

The Drive & Control Company

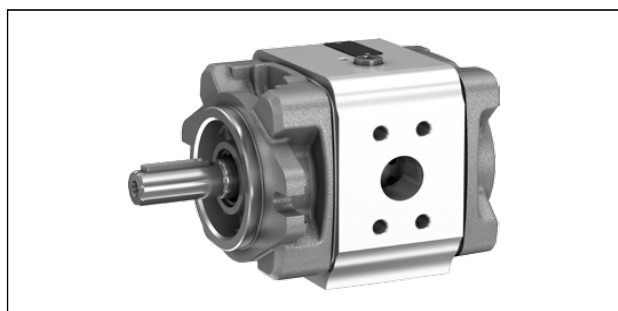
**Rexroth**  
 Bosch Group

## Internal gear pump PGM series 4X

**RE 10235**

Edition: 09.2014

Replaced: 10.2013



- ▶ Fixed displacement
- ▶ Frame sizes 4 and 5
- ▶ Sizes 25 to 125
- ▶ Maximum pressure 210 bar
- ▶ Displacement 25.3 to 125.3 cm<sup>3</sup>

### Features

- ▶ Low operating noise
- ▶ Low flow pulsation
- ▶ High efficiency even at low rotational speed and viscosity due to sealing gap compensation
- ▶ Suitable for a wide viscosity and speed range
- ▶ Use:  
 For drives with variable rotational speed with high load change numbers, e.g., plastics machines

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RE 10235/09.2014, **Bosch Rexroth AG**

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HYQUIP Limited New Brunswick Street Horwich Bolton Lancashire BL6 7JB UK

## 2 PGM Series 4X | Internal gear pump

Ordering code

### Ordering code

01	02	03	04	05	06	07	08	09	10	11
PG	M		4X	/	R		11	V	U2	

#### Type

01	Internal gear pump, fixed displacement, gap compensated	PG
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#### Series

02	Medium-pressure pump, maximum pressure 210 bar	M
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#### Frame size

03	Frame size 4	4
	Frame size 5	5

#### Series

04	Series 40 to 49 (40 to 49: unchanged installation and connection dimensions)	4X
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#### Sizes

		NG	
05	Frame size 4	25	025
		32	032
		40	040
		50	050
		63	063
	Frame size 5	80	080
		100	100
		125	125

#### Directions of rotation

06	Viewed on drive shaft	clockwise rotation	R
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#### Drive shafts

07	Parallel keyed shaft, ISO 3019-2	A
	Splined shaft to SAE J744 with involute spline according to ANSI B92.1a	T

#### Line port

08	Suction and pressure port according to SAE J518	11
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#### Seals

09	FKM (fluorelastomer)	V
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#### Mounting flange

10	SAE 2-hole according to SAE J744	U2
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11	Further parameters in clear text	
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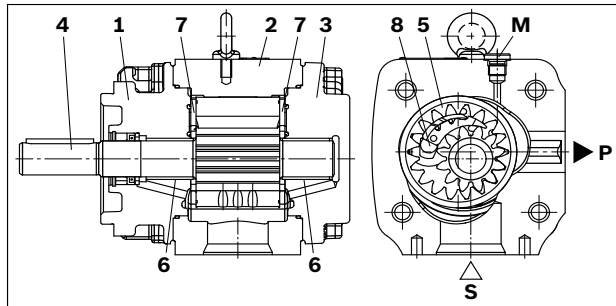
#### Preferred types PGM4-4X

Type	Material number
PGM4-4X/025RA11VU2	R901363096
PGM4-4X/032RA11VU2	R901363097
PGM4-4X/040RA11VU2	R901363098
PGM4-4X/050RA11VU2	R901363099
PGM4-4X/063RA11VU2	R901363100

#### Preferred types PGM5-4X

Type	Material number
PGM5-4X/080RA11VU2	R901363101
PGM5-4X/100RA11VU2	R901363102
PGM5-4X/125RA11VU2	R901363103

## Functional description



### Design

Hydraulic pumps of type PGM-4X are gap-compensated internal gear pumps with fixed displacement. They consist basically of: mounting flange (1), housing (2), cover (3), pinion shaft (4), internal gear (5), slide bearings (6), axial discs (7) and stop pin (8) as well as the radial compensation, consisting of segment (9), segment support (10) and the seal rolls (11).

### Suction and displacement process

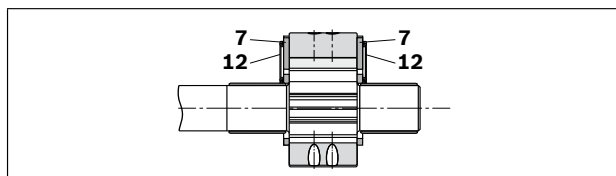
The hydrodynamically mounted pinion shaft (4) drives the toothed internal gear (5) in the indicated direction of rotation.

The spaces that open between the teeth in the suction area suck in the hydraulic fluids. The hydraulic fluid is transported from the suction area (S) to the pressure range (P) in the tooth spaces of the pinion and internal gear.

There, the hydraulic fluid is displaced out of the spaces between the teeth, which close, and is transported to the pressure port (P).

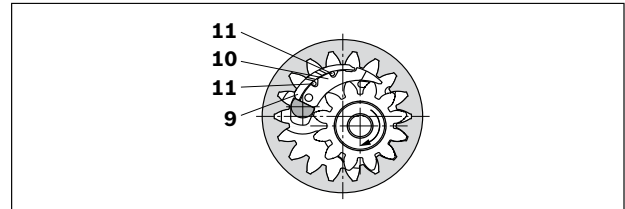
The suction and pressure range are separated by the radial compensation elements (9 to 11) and the tooth engagement between internal gear and pinion shaft.

### Axial compensation



The displacement chamber in the pressure range is axially sealed by axial washers (7). A pressure field (12) is applied to the sides of the axial washers that face away from the displacement area. These fields balance the axial washers vis-à-vis the displacement chamber, which results in optimum sealing with low mechanical losses.

### Radial compensation



The radial compensation elements consist of segment (9), segment support (10) and seal rolls (11).

Segment (9) and segment support (10) are arranged in the pressure field so that the resulting compressive force is largely supported by the stop pin.

A small component of the compressive force presses segment and segment support onto the tooth tips of pinion shaft and internal gear and in this way provides for the separation of the pressure range from the suction area with automatic clearance adjustment.

This is the requirement for constantly high volumetric efficiency during the entire operating time.

The clearance adjustment of segment and segment support is made possible by the seal rolls, which are located between the segment and segment support.

### Hydrodynamic and hydrostatic mounting

The pinion shaft (4) is supported by the hydrodynamically lubricated radial plain bearings (6). The internal gear (5) is hydrostatically mounted in the housing.

### Splines

The splines with involute edges have a large meshing length for low flow and pressure pulsation and thereby guarantee quiet operation.

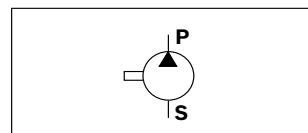
### Used materials

Flange (1) and cover (3): cast iron

Housing (2) and side panels (7): aluminum

Shaft (4) and internal gear (5): steel

### ▼ Symbol



## 4 PGM Series 4X | Internal gear pump Technical data

### Technical data

Frame size			BS	4	4	4	4	5	5	5		
Size			NG	25	32	40	50	63	80	100	125	
Displacement, geometric			$V_g$	cm <sup>3</sup>	25.3	32.7	40.1	50.7	65.5	81.4	100.2	125.3
Drive speed			$n_{\min}$	rpm	200	200	200	200	200	200	200	200
			$n_{\max}$	rpm	3000	3000	3000	3000	3000	3000	3000	3000
Operating pressure, absolute												
Inlet			$p$	bar	0.8 to 2 (short-term at start 0.6 bar)							
Outlet			continuous	$p_N$	bar	175	175	175	175	175	175	175
			intermittent <sup>1)</sup>	$p_{\max}$	bar	210	210	210	210	210	210	210
Flow (at n = 1450 rpm, p = 10 bar, v = 30 mm²/s)			$q_v$	l/min	36.3	46.9	57.6	72.8	94.0	116.9	143.8	179.8
Power consumption												
Minimum necessary drive power (at p ≈ 1 bar)			$P_{\text{input}}$	kW	1.1	1.1	1.1	1.5	1.5	2.2	3	4
Moment of inertia (around drive axis)			$J$	kgm²	0.00044	0.00055	0.00066	0.00081	0.00102	0.00289	0.00329	0.00407
Weight			$m$	kg	12	12.5	13.5	14	14.5	36.5	38	39.5
Shaft loading					Radial and axial forces (e.g., belt pulley) only after consultation							
Mounting style					Flange mounting							
Hydraulic fluid				HLP mineral oil according to DIN 51524 part 2 Observe our specifications according to data sheet 90220!								
Temperature range				−10 to +80, please consult us for other temperatures!								
Ambient temperature range				−20 to +60 °C								
Viscosity range		at 400 to 1800 rpm		2000 mm/s² permissible start viscosity								
		to n = 1800 rpm		10 to 300 mm/s²								
		to n = 3000 rpm		10 to 100 mm/s²								
Maximum permissible degree of contamination of the hydraulic fluid						Class 20/18/15 <sup>2)</sup>						
Cleanliness level according to ISO 4406 (c)												

#### Note

Please contact us if the unit is to be used outside the specified values!

1) Maximum 10 s, at most 50 % of the duty cycle

2) Cleanliness levels specified for the components must be maintained in the hydraulic systems. Effective filtration prevents malfunctions and simultaneously extends the service life of the components.

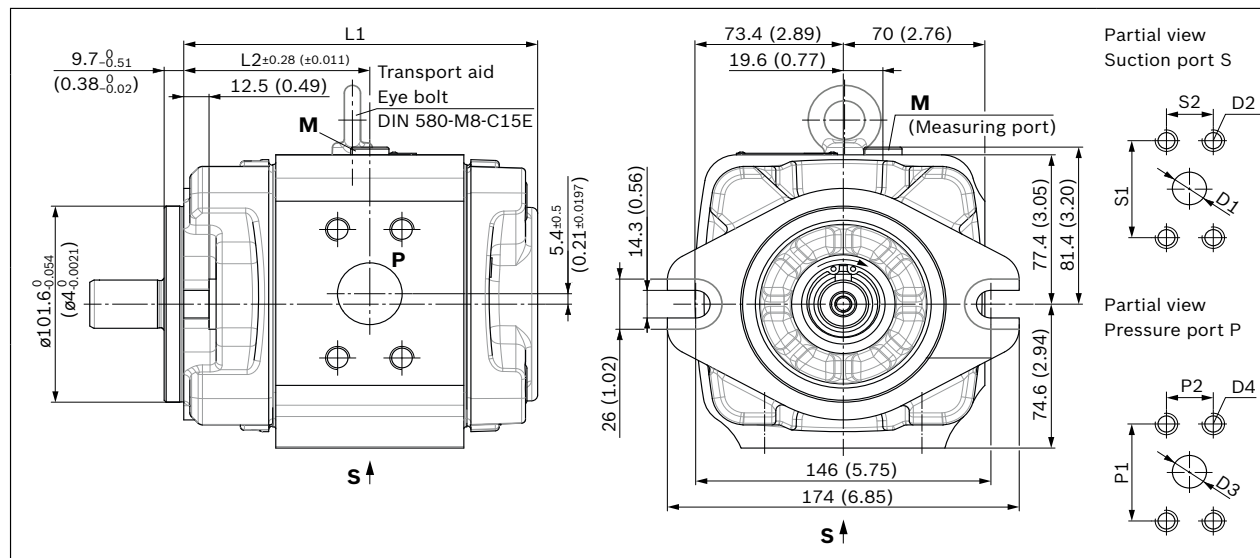
Dimensions [mm (inch)]

Internal gear pump | **PGM Series 4X**  
Dimensions frame size 4

5

## Dimensions frame size 4

With parallel keyed shaft or splined shaft and SAE mounting flange 101-2



Type	NG	Drive shaft		Material numbers	L1	L2
PGM4-4X/	<b>025R</b>	<b>A</b>	11VU2	R901363096	137 (5.39)	73 (2.87)
		<b>T</b>		R901374263		
	<b>032R</b>	<b>A</b>	11VU2	R901363097	144 (5.67)	76.5 (3.01)
		<b>T</b>		R901374264		
	<b>040R</b>	<b>A</b>	11VU2	R901363098	151 (5.94)	80 (3.15)
		<b>T</b>		R901374265		
	<b>050R</b>	<b>A</b>	11VU2	R901363099	161 (6.34)	85 (3.35)
		<b>T</b>		R901374266		
	<b>063R</b>	<b>A</b>	11VU2	R901363100	175 (6.89)	92 (3.62)
		<b>T</b>		R901374267		

NG	Suction port S Standard pressure series	øD1	D2	S1	S2	Pressure port P High-pressure series	øD3	D4	P1	P2
<b>025</b>	1 1/4 in	32 (1.260)	M10; 18 deep	58.7 (2.311)	30.2 (1.189)	3/4 in	19 (0.748)	M10; 18 deep	50.8 (2.000)	23.8 (0.937)
<b>032</b>	1 1/2 in	38 (1.496)	M12; 21 deep	69.9 (2.752)	35.7 (1.406)	1 in	25.4 (1.000)	M12; 23 deep	57.2 (2.252)	27.8 (1.094)
<b>040</b>	1 1/2 in	38 (1.496)	M12; 21 deep	69.9 (2.752)	35.7 (1.406)	1 in	25.4 (1.000)	M12; 23 deep	57.2 (2.252)	27.8 (1.094)
<b>050</b>	2 in	51 (2.008)	M12; 21 deep	77.8 (3.063)	42.9 (1.689)	1 in	25.4 (1.000)	M12; 23 deep	57.2 (2.252)	27.8 (1.094)
<b>063</b>	2 in	51 (2.008)	M12; 21 deep	77.8 (3.063)	42.9 (1.689)	1 1/4 in	32 (1.260)	M12; 20 deep	66.6 (2.622)	31.8 (1.252)

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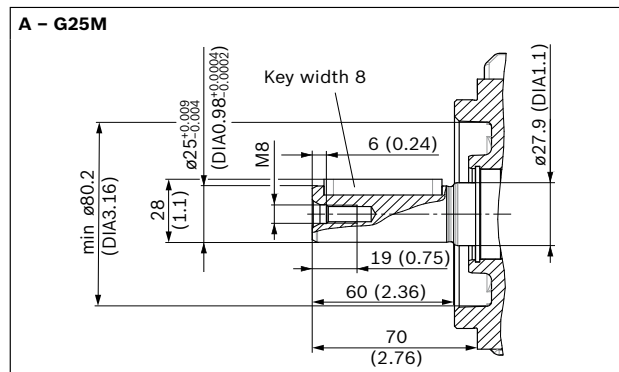
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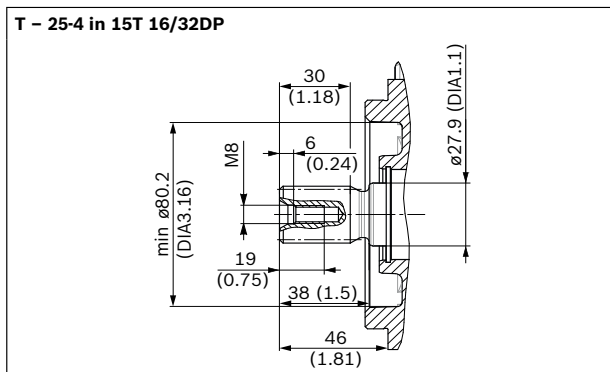
6 **PGM Series 4X** | Internal gear pump  
Dimensions frame size 4

Dimensions [mm (inch)]

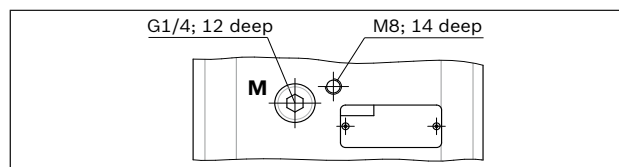
▼ **Parallel keyed shaft ISO 3019-2**



▼ **Splined shaft SAE J744**



▼ **Transport thread and measuring port**



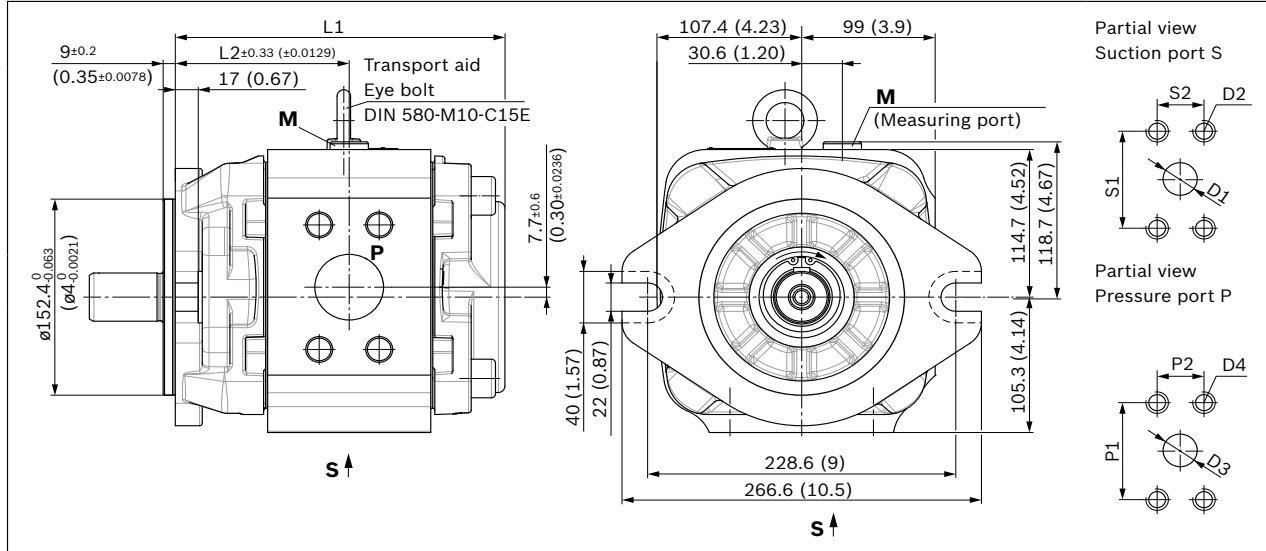
Dimensions [mm (inch)]

Internal gear pump | **PGM Series 4X**  
Dimensions frame size 5

7

## Dimensions frame size 5

With parallel keyed shaft and SAE mounting flange 152-2

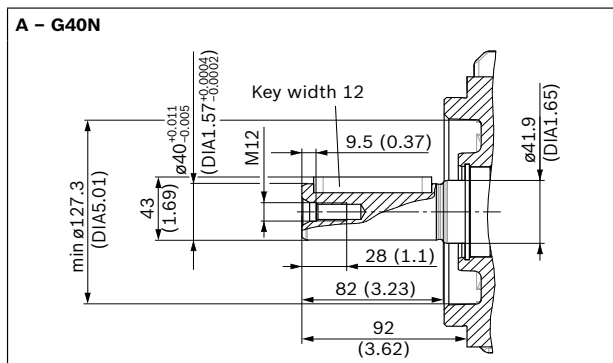


Type	NG	Drive shaft		Material numbers	L1	L2
PGM5-4X/	<b>080R</b>	<b>A</b>	11VU2	R901363101	218 (8.58)	109.5 (4.31)
	<b>100R</b>	<b>A</b>	11VU2	R901363102	227 (8.94)	114 (4.49)
	<b>125R</b>	<b>A</b>	11VU2	R901363103	239 (9.41)	120 (4.72)

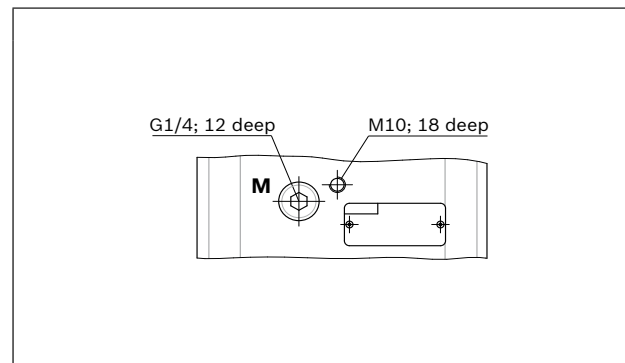
  

NG	Suction port S	øD1	D2	S1	S2	Pressure port P	øD3	D4	P1	P2
	Standard pressure series					High-pressure series				
<b>080</b>	2 in	51 (2.008)	M12; 21 deep	77.8 (3.063)	42.9 (1.689)	1 1/4 in	32 (1.260)	M12; 21 deep	66.6 (2.622)	31.8 (1.252)
<b>100</b>	2 1/2 in	64 (2.520)	M12; 23 deep	88.9 (3.500)	50.8 (2.000)	1 1/2 in	38 (1.496)	M16; 30 deep	79.3 (3.122)	36.5 (1.437)
<b>125</b>	2 1/2 in	64 (2.520)	M12; 23 deep	88.9 (3.500)	50.8 (2.000)	1 1/2 in	38 (1.496)	M16; 30 deep	79.3 (3.122)	36.5 (1.437)

### ▼ Parallel keyed shaft ISO 3019-2



### ▼ Transport thread and measuring port



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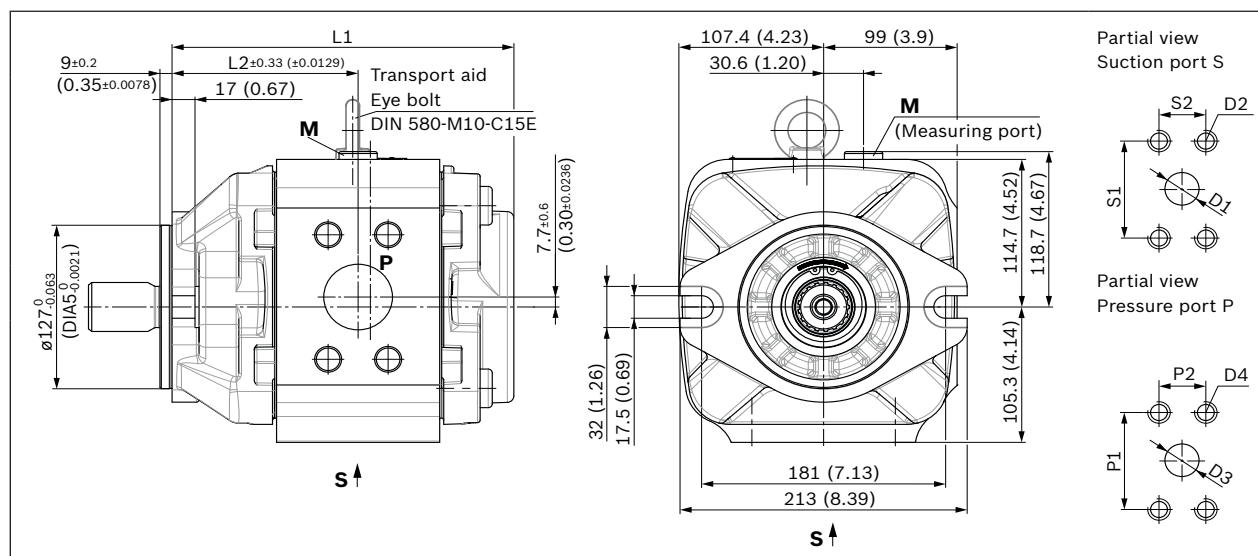
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## 8 PGM Series 4X | Internal gear pump Dimensions frame size 5

Dimensions [mm (inch)]

### With splined shaft and SAE mounting flange 127-2

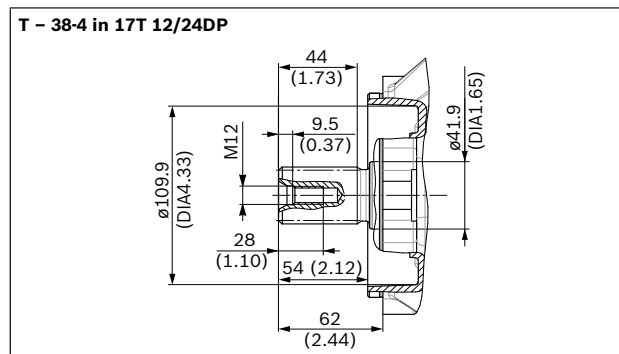


Type	NG	Drive shaft	Material numbers		L1	L2
PGM5-4X/	080R	T	11VU2	R901374270	218 (8.58)	109.5 (4.31)
	100R	T	11VU2	R901374271	227 (8.94)	114 (4.49)
	125R	T	11VU2	R901374272	239 (9.41)	120 (4.72)

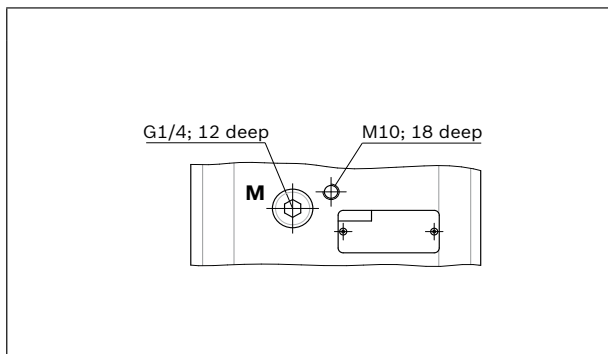
  

NG	Suction port S	øD1	D2	S1	S2	Pressure port P	øD3	D4	P1	P2
	Standard pressure series					High-pressure series				
080	2 in	51 (2.008)	M12; 21 deep	77.8 (3.063)	42.9 (1.689)	1 1/4 in	32 (1.260)	M12; 21 deep	66.6 (2.622)	31.8 (1.252)
100	2 1/2 in	64 (2.520)	M12; 23 deep	88.9 (3.500)	50.8 (2.000)	1 1/2 in	38 (1.496)	M16; 30 deep	79.3 (3.122)	36.5 (1.437)
125	2 1/2 in	64 (2.520)	M12; 23 deep	88.9 (3.500)	50.8 (2.000)	1 1/2 in	38 (1.496)	M16; 30 deep	79.3 (3.122)	36.5 (1.437)

### ▼ Splined shaft SAE J744



### ▼ Transport thread and measuring port



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## General project planning notes

### Intended use

Internal gear pumps are intended for the assembly of hydraulic drive systems in machine and system construction. During project planning, the basic principles of the EU Machine Directive or comparable national regulations outside of the EU are to be observed. They must not be used in explosive environments in accordance with directive 94/9/EC (ATEX).

### Technical data

The system or machine manufacturer must ensure compliance with the permissible technical data and operating conditions. The pump itself does not contain a device to prevent operation outside the permissible data. It is possible to operate the pump outside of the permissible technical data to a certain extent; the express written consent from Bosch Rexroth is, however, required. All specified technical performance features are median values and apply with the specified general conditions. In case of modifications to the general conditions (e.g., viscosity), the technical data may change as well. Scatter corresponding to the relevant state of technology is possible.

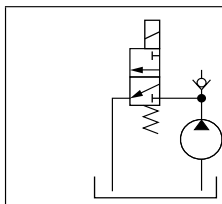
## Hydraulic project planning

### Air bleeding option for commissioning

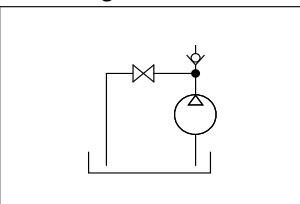
For Rexroth PGM.-4X internal gear pumps, a manual or switchable air bleeding option for the initial commissioning or any recommissioning after maintenance and repair work is to be provided. The air bleeding point is to be set in the pressure line before the first valve or check valve. Air bleeding may be performed with a maximum counter pressure of 0.2 bar.

### Examples of air bleeding circuits

#### ▼ Switchable air bleeding



#### ▼ Manually actuated air bleeding



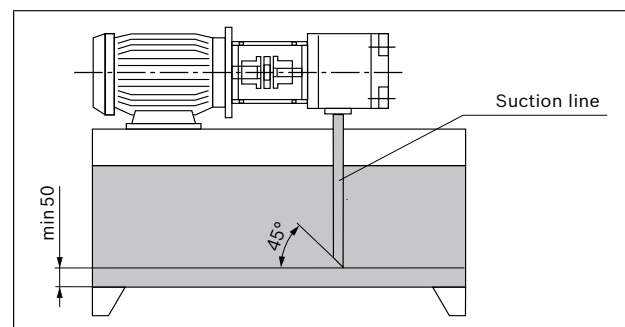
### Suction line

The line cross sections are to be dimensioned for the specified flows such that an ideal suction speed of 0.6 to 1.2 m/s is achieved on average. The suction speed should not exceed a maximum value of 2 m/s.

The suction cross sections at the pump itself are designed for the maximum flow and therefore serve only as reference. In case of continuous operation at rotational speeds lower than the permissible maximum speed, the suction tube diameter is also to be dimensioned smaller than the suction port of the pump depending on the actual suction speed. Overall, the suction line is to be designed so that the permissible inlet operating pressure is maintained. Bends and a combination of suction pipes from several pumps are to be avoided. If the use of a suction filter is unavoidable, it must be ensured on the system side that the lowest permissible inlet operating pressure is not exceeded even if the filter is contaminated.

Ensure the air tightness of the transitions and the pressure resistance of the suction hose with respect to the external air pressure.

The immersion depth of the suction pipe should be selected as large as possible (at least 100 mm at the lowest fluid level). Depending on the internal reservoir pressure, the viscosity of the operating medium and the flow conditions within the reservoir, no vortex may form even at maximum flow. There is otherwise a risk of air being drawn in. Return fluid and case drain fluid must not be immediately be drawn in again.



## 10 PGM Series 4X | Internal gear pump Mechanical project planning

Dimensions [mm (inch)]

### Pressure line

Sufficient burst resistance of the pipes, hoses and connecting elements must be ensured for pressure lines. The cross sections should be based on the maximum flow in order to avoid additional excessive loading of the pump due to back-pressure. Here, you must also take into account the pipe losses over the entire pressure line length and other line resistances (e.g., bends, pressure filters).

### Pressure safeguarding

The PGM internal gear pump does not include any devices for adherence to the maximum operating pressure. The setting and safeguarding of the permissible operating pressure must be ensured on the system side.

The pressure-relief valves necessary for this purpose are to be designed with consideration given to the maximum flow and the rate of pressure increase that will occur such that the permissible intermittent operating pressure is not exceeded.

### Pressure holding function

In the variable-speed drive, the pump can also be temporarily operated in the pressure holding function below the specified minimum rotational speed. The holding time and the rotational speed necessary for this purpose are a function of the operating viscosity and the pressure level. For the design, please contact Bosch Rexroth's technical sales department.

In the deactivated state (rotational speed = 0), a leakage flow flows through the pump back into the reservoir, depending on the load pressure. If this is to be prevented, a check valve is to be used.

When using a check valve, please observe the note on the air bleeding option for commissioning, page 9.

## Mechanical project planning

### Disassembly and mounting option

For installing and removing the pump on or from the drive, the accessibility must be provided for on the system side by means of a suitable lifting device. Please also give special consideration to the weight of the PGM frame size (see technical data, page 9).

Screws of tensile strength class 8.8 or 10.9 are to be provided for mounting purposes.

### Mounting

On the machine side, the screws are to be accessible in such a way that the required tightening torque can be applied. The screw tightening torque is oriented towards the operating conditions and elements involved in the screw connection and is to be specified by the manufacturer during project planning of the power unit, the machine, or the system.

### Reservoir

When designing the reservoir or selecting a suitable standard reservoir, the following requirements are to be observed:

- ▶ Select the largest possible reservoir volume, depending on the continuous or average flow, which is needed in order to allow separation of air bubbles by means of sufficient dwell time of the medium in the reservoir. The air separation ability of the used hydraulic fluid is also of importance here.
- ▶ Provide settling zones for the hydraulic fluid in the reservoir in order to allow for air separation.
- ▶ Provide guiding plates in order to allow contamination at the reservoir bottom to be deposited outside the pump suction area.
- ▶ Generously dimension the reservoir surfaces depending on the heat output to be dissipated via the reservoir walls.

### Required power unit functions

At a minimum, the hydraulic power units should be equipped with the following features:

- ▶ Reservoirs that are designed so that the internal pressure corresponds to the ambient pressure should be equipped with ventilation filters for pressure compensation purposes.
- ▶ The hydraulic fluid should only be filled using filling nozzles that eliminate the possibility of filling with unfiltered fluid.
- ▶ The ingress of contamination or moisture must be avoided. If used in highly contaminated environments, the reservoir must, for this purpose, be precharged by means of air pressure. If cleaning of the reservoir exterior is planned or anticipated during the period of use, reservoir bushings for pipes, lines, or hoses are to be selected so that a secure seal is ensured against external pressurization with a water jet.

## Place of installation and ambient conditions

With places of installation at a geodetic height of more than 1000 m, the pump is to be arranged in or below the reservoir or the reservoir is to be precharged by means of compressed air in order to ensure the permissible minimum inlet pressure. A short suction line with large cross section is to be selected; bends should not be used.

When installing the pump more than 10 m below the reservoir, the reduction of the inlet pressure to the maximum permissible value must be ensured by means of additional measures.

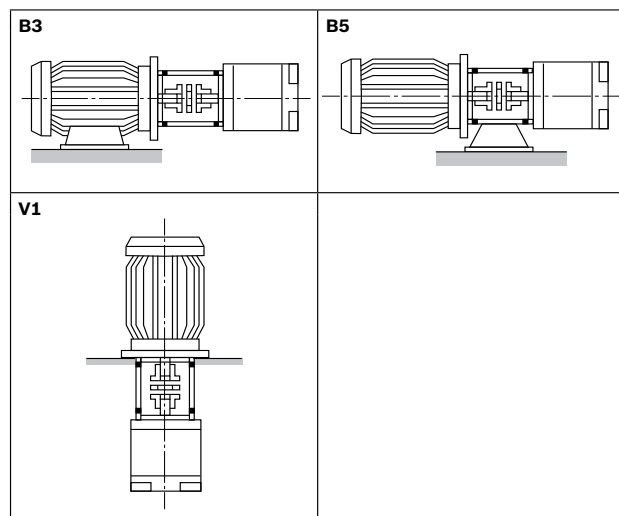
If operating the pump in salt-containing or corrosive environments or if there is a possibility of pressurization with strongly abrasive substances, it must be ensured on the system side that the shaft seal ring and the sealing area of the shaft do not make direct contact with the environment.

## Drive

Electric motor + pump support + coupling + pump

- ▶ No radial or axial forces permissible on the pump drive shaft!
- ▶ Motor and pump must be exactly aligned!
- ▶ Always use a coupling that is suitable for compensating shaft offsets!

## Installation position



## Maintenance schedule and operational safety

For safe operation and a long service life of the pump, a maintenance schedule must be prepared for the power unit, the machine, or the system. The maintenance schedule must ensure that the specified or permissible operating conditions of the pump are complied with over the entire period of use.

In particular, compliance with the following operating parameters is to be ensured:

- ▶ The required oil cleanliness
- ▶ The operating temperature range
- ▶ The filling level of the operating medium

Furthermore, the pump and the system are to be checked for changes to the following parameters on a regular basis:

- ▶ Vibrations
- ▶ Noise
- ▶ Temperature difference between pump – fluid in the reservoir
- ▶ Foaming in the reservoir
- ▶ Leak-proofness

Changes to these parameters indicate component wear (e.g., diesel engine, coupling, pump, etc.). The reason is to be determined and remedied immediately.

In order to achieve high operational safety of the pump in the machine or system, we recommend checking the aforementioned parameters continuously and automatically and the automatic shut-down in case of changes exceeding the usual fluctuations in the specified operating range.

Plastic components of drive couplings should be replaced regularly, though after no more than 5 years. The corresponding manufacturer's specifications are paramount.

For preventive maintenance of the pump, we recommend having the seals replaced after an operating period of no more than 5 years by an authorized Bosch Rexroth service company.

12 **PGM Series 4X** | Internal gear pump  
Accessories

## Accessories

### Pump safety block

For limiting the operating pressure and for the pump circulation at zero pressure, we recommend our pump safety blocks of type DBA... according to data sheet 25890.

Automatic air bleeding during commissioning is, however, not possible via DBA blocks. In this case, we recommend separate, manual air bleeding.

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