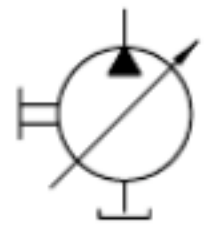
Variable displacement axial piston pump type V30E

Pressure p_{max} = 420 bar (6000 psi)
Displacement V_{max} = 190 ccm/rev



1. General description

The axial piston variable displacement pumps of the type V 30 of E offer extremely high function safety. Its remarkably low noise levels, the high pressure rating (peak = 420 bar / perm. = 350 bar), the low weight/performance ratio as well as the wide controller range make it possible to employ it for most industrial and mobile applications. The variable displacement pumps work according to the swash plate principal: 9 pistons operate in a rotating cylinder cavities where they fulfill one suction and one pressure stroke per rotation.
Opening and closing of the cylinder cavities is via openings in the control disc. The axial movement of the pistons is provided by an adjustable swash plate. The setting angle (0 - max) can be steplessly varied in proportion to the desired displacement/flow. The setting range can be mechanically limited by setting screws. The position of the swash plate can be controlled via a visual mechanical indicator.
The latest knowledge and experience with regard to noise reduction has been used in the development of this pump design. V30E is therefore rather quiet, even when taken to the limit. All components used in the V30E are manufactured from high grade materials and machined with close tolerances.
The wide range of modular controllers along with a thru-shaft (option for mounting auxiliary pumps or a second V30D) open up a wide range of application possibilities.
Therefore type V30E features a pump design, which ideally suits the special requirements of modern industrial and mobile hydraulic drive systems
Low dead weight and high self-priming speed in combination long service life and low noise level are the highlights of this pump design.

Main features:

? Low specific weight (low than the predecessor type V30D).

? Very fast response times due to low mass moment of inertia of the setting unit

? The short stroke design enhances the extremely high self priming speed

? Prolonged service life because of
- high pressure lubed swash plate bearing
- hydro-statically relieved steel followers with bronze sliding face
- generously dimensioned shaft bearings

Main benefits

? Low noise level an low flow/pressure-pulsation led to low noise emission.

? Controller assemblies have been designed on a modular basis and can be installed without dismantling the basic pump

? Thru- shaft allows tandem pump combinations and mounting of auxiliary pumps of all kinds (see sect. 5)

? Swash plate dial indicator provides visual indication of displacement and can also be used to provide feedback information in control systems

? High self-priming speed

? Long service life due to special design of followers, swash plate bearing and control disc

2. Available versions, main data

Calculation:

Flow rate

$$Q = \frac{V_g \; ?n \; ? \eta_v}{1000} \; (l / min)$$

Torque

$$M = \frac{1,59 \; ?V_g \; ?? p}{100 \; ? \eta_{mh}} \; (Nm)$$

Power

$$P = \frac{2 \; \pi ?M \; ?n}{60\,000} = \frac{M \; ?n}{9549} = \frac{Q \; ? ? p}{600 \; ? \eta_t} \; (kW)$$

V_g = Displacement [ccm/rev]
| p = Diff. pressure [bar]
n = Speed [rpm]

η_v = Volumentric efficiency
η_{mh} = Mechanical efficiency
η_t = Total efficiency ($\eta_t = \eta_v \times \eta_{mh}$)

Order example:

V30E - 095 R K N - 1 - 1 - XX/LN - 2/120 - 200

Basic type

Table 1: Designation

Coding	095	160	190
Displacement ccm/rev. (cu. in./rev.)	98	160	192
Flow (theor.) at 1450 rpm [lpm] (1800 rpm [gpm])	142	232	278
Max. continuous pressure bar (psi)	350	350	350
Max. peak pressure bar (psi)	420	420	420
Max. housing pressure bar (psi) [2]	1,0	1,0	1,0

Direction of rotation:
L = Left hand
R = Right hand
(facing the drive shaft)

Shaft :
D = Spline shaft (DIN 5480)
K = Key shaft
S = Spline shaft and flange SAE

Shaft seals :
N = NBR (Nitril)
E = EPDM [1])
V = FKM (Viton) [1])

Shaft design::
1 = Standard
2 = Thru-shaft
(see also sect. 5)

Swash angle indicator:
0 = without indicator
1 = with indicator

HAWE serial no.

see tab. 2 below

Special versions:
2 = With stroke limitation

Torque setting in Nm [2]):
alternative power in kW and speed in rpm as additional text

Pressure (bar) [3])

[1]) Special versions
[2]) Spec. required with controller coding L
[3]) Spec. required with controller coding N, LSN

Table 2: Controller

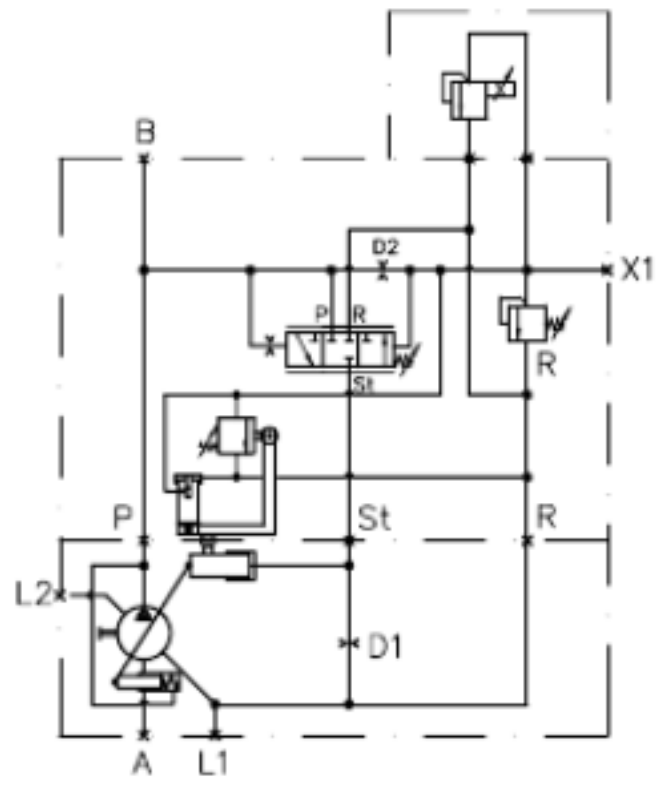
Type	Description
N	Pressure controller, adjustable directly at the pump, plus as port for external pilot valve. Pressure controller automatically mainains a constant system pressure independant of the required flow. Therefore it is suited for constant pressure systems, where differing flow is required or as efficient pressure limitation of the hydraulic system.
Nb	Like type N (only suited for systems heavily prone to oscillations e.g. accumulator systems). The system pressure is externally controlled
LSN	Load-Sensing-Controller with pressure limitation. Stand-by pressure, adjustable between 15 ... 35 bar
LN	The power controller with a really hyperbolic characteristic is used for systems where very differing pressure levels are required and the drive motor has to protected against over-load. The drive torque is limited at a set level (pressure x flow = constant), i.e. when the pressure is doubled the flow will automatically reduced by 50%. This drive torque level can be externally set or readjusted anytime.
LLSN	Power controller like type LN, but with additional Load-Sensing-Controller type LSN
-PMVP 4- 41 /G 12 / 42 /G 24 / 43 (Solenoid voltage)	Pressure range (5) ... 180 bar / (5) ... 290 bar / (5) ... 440 bar Additional, directly mounted prop. pressure limiting valve as reference setting for the pressure controller (nom. voltage 12V DC or 24V DC plus specification of the desired pressure range). This prop. pressure limiting valve is compatible to all controllers listed here. Type PMVP 4 acc. to D 7485/1 is utilized here.

In preparation

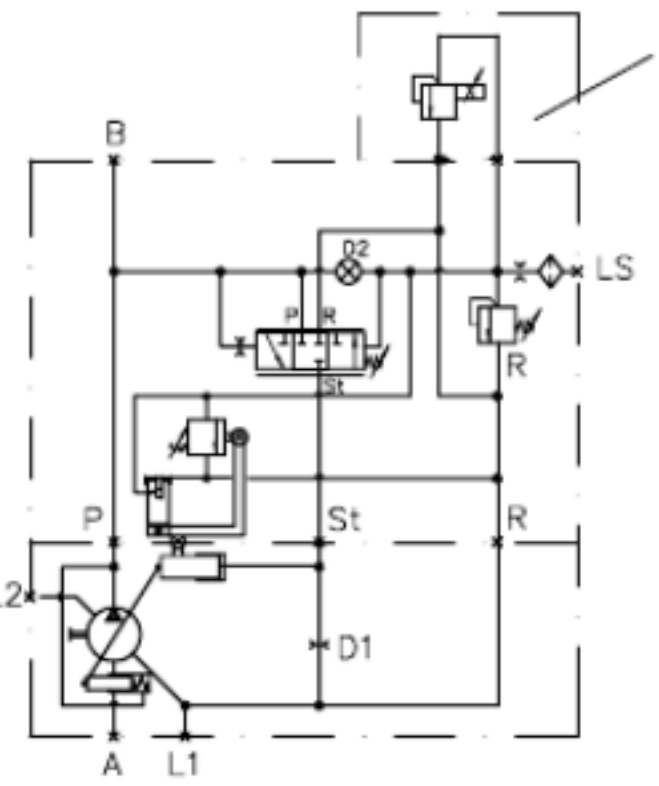
Table 3: Symbols

Variable displacement axial piston pump with controller

Coding LN

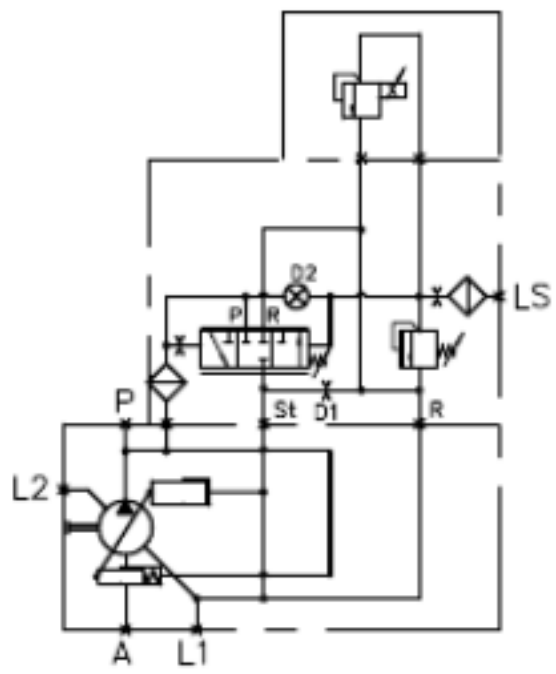


Coding LLSN

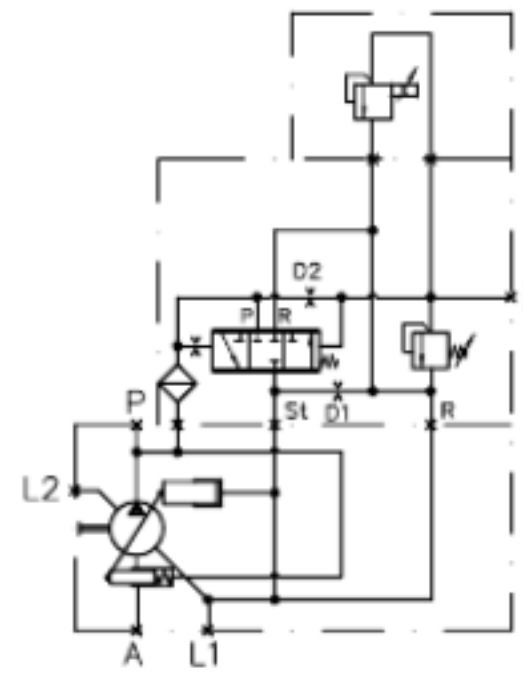


Prop. pressure limiting valve type PMVP 4.. acc. to D 7485/1

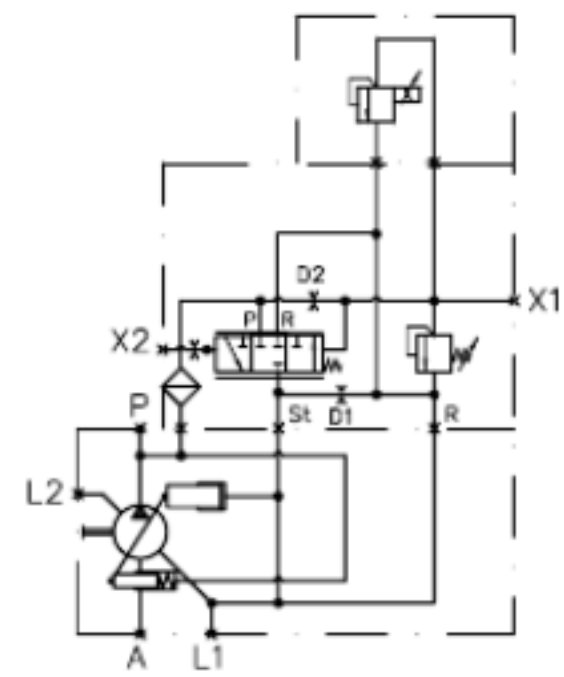
Coding LSN



Coding N



Coding Nb



S - Suction port
P - Pressure port
(D1) (D2) - Drain port
X1 - Remote control port (additional pilot valves)
LS - Load pressure port (Load Sensing-Pressure, picked up after the metering throttle at the main circuit)
X2 - External system pressure port
D1 - Dampening throttle
D2 - Piloting throttle (o plugged)

3. Additional versions

3.1 General

Working principle	Variable displacement axial piston pump acc. to swash plate principle
Installation	Flange or brachet mounting
Direction of rotation	Right hand or left hand
Mounting position	Optional / Observe the instructions for installation in B 7960!
Pressure fluid	Hydraulic fluid (DIN 51524 table 2 and 3); ISO VG 10 to 68 (DIN 51519) Viscosity range: min. 10; max. 1000 mm ^{2}/s, optimal operation range: 10...35 mm ^{2}/s Also sui table are bi odegradable pressure flui ds of the type HEES (synth. Ester) at operati on temperatures up to +70 °C.
Temperatur	Ambient: -40 ... +60 °C Fluid: -25...+80 °C, pay attention to the viscosity range! Start temperature down to -40 °C are allowable (Pay attention to the viscosity range during start!), as long as the operation temperature during consequent running is at least 20K (Kelvin) higher.
Filtration	Should conform to ISO standard 4406 coding 18/13.
Start-up	All hydraulic lines should be flushed with appropriate hydraulic fluid before start-up. The pump case should then be titled through the uppermost drain port. The drain line must be positioned so that the case i s always fi lled duri ng operati on. At start-up and duri ng the fi rst few mi nutes of the operation the pressure relief valve should be adjusted to 50 bar (700 psi) or less.

Designation		095	160	190
Max. swash plate angle	(°)	15	15	18
Min. inlet pressure (absolute) open circuit	(bar) (psi)	0,85	0,85	0,85
Self-priming speed at max swash plate angle and 1 bar (15 psi) absolute inlet pressure	rpm)	2500	2100	1900
Max. speed (requires increased inlet pressure)	rpm	2900	2500	2300
Min. continuous speed	rpm	500	500	500
Torque (theor.) at 1000 psi	(Nm) (lbf ft)	156	255	306
Input power at 250 bar and 1450 rpm at 3000 psiand 1800 rpm	(kW) (hp)	66	107	129
Weight (approx. kg)	without controller	54	74	74
	with controller	57	89	90
Moment of inertia	(kg m ^{2})	0,0216	0,03	0,03
L10 bearing life at 250bar (1450 rpm) or 3600 psi (1800 rpm) and max. displacement	(h)	20000	19000	10000
Max. dynamic torque	(Nm)			
Spline shaft	(D) input	1200	1700	1700
Spline shaft	(D) output	600	850	850
Key shaft	(K) input	650	850	850
Spline shaft	(S) input	1200	1200	1200
Spline shaft	(S) output [1]	600	850	850
Noise level at 250 bar and (1450 rpm), or 3600 psi and max. (1800 rpm) displacement (measured in a semi- anechoic room according to ISO 4412 measuring distance 1m)	(dB(A))	73	74	74

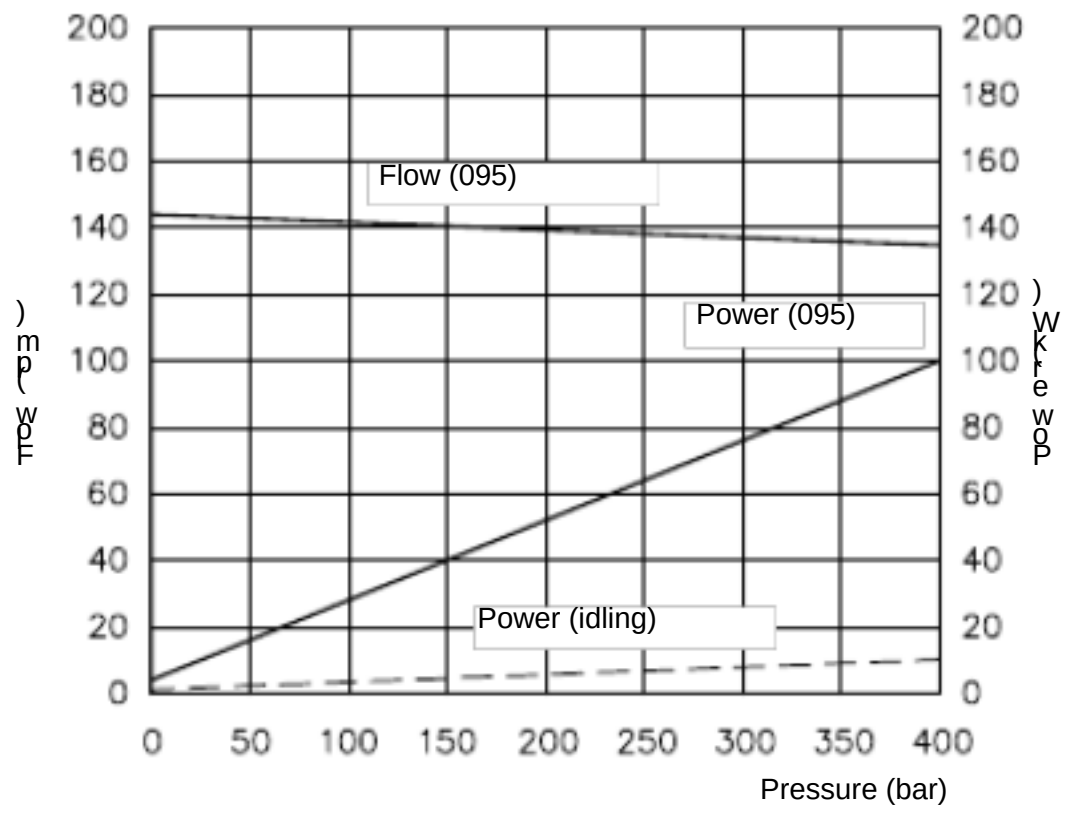
[1]) (theoretical) Drive torque must not be exeeded!

3.2 Curves

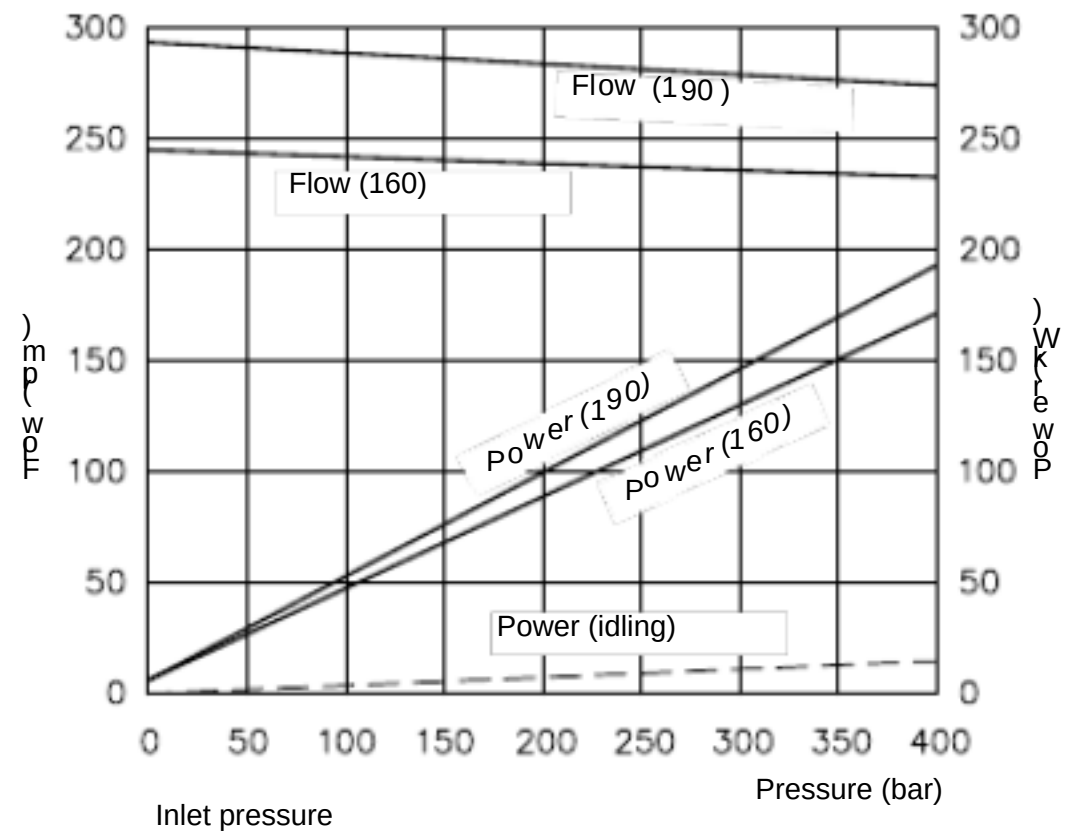
3.2.1 Flow and Power (basic pump)

The folloving diagrams show max. delivered flow vs. pressure (without controller).
Required input power at max. swash angle and required input power when the pump is operating at "idling". Shaft speed: 1450 rpm

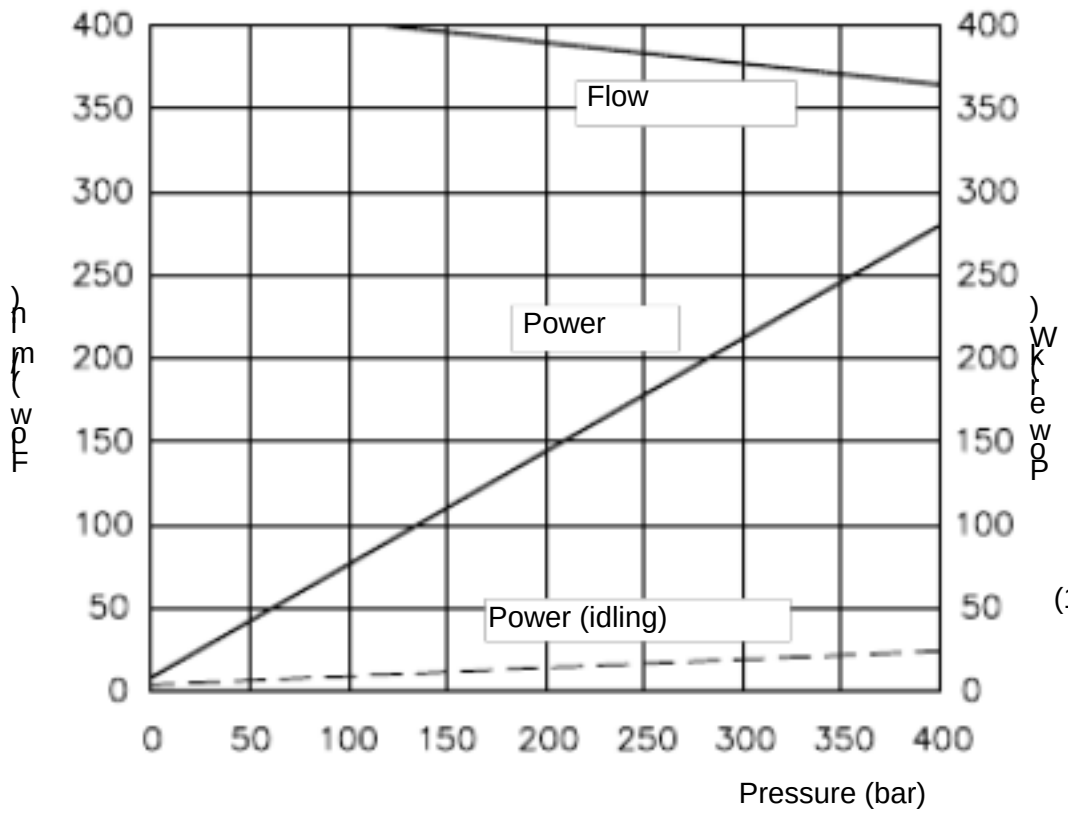
Type V30E - 095



Type V30E - 160 (190)

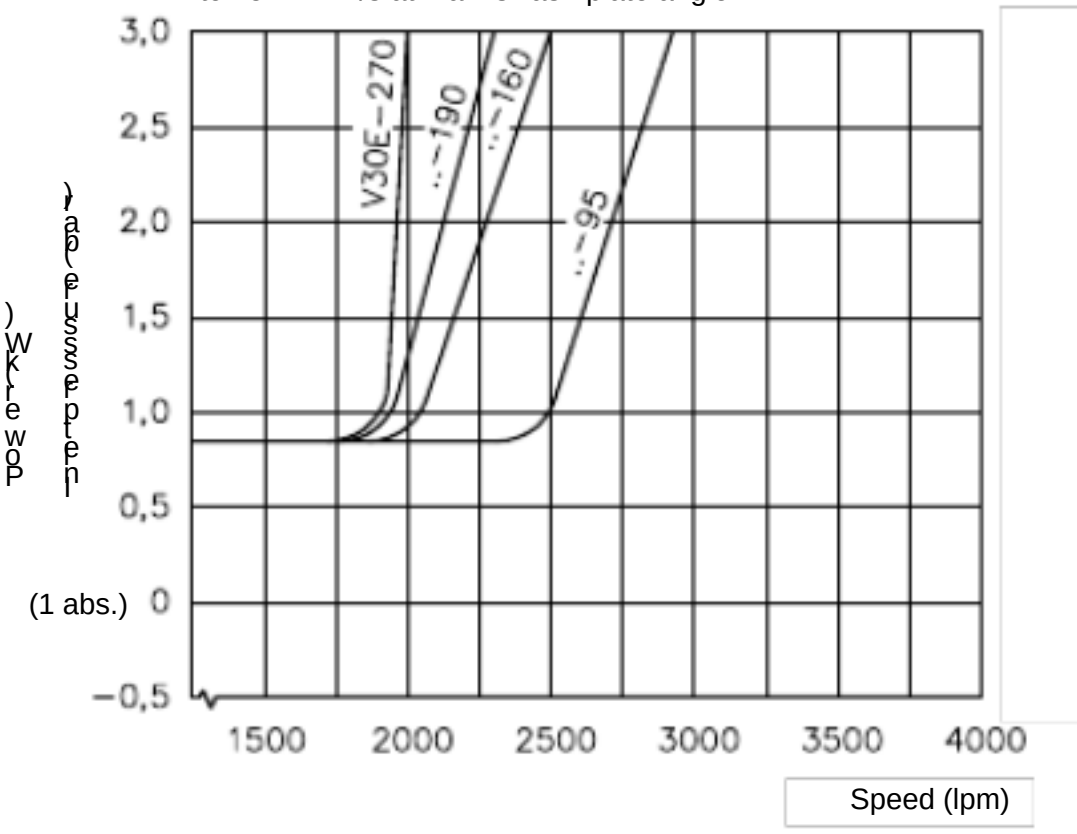


Type V30E - 270

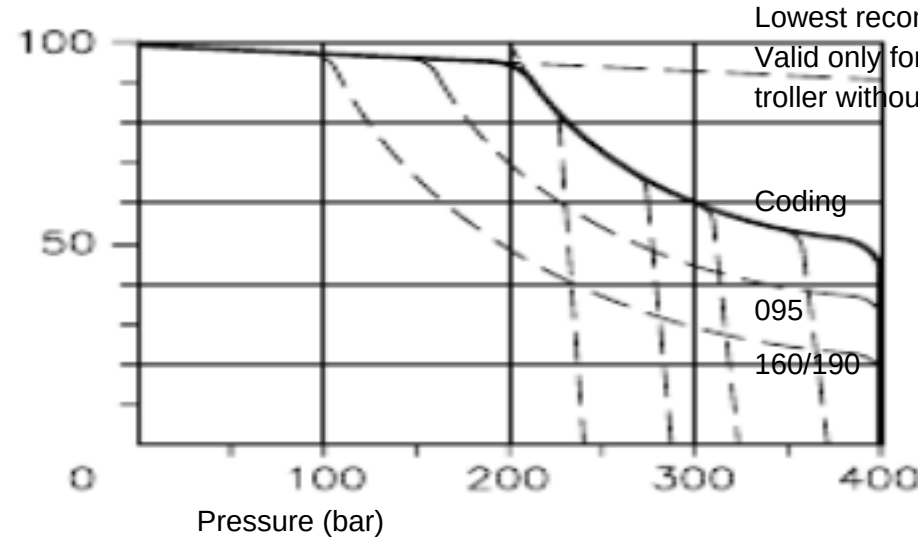
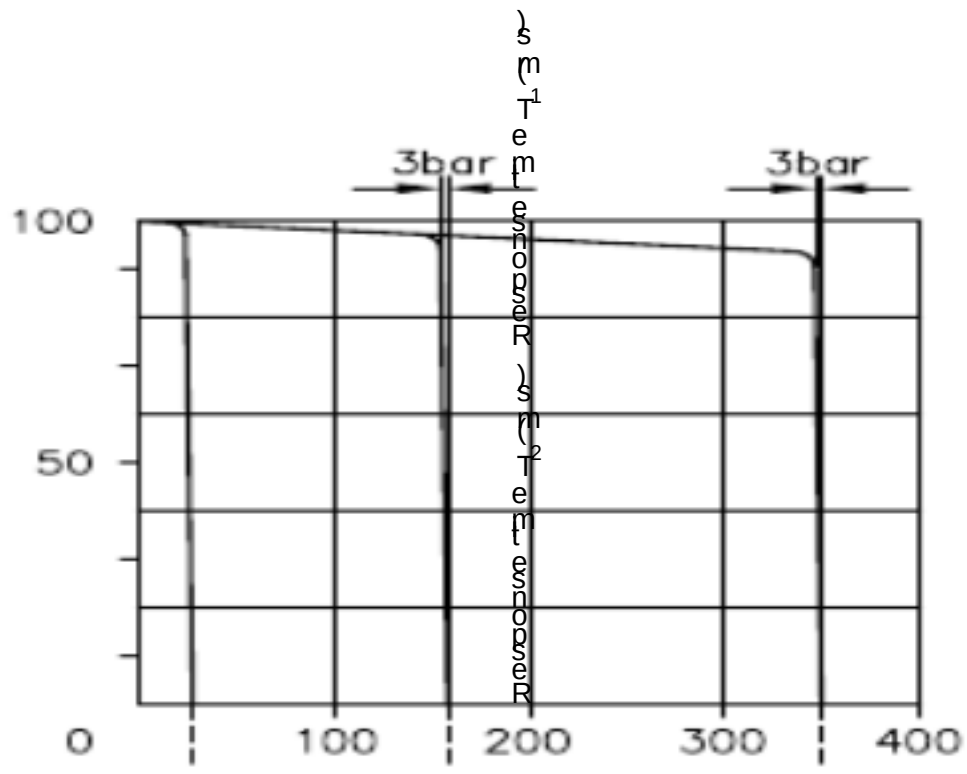
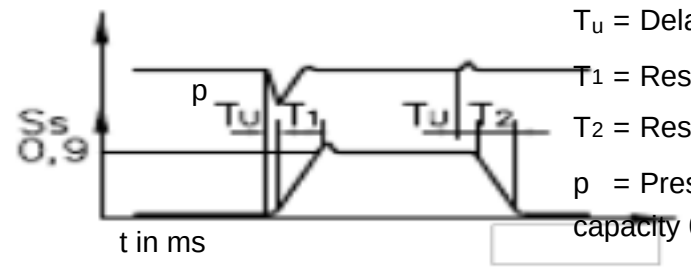
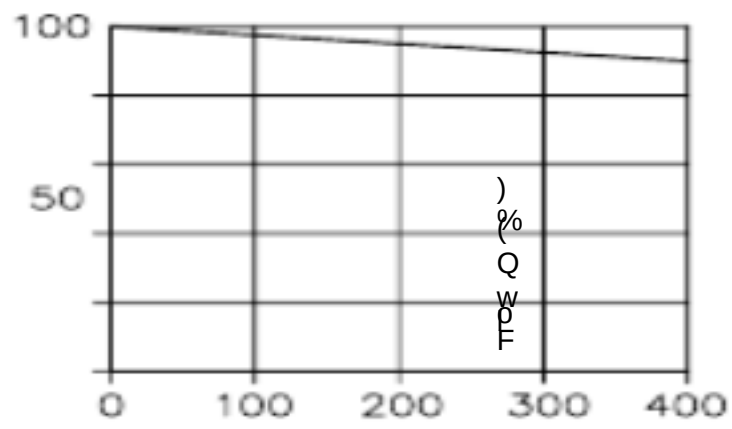
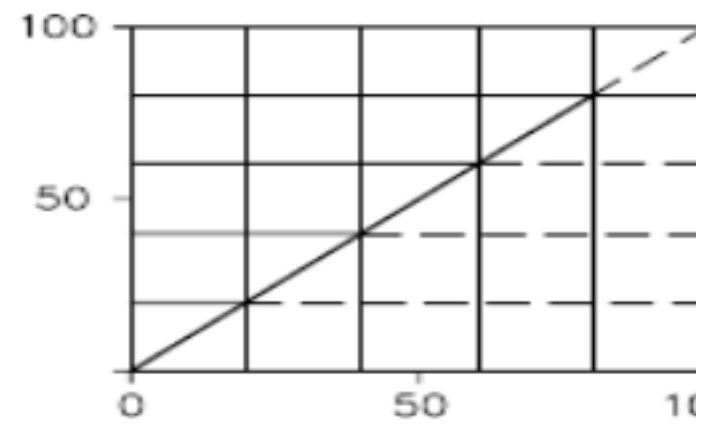


Inlet pressure

To avoid cavitation, it is essential to ensure that the pump inlet pressure always exceeds the min pressure shown in the diagram abowe. The diagram is valid for viscosities up to 75 mm ^{2}/s at max. swash plate angle



3.2.2 Controller-curves

Coding	Curves, notes
L	Pressure / flow  Lowest recommended torque setting: Valid only for version with power controller without additional combination Coding / Nm (lbf ft) / Power kW/rpm (hp/rpm) 095 / 99 / 15 / 1500 160/190 / 146 / 22 / 1500
N Nb	Pressure / flow   Ss = Displacement Tu = Delay < 3 ms T1 = Response time min to max T2 = Response time max to min p = Pressure for hydraulic capacity 0.15 cm 3/bar (1.5 m pipe nom. dia. 20 mm)
LSN	Speed constant  Speed varying 

Calculation of flow Q:

Q = C ? A ? p (lpm)

A = Size of orifice (mm 2)

| p = Pressure drop = 10 bar (LS = 30 bar)
= 145 psi (LS = 435 psi)

C = 0.6

Caracteristics:

Accuracy with max. flow:

a) Speed “ n ” constant, pressure varying between 30 and 350 bar, (430 and 3600 psi): (< 3%)

b) Pressure “ p ” constant, speed varying (< 1%)

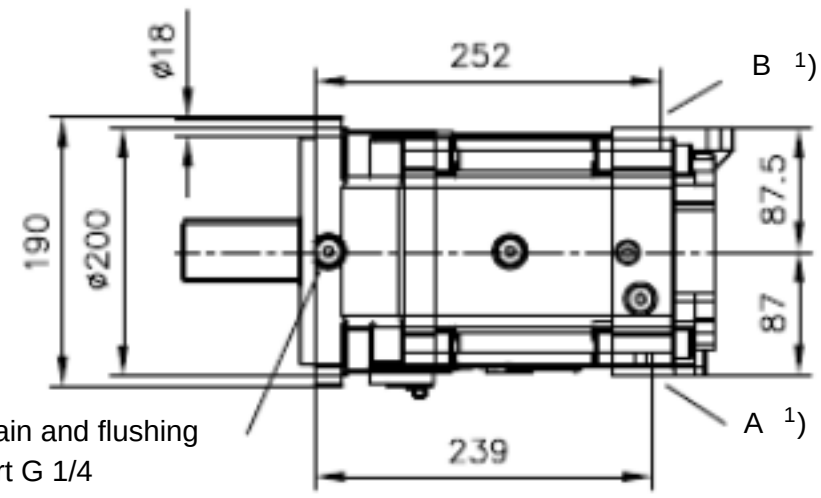
4. Unit dimensions

All dimensions in mm, (inch) and subject to change without notice!

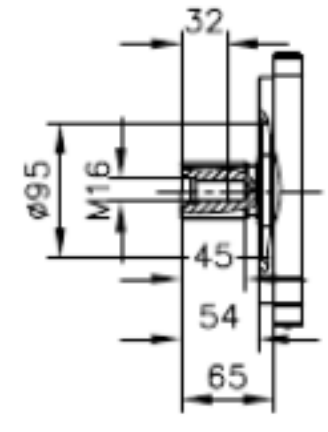
4.1 Basic pump

Type V30E - 095

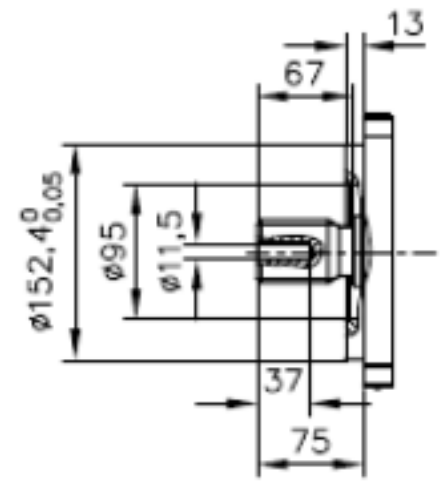
(Drawings shows clockwise rotation, ports A and B are located different with anti clockwise rotation, see foot note [1]))



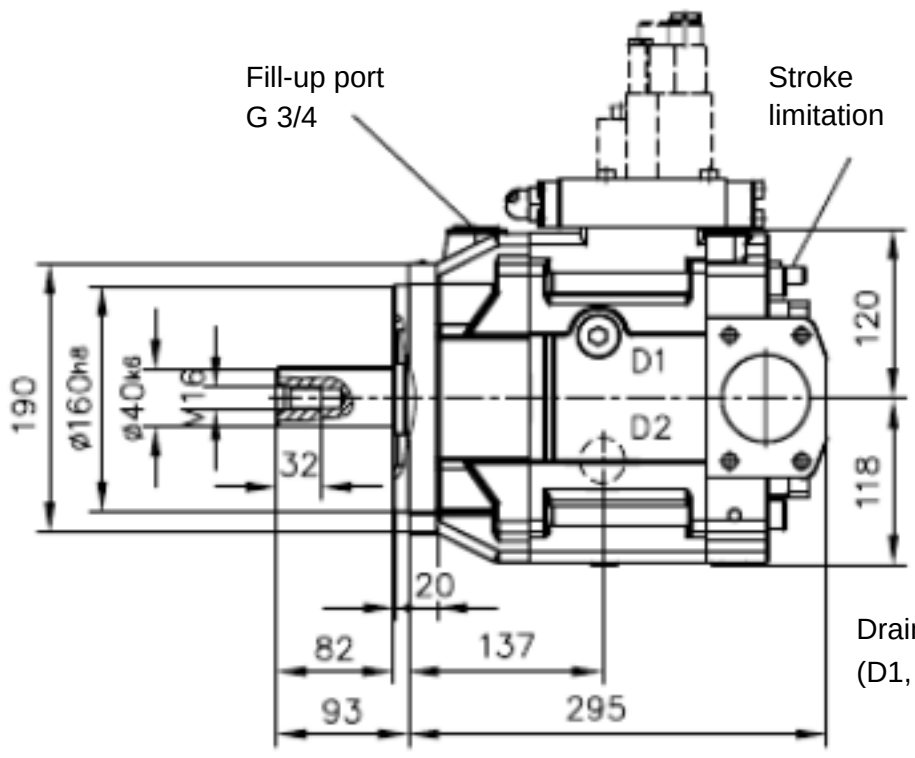
Drain and flushing port G 1/4



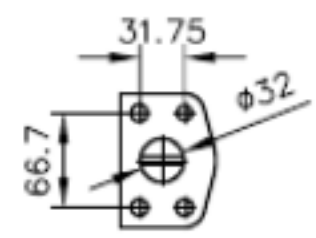
Coding D:
Spline shaft
W45x2x21x9g
DIN 5480



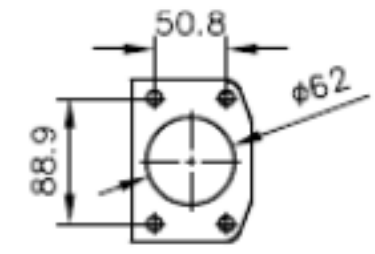
Coding S:
Spline shaft SAE-D13T - 8/16 DP
Flat Root Side Fit
For flange, see foot note [1]) page 9



Drain port
(D1, D2) G 3/4



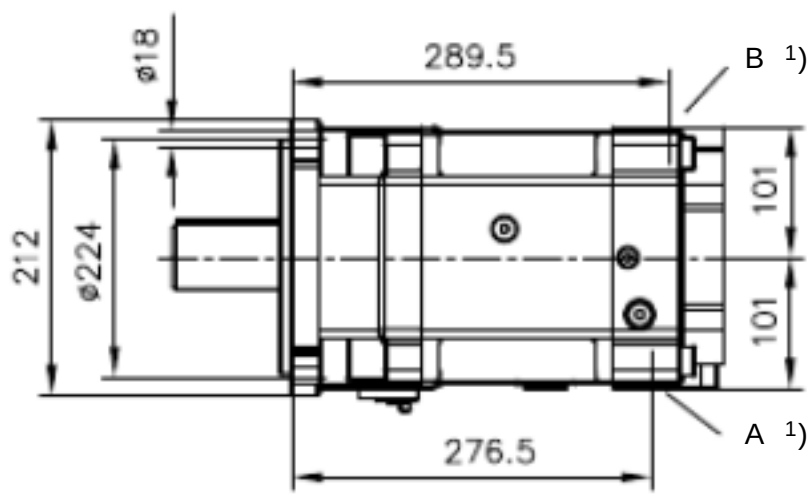
Pressure P



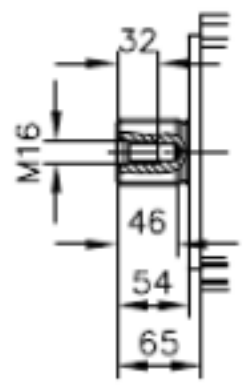
Suction S

Type V30E - 160 (190)

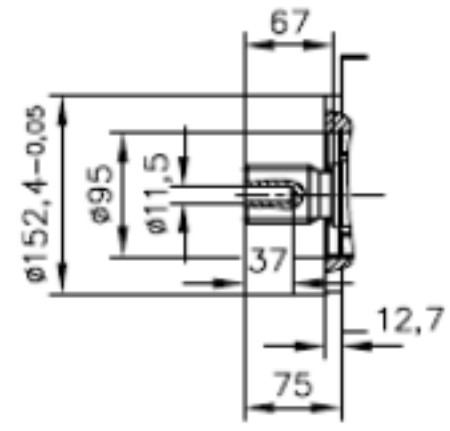
(Drawings shows clockwise rotation, ports A and B are located different with anti clockwise rotation, see foot note [1]))



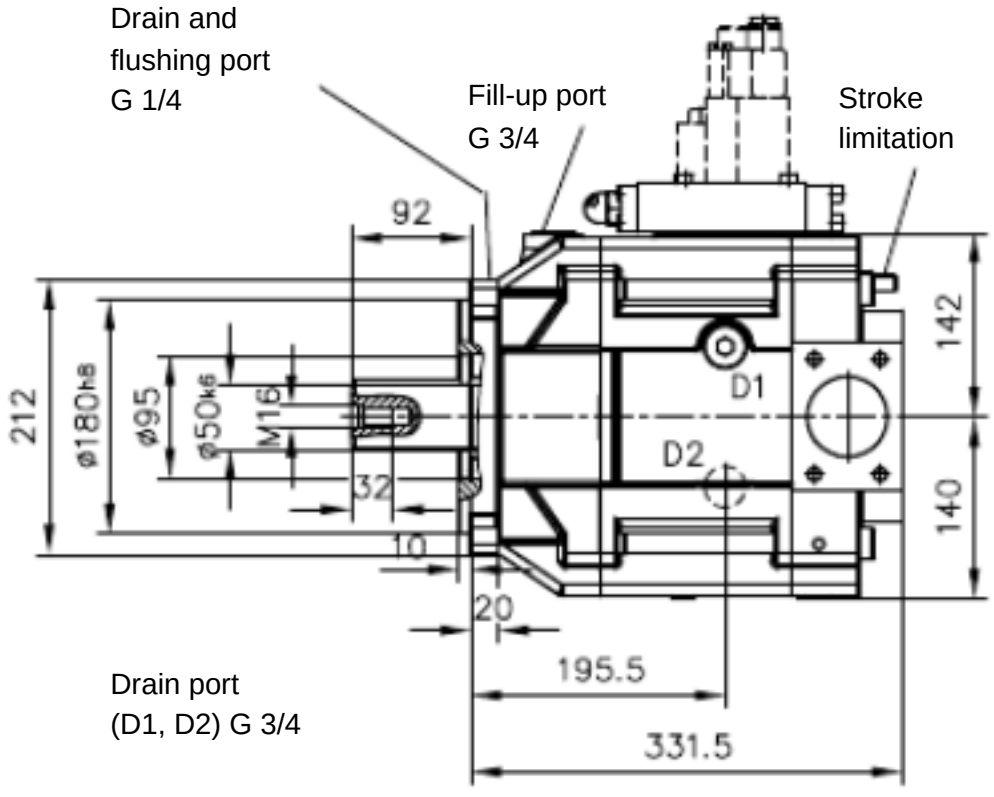
Drain and flushing port G 1/4



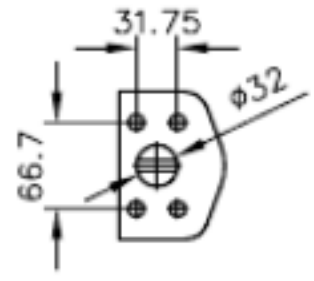
Coding D:
Spline shaft
W50x2x24x9g
DIN 5480



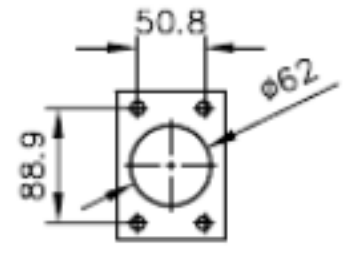
Coding S:
Spline shaft SAE-D13T - 8/16 DP
Flat Root Side Fit
For flange, see foot note [1]) page 9



Drain port
(D1, D2) G 3/4



Pressure P



Suction S

[1]) With right-hand rotation:

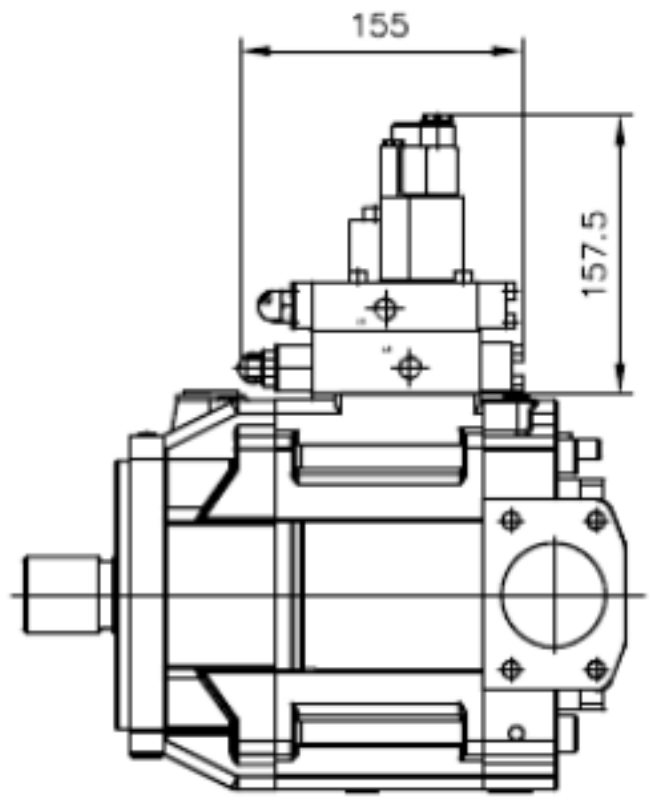
A = Suction	S = SAE 2 1/2	” (3000 psi)
B = Pressure	P = SAE 1 1/4	” (6000 psi)

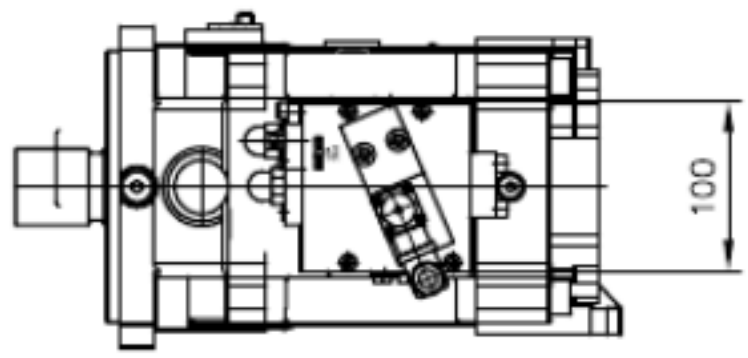
Anti clockwise rotation:

A = Pressure	P = SAE 1 1/4	” (6000 psi)
B = Suction	S = SAE 2 1/2	” (3000 psi)

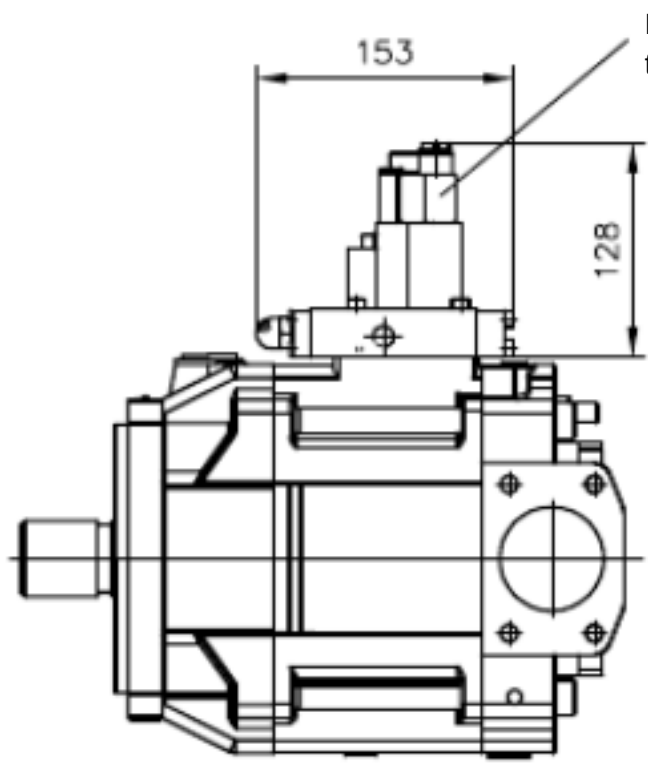
4.2 Controller

Codings LN and LLSN

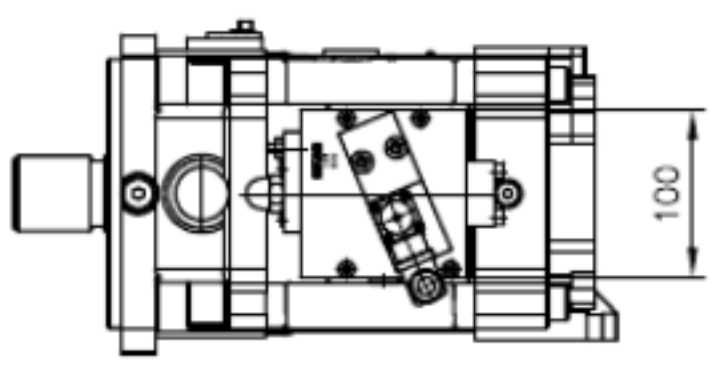




Codings N, Nb, and LSN



Prop. pressure limiting valve
type PMVP 4.. acc. to D 7485/1



5. Tandem pumps

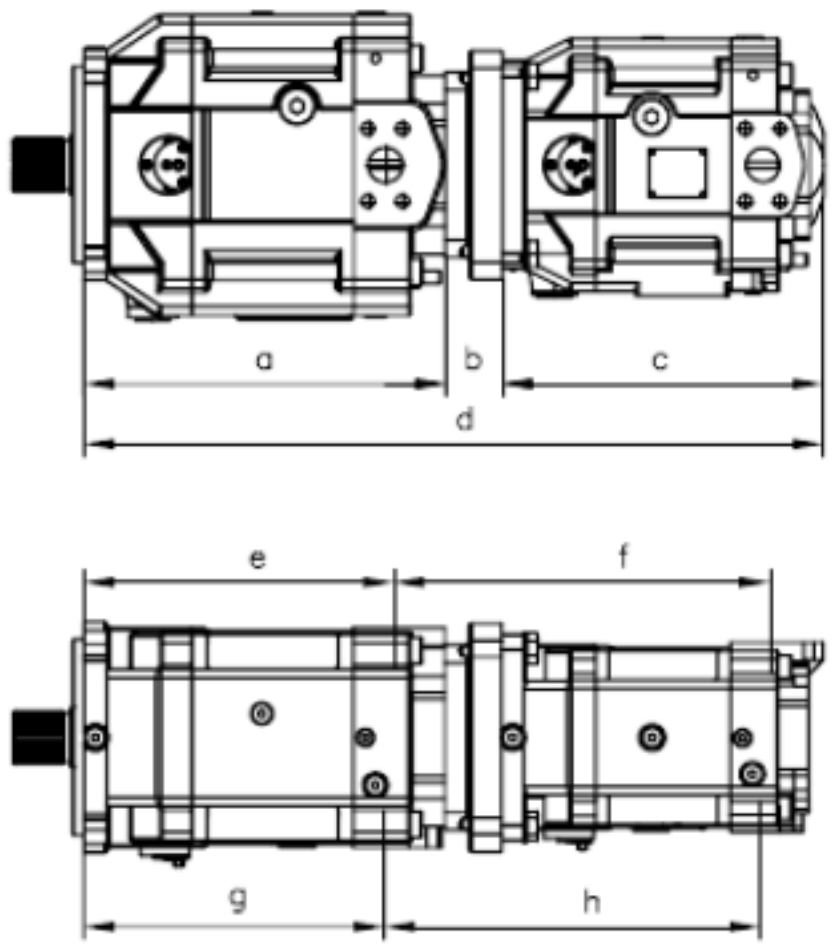
Two variable displacement axial piston pumps can be linked via an intermediate flange. The drive shafts are sufficiently dimensioned to run even the second pump also at max. torque.
Same controller range as for individual pumps.
Available shaft designs: "D" and "S".

Order example:

V30E - 160 RKN-2-1-XX/LLSN -2/120 - 200 - V30E - 160 RKN-1-1-XX/LLSN -2/120 - 200
(1. pump) (2. pump)

(For type coding key, see sect. 2)

1. pump 2. pump



1. pump / 2. pump	V30E-095							
	a	b	c	d	e	f	g	h
V30E-095	336	63	341	740	296	399	300	399
	V30E-160 (190)							
	a	b	c	d	e	f	g	h
V30E-095	358	63	341	762	317	400	323	398
V30E -160 (190)	358	84	363	805	317	442	323	442
	V30E-270							
	a	b	c	d	e	f	g	h
V30E-095	415	75	341	831	366	420	372	418
V30E -160 (190)	415	87	363	865	366	453	372	453
V30E-270	415	87	431	933	366	502	372	502

There are addi ti onally several other combi nati on possi bi li ti es vi a the SAE-flange (only shaft desi gn "S"). Thi s enables di rect connection of an auxiliary pump (e.g. gear pump).

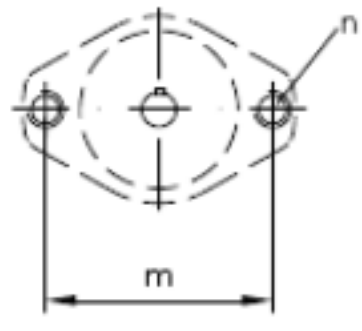
Order example:

V30E - 160 RSN -2-1-XX/LN - 2 /120 - 200 - SAE-C/4

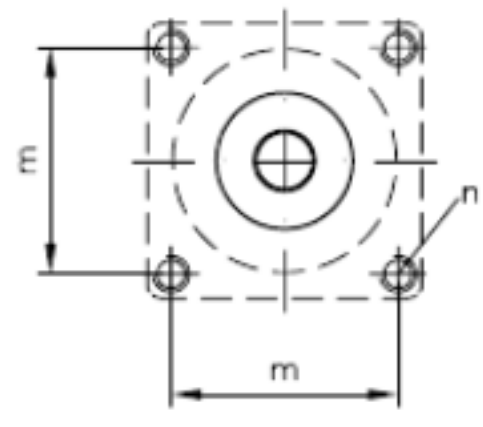
Combination possibilities and dimensions (dimension b acc. to above illustration)

	SAE-A	SAE-B/2	SAE-C/4	SAE-D	On-going drive shaft
V30E - 095	18	30	42	52	W32x1.25x24 DIN 5480
V30E - 160 (190)	18	30	42	52	W40x2x18 DIN 5480
Dimension m	106.4	146	114.5	161.9	
n	2xM10	2xM12	4xM12	4xM16	

Flange
SAE-A
SAE-B/2



Flange
SAE-C/4
SAE-D
[1])



[1]) Notes to version with shaft end coding S
The SAE-flanges on the drive side feature thru-holes instead of threads n