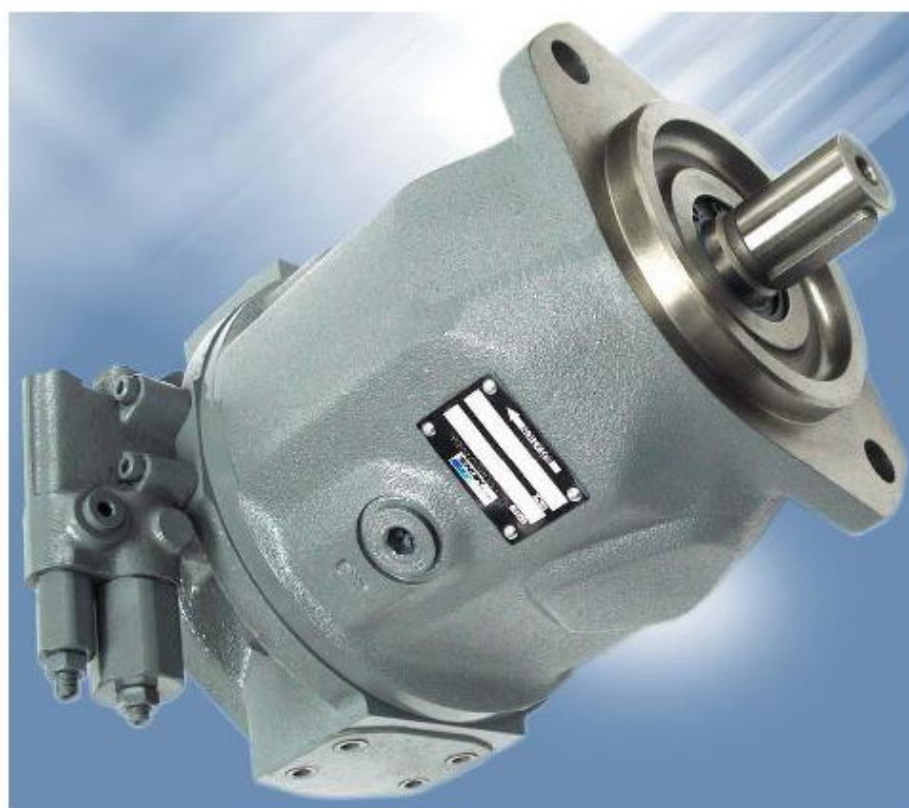


**Variable displacement Pistons Pumps  
for open circuit**

**M-A10VSO SERIES**

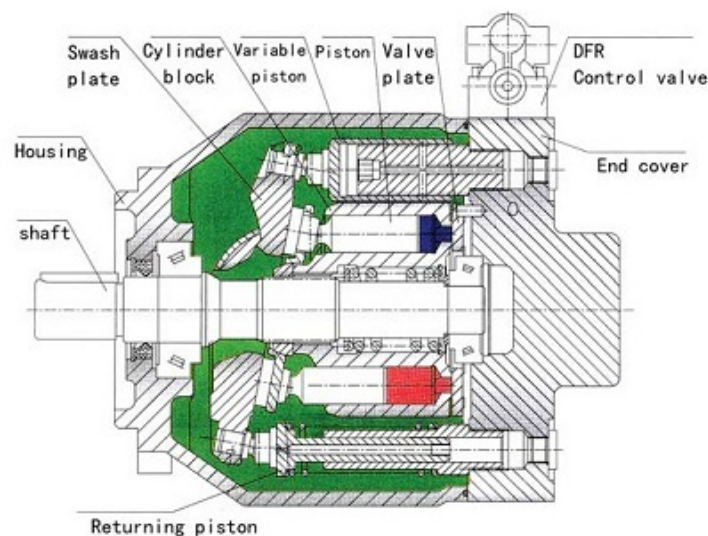




## Features

Axial piston pump MA10VO in swashplate design is used in open loop circuits. Flow is proportional to drive speed and displacement. By adjusting the position of the swashplate it is possible to smoothly vary the output flow of the pump.

- Port connections to SAE or metric
- 2 case drain ports
- Operating pressure 4000PSI (280 bar)
- Good suction characteristics
- Low noise level
- High power/weight ratio
- Long service life
- Short control times
- Axial and radial loading of drive shaft possible
- Wide range of controls
- Through drive option for multi-circuit system
- SAE & ISO mounting flanges available



## Technical Data

### 1. Input Operating Pressure Range

Absolute pressure at port S (A)  
 Pabs min ..... 11.6 PSI or (0.8 Bar)  
 Pabs max ..... 435 PSI or (30 Bar)

### 2. Output Operating Pressure Range

Pressure at port B  
 Nominal pressure .....  $P_N$  4000 PSI or (280 Bar)  
 Peak pressure .....  $P_{max}$  5070 PSI or (350 Bar)

### 3. Case Drain Pressure

The maximum pump case drain pressure measured at ports L, L1 is 7 PSI (0.5 Bar) higher than the input pressure at ports S, but not exceeding more than 30 PSI (2 Bar) absolute.

### 4. Direction of Flow

("S" inlet port to "B" pressure port)

### 5. Table of values (theoretical values, without considering $\eta_{mh}$ and $\eta_v$ ; values rounded)

Size			18	28	45	71	100	140		
Displacement	$V_{gmax}$	cm <sup>3</sup>	18	28	45	71	100	140		
Max. Speed	at $V_{gmax}$	$n_{omax}$	rpm	3000	3000	2600	2200	2000	1800	
Max. flow	at $n_{omax}$	$Q_{omax}$	L/min	59.4	84	117	156	200	252	
Max. power	$\Delta p = 4000$ psi ( $\Delta p = 280$ bar)	at $n_{omax}$	$P_{omax}$	kW	27.7	39	55	73	93	118
Max. torque	$\Delta p = 4000$ psi ( $\Delta p = 280$ bar)	at $V_{gmax}$	$T_{max}$	Nm	58.3	125	200	316	445	623
Weight (without fluid)		m	kg	26.5	15	21	33	45	60	

Notes: Values shown are valid for an absolute pressure of 1 bar at suction port. If the flow is reduced or if the inlet pressure is increased the speed may be increased.

### Hydraulic Formula

#### 6. Determination of Size

Imperial  
 Flow  $Q = \frac{V_g \cdot n \cdot \eta_v}{231}$  gpm

Metric  
 Flow  $Q = \frac{V_g \cdot n \cdot \eta_v}{1000}$  L/min

Torque  $T = \frac{V_g \cdot \Delta p}{24 \cdot \pi \cdot \eta_{mh}}$  lb-ft

Torque  $T = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}}$  Nm

Power  $P = \frac{Q \cdot \Delta p}{1714 \cdot \eta_t}$  HP

Power  $P = \frac{Q \cdot \Delta p}{600 \cdot \eta_t}$  kW

$V_g$  = geometric displacement cu.in. or [cm<sup>3</sup>] per rev.

$\Delta p$  = differential pressure PSI or (Bar)

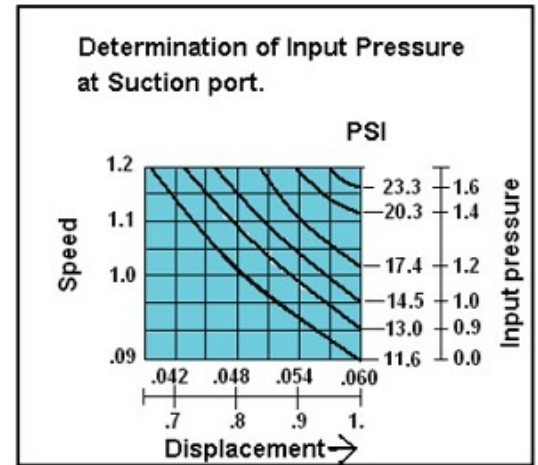
$n$  = speed [rpm]

$\eta_v$  = volumetric efficiency

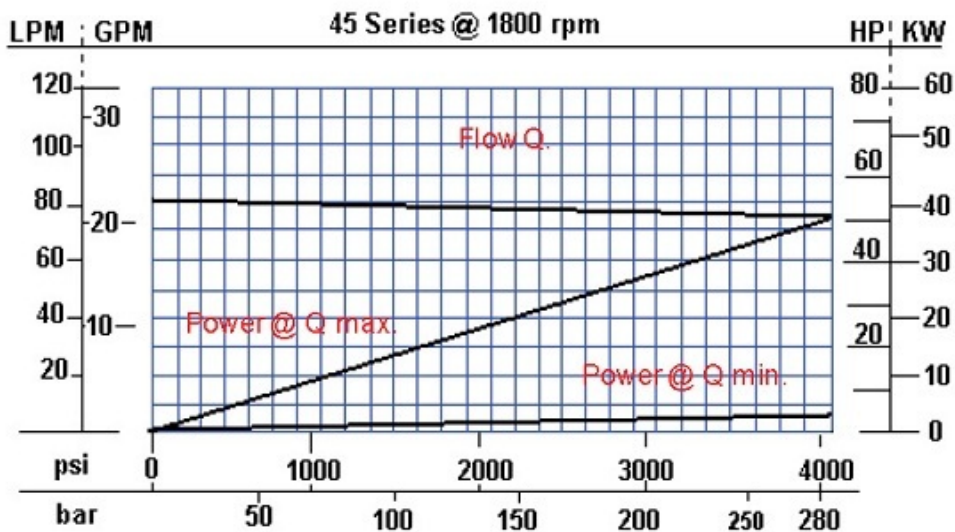
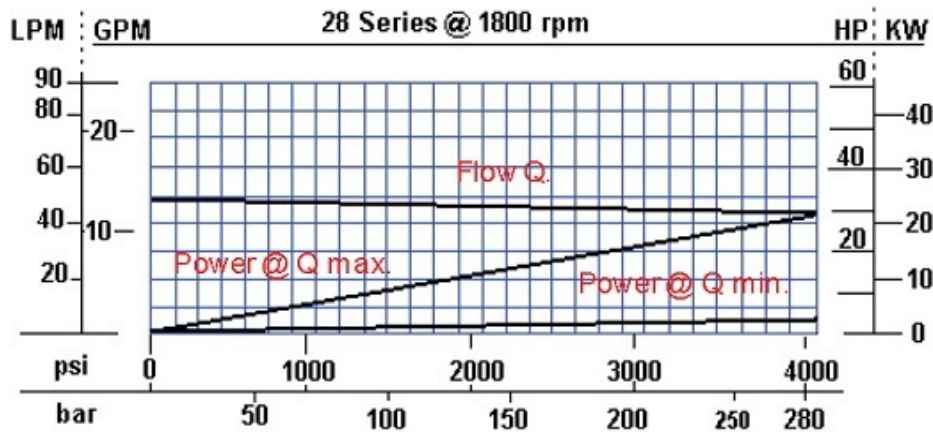
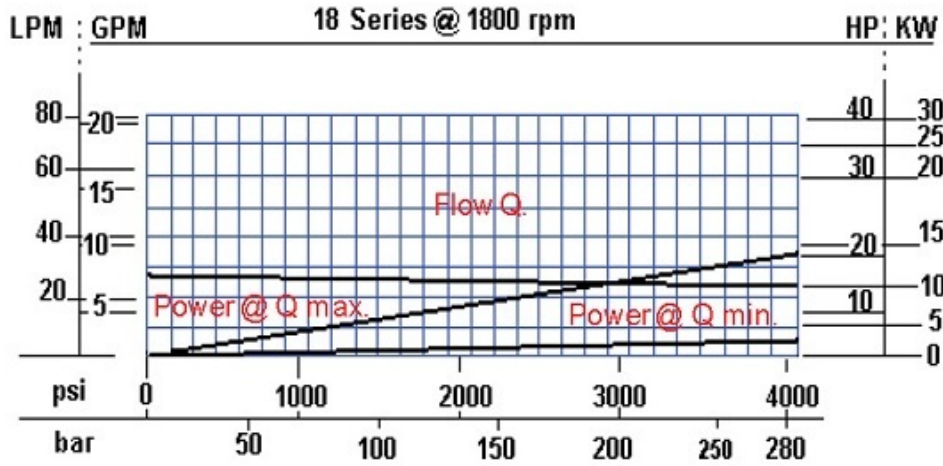
$\eta_{mh}$  = mechanical-hydraulic efficiency

$\eta_t$  = total efficiency ( $\eta_t = \eta_v \cdot \eta_{mh}$ )

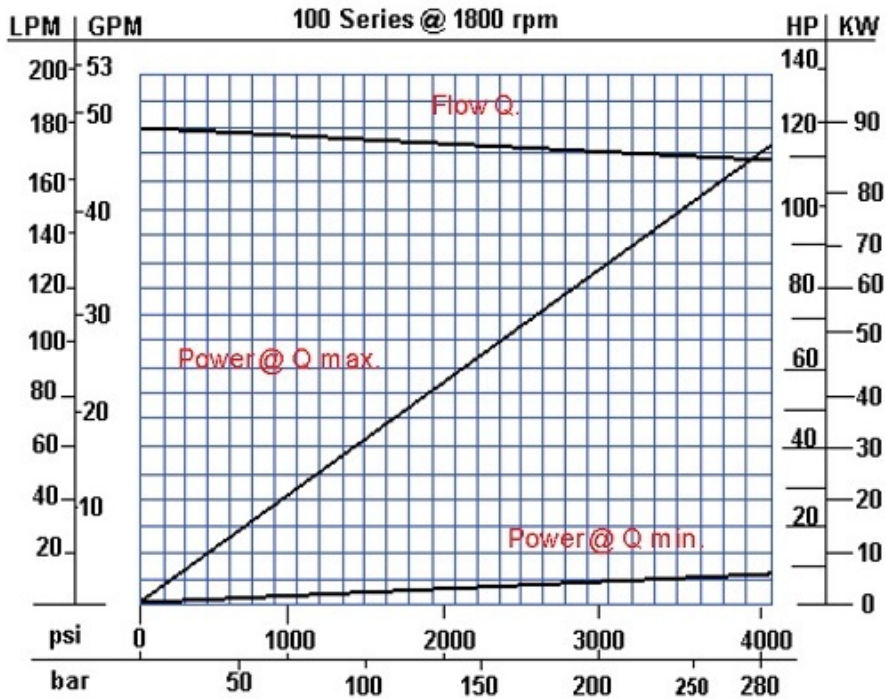
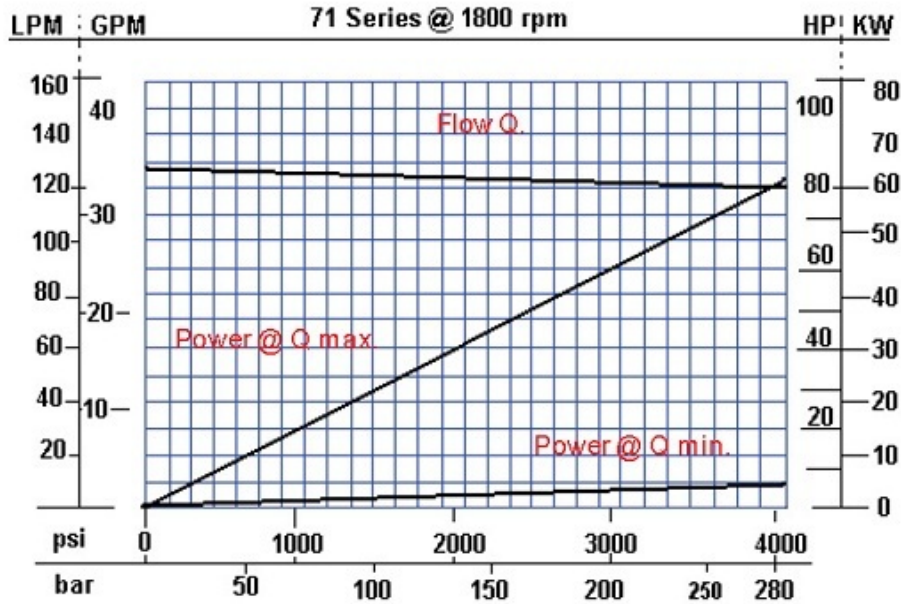
$Q$  = Flow (gpm) or (L/min.)



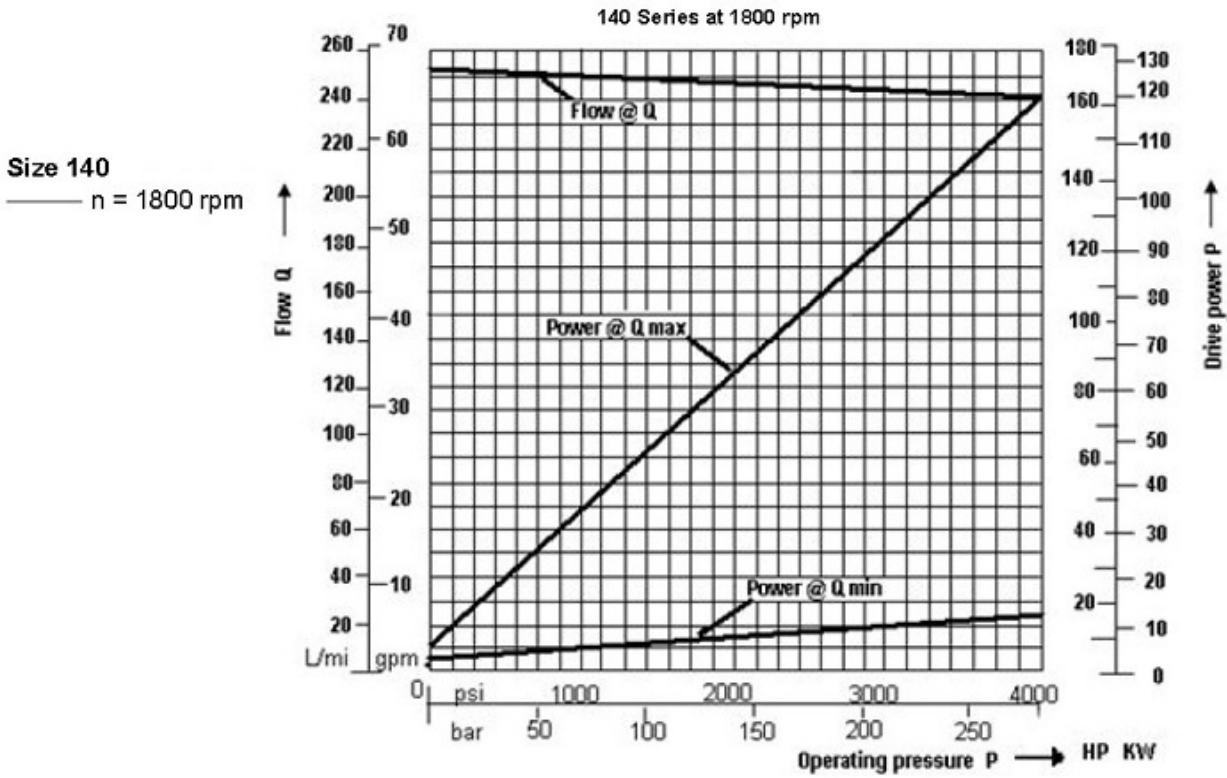
**Performance Information**



**Performance Information - cont'd**



**Performance Information - cont'd**



Total efficiency:

Imperial

$$\eta_t = \frac{Q \cdot P}{P_{Q \max} \cdot 1714}$$

Metric

$$\eta_t = \frac{Q \cdot P}{P_{Q \max} \cdot 600}$$

Volumetric efficiency:

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

## Ordering Code

		MA10V	0	71	DR	31	R	P	S
<b>Axial piston unit</b>									
Swash plate variable pump	MA10V								
Swash plate variable pump, for industrial	MA10VS								
<b>Modes of operation</b>									
Pump, open circuit	○								
<b>Size</b>									
Displacement Vgmax (cm <sup>3</sup> )	18	28	45	71	100	140			
<b>Control devices</b>									
Pressure control	●	●	●	●	●	●	DR		
G - Remote control							DRG		
Pressure and flow control, X channel plugged	●	●	●	●	●	●	DFR DFR1		
Pressure flow and power control	—	●	●	●	●	—	DFLR		
<b>Series</b>									
Series						31			
<b>Direction of rotation</b>									
Viewed on drive shaft	clockwise						R		
	counter-clockwise						L		
<b>Seals</b>									
Buna-N (NBR per DIN ISO 1629) ;							P		
FPM (fluorocarbon)							V		
<b>Shaft end</b>			18	28	45	71	100	140	
SAE-splined shaft		3/4"	7/8"	1"	1 1/4"	1 1/2"	1 3/4"	S	
SAE-splined shaft, reinforced (higher thru drive torques)		3/4"	7/8"	1"	1 1/4"	*	*	R	
SAE-splined shaft, smaller size (not for pumps with thru drive)		5/8"	*	7/8"	*	1 1/4"	*	U	
SAE-splined shaft, reinforced U-type shaft		*	*	7/8"	*	1 1/4"	*	W	
SAE-keyed shaft		3/4"	7/8"	1"	1 1/4"	1 1/2"	1 3/4"	K	
parallel with key DIN 6885		18mm	22mm	25mm	32mm	40mm	45mm	P	

## Ordering Code

C	62	N00
---	----	-----

Thru-drive	18	28	45	71	100	140	
Without through drive	●	●	●	●	●	●	N00

**Thru-drive pumps are only fitted with side ports**

Mounting flange	Shaft/coupling	SAE BB	A10V45	18	28	45	71	100	140	
82-2 (SAE A)	16-4 (SAE A)	G2, GC2/GC3-1X		–	●	●	●	●	●	K04
101-2 (SAE B)	22-4 (SAE B)	A10VO28 (shaft S), G3		–	●	●	●	●	●	K02
101-2 (SAE B)	22-4 (SAE B)	A10VO28 (shaft S), G4		–	●	●	●	●	–	K68
127-2 (SAE C)	32-4 (SAE C)	A10VO71 (shaft S)		–	–	–	●	●	●	K07
152-4 (SAE D)	44-4 (SAE D)	A10VO140 (S.E. S)		–	–	–	–	–	●	K17

*For unlisted coupling sizes please contact Metaris*

**Service ports**

(Pressure port B and Suction port S)	18	28	45	71	100	140		Port pos. 61, 11, 91 and 41 only for version without through drive
(Rear ports, UNC Mounting screws)	●	●	●	●	●	●	61	
(Opposite side ports, UNC mounting screws)	●	●	●	●	●	●	62	
(Rear ports, metric mounting screws)	–	●	●	●	●	●	11	
(Opposite side ports, metric mounting screws)	●	●	●	●	●	●	12	
(Rear ports, UNC Mounting screws)	–	–	–	●	–	–	91	
(Opposite side ports, UNC mounting screws)	–	–	–	●	–	–	92	
(Rear ports, metric mounting screws)	–	–	–	●	–	–	41	
(Opposite side ports, metric mounting screws)	–	–	–	●	–	–	42	

Mounting flange	18	28	45	71	100	140	
SAE 2 hole	3.250"	4"	4"	5"	5"	6"	C
ISO 2 hole	80mm	100mm	100mm	125mm	125mm	180mm	A
SAE 4 hole	3"	3"	3"	3"	3"	6"	D

● = available

### Multiple Pumps

1. If a second Metaris hydraulic pump is to be factory-mounted, then both ordering codes are to be specified, combined with a "+". Ordering code 1st pump + Ordering code 2nd pump. Ordering example: MA10VO71DR/31R-PSC62K02 + MA10VO28DR/31R-PSC62N00
2. If a gear pump is to be factory-mounted please contact Metaris support staff.



## Fluid

### 1. Hydraulic Fluid

The MA10V open loop pump in the standard design should be used with a good quality, petroleum based anti-wear hydraulic fluid.

### 2. Operating Viscosity Range

In order to obtain optimum efficiency we recommend that the operating viscosity be selected from within the range.

At operating temperature

Optimum viscosity ( $v_{opt}$ )  $\approx$  80...170 SUS (16 / 36 mm<sup>2</sup>/s)

#### Limits of viscosity range

The following values are valid for extreme operating conditions:

$v_{min}$  = 60 SUS (10 mm<sup>2</sup>/s)

for short periods at max. leakage oil temperature of 93° C

$v_{max}$  = 4600SUS (1000 mm<sup>2</sup>/s)

1400 SUS (300 mm<sup>2</sup>/s) on short term cold start

### 3. Temperature Range

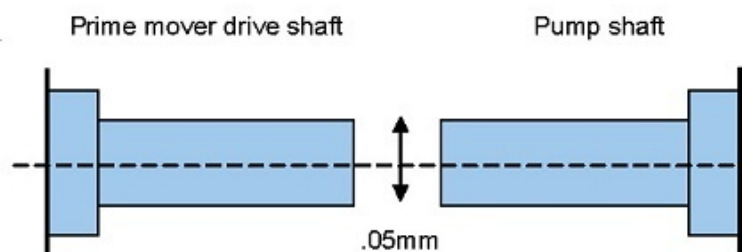
$t_{min}$  = -15°C;  $t_{max}$  = +80°C.;  $t_{min}$  = -5°F;  $t_{max}$  = +175°F

### Filtration

In order to ensure reliable operation of the axial piston unit, the operating fluid must be maintained to a cleanliness class of 18/14 to ISO4406 or NAS 1638 class 9. As a guide the fluid cleanliness level may be achieved using a 10 micron filter.

## Installation Information

The pump housing must be filled with clean hydraulic fluid prior to pump start up and remain full. The concentricity between the prime mover drive shaft and the pump shaft 0.05mm.

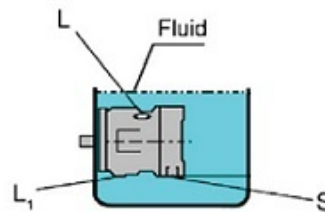
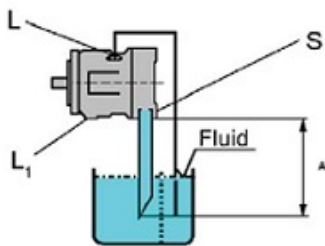
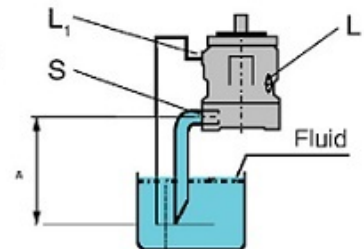
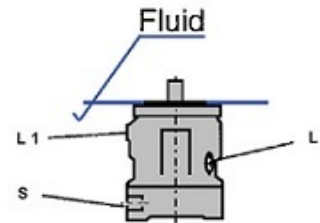


**Installation Information - cont'd.**

The installation position of the pump is optional.

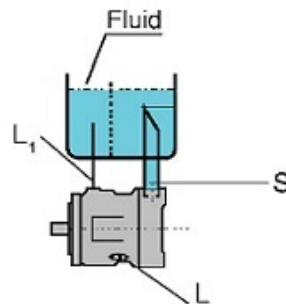
The pump housing must be filled with fluid both when commissioning and in operation. In order to achieve low noise levels, all connecting lines (inlet, case drain) should be isolated from the tank by flexible lines.

1. Vertical installation the following conditions should be noted:
  - Before installing the pump inside a tank fill the pump case with fluid
  - Make sure the ports are below the oil level (L), (L1) & S
  - Avoid mounting above the tank whenever possible in order to maintain a low noise level
  - The permissible inlet height is a result of the overall pressure loss "A" may not be greater than 32 inches (800 mm)
  
2. Horizontal Installation
  - The pumps must be install so (L) or (L1) the case drain is at the top of the pump
  - If the minimum fluid level is below the ports of the pump, pipe the ports L or L1 & S below the minimum oil level.
  - Avoid mounting above the tank whenever possible in order to maintain a low noise level.
  - The permissible inlet height (h) is a result of the overall pressure loss, "A" may not be greater then 32 inches (800 mm).



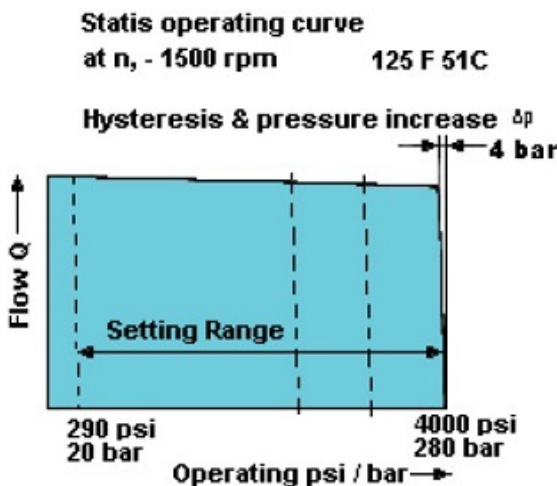
Below the tank position

- Pipe "L", "L1" and "S" must be mounted below the oil level



### DR Pressure Control

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

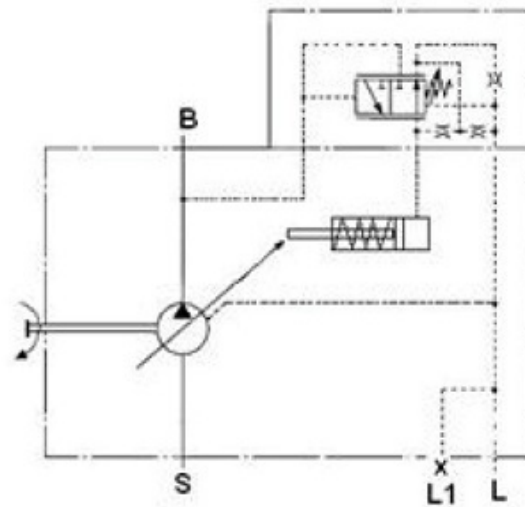
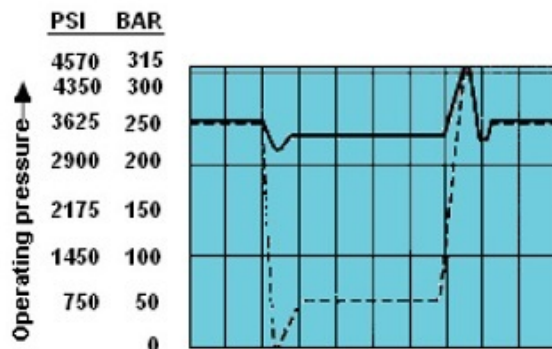


### Dynamic response curve

The operating curves values taken under the following conditions

Operating Conditions;    n = 1500 rpm  
 Oil temperature          120 F / 50C  
 Pressure cut-off          5100 psi / 350bar

Load values were taken by closing the pressure line with a load valve .

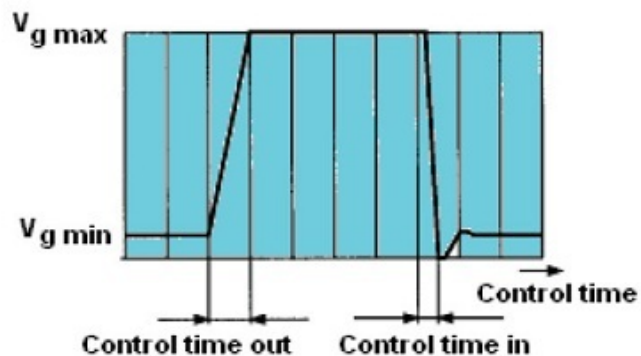


### Ports

<b>B</b>	Pressure Port
<b>S</b>	Suction port
<b>L, L1</b>	Case drain ports (L1 sealed)

### Response time

Size	$t_{sa}(ms)$	$t_{sa}(ms)$	$t_{sa}(ms)$
	725 psi / 50 bar	3200 psi / 220 bar	4000 psi / 280 bar
28	60	30	20
45	80	40	20
71	100	50	25
100	125	90	30
140	130	110	30



### Control Data

Hysteresis and repetition accuracy  $\Delta p$  ..... Max. 3 bar

#### Max. Pressure Increase

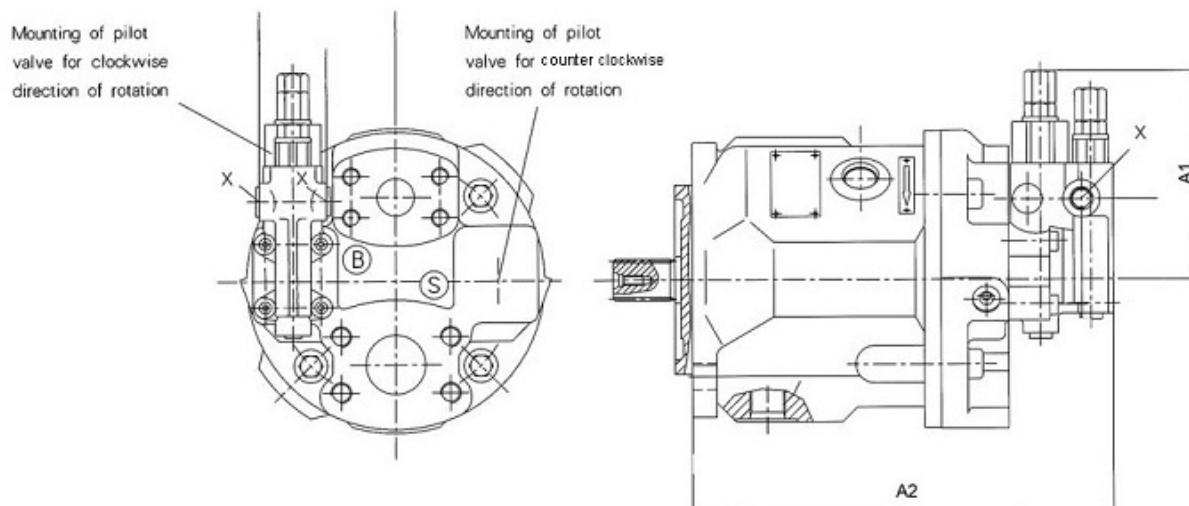
Size		18	28	45	71	100	140
$\Delta P$	BAR	4	4	6	8	10	12

Pilot oil consumption .....max. approx. 3 L/min

**Unit dimensions DR**

**Service ports at rear; Models 61N00 and 11N00**

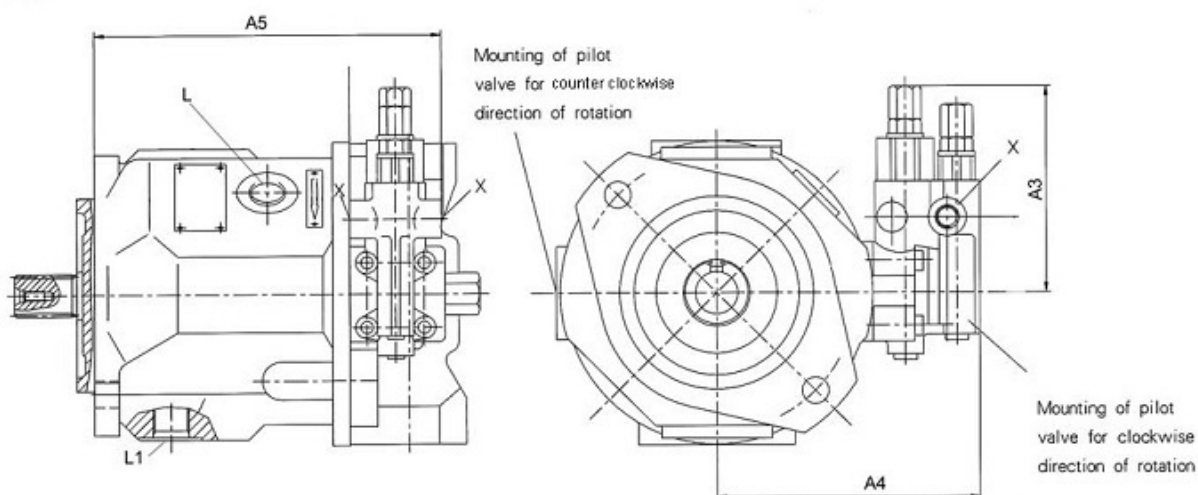
Size 18 to 140



**Unit dimensions DR**

**Service ports at side; Models 62N00 and 12N00**

Size 18 to 140



Size	A1	A2	A3	A4	A5	Metric Adapter L & L1	X
18	*	*	121	126	167	M16 X 1.5	7/16-20UNF-2B
28	74	36	121	136	179	M18 X 1.5	7/16-20UNF-2B
45	81	36	121	146	189	M22 X 1.5	7/16-20UNF-2B
71	92	36	121	160	215	M22 X 1.5	7/16-20UNF-2B
100	98	36	121	158	285	M27 X 2	7/16-20UNF-2B
140	*	*	120	209	292	M27 X 2	9/6-18UNF-2B

## DRG Pressure Control, Remote Control

Size 18 to 100

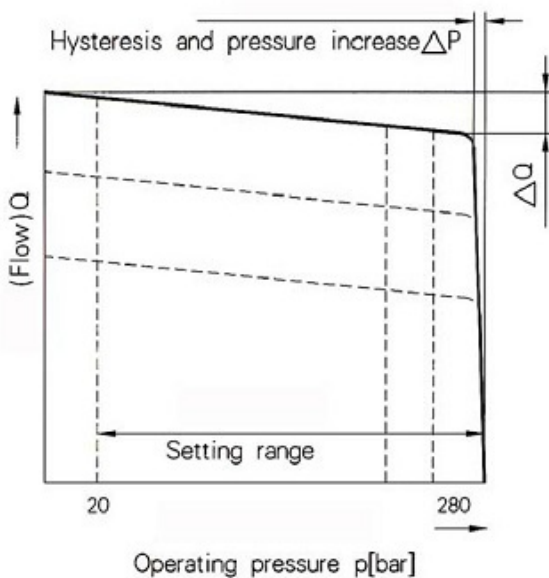
### Function and design as for DR

A pressure relief valve may be externally piped to port X for remote control purposes. It is not, however, included with the DRG control.

The differential pressure at the pilot valve is set as standard to 20 bar and this results in a pilot flow of 1,5 L/min. If another setting is required (in the range 10-22 bar), please state this in clear text.

The remote pilot valve should be mounted no more than 78in (2 meters) from the pump.

Static characteristic  
(at n=1500 rpm; oil temp. = 125°F / 51°C)



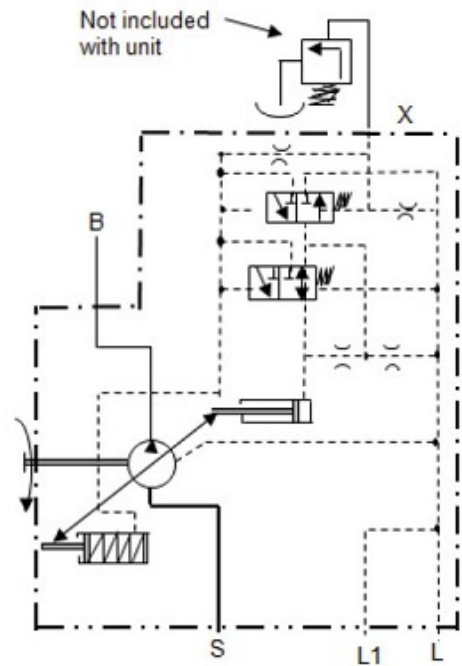
## Control Data

Hysteresis and repetition accuracy  $\Delta p$  ..... Max. 3 bar

### Max. Pressure Increase

Size		18	28	45	71	100	140
$\Delta P$	BAR	4	4	6	8	10	12

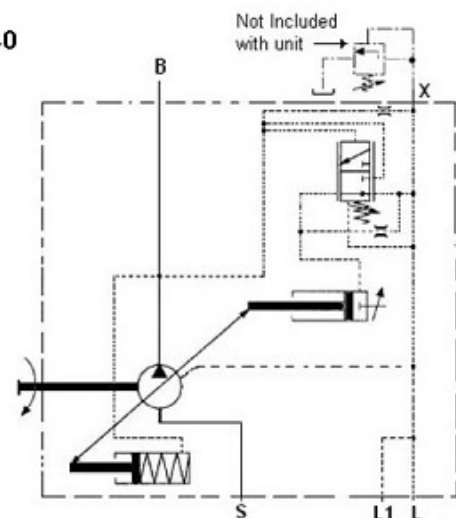
Pilot oil consumption .....max. approx. 4.5 L/min



## Ports

B	Pressure Port
S	Suction port
L, L1	Case drain ports (L1 sealed)
X	Pilot pressure port

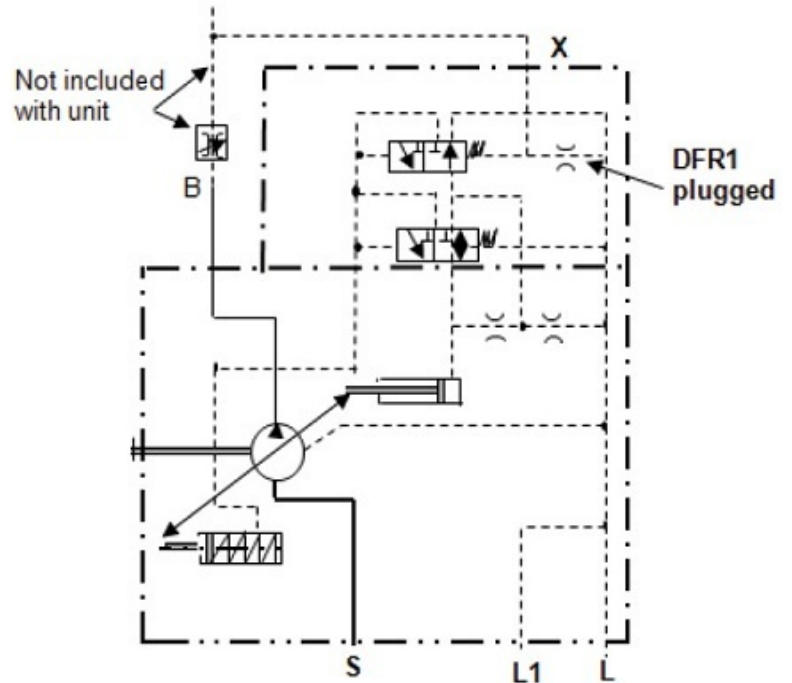
### DRG 140



## DFR/DFR1 Pressure/Flow Control

In addition to the pressure control function, the pump flow may be varied by means of a differential pressure at the actuator (e.g. an orifice).

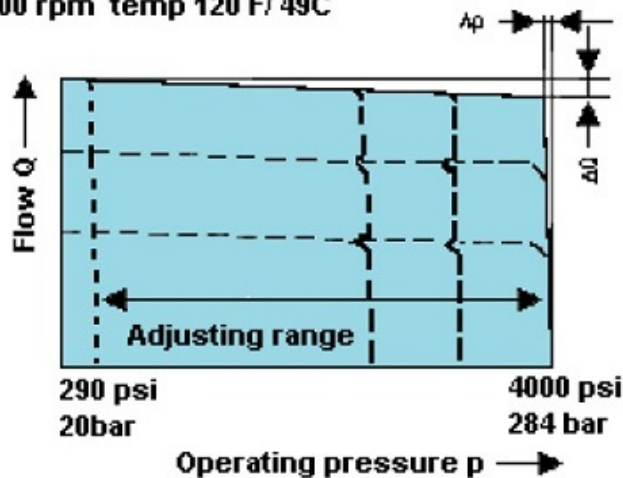
In model DFR1 the X orifice is plugged.



## Ports

<i>B</i>	Pressure Port
<i>S</i>	Suction port
<i>L, L1</i>	Case drain ports (L1 sealed)
<i>X</i>	Pilot pressure port

**Static curve**  
at 1500 rpm temp 120 F / 49C



**DFR/DFR1 Pressure/Flow Control - cont'd**

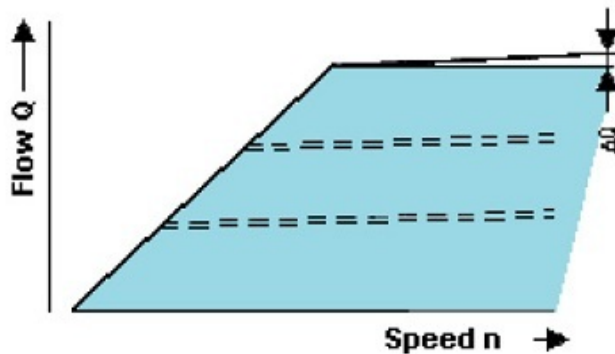
**Flow Control/Differential Pressure  $\Delta p$ :**

Adjustable between 10 and 22 bar (higher values on request). Standard setting: 14 bar. If a different setting is required, please state in clear text.

When port X is unloaded to tank, a zero stroke pressure of

$p = 18 \pm 2$  bar ("stand by") results.

Static curve at variable rpm



**Control Data**

For pressure control technical data see DR Pressure control

Max. flow deviation (hysteresis and increase) measured at drive speed  $n = 1450$  rpm

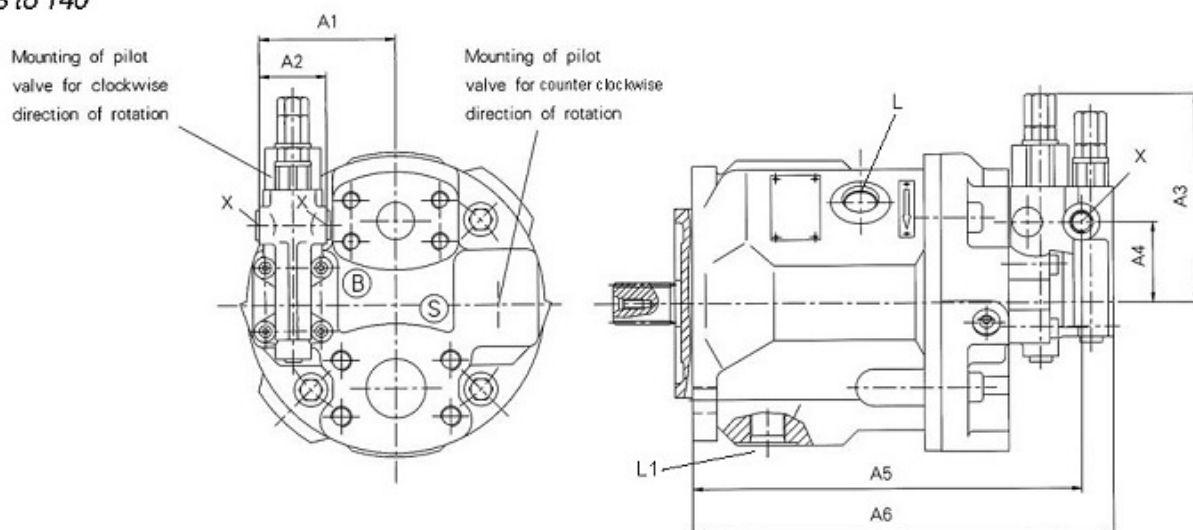
Size		18	28	45	71	100	140
$\Delta Q_{max}$	L/min	0.5	1	1.8	2.8	4.0	6.0

Pilot oil consumption DFR ..... max. approx. 3-4.5 L/min

Pilot oil consumption DFR1 ..... max. approx. 3 L/min

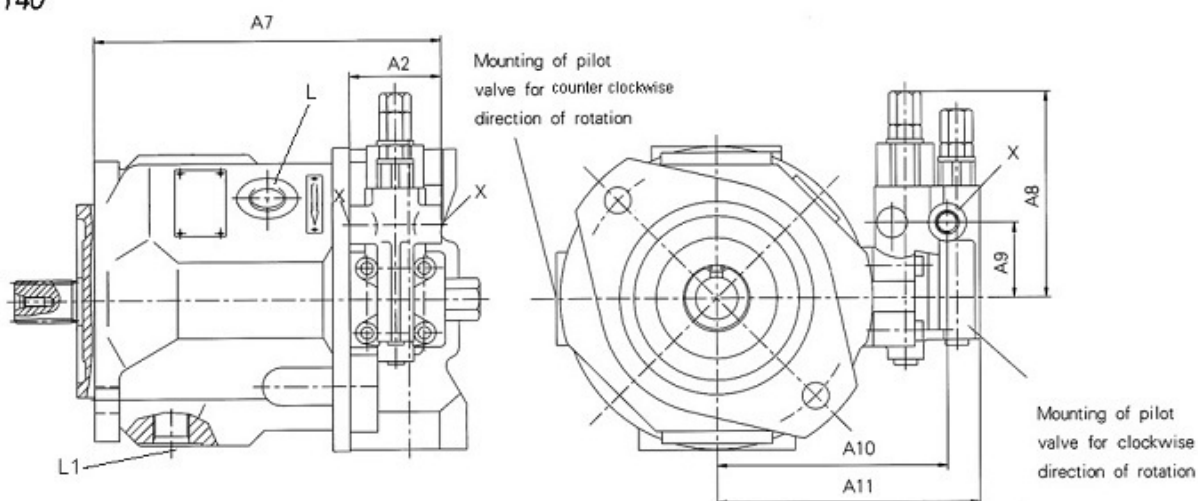
**Unit dimensions DFR / DFR1 / DRG  
Service ports at rear; Models 61N00 and 11N00**

Size 28 to 140



**Unit dimensions DFR / DFR1 / DRG  
Service ports on sides; Models 62N00 and 12N00**

Size 18 to 140



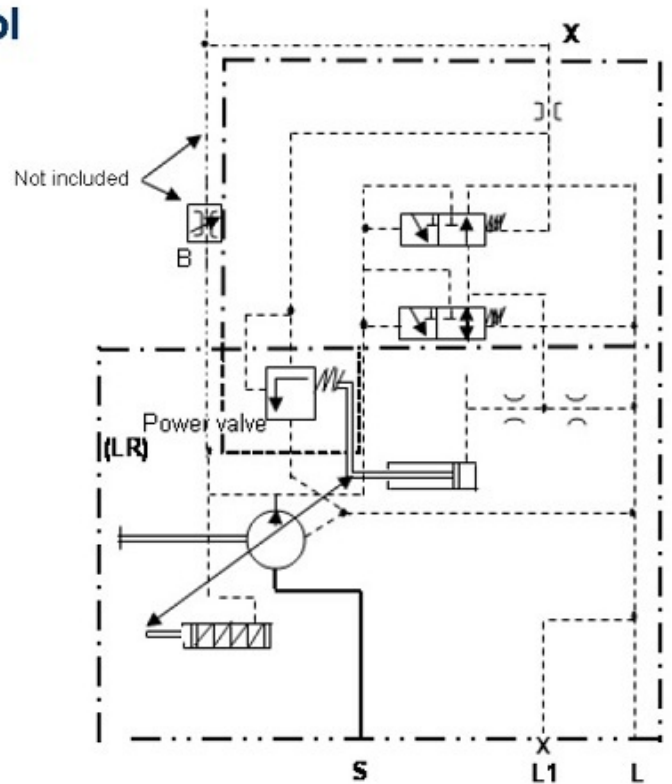
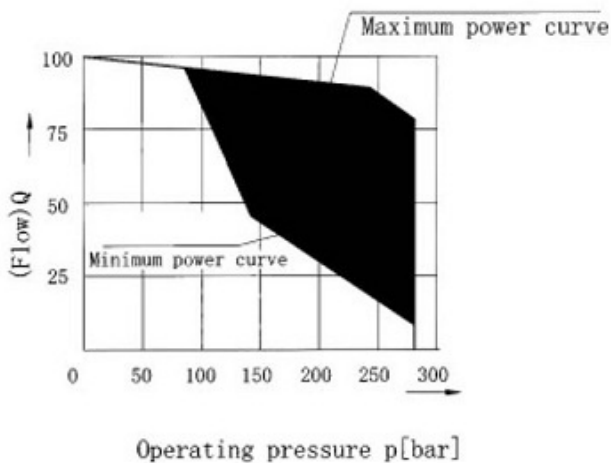
Size	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	X
18	*	36	*	*	*	*	167	121	41	112	126	7/16-20UNF-2B
28	74	36	121	40	211	228	179	121	41	116	135	7/16-20UNF-2B
45	81	36	121	40	231	248	189	118	40	122	140	7/16-20UNF-2B
71	92	36	121	40	264	281	215	119	40	145	163	7/16-20UNF-2B
100	98	36	121	40	328	346	286	119	40	145	164	7/16-20UNF-2B
140	*	50	*	*	*	*	292	120	26	186	210	9/16 - 18 UNF-2B



## DFLR Pressure/Flow/Power Control

In order to achieve a constant drive torque with a varying operating pressure, the swivel angle and with it the output flow from the axial piston unit is varied so that the product of flow and pressure remain constant.

Flow control is possible below the limit of the power curve.



### Ports

<b>B</b>	Pressure Port
<b>S</b>	Suction port
<b>L, L1</b>	Case drain ports (L1 sealed)
<b>X</b>	Pilot pressure port

The power characteristic is factory-set, so please enter details in clear text, e.g. 20 kW at 1450 rpm.

There are four spring arrangements used for the power valve set-up refer to the chart below.

- Spring group A ..... to 1300 psi/90 bar
- Spring group B ..... to 2320 psi/160 bar
- Spring group C ..... to 3480 psi/240 bar
- Spring group D ..... over 3480 psi/240 bar

### Control data

For pressure control technical data see DR Pressure control.

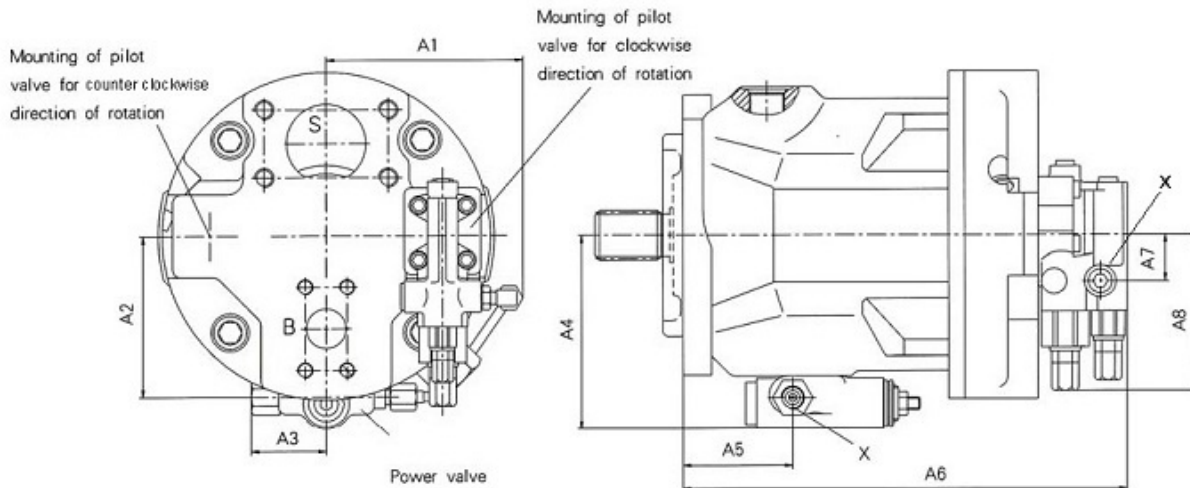
For flow control technical data see DFR control.

Start of control ..... from 80 bar

Pilot oil consumption ..... max. approx. 5.5 L/min

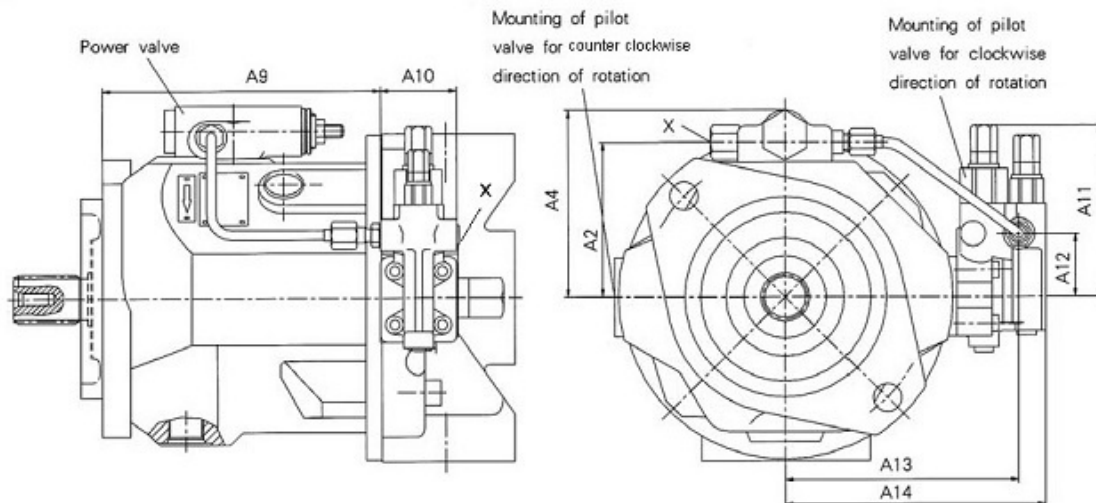
**Unit dimensions DFLR**  
**Service ports at rear; Models 61N00 and 11N00**

Size 28 to 100



**Unit dimensions DFR / DFR1 / DRG / DFLR**  
**Service ports on sides; Models 62N00 and 12N00**

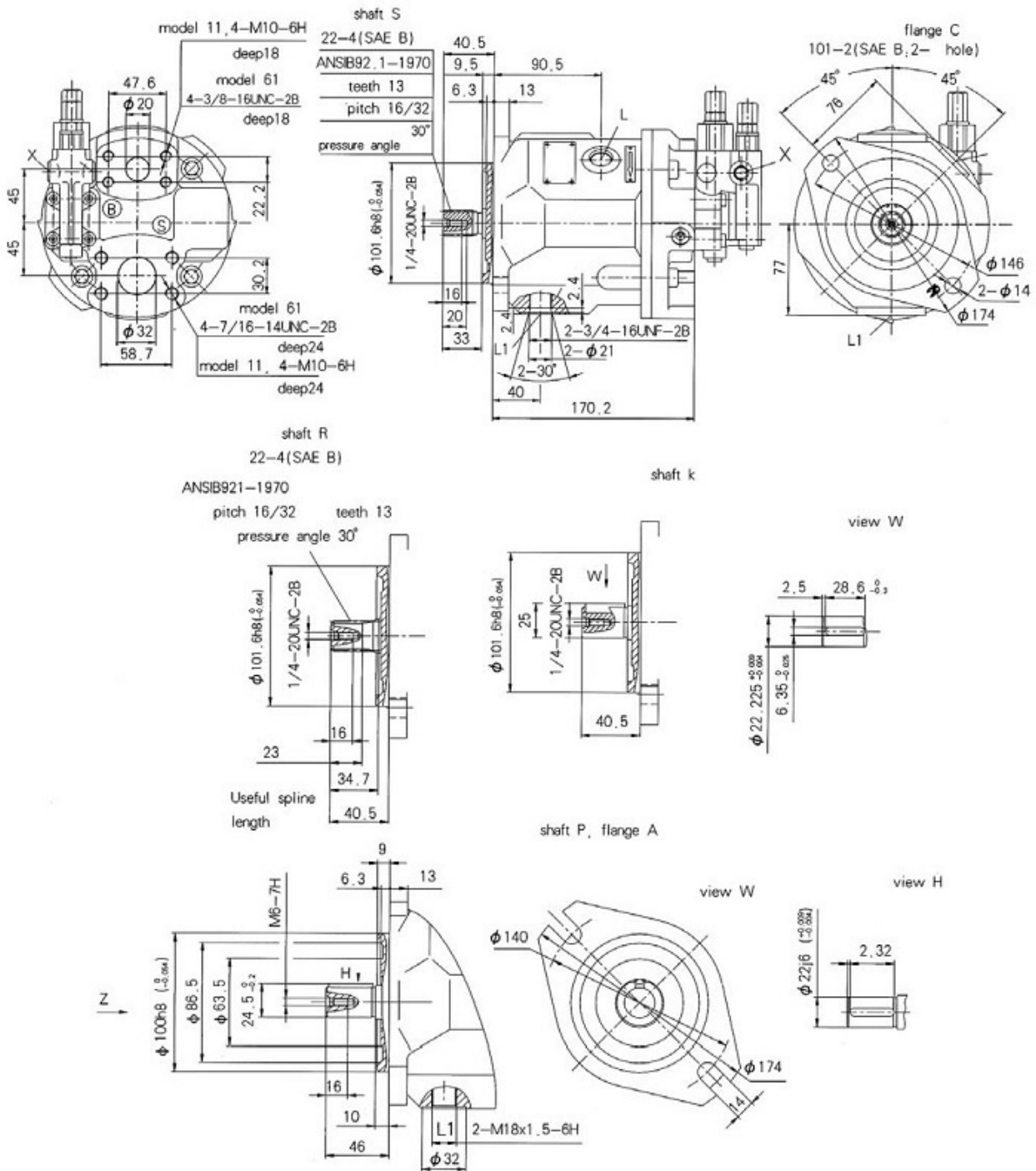
Size 18 to 100



Size	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	X
18	*	*	*	*	*	*	40	121	130	36	121	40	109	126	7/16-20UNF-2B
28	102	88	57	109	48	228	40	121	143	36	121	40	116	135	7/16-20UNF-2B
45	109	90	57	111	54	248	40	121	153	36	118	40	122	140	7/16-20UNF-2B
71	120	103	57	124	70	281	40	121	180	36	119	40	145	163	7/16-20UNF-2B
100	126	112	57	133	112	345	40	121	249	36	119	40	146	164	7/16-20UNF-2B
140	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

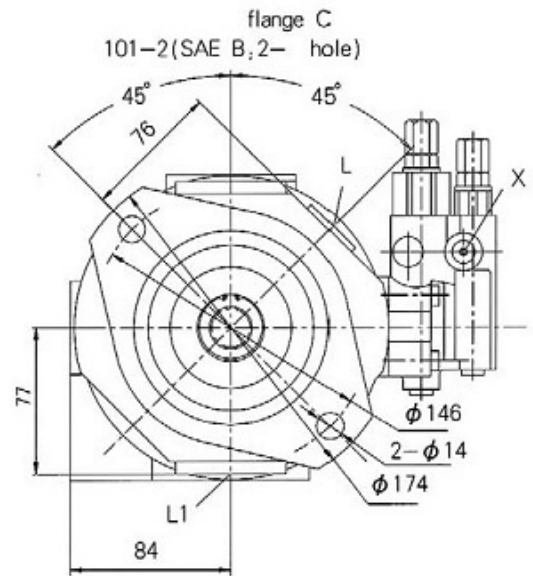
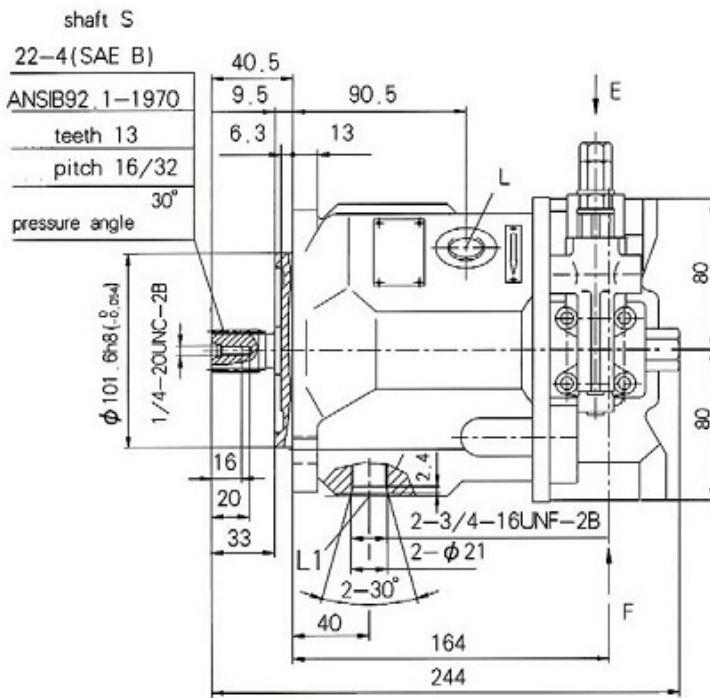
**Mounting Dimension, Sizes 28**

**Service ports at rear: no through drive**  
**Models 61N00 and 11N00**

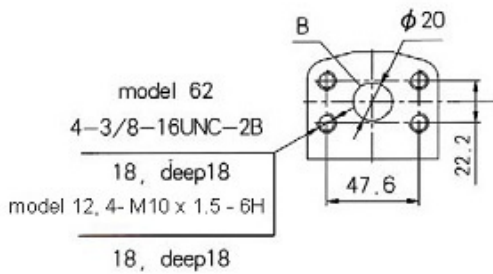


**Mounting Dimension, Sizes 28**

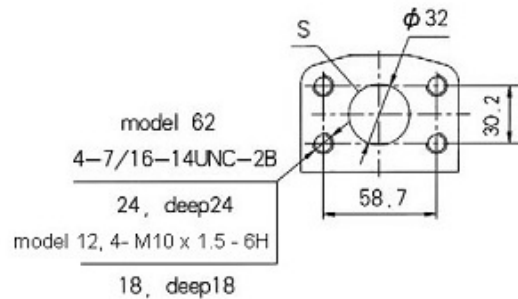
**Service ports on side;  
no through drive, Models 62N00 and 12N00**



view E rotation

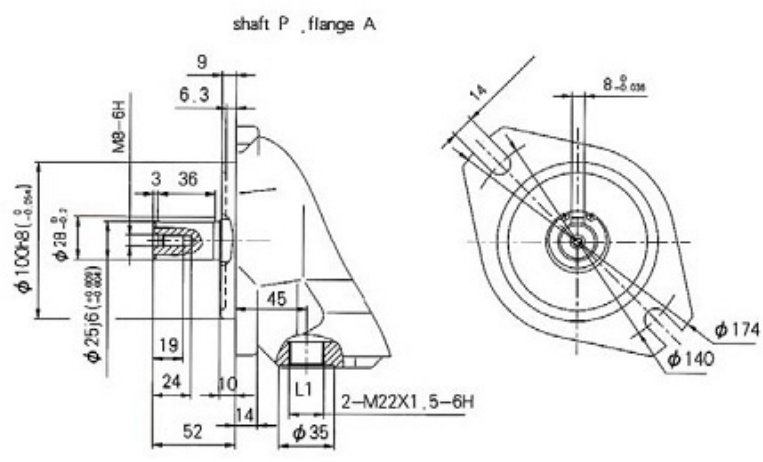
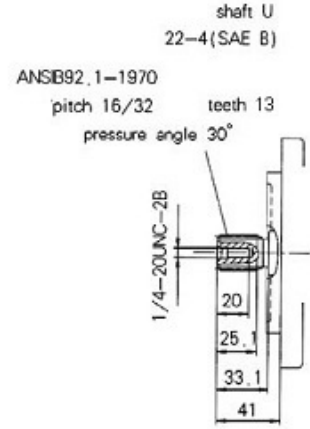
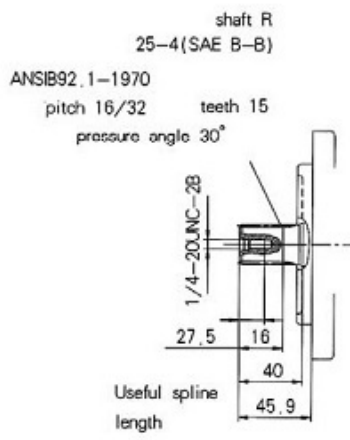
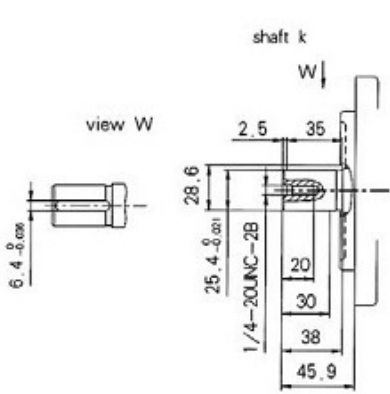
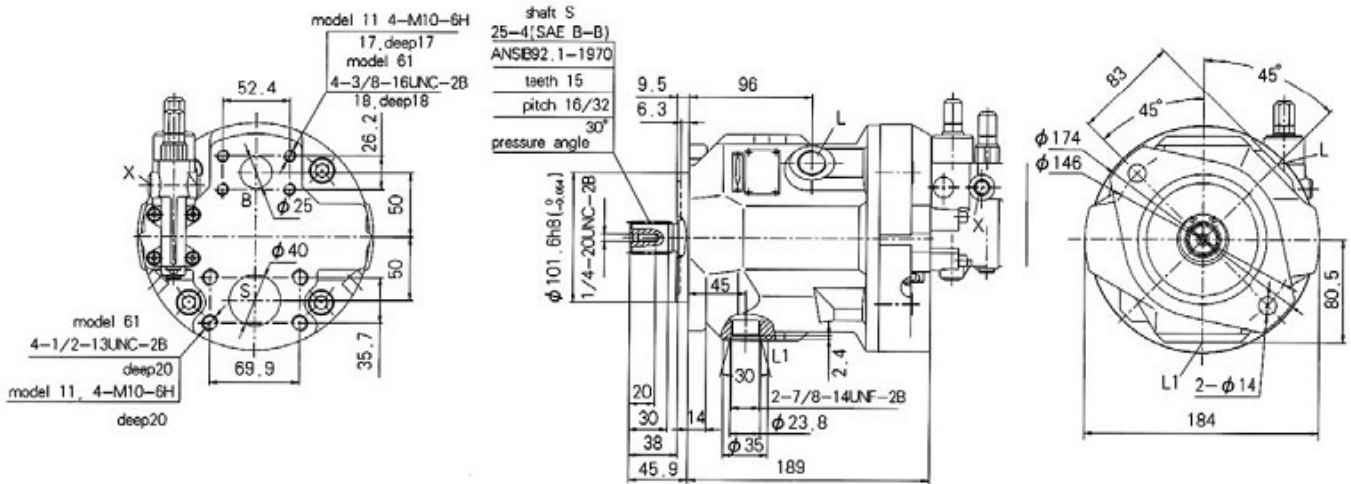


view F rotation



**Mounting Dimension, Sizes 45**

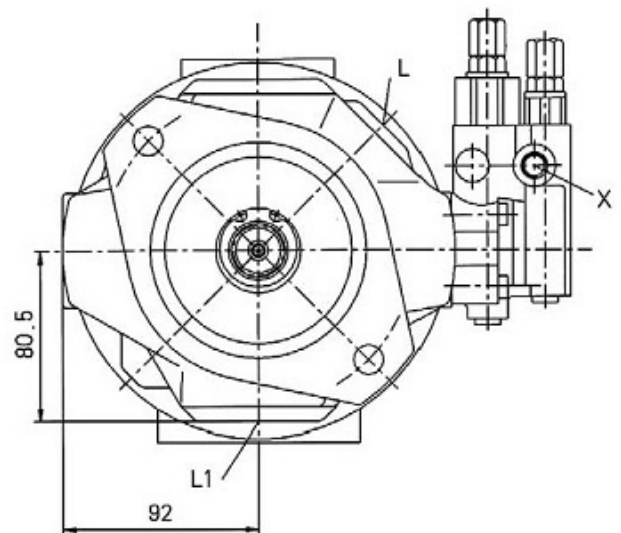
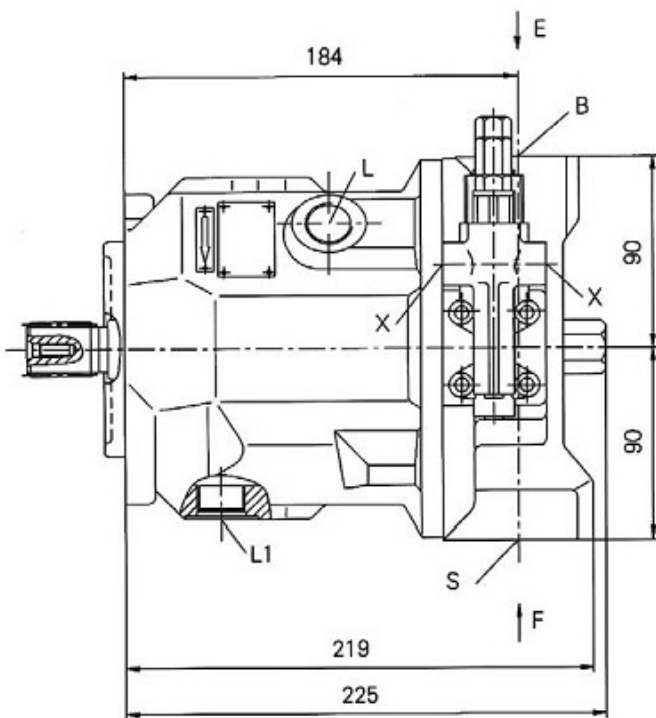
**Service ports at rear;  
no through drive, Models 61N00 and 11N00**



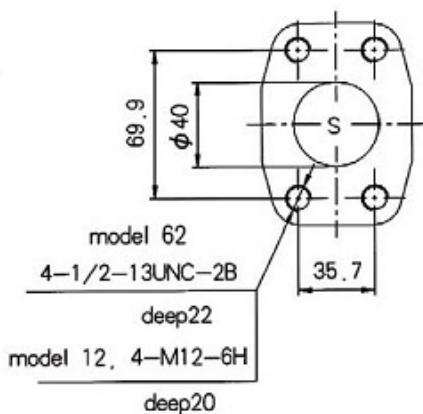
**Mounting Dimension, Sizes 45**

**Service ports on side;  
no through drive, Models 62N00 and 12N00**

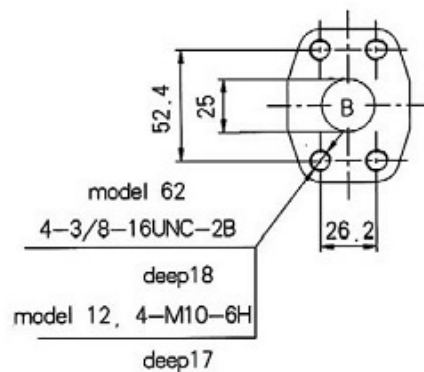
Without considering adjustments



view F rotation

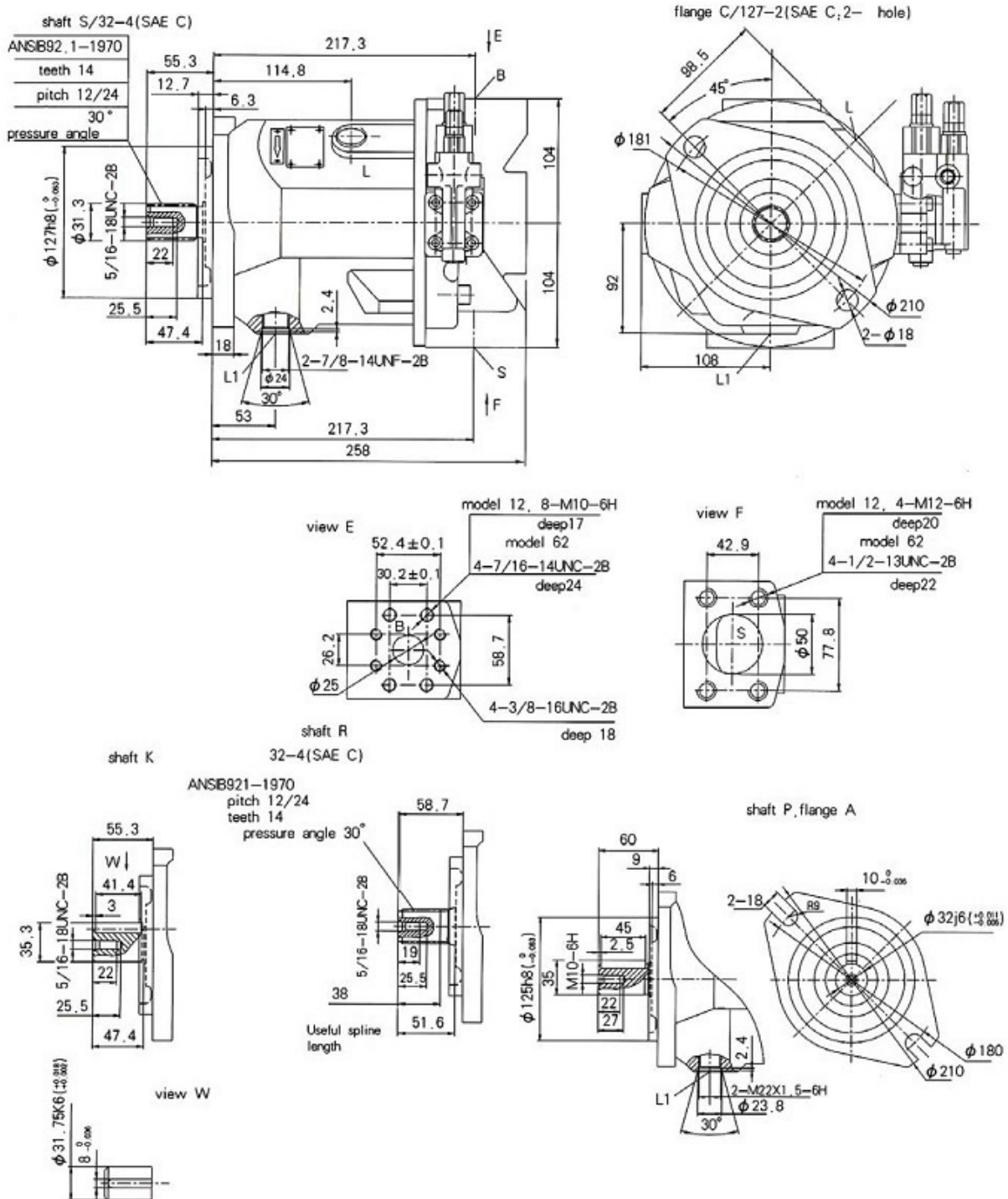


view E rotation



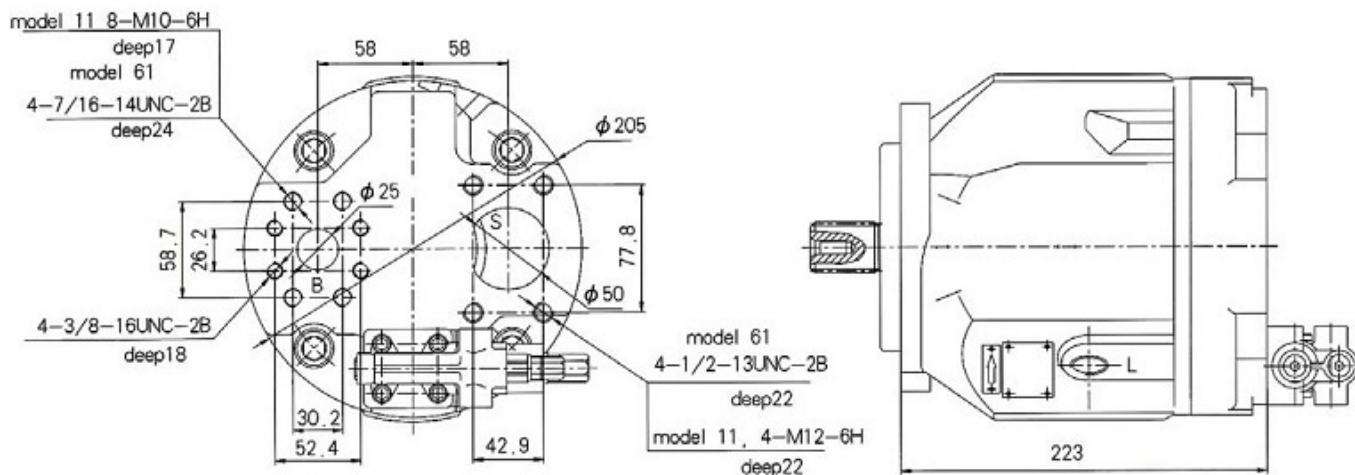
**Mounting Dimension, Sizes 71**

**Service ports on sides:  
no through drive, Models 62N00 and 12N00**



**Mounting Dimension, Sizes 71**

**Service ports at rear;  
no through drive, Models 61N00 and 11N00**

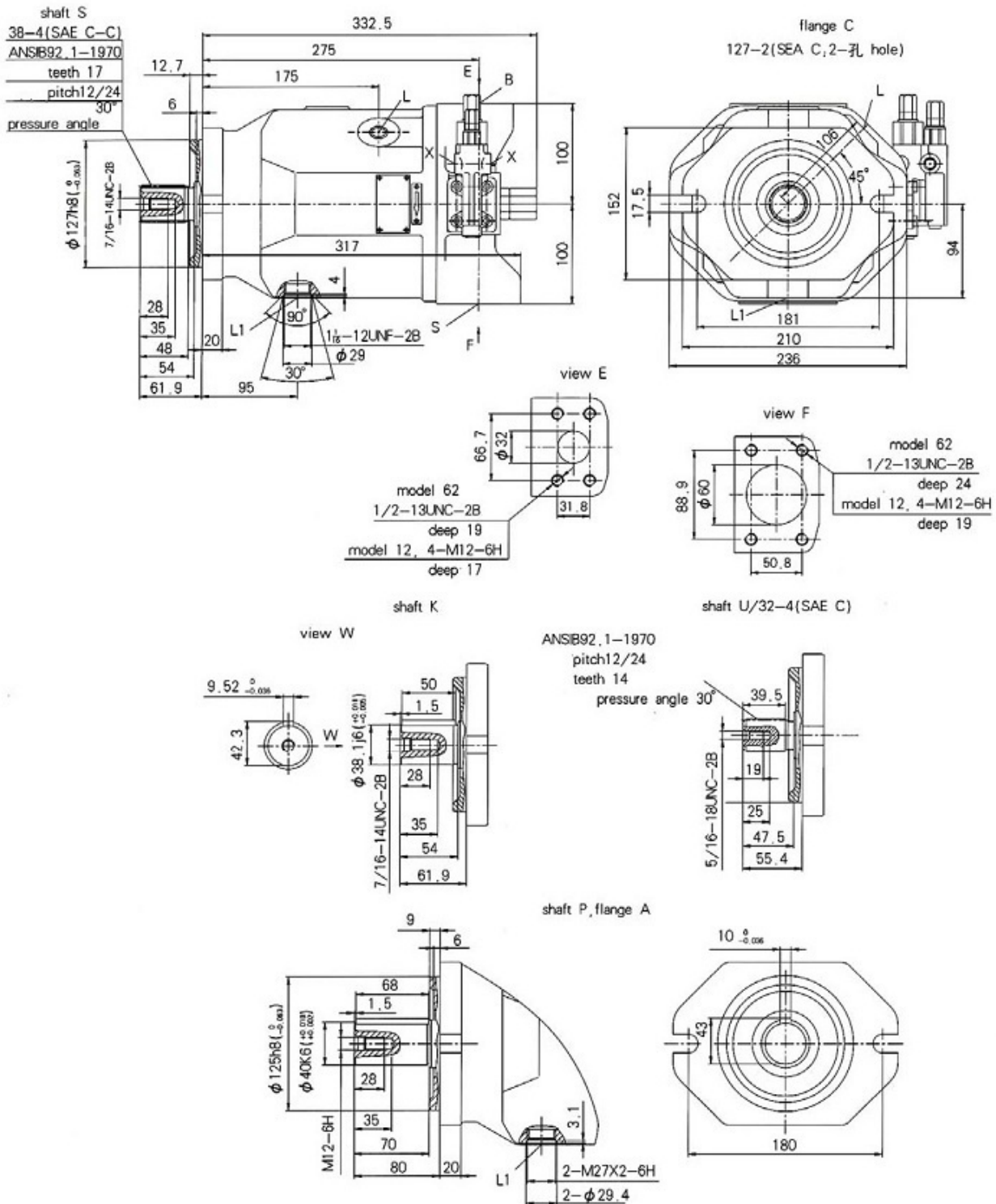


MA10 Piston pump with MV10 Vane pump fitted



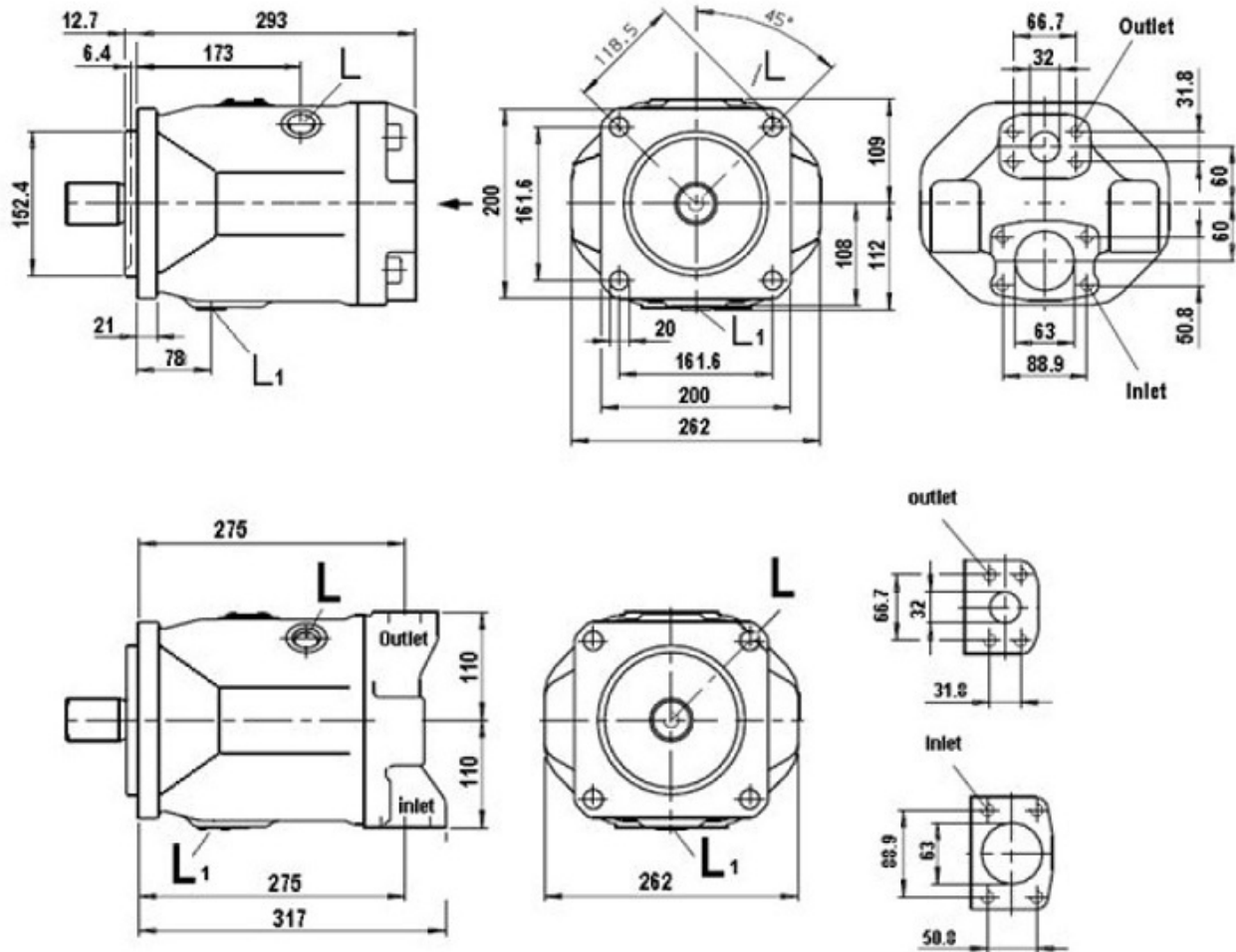
**Mounting Dimension, Sizes 100**

**Service ports on sides;  
no through drive, Models 62N00 and 12N00**



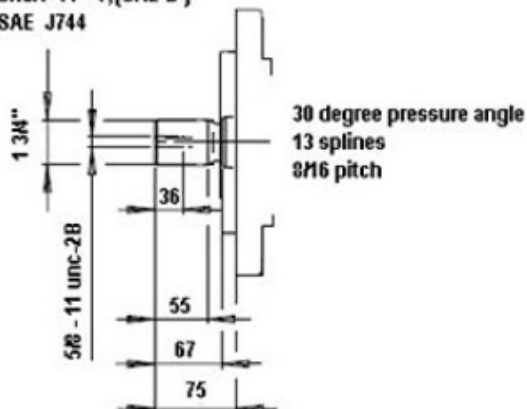
### Mounting Dimension, Sizes 140

Service ports on sides; Models 62N00 and 12N00  
 Service ports on rear; Models 61N00 and 11N00

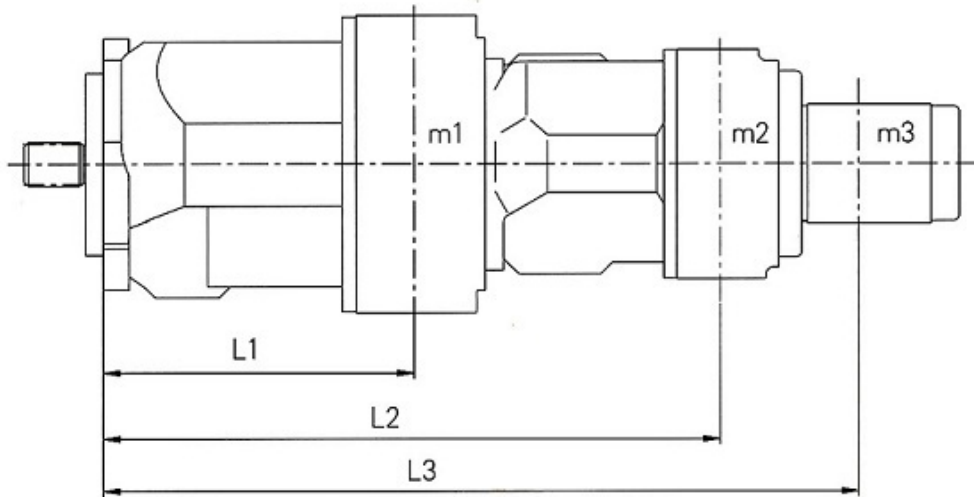


**Shaft S**

Shaft 44 - 4; (SAE D)  
 SAE J744



## Permissible Bending



$m_1, m_2, m_3$  Weight of pump lbs (kg)  
 $l_1, l_2, l_3$  Distance to center of gravity in (mm)  
 $T_m = (m_1 \cdot l_1 + m_2 \cdot l_2 + m_3 \cdot l_3) \cdot \frac{1}{12}$  lb-ft  
 $T_m = (m_1 \cdot l_1 + m_2 \cdot l_2 + m_3 \cdot l_3) \cdot \frac{1}{102}$  (Nm)

Size			28	45	71	100	140
Permissible bending moment	$T_m$	lb-ft	65	101	159	221	332
		Nm	88	137	216	300	450
Weight	$m_1$	lbs	33	46	73	99	132
		kg	15	21	33	45	60
Distance to center of gravity	$l_1$	in	4.33	5.11	5.91	6.30	6.30
		mm	110	130	150	160	160

### Through Drive

Axial piston unit MA10VO can be supplied with a through drive, as shown in the ordering code on page 7 & 8.

The type of through drive is determined by codes (K01-K17). If the combination pump is not mounted in the factory, the simple type code is sufficient.

Included with the pump are: Coupling sleeve, seals and necessary hardware.

### Combination pumps

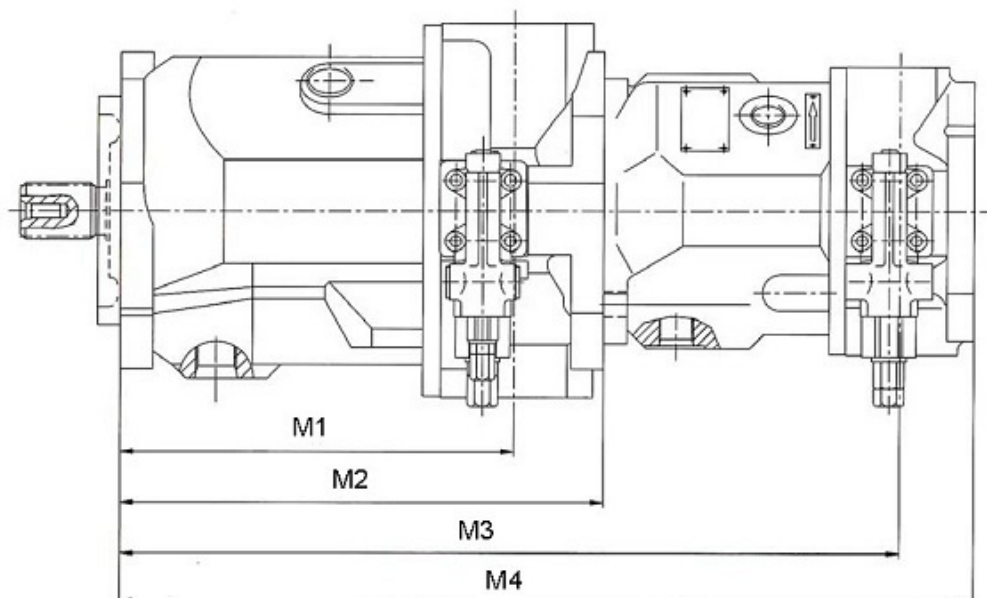
By mounting combination pumps circuits independent of each other are available for use.

1. If the combination pump consists of 2 MA10VO pumps and if these are to be delivered ready assembled, then the two type codes are to be combined with a "+".

Ordering example: MA10VO71DR/31R-PSC62K02 + MA10VO28DR/31R-PSC62N00

2. If a gear pump, vane or other type pump is to be mounted in the factory as a second or third pump, please consult the factory for available mounting information.

**Unit Dimensions of Combination Pumps**



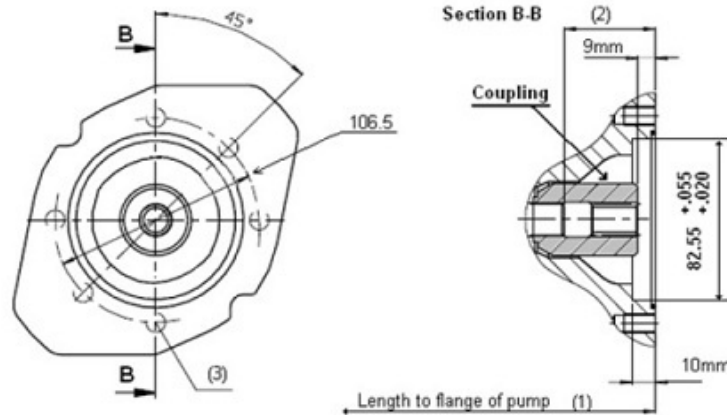
Pump 1		MA10VO28				MA10VO45				MA10VO71				MA10VO100				MA10VO140			
		M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4	M1	M2	M3	M4
Pump 2																					
MA10VO18	in.	6.5	8.03	13.74	15.71	7.24	9.02	14.72	16.69	8.54	10.51	16.21	18.19	10.83	13.31	19.02	20.98	10.83	13.78	19.49	21.46
	mm	165	204	349	399	184	229	373	424	217	267	412	462	275	338	483	533	275	350	495	545
MA10VO28	in.	6.5	8.03	14.53	15.67	7.24	9.02	15.51	16.65	8.54	10.51	17.01	18.15	10.83	13.31	19.8	20.94	10.83	13.78	20.28	21.42
	mm	165	204	369	398	184	229	394	423	217	267	432	461	275	338	503	532	275	350	515	544
MA10VO45	in.					7.24	9.02	16.3	17.64	8.54	10.51	17.76	19.36	10.83	13.31	20.55	21.93	10.83	13.78	21.02	22.4
	mm					184	229	413	448	217	267	451	486	275	338	522	557	275	350	534	569
MA10VO71	in.									8.54	10.51	19.06	20.63	10.83	13.31	21.85	23.43	10.83	13.78	22.32	23.9
	mm									217	267	484	524	275	338	555	585	275	350	567	607
MA10VO100	in.													10.83	14.02	24.84	26.5	10.83	14.49	24.31	29.97
	mm													275	356	631	673	275	368	643	685
MA10VO140	in.																	10.83	14.49	25.31	29.97
	mm																	275	368	643	685

### Dimensions of Through Drive Covers:

#### Mounting Flange for SAE A 2-holes 3.250 (82.55) pilot

Ordering code with 5/8" 9T spline coupling K01

Ordering code with 3/4" 11T spline coupling K52



SIZE	(1)	(2)	(3)
28	204mm	47mm	M10-16mm deep
45	229mm	53mm	M10-16mm deep
71	267mm	60mm	M10-20mm deep
100	338mm	65mm	M10-20mm deep
140	350mm	77mm	M10-20mm deep

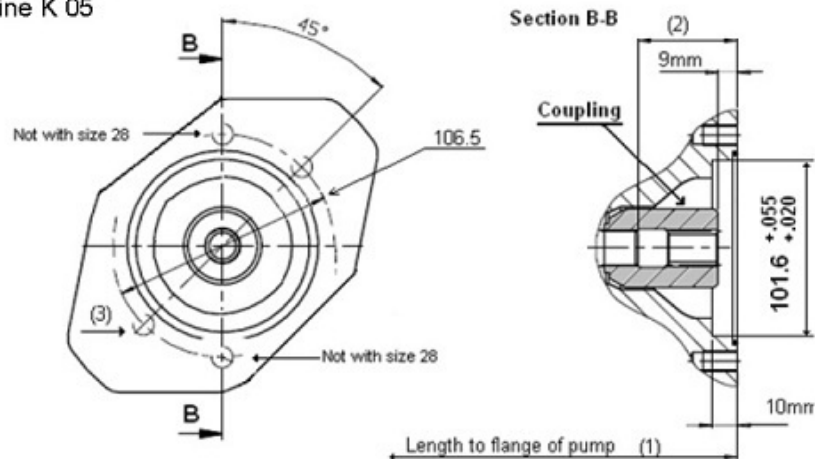
#### Mounting Flange for SAE B 2-hole 4" (101.6) pilot

Ordering code with 7/8" 13T spline coupling K 02 & K 68

Ordering code with 1" 15T spline coupling K 04

Ordering code 7/8" keyed coupling K 03

Ordering code 1" keyed coupline K 05

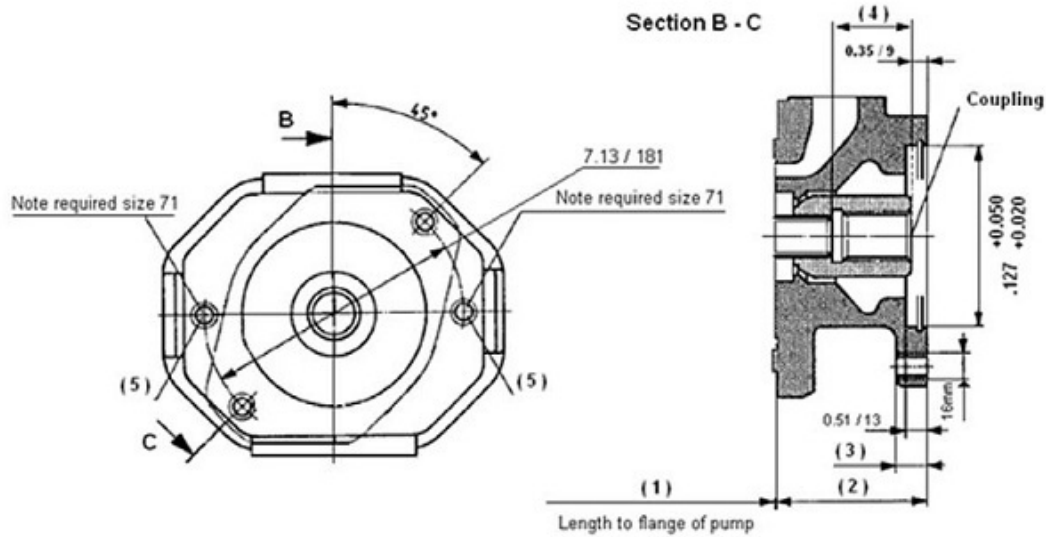


SIZE	(1)	(2)	(3)
28	204mm	47mm	M12-15mm deep
45	229mm	53mm	M12-18mm deep
71	267mm	60mm	M12-20mm deep
100	338mm	65mm	M12-20mm deep
140	350mm	77mm	M12-20mm deep

**Mounting flange for SAE 2 hole 5" (127) pilot**

Ordering code with 1 1/4" 14T spline coupling K07

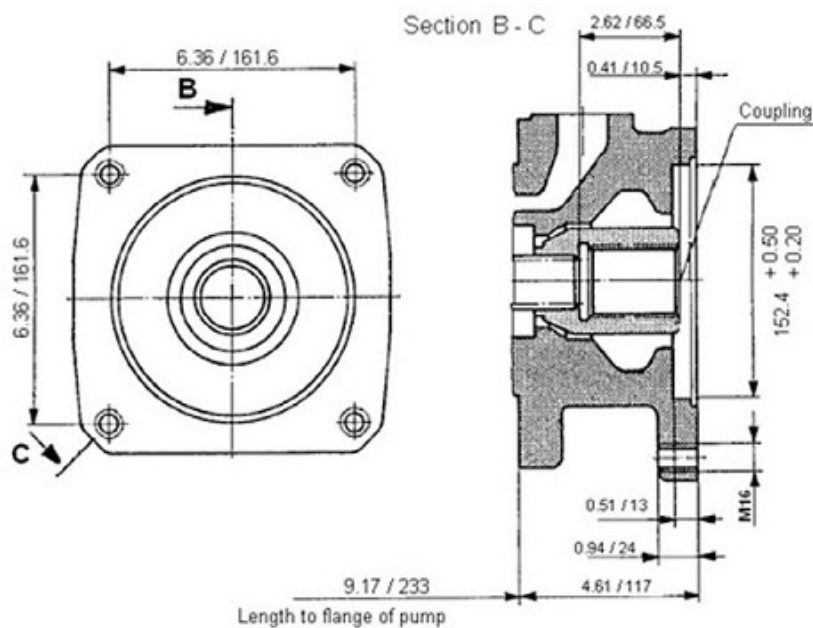
Ordering code with 1 1/4" Keyed coupling K08

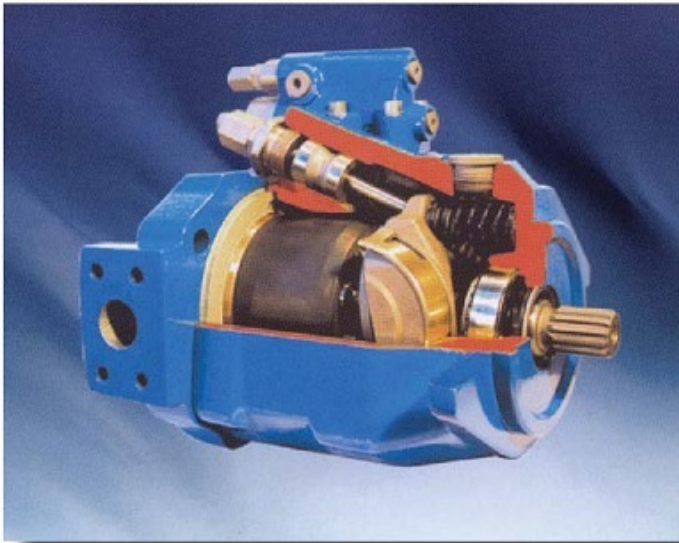


SIZE	(1)	(2)	(3)	(4)	(5)
71	177mm	90mm	18mm	52mm	M16-18mm deep
100	233mm	105mm	20mm	57mm	M16-25mm deep
144	233mm	117mm	24mm	68mm	M16-25mm deep

**Mounting flange for SAE D 4 hole MA10V140**

Ordering code K17

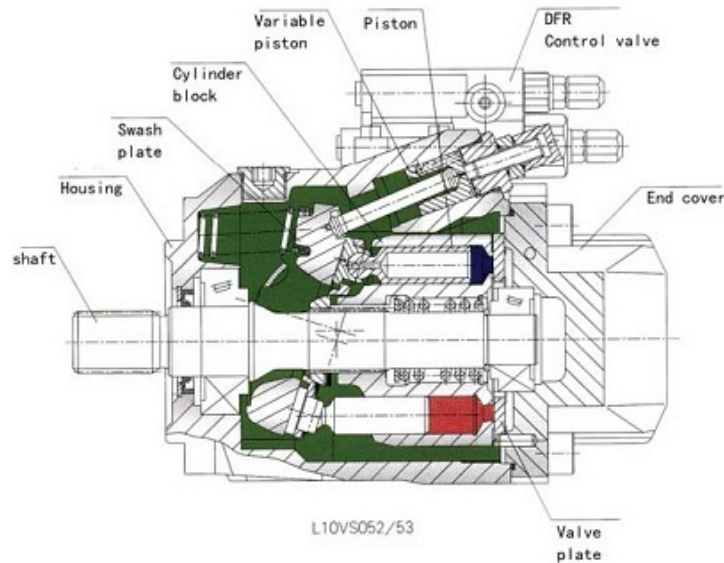




## Features

Axial piston pump MA10VO in swashplate design is used in open loop circuits. Flow is proportional to drive speed and displacement. By adjusting the position of the swashplate it is possible to smoothly vary the output flow of the pump.

- Port connections to SAE or metric
- 2 case drain ports
- Operating pressure 3625 psi (250 bar)
- Good suction characteristics
- Low noise level
- High power/weight ratio Long service life
- Short control times
- Axial and radial loading of drive shaft possible
- Wide range of controls
- Through drive available
- SAE & ISO mounting flanges available



## Technical Data

### 1. Input Operating Pressure Range

Absolute pressure at port S (A)  
 Pabs min ..... 11.6 PSI or (0.8 Bar)  
 Pabs max ..... 435 PSI or (30 Bar)

### 2. Output Operating Pressure Range

Pressure at port B  
 Nominal pressure ..... P<sub>N</sub> 3625 PSI or (250 Bar)  
 Peak pressure ..... P<sub>max</sub> 4500 PSI or (315 Bar)

### 3. Case Drain Pressure

The maximum pump case drain pressure measured at ports L, L1 is 7 PSI (0.5 Bar) higher than the input pressure at ports S, but not exceeding more than 30 PSI (2 Bar) absolute.

### 4. Direction of Flow

("S" inlet port to "B" pressure port)

### 5. Table of values (theoretical values, without considering $\eta_{mh}$ and $\eta_v$ ; values rounded)

Size				45	60
Displacement		V <sub>gmax</sub>	cm <sup>3</sup>	45	60
Max. Speed	at V <sub>gmax</sub>	n <sub>omax</sub>	mp	2600	2700
Max. flow	at n <sub>omax</sub>	Q <sub>omax</sub>	L/min	117	162
Max. power	at n <sub>omax</sub>	P <sub>omax</sub>	kW	49	68
Max. torque	at V <sub>gmax</sub>	T <sub>max</sub>	Nm	179	238
Weight (without fluid)		m	kg	18	22

Notes: Values shown are valid for an absolute pressure of 1 bar at suction port. If the flow is reduced or if the inlet pressure is increased the speed may be increased.

### Hydraulic Formula

#### 1. Determination of Size

Imperial  
 Flow  $Q = \frac{V_g \cdot n \cdot \eta_v}{231} \text{ gpm}$

Metric  
 $\frac{V_g \cdot n \cdot \eta_v}{1000} \text{ L/min}$

V<sub>g</sub> = geometric displacement cu.in. or [cm<sup>3</sup>] per rev.

Δp = differential pressure PSI or (Bar)

n = speed [rpm]

η<sub>v</sub> = volumetric efficiency

η<sub>mh</sub> = mechanical-hydraulic efficiency

η<sub>t</sub> = total efficiency (η<sub>t</sub> = η<sub>v</sub> • η<sub>mh</sub>)

Q = Flow (gpm) or (L/min.)

Torque  $T = \frac{V_g \cdot \Delta p}{24 \cdot \pi \cdot \eta_{mh}} \text{ lb-ft}$

$\frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}} \text{ Nm}$

Power  $P = \frac{Q \cdot \Delta p}{1714 \cdot \eta_t} \text{ HP}$

$\frac{Q \cdot \Delta p}{600 \cdot \eta_t} \text{ kW}$



## Ordering Code

		MA10VS	0	45	DFR	52	R	P	S
<b>Axial piston unit</b>									
Swash plate variable pump	MA10VS								
<b>Modes of operation</b>									
Pump, open circuit			●						
<b>Size</b>									
Displacement Vgmax (cm <sup>3</sup> )			45	60					
<b>Control devices</b>									
Pressure control			●	●	DR				
G - Remote control					DRG				
Pressure and flow control, X channel plugged			●	●	DFR DFR1				
<b>Series</b>									
Series Consult the factory for other series 50/53						52			
<b>Direction of rotation</b>									
Viewed on drive shaft	clockwise						R		
	counter-clockwise						L		
<b>Seals</b>									
Buna-N (NBR per DIN ISO 1629) ;								P	
FPM (fluorocarbon)								V	
<b>Shaft end</b>							45	60	
SAE-splined shaft			●	●					S
SAE-splined shaft, smaller size (not for pumps with thru drive)			●	●					U
SAE-splined shaft, reinforced U-type shaft			-	-					W
SAE-keyed shaft			●	●					K
parallel with key DIN 6885			●	●					P

**Ordering Code**

C	62	N00					
				45	60		
			Without through drive	●	●		
					N00		
			Thru-drive pump with side ports only				
			82-2 SAE A 16-4 SAE A	●	●		
					K01		
			101-2 SAE B 22-4 SAE B	●	●		
					K02 & K04		
			<b>Service ports</b>				
			<b>(Pressure port B and Suction port S)</b>		45	60	
			(Rear ports, UNC Mounting screws)	●	●		
					61		
			(Opposite side ports, UNC mounting screws)	●	●		
					62		
			(Rear ports, metric mounting screws)	●	●		
					11		
			(Opposite side ports, metric mounting screws)	-	-		
					12		
			(SAE-threaded rear)	●	-		
					64		
			<b>Mounting flange</b>				
						45	60
						SAE 2 Bolt hole	●
					C		
			SAE 4 Bolt hole	-	●		
					D		

● = available

## Fluid

### 1. Hydraulic Fluid

The MA10V open loop pump in the standard design should be used with a good quality, petroleum based anti-wear hydraulic fluid.

### 2. Operating Viscosity Range

In order to obtain optimum efficiency we recommend that the operating viscosity be selected from within the range.

At operating temperature

Optimum viscosity (vopt)  $\approx$  80...170 SUS (16 / 36 mm<sup>2</sup>/s)

### Limits of viscosity range

The following values are valid for extreme operating conditions:

vmin = 60 SUS (10 mm<sup>2</sup>/s)

for short periods at max. leakage oil temperature of 93° C

vmax = 4600SUS (1000 mm<sup>2</sup>/s)

1400 SUS (300 mm<sup>2</sup>/s) on short term cold start

### 3. Temperature Range

tmin = -15°C; tmax = +80°C.; tmin

### 4. Filtration

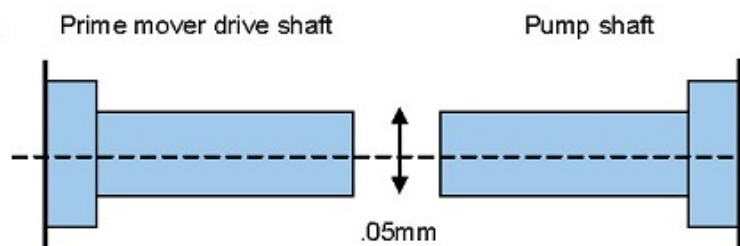
In order to ensure reliable operation of the axial piston unit, the operating fluid must be maintained to a cleanliness class of 18/14 to ISO4406 or NAS 1638 class 9. As a guide the fluid cleanliness level may be achieved using a 10 micron filter.

### Installation Information

The pump housing must be filled with clean hydraulic fluid prior to pump start up and remain full.

The concentricity between the prime mover drive shaft and the pump shaft 0.05mm.

## Installation Information



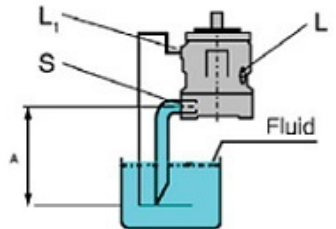
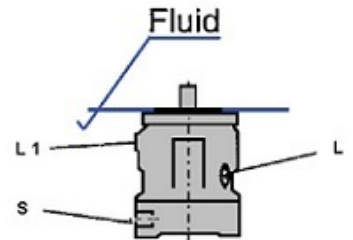
## Installation Information - cont'd.

The installation position of the pump is optional.

The pump housing must be filled with fluid both when commissioning and in operation. In order to achieve low noise levels, all connecting lines (inlet, case drain) should be isolated from the tank by flexible lines.

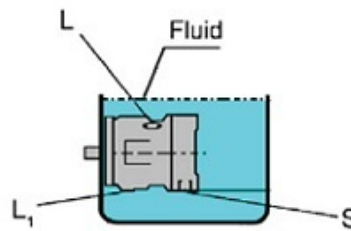
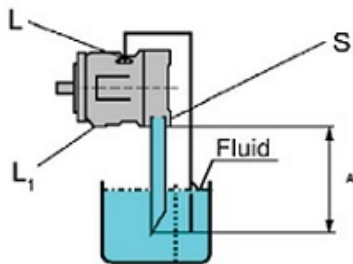
### 1. Vertical installation the following conditions should be noted:

- Before installing the pump inside a tank fill the pump case with fluid
- Make sure the ports are below the oil level (L), (L1) & S
- Avoid mounting above the tank whenever possible in order to maintain a low noise level
- The permissible inlet height is a result of the overall pressure loss "A" may not be greater than 32 inches (800 mm)



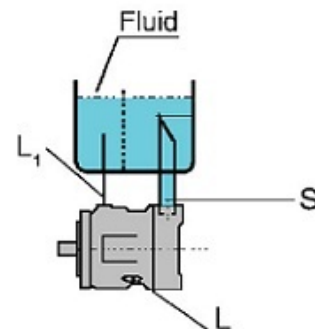
### 2. Horizontal Installation

- The pumps must be install so (L) or (L1) the case drain is at the top of the pump
- If the minimum fluid level is below the ports of the pump, pipe the ports L or L1 & S below the minimum oil level.
- Avoid mounting above the tank whenever possible in order to maintain a low noise level.
- The permissible inlet height (h) is a result of the overall pressure loss, "A" may not be greater then 32 inches (800 mm).



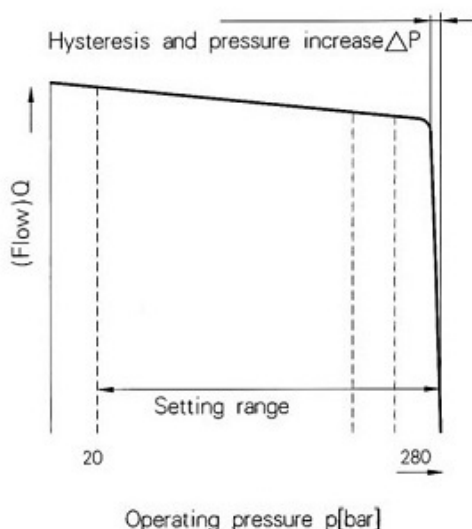
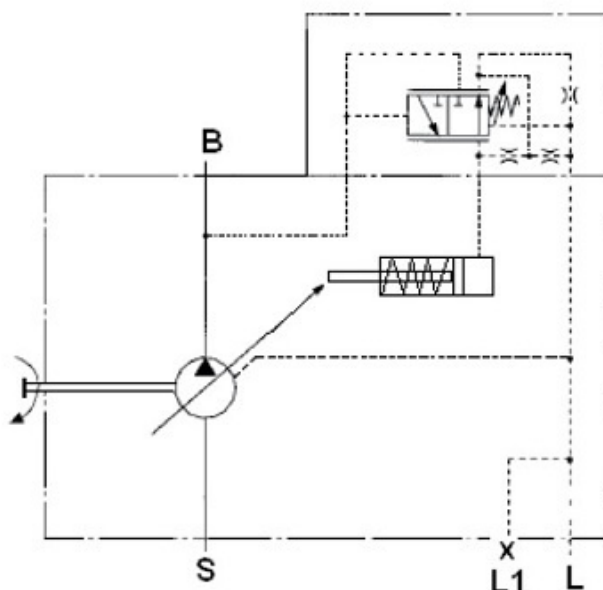
### Below the tank position

- Pipe "L", "L1" and "S" must be mounted below the oil level



## DR Pressure Control

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



## Ports

<b>B</b>	Pressure Port
<b>S</b>	Suction port
<b>L, L1</b>	Case drain ports (L1 sealed)

## Control Data

Hysteresis and repetitive accuracy  $\Delta p$  ..... Max. 3 bar

### Max. Pressure Increase

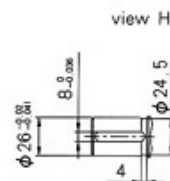
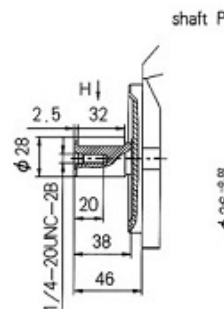
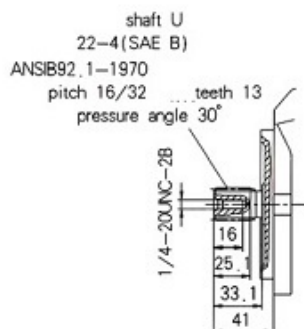
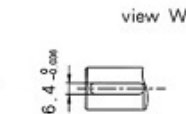
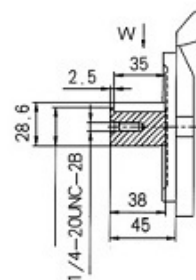
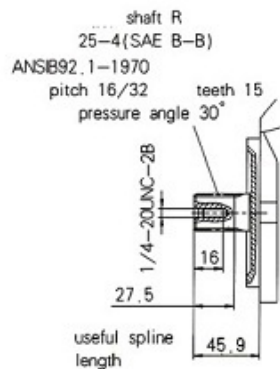
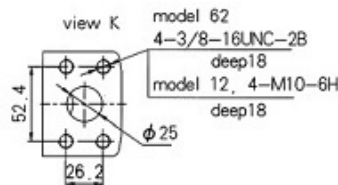
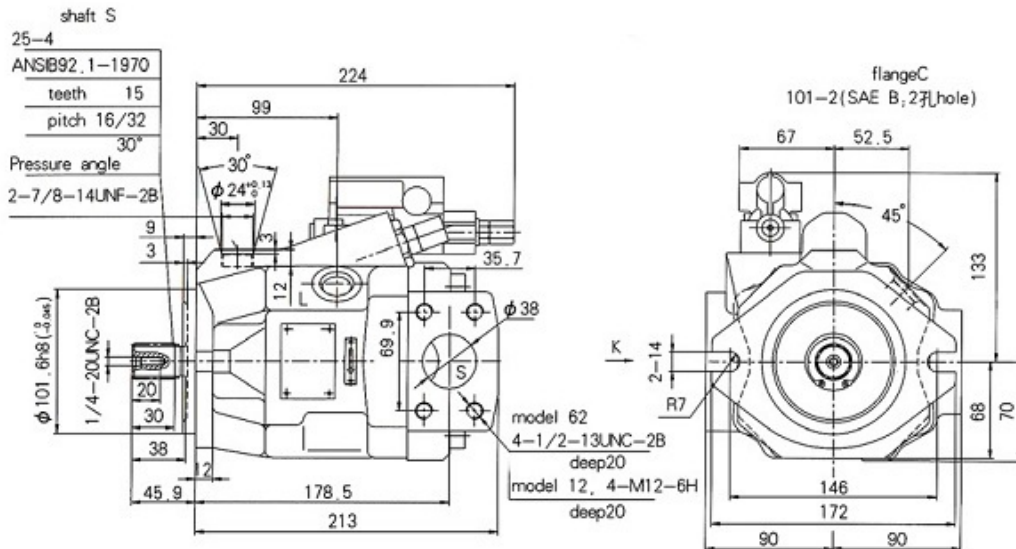
Size		45	60
$\Delta P$	BAR	6	8

Pilot oil consumption .....max. approx. 3 L/min

For other controls DRG and DFR see page 13 & 14

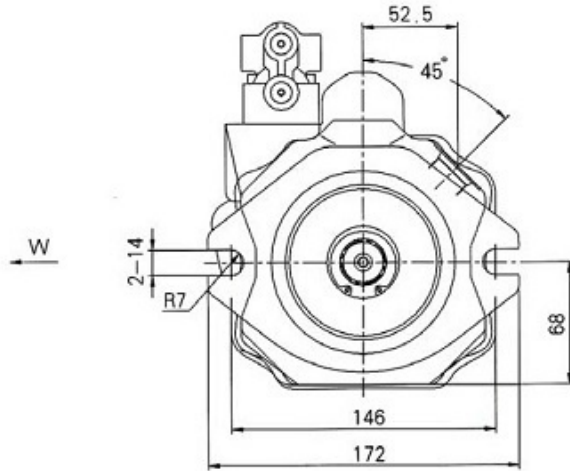
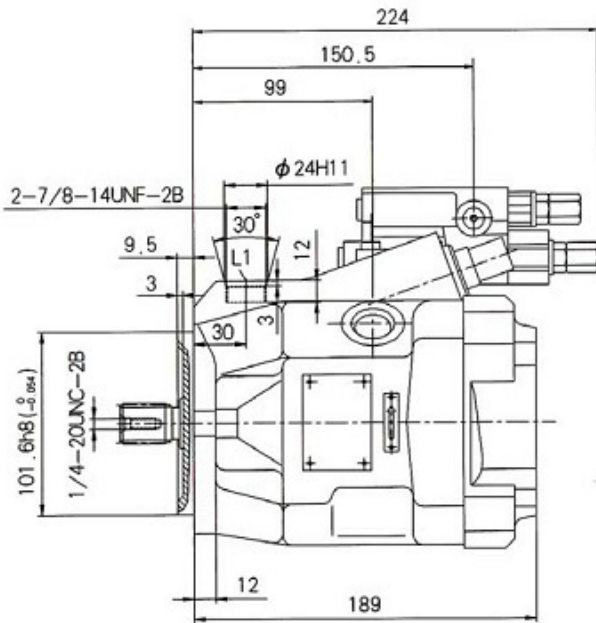
**Mounting Dimension, Sizes 45**

**Pressure control DR  
Version MA10VSO45DR/52R-XXC62/12NOO**

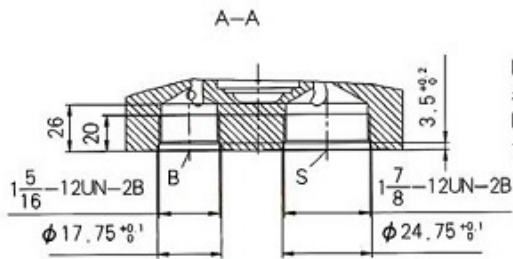


**Mounting Dimension, Sizes 45**

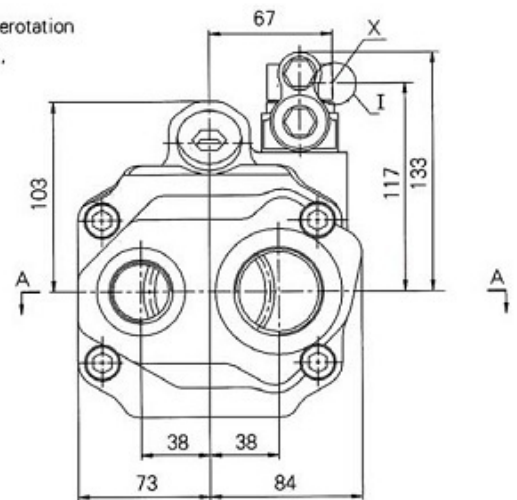
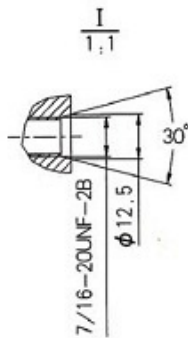
**DFR**  
**Version MA10VS045 DFR1/52L-XXC64N00**  
**DRG**



W向; view W

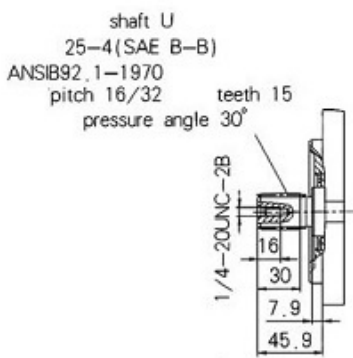
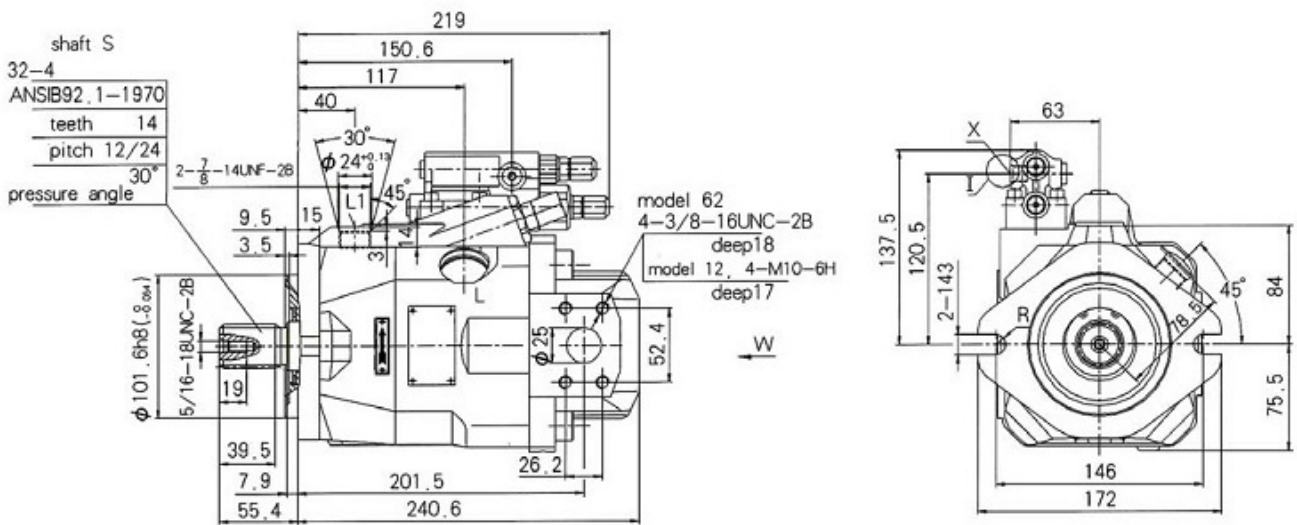


Port plate 64 shown is anticlockwise rotation  
 For clockwise rotation, turn port plate 180°

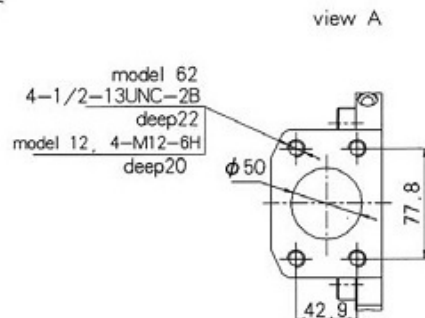
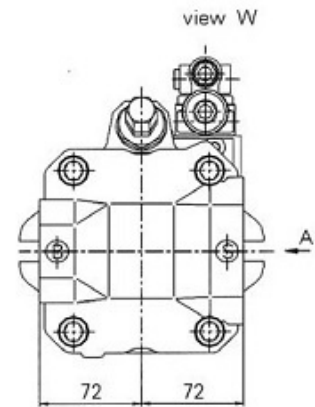
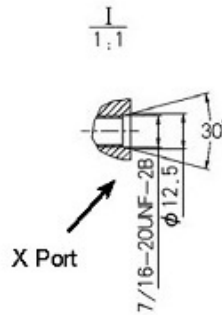


**Mounting Dimension, Sizes 60**

**DFR**  
**Version MA10VS060 DFR1/52L-XXC62/12N00**  
**DRG**



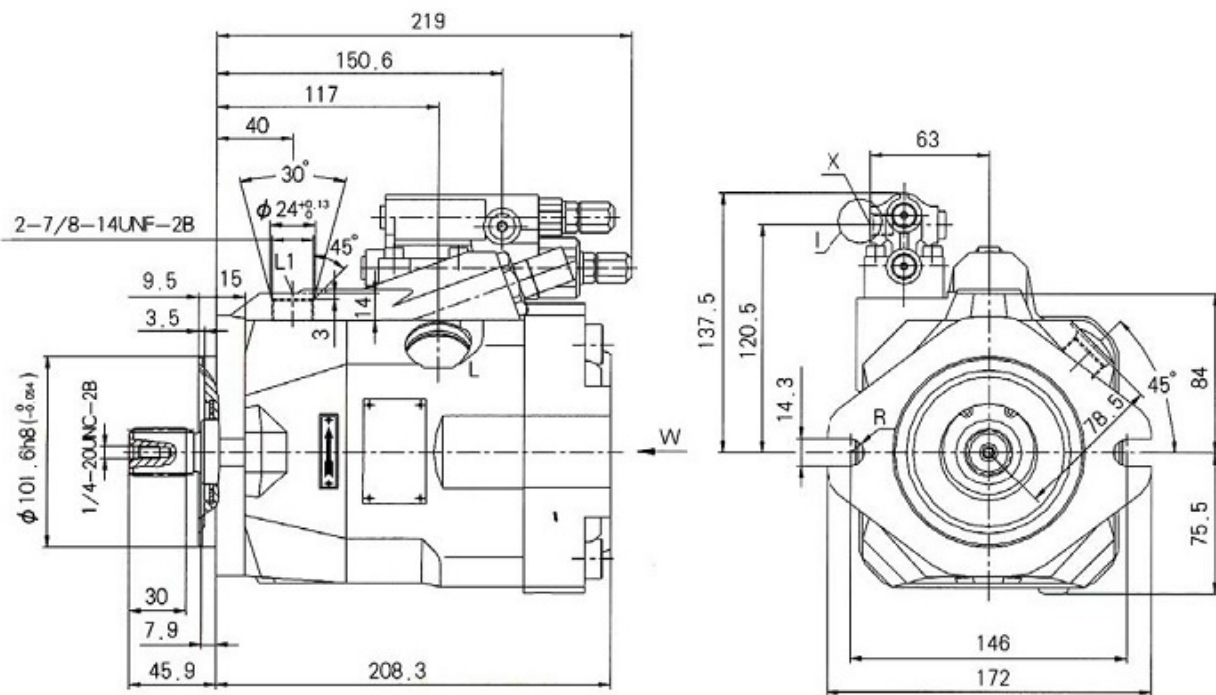
Port plate 62/12  
 shown is anticlockwise rotation  
 For clockwise rotation,  
 turn port plate 180°





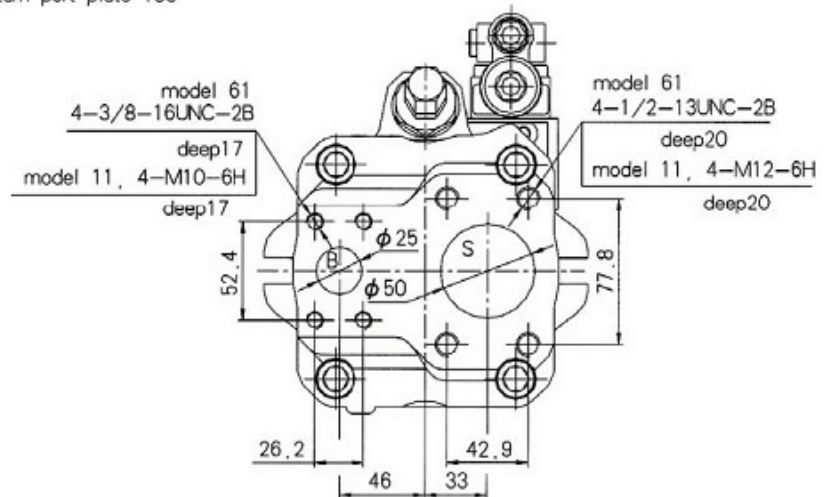
**Mounting Dimension, Sizes 60**

**DFR**  
**Version MA10VS060 DFR1/52L-XXC61/11N00**  
**DRG**



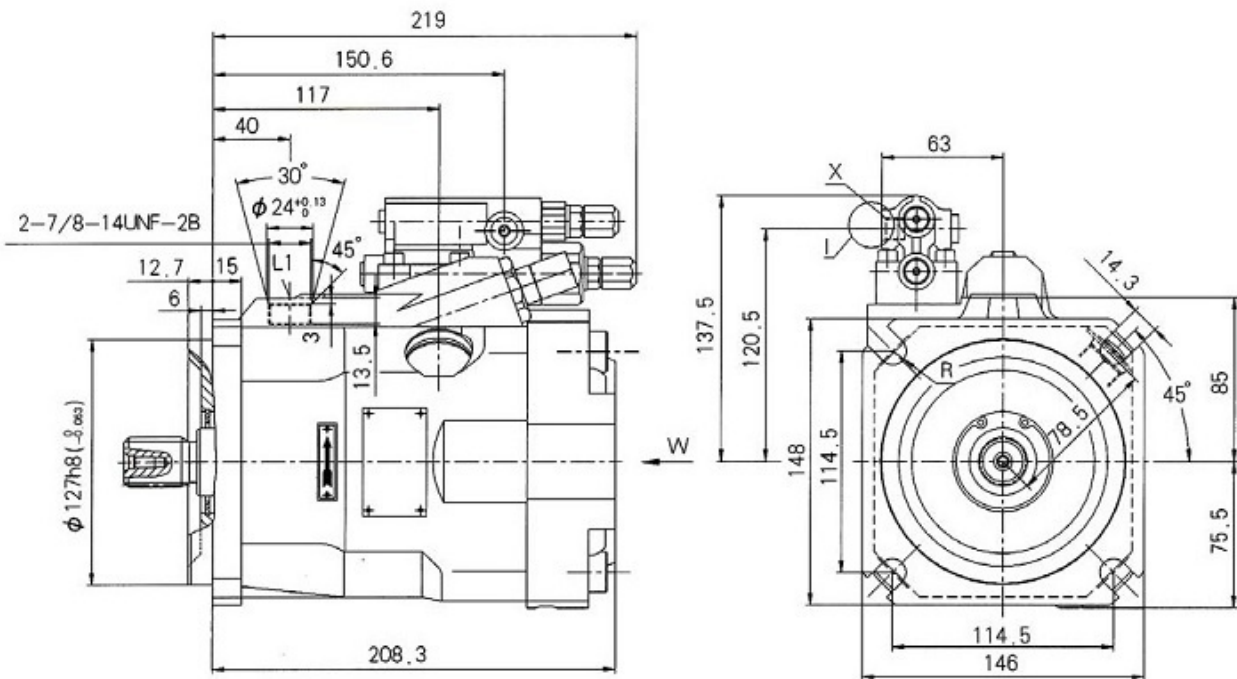
Port plate 61/11  
 shown is anticlockwise rotation  
 For clockwise rotation,  
 turn port plate 180°

view W



**Mounting Dimension, Sizes 60**

**DFR**  
**Version MA10VS060 DFR1/52L-XXC61/11N00**  
**DRG**



Port plate 61/11  
 shown is anticlockwise rotation  
 For clockwise rotation,  
 turn port plate 180°

