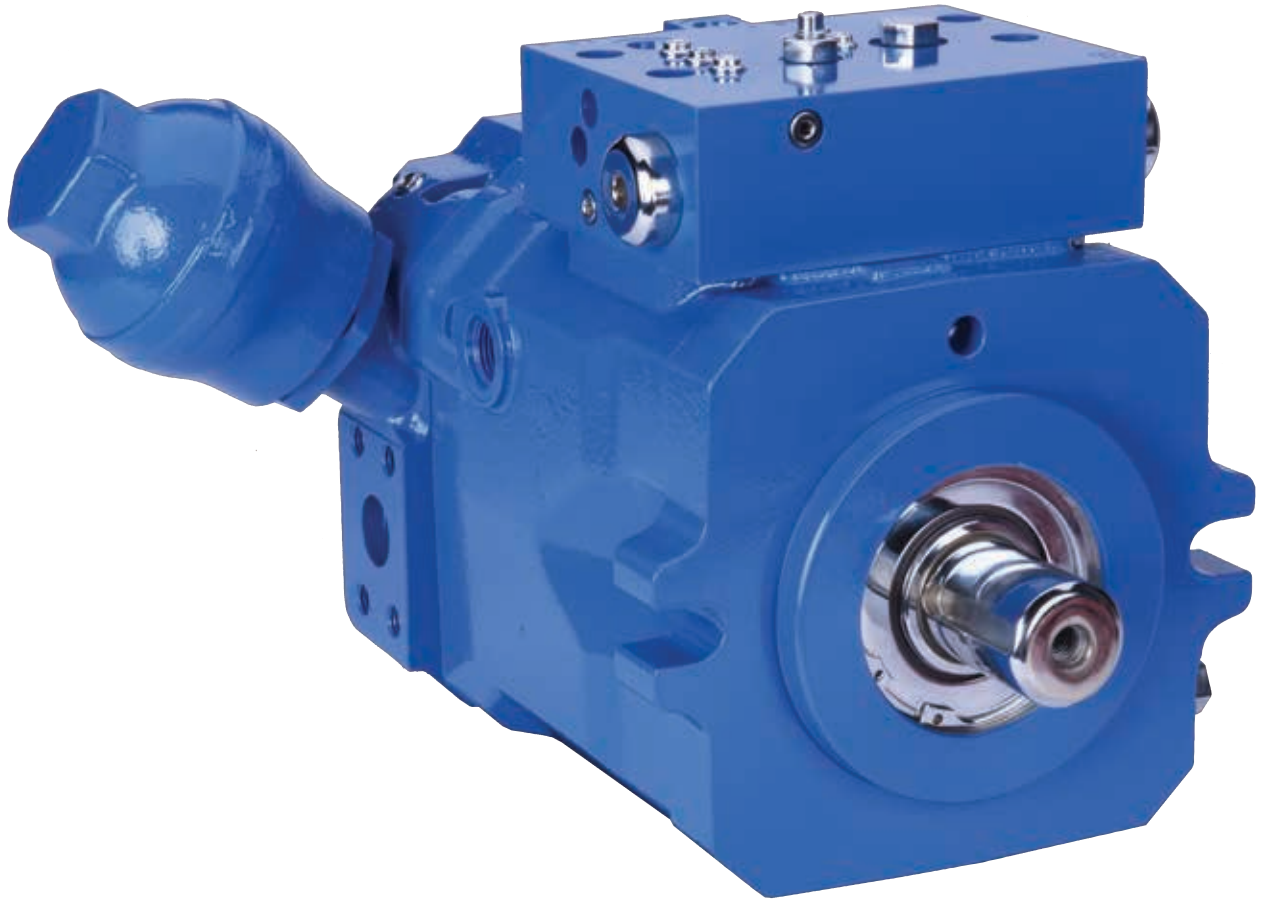


## DuraForce™ HPR

Self-regulating Pump for Open Loop Operation



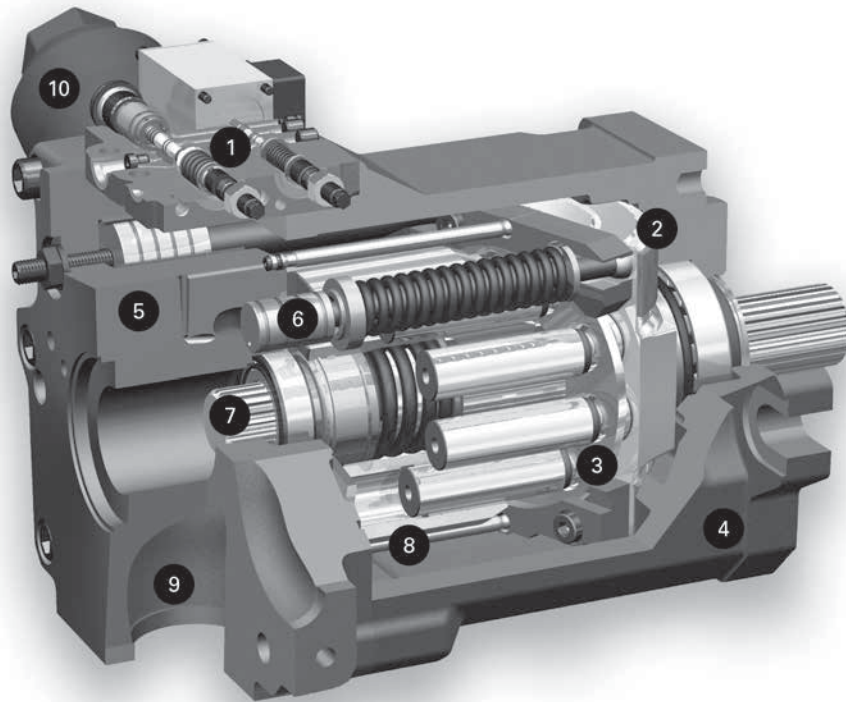
**EATON**

*Powering Business Worldwide*

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- 1 LS-Controller**  
Optimum utilization
- 2 Swash Plate**  
Hydrostatic bearing
- 3 Piston-Slipper Assembly**  
21° swash angle
- 4 Housing**  
One piece design for high rigidity
- 5 Valve Plate Housing**  
Highly integrated
- 6 Actuator Piston**  
Precise swashplate control
- 7 Power Take-Off**  
For mounting of additional pumps
- 8 Cylinder Barrel**  
Compact due to 21° technology
- 9 Suction Port**  
Optimized suction capacity without tank pressurization
- 10 SPU**  
Reduced of pressure pulsation over the entire operating range

#### Design Characteristics

- High pressure axial piston pump in swash plate design for open loop systems
- Clockwise or counter clockwise rotation
- Self-priming at high nominal speed
- Higher rotating speed by tank pressurization or swash angle reduction
- Adaptive noise optimization SPU
- Decompression fluid is drained via pump housing for suction side stability
- Exact and rugged load sensing controls
- SAE high pressure ports
- SAE mounting flange with ANSI or SAE spline shaft
- Through shaft SAE A, B, B-B, C, D and E
- Optional tandem and multiple pumps

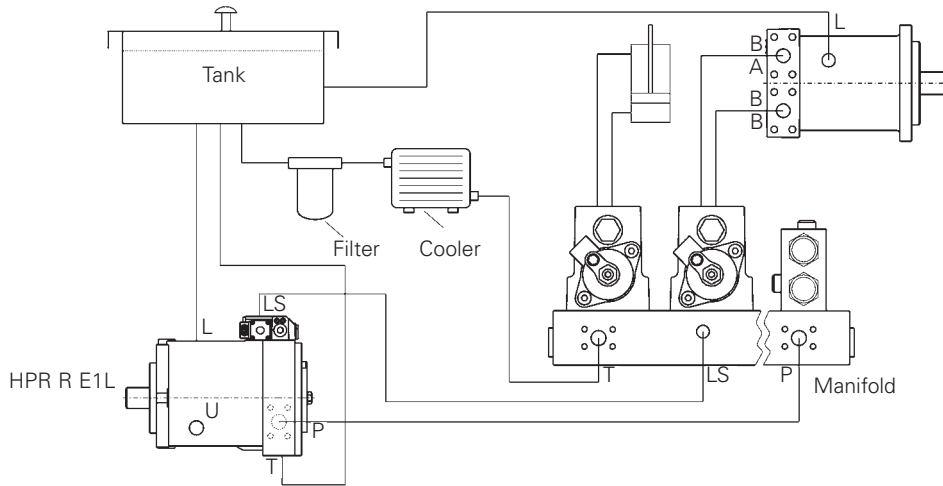
#### Product Advantages

- Energy saving operation by "flow on demand" control
- Dynamic response
- Excellent suction up to rated speed
- Noise optimization over the entire range of operation
- Optimum interaction with Eaton LSC-Directional Control Valves and LinTronic
- Compact design
- High power density
- High pressure rating
- High reliability
- Long working life

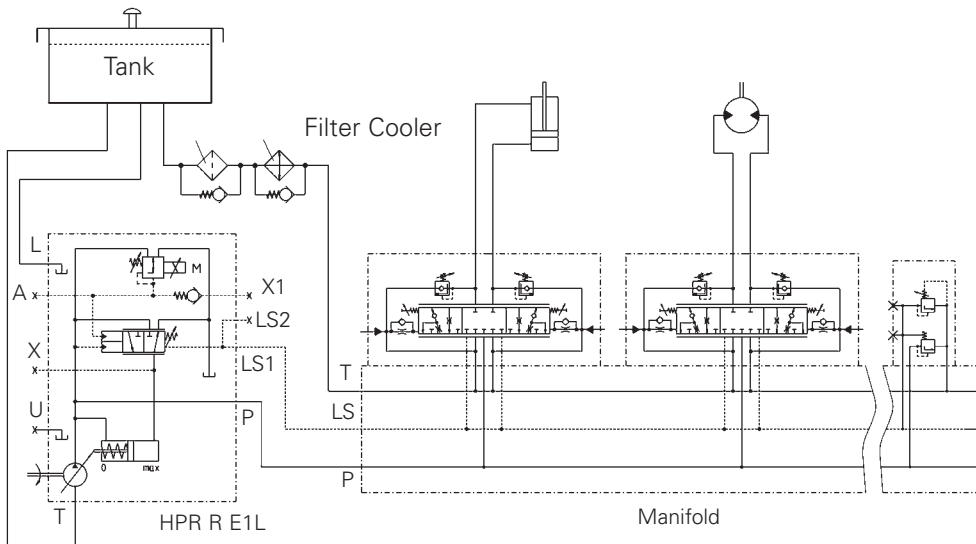
# Open loop

Representation of hydraulic components in an open loop circuit: HPR regulating pump with load sensing function for energy saving, flow on demand control and VW load sensing directional control valves for load-independent, synchronous movements of actuators without unintentional interaction. The system is complemented with proven Eaton products such as electronic controls, swing drives and hydraulic motors.

## Function Diagram



## Circuit Diagram



# Specifications and performance

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 HPR pump with control limit between 200 bar  $\Delta p$  minimum and 280 bar  $\Delta p$  maximum. It enables initial selection of the required nominal pump size.

## Specifications

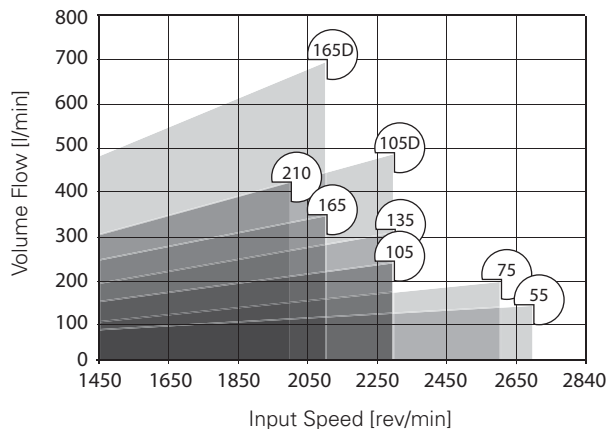
Model		55	75	105	135	165	210	280	105D	165D
<b>Rated Size</b>										
Maximum Displacement	cm <sup>3</sup> /rev	55	75.9	105	135.7	165.6	210.1	281.9	2x105	2x165.6
Speed*	min <sup>-1</sup>	2700	2500	2350	2300	2100	2000	1800	2350	2100
<b>Volume Flow</b>										
Max. oil flow	l/min	148.5	189.8	246.8	312.1	347.8	420.2	507.4	493.5	695.5
<b>Pressure</b>										
Nominal Pressure	bar	420	420	420	420	420	420	420	420	420
Peak Pressure	bar	500	500	500	500	500	500	500	500	500
Permissible Housing Pressure (absolute)	bar	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
<b>Power**</b>										
Continous Power	kW	61.9	79.1	102.8	130	144.9	175.1	211.4	205.6	289.8
Maximum Power	kW	104	132.8	172.7	218.5	243.4	294.1	355.2	306.7	431.8
<b>Input Torque</b>										
Max. Input torque at max. operating pressure and Vmax	Nm	368	507	702	907	1107	1404	1884	1245	1964
<b>Response Times**</b>										
Vmax -> Vmin swashing at constant max. system pressure HP	HP 100 bar ms	120	120	120	140	150	200	300	200	150
Vmin -> Vmax swashing from stand-by pressure and zero outlet flow to constant max. system pressure HP	HP 200 bar ms	70	70	70	70	130	170	270	170	130
	HP 100 bar ms	180	180	180	180	180	180	430	160	180
	HP 200 bar ms	160	180	160	160	160	160	350	160	160
<b>Permissible Shaft Loads</b>										
Axial	N	2000	2000	2000	2000	2000	2000	2000	2000	2000
Radial										
<b>Perm. Housing Temperature</b>										
Perm. Housing Temp. with min. perm. viscosity > 10 cST	°C	90	90	90	90	90	90	90	90	90
<b>Weights</b>										
HPR without oil (approximate)	kg	39	39	50	65	89	116	165	96	177
Maximum moment of inertia	kgm <sup>2</sup> x 10 <sup>-2</sup>	0.79	0.79	1.44	2.15	3.41	4.68	8.34	2.88	6.88

\* Max. operating speed (rated speed) without tank pressurization Operating speed with tank pressurization see chapter operational parameters.

\*\* Measured at fluid viscosity 20 cST and input speed 1500 rpm.

\*\*Theoretical data of a single unit without efficiency effects

## Performance Data



# Model code

HPR – Self-regulating Pump for Open Loop Operation

**HPR 105 R 0 S1 M A AC AC 000 0 0 0 0 AA 00 0 0 000 A 00 A A A**

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38

	55	75	105	135	165	210	280
<b>1 2 3 Product</b>							
<b>HPR</b> – Open Loop Variable Displacement Pump	●	●	●	●	●	●	●
<b>4 5 6 Displacement</b>							
<b>055</b> – 055 cc/r	●						
<b>075</b> – 075 cc/r		●					
<b>105</b> – 105 cc/r			●				
<b>135</b> – 135 cc/r				●			
<b>165</b> – 165 cc/r					●		
<b>210</b> – 210 cc/r						●	
<b>280</b> – 280 cc/r							●
<b>7 Rotation</b>							
<b>R</b> – cw	●	●	●	●	●	●	●
<b>L</b> – ccw	○	○	○	○	○	○	○
<b>8 Mounting Flange</b>							
<b>0</b> – SAE J744 standard (size 105; LP;H1L;E1L only)	●	●	●	●		●	●
<b>1</b> – SAE J744 standard / additional threads (sizes 105; 135; (*u))			●	●			
<b>2</b> – SAE J744 standard / additional holes					●		
<b>3</b> – ISO 30119-2 metric (TL2;ETP;LEP only)(*m)			●				●
<b>4</b> – plug-in (LP;H1L;E1L only)/(size 105; (*d))				○	○		
<b>5</b> – bell housing SAE 3 (LP;H1L;E1L only)/(sizes 105; (*d))				○	○		
<b>6</b> – bell housing SAE 4 (LP;H1L;E1L only)/(sizes 105; (*d))				○	○		
<b>9 10 Input Shaft</b>							
<b>S1</b> – splined ANSI B92.1 12/24 - 14t (SAE C)/(size 105; (*w))	●	●	○				
<b>S2</b> – splined ANSI B92.1 12/24 - 17t (SAE C-C)			●	○			
<b>S3</b> – splined ANSI B92.1 8/16 - 13t (SAE D&E)				●	●		
<b>S4</b> – splined ANSI B92.1 8/16 - 15t (SAE F)/(sizes 210;280; (*t))					●	●	
<b>T1</b> – splined ANSI B92.1 16/32 - 21t (*t)		●					
<b>T2</b> – splined ANSI B92.1 16/32 - 23t (*t)			●				
<b>T3</b> – splined ANSI B92.1 16/32 - 27t (*t)				●	○	○	
<b>T4</b> – splined ANSI B92.1 16/32 - 33t (*t) (200000)							○
<b>K1</b> – keyed ISO3019-2 / 40 mm (metric flange only (pos. 8))				○			
<b>K2</b> – keyed ISO3019-2 / 60 mm							○
<b>11 Porting</b>							
<b>M</b> – ISO 6149 metric	●	●	●	●	●	●	●
<b>D</b> – DIN 3852	○	○	○	○	○	○	○
<b>12 Pump Control</b>							
<b>A</b> – LP: LS/pressure cut-off	●	●	●	●	●	●	●
<b>B</b> – H1L: LS/hydraulic override (*m)	●	●	●	●	●	●	●
<b>C</b> – E1L: LS/electric override (*m)	●	●	●	●	●	●	●
<b>D</b> – TL2: LS/power limiter (*m)/(*r)		○	○	○	○	○	○
<b>E</b> – ETP: electro-proportional/power limiter/PCO (*m)/(*r)			○	○	○	○	○
<b>F</b> – LEP: LS/electric stroke limiter/PCO (*m)/(*r)			○	○	○	○	○

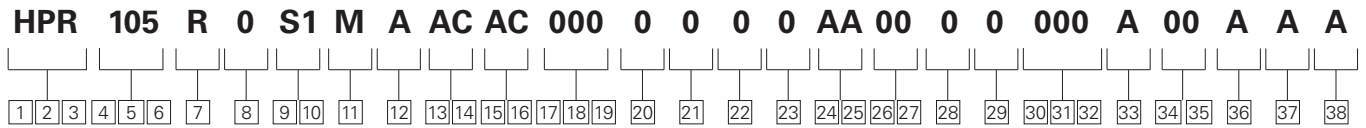
	55	75	105	135	165	210	280
<b>13 14 Pressure Compensator Setting (125-420)</b>							
<b>00</b> – not applicable (H1L; E1L; TL2)	○	○	○	○	○	○	○
<b>AE</b> – 200 bar	●	●	●	●	●	●	●
<b>AM</b> – 220 bar	●	●	●	●	●	●	●
<b>AA</b> – 250 bar	●	●	●	●	●	●	●
<b>AD</b> – 280 bar	●	●	●	●	●	●	●
<b>AY</b> – 300 bar	●	●	●	●	●	●	●
<b>AJ</b> – 320 bar	●	●	●	●	●	●	●
<b>BN</b> – 345 bar	●	●	●	●	●	●	●
<b>BA</b> – 360 bar	●	●	●	●	●	●	●
<b>AH</b> – 380 bar	●	●	●	●	●	●	●
<b>BC</b> – 400 bar	●	●	●	●	●	●	●
<b>AC</b> – 420 bar	●	●	●	●	●	●	●
<b>15 16 Load Sensing Differential Pressure</b>							
<b>00</b> – not applicable (ETP or PO only)	○	○	○	○	○	○	○
<b>AC</b> – 20 bar	●	●	●	●	●	●	●
<b>17 18 19 Power Limiter Setting</b>							
<b>000</b> – not applicable (LP; H1L; E1L; LEP)	○	○	○	○	○	○	○
<b>value</b> – 007 - 085 kW (numeric 3 digits)		●					
<b>value</b> – 009 - 106 kW (numeric 3 digits)			●				
<b>value</b> – 012 - 136 kW (numeric 3 digits)				●			
<b>value</b> – 019 - 151 kW (numeric 3 digits)					●		
<b>value</b> – 019 - 184 kW (numeric 3 digits)						●	
<b>value</b> – 032 - 221 kW (numeric 3 digits)							●
<b>20 Pressure Limiter Remote Control</b>							
<b>0</b> – not applicable (LP; H1L; E1L; TL2)	●	●	●	●	●	●	●
<b>D</b> – disabled (ETP; LEP only)			○	○	○	○	○
<b>R</b> – enabled (ETP; LEP only)			○	○	○	○	○
<b>21 Power Limiter Remote Control</b>							
<b>0</b> – not applicable (LP; H1L; E1L; LEP only)	●	●	●	●	●	●	●
<b>1</b> – remote power uprating (default for TL2; ETP)		○	○	○	○	○	○
<b>2</b> – remote power up- & downrating (TL2; ETP only)		○	○	○	○	○	○
<b>22 Control Solenoids</b>							
<b>0</b> – not applicable (LP; H1L; TL2)	●	●	●	●	●	●	●
<b>A</b> – AMP/12V	○	○	○	○	○	○	○
<b>B</b> – AMP/24 V	○	○	○	○	○	○	○
<b>C</b> – DIN/12 V	○	○	○	○	○	○	○
<b>D</b> – DIN/24 V	○	○	○	○	○	○	○
<b>E</b> – Deutsch/12V	●	●	●	●	●	●	●
<b>F</b> – Deutsch/24V	●	●	●	●	●	●	●

○ Available Option ● Preferred Option ◆ Separate Specification Required

(\*d) DIN porting only (see position 11) (\*t) Recommended if HPV/R unit is attached to PTO (see position 26,27)  
 (\*e) Availability depends on controller type (see position 12) (\*u) Required for PTO flange size C (see position 26,27)  
 (\*m) ISO metric porting only (see position 11) (\*r) CW rotation only (see position 7)  
 (\*s) Second HPV/R unit has to be specified separately

# Model code

## HPR – Self-regulating Pump for Open Loop Operation



	55	75	105	135	165	210	280
<b>23 Noise Optimization Devices</b>							
0 – no noise reduction device	●	●	●	●	○	○	○
1 – with SPU primary noise reduction (sizes 55-105: (*r))	●	●	●	●	●	●	●
<b>24 25 Auxiliary Pad and Shaft Definition</b>							
0G – to add gear pump see positions 26,27	○	○	○	○	○	○	○
AA – SAE J744 A without shaft coupling (default)	●	●	●	●	●	●	●
AB – SAE J744 A/ANSI B92.1 16/32 - 9 teeth (A)	●	●	●				
AB – SAE J744 A/ANSI B92.1 16/32 - 9 teeth (A)				●			
AB – SAE J744 A/ANSI B92.1 16/32 - 9 teeth (A)					●		
AB – SAE J744 A/ANSI B92.1 16/32 - 9 teeth (A)						●	
AC – SAE J744 A/ANSI B92.1 16/32 - 11 teeth				○		○	
AD – SAE J744 A/ANSI B92.1 16/32 - 13 teeth			○	○		○	○
AE – SAE J744 B without shaft coupling	○	○	○	○	○	○	○
AF – SAE J744 B/ANSI B92.1 16/32 - 13 teeth (B)	○	○	○				
AF – SAE J744 B/ANSI B92.1 16/32 - 13 teeth (B)				○			
AF – SAE J744 B/ANSI B92.1 16/32 - 13 teeth (B)					○	○	○
AG – SAE J744 B/ANSI B92.1 16/32 - 15 teeth (B-B)	○	○	○				
AG – SAE J744 B/ANSI B92.1 16/32 - 15 teeth (B-B)				○			
AG – SAE J744 B/ANSI B92.1 16/32 - 15 teeth (B-B)						○	
AH – SAE J744 C without shaft coupling	○	○	○	○	○	○	○
AJ – SAE J744 C / ANSI B92.1 12/24 - 14 teeth (C)	○	○	○				
AJ – SAE J744 C/ANSI B92.1 12/24 - 14 teeth (C)				○			
AJ – SAE J744 C/ANSI B92.1 12/24 - 14 teeth (C)					○		
AJ – SAE J744 C/ANSI B92.1 12/24 - 14 teeth (C)						○	○
AK – SAE J744 C/ANSI B92.1 16/32 - 21 teeth		○	○	○			
AL – SAE J744 C/ANSI B92.1 16/32 - 23 teeth			○	○	○	○	
AM – SAE J744 D without shaft coupling				○	○	○	○
AN – SAE J744 D/ANSI B92.1 8/16 - 13 teeth (D)				○			
AP – SAE J744 D/ANSI B92.1 12/24 - 17 teeth				○			
AQ – SAE J744 D/ANSI B92.1 16/32 - 27 teeth				○	○	○	
AR – SAE J744 E without shaft coupling						○	○
AS – SAE J744 E/ANSI B92.1 16/32 - 27 teeth						○	
AT – SAE J744 E/ANSI B92.1 16/32 - 33 teeth							○

	55	75	105	135	165	210	280
<b>26 27 Auxiliary Pump or Tandem Adaptor</b>							
00 – without	●	●	●	●	●	●	●
BA – internal gear pump 16 cc	●	●	○	○			
BB – internal gear pump 22,5 cc	○	○	○	●			
BC – internal gear pump tandem 16+16 cc	○	○	○	○			
BD – internal gear pump tandem 16+22,5 cc	○	○	○	○			
BE – internal gear pump tandem 22,5+16 cc	○	○	○	○			
BF – internal gear pump tandem 22,5+22,5 cc	○	○	○	○			
BG – external gear pump 31 cc (*r)			○	○			
BH – external gear pump 38 cc			○	○		○	○
BJ – external gear pump 44 cc (*r)						○	○
BK – external gear pump tandem 22,5+22,5 cc (*r)				○	○	○	○
BL – HPV/R 55 mounting preparation (*s)	○	○	○	○	○	○	○
BM – HPV/R 75 mounting preparation (*s)		○	○	○	○	○	○
BN – HPV/R 105 mounting preparation (*s)			○	○	○	○	○
BP – HPV/R 135 mounting preparation (*s)				○	○	○	
BQ – HPV/R 210 mounting preparation (*s)						○	○
BR – HPV/R 280 mounting preparation (*s)							○
<b>28 Auxiliary Drive on Internal Gear Pump</b>							
0 – without internal gear pump (single pump)	●	●	●	●	●	●	●
A – SAE J744 A/ANSI B92.1 16/32 - 9 teeth (A) (default)	●	●	●	●			
B – SAE J744 B without shaft coupling	○	○	○	○			
C – SAE J744 B/ANSI B92.1 16/32 - 13 teeth (B)	○	○	○	○			
D – SAE J744 B/ANSI B92.1 16/32 - 15 teeth (B-B)	○	○	○	○			
E – SAE J744 C without shaft coupling			○	○			
F – SAE J744 C/ANSI B92.1 12/24 - 14 teeth (C)			○	○			
<b>29 Internal Gear Pump Supply</b>							
0 – without internal gear pump	●	●	●	●	●	●	●
E – external supply port	●	●	●	●			
<b>30 31 32 Maximum Displacement Setting</b>							
000 – Catalog Pump Rating	●	●	●	●	●	●	●
value – numeric 3 digit, setting range see position 4,5,6	○	○	○	○	○	○	○

○ Available Option ● Preferred Option ◆ Separate Specification Required

(\*d) DIN porting only (see position 11)

(\*e) Availability depends on controller type (see position 12)

(\*m) ISO metric porting only (see position 11)

(\*r) CW rotation only (see position 7)

(\*s) Second HPV/R unit has to be specified separately

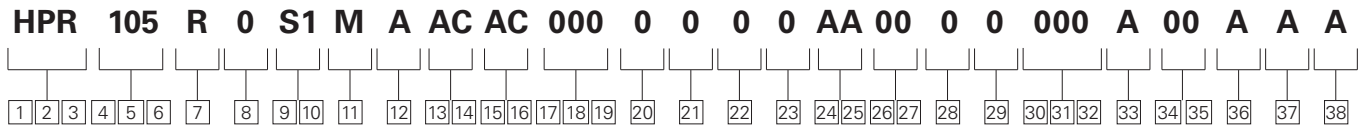
(\*t) Recommended if HPV/R unit is attached to PTO (see position 26,27)

(\*u) Required for PTO flange size C (see position 26,27)

(\*w) Not for tandem units (see position 26,27)

# Model code

HPR – Self-regulating Pump for Open Loop Operation



	55	75	105	135	165	210	280
<b>33 Operating Speed</b>							
<b>A</b> – Catalog Pump Rating (LP; E1L; H1L, LEP)	●	●	●	●	●	●	●
<b>B</b> – 1200 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>C</b> – 1800 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>D</b> – 2300 RPM (TL2; ETP)	○	○	○	○			
<b>E</b> – 2600 RPM (TL2; ETP)	○	○					
<b>F</b> – 2700 RPM (TL2; ETP)	○						
<b>G</b> – 1700 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>H</b> – 2100 RPM (TL2; ETP)	○	○	○	○	○		○
<b>J</b> – 2000 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>K</b> – 1480 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>L</b> – 1725 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>M</b> – 1750 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>N</b> – 1760 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>P</b> – 2200 RPM (TL2; ETP)	○	○	○	○			
<b>R</b> – 1740 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>S</b> – 1450 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>T</b> – 1900 RPM (TL2; ETP)	○	○	○	○	○	○	
<b>U</b> – 1780 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>V</b> – 1500 RPM (TL2; ETP)	○	○	○	○	○	○	○
<b>W</b> – 2430 RPM (TL2; ETP)	○	○					
<b>34 35 Special Requirements</b>							
<b>00</b> – without special requirements (default)	●	●	●	●	●	●	●
<b>36 Surface Coating</b>							
<b>0</b> – anti rust conservation oil (default)	●	●	●	●	●	●	●
<b>A</b> – primer blue	●	●	●	●	●	●	●
<b>37 Unit Identification</b>							
<b>A</b> – Eaton	●	●	●	●	●	●	●
<b>B</b> – Eaton Shanghai	●	●	●	●	●	●	●
<b>38 Type Code Release</b>							
<b>A</b> – Revision Level	●	●	●	●	●	●	●

○ Available Option ● Preferred Option ◆ Separate Specification Required



# Operational parameters

## Life Time Recommendations

Eaton 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.

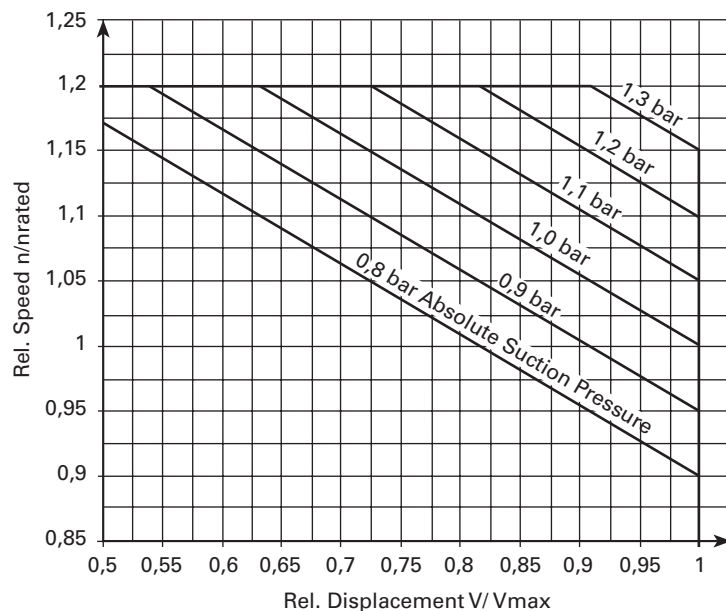
### **Beneficial Conditions for Long Service Life**

Speed	Lower continuous maximum speed
Operating Pressure	Less than 300 bar $\Delta p$ 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 $\Delta p$ 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. HPR Suction Speed



# Operational parameters

Tank connection

The leakage and decompression oil generated during pump operation is drained from the rotating group into the pump housing.

Excessive housing pressure must be avoided through suitably dimensioned piping between the housing and the tank.

## Operational Parameters. Filtration

In order to guarantee long-term proper function and high efficiency of the hydraulic pumps the

cleanliness level of the lubricant must comply with the following criteria according to Eaton

Hydraulic Fluid Recommendation 03-401-2010. Maintaining the recommended

cleanliness level can extend the service life of the hydraulic system significantly.

### For reliable proper function and long service life

18/16/13 in accordance with ISO 4406 or better

### Commissioning

The minimum cleanliness level requirement for the hydraulic oil is based on the most sensitive component. For commissioning we recommend a filtration in order to achieve the required cleanliness level.

### Filling and operation of hydraulic systems

The required cleanliness level 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 filters to ensure that the required cleanliness level of the oil is achieved and maintained during operation.

### International standard

#### Code Number According to ISO 4406

---

18/16/13

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# 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. Eaton 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
- Eaton 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	[mm <sup>2</sup> /s] = [cSt]	10 to 80
Optimum working viscosity	[mm <sup>2</sup> /s] = [cSt]	15 to 30
Max. viscosity (short time start up)	[mm <sup>2</sup> /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 Eaton if the stated conditions cannot be met or in special circumstances.

### Viscosity Recommendations

Working Temperature [°C]	Viscosity [mm <sup>2</sup> /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 or Eaton document 03-401-2010.

# LSC-System

The Synchron Control System (SC-System) for open loop hydraulic circuits enables demand-orientated pump volume control based on load sensing technology. A SC-System compensates the effect of varying loads, varying numbers of actuators and different load levels at different actuators. This happens automatically, thereby making machine operation more convenient since, unlike in other systems, continuous corrective action is no longer required. The SC-System enables high-efficiency hydraulic systems to be realized that are strictly orientated to the machine functions. Our application specialists will be happy to provide advice for individual machine configurations.

## Functionality

- Demand-oriented pump control
- Excellent precision control characteristics without readjustment
- Reproducibility of machine movements through exact control of actuators
- Dynamic response characteristics
- Load-independent, synchronous movements of several actuators
- "Social" oil distribution even in the event of overload
- Automatic venting of directional control valve end caps
- Optimum movement continuity even for combined movements

## Additional Functionality

- Priority control of individual actuators
- Output control
- High-pressure protection
- Regeneration function
- Combined function shuttle valve
- Load holding function

## Machine Equipment

- Customized system design for optimum implementation of customer requirements
- Optimum utilization of the installed power with simultaneous improvement of energy consumption
- High flexibility through manifold plates
- Compact, integrated solutions
- Modular design of valve sections
- Add-on cylinder valves for direct and fast cylinder supply, no additional hose burst protection required
- Optimized piping

## Benefits

- Perfect matching of the individual operating functions for customized machine characteristics
- Efficient and dynamic machine control for short operating cycles
- Optimized energy balance for reduced fuel consumption and enhanced handling performance
- Simple and safe machine operation for non-fatigue and efficient working
- Unsurpassed reliability even under harsh operating conditions
- Reduced installation times

# Noise reduction

## SPU Silencer

In hydraulic systems pressure pulsations can lead to noise emission. These pressure pulsations are a result of the inherent non-uniformity of the volume flow in rotary piston pumps.

In open loop hydraulic circuits pressure pulsations primarily originate from within the hydraulic pump during the compression stroke, i.e. when a piston coming from the low-pressure side (suction side) enters the high-pressure side, where it is suddenly subjected to high pressure.

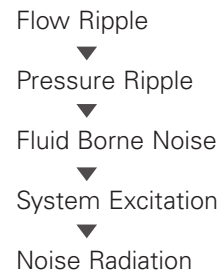
The higher the pump speed and the pressure difference between the low-pressure and high-pressure side, the more pulsation energy is added to the hydraulic system via the hydraulic fluid.

Pressure pulsations can cause components of the hydraulic system or the machine to oscillate, thereby generating noise that is perceivable for the human ear.

In principle noise emissions from machinery with hydraulic systems can be reduced in the following ways:

- Reduction of operating pressure and speed. This reduces the pulsation energy introduced into the hydraulic system
- Primary measures for optimizing the compression stroke in rotary piston machines with the aim of reducing pulsation
- Secondary measures such as vibration-optimized design and installation of machine components and sound-proofing for noise suppression

### Noise Generation



### Noise Reduction. SPU Silencer

All Eaton hydraulic pumps are optimized with respect to pulsation characteristics and therefore noise generation.

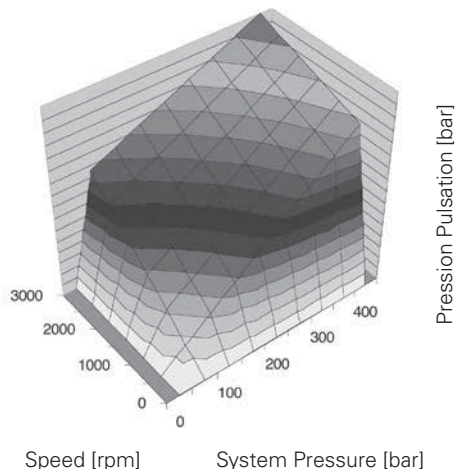
In addition to common primary measures such as exclusive use of pulsation-optimized port plates, Eaton offers the SPU silencer for HPR open loop pumps.

Without affecting the functionality and efficiency of the pump, this system reduces pressure pulsations by up to 70%, irrespective of pressure, speed or temperature.

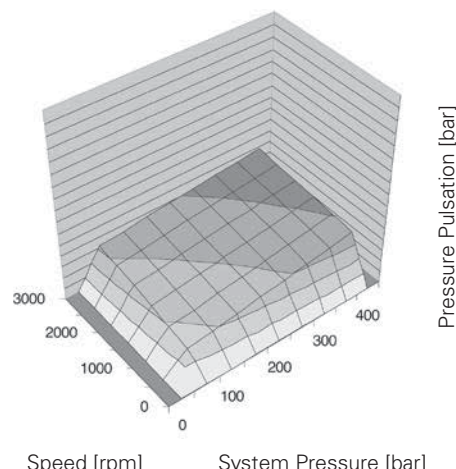
The SPU system is adaptive over the entire operating range. No setting up or maintenance is required.

### Pressure Pulsations With and Without SPU

#### Conventional Commutation



#### SPU Commutation



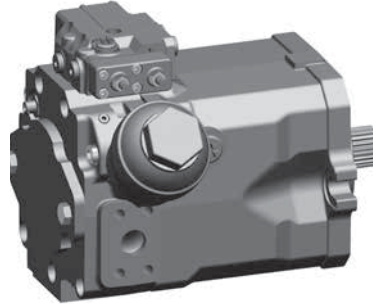
# Noise reduction

## SPU Silencer

### SPU Silencer Function

- Reduction of pressure pulsations over the entire operating range
- Reduction of noise emission by approx. 50% (equals approx. 3dB(A))
- Reduction of volume flow fluctuations
- No impairment of efficiency
- Ready for use immediately, no maintenance required
- Simple and rugged design
- Minimum increase in weight and volume

### HPR with SPU

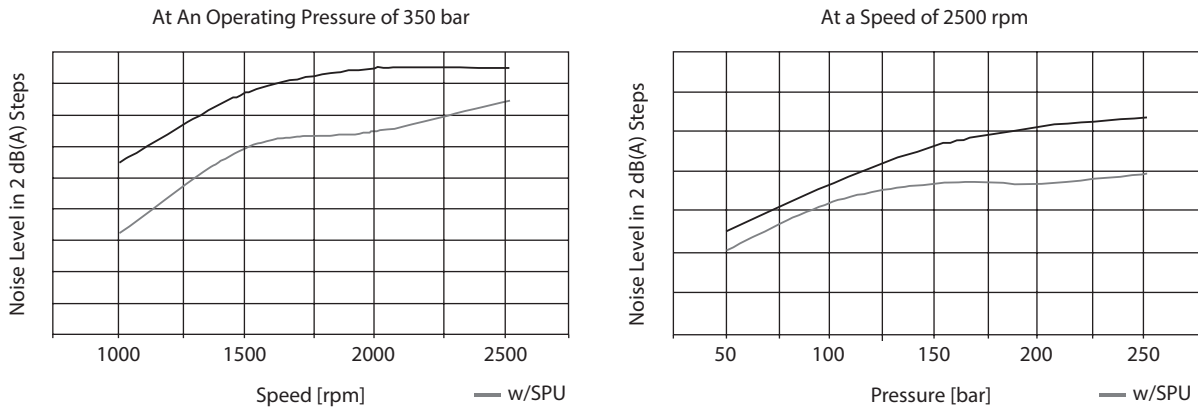


### Noise Reduction SPU Silencer

The following diagrams illustrate the immediate effect of pulsation level reduction via SPU on the

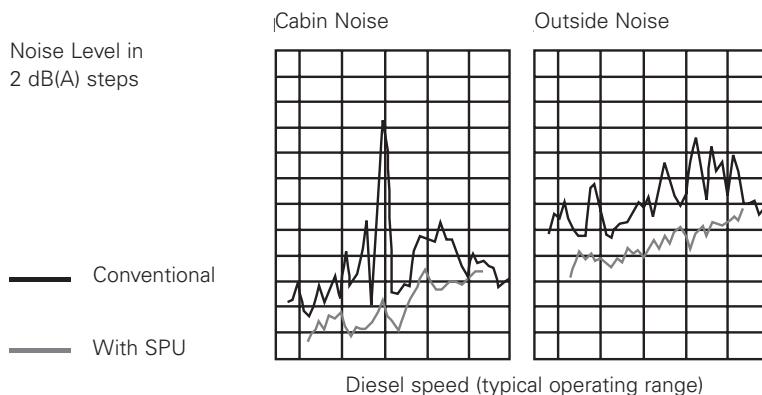
sound pressure level and therefore the perceived noise emission.

### Comparison of Sound Pressure Levels for a HPR 75-02 Pump With and Without SPU



### Comparison of Resulting Noise Emission

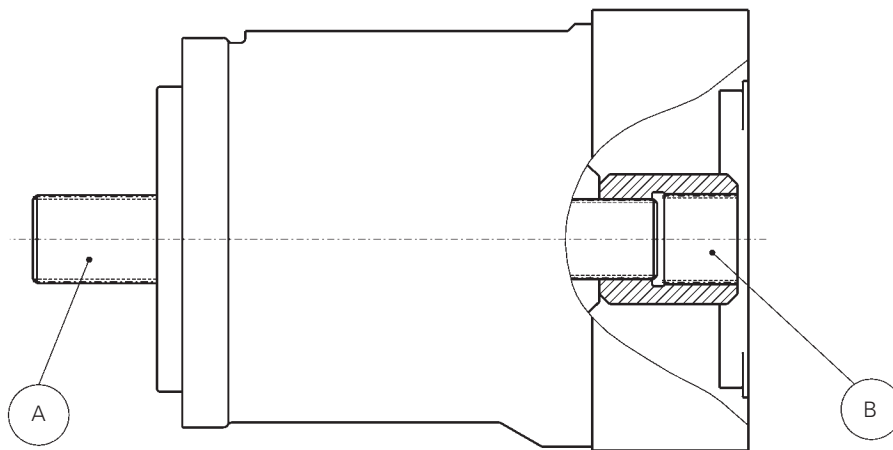
Shown in 2 dB(A) steps over a typical diesel engine operating speed range.



# 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 HPR



This shows the input side (A) and PTO- / output side (B) of a HPR pump.

The information on the following pages refers to

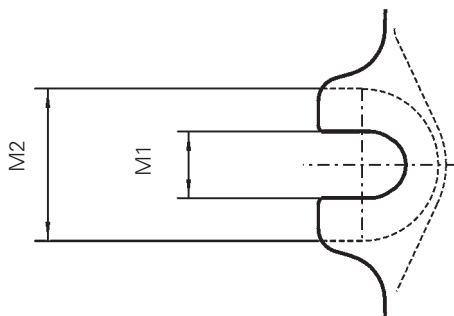
- Mounting flange and drive shaft (A)
- PTO flange and through shaft (B)

### A) Flange Profile

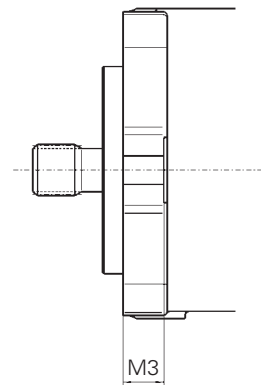
#### Rated Size HPR

Bolt Bolt	Dimensions	55	75	105	135	165	210	105D	280	165D
M1 Inside Diameter	mm	17.5	17.5	17.5	21.5	21.5	22	17.5	22	17.5
M2 Outside Diameter	mm	34	34	40	40	40	-	40	-	-
M3 Bolt Hole Length	mm	20	20	20	20	25	26	20	30	25

#### Bolt Hole Diameter



#### Bolt Hole Length



# Torque transmission

## Mounting Flange

### A) Mounting Flange Dimensions

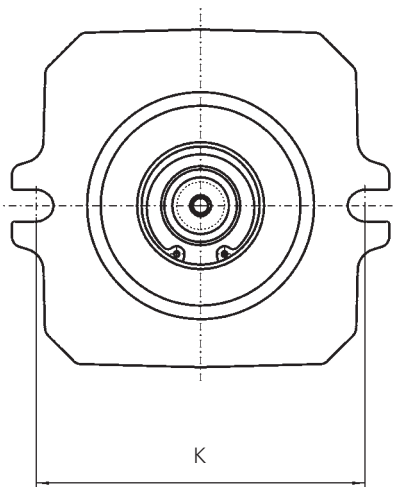
#### Rated Size HPR

#### Mounting Flange Dimensions in Accordance with SAE J744

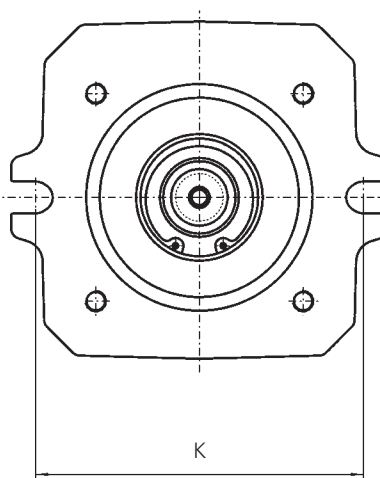
	Dimensions K (mm)	55	75	105	135	165	210	105D	280	165D
SAE C, C-C 2-hole	181.0	X	X	X						
SAE, C-C 2-hole with additional thread holes	181.0			X				X		
SAE D, 2-hole with additional bolt holes	228.6					X				X
SAE D 2-hole	228.6				X					
SAE E 4-hole	224.5						X		X	
Plug-in flange	251.8			X	X			X		
SAE 3 bell-housing	428.6			X	X			X		

### A) Fixing Hole Distance K

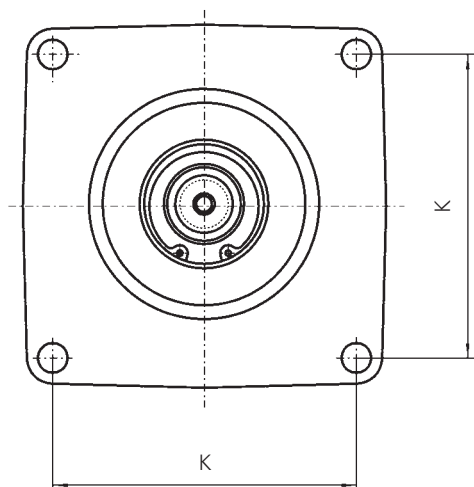
#### 2-hole Flange



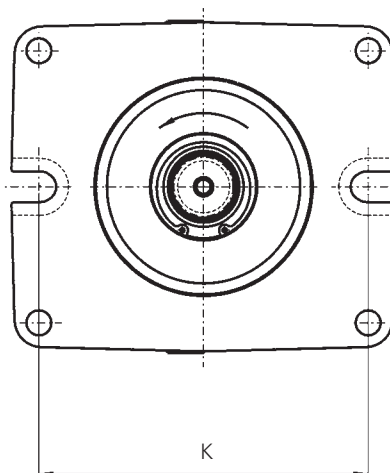
#### 2-hole Flange with 4 Additional Threaded Holes



#### 4-hole Flange



#### 2-hole Flange with 4 Additional Bolt Holes





# Torque transmission

## Drive Shaft

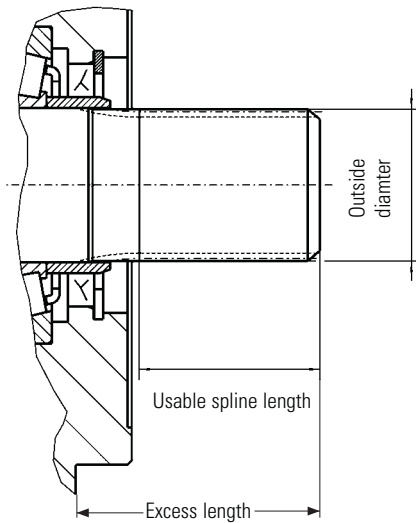
### A) Dimensions Drive Shafts

Shaft Spline (in accordance with ANSI B92.1)	SAE J744 Code (for centring and shaft)	Outside diameter	Useable Spline Length	Shaft Type	Available for Rated Size HPR								
					55	75	105	105D	135	165	165D	210	280
12/24, 14 t	C	31.22	30	2	X	X	-	-	-	-	-	-	-
16/32, 21 t		34.51	39.5	1	-	X*	-	-	-	-	-	-	-
12/24, 17 t	C-C	37.68	30	2	-	-	X	X	X	-	-	-	-
16/32, 23 t		37.68	38.5	1	-	-	X*	X	-	-	-	-	-
8/16, 13 t	D, E	43.71	50	2	-	-	-	-	X	X	X	-	-
16/32, 27 t		44.05	62	1	-	-	-	-	X	X*	X	X	-
8/16, 15 t	F	50.06	58	1	-	-	-	-	-	-	-	X*	X

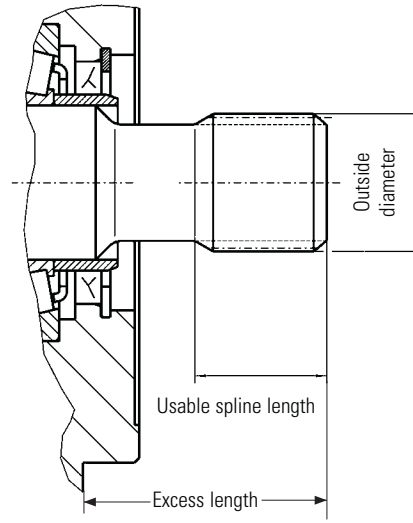
\*) Recommended for tandem configurations

### A) Hydraulics Shaft Types

#### Type 1. Without Undercut



#### Type 2. With Undercut



Rated Size		55	75	105	105D	135	165	165D	210	280
Excess length	mm	54	55	55	61.3	75	75	75	75	75

# Torque transmission

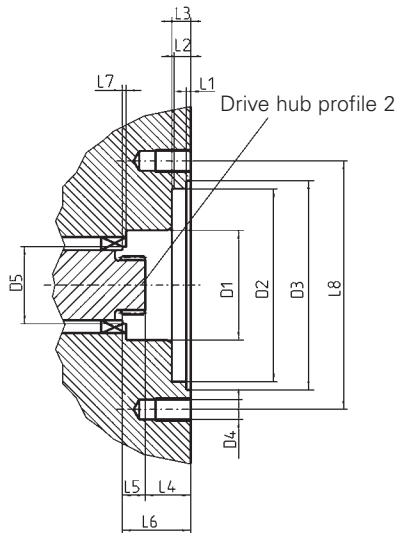
PTO through drive

Eaton 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) Dimensions PTO

Rated Size	Dimensions (mm)	55	75	105	135	165	210	280
<b>Z Drive Hub Profile in Accordance with ANSI B92.1</b>		<b>16/32, 18 t</b>	<b>16/32, 18 t</b>	<b>16/32, 19 t</b>	<b>16/32, 21 t</b>	<b>16/32, 23 t</b>	<b>16/32, 24 t</b>	<b>16/32, 27t</b>
D1	mm	47	47	48	54	55	63	72
D2 Spigot Pilot Diameter	mm	82.55	82.55	82.55	82.55	82.55	82.55	82.55
D3	mm	89.5	89.5	89.5	89.5	89.5	89.5	89.5
D4		M10	M10	M10	M10	M10	M10	M10
D5 Max. Bearing Clearance	mm	30	35	38	43	42	46	51
L1	mm	1.5	1.5	1.5	1.5	1.9	1.9	1.9
L2 Adapter Length	mm	7	7	7	7	8	8	8
L3	mm	9	9	9	9	9	9	9
L4 Minimum Distance	mm	35	39	33	35	57.8	46	47.5
L5 Usable Spline Length	mm	18	18	24	15.8	24.4	29.5	39
L6 Distance to Bearing	mm	48	48	52.7	54.2	83.3	46	86
L7 Min. Bearing Clearance	mm	3	3	3	3	5	5	0.7
L8 Hole Distance 2-hole	mm	106.4	106.4	106.4	106.4	106.4	106.4	106.4

## B) Dimensions PTO



# Torque transmission

## PTO flange and output shaft

Beside the combination of the HPR with other HPRs or HPVs to create multiple and tandem units (see section <<Dimensions. Multiple pumps>>), single HPRs can be prepared ex works for the combination with other pumps. Depending on the rated size, we offer different centring for the rear pump. A matching coupling muff for the drive shaft can also be selected. Currently, the following combinations are available. For more information about the output torque, see annotations to table at chapter <<General technical data>>.

### B) PTO mounting possibilities

Centring symbol acc to SAE J744	Coupling muff, acc to ANSI B92.1	Rated size						
		55	75	105	135	165	210	280
Directly mounted Linde gear pumps		X	X	X	X	X	X	X
A	without	X	X	X	X	X	X	X
A	16/32 9 t (A)	X	X	X	X	X	X	–
A	16/32 11 t	–	–	–	–	–	X	–
A	16/32 13 t	–	–	X	X	–	X	X
B	without	X	X	X	X	X	X	X
B	16/32 13 t (B)	X	X	X	X	X	X	X
B	16/32 15 t (B+B)	X	X	X	X	–	–	X
C	without	X	X	X	X	X	X	X
C	12/24 14 t (C)	X	X	X	X	X	X	X
C	16/32 21 t	–	X	X	X	–	X	–
C	16/32 23 t	–	–	X	X	X	X	–
D	without	–	–	–	X	X	X	X
D	8/16 13 t (D)	–	–	–	X	–	–	–
D	12/24 17 t	–	–	–	X	–	–	–
D	16/32 27 t	–	–	–	X	X	X	–
E	without	–	–	–	–	–	X	X
E	16/32 27 t	–	–	–	–	–	X	–

### B) Output Shaft Transfer Torque

Rated Size		55	75	105	135	165	210	280
Continuous Transfer Torque	Nm	219	302	418	540	659	836	1122
Max. Transfer Torque	Nm	433	598	763	1069	1069	1655	2221

# Gear pumps

The gear pumps are available in two designs. Internal gear pumps (IGP) and external gear pumps (EGP). Both types can be used for the control circuits as well as the cooling circuit. The suction is always external for both types, when used in combination with a HPR-02. The internal connection of the IGP is closed.

Internal gear pumps offer a cold start valve and a PTO interface for mounting further pumps. The possible combinations of IGPs and EGPs are determined by PTO option and the permitted shaft torque.

## Overview gear pumps

Displacement	cc/rev	16	19	22.5	31	38	44
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 in conjunction with HPR-02		External	External	External	External	External	External
Max. perm. operating pressure observe max. permissible rated pressures for filter and cooler	bar	40	210	40	165	275	220
Supply pressures min.	bar	0.8 (absolut)	0.8 (absolut)	0.8 (absolut)	0.8 (absolut)	0.8 (absolut)	0.8 (absolut)
Supply pressures max.	bar	3.0 (absolut)	3.0 (absolut)	3.0 (absolut)	3.0 (absolut)	3.0 (absolut)	3.0 (absolut)
Cold start relief valve		Integrated	–	Integrated	–	–	–

>> Port names clockwise rotation: A pressure port, B suction port (as shown)

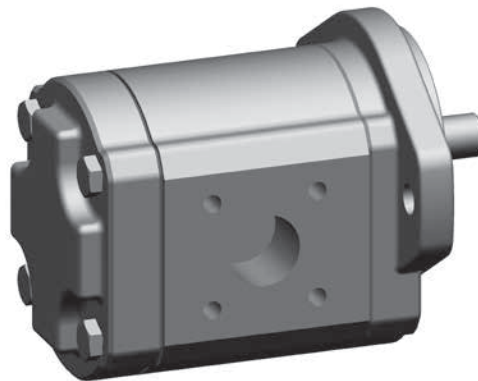
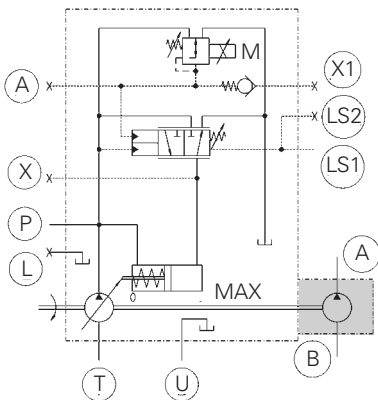
>> Port names counter-clockwise rotation: A suction port, B pressure port (not shown)

>> Ports according to ISO 6149-1

>> Alternatively DIN 3852-1

>> Suction port of the IGP according to ISO 8434-1 L28

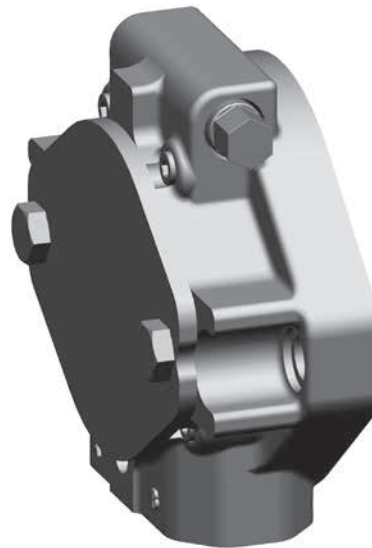
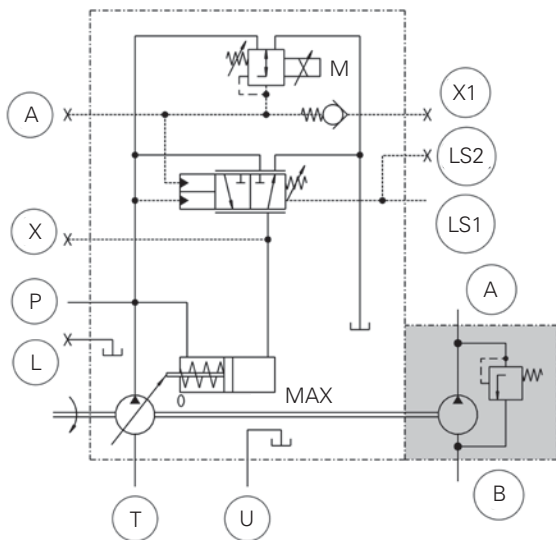
## External gear pump EGP



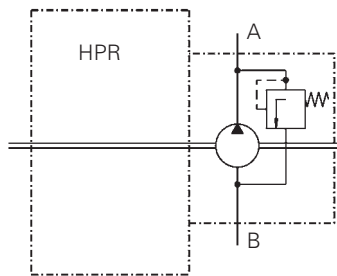
# Gear pumps

The IGP gear pumps include a cold start relief valve and a through drive for attaching additional pumps. In conjunction with an HPR regulating pump suction is always external. IGP types are available in rated sizes of 16 cm<sup>3</sup>/rev and 22.5 cm<sup>3</sup>/rev.

## Internal Gear Pump IGP with External Suction



## External Suction



## External suction

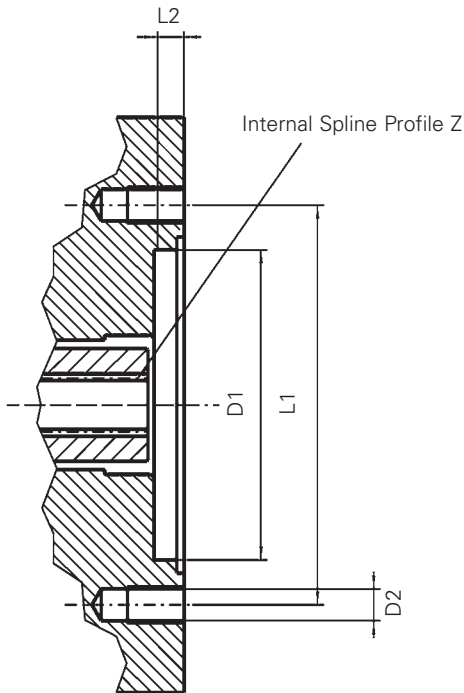
The gear pump supplies the main circuit with oil from the oil tank.  
The internal connection is closed.

# Gear pumps

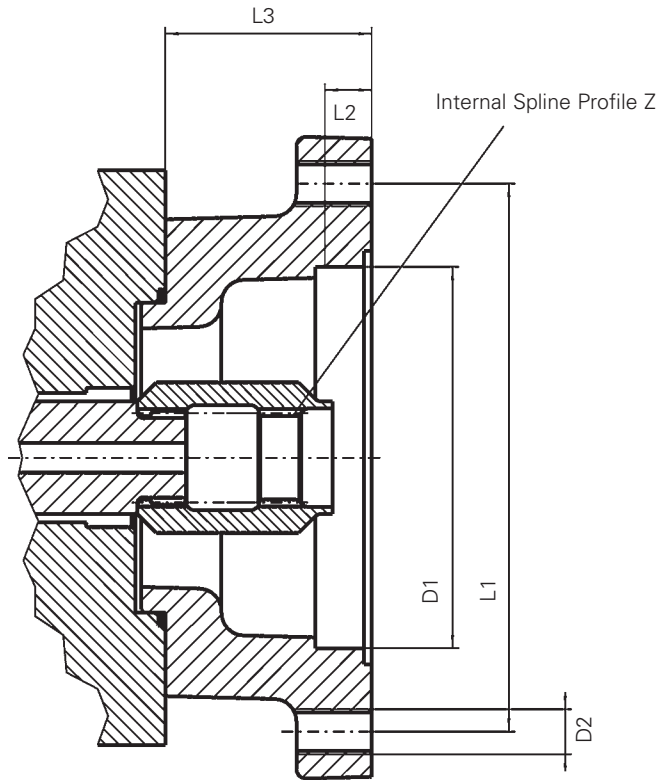
## PTO Flange with IGP

Flange Profile 2-hole	SAE A	SAE B	SAE B-B	SAE C
Z Internal Spline Profile in Accordance with 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	101.6	127
D2 Thread Size	M 10	M 12	M 12	M16
L1 Hole Distance	mm 106.4	146	146	181
L2 Adapter Length	mm 7	11	11	13
L3 Flange Length	-	55	55	72
Continuous Transfer Torque	Nm 75	175	175	175
Maximum Transfer Torque	Nm 107	250	250	250

## PTO SAE A with IGP



## PTO SAE B, B-B, and C with IGP



# Type of control

The modular controller unit enables a wide range of functional system requirements to be met. In all regulator unit versions, the regulating functions are integrated in a housing in order to ensure direct signal transfer without delays and with maximum compactness. All regulators equipped with load sensing function are fully compatible with the Eaton Synchron Control System (see section Eaton LSC-System).

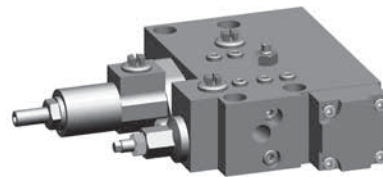
## Technical Data

Type of Control	Additional Option	Swashplate Position Feedback	Name of Regulator
Load Sensing	With Pressure Cut-off	Without	LP
	With Power Limitation, Hyperbolic	With	TL2
	With Electric Override	Without	E1L
Control	With Hydraulic Override	Without	H1L
	Electro-proportional flow limitation and pressure cut-off	With	LEP
	Electro-proportional flow setting, power limitation and pressure cut-off	Without	ETP

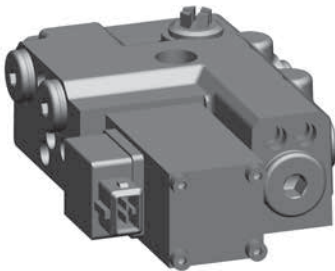
### LP-Controller



### TL2-Controller



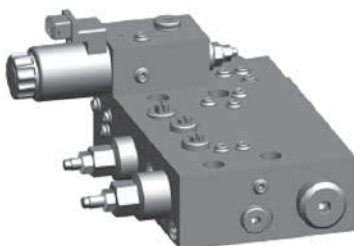
### E1L-Controller



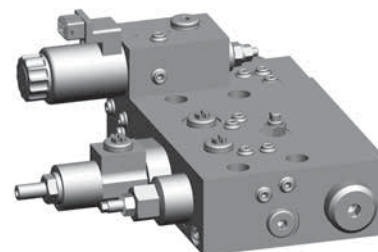
### H1L-Controller



### LEP-Controller



### ETP-Controller

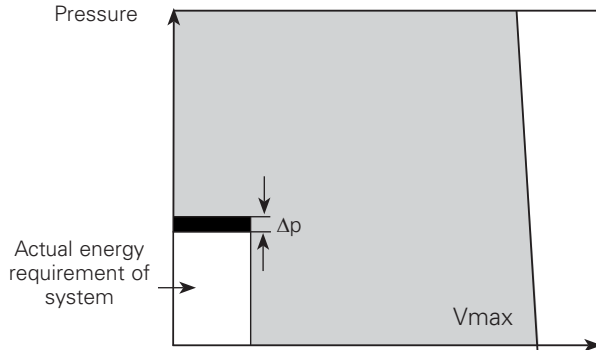


# Type of control

## Load sensing LS

Eaton pumps with load sensing control enable the movement speed required of the selected actuator, e.g. of a boom, to be specified via the valve opening. The measured pump and load pressures are continuously balanced by the load sensing regulator of the hydraulic pump.

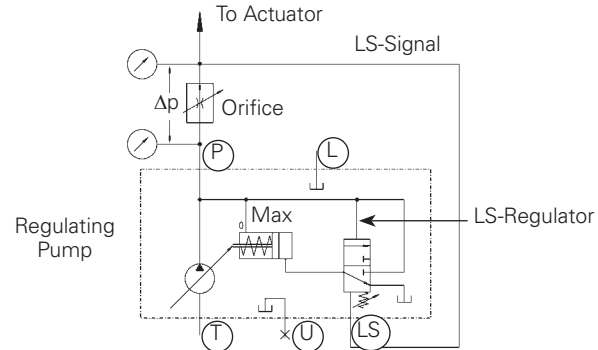
### Load Sensing. Flow on Demand Control.



At the regulator a pressure gradient is set which is defined by the actuator requirements. The volume flow results from the orifice A of the control valve and the actual pressure gradient.

Due to the LS-regulator, the  $\Delta p$  corresponds to the setting value. If the required volume flow differs, the pump displacement is changed accordingly.

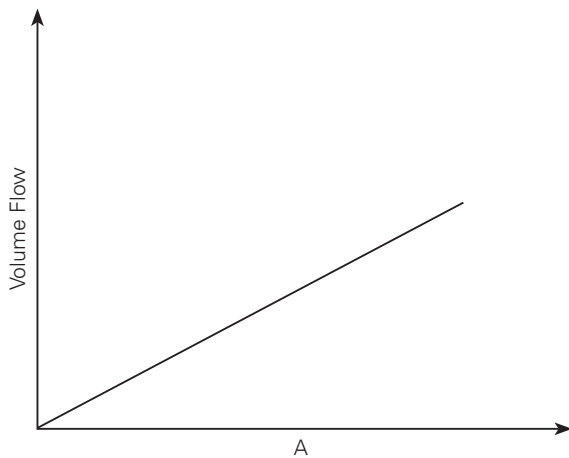
### Regulating pump with LS-regulator and measure orifice (in valve)



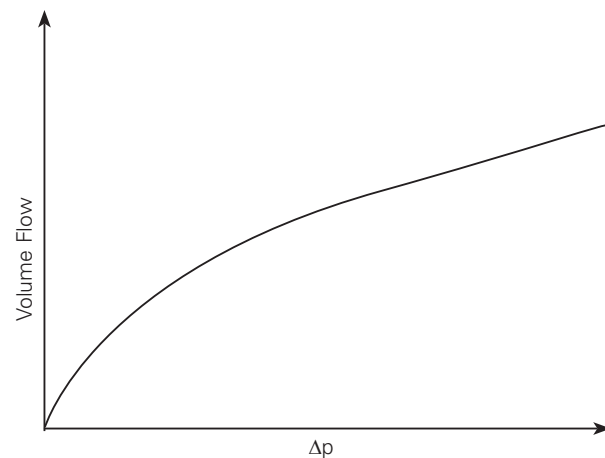
This happens automatically and reduces the effort required by the operator. Since varying loads and varying numbers of actuators are compensated automatically.

The  $\Delta p$  LS basic setting is possible from 16 to 27 bar with 20 bar as standard (The LS differential pressure influences the response times of the pump system).

### LS-Function at $\Delta p = \text{Constant}$



### LS-Function at Area A = Constant



### Benefits of LS-control

- Any volume flow below the pump's maximum can be set
- Response speed of the machine can be defined
- OEM-specific machine response is possible
- Optimum precision control capability

### Demand-oriented pump control offers the following benefits

- Load-independent machine control
- Minimum heat generation
- Increased pump service life
- Low noise generation in the whole system
- Fewer components for the control mechanism
- Lower energy consumption, particularly with partial volume flow

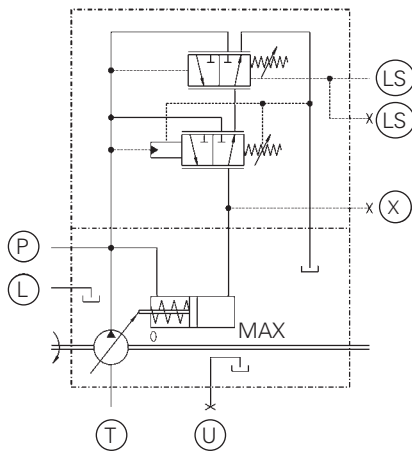


# Type of control

## LS with Hydraulic Pressure Cut-off LP

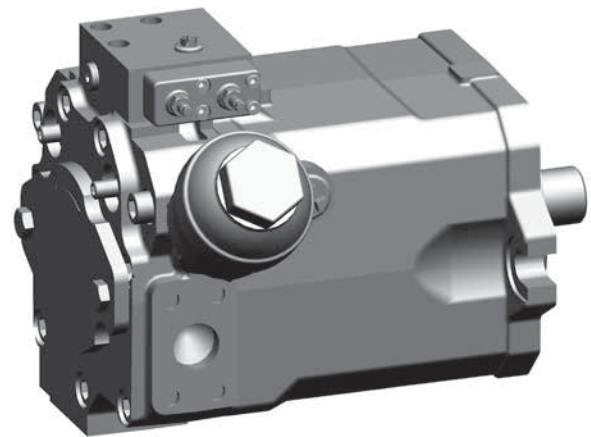
In addition to the load sensing function the LP-regulator offers maximum pressure limitation. Once the system pressure reaches the set pressure of the pressure cut-off valve, the LS-regulator is overridden and the pump swashes back, whilst maintaining the system's regulating pressure. The hydraulic pump remains in this state until the system pressure falls below the set pressure. The hydraulic pump then returns to normal LS operation.

### LP: LS with Hydraulic Pressure Cut-off



The maximum pressure cut-off valve prevents prolonged operation of pressure relief valves installed in the hydraulic system for protection. This has the following benefits for the hydraulic system:

- Operating pressure is maintained
- No operation in the overload range
- Any operating point under the power curve remains accessible
- Demand-oriented volume flow generation

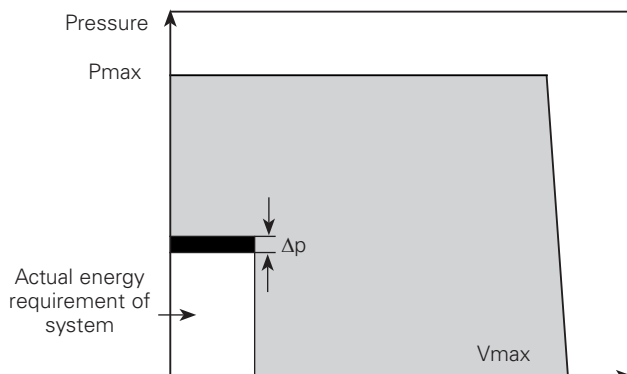


- Minimum power loss
- Reduced heat and noise generation
- Longer service life of the pump and the entire hydraulic system
- Improved energy consumption of the overall system

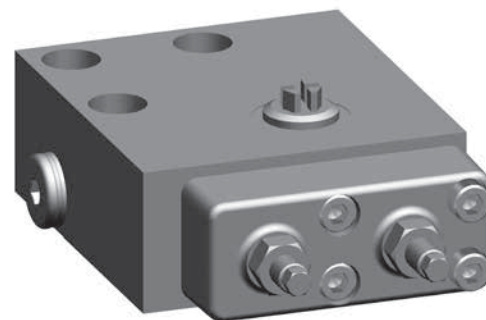
#### Possible maximum pressure control setting ranges

- 125 - 230 bar
- 231 - 350 bar
- 351 - 420 bar

### LP-Characteristic Curve



### LP-Regulator



# Type of control

E1L/H1L. Load Sensing with electric /hydraulic override

In addition to the load sensing function, HPR-02 pumps with H1L or E1L controllers offer the possibility of overriding the  $\Delta p$  LS-signal hydraulically or electrically. This enables a so called mode control for selecting different operating points or enables a power limit regulation (underspeed control). The integration of all functions in the pump controller enables direct signal transfer without delay. The controller-specific data are independent of the nominal pump size.

## Possible applications of the LS signal override

### Mode-control

A mode control (mode selection) modulates electrically the  $\Delta p$  LS-signal at an orifice (e.g. directional control valve). The current  $\Delta p$  LS value is reduced proportionally or in steps and the pump output adjusted via the pressure reducing valve (see the diagrams on following pages). In this way the volume flow of

the pump can be reduced using the same orifice. In applications with proportional valves this leads to enhanced control resolution, enabling particularly precise and sensitive actuator movement.

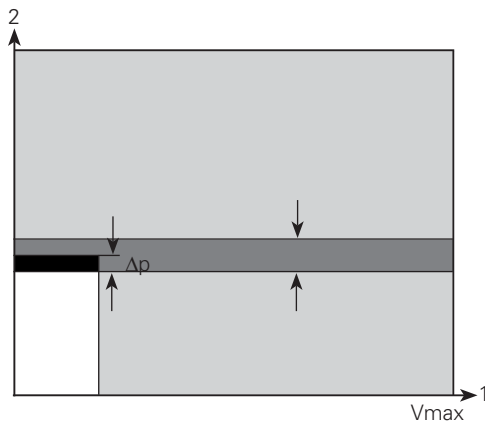
### Power limit regulation

Any reduction in the prime mover speed is detected in conjunction with an electronic control unit, and the pump's volume flow is limited through modulation of the  $\Delta p$  LS value to ensure that the maximum power capacity is not exceeded. The maximum prime mover power is thus available at all times,

irrespective of ambient influences and the number of actuators.

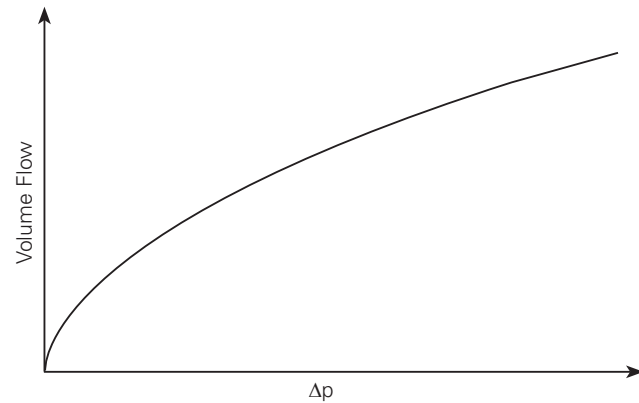
In principle, the  $\Delta p$  LS value acting at the LS-pilot can be modulated down to zero, whereas modified times of the pump system should be expected in the operating range near zero.

### E1L/H1L-characteristic curve



- 1 - Flow
- 2 - Pressure
- Maximum performance range of the pump
- Actual power demand of the system
- Mechanical  $\Delta p$  basic setting
- Effective, modulated regulating  $\Delta p$

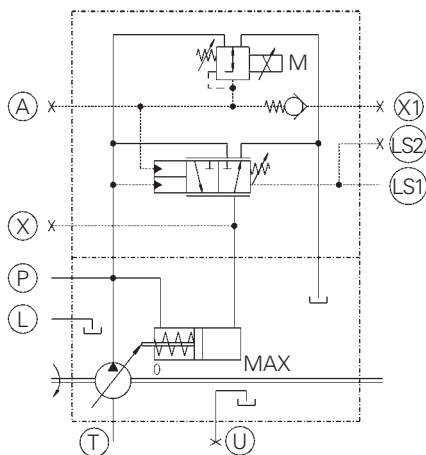
### Pump volume flow at fixed orifice (e.g. directional control valve opening)



# Type of control

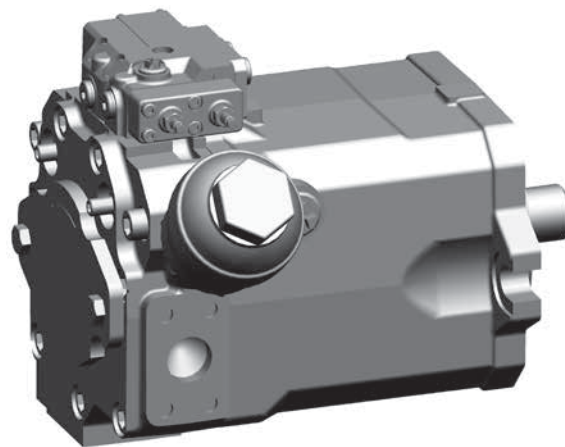
## E1L. Load Sensing with electric override

In addition to the load sensing function, the HPR- 02 E1L offers an electric override for mode selection and power limit regulation (underspeed control). The integration of all functions in the pump controller enables direct signal transfer without delays. The controller specific data are independent of the nominal pump size.



In the event of an electric override of the LS-signal, a pressure reducing valve is activated via the proportional solenoid. The control pressure generated in this way acts

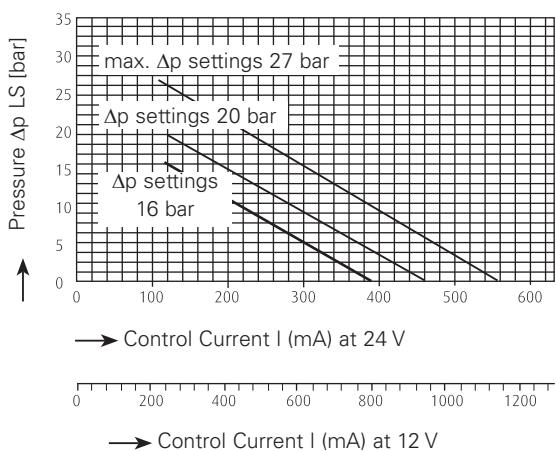
proportionally against the LS-spring, and the effect of the  $\Delta p$  LS signal is modulated accordingly. This causes the pump to swash back, thereby reducing its output. The function



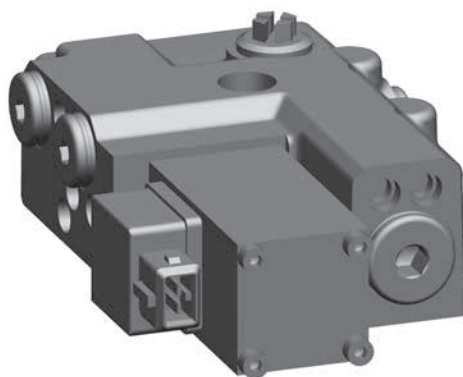
between control current (I) at the control solenoid and the associated  $\Delta p$  LS value is shown in the diagram. At the port "A" the control pressure can be picked up and forwarded to an H1L

controller at another HPR pump, which follows the first pump with the E1L controller (master-slave-operation).

### $\Delta p$ LS-reduction



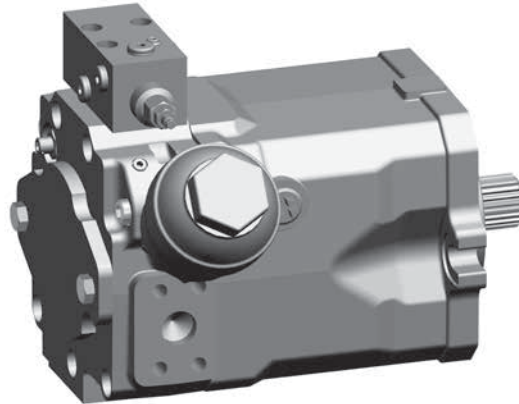
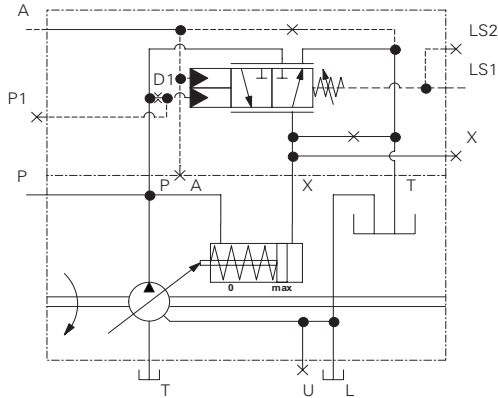
### E1L-controller



# Type of control

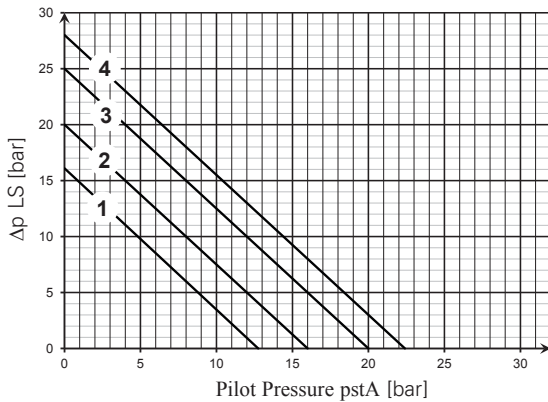
## H1L. Load Sensing with hydraulic override

In addition to the load sensing function, HPR-02 pumps with H1L-controller offer the possibility of overriding the  $\Delta p$  LS-signal hydraulically. This enables either a so called mode control for selecting different operation points or establish a power limit regulation (understand control). The integration of all functions in the pump controller enables direct signal transfer without delay. The controller specific data are independent of the nominal pump size. The H1L-controller is particularly useful for tandem configurations of two HPR-02 pumps, in which the first is equipped with an E1L-controller. The second pump with H1L-controller uses the resulting hydraulic signal of the first controller and follows the first pump's actions (master-slave-configuration).



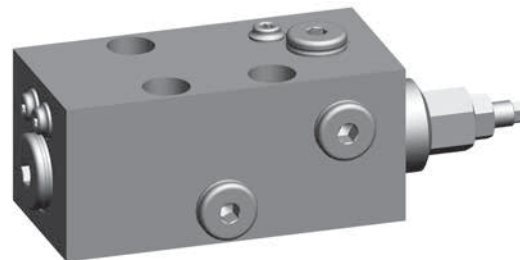
In the event of hydraulically overriding the LS-signal, a control pressure at the port A and the associated  $\Delta p$  LS value is shown in the following diagram.

### $\Delta p$ LS-reduction



- 1 16 bar  $\Delta p$  setting
- 2 20 bar  $\Delta p$  setting
- 3 25 bar  $\Delta p$  setting
- 4 28 bar  $\Delta p$  setting

### H1L-controller



# Type of control

## Pump controllers with position feedback

### T-Axis (TL2/ETP): hydraulic movement of the regulation begin

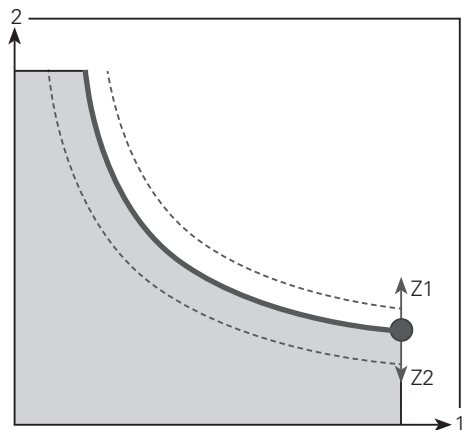
Controllers of the TL2 and ETP type offer a power limitation with a hyperbolic characteristic. The controller is set ex works to a customer specific power limit value. The volume flow is

restricted, when this limit is exceeded. By means of control ports at the controller, the point at which the power limiter sets in can be raised, as well as lowered during operation.

Dependent on the rated size of the unit, there is a minimum value for the power limitation which must not be underrun, neither by the ex works setting, nor by shifting. The maximum mechanically

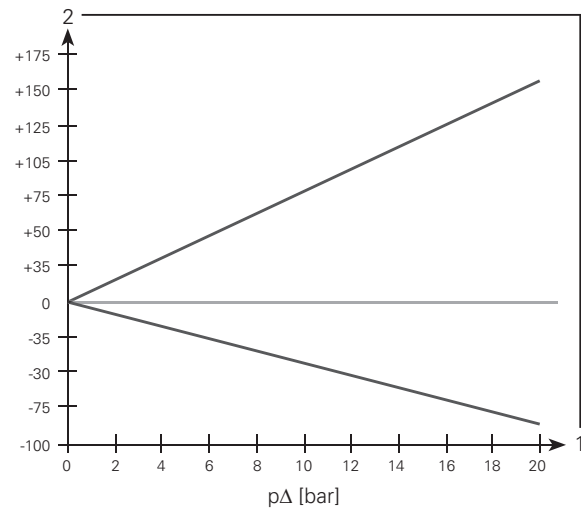
set value at which the power limitation sets in, is 250 bar, independent of the pump's rated size and speed. The pump must never be operated with more than its maximum power.

### Power limiter characteristic curve



- 1 - Displacement
- 2 - Pressure
- Power range of the pump
- Regulation begin power limitation

### Shifting of the regulation begin



- 1 - Pilot pressure port Z1, Z2
- 2 - Displacement of the regulation begin [bar]
- Pilot pressure port Z1
- Pilot pressure port Z2

### Power limiter performance

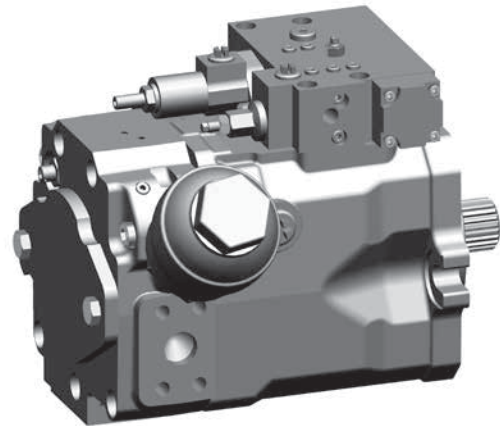
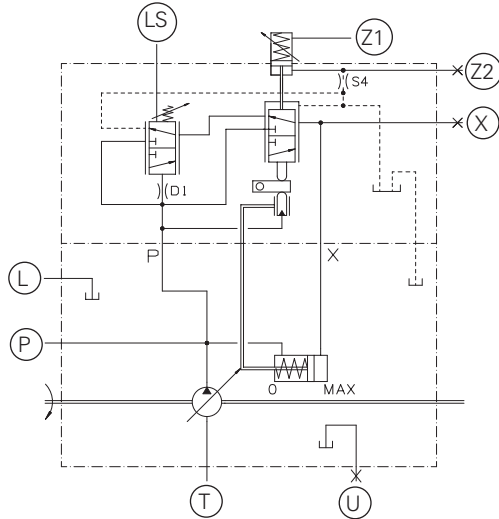
		Rated size					
		75	105	135	165	210	280
Ex works setting [kW]		6 – 82	9 – 106	12 – 136	19 – 151	24 – 184	32 – 221
Shifting of the regulation begin [bar/bar]	Z1	7.1	7.1	7.1	7.4	7.4	7.8
	Z2	-3.2	-3.2	-3.2	-3.3	-3.3	-3.4
Regulation begin minimum [bar]	60	60	60	60	80	80	80
Regulation begin [bar] (mechanically set)		250	250	250	250	250	250
Max. pressure at Z1/Z2 [bar]		25	25	25	25	25	25

# Type of control

## TL2. Load Sensing with hyperbolic power limitation

The control principle with power limitation is used to optimize power utilization of the prime mover in applications where less than the full power capacity is available for the hydraulic system. In addition to the load sensing function the HPR-02 TL2 offers hyperbolic power limitation. The volume flow is limited when the set value is reached.

### TL2. LS with hyperbolic power limitation



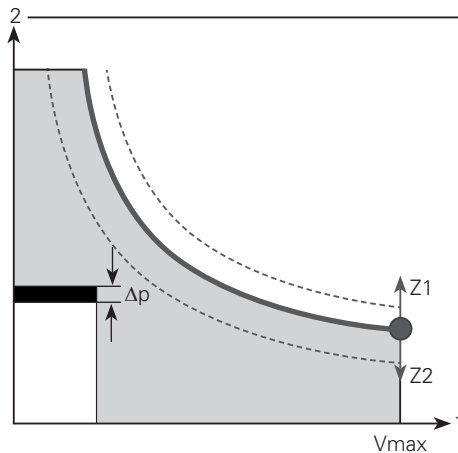
The TL2 controller offers a so called hydraulic power mode function. This means, that the regulation begin of the power limitation/ torque control can be

shifted from its mechanical basic setting by means of a remote control port Z1/ Z2 at the controller. If the regulation begin is intended to be below the basic

setting, which means that the pump performance is reduced, then the port Z2 is used while S4 is plugged. If the mode function is not used at all,

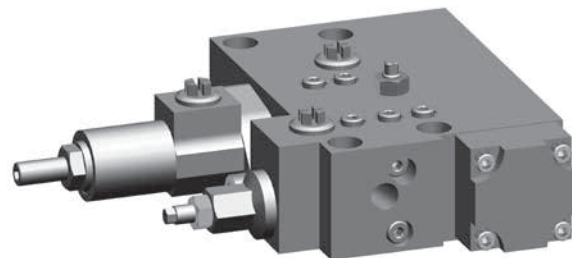
or only with the Z1 port, S4 is equipped with an orifice. Z2 is then sealed pressure tight. For details, see <<Pump controllers with position feedback. T-axis>>

### TL2-Characteristic Curve



- 1 - Flow
- 2 - Pressure
- Maximum performance range of the pump
- Actual power demand of the system
- Regulating  $\Delta p$
- Power limitation regulation begin
- Power limitation basic setting
- Characteristic shifting by control signal

### TL2-Controller



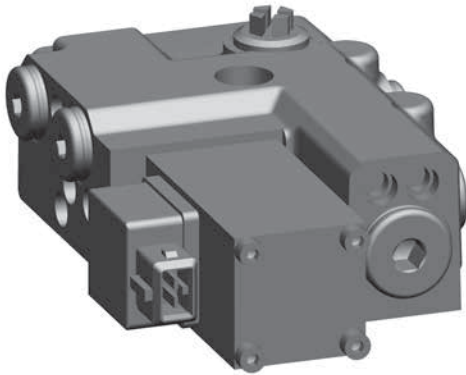
# Type of control

## Electrical properties

<b>Supply Voltage – limiting Voltage</b>		<b>V</b>	<b>12</b>	<b>24</b>
Control types	Digital control via Pulse Width Modulation PWM Analogue		100 Hz rectangle, pulse duty ratio variable over control range Direct current with dither overlay (dither frequency nom. 35 Hz, duty cycle 1:1). Further details on request	
Connector type			DIN EN 175301-803, Deutsch, AMP Junior Timer (2-pin)	
Protection class			IP54 (DIN), IP 67 (Deutsch), IP6K6K (AMP)	
Voltage type			Direct Current (DC)	
Power consumption		W	15.6	
Rated current – limiting current		mA	1200	600
Relative duty cycle		%	100	
Further details on request				

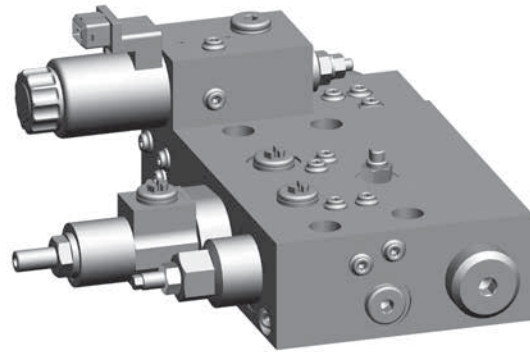
### E1L-controller

Rectangular Solenoid and AMP-connector



### ETP – controller

Tubular Solenoid and AMP – connector



# Type of control

## Pump controllers with position feedback

TL2-, LEP- and ETP-controllers offer a feedback of the swashplate position. Therefore they are – unlike LP-, E1L- and H1L-controllers – not mounted on the valve plate housing, but on the pump housing. Besides their individual characteristics, these controllers have some similar features.

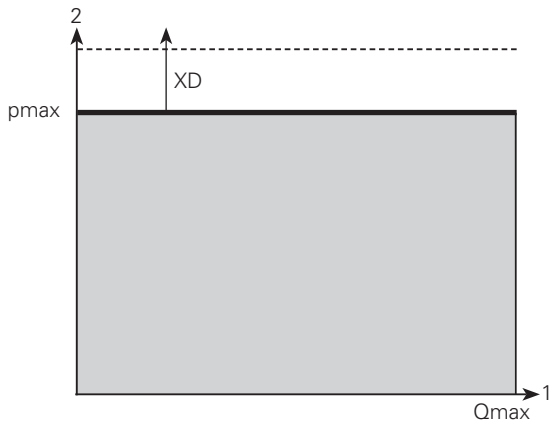
### P-axis (LEP/ETP): Pressure cut-off characteristic

LEP- and ETP-controllers offer a pressure cut-off (PCO), just like the LP-controller. This prevents the pump pressure exceeding a previously

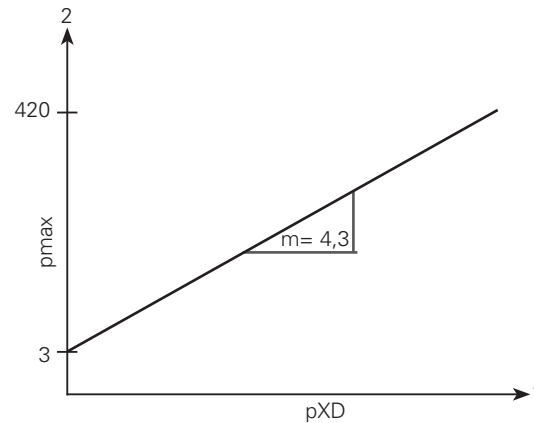
set maximum. The PCO is set to a customer-specific value between 125 bar and 420 bar ex works. Using a control signal at the XD port, the actual

response pressure of the PCO valve of LEP- and ETP-controllers can be increased steplessly. The response pressure of the valve is increased by 4.3

bar by every bar increase at the XD port. The maximum pressure of 420 bar must not be exceeded.



- 1 - Displacement volume
- 2 - Pressure
- Maximum performance range of the pump
- Pressure cut-off basic setting
- Characteristic shifting by control signal



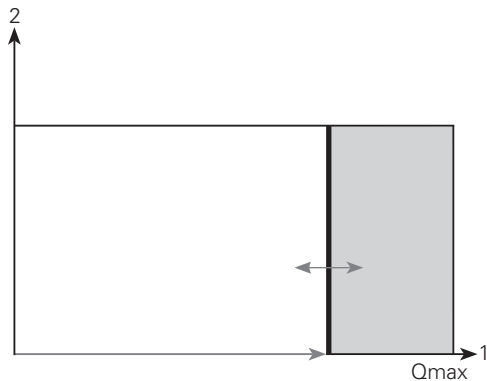
- 1 - Control pressure at XD port
- 2 - Pressure cut-off response pressure
- 3 - Pressure cut-off basic setting

### E-Axis (LEP/ETP): Electric flow setting

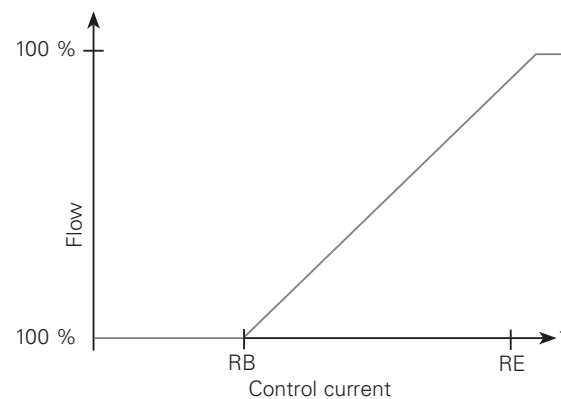
The swash angle and thus the flow of the pump is set by means of an electric signal with the LEP and

ETP controller. The actual current depends on the voltage-level of the application and the nominal

size of the pump. Without an electric signal, the pump swashes to minimal displacement.



- 1 - Displacement volume
- 2 - Pressure
- Maximum performance range of the pump
- Pressure cut-off basic setting
- Provided power



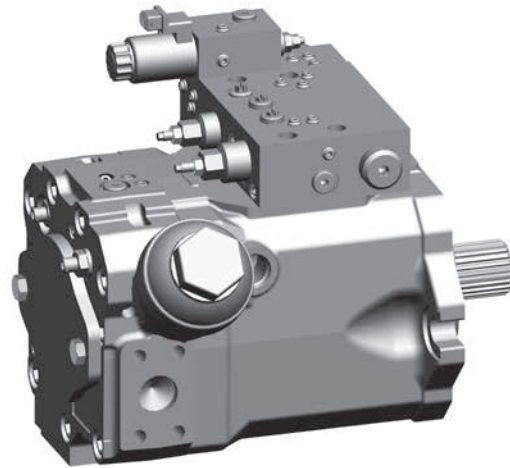
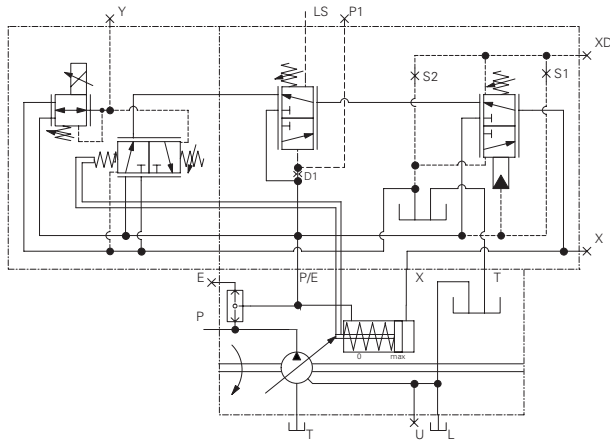
Rated size	Control current	
	12 V	24 V
RB	105, 135	464 mA
Regulation begin	210	490 mA
	280	524 mA
RE	105 - 280	1200 mA
Regulation end		600 mA



# Type of control

LEP. Load sensing with electro-proportional flow limitation and pressure cut-off

The HPR with LEP-controller offers an On-demand load sensing flow control. The actual volume flow, delivered by the pump can be restricted by an electrical signal in certain points of operation. A pressure cut-off function protects the hydraulic system from overload.



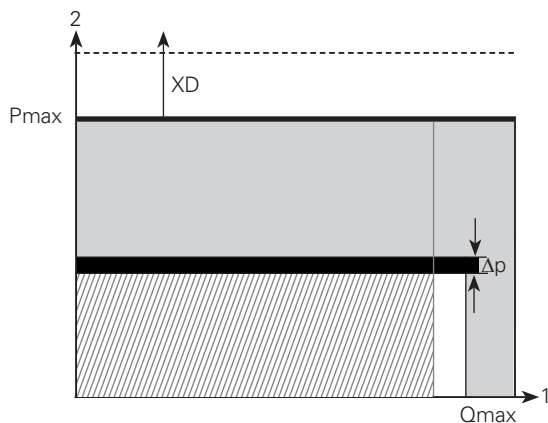
Without any signal at the solenoid or the LS-port, the pump is swashed back to stand-by position. Both signals at the same time are required for the pump to leave stand-by position.

The actual swash angle of the pump is determined by the signal with the lower target value.

The responding behavior of the pressure cut-off can be remote-controlled by a hydraulic signal at the XD port as an option. S1 is then equipped with an orifice and S2 is sealed. If

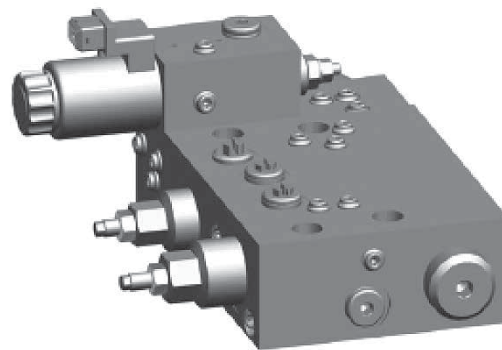
only the mechanical preset of the PCO is used, S1 is sealed and S2 is not equipped. Details, see <<Pump controllers with position feedback. P-axis>>

## Characteristic LEP controller



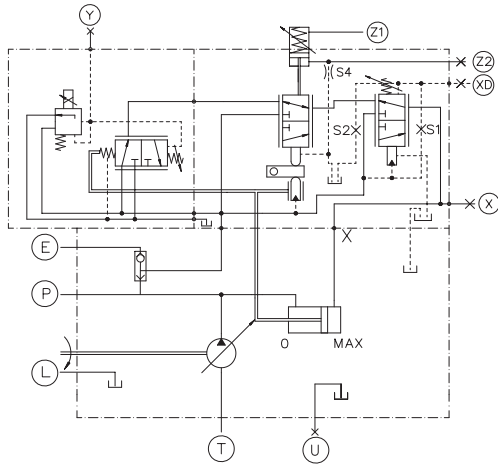
- 1 - Flow
- 2 - Pressure
- Maximum performance range of the pump
- Actual power demand of the system
- Regulating  $\Delta p$
- Provided power
- Pressure cut-off basic setting
- Characteristic shifting by control signal
- Electro-proportional flow setting

## LEP-controller



# Type of control

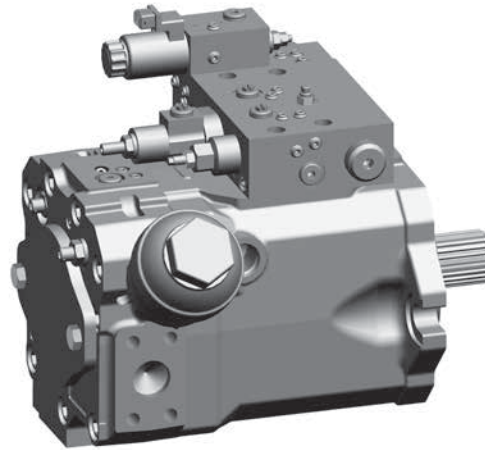
ETP. Electro-proportional flow setting, power limitation and pressure cut-off



The ETP-controller offers a so called hydraulic power mode function. This means, that the regulation begin of the power limitation can be shifted from its mechanical basic setting by means of a remote control port Z1/ Z2 at the controller. If the regulation begin is intended

to be below the basic setting, which means that the pump performance is reduced, then the port Z2 is used, S4 is plugged. If the mode function is not used at all, or only with the Z1 port, S4 is equipped with an orifice. Z2 is then sealed pressure tight.

The HPR with ETP- controller delivers a volume flow which is exactly proportional to the electric control signal. Superposed, the controller offers a hyperbolic power limitation, which optimally exploits the power of the prime mover and also protects it from overload. In addition to this, a pressure cut-off protects the hydraulic system.

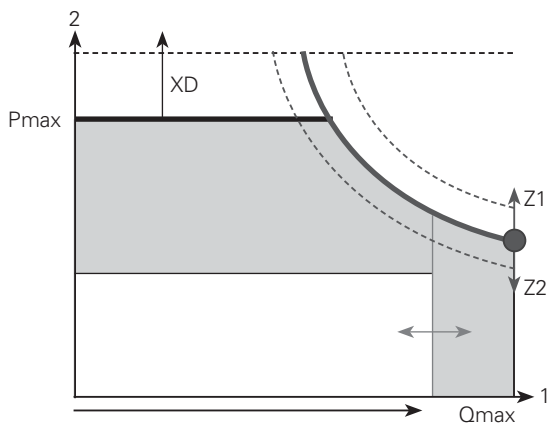


For details, see <<Pump controllers with position feedback. P-axis>>

The responding behavior of the pressure cut-off can be remote-controlled by an hydraulic signal at the XD port as an option. S1 is then equipped with an

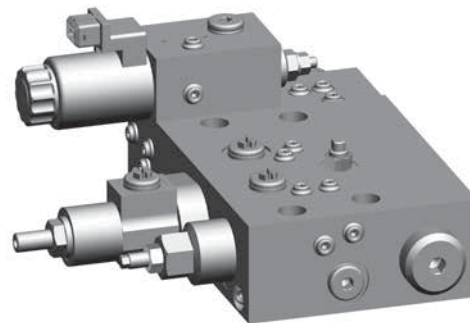
orifice and S2 is sealed. If only the mechanical preset of the PCO is used, S1 is sealed and S2 is not equipped. Details, see <<Pump controllers with position feedback. P-axis>>

## Characteristic ETP-controller



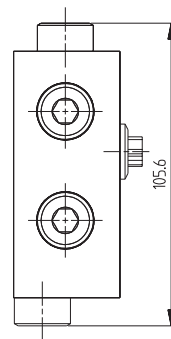
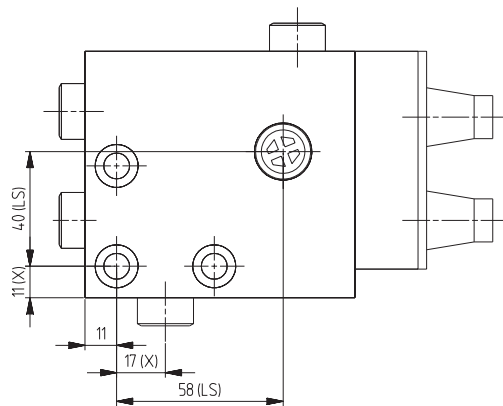
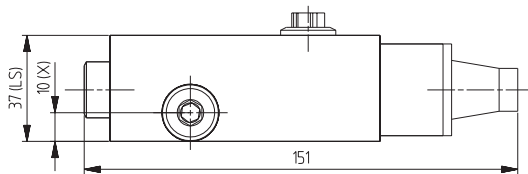
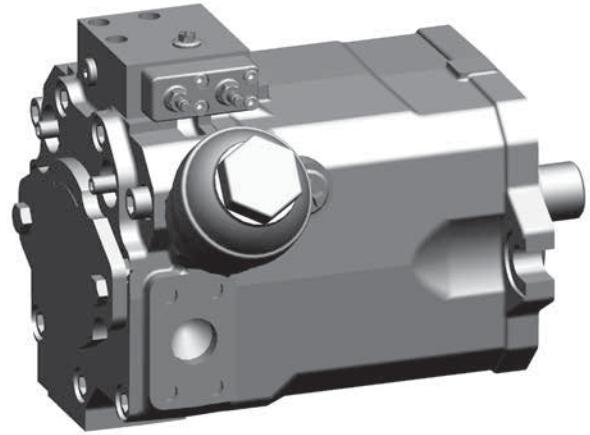
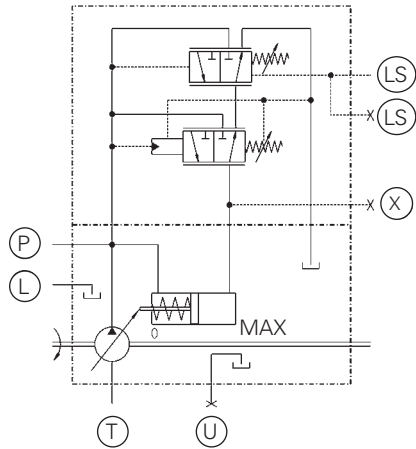
- 1 - Displacement
- 2 - Pressure
- Maximum performance range of the pump
- Electro-proportional flow setting
- Provided power
- Regulation begin power limitation
- Pressure cut-off basic setting
- Characteristic shifting by control signal
- Pressure cut-off basic setting
- Characteristic shifting by control signal

## ETP controller



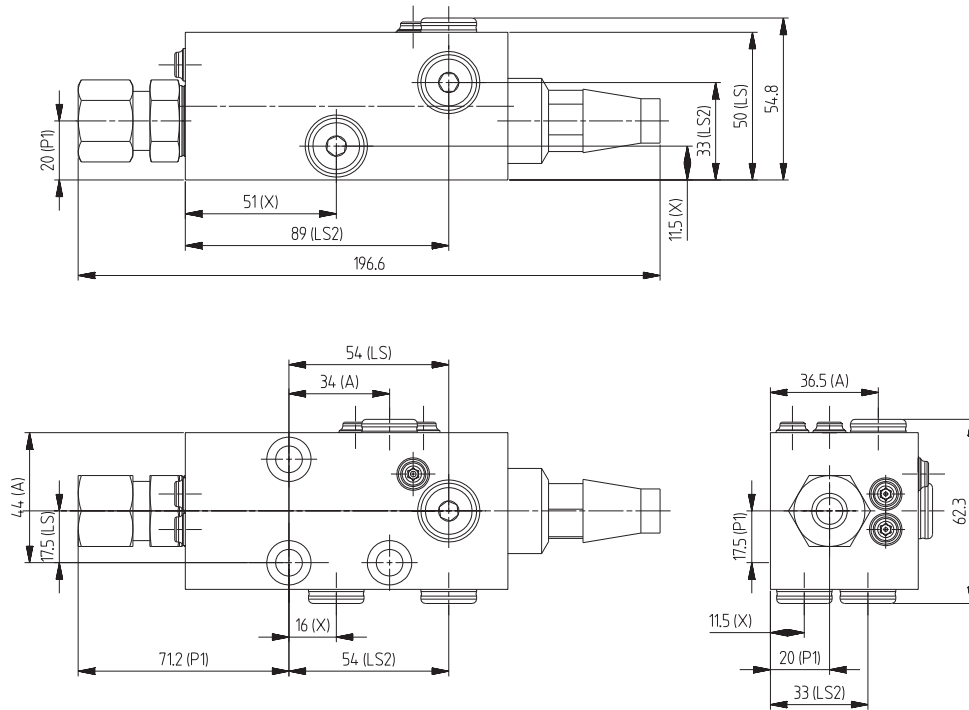
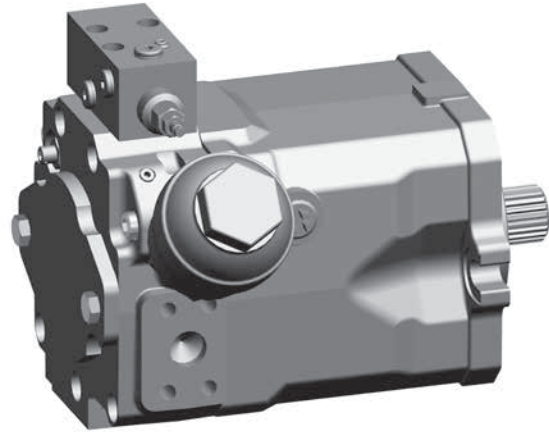
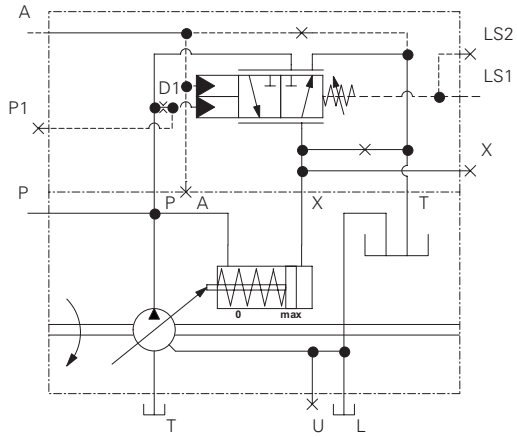
# Dimensions

LP-controller



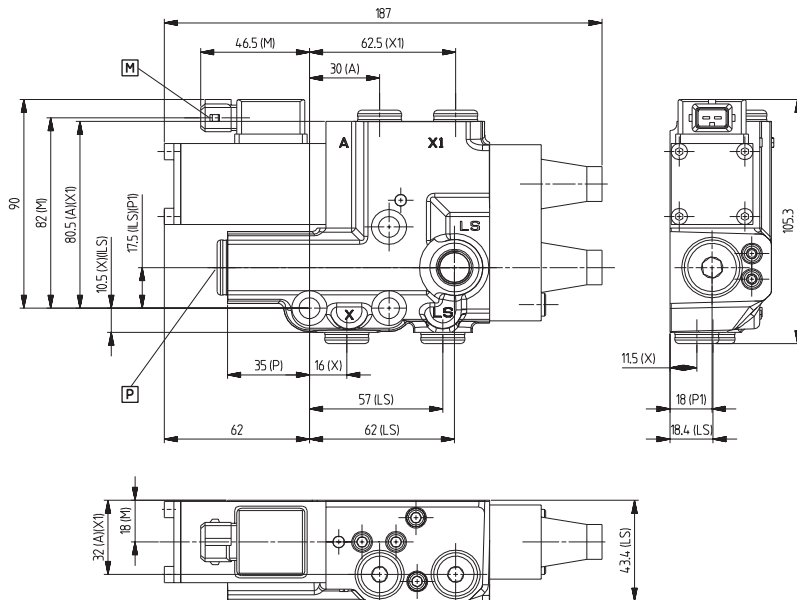
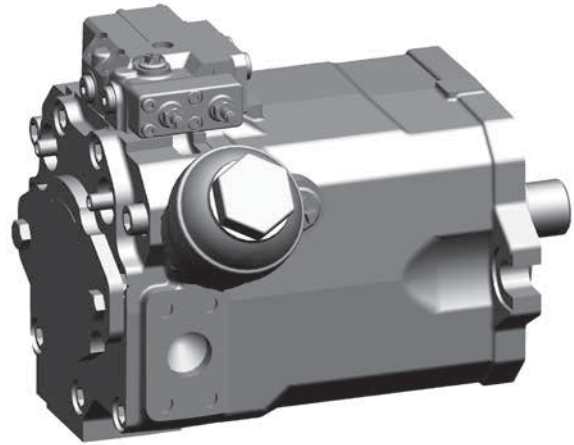
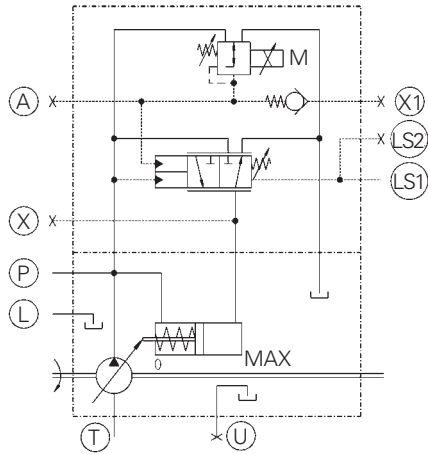
# Dimensions

H1L-controller



# Dimensions

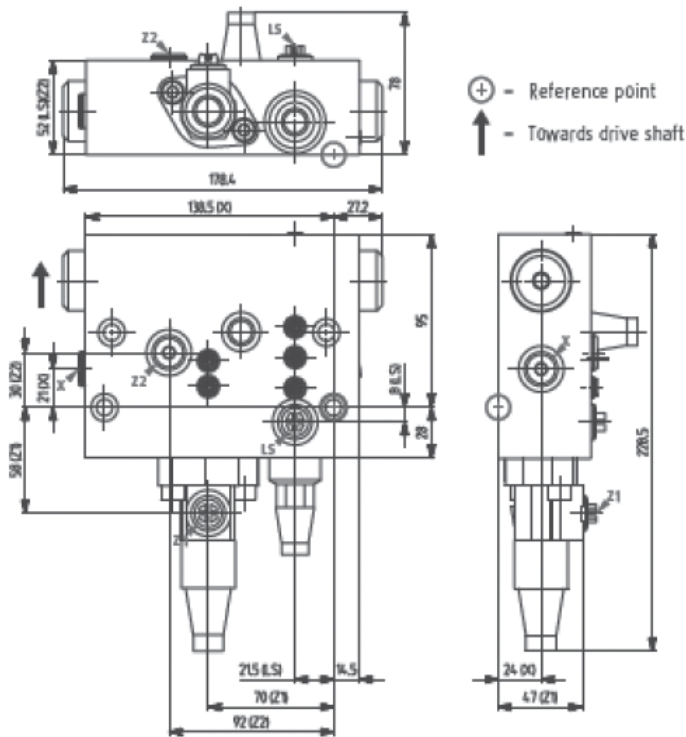
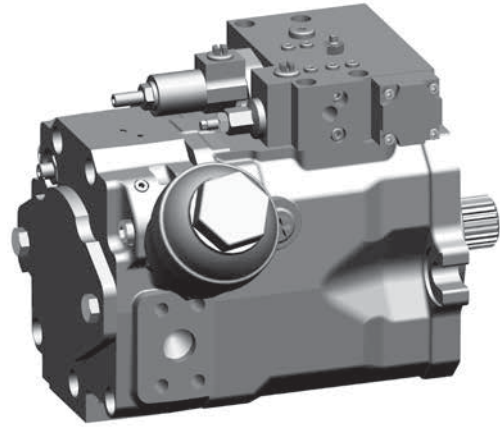
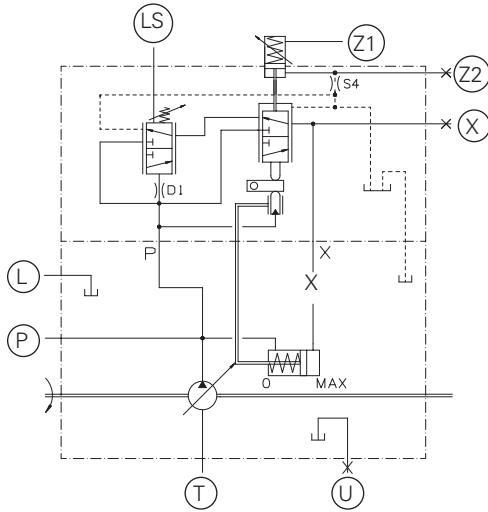
## E1L-controller



Dimensions:	approx. 187 x 105.3 x 43.4 mm	
Connections:	A	Test port control pressure M14x1.5
	X	Test port actuating pressure M14x1.5
	LS1, 2	Load sensing signal/test port M14x1.5
	P1	Test port pump pressure M18x1.5
	M	Solenoid with AMP-JPT connector (example)
Further information, see <<Controllers. Electrical properties>>		

# Dimensions

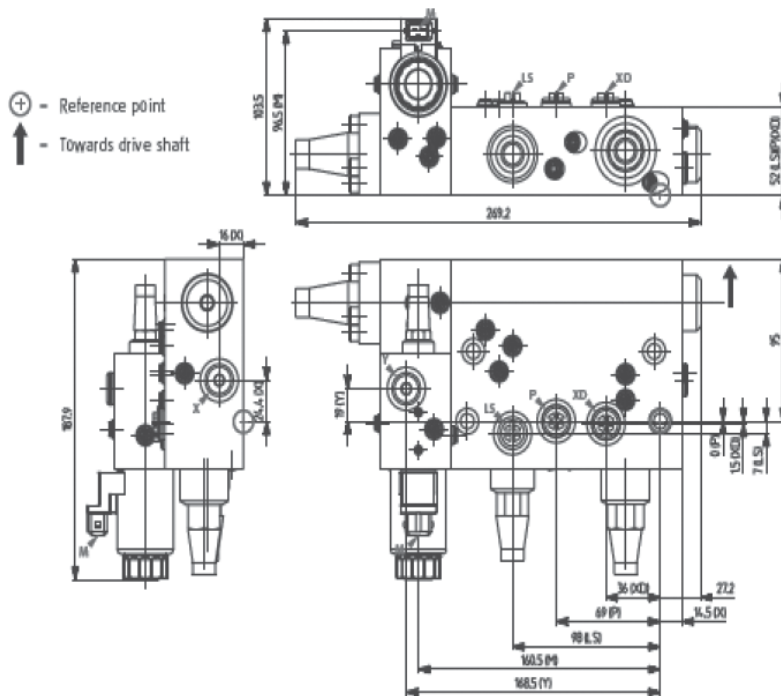
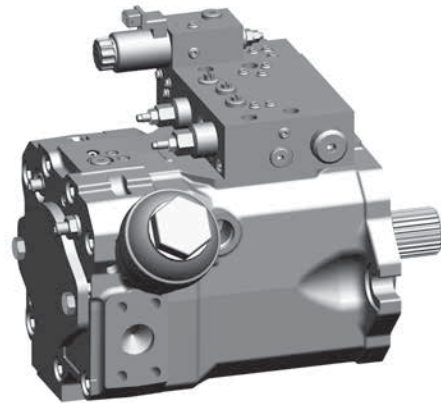
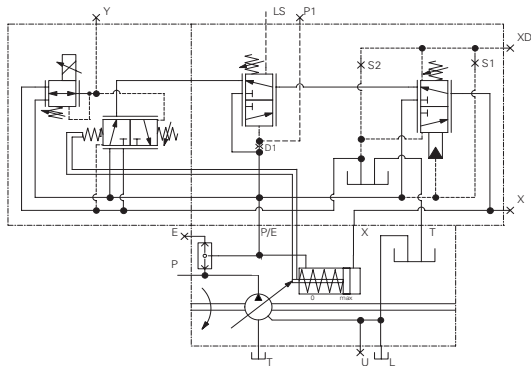
TL2-controller



Dimensions:	approx. 178.4 x 228.5 x 78 mm		
Connections:	X	Test port actuating pressure	M14x1.5
	LS	Load sensing signal	M14x1.5
	Z1/Z2	Remote control for power limitation	M14x1.5

# Dimensions

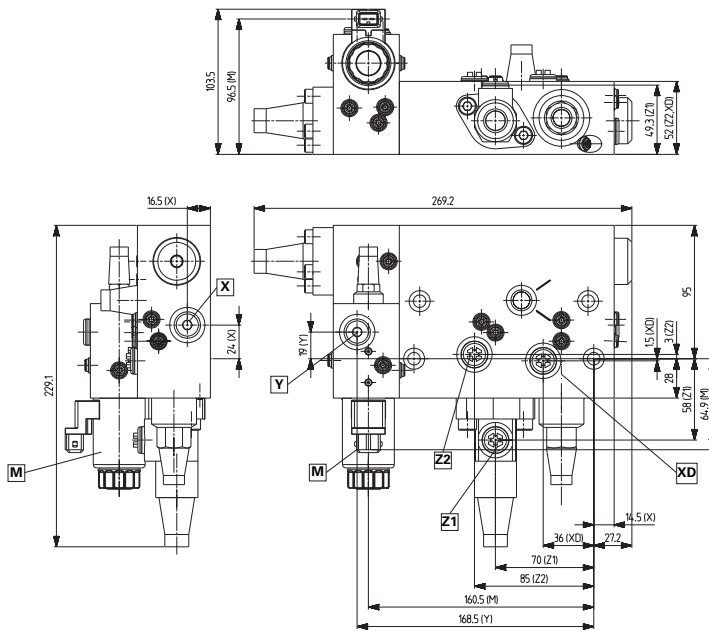
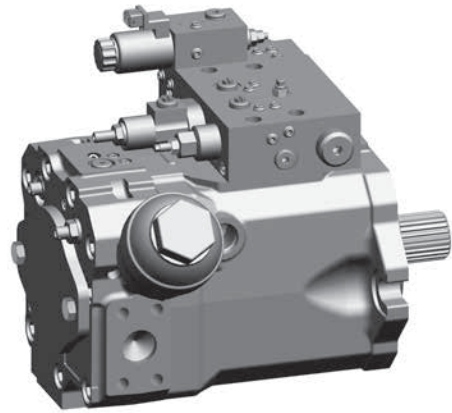
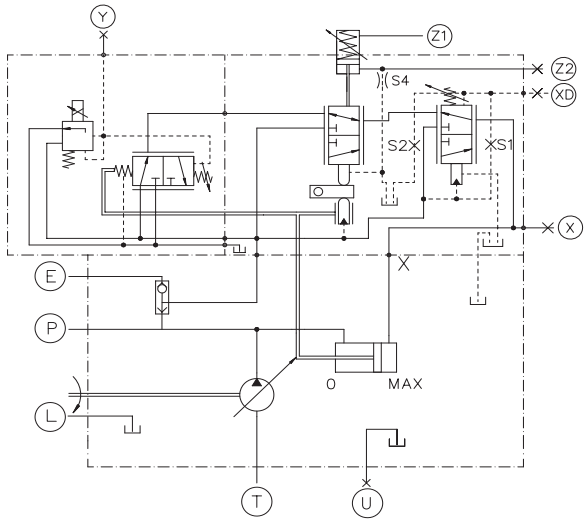
LEP- controller



Dimensions:	approx. 269.2 x 229.1 x 103.5mm	
Connections:	X	Test port set pressure M14x1.5
	Y	Test port actuating pressure M14x1.5
	XD	Connection for external pressure cut-off M14x1.5
	LS	Load sensing signal M14x1.5
	P	Test port pump pressure M14x1.5
	M	Solenoid with AMP-JPT connector (example) M14x1.5
Further information, see <<Controllers. Electricity properties>>		

# Dimensions

## ETP controller



Dimensions:	approx. 269.2 x 229.1 x 103.5mm	
Connections:	X	Test port set pressure M14x1.5
	Y	Test port actuating pressure M14x1.5
	XD	Connection for external pressure cut-off M14x1.5
	Z1/Z2	Remote control for power limitation M14x1.5
	M	Solenoid with AMP-JPT connector (example) M14x1.5
	Further information, see <<Controllers. Electricity properties>>	



# Dimensions

Single pumps HPR-02 for LP, E1L, H1L

The dimensioning is shown by one exemplary pump configuration. The external dimensioned by the individual configuration, including the choice of a controller, direction of rotation, optional SPU and the settings of the pump. Further information can be found in the specific sections of this datasheet, in particular the sections <<Torque transmission. Mounting flange>> and <<Torque transmission. Drive shaft>>.

## Dimensions of the pump without controller

Rated size	55	75	105	135	165	210	280
D	127	127	127	152.4	152.4	165.1	224
L1	220.3	231.8	262	284.5	333.1	348	403
L2	259.3	270.8	301	323.5	372.1	387	442
L3	207.3	220.3	241	263.5	317.1	333	375
H1	100	102	103.5	111.5	128.5	134.5	152
H2	146	146	136	145.5	152.4	143.5	238
B1	111	190.3	199.6	216	251.5	268	306.1
B2	208	208	207	256	269	268.8	314.5
B3	120	111	122	129	128.9	126.5	125.1
B4	21	21	21	21	19	21	21

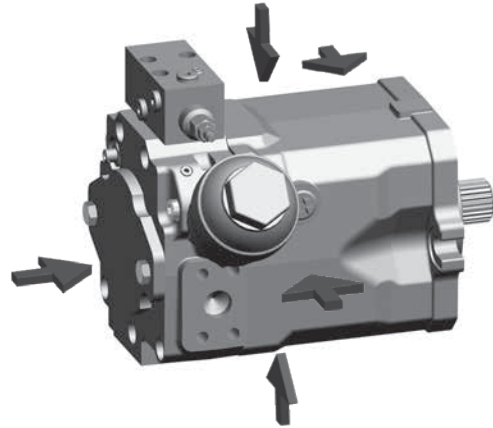
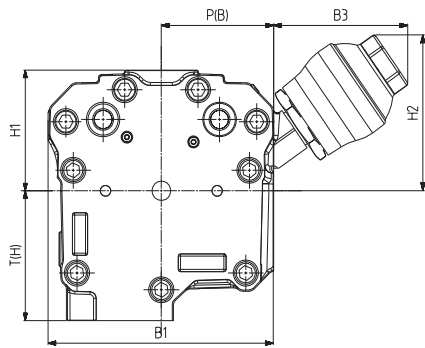
## Ports

Rated size	55	75	105	135	165	210	280
P	¼"	¾"	1"	1 ¼"	1 ¼"	1 ½"	1 ½"
P(L)	182.8	164.3	218	243.5	283.1	295	344.5
P(H)	23.5	23.5	26	3.	43	27	46
P(B)	91	90.5	100	107	134.5	134.5	149.5
T	1 ½"	1 ½"	2"	2"	2 ½"	3"	3 ½"
T(L)	189.8	201.3	227	249.5	285.6	298	344.5
T(H)	94	94	103.5	120	119	149	167
T(B)	21	21	25	30	0	57	57
L/U	M22x1.5	M22x1.5	M22x1.5	M27x2	M27x2	M27x2	M33x2
L(L)	112.8	124.3	142	164	180.6	197.5	215.5
L(H)	52	52	53	61	65	71.5	80.5
L(B)	86.5	86.5	85	101.5	108	128	145
U(L)	72	72	72	74.5	81.1	83	109
U(H)	44	44	54	54	62	60	68
U(B)	78.5	78.5	92.5	92.5	101	118	129.5

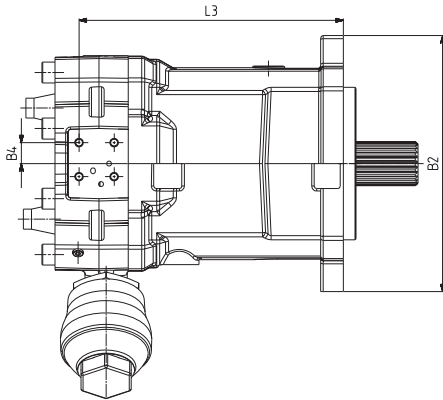
# Dimensions

Single pumps HPR-02 for LP, E1L, H1L

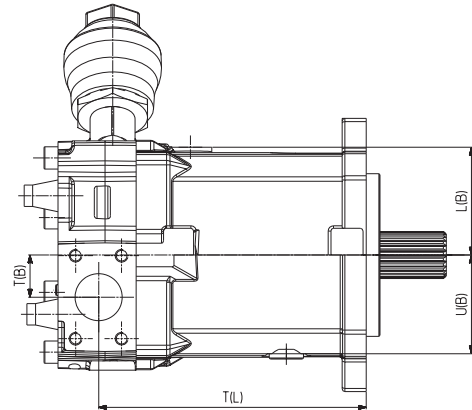
View 1



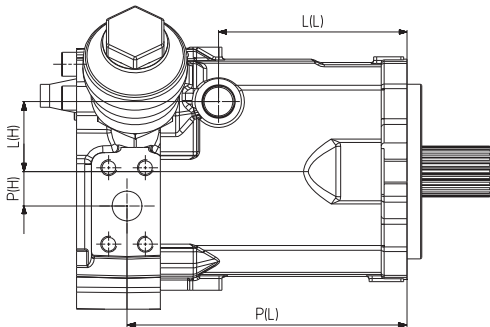
View 2



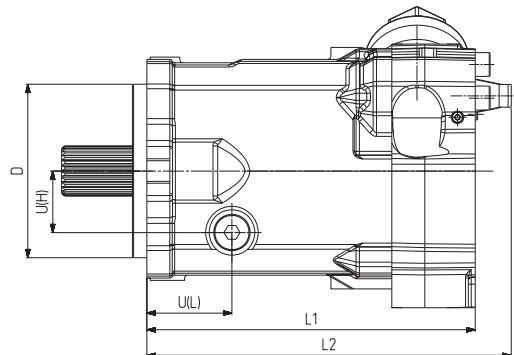
View 3



View 4



View 5



# Dimensions

Single pumps HPR-02 for TL2, LEP, ETP

The dimensioning is shown with one exemplary pump configuration. The external dimensions are determined by the individual configuration, including the choice of a controller, direction of rotation, optional SPU and the settings of the pump. Further information can be found in the specific sections of this datasheet, in particular the sections <<Torque transmission. Mounting flange>> and <<Torque transmission. Drive shaft>>.

## Dimensions of the pump without controller

Rated size	105	105	135	210	280	280
In accordance with ISO 3019	-1	-2	-1	-1	-1	-2
D	127	125	125.4	165.1	165	224
L1	262	272	284.5	348	403	403
L2	301	311	323.5	387	442	442
L3	108.9	118.5	82.8	138.5	168	168
H1	104.5	104.5	111.5	134.5	152	152
H2	134	134	144	144.3	200.7	238
H3	104.5	104.5	104	135	135	144.5
B1	194.5	194.5	214.8	266.3	314.5	314.5
B2	208	208	256.5	269	272	272
B3	118	116	106.7	102.4	119.5	120.2
B4	64	64	64	64	82.5	82.5

## Ports

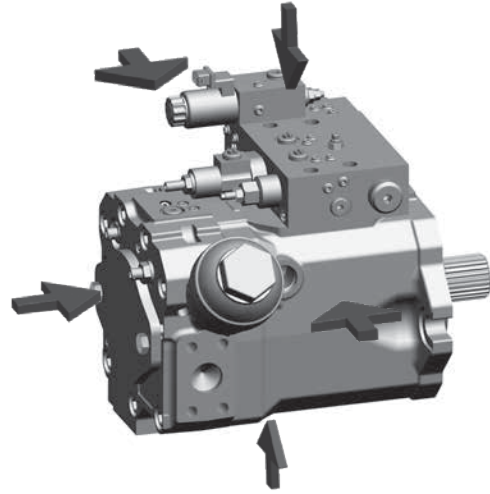
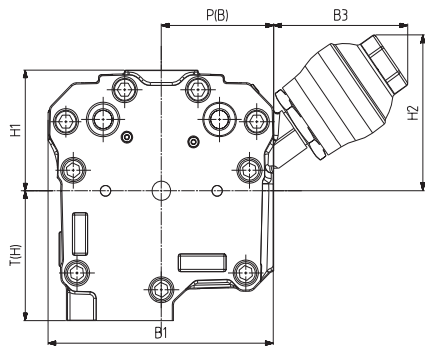
Rated size	105	105	135	210	280	280
P	1"	1"	1 ¼"	1 ½"	1 ½"	1 ½"
P(L)	218	228	243.5	295	344.5	344.5
P(H)	26	26	30	27	46	46
P(B)	100	100	107	144.5	154.1	155.5
T	2"	2"	2"	3"	3 ½"	3 ½"
T(L)	227	237	249.5	298	344.5	344.5
T(H)	104	104	120	149	167	167
T(B)	25	25	39.5	27	44	57
L/U	M22x1.5	M22x1.5	M22x2	M27x2	M33x2	M33x2
L(L)	142	152	164	191	215.5	215.5
L(H)	53	53	61	97.5	80.5	80.5
L(B)	92.5	92.5	101	128	129.5	144.9
U(L)	72	82	74.5	83	109	109
U(H)	54	54	54	60	68	68
U(B)	85	85	92	118	159.5	131.3
E*	M14x1.5	M14x1.5	M14x1.5	M14x1.5	M14x1.5	M14x1.5
E(L)	240.8	250.8	249.5	303	375	346
E(H)	135.6	135.6	142.6	165.6	183.1	183.1
E(B)	15	15	16	20	20	20

\*) ETP-controller only: External supply pressure

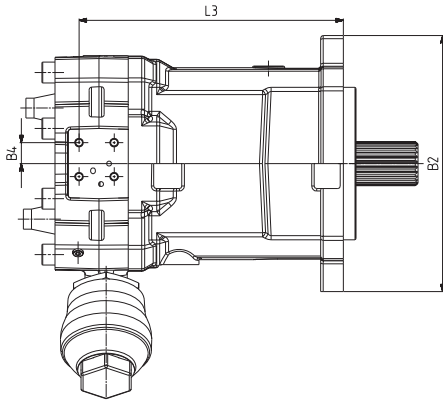
# Dimensions

Single pumps HPR-02 for TL2, LEP, ETP

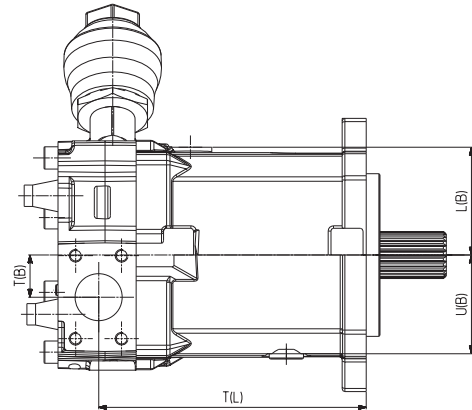
View 1



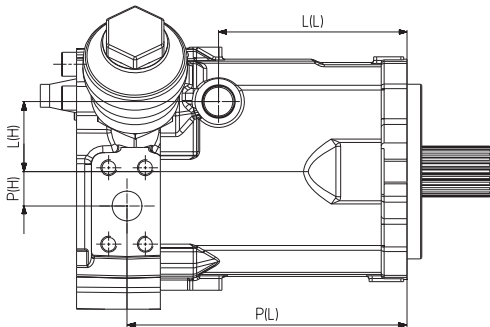
View 2



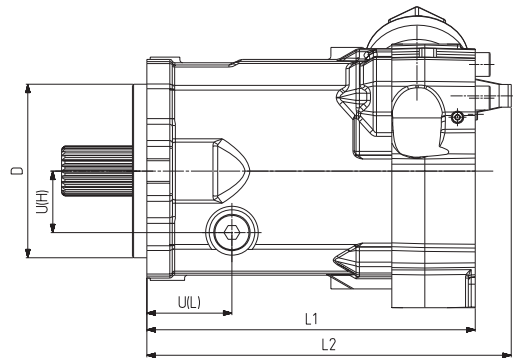
View 3



View 4



View 5



# Dimensions

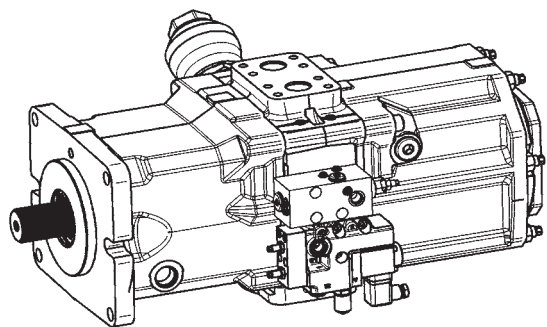
## Double pumps and plug-in pumps

Double pumps consist of two HPR rotating groups, arranged back-to-back to a common port plate housing, sharing one common suction port. They are thus more compact than tow standard pumps in a tandem configuration. Compared to a pump of equal rated size with a single rotating group, double pumps offer higher speed and more narrow radial dimensions. They also provide a PTO option. The position of the ports, controllers and SPU differs from the previously shown pumps. Further details on request.

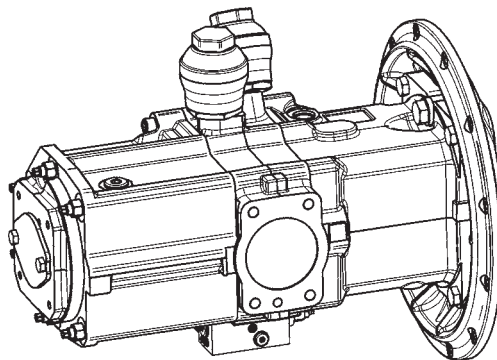
### Dimensions of the pump without controller

Rated size	105D	105D	105D	165D	165D
Circuit	Single circuit pump		Single or dual pump		
Flange	SAE C with 4 additional bolt holes	Plug-in version	SAE 3 / SAE 4 bolt holes	SAE D with 4 additional	SAE 3
D1(mm)	127	216	SAE J617a	152.4	SAE J617a
D2(mm)	-	-	SAE J617a	-	SAE J617a
D3(mm)	-	-	SAE J617a	-	SAE J617a
B1(mm)	124	124	124	147	147
B2(mm)	120	120	120	136	136
B4(mm)	-	222	222	162.3	162.3
H1(mm)	107	141	141	116	116
H2(mm)	107	141	141	116	116
H3(mm) (105:Le 165 E1L)	138	144	144	170	170
H4(mm)	-	137	137	255	255
H5(mm) port P	75	75	75	80	80
H6(mm) port T	38	38	38	0	0
H7(mm)	195	196	196	260	260
L1(mm)	474	358	450	587.6	587.6
L2(mm)	478	376	468	601	625
L3(mm)	61.3	171	79	74.6	50.1
L4(mm)	232	116	208	286.1	310.6
P (SAE)	2 x 1"	2 x 1"	2 x 1"	2 x 1" 1/4"	2 x 1" 1/4"
T (SAE)	1 x 3"	1 x 3"	1 x 3"	1 x 4"	1 x 4"
L	M22x1.5	M22x1.5	M22x1.5	M27x2	M27x2
U	M22x1.5	M22x1.5	M22x1.5	M27x2	M27x2

### Double pump with SAE J744 flange



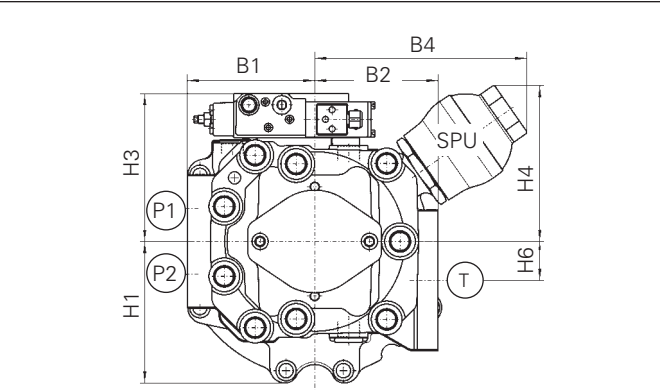
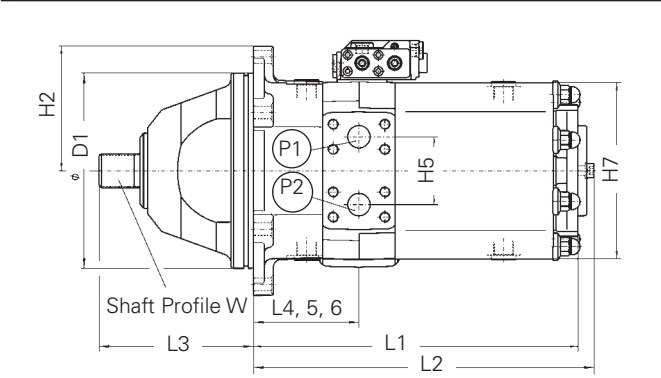
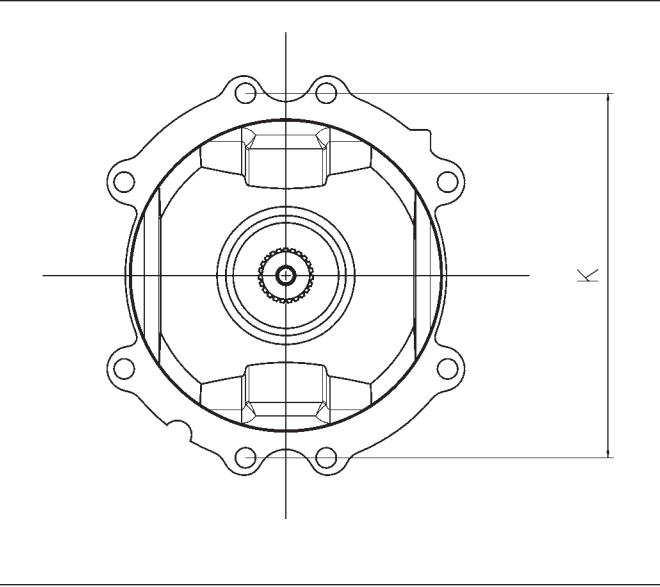
### Double pump with SAE J617a flange



# Dimensions

Double pumps and plug-in pumps

## Plug-in flange

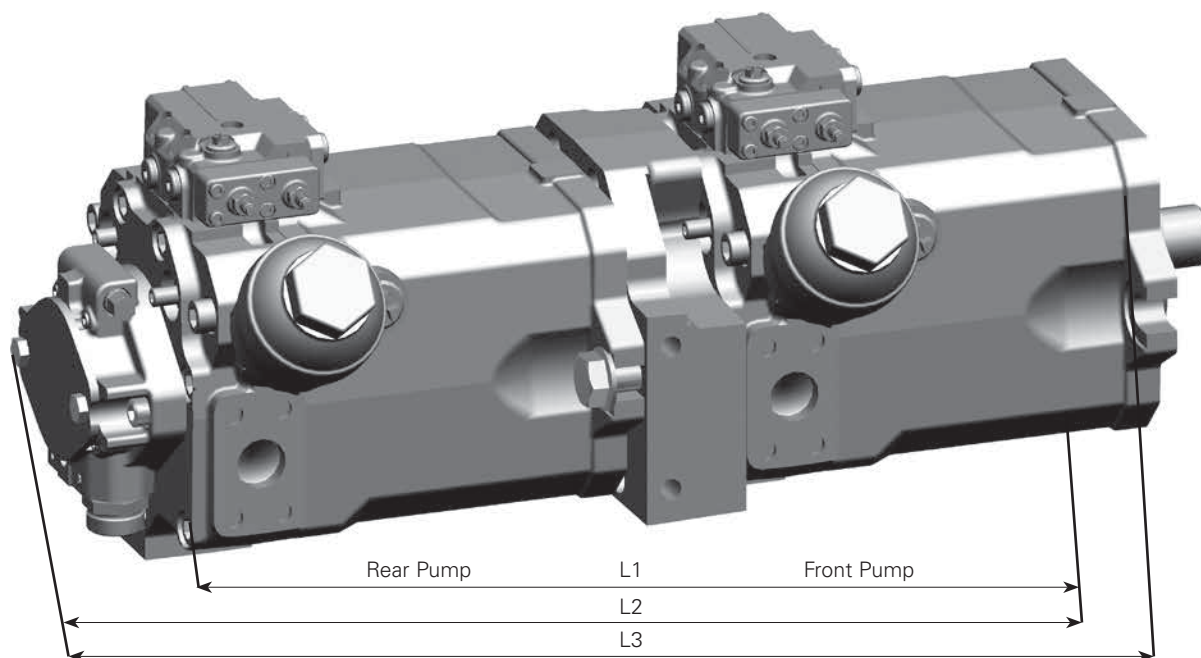


# Dimensions

## Multiple pumps

Multiple pumps are created by connecting individual pump units in series, with the pumps arranged by capacity. Positioning the gear pump(s) at the end of the tandem ensures optimum space utilization, output allocation and load distribution. The following table is based on the attached gear pump acting as a pilot pressure pump for the control circuit.

### Multiple pump HPR-HPR-02



### Overall Length of Multiple Pump HPR-HPR

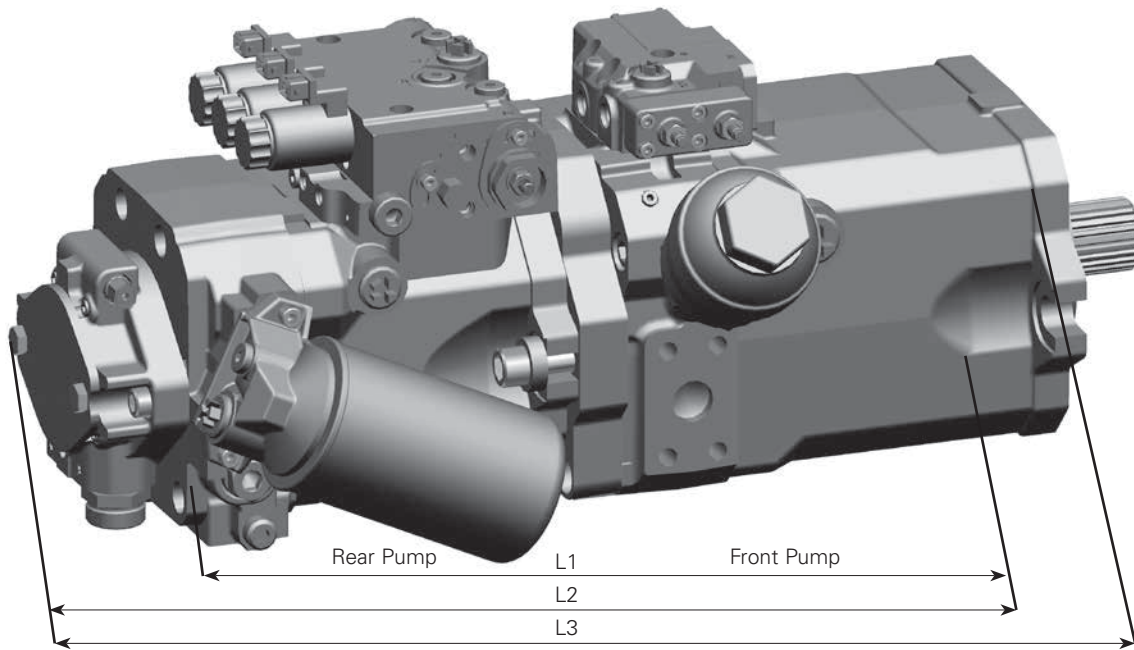
Rated Size	Rear Pump	HPR 55	HPR 75	HPR 105	HPR 135	HPR 165	HPR 210	HPR 280
Front pump	Charge pump	16 cc/rev	22.5 cc/rev	22.5 cc/rev	22.5 cc/rev	38 cc/rev	38 cc/rev	38 cc/rev
HPR 55	L1	488	-	-	-	-	-	-
	L2	548	-	-	-	-	-	-
	L3	602	-	-	-	-	-	-
HPR 75	L1	500	511	-	-	-	-	-
	L2	565	576	-	-	-	-	-
	L3	620	631	-	-	-	-	-
HPR 105	L1	520	531	562	-	-	-	-
	L2	585	596	627	-	-	-	-
	L3	640	651	682	-	-	-	-
HPR 135	L1	536	547	578	619	-	-	-
	L2	596	612	643	684	-	-	-
	L3	671	667	698	759	-	-	-
HPR 165	L1	579	591	621	679	728	-	-
	L2	754	766	796	854	903	-	-
	L3	829	841	871	929	978	-	-
HPR 210	L1	600	612	642	701	749	751	-
	L2	775	787	817	876	924	926	-
	L3	850	862	892	951	999	1001	-
HPR 280	L1	669	680	711	727	775	790	845
	L2	844	855	886	902	950	965	1020
	L3	919	930	961	977	1025	1040	1095

# 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.

### Multiple pump HPR-HPV-02



### Overall length of multiple pump HPR-HPV-02

Rated Size	Rear Pump	HPR 55	HPR 75	HPR 105	HPR 135	HPR 165	HPR 210	HPR 280
Front pump	Charge pump	16 cc/rev	22.5 cc/rev	22.5 cc/rev	22.5 cc/rev	38 cc/rev	38 cc/rev	38 cc/rev
HPR 55	L1	493	-	-	-	-	-	-
	L2	553	-	-	-	-	-	-
	L3	607	-	-	-	-	-	-
HPR 75	L1	504	521	-	-	-	-	-
	L2	569	586	-	-	-	-	-
	L3	624	641	-	-	-	-	-
HPR 105	L1	525	542	567	-	-	-	-
	L2	590	607	632	-	-	-	-
	L3	645	662	687	-	-	-	-
HPR 135	L1	541	558	583	623	-	-	-
	L2	601	623	648	688	-	-	-
	L3	676	678	703	763	-	-	-
HPR 165	L1	584	601	626	683	715	-	-
	L2	759	776	801	858	890	-	-
	L3	834	851	876	933	965	-	-
HPR 210	L1	605	622	647	704	736	749	-
	L2	780	797	822	879	911	924	-
	L3	855	872	897	954	986	999	-
HPR 280	L1	674	691	716	730	762	788	834
	L2	849	866	891	905	937	963	1009
	L3	924	941	966	980	1012	1038	1048



# Modular system features

The HPR is based on a modular system and offers the features listed below. This enables our distribution partners to configure the product according to your requirements. The modular system is expanded continuously. Please ask our sales department for the latest characteristics.

- Size
- Vmax
- 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 gear pump suction
- PTO-mounting on internal gear pump
- Port threads
- Silencer SPU
- Type of control
- Maximum pressure setting
- Electrical voltage
- Solenoid connector
- Arrangement of solenoid connector
- Power settings for TL-regulator
- Tamper proof for control
- Swash speed
- Drain port U + L
- Surface treatment
- Name plate





Eaton  
Hydraulics Group USA  
14615 Lone Oak Road  
Eden Prairie, MN 55344  
USA  
Tel: 952-937-9800  
Fax: 952-294-7722  
[www.eaton.com/hydraulics](http://www.eaton.com/hydraulics)

Eaton  
Hydraulics Group Europe  
Route de la Longeraie 7  
1110 Morges  
Switzerland  
Tel: +41 (0) 21 811 4600  
Fax: +41 (0) 21 811 4601

Eaton  
Hydraulics Group Asia Pacific  
Eaton Building  
No.7 Lane 280 Linhong Road  
Changning District, Shanghai  
200335 China  
Tel: (+86 21) 5200 0099  
Fax: (+86 21) 2230 7240