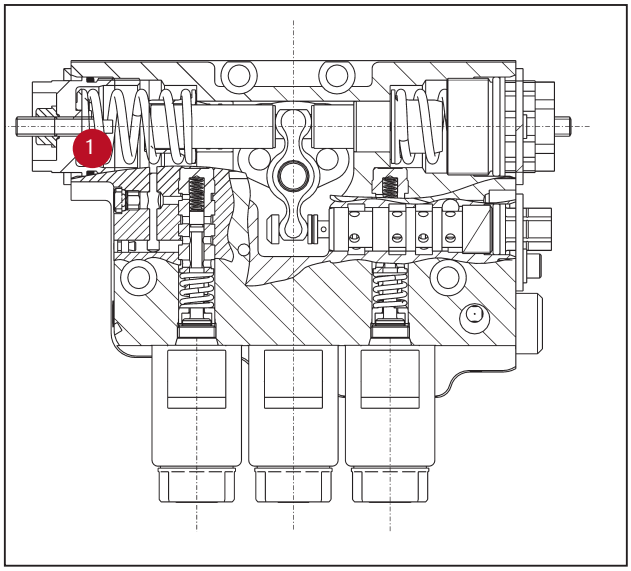
Controls. Control accuracy

All Series 02-pump controls result in the same machine response for identical motion commands, irrespective of the control type. Corrective action by the operator is no longer required. The reliable control of the pump can easily be integrated into any kind of vehicle management control system.

Control accuracy of a HPV-02 pump



E2-control

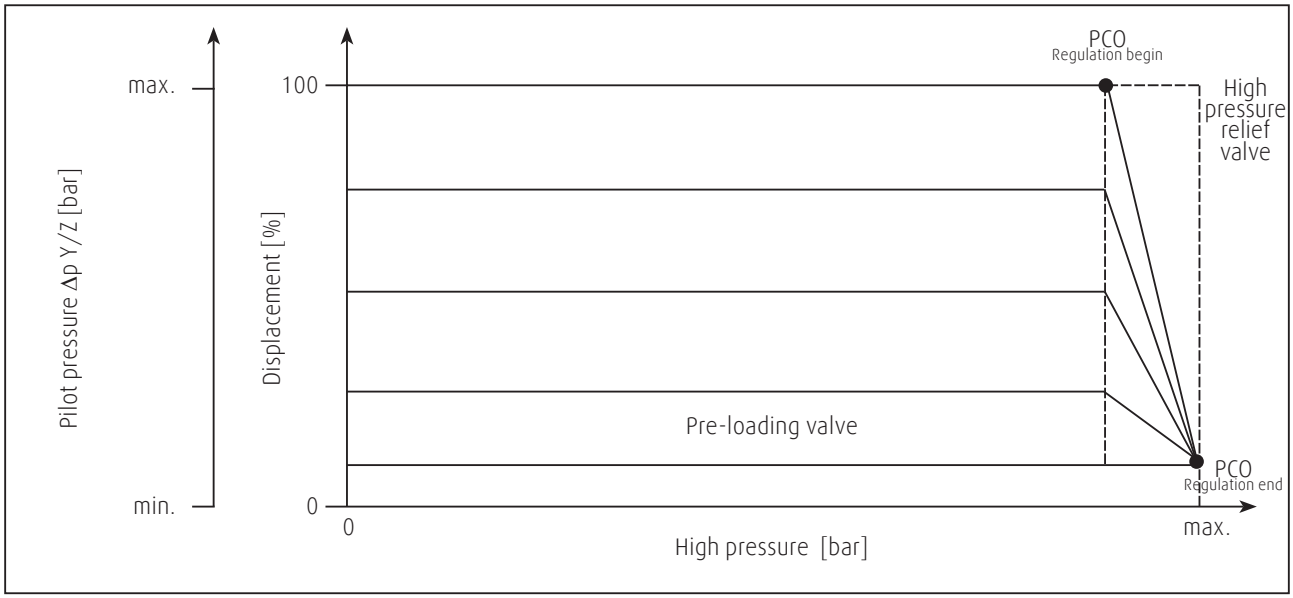


1 Setting the maximum displacement

Pressure cut-off regulation PCO

Special control elements deal with functions such as torque control or pressure cut-off regulation. Controls with pressure cut-off regulation (PCO) reduce pump flow when the cut-off pressure is reached. Because system pressure is maintained at low flow, the power consumption and thermal balance of the system are optimised.

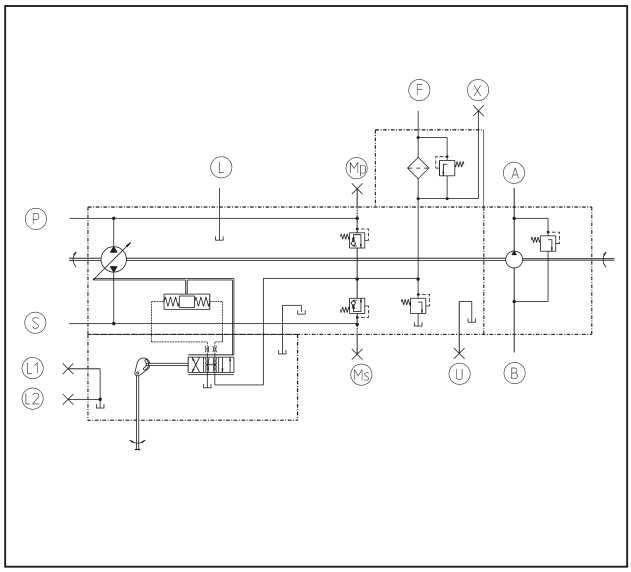
Displacement relative to pilot pressure and pressure cut-off regulation for M-, H- and E-controls

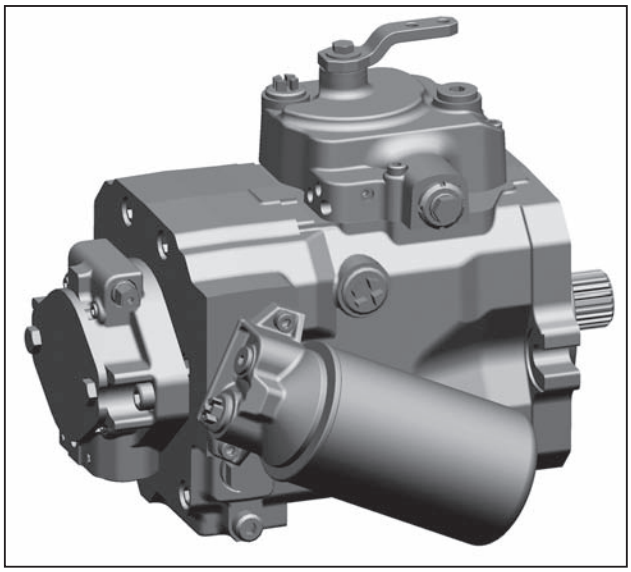


Controls. Mechanical-hydraulic M

The M1-pump control combines robustness with high precision for direct and reliable machine control. It is mechanically controlled and can be combined with a fixed, variable or regulating hydraulic motor. The control-specific data is independent of the nominal pump size.

M1. Mechanical control





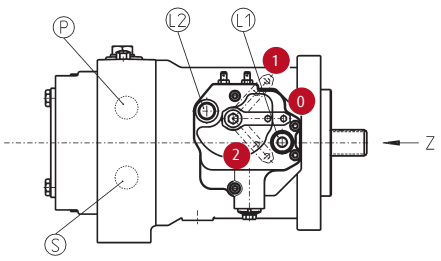
Flow direction

By turning the control lever the pump flow rate and direction of flow are controlled via a cam plate. The flow direction of the fluid depends on

>> the pump direction of rotation

>> the over centre direction of the swash plate.

High pressure outlet port

Cam lever direction	Shaft rotation (view on Z)	Right hand	Left hand
	0 → 1	P	S
	0 → 2	S	P

P, S	High pressure ports
A	Pressure port, boost pump
B	Suction port, boost pump
F	Feed port, boost and control
X	Test port, control pressure
Ms, Mp	Test ports, high pressure
L, U	Drain ports
L1, L2	Vent ports

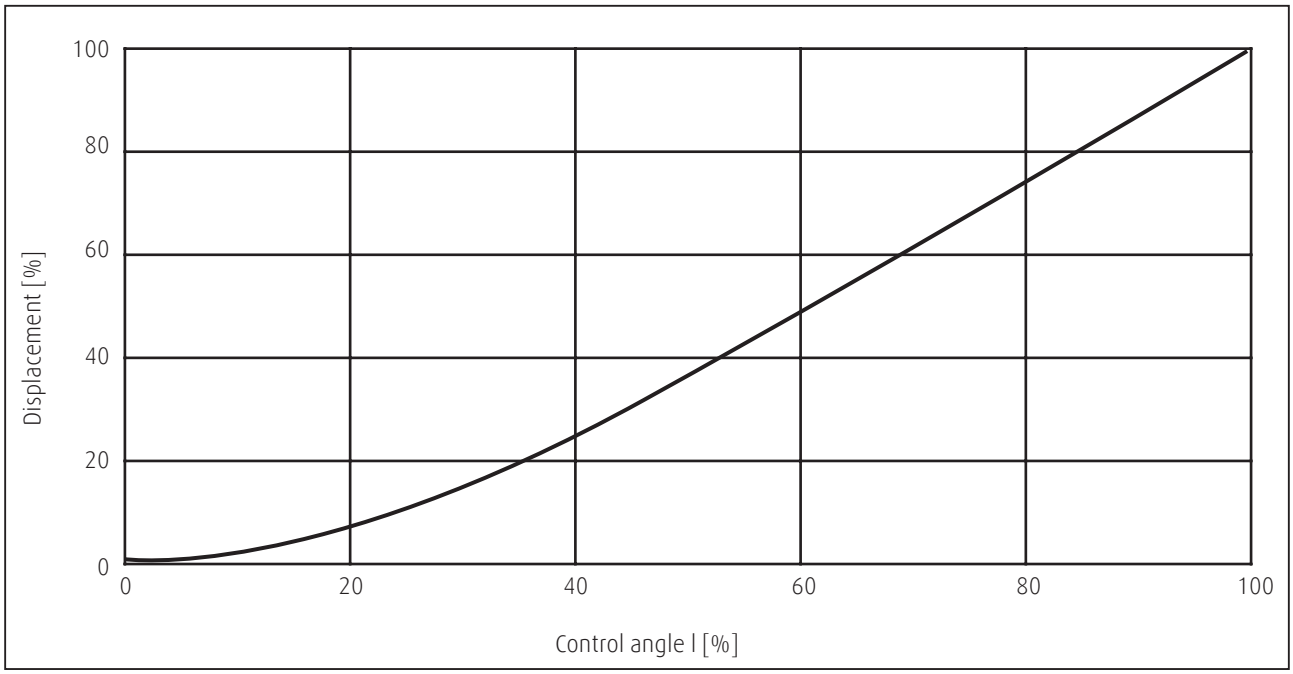
Note for left hand rotation

A	Suction port, boost pump
B	Pressure port, boost pump

Controls. Mechanical-hydraulic M

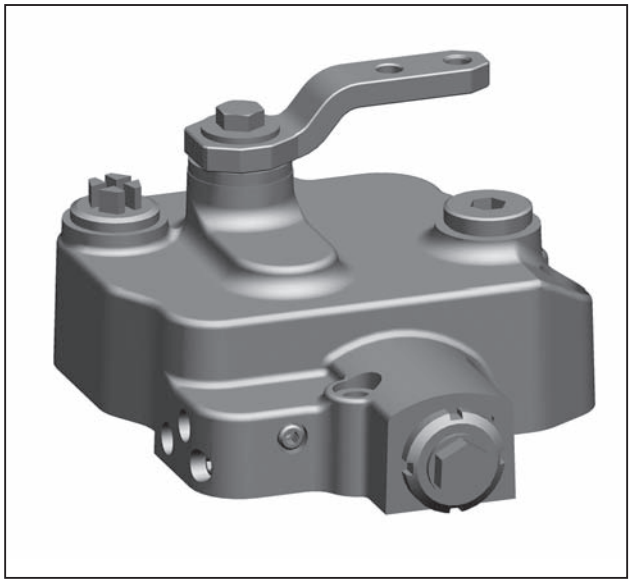
The cam plate offers a large control angle with progressive control characteristic and a wide neutral range. The resulting high resolution for movements from the neutral range (and vice versa) enables precise manoeuvring. Reliable and robust control of the displacement volume is achieved through position feedback.

Displacement relative to control angle

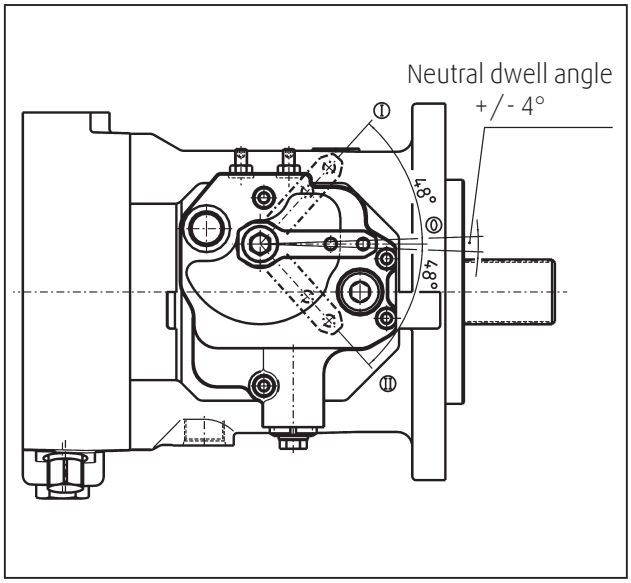


Control force with max. long lever radius r= 70 mm	17 N
Max. permissible control force (intermittent)	500 N
Control torque	1.2 Nm
Centred reset by external force	1.2 Nm
Control angle neutral range ... to end position	± 4° ...± 48°
Minimum response time with standard restrictors	0.5 sec

M1-cam plate



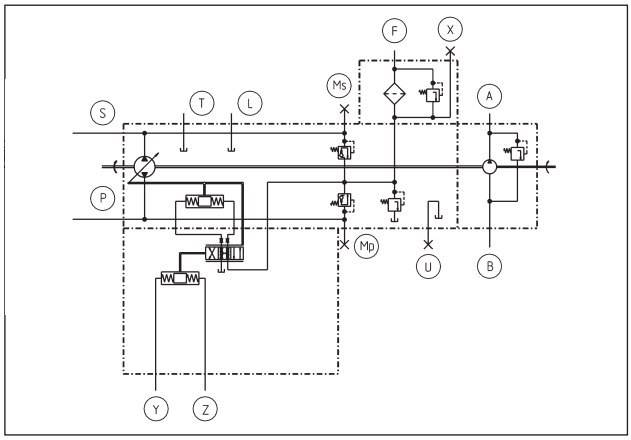
Control range

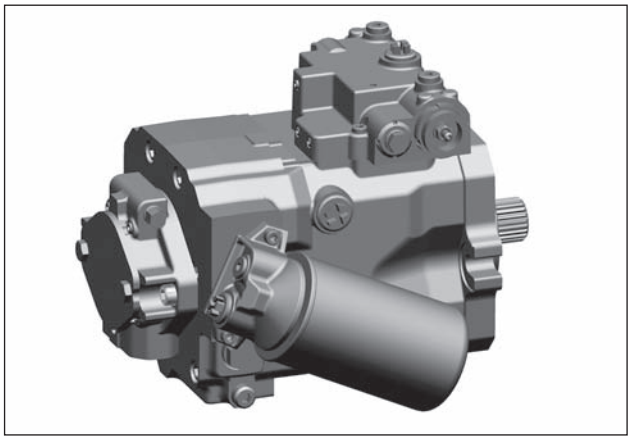


Controls. Hydraulic H

The HPV-02 H1 features hydraulic control with a wide pilot pressure range for improved machine control. It can be combined with a fixed, variable or regulating hydraulic motor. The data is specific for hydraulic controls, and independent of the nominal pump size and pressure cut-off regulation PCO, unless specified otherwise otherwise (see section Controls. Control accuracy).

H1. Hydraulic control





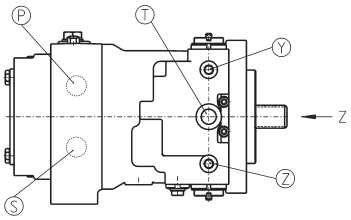
Flow direction

By an external hydraulic signal input at the pilot pressure ports (Y, Z) the pump flow rate and direction of flow are controlled. The flow direction of the fluid depends on

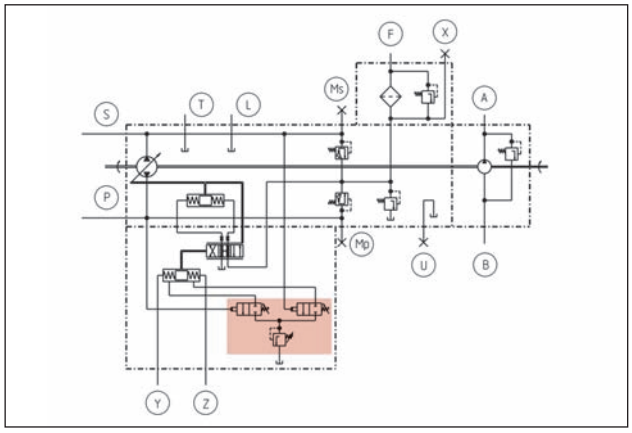
>> the pump direction of rotation

>> the over centre direction of the swash plate.

High pressure outlet port

Pilot pressure port		Shaft rotation (view on Z) Right hand	Left hand
	Y	P	S
	Z	S	P

H1P. Hydraulic control with PCO



P, S	High pressure ports
A	Pressure port, boost pump
B	Suction port, boost pump
F	Feed port, boost and control
X	Test port, pilot pressure
Ms, Mp	Test ports, high pressure
L, U	Drain ports
T	Vent port
Y, Z	Pilot pressure ports

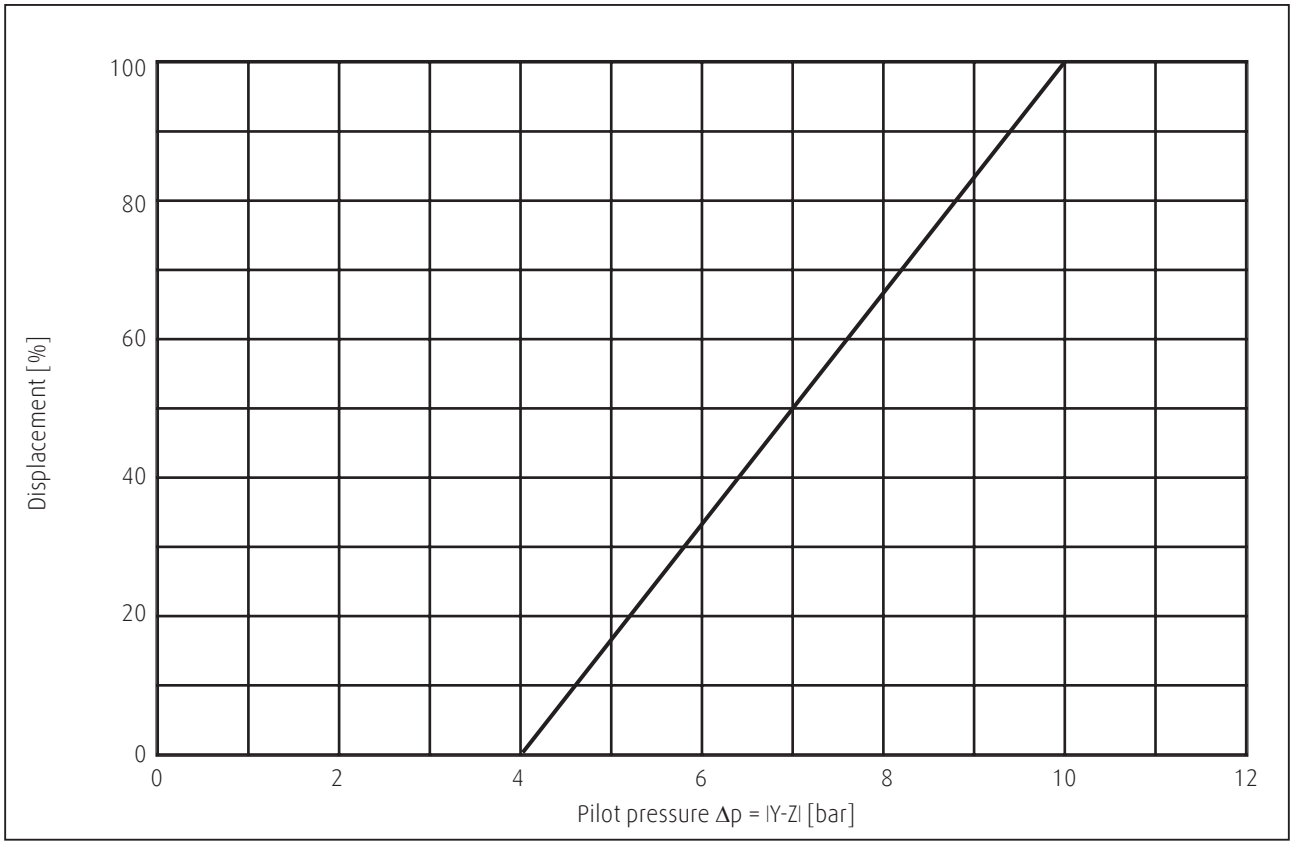
Note for left hand rotation

A	Suction port, boost pump
B	Pressure port, boost pump

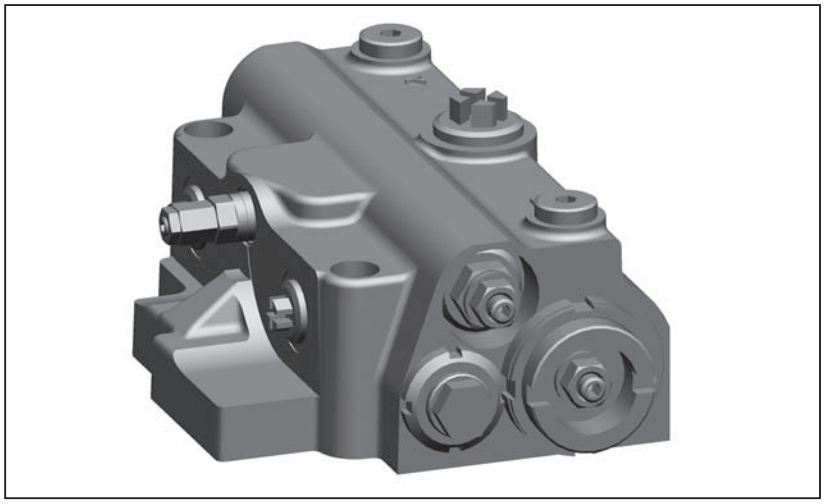
Controls. Hydraulic H

Pilot pressure range standard	4 - 10 bar differential pressure |Y – Z|
Maximum permissible pressure at Y or Z	30 bar
Minimum response time with standard orifices for one-way swashing between 0 and ±max	0.5 sec

Displacement relative to pilot pressure



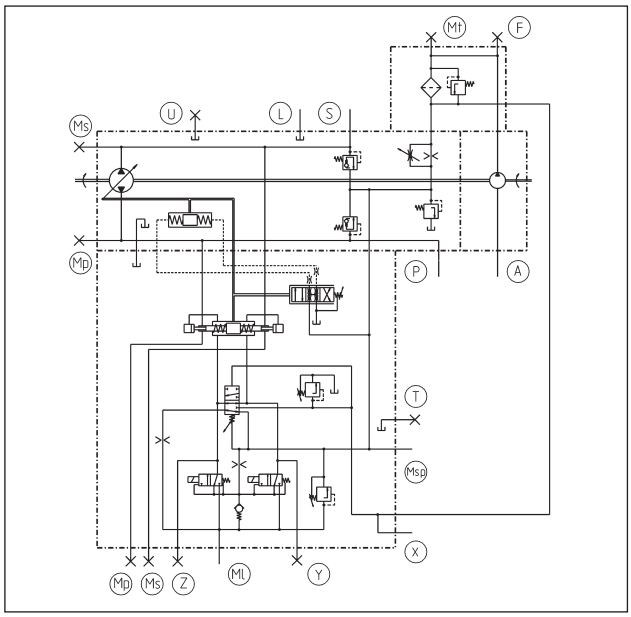
H1P-control with PCO

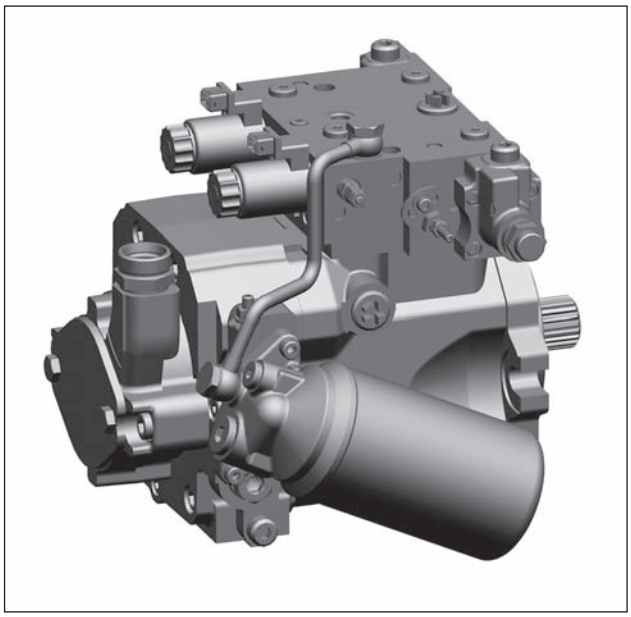


Controls. Hydraulic-mechanical CA

The HPV-02 CA is a speed-dependent pump control with torque/power regulation. It can be combined with a hydraulic motor as fixed, variable or regulating motor or a variable motor with pressure regulator. The modular design offers a high degree of versatility in terms of function and control.

CA. Hydraulic-mechanical control





CA-control. Advantages

>> pilot operated system
- >> controlled load response
- >> temperature independent
- >> dynamics
- >> precision
- >> low hysteresis
- >> high versatility (modular design)
- >> various motor control possible

>> simple adjusting
>> direct control of torque and tractive force
>> speed optimized inching function
>> high safety standard
>> hydrostatic deceleration

P, S	High pressure ports
A	Suction port, boost pump
F	Feed port, boost and control

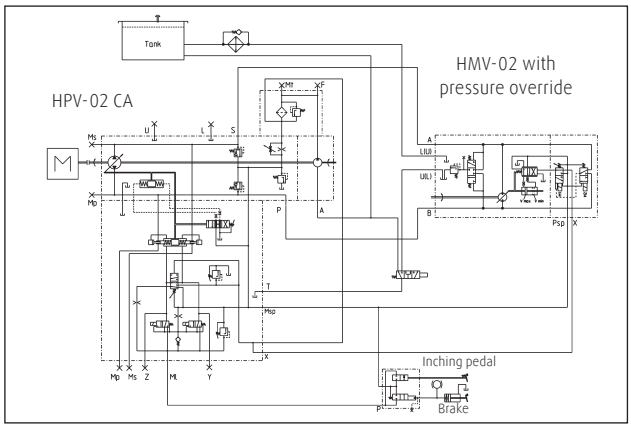
Test ports

Mt	Temperature
Ms, Mp	High pressure
Y, Z	Pilot pressure
Ml	For power settings and inch pressure port
Msp	Boost pressure
X	Pilot pressure port HMV
L, U	Drain ports
L1, L2	Vent ports
T	Drain and vent port

Note for left hand rotation

A	Suction port, boost pump

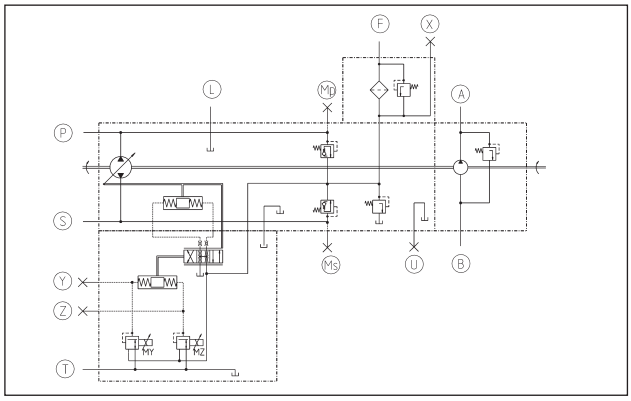
Drive with speed-dependent variable pump and variable motor with pressure override

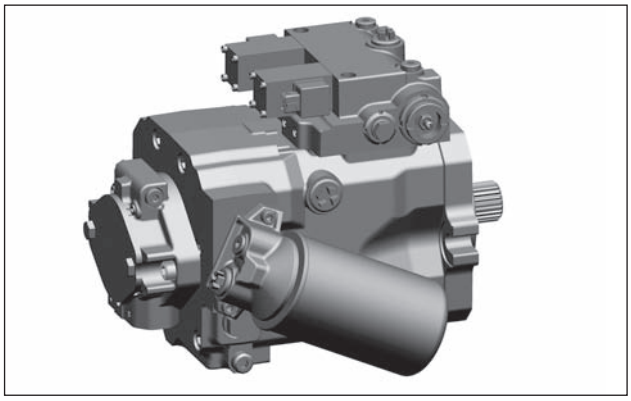


Controls. Electro-hydraulic E1

The HPV-02 E1 has two proportional solenoids and through the upstream signal circuit it combines the flexibility of electronic vehicle management with the reliability of a pump control marked by its high operational availability. Precise and simple. Identical commands always call for the same response in the machine, so no corrective action is required by the operator or the electronic system.

E1. Electro-hydraulic control



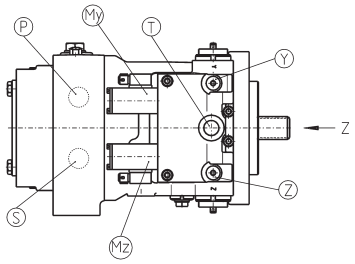


Flow direction

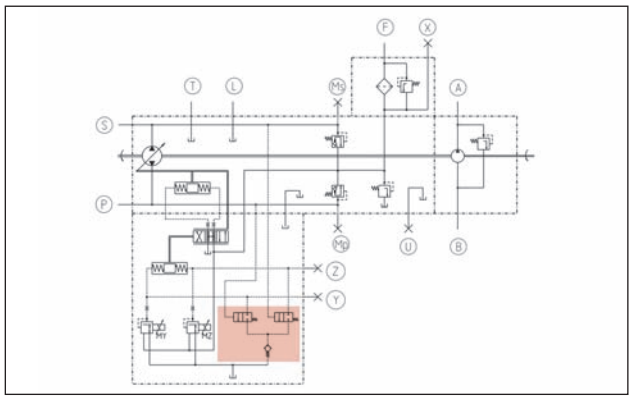
By an external electrical signal input at the solenoids (MY and MZ) the pump flow rate and direction of flow are controlled.
The flow direction of the fluid depends on

>> the pump direction of rotation
>> the over centre direction of the swash plate.

High pressure outlet port

Active solenoid		Shaft rotation (view on Z) Right hand	Left hand
	MY	P	S
	MZ	S	P

E1P. Electro-hydraulic control with PCO



P, S	High pressure ports
A	Pressure port, boost pump
B	Suction port, boost pump
F	Feed port, boost and control
X	Test port, pilot pressure
Ms, Mp	Test ports, high pressure
L, U	Drain ports
T	Vent port

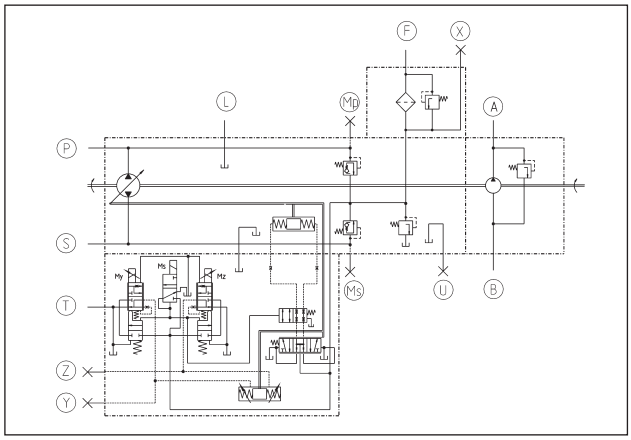
Note for left hand rotation

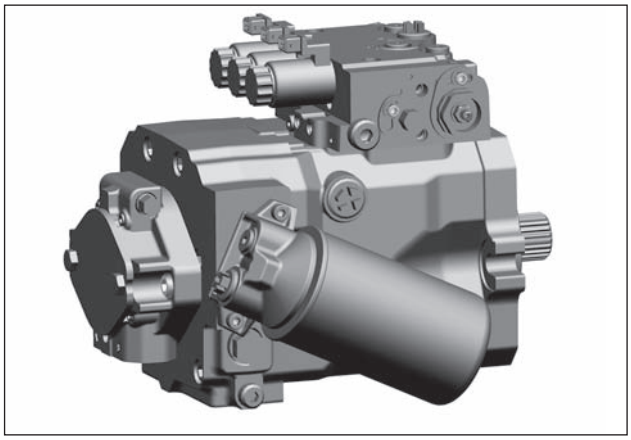
A	Suction port, boost pump
B	Pressure port, boost pump

Controls. Electro-hydraulic E2

The HPV-02 E2, with its additional release function, can easily be integrated in an electronic vehicle management control system like an E1-control. In addition it offers a safety standard that meets the stringent requirements for road traffic use. The E2-control features two proportional solenoids and a switching solenoid.

E2. Electro-hydraulic control





Flow direction

By an external electrical signal input at the solenoids (MY and MZ) the pump flow rate and direction of flow are controlled.
The flow direction of the fluid depends on

>> the pump direction of rotation

>> the over centre direction of the swash plate.

High pressure outlet port (see section Control. Electro-hydraulic E1)

E2 with safety function

The electronic control unit compares the travel command to other machine signals. In case of a system fault (e.g. by cable break or short-circuit) the electronic control unit will deactivate the release solenoid of the E2-control and the pump is brought actively to neutral under full control. Upon this the vehicle is brought to rest in a smooth jerk-free manner – without endangering the driver.

Its use is recommended for mobile applications where specific criteria have to be met in terms of travel and coasting behaviour, e.g. road traffic use.

Product advantages of E2

>> fulfils the rigorous demands for road traffic use

>> active drive enable

>> minimized susceptibility to interference

>> with HMF-02: defined swashing back of pump for controlled deceleration and stop in case of system fault
with HMV-02: diesel overspeed protection by fast swashing back of pump

P, S	High pressure ports
A	Pressure port, boost pump
B	Suction port, boost pump
F	Feed port, boost and control
X	Test port, control pressure
Ms, Mp	Test ports, high pressure
Y, Z	Test ports, control pressure
L, U	Drain ports
T	Vent port

Note for left hand rotation

A	Suction port, boost pump
B	Pressure port, boost pump

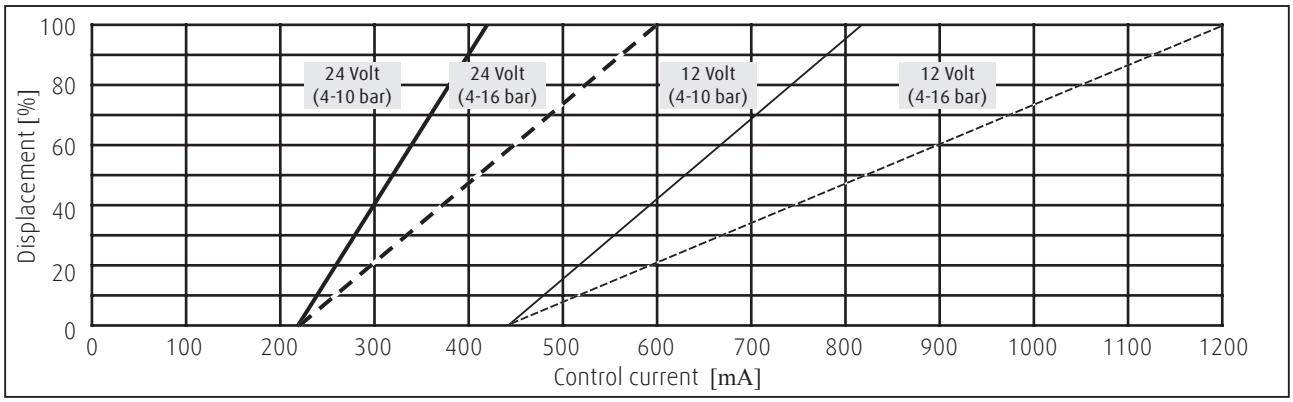
Controls. Electro-hydraulic E

The data is specific for electrical controls, and independent of the nominal pump size and PCO pressure cut-off regulation, unless specified otherwise (see section Controls. Control accuracy). Figures HPV-02 E1 and HPV-02 E2 (page 22, 23) show the standard mounting position for the respective E-control.

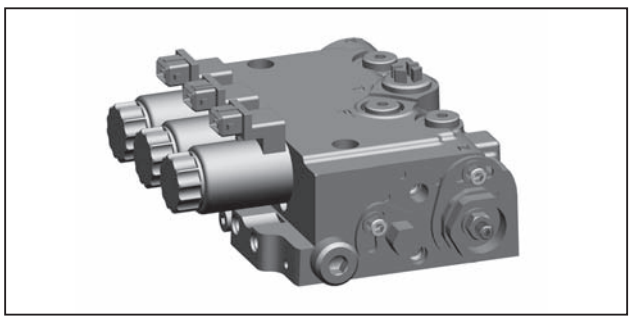
Control signal characteristics

Supply voltage = limiting voltage			V	12	24
Connector type				Hirschmann (not for round solenoids) AMP-Junior-Timer, 2-pin	
Voltage type				Direct Current (D.C.)	
Power consumption			W	15.6	
Rated current= limiting current			mA	1300	650
Control current	Swash begin		mA	450 ±10	225 ±10
	Swash end on request	pilot pressure range 4-10 bar	mA	810	410
		pilot pressure range 4-16 bar	mA	1200	600
Relative duty cycle			%	100	
Protection class				IP 6K6K, Teil 9	
Control types	digital control via Pulse Width Modulation PWM with Linde transducers			100 Hz Rectangle, Pulse duty ratio variable over control range	
	analogue control with alternative transducers			Direct Current (with or without superimposed dither signal for stability and reducing hysteresis, dither: ± 125 mA, 32-40 Hz, pulse duty ratio 1:1)	
Minimum response time with standard orifices			s	0.5	

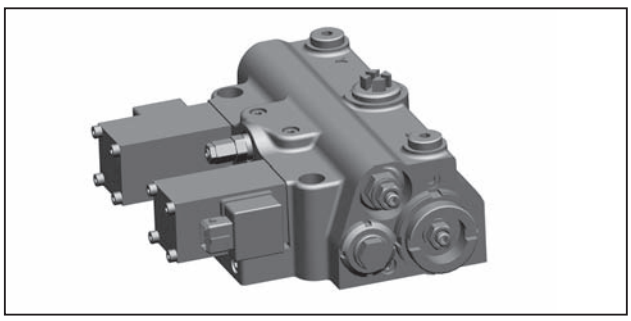
Displacement relative to control current



E2-electro-hydraulic control



E1P-electro-hydraulic control with PCO

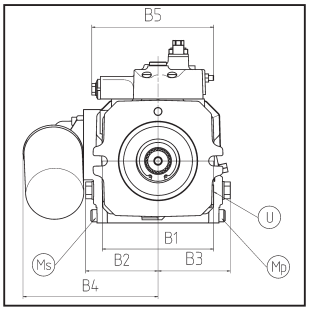


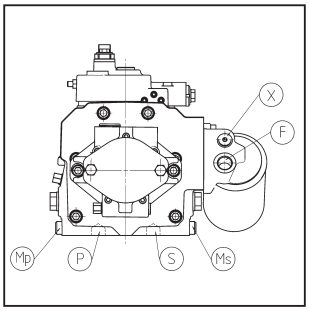
Dimensions. M-controls

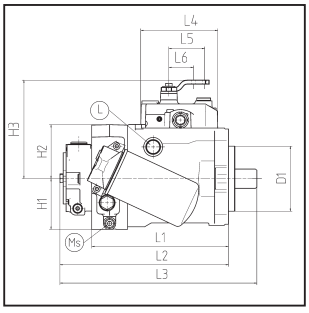
Control-specific dimensions for HPV-02 with mechanical-hydraulic controls.

Port sizes and dimensions for M-controls

Rated size	55	75	105	135	165	210	280
Gear pumps rated size [cm³]	16	22.5			under development	38	44
F flange profile	2-hole mounting flange					4-hole mounting flange	
	SAE C			SAE D		SAE E	
W shaft profile in accordance with ANSI B92.1	16/32 spline pitch					16 / 32	
	21 teeth		23 teeth	27 teeth		27 teeth	33 teeth
D1 [mm]	127			152.4		165.1	
B1 [mm]	181			228.6		224	225
B2 [mm]	101	116		141		142	155
B3 [mm]	101	116		141		135	-
B4 [mm]	192	216		219		240	246
B5 [mm]	194					194	
L1 [mm]	225	242	267	288		346	392
L2 [mm]	282	304	329	350		516	571
L3 [mm]	335	359	385	425		591	646
L4 [mm]	151					151	
L5 [mm]	70					70	
L6 [mm]	48					48	
H1 [mm]	88	93	99	106		134	152
H2 [mm]	95	103	105	112		133	150
H3 [mm]	184	188	193	198		226	238
P	SAE ¾“	SAE 1“		SAE 1 ¼“		SAE 1 ½“	
S	SAE ¾“	SAE 1“		SAE 1 ¼“		SAE 1 ½“	
A gear pump	M27x2					SAE ¾“	
B gear pump	M27x2					SAE 1 ¼“	
L	M22x1.5			M27x2		M27x2	M33x2
U	M22x1.5			M27x2		M27x2	M33x2
F	M22x1.5					M27x2	M27x2
X	M22x1.5					M14x1.5	
Mp	M14x1.5					M14x1.5	
Ms	M14x1.5					M14x1.5	
L1	M22x1.5					M22x1.5	
L2	M22x1.5					M22x1.5	

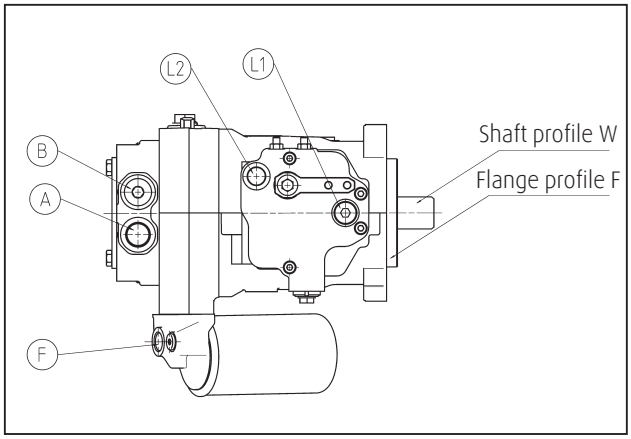






Threads metric in accordance with ISO 6149
Threads for SAE high pressure port metric in accordance with ISO 261
Socket cap screw in accordance with ISO 4762

Further threads on request

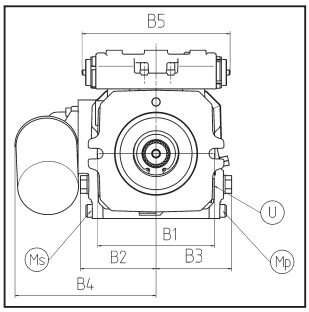


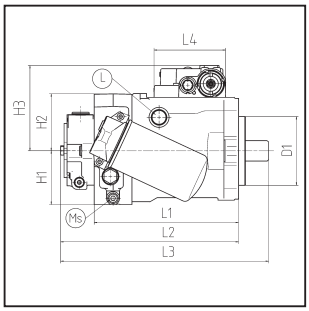
Dimensions. H-controls

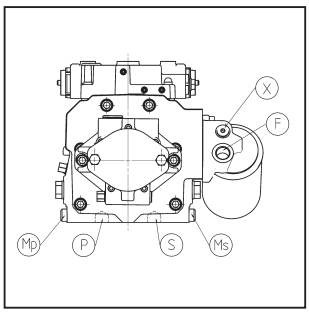
Control-specific dimensions for HPV-02 with hydraulic controls.

Port sizes and dimensions for H-controls

Rated size		55	75	105	135	165	210	280
Gear pumps rated size [cm³]		16	22.5			in development	38	44
F flange profile		2-hole mounting flange					4-hole mounting flange	
		SAE C			SAE D		SAE E	
W shaft profile in accordance with ANSI B92.1		16/32 spline pitch					16 / 32	
		21 teeth		23 teeth	27 teeth		27 teeth	33 teeth
D1 [mm]		127			152.4		165.1	
B1 [mm]		181			228.6		224	225
B2 [mm]		101	116		141		143	155
B3 [mm]		101	116		141		135	139
B4 [mm]		192	216		219		240	246
B5 [mm]		231					231	
L1 [mm]		225	242	267	288		346	392
L2 [mm]		282	304	329	350		516	571
L3 [mm]		335	359	385	425		591	646
L4 [mm]		133					133	
H1 [mm]		88	93	99	106		134	152
H2 [mm]		95	103	105	112		133	150
H3 [mm]	w/o PCO	194	154	158	163		191	204
	with PCO	185	190	194	199		201	214
P		SAE ¾"	SAE 1"		SAE 1 ¼"		SAE 1 ½"	
S		SAE ¾"	SAE 1"		SAE 1 ¼"		SAE 1 ½"	
A gear pump		M27x2					SAE ¾"	
B gear pump		M27x2					SAE 1 ¼"	
L		M22x1.5					M27x2	M33x2
U		M22x1.5					M27x2	M33x2
F		M22x1.5					M27x2	M27x2
T		M22x1.5					M22x1.5	
X		M14x1.5					M14x1.5	
Mp		M14x1.5					M14x1.5	
Ms		M14x1.5					M14x1.5	
Y		M14x1.5					M14x1.5	
Z		M14x1.5					M14x1.5	

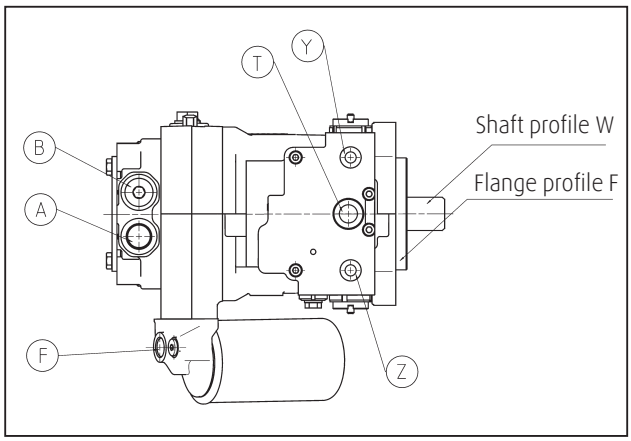






Threads metric in accordance with ISO 6149
Threads for SAE high pressure port metric in accordance with ISO 261
Socket cap screw in accordance with ISO 4762

Further threads on request

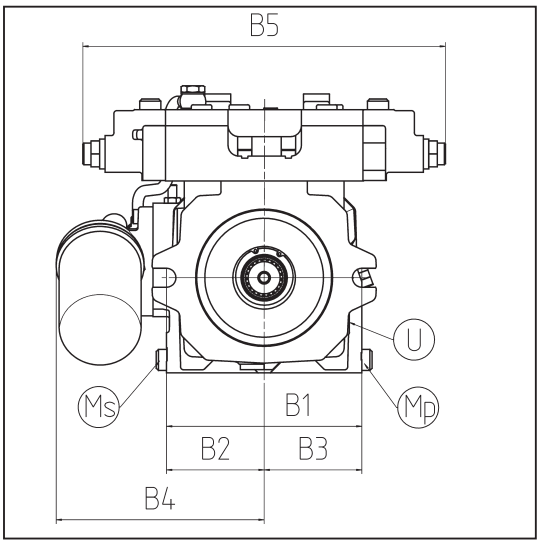


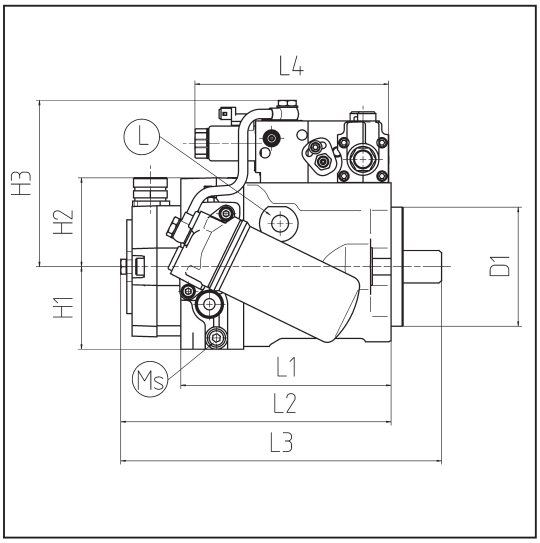
Dimensions. CA-controls

Control-specific dimensions for HPV-02 with hydraulic-mechanical controls.

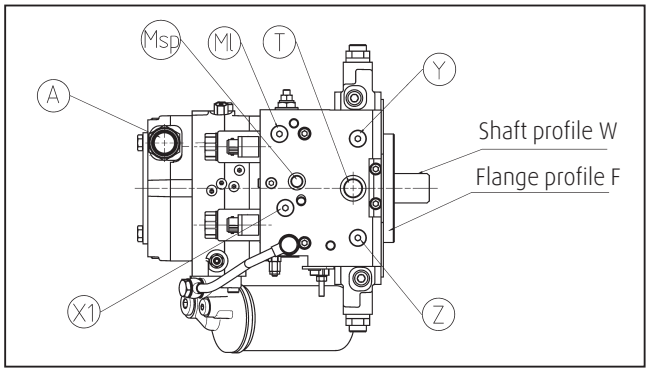
Port sizes and dimensions for CA-controls

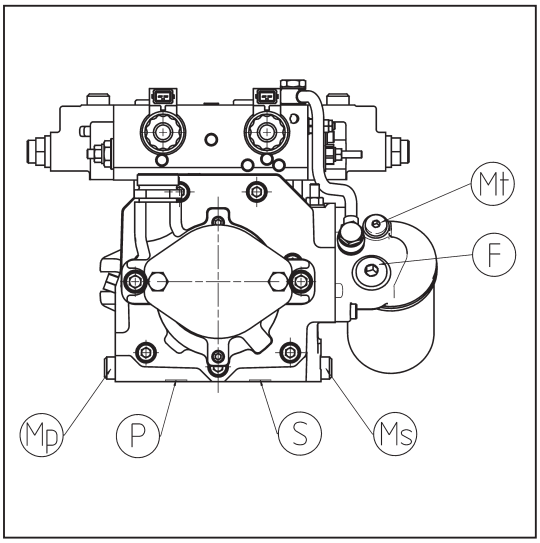
Rated size	55	75	105	135
Gear pumps rated size [cm³]	16	16	in development	in development
F flange profile	2-hole mounting flange			
	SAE C			
W shaft profile in accordance with ANSI B92.1	16/32 spline pitch			
	21 teeth			
D1 [mm]	127			
B1 [mm]	181			
B2 [mm]	101	116		
B3 [mm]	101	116		
B4 [mm]	193	212		
B5 [mm]	336			
L1 [mm]	225	242		
L2 [mm]	289	306		
L3 [mm]	343	361		
L4 [mm]	207			
H1 [mm]	88	93		
H2 [mm]	95	103		
H3 [mm]	178	184		
A gear pump	M36x2			
P	SAE 1"			
S	SAE 1"			
L	M22x1.5			
U	M22x1.5			
F	M22x1.5			
T	M22x1.5			
X1	M14x1.5			
Mp	M14x1.5			
Ml	M14x1.5			
Ms	M14x1.5			
Msp	M14x1.5			
Mt	M14x1.5			
Y	M14x1.5			
Z	M14x1.5			





Threads metric in accordance with ISO 6149
Threads for SAE high pressure port metric in accordance with ISO 261
Socket cap screw in accordance with ISO 4762
Further threads on request



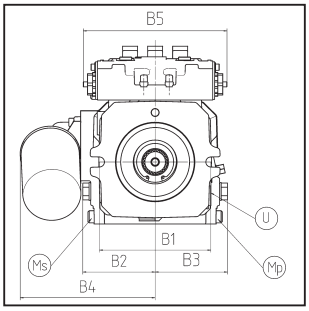


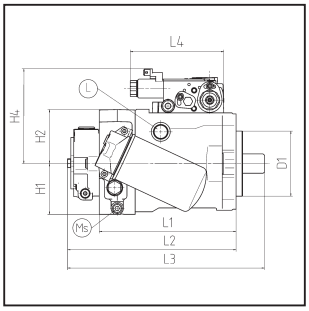
Dimensions. E-controls

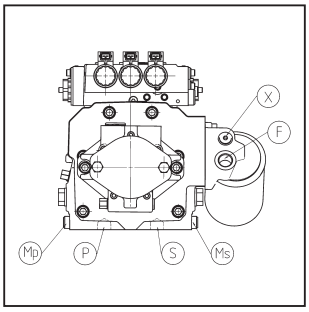
Control-specific dimensions for HPV-02 with electro-hydraulic controls.

Port sizes and dimensions for E-controls

Rated size		55	75	105	135	165	210	280
Gear pumps rated size [cm³]		16	22.5			in development	38	44
F flange profile		2-hole mounting flange					4-hole mounting flange	
		SAE C			SAE D		SAE E	
W shaft profile in accordance with ANSI B92.		16/32 spline pitch					16 / 32	
		21 teeth		23 teeth	27 teeth		27 teeth	33 teeth
D1 [mm]		127			152.4		165.1	
B1 [mm]		181			228.6		224	225
B2 [mm]		101	116		141		143	155
B3 [mm]		101	116		141		135	139
B4 [mm]		192	216		219		240	246
B5 [mm] E1		226					226	
B5 [mm] E2		230					230	
L1 [mm]		225	242	267	288		346	392
L2 [mm]		282	304	329	350		516	571
L3 [mm]		335	359	385	425		591	646
L4 [mm]		183					183	
H1 [mm]		88	93	99	106		134	152
H2 [mm]		95	103	105	112		133	150
H4 [mm] E1 /E2 with AMP-JT-connector		159	164	168	173		218	231
H4 [mm] E1 with Hirschmann-connector		195	200	204	209		254	(267)
P		SAE ¾“	SAE 1“		SAE 1 ¼“		SAE 1 ½“	
S		SAE ¾“	SAE 1“		SAE 1 ¼“		SAE 1 ½“	
Mp		M14x1.5					M 14x1.5	
Ms		M14x1.5					M 14x1.5	
A gear pump		M27x2					SAE ¾“	
B gear pump		M27x2					SAE 1 ¼“	
L		M22x1.5					M27x2	M33x2
U		M22x1.5					M27x2	M33x2
F		M22x1.5					M27x2	M27x2
T		M22x1.5					M22x1.5	
X		M14x1.5					M14x1.5	
Y		M14x1.5					M14x1.5	
Z		M14x1.5					M14x1.5	
F2		M14x1.5					M14x1.5	
Ms	E1-control	-					-	
	E2-control round solenoids	AMP-JT					AMP-JT	
My	E1-control	Hirschmann, AMP-JT					Hirschmann, AMP-JT	
	E2-control round solenoids	AMP-JT					AMP-JT	
Mz	E1-control	Hirschmann, AMP-JT					Hirschmann, AMP-JT	
	E2-control round solenoids	AMP-JT					AMP-JT	

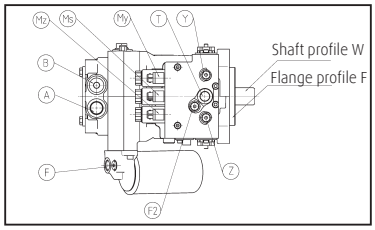






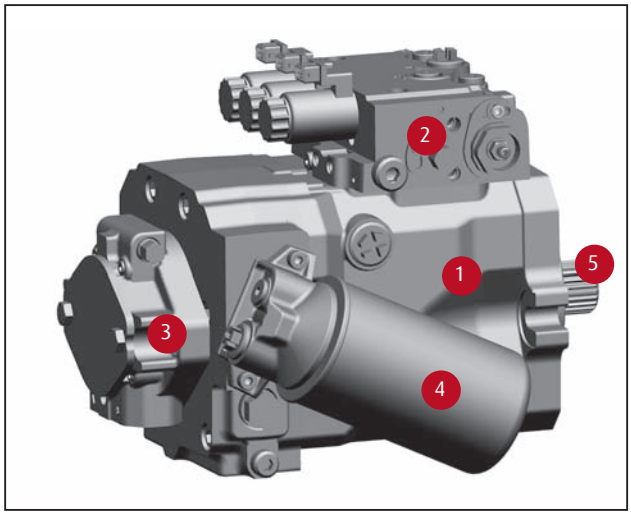
Threads metric in accordance with ISO 6149
Threads for SAE high pressure port metric in accordance with ISO 261
Socket cap screw in accordance with ISO 4762

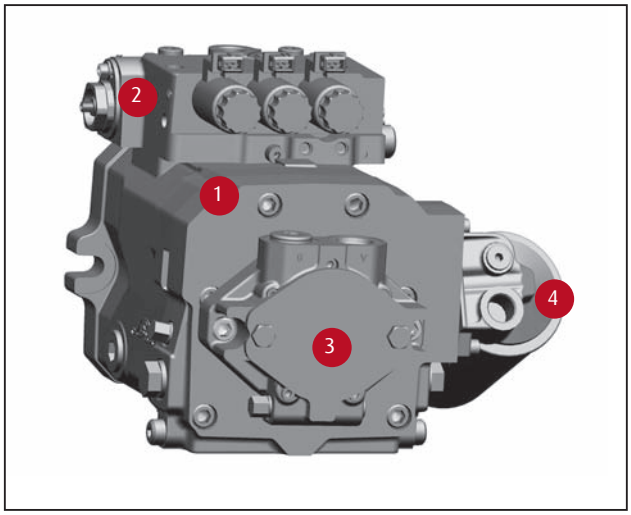
Further threads on request



Dimensions. Modular system

The following data enable quick calculation of the overall maximum external dimensions. In each case only the relevant dimensions are shown so that length, width and height can simply be determined through addition. The actual fitting dimensions of the respective units are shown on the installation drawing.





External dimensions for addition

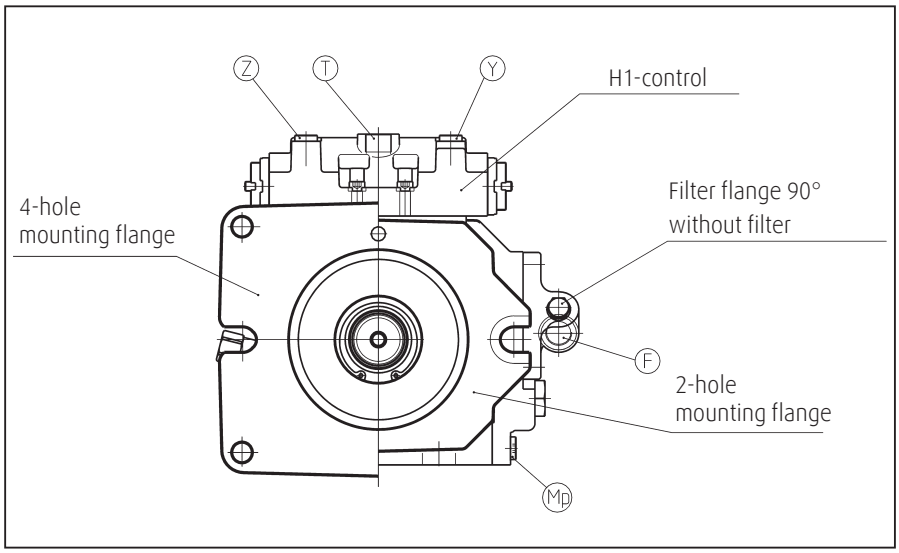
Component	Type	Length	Width	Height
1 Basic unit	55	230	210	185
	75	245	235	190
	105	270	235	210
	135	290	280	220
	165	in development		
	210	350	290	275
	280	395	315	305
2 Control	M1	-	10	95
	H1	-	5	55
	H1P	-	10	75
	CA	-	135	95
	E1	-	5	110
	E1P	-	10	110
	E2	-	15	110
3 Gear pump	16 cm³	60	-	-
	22,5 cm³	65	-	-
	31 cm³	135	-	-
	38 cm³	175	-	-
	44 cm³	180	-	-
4 Filter	No. 2	10 without gear pump	95	-
	No. 3		105	-
	F-port 90°	15	50	-
5 Coupling flange not shown		75	-	-
6 Intermediate flange Shown under Dimensions. Tandem pumps	SAE B, B-B	20	-	-
	SAE C size 55/75	50	-	-
	SAE C size 105	40	-	-
	SAE C, C-C, D	65	-	-

Example:
HPV 135-02 H1 with IGP 22.5, filter no. 3 and coupling flange L. 440 mm W. 390 mm H. 275 mm

Dimensions. Modular system

The following diagrams show the proportions of similar components.

View on mounting flange



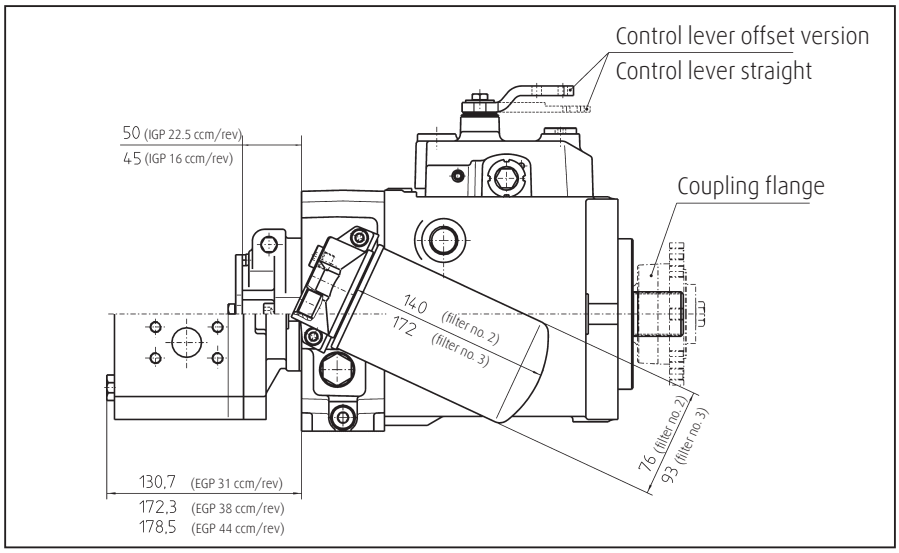
>> 4-hole mounting flange

>> 2-hole mounting flange

>> H1-control

>> filter flange 90° without filter

Side view



>> M1-control lever geometry

>> IGP

>> EGP

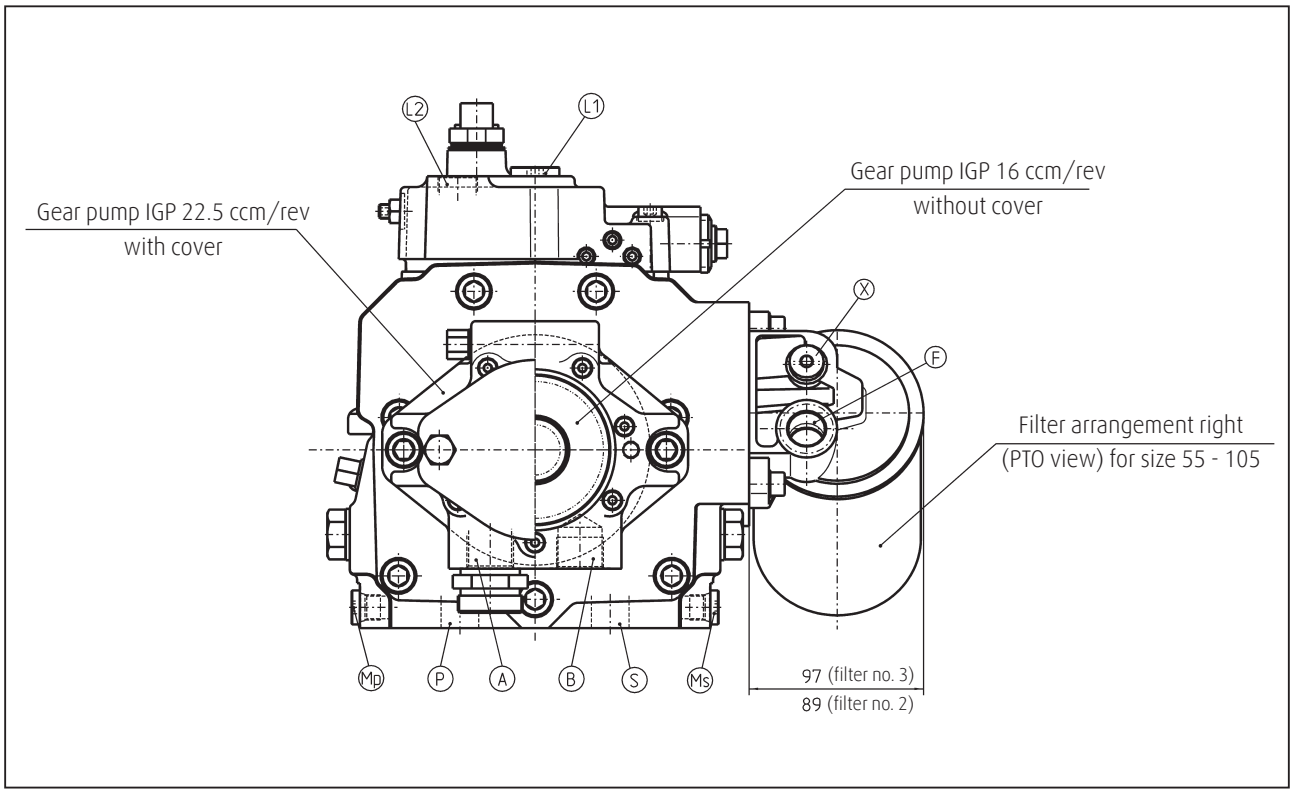
>> filter

>> coupling flange

Dimensions. Modular system

The following diagrams show the proportions of similar components.

PTO view



>> M1-control

>> IGP 22.5 cm³/rev with cover

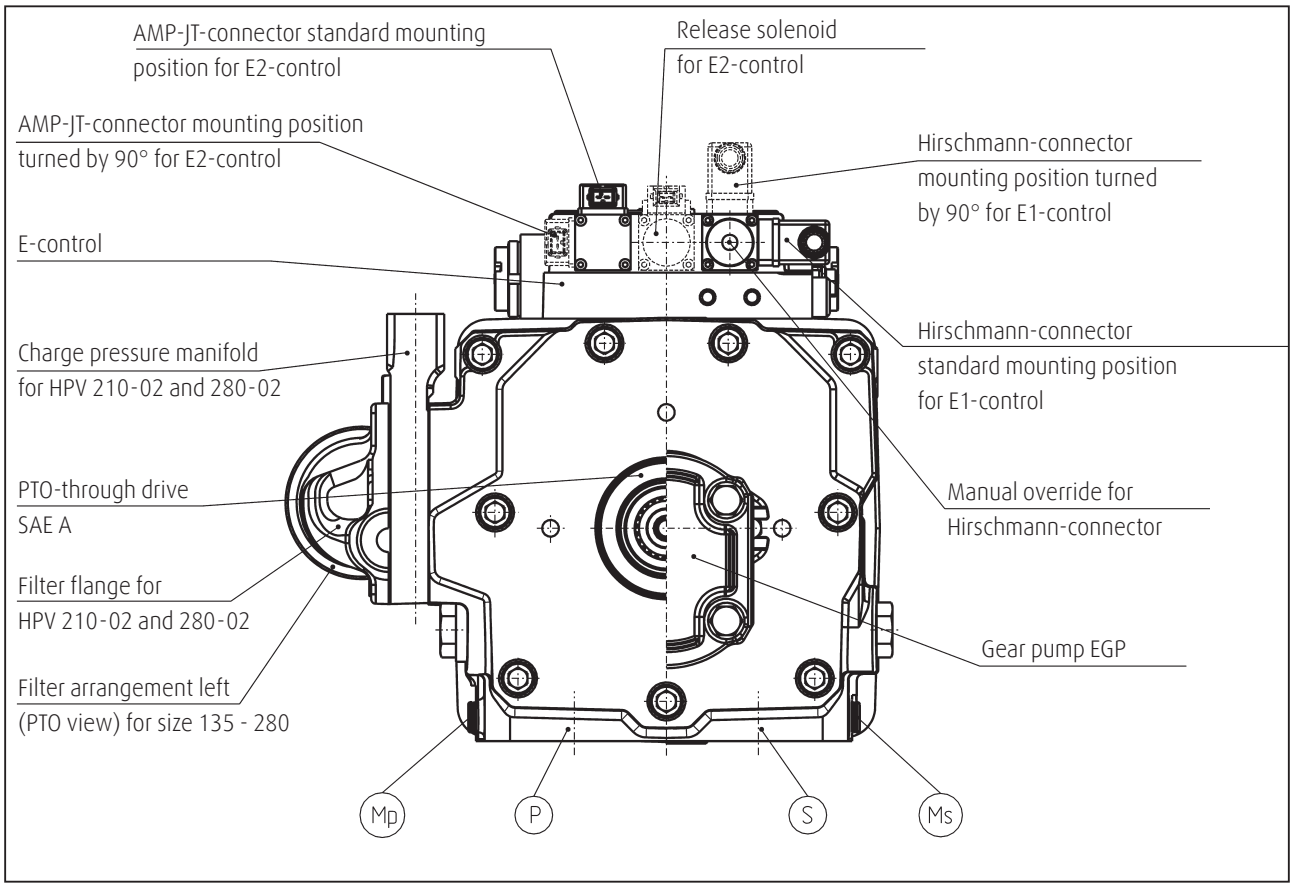
>> IGP 16 cm³/rev without cover

>> filter mounting side for rated sizes 55 - 105

Dimensions. Modular system

The following diagrams show the proportions of similar components.

PTO view

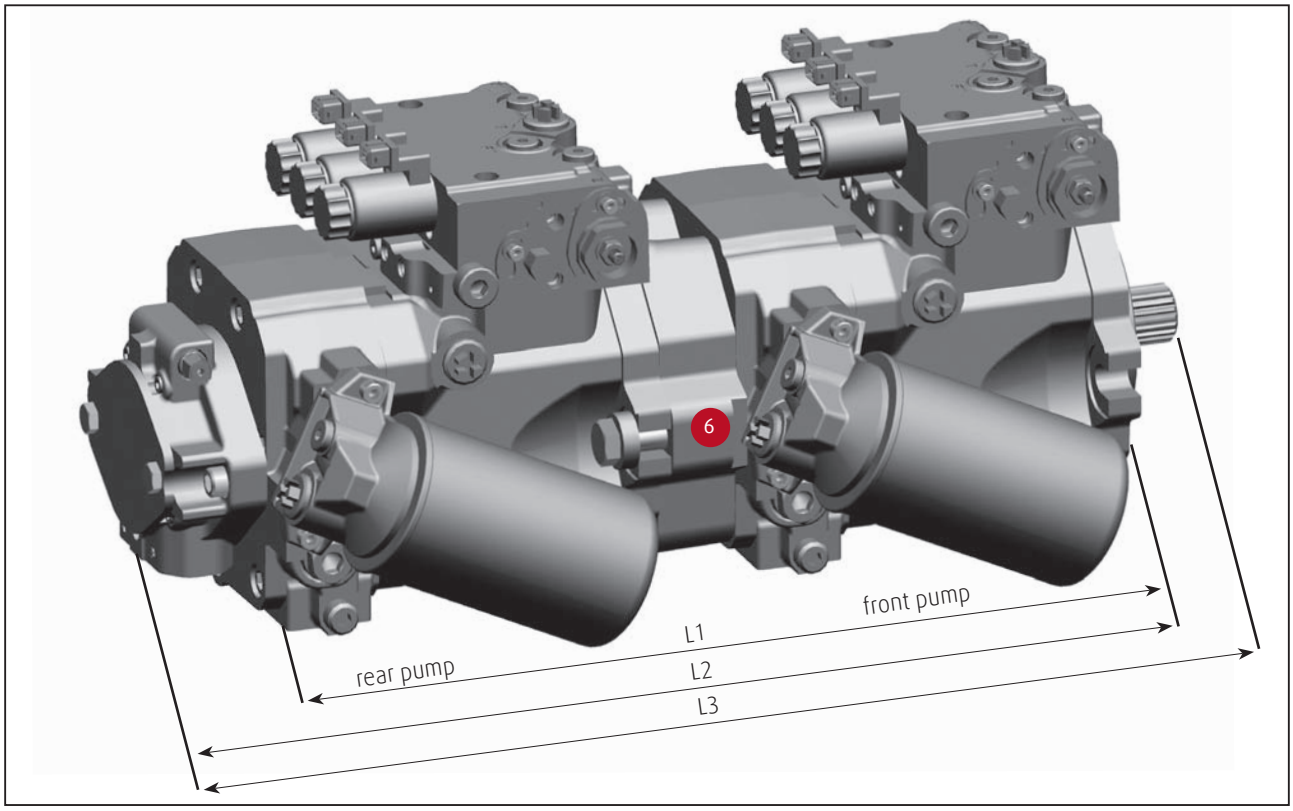


>> E1-control with mounting position of solenoid connectors
>> E2-control with mounting position of solenoid connectors
>> manual override
>> Hirschmann-connector
>> AMP-JT-connector
>> filter mounting side for rated size 135 - 280
>> charge pressure manifold for rated size 210 and 280 without filter
>> SAE A PTO-mounting flange
>> EGP

Dimensions. Tandem pumps

Tandem pumps are created by connecting individual HPV units in series, with the pumps arranged by capacity. Positioning the boost pump(s) at the end of the tandem ensures optimum space utilisation, output allocation and load distribution.

HPV-02 tandem pump



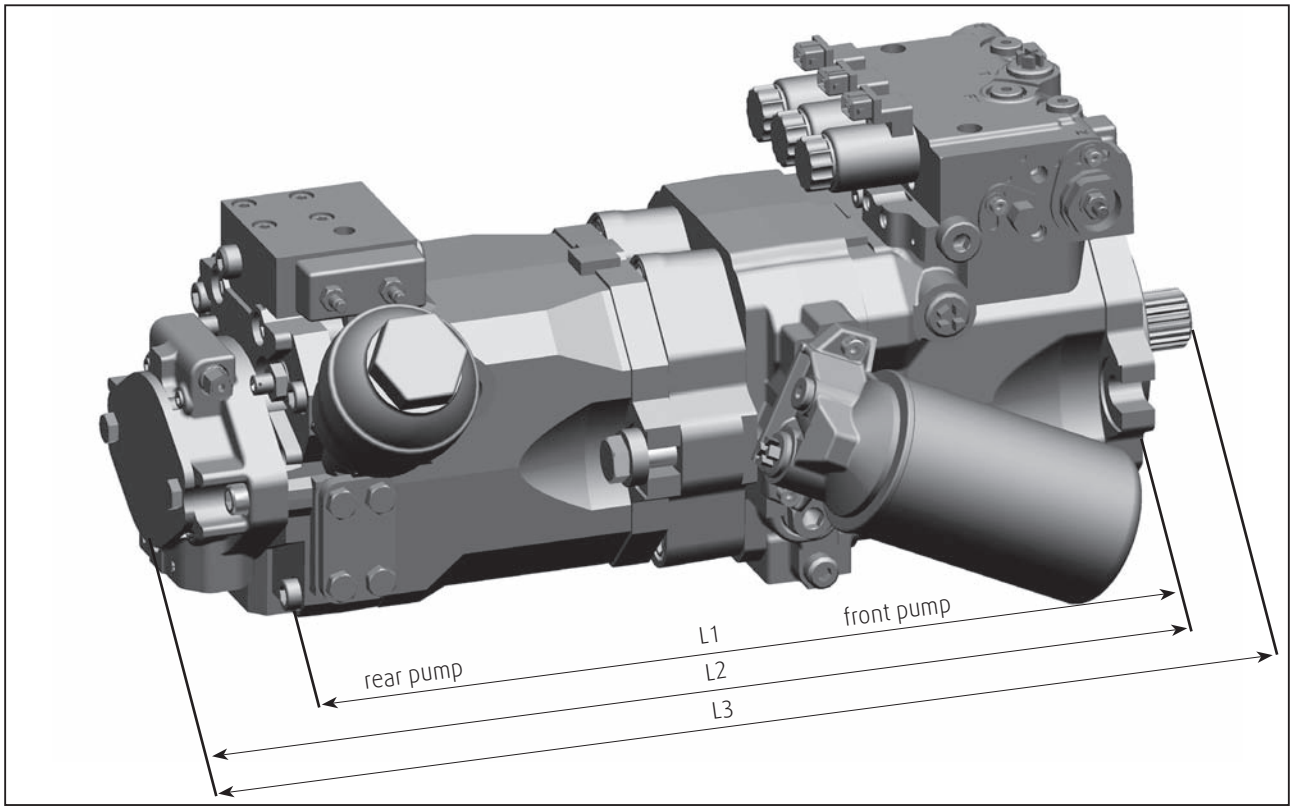
Overall length of tandem pump

Rated size	Rear pump	HPV 55	HPV 75	HPV 105	HPV 135	HPV 165	HPV 210	HPV 280
Front pump	Lengths [mm]					in development		
HPV 55 with IGP 16 cm³ at rear pump	L1	496	-	-	-		-	-
	L2	553	-	-	-		-	-
	L3	607	-	-	-		-	-
HPV 75 with IGP 22.5 cm³ at rear pump	L1	513	530	-	-		-	-
	L2	575	592	-	-		-	-
	L3	631	648	-	-		-	-
HPV 105 with IGP 22.5 cm³ at rear pump	L1	529	546	572	-		-	-
	L2	591	608	634	-		-	-
	L3	647	663	689	-		-	-
HPV 135 with IGP 22.5 cm³ at rear pump	L1	543	560	586	640		-	-
	L2	605	622	648	702		-	-
	L3	680	696	722	777		-	-
HPV 210 with EGP 38 cm³ at rear pump	L1	610	627	653	689		731	-
	L2	782	799	825	861		903	-
	L3	857	874	900	935		978	-
HPV 280 with EGP 44 cm³ at rear pump	L1	655	672	698	in development		777	823
	L2	834	851	877			956	1002
	L3	909	925	951			1030	1076

Dimensions. Multiple pumps

Multiple pumps are created by combining individual pump units in series, with the pumps arranged by capacity. Positioning the gear pump(s) at the end of the unit ensures optimum space utilization, output allocation and load distribution. The following table is based on the gear pump acting as boost pump for the HPV-02 variable pump.

HPV-HPR-02 multiple pump



Overall length of multiple pump

Rated size	Rear pump	HPR 55	HPR 75	HPR 105	HPR 135	HPR 165	HPR 210
Front pump	Lengths [mm]					in development	
HPV 55 with IGP 16 cm³ at HPR	L1	492	-	-	-		-
	L2	549	-	-	-		-
	L3	603	-	-	-		-
HPV 75 with IGP 22.5 cm³ at HPR	L1	509	521	-	-		-
	L2	586	598	-	-		-
	L3	642	653	-	-		-
HPV 105 with IGP 22.5 cm³ at HPR	L1	525	536	567	-		-
	L2	602	613	629	-		-
	L3	657	669	684	-		-
HPV 135 with IGP 22.5 cm³ at HPR	L1	539	550	581	637		-
	L2	616	627	643	699		-
	L3	690	702	717	774		-
HPV 210 with EGP 38 cm³ at HPR	L1	606	618	648	686		733
	L2	793	805	820	858		905
	L3	868	879	895	932		980
HPV 280 with EGP 44 cm³ at HPR	L1	651	663	693	in development		779
	L2	845	856	872			958
	L3	919	931	946			1032

Modular system features.

The HPV-02 is based on a modular system and offers the features listed below. This enables the product to be configured to your requirements. With the modular system being constantly extended, we ask you to contact our sales engineers for the latest system features.

>> Size
>> V_{max}
>> Mounting flange
>> Coupling flange
>> Drive Shaft
>> Direction of Rotation
>> PTO direct mounting
>> Tandem pump
>> Internal gear pump
>> External gear pump
>> Suction internal gear pump
>> Direction of GP suction
>> PTO mounting on IGP
>> Port threads
>> Control
>> Pilot pressure range for H-/E-control
>> Control lever geometry
>> Position of control lever
>> Voltage for E-controls
>> Cut-off for E-controls
>> Connectors for E-controls
>> Arrangement of solenoids
>> High pressure relief valve
>> Boost pressure relief valve
>> Cold start relief valve
>> Drain port U + L
>> Filter / charge pressure manifold
>> Filter flange mounting
>> Surface treatment
>> Name plate

Your notes.

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Excellence at work.