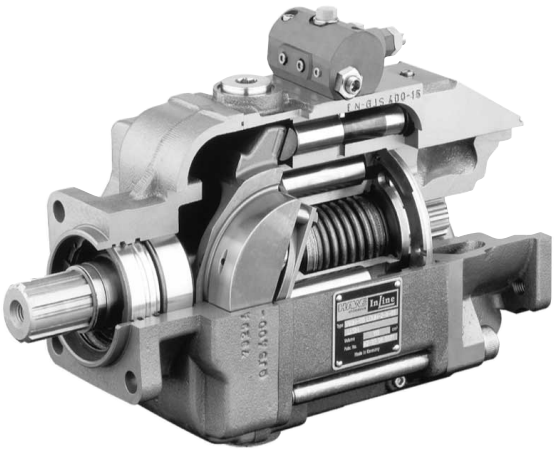
Variable displacement axial piston pump type V60N

Product documentation

Open circuit,
for the power take-off of commercial vehicles

Nominal pressure $p_{nom\ max}$:	400 bar
Peak pressure p_{max}:	450 bar
Geometric displacement V_{max}:	130 cm^3/rev



D 7960 N - V60N
01-2020-2.6

HAWE HYDRAULIK

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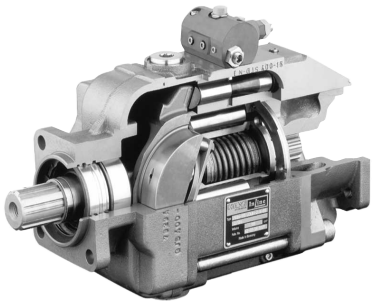
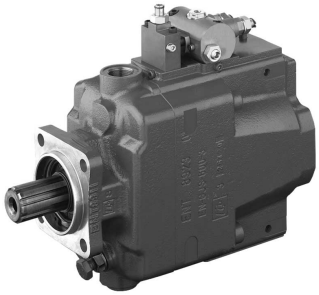
Contents

1 Overview: variable displacement axial piston pump type V60N

Variable displacement axial piston pumps adjust the geometric output volume from maximum to zero. As a result they vary the flow rate that is provided to the consumers.
The axial piston pump type V60N is designed for open circuits in mobile hydraulics and operate according to the swash plate principle. They are available with the option of a thru-shaft for operating additional hydraulic pumps in series.
The pump is fitted mainly to the power take-off on commercial vehicle transmissions. The large selection of different pump controllers allows the type V60N axial piston pump to be used in a variety of applications.



Variable displacement axial piston pump type V60N-110



Variable displacement axial piston pump type V60N-130

Features and benefits:

- Optimized power-to-weight ratio
- Broad selection of controllers
- Slim design
- Thru-shaft compatibility
- High self-suction speed

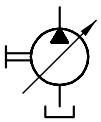
Intended applications:

- Municipal trucks
- Fire trucks
- Loading cranes and elevating work platforms
- Tipper trucks and skip trucks
- Suction dredgers and sewer cleaning vehicles

2 Available versions, main data

2.1 Basic version

Circuit symbol:



Order coding example:

V60N	-090	R	D	Y	N	- 2	-0	03	/LSP/ZL	- 2/65	- 350	-	A00/76	- C 022

Thru-shaft version Table 12 Thru-shaft versions

Suction intake For suction intake see Chapter 6.1, "Accessories, spare parts and separate components"

Connections Table 11 Connections

Pressure specification (bar)

Stroke limitation Table 10 Stroke limitations

Controller Table 8 Controllers
Table 9 Solenoid voltage and versions

Release

Additional function Table 7 Additional function

Housing version Table 6 Housing versions

Seal Table 5 Seals

Flange version Table 4 Flange versions (input side)

Shaft version Table 3 Shaft versions

rotation direction Table 2 Rotation directions

Nominal size Table 1 Nominal sizes

Basic type

Table 1 Nominal size

Coding	Geometric displacement (cm^3/rev)	Nominal pressure p_{nom} (bar)	Peak pressure p_{max} (bar)
060	60	350	400
090	90	350	400
110	110	350	400
130	130	400	450

Table 2 Rotation directions

Coding	Description
L	Anti-clockwise
R	Clockwise

When looking at the shaft journal

(for information on change of rotating direction, see Chapter 3, "Parameters")

Table 3 Shaft versions

Coding	Description	Designation/standard	Max. drive torque (Nm)
D	Parallel key splined shaft	Similar to DIN ISO 14 (LKW) B8x32x35	800
M	Spline shaft	W30x2x14x9g DIN 5480 (only V60N-090, V60N-110)	530
H	Spline shaft	SAE-B J 744 13T 16/32 DP 22-4 DIN ISO 3019-1 (only V60N-060)	210
U	Spline shaft	SAE-B J 744 short 13T 16/32 DP 22-4 DIN ISO 3019-1 short (only V60N-060)	210
T	Spline shaft	SAE-BB J 744 15T 16/32 DP 25-4 DIN ISO 3019-1 (only V60N-060)	340
S	Spline shaft	SAE-C J 744 14T 12/24 DP 32-4 DIN ISO 3019-1	640
Q	Spline shaft	SAE-CS 21T 16/32 DP 35-4 DIN ISO 3019-1 (only V60N-090, V60N-110, V60N-130)	900

Table 4 Flange versions (input side)

Coding	Description	Designation
Y	Flange	DIN ISO 7653 (for trucks)
P	Flange	DIN ISO 7653 -10° rotated (for lorries) (only V60N-110, V60N-130) *
X	Flange	SAE-B 2-hole J 744 - 45° rotated 101-2 DIN ISO 3019-1 (only V60N-060)
Z	Flange	SAE-B 4-hole J 744 101-4 DIN ISO 3019-1 (only V60N-060)
F	Flange	SAE-C 4-hole J 744 127-4 DIN ISO 3019-1
G	Flange	125 B4 HW DIN ISO 3019-2 (only V60N-090, V60N-110)

* In particularly tight installation situations, a flange that is turned by 10° can be used to prevent a collision with the cardan shaft.

Table 5 Seals

Coding	Description
N	NBR (gearbox-side shaft seal made of FKM, pump-side shaft seal and other NBR seals)
V	FKM

NOTE

When switching on the pump, the transmission side oil must be warmer than -25 °C.

Table 6 Housing versions

Coding	Description
1	Suction and pressure connection axial
2	Suction and pressure connection radial, with thru-shaft
3	Suction and pressure connection radial
4	Suction and pressure connection axial, connections SAE J 518 (only V60N-090)

Table 7 Additional functions

Coding	Description
0	None

Table 8 Controllers

Coding	Description
Delivery flow controller	
LSP	Load-sensing controller with integrated pressure limitation (Standard version for combination with hydraulic valves that relieve the LS signal in the valve, for example, type PSV proportional directional spool valve See "Further information" See Chapter 2.2.1
LSPT	Load-sensing controller with integrated pressure limitation and additional LS relief (only for use with hydraulic valves without their own relief of the LS signal) See Chapter 2.2.1
LSNR	Load sensing controller with integrated pressure limitation Discontinued type; use coding LSP for new projects. (Version for combination with hydraulic valves that relieve the LS signal in the valve, for example, type PSV proportional directional spool valve See "Further information" See Chapter 2.2.2
LSNRT	Load-sensing controller with integrated pressure limitation and additional LS relief Discontinued type; use coding LSPT for new projects. (only for use with hydraulic valves without their own relief of the LS signal) See Chapter 2.2.2
QP/...	Flow controller with integrated pressure limitation for setting a constant flow rate independently of the speed. See Chapter 2.2.3
ZV	Size **060**, **090**, **110**: Electric proportional delivery flow controller with increasing characteristic curve (intermediate plate) Only in combination with a pressure controller (coding NR2) See Chapter 2.2.4
ZV1	Size **060**, **090**, **110**: Electric proportional delivery flow controller with decreasing characteristic curve (intermediate plate). Only in combination with a pressure controller (coding NR2). See Chapter 2.2.4
V	Size **130**: Electric proportional delivery flow controller with increasing characteristic curve. Only in combination with a pressure controller (coding NR3) See Chapter 2.2.4
pressure controller	
NR	Mechanically adjustable pressure controller (standard version). See Chapter 2.2.5
NR2	Mechanically adjustable pressure controller. Only in combination with type ZV, ZV1 flow controllers. See Chapter 2.2.5
NR3	Mechanically adjustable pressure controller. Only in combination with type V flow controllers. See Chapter 2.2.5
PR	Electric proportional pressure controller with increasing characteristic curve. Cannot be combined with other pump controllers! See Chapter 2.2.6
P1R	Size **060, 090, 110**: Electro-proportional pressure controller with falling characteristic curve. Cannot be combined with other pump controllers! See Chapter 2.2.5

Table 8: Controllers

Coding	Description
Power controller	
ZL	Size **060**, **090**, **110**: Power controller (intermediate plate) Only in combination with a flow controller or pressure controller See Chapter 2.2.7
L	Size **130**: Power controller (as standard) Only in combination with a flow controller or pressure controller See Chapter 2.2.7
Intermediate plate	
ZW	Size **060**, **090**, **110**: 45° angle intermediate plate Standard for housing versions -2 and -3, to avoid a collision between the pump controller and the suction or pressure line Only in combination with a flow controller or pressure controller See Chapter 2.2.8

Table 9 Solenoid voltage and design

Coding	Electrical connection	Nominal voltage	Protection class (IEC 60529)	PR controller	ZV, ZV1, V, P1R controller
G 12 **G 24**	DIN EN 175 301-803A	12 V DC 24 V DC	IP 65	● ●	● ●
AMP 12 **APM 24**	AMP Junior Timer	12 V DC 24 V DC	IP 65		● ●
DT 12 **DT 24**	Deutsch (DT 04-2P)	12 V DC 24 V DC	IP 67		● ●

Table 10 Stroke limitation

Coding	Description
No designation	No stroke limitation
2	With adjustable stroke limitation (for housing version 1 and 4: all sizes; for housing version 2 and 3: only V60N-090, V60N-130)
2/...	Stroke limitation fixed with specification of the set geometric displacement V_g (cm^3/rev.)

Table 11 Connections

Coding	Connections
No designation	DIN EN ISO 228-1
UNF	SAE J 514

Order coding example:

V60N-110 RDYN-2-0-01/LSP-350-A00/76- **C 022**

Table 12 Thru-shaft versions

Coding V60N			Flange	Shaft
060	090/110	130		
C 001	C 002	C 003	Prepared for thru-shaft, sealed with cap	
C 010	--	C 030	DIN ISO 7653	DIN ISO 14
C 011	C 021	C 031	SAE-A 2-hole J 744 82-2 DIN ISO 3019-1	SAE-A J 744 (16-4 DIN ISO 3019-1) 9T 16/32 DP
C 012	C 022	C 032	SAE-A 2-hole J 744 82-2 DIN ISO 3019-1	SAE-A J 744 (16-4 DIN ISO 3019-1) [1] 9T 16/32 DP [1]
C 013	--	--	SAE-A 2-hole J 744 82-2 DIN ISO 3019-1	19-4 DIN ISO 3019-1 11T 16/32 DP
C 014	C 024	C 034	SAE-B 2-hole J 744 101-2 DIN ISO 3019-1	SAE-B J 744 (22-4 DIN ISO 3019-1) 13T 16/32 DP
--	C 026	C 036	SAE-B 2-hole J 744 101-2 DIN ISO 3019-1	SAE-BB J 744 (25-4 DIN ISO 3019-1) 15T 16/32 DP
C 015	C 025	C 035	SAE-B 4-hole J 744 101-4 DIN ISO 3019-1	SAE-B J 744 (22-4 DIN ISO 3019-1) 13T 16/32 DP
--	C 027	C 037	SAE-C 2-hole J 744 127-2 DIN ISO 3019-1	SAE-C J 744 (32-4 DIN ISO 3019-1) 14T 12/24 DP
--	C 028	C 038	SAE-C 4-hole J 744 127-4 DIN ISO 3019-1	SAE-C J 744 (32-4 DIN ISO 3019-1) 14T 12/24 DP

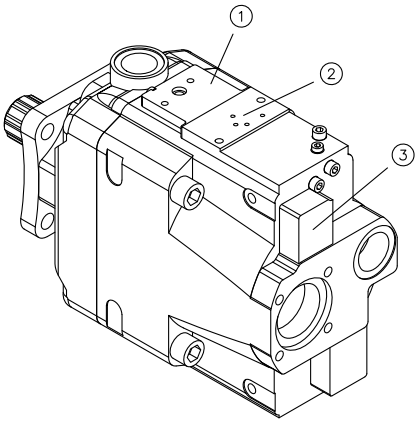
NOTE
Pay attention to the maximum permissible weight toruqe and drive torque, as the flange or shaft may be damaged otherwise.

NOTE
An additional support is to be provided for pump combinations.

[1] ANSI B 92.1, FLAT ROOT SIDE FIT, spline width deviating from the standard, s = 2.357-0.03

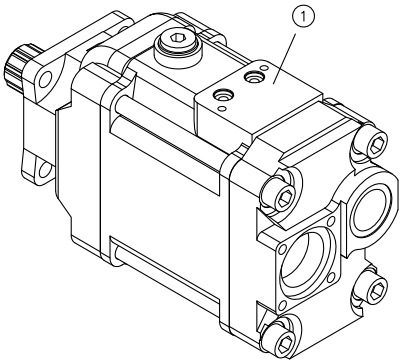
2.2 Controller

V60N-130



1 Type L controller mounting point
2 Type LSP, LSPT, LSNR, LSNRT, QP, NR, NR3, PR, ZW controller mounting point
3 Type V controller mounting point

V60N-060/090/110



1 Type LSP, LSPT, LSNR, LSNRT, QP, NR, NR2, PR, P1R, ZL, ZW controller mounting point

2.2.1 LSP, LSPT controller

The LSP and LSPT controllers are flow controllers that generate a variable, speed-independent flow rate. They adapt the geometric displacement of the pump to the required flow rate of the consumer and regulate a constant difference between load pressure and pump pressure.

The integrated pressure limitation restricts the maximum pressure to a set value.

The LSP and LSPT controllers are further developments based on the LSNR and LSNRT controllers. They offer better control behaviour and a two-part dynamic screw for individual adjustment of the on-stroke and destroke velocities.

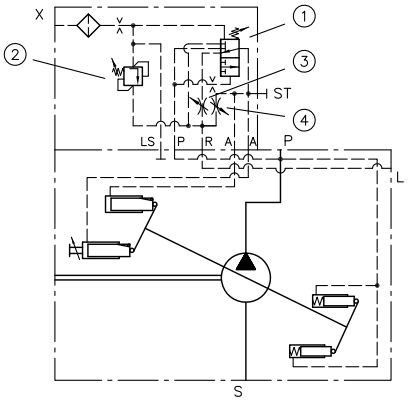
LSP

- Connection X-R sealed
- Standard version for combination with hydraulic valves that relieve the LS signal in the valve, for example, type PSV proportional directional spool valve

LSPT

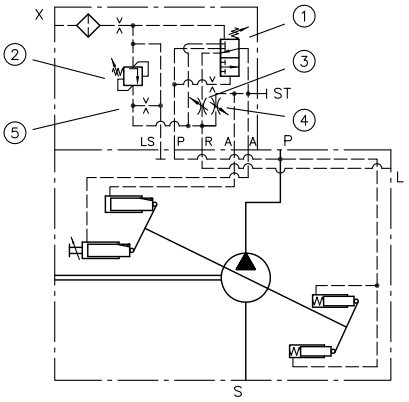
- Connection X-R open
- Only for use with hydraulic valves without their own relief of the LS signal

Coding **LSP**



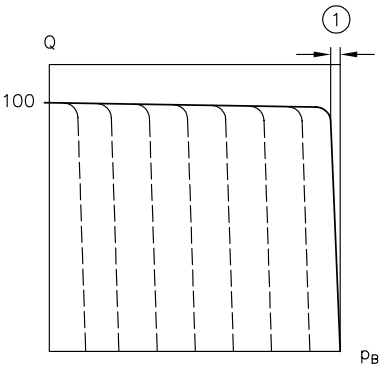
1 Flow controller: Regulates a constant difference between load pressure and pump pressure
2 Pressure limitation: Limits the pump pressure to a maximum value
3 Return throttle
4 Bypass throttle

Coding **LSPT**



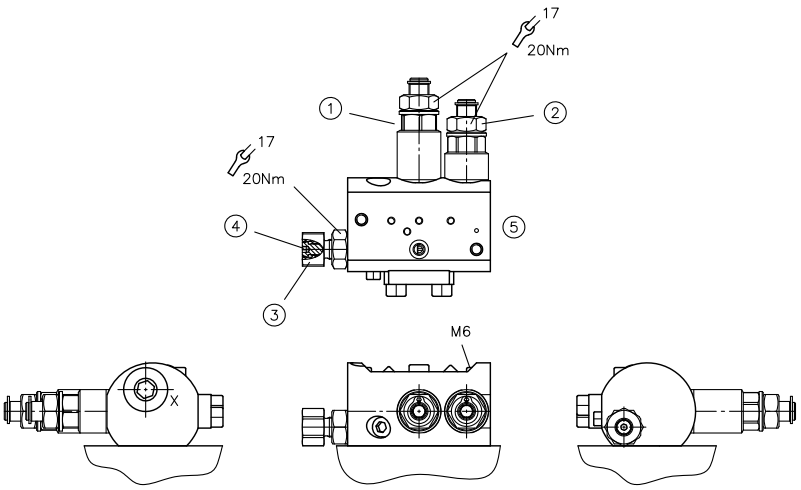
1 Flow controller: Regulates a constant difference between load pressure and pump pressure
2 Pressure limitation: Limits the pump pressure to a maximum value
3 Return throttle
4 Bypass throttle
5 LS signal relief

LSP, LSPT characteristics

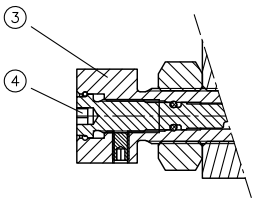


p_B operating pressure (bar); Q delivery flow (%)

1 Approx. 4 bar



1 Differential pressure Δp (stand-by pressure)
2 Maximum pressure p_{max} (pressure limitation)
3 Return throttle
4 Bypass throttle
5 X port for LS signal: G 1/4
Order coding for adapter to 9/16-18 UNF (SAE-6): 7993245.00



3 Return throttle
4 Bypass throttle

Adjustment range for ① and ② restricted by retaining ring.

Description of the two-part dynamic screw

- While the pump is swinging out, the return throttle (outer screw on the two-part dynamic screw) adjusts the on-stroke time from V_{gmin} to V_{gmax}.
  - Loosening the screw reduces the damping and accelerates the on-stroke time.
  - Adjustment range: Approx. 5.5 rotations/4 mm
- While the pump is swinging in, a bypass throttle (inner screw on the two-part dynamic screw) adjusts the destroke time from V_{gmax} to V_{gmin}.
  - Loosening the screw increases the damping and slows down the destroke time.
  - Tightening the screw reduces the damping and accelerates the destroke time.
  - Adjustment range: Approx. 4 rotations/2 mm

Pressure adjustment	Pressure range (bar)	Δp (bar)/revolution	Factory-set pressure setting (bar)
Maximum pressure p_{max}	20 ... 400	Approx. 50	300
Differential pressure Δp	20 ... 55	Approx. 10	27

⚠ CAUTION

Risk of injury on overloading components due to incorrect pressure settings!

Risk of minor injury.

- Pay attention to the maximum operating pressure of the pump and the valves.
- Always monitor the pressure gauge when setting and changing the pressure.

2.2.2 LSNR and LSNRT controllers (discontinued types; use LSP and LSPT controllers for new projects)

The LSNR, LSNRT controllers are flow controllers that generate a variable, speed-independent flow rate. They adapt the geometric displacement of the pump to the required flow rate of the consumer and regulate a constant difference between load pressure and pump pressure.

The integrated pressure limitation restricts the maximum pressure to a set value.

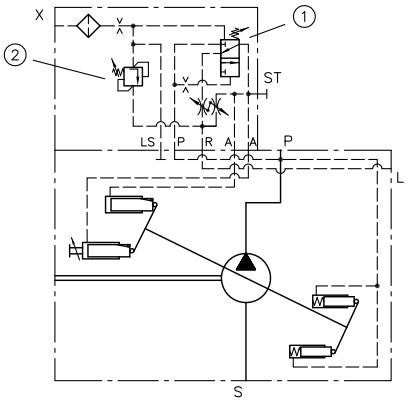
LSNR

- Connection X-R sealed
- Version for combination with hydraulic valves that relieve the LS signal in the valve, for example, type PSV proportional directional spool valve

LSNRT

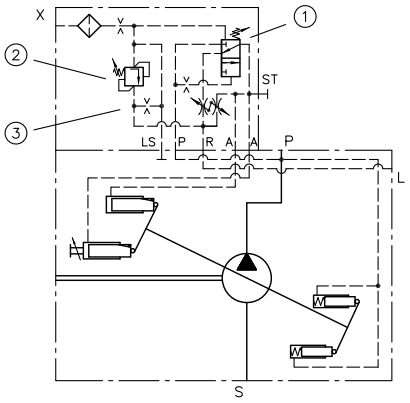
- Connection X-R open
- Only for use with hydraulic valves without their own relief of the LS signal

Coding **LSNR**



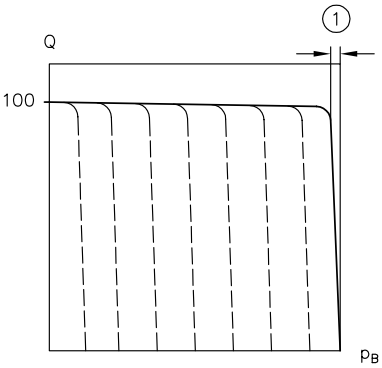
1 Delivery flow controller: Regulates a constant difference between load pressure and pump pressure
2 Pressure limitation: Limits the pump pressure to a maximum value

Coding **LSNRT**



1 Delivery flow controller: Regulates a constant difference between load pressure and pump pressure
2 Pressure limitation: Limits the pump pressure to a maximum value
3 Relief of the LS signal (only LSNRT)

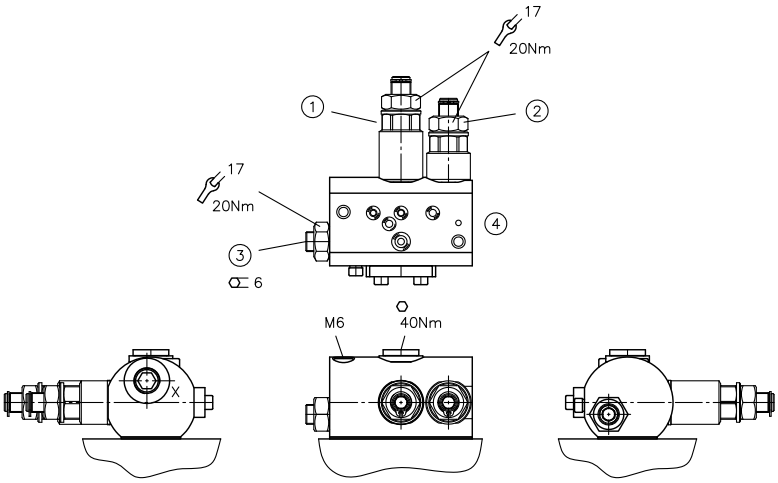
Characteristic curve **LSNR, LSNRT**



p_B operating pressure (bar); Q delivery flow (%)

1 Approx. 4 bar

Coding **LSNR, LSNRT**



1 Differential pressure Δp (stand-by pressure)
2 Maximum pressure p_{max} (pressure limitation)
3 Dynamic throttle
4 X port for LS signal: G 1/4
Order coding for adapter to 9/16-18 UNF (SAE-6): 7993245.00

Adjustment range for ① and ② restricted by retaining ring.

Pressure adjustment	Pressure range (bar)	Δp (bar)/revolution	Factory-set pressure setting (bar)
Maximum pressure p_{max}	20 ... 400	Approx. 50	300
Differential pressure Δp	20 ... 55	Approx. 10	27

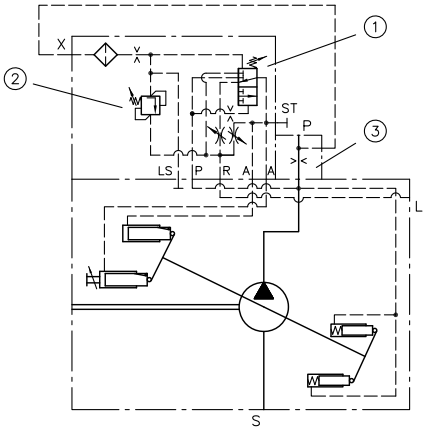
CAUTION
Risk of injury on overloading components due to incorrect pressure settings!
Risk of minor injury.
- Pay attention to the maximum operating pressure of the pump and the valves.
- Always monitor the pressure gauge when setting and changing the pressure.

2.2.3 QP controller

The QP controller is a flow controller that generates a constant flow rate independently of the speed. It regulates a constant differential pressure via an orifice in the P gallery. The differential pressure is adjustable between 20 and 55 bar. The orifice is available in various graduations (see table).

The integrated pressure limitation restricts the maximum pressure to a set value.

Coding **QP**

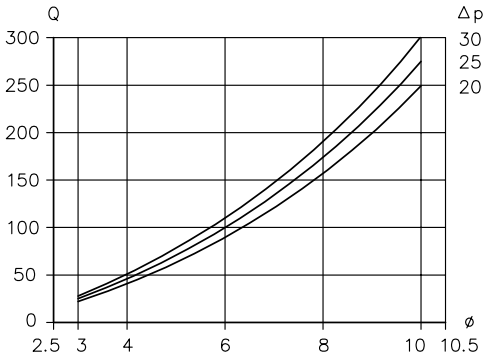


1 Delivery flow controller: Regulates a constant differential pressure before and after the orifice
2 Pressure limitation: Limits the pump pressure to a maximum value
3 Orifice according to table

Order coding example: V60N-110 RDYN-1-0-03/QP/5-350

Orifice (mm)	Flow rate (lpm) at 20 bar differential pressure
3	23
3.5	32
4	42
4.5	53
5	65
5.5	79
6	94
6.5	110
7	127
7.5	146
8	166
8.5	188
9	210
9.5	234
10	260

Coding **QP**



∅ Orifice diameter (mm); Q delivery flow (lpm)

∅ Orifice diameter (mm); Q delivery flow (lpm)

Determination of the flow rate

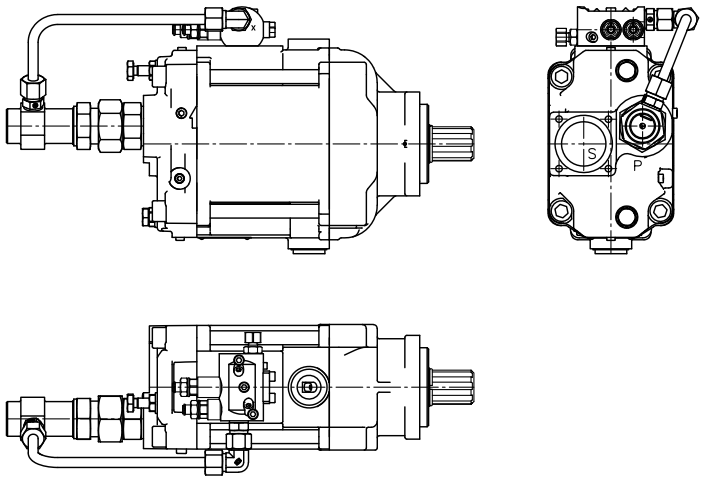
$Q = 0,55 \cdot d^2\sqrt{\Delta p}$

Q = Flow rate (lpm)

d = Orifice diameter (mm)

Δp = Pressure difference (bar)

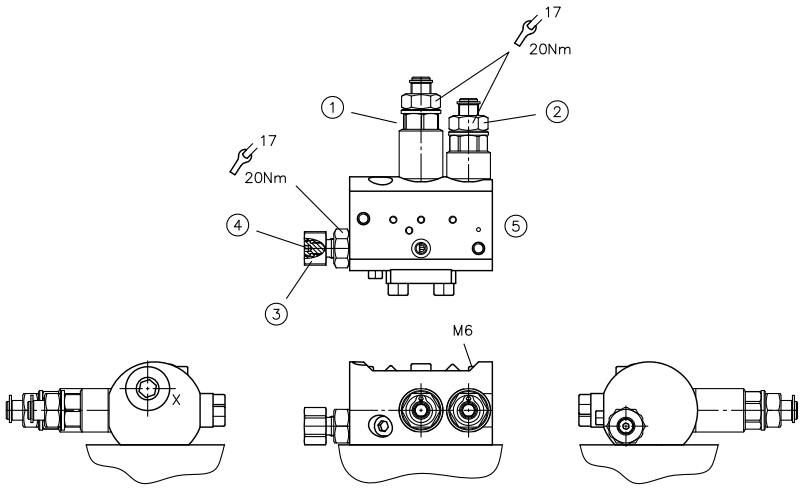
Coding **QP**



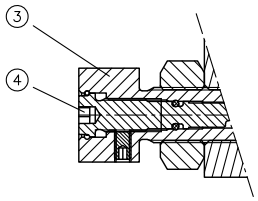
NOTE

The hosing varies depending on the size and rotation direction.

Coding **QP**



1 Differential pressure Δp (stand-by pressure)
2 Maximum pressure p_{max} (pressure limitation)
3 Return throttle
4 Bypass throttle
5 X port for LS signal: G 1/4
Order coding for adapter to 9/16-18 UNF (SAE-6): 7993245.00



3 Return throttle
4 Bypass throttle

Adjustment range for ① and ② restricted by retaining ring.

Description of the two-part dynamic screw

- While the pump is swinging out, the return throttle (outer screw on the two-part dynamic screw) adjusts the on-stroke time from V_{gmin} to V_{gmax}.
  - Loosening the screw reduces the damping and accelerates the on-stroke time.
  - Adjustment range: Approx. 5.5 rotations/4 mm
- While the pump is swinging in, a bypass throttle (inner screw on the two-part dynamic screw) adjusts the destroke time from V_{gmax} to V_{gmin}.
  - Loosening the screw increases the damping and slows down the destroke time.
  - Tightening the screw reduces the damping and accelerates the destroke time.
  - Adjustment range: Approx. 4 rotations/2 mm

Pressure adjustment	Pressure range (bar)	Δp (bar)/revolution	Factory-set pressure setting (bar)
Maximum pressure p_{max}	20 ... 400	Approx. 50	300
Differential pressure Δp	20 ... 55	Approx. 10	27

⚠ CAUTION

Risk of injury on overloading components due to incorrect pressure settings!

Risk of minor injury.

- Pay attention to the maximum operating pressure of the pump and the valves.
- Always monitor the pressure gauge when setting and changing the pressure.

2.2.4 ZV, ZV1 and V controller

The ZV-, ZV1- and V controllers are electrical-proportional flow controllers that generate a variable, speed-dependent flow rate. They adjust the geometric displacement of the pump based on an electrical input signal. The resulting flow rate depends on the geometric displacement and the rotation speed.

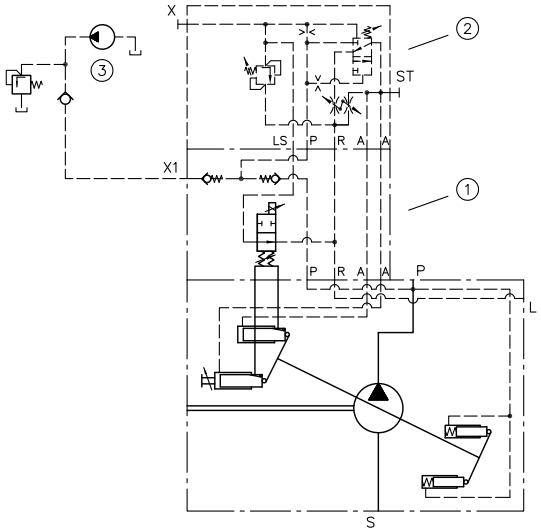
The required pilot pressure for adjusting the pivoting angle is tapped internally. When used in open centre systems with operating pressures of < 25 bar, an external auxiliary pump or a pre-load valve must be provided to ensure reliable adjustment.

ZV controller: V60N-060/090/110, increasing characteristic curve
Nur possible in combination with an NR2 coding pressure controller!

ZV1 controller: V60N-060/090/110, decreasing characteristic curve
Nur possible in combination with an NR2 coding pressure controller!

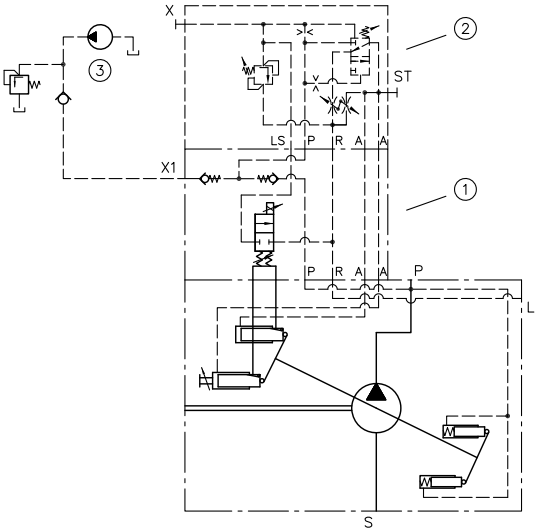
V controller: V60N-130, increasing characteristic curve
Nur possible in combination with an NR3 coding pressure controller!

Coding **NR2/ZV**



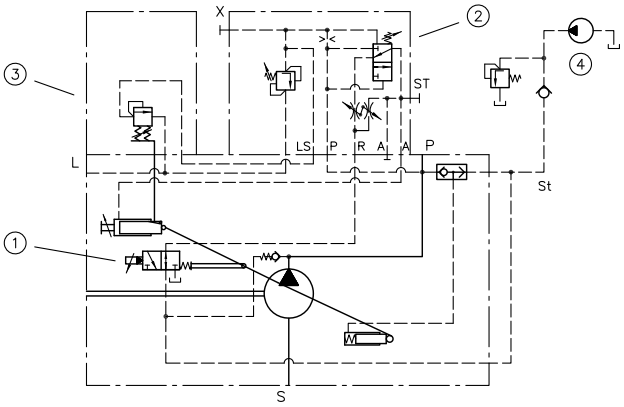
1 ZV controller
2 NR2 controller
3 External auxiliary pump, pressure-limiting valve and check valve (not included)
Recommended flow rate: 3-4 lpm
Recommended pressure: 40-60 bar

Coding **NR2/ZV1**



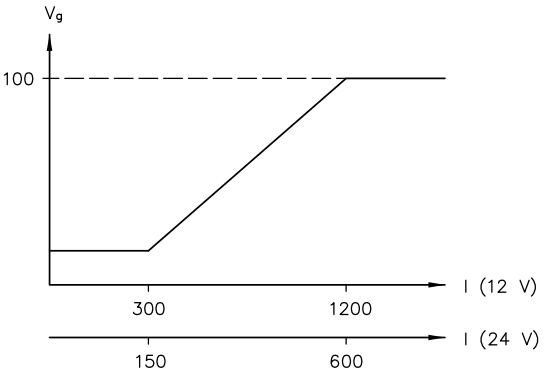
1 ZV1 controller
2 NR2 controller
3 External auxiliary pump, pressure-limiting valve and check valve (not included)
Recommended flow rate: 3-4 lpm
Recommended pressure: 40-60 bar

Coding **NR3/V/L**

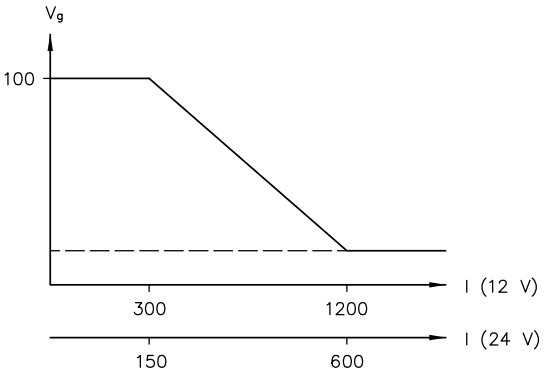


1 V controller
2 NR3 controller
3 L controller (installed as standard for V60N-130)
4 External auxiliary pump, pressure-limiting valve and check valve (not included in scope of delivery)

Coding **ZV**



Coding **ZV1**



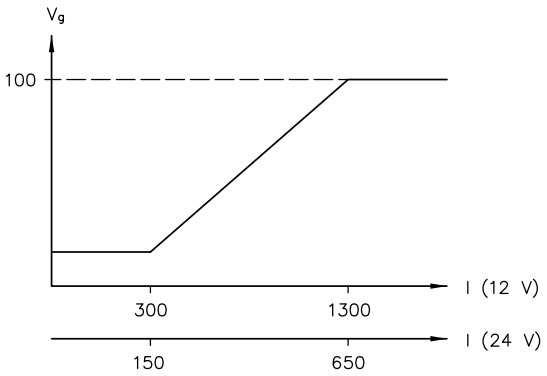
I current (mA); V_g geometric displacement (%)

NOTE

V_g = 0 cm³/rev possible through the use of an auxiliary pump.

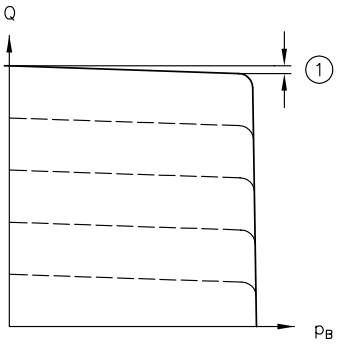
At V_g = 0 cm³/rev, additional rinsing via the drain port is required to ensure sufficient lubrication of the pump. Recommended flow rate: 3 lpm.

Coding **V**



I current (mA); V_g geometric displacement (%)

Coding **ZV, ZV1, V**



1 Approx. 5%

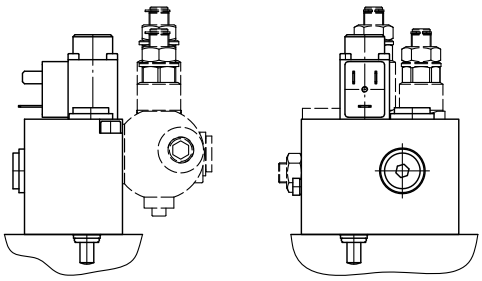
p_B operating pressure (bar); Q delivery flow (%)

NOTE

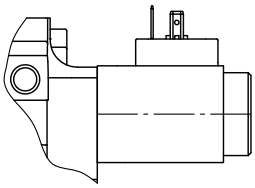
V_g = 0 cm³/rev possible through the use of an auxiliary pump.

At V_g = 0 cm³/rev, additional rinsing via the drain port is required to ensure sufficient lubrication of the pump. Recommended flow rate: 3 lpm.

Coding **ZV, ZV1**
Intermediate plate version



Coding **V**



2.2.5 NR, NR2, NR3 controller

The NR, NR2, NR3 controllers are pressure controllers with a fixed pressure setting. As soon as the pump pressure exceeds the set value, they reduce the pivoting angle of the pump and regulate a constant pressure level. The pressure setting is adjusted using a setting screw on the controller, and, in addition, an external pilot valve can be connected to the X port to enable a remote adjustment when necessary.

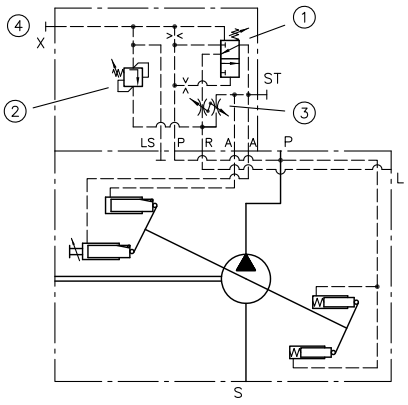
The NR, NR2, NR3 controllers can either be used in constant pressure systems or as a low-loss pressure limitation in combination with an electric proportional flow controller.

NR controller: Individually or in combination with type ZL and L power controllers

NR2 controller: Only in combination with type ZV and ZV1 flow controllers

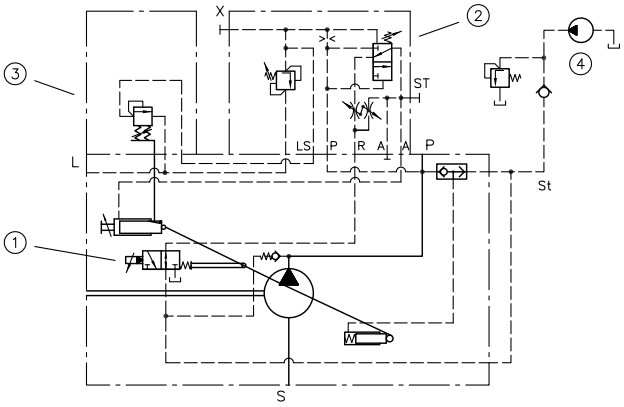
NR3 controller: Only in combination with type V flow controllers

Coding **NR, NR2**



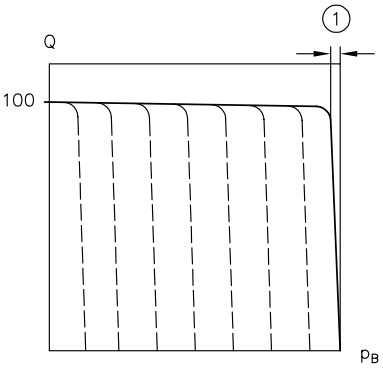
1 Main stage
2 pilot valve
3 Dynamic throttle
4 X port for external pilot valve (optional)

Coding **NR3/V/L**



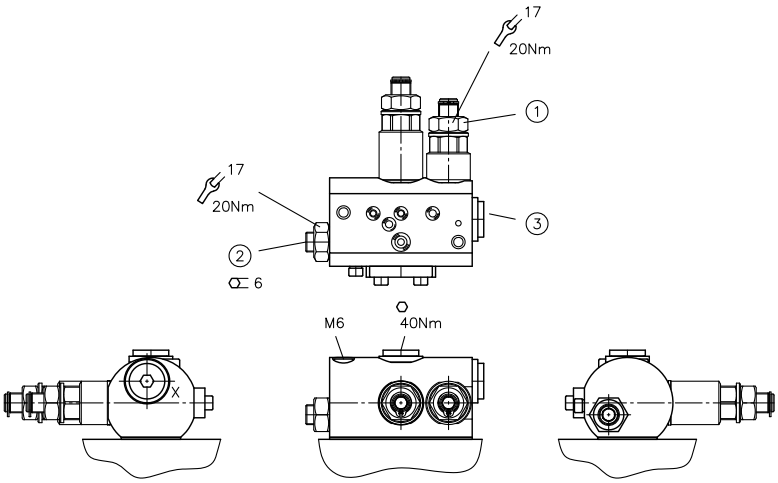
1 V controller
2 NR3 controller
3 L controller (installed as standard for V60N-130)
4 External auxiliary pump, pressure-limiting valve and check valve (not included in scope of delivery)

Coding **NR, NR2, NR3**



1 Approx. 4 bar

p_B operating pressure (bar); Q delivery flow (%)



1 Maximum pressure p_{max}
2 Dynamic throttle
3 X port: G 1/4
Order coding for adapter to 9/16-18 UNF (SAE-6): 7993245.00

Adjustment range for ① and ② restricted by retaining ring.

Pressure adjustment	Pressure range (bar)	Δp (bar)/revolution	Factory-set pressure setting (bar)
Maximum pressure p_{max}	20 ... 400	Approx. 50	300

CAUTION
Risk of injury on overloading components due to incorrect pressure settings!
Risk of minor injury.
- Pay attention to the maximum operating pressure of the pump and the valves.
- Always monitor the pressure gauge when setting and changing the pressure.

2.2.6 PR, P1R controllers

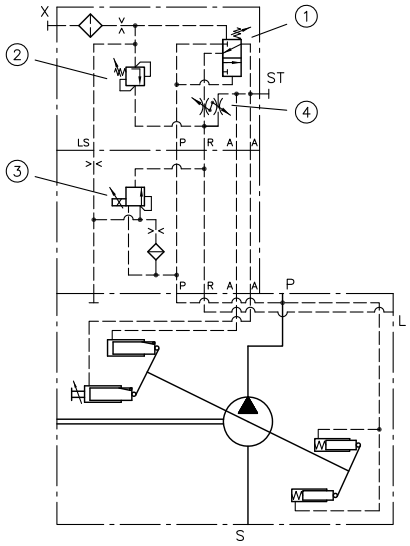
The PR and P1R controllers are electric proportional pressure controllers. As soon as the pump pressure exceeds the set value, the controller reduces the pivoting angle of the pump and regulates a constant pressure level.

The minimum and maximum pressures are set mechanically on the controller. In between these values, the pressure can be adjusted proportionally using an electrical signal.

PR controller: Increasing characteristic curve, all sizes, cannot be combined with other pump controllers (type ZL or ZV)

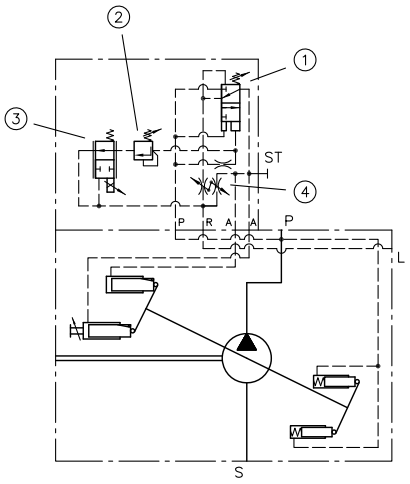
P1R controller: Decreasing characteristic curve, only V60N-060/090/110, cannot be combined with other pump controllers (type ZL or ZV)

Coding **PR**



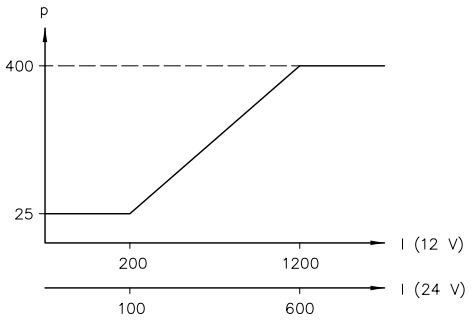
1 Minimum pressure setting p_{min}
2 Maximum pressure setting p_{max}
3 Electric proportional pressure adjustment
4 Dynamic throttle

Coding **P1R**

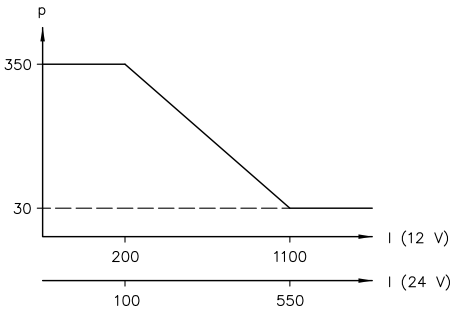


1 Maximum pressure setting p_{max}
2 Maximum pressure reduction p_{red}
3 Electric proportional pressure adjustment
4 Dynamic throttle

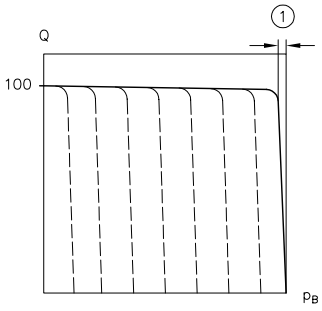
Coding **PR**



Coding **P1R**



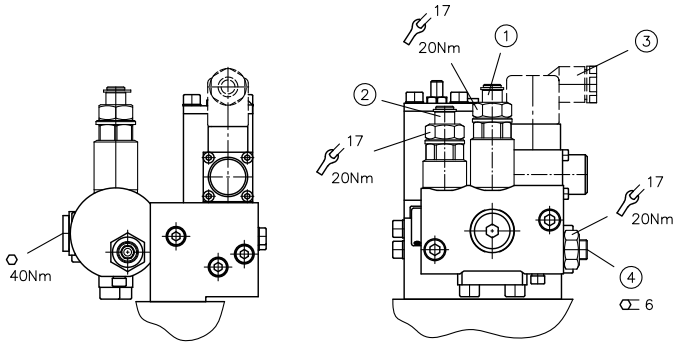
Coding **PR, P1R**



1 Approx. 4 bar

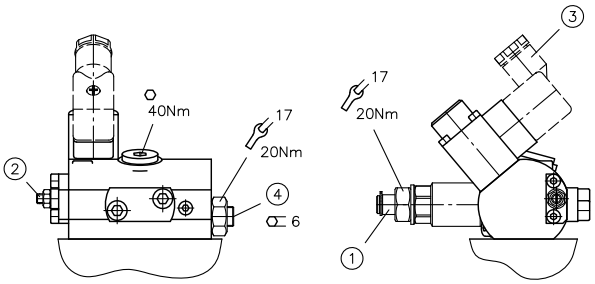
p_B operating pressure (bar); Q delivery flow (%)

Coding **PR**



1 Minimum pressure p_{min}
2 Maximum pressure p_{max}
3 Electric proportional pressure adjustment
4 Dynamic throttle
Adjustment area for 1 and 2 restricted by retaining ring.

Coding **P1R**



1 Maximum pressure p_{max}
2 Maximum pressure reduction p_{red}
3 Electric proportional pressure adjustment
4 Dynamic throttle

Pressure adjustment	Pressure range (bar)	Δp (bar)/revolution	Factory-set pressure setting (bar)
Maximum pressure p_{max} (PR)	20 to 400	Approx. 50	300
Maximum pressure p_{max} (P1R)	20 to 400	Approx. 140	300
Minimum pressure p_{min}	20 to 55	Approx. 10	27

CAUTION
Risk of injury on overloading components due to incorrect pressure settings!
Risk of minor injury.
- Pay attention to the maximum operating pressure of the pump and the valves.
- Always monitor the pressure gauge when setting and changing the pressure.

2.2.7 ZL and L controllers

The ZL and L controllers are power controllers with fixed settings. As soon as the product of geometric displacement and pressure exceeds the set value, the controller reduces the pivoting angle of the pump to protect the drive shaft, motor or gearbox from overload (p_B x V_g = constant).

ZL controller: V60N-060/090/110

L controller: V60N-130 (series)

The setting is made either as a torque limitation (Nm) or power limitation (kW) at the corresponding rotation speed (rpm).

Drive torque

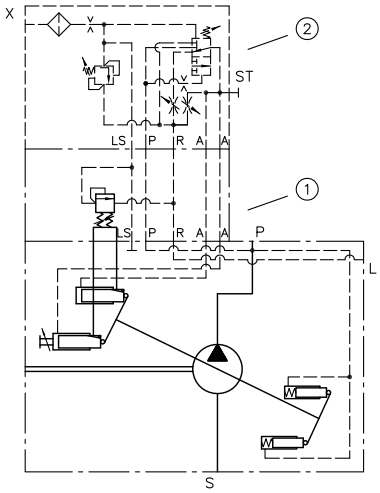
$$M = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}} (Nm)$$

Drive power

$$P = \frac{2\pi \cdot M \cdot n}{60000} = \frac{Q \cdot \Delta p}{600 \cdot \eta_t} (kW)$$

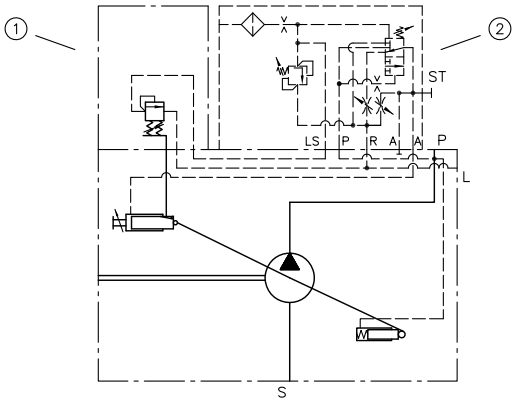
V_g	= Geometric output volume (cm³/rev)
Δp	= Differential pressure
n	= Rotation speed (rpm)
η_v	= Volumetric efficiency
η_{mh}	= Mechanical-hydraulic efficiency
η_T	= Overall efficiency $\eta_T = \eta_v * \eta_{mh}$)
Q	= Flow rate (lpm)
M	= Torque (Nm)
P	= Power (kW)

Coding **LSP/ZL**



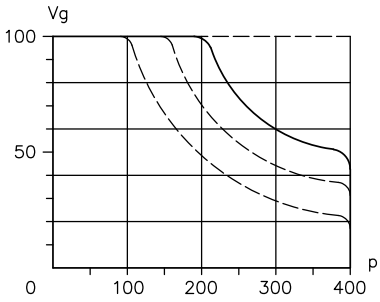
1 ZL controller
2 LSP controller

Coding **LSP/L**



1 L controller
2 LSP controller

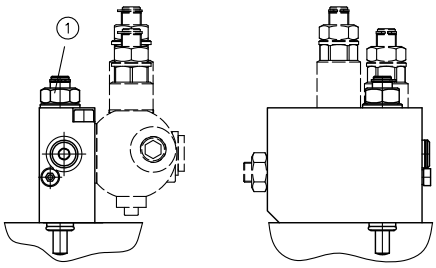
Coding **/ZL, /L**



pB pressure (bar)

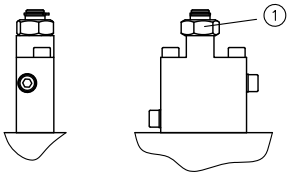
V_g geometric displacement (%)

Coding **ZL**
Intermediate plate version



1 Torque setting

Coding **L**



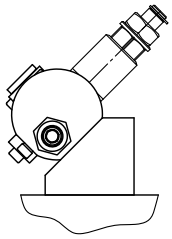
1 Torque setting

Torque setting

	ΔM (Nm)/revolution	Factory-set torque setting (Nm)	Adjustment area
Power controller ZL	Approx. 190	200	25 ... 100% of Nm_{max}
Power controller L	Approx. 190	700	200 ... 700 Nm

2.2.8 ZW intermediate plate

The ZW intermediate plate is a 45° spacer plate. For V60N-060/090/110, it is required for housing versions with radial connections (coding 2 and 3) to avoid a collision between the pump controller and the suction or pressure line.



3 Parameters

3.1 General

Designation	Variable displacement axial piston pump
Design	Axial piston pump according to the swash plate principle
Mounting	Mounting flange according to DIN ISO 7653, DIN ISO 3019-1 or DIN ISO 3019-2
User interface	Primed RAL 7043
Drive/output torque	See Chapter 3.1, "General" ("Max. permissible drive/output torque")
Installation position	Any (for installation information see Chapter 5, "Assembly, operation and maintenance recommendations")
rotation direction	Clockwise or anti-clockwise
Change of rotating direction	**V60N-060/-090/-110:** Turn the end plate of the pump (see dimension diagram) and replace the port plate; see also Assembly instructions for variable displacement axial piston pump type V60N: B 7960 N
Connections	▪ Suction port ▪ Pressure connection ▪ Drain port ▪ Pressure gauge connection ▪ LS port
Hydraulic fluid	▪ Hydraulic oil according to Part 1 to 3; ISO VG 10 to 68 according to DIN 51519 ▪ Viscosity range: min. 10; max. 1000 mm^2/s optimal operation between 16 and 60 mm^2/s ▪ See Chapter 5.2.3, "Restrictions during cold-start and warm-up phase" ▪ Also suitable for biologically degradable hydraulic fluids type HEPG (polyalkylene glycol) and HEES (synthetic ester) at operating temperatures up to approx. +70°C
Cleanliness level	**ISO 4406** 19/17/14
Temperatures	▪ Surrounding area: -40°C to +60°C (observe viscosity range) ▪ Oil: - 25°C to +80°C (observe viscosity range) ▪ Start temperature: Down to -40°C permissible (note start viscosities), if the application limits are observed, See "Operating instructions" ▪ Biologically degradable hydraulic fluids: Not above +70°C **NOTE** When switching on the pump, the transmission side oil must be warmer than -25 °C.

Pressure and delivery flow

Operating pressure	See Chapter 2, "Available versions, main data"
Geometric displacement	See Chapter 2, "Available versions, main data"

Weight

Type V60N	Without controller (kg)	With controller (kg)					
		LSP, LSPT, LSNR, LSNRT, NR, NR2, NR3	ZL	ZW	PR	P1R	ZV, ZV1
060	23	+1.1	+1.0	+0.7	+2.6	+1.2	+1.9
090	26	+1.1	+1.0	+0.7	+2.6	+1.2	+1.9
110	29	+1.1	+1.0	+0.7	+2.6	+1.2	+1.9
130	29.8	+1.1	--	--	+2.6	--	--

Additional parameters

Designation	Nominal size			
	060	090	110	130
Max. swash plate angle	20.5°	21.5°	21.5°	21.5°
Absolute inlet pressure required in open circuit	0.85 bar	0.85 bar	0.85 bar	0.85 bar
Max. permissible housing pressure (static/dynamic)	2 bar/3 bar	2 bar/3 bar	2 bar/3 bar	2 bar/3 bar
Max. permissible inlet pressure (static/dynamic)	20 bar/30 bar	20 bar/30 bar	20 bar/30 bar	20 bar/30 bar
Max. rotation speed during suction operation and max. swash plate angle at 1 bar abs. Inlet pressure	2500 rpm	2300 rpm	2200 rpm	2100 rpm
Max. rotation speed with zero stroke and 1 bar abs. Inlet pressure	3000 rpm	3000 rpm	3000 rpm	3000 rpm
Min. rotation speed in continuous operation	500 rpm	500 rpm	500 rpm	500 rpm
Required drive torque at 100 bar	100 Nm	151 Nm	184 Nm	230 Nm
Drive power at 250 bar and 2000 rpm	53 kW	79.5 kW	97.2 kW	120 kW
Weight torque	30 Nm	35.5 Nm	40 Nm	40 Nm
Inertia torque	0.005 kg m^2	0.008 kg m^2	0.01 kg m^2	0.011 kg m^2
Noise level at 250 bar, 1500 rpm and max. swash plate angle (measured in acoustic measurement chamber according to DIN ISO 4412-1, measuring distance 1 m)	75 dB(A)	75 dB(A)	75 dB(A)	75 dB(A)

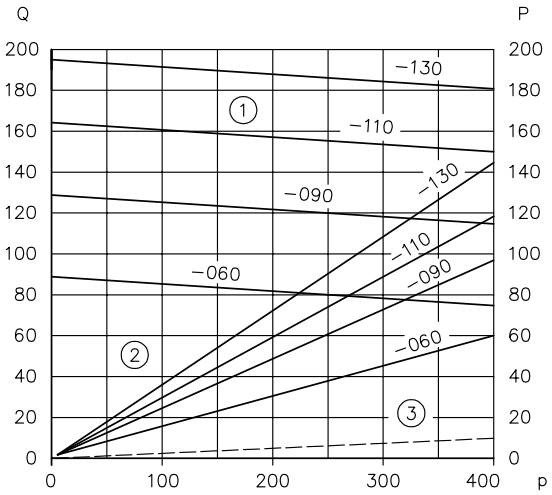
Max. permissible drive/output torque

Designation		Nominal size (Nm)			
		060	090	110	130
Parallel key splined shaft D	Drive/output	530/100	800/600	800/600	800 /700
Spline shaft M	Drive/output	--	530/530	530/530	--
Spline shaft H	Drive/output	210/100	--	--	--
Spline shaft U	Drive/output	210/100	--	--	--
Spline shaft T	Drive/output	340/100	--	--	--
Spline shaft S	Drive/output	530/100	640/600	640/600	640/640
Spline shaft Q	Drive/output	--	900/600	900/600	900/700

3.2 Characteristics

Delivery flow and power (basic pump)

The diagrams show delivery flow and drive power over pressure without a controller at 1500 rpm.

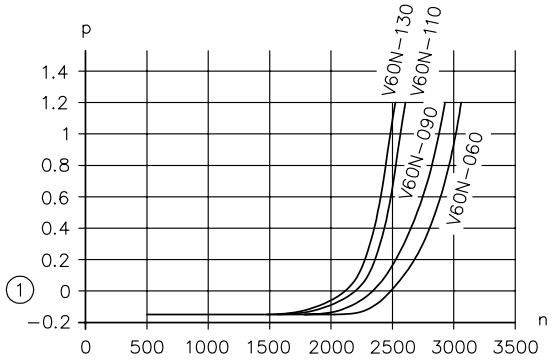


p pressure (bar); Q delivery flow (lpm); P power (kW)

1 Delivery flow/pressure
2 Drive power/pressure (max. swash plate angle)
3 Drive power/pressure (zero stroke)

Inlet pressure and self-suction speed

The diagrams show the inlet pressure/rotation speed at the max. swash plate angle and an oil viscosity of 75 mm²/s.



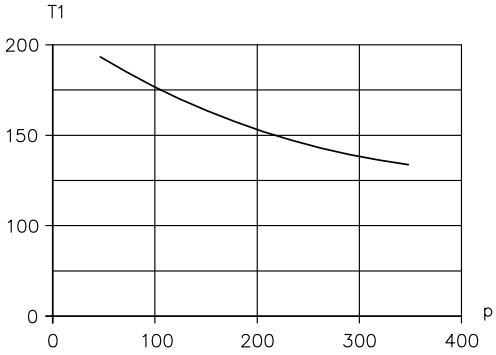
n rotation speed (rpm); p inlet pressure (bar)

1 0 bar relative = 1 bar absolute

Acting times

Acting times T1 (LSP and LSPT controllers)

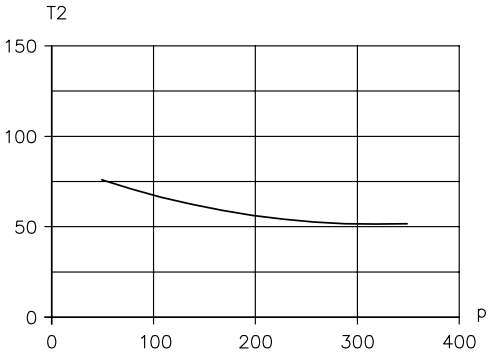
The diagram illustrates the on-stroke time based on the pressure for the LSP and LSPT controllers, i.e. the time required to swing out the pump and to adjust the geometric displacement from the minimum to the maximum.



p pressure (bar); acting time T1 (ms)

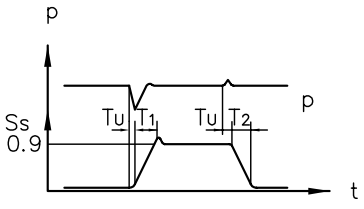
Acting times T2 (LSP and LSPT controllers)

The diagram shows the destroke time based on the pressure for the LSP and LSPT controllers, i.e. the time required to swing in the pump and to adjust the geometric displacement from the maximum to the minimum.



p pressure (bar); acting time T2 (ms)

Acting times Tu, T1 and T2



t in ms; p pressure (bar)

S_S	= positioning travel of actuator
T_u	= delay < 3 ms
T_1	= on-stroke time
T_2	= destroke time
p	= pressure

LS line approx. 10% of the volume of the P line

3.3 Electrical parameters

Controller coding ZV, ZV1, PR, P1R

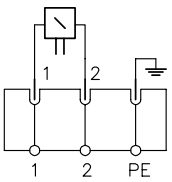
Nominal voltage	12 VDC	24 VDC
Resistance R_{20}	5.9 Ω	24 Ω
Current, cold I_{20}	2.0 A	1.0 A
Limit current I_G	1.26 A	0.63 A
Limit power P_G	14.1 W	14.1 W
Actuated time	S1 (100 %)	
Dither frequency	210 Hz	
Dither amplitude $A_D(\%) = \frac{I_{Spitze-Spitze}}{IG} \cdot 100$	0 % ≤ A_D ≤ 20 %	

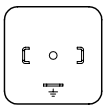
Controller coding V

Nominal voltage	12 VDC	24 VDC
Resistance R_{20}	7 Ω	24 Ω
Current, cold I_{20}	1.7 A	1.0 A
Limit current I_G	1.3 A	0.7 A
Limit power P_G	17.7 W	17.8 W
Actuated time	S1 (100 %)	
Dither frequency	60 - 110 Hz	
Dither amplitude $A_D(\%) = \frac{I_{Spitze-Spitze}}{IG} \cdot 100$	20 % ≤ A_D ≤ 40 %	

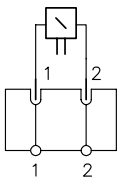
Electrical connection

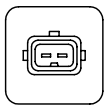
Coding **G 12, G 24**



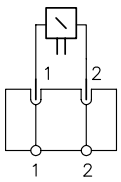


Coding **AMP 12, AMP 24**





Coding **DT 12, DT 24**



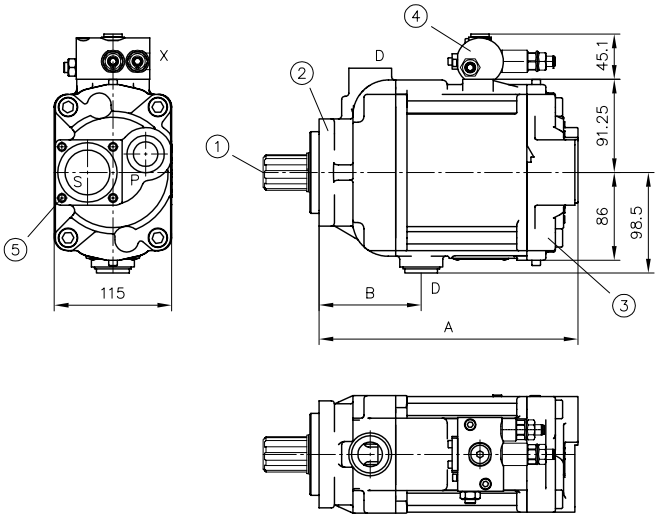
4 Dimensions

All dimensions in mm, subject to change.

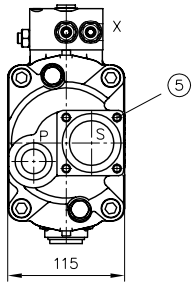
4.1 Basic pump

4.1.1 Type V60N-060

Rotating direction **clockwise** (viewed from shaft journal)



Rotating direction **anti-clockwise** (viewed from shaft journal)



1 Shaft version
2 Flange version
3 Housing version
4 Controllers and intermediate plates according to Chapter 4.2, "Controllers and intermediate plates"
5 Attachment kit for suction intake according to Chapter 6.1.1, "Suction intake" is included in the delivery

Flange version	Housing version	A	B
Y	-1	253.5	100.0
F, Z, X	-1	249.8	96.3
Y	-2, -3	292.0	100.0
F, Z, X	-2, -3	288.3	96.3

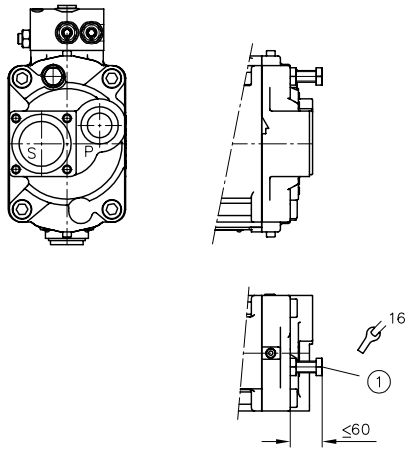
Ports P, S and D (DIN EN ISO 228-1)

P	Pressure port G 3/4 (BSPP)
S	Flange suction port
D	Drain port G 3/4 (BSPP)
X	G 1/4 (BSPP)

For coding UNF connections SAE J 514

P	Pressure connection 1 1/16-12 UN-2B
S	Flange suction port
D	Drain port 1 1/16-12 UN-2B
X	G 1/4 (BSPP) (DIN EN ISO 228-1) with adapter for 7/16-20 (SAE-4)

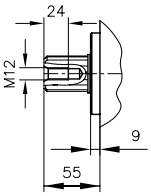
Stroke limitation



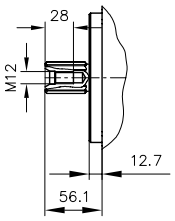
1 Stroke limitation (V_g approx. 4 cm³/rev.)

Shaft versions

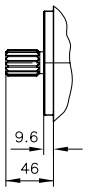
Parallel key splined shaft
Coding **D**
(similar to DIN ISO 14)
B8x32x35



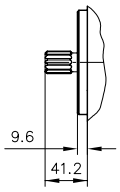
Spline shaft
Coding **S**
(SAE-C 14T 12/24DP)



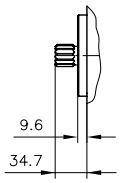
Spline shaft
Coding **T**
(SAE-B-B 15T 16/32DP)



Spline shaft
Coding **H**
(SAE-B 13T 16/32DP)

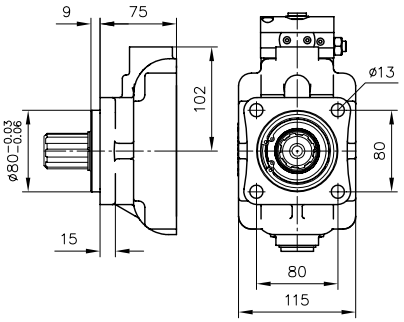


Spline shaft
Coding **U**
(SAE-B 13T 16/32DP short)

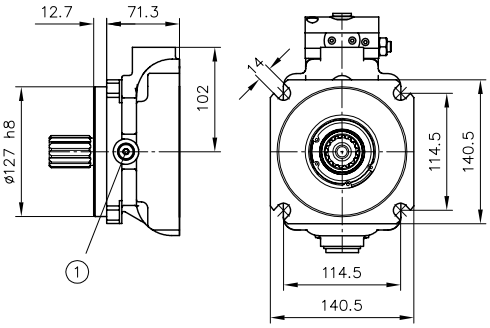


Flange versions

Coding **Y**
(DIN ISO 7653)

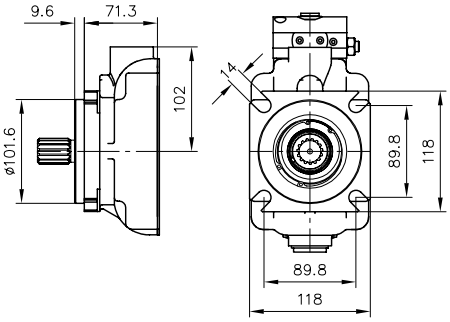


Coding **F**
(SAE-C 4-hole)
(127-4 DIN ISO 3019-1)

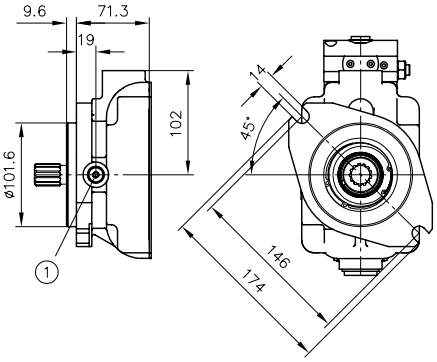


1 Bleeding G 1/8

Coding **Z**
(SAE-B 4-hole)
(101-4 DIN ISO 3019-1)

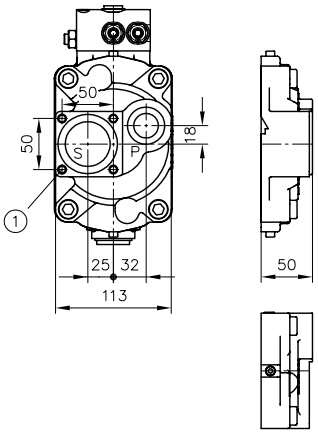


Coding **X**
(SAE-B 2-hole)
(101-2 DIN ISO 3019-1)



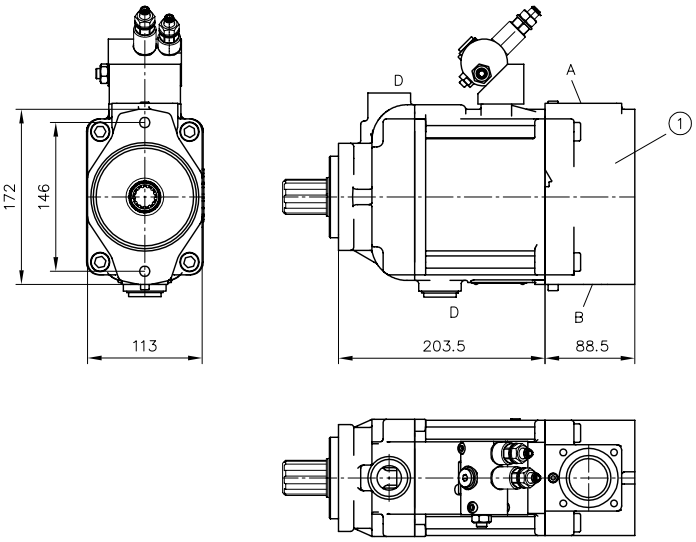
1 Bleeding G 1/8

Housing version -1 (axial ports)



1 Delivery includes attachment kit for suction intake according to Chapter 6.1.1, "Suction intake"

Housing version -2 (radial ports, with thru-shaft)

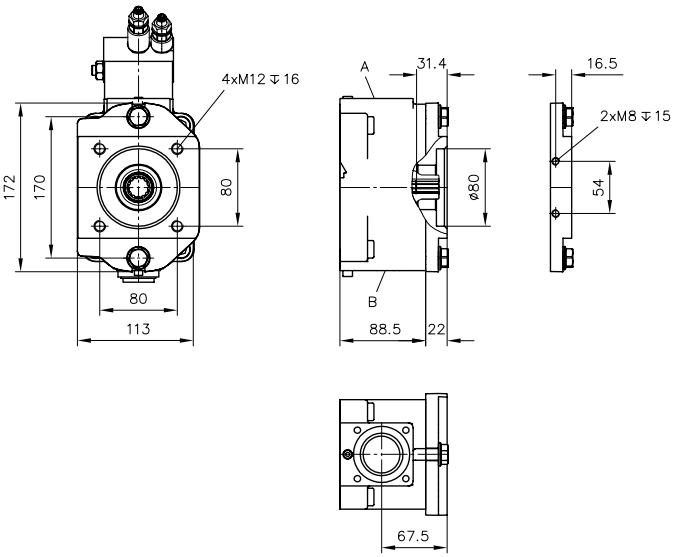


1 Flange version (output side)

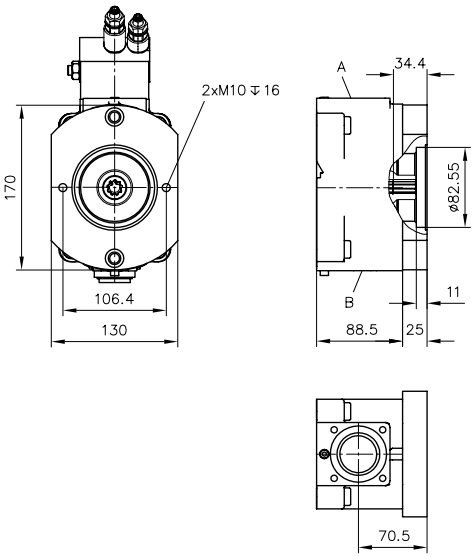
Rotating direction clockwise	Rotating direction anti-clockwise
A = suction port	A = pressure port
B = pressure port	B = suction port

Flange version (output side)

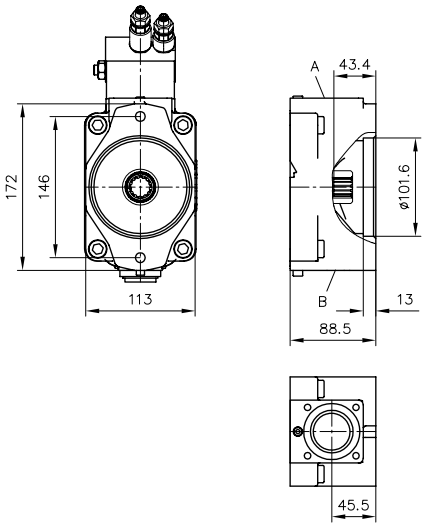
Coding **C 010**
(DIN ISO 7653)



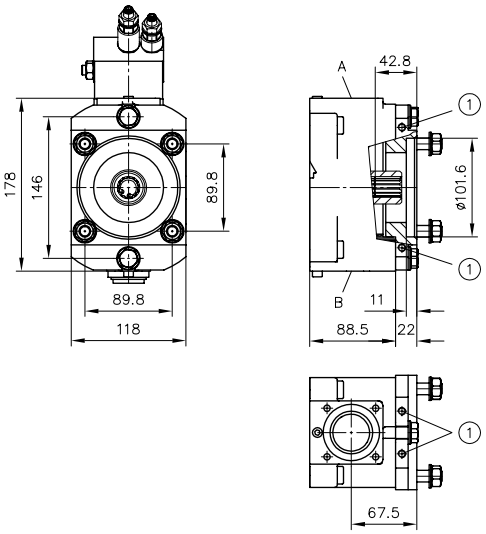
Coding **C 011, C 012, C 013**
(SAE-A 2-Hole)



Coding **C 014**
(SAE-B 2-hole)

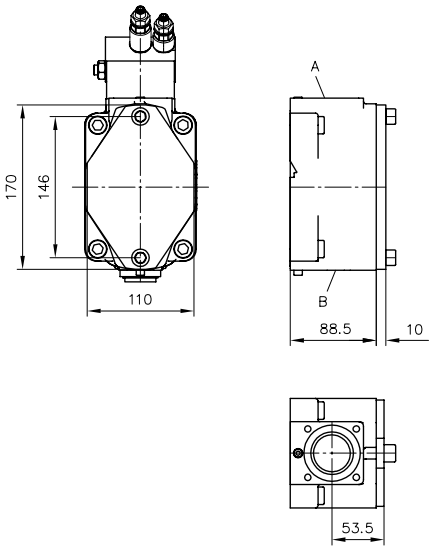


Coding **C 015**
(SAE-B 4-hole)



1 Support 8xM8

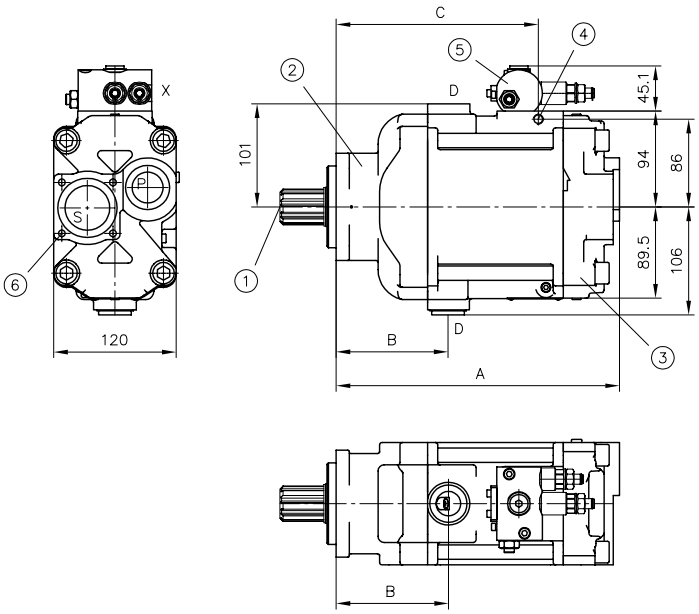
Housing version -3 (radial ports)



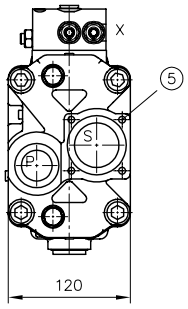
Rotating direction clockwise	Rotating direction anti-clockwise
A = suction port	A = pressure port
B = pressure port	B = suction port

4.1.2 Type V60N-090

Rotation direction **clockwise** (viewed from shaft journal)



Rotation direction **anti-clockwise** (viewed from shaft journal)



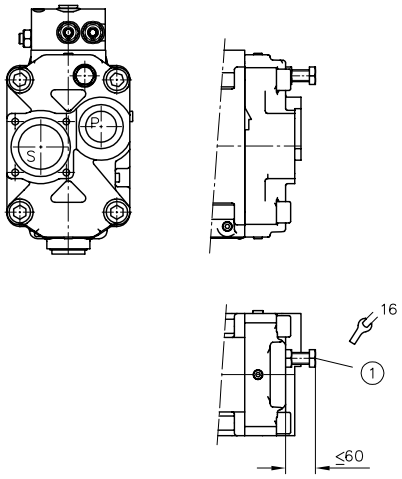
1 Shaft version
2 Flange version
3 Housing version
4 Thread M10 for attaching a support
5 Controllers and intermediate plates according to Chapter 4.2, "Controllers and intermediate plates"
6 Attachment kit for suction intake according to Chapter 6.1.1, "Suction intake" is included in the delivery

Flange version	Housing version	A	B	C
Y	-1	277.5	110.0	198.0
F, G	-1	273.8	106.3	194.3
Y	-2, -3	310.5	110.0	198.0
F, G	-2, -3	306.8	106.3	194.3

Ports P, S and D (DIN EN ISO 228-1)	
P	Pressure port G 1 (BSPP)
S	Flange suction port
D	Drain port G 3/4 (BSPP)
X	G 1/4 (BSPP)

For coding UNF connections SAE J 514	
P	Pressure port 1 5/16-12 UN-2B
S	Flange suction port
D	Drain port 1 1/16-12 UN-2B
X	G 1/4 (BSPP) (DIN EN ISO 228-1) with adapter for 7/16-20 (SAE-4)

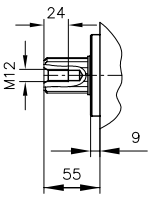
Stroke limitation



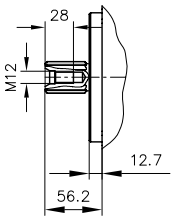
1 Stroke limitation (V_g approx. 5 cm³/rev.)

Shaft versions

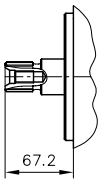
Parallel key splined shaft
Coding **D**
(similar to DIN ISO 14)
B8x32x35



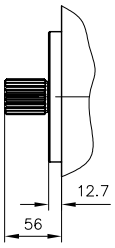
Spline shaft
Coding **S**
(SAE-C 14T 12/24DP)



Spline shaft
Coding **M**
(W30x2x14x9g DIN 5480)

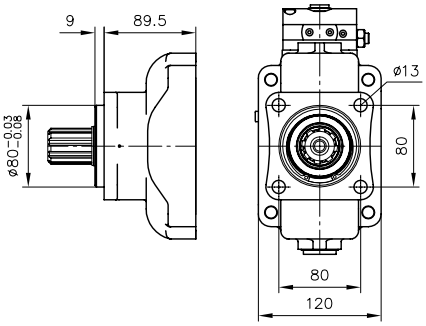


Spline shaft
Coding **Q**
(SAE-CS 21T 16/32 DP)

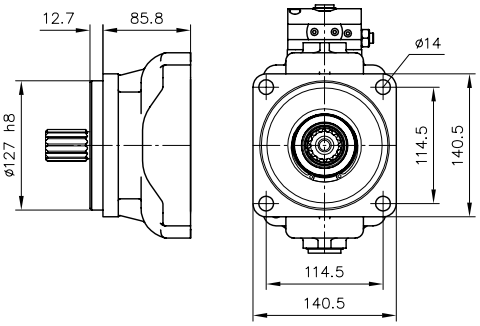


Flange versions

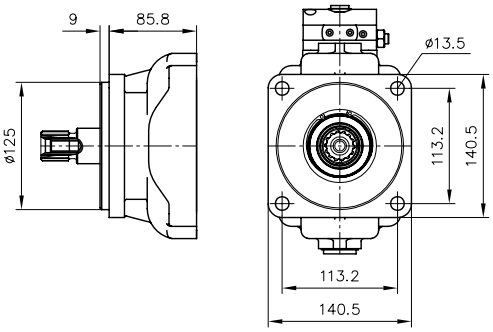
Coding **Y**
(DIN ISO 7653)



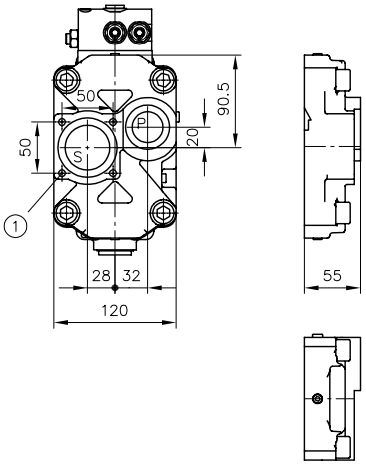
Coding **F**
(SAE-C 4-hole)
(127-4 DIN ISO 3019-1)



Coding **G**
(125 B4 HW DIN ISO 3019-2)

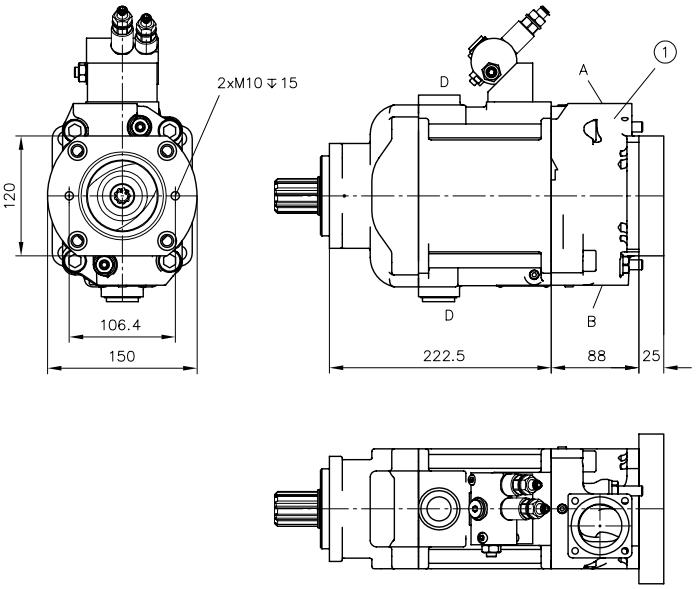


Housing version -1 (axial ports)



1 Delivery includes attachment kit for suction intake according to Chapter 6.1.1, "Suction intake"

Housing version -2 (radial ports, with thru-shaft)

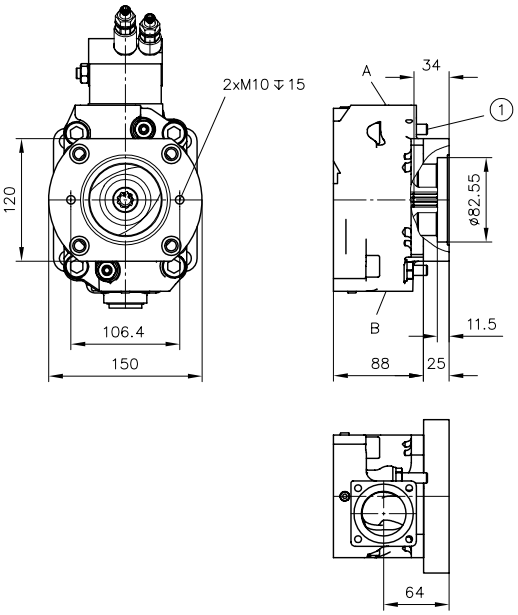


1 Flange version (output side)

Rotation direction clockwise	Rotation direction anti-clockwise
A = suction port	A = pressure connection
B = pressure connection	B = suction port

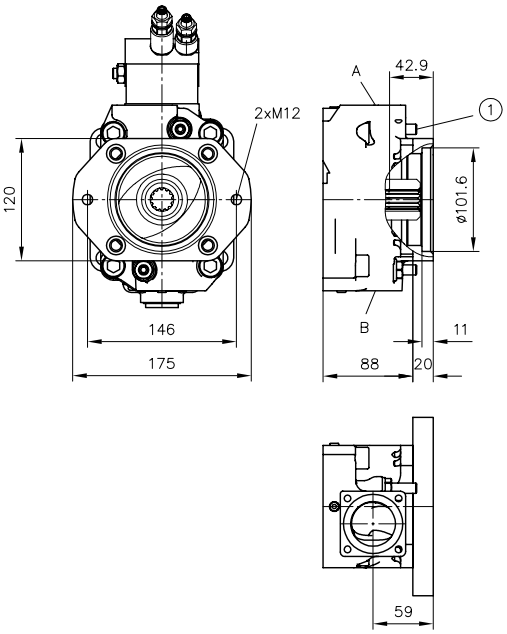
Flange version (output side)

Coding **C 021, C 022**
(SAE-A 2-hole)



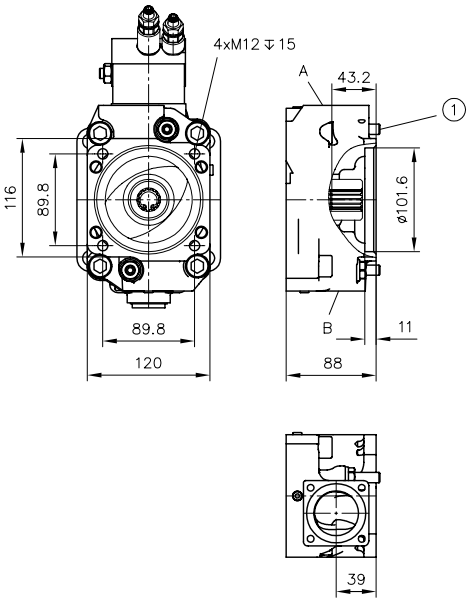
1 Stroke limitation

Coding **C 024, C 026**
(SAE-B 2-hole)



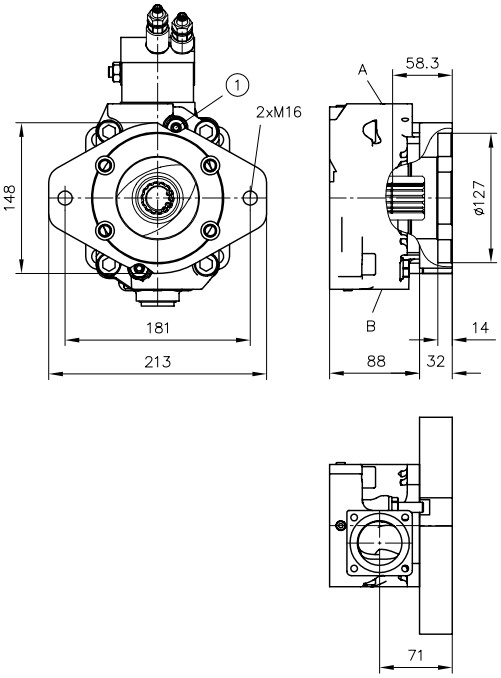
1 Stroke limitation

Coding **C 025**
(SAE-B 4-hole)



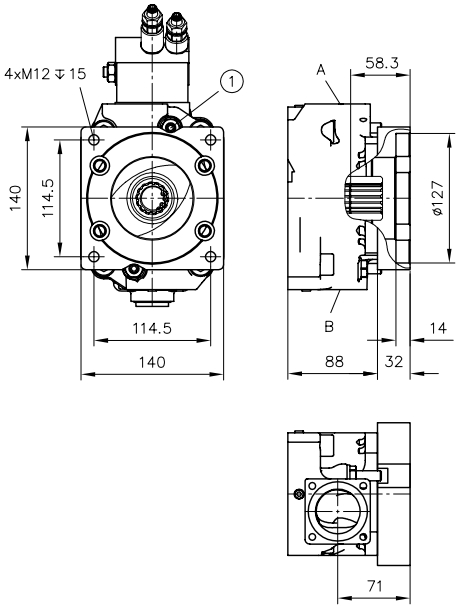
1 Stroke limitation

Coding **C 027**
(SAE-C 2-hole)



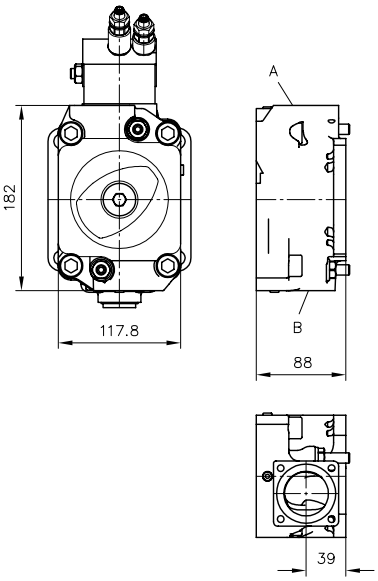
1 Stroke limitation

Coding **C 028**
(SAE-C 4-hole)



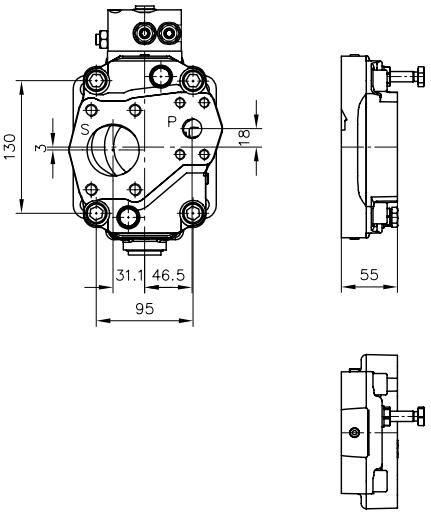
1 Stroke limitation

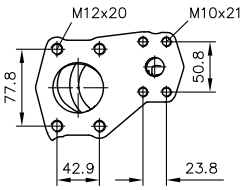
Housing version -3 (radial ports)



Rotation direction clockwise	Rotation direction anti-clockwise
A = suction port	A = pressure connection
B = pressure connection	B = suction port

Housing version -4 (axial ports)



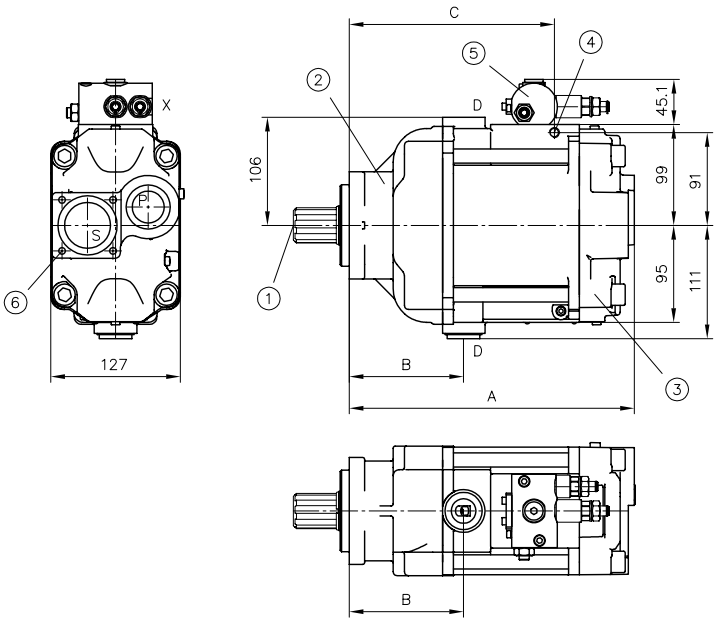


Ports P, S (SAE J 518)

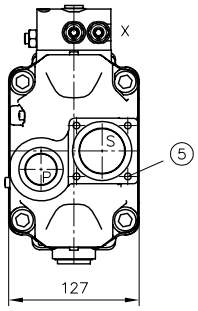
P	Pressure connection SAE 3/4”	(6000 psi)
S	Suction port SAE 2”	(3000 psi)

4.1.3 Type V60N-110

Rotation direction **clockwise** (viewed from shaft journal)



Rotation direction **anti-clockwise** (viewed from shaft journal)



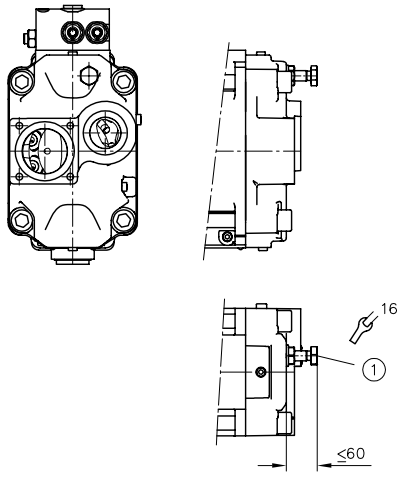
1 Shaft version
2 Flange version
3 Housing version
4 Thread M10 for attaching a support
5 Controllers and intermediate plates according to Chapter 4.2, "Controllers and intermediate plates"
6 Attachment kit for suction intake according to Chapter 6.1.1, "Suction intake" is included in the delivery

Flange version	Housing version	A	B	C
Y	-1	279.5	112.0	201.0
F	-1	275.7	108.7	197.7
P	-1	278.5	111.0	200.0
Y	-2, -3	313.5	112.0	201.0
F	-2, -3	309.7	108.2	197.7
P	-2, -3	312.5	111.0	200.0

Ports P, S and D (DIN EN ISO 228-1)	
P	Pressure port G 1 (BSPP)
S	Flange suction port
D	Drain port G 3/4 (BSPP)
X	G 1/4 (BSPP)

For coding UNF connections SAE J 514	
P	Pressure port 1 5/16-12 UN-2B
S	Flange suction port
D	Drain port 1 1/16-12 UN-2B
X	G 1/4 (BSPP) (DIN EN ISO 228-1) with adapter for 7/16-20 (SAE-4)

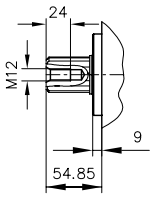
Stroke limitation



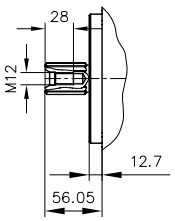
1 Stroke limitation (V_g approx. 6 cm³/rev.)

Shaft versions

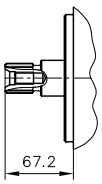
Parallel key splined shaft
Coding **D**
(similar to DIN ISO 14)
B8x32x35



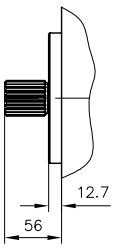
Spline shaft
Coding **S**
(SAE-C 14T 12/24DP)



Spline shaft
Coding **M**
(W30x2x14x9g DIN 5480)

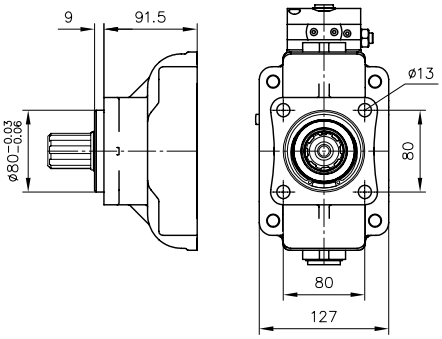


Spline shaft
Coding **Q**
(SAE-CS 21T 16/32 DP)

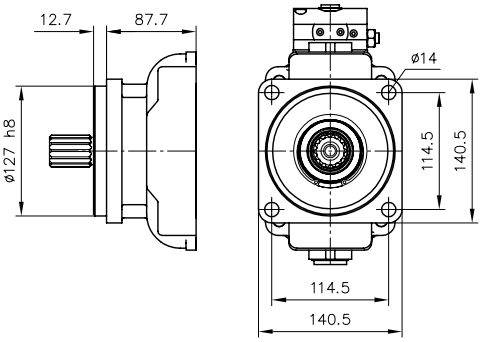


Flange versions

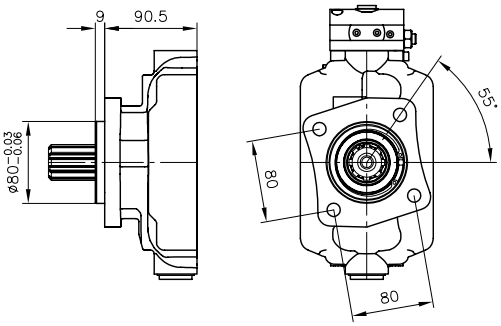
Coding **Y**
(DIN ISO 7653)



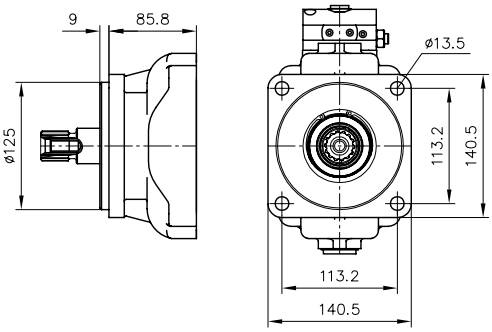
Coding **F**
(SAE-C 4-hole)
(127-4 DIN ISO 3019-1)



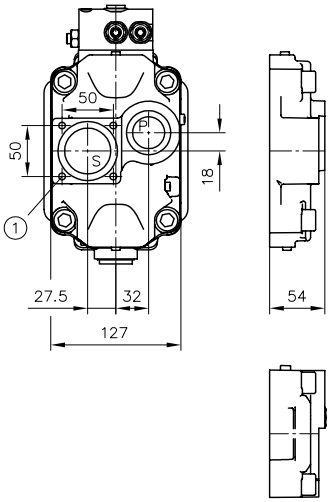
Coding **P**
(DIN ISO 7653)



Coding **G**
(125 B4 HW DIN ISO 3019-2)

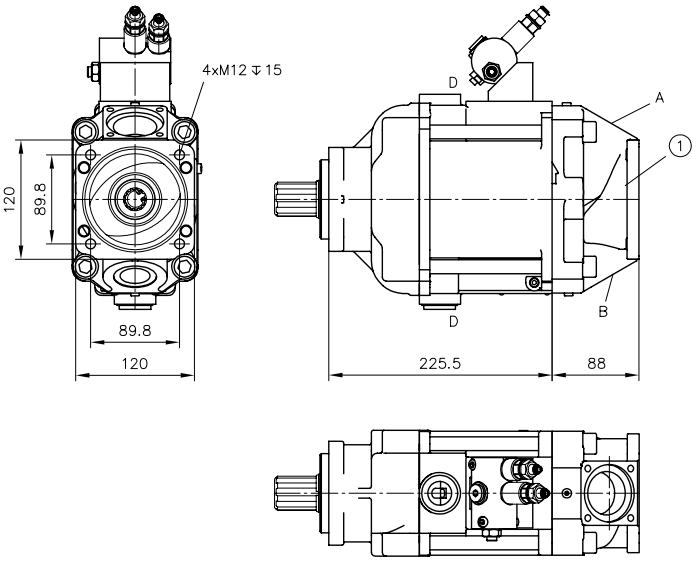


Housing version -1 (axial ports)



1 Delivery includes attachment kit for suction intake according to Chapter 6.1.1, "Suction intake"

Housing version -2 (radial ports with thru-shaft)

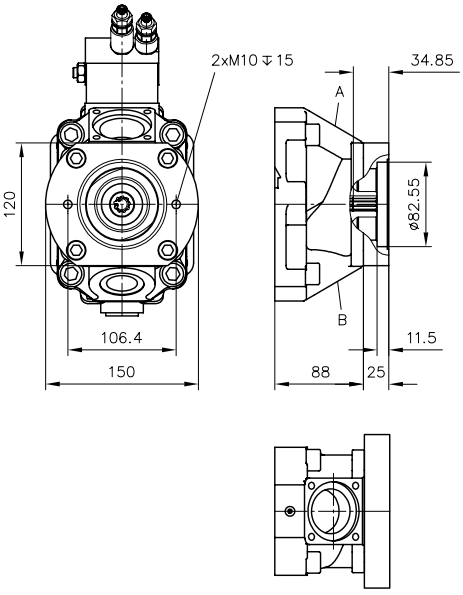


1 Flange version (output side)

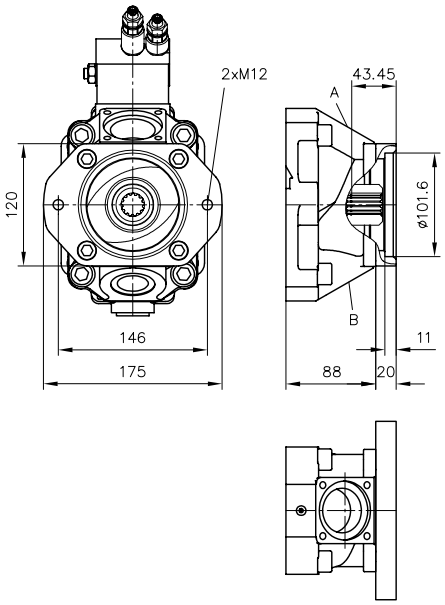
Rotation direction clockwise	Rotation direction anti-clockwise
A = suction port	A = pressure connection
B = pressure connection	B = suction port

Flange version (output side)

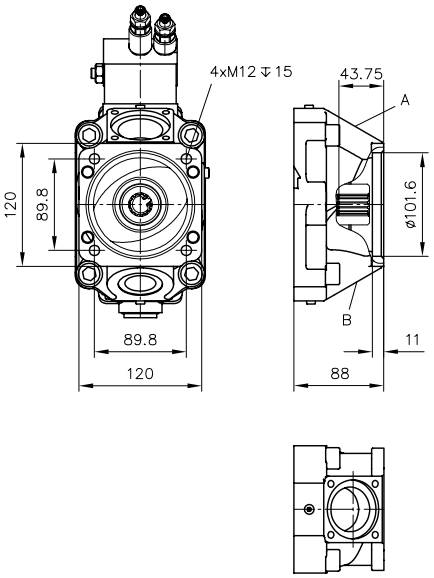
Coding **C 021, C 022**
(SAE-A 2-hole)



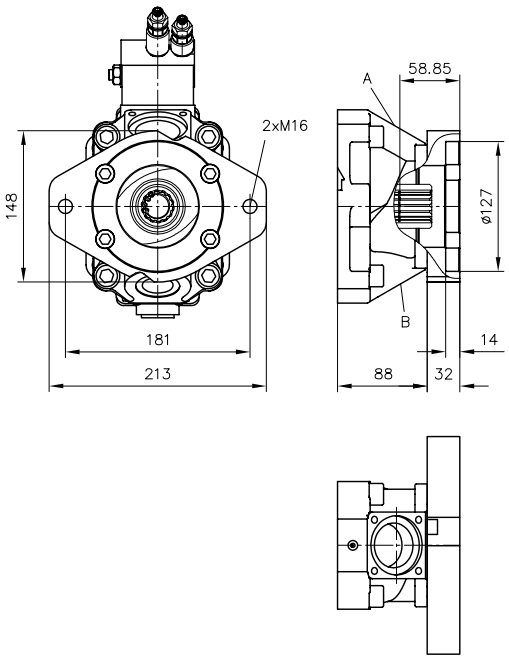
Coding **C 024, C 026**
(SAE-B 2-hole)



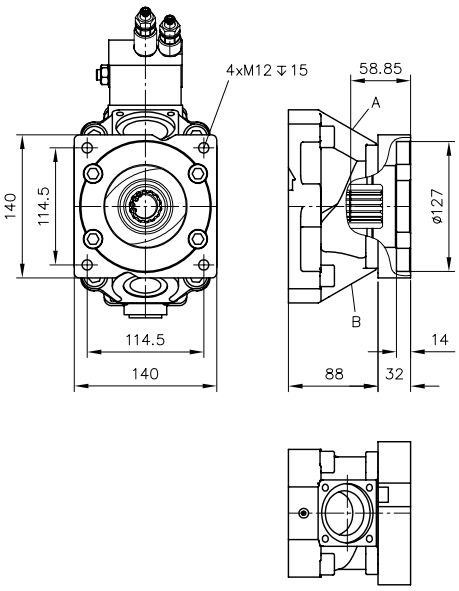
Coding **C 025**
(SAE-B 4-hole)



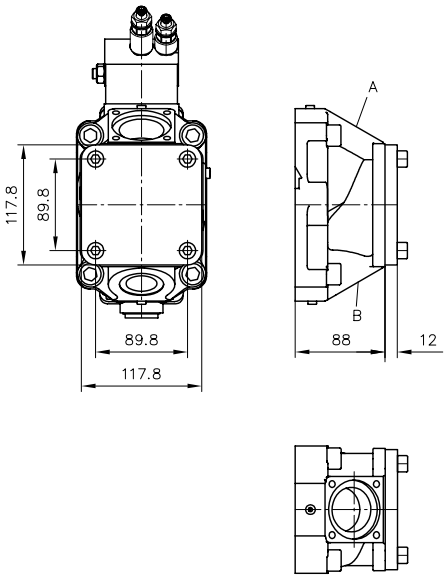
Coding **C 027**
(SAE-C 2-hole)



Coding **C 028**
(SAE-C 4-hole)



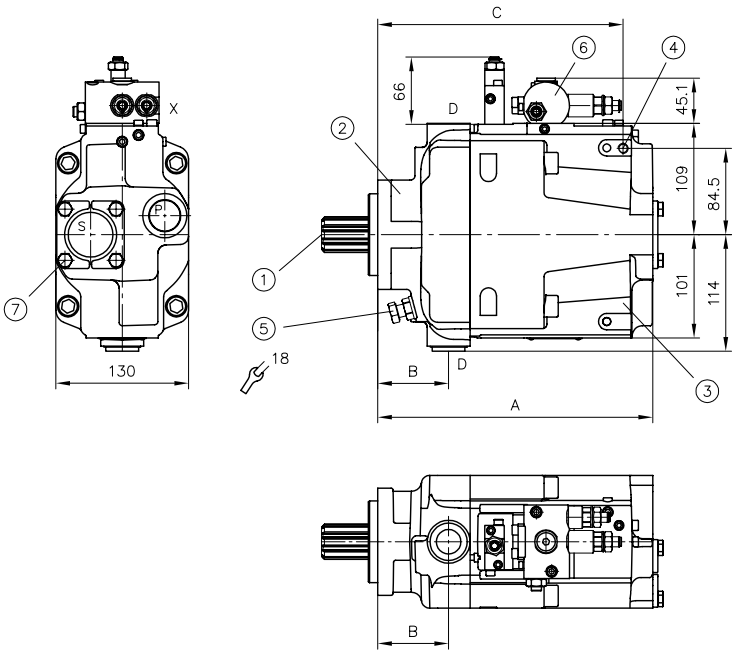
Housing version -3 (radial ports)



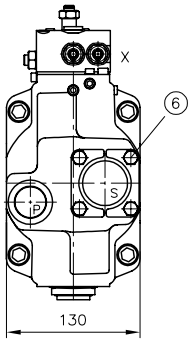
Rotation direction clockwise	Rotation direction anti-clockwise
A = suction port	A = pressure connection
B = pressure connection	B = suction port

4.1.4 Type V60N-130

Rotation direction **clockwise** (viewed from shaft journal)



Rotation direction **anti-clockwise** (viewed from shaft journal)



1 Shaft version
2 Flange version
3 Housing version
4 Thread M10 for attaching a support
5 Stroke limitation (13 cm³/rev.)
6 Controllers and intermediate plates according to Chapter 4.2, "Controllers and intermediate plates"
7 Attachment kit for suction intake according to Chapter 6.1.1, "Suction intake" is included in the delivery

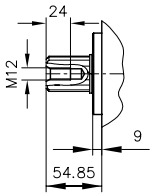
Flange version	Housing version	A	B	C
Y, P	-1	269.5	69.5	240.5
F	-1	266.8	66.8	237.8
Y, P	-2	323.5	69.5	240.5
F	-2	320.8	66.8	237.8

Ports P, S and D (DIN EN ISO 228-1)	
P	Pressure port G 1 (BSPP)
S	Flange suction port
D	Drain port G 3/4 (BSPP)
X	G 1/4 (BSPP)

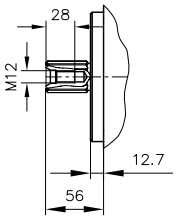
For coding UNF connections SAE J 514	
P	Pressure port 1 5/16-12 UN-2B
S	Flange suction port
D	Drain port 1 1/16-12 UN-2B
X	G 1/4 (BSPP) (DIN EN ISO 228-1) with adapter for 7/16-20 (SAE-4)

Shaft versions

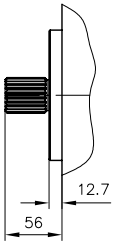
Spline shaft
Coding **D**
(similar to DIN ISO 14)
B8x32x35



Spline shaft
Coding **S**
(SAE-C 14T 12/24DP)

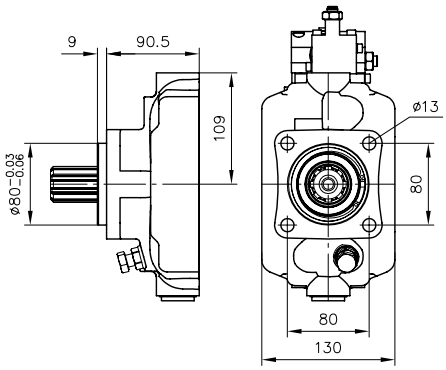


Spline shaft
Coding **Q**
(SAE-CS 21T 16/32 DP)

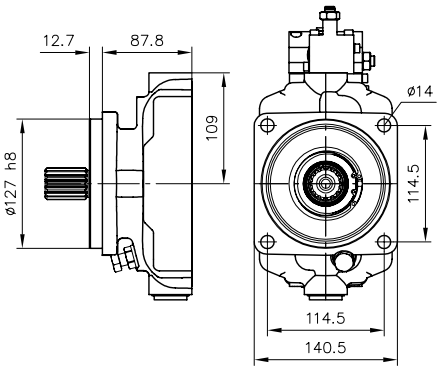


Flange versions

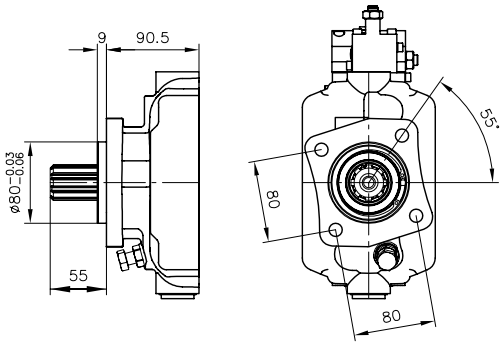
Coding **Y**
(DIN ISO 7653)



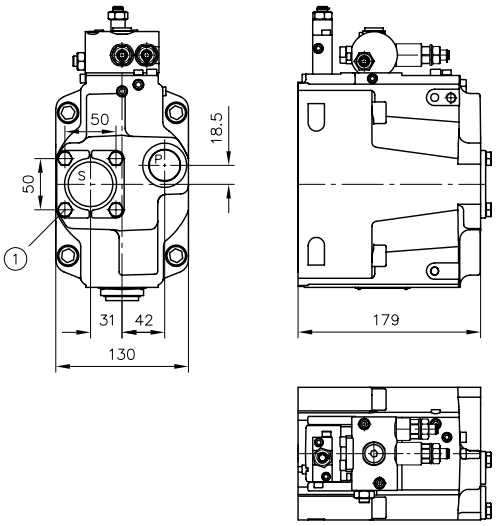
Coding **F**
(SAE-C 4-hole)
(127-4 DIN ISO 3019-1)



Coding **P**
(DIN ISO 7653)



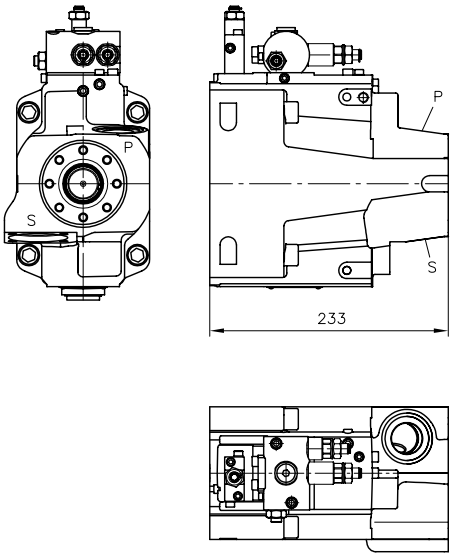
Housing version -1 (axial ports)



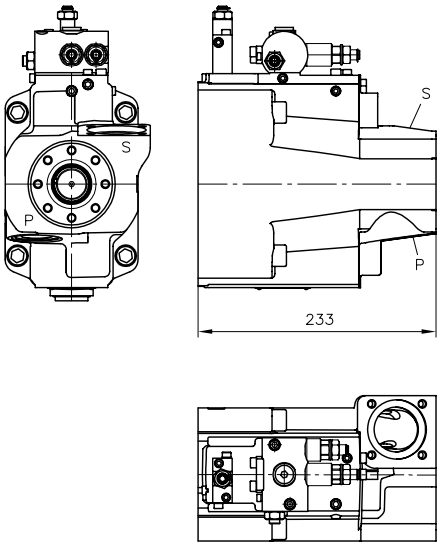
1 Delivery includes attachment kit for suction intake according to Chapter 6.1.1, "Suction intake"

Housing version -2 (radial ports, with thru-shaft)

Rotation direction **clockwise**

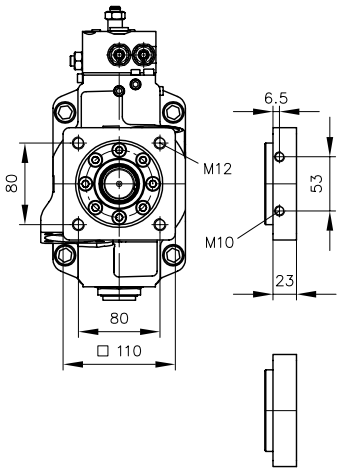


Rotation direction **anti-clockwise**

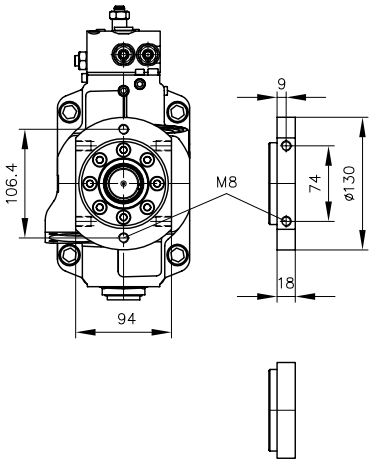


Flange version (output side)

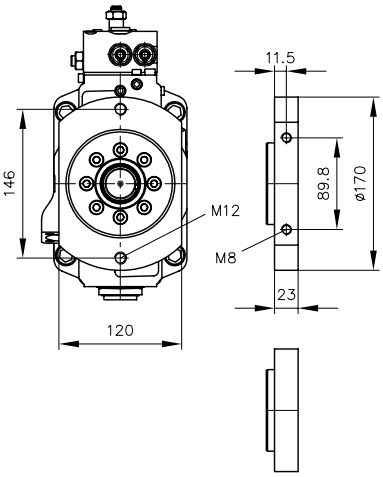
Coding **C 030**
(ISO 7653-1985)



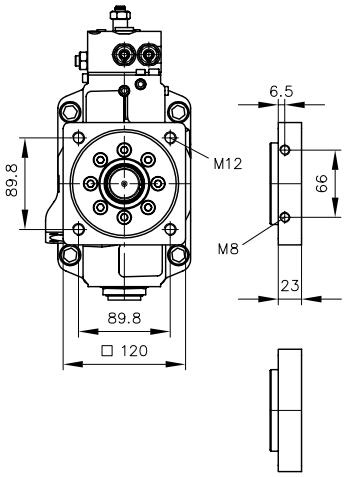
Coding **C 031, C 032**
(SAE-A 2-hole)



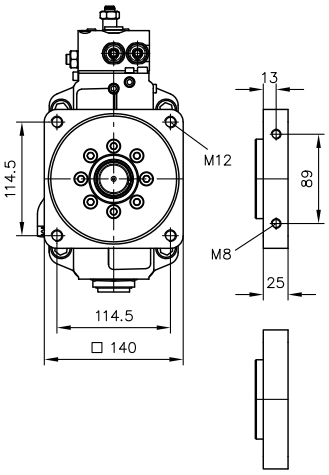
Coding **C 034, C 036**
(SAE-B 2-hole)



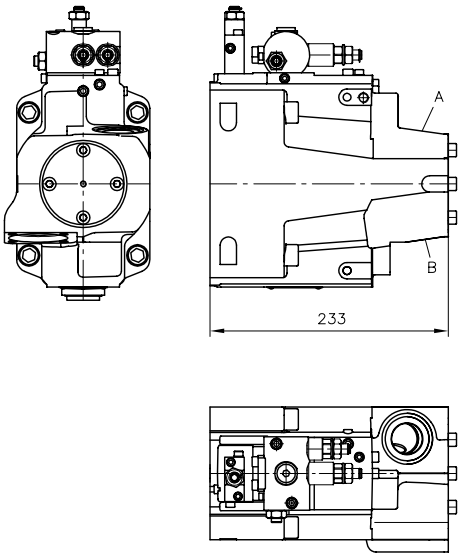
Coding **C 035**
(SAE-B 4-hole)



Coding **C 038**
(SAE-C 4-hole)



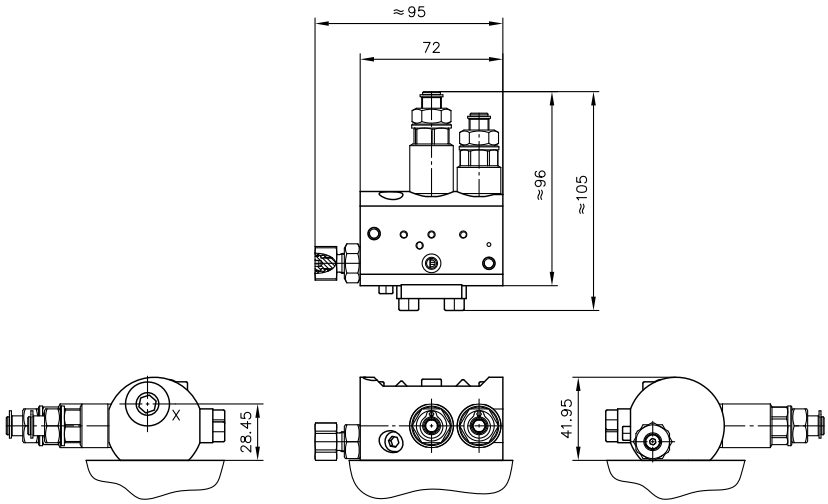
Housing version -3 (radial ports)



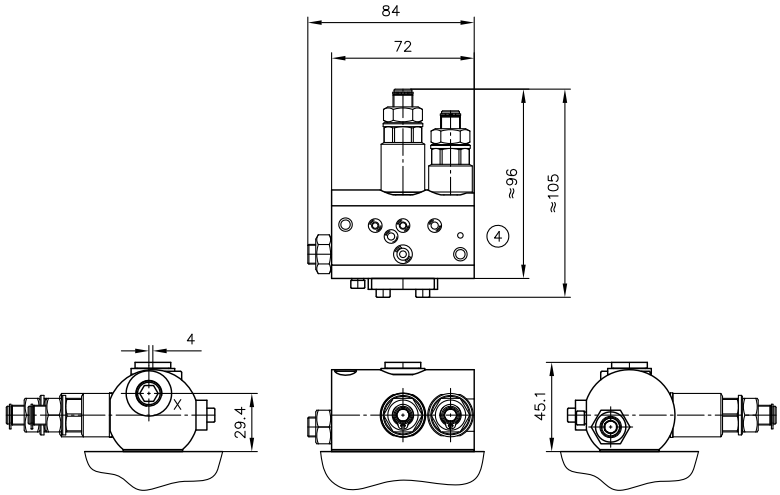
Rotation direction clockwise	Rotation direction anti-clockwise
A = pressure connection	A = suction port
B = suction port	B = pressure connection

4.2 Controllers and intermediate plates

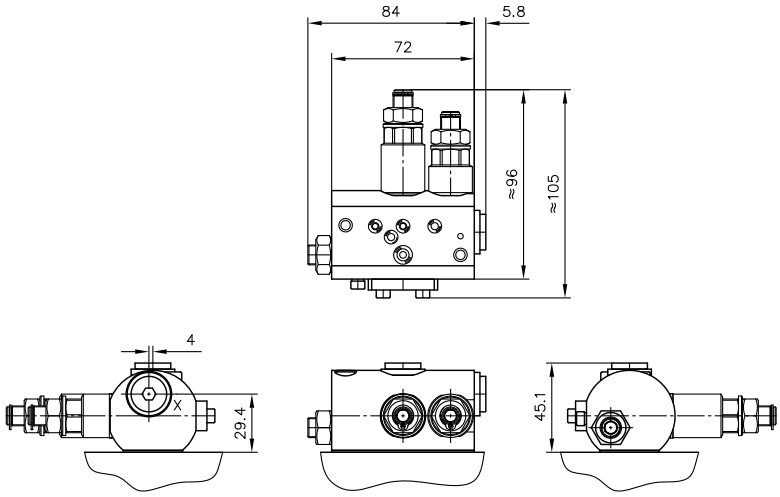
Coding **LSP, LSPT**



Coding **LSNR, LSNRT**



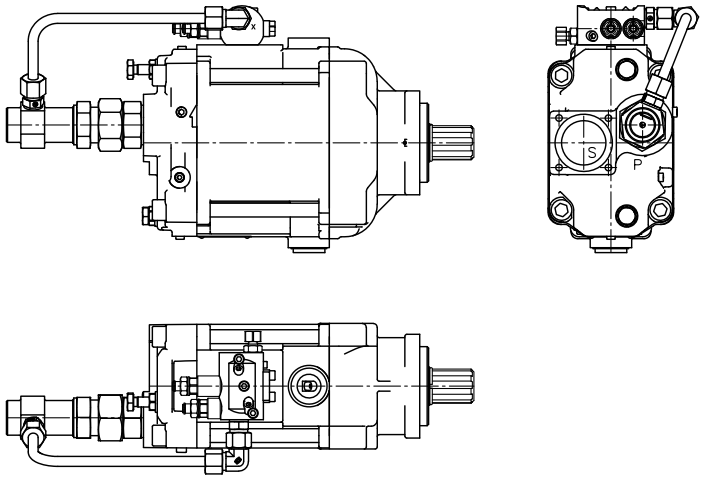
Coding **NR**



Connection X: G 1/4

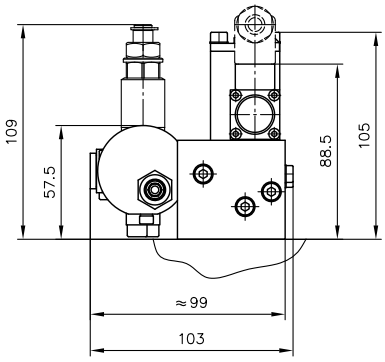
LS signal port order coding for adapter for UNF thread 79 93245 00

Coding **QP**

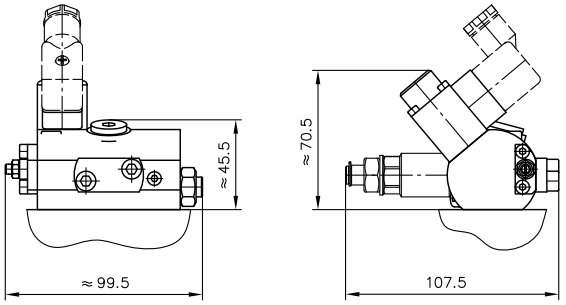


NOTE
The piping varies depending on the size and direction of rotation.

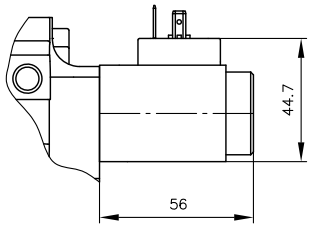
Coding **PR**



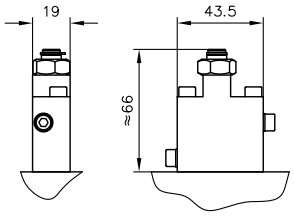
Coding **P1R**



Coding **V**

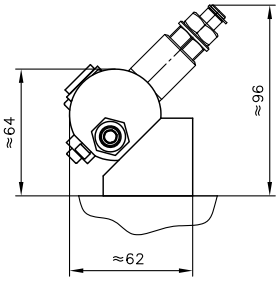


Coding **L** (only for type V60N-130)

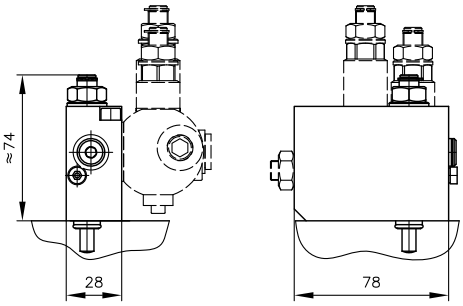


Intermediate plates

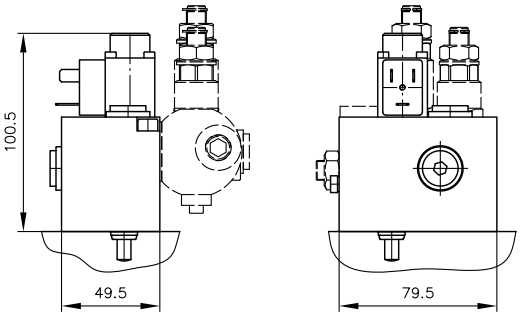
Coding **ZW**



Coding **ZL**
Intermediate plate version



Coding **ZV, ZV1**
Intermediate plate version



CAUTION

Risk of injury on overloading components due to incorrect pressure settings!

Risk of minor injury.

- Pay attention to the maximum operating pressure of the pump and the valves.
- Always monitor the pressure gauge when setting and changing the pressure.

5 Assembly, operation and maintenance recommendations

5.1 Intended use

This product is intended exclusively for hydraulic applications (fluid technology).

The user must observe the safety measures and warnings in this documentation.

Essential requirements for the product to function correctly and safely:

- All information in this documentation must be observed. This applies in particular to all safety measures and warnings.
- The product must only be assembled and put into operation by qualified personnel.
- The product must only be operated within the specified technical parameters. The technical parameters are described in detail in this documentation.
- All components must be suitable for the operating conditions in the event of application in an assembly.
- The operating and maintenance manual of the components, assemblies and the specific complete system must also always be observed.

If the product can no longer be operated safely:

1. Remove the product from operation and mark it accordingly.

✓ It is then not permitted to continue using or operating the product.

5.2 Assembly information

The product must only be installed in the complete system with standard and compliant connection components (screw fittings, hoses, pipes, fixtures etc.).

The product must be shut down correctly prior to dismounting (in particular in combination with hydraulic accumulators).

⚠ **DANGER**

Risk to life caused by sudden movement of the hydraulic drives when dismantled incorrectly!

Risk of serious injury or death.

- Depressurise the hydraulic system.
- Perform safety measures in preparation for maintenance.

5.2.1 General information

The V60N variable displacement axial piston pump is designed for use in an open or semi-closed circuit.

It can be mounted on the usual mounting points (e.g. gearbox power take-off, combustion engine or electric drive, cardan shaft) using a flange mounting. Suitable coupling flanges are available as accessories for attachment to a cardan shaft "Coupling flange for cardan shafts".

In order to reduce the weight torque of the pump, a separate support can be attached in addition to the flange mounting. For this purpose, M10 threads are included in the pump housing (only V60N-090/110/130)See "Dimensions" .

A change of rotating direction is available for types V60N-060, V60N-090 and V60N-110 variable displacement axial piston pumps. For conversion instructions, please contact HAWE Hydraulik SE.

The housing pressure in the pump must always be greater than or equal to the ambient pressure.

During assembly, note the following principles:

Only trained persons are allowed to mount or remove the pump. Always ensure absolute cleanliness to prevent contamination from affecting the pump.

- Remove all plastic plugs before operation.
- Avoid installation above the tank (see installation positions in Chapter 5.2.3, "Installation positions").
- Observe the electrical reference values Chapter 2.2, "Controller".
- Before initial use, fill the pump with hydraulic fluid and bleed. Automatic pump filling via the suction line by opening the drain ports is not possible.
- Never drain the pump.
- Always supply the pump with hydraulic fluid from the start. Even just a short period with insufficient hydraulic fluid can damage the pump. Such damage is not immediately visible once the pump is put into operation.
- Hydraulic fluid which flows back into the tank must not be sucked back in immediately (install baffles!).
- If there is a check valve installed in the leakage line, negative pressure may occur in the pump housing during operation. If this happens, install an auxiliary pump to flush the housing.
- Before first use, run the pump for approx. 10 minutes at max. 50 bar after initial start-up.
- The leakage line must be installed in the tank in such a way that it ends below the oil level. The end of the leakage line should be positioned roughly equidistant from both the bottom of the tank and the oil level.
- Do not use the entire pressure range of the pump until it has been thoroughly bled and flushed.
- From the start, always keep the temperature within the specified range (see Chapter 3, "Parameters"). Never exceed the maximum temperature.
- Always comply with the cleanliness level of the hydraulic fluid. In addition, always filter the hydraulic fluid appropriately (see Chapter 3, "Parameters").
- Self-installed filters in the suction line must be approved beforehand by HAWE Hydraulik.
- A system pressure-limiting valve must be installed in the pressure line so that the maximum system pressure is not exceeded.

5.2.2 Connections

The nominal width of the connecting lines depends on the specified operating conditions, the viscosity of the hydraulic fluid, the start-up and operating temperatures and the rotation speed of the pump. In principle we recommend the use of hose lines due to the superior damping characteristics.

Pressure connection

The pressure connection on type V60N-060 is established via a threaded connection G 3/4"; on type V60N-090/110/130 via a threaded connection G 1".

Observe the tightening torque specified by the fitting manufacturer.

Suction port

The suction port on all pumps is established via standardised suction intakes with a size which depends on the max. delivery flow of the pump.

The specifications of the max. delivery flow Q_{max} must be observed. These can be found in the following table.

Nominal width (N)	38 (1 1/2")	42	50 (2")	64 (2 1/2")	76 (3")	6 (1 1/4)	7 (1 1/2)
Q_{max} (lpm)	75	90	125	190	250	90	125

The suction intakes can be ordered as an option with the pump.

If possible, route the suction line to the tank on a rising gradient. This allows trapped air to escape. Observe the specifications for the installation positions Chapter 5, "Assembly, operation and maintenance recommendations". The absolute suction pressure must not fall below 0.85 bar. A hose line should generally be used in preference to a rigid pipe line.

Drain port

The V60N pumps have 2 drain ports G 3/4" or 1 1/16-12-UN-2B. A G 1/8" threaded connection is also available for the flange version SAE-B2, SAE-B4 and SAE-4. This is used for bleeding in the case of vertical installation positions.

The nominal width of the leakage line must not be less than 16 mm. The cross-section is determined by the max. permissible housing pressure.

Integrate the leakage line in the system in such a way as to prevent direct connection with the suction line of the pump. Both drain ports can be used simultaneously.

A separate leakage line from the controller to the tank is not required. Observe the specifications in Chapter 5.2.3, "Installation positions".

LS port for LSP, LSPT, LSNR and LSNRT variants

The LS line is connected to the controller via a G 1/4 (BSPP) threaded connection.

The nominal width of the line depends on the installation position of the pump and should be 10% of the pressure line capacity. A hose line should generally be used in preference to a rigid pipe connection.

- When the proportional directional spool valve is in a neutral position, the LS line must be fully relieved (controller types LSP and LSNR only)! In controller types LSPT and LSNRT, relief takes place internally in the controller.

5.2.3 Installation positions

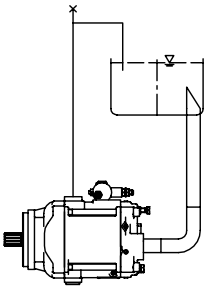
The V60N variable displacement axial piston pump can be mounted in any installation position.

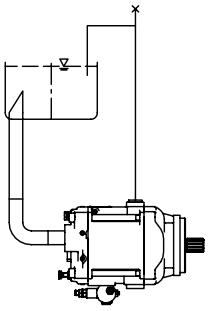
Observe the truck manufacturer's specifications if installing the pump directly on a truck power take-off.

A support is required for tandem pumps or two hydraulic pumps mounted in series (see Chapter 5.2.1, "General information"). The following points must be observed:

Horizontal installation: (pump below the min. fill level)

⇨ For horizontal installation, use the uppermost drain port

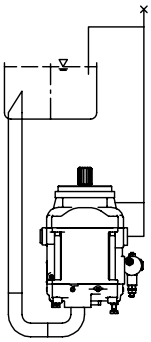




Vertical installation: (pump below the min. fill level)

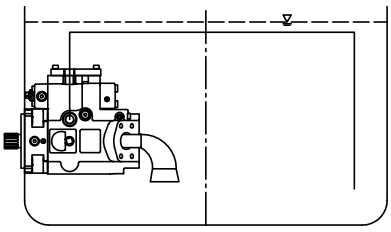
⇨ Assemble the pump so that the pump mounting flange is facing upwards.
⇨ For vertical installation, use the uppermost drain port.
⇨ Also connect the G 1/8" (BSPP) bleeding port on the pump flange (see Chapter 4, "Dimensions").
⇨ Take appropriate measures to ensure continuous bleeding of this line (line routing/bleeding).

For installation with the pump flange facing downwards, please contact HAWE Hydraulik.



Tank installation (pump below the min. fill level)

The pump can be operated either with or without a suction intake. We recommend using a short suction intake (see D 7960 N, 6.1.1 Suction intakes).

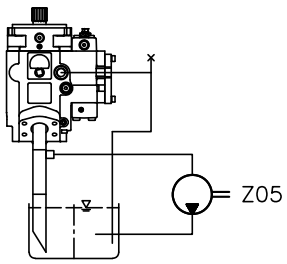


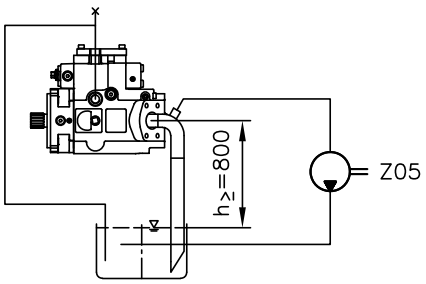
Additional notes regarding installation above the fill level

Special measures are required if the pump is installed above the fill level. The pump must not run dry via the pressure, intake, drain, bleed or control lines. This applies in particular to long periods of downtime.

- Facilitate bleeding of connecting lines via separate bleed openings.
- Adjust the bleeding sequence to the specific installation.
- If necessary, a gear pump should be provided in order to draw air from the suction line.

For specialist advice on designing axial piston pumps, the following contact form is available:
Checklist for designing variable displacement axial piston pumps: B 7960 checklist.





For further information on installation, operation and maintenance, see the relevant assembly instructions:
B 7960, B 5488.

5.3 Operating instructions

Restrictions in operation during cold start phase and warm-up phase

Phase	Temperature	Viscosity (mm²/s)
Cold start phase	-25 .... -40°C	< 1000
Warm-up phase	-25 .... 80 °C	500 ... 1000
Normal operation	-25 .... 80 °C	10 ... 500

NOTE
Optimum range: 16 - 35 mm²/s

Cold start phase:

- p_B = 20 – 30 bar
- n ≤ 1000 rpm

Warm-up phase:

- p_B = 20 – 200 bar
- n ≤ 1500 rpm

Normal operation:
No further restrictions. Service conditions according to Chapter 3 Parameters.

Note product configuration and pressure / flow rate

The statements and technical parameters in this documentation must be strictly observed.
The instructions for the complete technical system must also always be followed.

NOTE

- Read the documentation carefully before usage.
- The documentation must be accessible to the operating and maintenance staff at all times.
- Keep documentation up to date after every addition or update.

CAUTION
Risk of injury on overloading components due to incorrect pressure settings!
Risk of minor injury.

- Pay attention to the maximum operating pressure of the pump and the valves.
- Always monitor the pressure gauge when setting and changing the pressure.

Purity and filtering of the hydraulic fluid

Fine contamination can significantly impair the function of the hydraulic component. Contamination can cause irreparable damage.

Examples of fine contamination include:

- Metal chips
- Rubber particles from hoses and seals
- Dirt due to assembly and maintenance
- Mechanical debris
- Chemical ageing of the hydraulic fluid

NOTE
Fresh hydraulic fluid from the drum does not always have the necessary degree of purity.
When pouring in hydraulic fluid, filter it.

Pay attention to the cleanliness level of the hydraulic fluid to maintain faultless operation.
(See also cleanliness level in Chapter 3, "Parameters")

Additionally applicable document: D 5488/1 Oil recommendations

6 Other information

6.1 Accessories, spare parts and separate components

6.1.1 Suction intake

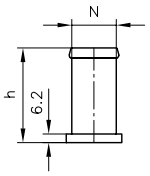
Order coding example:

V60N - 090 R DY N - 1 - 0 - 01/LSP - 350 - **A00/76**

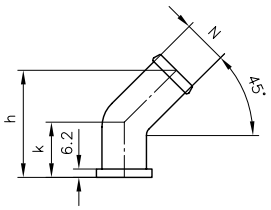
Table of suction intakes (including attachment kit)

Nominal width (N)	Flow rate Q_{max} (lpm)	Geometric shape									
		Straight	Order number	45°		Order number	90°		Order number	Thread	Order number
		A00/..		A45/..			A90/..			A.	
		h		h	k		h	k		h	
38 (1 1/2″)	75	65	79 93336 00	-	-	-	53	70	79 93344 00	-	-
42 (1 5/8")	90	-	-	85	40	79 93340 00	-	-	-	-	-
50 (2″)	125	65	79 93337 00	96	40	79 93341 00	53	84	79 93345 00	-	-
64 (2 1/2″)	190	90	79 93338 00	96	40	79 93342 00	109	129	79 93346 00	-	-
76 (3″)	250	106	79 93339 00	106	40	79 93343 00	-	-	-	-	-
7 (1 1/2″)	125	-	-	-	-	-	-	-	-	28.5	79 40719 00
7 UNF (7/8-12 UN-2B)	125	-	-	-	-	-	-	-	-	28.5	79 41599 00

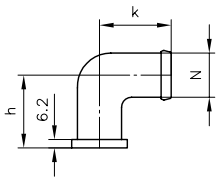
A00/...



45/...



A90/...



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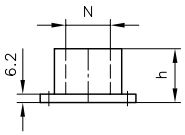


For pump orders, delivery includes the attachment kit for suction intakes, comprising:

- 4x hex bolt M8x16-8.8
- Sealing ring 44.2x3 NBR 70 Sh
- 2 mounting flange halves

(Order no. 79 93355 00)

NOTE
Use nominal width 38 (1 1/2″) for reduced displacement volume only!

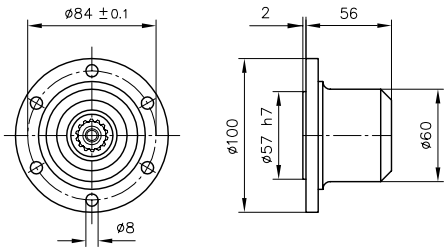
Observe installation information in Chapter 5, "Assembly, operation and maintenance recommendations".

6.1.2 Coupling flange for cardan shafts

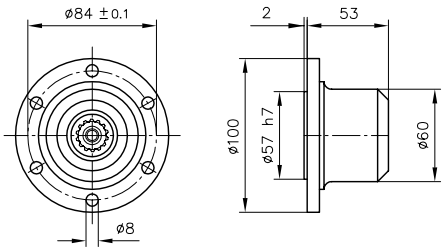
Special coupling flanges for cardan shafts (∅100-6-∅8) according to ISO 7646.

For telescopic propshafts also with spacer ring and connecting screw for attachment to the drive shaft of the pump.

Coding **SAE-C, SAE-CS**

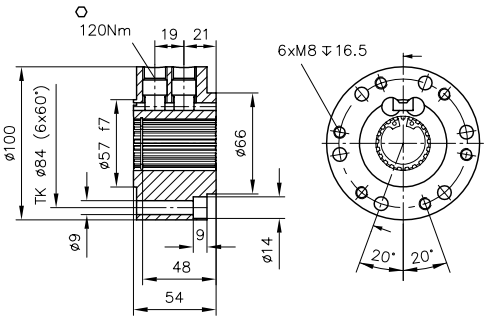


Coding **DIN ISO 014**



Coding	Spline profile	Order number
SAE C	14T 12/24 DP	79 29555 00
SAE CS	21T 16/32 DP	79 42793 00
DIN ISO 14	B8 x 32 x 36	79 29709 00

Coding **SAE-C, SAE-CS, DIN ISO 014**



Coding	Spline profile	Order number
SAE-C	14T 12/24 DP	79 94495 00
SAE-CS	21T 16/32 DP	79 94479 00
DIN ISO 14	B8 x 32 x 36	79 94496 00

6.2 Planning information

Determination of nominal sizes

Delivery flow	$Q = \frac{V_g \cdot n \cdot \eta_V}{1000} (l/\min)$
Drive torque	$M = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}} (Nm)$
Drive power	$P = \frac{2\pi \cdot M \cdot n}{60000} = \frac{Q \cdot \Delta p}{600 \cdot \eta_t} (kW)$

Q	= Flow rate (lpm)
M	= Torque (Nm)
P	= Power (kW)
V_g	= Geom. output volume (cm^3/rev.)
Δp	= Differential pressure
n	= Rotation speed (rpm)
η_v	= Volumetric efficiency
η_{mh}	= Mechanical-hydraulic efficiency
η_t	= Overall efficiency ($\eta_t = \eta v \cdot \eta_{mh}$)

Further information

Additional versions

- General operating manual for the assembly, initial operation and maintenance of hydraulic components and systems: B 5488
- Variable displacement axial piston pump type V30D: D 7960
- Variable displacement axial piston pump type V30E: D 7960 E
- Fixed displacement axial piston pump type K60N: D 7960 K
- Axial piston motors type M60N: D 7960 M
- Proportional directional spool valve, type PSL and PSV size 2: D 7700-2
- Proportional directional spool valve, type PSL, PSM and PSV size 3: D 7700-3
- Proportional directional spool valve, type PSL, PSM and PSV size 5: D 7700-5
- Proportional directional spool valve type PSLF, PSVF and SLF size 3: D 7700-3F
- Proportional directional spool valve type PSLF, PSVF and SLF size 5: D 7700-5F
- Proportional directional spool valve type EDL: D 8086
- Proportional directional spool valve banks type PSLF and PSVF size 7: D 7700-7F
- Load-holding valve type CLHV-C: D 7918-VI-C
- Load-holding valve type CLHV: D 7918-VI-PIB
- Load-holding valve type LHDV: D 7770
- Proportional amplifier type EV1M3: D 7831/2
- Proportional amplifier type EV1D: D 7831 D
- Proportional amplifier type EV2S: D 7818/1

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