# Pump elements types MPE and PE for radial piston pumps

1. General

These pump elements deliver lubricating pressure fluid (primarily hydraulic oil) and generate simultaneously a pressure opposing the working resistance of an actuator to which it is connected. It is the basic module of all HAWE radial piston pumps which is also available as individual unit. This way, by utilizing appropriate drive components (rocker arm for manual operation, eccenters for drive shafts) high pressure pumps can be designed which will be compatible with the local operating needs and space requirements. The most common drive is a motor via a rotating shaft. The rotary motion is converted to a reciprocating movement via a roller bearing mounted eccentrically on the motor shaft, and a return spring. The outer race of the bearing acts directly on the back of the piston. The delivery flow is controlled by automatic suction and pressure valves peened in the housing. The direction of delivery will not be changed if the sense of rotation of the shaft is altered. The pump element can be used for all kind of applications as long as the pressure ratings are observed (see table below). Most common applications are:

Machine tools where several pump elements are arranged around a power take-off shaft and used for supplying pressure oil to the clamping devices for tools and machine components (tailstock, columns, table, spindle box) or to the jigs used for clamping work; laboratory-type table presses for compression and tensile test samples; e.g. pump element driven via a hand lever, etc.

Oil

Suction side

Eccentricity

To the pressure line

Pump element

1.2
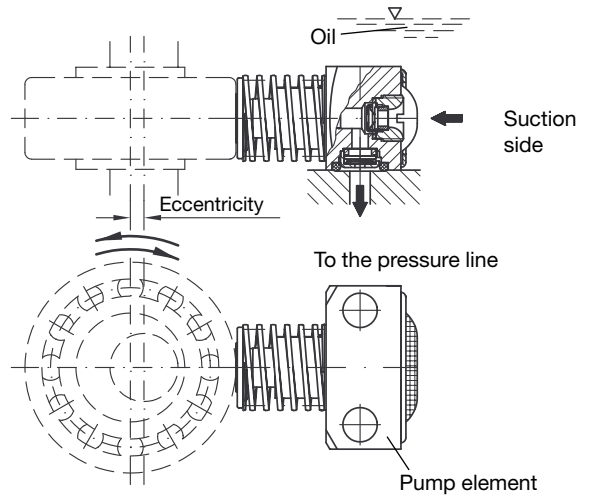
2. Available versions

Coding	Piston displacement cm^3	Delivery flow lpm [1]		max. perm. operating pressure [3] bar	Piston force in stroke dir. per 1 bar (N)	Power required per 100 bar (kW) [2]		Mass (weight) g
		1450 rpm	2850 rpm			1450 rpm	2850 rpm	
MPE 4	0.062	0.09	0.18	700	1.26	0.018 k	0.033 k	
MPE 5	0.096	0.14	0.27	700	1.96	0.026 k	0.050 k	
MPE 6	0.14	0.2	0.4	700	2.83	0.036 k	0.073 k	
MPE 7	0.19	0.28	0.54	700	3.85	0.050 k	0.10 k	90
MPE 8	0.25	0.36	0.71	700	5.03	0.070 k	0.13 k	
MPE 9	0.31	0.45	0.89	550	6.36	0.087 k	0.17 k	
PE 6	0.21	0.3	0.6	700	2.83	0.055 k	0.12 k	
PE 7	0.29	0.4	0.8	700	3.90	0.07 k	0.16 k	
PE 8	0.38	0.5	1.0	700	5.03	0.09 k	0.18 k	
PE 10	0.59	0.8	1.6	560	7.85	0.15 k	0.29 k	
PE 12	0.84	1.2	2.4	390	11.3	0.22 k	0.44 k	300
PE 13	1.0	1.45	2.8	330	13.3	0.26 k	0.52 k	
PE 14	1.15	1.7	3.3	290	15.4	0.31 k	0.63 k	
PE 15	1.32	1.9	3.7	250	17.7	0.35 k	0.70 k	
PE 16	1.52	2.2	4.2	220	20.0	0.43 k	0.84 k	

[1] For full stroke h_{max} and $\eta_{Vol.} \approx 0.95$
   h_{max} = 5 mm for type MPE and 7.6 mm for type PE

[2] k = Multiplication factor for number of cylinders and non-uniformity (sec. 5)

L_h - Service life in h
$c_{dyn.}$ - Dynamic load capacity of the bearing in N
$h_{mechan.}$ - Mechanical efficiency (ca. 0.85)
e - Eccentricity in mm
V - Displacement in cm^3
p - Operating pressure in bar
n - Speed in rpm

[3] The max. permissible operating pressure refers to the pump element only. But the load on the bearing is usually the main parameter for the service life when the pump elements are combined with ball bearings. The perm. shaft load must be observed as well.

Bearing service life

$$L_h = \left(\frac{\pi \cdot c_{dyn.} \cdot \eta_{mechan.} \cdot e}{50 \cdot V \cdot p} \right)^3 \cdot \frac{10^6}{n \cdot 60}$$

Operating pressure at desired bearing service life

$$p = \frac{\pi \cdot c_{dyn.} \cdot \eta_{mechan.} \cdot e}{1.96 \cdot V \cdot \sqrt[3]{L_h \cdot n}}$$

3. Further data

Design	Valve controlled pump element
Installed position	Any The inlet of the pump element's suction valve must be completely below the fluid level to prevent any air to be sucked in. The same applies to piston and bearing to ensure permanent lubrication during operation.
Max. operating pressure	p_{max} = 700 bar (the efficiency will drop slightly at pressure below 20 bar)
Static overload capacity	ca. 2 x p_{max}
Degree of effectiveness	$\eta_{Vol} \approx 0{,}95$
Pressure fluid	Hydraulic fluid acc. to DIN 51524 part 1 to 3; 10 ... 68 mm²/sec at 40°C (ISO VG 10 to 68 conforming DIN 51 519)

Viscosity range: (starting viscosity)

          Type MPE approx. 4 ...800 mm²/sec

          Type PE   approx. 4 ...1500 mm²/sec

Optimum operating viscosity: approx. 10 ... 500 mm²/sec

Any viscosity below 10 mm²/sec and above 500 mm²/sec will reduce the efficiency

Also suitable for biological degradable pressure fluids types HEPG (Polyalkylenglycol) and HEES (Synth. Ester) at service temperatures up to approx. +70 °C.

Temperature	Ambient: approx. -40 ... +80 °C Fluid: -25 ... +80°C, Note the viscosity range! Permissible temperature during start: -40°C (Note start-viscosity!), as long as the service temperature is at least 20K higher for the following operation. Biological degradable pressure fluids: Note manufacturer's specifications. By consideration of the compatibility with seal material not over +70 °C.
Perm. piston stroke frequency	min. 200 /min max. 2850 /min The volumetric efficiency will drop significantly when operated below this min. rating. On the other side the efficiency will drop as well when operated above the max. rating due to suction problems especially with smaller piston diameters
Special versions	Versions for low viscosity (e.g. HFA, or conditioned water) Surface gas nitrided Type PE 6(7,8,10,12)-HFA These versions show a reduced efficiency due to the low viscosity. Order example: PE 10-HFA For dimensions, see standard versions Versions with seal material FKM Type MPE 4...9-PYD, Type PE 6...16-PYD Order example: MPE 4-PYD For dimensions, see standard versions Versions with seal material EPDM (e.g. brake fluid or Skydrol) Type MPE 4...9-AT, Type PE 6...16-AT Order example: PE 12-AT For dimensions, see standard versions Versions with additional suction pipe (utilized e.g. with type HC(W) acc. to D 7900 in vertical orientation) Type MPE 4...9-HC complete, Type PE 6...16-HC34 complete, Type PE 6...16-HC32 complete Order example: MPE 6-HC complete Versions with additional suction pipe (utilized e.g. with type HKL(W) acc. to D 7600-3L) Type PE 6...16-HKL complete Order example: PE 12-HKL complete Version with barrel type housing for mounting in holes Type MPER 4...9 Order example: MPER 5

4.   Dimensions of units   All dimensions in mm . subject to change without notice.
### 4.1   Standard version

Type MPE and PE

The max. permissible piston stroke must not be exceeded, especially reference dimension L, to prevent damage of the suction valve at the bottom dead center..
The distance has to be recalculated when other roller bearings with differing diameter D are employed

$$L \pm 0,1 = e_{max} + \frac{D}{2} + l \quad \text{(mm)}$$

Type	Eccenter bearing DIN 628	ØD	Distance L ± 0.1
MPE	3204	47	46
PE	3205	52	60
PE	3206	62	65
PE	3207	72	70
PE	3208	80	74
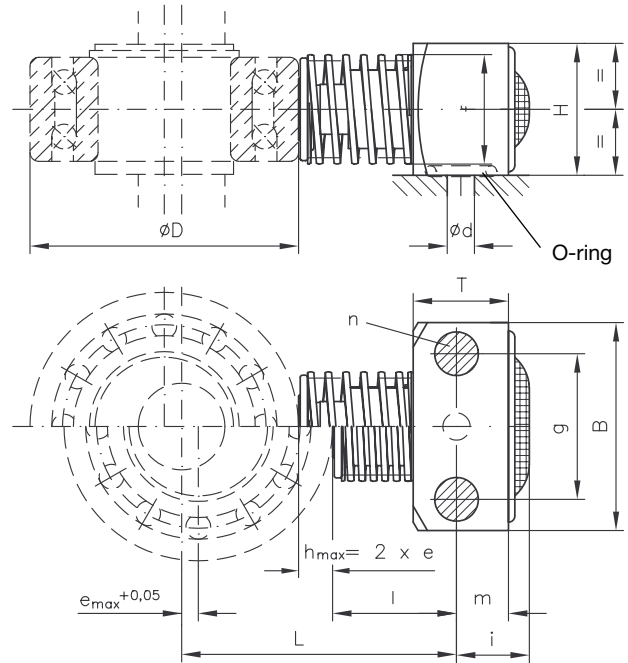
Type	B	H	T	Ød	e_{max}	f	g±0.1	i	l	m	n	O-ring
MPE 4...9	32	$19.7_{-0.04}$	16	3	2.5	18.5	24	11	20	8	M6-8.8 (9Nm)	8x2 NBR 90 Shore
PE 6...16	50	31.7± 0.02	21.9	6	3.8	26	35	16	30.2	11.5	M10-8.8 (48Nm)	12.37x2.62 NBR 90 Shore

4.2   Special finishes

Type MPE..- HC complete and PE..-HC (HKL) complete

May be installed to the left and to the right
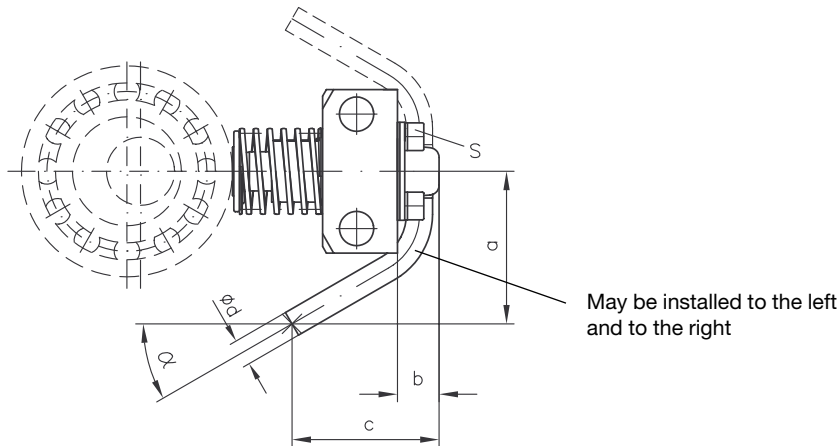
For missing dimensions, see standard version in sect. 4.1.

Type	a	b	c	Ø d	α	s
MPE 4...9-HC compl.	74	8	39	6x0,8	45	4xSkt.-head screw M3x6
PE 6...16-HC34 compl.	70	13	100	8x1	30	4xSkt.-head screw M5x10
PE 6...16-HC32 compl.	80	20	55	12x1	60	Skt.-head screw 2xM5x16 2xM5x25
PE 6...16-HKL compl.	47	13	45	8x1	45	4xSkt.-head screw M5x10

$e_{max}=2.5^{+0.05}$

Retainer plate

17.6

9

1.1

ϕd

$\phi 12.5$

$\phi 20$

$\phi 21$

$h_{max}= 2 \times e$

$\phi 47$

$30^{+0.1}$

56

O-ring 17.17x1.78 AU 90 Shore

$17.6^{+0.1}$

12.2

8.6

5

max. 1

$\phi 4.5$

Retainer plate

max.1.8

$60°$

$\phi 22$

$\phi 18.5^{+0.1}$

$60°$

$90°$

Rt=16

$\phi 14$

$60°$

$\phi 20.6$

$\phi 21^{H7}$

Rt=16

Rt=16

Rt=16

Flat seal
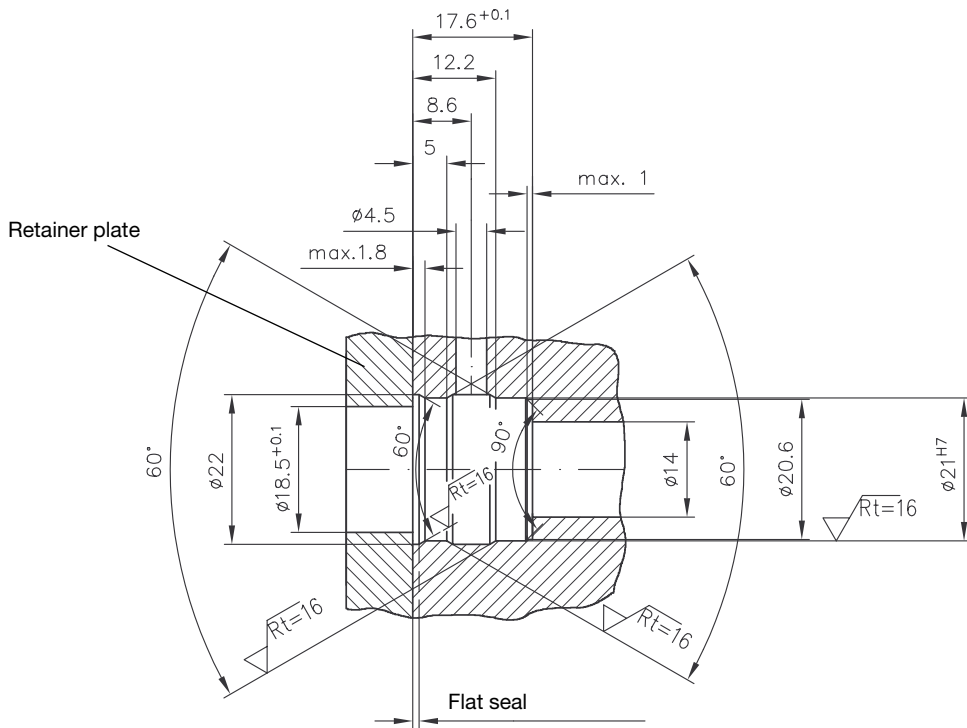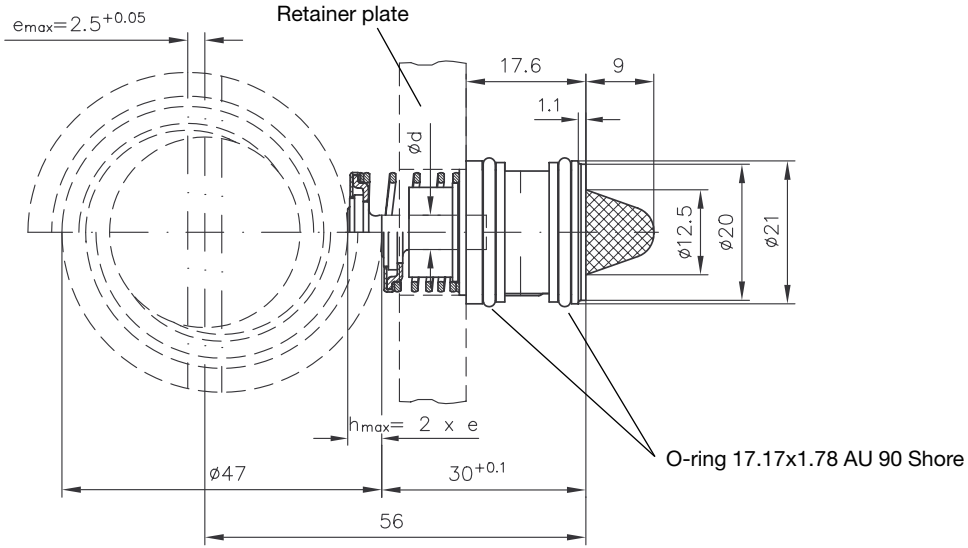
5. Cylinder arrangement

	1 cylinder	2 cylinders	3 cylinders	5 cylinders 6 cylinders 7 cylinders
Illustration				
Calculation factor k	3	1.5	1	1