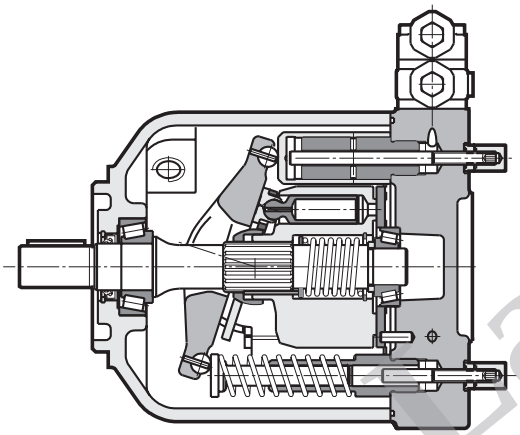
DUPLOMATIC
HYDRAULICS

VPPM

VARIABLE DISPLACEMENT AXIAL-PISTON PUMPS

SERIES 10

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 and 73 cm^3/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 (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-hole flange and a SAE J744 splined shaft (see par. 19).

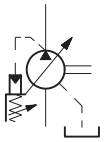
— They are available with eight different types of regulating control, each according to the application needs (see par. 7 ÷ 14).

TECHNICAL SPECIFICATIONS

VPPM PUMP SIZE		**029**	**046**	**073**
Maximum displacement	cm^3/rev	29	46	73
Operating flow rate and pressures		see table 3 - Performance		
Rotation speed		see table 3 - Performance		
Rotation direction		clockwise or anticlockwise (seen from the shaft side)		
Loads on the shaft axial load radial load	N	1000 2500	1500 3800	2500 6100
Maximum shaft torque		see table 3 - Performance		
Hydraulic connection		SAE flange fittings (see par. 21)		
Type of mounting (single pumps)		with a ISO 3019/2 flange		
Oil volume of the pump body	dm^3	0.7	0.9	1.5
Mass (single pump empty)	kg	18	24	35

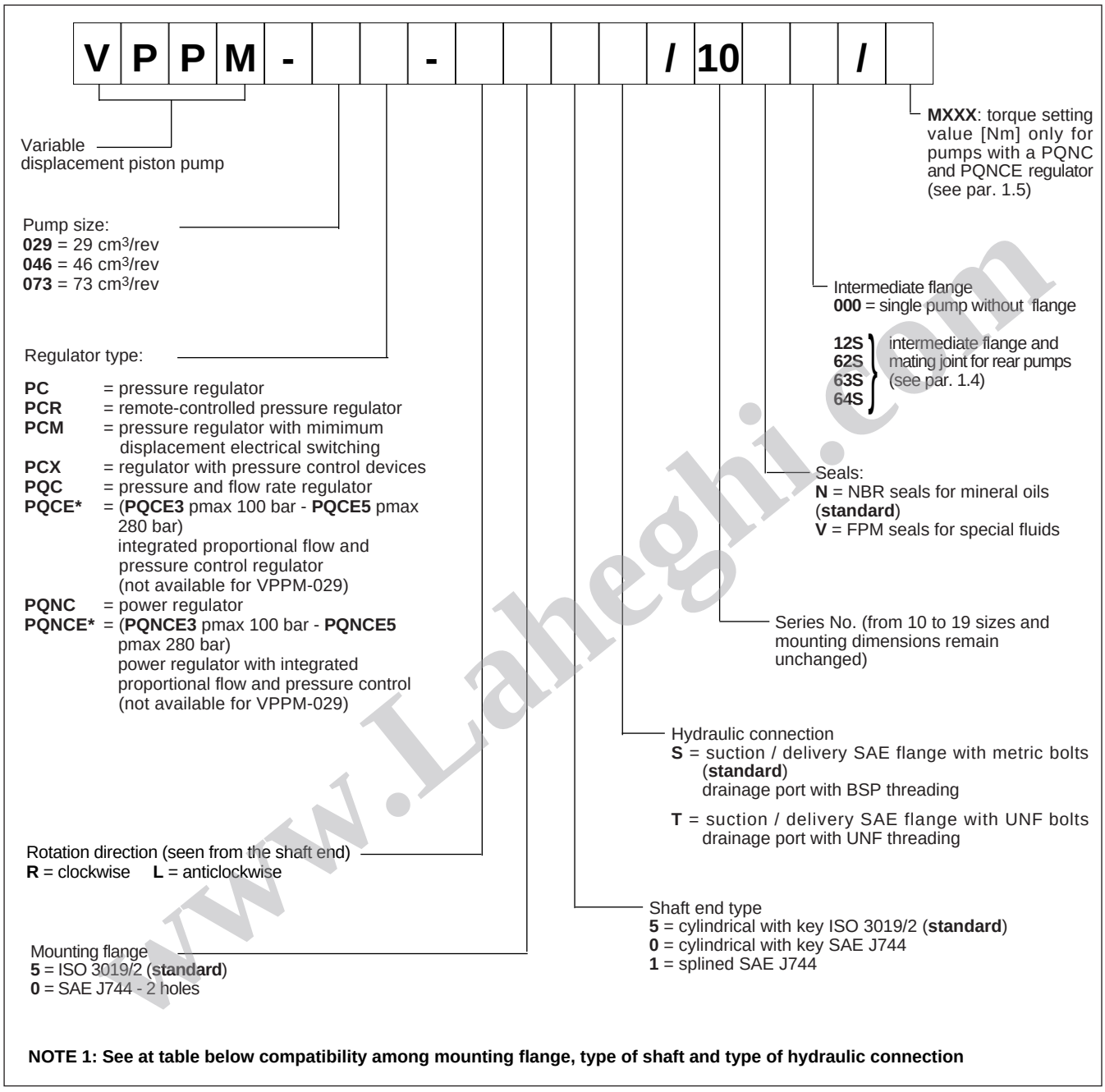
Ambient temperature range	°C	-15 ÷ +70
Fluid temperature range	°C	–25 ÷ +90
Fluid viscosity range	see par. 2.2	
Recommended viscosity	cSt	15 ÷ 35
Degree of fluid contamination	see par. 2.3	

HYDRAULIC SYMBOL



1 - IDENTIFICATION CODES

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



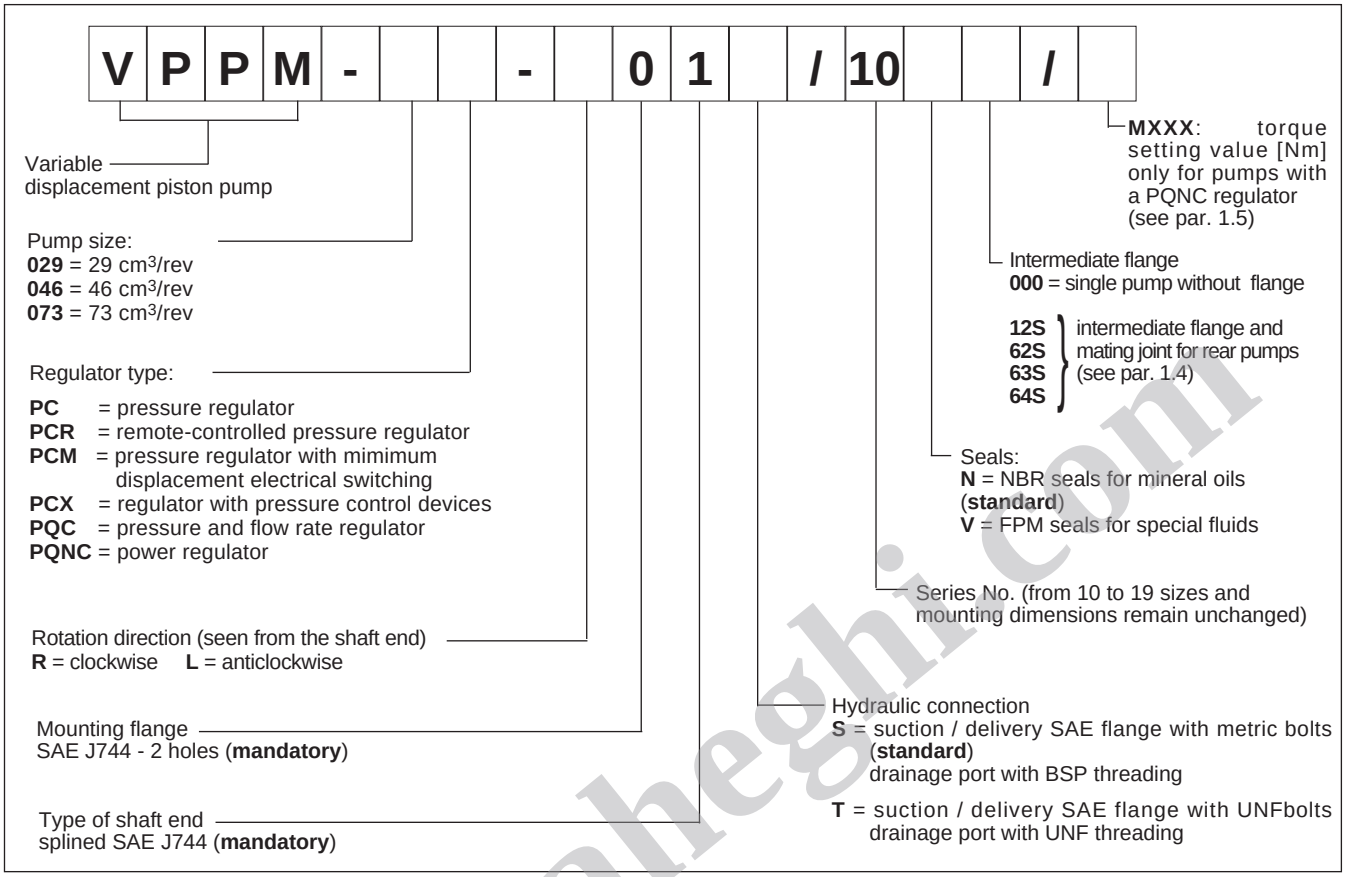
NOTE 1: See at table below compatibility among mounting flange, type of shaft and type of hydraulic connection

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 an intermediate flange plus mating joint	intermediate flange	mating joint	pump to be mated	possible combinations for VPPM pump with a through output shaft		
				029	046	073
12S	2-hole SAE J744 - type “A”	SAE J744 output shaft 16/32 D.P. - 9T	external gear group 2	YES	YES	YES
62S	2-hole SAE J744 type“B”	SAE J744 output shaft 16/32 D.P. - 13T	external gear group 3	NO	YES	YES
			VPPM-029	YES		
63S	2-hole SAE J744 type “B”	SAE J744 output shaft 16/32 D.P. - 15T	VPPM-046	NO	YES	YES
64S	2-hole SAE J744 type “C”	SAE J744 output shaft 12/24 D.P. - 14T	VPPM-073	NO	NO	YES

N.B. For the flange type and dimensions see par. 21.

1.5 - Standardized torque values for PQNC and PQNCE regulators

ELECTRICAL MOTOR 4 POLES		VPPM-029		VPPM-046		VPPM-073	
Power [kW]	N [rpm]	**torque** [Nm]	p regulation start [bar]	**torque** [Nm]	p regulation start [bar]	**torque** [Nm]	p regulation start [bar]
3	1430	**020**	34	-	-	-	-
4	1425	**026**	46	**026**	30	-	-
5.5	1440	**036**	62	**036**	41	-	-
7.5	1450	**050**	84	**050**	56	**050**	36
9.2	1460	**060**	103	**060**	68	**060**	44
11	1455	**072**	124	**072**	82	**072**	53
15	1460	**098**	168	**098**	111	**098**	72
18.5	1460	-	-	**122**	137	**122**	89
22	1465	-	-	**144**	163	**144**	105
30	1470	-	-	-	-	**196**	143
37	1475	-	-	-	-	**240**	175

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 mimimum displacement electrical switching - SAE mounting flange and SAE splined shaft
VPPM-046PCM-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/10N000

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/10N000/M098

g) 73 cm^3/rev front pump with pressure regulator, ready to mate to a VPPM029 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 in par. 3 must be reduced as follows: maximum continuous pressure: 200 bar max. rotation speed: VPPM-029 = 2100 rev/min VPPM-046 = 2000 rev/min VPPM-073 = 1700 rev/min - The suction pressure must be lower than 0,8 absolute bars (-0,2 relative bars) - The fluid maximum temperature must be lower than 50°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 240 bars.

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 NAS 1638 class 9; therefore the use of a delivery or return filter with $\beta_{20} \geq 75$ is suggested.
A degree of maximum fluid contamination according to NAS 1638 class 7 is recommended for optimum endurance of the pump. Hence, the use of a filter with $\beta_{10} \geq 100$ 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 par. 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 - PERFORMANCE RATINGS (measured with mineral oil with viscosity of 36 cSt at 50°C)

PUMP SIZE			029	046	073
Maximum displacement			29	46	73
Maximum flow rate	at 1500 rev/min	l/min.	43.5	69	109.5
	at the max. rotation speed		87	119.6	160.6
Input pressure	min	bar	- 0.2		
	max		24		
Max. delivery pressure	continuous	bar	280		
	intermittent (note 1)		315		
	peak		350		
Max. pressure on the drainage port		bar	0.5		
Max. power (with Δp = 280 bar)	at 1500 rev/min	kW	19.9	31.6	50.1
	at the max. rotation speed		39.8	54.7	73.5
Max. absorbed torque	Δp = 100 bars	Nm	46.2	73.2	116.2
	Δp = 280 bars		129.3	205.1	325.5
Moment of inertia on the shaft		kgm^2	0.0020	0.0030	0.0080
Max. rotation speed with maximum displacement (note 2)		rev/min	3000	2600	2200

The pressure values stated in the table are to be understood as relative ones

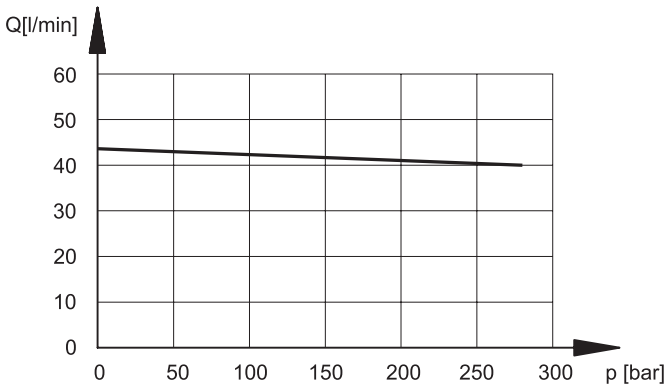
NOTE 1: Allowed intermittent duty pressures with a duration equal to 10% of the working time (e.g. 6 seconds for each minute)

NOTE 2: Values referring to a zero bar pressure (relative) on the suction port

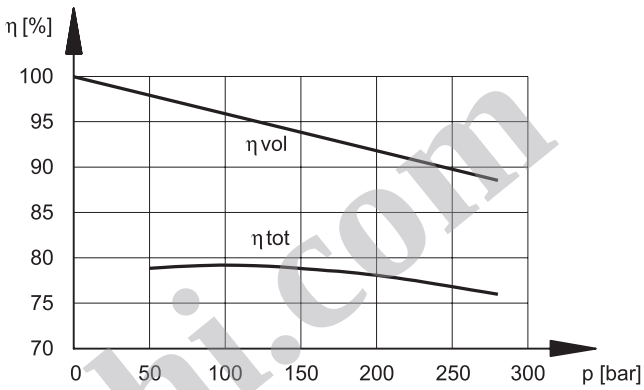
4- VPPM029 PUMP CHARACTERISTIC CURVES (values obtained with mineral oil with viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rev/min.

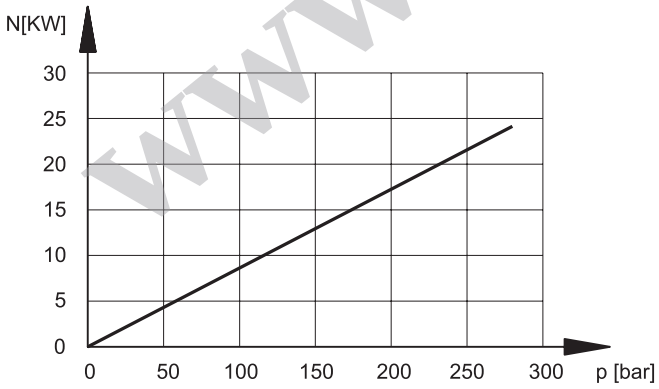
FLOW RATE/PRESSURE CURVES



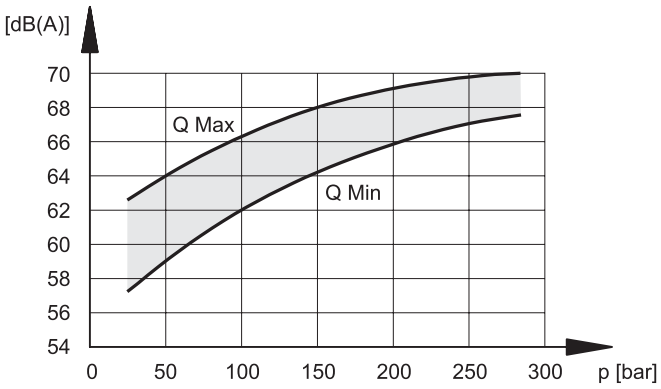
VOLUMETRIC AND TOTAL EFFICIENCY



ABSORBED POWER



NOISE LEVEL

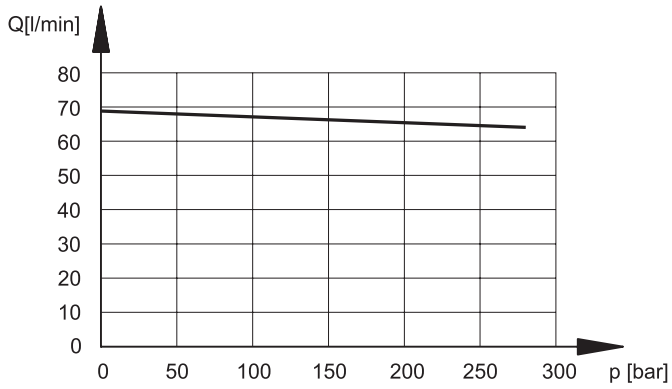


The noise pressure levels were measured in a semi-anecoic room, at a distance of 1 m from the pump and with a tolerance of ± 2 dB(A).
The values shown must be reduced by 5 dB(A) if they are to be considered in a completely anecoic room.

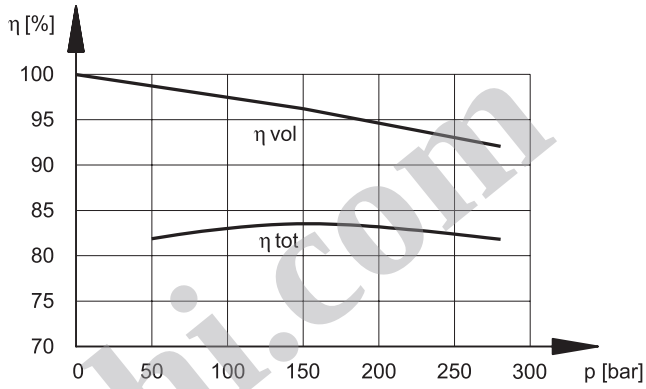
5- VPPM-046 PUMP CHARACTERISTIC CURVES (values obtained with mineral oil with viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rev/min.

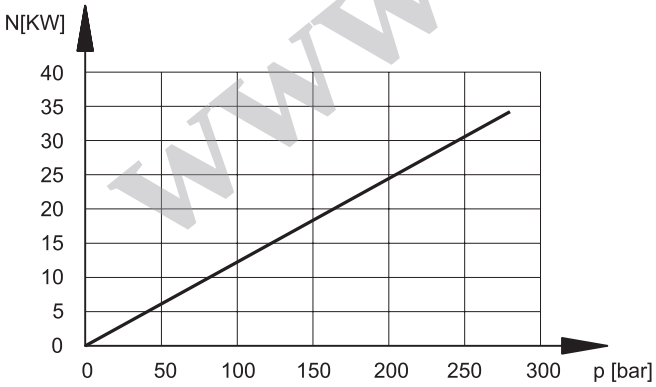
FLOW RATE/PRESSURE CURVES



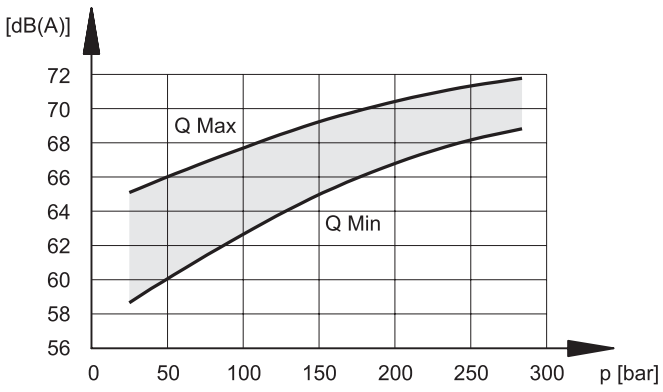
VOLUMETRIC AND TOTAL EFFICIENCY



ABSORBED POWER



NOISE LEVEL

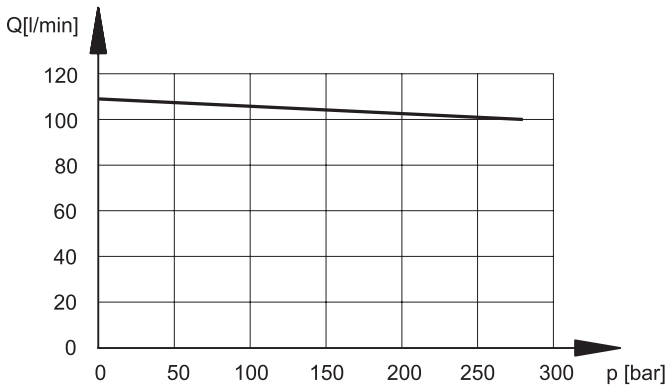


The noise pressure levels were measured in a semi-anecoic room, at a distance of 1 m from the pump and with a tolerance of ± 2 dB(A).
The values shown must be reduced by 5 dB(A) if they are to be considered in a completely anecoic room.

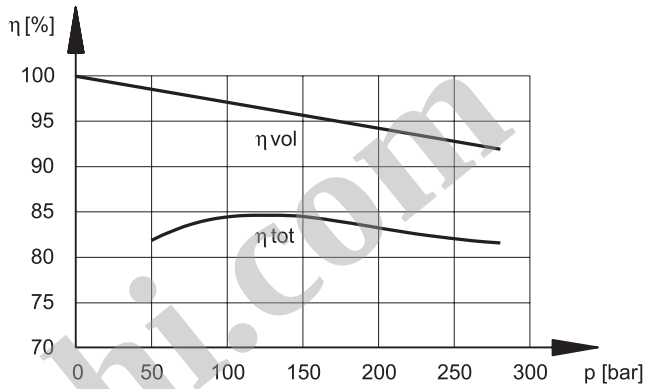
6- VPPM-073 PUMP CHARACTERISTIC CURVES (values obtained with mineral oil wiith a viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rev/min.

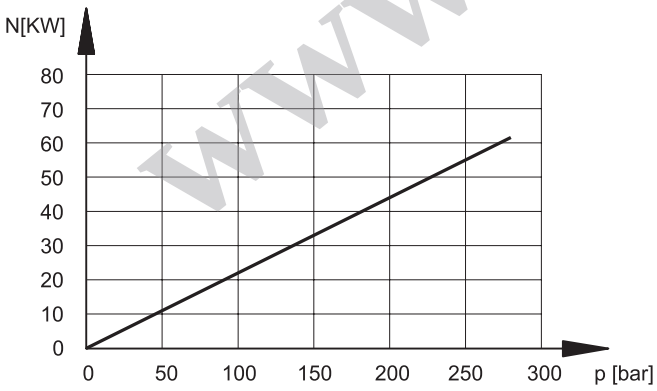
FLOW RATE/PRESSURE CURVES



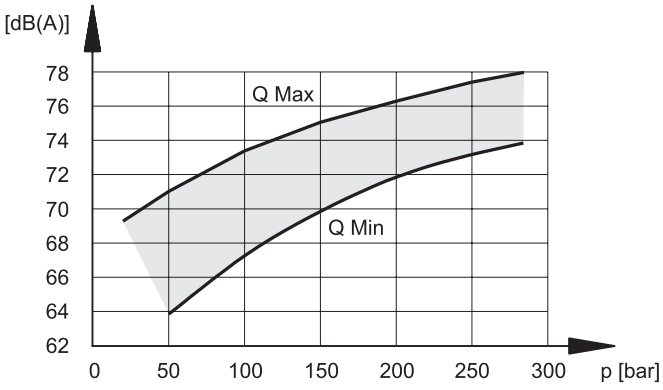
VOLUMETRIC AND TOTAL EFFICIENCY



ABSORBED POWER



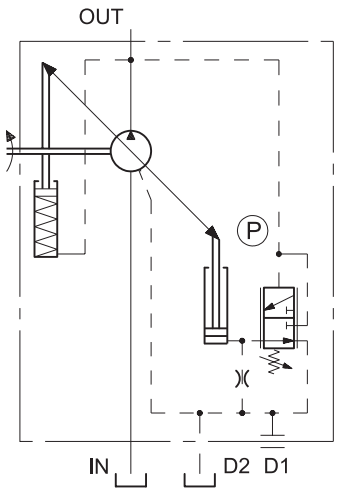
NOISE LEVEL



The noise pressure levels were measured in a semi-anecoic room, 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 anecoic room.

7- 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 Ⓟ regulation valve.

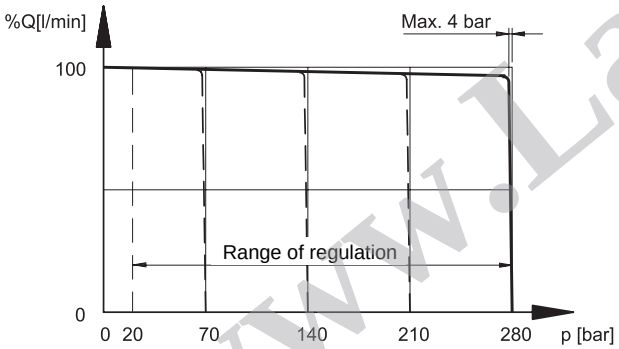
FEATURES OF THE PC REGULATOR:

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

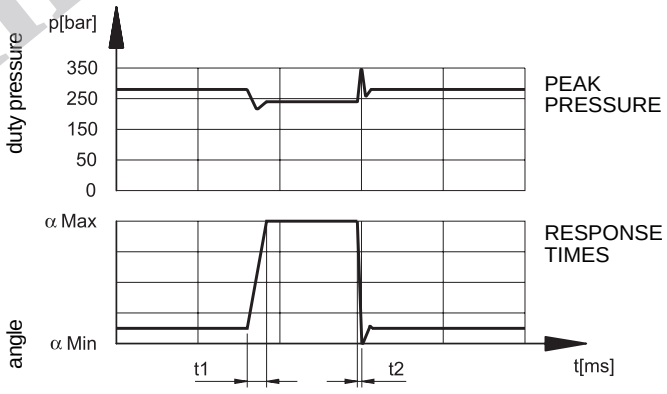
7.1- CHARACTERISTIC CURVES OF THE PC REGULATOR (values obtained with mineral oil wiith a viscosity of 36 cSt at 50°C)

The diagram curves were measured with a pump rotation speed of 1500 rev/min 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.

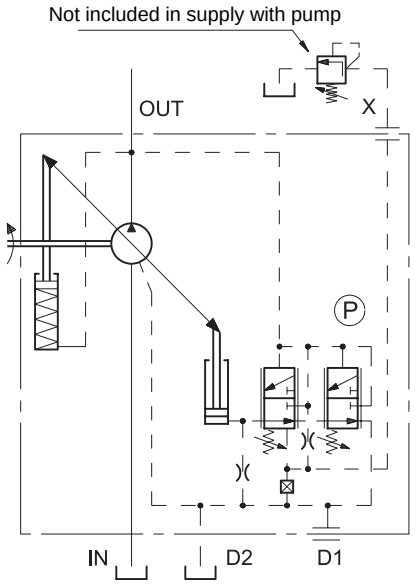
The values stated in the table are obtained from the opening until the instant the delivery level is achieved, by using a maximum pressure valve set at 350 bars for a load simulation, placed at a distance of 1 m from the pump delivery port.

PC pressure regulator set at 280 bars

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

8- REMOTE-CONTROLLED PRESSURE REGULATOR: PCR

FUNCTIONAL DIAGRAM



The PCR regulator, apart from limiting the line maximum pressure (Ⓟ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.

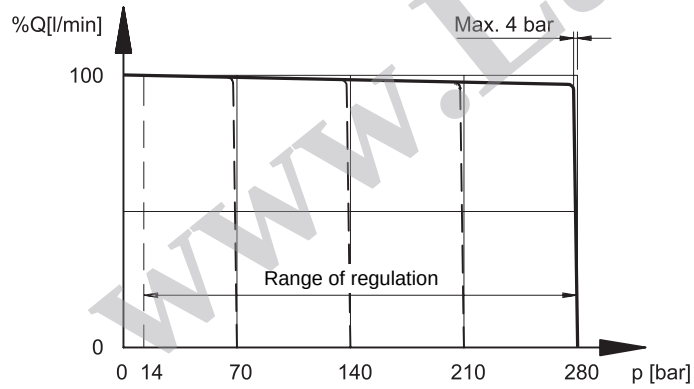
PCR FEATURES:

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

8.1- CHARACTERISTIC CURVES OF THE PCR REGULATOR (values obtained with mineral oil wiith a viscosity of 36 cSt at 50°C)

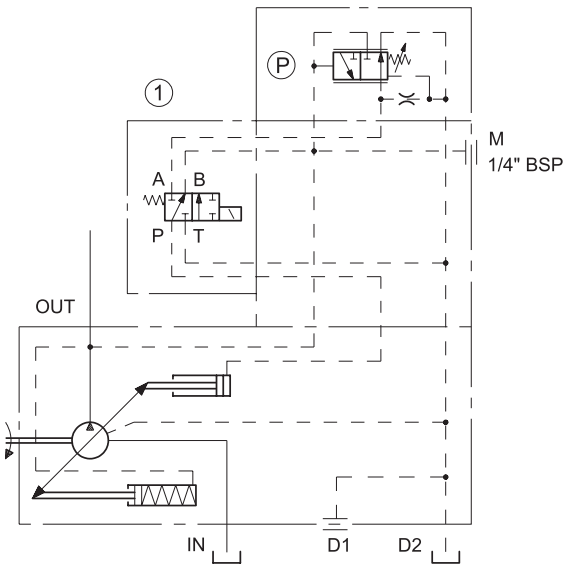
The diagram curves were measured with a pump rotation speed of 1500 rev/min and an oil temperature of 50°C.

FLOW RATE/PRESSURE FEATURE



9- PRESSURE REGULATOR WITH MINIMUM DISPLACEMENT ELECTRICAL SWITCHING: PCM

FUNCTIONAL DIAGRAM



The PCM pressure regulator allows, by means of a suitable solenoid valve, the electrical switching of the pump displacement from the maximum to the minimum (or zero) value.
The solenoid valve is installed on the pump regulator directly and is to be ordered separately.

This function is useful for:
- pump unloading at the start-up
- performing fast-slow movements, by switching the pump displacement from the maximum to a reduced value, setted with the relevant limiting screw (see par. 16 - 17 - 18).

PCM FEATURES:

- solenoid switching valve ① = DS3-TA23 (to be ordered separately see cat. 41 150)
- solenoid valve OFF = minimum displacement
- delivery pressure with solenoid valve OFF = 6 bar
- solenoid valve ON = max displacement and delivery pressure set on regulator Ⓟ .

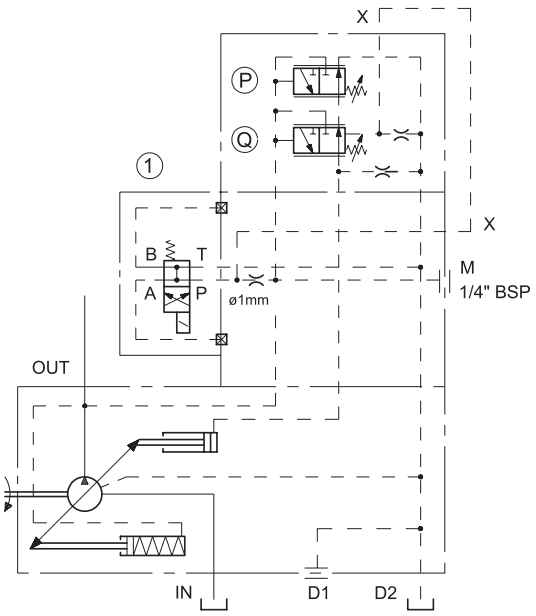
- pressure regulating range Ⓟ = 20 ÷ 350 bar with solenoid valve ON
- default setting Ⓟ = 280 bar

NOTE: For PCM regulator characteristic curves see PC diagrams, par. 7.1.

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 funcion 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.

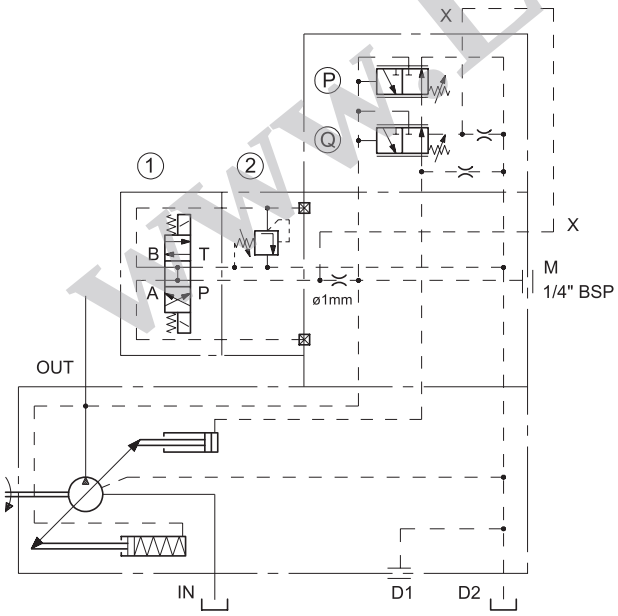
The pressure switching is made by means of a solenoid valve (to be ordered separately) installed on the pump regulator directly.

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 Ⓟ
- pressure regulating range Ⓟ = 20 ÷ 350 bar
- default setting Ⓟ = 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 cat. 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 Ⓟ (maximum value)

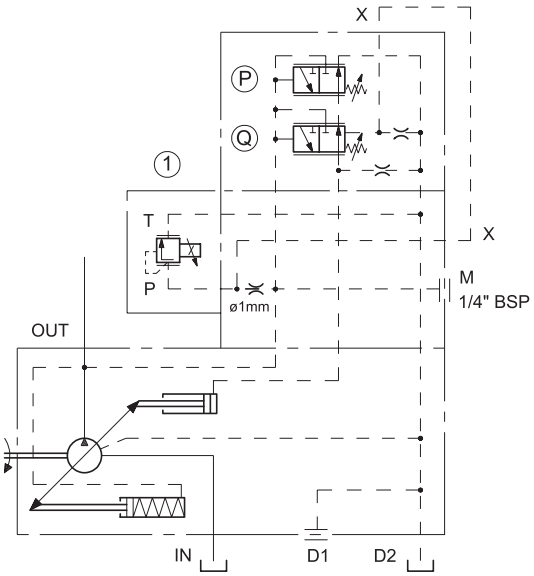
- pressure relief valve ② = MCD*-SBT (to be ordered separately - see cat. 61 200)
- pressure regulating range ② = MCD3-SBT 20 ÷ 100 bar
  MCD5-SBT 20 ÷ 250 bar

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

NOTE: For PCX regulators characteristic curves (with two pressure settings + unloading functions), see PC regulator diagrams, par. 7.1.

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 Ⓟ = 20 ÷ 350 bar
- default setting Ⓟ = 280 bar

- proportional pressure relief valve ① = CDE* (to be ordered separately - see cat. 81 200)
- proportional pressure regulating range :
  CDE3 20 ÷ 100 bar
  CDE5 20 ÷ 280 bar

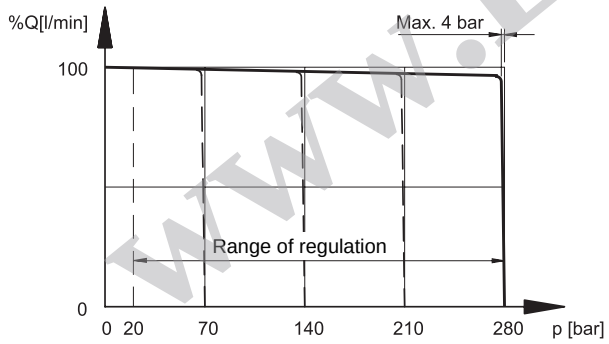
Hysteresis = < 5% di p nom
Repeatability = < ± 2% di p nom

Electronic control units for proportional pressure relief valve:
EPA-M110 (see cat. 89 220) - UEIK-11 (see cat. 89 300)

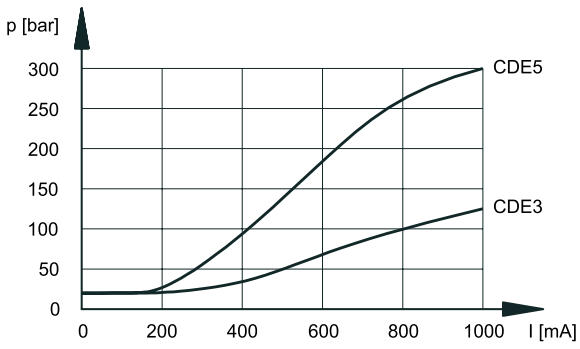
10.3.1- CHARACTERISTIC CURVES (values obtained with mineral oil wiith a viscosity of 36 cSt at 50°C)

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

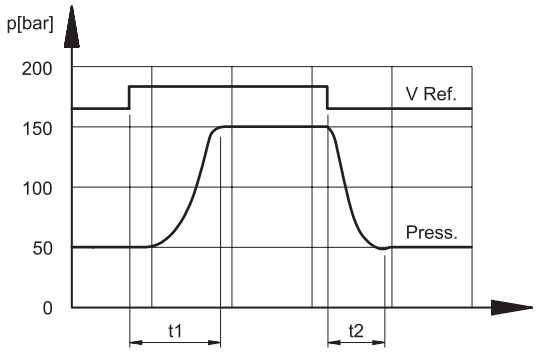
FLOW RATE/PRESSURE FEATURE



CURRENT/PRESSURE FEATURE



RESPONSE TIME

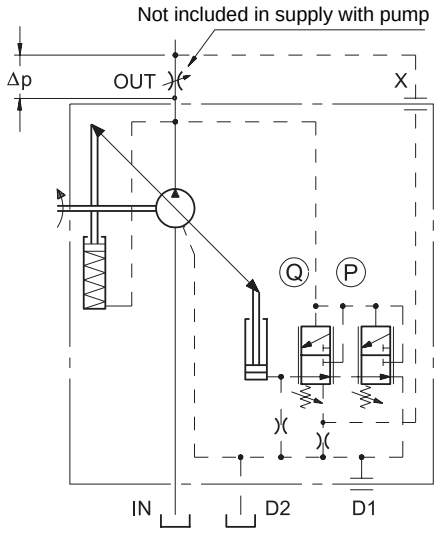


The response times are obtained with a VPPM-046 pump, by changing the reference signal (V Ref)on the proportional valve in order to have a line pressure variation from 50 to 150 bar and vice versa, with an oil volume of 5lt.

t1 = 80 ms (response time for an increasing pressure change)
t2 = 60 ms (response ti me 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 flowline downstream the restrictor (or valve) must always be made (customer charge).

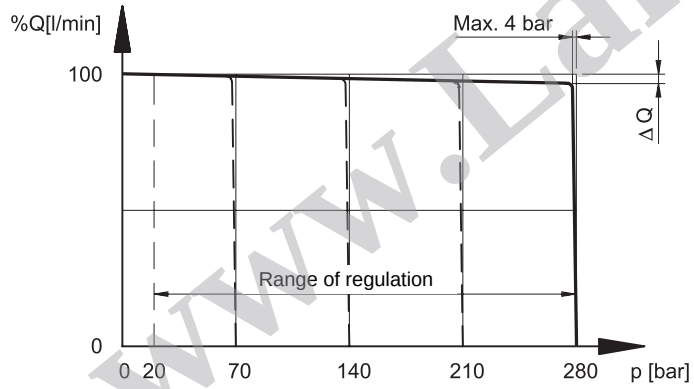
PQC FEATURES:

- pressure regulating range Ⓟ = 20 ÷ 350
- default setting Ⓟ = 280 bars
- differential pressure regulating range Ⓠ = 10 ÷ 30 bars
- default setting = 14 bars
- Min. discharge head = 18 ± 2 bars
  (with a zero flow rate , X discharge pilot and with a default Ⓠsetting of the differential regulator)

11.1- CHARACTERISTIC CURVES OF THE PQC REGULATOR (values obtained with mineral oil wiith a viscosity of 36 cSt at 50°C)

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

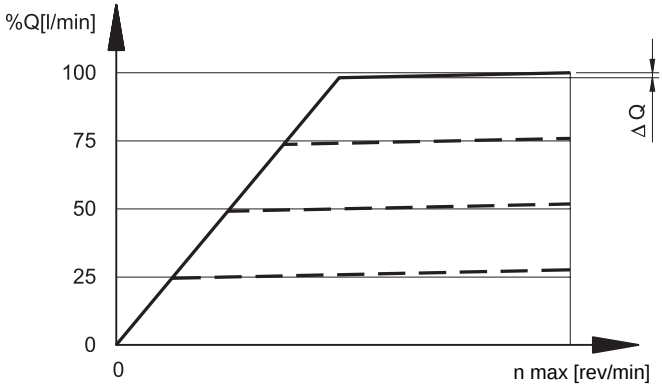
FLOW RATE/PRESSURE FEATURE



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

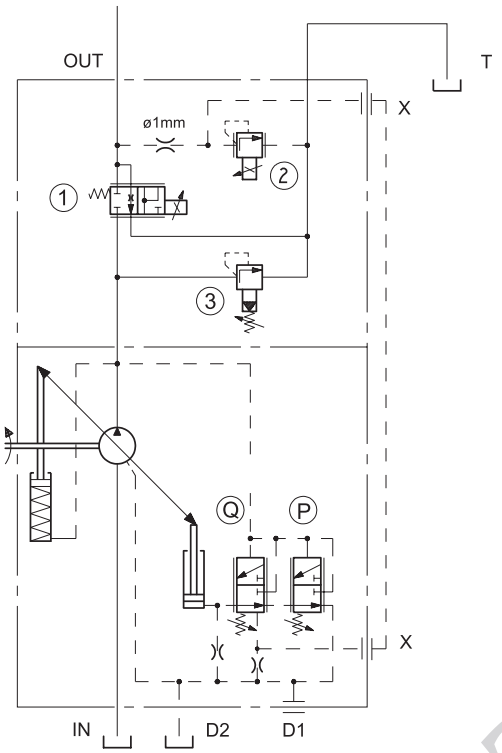
pump size	ΔQmax [l/min]
029	0.9
046	1.7
073	2.5

FLOW RATE/ROTATION SPEED STATIC FEATURE



12 - INTEGRATED PROPORTIONAL FLOW AND PRESSURE CONTROL REGULATOR: PQCE

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 Ⓠ .

The maximum system pressure is limited by the regulator Ⓟ . 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.

PQCE FEATURES

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

- differential pressure regulating range Ⓠ = 10 ÷ 30 bar
- default setting = 14 bar

- proportional pressure regulating range:
  20 ÷ 100 bar (for VPPM-*PQCE3 pump)
  20 ÷ 280 bar (for VPPM-*PQCE5 pump)

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

PERFORMANCES AND ELECTRICAL CHARACTERISTICS

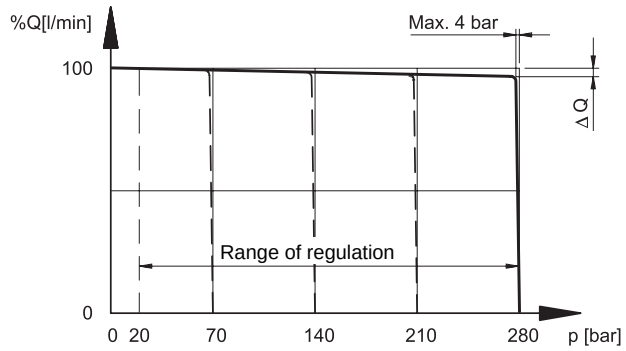
	FLOW REGULATION ①	PRESSURE REGULATION ②
Hysteresis	< 6% of Q max	< 5% of nom p
Repeatability	< ± 2% of Q max	< ± 2% of nom p
Nominal voltage	24 [Vcc]	20 [Vcc]
Coil resistance (at 20°C)	16,7 [Ω]	18,5 [Ω]
Current nominal	1,11 [A]	0,7 [A]
Current maximum	1,20 [A]	0,82 [A]
Electromagnetic compatibility (EMC)	- emissions EN 50081 - 1 - immunity EN 50082 - 2	
Protection to atmospheric agents	IP 65	
Electronic control units for proportional valves	EPA-M3210 (see cat. 89 220) UEIK-12 (see cat. 89 300)	UEIK-11 (see cat. 89 300)

In the case of using the EPA-M3210 double channel electronic control unit, connect the proportional flow control valve to the channel 1 and the proportional pressure relief valve to the channel 2.

12.1- CHARACTERISTIC CURVES OF THE PQCE REGULATOR (values obtained with mineral oil wiith a viscosity of 36 cSt at 50°C)

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

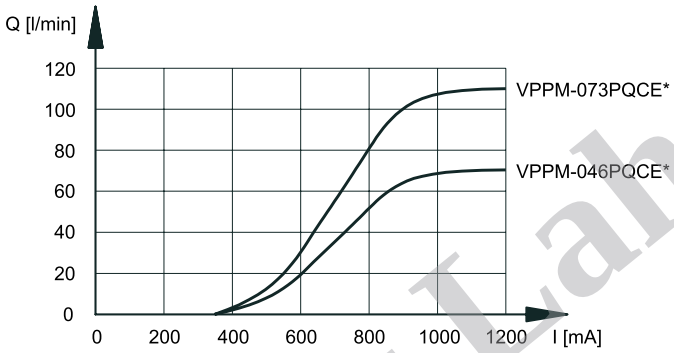
FLOW RATE/PRESSURE FEATURE



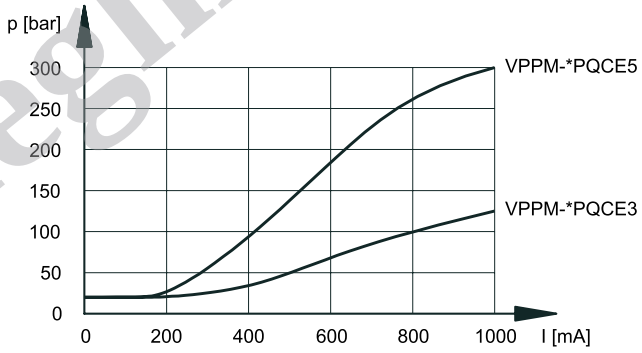
Flow variation between minimum and maximum pressure with pump set at max displacement

pump size	ΔQmax [l/min]
046	1,7
073	2,5

CURRENT/FLOW FEATURE

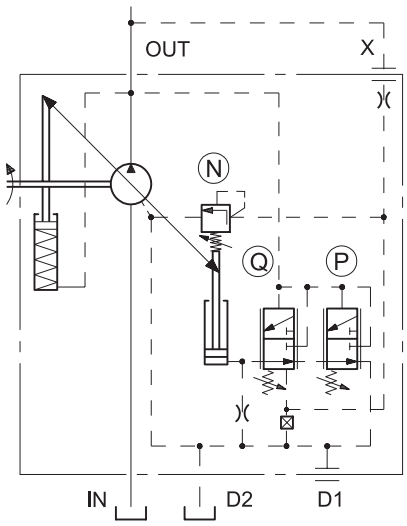


CURRENT/PRESSURE FEATURE



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 Ⓟ maximum pressure and regulating the Ⓠ 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 ∅ 0,8 orifice. **Note**: The connection pipe between the X port and the pump outlet must always be made (customer charge).

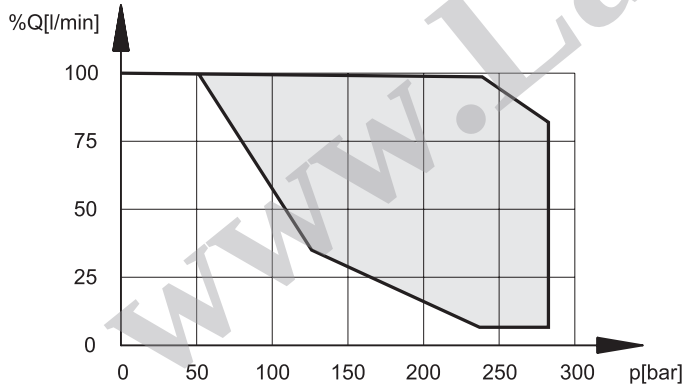
PQNC FEATURES:

- pressure regulating range Ⓟ = 20 ÷ 350
- default setting Ⓟ = 280 bars
- differential pressure regulating range Ⓠ = 10 ÷ 30 bars
- default setting = 14 bars
- min. discharge head = 18 ± 2 bars
  (with a zero flow rate , X discharge pilot and with a default Ⓠ 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 par. 1).
- Start of the regulation: see values at table of par. 1.5

13.1- CHARACTERISTIC CURVES OF THE PQNC REGULATOR (values obtained with mineral oil wiith a viscosity of 36 cSt at 50°C)

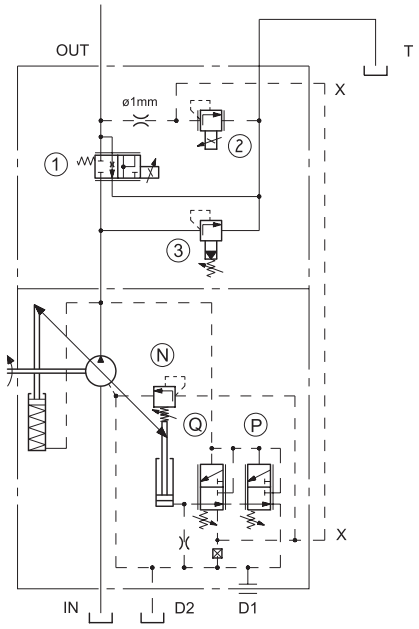
The diagram curves were measured with a pump rotation speed of 1500 rev/min and an oil temperature of 50°C.

FLOW RATE/PRESSURE FEATURE



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

FUNCTIONAL DIAGRAM



This system combines all the functions of the constant power control as a standard PQNC 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 Ⓝ.

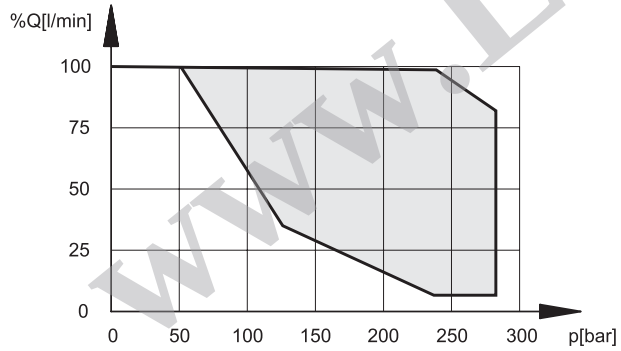
PQNCE FEATURES

For technical characteristics and settings of PQNCE regulator, see par. 13.

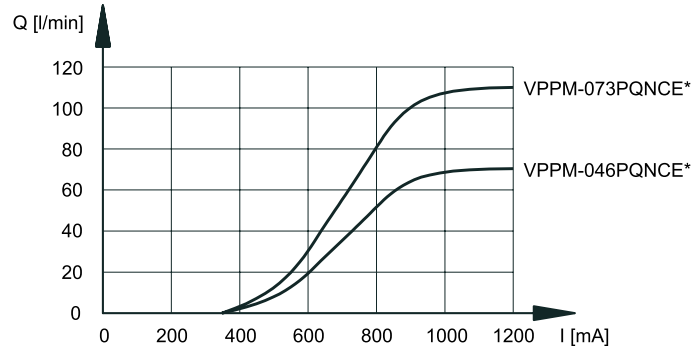
14.1- CHARACTERISTIC CURVES OF THE PQNCE REGULATOR (values obtained with mineral oil wiith a viscosity of 36 cSt at 50°C)

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

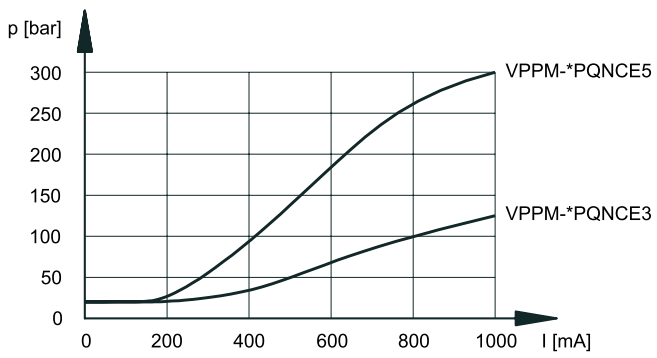
FLOW RATE/PRESSURE FEATURE



CURRENT/FLOW FEATURE

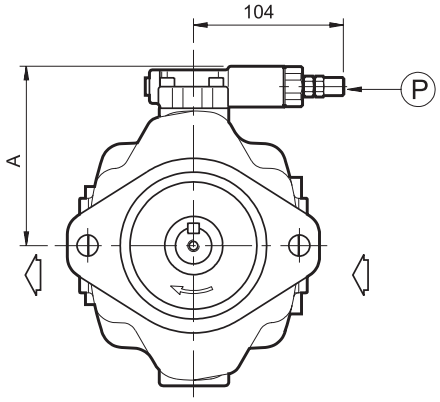


CURRENT/PRESSURE FEATURE



15 - REGULATOR OVERALL DIMENSIONS

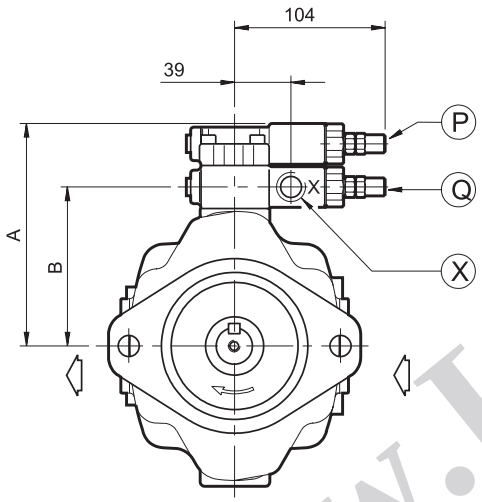
dimensions in mm



PRESSURE REGULATOR PC

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

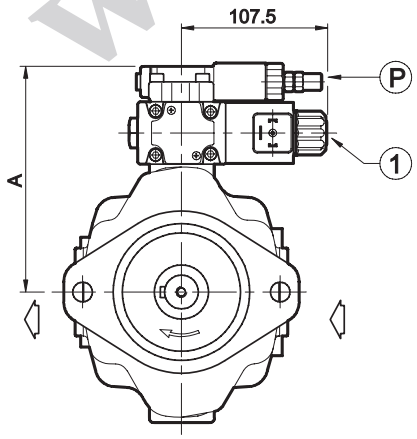
Ⓟ	Pressure regulator countersunk hex adjustment screw: Spanner 4 Clockwise rotation to increase pressure



REMOTE-CONTROLLED PRESSURE REGULATOR PCR

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

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

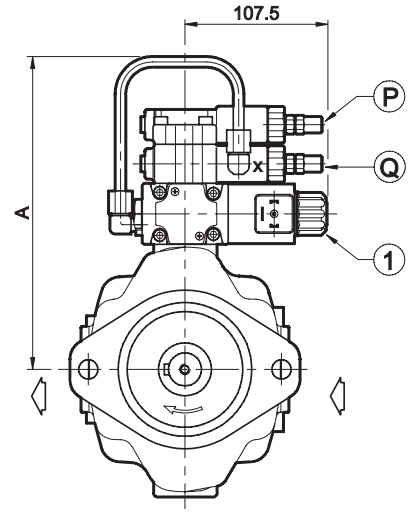


PRESSURE REGULATOR WITH MINIMUM DISPLACEMENT ELECTRICAL SWITCHING PCM

pump size	A [mm]
029	164
046	173
073	186

Ⓟ	Pressure regulator countersunk hex adjustment screw: Spanner 4 Clockwise rotation to increase pressure
①	Solenoid switching valve DS3-TA23

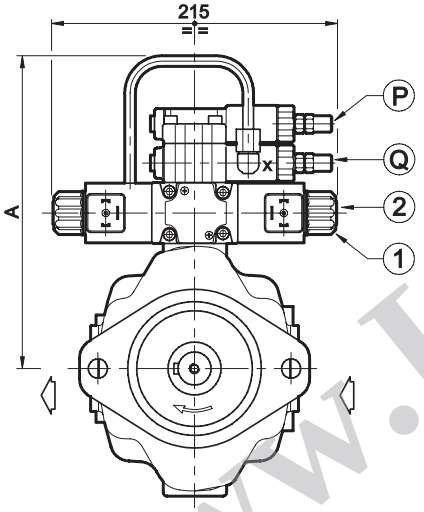
dimensions in mm



PCX REGULATOR WITH ELECTRICAL UNLOADING

pump size	A [mm]
029	194
046	203
073	215

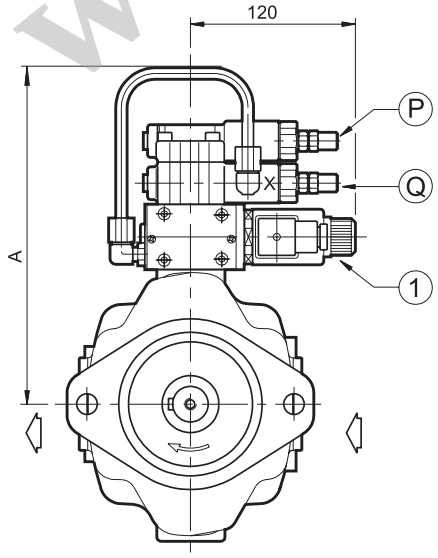
Ⓟ	Pressure regulator countersunk hex adjustment screw: Spanner 4 Clockwise rotation to increase pressure
Ⓠ	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure
①	Solenoid switching valve DS3-SA2



PCX REGULATOR WITH TWO PRESSURE SETTINGS + UNLOADING

pump size	A [mm]
029	194
046	203
073	215

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

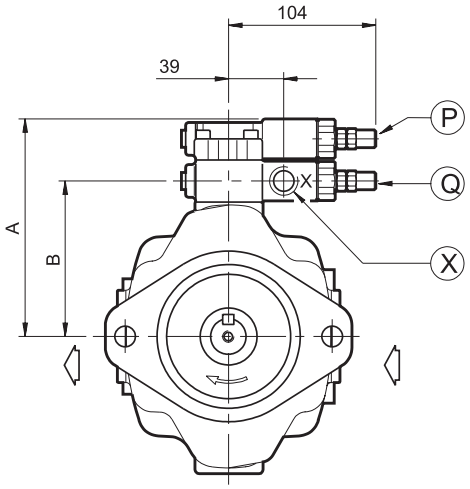


PCX REGULATOR FOR PRESSURE REGULATION WITH ELECTRIC PROPORTIONAL CONTROL

pump size	A [mm]
029	194
046	203
073	205

Ⓟ	Pressure regulator countersunk hex adjustment screw: Spanner 4 Clockwise rotation to increase pressure
Ⓠ	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure
①	Proportional pressure relief valve CDE* type

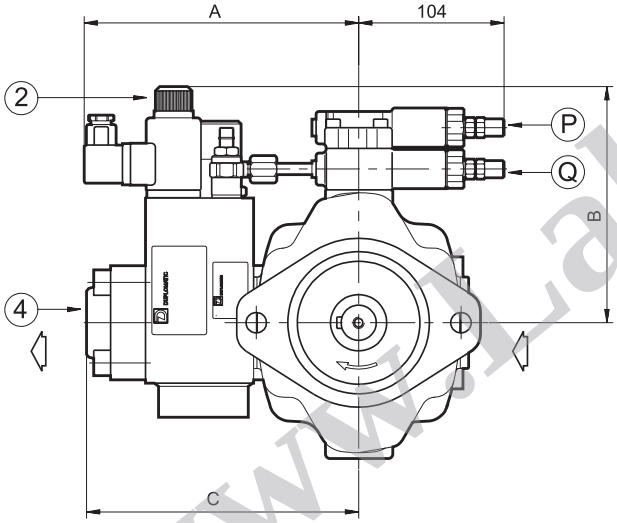
dimensions in mm



FLOW RATE AND PRESSURE REGULATOR PQC

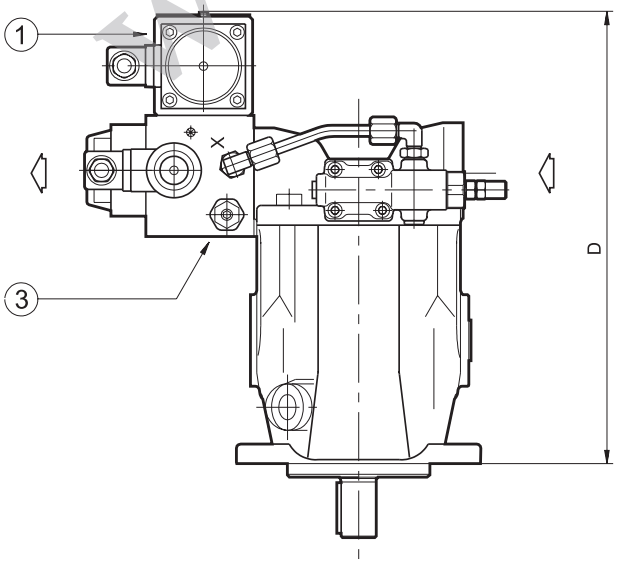
pump size	A [mm]	B [mm]
029	144	100
046	153	109
073	165	122

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



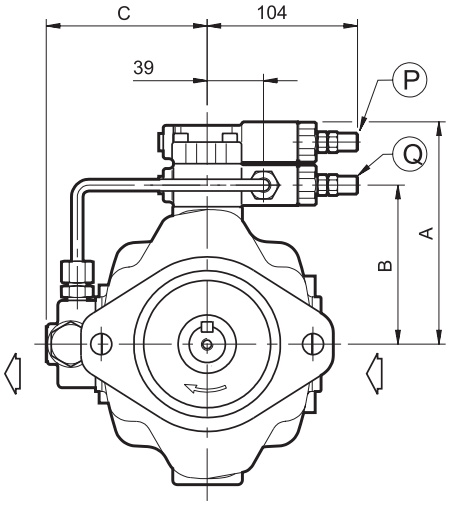
PQCE REGULATOR WITH INTEGRATED PROPORTIONAL FLOW AND PRESSURE CONTROL

pump size	A [mm]	B [mm]	C [mm]	D [mm]
046	196	169	194	320
073	206	174	207	350



Ⓟ	Pressure regulator countersunk hex adjustment screw: Spanner 4 Clockwise rotation to increase pressure
Ⓠ	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure
①	Proportional flow control valve: D4E-070TC - D4E-100TC
②	Proportional pressure control valve: CRE3 - CRE5
③	Safety pressure relief valve
④	Delivery port SAE 6000 flange 1" for VPPM-046 1 1/4" for VPPM-073

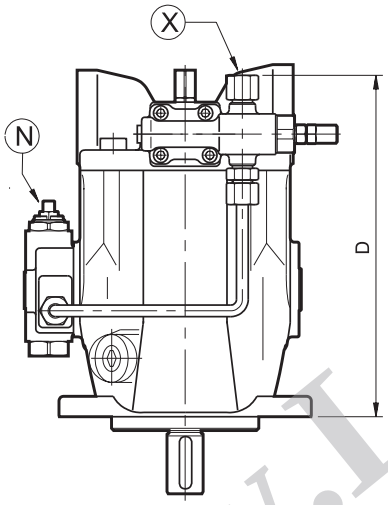
dimensions in mm



POWER REGULATOR PQNC

pump size	A [mm]	B [mm]	C [mm]	D [mm]
029	144	100	104	211
046	153	109	111	235
073	165	122	120	258

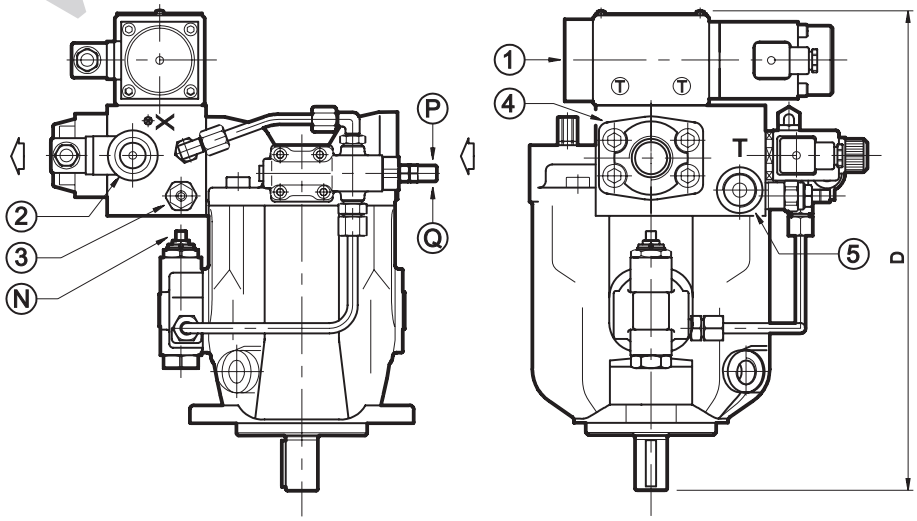
Ⓟ	Pressure regulator countersunk hex adjustment screw: Spanner 4 Clockwise rotation to increase pressure
Ⓠ	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differentialpressure
Ⓧ	Pilotage port X: 1/8" BSP (restrictor with ∅ 0,8 orifice included) See par. 13
Ⓝ	Power regulator



POWER REGULATOR WITH INTEGRATED PROPORTIONAL FLOW AND PRESSURE CONTROL PQNCE

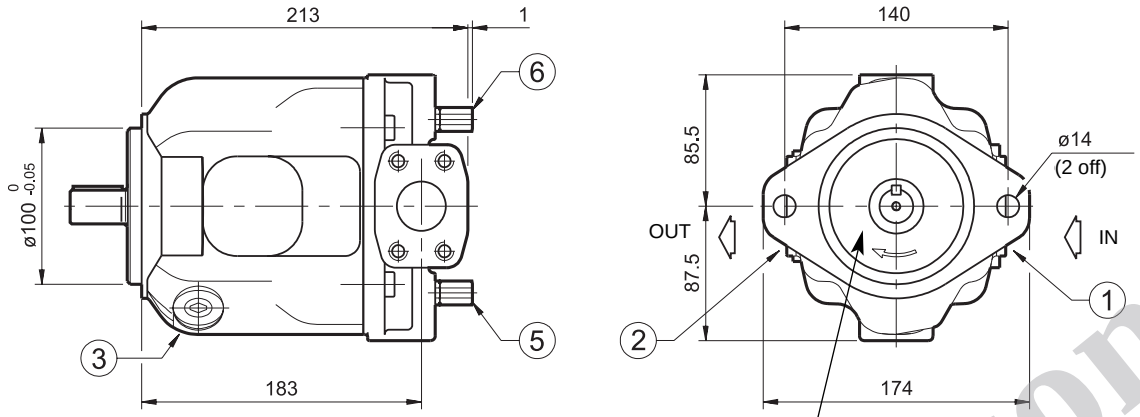
(for dimensions see PQCE page 22)

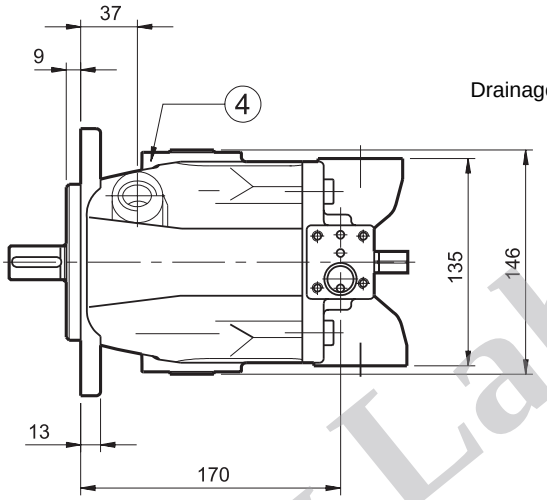
Ⓟ	Pressure regulator countersunk hex adjustment screw: Spanner 4 Clockwise rotation to increase pressure
Ⓠ	Differential pressure regulator countersunk hex adjustment screw: spanner 4 Clockwise rotation to increase differential pressure
Ⓝ	Power regulator
①	Proportional flow control valve: D4E-070TC - D4E-100TC
②	Proportional pressure control valve: CRE3 - CRE5
③	Safety pressure relief valve
④	Delivery port SAE 6000 flange 1" for VPPM-046 1 1/4" for VPPM-073
⑤	Outlet port T: 3/4" BSP



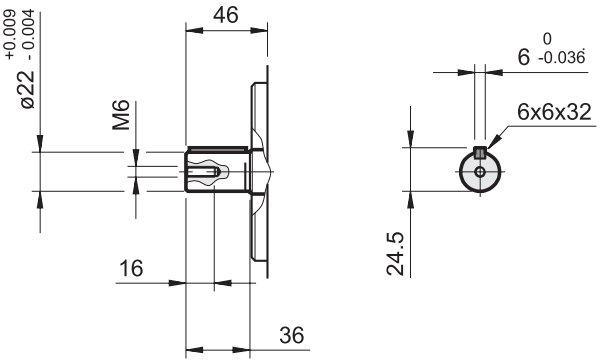
16 - VPPM-029 OVERALL AND MOUNTING DIMENSIONS

dimensions in mm





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

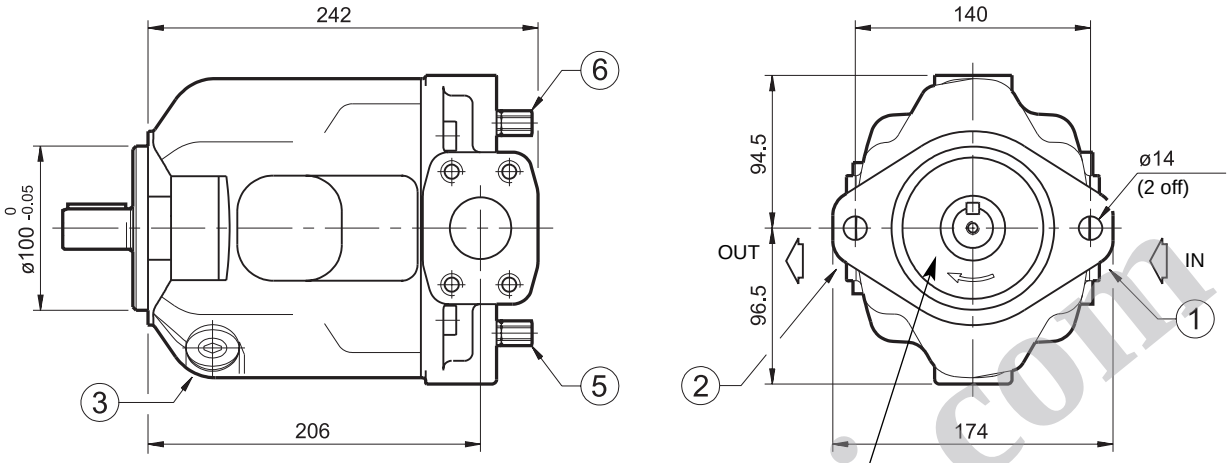


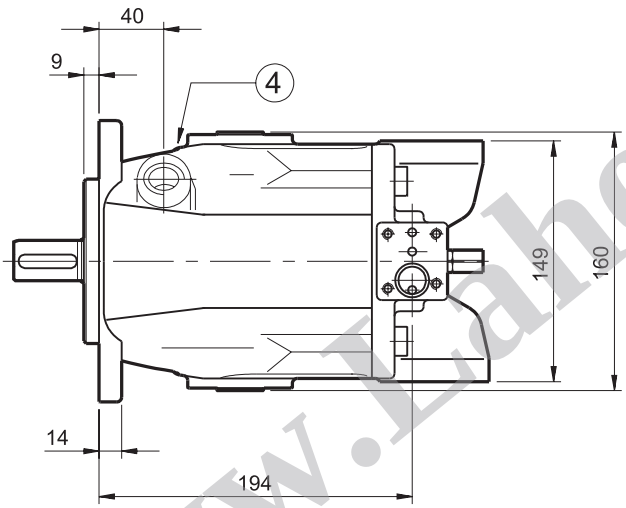
1	Suction port: IN flange SAE 3000 1 1/4" (for overall dimensions see par. 25)
2	Delivery port: OUT flange SAE 6000 3/4" (for overall dimensions see par. 25)
3	Additional drainage port D1: 1/2" BSP (closed)
4	Drainage port D2: 1/2" BSP
5 (see note)	Min. displacement limit control - protection plug: spanner 14 - countersunk hex adjustment screw : spanner 4 - displacement regulation range: 0 ÷ 50 % max. displ.
6	Max. displacement control limit - protection plug: spanner 14 - countersunk hex adjustment screw: spanner 4 - displacement regulation range: 100 ÷ 50 % max. displ.

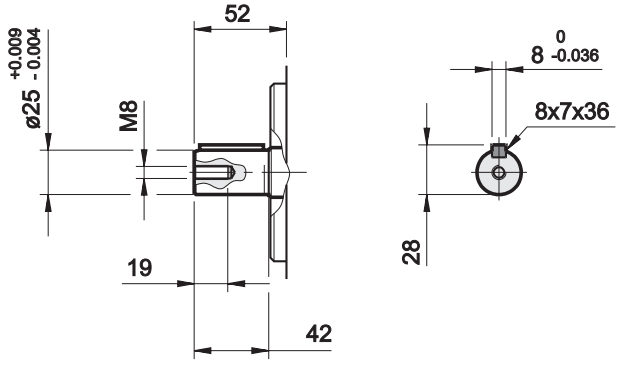
Note: The limit control is supplied factory set at zero minimum displacement and is sealed up with red paint.
Any modification of this setting by the user makes the pump unable to reach the null displacement condition.

17 - VPPM-046 OVERALL AND MOUNTING DIMENSIONS

dimensions in mm





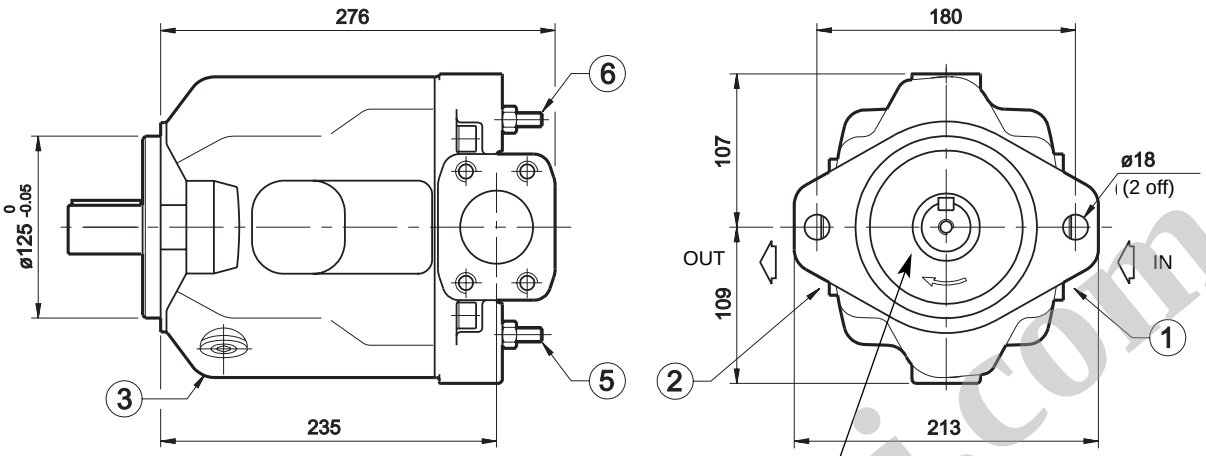


1	Suction port: IN flange SAE 3000 1 1/2” (for overall dimensions see par. 25)
2	Delivery port: OUT flange SAE 6000 1” (for overall dimensions see par. 25)
3	Additional drainage port D1: 1/2” BSP (closed)
4	Drainage port D2: 1/2” BSP
5 (see note)	Min. displacement limit control - protection plug: spanner 14 - countersunk hex adjustment screw : spanner 4 - displacement regulation range: 0 ÷ 50 % max. displ.
6	Max. displacement control limit - protection plug: spanner 14 - countersunk hex adjustment screw: spanner 4 - displacement regulation range: 100 ÷ 50 % max. displ.

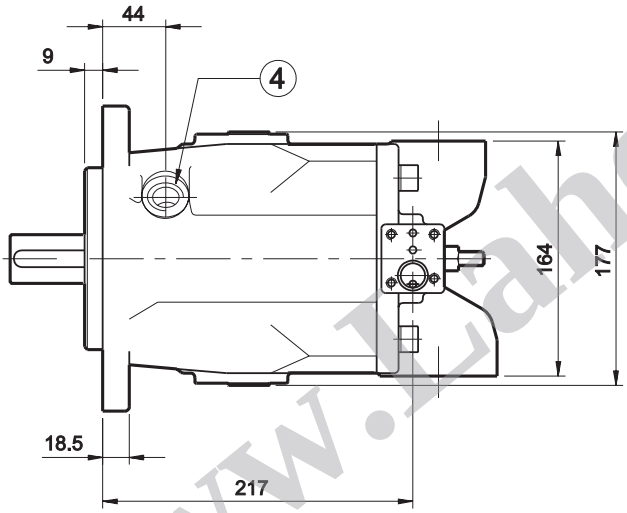
Note: The limit control is supplied factory set at zero minimum displacement and is sealed up with red paint.
Any modification of this setting by the user makes the pump unable to reach the null displacement condition.

18 - VPPM-073 OVERALL AND MOUNTING DIMENSIONS

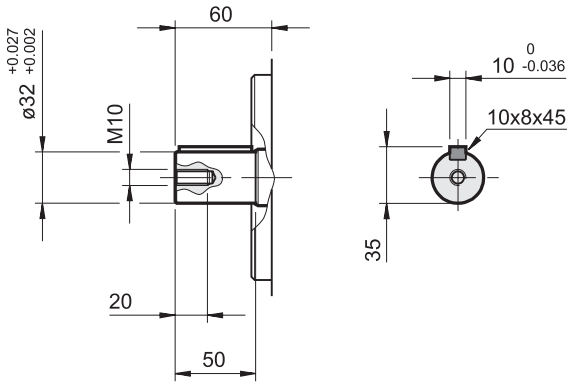
dimensions in mm



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



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



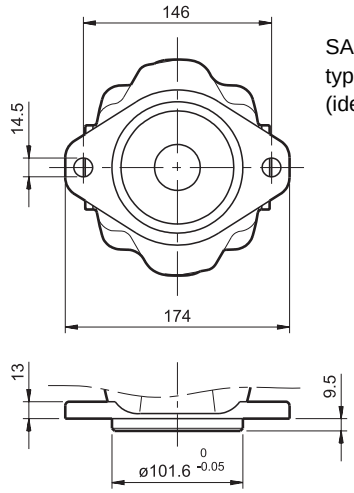
1	Suction port: IN flange SAE 3000 2” (for overall dimensions see par. 25)
2	Delivery port: OUT flange SAE 6000 1 1/4” (for overall dimensions see par. 25)
3	Additional drainage port D1: 1/2” BSP (closed)
4	Drainage port D2: 1/2” BSP
5 (see note)	Min. displacement limit control - protection plug: spanner 14 - countersunk hex adjustment screw : spanner 4 - displacement regulation range: 0 ÷ 50 % max. displ.
6	Max. displacement control limit - protection plug: spanner 14 - countersunk hex adjustment screw: spanner 4 - displacement regulation range: 100 ÷ 50 % max. displ.

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.

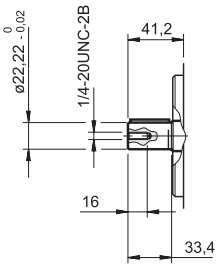
19 - OVERALL DIMENSIONS FOR FLANGES AND SHAFTS TYPE SAE J744

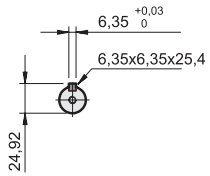
dimensions in mm

VPPM-029



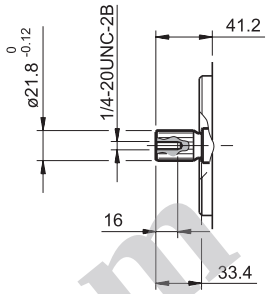
SAE J744 - 2-hole fitting flange
type “B”
(identification code: **0**)





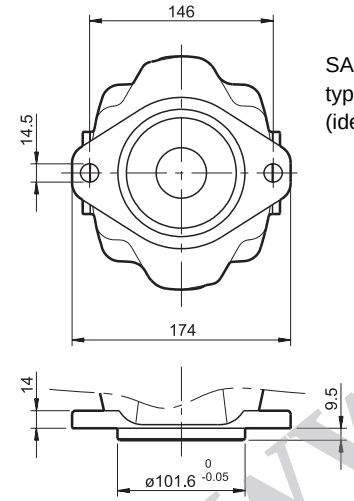
cylindrical with key shaft end
SAE J744
(identification code: **0**)

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

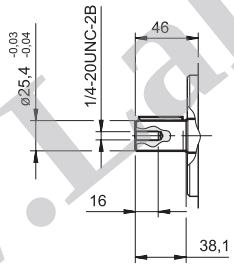


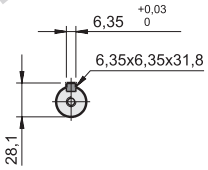
dimensioni in mm

VPPM-046



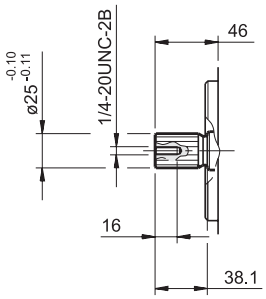
SAE J744 - 2-hole fitting flange
type “B”
(identification code: **0**)





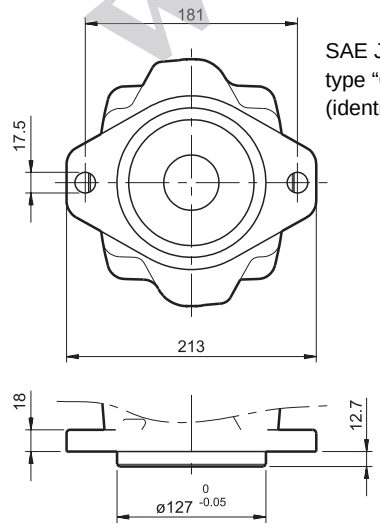
cylindrical with key shaft end
SAE J744
(identification code: **0**)

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

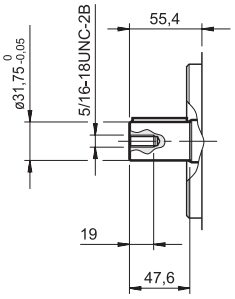


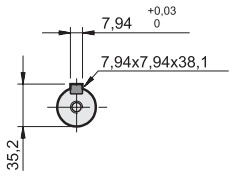
dimensioni in mm

VPPM-073



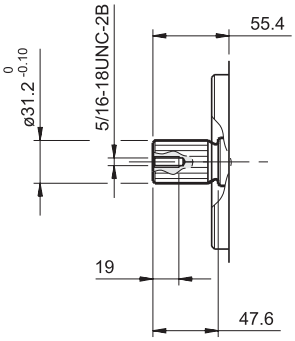
SAE J744 - 2-hole fitting flange
type “C”
(identification code: **0**)





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

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



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.

- 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 “Technical specifications”.
- As for details and the installation of filter elements, see par. 2.3.

21 - THROUGH OUTPUT SHAFT

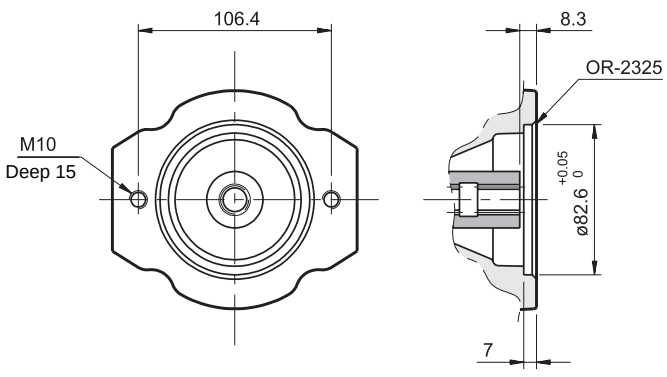
The VPPM pumps can be supplied with a through output shaft, which allows coupling with other pump models.

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 par. 19 “Coupled pumps”.

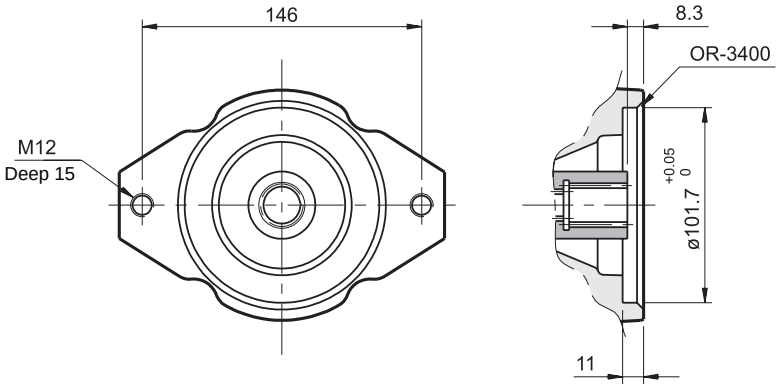
FLANGE + JOINT FOR THE COUPLING OF A GEAR PUMP GROUP 2
identification code **12S**



SAE J744 - 2-hole intermediate flange
type “A”

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

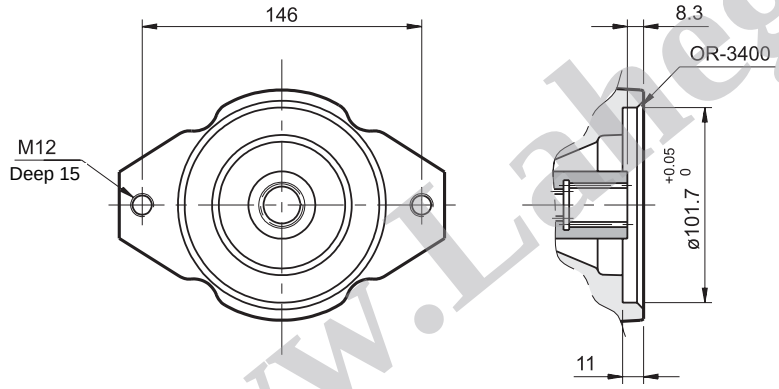
FLANGE + JOINT FOR THE COUPLING OF A PUMP TYPE VPPM-029
OR OF A GEAR PUMP GROUP 3
identification code **62S**



SAE J744 - 2-hole intermediate flange type “B”

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

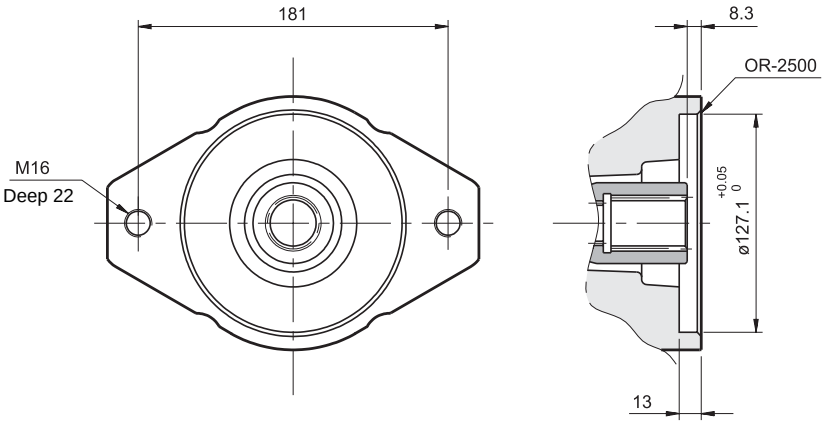
FLANGE + JOINT FOR THE COUPLING OF A PUMP TYPE VPPM-046
identification code **63S**



SAE J744 - 2-hole 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-hole 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 is 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:

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

n = rotation speed [rev/min]

where the absorbed power (N) is given by:

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

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).

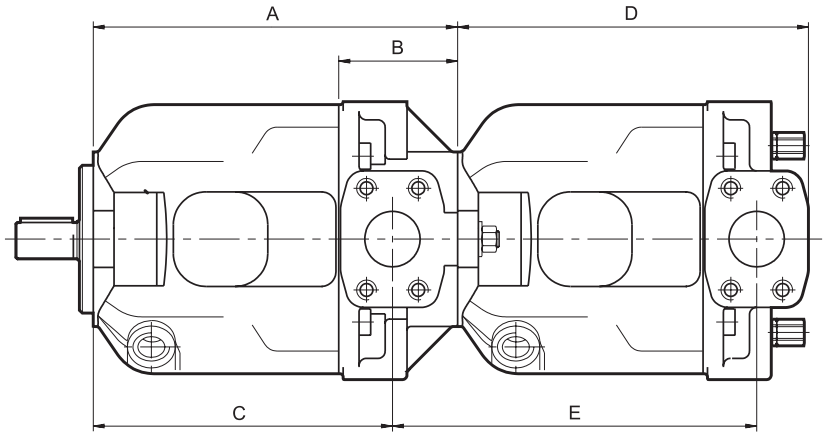
If several pumps are coupled, the torque of each single pump has to be added to the torque of subsequent pumps when they are loaded simultaneously.
The obtained torque value for each pump has to be lower than the value specified in the below table:

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.

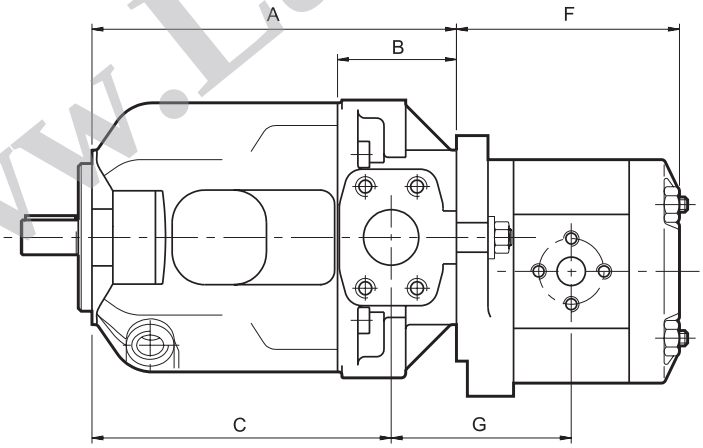
SIZE OF THE PUMP WITH A THROUGH OUTPUT SHAFT	MAX. TORQUE APPLICABLE TO THE SHAFT OF THE FRONT PUMP [Nm]			MAX. APPLICABLE TORQUE [Nm] (not simultaneously to the front pump)				
				PUMP MODEL TO BE COUPLED				
	cylindrical shaft ISO 3019/2 (cod. 5)	cylindrical SAEJ744 (cod. 0)	splined shaft SAE J744 (cod.1)	EXTERNAL GEAR GR. 2	EXTERNAL GEAR GR. 3	VPPM-029	VPPM-046	VPPM- 073
VPPM-029	160	155	190	100	135	135	-	-
VPPM-046	245	220	330	135	220	190	220	-
VPPM-073	400	400	620	135	330	190	330	400

23- OVERALL DIMENSIONS FOR COUPLED PUMPS

dimensions in mm



FRONT PUMP	REAR PUMP														
	VPPM-029					VPPM-046					VPPM-073				
	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	291	99	235	213	226	291	99	235	242	249	296	104	235	276	296



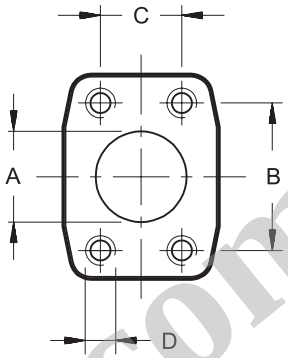
FRONT PUMP	REAR PUMP									
	EXTERNAL GEAR GR.2					EXTERNAL GEAR GR. 3				
	A	B	C	F	G	A	B	C	F	G
VPPM-029	222	77	183	99÷121	86÷97	-	-	-	-	-
VPPM-046	251	82	206	99÷121	85÷96	251	82	206	132÷147	103÷110
VPPM-073	291	99	235	99÷121	91÷102	291	99	235	132÷147	109÷116

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

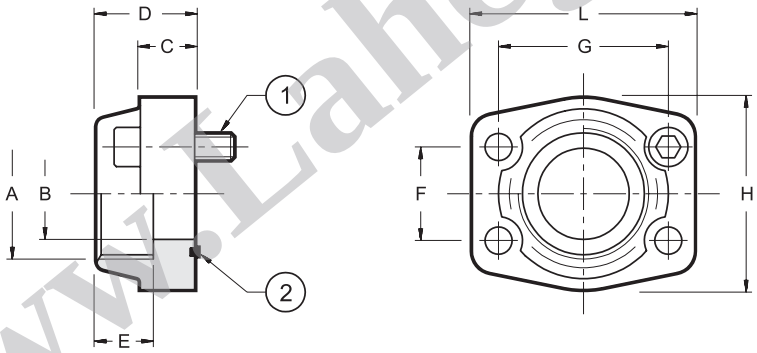
SUCTION PORT : "IN" (SAE 3000)					
Code	Nominal size	**A** mm	**B** mm	**C** mm	**D** Threading and depth (mm)
VPPM-029	1 1/4"	32	58,7	30,2	M10 x 28
VPPM-046	1 1/2"	38,1	70	35,7	M12 x 26
VPPM-073	2"	50,8	77,8	43	M12 x 25

DELIVERY PORT : "OUT" (SAE 6000)					
Code	Nominal size	**A** mm	**B** mm	**C** mm	**D** Threading and depth (mm)
VPPM-029	3/4"	19	50,8	23,8	M10 x 24
VPPM-046	1"	25,4	57,1	27,7	M12 x 20
VPPM-073	1 1/4"	32	66,7	31,7	M14 x 23



25 - CONNECTION FLANGES

dimensions in mm



	Flange code	Flange description	pmax [bar]	∅A	∅B	C	D	E	F	G	H	L	1 4 bolts	2
SAE 3000	0610720	SAE - 1 1/4"	280	1 1/4" BSP	32	21	41	22	30,2	58,7	68	79	M10 x 35	OR 4150
	0610714	SAE - 1 1/2"	210	1 1/2" BSP	38	25	45	24	35,7	70	78	94	M12 x 45	OR 4187
	0610721	SAE - 2"	210	2" BSP	51	25	45	30	43	77,8	90	102	M12 x 45	OR 4225
SAE 6000	0770075	SAE - 3/4"	420	3/4" BSP	19	21	35	22	23,8	50,8	55	71	M10 x 35	OR 4100
	0770092	SAE - 1"	420	1" BSP	25	25	42	24	27,7	57,1	65	81	M12 x 45	OR 4131
	0770106	SAE - 1 1/4"	420	1 1/4" BSP	32	27	45	25	31,7	66,7	78	95	M14 x 50	OR 4150

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

DUPLOMATIC HYDRAULICS

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