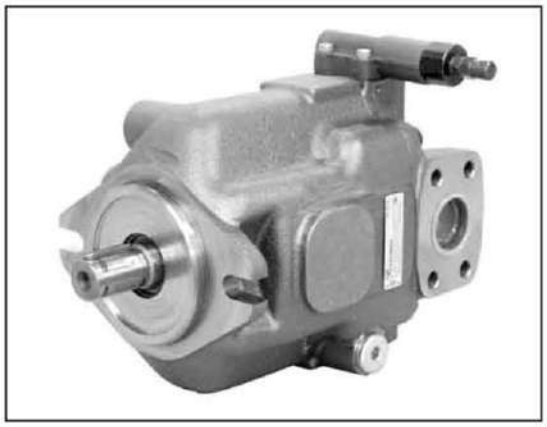
Part number:

HYDROMA HYDRAULICKÉ SYSTÉMY

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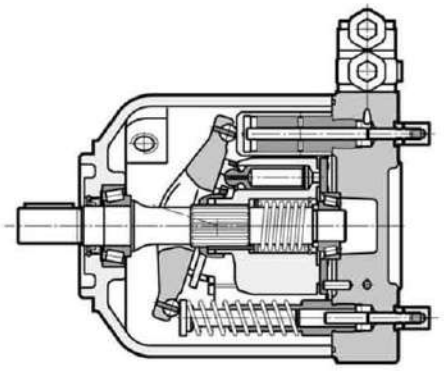
16 100/110 ED



VPPM

VARIABLE DISPLACEMENT AXIAL-PISTON PUMPS

OPERATING PRINCIPLE



— The VPPM pumps are variable displacement axial-piston pumps with variable swash plate, suitable for applications with open circuits.

— They are available in three different frame sizes with maximum displacements up to 29, 46, 73 and 87cm³/rev.

— The pump flow rate is proportional to the rotation speed and to the angle of the swash plate, which can be continuously modulated. The maximum and minimum angle can be limited mechanically via suitable regulating screws.

— The pumps feature medium-high working pressures (up to 280 bar constant and 350 bar peak). Thanks to some particular design features, these pumps are able to bear high axial and radial loads on the shaft.

— They are usually supplied with a ISO 3019/2 mounting flange, with the exception of the rear and intermediate pumps, if multiple pumps, which are only available with a SAE J744 2-holes flange and a SAE J744 splined shaft (see paragraph 16).

— They are available with seven different types of regulating control, each according to the application needs (see paragraphs 8 ÷ 14).

TECHNICAL SPECIFICATIONS

PUMP SIZE		**029**	**046**	**073**	**087**
Maximum displacement	cm³/rev	29	46	73	087
Max. delivery pressure (relative): - continuous - intermittent (**NOTE 1**) - peak	bar	280 315 350			250 280 315
Maximum rotation speed at maximum displacement (**NOTE 2**)	rpm	3000	2600	2200	1850
Rotation direction		clockwise or anticlockwise (looking at the drive shaft)			
Hydraulic connection		SAE flange fittings (see paragraph 24)			
Type of mounting (single pump)		ISO 3019/2 flange			
Mass (empty single pump)	kg	18	24	33	33

Ambient temperature range	°C	-15 / +70
Fluid temperature range	°C	-25 / +80
Fluid viscosity range	see paragraph 2.2	
Fluid contamination degree	see paragraph 2.3	
Recommended viscosity	cSt	15 ÷ 35

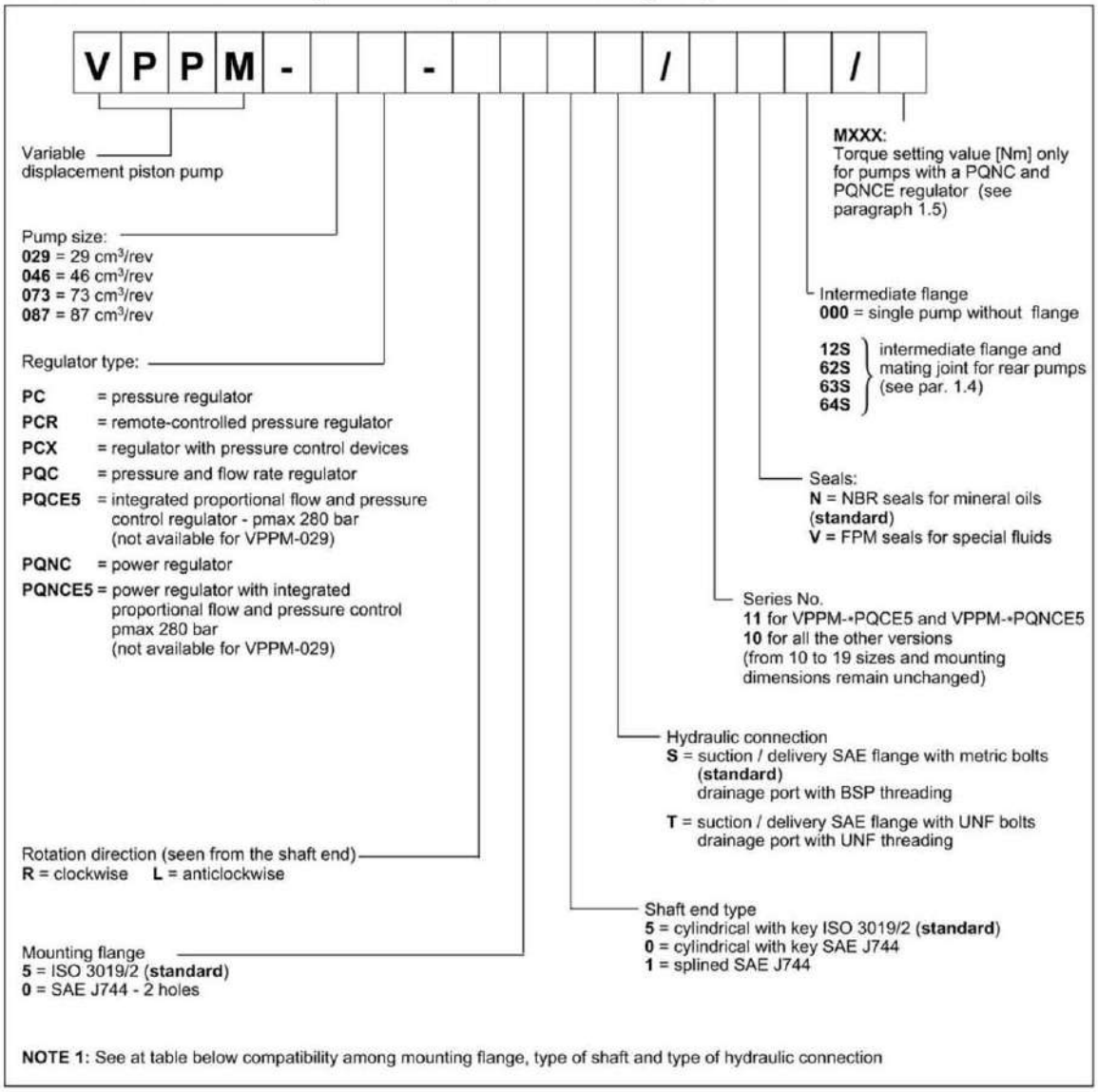
HYDRAULIC SYMBOL



NOTE 1: Allowed intermittent duty pressures with a duration equal to 6 seconds per minute.
NOTE 2: Values referring to a zero bar pressure (relative) on the suction port.

1 - IDENTIFICATION CODES

1.1 - Identification code for single and front pumps with a through output shaft



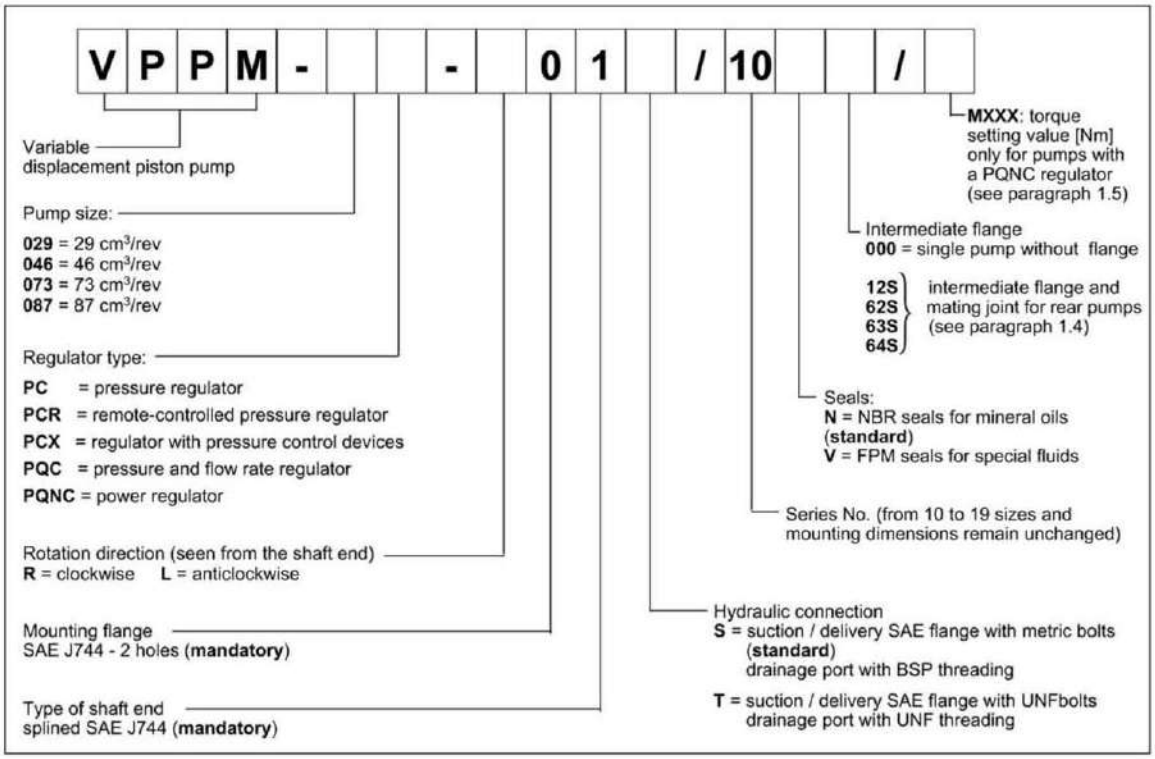
NOTE 1: See at table below compatibility among mounting flange, type of shaft and type of hydraulic connection

Compatibility among mounting flange, type of shaft and type of hydraulic connection

FLANGE CODE	SHAFT CODE			HYDRAULIC CONNECTION CODE	
	5	0	1	S	T
5	yes	no	no	yes	no
0	no	yes	yes	yes	yes

VPPM pumps are supplied as standard with mechanical minimum and maximum displacements limit controls.
These devices are not available for front and intermediate pumps with a through output shaft.

1.2 - Identification code for intermediate pumps with a through output shaft and rear pumps



1.3 - Identification code for double pumps

identification code + identification code
1st pump 2nd pump

1.4 - Identification code for intermediate flange and mating joint for pumps with a through output shaft

According to the pump to be coupled, it is necessary to define, into the identification code, the flange and mating joint type to be applied to the pump with a through output shaft.
The following table states the flange and joint reference code according to the different pump types to be pulled, stating also the possible coupling combinations.

Identification code for intermediate flange + mating joint	intermediate flange	mating joint	pump to be mated	possible combinations for VPPM pump with a through output shaft			
				29	46	73	87
12S	SAE J744 2 holes - type "A"	SAE J744 splined 16/32 D.P. - 9T	GP 2 external gear	yes	yes	yes	yes
62S	SAE J744 2 holes - type "B"	SAE J744 splined 16/32 D.P. - 13T	GP 3 external gear VPPM-029	yes	yes	yes	yes
63S	SAE J744 2 holes - type "B"	SAE J744 splined 16/32 D.P. - 15T	VPPM-046	no	yes	yes	yes
64S	SAE J744 2 holes - type "C"	SAE J744 splined 12/24 D.P. - 14T	VPPM-073	no	no	yes	yes
64S	SAE J744 2 holes - type "C"	SAE J744 splined 12/24 D.P. - 14T	VPPM-087	no	no	no	yes

NOTE: For the flange type and dimensions see paragraph 20.

1.5 - Standardized torque values for PQNC and PQNCE regulators

ELECTRICAL MOTOR 4 POLES		VPPM-029		VPPM-046		VPPM-073		VPPM-087	
Power [kW]	N [rpm]	**torque [Nm]**	p regulation start. [bar]	**torque [Nm]**	p regulation start. [bar]	**torque [Nm]**	p regulation start. [bar]	**torque [Nm]**	p regulation start. [bar]
4	1425	**26 (#)**	46	**-**	-	**-**	-	**-**	-
5,5	1440	**36 (#)**	62	**36 (#)**	41	**-**	-	**-**	-
7,5	1450	**50**	84	**50 (#)**	56	**-**	-	**-**	-
9,2	1460	**60**	103	**60 (#)**	68	**60 (#)**	44	**-**	-
11	1455	**72**	124	**72**	82	**72 (#)**	53	**-**	-
15	1460	**98**	168	**98**	111	**98 (#)**	72	**-**	-
18,5	1460	**-**	-	**122**	137	**122**	89	**-**	-
22	1465	**-**	-	**144**	163	**144**	105	**-**	-
30	1470	**-**	-	**-**	-	**196**	143	**196**	126
37	1470	**-**	-	**-**	-	**240**	175	**240**	156
45	1470	**-**	**-**	**-**	**-**	**-**	**-**	**293**	190
55	1475	**-**	**-**	**-**	**-**	**-**	**-**	**356**	231

(#) With this adjustment value the pump is in venting position with a pressure lower than 280 bar.

1.6 - Identification examples

a) 29 cm^3/rev single pump with pressure regulator - ISO mounting flange and shaft (standard)
VPPM-029PC-R55S/10N000

b) 46 cm^3/rev single pump with pressure regulator with remote control - SAE mounting flange and SAE splined shaft
VPPM-046PCR-R01S/10N000

c) 73 cm^3/rev single pump with pressure control devices - ISO mounting flange and shaft (standard)
VPPM-073PCX-R55S/10N000

d) 46 cm^3/rev single pump with integrated proportional flow and pressure control regulator - pressure regulation up to 280 bar
VPPM-046PQCE5-R55S/11N000

e) 46 cm^3/rev single pump with power regulator set at 18,5 kW at 1460 rpm (torque = 122 Nm)
VPPM-046PQNC-R55S/10N000/M122

f) 73 cm^3/rev single pump with power regulator with integrated proportional flow and pressure control - power regulator set at 98 Nm - pressure regulation up to 280 bar
VPPM-073PQNCE5-R55S/11N000/M098

g) 73 cm^3/rev front pump with pressure regulator, ready to mate to a VPPM-029 pump
VPPM-073PC-R55S/10N62S

h) double pump made of:
- 46 cm^3/rev front pump with pressure and flow rate regulator
- 29 cm^3/rear pump with pressure regulator

VPPM-046PQC-R55S/10N62S + VPPM-029PC-R01S/N000

i) triple pump made of:
- 73 cm^3/rev front pump with flow rate and pressure regulator
- 46 cm^3/rev intermediate pump with pressure regulator
- 14 cm^3/rev rear gear pump group 2

VPPM-073PQC-R55S/10N63S + VPPM-046PC-R01S/10N12S + GP2-0140R01F/10N

2 - HYDRAULIC FLUID

2.1 - Fluid type

Use mineral oil based hydraulic fluids with anti-foam and antioxidant additives according to the DIN 51524 norm.
For use with other types of fluid, keep in mind the limitations shown in the following table or consult our technical department for authorization of use.

FLUID TYPE	NOTES
HFC (water glycol solution with proportion of water ≤ 40 %)	- The performance ratings shown in the table at page 1 must be reduced as follows: maximum continuous pressure: 170 bar max. rotation speed: VPPM-029 = 2100 rpm VPPM-046 = 2000 rpm VPPM-073 and VPPM-087 = 1700 rpm - The suction pressure must be lower than 0,8 absolute bars (-0,2 relative bars) - The fluid maximum temperature must be lower than 90°C.
HFD (phosphate esters)	Such fluids do not require any particular performance limitation. It is suggested to operate with continuous duty pressures not higher than 200 bars. - The fluid maximum temperature must be lower than 50°C.

2.2 - Fluid viscosity

The operating fluid viscosity must be within the following range:

minimum viscosity	10 cSt	referred to a maximum temperature of 90 °C for the drainage fluid
optimum viscosity	15÷ 35 cSt	referred to the operating temperature of the fluid in the tank
maximum viscosity	1000 cSt	limited only to the cold start-up of the pump, which has to be carried out with the plant at minimum pressure.

When selecting the fluid type, be sure that the true viscosity is within the range specified above at the operating temperature.

2.3 - Degree of fluid contamination

The maximum degree of fluid contamination must be according to ISO 4406:1999 class 20/18/15; therefore the use of a delivery or return filter with $\beta_{10\,(c)} \geq 75$ is suggested.

A degree of maximum fluid contamination according to ISO 4406:1999 class 18/16/13 is recommended for optimum endurance of the pump. Hence, the use of a filter with $\beta_{10\,(c)} \geq 100$ is recommended.

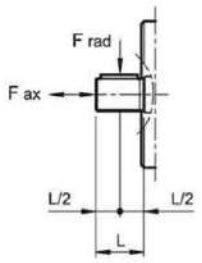
In the event that the filter is installed on the suction line, be sure that the pressure at the pump inlet is not lower than the values specified in the table of paragraph 3.

The suction filter must be equipped with a by-pass valve and, if possible, with a clogging indicator and should be oversized to avoid cavitation problems.

3 - PERFORMANCES (measured with mineral oil with viscosity of 36 cSt at 50°C)

PUMP SIZE		029	046	073	087
Maximum displacement	cm^3/rev	29	46	73	87
Maximum flow rate: - at 1500 rpm - at max rotation speed	l/min	43,5 87	69 119,6	109,5 160,5	131,9 162,6
Input pressure (relative): - min - max	bar	-0,2 24			
Max. delivery pressure (relative): - continuous - intermittent (**NOTE 1**) - peak		280 315 350			250 280 315
Max pressure on drainage port	bar	0,5			
Maximum power (Δp = 280 bar): - at 1500 rpm - at max rotation speed	kW	20,3 40,6	32,2 55,8	51,1 74,9	54,9 67,8
Max velocity at maximum displacement	rpm	3000	2600	2200	1850
Moment of inertia on the shaft	kgm^2	0,0020	0,0030	0,0080	0,0080
Max absorbed torque: - Δp = 100 bar - Δp = 280 bar	Nm	46,2 129,3	73,2 205	116,2 325,3	139,9 349,8
Max operating pressure with NBR seals - minimum - continuous - peak	°C	-25 80 100			
Max operating pressure with Viton seals - minimum - continuous - peak	°C	-10 110 125			
Oil volume in the pump body	lt	0,7	0,9	1,5	1,5

NOTE 1: Allowed intermittent duty pressures with a duration equal to 6 seconds per minute.

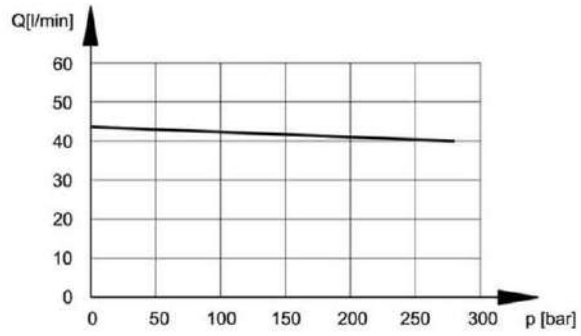


Loads on the shaft: - axial load (F_{ax}) - radial load (F_{rad})	N	1000 1500	1500 1500	2000 3000	2000 3000

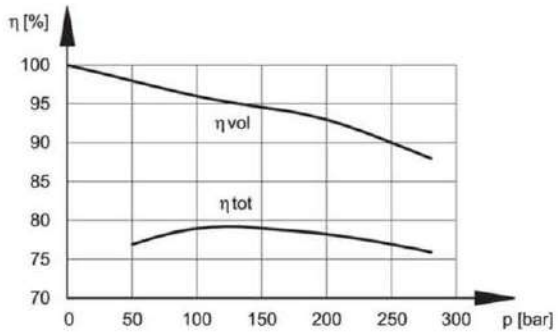
4 - VPPM-029 PUMP CHARACTERISTIC CURVES (values obtained with mineral oil with viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rpm.

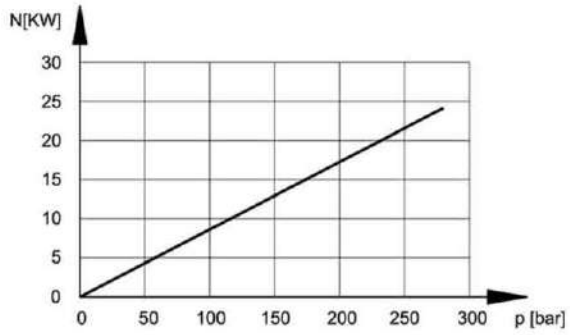
FLOW RATE/PRESSURE CURVES



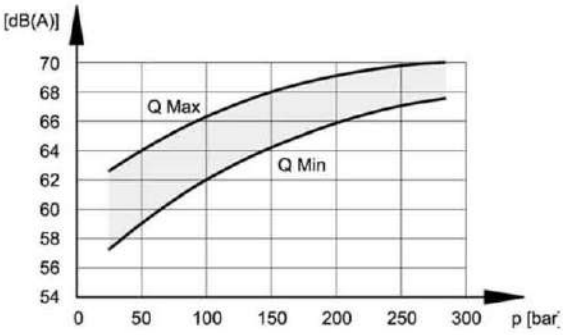
VOLUMETRIC AND TOTAL EFFICIENCY



ABSORBED POWER



NOISE LEVEL

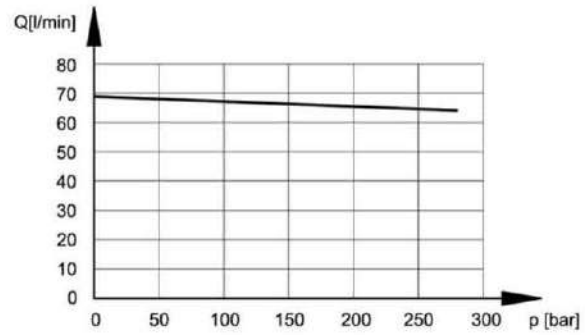


The noise pressure levels were measured in a semi-anechoic chamber, at a distance of 1 m from the pump and with a tolerance of ± 2 dB(A). The values shown must be reduced by 5 dB(A) if they are to be considered in a completely anechoic room.

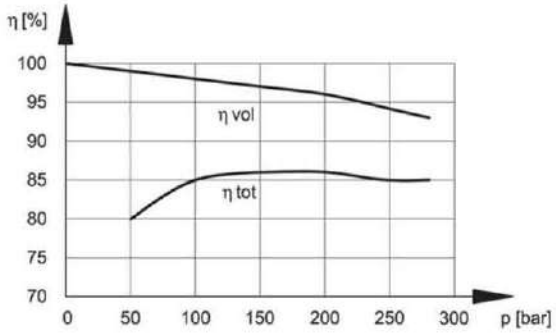
5 - VPPM-046 PUMP CHARACTERISTIC CURVES (values obtained with mineral oil with viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rpm.

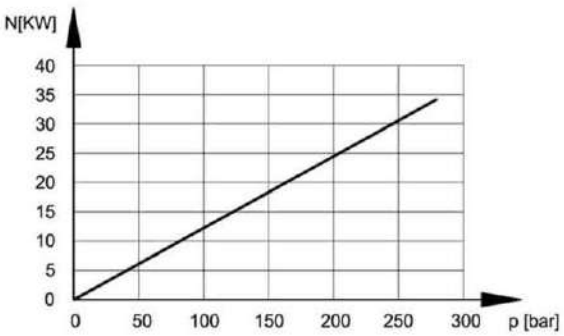
FLOW RATE/PRESSURE CURVES



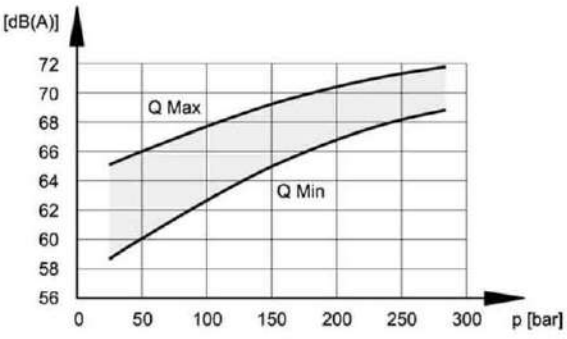
VOLUMETRIC AND TOTAL EFFICIENCY



ABSORBED POWER



NOISE LEVEL

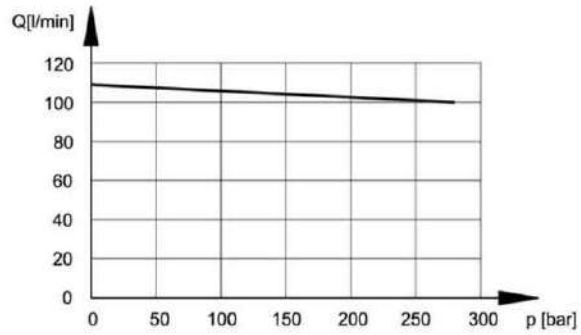


The noise pressure levels were measured in a semi-anechoic chamber, at a distance of 1 m from the pump and with a tolerance of ± 2 dB(A). The values shown must be reduced by 5 dB(A) if they are to be considered in a completely anechoic room.

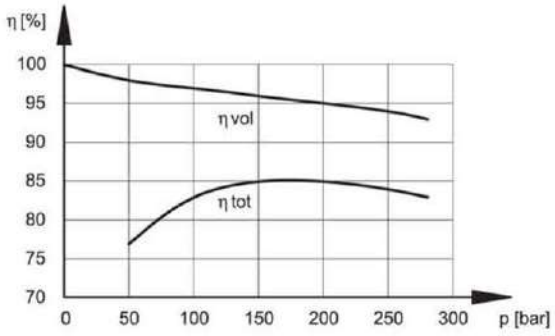
6 - VPPM-073 PUMP CHARACTERISTIC CURVES (values obtained with mineral oil with a viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rpm.

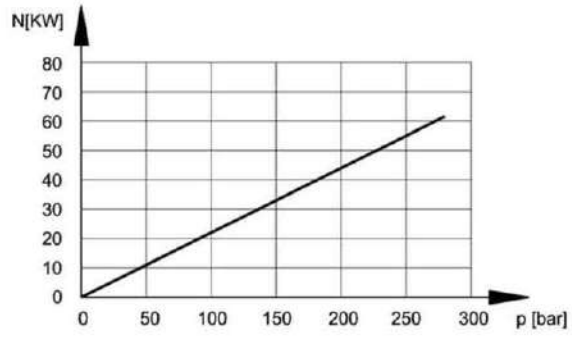
FLOW RATE/PRESSURE CURVES



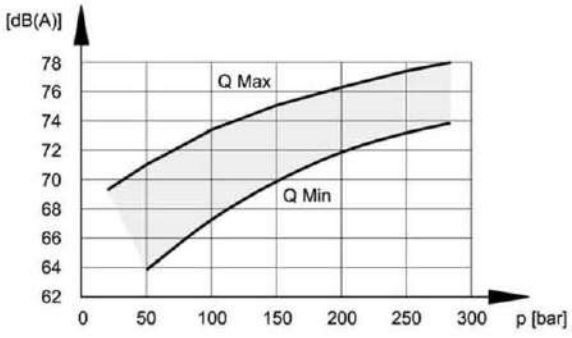
VOLUMETRIC AND TOTAL EFFICIENCY



ABSORBED POWER



NOISE LEVEL

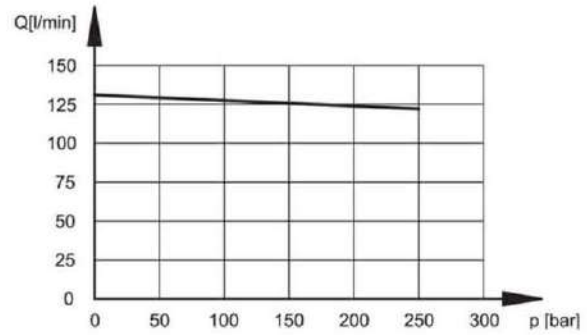


The noise pressure levels were measured in a semi-anechoic chamber, at a distance of 1 m from the pump and with a tolerance of ± 2 dB(A). The values shown must be reduced by 5 dB(A) if they are to be considered in a completely anechoic room.

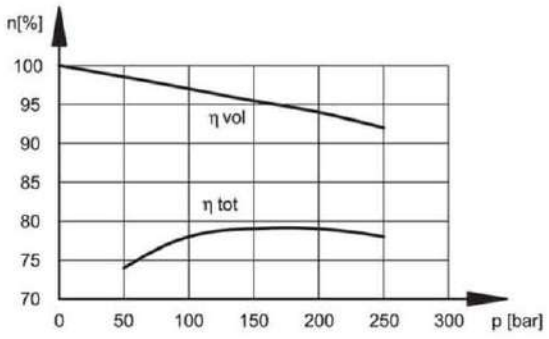
7 - VPPM-087 PUMP CHARACTERISTIC CURVES (values obtained with mineral oil with viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rpm.

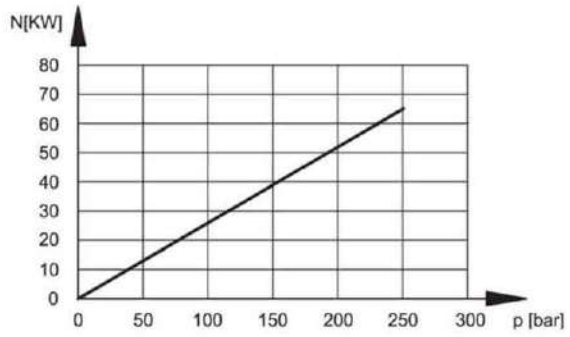
FLOW RATE/PRESSURE CURVES



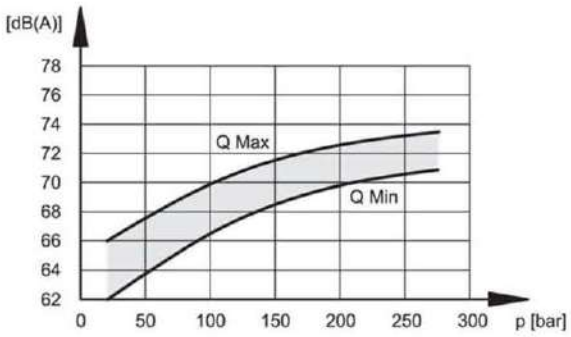
VOLUMETRIC AND TOTAL EFFICIENCY



ABSORBED POWER



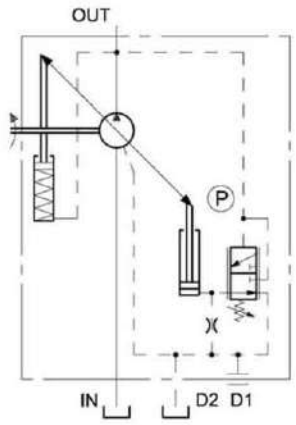
NOISE LEVEL



The noise pressure levels were measured in a semi-anechoic chamber, at a distance of 1 m from the pump and with a tolerance of ± 2 dB(A). The values shown must be reduced by 5 dB(A) if they are to be considered in a completely anechoic room.

8 - PRESSURE REGULATOR: PC

FUNCTIONAL DIAGRAM



The PC pressure regulator keeps the pressure at a constant set level in the circuit, thus adjusting automatically the pump flow rate according to the real need of the system.
The desired pressure can be set by manually adjusting the (P) regulation valve.

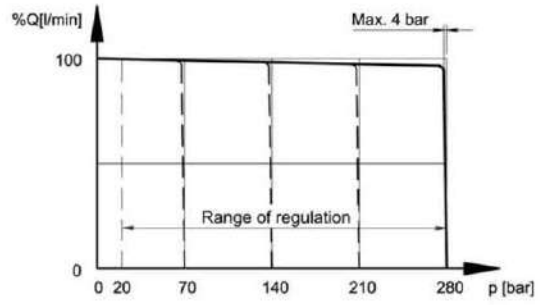
FEATURES OF THE PC REGULATOR:

- pressure regulating range (P) = 20 ÷ 350 bars
- default setting (P) = 280 bars

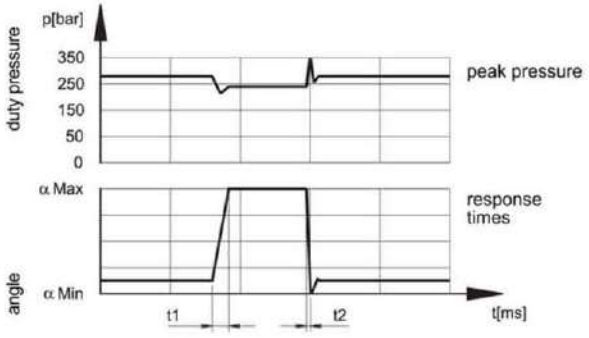
8.1 - Characteristic curves of the PC regulator (values obtained with mineral oil with a viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rpm and an oil temperature of 50°C.

FLOW RATE/PRESSURE FEATURE



RESPONSE TIMES AND PEAK PRESSURE



t1 = response time for a change from a min. to a max. displacement.
t2 = response time for a change from a max. to a min. displacement.

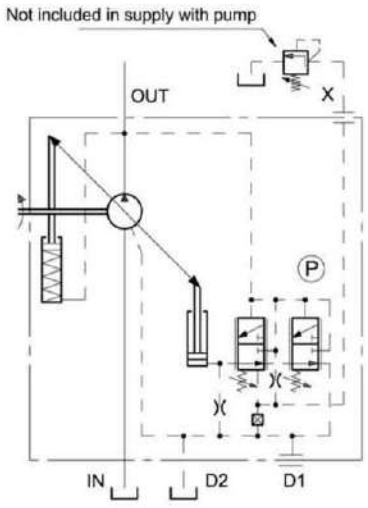
PC pressure regulator set at 280 bars

pump size	t1 [ms]	t2 [ms]
029	30	20
046	45	25
073	50	30
087	53	28

The values stated in the table are obtained from the opening until the instant the delivery level is achieved, by using a maximum pressure valve set at 350 bars for a load simulation, placed at a distance of 1 m from the pump delivery port.

9 - REMOTE-CONTROLLED PRESSURE REGULATOR: PCR

FUNCTIONAL DIAGRAM



The PCR regulator, apart from limiting the line maximum pressure (P valve), allows a remote-control of the device via a remote control connected to the X port (typical application for submerged pumps). In case a pressure regulating valve is used for the remote-control, it is suggested to use a direct operated valve with a size suitable to 1,5 l/min pilot flow rate.

N.B. The maximum length of the connection between the valve and the pump X port must not be longer than 2 m.

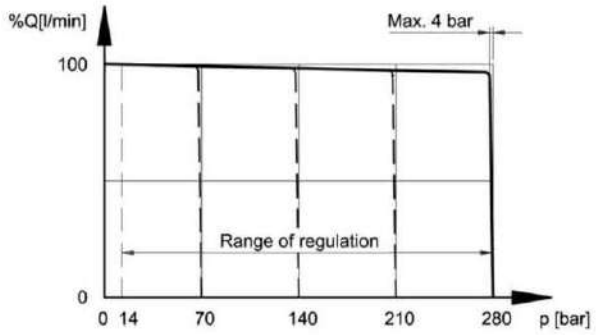
PCR FEATURES:

- pressure regulating range (P) = 20 ÷ 350 bars
- default setting (P) = 280 bars
- remote-regulated pressure range = 14 ÷ 315 bars
- flow rate available on the X port for the remote-control = about 1,5 l/min

9.1- Characteristic curves of the PCR regulator (values obtained with mineral oil with a viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rpm and an oil temperature of 50°C.

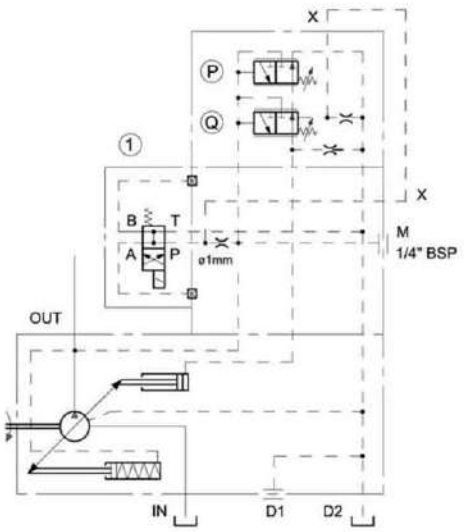
FLOW RATE / PRESSURE FEATURE



10 - REGULATOR WITH PRESSURE CONTROL DEVICES: PCX

10.1 - Electrical unloading

FUNCTIONAL DIAGRAM



The PCX regulator, mated to a suitable two-position solenoid valve, allows the electrical switching of the pump displacement in null condition and with minimum delivery pressure.

This function is useful for the pump unloading at the start-up or to operate at minimum pressure in the system during the machine cycle pause, with considerable energy saving.

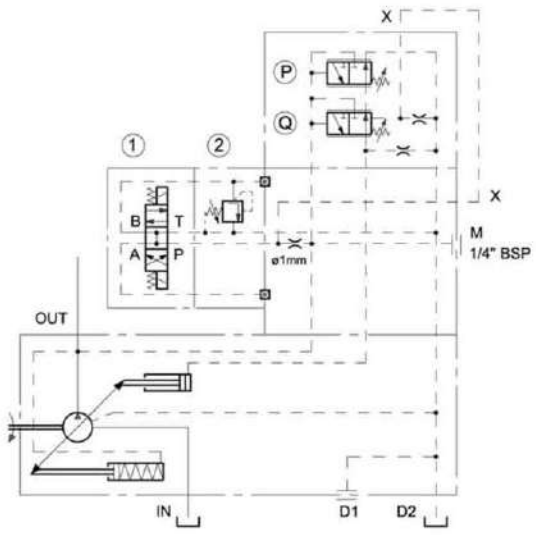
The pressure switching is made by means of a solenoid valve (to be ordered separately) installed on the pump regulator directly.

PCX FEATURES (electrical unloading):

- solenoid switching valve (1) = DS3-SA2 (to be ordered separately see cat. 41 150)
- solenoid valve OFF = pump at null displacement and delivery pressure = 20 bar
- solenoid valve ON = maximum displacement and delivery pressure set on regulator (P).
- pressure regulating range (P) = 20 ÷ 350 bar
- default setting (P) = 280 bar

10.2 - Two pressure settings + unloading

FUNCTIONAL DIAGRAM



This type of regulator allows to select, by means of a three-position solenoid valve, two different working pressures; it allows also the pump unloading.

The solenoid valve (1) and the relief valve (2) for the intermediate pressure setting are directly installed on the pump regulator and they are to be ordered separately.

PCX FEATURES (two pressure settings + unloading):

- solenoid switching valve (1) = DS3-S2 (to be ordered separately see catalogue 41 150)
- solenoid valve OFF = pump unloading - delivery pressure = 20 bar
- solenoid side "a" ON = maximum displacement and delivery pressure set on relief valve (2) (intermediate value)
- solenoid side "b" ON = maximum displacement and delivery pressure set on regulator (P) (maximum value)

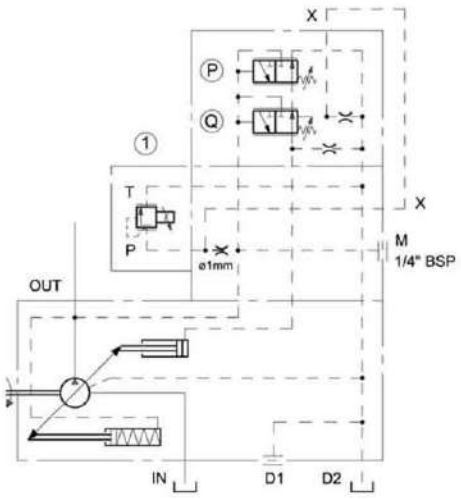
- pressure relief valve (2) = MCD*-SBT (to be ordered separately - see cat. 61 200)
- pressure regulating range (2) = MCD3-SBT 20 ÷ 100 bar
  MCD5-SBT 20 ÷ 250 bar

- pressure regulating range (P) = 20 ÷ 350 bar
- default setting (P) = 280 bar

NOTE: For PCX regulators characteristic curves (with two pressure settings + unloading functions), see PC regulator diagrams at paragraph 8.1.

10.3 - Pressure regulation with electric proportional control

FUNCTIONAL DIAGRAM



The PCX regulator mated with a proportional pressure relief valve, allows a continuous control and modulation of the system pressure.

The proportional pressure relief valve (to be ordered separately) is installed on the pump regulator directly.

PCX FEATURES (proportional pressure regulation):

- pressure regulating range (P) = 20 ÷ 350 bar
- default setting (P) = 280 bar

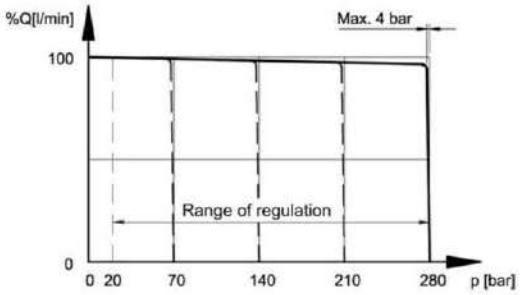
- proportional pressure relief valve (1) = PRED3 (to be ordered separately with its relative electronic control unit - see catalogue 81 210)
- proportional pressure regulating range:
  PRED3-070 20 ÷ 100 bar
  PRED3-210 20 ÷ 240 bar

Hysteresis = < 5% of p nom
Repeatability = < ± 1,5% of p nom

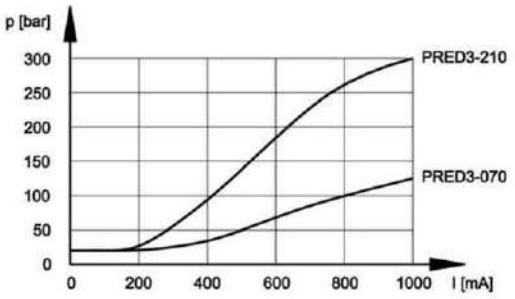
10.3.1 - Characteristic curves (values obtained with mineral oil with a viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rpm and an oil temperature of 50°C.

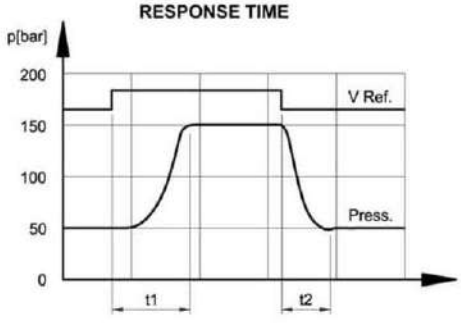
FLOW RATE / PRESSURE FEATURE



CURRENT / PRESSURE FEATURE



RESPONSE TIME

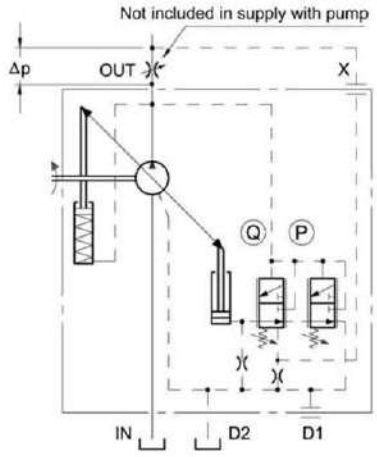


The response times are obtained with a VPPM-046 pump, by changing the reference signal (V Ref) on the proportional valve in order to have a line pressure variation from 50 to 150 bar and vice versa, with an oil volume of 5 lt.

t1 = 80 ms (response time for an increasing pressure change)
t2 = 60 ms (response time for a decreasing pressure change)

11 - FLOW RATE AND PRESSURE REGULATOR: PQC

FUNCTIONAL DIAGRAM



This regulator, apart from regulating the pressure (as for the PC model), allows the pump flow rate to be regulated according to the Δp pressure drop measured on either side of a throttle valve installed on the user line. The connection pipe between the X port and the flow line downstream the restrictor (or valve) must always be made (customer charge).

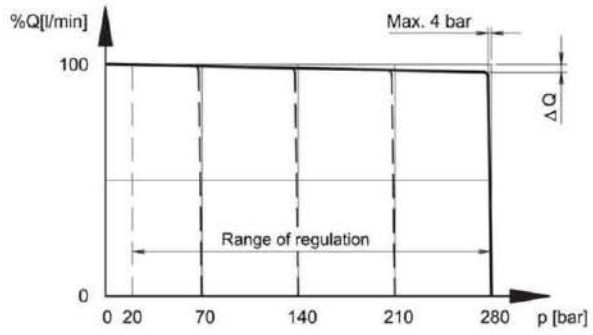
PQC FEATURES:

- pressure regulating range (P) = 20 ÷ 350
- default setting (P) = 280 bar
- differential pressure regulating range (Q) = 10 ÷ 40 bars
- default setting = 14 bar
- Min. discharge head = 18 ± 2 bar
  (with a zero flow rate, X discharge pilot and with a default (Q) setting of the differential regulator)

11.1 - Characteristic curves of the PQC regulator (values obtained with mineral oil with a viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rpm and an oil temperature of 50°C.

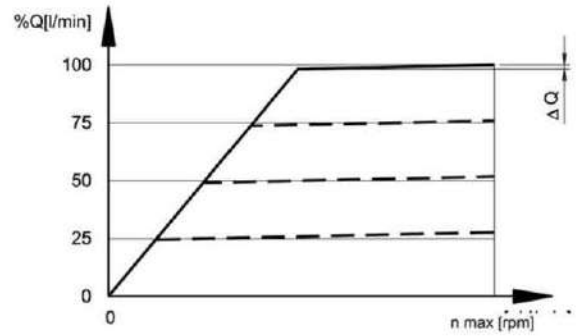
FLOW RATE / PRESSURE FEATURE



Flow variation
between minimum and maximum pressure
with pump set at max displacement

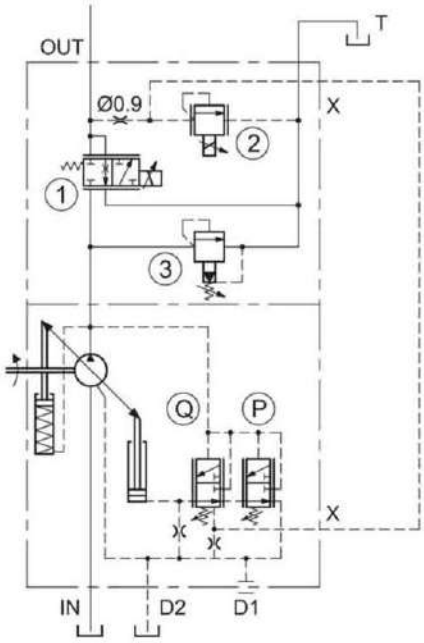
pump size	ΔQ max [l/min]
029	0.9
046	1.7
073	2.5
087	2.5

FLOW RATE / ROTATION SPEED STATIC FEATURE



12 - INTEGRATED PROPORTIONAL FLOW AND PRESSURE CONTROL REGULATOR: PQCE5

FUNCTIONAL DIAGRAM



This regulator allows an independent regulation of the pump flow and pressure, both with an electric proportional control.

The pump flow is regulated through the proportional valve (1) which operates directly on the pump delivery, while the system pressure is controlled by means of the proportional relief valve (2) working as a pilot stage of the differential regulator (Q).

The maximum system pressure is limited by the regulator (P). The regulator is also equipped of a built-in pressure relief valve (3) with manual adjustment, which limits the pressure peak due to quick flow variations in the system.

PQCE5 FEATURES

- pressure regulating range (P) = 20 ÷ 350 bar
- default setting (P) = 280 bar

- differential pressure regulating range (Q) = 10 ÷ 30 bar
- default setting = 16 bar

- proportional pressure regulating range:
  20 ÷ 250 bar (for VPPM-*PQCE5 pump)

- proportional flow regulating range:
  0 ÷ 69 l/min (for VPPM-046 PQCE5 pump)
  0 ÷ 109,5 l/min (for VPPM-073 PQCE5 pump)
  0 ÷ 132 l/min (for VPPM-073 PQCE5 pump)

PERFORMANCES and ELECTRICAL CHARACTERISTICS

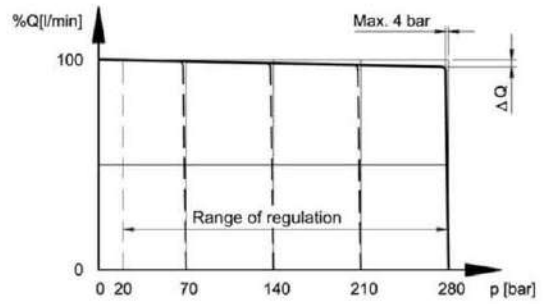
	FLOW REGULATION (1) (DSE5 valve)	PRESSURE REGULATION (2) (CRE valve)
HYSTERESIS	< 6% of Q max	< 5% of p nom
REPEATABILITY	< ±1,5% of Q max	< ±1,5% of p nom
NOMINAL VOLTAGE	24 VCC	24 VCC
COIL RESISTANCE (at 20°C)	8,65 Ω	16,6 Ω
MAXIMUM CURRENT	1,6 A	0,85 A
ELECTROMAGNETIC COMPATIBILITY (EMC)	According to 2004/108/CEE	
DEGREE OF PROTECTION : Atmospheric agents (CEI EN 60529)	IP 65	
ELECTRONIC CONTROL UNITS for proportional valves	EDM-M3312 see cat. 89 250	

12.1 - Characteristic curves of the PQCE5 regulator

(values obtained with mineral oil with a viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rpm and an oil temperature of 50°C.

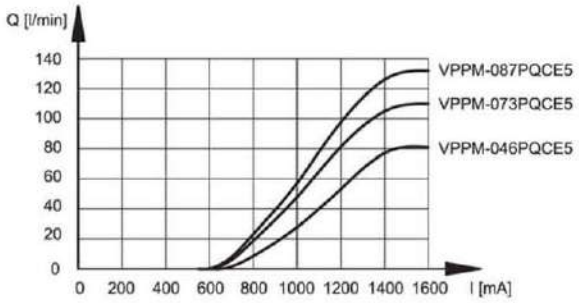
FLOW RATE / PRESSURE CURVE



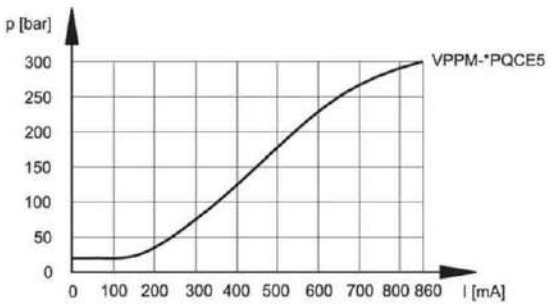
Flow variation
between minimum and maximum pressure
with pump set at max displacement

pump size	ΔQ max [l/min]
046	1.7
073	2.5
087	2.5

CURRENT / FLOW CURVE

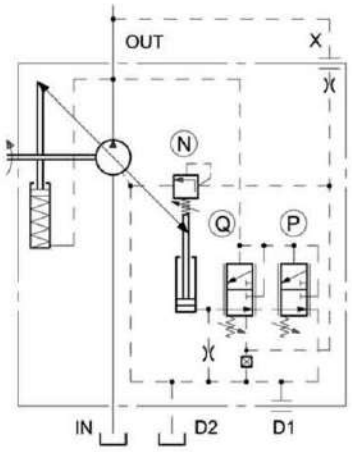


CURRENT / PRESSURE CURVE



13 - POWER REGULATOR: PQNC

FUNCTIONAL DIAGRAM



Such regulator keeps the pump torque at a constant level by changing the displacement according to the delivery pressure, so that the ratio p x (Q) (absorbed power) remains unchanged. The functions limiting the (P) maximum pressure and regulating the (Q) flow rate are always present, if a restrictor has been installed on the user line.

In the 1/8" BSP coupling supplied for the X port, there is a restrictor of Ø0,8 orifice.

Note: The connection pipe between the X port and the pump outlet must always be made (customer charge).

PQNC FEATURES:

- pressure regulating range (P) = 20 ÷ 350
- default setting (P) = 280 bar

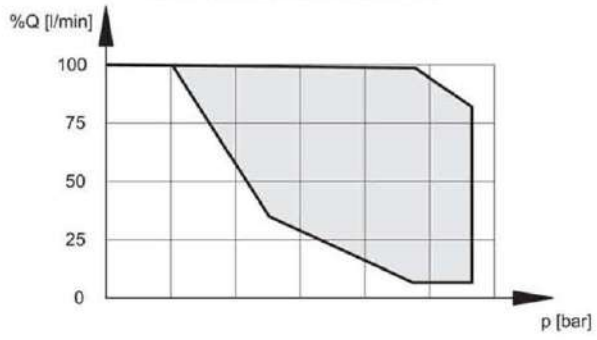
- differential pressure regulating range (Q) = 10 ÷ 30 bar
- default setting = 16 bar

- min. discharge head = 18 ± 2 bar
  (with a zero flow rate, X discharge pilot and with a default Q setting of the differential regulator)
- the power regulator is factory set. The setting value has to be specified with the order, by stating into the identification code the Nm torque value (see paragraph 1).
- Start of the regulation: looking at values table of paragraph 1.5

13.1 - Characteristic curves of the PQNC regulator (values obtained with mineral oil with a viscosity of 36 cSt at 50°C)

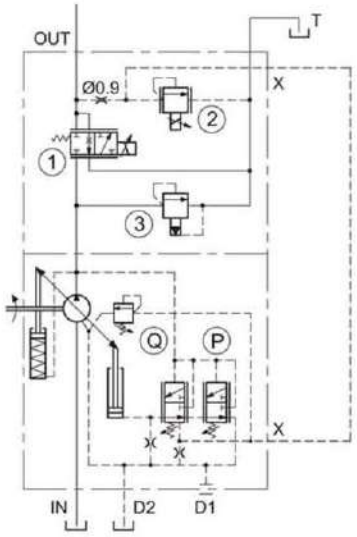
The diagram curves were measured with a pump rotation speed of 1500 rpm and an oil temperature of 50°C.

FLOW RATE / PRESSURE CURVE



14 - POWER REGULATOR WITH INTEGRATED PROPORTIONAL FLOW AND PRESSURE CONTROL: PQNCE5

FUNCTIONAL DIAGRAM



This system combines all the functions of the constant power control as a standard PQNC5 regulator, and moreover it allows the independent proportional regulation of the pump flow and pressure at values behind the power curve characteristic set on the regulator (N).

PQNCE5 FEATURES

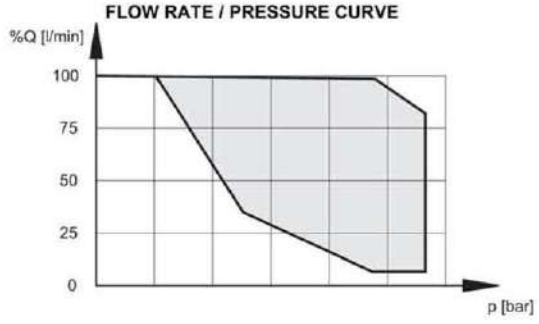
For technical characteristics and settings of regulator, see paragraph 13.

14.1 - Characteristic curves of the PQNCE5 regulator

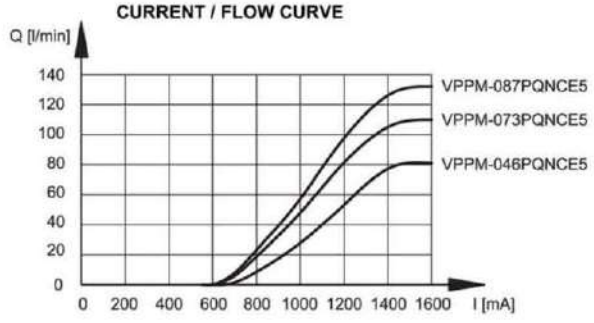
(values obtained with mineral oil with viscosity of 36 cSt at 50°C with driver EDM-M3312)

The diagram curves were measured with a pump rotation speed of 1500 rpm and an oil temperature of 50°C.

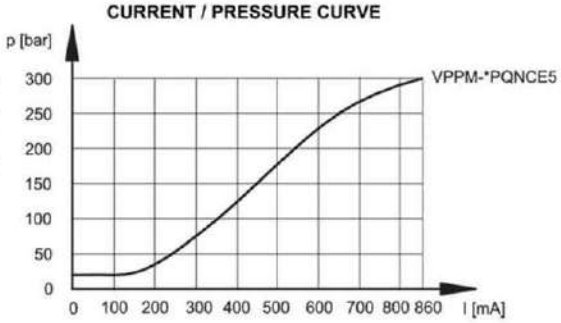
FLOW RATE / PRESSURE CURVE



CURRENT / FLOW CURVE

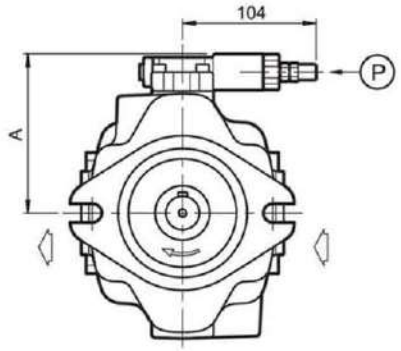


CURRENT / PRESSURE CURVE



15 - REGULATOR OVERALL DIMENSIONS

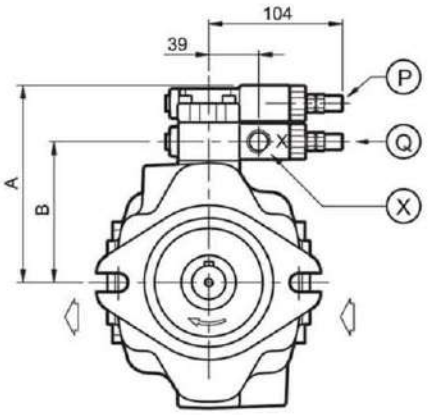
dimensions in mm



PRESSURE REGULATOR PC

pump size	A [mm]
029	114
046	123
073 / 087	136

P	Pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase pressure Locknut: spanner 13



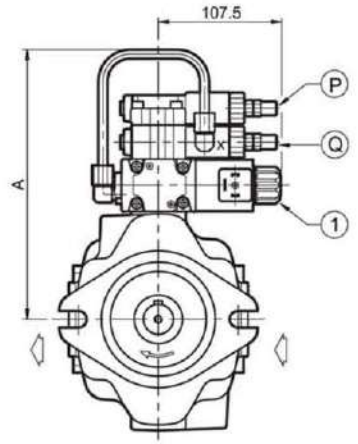
REMOTE-CONTROLLED PRESSURE REGULATOR PCR

pump size	A [mm]	B [mm]
029	144	100
046	153	109
073 / 087	165	122

P	Pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase pressure Locknut: spanner 13
Q	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure Locknut: spanner 13
X	Pilot port for remote control X: 1/8" BSP

VPPM

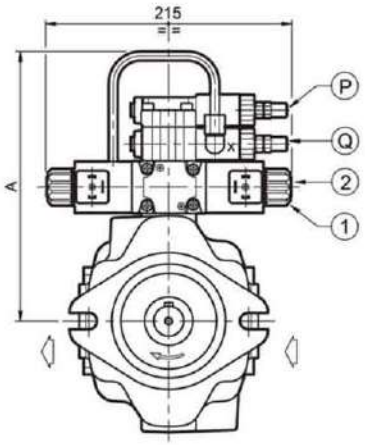
dimensions in mm



PCX REGULATOR WITH ELECTRICAL UNLOADING

pump size	A [mm]
029	244
046	253
073 / 087	265

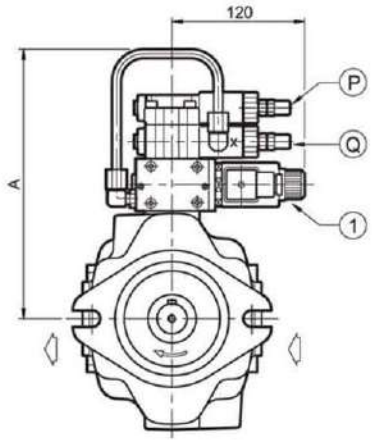
P	Pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase pressure Locknut: spanner 13
Q	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure Locknut: spanner 13
1	Solenoid switching valve type DS3-SA2



PCX REGULATOR WITH TWO PRESSURE SETTINGS + UNLOADING

pump size	A [mm]
029	244
046	253
073 / 087	265

P	Pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase pressure Locknut: spanner 13
Q	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure Locknut: spanner 13
1	Solenoid switching valve type DS3-S2
2	Relief valve for the intermediate pressure setting MCI*-SBT



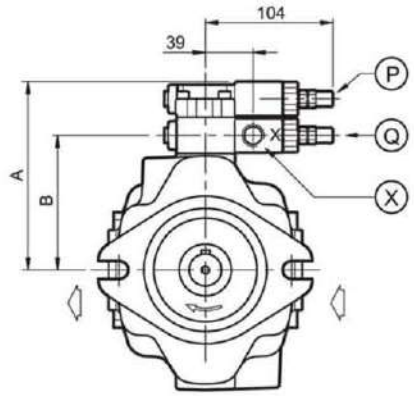
PCX REGULATOR FOR PRESSURE REGULATION WITH ELECTRIC PROPORTIONAL CONTROL

pump size	A [mm]
029	244
046	253
073 / 087	265

P	Pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase pressure Locknut: spanner 13
Q	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure Locknut: spanner 13
1	Proportional pressure relief valve PRED3 type

VPPM

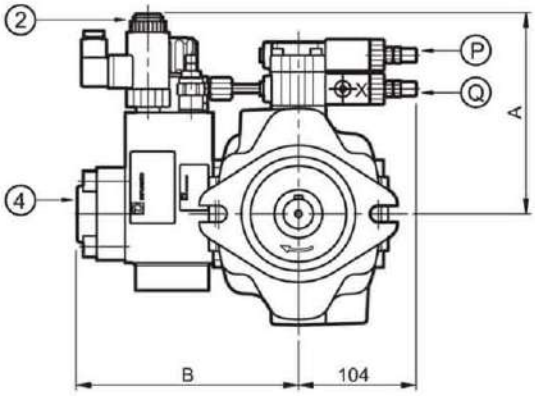
dimensions in mm



FLOW RATE AND PRESSURE REGULATOR PQC

pump size	A [mm]	B [mm]
029	144	100
046	153	109
073 / 087	165	122

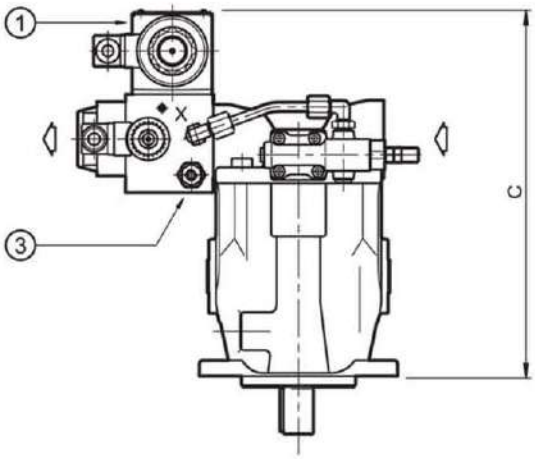
P	Pressure regulator countersunk hex adjustment screw: Spanner 4 Clockwise rotation to increase pressure Locknut: spanner 13
Q	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure Locknut: spanner 13
X	Pilotage port X: 1/8" BSP (see paragraph 11)



PQCE REGULATOR WITH INTEGRATED PROPORTIONAL FLOW AND PRESSURE CONTROL

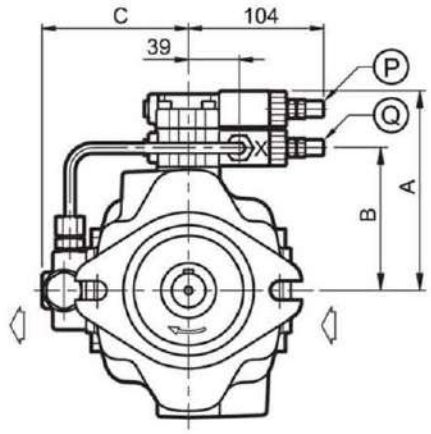
pump size	A [mm]	B [mm]	C [mm]
046	175	194	322
073 / 087	181	207	345

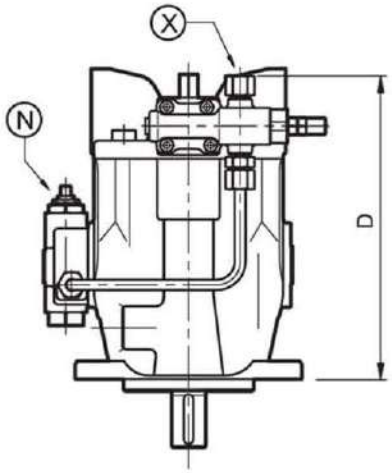
P	Pressure regulator countersunk hex adjustment screw: Spanner 4 Clockwise rotation to increase pressure Locknut: spanner 13
Q	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure Locknut: spanner 13
1	Proportional flow control valve type: DSE5-P070B - DSE5-P110SB
2	Proportional pressure valve type: CRE-250
3	Safety pressure relief valve
4	Delivery port SAE 6000 flange 1" for VPPM-046 - 1 ¼" for VPPM-073 and -087



VPPM

dimensions in mm





POWER REGULATOR PQNC

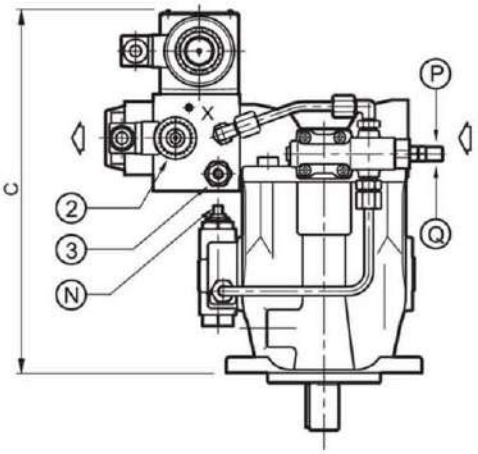
grandezza pompa	A [mm]	B [mm]	C [mm]	D [mm]
029	144	100	104	211
046	153	109	111	235
073 / 087	165	122	120	258

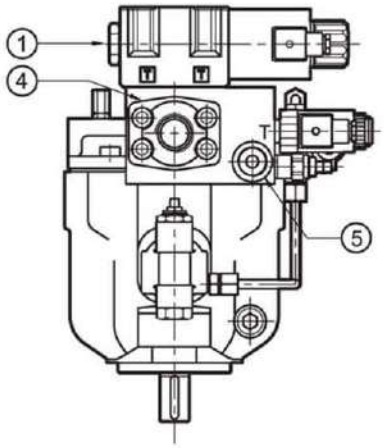
P	Pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase pressure Locknut: spanner 13
Q	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure Locknut: spanner 13
X	Pilotage port X: 1/8" BSP (restrictor with Ø0,8 orifice included - see paragraph 13)
N	Power regulator

POWER REGULATOR WITH INTEGRATED PROPORTIONAL FLOW AND PRESSURE CONTROL PQNCE5

(for dimensions see PQCE5 page 22)

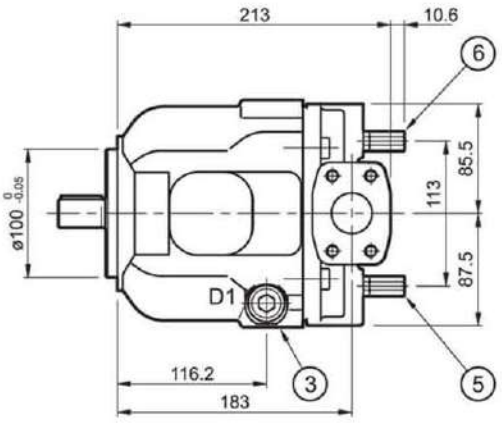
P	Pressure regulator countersunk hex adjustment screw: spanner 4. Clockwise rotation to increase pressure Locknut: spanner 13
Q	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure Locknut: spanner 13
N	Power regulator
1	Proportional flow control valve type: DSE5-P070SB - DSE5-P110SB
2	Proportional pressure control valve type: CRE-250
3	Safety pressure relief valve
4	Delivery port SAE 6000 flange: 1" for VPPM-046 - 1 ¼" for VPPM-073 and -087
5	Outlet port T: 3/4" BSP

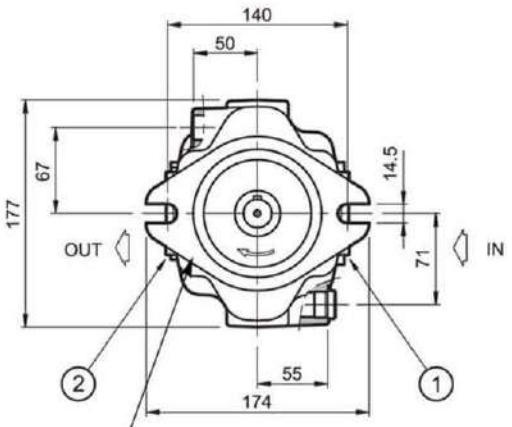




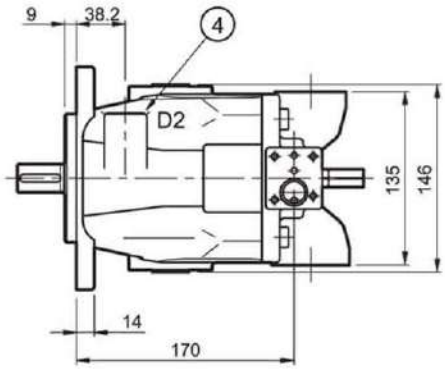
16 - VPPM-029 OVERALL AND MOUNTING DIMENSIONS

dimensions in mm



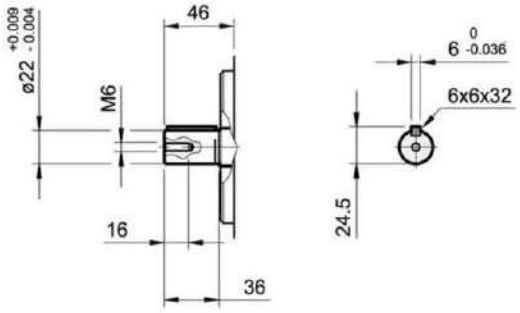


ISO 3019/2 fitting flange
(standard, identification code **5**)



1	Suction port: IN flange SAE 3000 1¼" (for overall dimensions see paragraph 24)
2	Delivery port: OUT flange SAE 6000 3/4" (for overall dimensions see paragraph 24)
3	Additional port drainage D1: 1/2" BSP (closed)
4	Drainage port D2: 1/2" BSP
5	Minimum displacement limit control (**NOTE**) - Locknut: spanner 14 - countersunk hex adjustment screw: spanner 4 - displacement regulation range: 0 ÷ 50 % max. displacement
6	Maximum displacement limit control - Locknut: spanner 14 - countersunk hex adjustment screw: spanner 4 - torque: 10 Nm - displacement regulation range: 100 ÷ 70% max. displacement Δ displacement / screw round = 1,5 cm^3

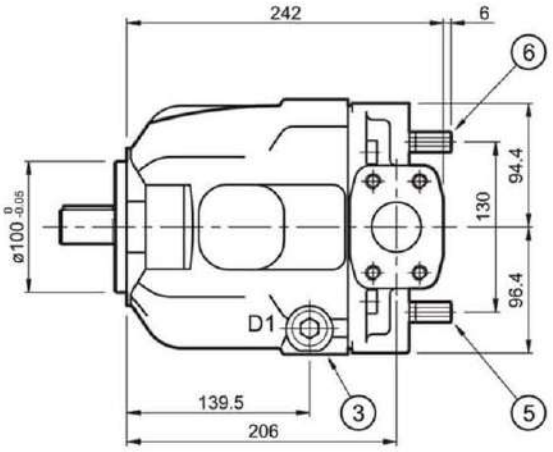
Cylindrical shaft end with ISO 3019/2 key
(standard, identification code **5**)

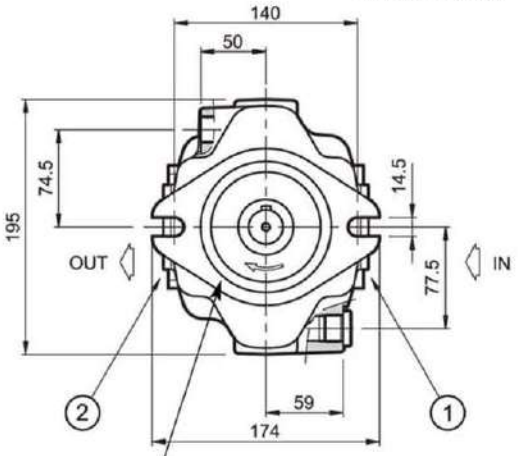


NOTE: The limit control is supplied factory set at zero minimum displacement and is sealed up with red paint.
Any modification of this setting by the user makes the pump unable to reach the null displacement condition.

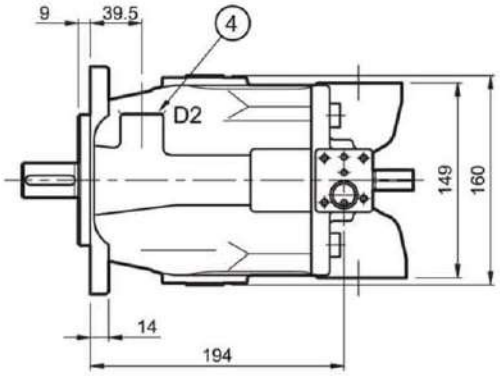
17 - VPPM-046 OVERALL AND MOUNTING DIMENSIONS

dimensions in mm





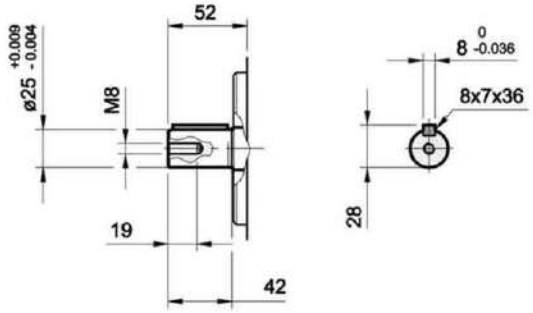
ISO 3019/2 fitting flange
(standard, identification code **5**)



1	Suction port: IN flange SAE 3000 1½" (for overall dimensions see paragraph 24)
2	Delivery port: OUT flange SAE 6000 1" (for overall dimensions see paragraph 24)
3	Additional port drainage D1: 1/2" BSP (closed)
4	Drainage port D2: 1/2" BSP
5	Minimum displacement limit control (**NOTE**) - Locknut: spanner 14 - countersunk hex adjustment screw: spanner 4 - displacement regulation range: 0 ÷ 50 % max. displacement
6	Maximum displacement limit control - Locknut: spanner 14 - countersunk hex adjustment screw: spanner 4 - torque: 10 Nm - displacement regulation range: 100 ÷ 70% max. displacement Δ displacement / screw round = 2,2 cm^3

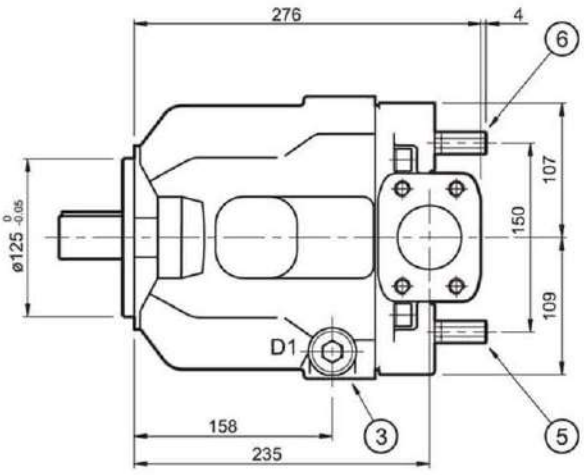
NOTE: The limit control is supplied factory set at zero minimum displacement and is sealed up with red paint.
Any modification of this setting by the user makes the pump unable to reach the null displacement condition.

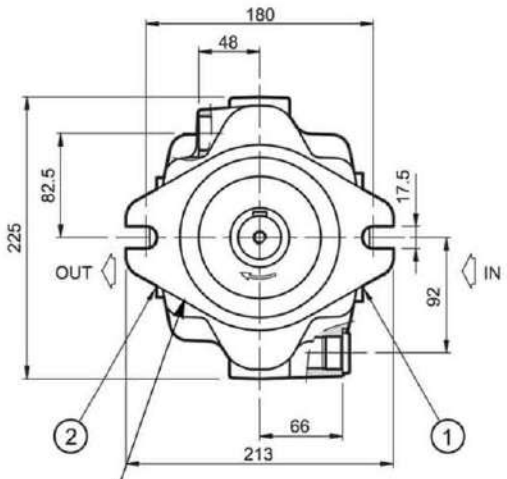
Cylindrical shaft end with ISO 3019/2 key
(standard, identification code **5**)



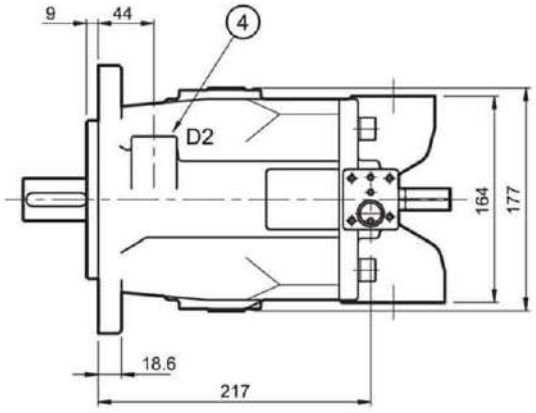
18 - VPPM-073 AND VPPM-087 OVERALL AND MOUNTING DIMENSIONS

dimensions in mm

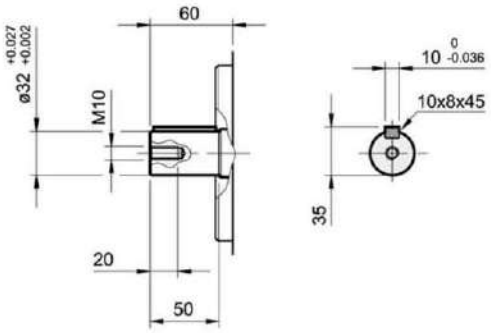




ISO 3019/2 fitting flange
(standard, identification code **5**)



Cylindrical shaft end with ISO 3019/2 key
(standard, identification code **5**)

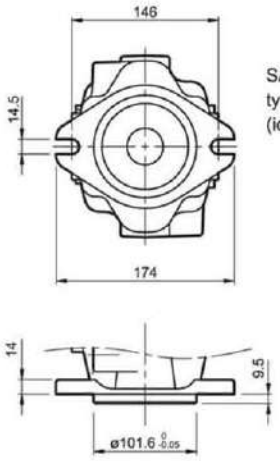


1	Suction port: IN flange SAE 3000 2" (for overall dimensions see paragraph 24)
2	Delivery port: OUT flange SAE 6000 1 ¼" (for overall dimensions see paragraph 24)
3	Additional port drainage D1: 1/2" BSP (closed)
4	Drainage port D2: 1/2" BSP
5	Minimum displacement limit control (**NOTE**) - Locknut: spanner 17 - countersunk hex adjustment screw: spanner 5 - displacement regulation range: 0 ÷ 50 % max. displacement
6	Maximum displacement limit control - Locknut: spanner 17 - countersunk hex adjustment screw: spanner 5 - torque: 10 Nm - displacement regulation range: 100 ÷ 50% max. displacement Δ displacement / screw round = 3,9 cm^3

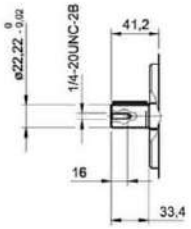
NOTE: The limit control is supplied factory set at zero minimum displacement and is sealed up with red paint.
Any modification of this setting by the user makes the pump unable to reach the null displacement condition.

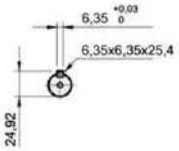
19 - OVERALL DIMENSIONS FOR FLANGES AND SHAFTS TYPE SAE J744

VPPM-029



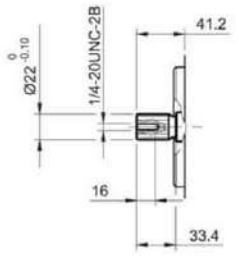
SAE J744 - 2-hole fitting flange
type "B"
(identification code: **0**)





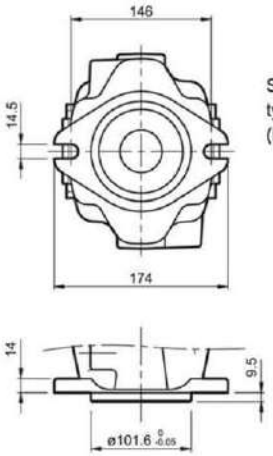
cylindrical with key shaft end
SAE J744
(identification code: **0**)

SAE J744 splined shaft end
16/32 d.p. - 13T
(identification code: **1**)

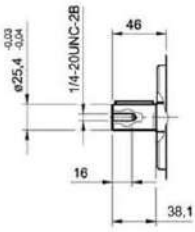


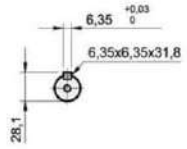
dimensions in mm

VPPM-046



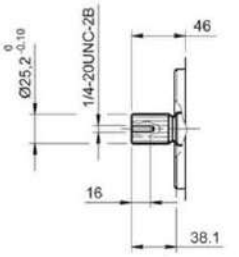
SAE J744 - 2-hole fitting flange
type "B"
(identification code: **0**)





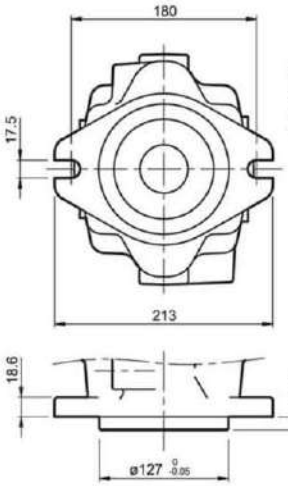
cylindrical with key shaft end
SAE J744
(identification code: **0**)

SAE J744 splined shaft end
16/32 d.p. - 15T
(identification code: **1**)

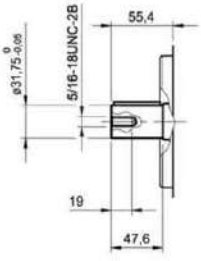


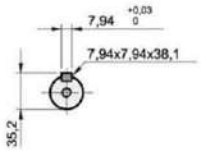
dimensions in mm

VPPM-073
VPPM-087



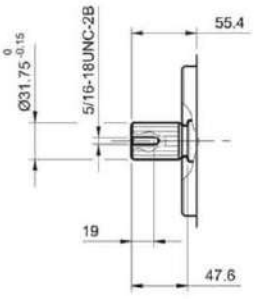
SAE J744 - 2-hole fitting flange
type "C"
(identification code: **0**)





cylindrical with key shaft end
SAE J744
(identification code: **0**)

SAE J744 splined shaft end
12/24 d.p. - 14T
(identification code: **1**)



dimensions in mm

20 - INSTALLATION

- The VPPM pumps can be installed both in a horizontal and vertical position, with the shaft in an upward position.

  N.B.: The drainage port has to be oriented so that the oil level inside the pump body is never lower than 3/4 of its volume (according to the installation use the D1 or D2 drainage ports).

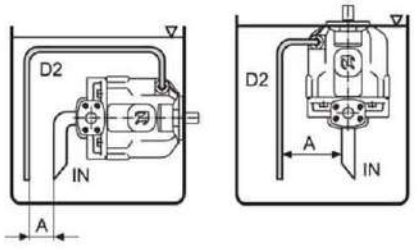
- Installation below the oil reservoir is suggested. As for an installation above the oil level, check that the min. suction pressure is not lower than -0.2 bars (relative). If a low noise emission level is required, the installation inside the tank is suggested.

  In case of an installation inside the tank, with an oil level which does not grant complete pump submersion, it is suggested that the drain tube is adjusted so that the pump higher bearing can be always lubricated.

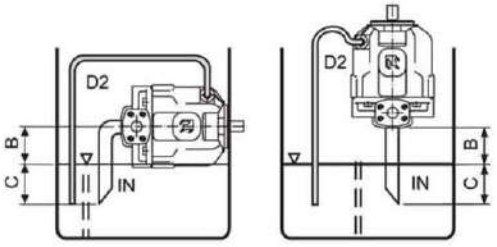
- **Before starting, the pump body has to be filled with the fluid.**
- It is necessary to vent the air from the delivery connection before operating it the first time. The pump start up, especially at a cold temperature, should occur with the plant at minimum pressure.
- The suction tube has to be suitably sized so that the suction pressure is never lower than -0.2 bar (relative). Bends or restrictions or an excessive tube length could further decrease the value of the suction pressure with a following increase in the noise emissions and a decrease in the pump lifetime.
- The drainage tube has to be sized so that the pressure inside the pump body is always lower than 0.5 bars (relative), even during the dynamic change and flow rate phases. The drainage tube has to unload inside the tank far from the suction area. We suggest to interpose a screen between the two lines.
- No check valves allowed on the suction line
- The motor-pump connection must be carried out directly with a flexible coupling. Radial and axial loads have to be lower than the values specified in the table at paragraph 3.
- As for details and the installation of filter elements, see par. 2.3.

MOUNTING INSIDE THE TANK

Minimum level of oil in the tank at or above the surface of the pump flange
A ≥ 200 mm

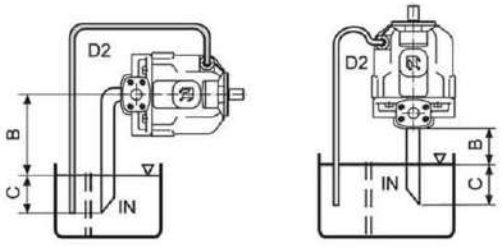


Minimum level of oil in the tank below the surface of the pump flange
Minimum inlet pressure = -0,2 bar (relative)
B ≤ 800 mm C = 200 mm

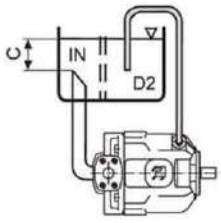


MOUNTING OUTSIDE THE TANK

Minimum inlet pressure = -0,2 bar (relative)
B ≤ 800 mm C = 200 mm



C = 200 mm



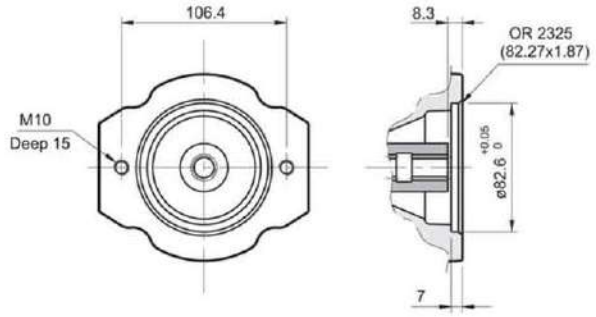
21 - THROUGH OUTPUT SHAFT

The VPPM pumps can be supplied with a through output shaft, which allows coupling with other pump models.

N.B.: The pumps with a through output shaft are supplied with an intermediate 2-hole flange type SAE J744 - and with a mating joint for splined shaft type SAE J744. In this version the mechanical adjustment for the min. and max. displacement are not available.

- As for identification see par. 1 "Identification code".
For the pump overall dimensions (intermediate flange included) see paragraph 23 "overall dimensions for multiple pumps".

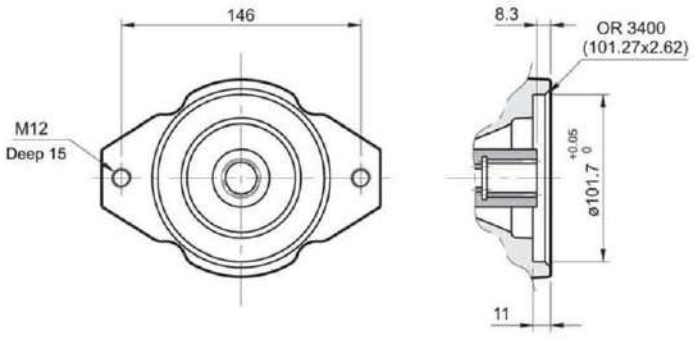
FLANGE + JOINT FOR THE COUPLING OF A GEAR PUMP GROUP 2
identification code **12S**



SAE J744 - 2-hole intermediate flange
type "A"

mating joint for a SAE J744 splined shaft
16/32 D.P. - 9T

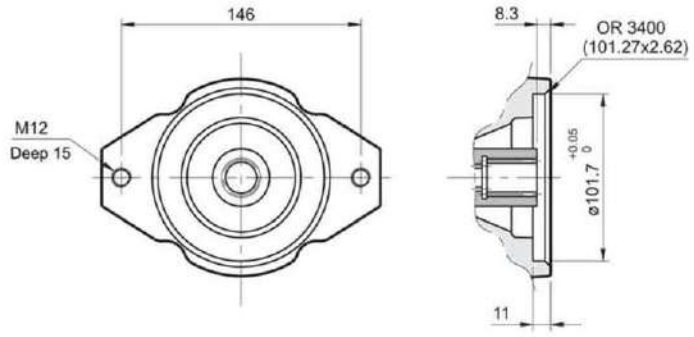
FLANGE + JOINT FOR THE COUPLING OF A PUMP TYPE VPPM-029
OR OF A GEAR PUMP GROUP 3
identification code **62S**



SAE J744 - 2-holes intermediate flange
type "B"

mating joint for a SAE J744 splined shaft
16/32 D.P. - 13T

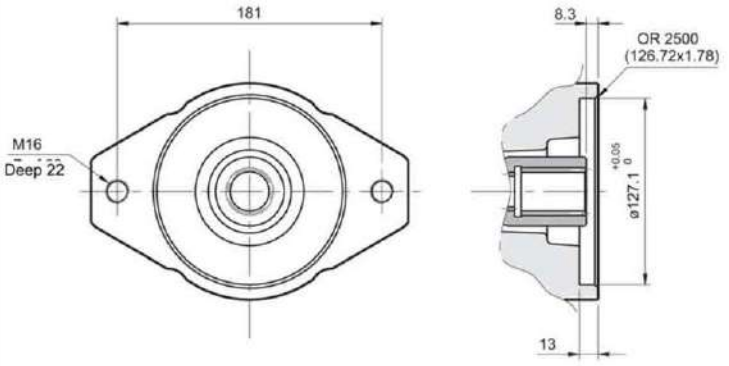
FLANGE + JOINT FOR THE COUPLING OF A PUMP TYPE VPPM-046
identification code **63S**



SAE J744 - 2-holes intermediate flange
type"B"

mating joint for a SAE J744 splined shaft
16/32 D.P. - 15T

FLANGE + JOINT FOR THE COUPLING OF A PUMP TYPE VPPM-073
identification code **64S**



SAE J744 - 2-holes intermediate flange type "C"

mating joint for a SAE J744 splined shaft 12/24 D.P. - 14T

22 - MULTIPLE PUMPS

The possibility to couple several pumps makes it possible to create multi-flow groups with independent hydraulic circuits. While sizing coupled pumps, it's necessary to make reference to the following conditions:

- The coupling can be carried out between pumps with the same dimensions or to a size of decreasing order.
- The max. rotation speed is determined by the pump with the lowest speed.
- The values of the max. applicabe torque can not be exceeded.

22.1 - Max. applicable torque

The input torque (M) for each pump is given by the following ratio:

$$M = \frac{9550 \cdot N}{n} = [Nm]$$

where the absorbed power (N) is given by:

$$N = \frac{Q \cdot \Delta p}{600 \cdot \eta_{tot}} = [kW]$$

n = rotation speed [rpm]

Q = flow rate [l/min]
Δp = differential pressure between the pump suction and delivery [bar]
η_{tot} = total efficiency (obtainable from the diagrams in par. 4-5-6)

or it can be obtained from the diagrams ABSORBED POWER (see par. 4 - 5 - 6 -7).

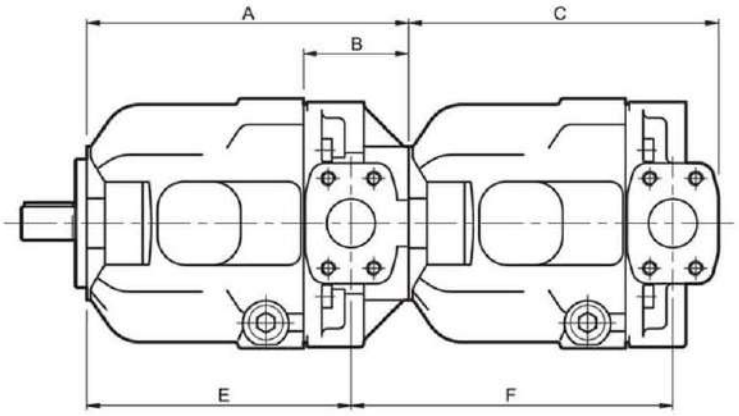
If several pumps are coupled, the torque of each single pump has to be added to the torque of subsequent pumps when they are loaded simultaneously.
The obtained torque value for each pump has to be lower than the value specified in the table below :

pump with a through output shaft	MAXIMUM TORQUE APPLICABLE AT THE FRONT PUMP SHAFT [Nm]			MAXIMUM TORQUE APPLICABLE AT THE PUMP TO BE COUPLED [Nm] (not simultaneously to the front pump)					
	cylindrical ISO 3019/2 (cod. 5)	cylindrical SAE J744 (cod. 0)	splined SAE J744 (cod. 1)	GP2 external gear	GP3 external gear	VPPM-029	VPPM-046	VPPM-073	VPPM-087
VPPM-029	170	200	190	100	135	135	-	-	-
VPPM-046	220	230	330	135	250	250	250	-	-
VPPM-073	450	490	620	135	330	330	400	440	-
VPPM-087	450	490	620	135	330	330	400	440	440

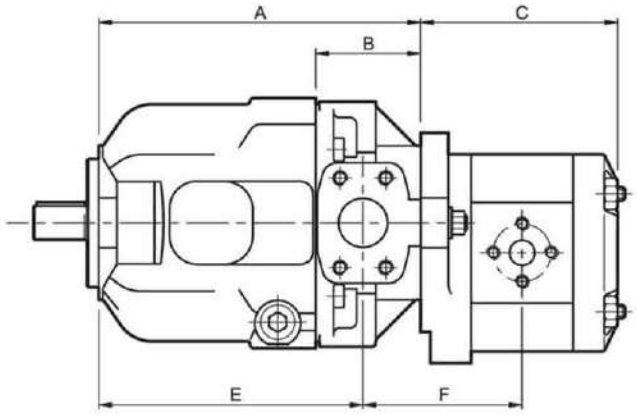
The maximum transmissible torque for those pumps with a through output shaft is determined by the coupling used for the transmission. If the obtained torque values are higher than the ones stated in the table, it is necessary to reduce the working pressure value or to replace the overloaded pump with a pump suitable to bear the required torque.

23 - OVERALL DIMENSIONS FOR MULTIPLE PUMPS

dimensions in mm



	REAR PUMP														
	VPPM-029					VPPM-046					VPPM-073 / 087				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
VPPM-029	222	77	183	213	222	-	-	-	-	-	-	-	-	-	-
VPPM-046	251	82	206	213	220	251	82	206	242	251	-	-	-	-	-
VPPM-073 VPPM-087	291	99	235	213	226	291	99	235	242	249	296	104	235	276	296



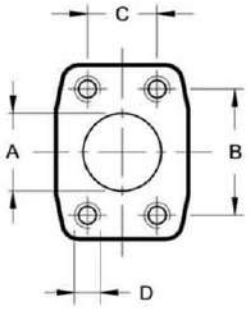
	REAR PUMP									
	external gear GP2					external gear GP3				
	A	B	C	F	G	A	B	C	F	G
VPPM-029	222	77	183	99 ÷ 121	86 ÷ 97	-	-	-	-	-
VPPM-046	251	82	206	99 ÷ 121	85 ÷ 96	251	82	206	132 ÷ 147	103 ÷ 110
VPPM-073 VPPM-087	291	99	235	99 ÷ 121	91 ÷ 102	291	99	235	132 ÷ 147	109 ÷ 116

NOTE: The F and G values in the table make reference to the dimensions of the gear pumps according to the availabe min. and max. displacement range. For further details apply to our Technical department.

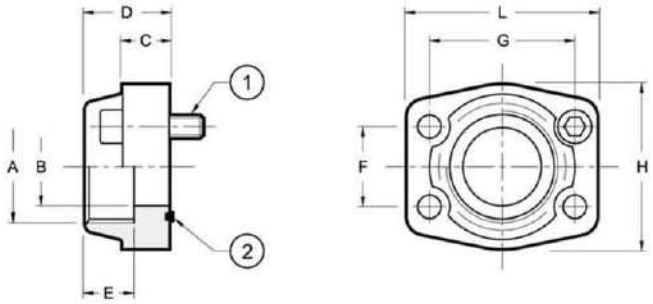
24 - SUCTION AND DELIVERY PORTS DIMENSIONS FOR SAE FLANGE WITH METRIC BOLTS

SUCTION PORT: "IN" (SAE 3000)					
Pump	**nominal size**	**A** mm	**B** mm	**C** mm	**D** threading and depth (mm)
VPPM 029	1 ¼"	32	58,7	30,2	M 10x28
VPPM 046	1 ½"	38,1	70	35,7	M12x26
VPPM 073 **VPPM 087**	2"	50,8	77,8	43	M12x25

DELIVERY PORT "OUT" (SAE 6000)					
Pump	**nominal size**	**A** mm	**B** mm	**C** mm	**D** threading and depth (mm)
VPPM 029	3/4"	19	50,8	23,8	M10x24
VPPM 046	1"	25,4	57,1	27,7	M12x20
VPPM 073 **VPPM 087**	1 ¼"	32	66,7	31,7	M14x23



25 - CONNECTION FLANGES



dimensions in mm

The fastening bolts and the O-Rings must be ordered separately

	Flange code	Flange description	P_{max} [bar]	ØA	ØB	C	D	E	F	G	H	L	1 bolts TCEI	2
SAE 3000	0610720	SAE - 1 ¼"	280	1 ¼" BSP	32	21	41	22	30,2	58,7	68	79	n° 4 - M10x35	OR 4150 (37.69x3.53)
	0610714	SAE - 1 ½"	210	1 ½" BSP	38	25	45	24	35,7	70	78	94	n° 4 - M12x45	OR 4187 (47.22x3.53)
	0610721	SAE - 2"	210	2" BSP	51	25	45	30	43	77,8	90	102	n° 4 - M12x45	OR 4225 (56.74x3.53)
SAE 6000	0770075	SAE - 3/4"	420	3/4" BSP	19	21	35	22	23,8	50,8	55	71	n° 4 - M10x35	OR 4100 (24.99x3.53)
	0770092	SAE - 1"	420	1" BSP	25	25	42	24	27,7	57,1	65	81	n° 4 - M12x45	OR 4131 (32.93x3.53)
	0770106	SAE - 1 ¼"	420	1 ¼" BSP	32	27	45	25	31,7	66,7	78	95	n° 4 - M14x50	OR 4150 (37.69x3.53)