MANNESMANN REXROTH

Brueninghaus Hydromatik

Variable Displacement Pump AA10VSO

Series 31, Industrial Model, for Open Circuits
Axial piston, swashplate design

Sizes 28...140 | Nominal pressure 4000 psi (280 bar) | Peak pressure 5100 psi (350 bar)

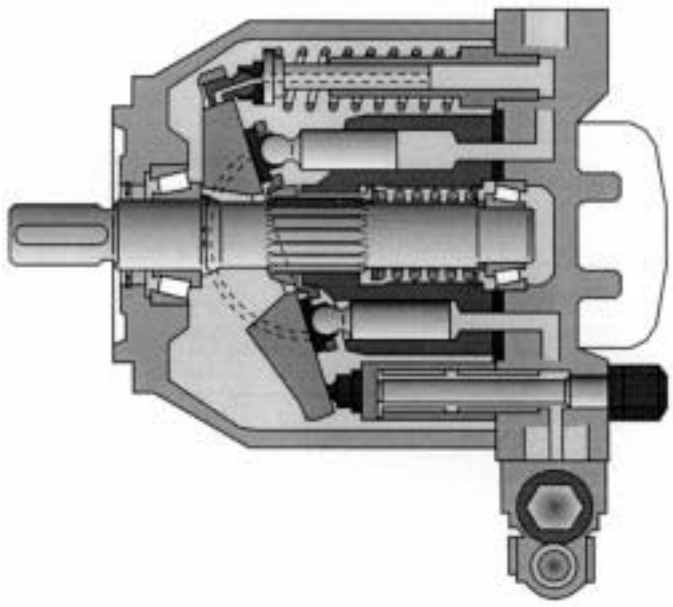
RA 92 711/05.95

replaces 03.93

Variable displacement, axial piston pump AA10VSO of swashplate design is designed for hydrostatic transmissions in open circuits.

Flow is proportional to the drive speed and the displacement. By adjusting the position of the swashplate a stepless variation of the flow is possible.

- SAE mounting flange and shaft
- flange connections SAE
- 2 case drain connections
- good suction characteristics
- permissible continuous operating pressure 4000 psi (280 bar)
- low noise level
- long service life
- axial and radial loading of drive shaft possible
- high power/weight ratio
- wide range of controls available
- short response times
- optional through drive for combination pumps



Ordering code

AA10VSO			/	31	R	–	P	K	C	62	N00

Fluid/Version

Mineral oil (no code)	**omit**
For use with HF fluids	**E-**

Axial piston unit

Swashplate design, variable displacement open circuit, Industrial SAE version	**AA10VSO**

Size

Displacement $V_{g\,max}$		**28**	**45**	**71**	**100**	**140**
	in³/rev.	1.71	2.75	4.33	6.10	8.54
	cm³/rev.	28	45	71	100	140

Control devices

				28	**45**	**71**	**100**	**140**	
Pressure control	DR			●	●	●	●	●	**DR**
	DR	G		●	●	●	●	●	**DRG**
remote pressure control									
Adjustable pressure control for pressure demand control	DFR			●	●	●	●	●	**DFR**
	DFR	1		●	●	●	●	●	**DFR1**
without vent orifice									
Pressure, flow and power control	DFLR			●	●	●	●	●	**DFLR**
Flow control, pilot pressure dependent with pressure control	FHD			●	●	●	●	❍	**FHD**
Electronic flow control	FE1			●	●	●	●	❍	**FE1**
	FE1	D		●	●	●	●	❍	**FE1D**
pressure control									
Electronic pressure / flow control	DFE1			●	●	●	●	●	**DFE1**
Electronic pressure / flow control / integrated electronics	DFEE			●	●	●	●	●	**DFEE** **

Series

	31

Direction of rotation

As viewed from drive shaft	clockwise	**R**
	counter-clockwise	**L**

Seals

Buna-N (NBR per DIN ISO 1629); shaft seal FPM (Fluorocarabon)	**P**
FPM (fluorocarbon)	**V**

Shaft end

	28	**45**	**71**	**100**	**140**	
SAE-keyed shaft	7/8"	1"	1 1/4"	1 1/2"	1 3/4"	**K**
SAE-splined shaft modified, reinforced (higher thru-drive torques)	7/8"	1"	1 1/4"	–	–	**R**

****For complete ordering code information for DFEE, see Page 37.**

– = not available
● = available
❍ = in preparation

*** CAUTION!!**
Project note for size 71:
Pressure port B is available in:
SAE 1" standard pressure range, 5000 psi, for **pressures in excess of 3600 psi (250 bar)** (see page 11)

For new applications high pressure port SAE 1" must be used.

Axial piston unit
Size
Control devices
Series
Direction of rotation
Seals
Shaft end

Mounting flange

SAE 2 hole	●	●	●	●	–	**C**
SAE 4 hole	–	–	–	–	●	**D**

Service ports

		28	**45**	**71**	**100***	**140***	
Ports B and S	Opposite side ports, SAE flange, standard series, UNC mounting screws (Code 62)	●	●	–	●	●	**62**
*Note: Size 100 & 14 pressure ports are SAE code 62.	Opposite side ports, SAE flange, standard series, B port size 1", UNC mounting screws (Code 62)	–	–	●	–	–	**92**

Through drives

	28	**45**	**71**	**100**	**140**	
without through drive	●	●	●	●	●	**N00**
with through drives for mounting of axial piston pump, gear pump or radial piston pump						
mounting flange	**shaft/coupling**	**for mounting:**					
SAE A, 2-bolt	keyed SAE A-B	AA10VSO 18	●	●	●	●	●	**K40**
SAE B, 2-bolt	keyed SAE B	AA10VSO 28	●	●	●	●	●	**K03**
SAE B-B, 2-bolt	keyed SAE B-B	AA10VSO 45		●	●	●	●	**K05**
SAE C, 2-bolt	keyed SAE C	AA10VSO 71			●	●	●	**K08**
SAE C, 2-bolt	keyed SAE C-C	AA10VSO 100				●	●	**K38**
SAE D, 4-bolt	keyed SAE D	AA10VSO 140					●	**K21**
ISO 63, 4-bolt metric	keyed ø 25 (mm)	R4	●	●	●	●	●	**K57**
SAE-A, 2-bolt	splined shaft 5/8", SAE A	G2, GC2/3, A10VO 18	●	●	●	●	●	**K01**
SAE-B, 2-bolt	splined shaft 7/8", SAE B	G3, A10VO 28	●	●	●	●	●	**K02**
SAE-A, 2-bolt	splined shaft 3/4"	A10VSO 18	●	●	●	●	●	**K52**
SAE-B, 2-bolt	splined shaft 1", SAE B-B	A10VO 45		●	●	●	●	**K04**
SAE-B, 2-bolt	splined shaft 11/4", SAE C	GC4/5		❍	❍	❍	❍	**K06**
SAE-C, 2-bolt	splined shaft 1 1/4", SAE C	G4, A10VO 71			●	●	●	**K07**
SAE-C, 2-bolt	splined shaft 1 1/2", SAE C-C	A10VO 100,GC6				●	●	**K24**
SAE-D, 4-bolt	splined shaft 1 3/4", SAE D	A10VO 140					●	**K17**
82-2 (SAE A)	19-4 (SAE A-B mod.)	A10VSO 18 (shaft end R)	●	●	●	●	●	**KA1**
101-2 (SAE B)	22-4 (SAE B moc.)	A10VO 28 (shaft end R), PVV 1 and 2 (w/J shaft)	●	●	●	●	●	**KA3**
101-2 (SAE B)	25-4 (SAE B-B mod.)	A10VO 45 (shaft end R)	–	●	●	●	●	**KA4**
127-2 (SAE C)	3204 (SAE C mod.)	A10VO 71 (shaft end R), PVV 4 and 5 (w/J shaft)	–	–	●	●	●	**KA5**

Combination pumps

1. If a second pump is to be mounted at the factory, both ordering codes must be combined with a "+" symbol. Ordering code of the 1st pump + Ordering code of 2nd pump.
   Example: AA10VSO 100 DR/31R-PKC62K08 + AA10VSO 71 DFR/31R-PKC62N00
2. If a gear or radial piston pump is to be mounted at the factory, please consult us.

Hydraulic fluid

The AA10VSO pumps in the standard design, should be used with good quality, petroleum oil based, anti-wear hydraulic fluids. More detailed information regarding the selection of hydraulic fluids and their application limits can be found in our Data Sheets RA 90 220 (Petroleum Oil), RA 90 221 (Biodegradable Fluids) and RA 90 223 (Type HF–Fire Resistant/Synthetic Fluids).
When operating with environmentally compatible fluids (Biodegradable) or Fire Resistant (Type HF synthetic fluids) possible reduction of the operating specifications may be required.

Operating viscosity range
In order to obtain optimum efficiency and service life, we recommend that the operating viscosity (at operating temperature) be selected from within the range:

Optimum Viscosity (ν_{opt}) 80...170 SUS (16...36 mm²/s)

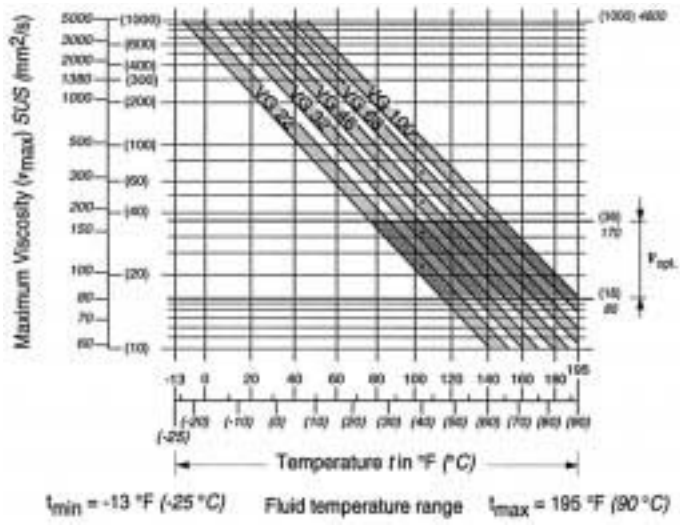
Viscosity limits
The limiting values for viscosity are as follows:

Absolute Minimum Viscosity (ν_{min}) 60 SUS (10 mm²/s)
for short periods at max. permissible leakage oil temperature t_{max} = 195° F (90° C)

Maximum Viscosity (ν_{max}) 4600 SUS (1000 mm²/s)
for short periods during cold start-up

Temperature range (see Selection Diagram)
t_{min} = –13° F (–25° C)
t_{max} = +195° F (+90° C)

Selection diagram



Notes on hydraulic fluid selection
In order to select the correct fluid, it is necessary to know the operating temperature in the tank (open circuit) in relation to the ambient temperature.

The hydraulic fluid should be selected so that, within the operating temperature range, the fluid viscosity is within the optimum range ν_{opt} (see shaded area of the selection diagram). We recommend that the higher viscosity grade is selected in each case.

Example: At an ambient temperature of X°, the operating temperature in the reservoir is 140°F (60°C). In the optimum operating viscosity range ν_{opt}, (shaded area), this corresponds to viscosity grades VG 46 or VG 68, VG 68 should be selected.

Important: The leakage fluid (case drain fluid) temperature is influenced by pressure and speed and is typically higher than the circuit temperature. However, maximum temperature at any point in the system must be less than 195 °F (90°C).

If it is not possible to comply with the above conditions because of extreme operating parameters or high ambient temperature, please consult us.

Filtration of the hydraulic fluid (axial piston unit)
In order to garantee reliable function, the operating fluid must be maintained to a minimum cleanliness level of

9 to NAS 1638
6 to SAE
18/15 to ISO/DIS 4406

This is achievable, for example, using filter elements type ...D020 (see RA 31278). This gives a filtration quotient of fitted

$\beta_{20} \geq 100$

Mechanical stroke limiter

Mechanical stroke limiter is standard for the non-through drive version (N00). It is not possible in combination with through drive.

Q_{max}: with sizes 28 to 140
adjustment range $V_{g\,max}$ to 50 % $V_{g\,max}$

Q_{min}: with sizes 100 to 140
adjustment range $V_{g\,min}$ to 5 0% $V_{g\,max}$

Technical data

(valid for operation with petroleum oil; for biodegradable fluids, see RA 90 221; for water based and other fire resistant fluids see RA 90 223)

Operating pressure range – Inlet side

Absolute pressure at port S (suction inlet)

$p_{abs\ min}$ ——— 12 psi (0.8 bar)

$p_{abs\ max}$ ——— 435 psi (30 bar)

Operating pressure range – Outlet side

Pressure at port B

Nominal pressure p_N ——— 4000 psi (280 bar)

Intermittent pressure (10% of duty cycle) ——— 4600 psi (315 bar)

Peak pressure p_{max} ——— 5100 psi (350 bar)

Applications with intermittend operating pressure up to 4600 psi (315 bar) at ≤ 10 % of duty cycle are possible.

Direction of flow:

S to B.

Case drain pressure

Maximum permissible pressure of leakage fluid (at port L, L_1): Maximum 7 psi (0.5 bar) higher than the inlet pressure at port S, but not higher than 30 psi (2 bar).

Determination of inlet pressure p_{abs} at the suction port S, or the reduction in output flow for increasing speed.

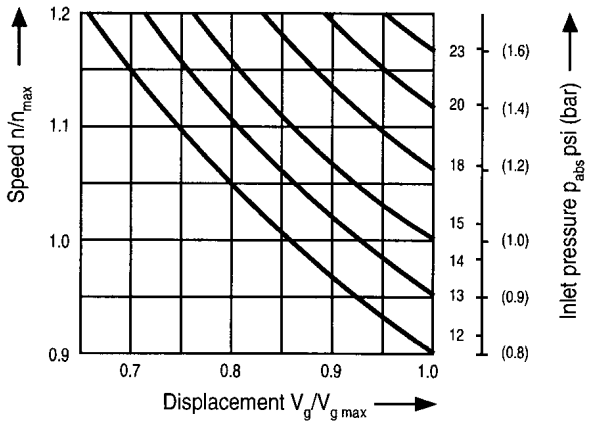
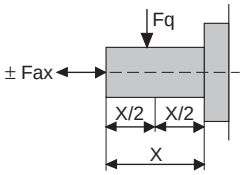


Table of values (theoretical values, without considering η_{mh} and η_v; values rounded)

Size				28	45	71	100	140
Displacement		$V_{g\ max}$	in³ (cm³)	1.71 (28)	2.75 (45)	4.33 (71)	6.10 (100)	8.54 (140)
Max. Speed [1])	at $V_{g\ max}$	$n_{o\ max}$	rpm	3000	2600	2200	2000	1800
Max. permissible speed (speed limit) dependent on inlet pressure p_{abs} or reduced displacement $V_g < V_{g\ max}$		$n_{o\ max\ perm.}$	rpm	3600	3100	2600	2400	2100
Max. Flow	at $n_{o\ max}$	$Q_{o\ max}$	gpm (L/min)	22 (84)	31 (117)	41 (156)	53 (200)	67 (252)
	at n_E = 1800 rpm	Q	gpm (L/min)	13.3 (50)	21.4 (81)	33.8 (128)	47.6 (180)	67 (252)
Max. Power	at $n_{o\ max}$	$P_{o\ max}$	Hp (kW)	51 (39)	72 (55)	96 (73)	124 (93)	156 (118)
Δp = 4000 psi (280 bar)	at n_E = 1800 rpm	P	Hp (kW)	31 (24)	50 (38)	79 (60)	111 (84)	156 (118)
Max. Torque Δp = 4000 psi (280 bar)	at $V_{g\ max}$	T_{max}	lb-ft (Nm)	91 (125)	146 (200)	230 (316)	324 (445)	453 (623)
Torque Δp = 1450 psi (100 bar)	at $V_{g\ max}$	T	lb-ft (Nm)	33 (45)	53 (72)	83 (113)	117 (159)	164 (223)
Moment of inertia about drive axis		J	lb-ft² (kgm²)	0.0403 (0.0017)	0.0783 (0.0033)	0.1970 (0.0083)	0.3963 (0.0167)	0.5743 (0.0242)
Filling volume (case)			gal (L)	0.2 (0.7)	0.26 (1.0)	0.4 (1.6)	0.6 (2.2)	0.8 (3.0)
Approx. weight (without fluid)		m	lbs. (kg)	33 (15)	46 (21)	73 (33)	99 (45)	132 (60)
Max. Force on drive shaft	Max. permissible axial force	$F_{ax\ max}$	lbs.f. (N)	225 (1000)	337 (1500)	540 (2400)	900 (4000)	1080 (4800)
	Max. permissible radial force	$F_{q\ max}$	lbs.f. (N)	270 (1200)	337 (1500)	427 (1900)	517 (2300)	630 (2800)

[1]) These values are valid for an absolute pressure of 14.5 psi (1 bar) at the suction port S. By reducing the output flow or increasing the input pressure, the speed can be increased as shown in the diagram.

Application of forces



Calculation of size

Output Flow

$$Q = \frac{V_g \bullet n \bullet \eta_v}{231}\ \text{gpm} \qquad \left(Q = \frac{V_g \bullet n \bullet \eta_v}{1000}\right)\ \text{L/min}$$

Output Torque

$$T = \frac{V_g \bullet \Delta p}{24 \bullet \pi \bullet \eta_{mh}}\ \text{lb-ft} \qquad \left(T = \frac{1.59 \bullet V_g \bullet \Delta p}{100 \bullet \eta_{mh}}\right)\ \text{Nm}$$

Input Power

$$P = \frac{T \bullet n}{5252} = \frac{Q \bullet \Delta p}{1714 \bullet \eta_t}\ \text{HP} \qquad \left(P = \frac{2\pi \bullet T \bullet n}{60000} = \frac{T \bullet n}{9549} = \frac{Q \bullet \Delta p}{600 \bullet \eta}\right)\ \text{kW}$$

V_g = Geometric displacement - in³ (cm³) per rev.
Δp = Pressure differential - psi (bar)
n = Speed (rpm)
η_v = Volumetric efficiency
η_{mh} = Mechanical-hydraulic efficiency
η_t = Total efficiency ($\eta_t = \eta_v \bullet \eta_{mh}$)

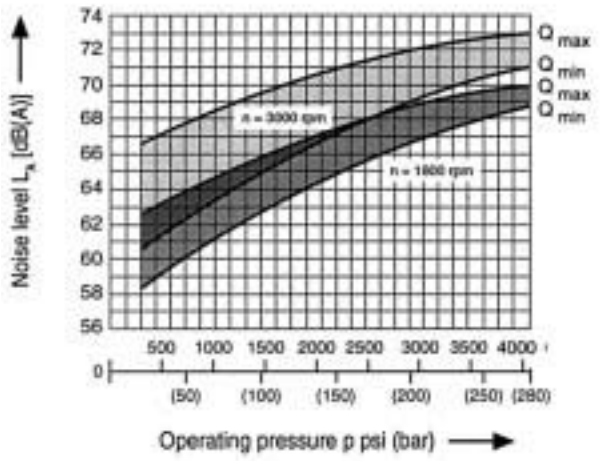
Installation notes

Installation position is optional. The pump housing must be filled with fluid both when commissioning and in operation. In order to achieve low noise level, all connecting lines (suction, pressure, and drain lines) are to be isolated from the tank by flexible members.
A check valve in the drain lines should be avoided. In individual cases, this may be possible, please enquire.

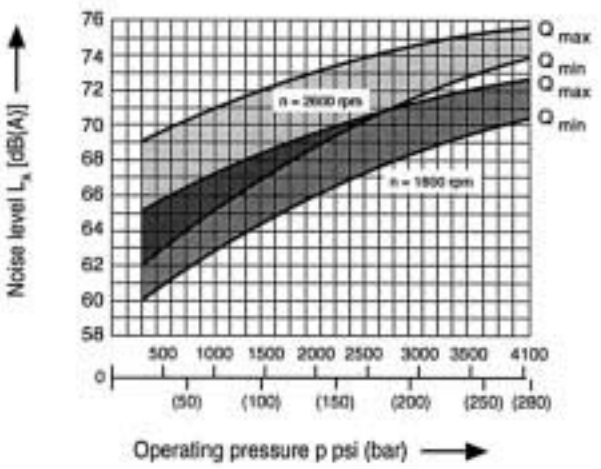
Operating curves for pump with constant pressure control DR

Noise level
Measured in an anechoic chamber to DIN 43635
Distance from microphone to pump = 3.3 ft (1 m)
Measuring error ±2 dB (A)
Fluid used: petroleum oil to ISO VG 46 DIN 51519; temperature = 122°F (50°C)

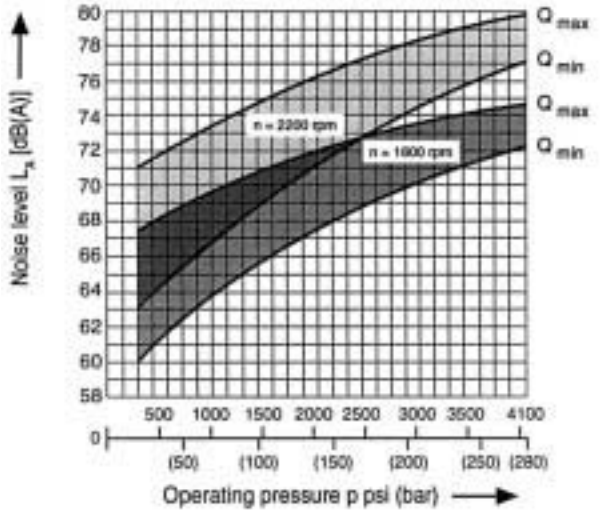
Size 28



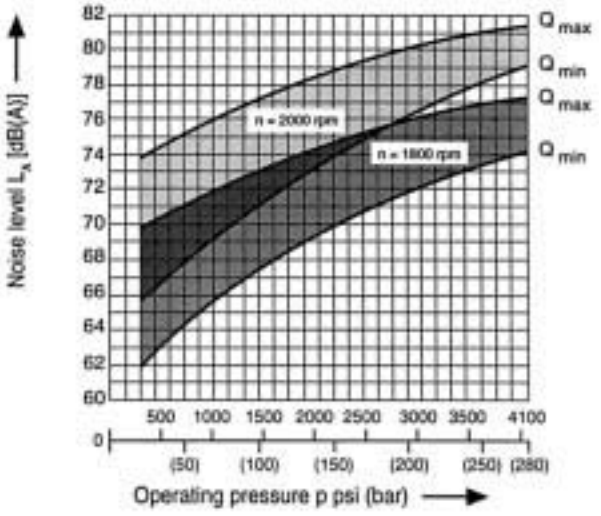
Size 45



Size 71



Size 100

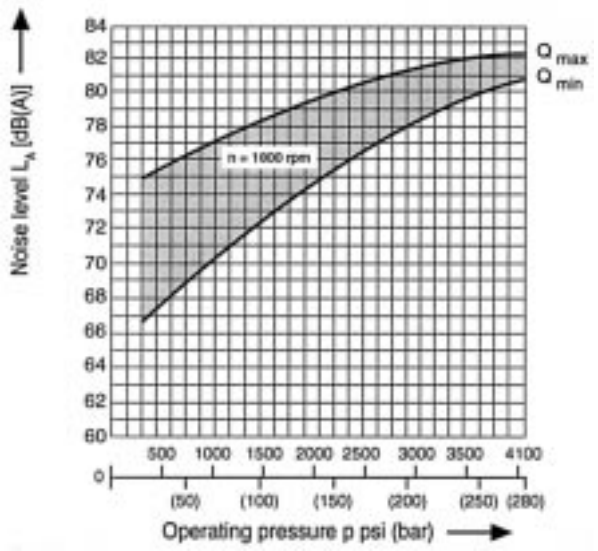


Operating curves for pump with constant pressure control DR

Noise level

Measured in an anechoic chamber to DIN 43635
Distance from microphone to pump = 3.3 ft (1 m)
Measuring error ±2 dB (A)
Fluid used: petroleum oil to ISO VG 46 DIN 51519; temperature = 122°F (50°C)

Size 140

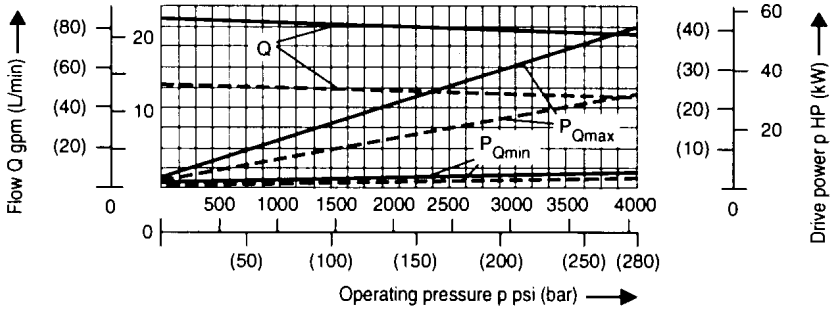


Drive power and output flow

(Fluid: petroleum oil to ISO VG 46 DIN 51519,
temperature t = 122°F (50°C)

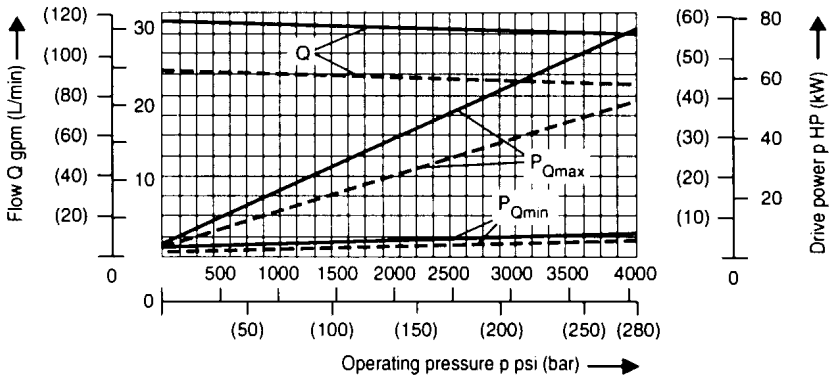
Size 28

– – – – n = 1800 rpm
——— n = 3000 rpm



Size 45

– – – – n = 1800 rpm
——— n = 2600 rpm

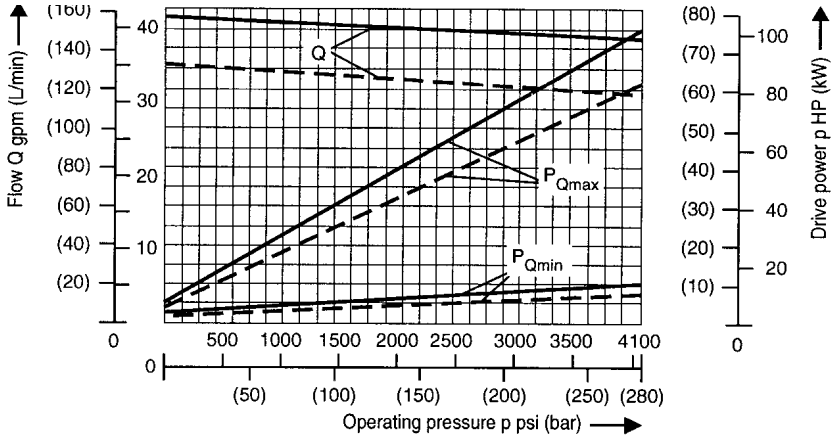


Drive power and output flow

(Fluid: petroleum oil to ISO VG 46 DIN 51519,
temperature t = 122°F (50°C)

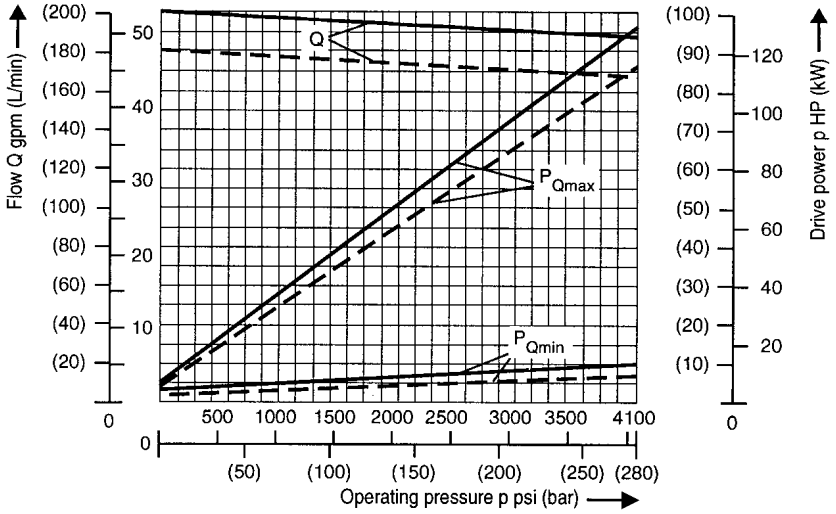
Size 71

– – – – n = 1800 rpm
——— n = 2200 rpm



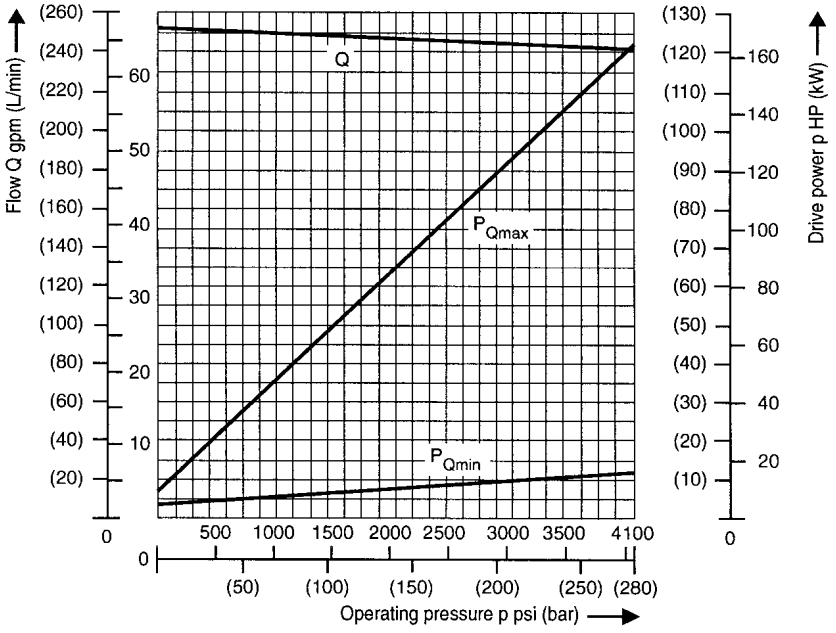
Size 100

– – – – n = 1800 rpm
——— n = 2000 rpm



Size 140

——— n = 1800 rpm



Total efficiency:

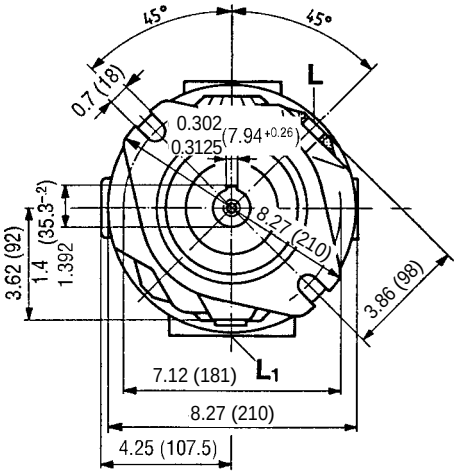
$$\eta_t = \frac{Q \cdot p}{P_{Q\,max} \cdot 1714} \left(\frac{Q \cdot p}{P_{Q\,max} \cdot 600} \right)$$

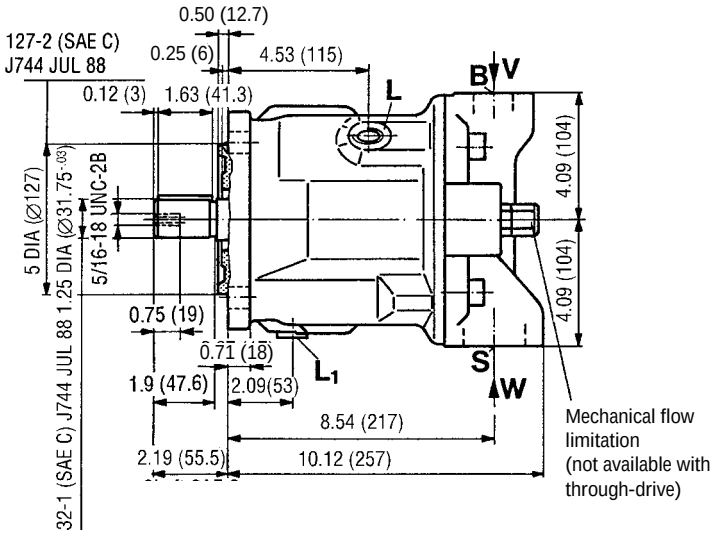
Volumetric efficiency:

$$\eta_v = \frac{Q}{Q_{theor.}}$$

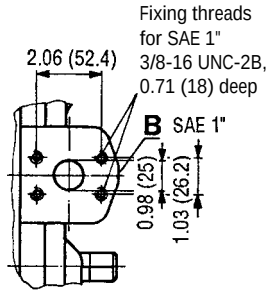
Unit dimensions size 71

Model N**00** (without through drive)
not including control

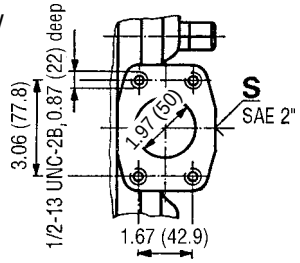




Portplate 92 (1" – 5000 psi)
Detail V



Detail W

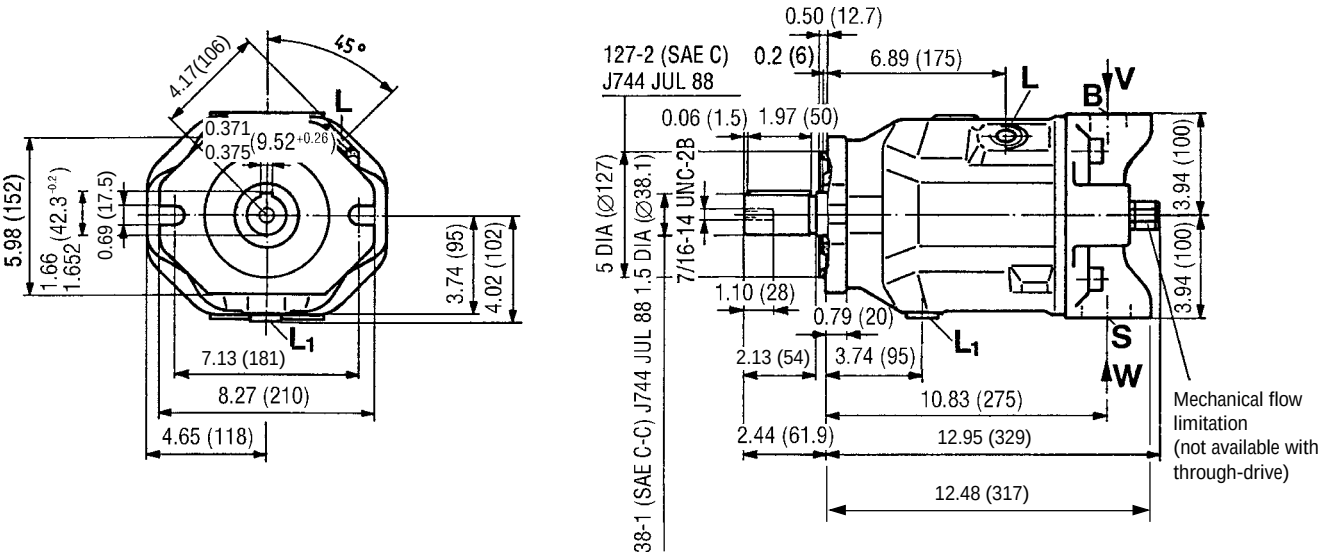


B	Pressure port	1" SAE – 5000 psi	(standard pressure series, Code 61)
S	Suction port	2" SAE	(standard pressure series)
L/L_1	Case drain ports	SAE 10; 7/8 - 14 UNF - 2B	(L_1 plugged at factory)

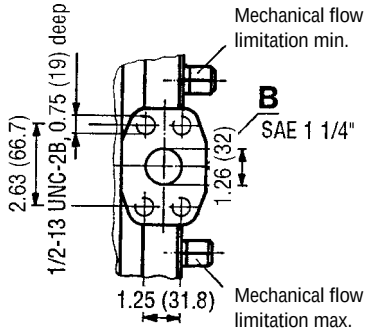
CAUTION!!
At pressure port B there is one optional SAE mounting available,
Portplate code 92 **SAE 1"** standard pressure series, 5000 psi, for pressures **in excess of 3600 psi (250 bar)**. For operating pressures in excess of 3600 psi (250 bar) or for new projects an SAE 1" pressure flange should be used.

Unit dimensions size 100

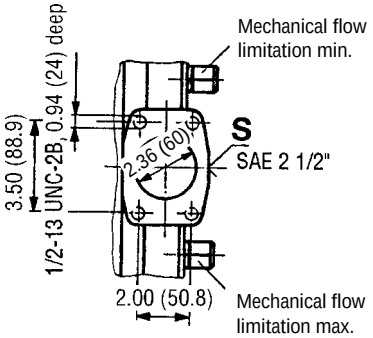
Model N**00** (without through drive)
not including control



Detail V



Detail W



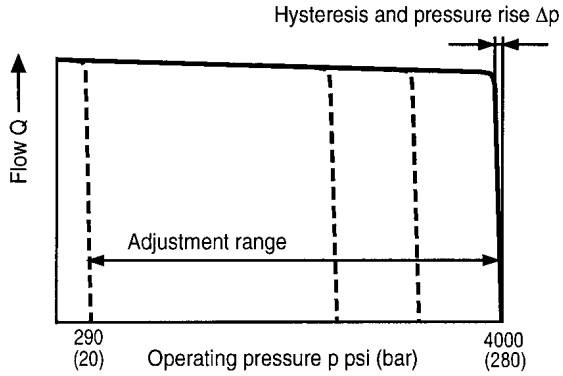
B	Pressure port	1 1/4" SAE – 6000 psi	(high pressure series, Code 62)
S	Suction port	2 1/2" SAE	(standard pressure series, Code 61)
L/L_1	Case drain ports	SAE 12; 1-1/16 - 12UN - 2B	(L_1 plugged at factory)

DR Constant pressure control

The constant pressure control pressure compensation, serves to maintain a constant pressure in a hydraulic system, within the control range of the pump. The pump therefore supplies only the amount of hydraulic fluid required by the services. Pressure may be steplessly set at the pilot valve.

Static operating curve

at n_1 = 1500 rpm; t_{oil} = 122°F (50°C)

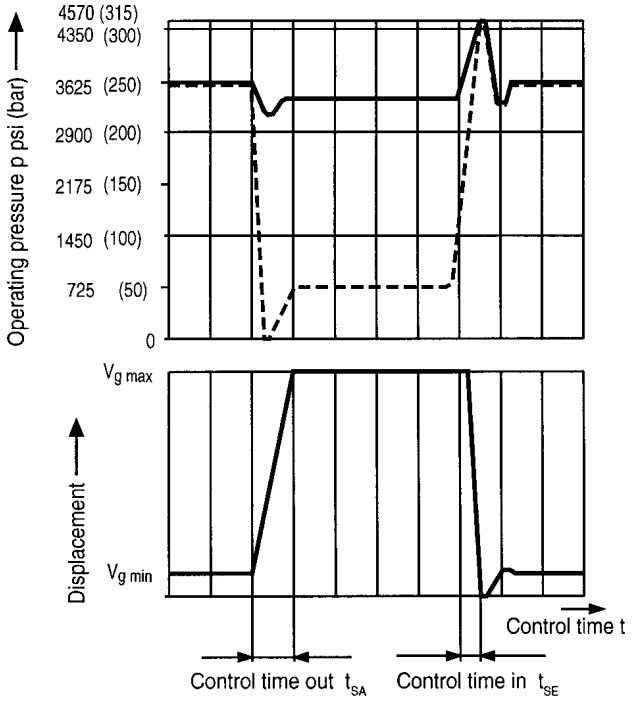


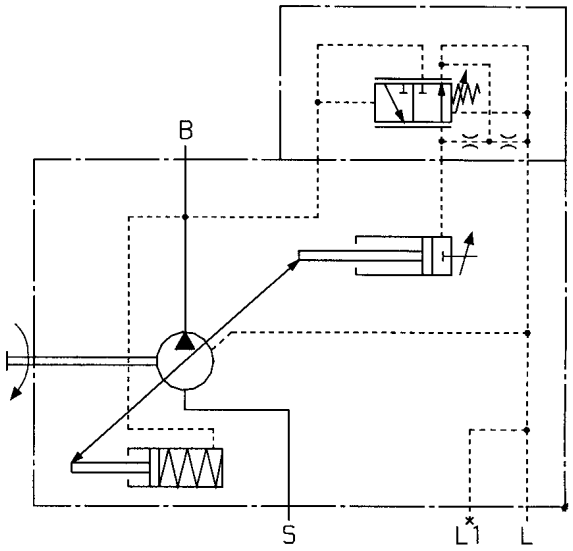
Dynamic response curve

The operating curves are measured mean values taken under test conditions with the unit mounted inside the tank.

Operating conditions: n = 1500 rpm
t_{oil} = 122°F (50°C)
Pressure cut-off at 5100 psi (350 bar)

Load steps were obtained by suddenly opening and closing the pressure line with a pressure relief valve as load valve 3.3 ft (1 m) from the output flange of the pump.





Port connections

B Pressure port
S Suction port
L/L_1 Case drain ports (L_1 plugged at factory)

CAUTION!!

Unloading the compensated pump too fast, e.g. by means of a non-dampened directional valve, too low pressure may lead to cavitation under certain inlet conditions. For sizes 28–100 a damping orifice can be fitted in the control to slow down the on-stroke time of the pump. For the size 140, an adjustable stroke limiter on the compensator spool is available for this purpose. Consult factory for details.

Technical data

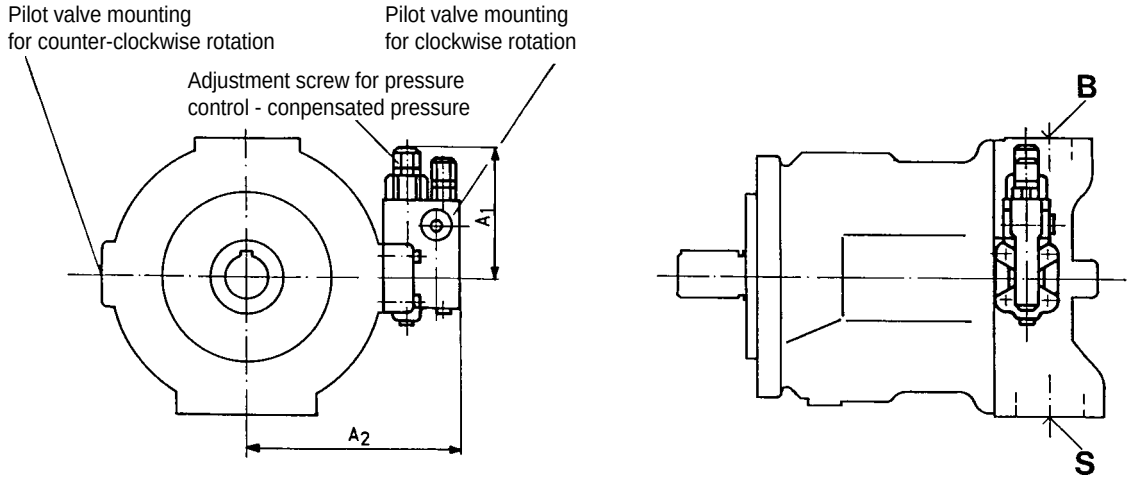
Hysteresis and pressure rise Δp ——— max. 60 psi (4 bar)
External pilot oil usage ——— max. 0.8 gpm (3 L/min)
Loss of flow at Q_{max} see page 7 and 8.

Response time

Size	t_{SA} (ms) against 725 psi (50 bar)	t_{SA} (ms) against 3200 psi (220 bar)	t_{SE} (ms) zero stroke 4000 psi (280 bar)
28	60	30	20
45	80	40	20
71	100	50	25
100	125	90	30
140	130	110	30

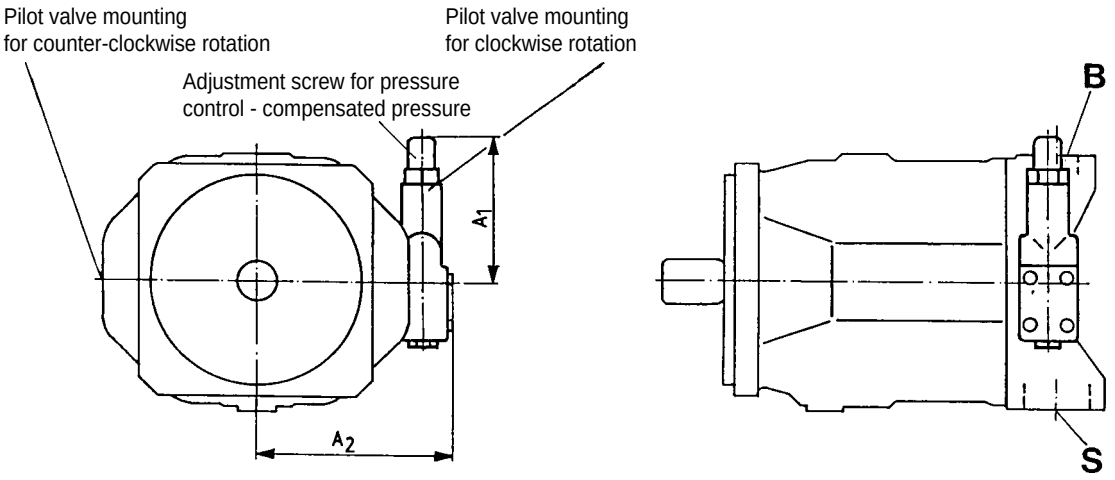
DR Constant pressure control – pressure compensation

Unit dimensions - Sizes 28 to 100



In sizes 28 to 100, the DFR valve is used in which the flow control is blocked at the factory and not tested.

Unit dimensions - Size 140



Size	A_1	A_2
28	4.11 (105)	5.35 (135.5)
45	4.11 (105)	5.75 (145.5)
71	4.11 (105)	6.30 (159.5)
100	4.11 (105)	6.50 (164.5)
140	4.92 (125)	6.65 (169)