HA10VSO Series
Variable Displacement Pump

Product show and brief introduction

Open Circuit

Size 28...140
Series 31
Nominal Perssure 28 MPa
Peak pressure 35 MPa

Features

— Variable displacement axial piston pump of swashplate design for hydraulic open circuit systems
— Flow is proportional to drive speed and displacement.It can be infinitely varied by adjustment of the swashplate
— ISO mounting flange
— Flange connections to SAE metric
— 2 case drain ports
— Good suction characteristics
— Permissible continous pressure 28 MPa
— Low noise level
— Long service life
— Axial and radial loading of drive shaft possible
— High power-weight ratio
— Wide range of controls
— Short response times
— Through drive option for mulit-circuit system

Model Code

HA10VS	O	71	DR	/31	R	-P	P	A	12	N00
Axial piston unit	Type of operation	Size (mL/r)	Control device	Series	Direction of rotation	Seals	Shaft end	Mounting flange	Service line connections	Through drives
HA10VS: Variable swashp-late design,for industrial applica-tions Nominal pressure 28MPa, peak pressure 35MPa	O: Pump in open circuits	28 45 71 100 140	DR: Pressure control DRG: Pressure control, remotely controlled DFR: Pressure /flow control DFR1: Pressure /flow control, without orifice in X-line	31	(Viewed on shaft end) R: Clockwise L: Anti clockwise	P: NBR nitrl~ caoutchouc to DIN ISO 1629 (shalft seal in FKM) V: FKM fluor~ caoutchouc to DIN ISO 1629	See below	A: ISO 2-hole B: ISO 4-hole	12: Pressure port B, Suction port S (SAE ports at opposite sides Metric fixing thread)	See below

Shaft end

Size		28	45	71	100	140
Parallel with key DIN6885	P	√	√	√	√	√
Splined shaft SAE	S	7/8 "	1 "	1 1/4 "	1 1/2 "	1 3/4 "
Splined shaft SAE (higher through drive torque)	R	7/8 "	1 "	1 1/4 "	/	/

Through drives

Size		28	45	71	100	140
Withiout through drive	N00	√	√	√	√	√
ISO 100,2-hole splined shaft 7/8 " 22-4 (SAE B) HA10VSO28(shaft S or R)	KB3	√	/	√	√	√
ISO 100,2-hole splined shaft 1 " 25-4 (SAE B-B) HA10VSO45(shaft S or R)	KB4	/	√	√	√	√
ISO 125,2-hole splined shaft 1 1/4 " 32-4 (SAE C) HA10VSO71(shaft S or R)	KB5	/	/	√	√	√
ISO 125,2-hole splined shaft 1 1/2 " 38-4 (SAE C-C) HA10VSO100(shaft S)	KB6	/	/	/	√	√

√ = available / = not available

1.If a second Brueninghaus pump is to be fitted at factory then the two model codes must be linked with a "+" sign.
Model code 1st pump + Model code 2nd pump.
Ordering example:HA10VSO 100DR/31R-PPA12KB5 + HA10VSO 71DFR/31R-PSA12N00
2. If a gear or radial piston pump is to be fitted at factory please consult us.

Hydraulic fluid

The HA10VSO variable displacement pump is suitable for use with mineral oil.

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

ν_{opt}=operating viscosity 16...36 mm^2/s

Referred to the reservoir temperature(open circuit).

Viscosity limits

The limiting values for viscosity are as follows:

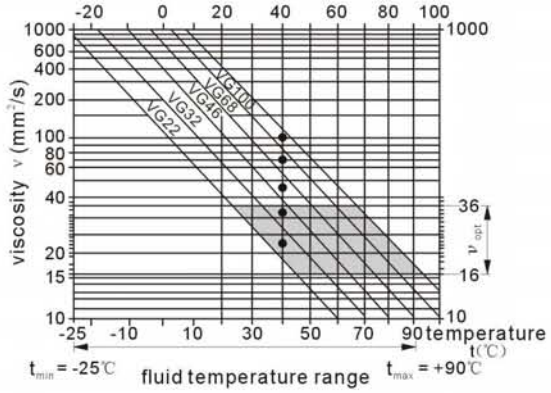
ν_{min}=10 mm^2/s
short term at a max.permissible case temp. of 90℃.

ν_{max}=1000 mm^2/s
short term on cold start

Temperature range (see selection diagram)

t_{min}=-25℃
t_{max}=90℃

Selection diagram



Notes on the selection of the hydraulic fluid

In order to select the correct fluid,it is necessary to know the operating temperature in the tank (open loop) in relation to the ambient temperature.

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

Example:At an ambient temperature of x℃ the operating temperature is 60℃.Within the operating viscosity range (ν_{opt};shaded area), this corresponds to viscosity ranges VG46 or VG68;VG68 should be selected.

Important:The leakage oil (case drain oil) temperature is influenced by pressure and pump speed and is always higher than the tank temperature. However, at on point in the circuit may the temperature exceed 90℃.

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

Filtration

The finer the filtration the better the cleanliness of the pressure fluid and the longer the life of the axial piston unit. To ensure the functioning of the axial piston unit a minimum cleanliness level of:

9 to NAS 1638
18/15 to ISO/DIS 4406 is necessary

if above mentioned grades cannot be maintained please consult supplier.

High-speed-version

The size 140 is available in an optional high speed version.This version allows higher drive speeds at max. displacement (higher output flow) without affecting outside dimensions,see table on page 80.

Mechanical displacement limiter

Mechanical displacement limiter is possible on the nonthrough-drive model, N00 series but not for the model with through-drive.

$V_{g\,max}$: for sizes 28 to 140
setting range $V_{g\,max}$ to 50% $V_{g\,max}$ stepless

$V_{g\,min}$: for sizes 100 and 140
setting range $V_{g\,min}$ to 50% $V_{g\,min}$ stepless

Operating pressure range-inlet

Absolute pressure at port S

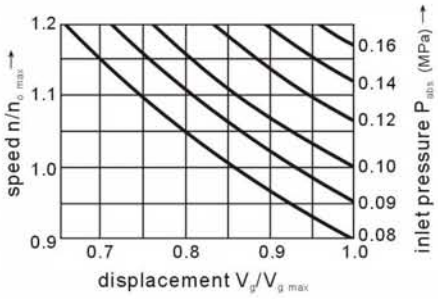
$P_{abs\,min}$ _____ 0.08 MPa
$P_{abs\,max}$ _____ 3 MPa

Operating pressure range-outlet

Pressure at port B
Nominal pressurre P_N _____ 28 MPa
Peak pressure P_{max} _____ 35 MPa

(Pressure data to DIN 24312)
Applications with intermittent operating pressures up to 31.5 MPa at 10% duty are permissible.
Limitation of pump output pressure spikes is possible with relief valve blocks mounted directly on flange connection.

Determination of inlet pressure P_{abs} at suction port S or reduction of displacement for increasing speed.



Case drain pressure

Maximum permissible pressure of leakage fluid (at port L, L_1); Maximum 0.05 MPa higher than the inlet pressure at port S, but no higher than 0.2 MPa absolute.

Direction of through flow

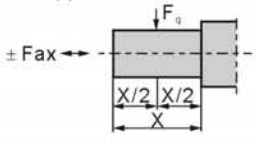
S to B

Table of values (theoretical values, without taking into accout η_{mh} and η_v; values rounded off)

Size				28	45	71	100	140
Displacement		$V_{g\,max}$	mL/r	28	45	71	100	140
Max.speed[1]	at $V_{g\,max}$	$n_{o\,max}$	rpm	3000	2600	2200	2000	1800
Max.permitted speed (limit speed) with increased input pressure P_{abs} bzw. $V_g < V_{g\,max}$		$n_{o\,max}$	rpm	3600	3100	2600	2400	2100
Max.flow	at $n_{o\,max}$	$q_{vo\,max}$	L/min	84	117	156	200	252
	at n_E=1500 min^{-1}		L/min	42	68	107	150	210
Max.power (△P= 28 MPa)	at $n_{o\,max}$	$P_{o\,max}$	kW	39	55	73	93	118
	at n_E=1500 min^{-1}		kW	20	32	50	70	98
Max.torque (△P= 28 MPa)	at $V_{g\,max}$	T_{max}	Nm	125	200	316	445	623
Torque (△P= 10 MPa)	at $V_{g\,max}$	T	Nm	45	72	113	159	223
Moment of inertia about drive axis		J	kgm^2	0.0017	0.0033	0.0083	0.0167	0.0242
Case volume			L	0.7	1.0	1.6	2.2	3.0
Weight (without fluid)		m	kg	15	12	33	45	60
Permissible loading of drive shaft: max.axial force		$F_{ax\,max}$	N	1000	1500	2400	4000	4800
Max.permissible radial force[2]		$F_{q\,max}$	N	1200	1500	1900	2300	2800

1) These values are valid for an absolute pressure of 0.1 MPa at the suction port S. By reducing the displacement or increasing the input pressure the speed can be increased as shown in the diagram.
2) Please consult us for higher radial forces.

application of forces



Determination of displacement

Flow $q_v = \dfrac{V_g \cdot n \cdot \eta_v}{1000}$ [L/min]

Torque $T = \dfrac{1.59 \cdot V_g \cdot \triangle P}{1000 \cdot \eta_{mh}} = \dfrac{V_g \cdot \triangle P}{20 \cdot \pi \cdot \eta_{mh}}$ [Nm]

Power $P = \dfrac{T \cdot n}{9549} = \dfrac{2\pi \cdot T \cdot n}{60000} = \dfrac{q_v \cdot \triangle P}{600 \cdot \eta_t}$ [kW]

V_g = displacement (mL/r) per revolution
$\triangle P$ = pressure differential (MPa)
n = speed (rpm)
η_v = volumetric efficiency
η_{mh} = mechanical-hydraulic efficiency
η_t = overall efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

Optional installation position.The pump housing must be filled with fluid during commissioning and remain full when operating. In order to attain the lowest noise level, all connections(suction, pressure,case drain ports) must be linked by flexble couplings to tank.
Avoid placing a check valve in the case drain line.
This may, however, be permissible in individual cases, after consultation with us.

1. Vertical installation (shaft end upwards)

The following installation conditions must be taken into account:

1.1.Arrangement in the reservoir

Before installation fill pump housing,keeping it in a horizontal position.
a) If the minmum fluid level is equal to or above the pump mounting face close port "L"plugged, leave ports "L_1" and "S" open; L_1 piped and recommendation S piped (see Fig.1).
b) If the minmum fluid level is below the pump mounting face pipe port "L_1" and "S" according to Fig.2.
Close port "L" with respect taking into consideration conditions in 1.2.1.

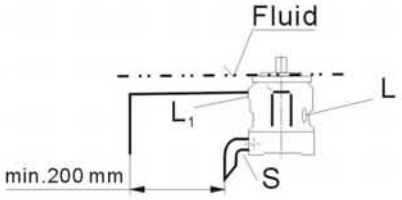


Fig.1

1.2. Arrangement outside the reservoir

Before installation fill the pump housing, keeping it in a horizontal position.For mounting above resrvoir see Fig.2.

Limiting condition:

1.2.1. Minimum pump inlet pressure $P_{abs\,min}$ = 0.08 MPa under both static and dynamic conditions.
Note: Avoid mounting above reservoir wherever possible in order to achieve a low noise level.
The permissible suction height h comes from the overall pressure loss, but may not be bigger than h_{max} = 800 mm (immerdion depth $h_{t\,min}$ = 200mm).

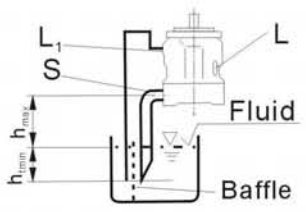


Fig.2

Overall pressure loss $\triangle P_{tot} = \triangle P_1+\triangle P_2+\triangle P_3 \leq (1-P_{abs\,min})=0.02MPa$

$\triangle P_1$: Pressure loss in pipe due to accelerating column of fluid

$$\triangle P_1 = \frac{\rho \cdot l \cdot dv}{dt} \cdot 10^{-6}(MPa)$$

ρ = density(kg/m³)
l = pipe lenght (m)
dv/dt = rate of change in fluid velocity(m/s²)

$\triangle P_2$: Pressure loss due to static head

$\triangle P_2 = h \cdot \rho \cdot g \cdot 10^{-6}(MPa)$

h = height(m)
ρ = density(kg/m³)
g = gravity=9.81m/s²

$\triangle P3$:Line losses (elbows etc.)

2. Horizontal installation

The pump must be installed,so that "L" or "L_1" is at the top.

2.1.Arrangement in the reservoir

a) If the minimum fluid level is above the top of the pump, port "L_1" closed,"L" and "S" should remain open, L piped and recommendation S piped (see Fig.3)
b) If the minimum fluid level is equal to or below the top of the pump, pipe ports "L" and possibly "S" as Fig.4.; close port "L_1".
The conditions acconrding to tiem 1.2.1.

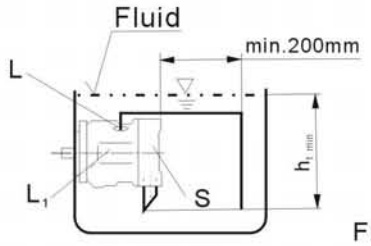


Fig.3

2.2. Installation outside the reservoir

Fill the pump housing before commissionsing.
Pipe ports "s" and the higher port "L" or "L_1".
a) When mounting above the reservoir, see fig.4.
Conditions according to 1.2.1.

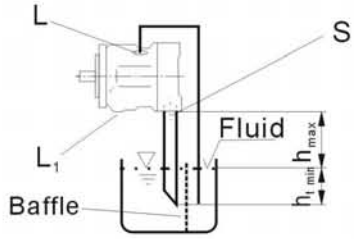


Fig.4

b) Mounting below the reservoir
Pipe ports "L_1" and "S" according to Fig.5, close port "L".

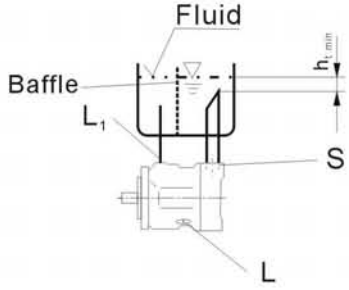
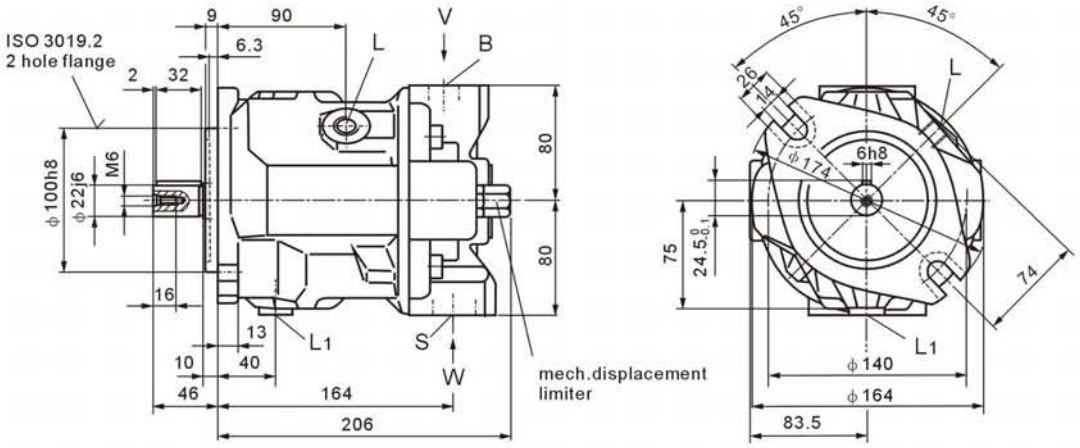


Fig.5

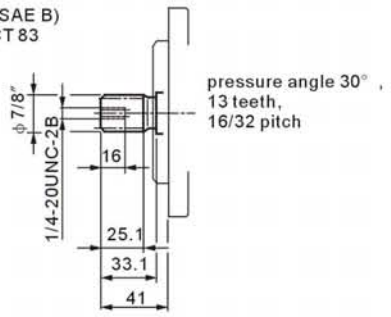
HA10VSO28※/31※-※A12N00(without control valves)

Shaft P

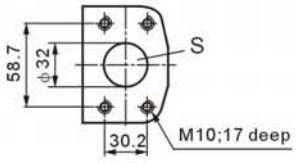


Shaft S

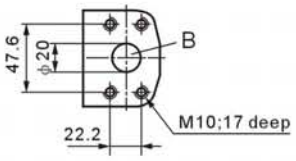
Shaft 22-4; (SAE B)
SAE J744 OCT 83



View W

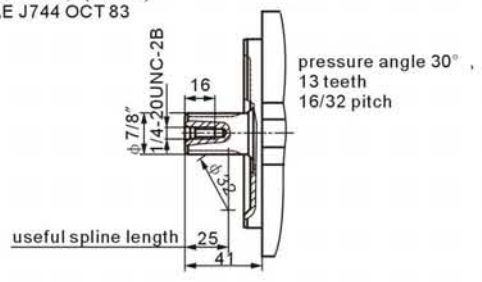


View V



Shaft R

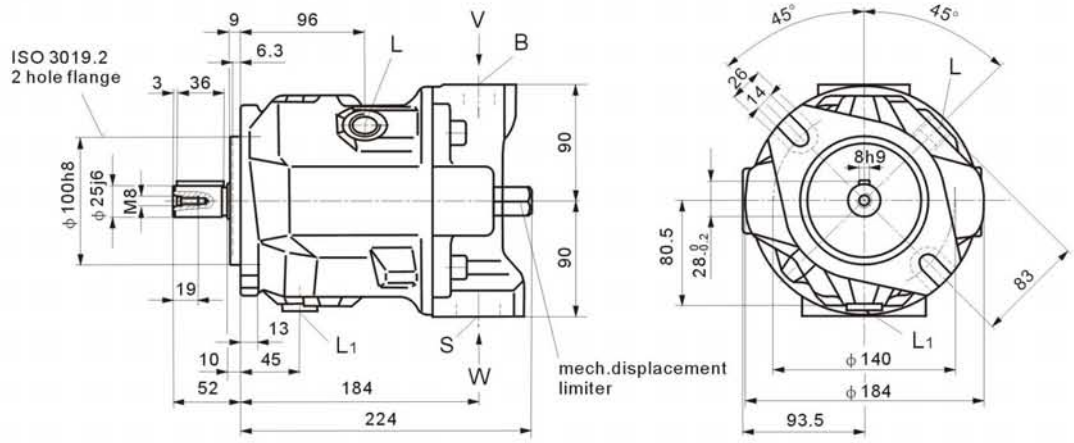
Shaft 22-4; (SAE B)
SAE J744 OCT 83



B	Pressure port	SAE 3/4″	(Standard pressure range)
S	Suction port	SAE 11/4″	(Standard pressure range)
L/L$_1$	Case drain ports	M18 × 1.5	(L$_1$ plugged at factory)

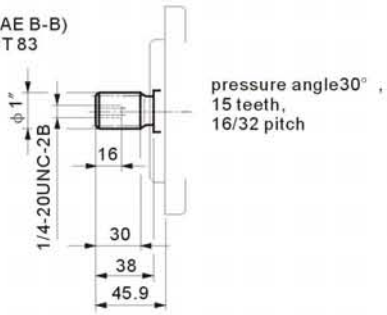
HA10VSO45※/31※-※A12N00(without control valves)

Shaft P

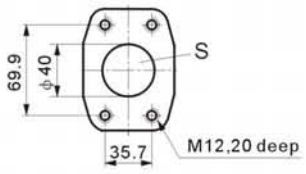


Shaft S

Shaft 25-4;(SAE B-B)
SAE J744 OCT 83



View W



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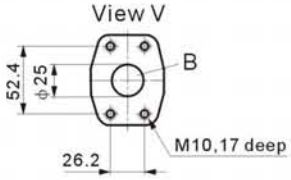
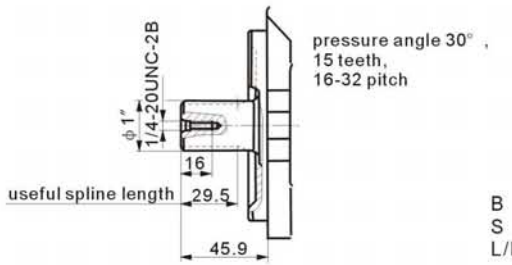


Shaft R

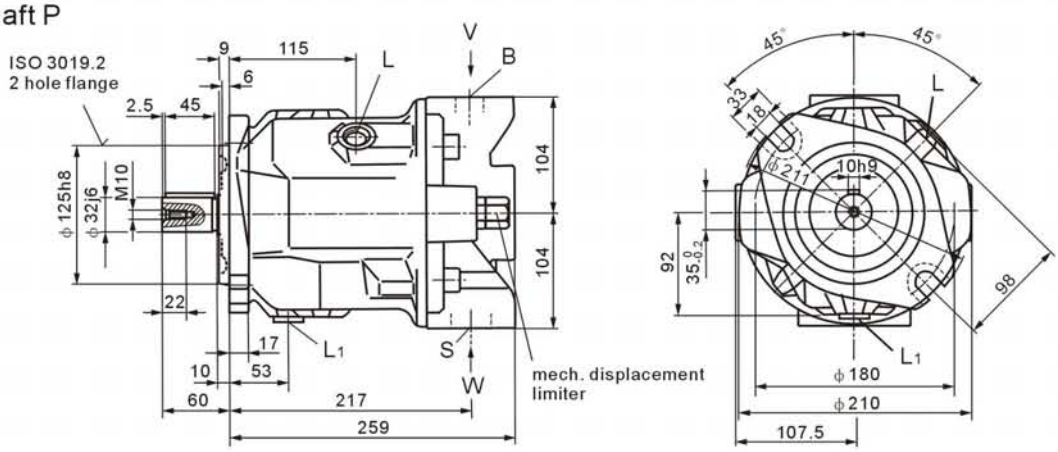
Shaft 25-4;(SAE B-B)
SAE J744 OCT 83



B	Pressure port	SAE 1″	(Standard pressure range)
S	Suction port	SAE 11/2″	(Standard pressure range)
L/L_1	Case drain ports	M22 × 1.5	(L_1 plugged factory)

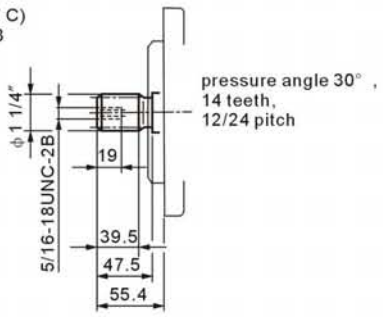
HA10VSO71※/31※-※A12N00(without control valves)

Shaft P

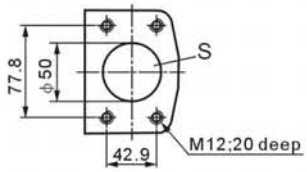


Shaft S

Shaft 32-4; (SAE C)
SAE J744 OCT 83

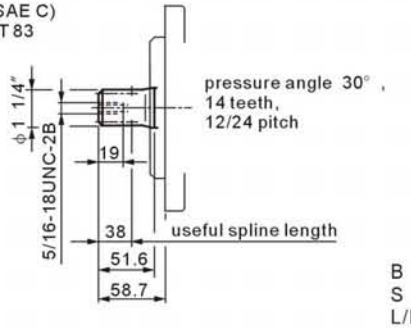


View W

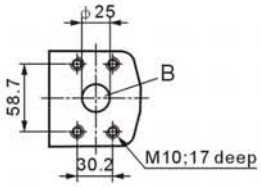


Shaft R

Shaft 32-4; (SAE C)
SAE J744 OCT 83



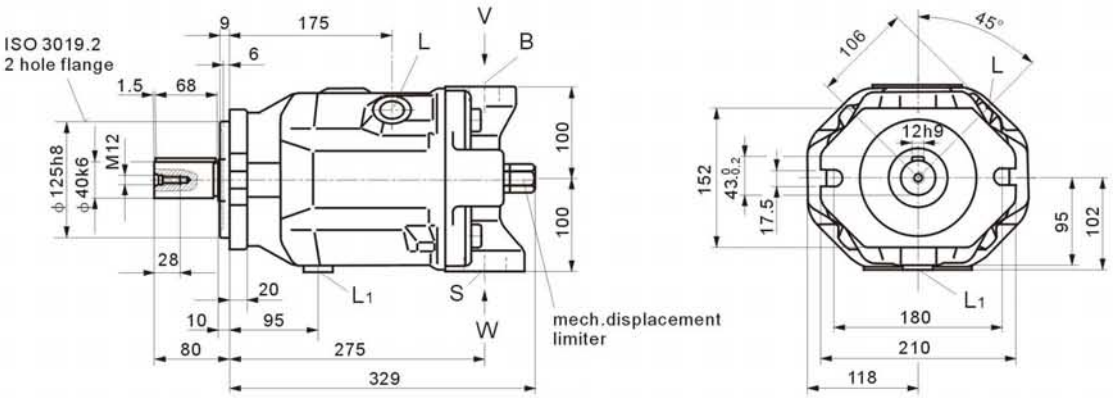
View V



B	Pressure port	SAE 1″	(Standard pressure range)
S	Suction port	SAE 2″	(Standard pressure range)
L/L1	Case drain ports	M22 × 1.5	(L1 plugged at factory)

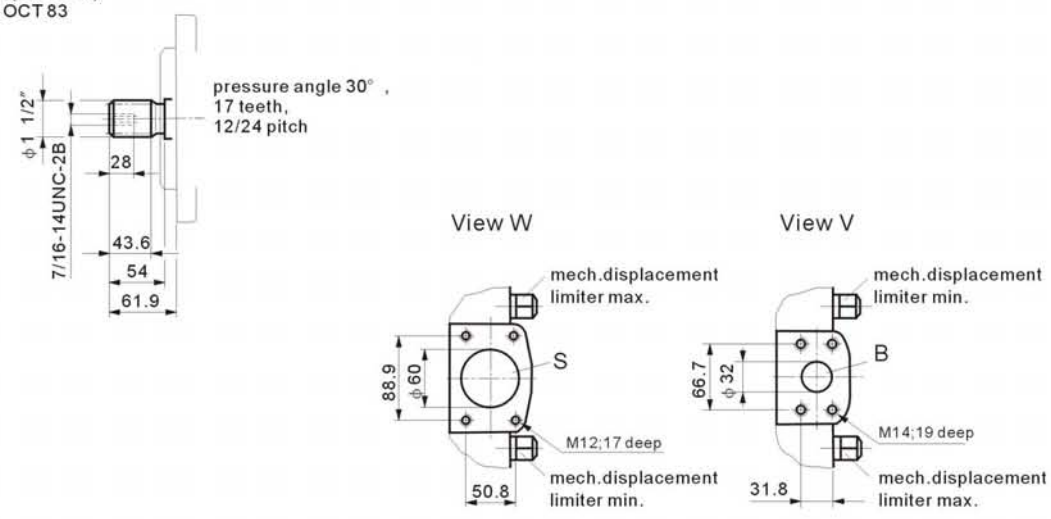
HA10VSO100※/31※-※A12N00(without control valves)

Shaft P



Shaft S

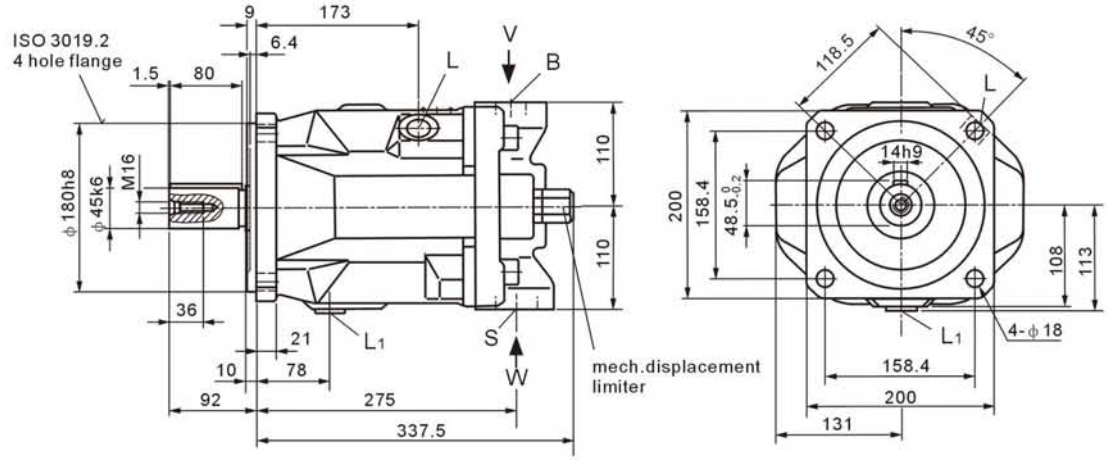
Shaft 38-4;(SAE C-C)
SAE J744 OCT 83



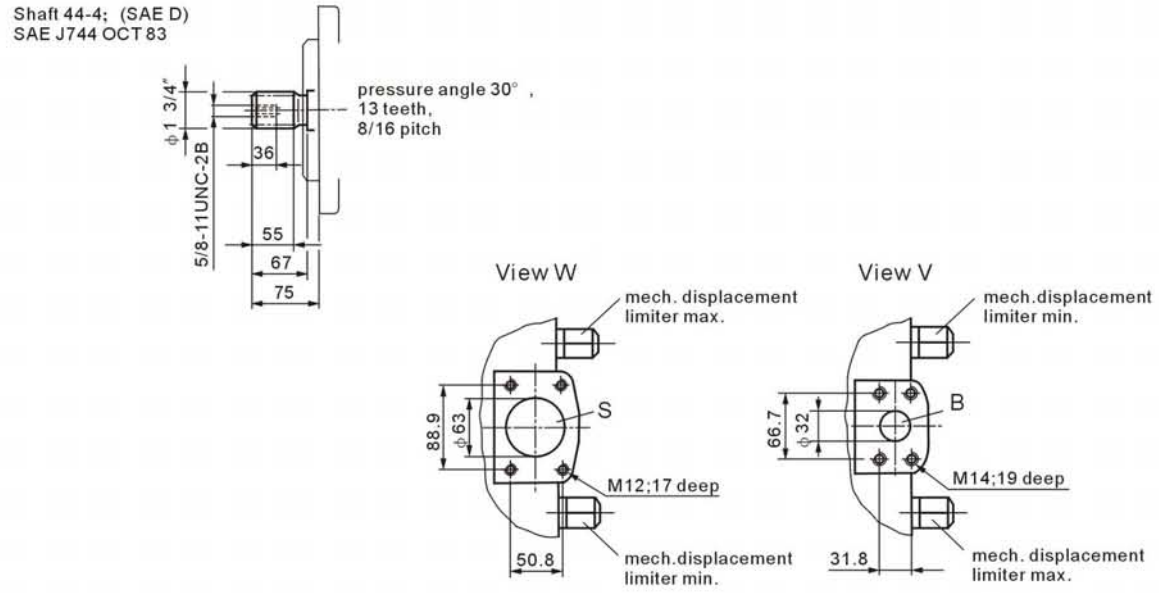
B	Pressure port	SAE 1 1/4″	(High pressure range)
S	Suction port	SAE 2 1/2″	(Standard pressure range)
L/L_1	Case drain ports	M27 × 2	(L_1 plugged at factory)

HA10VSO140※/31※-※A12N00(without control valves)

Shaft P



Shaft S

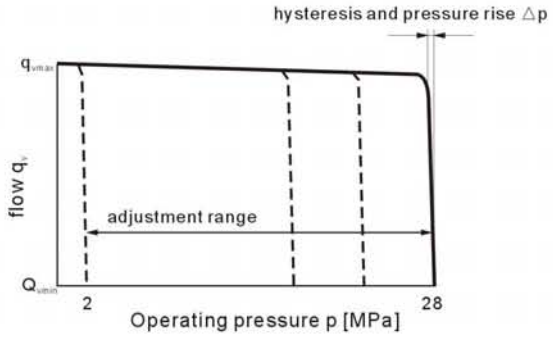


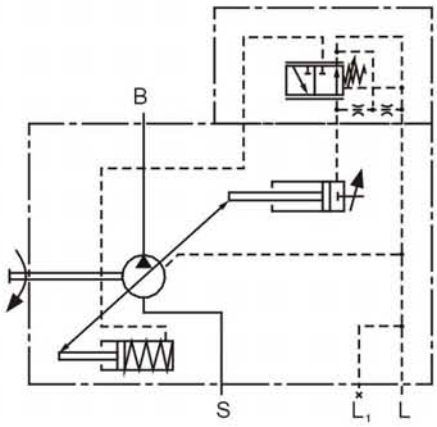
B	Pressure port	SAE 1 1/4″	(High pressure range)
S	Suction port	SAE 2 1/2″	(Standard pressure range)
L/L_1	Case drain port	M27 × 2	(L_1 plugged at factory)

The pressure controller 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 system. Pressure may be steplessly set at the contorl valves.

Static operating curve

(at n_1=1500 rpm; t_{oil}=50℃)





Ports

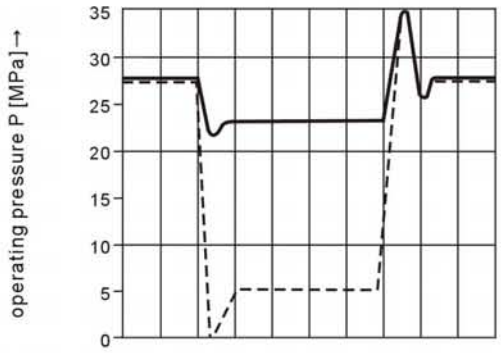
B	Pressure port
S	Suction port
L, L_1	Case drain ports (L_1 plugged)

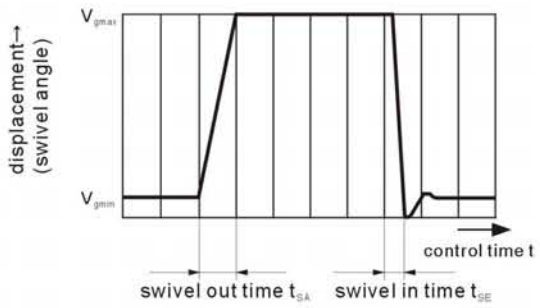
Dynanmic operating curves

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

Conditions: n = 1500 rpm
t_{oil} = 50℃
Main relief set at 35 MPa

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





Contorller Data

Hysteresis and repetitive accuracy △P _____ max. 0.3 MPa

Max.pressure rise

Size		28	45	71	100	140
△P	MPa	0.4	0.6	0.8	1.0	1.2

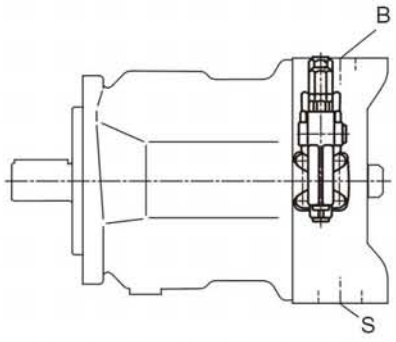
Polit oil requirement _____ Max.approx 3 L/min

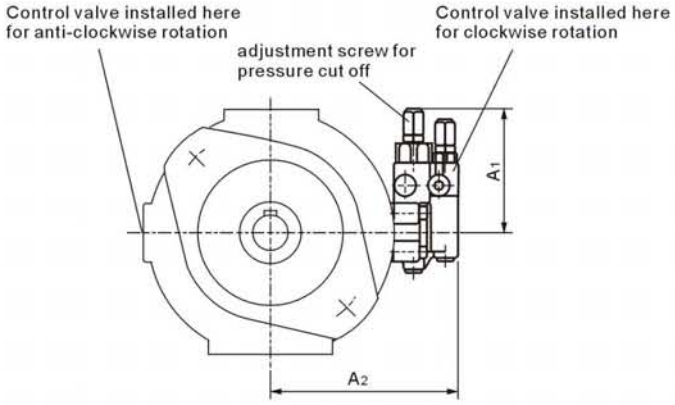
Control Times

Size	t_{SA} (ms) again 5 MPa	t_{SA} (ms) again 22 MPa	t_{SA} (ms) again 28 MPa
28	60	30	20
45	80	40	20
71	100	50	25
100	125	90	30
140	130	110	30

HA10VSO※DR/31R-※12N00

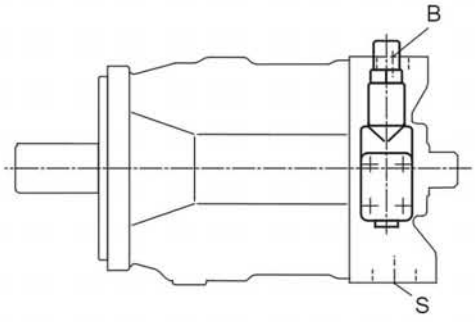
Sizes 28...100

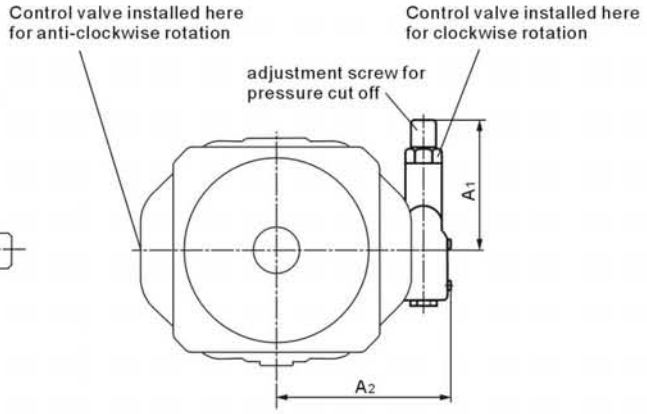




On sizes 28 to 100 the DFR valve used has the flow control spool blocked in the factory and is not tested.

Size 140





Size	A_1	A_2
28	109	136
45	106	146
71	106	160
100	106	165
140	127	169

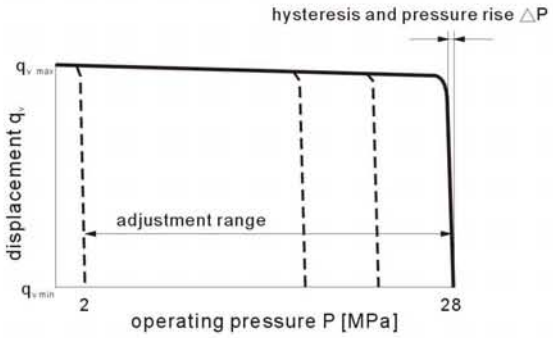
Function and equipment as for DR.

A pressure refief valve can be connected to port X for remote control applications;this is not included in the items supplied with the DRG control.

The standard pressure differential setting at the control valve is 2 MPa. A pilot oil flow of approw. 1.5 L/min is then used. If an other setting (range1-2.2 Mpa) is required please indicate in clear text.

Static Operating Curve

(at n_1=1500 rpm; t_{oil}=50℃)



Contorller Data

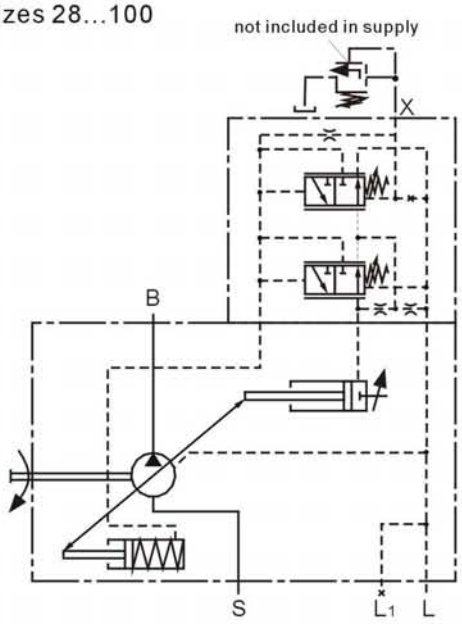
Hysteresis △P_____max. 0.3 MPa

Max. pressure rise

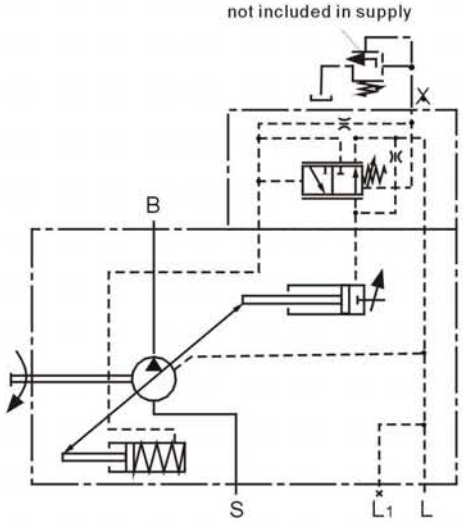
Size		28	45	71	100	140
△P	MPa	0.4	0.6	0.8	1.0	1.2

Pilot oil requirement _____approx. 4.5 L/min

Sizes 28...100



Size 140

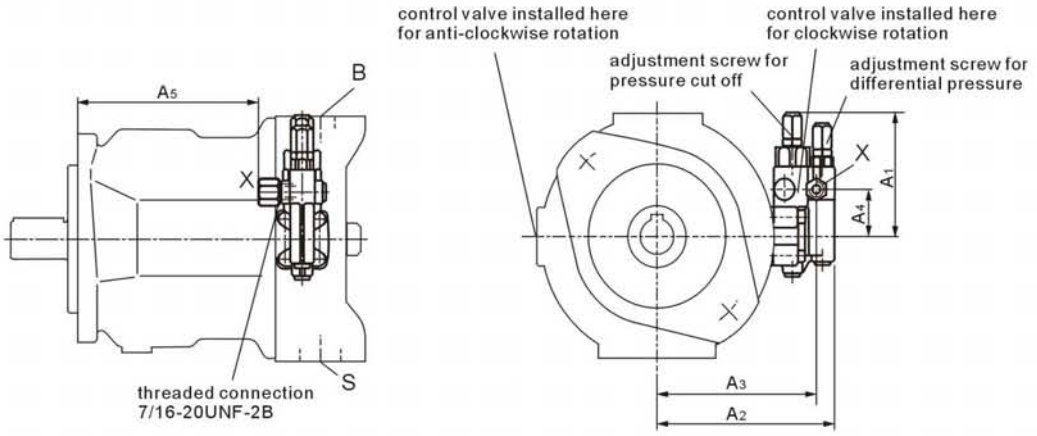


Ports

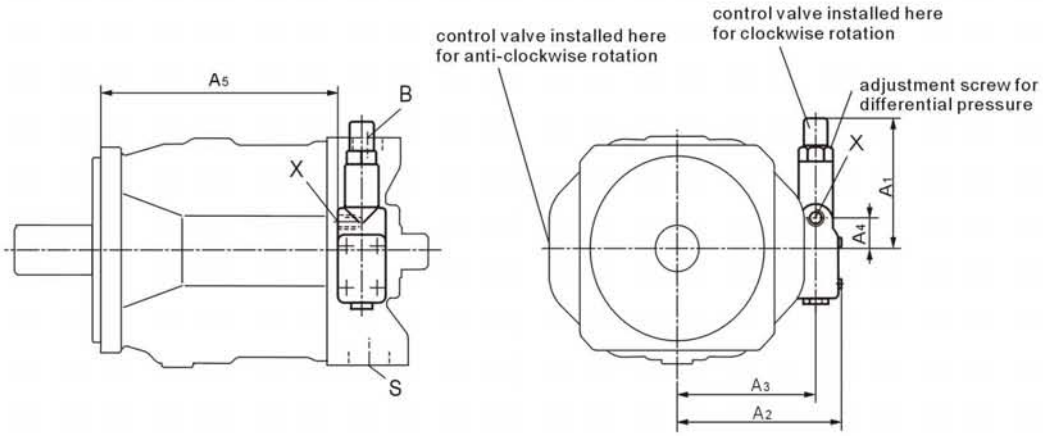
B	Pressure port
S	Suction port
L, L_1	Case drain ports(L_1 plugged)
X	Pilot pressure port

HA10VSO※DRG/31R-※12N00

Sizes 28...100



Size 140



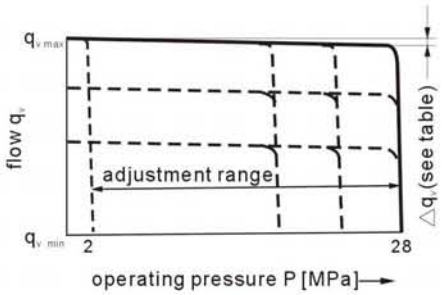
Size	A_1	A_2	A_3	A_4	A_5	Port X	
28	109	136	119	40	119	M14 × 1.5;12 deep	with adaptor
45	106	146	129	40	134	M14 × 1.5;12 deep	
71	106	160	143	40	162	M14 × 1.5;12 deep	
100	106	165	148	40	229	M14 × 1.5;12 deep	
140	127	169	143	27	244	M14 × 1.5;12 deep	without adaptor

In addition to the pressure control function, the pump flow may be varied by means of a differential pressure over an orifice or valvespool, installed in the service line. The pump flow is equal to the actual required flow by the actuator.

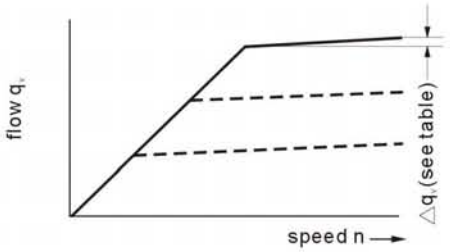
The DFR1-valve has no connection between X and the tank. For function of pressure control see pages 87/88.

Static operating curve

(at n_1=1500 rpm; t_{oil}=50℃)

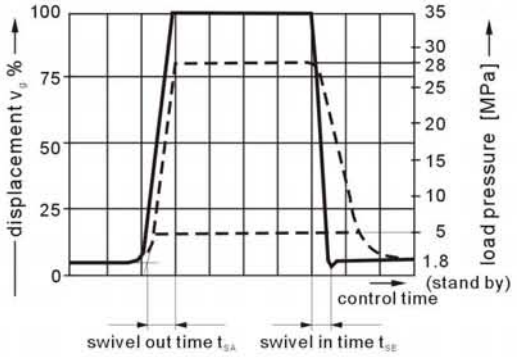


Static operating curve at variable speed

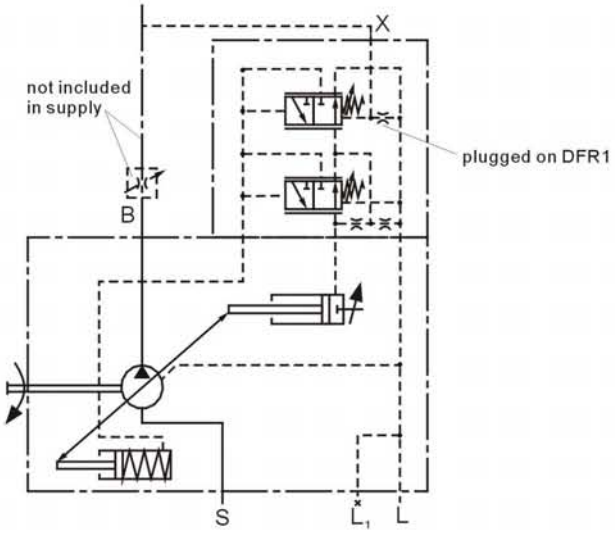


Dynamic flow control operating curve

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



Size	t_{SA} (ms) stand by-28 MPa	t_{SE} (ms) 28 MPa-stand by	t_{SE} (ms) 5 MPa-stand by
28	40	20	40
45	50	25	50
71	60	30	60
100	120	60	120
140	130	60	130



Ports

B	Pressure port
S	Suction port
L, L_1	Case drain ports(L_1 plugged)
X	Pilot pressure port

Differential Pressure △P

Adjustable between 1 and 2.2 MPa (higher valves on request).
Standard setting: 1.4 MPa . If a different setting is required please indicate in clear text.
When port X is unloaded to tank a "zerostroke pressure" of P=1.8 ± 0.2 MPa (stand by) results (dependent on △P).

Controller Data

Data pressure controller see page 87.
Max. Flow variation (hysteresis and increase) measured at drive speed n=1500 rpm

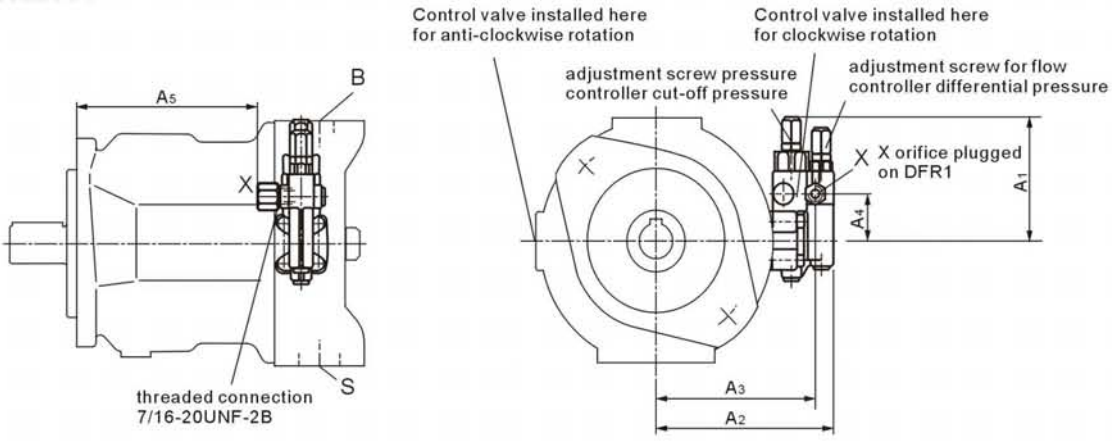
Size		28	45	71	100	140
$\triangle q_{vmax}$	L/min	1.0	1.8	2.8	4.0	6.0

DFR pilot oil consumption ___ max.approx. 3...4.5 L/min

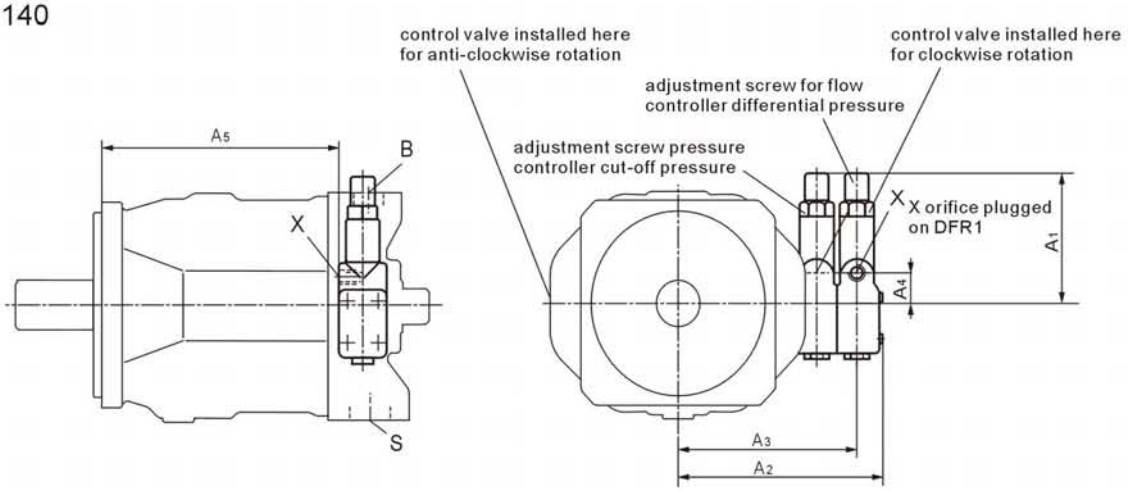
DFR1 pilot oil consumption _____ max.approx. 3 L/min

HA10VSO※DFR/31R-※12N00
HA10VSO※DFR1/31R-※12N00

Sizes 28...100



Size 140



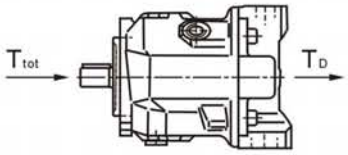
Size	A_1	A_2	A_3	A_4	A_5	Port X	
28	109	136	119	40	119	M14 × 1.5;12 deep	with adaptor
45	106	146	129	40	134	M14 × 1.5;12 deep	
71	106	160	143	40	162	M14 × 1.5;12 deep	
100	106	165	148	40	229	M14 × 1.5;12 deep	
140	127	209	183	27	244	M14 × 1.5;12 deep	without adaptor

The HA10VSO pump can be supplied with through drive in accordance with the type code on page 78.
The through drive version is designated by the code numbers (KB3-KB6).
If on other pumps are fitted by the manufacturer,the simple type designation is sufficient.
in this case, the delivery package comprises:
Hub fixing screws,seal and,if necessary, an adaptor flange.

Combination Pump

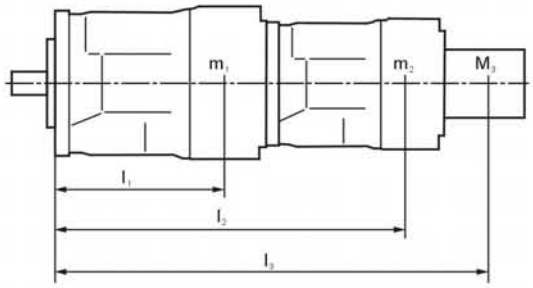
By building on further pumps it is possible to obtain independent circuits:
1. If the combination pump consists of 2 HA10VSO and if these are to be supplied assembled then the two order codes should be linked by means of a "+"sign.
Ordering example:
HA10VSO 71 DR/31 L -PPA12KB3+
HA10VSO 28 DR/31 L -PSA12N00
2. If a gear or radial piston pump is to be built on at the factory, please consult us.

Maximum permissible input and through drive torque



The split in torque between pump 1 and 2 is optional.
The max. permissible input torque T_{tot} as well as the max. permissible through drive torque T_D may not be exceeded.

Permissible moment of inertia



m_1, m_2, m_3[kg] Pump mass
l_1, l_2, l_3[mm] distance to center of gravity
$T_m = (m_1 \cdot l_1 + m_2 \cdot l_2 + m_3 \cdot l_3) \cdot \frac{1}{102}$ [Nm]

Size			28	45	71	100	140
Permissible moment of inertia	T_m	Nm	880	1370	2160	3000	4500
Permissible moment of inertia at dynamic mass acceleration 10g ≙ 98.1 m/s²	T_m	Nm	88	137	216	300	450
Mass	m_1	kg	15	21	33	45	60
To center of gravity	l_1	mm	110	130	150	160	160

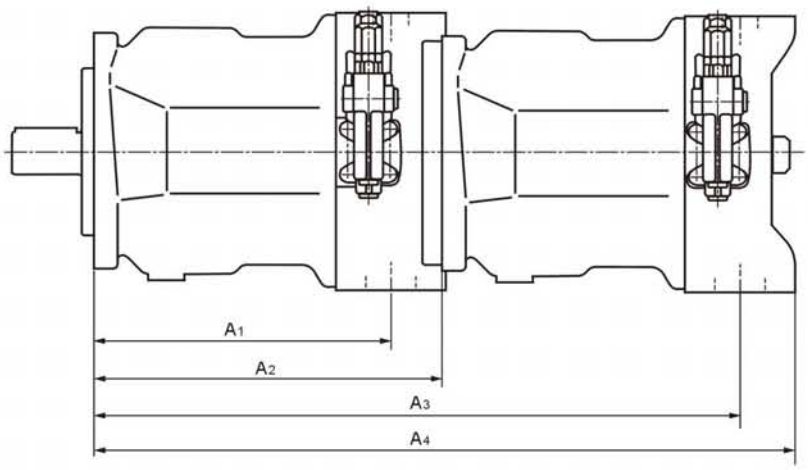
Size			28	45	71	100	140
Max. permissible input torque at pump 1 with shaft "P"							
	T_{tot}	Nm	137	200	439	857	1206
Max. permissible through-drive torque	T_D	Nm	137	200	439	778	1206
	$T_{D\ keyed\ shaft}$	Nm	112	179	283	398	557

Size			28	45	71	100	140
Max. permissible input torque at pump 1 with shaft "S"							
	T_{tot}	Nm	137	319	626	1104	1620
Max. permissible through-drive torque	T_D	Nm	160	319	492	778	1266
	$T_{D\ keyed\ shaft}$	Nm	112	179	283	398	557

Size			28	45	71	100	140
Max. Permissible input torque at pump 1 with shaft "R"							
	T_{tot}	Nm	225	400	644	-	-
Max. permissible through-drive torque	T_D	Nm	176	365	548	-	-
	$T_{D\ keyed\ shaft}$	Nm	112	179	283	-	-

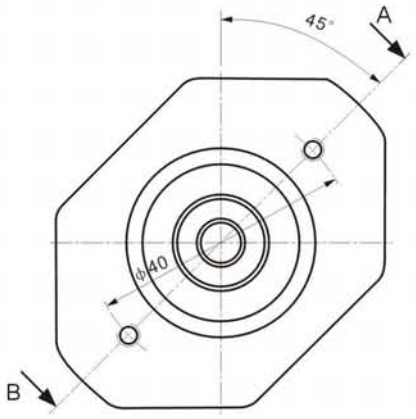
T_{tot} = Max. permissible input torque at pump 1
T_D = Max. permissible through-drive torque at through-drive to splined shaft
$T_{D\ keyed\ shaft}$ = Max. permissible through-drive torque at through-drive to keyed shaft

HA10VSO+HA10VSO

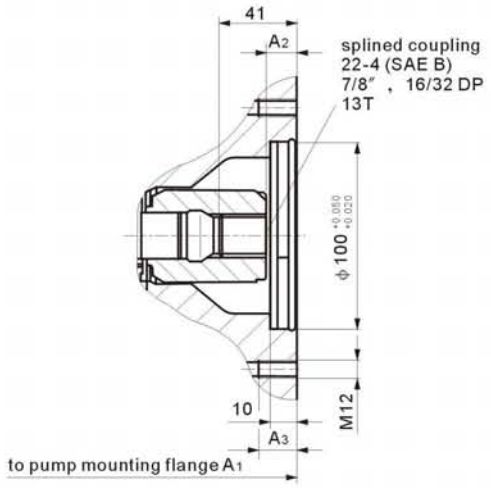


main p. / built-on p.	HA10VSO 28				HA10VSO 45				HA10VSO 71				HA10VSO 100				HA10VSO 140			
	A1	A2	A3	A4	A1	A2	A3	A4	A1	A2	A3	A4	A1	A2	A3	A4	A1	A2	A3	A4
HA10VSO28	164	204	368.5	410	-	-	-	-	217	267	431.5	473	275	338	502.5	544	275	350	514	556
HA10VSO45	-	-	-	-	184	229	413	453	217	267	451	491	275	338	522	562	275	350	534	574
HA10VSO71	-	-	-	-	-	-	-	-	217	267	484	524	275	338	555	595	275	350	567	609
HA10VSO100	-	-	-	-	-	-	-	-	-	-	-	-	275	337	613	664	275	350	625	679

Flange ISO 100,2-hole for built-on HA10VSO 28 (splined shaft S or R)
Order code KB3

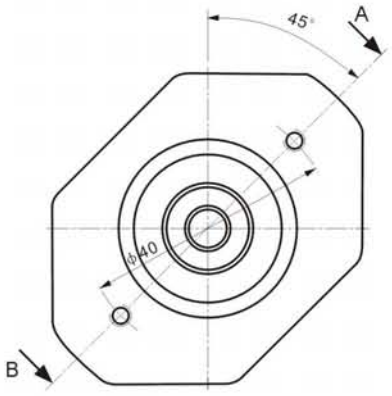


section A-B

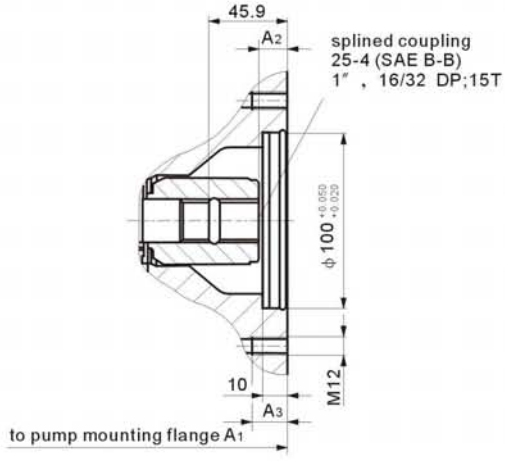


Size main pump	A_1	A_2	A_3
28	204	19.2	14
71	267	16.5	18
100	338	17.6	18
140	350	18.2	24

Flange ISO 100,2-hole for built-on HA10VSO 45 (splined S or R)
Order code KB4

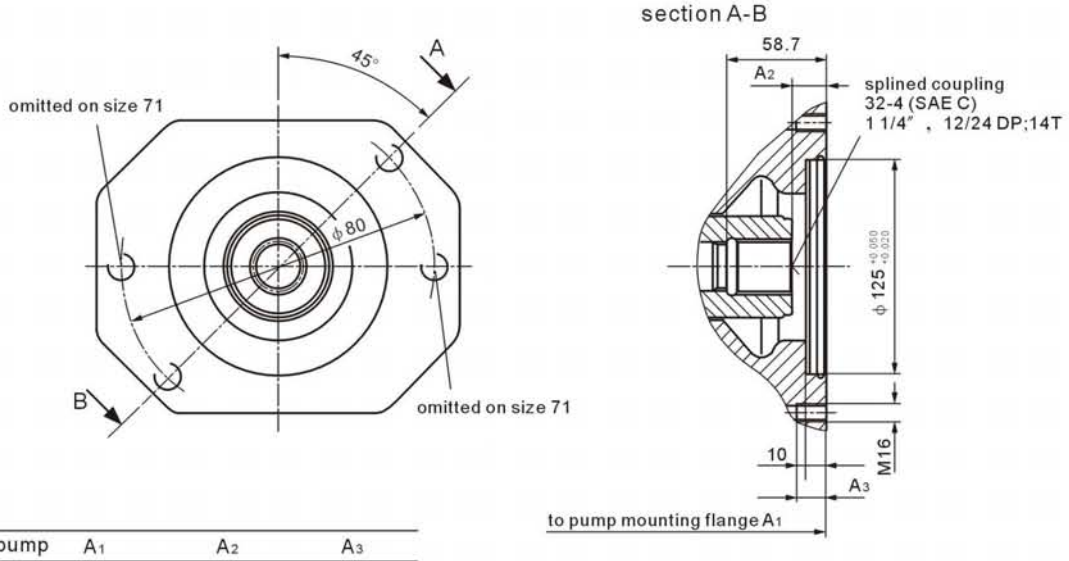


section A-B



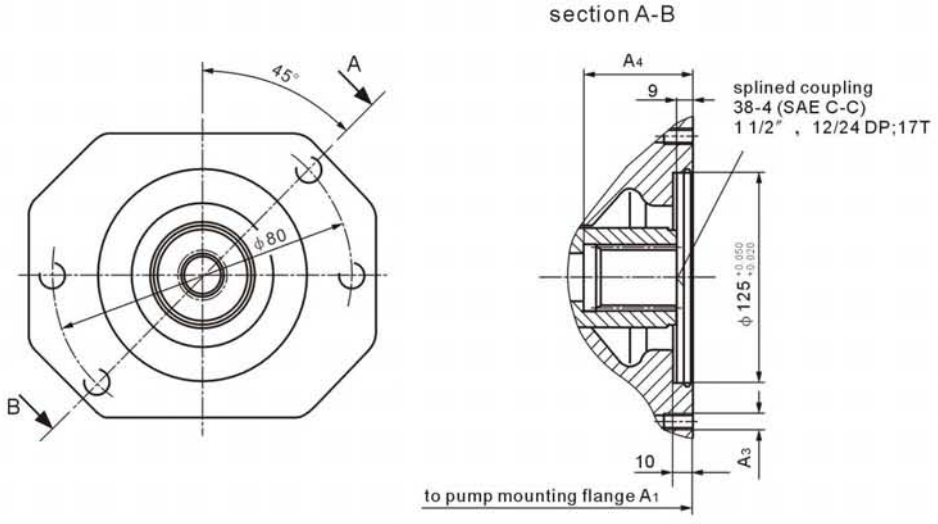
Size main pump	A_1	A_2	A_3
45	229	17.2	14
71	267	17.2	18
100	338	18.2	20
140	350	18.2	24

Flange ISO 125,2-hole for built-on HAVSO 71 (splined S or R)
Order code KB5



Size main pump	A_1	A_2	A_3
71	267	20	18.5
100	338	20	25
140	350	21	32

Flange ISO 125,2-hole for built-on HA10VSO 100 (splined shaft S)
Order code KB6



Size mian pump	A_1	A_3	A_4
100	338	M16; 25 deep	65
140	350	M16; 32 deep	77.3

HA2FO Series Axial Piston Fixed Displacement Pump

Product show and brief introduction

Open circuits

Sereis 6
Sizes 10...180
Nominal pressure 40MPa
Peak pressure 45MPa

Features

— Fixed displacement pump HA2FO of axial piston,bent axis design, suitable for hydrostatic drives in open circuits

— Use in mobile and industrial applications

— Output flow is proportional to drive speed and displacement

— The drive shaft bearings are designed to give the service life expected in these areas of operation

— High power density

— High overall efficiency

— One piece pistons with piston rings

Model Code

HA2F	O	80	/6	1	R	-P	A	B	05
Axial piston unit	Mode of operation	Size (mL/r)	Series	Index	Direction of rotation	Seals	Shaft end	Mounting flange	Service line ports
HA2F: Bent axis design, fixed displa-cement	O: Pump, open circuits	10 12 16 23 28 32 45 56 63 80 90 107 125 160 180	6	1	(Viewed on shaft end) R: Clockwise L: Counter-clockwise	P: NBR (nitrl~ caoutchouc) V: FKM (fluor~ caoutchouc)	See below	B: 4-hole ISO 3019-2	See below

Shaft end

Size		10	12	16	23	28	32	45	56	63	80	90	107	125	160	180
Spined shaft DIN 5480	A	√	√	√	√	√	√	/	√	√	√	√	√	√	√	√
	Z	√	√	/	√	√	/	√	√	/	√	/	√	/	√	/
Parallel keyed shaft, DIN 6885	B	√	√	√	√	√	√	/	√	√	√	√	√	√	√	√
	P	√	√	/	√	√	/	√	√	/	√	/	√	/	√	/

Service line port[1)]

Size	10	12	16	23	28	32	45	56	63	80	90	107	125	160	180
05:SAE flange ports A and B, at side and SAE flange port S,rear	/	/	/	√	√	√	√	√	√	√	√	√	√	√	√
06:Threaded ports A and B, at side and SAE flange potr S,rear	√	√	√	/	/	/	/	/	/	/	/	/	/	/	/

√ = available / = not available

1) fastening threads resp.threaded ports are metric

Hydraulic fluid

The HA2FO fixed displacement pump is suitable for use with mineral oil

Viscosity range

We recommend that a viscosity (at operating temperature)for optimum efficiendy and service life purposes of

V_{opt} = optimum viscosity16···36mm²/s

Be chosen,taken the tank temperature(open circuit) into account.

Limits of viscosity range

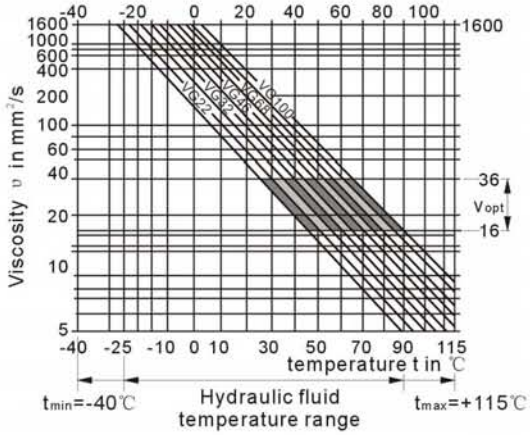
The following values apply in extreme cases:

Vmin = 5 mm²/s
short term(t<3 min)at max.permitted temperature
tmax=115℃

Vmax = 1600 mm²/s
short term(t<3 min) with cold start(P<3MPa,
n≤1000rpm t_{min}=-40℃)

Note that the maximun hydraulic fluid temperature must not be exceeded locally either (e.g.bearing area).The temperature in the bearing area is-depending on pressure and speed-up to 12 K higher than the average case drain temperature.

Setlection diagram



Details regarding the choice of hydraulic fluid

The correct selection of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature, in an open circuit the tank temperature.

The hydraulic fliuid should be selected so that within the operating temperature range, the operating viscosity lies within the optimun range (υ_{opt})(see shaded section of the selection diagram).We recommend that the highest possible viscosity range should be chosen in each case.

Example:At an ambient temperature of X℃ an operating temperature of 60℃is set in the circuit. In the optimun operating viscosity range(υ_{opt}; shaded area) this corresponds to the viscosity classes VG 46 or VG68; to be selected: VG 68.

Please note: The leakage fluid temperature, which is affected by pressure and rotational spaad,is always higher than the tank temperature . At no point in the system may the temperature be higher than 115℃.

Filtartion

The finer the filtration, the cleaner the fluid and the longer the service life of the axial piston unit.

To ensure proper function of the axial piston unit,the hydraulic fluid must have a cleanliness level of at least

20/18/15 according to ISO 4406.

At very high hydraulic fluid temperatures
(90℃ to max.115℃),a cleanliness level of at least

19/17/14 according to ISO 4406 is required.

Operational pressure range

Inlet

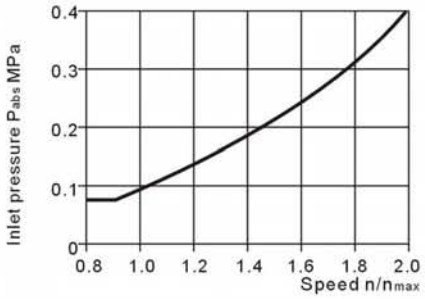
Pressure at port S
The minmum inlet pressure depends on speed. The following limits must not be exceeded.

$P_{abs\ min}$ ——— 0.08 MPa

$P_{abs\ max}$ ——— 3 MPa

Minimum inlet pressure at suction port S with increased speed

In order to avoid damage of the pump a minimum inlet pressure at the suction port must be assured.The minimum inlet pressure is related to the rotational speed of the fixed pump.



Note:
— max. permissible speed $n_{max\ perm.}$(speed limit)
— min. permissble inlet pressure at port S
— admissible values for the drive shaft seal

Outlet

Maximum pressure on port A or B
(pressure data according to DIN 24312)

	Shaft end A, Z	Shaft end B, P
Nominal pressure P_N	40 MPa	35 MPa
Peak pressure P_{max}	45 MPa	40 MPa

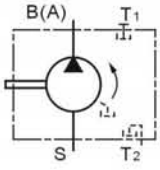
Direction of flow

Direction of rotation,viewed on shaft end	
clockwise	counter-clockwise
S to B	S to A

Symbol

Connections

A, B	Service line port
S	Suction port
T_1,T_2	Drain ports



Teble of values (the oretical values, ignoring η_{min} and η_v; values rounded)

Size				10	12	16	23	28	32	45
Displacement		V_g	mL/r	10.3	12	16	22.9	28.1	32	45.6
Speed max		N_{max} [1]	rpm	3150	3150	3150	2500	2500	2500	2240
		$n_{max\ limit}$ [2]	rpm	6000	6000	6000	4750	4750	4750	4250
Flow max.	at n_{max}	q_{vmax}	L/min	32.4	37.8	50	57	70	80	102
Power at	△P=35 MPa	P_{max}	Nm/MPa	18.9	22	29.2	33	41	47	59.5
	△P=40 MPa	P_{max}	Nm	21.6	25	34	38	47	53	68
Torque at	△P=35 MPa	T	Nm	57	67	88	126	156	178	254
	△P=40 MPa	T	Nm	65	76	101	145	178	203	290
Filling capacity			L	0.17	0.17	0.17	0.20	0.20	0.20	0.33
Mass(approx.)		m	kg	6	6	6	9.5	9.5	9.5	13.5

Size				56	63	80	90	107	125	160	180
Displacement		V_g	mL/r	56.1	63	80.4	90	106.7	125	160.4	180
Speed max		N_{max} [1]	rpm	2000	2000	1800	1800	1600	1600	1450	1450
		$n_{max\ limit}$ [2]	rpm	3750	3750	3350	3350	3000	3000	2650	2650
Flow max.	at n_{max}	q_{vmax}	L/min	112	126	144	162	170	200	232	261
Power at	△P=35 MPa	P_{max}	Nm/MPa	65	73.5	84	95	100	117	135	152
	△P=40 MPa	P_{max}	Nm	75	84	96	108	114	133	155	174
Torque at	△P=35 MPa	T	Nm	312	350	445	501	594	696	893	1003
	△P=40 MPa	T	Nm	356	400	511	572	678	795	1020	1145
Filling capacity			L	0.45	0.45	0.55	0.55	0.8	0.8	1.1	1.1
Mass(approx.)		m	kg	18	18	23	23	32	32	45	45

1) the values shown are valid for an absolute pressure (P_{abs}) of 0.1 MPa at the suction inlet S and when operated on mineral oil (with a specific mass of 0.88kg/L).
2)by increase of the input pressure ($P_{abs} > 0.1$ MPa) the rotational speeds can be increased to the max.admissible speeds $n_{max\ limit}$ (speed limits) (see diagram page 99).

Determining the size

Flow $q_v = \frac{V_g \cdot n \cdot \eta_v}{1000}$ [L/min]

Torque $T = \frac{V_g \cdot \triangle P}{20\pi \cdot \eta_{mh}}$ [Nm]

Power $P = \frac{2\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \triangle P}{600 \cdot \eta_t}$ [kW]

V_g = Displacement per revolution in mL/r

△P = Differential pressure in MPa

n = Speed in rpm

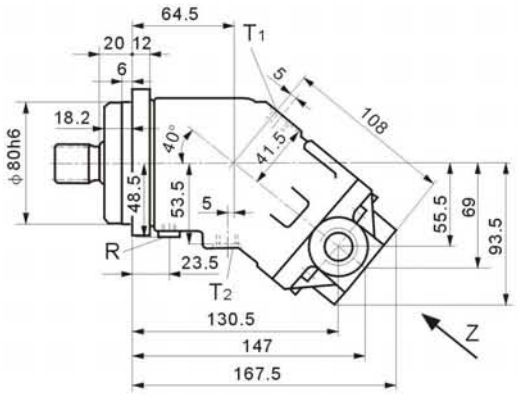
η_v = Volumetric efficiency

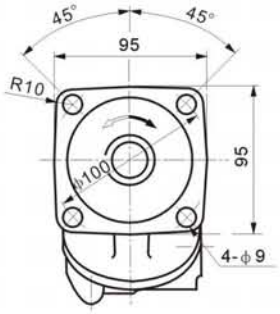
η_{mh} = Mechanical-hydraulic efficiency

η_t = Overall efficiency

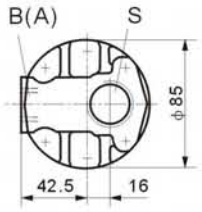
HA2F010/61R-※B06
HA2F012/61R-※B06
HA2F016/61R-※B06

Counter-clockwise rotation:
port plate is rotated through 180°





View Z

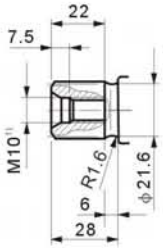


Ports

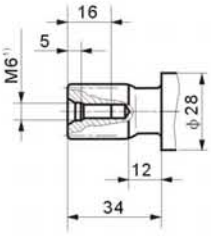
B(A)	Service line port	M22×1.5
S	Suction port	M33×2
T_1,T_2	Case drain ports (T_1 plugged)	M12×1.5
R	Air bleed (plugged)	M8×1

Shaft ends

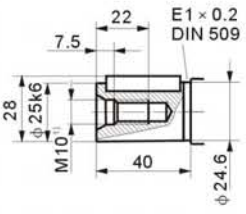
Sizes 10,12,16
A Splined shaft DIN 5480
W25×1.25×30×18×9g
P_N = 40 MPa



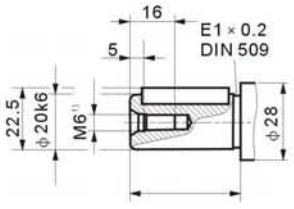
Sizes 10,12
Z Splined shaft DIN 5480
W20×1.25×30×14×9g
P_N = 40 MPa



Sizes 10,12,16
B Parallel keyed shaft,
DIN 6885, AS8×7×32
P_N = 35 MPa



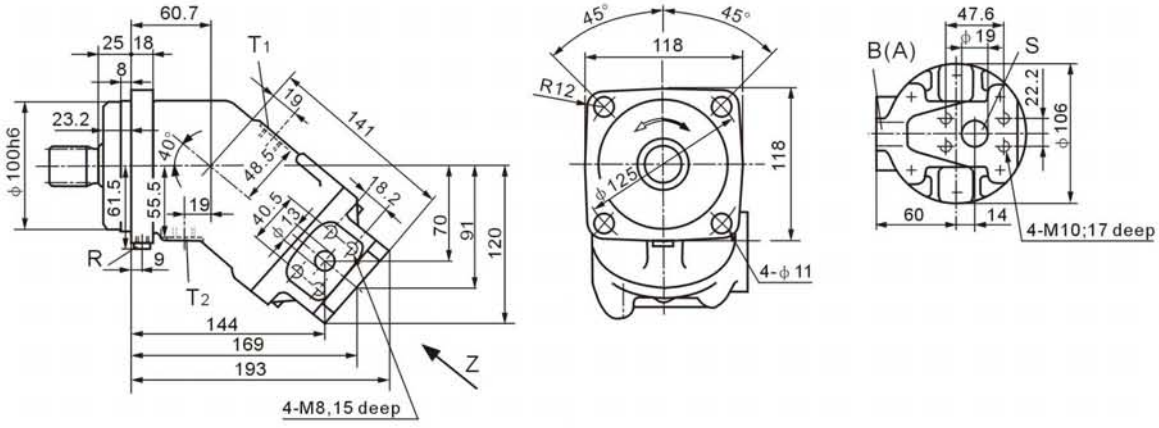
Sizes 10,12
P Parallel keyed shaft
DIN 6885, A6×6×32
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

HA2F023/61R-※B05
HA2F028/61R-※B05
HA2F032/61R-※B05

Counter-clockwise rotation:
port plate is rotated through 180°

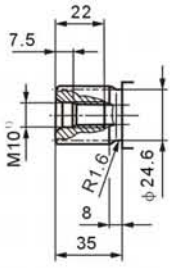


Ports

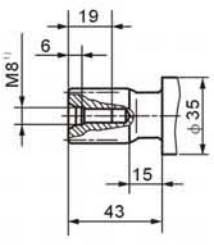
B(A)	Service line port (high pressure series)	SAE 1/2″
S	Suction port (standard pressure series)	SAE 3/4″
T_1, T_2	Case drain ports (T_1 plugged)	M16×1.5
R	Air bleed (plugged)	M10×1

Shaft ends

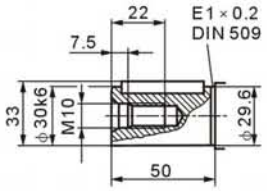
Sizes 23,28,32
A Splined shaft DIN 5480
W30×2×30×14×9g
P_N = 40 MPa



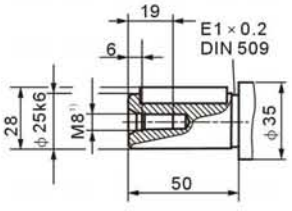
Sizes 23,28
Z Splined shaft DIN 5480
W25×1.25×30×18×9g
P_N = 40 MPa



Sizes 23,28,32
B Parallel keyed shaft,
DIN 6885, AS8×7×40
P_N = 35 MPa



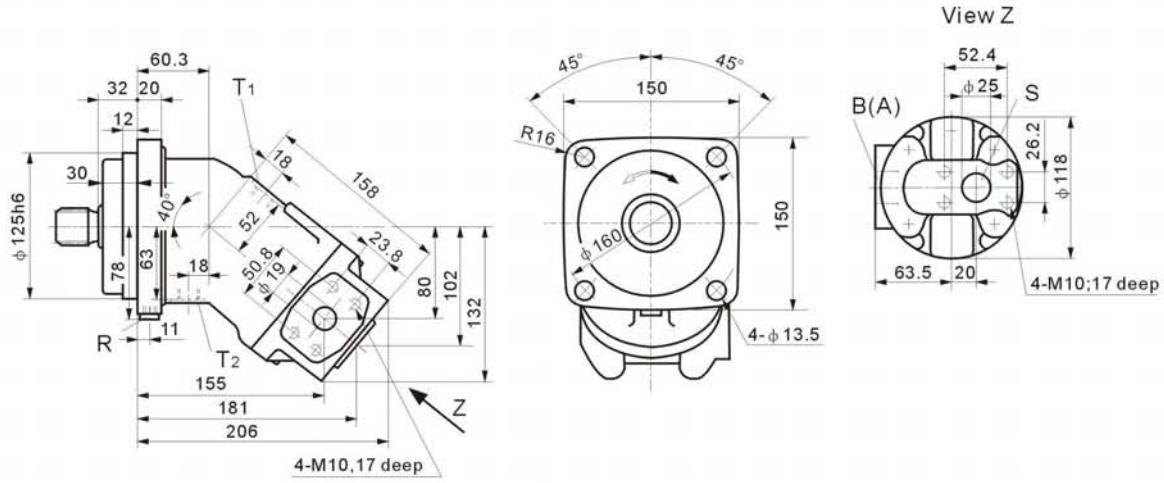
Sizes 23,28
P Parallel keyed shaft
DIN 6885, AS8×7×40
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

HA2F045/61R-※B05

Counter-clockwise rotation:
port plate is rotated through 180°

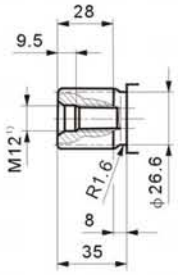


Ports

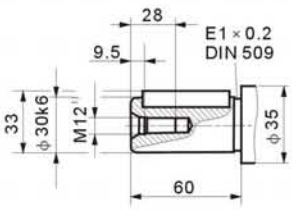
B(A)	Service line port (high pressure series)	SAE 3/4″
S	Suction port (standard pressure series)	SAE 1″
T_1, T_2	Case drain ports (T_1 plugged)	M18×1.5
R	Air bleed (plugged)	M12×1.5

Shaft ends

Size 45
Z Splined shaft DIN 5480
W30×2×30×14×9g
P_N = 40 MPa



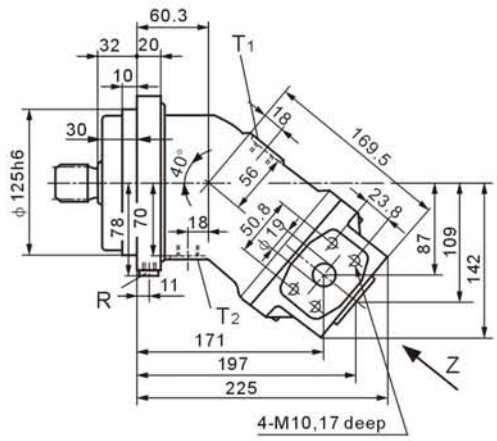
Size 45
P Parallel keyed shaft
DIN 6885, AS8×7×50
P_N = 35 MPa

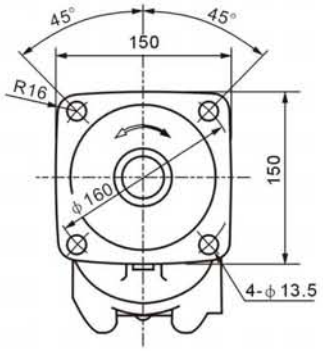


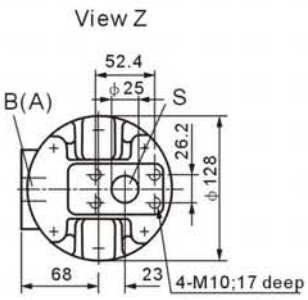
1) centering bore according to DIN 332 (thread according to DIN 13)

HA2F056/61R-※B05
HA2F063/61R-※B05

Counter-clockwise rotation:
port plate is rotated through 180°





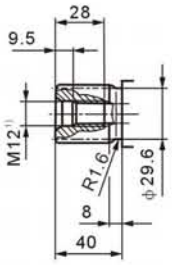


Ports

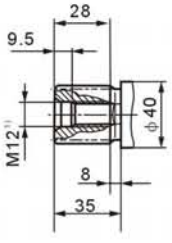
B(A)	Service line port (high pressure series)	SAE 3/4″
S	Suction port (standard pressure series)	SAE 1″
T_1, T_2	Case drain ports (T_1 plugged)	M18×1.5
R	Air bleed (plugged)	M12×1.5

Shaft ends

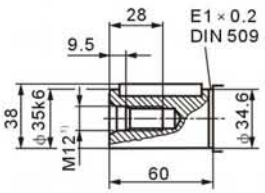
Sizes 56,63
A Splined shaft DIN 5480
W35×2×30×16×9g
P_N = 40 MPa



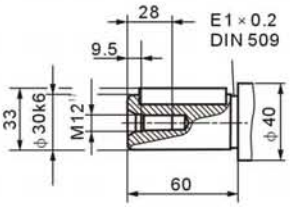
Size 56
Z Splined shaft DIN 5480
W30×2×30×14×9g
P_N = 35 MPa



Sizes 56,63
B Parallel keyed shaft,
DIN 6885, AS10×8×50
P_N = 35 MPa



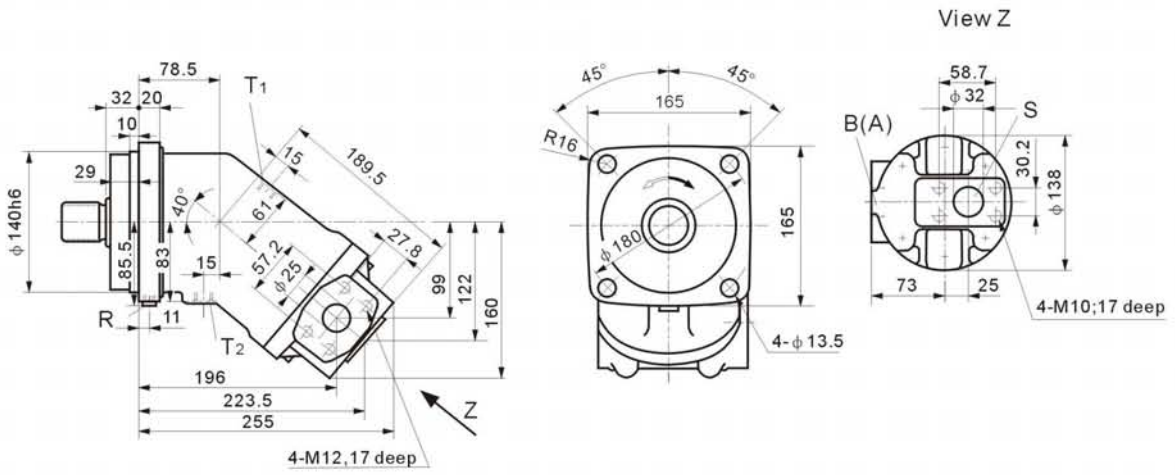
Size 56
P Parallel keyed shaft
DIN 6885, AS8×7×50
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

HA2F080/61R-※B05
HA2F090/61R-※B05

Counter-clockwise rotation:
port plate is rotated through 180°

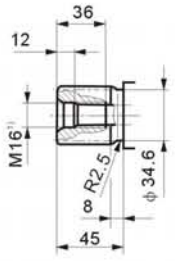


Ports

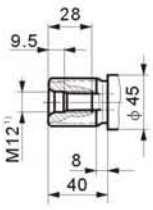
B(A)	Service line port (high pressure series)	SAE 1″
S	Suction port (standard pressure series)	SAE 1 1/4″
T_1, T_2	Case drain ports (T_1 plugged)	M18×1.5
R	Air bleed (plugged)	M12×1.5

Shaft ends

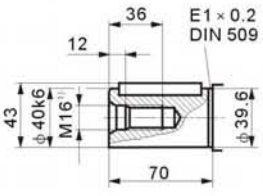
Sizes 80,90
A Splined shaft DIN 5480
W40×2×30×18×9g
P_N = 40 MPa



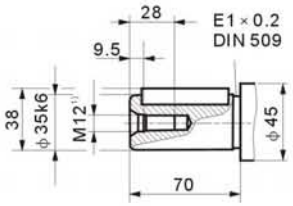
Size 80
Z Splined shaft DIN 5480
W35×2×30×16×9g
P_N = 40 MPa



Sizes 80,90
B Parallel keyed shaft,
DIN 6885, AS12×8×56
P_N = 35 MPa



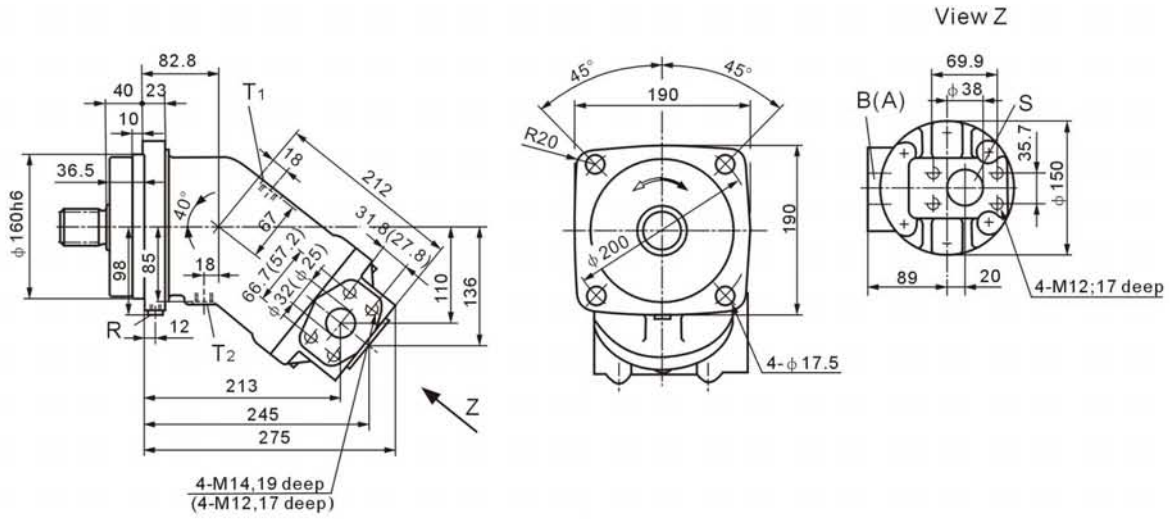
Size 80
P Parallel keyed shaft
DIN 6885, AS10×8×56
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

HA2F0107/61R-※B05
HA2F0125/61R-※B05

Counter-clockwise rotation:
port plate is rotated through 180°



(dimensions for size 107 in bracket)

Ports

B(A)	Service line ports (high pressure series)	SAE 11/4″(1″)
S	Suction port (standard pressure series)	SAE 1 1/2″
T_1, T_2	Case drain ports (T_1 plugged)	M18×1.5
R	Air bleed (plugged)	M14×1.5

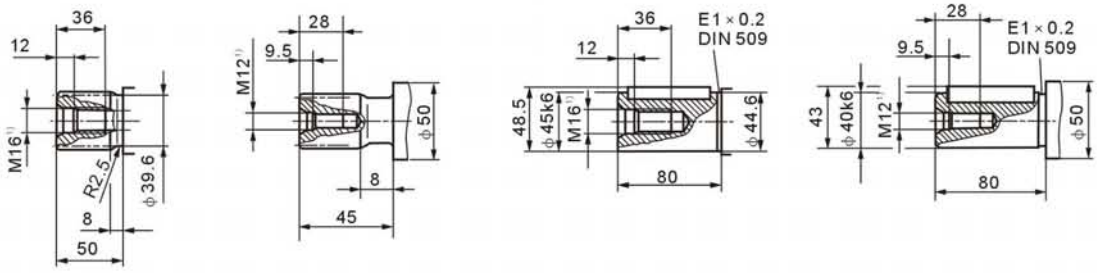
Shaft ends

Sizes 107,125
A Splined shaft DIN 5480
W45×2×30×21×9g
P_N = 40 MPa

Size 107
Z Splined shaft DIN 5480
W40×2×30×18×9g
P_N = 40 MPa

Sizes 107,125
B Parallel keyed shaft,
DIN 6885, AS14×9×63
P_N = 35 MPa

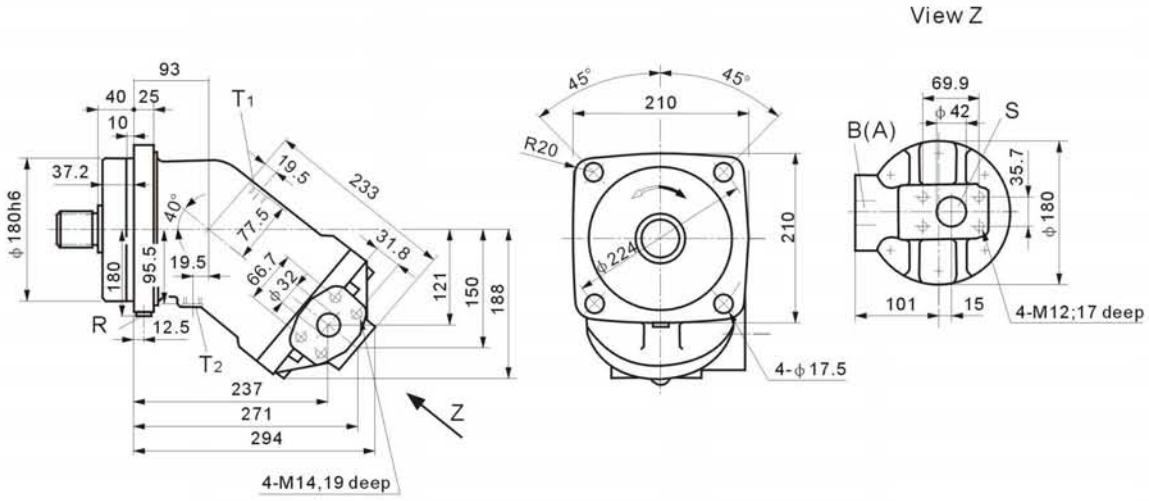
Size 107
P Parallel keyed shaft
DIN 6885, AS12×8×63
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

HA2F0160/61R-※B05
HA2F0180/61R-※B05

Counter-clockwise rotation:
port plate is rotated through 180°

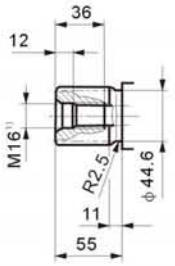


Ports

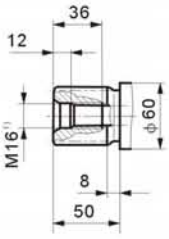
B(A)	Service line port (high pressure series)	SAE 1 1/4″
S	Suction port (standard pressure series)	SAE 1 1/2″
T_1, T_2	Case drain ports (T_1 plugged)	M22×1.5
R	Air bleed (plugged)	M14×1.5

Shaft ends

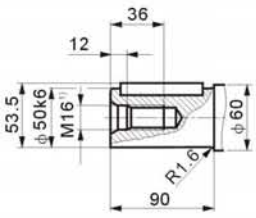
Sizes 160,180
A Splined shaft DIN 5480
W50×2×30×24×9g
P_N = 40 MPa



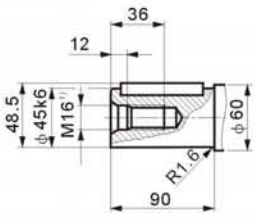
Size 160
A Splined shaft DIN 5480
W45×2×30×21×9g
P_N = 40 MPa



Sizes 160,180
P Parallel keyed shaft
DIN 6885, As14×9×70
P_N = 35 MPa



Size 160
P Parallel keyed shaft
DIN 6885, AS14×9×70
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

General

The pump case must be completely filled up with hydraulic fluid during startup and during operation (filling the case chamber). The pump must be started up at low speed and no load until the system has been bled completely.

If stopped for an extended period,fluid may drain out of the case through the service lines. When restarting, make sure that the case contains sufficient fluid.

The leakage fluid inside the case chamber must be drained off to the tank through the highest case drain port. The min. suction pressure at port S must not fall bellow 0.08 MPa absolute.

Installation position

Optional

Installation below the tank

Pump below min.fluid level in the tank (standard)

— Fill axial piston pump before startup via the highest case drain port

— Additional measures required for installation position 2 (shaft facing up); with installation position 2,make sure that the pump case is completely full before starting up.Bleed at port R. An air pocket in the bearing area is leading to damage of the axial piston pump.

— Recommendation: Fill up suction lines.

— Run the pump at low speed until the system is bled completely.

— Minimum immersion depth of leakage line in tank:200mm (relative to the min. fluid level in the tank).

Installation above the tank

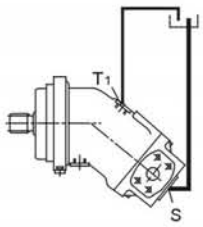
Pump above minimum fluid level in tank

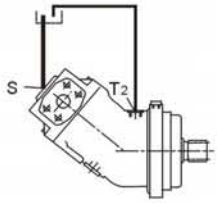
— Proceed in same way as below the tank installation.

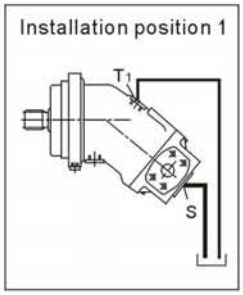
— Additional measures for installation position 1 and 2.
If stopped for an extended period, fluid may drain out of the case chamber through the service lines (air enters through the shaft seal). The bearing will therefore not be properly lubricated when the pump is started up again. Fill the axial piston pump before restarting via the highest case drain port. Installation position 2: bleed at port R.

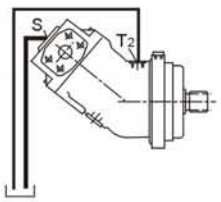
— Additional measures required for installation position 2 (shaft facing up):
In this installation position the bearings will not be properly lubricated, even if there is still some fluid in the case chamber. Putting a non-return valve (opening pressure 0.05 MPa) in the leakage line can prevent the system emptying through the line.

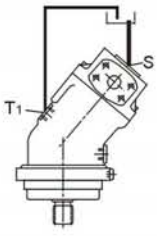
— Note: min.admissible pressure at port S.

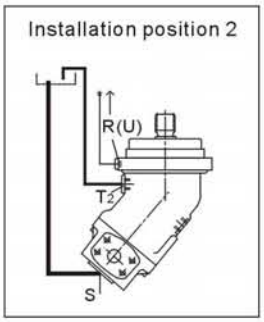


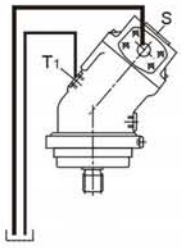


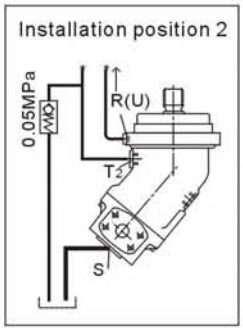












HA2FM Series Axial Piston Fixed Displacement Motor

Product show and brief introduction

Open and closed circuits

Series 6
Sizes 10...180
Nominal pressure 40MPa
Peak pressure 45MPa

Features

— Fixed displacement motor HA2FM of axial piston,bent axis design, suitable for hydrostatic drives in open and closed circuits

— Use in mobile and industrial applications

— The output speed depends on the flow capacity of the pump and the displacement of the motor

— The torque increases with the pressure differential between the high and low pressure side and with increasing displacement

— Careful selection of the displacements offered, permit sizes to be matched to practically every application

— High power density

— Compact design

— High overall efficiency

— Excellent starting torque efficiency

— Economical conception

— One piece pistons with piston rings

Model Code

HA2F	M	80	/6	1	W	-V	A	B	010
Axial piston unit	Mode of operation	Size (mL/r)	Series	Index	Direction of rotation	Seals	Shaft end	Mounting flange	Service line ports
HA2F: Bent axis design, fixed displa-cement	M: Motor	10 12 16 23 28 32 45 56 63 80 90 107 125 160 180	6	1	(Viewed on shaft end) W: Alternating	V: FKM (fluor~ caoutchouc)	See below	B: 4-hole ISO 3019-2	See below

Shaft end

Size		10	12	16	23	28	32	45	56	63	80	90	107	125	160	180
Spined shaft DIN 5480	A	√	√	√	√	√	√	/	√	√	√	√	√	√	√	√
	Z	√	√	/	√	√	/	√	√	/	√	/	√	/	√	/
Parallel keyed shaft, DIN 6885	B	√	√	√	√	√	√	/	√	√	√	√	√	√	√	√
	P	√	√	/	√	√	/	√	√	/	√	/	√	/	√	/

Service line port[1)]

Size	10	12	16	23	28	32	45	56	63	80	90	107	125	160	180
010:SAE flange ports A and B,rear	/	/	/	√	√	√	√	√	√	√	√	√	√	√	√
020:SAE flange ports A and B,at side,opposite	/	/	/	√	√	√	√	√	√	√	√	√	√	√	√
030:Threaded ports A and B, at side,opposite	√	√	√	√	√	√	/	/	/	/	/	/	/	/	/
040:Threaded pord A and B, at side and rear[2)]	√	√	√	√	√	√	√	√	√	/	/	/	/	/	/

√ = available / = not available

1) fastening threads resp.threaded ports are metric
2) at side (sizes 10...63) or rear thread ports plugged with locking screw

Hydraulic fluid

The HA2FM fixed displacement motor is suitable for use with mineral oil.

Viscosity range

We recommend that a viscosity (at operating temperature)for optimum efficiency and service life purposes of

V_{opt} = optimum viscosity16···36mm²/s

Be chosen,taken the circulation temperature (closed circuit)and tank temperature(open circuit) into account.

Limits of viscosity range

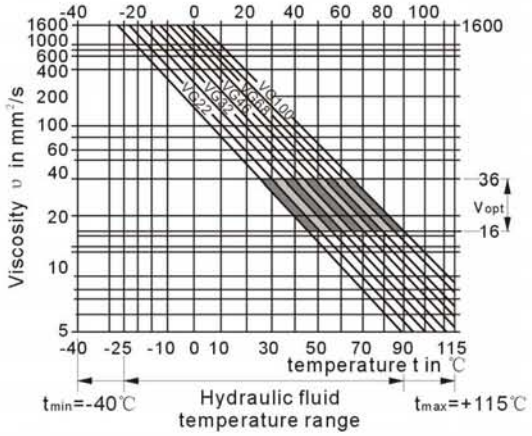
The following values apply in extreme cases:

V_{min} = 5 mm²/s
short term(t<3 min)at max.permitted temperature
t_{max}=115℃

V_{max} = 1600 mm²/s
short term(t<3 min) with cold start(P<3MPa,
n≤1000rpm t_{min}=-40℃)

Note that the maximun hydraulic fluid temperature must not be exceeded locally either (e.g.bearing area).The temperature in the bearing area is-depending on pressure and speed-up to 12 K higher than the average case drain temperature.

Selection diagram



Details regarding the choice of hydraulic fluid

The correct choiceof pressure fluid requires knowledge of the operating temperature in relation to the ambient temperature:in a closed circuit the circulation temperature,in an open circuit the tank temperature.

The hydraulic fluid should be selected so that within the operating temperature range,the operating viscosity lies within the optimun range (υ_{opt})(see shaded section of the selection diagram).We recommend that the highest possible viscosity range should be chosen in each case.

Example:At an ambient temperature of X℃ an operating temperature of 60℃ is set in the circuit. In the optimun operating viscosity range(υ_{opt}; shaded area) this corresponds to the viscosity classes VG 46 or VG68; to be selected: VG 68.

Please note: The leakage fluid temperature, which is affected by pressure and rotational speed,is alway higher than the circulation temperature or tank temperature. At no point in the system may the temperature be higher than 115℃.

Filtartion

The finer the filtration, the cleaner the fluid and the longer the service life of the axial piston unit.

To ensure proper function of the axial piston unit,the hydraulic fluid must have a cleanliness level of at least

20/18/15 according to ISO 4406.

At very high hydraulic fluid temperatures
(90℃ to max.115℃),a cleanliness level of at least

19/17/14 according to ISO 4406 is required.

Please contact us if these cleanliness leveles cannot be achieved.

Operational pressure range

Maximum pressure on port A or B
(pressure data according to DIN 24312)

	Shaft end A, Z	Shaft end B, P
Nominal pressure P_N	40 MPa	35 MPa
Peak pressure P_{max}	45 MPa	40 MPa
summation pressure (A+B)	70 MPa	70 MPa

Please note:at the shaft end Z and P,a nominal pressure of P_N=31.5MPa (P_{max}=35MPa) is permitted for the driven shaft end that is subjected to transverse bending (pinions, V-belts)!

Size 56 with shaft end Z:P_N=35MPa, P_{max}=40MPa

in cases of pulsating loading above 31.5MPa, we recommend the version with splined shaft A or splined shaft Z(sizes 45)

Direction of flow

Direction of rotation, viewed on shaft end

clockwise	counter-clockwise
A to B	B to A

Speed rang

No limit to minimum speed n_{min}. If uniform motion is required, n_{min} must not be less than 50 rpm.

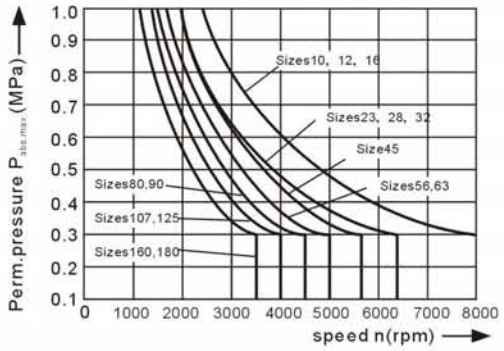
Shaft seal ring

Permissible pressure load

The service life of the shaft seal ring is affected by the speed of the motor and the case drain pressure.The permitted loading with intermittent case drain preessure depends on the rotational speed (see chart).Short-term(t<5 min) pressure spikes of up to 1 MPa absolute are permitted.

The average permanent case drain pressure must not exceed 0.3 MPa absolute.

The pressure in the case must be equal to or greater than the external pressure on the shaft seal.



Temperature range

The FKM shaft seal is admissible for a housing temperature range from -25℃ to +115℃

Teble of values (theoretical values, ignoring η_{min} and η_v; values rounded)

Size				10	12	16	23	28	32	45
Displacement		V_g	mL/r	10.3	12.0	16.0	22.9	28.1	32.0	45.6
Speed max		n_{max}	min^{-1}	8000	8000	8000	6300	6300	6300	5600
		$n_{max\ limit}$ [1]	min^{-1}	8800	8800	8800	6900	6900	6900	6200
Flow max.		q_{vmax}	L/min	82	96	128	144	176	201	255
Torque constants		T_k	Nm/MPa	1.64	1.9	2.5	3.6	4.45	5.09	7.25
Torque at	△P=35 MPa	T	Nm	57	67	88	126	156	178	254
	△P=40 MPa	T	Nm	65	76	100	144	178	204	290
Filling capacity			L	0.17	0.17	0.17	0.20	0.20	0.20	0.33
Mass moment of inertia around output shaft		J	kgm^2	0.0004	0.0004	0.0004	0.0012	0.0012	0.0012	0.0024
Mass(approx.)			kg	5.4	5.4	5.4	9.5	9.5	9.5	13.5

Size				56	63	80	90	107	125	160	180
Displacement		V_g	mL/r	56.1	63.0	80.4	90.0	106.7	125.0	160.4	180.0
Speed max		n_{max}	min^{-1}	5000	5000	4500	4500	4000	4000	3600	3600
		$n_{max\ limit}$ [1]	min^{-1}	5500	5500	5000	5000	4400	4400	4000	4000
Flow max.		q_{vmax}	L/min	280	315	360	405	427	500	577	648
Torque constants		T_k	Nm/MPa	8.9	10.0	12.7	17.0	19.9	25.4	28.6	31.8
Torque at	△P=35 MPa	T	Nm	312	350	445	501	595	697	889	1001
	△P=40 MPa	T	Nm	356	400	508	572	680	796	1016	1144
Filling capacity			L	0.45	0.45	0.55	0.55	0.8	0.8	1.1	1.1
Mass moment of inertia around output shaft		J	kgm^2	0.0042	0.0042	0.0072	0.0072	0.0116	0.0116	0.0220	0.0220
Mass(approx.)			kg	18	18	23	23	32	32	45	45

1) intermittent maximum speed:overspeed at discharge and over-running travel operations,t<5 sec. and △P<15 MPa.

Determining the size

Flow $q_v = \frac{V_g \cdot n}{1000 \cdot \eta_v}$ [L/min]

Speed $n = \frac{q_v \cdot 1000 \cdot \eta_v}{V_g}$ [rpm]

Torque $T = \frac{V_g \cdot \triangle P \cdot \eta_{mh}}{20\pi}$ [Nm]

Power $P = \frac{2\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \triangle P}{600 \cdot \eta_t}$ [kW]

V_g = Displacement per revolution in mL/r

△P = Differential pressure in MPa

n = Speed in rpm

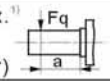
η_v = Volumetric efficiency

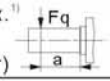
η_{mh} = Mechanical-hydraulic efficiency

η_t = Overall efficiency

Permissible radial and axial loading on the drive shaft

The values given are maximum values and do not apply to continuous operation

Size				10	12	16	23	28	32	45	56
Radial force, max.[1] at distance a (from shaft collar)		$F_{q\,max}$	N	2350	2750	3700	4300	5400	6100	8150[2]	9200[2]
		a	mm	16	16	16	16	16	16	18	18
Axial force, max.[3]		$+F_{ax\,max}$	N	320	320	320	500	500	500	630	800
		$-F_{ax\,max}$	N	320	320	320	500	500	500	630	800
Permissible axial force/MPa operating pressure		$\pm F_{ax\,per}$/MPa	N/MPa	30	30	30	52	52	52	70	87

Size				63	80	90	107	125	160	180
Radial force, max.[1] at distance a (from shaft collar)		$F_{q\,max}$	N	10300	11500[2]	12900	13600	15900	18400	20600
		a	mm	18	20	20	20	20	25	25
Axial force, max.[3]		$+F_{ax\,max}$	N	800	1000	1000	12500	1250	1600	1600
		$-F_{ax\,max}$	N	800	1000	1000	12500	1250	1600	1600
Permissible axial force/MPa operating pressure		$\pm F_{ax\,per}$/MPa	N/MPa	87	106	106	129	129	167	167

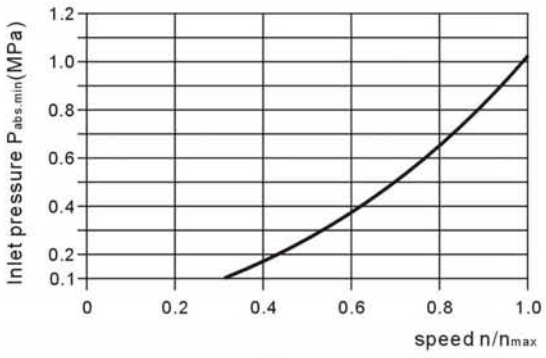
1) during intermittent operation
2) permissible max.radial force with shaft end Z: $F_{q\,max}$ = 6500N
3) max.permissble axial force when stopped or when axial piston unit working in pressureless conditions
4) when stopped or when axial piston unit working in pressureless conditions.Higher forces are permitted when under pressure. Please contact us.

When considering the permissible axial force, the force-transfer direction must be taken into account:

$-F_{ax\,max}$ = increase in service life of bearings
$+F_{ax\,max}$ = reduction in service life of bearings(avoid if at all possible)

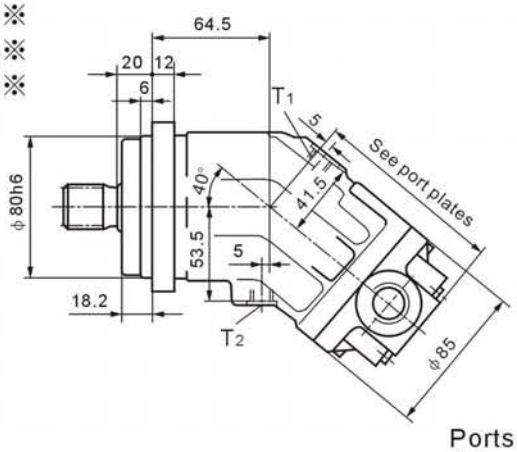
Minimum inlet pressure on service line port A(B)

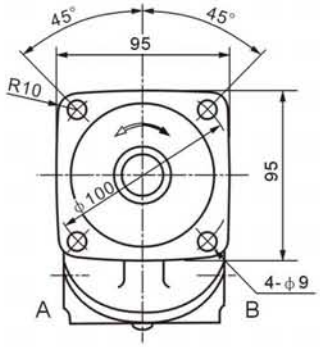
In order to avoid damage of the motor a minimum inlet pressure at the inlet zone must be assured.
The minimum inlet pressure is related to the rotational speed of the fixed motor.



Please contact us if these conditions cannot be satisfied.

HA2FM10/61W-V※B※
HA2FM12/61W-V※B※
HA2FM16/61W-V※B※



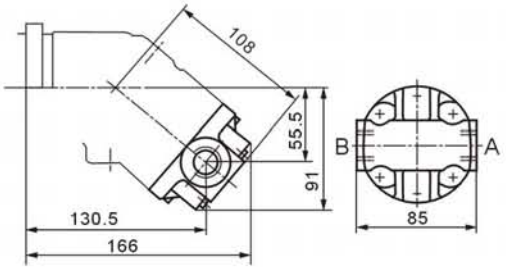


Ports

A,B	Service line ports (see port plates)	
T_1,T_2	Case drain ports (T_1 plugged)	M12×1.5

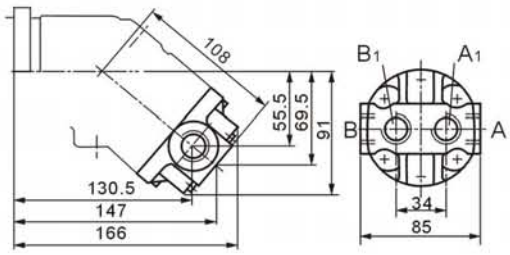
Port plates

03 Threaded ports, at side



A,B	Service line ports	M22×1.5

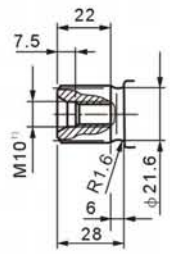
03 Threaded ports, at side and rear



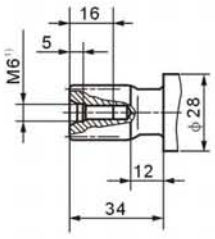
A,B,A_1,B_1	Service line ports	M22×1.5

Shaft ends

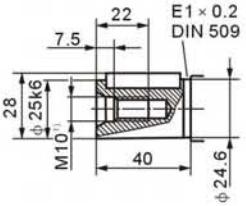
Sizes 10,12,16
A Splined shaft DIN 5480
W25×1.25×30×18×9g
P_N = 40 MPa



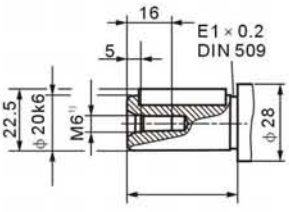
Sizes 10,12
Z Splined shaft DIN 5480
W20×1.25×30×14×9g
P_N = 40 MPa



Sizes 10,12,16
B Parallel keyed shaft,
DIN 6885, AS8×7×32
P_N = 35 MPa

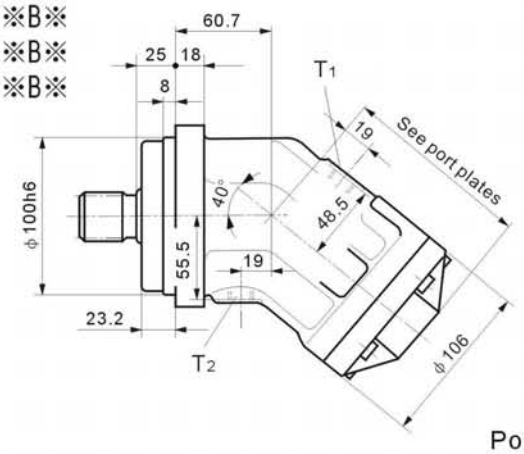


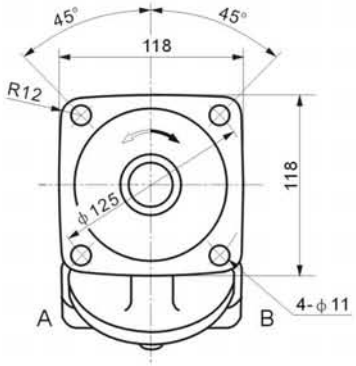
Sizes 10,12
P Parallel keyed shaft
DIN 6885, A6×6×32
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

HA2FM23/61W-V※B※
HA2FM28/61W-V※B※
HA2FM32/61W-V※B※



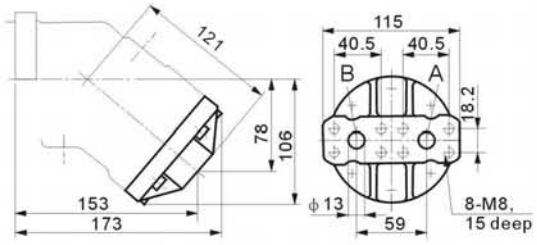


Ports

A,B	Service line ports (see port plates)	
T_1,T_2	Case drain ports (T_1 plugged)	M16×1.5

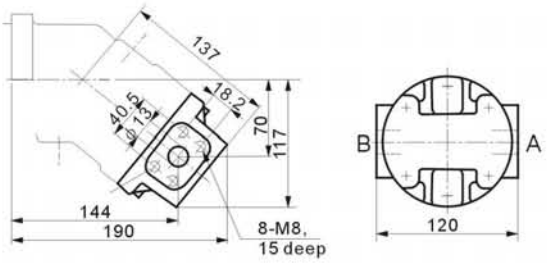
Port plates

01 SAE flange ports,rear



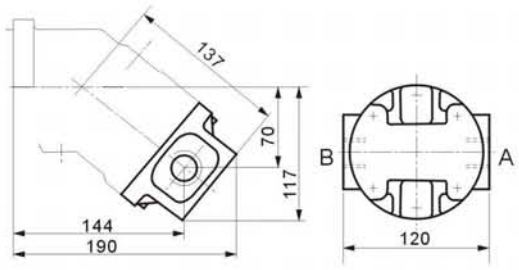
A,B	Service line ports 42 MPa(6000 psi)high pressure series	SAE 1/2″

02 SAE flange ports,at side



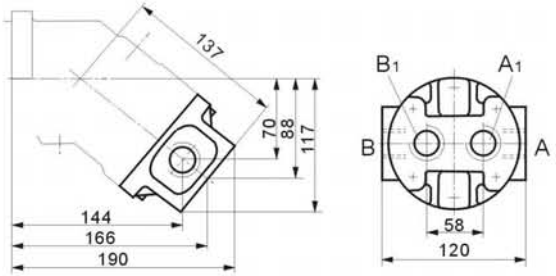
A,B	Service line ports 42 MPa(6000 psi)high pressure series	SAE 1/2″

03 Threaded ports,at side



A,B	Service line ports	M27×2

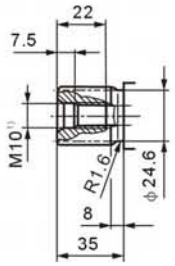
04 Threaded ports,at side and rear



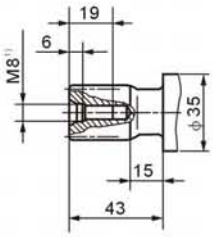
A,B,A_1,B_1	Service line ports	M27×2

Shaft ends

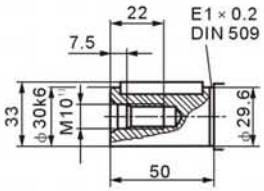
Sizes 23,28,32
A Splined shaft DIN 5480
W30×2×30×14×9g
P_N = 40 MPa



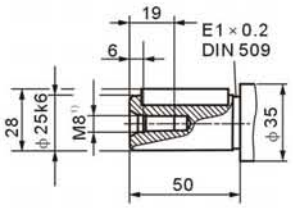
Sizes 23,28
Z Splined shaft DIN 5480
W25×1.25×30×18×9g
P_N = 40 MPa



Sizes 23,28,32
B Parallel keyed shaft,
DIN 6885, AS8×7×40
P_N = 35 MPa

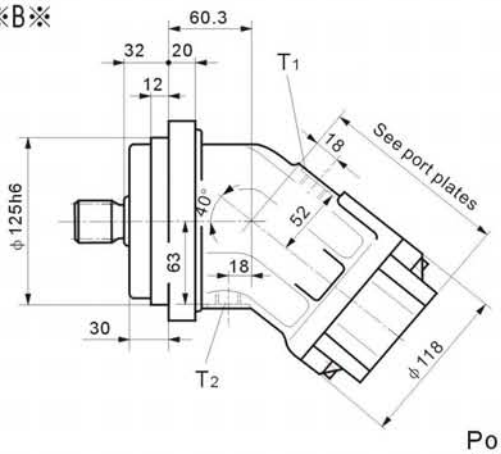


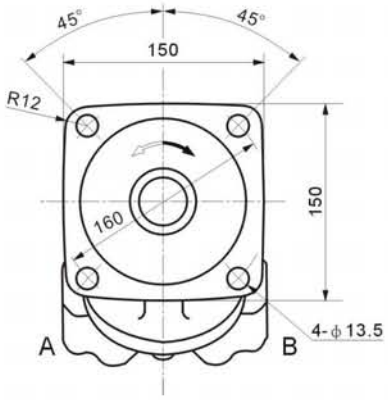
Sizes 23,28
P Parallel keyed shaft
DIN 6885, AS8×7×40
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

HA2FM45/61W-V※B※



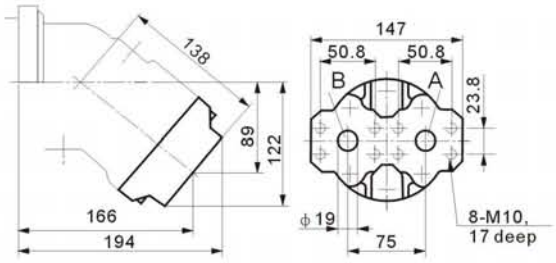


Ports

A,B	Service line ports (see port plates)	
T_1T_2	Case drain ports (T_1 plugged)	M18×1.5

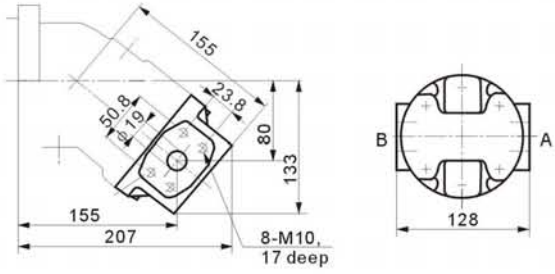
Port plates

01 SAE flange ports,rear



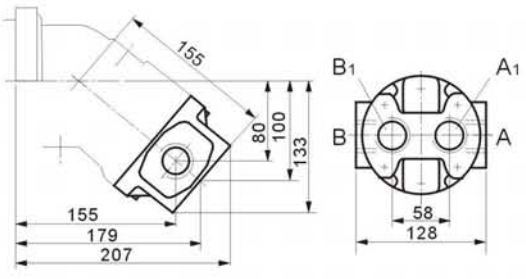
A,B	Service line ports 42 MPa(6000 psi)high pressure series	SAE 3/4″

02 SAE flange ports,at side



A,B	Service line ports 42 MPa(6000 psi)high pressure series	SAE 3/4″

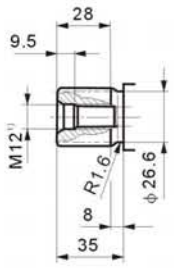
04 Threaded ports,at side and rear



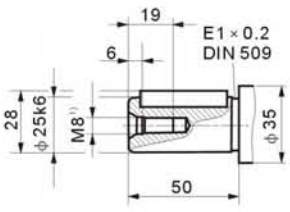
A,B,A_1,B_1	Service line ports	M33×2

Shaft ends

Size 45
Z Splined shaft DIN 5480
W30×2×30×14×9g
P_N = 40 MPa

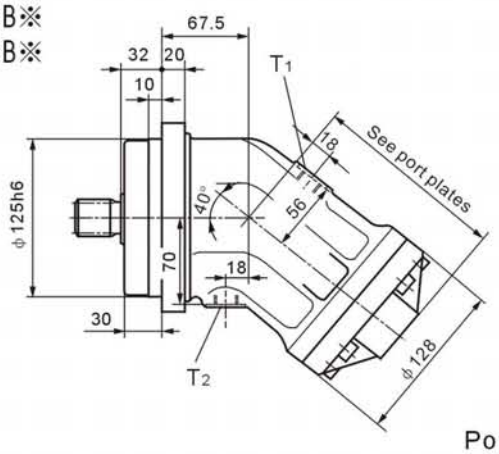


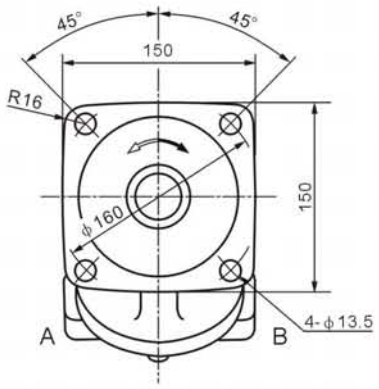
Size 45
P Parallel keyed shaft
DIN 6885, AS8×7×50
P_N = 35 MPa



1) centering bore according to DIN 332
(thread according to DIN 13)

HA2FM56/61W-V※B※
HA2FM63/61W-V※B※



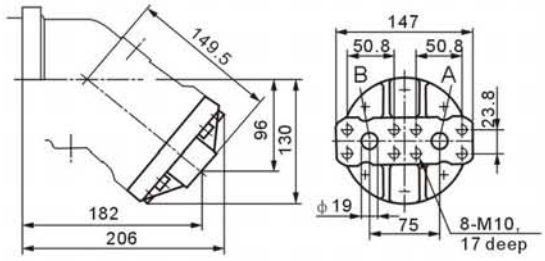


Ports

A,B	Service line ports (see port plates)	
T_1,T_2	Case drain ports (T_1 plugged)	M18×1.5

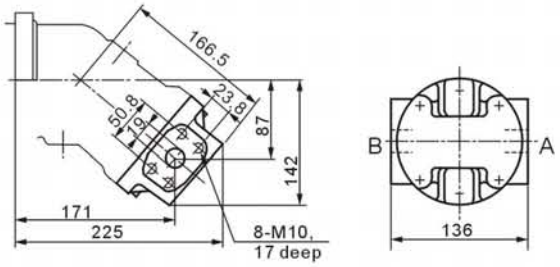
Port plates

01 SAE flange ports,rear



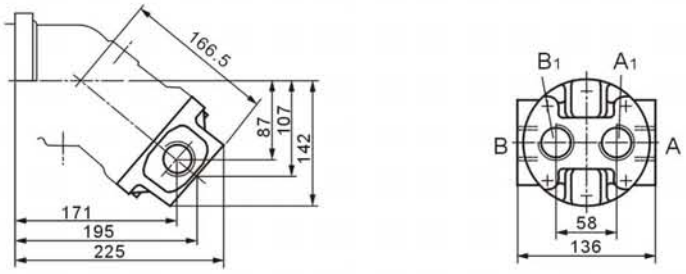
A,B	Service line ports 42 MPa(6000 psi)high pressure series	SAE 3/4″

02 SAE flange ports,at side



A,B	Service line ports 42 MPa(6000 psi)high pressure series	SAE 3/4″

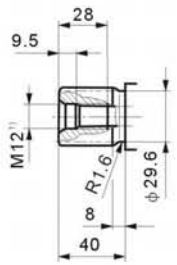
04 Threaded ports,at side and rear



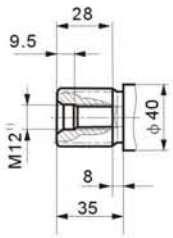
A,B,A_1,B_1	Service line ports	M33×2

Shaft ends

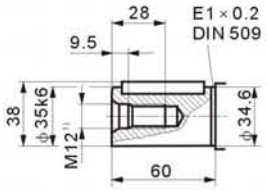
Sizes 56,63
A Splined shaft DIN 5480
W35×2×30×16×9g
P_N = 40 MPa



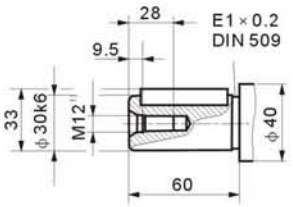
Sizes 56
Z Splined shaft DIN 5480
W30×2×30×14×9g
P_N = 35 MPa



Sizes 56,63
B Parallel keyed shaft,
DIN 6885, AS10×8×50
P_N = 35 MPa

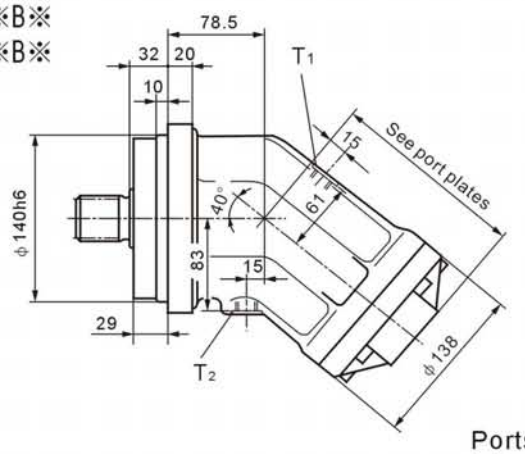


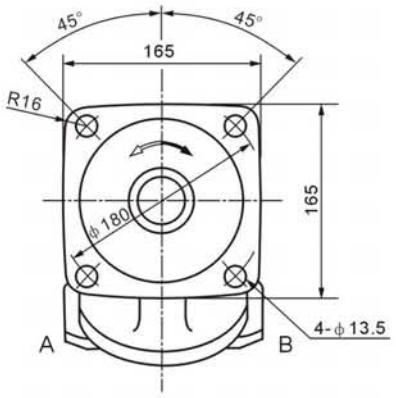
Size 56
P Parallel keyed shaft
DIN 6885, AS8×7×50
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

HA2FM80/61W-V※B※
HA2FM90/61W-V※B※



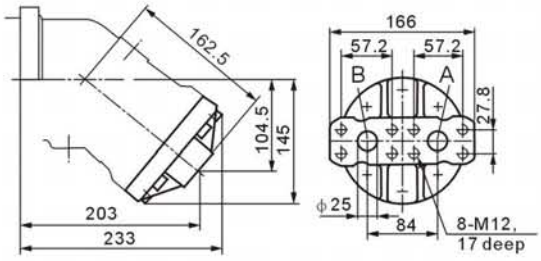


Ports

A,B	Service line ports (see port plates)	
T_1,T_2	Case drain ports (T_1 plugged)	M18×1.5

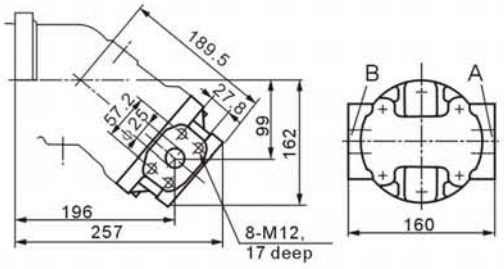
Port plates

01 SAE flange ports,rear



A,B	Service line ports 42 MPa(6000 psi)high pressure series	SAE 1″

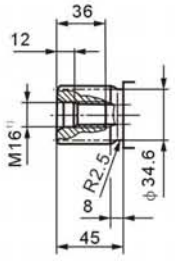
02 SAE flange ports,at side



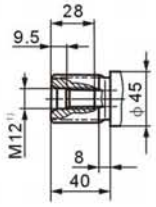
A,B	Service line ports 42 MPa(6000 psi)high pressure series	SAE 1″

Shaft ends

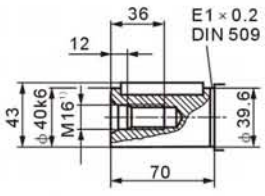
Sizes 80,90
A Splined shaft DIN 5480
W40×2×30×18×9g
P_N = 40 MPa



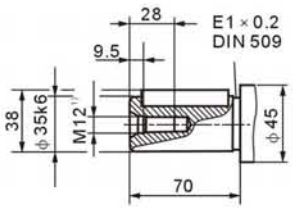
Size 80
Z Splined shaft DIN 5480
W35×2×30×16×9g
P_N = 40 MPa



Sizes 80,90
B Parallel keyed shaft,
DIN 6885, AS12×8×56
P_N = 35 MPa

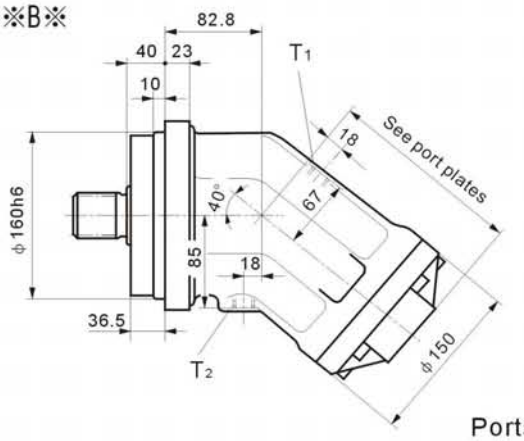


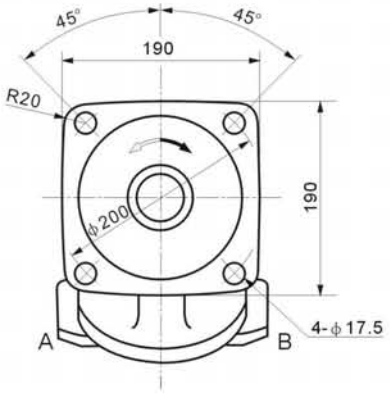
Size 80
P Parallel keyed shaft
DIN 6885, AS10×8×56
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

HA2FM107/61W-V※B※
HA2FM125/61W-V※B※



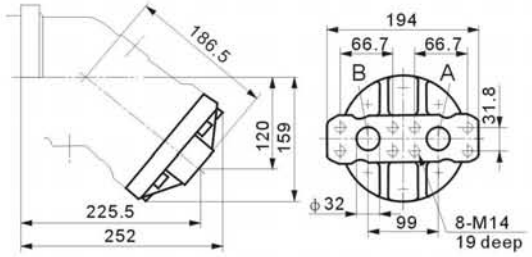


Ports

A,B	Service line ports (see port plates)	
T_1,T_2	Case drain ports (T_1 plugged)	M18×1.5

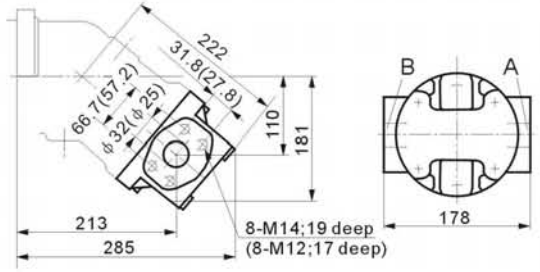
Port plates

01 SAE flange ports,rear



A,B Service line ports SAE 1 1/4″
42 MPa(6000 psi)high pressure series

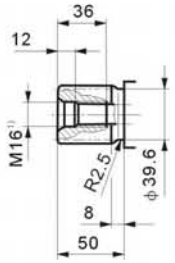
02 SAE flange ports,at side
(dimensions for size 107 in bracket)



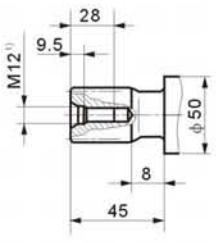
A,B Service line ports SAE 1 1/4″ (1″)
42 MPa(6000 psi)high pressure series

Shaft ends

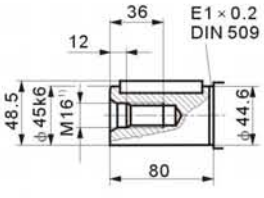
Sizes 107,125
A Splined shaft DIN 5480
W45×2×30×21×9g
P_N = 40 MPa



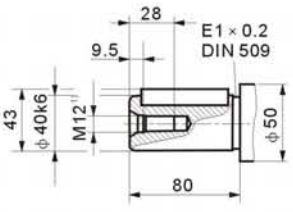
Size 107
Z Splined shaft DIN 5480
W40×2×30×18×9g
P_N = 40 MPa



Sizes 107,125
B Parallel keyed shaft,
DIN 6885, AS14×9×63
P_N = 35 MPa

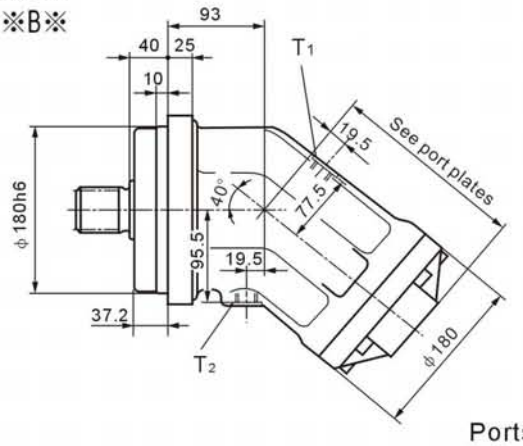


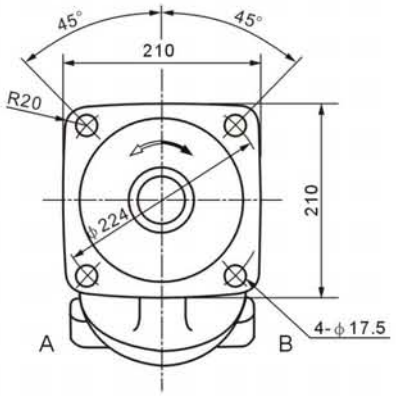
Size 107
P Parallel keyed shaft
DIN 6885, AS12×8×63
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

HA2FM160/61W-V※B※
HA2FM180/61W-V※B※



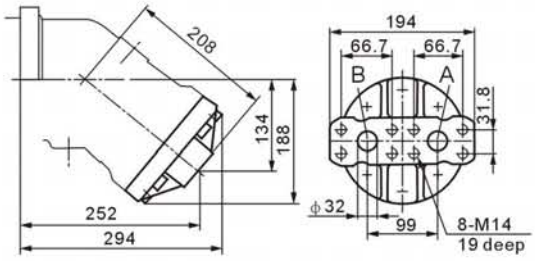


Ports

A,B	Service line ports (see port plates)	
T_1 T_2	Case drain ports (T_1 plugged)	M22×1.5

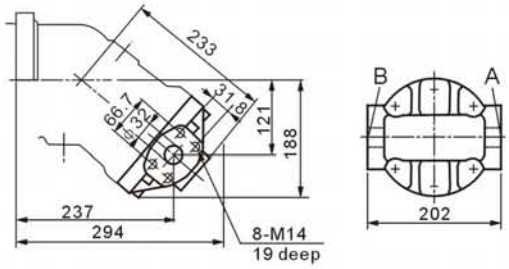
Port plates

01 SAE flange ports,rear



A,B	Service line ports	SAE 1 1/4″
	42 MPa(6000 psi)high pressure series	

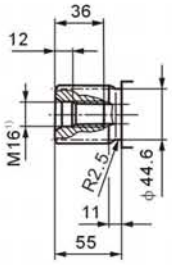
02 SAE flange ports,at side



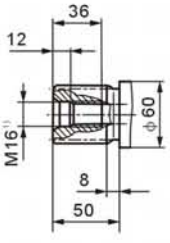
A,B	Service line ports	SAE 1 1/4″
	42 MPa(6000 psi)high pressure series	

Shaft ends

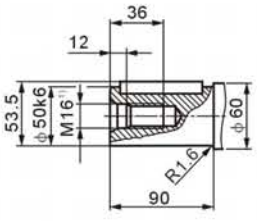
Sizes 160,180
A Splined shaft DIN 5480
W50×2×30×24×9g
P_N = 40 MPa



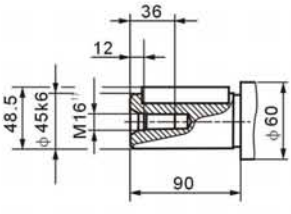
Size 160
A Splined shaft DIN 5480
W45×2×30×21×9g
P_N = 40 MPa



Sizes 160,180
P Parallel keyed shaft
DIN 6885, AS14×9×70
P_N = 35 MPa



Size 160
P Parallel keyed shaft
DIN 6885, AS14×9×70
P_N = 35 MPa



1) centering bore according to DIN 332 (thread according to DIN 13)

General

The motor case must be completely filled up with hydraulic fluid during startup and during operation (filling the case chamber). The motor must be started up at low speed and no load until the system has been bled completely.

If stopped for an extended period, fluid may drain out of the case through the service lines.When restarting, make sure that the case contains sufficient fluid.

The leakage fluid inside the case chamber must be drained off to the tank through the highest case drain port.

Installation osition

Optional. With installation position "shaft to the top" use motor with bleeding port R.

Installation below the tank

Motor below min. fluid level in the tank (standard)

— Fill axial piston motor before startup via the highest case drain port

— Run the motor at low speed until the system is bled completely (bleed through service line port A, B if tubing is long)

— Minimum immersion depth of leakage line in tank:200mm (relative to the min. fluid level in the tank).

— Additional measures required for installation position 2 (shaft facing up); with installation position 2,make sure that the motor case is completely full before starting up. Bleed at port R .
Order port R in clear text. An air pocket in the bearing area is leading to damage of the axial piston motor.

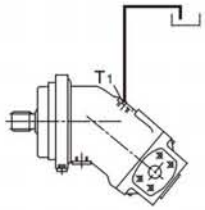
Installation above the tank

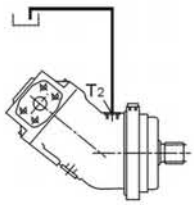
Motor above min. fluid level in tank

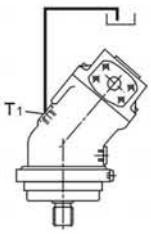
— Proceed in same way as below the tank installation

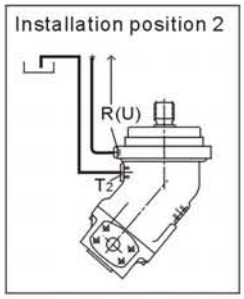
— Additional measures for installation position 1 and 2: If stopped for an extended period, fluid may drain out of the case chamber through the service lines (air enters through the shaft seal). The bearing will therefore not be properly lubricated when the motor is started up again. Fill the axial piston motor before restarting via the highest case drain port. Installation position 2: bleed at port R. Order port R in clear text

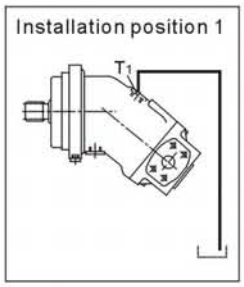
— Additional measures required for installation position 2 (shaft facing up):
In this installation position the bearings will not be properly lubricated, even if there is still some fluid in the case chamber. Putting a non-return valve (opening pressure 0.05 MPa) in the leakage line can prevent the system emptying through the line.

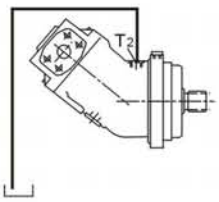


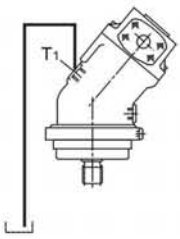


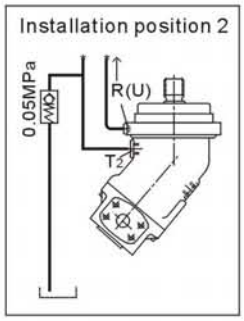












HA Series Piston Pumps

Product show and brief introduction

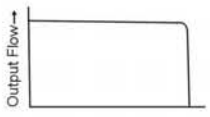
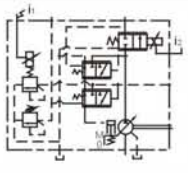
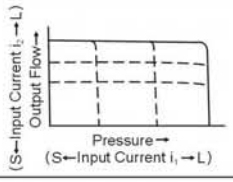
HA series variable displacement piston pumps has high efficiency, lower noise and accomplishment energy-saving characteristic and so widely used in plastic Injection machinery, pressure founding machinery, tools machinery, chemical and light industry field and so on. It has two kinds of control type, which are pressure compensator type ("01" type) and proportional electro-Hydraulic load sensing type("04"type).

Model Code

HA	16	-F	-R	-01	-B	-S	-K	-32	-V
Series Number	Geometric displacement	Mounting	Direction of Rotation	Control Type	Pres.Adj.Rang Mpa	Port Position	Shaft Extension	Design Number	Back pressure control type
HA	16	F: Flange Mtg. L: Foot Mtg.	(View form Shaft End) R: Clockwise	01: Pressure Compensator Type 04: Proportional Electro-Hydraulic Load Sensing Type	B:1.2-7 C:1.2-16 H:1.2-21	None: Axial Port S: Side Port	K: Keyed Shaft	32	Without note: without proportional back pressure control type
	22				B:1.2-7 C:1.2-16			32	
	37、45、56、64				B:1.2-7 C:1.2-16 H:1.2-21			32	
	70、80、90、100、120、145、160				"01" B:1.2-7 C:1.2-16 H:1.2-21 "04" H:1.5-21			32	V : with proportional back pressure control type

Note:back pressure control type only use for "04" code, please contract with us for detail information.

Control Type

Control Type	Graphic Symbols	Performarce Characteristics	Explanation
"01" :Pressure Compensator Type			When the system pressure increases and comes close to the preset cut-off pressure, the pump flow decreases automatic ally while maintaining the set pressure as it is.
"04" : Proportional Electro-Hydraulic Load Sensing Type			This is an energy-saving type control which regulates the pump flow and load pressure to be at absolute minimun necessary level to operate the actuator. Pump flow rate and cut-off pressure are controlled proportional to the input current to the control device on the p-ump and the input current is regurated by the specific amplifier.

Specification

"01" Type

Size	Geometic Displacement mL/r	Operating Press MPa		Speed Range r/min		Approx.Mass Kg	
		Rated	Max	Max	Min	Flange Mtg	Foot Mtg
HA16	15.8	16	21	1800	600	16.5	18.7
HA22	22.2	16	16	1800	600	16.5	18.7
HA37	36.9	16	21	1800	600	28.0	32.3
HA45	45.0	16	21	1800	600	28.0	32.3
HA56	56.2	16	21	1800	600	35.0	39.3
HA64	64.0	16	21	1800	600	35.0	39.3
HA70	70.0	21	21	1800	600	56.5	68.6
HA80	80.0	21	21	1800	600	56.5	68.6
HA90	90.0	21	21	1800	600	70.0	90.5
HA100	100.0	21	21	1800	600	70.0	90.5
HA120	120.0	21	21	1800	600	70.0	90.5
HA145	145.0	21	21	1800	600	96.0	121
HA160	160.0	21	21	1800	600	96.0	121

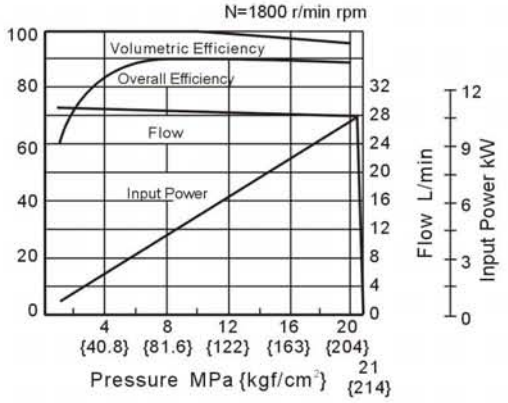
"04" Type

Descriptions \ Model Number			HA16	HA22	HA37	HA45	HA56	HA64	HA70	HA80	HA90	HA100	HA120	HA145	HA160
Geometric Displacement		mL/r	15.8	22.2	36.9	45	56.2	64.0	70.0	80.0	90.0	100	120	145	160
Operating Pres MPa	Rated*2		16	16	16	16	16	16	21	21	21	21	21	21	21
	Max*1		21	16	21	21	21	21	21	21	21	21	21	21	21
Shaft Speed Range r/min	Max		1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
	Min		600	600	600	600	600	600	600	600	600	600	600	600	600
Flow Control	Flow adj range	L/min	1-28.4	1-40	1-66	1-81	1-101	1-115	1-126	1-144	1-163	1-180	1-216	1-261	1-288
	Min pres.required for flow addition	MPa	1.5	1.5	1.5	1.5	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Differenhal president (discharge pres.-load pres.)		0.37						0.22						
	Step Response*3 (0→Max.Flow)	ms	70	80	120	120	125	125	100	100	120	120	120	210	210
	Hysteresis		Less than 3%*4												
	Rated Cunent	mA	900	700	740	740	790	790	820	820	920	920	920	920	920
	Coil Resistance [20℃ (68°F)]	Ω	10												
Pres. Control	Pres.Adj.Range	MPa	Refer to model number designation												
	Step Response ms	t_1*5	80	80	50	50	55	55	150	150	150	150	150	160	160
		t_2*5	140	90	80	80	80	80	80	80	120	120	120	180	180
	Hysteresis		Less than 2%*4												
	Rated Cunent	mA	Pres.Adj.Range B: 770 C: 880 H: 790						H: 755						
	Coil Resistance [20℃(68°F))	Ω	10												
Applicable Amplifier Model*6			HT-A-P/F-10												
Approx.Mass kg(Lbs)	Flarge Mtg		32	32	38	38	45	45	72.5	72.5	88.5	88.5	88.5	109.5	109.5
	Foot Mtg		34.2	34.2	43.2	43.2	49.3	49.3	84.5	84.5	109	109	109	134.5	134.5

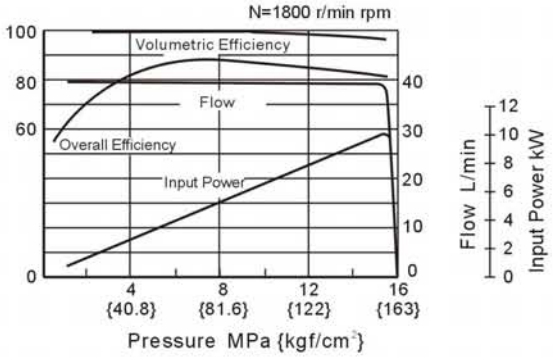
1. When ever setting pressure, make sure the full cut-off pressure never exceeds the maximum inte mmittent pressure.
2. When operating the pump exceeding the rated pressure, operating conditions are restricted. Refer to page 57 for the details.
3. For detail specifications of power amplifier, refer to HT-A-P/F-10.
4. The figure mentioned in the above table are those obtained using HT-A-P/F-10 amplifier.
5. Step response depend on circuit and operating conditions. Data shown in the table above is an example based on the Condition right.

Model	Pres. Step Response		Loading Volume
	t_1	t_2	
HA16、HA22	1.5→16MPa	16→1.5MPa	High Pressure Hose 3/8" × 2m(6.6ft)
HA37、HA45、HA56、HA64	2.0→16MPa	16→2.5MPa	High Pressure Hose 3/4" × 2m(6.6ft)
HA70、HA80、HA90、HA100、HA120、HA145、HA160	3.0→16MPa	16→3.0MPa	High Pressure Hose 1-1/4" × 2m(6.6ft)

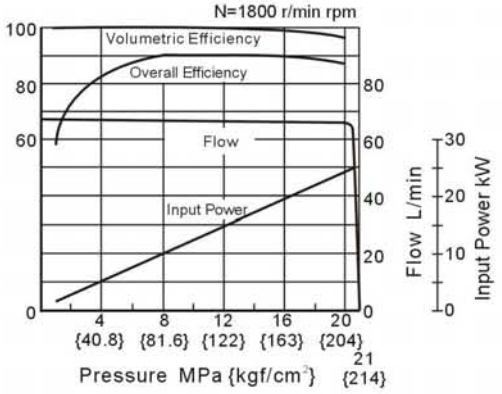
HA 16



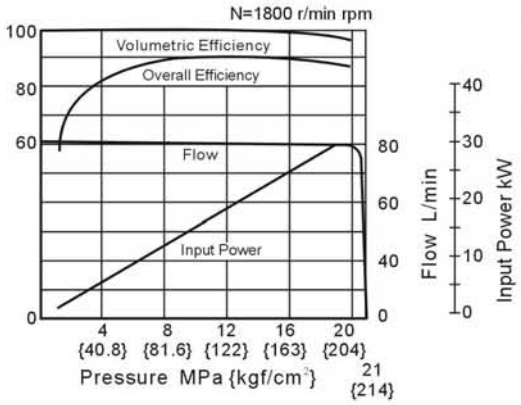
HA 22



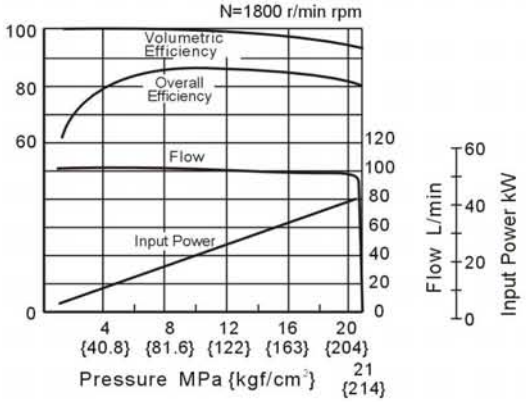
HA 37



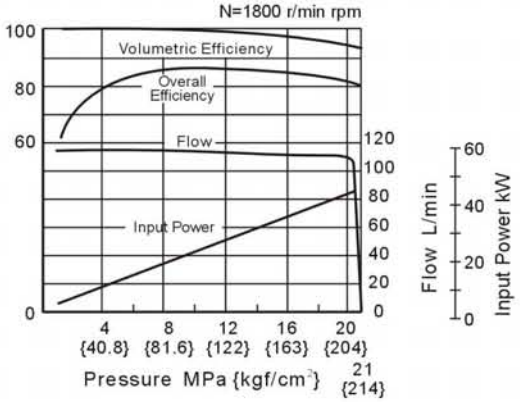
HA 45



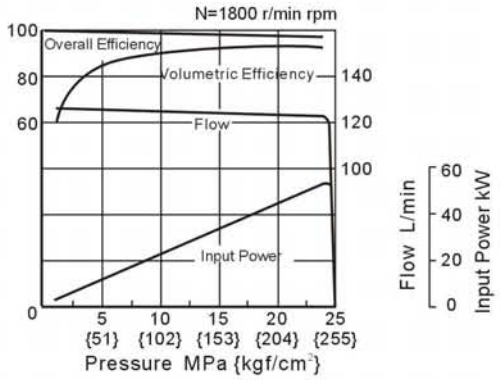
HA 56



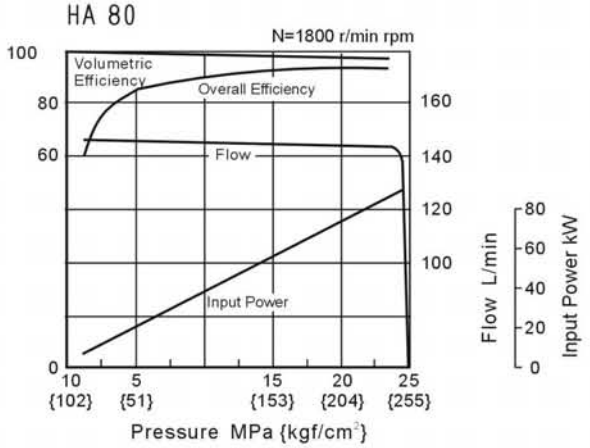
HA 64



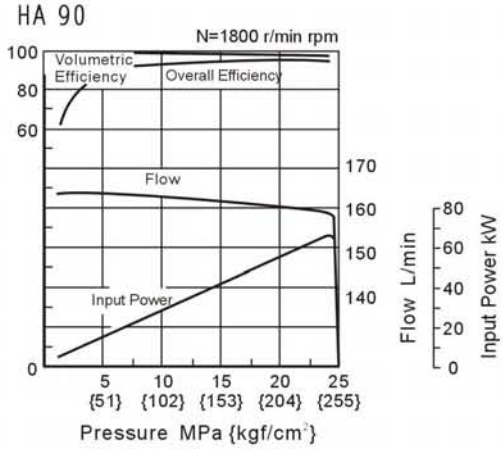
HA 70



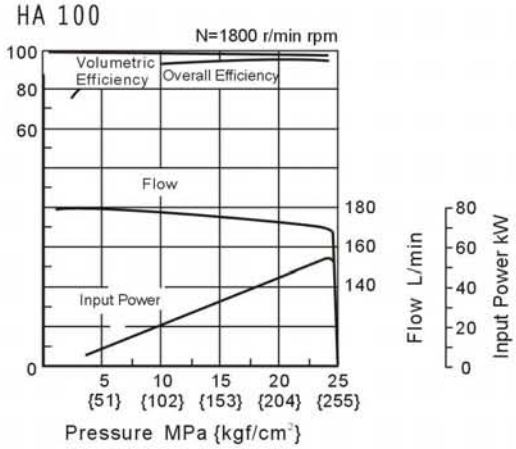
HA 80



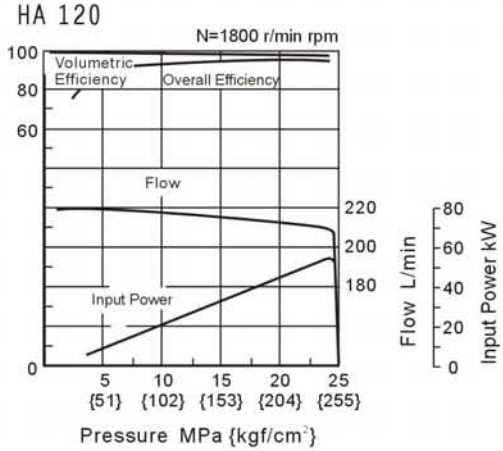
HA 90



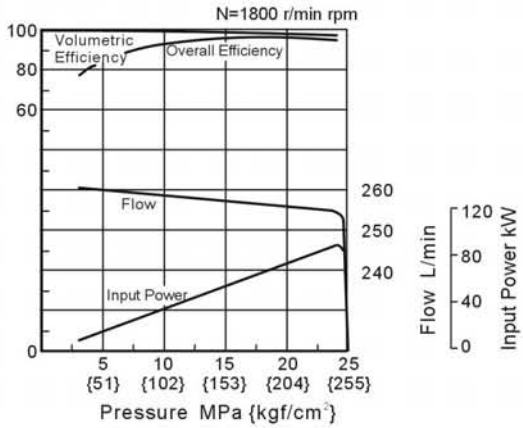
HA 100



HA 120



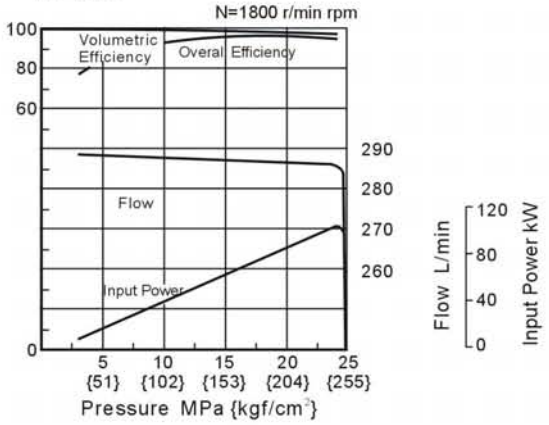
HA 145



Characteristic Curves Performance characteristics

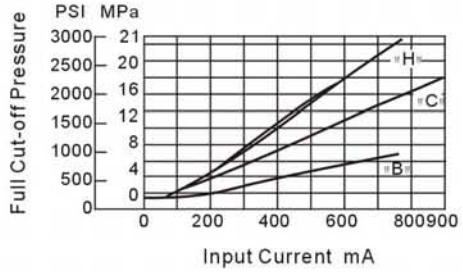
[At Viscosity 20mm²/s{cSt}[ISO VG32 Oils,50℃]

HA 160

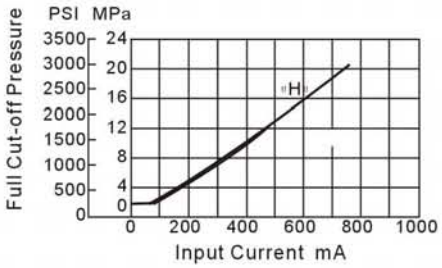


Characteristic Curves Full Cut-off Pres.vs.Input Current ("04" Type)

HA16/HA22/HA37/HA45/HA56/HA64



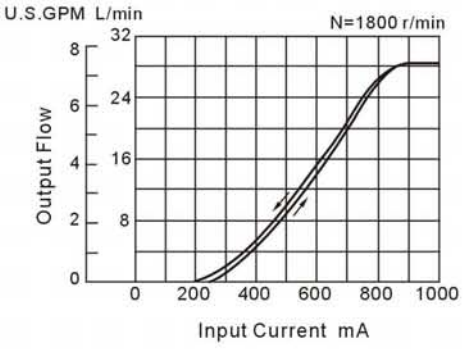
HA70/HA80/HA90/HA100/HA120/HA145/HA160



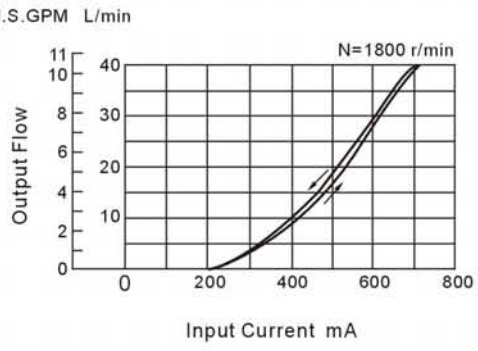
Note:Pressure adjustment range "H" is not available for HA22

Characteristic Curves Output Flow Vs.Input Current ("04" Type)

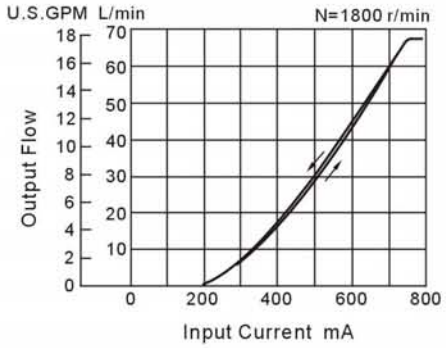
HA 16



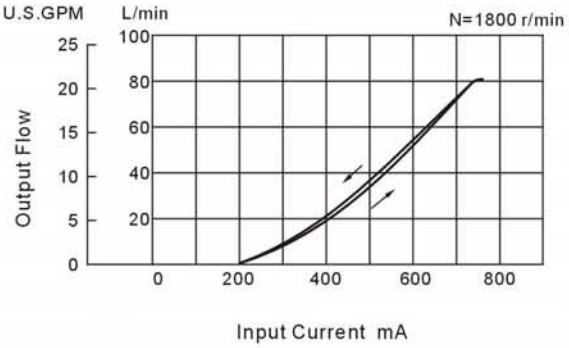
HA 22



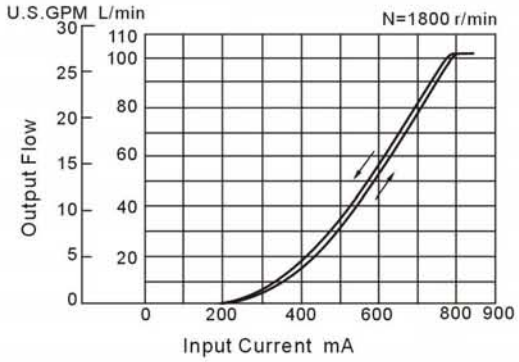
HA 37



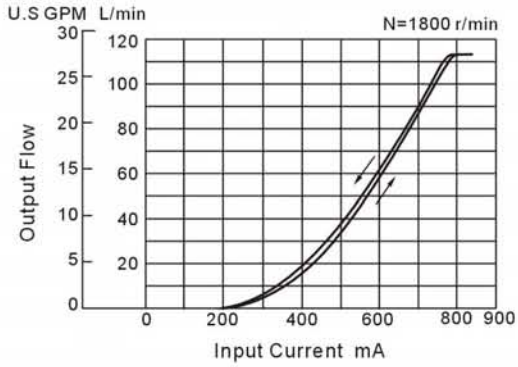
HA 45



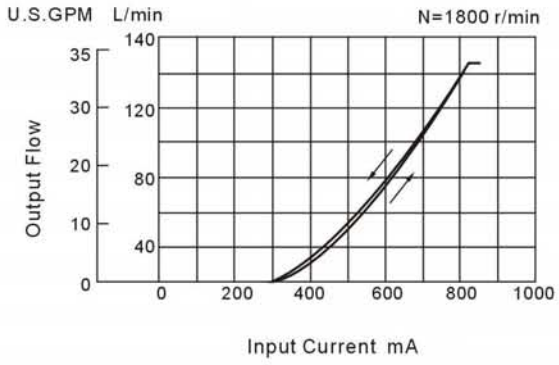
HA 56



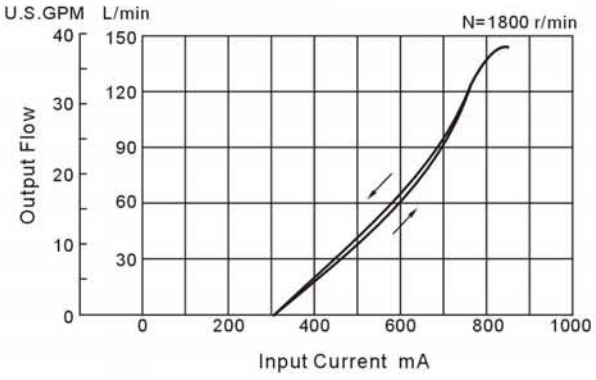
HA 64



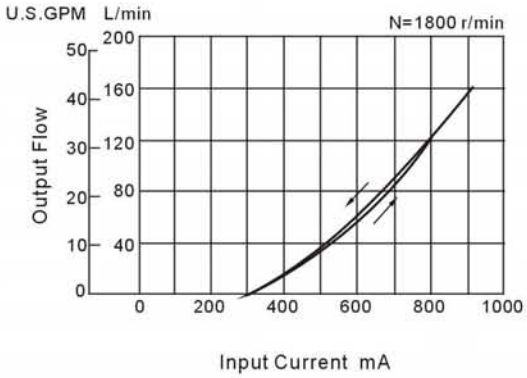
HA 70



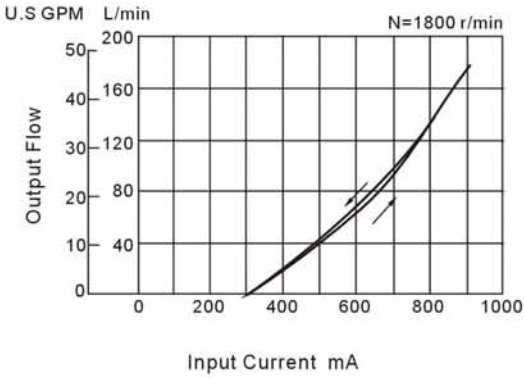
HA 80



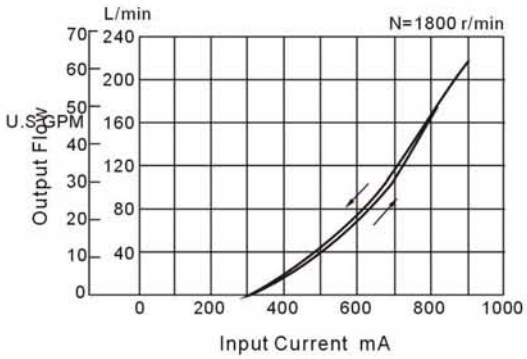
HA 90



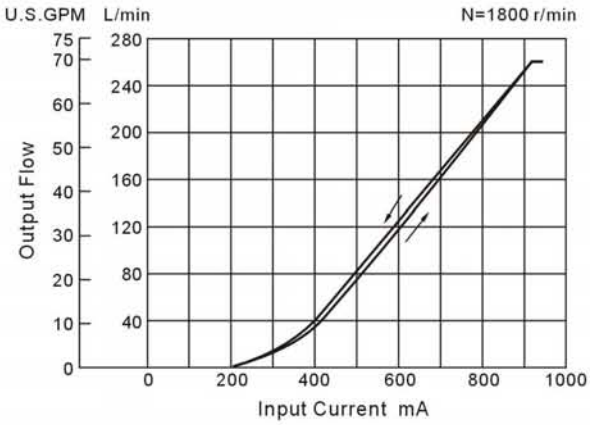
HA 100



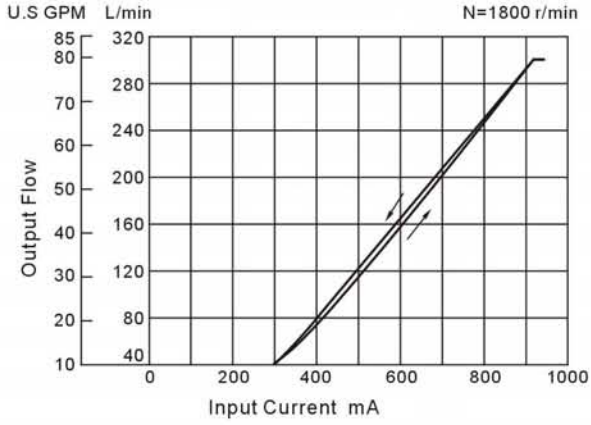
HA 120



HA 145

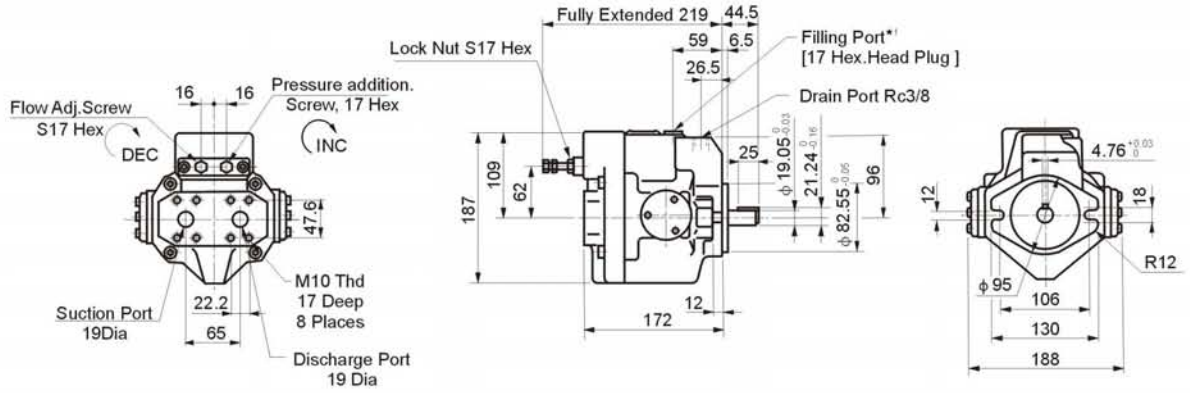


HA 160



Axial Port Type

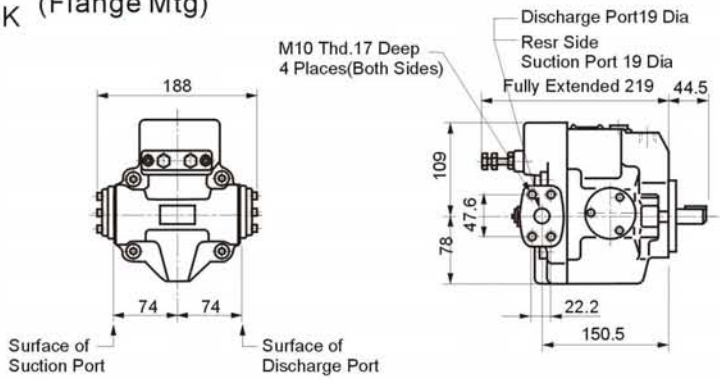
HA16-F-R-01-※-K
HA22-F-R-01-※-K (Flange Mtg)



★1、Install the pump so that the "Filling Port"is at the top.

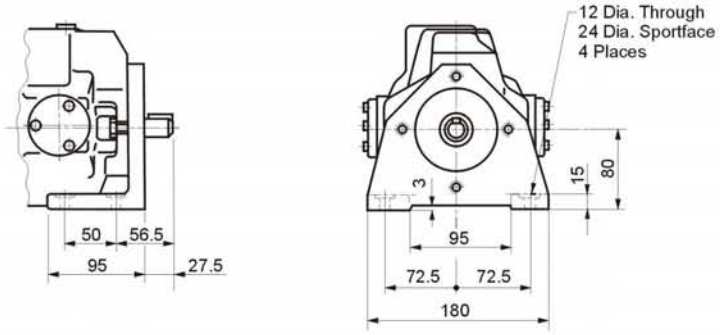
Side Port Type

HA16-F-R-01-※-S-K
HA22-F-R-01-※-S-K (Flange Mtg)



●For other dimensions,refer to"Axial Port Type".

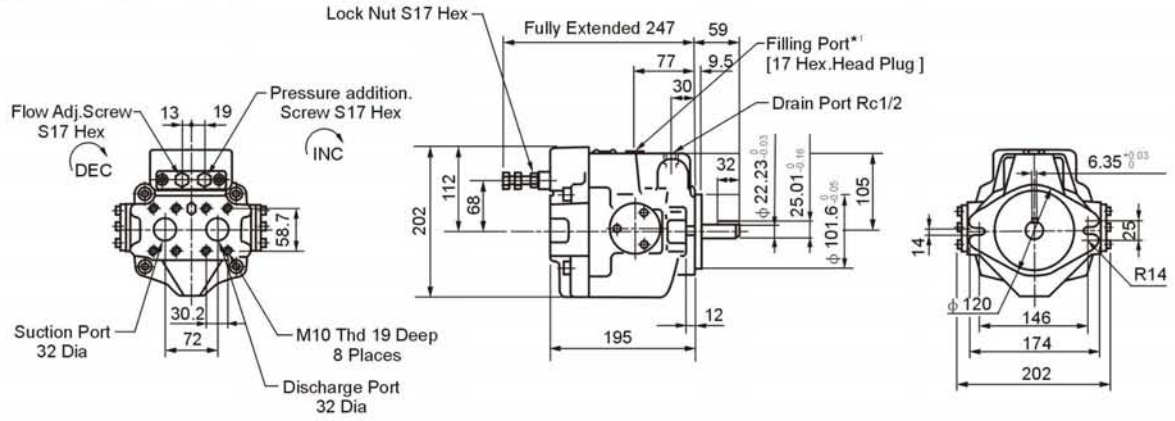
HA16-L-R-01-※-K
HA22-L-R-01-※-K (Foot Mtg)



●For other dimensions,refer to"Flange Mtg".

Axial Port Type

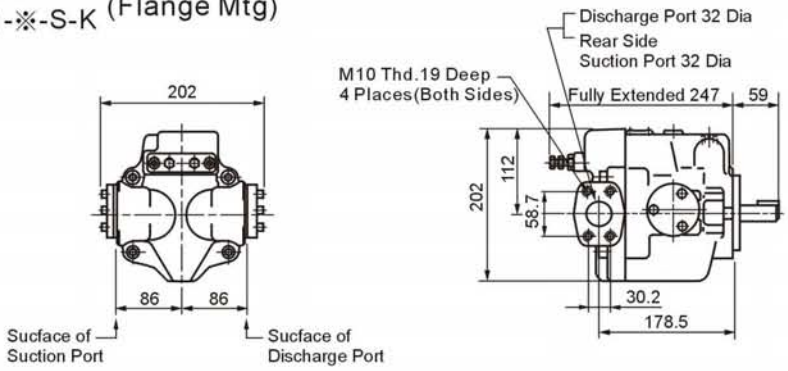
HA37-F-R-01-※-K
HA45-F-R-01-※-K (Flange Mtg)



★1、Install the pump so that the "Filling Port"is at the top.

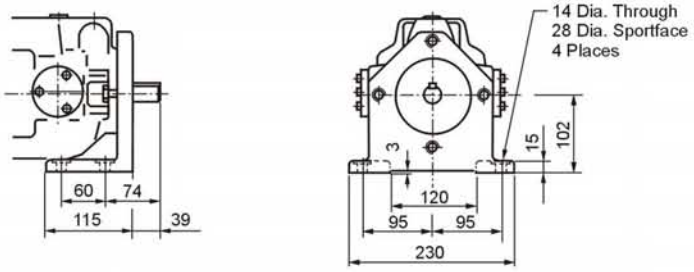
Side Port Type

HA37-F-R-01-※-S-K
HA45-F-R-01-※-S-K (Flange Mtg)



●For other dimensions,refer to"Axial Port Type".
●Foot Mtg. Type,Mounting bracket is common to that of"Axial Port Type".

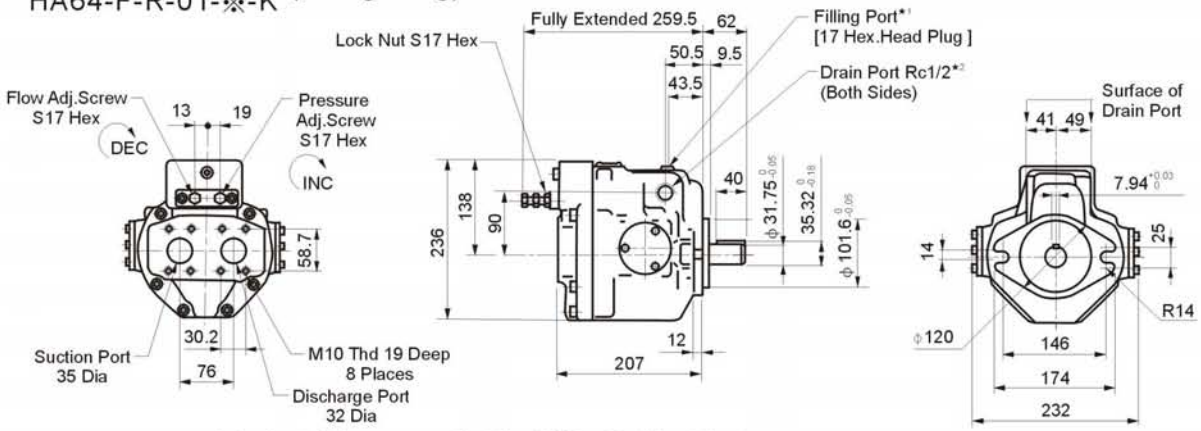
HA37-L-R-01-※-K
HA45-L-R-01-※-K (Foot Mtg)



●For other dimensions,refer to"Flange Mtg".

Axial Port Type

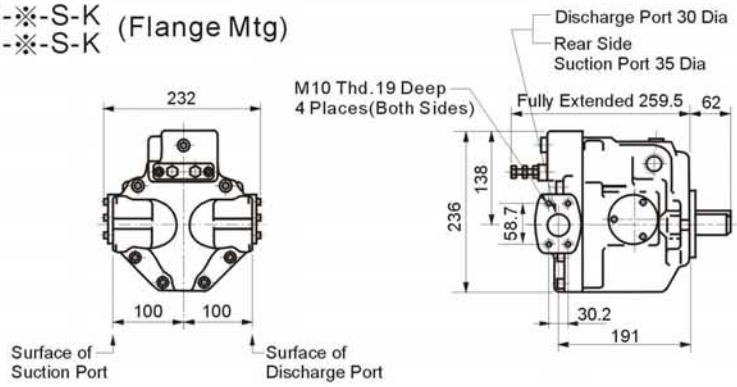
HA56-F-R-01-※-K
HA64-F-R-01-※-K (Flange Mtg)



★1、 Install the pump so that the "Filling Port"is at the top.
★2、 Use either port of the two drain ports at your option Keep the remaining port plugged.

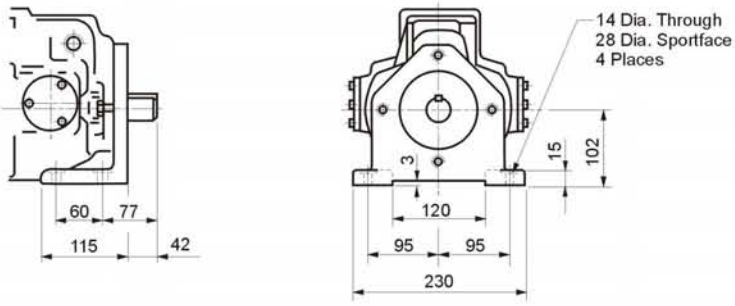
Side Port Type

HA56-F-R-01-※-S-K
HA64-F-R-01-※-S-K (Flange Mtg)



●For other dimensions,refer to"Axial Port Type".
●Foot Mtg. Type,Mounting bracket is common to that of"Axial Port Type".

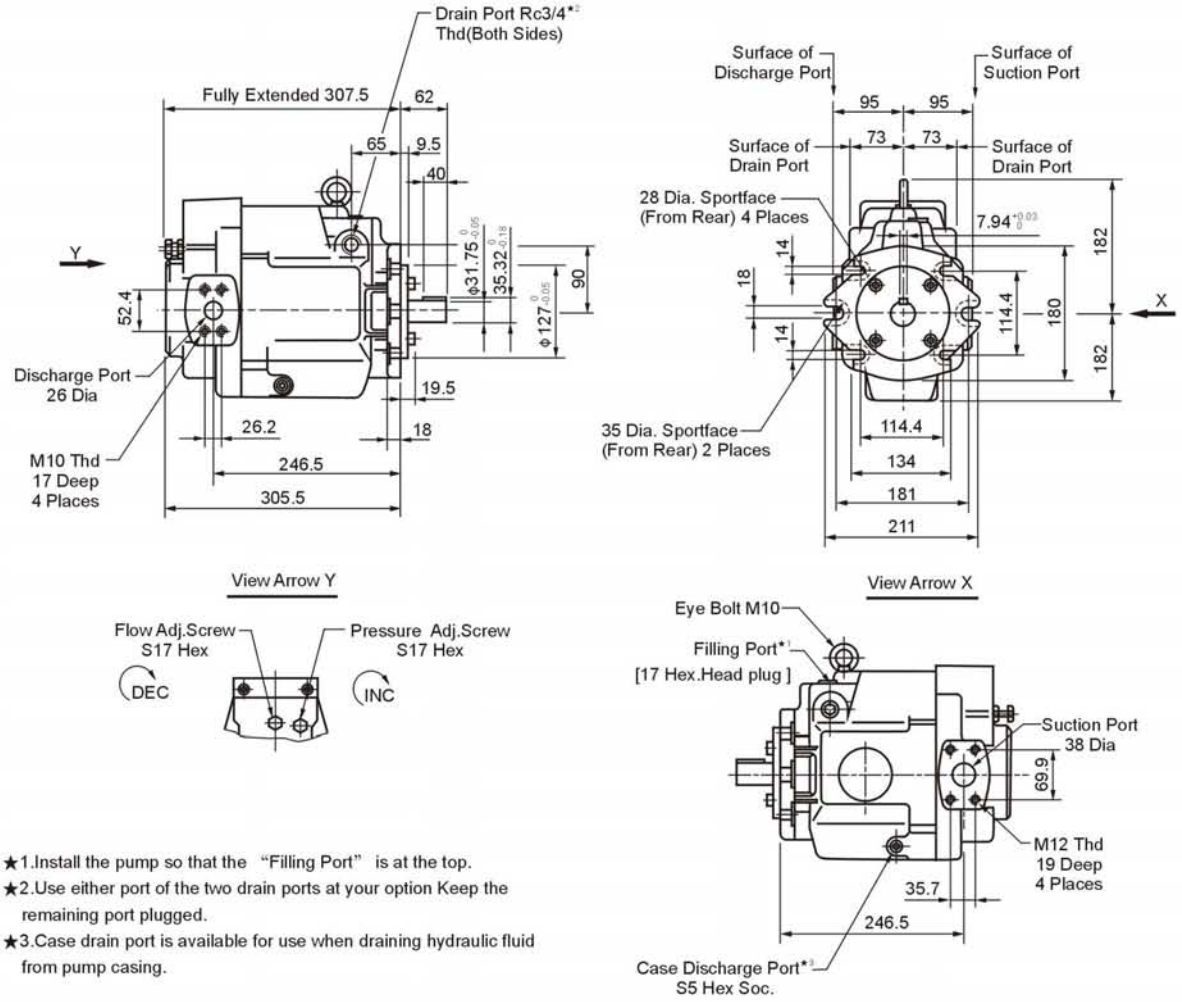
HA56-L-R-01-※-K
HA64-L-R-01-※-K (Foot Mtg)



●For other dimensions,refer to"Flange Mtg".

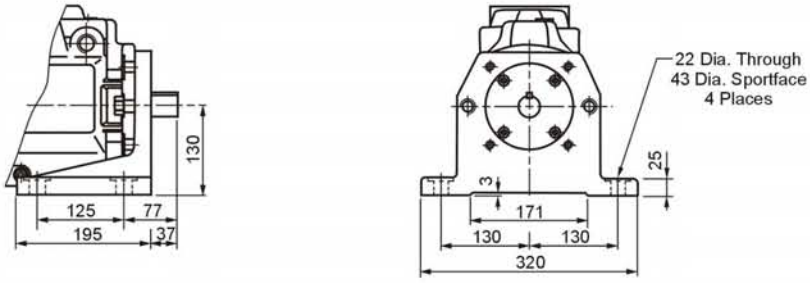
Side Port Type

HA70-F-R-01-※-S-K (Flange Mtg)
HA80-F-R-01-※-S-K



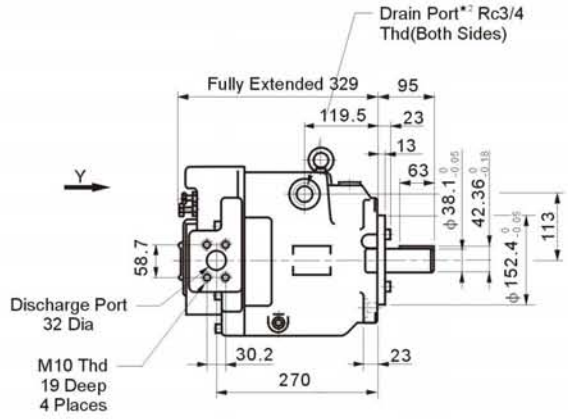
★1.Install the pump so that the "Filling Port" is at the top.
★2.Use either port of the two drain ports at your option Keep the remaining port plugged.
★3.Case drain port is available for use when draining hydraulic fluid from pump casing.

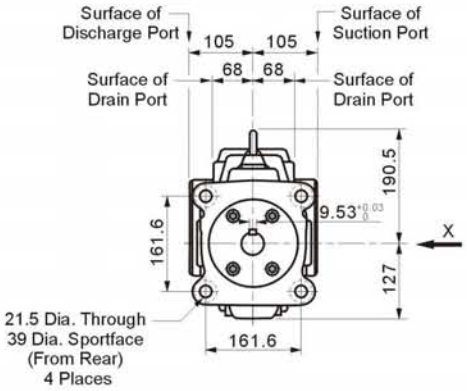
HA70-L-R-01-※-S-K (Foot Mtg)
HA80-L-R-01-※-S-K



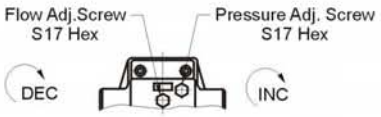
●For other dimensions,refer to"Flange Mtg".

HA90-F-R-01-※-S-K
HA100-F-R-01-※-S-K (Flange Mtg)
HA120-F-R-01-※-S-K

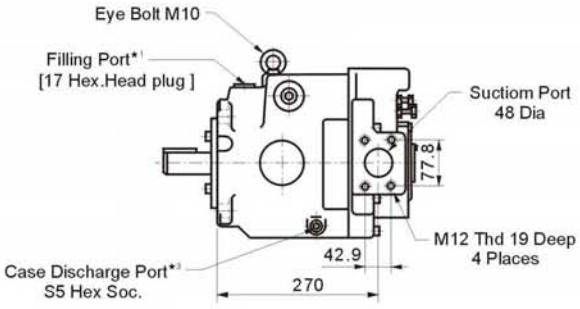




View arrow Y

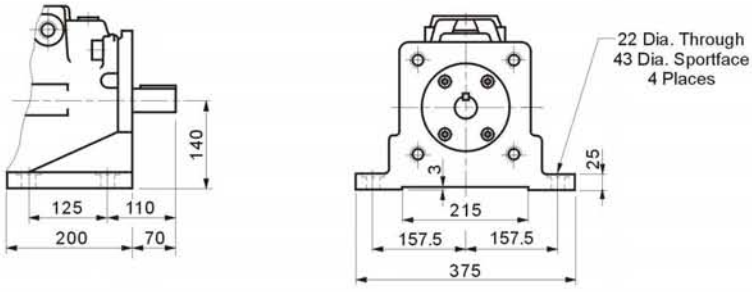


View arrow X



★1.Install the pump so that the "Filling Port" is at the top.
★2.Use either port of the two drain ports at your option Keep the remaining port plugged.
★3.Case drain port is available for use when draining hydraulic fluid from pump casing.

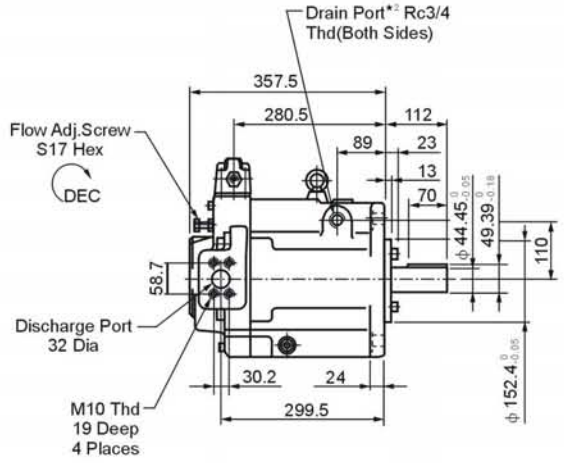
HA90-L-R-01-※-S-K
HA100-L-R-01-※-S-K (Foot Mtg)
HA120-L-R-01-※-S-K

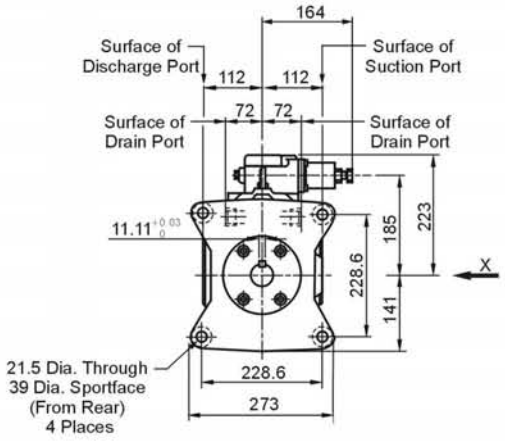


●For other dimensions,refer to"Flange Mtg".

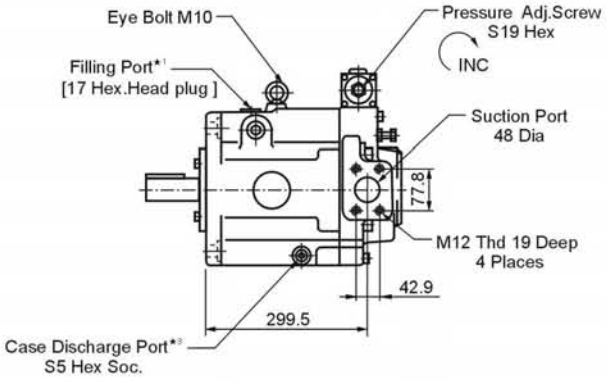
Side Port Type

HA145-F-R-01-※-S-K
HA160-F-R-01-※-S-K (Flange Mtg)



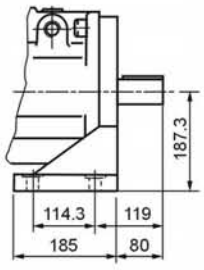


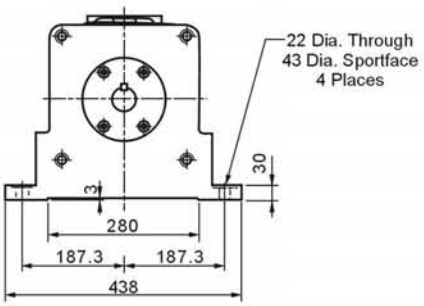
View arrow X



★1.Install the pump so that the "Filling Port" is at the top.
★2.Use either port of the two drain ports at your option Keep the remaining port plugged.
★3.Case drain port is available for use when draining hydraulic fluid from pump casing.

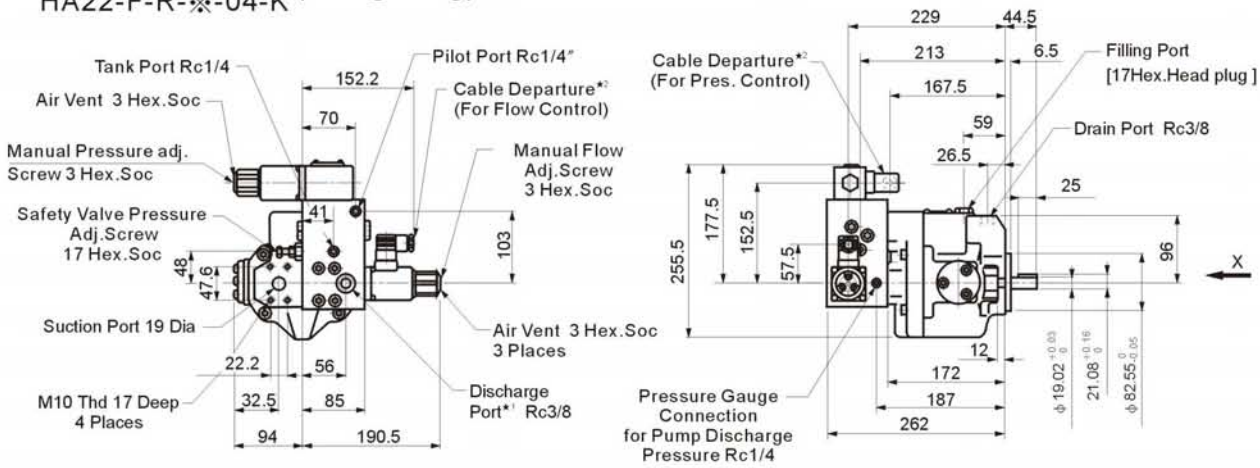
HA145-L-R-01-※-S-K
HA160-L-R-01-※-S-K (Foot Mtg)



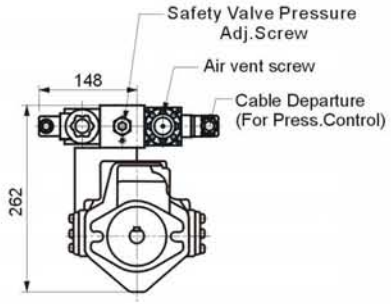


●For other dimensions,refer to"Flange Mtg".

HA16-F-R-※-04-K
HA22-F-R-※-04-K (Flange Mtg)

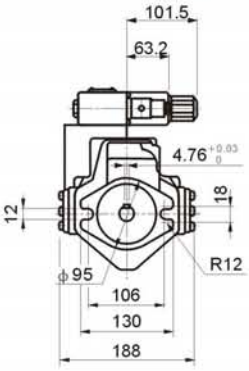


HA16-F-R-※-04-K-V
HA22-F-R-※-04-K-V

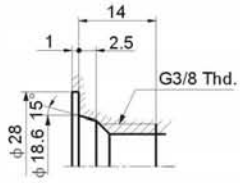


●For other dimensions,refer to"Flange Mtg".

View arrow X

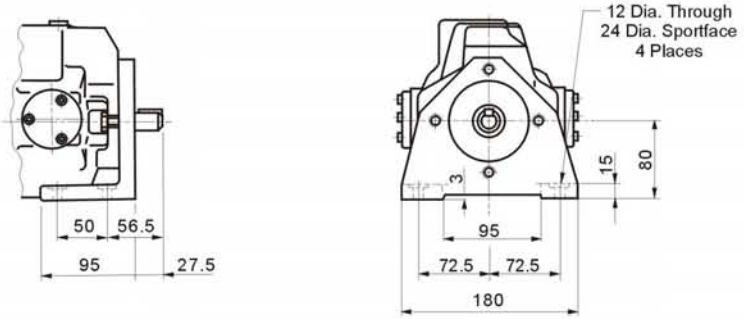


★1、Detail of Discharge Ports [For Japanese Standard]



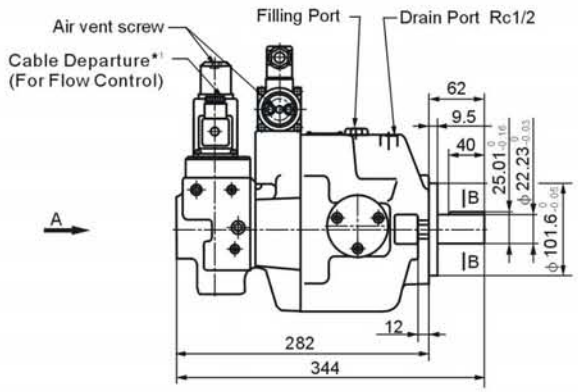
★2、Cable Applicable.
Outside Dia·····8-10mm
Conductor Area·····Not Exceeding 1.5mm²

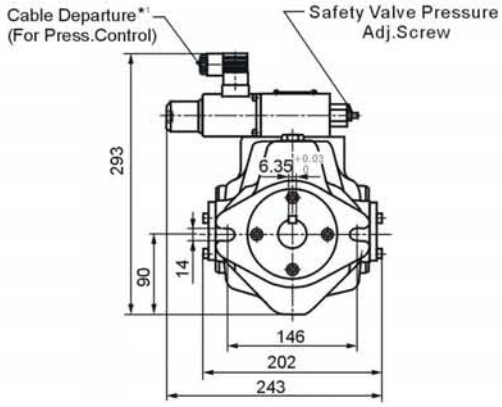
HA16-L-R-※-04-K
HA22-L-R-※-04-K (Foot Mtg)



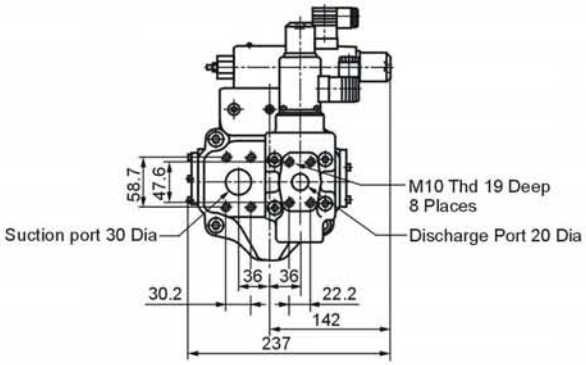
●For other dimensions,refer to"Flange Mtg".

HA37-F-R-04-※-K
HA45-F-R-04-※-K (Flange Mtg)



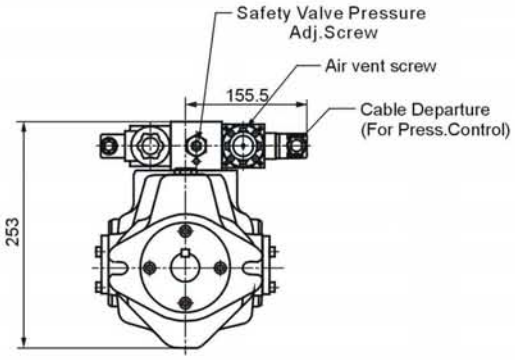


View arrow A



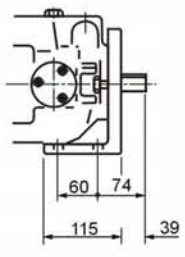
★1.Cable Applicable
Outside Dia·····8-10mm
Conductor Area·····Not Exceeding 1.5mm²

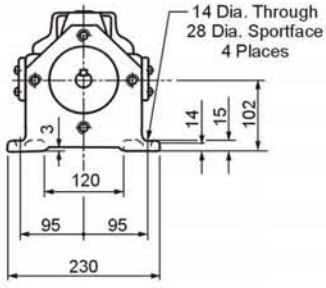
HA37-F-R-※-04-K-V
HA45-F-R-※-04-K-V



●For other dimensions,refer to"Flange Mtg".

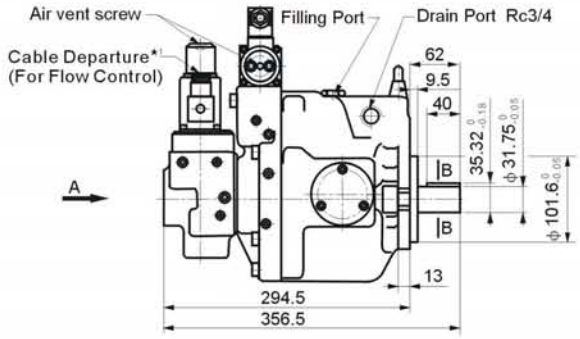
HA37-L-R-04-※-K
HA45-L-R-04-※-K (Foot Mtg)

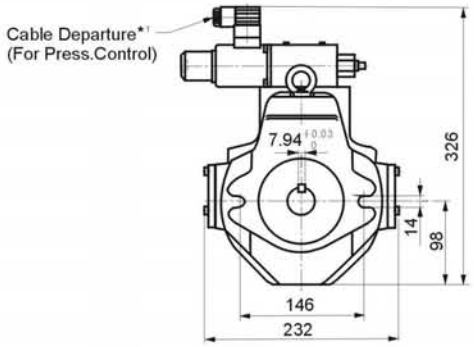




●For other dimensions,refer to"Flange Mtg".

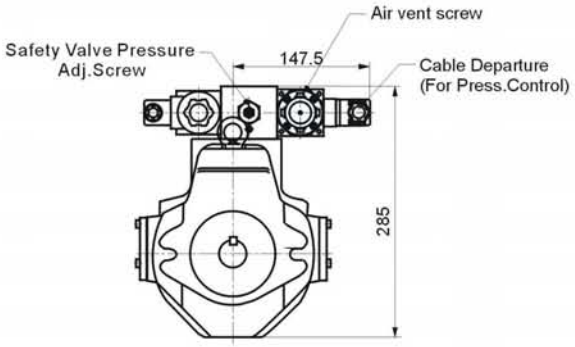
HA56-F-R-04-※-K
HA64-F-R-04-※-K (Flange Mtg)



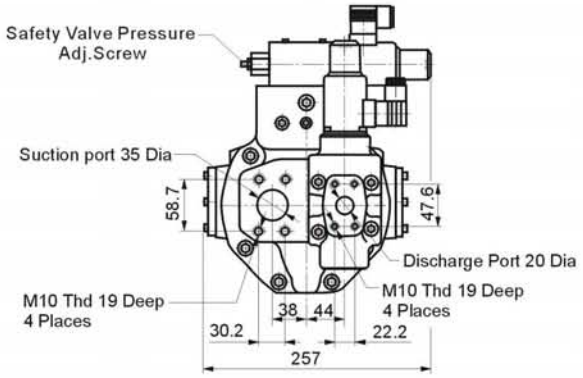


View arrow A

HA56-F-R-※-04-K-V
HA64-F-R-※-04-K-V

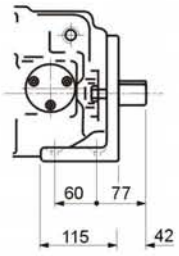


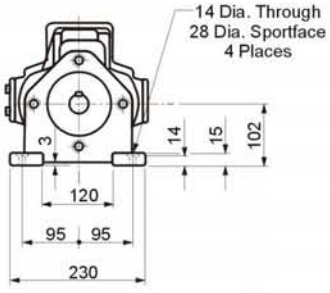
●For other dimensions,refer to"Flange Mtg".



★1.Cable Applicable
Outside Dia·····8-10mm
Conductor Area·····Not Exceeding 1.5mm²

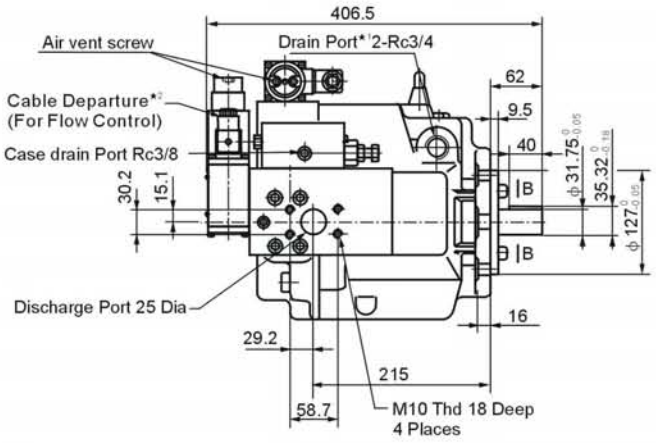
HA56-L-R-04-※-K
HA64-L-R-04-※-K (Foot Mtg)

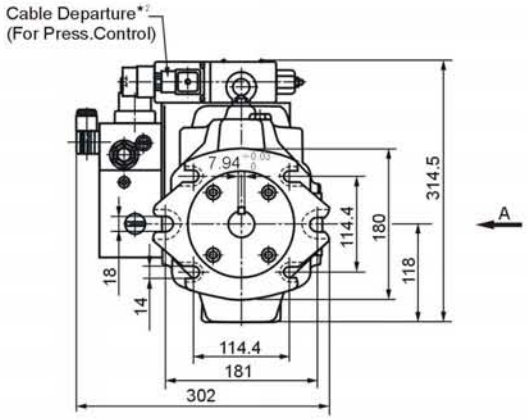




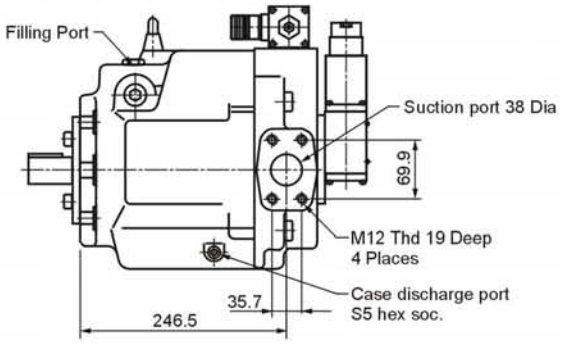
●For other dimensions,refer to"Flange Mtg".

HA70-F-R-04-※-S-K
HA80-F-R-04-※-S-K (Flange Mtg)





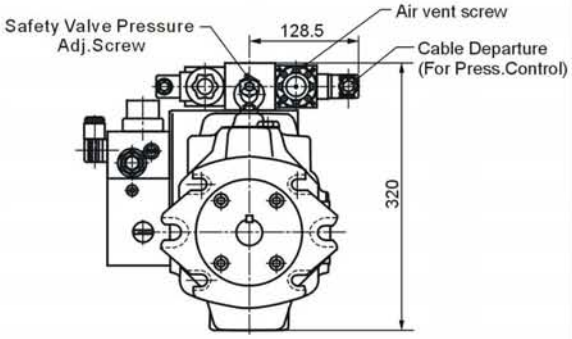
View arrow A



★1.Use either port of two pilot and drain ports at your optional Keep the remaining port plugged.

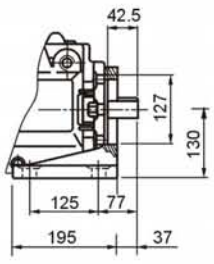
★2.Cable Applicable
Outside Dia……8-10mm
Conductor Area……Not Exceeding 1.5mm²

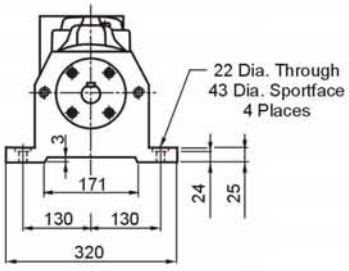
HA70-F-R-※-04-K-V
HA80-F-R-※-04-K-V



●For other dimensions,refer to"Flange Mtg".

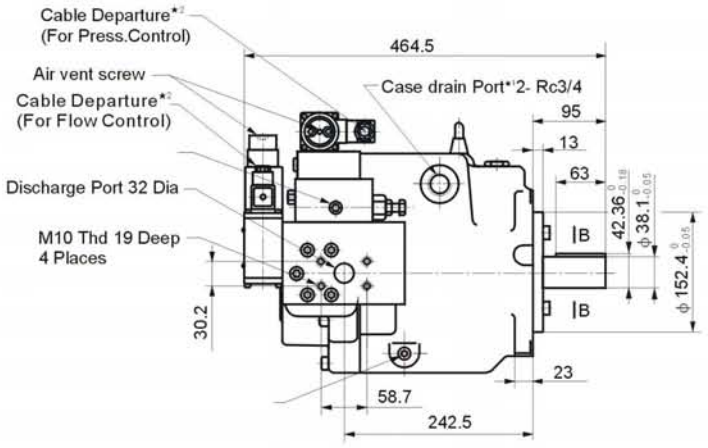
HA70-L-R-04-※-S-K
HA80-L-R-04-※-S-K (Foot Mtg)

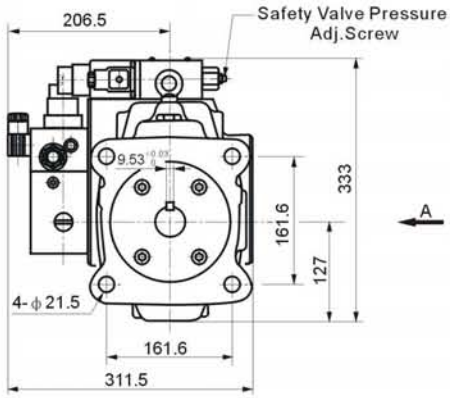




●For other dimensions,refer to"Flange Mtg".

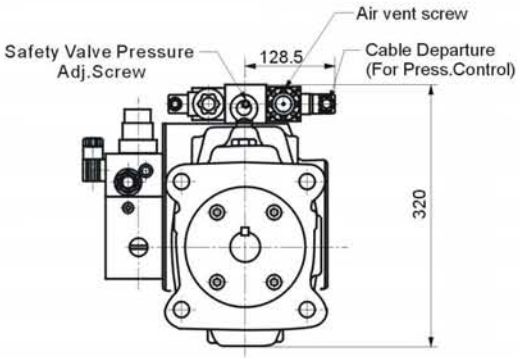
HA90-F-R-04-※-S-K
HA100-F-R-04-※-S-K (Flange Mtg)
HA120-F-R-04-※-S-K



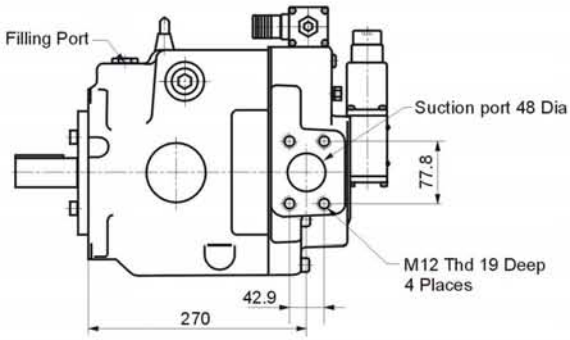


View arrow A

HA90-F-R-※-04-K-V
HA100-F-R-※-04-K-V
HA120-F-R-※-04-K-V



●For other dimensions,refer to"Flange Mtg".



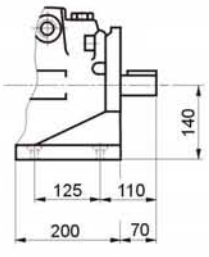
★1.Use either port of two pilot and drain ports at your optionl Keep the remaining port plugged.

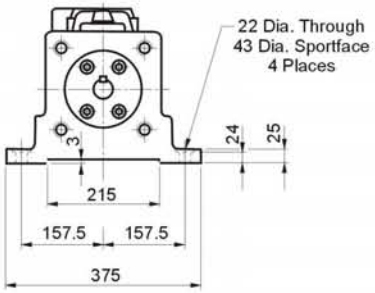
★2.Cable Applicable

Outside Dia……8-10mm

Conductor Area……Not Exceeding 1.5mm²

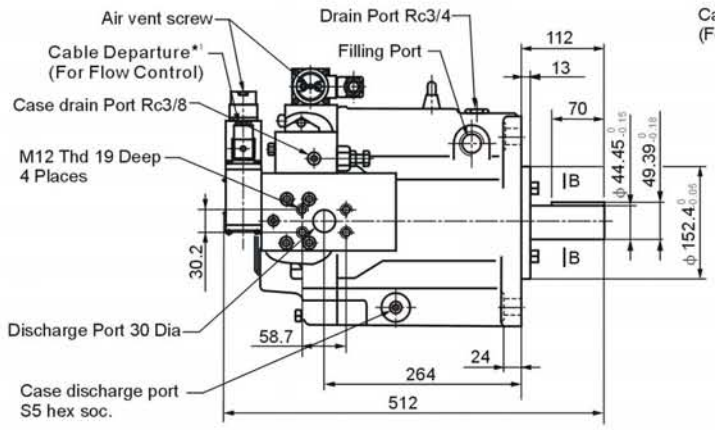
HA90-L-R-04-※-S-K
HA100-L-R-04-※-S-K(Foot Mtg)
HA120-L-R-04-※-S-K

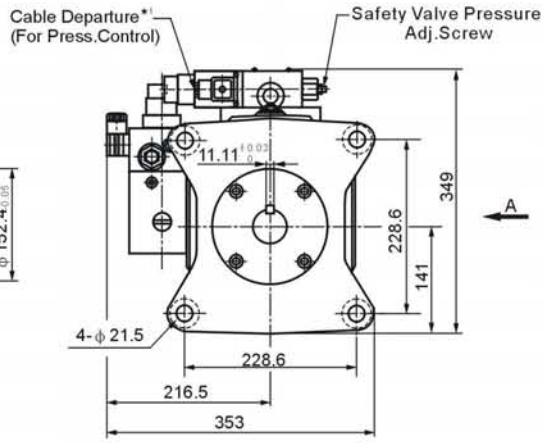




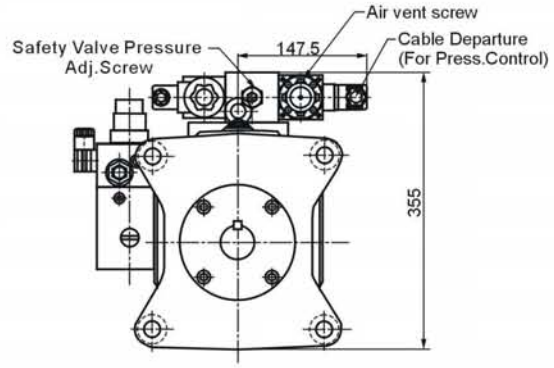
●For other dimensions,refer to"Flange Mtg".

HA145-F-R-04-※-S-K
HA160-F-R-04-※-S-K (Flange Mtg)



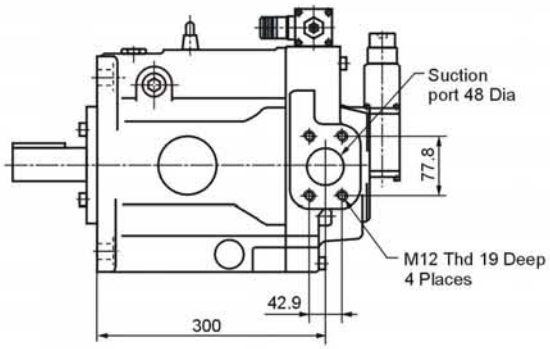


HA145-F-R-※-04-K-V
HA160-F-R-※-04-K-V



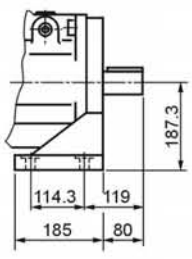
●For other dimensions,refer to"Flange Mtg".

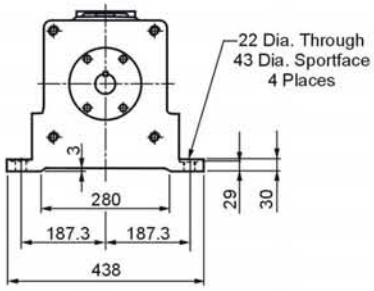
View arrow A



★1.Cable Applicable
Outside Dia·····8-10mm
Conductor Area·····Not Exceeding 1.5mm²

HA145-L-R-04-※-S-K
HA160-L-R-04-※-S-K (Foot Mtg)





●For other dimensions,refer to"Flange Mtg".

Hydraulic Fluids

Use petroleum based oils such as anti-wear type hydraulic oils or R&O(Rust and Oxi dation inhibitor) type hydraulic oils equivalent to ISO VG32 or VG46 .The recommended viscosity range is from 20 to 400 mm^2/s (98 to 1800 SSU) and temperature range is from 0 to 60° (32 to 140° F),both of which have to be satisfied for the use of the above hydraulic oils.

Control of Contamination

Due caution must be paid to maintaining control over contamination of the operating oil which can other wise lead to break downs and shorten the lift of the unit. Please maintain the degree of contamination within NAS Grade10.The suction port must be equipped with at least 100 μm (150mesh) reservation type filter and the return line must have a line type filter of under 25 μm.

Mounting

When installing the pump the filling port should be positioned upwards.

Alignment of shaft

Employ a flexible coupling whenever possible, and avoidable stress from bending or thrust. Maximum permissible misalignment is less than 0.1mm (.004inches) TIR and maximum permissible misangular is less than 0.2° .

Suction Pressure

Permissible suction pressure at inlet port of the pump is between-16.7 and +50kPa(5 in Hg Vacuum and 7PSIG).
For piping to the suction port,use the pipes of the same diametre as that of the specified pipe flange to be used.Make sure that the height of the pump suction port is within one metre(3.3ft) from the oil level in the reservoir.

Hints on Piping

When using steel pipes for the suction or discharge ports,excessive load from the piping to the pump generates excessive noise. Whenever there is fear of excessive load, please use rubber hoses.

Suction Piping

In case the pump is installed above the oil level, the suction piping and suction line filter should be located lower than the pump position to prevent air in the suction line.

Drain Piping

Install drain piping according to the chart and ensure that pressure within the pump housing should be maintained at a normal pressure or less than 0.1MPa(14.5PSI)and surge pressure of less than 0.5MPa(72.5PSI).
Length of piping should be less than 1 m (3.3ft), and the pipe end should be submerged in oil.

[Recommended Drain Piping Size]

Model	Fitting Size	Inside Dia. Of Pipe
HA16、HA22	3/8[Inside Dia.8.5mm in more]	10mm
HA37、HA45	1/2[Inside Dia.12mm in more]	12mm
HA56、HA64、HA70、HA80、HA90、HA100、HA120、HA145、HA160	3/4[Inside Dia.16mm in more]	19mm

- Bleeding Air

It may be necessary to bleed air from pump case and outlet line to remove causes of vibration.

- Starting

Before first starting,fill pump case with clean operating oil via the fill port. In order to avoid air blockage when first starting,adjust the control valves so that the discharged oil from the pump is return direct to the tank or the actuator moves in a free load .

- Setting Discharge Pressure and Delivery

At the time of shipment,the unit has been preset to maximum delivery and minimum discharge pressure.

(1) Adjustment of Discharge Pressure
Turning the adjustment screw clockwise,increases pressure.

(2) Adjustment of Delivery
Turning the flow adjustment screw clockwise,decreases delivery.