A4VSO Series
Axial piston variable pump

Product show and brief introduction

Open circuits

Series 10、30
Sizes 40...355
Nominal pressure 35MPa
Maxmum pressure 40MPa

Features

— The capacity of the pump is in proportion to its rotating speed and displacement; the stepless adjustment of the displacement can be materialized by regulating the swivel angle of its swash plate

— With through-shaft structure, able to form combination pump

— Position constraint return mechanism;Spherical flow distribution, the piston is inclined around the shaft

— Equipped with swivel angle indicator of swash plate

— Excellent suction performance;Fast control response;Low noise;Long lifespan

— Excellent power/weight ratio;Modular design;Optional installation position

— The drive shaft is able to bear the axial and radial load;

— It can operate with HF fluid to lower the operating parameter

Model Code

E	A4V	S	O	125	DR	/	30	R	–	P	P	B	25	34
1	2	3	4	5	6		7	8		9	10	11	12	13

1– Operating Medium

Mineral oil and HFD Hydraulic fluid（ No Code ）	
HFA、HFB、HFC Hydraulic fluid	E

2– Machinery Type

Axial piston， swash plate design， variable	A4V

3– Speed

Normol speed	S
High Speed	L

4–Operational Mode

Open circuit	O

5–Size

Nominal displacement mL/r	40	71	125	180	200	250	280	355	

6–Control devices

Pressure control	DR	●	●	●	●	●	●	●	●	DR
Flow control	FR	●	●	●	●	●	●	●	●	FR
Pressure and flow control	DFR	●	●	●	●	●	●	●	●	DFR
Power control with hyperbolic curve	LR2	●	●	●	●	●	●	●	●	LR2
Constant power remote pressure control	LR2G	●	●	●	●	●	●	●	●	LR2G
Constant power pressure control	LR2D	●	●	●	●	●	●	●	●	LR2D
Manual control	MA	●	●	●	●	●	●	●	●	MA
Hydraulic flow control	E02	○	○	●	●	●	●	●	●	E02

7– Series

	●	●	–	–	–	–	–	–	10
	–	–	●	●	●	●	●	●	30

8–Rotating Direction（View on Shaft End ）

Clockwise	R
Counterclockwise	L

Model Code

9–Seals

NBR， Shaft seal FKM	P
FKM	V

10–Shaft End

Keyed shaft D|N6885	P
Splined shaft DIN5480	Z

11–Mounting Flange

ISO 3019-2 4Hole	B

12–Ports Type

Oil ports B and S: SAE flanges with 90° lateral offset, metric set screws	13
1.Oil ports B and S: SAE flanges with 90° lateral offset, metric set screws 2.Pressure oil port B1, opposite to B - closed with pipe port cover when delivered	25

13 –Through Drive

			40	71	125	180	200	250	300	355	
Without through drive			●	●	●	●	●	●	●	●	N00
With through drive， mounting dimensions are as follows			●	●	–	–	–	–	–	–	K
Universal through drive,mounting dimensions are as follows			–	–	●	●	●	●	●	●	U
Flange	Splined shaft	To mount pump									
ISO125，4 Hole	W32x2x30x14x9g	-A4VSO40	●	●	●	●	●	●	●	●	31
ISO140，4 Hole	W40x2x30x18x9g	-A4VSO71	–	●	●	●	●	●	●	●	33
ISO160，4 Hole	W50x2x30x24x9g	-A4VSO125	–	–	●	●	●	●	●	●	34
ISO160，4 Hole	W50x2x30x24x9g	-A4VSO180/200		–	–	●	●	●	●	●	34
ISO224，4 Hole	W60x2x30x28x9g	-A4VSO250/280	–	–	–	–	–	●	●	●	35
ISO224，4 Hole	W70x3x30x22x9g	-A4VSO355	–	–	–	–	–	–	–	●	77
ISO80， 2 Hole	3/4in11T16/32DP	-A10VS018	●	●	○	○	○	○	○	○	B2
ISO100，2 Hole	7/8in13T16/32DP	-A10VSO28	●	●	●	●	●	●	●	●	B3
ISO100，2 Hole	1in15T16/32DP	-A10VS045	●	●	●	●	●	●	●	●	B4
ISO125，2 Hole	1 1/4in14T12/24DP	-A10VS071/31	–	●	●	●	●	●	●	●	B5
ISO125，2 Hole	1 1/2in17T12/24DP	-A10VS0100/31	–	–	●	●	●	●	●	●	B6
ISO180，4 Hole	1 3/4in13T8/16DP	-A10VSO140	–	–	–	●	●	●	●	●	B7
ISO160，4 Hole	1 1/4in14T12/24DP	-A10VSO71/32	–	○	○	○	○	○	○	○	B8
ISO180，4 Hole	1 1/2in17T12/24DP	-A10VSO100/32	–	–	○	○	○	○	○	○	B9
SAE82，2 Hole	3/4in11T16/32DP	-A10VSO18	●	●	○	○	○	○	○	○	52

Model Code

SAE101，2 Hole	7/8in13T16/32DP	-A10VO28	●	●	●	●	●	●	●	●	68
SAE101，2 Hole	1in15T16/32DP	-A10VO45	●	●	●	●	●	●	●	●	04
SAE127，2 Hole	1 1/4in14T12/24DP	-A10VO71	–	●	●	●	●	●	●	●	07
SAE127，2 Hole	1 1/2in17T12/24DP	-A10V0100	–	–	●	●	●	●	●	●	24
SAE152，4 Hole	1 3/4in13T8/16DP	-A10VO140	–	–	–	●	●	●	●	●	17
With through drive shaft, without coupler closed with blind flange.			●	●	●	●	●	●	●	●	99

● Chart shows：●= Available，O=In preparation，- =Not available

Combination pump

Two pumps can be connectec in series by their head and end， namely integrated to be a combination pump by the means of through-shaft，and the second pump of the series combination is called the subordinate pump.
In case of placing an order，the combination pump model equals to the model of the first pump + the model of the second.
Examples of combination pump models:A4VSO250DR/30R-PPB13U34+A4VSO250DR/30R-PPB13N00

Technical Data

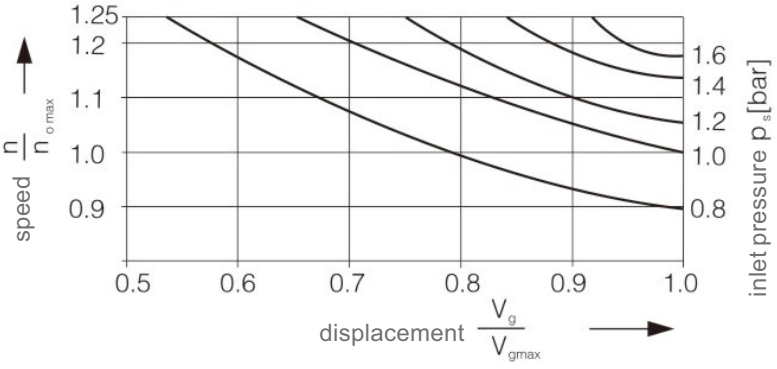
● 1、Range of operating pressure——Side of inlet

Pressure at suction port S（absolute pressure）

$p_{s\,min}$ 0.8bar

$p_{s\,max}$ 30bar

In order to avoid axial piston pump damage, suction S must ensure a minimum pressure. This minimum inlet pressure depends on the speed and displacement of the axial piston pump:



● 2、Range of operating pressure——Side of outlet

Pressure at port B (absolute pressure)

p_n ..... 350 bar

p_{max} ..... 400 bar

p_{min} ..... 15 bar

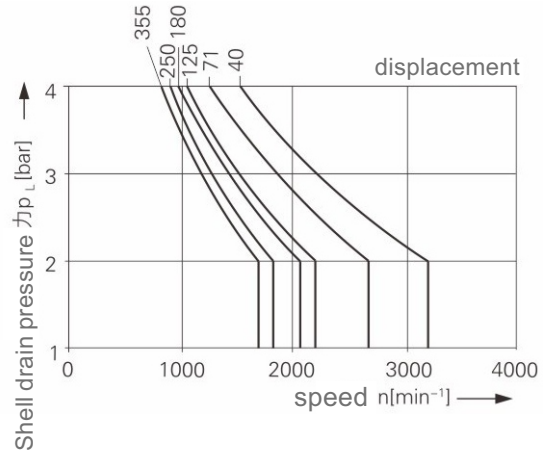
Technical Data

● 3、Flowing Direction

S→B

● 4、Case Drain Pressure

The allowed maximum case drain pressure (absolute pressure) depends on the rotating speed of the pump. Please see the figure.



The maximum case drain pressure (absolute pressure):

P_{Lmax} 4 bar

This is approximate value. This value needs to be decreased under some operating conditions.

● 5、The Parameter List (theoretical values)

Size				40	71	125	180	200	250	280	355
Displacement		$V_{g\,max}$	mL/r	40	71	125	180	200	250	280	355
Max. Speed[1)]	$V_g = V_{g\,max}$	no max	r/min	2600	2200	1800	1800	1800	1500	1500	1500
	$V_g < V_{g\,max}$		r/min	3200	2700	2200	2100	2100	1800	1800	1700
Flow	$n = n_{o\,max}$	$q_{vo\,max}$	L/min	104	156	225	324	360	375	420	533
	n = 1500 r/min		L/min	60	107	186	270	420	375	504	533
Power △p= 350 bar	$n = n_{o\,max}$	$p_{o\,max}$	kW	61	91	131	189	210	219	245	311
	n = 1500 r/min		kW	35	62	109	158	245	219	294	311
Torque $V_g = V_{g\,max}$	△ p=350 bar	T_{max}	Nm	223	395	696	1002	1114	1391	1560	1976
	△ p=100 bar	T	Nm	64	113	199	286	318	398	445	564
Inertia moment of the drive shaft		J	kgm^2	0.0049	0.0121	0.03	0.055	0.055	0.0959	0.0959	0.19
Volume of case			L	2	2.5	5	4	4	10	10	8
Weight			kg	39	53	88	102	102	184	184	207
Permissibleload of the drive shaft	Max.axial force		N	600	800	1000	1400	1400	1800	1800	2000
	Max.radial force		N	1000	1200	1600	2000	2000	2000	2000	2200

1）Once Vg=Vgmax, the value is applicable for the condition in which inlet pressure at Suction Port S equals to 1 bar, the absolute pressure; when the inlet pressure ps increases or the displacement decreases, the rotating speed will increase; once Vg < Vgmax, the value amounts to the limit of the rotating speed.

Technical Data

6、Determining the nominal value

Flow	$q_v = \frac{V_g \times n \times \eta_v}{1000}$	(L/min)	V_g = Displacement per revolution in mL/r $\triangle P$ = Differential pressure in bar n = Speed in rpm η_v = Volumetric efficiency η_{mh} = Mechanical-hydraulic efficiency η_t = Overall efficiency($\eta_t = \eta_v . \eta_{mh}$)
Torque	$T = \frac{V_g \times \triangle P}{20 \times \pi \times \eta_{mh}}$	(Nm)	
Power	$P = \frac{2\pi \times T \times n}{60000} = \frac{q_v \times \triangle P}{600 \times \eta_t}$	(kW)	

7、Bearing flushing

For the axial piston variable pump A4VSO at the following operating conditions bearing flushing is required for a safe, continuons operation.
——Applications with special fluids (non mineral oils)due to limited lubricity and narrow operating temperature range.
——Operation at critical conditions of temperature and viscosity with mineral oil and vertical mounting （drive shaft facing upwards).
Flushingis recommended in order to ensure lubrication of the front bearing and shaft seal.

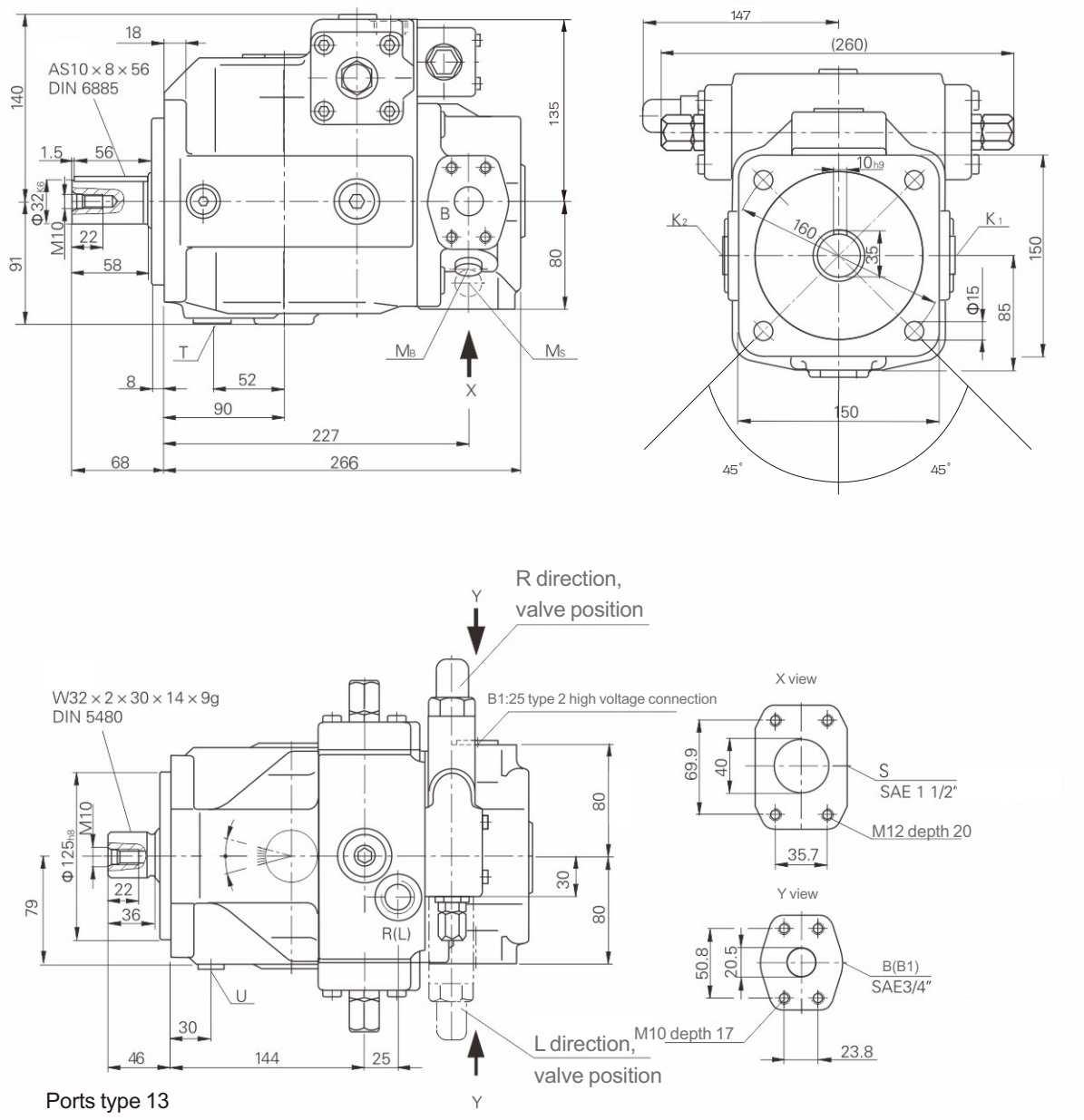
Flushing is carried out via port "U" located in the front bearing and leaves the pump together with the case drain flow.
Regarding series 30 when using external bearing flushing the throttle screw at port U must be turned in to the end stop.

Depending on pump size, the following flushing flows are recommended(L/min):

Size	40	71	125	180/200	250/280	355
Flow	3	4	5	7	10	15

These recommended flushing flows will cause a pressure drop of approx. 2bar (series 10) and 3 bar (series 30) between the entrance to port U and the pump case

Installation dimensions Size 40, Series 10 (Example: pressure control)



Ports type 13

B	pressure port	SAE3/4"(high pressure series)
B1	auxiliary port	M22 x 1.5 depth14 (plugged)

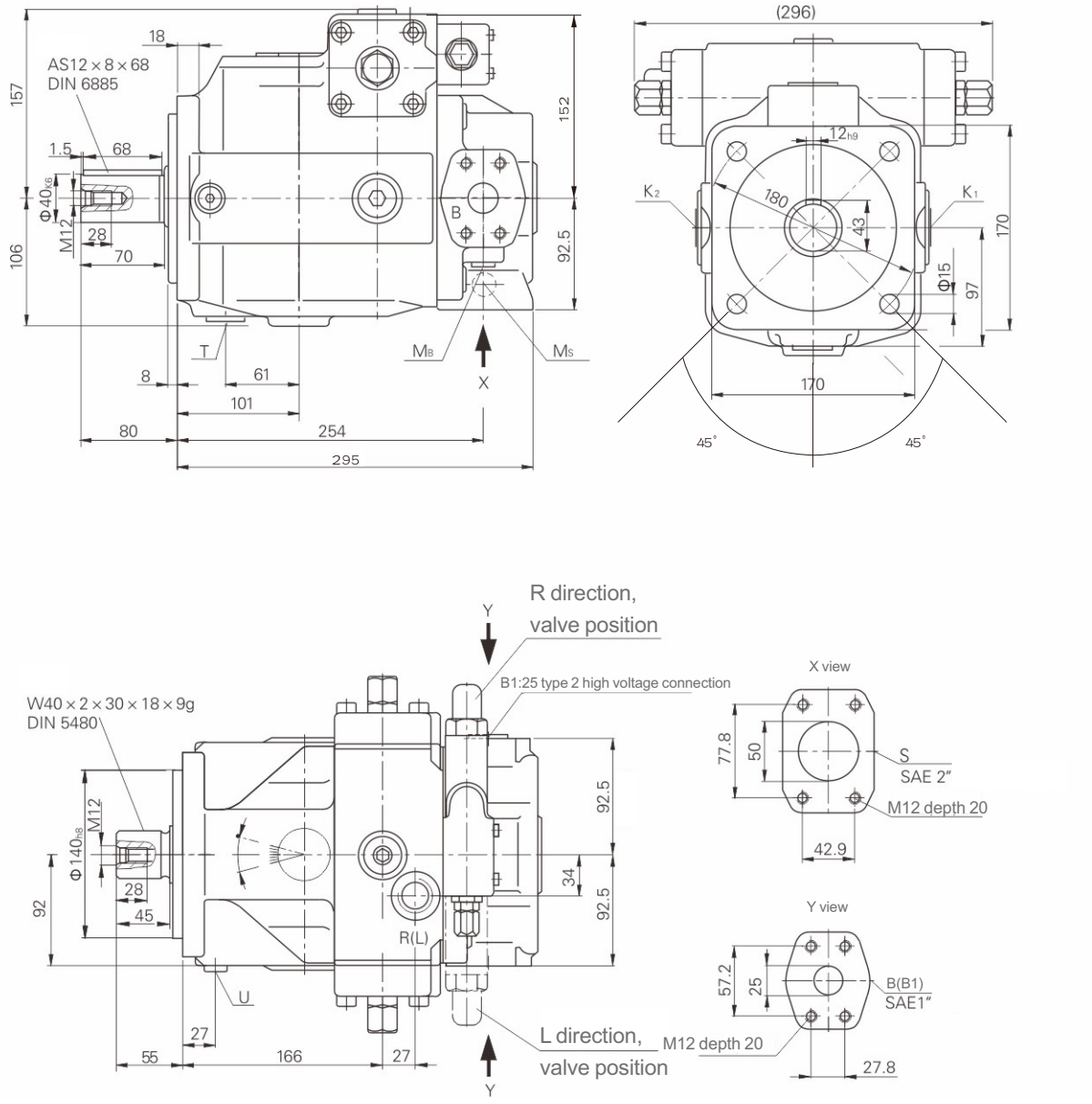
Ports type 25

B	pressure port	SAE3/4" (high pressure series)
B1	second pressure port	SAE3/4" (high pressure series) (closed)

Other ports

S	suction port	SAE1 1/2" (standard series)
K1,K2	flushing port	M22 x 1.5 depth14 (plugged)
T	drain port	M22 x 1.5 depth14 (plugged)
MB,MS	measuring port	M14 x 1.5 depth12 (plugged)
R(L)	filling port + bleed port	M22 x 1.5
U	flushing port	M14 x 1.5 depth12 (plugged)

Installation dimensions Size 71, Series 10 (Example: pressure control)



Ports type 13

B	pressure port	SAE1"(high pressure series)
B_1	auxiliary port	M27 x 2 depth16 (plugged)

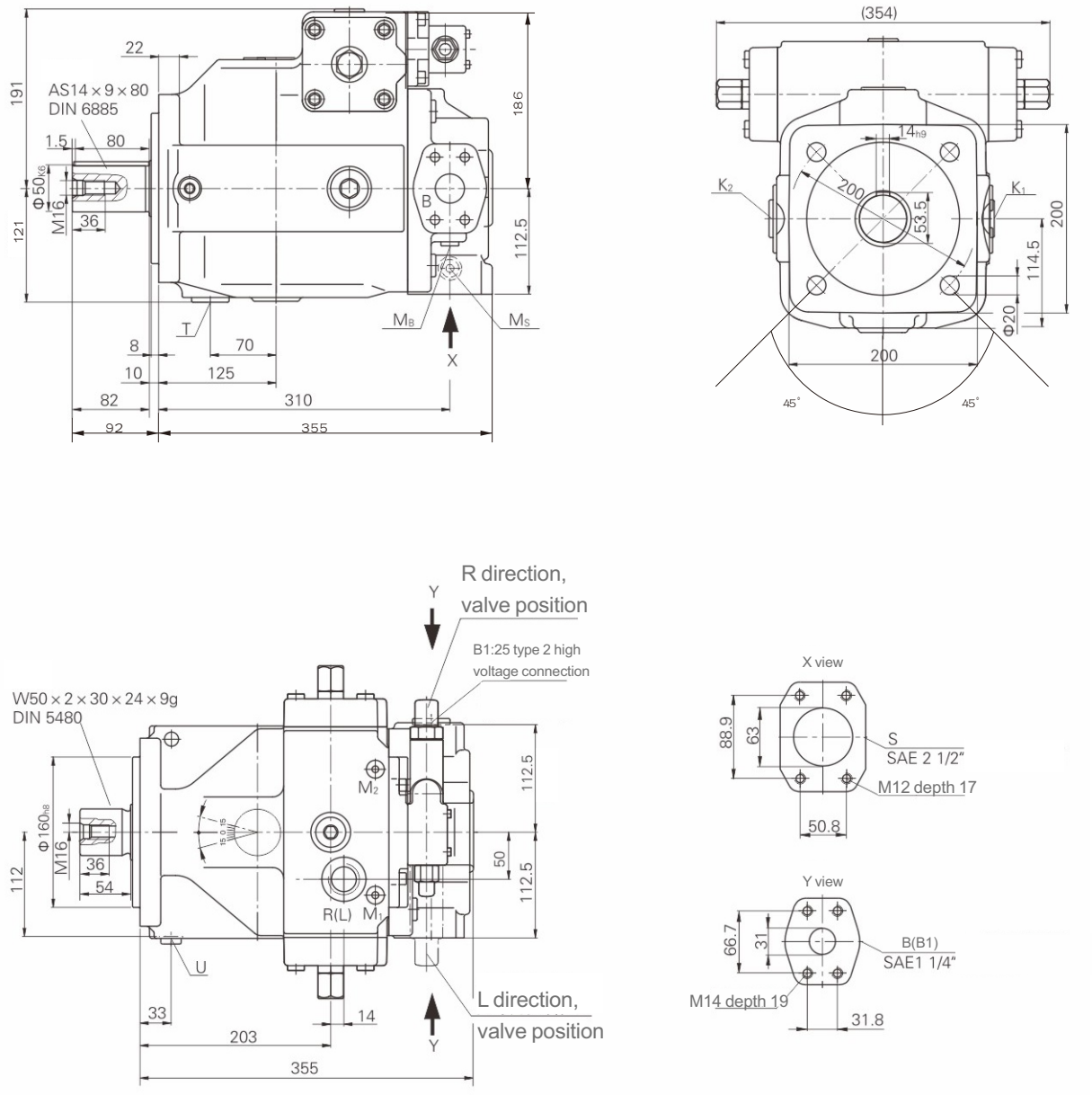
Ports type 25

B	pressure port	SAE1"(high pressure series)
B_1	second pressure port	SAE1"(high pressure series) (closed)

Other ports

S	suction port	SAE2" (standard series)
K_1,K_2	flushing port	M27 x 2 depth16 (plugged)
T	drain port	M27 x 2 depth16 (plugged)
M_B,M_S	measuring port	M14 x 1.5 depth12 (plugged)
R(L)	filling port + bleed port	M27 x 2
U	flushing port	M14 x 1.5 depth12 (plugged)

Installation dimensions Size 125, Series 30 (Example: pressure control)



Ports type 13

B	pressure port	SAE1 1/4"(high pressure series)
B_1	auxiliary port	M33 x 2 depth18 (plugged)

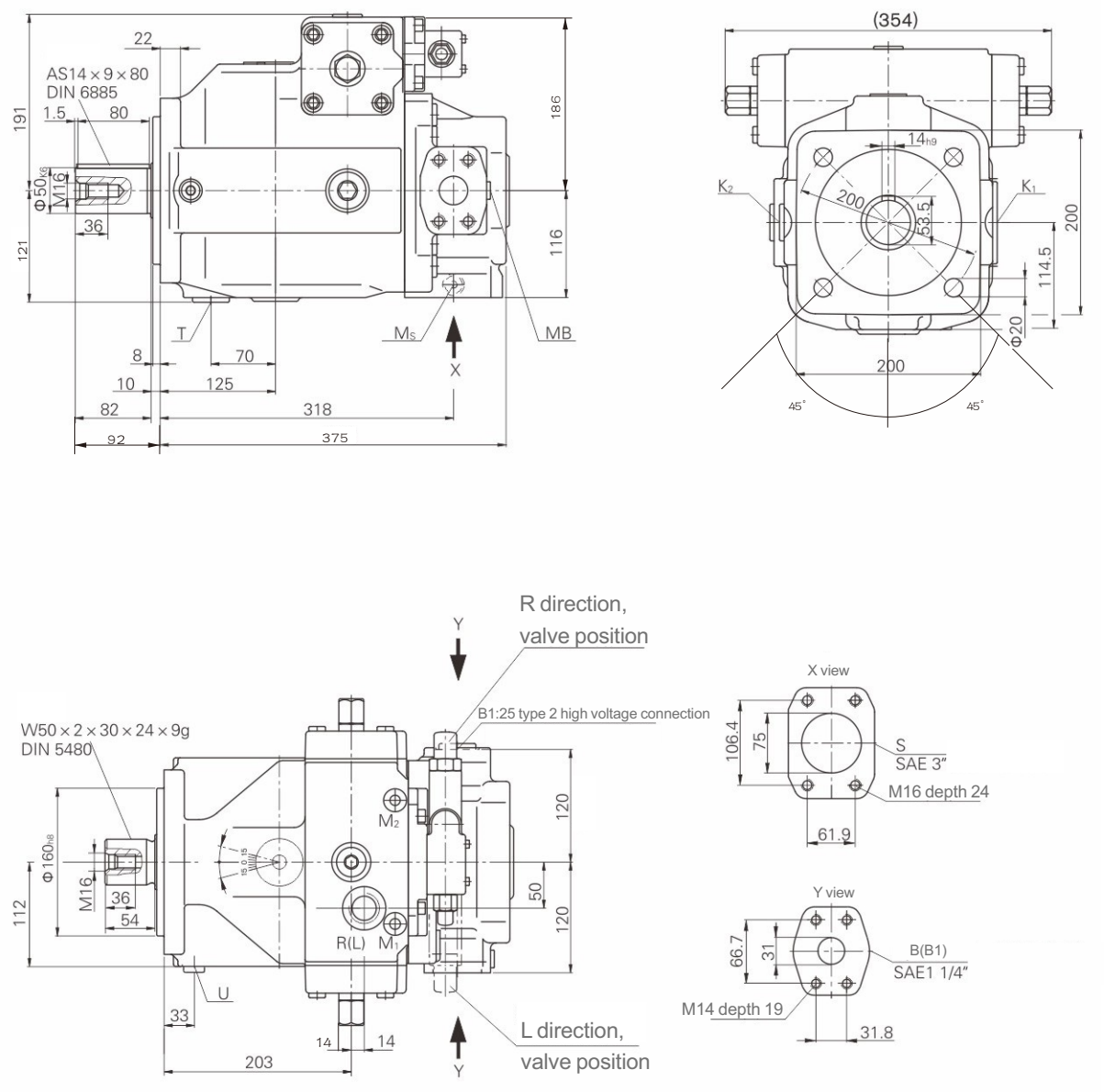
Ports type 25

B	pressure port	SAE1 1/4"(high pressure series)
B_1	second pressure port	SAE1 1/4"(high pressure series) (closed)

Other ports

S	suction port	SAE2 1/2"(standard series)
K_1,K_2	flushing port	M33 x 2 depth18 (plugged)
T	drain port	M33 x 2 depth18 (plugged)
M_B,M_S	measuring port	M14 x 1.5 depth12 (plugged)
R(L)	filling port + bleed port	M33 x 2
U	flushing port	M14 x 1.5 depth12 (plugged)
M_1,M_2	measuring port control device	M14 x 1.5 (plugged)

Installation dimensions Size 180/200, Series 30 (Example: pressure control)



Ports type 13

B	pressure port	SAE1 1/4"(high pressure series)
B_1	auxiliary port	M33 x 2 depth18 (plugged)

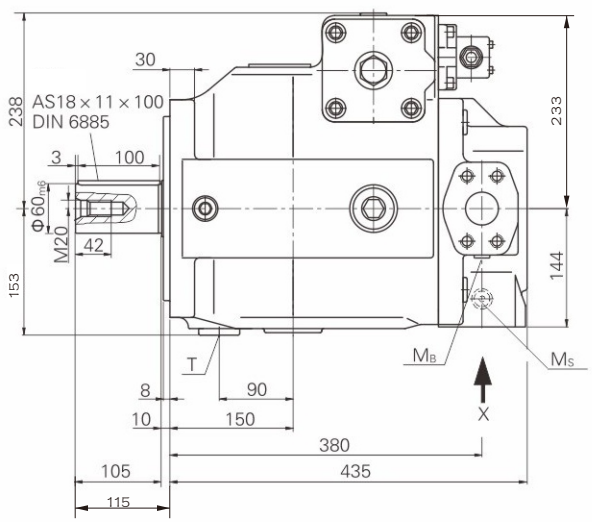
Ports type 25

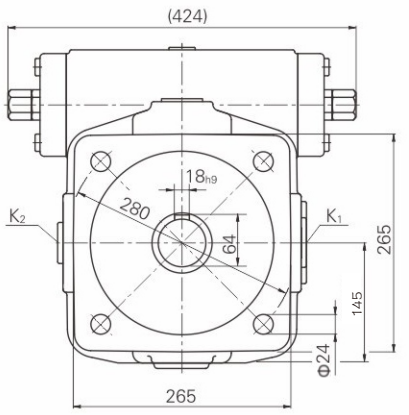
B	pressure port	SAE1 1/4"(high pressure series)
B_1	second pressure port	SAE1 1/4"(high pressure series) (closed)

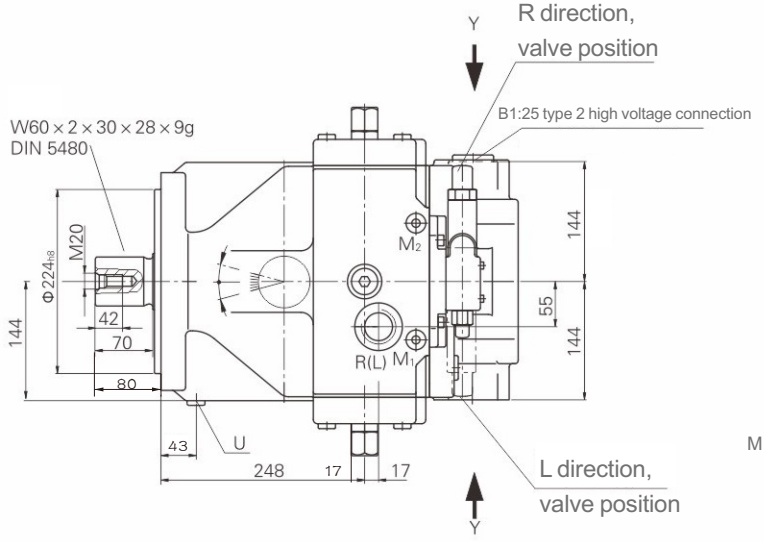
Other ports

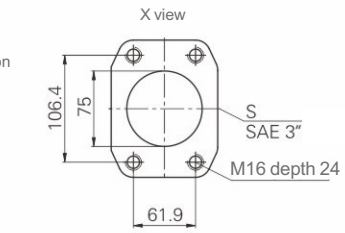
S	suction port	SAE3"(standard series)
K_1,K_2	flushing port	M33 x 2 depth18 (plugged)
T	drain port	M33 x 2 depth18 (plugged)
M_B,M_S	measuring port	M14 x 1.5 depth12 (plugged)
R(L)	filling port + bleed port	M33 x 2
U	flushing port	M14 x 1.5 depth12 (plugged)
M_1,M_2	measuring port control device	M14 x 1.5 (plugged)

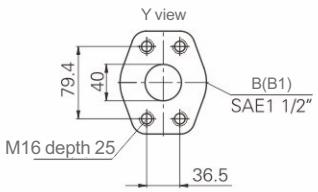
Installation dimensions Size 250/280, Series 30 (Example: pressure control)











Ports type 13

B	pressure port	SAE1 1/2"(high pressure series)
B_1	auxiliary port	M42 x 2 depth20 (plugged)

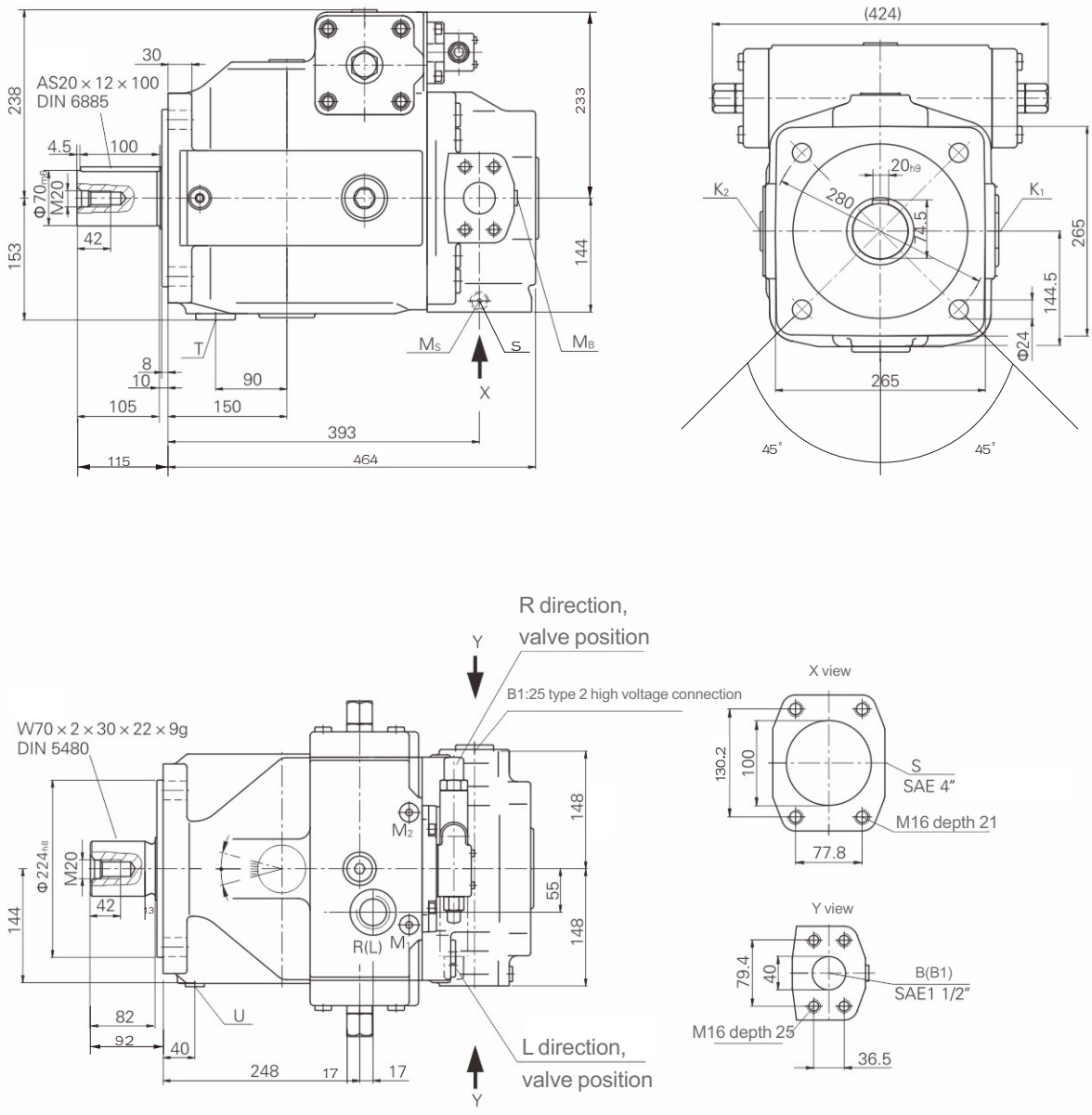
Ports type 25

B	pressure port	SAE1 1/2"(high pressure series)
B_1	second pressure port	SAE1 1/2"(high pressure series) (closed)

Other ports

S	suction port	SAE3"(standard series)
K_1,K_2	flushing port	M42 x 2 depth20 (plugged)
T	drain port	M42 x 2 depth20 (plugged)
M_B,M_S	measuring port	M14 x 1.5 depth12 (plugged)
R(L)	filling port + bleed port	M42 x 2
U	flushing port	M14 x 1.5 depth12 (plugged)
M_1,M_2	measuring port control device	M18 x 1.5 (plugged)

Installation dimensions Size 355, Series 30 (Example: pressure control)



Ports type 13

B	pressure port
B_1	auxiliary port

Ports type 25

B	pressure port
B_1	second pressure port

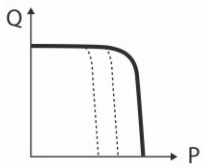
Other ports

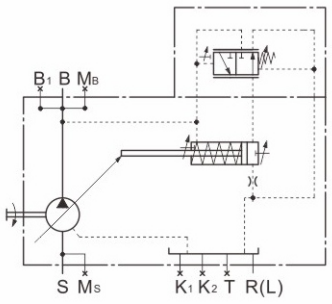
S	suction port	SAE1 1/2"(high pressure series)
K_1,K_2	flushing port	M42 x 2 depth20 (plugged)
T	drain port	SAE1 1/2"(high pressure series)
M_B,M_S	measuring port	SAE1 1/2"(high pressure series) (closed)
R(L)	filling port + bleed port	SAE4"(standard series)
U	flushing port	M42 x 2 depth20 (plugged)
M_1,M_2	measuring port control device	M42 x 2 depth20 (plugged)
		M14 x 1.5 depth12 (plugged)
		M42 x 2
		M18 x 1.5 depth12 (plugged)
		M18 x 1.5 (plugged)

Control Devices

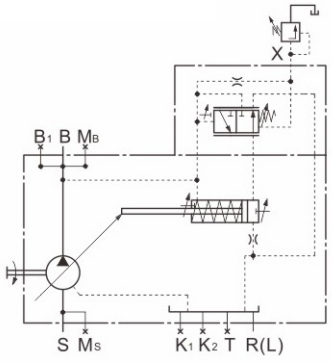
1、Pressure Control DR

Pressure control keeps the pressure constant within the control range of the pump at the pump outlet. There fore, the pump only delivers as much fluid as required by the actuators.
Setting range 20 ~ 350bar.
Optional: with remote pressure control DRG





DR Schematic



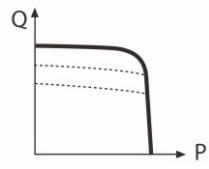
DRG Schematic

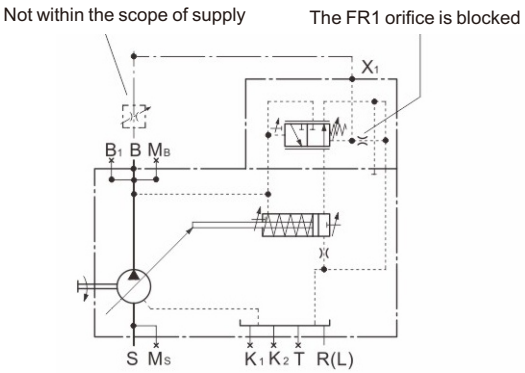
Ports

X Pilot pressure port, for remote pressure control M14 x 1.5 depth12

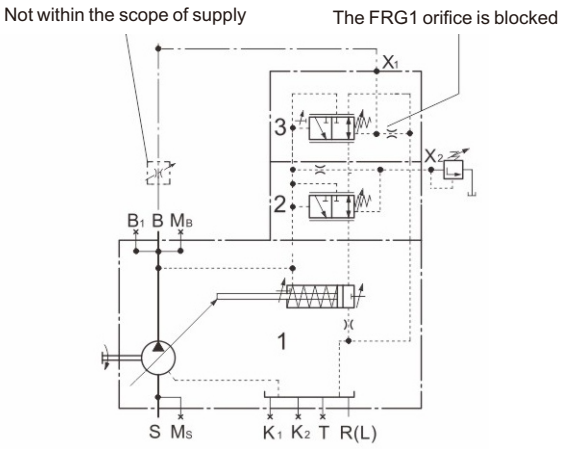
2、Flow Control FR

Pump flow may be requlated by means of a differential pressure at an orifice and maintains a constant regulating flow in a hydraulic system.
Optional: with remote pressure control FRG
For model FR1 or FRG1 the orifice closed in the X port





FR Schematic



FRG Schematic

Ports

X1 Pilot pressure port, for flow control M14 x 1.5 depth12

X2 Pilot pressure port, for remote pressure control M14 x 1.5 depth12

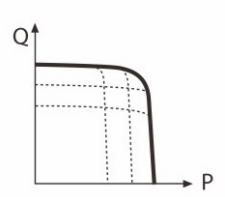
Diagram components

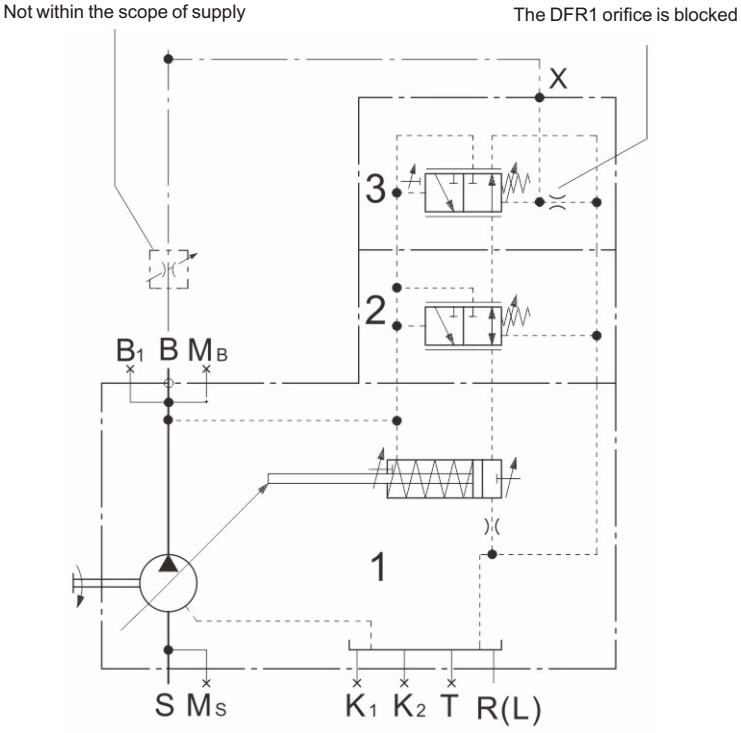
1. A4VSO Axial piston pump (with hydraulic positioning device)
2.Pressure control valve
3.Flow controly valve

Control Devices

- 3、Pressure and Flow Control DFR

  This control maintains a constant flow from the pump even under varying oprerating conditions. Overriding this control is a mechanically adjustable pressure control.
  Optional: For model DFR1 the orifice closed in the X port





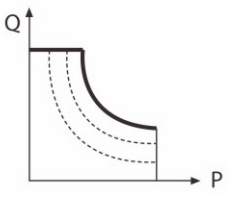
DFR Schematic

Ports

X Pilot pressure port, for flow control M14 x 1.5 depth12

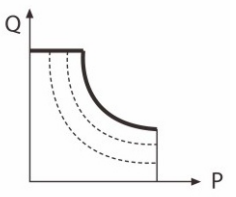
Diagram components

1. A4VSO Axial piston pump (with hydraulic positioning device)
2. Pressure control valve
3. Flow control valve



- 4、Pressure Control LR 2

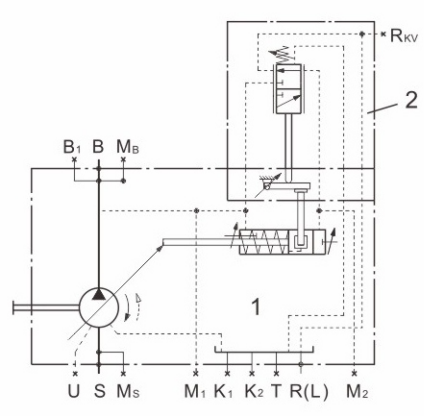
  The hyperbolic power control maintains a constant preset drive power at the same input speed.
  Optional: with pressure control LR2D, with remote pressure control LR2G



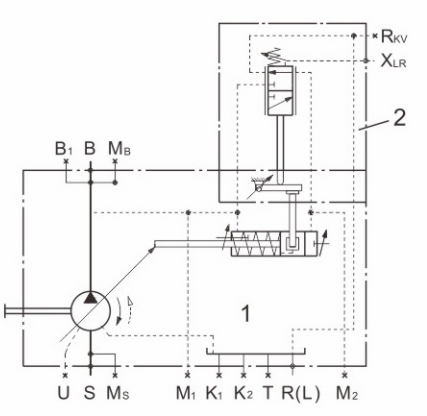
- 5、Pressure Control LR 3

  The hyperbolic power control maintains a constant preset drive power at the same input speed. The power characteristics can be adjusted remotely.
  Optional: with pressure control LR3D, with remote pressure control LR3G

Control Devices



LR2 Schematic



LR3 Schematic

Ports

R_{KV} External control oil return port M18x1.5 depth 12

X_{LR} Pilot pressure port, for rem ote power control M14 x 1.5 depth 12

Diagram components

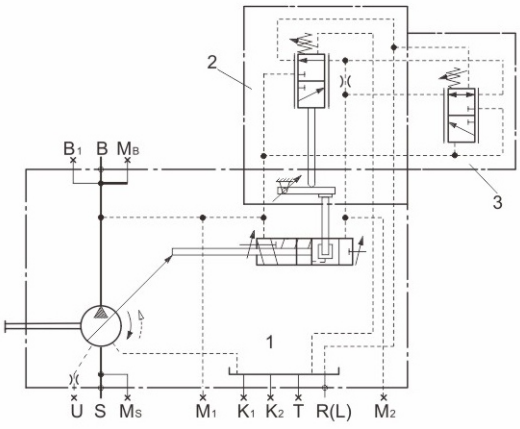
1. A4VSO Axial piston pump (with hydraulic positioning device)
2. Power control valve

···D With Pressure Control

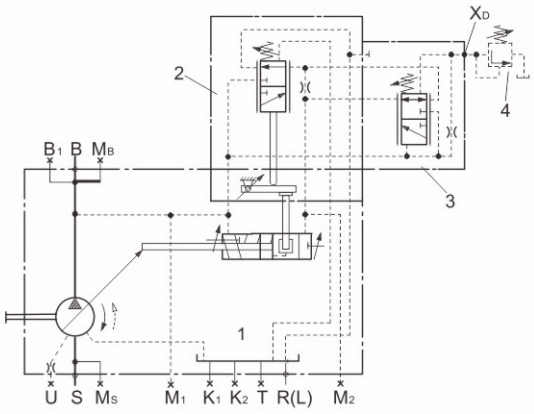
The pressure control overrides the power control, i.e. below the set pressure control level the unlt follwes the power control function. As soon as the pump output pressure reaches the pressure control level, the pump turns into the pressure control model and delivers only the amount of fluid as requlred to maintain this pressure.

···G With Remote Pressure Control

Pressure rellef valve is connected to port XD, for remote control. As soon as the pump output pressure(relief valve setting plus pressure differential over the pressure control valve spool) reaches the pressure control level, the pump turns into the pressure control model and delivers only the amount of fluid as required to maintain this pressure.



LR2D Schematic



LR2G Schematic

Ports

X_D Pilot pressure port, for remot e pressure control M14 x 1.5 depth 12

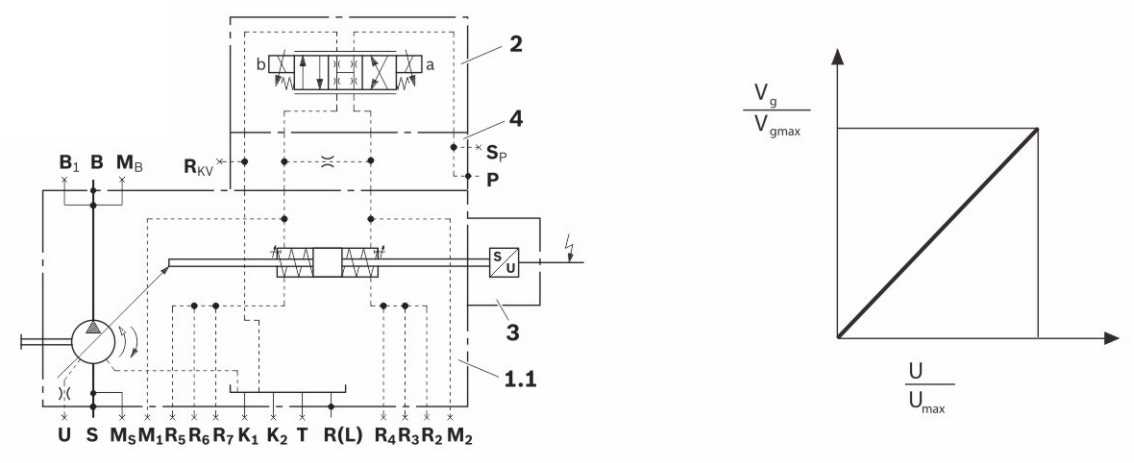
Diagram components

1.A4VSO Axial piston pum p (with hydraulic positioning device)
2.Power control valve
3.Pressure control valve
4.Pressure reliefl valve (noti in scope of supply)

Control Devices

- 6、Hydraulic flow control Eo2

The displacement is adjusted wirelessly by means of a proportional valve with electric feedback of swash plate swing Angle.

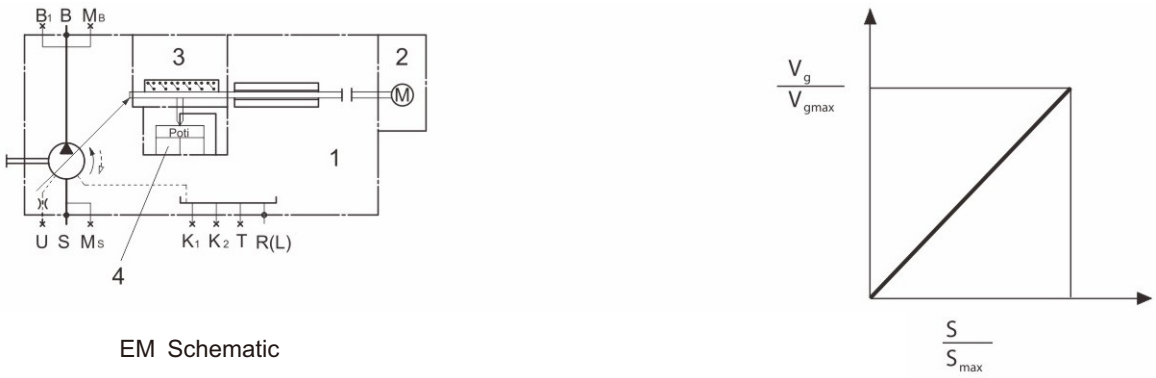


Eo2 Schematic

Diagram components
1.A4VSO type axial piston pump(with mechanical positioning device)
2.Proportional valve
3.Position sensor
4.Transition board

- 7、Motor Control EM

Stepless adjustment of displacement via an electric motor. Various intermediate displacement values can be selected with a programmed sequence control, by means of built on limit switches and an optional potentiometer for feedback signal.



EM Schematic

Diagram components
1. A4VSO Axial piston pump (with mechanical positioning device)
2. Motor
3. Limit switch
4. Potentiometer

Through Drive

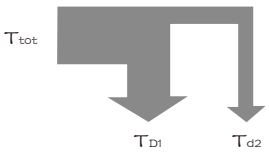
A4VSO axial piston pump can be equipped with a through drive, as shown in the type code on page 2-3
We recommend that no more than three pumps be coupled together(main pump and following pump a total of three).

Permissible input torque and through drive torque（Unit：Nm）

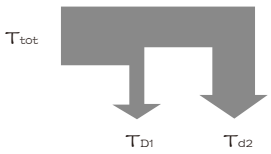
Size		40	71	125	180/200	250/280	355
Splined Shaft							
Maximum input torque of the main pump	$T_{tot\,max}$	446	790	1392	2004	2782	3952
A Type Permissible through drive torque	T_{D1max}	223	395	696	1002	1391	1976
	$T_{D2\,max}$	223	395	696	1002	1391	1976
B Type Permissible through drive torque	T_{d1max}	223	395	696	1002	1391	1976
	$T_{D2\,max}$	223	395	696	1002	1391	1976
Keyed shaft							
Maximum input torque of the main pump	$T_{tot\,max}$	380	700	1392	1400	2300	3557
A Type Permissible through drive torque	T_{D1max}	223	395	696	1002	1391	1976
	$T_{D2\,max}$	157	305	696	398	909	1581
B Type Permissible through drive torque	T_{D1max}	157	305	696	398	909	1581
	$T_{D2\,max}$	223	395	696	1002	1391	1976

Torque Distribution Pattern

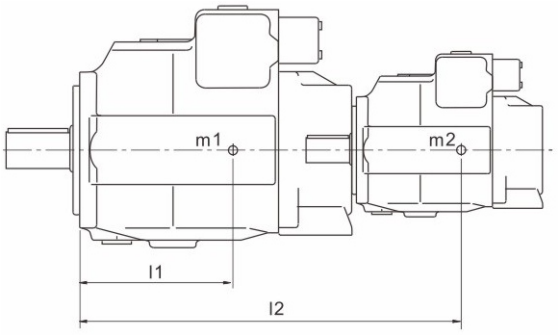
Distribution pattern A



Distribution pattern B



Permissible mass moment of inertia referred to the mounting flange of the main pump



Size	40	71	125	180/200	250/280	355
T_m	1800	2000	4200		9300	
$T_{m\,10g}$	180	200	420		930	
m	39	53	88	102	184	207
l_1	120	140	170	180	210	220

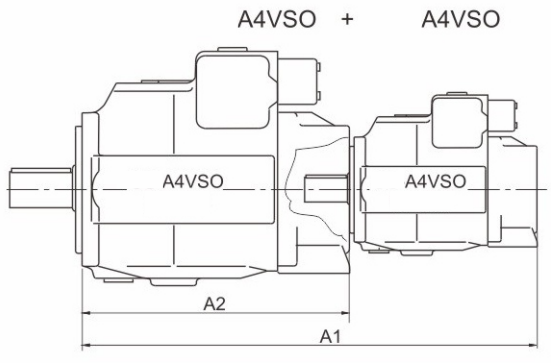
T_m-Perm. mass moment of inertia (Nm)
T_{m10g}-Perm. mass moment at dynam acceleration of 10g (Nm)
m_1-The quality of the main pump (kg)
m_2-The quality of the following pump (kg)
l_1-The distance between barycenter of main pump and mounting flange (mm)
l_2-The distance between barycenter of following pump and mounting flange of main pump (mm)

$$T = m_1 \times l_1 \times 102 + \frac{1}{m_2} \times l_2 \times 102 < \frac{1}{T_m}$$

Through Drive

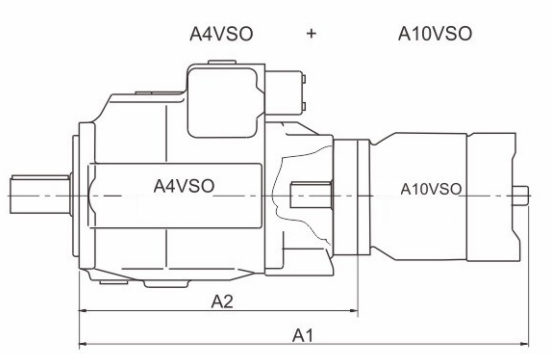
Combination Pump Dimensions

Dimensions of following pumps A4VSO (mm)



Main pump			40	71	125	180/200	250/280	355
Following pump	A_1	40	554	582	635	659	719	748
		71	-	611	664	688	748	777
		125	-	–	724	748	808	837
		180	-	–	-	768	828	857
		250	-	–	-	–	904	933
		355	-	–	-	–	–	962
	A_2	≤180	288	316	369	393	453	482
		≥250	-	–	-	–	469	498

Dimensions of following pumps A10VO and A10VSO(mm)



Main pump			40	71	125	180/200	250/280	355
Following pump	A_1	18	458	486	564	588	648	677
		28	496	497	575	599	659	688
		45	514	540	593	617	677	706
		71	-	580	628	652	712	741
		100	-	-	698	722	782	801
		140	-	-	-	744	791	820
	A_2		288	316	369	393	453	482

The dimension A2 is 406 for that A4VSO180 pump couples A10VSO 140 or A10V0 140 pump

Mounting

- General requirements

The mounting position is discretionary. Before trial running, the pump body must be filled with fluid and kept filled while working.
To reduce noise, all connecting pipes (inlet pipe, pressure pipe and casting drain pipe) must be separated from the tank by using flexible components. Avoid mounting check valve on the casting drain pipe. The leaked oil shall return directly to the tank, but the through- flow section shall not be reduced.

- Vertical mounting (with shaft end upward)

In case of vertical mounting, we recommend flushing bearings as mentioned above to ensure the lubricatlon of the front bearings.

Mounting inside the tank

a) When the minimum level in the tank is as same as or larger than the height of the flange face of the pump, port R/L, T and S can be open(see Figure 1)

b) When the minimum level in the tank is lower than the flange face of the pump, port R/L, T and possible port S must be connected with pipes, as shown in Figure 2.This situation is same as what is specified in Mounting outside of the Tank in this section.

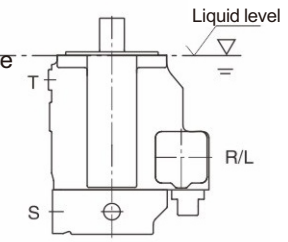


Figure 1

Mounting outside the tank

Before mounting, the pump shall be placed horizontally and filled with fluid. Port T is connected with the tank and port R/L shall be blocked. Filling while mounting：Filling from port R/L and venting by port T and then blocking port R/L(see Figure 2)

Conditions：The minimum inlet pressure (absorption pressure) of the pump shall not be lower than 0.8 bar, the absolute pressure. If low noise running is required, the pump shall not be placed on the tank.

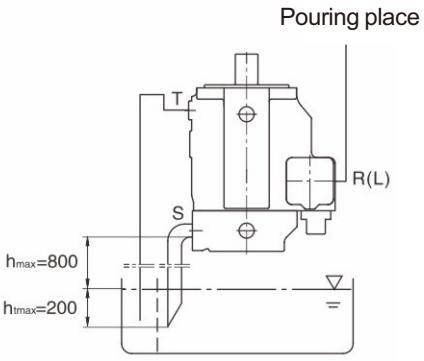


Figure 2

- Horizontally placed

Place port T, K1, K2 or R/L higher than the highest position for filling /venting and for connecting with drain pipe.

Mounting

Mounting inside the tank

a) When the minimum level in the tank is as same as or higher than the upper end of the drain port and port S can be open (see Figure 3)

b) When the minimum level in the tank is lower than the upper end of the pump, the drain port and possible port S must be connected with pipes.（See Figure 4）.This situation is same as what is specified in （a) Mounting outside of the Tank in this section.

Before trial running, the pump body must be filled with fluid

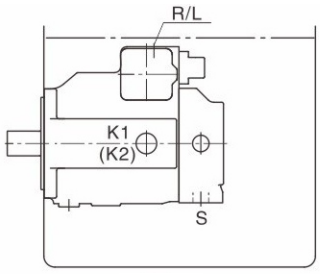


Figure 3

Mounting outside the tank

Before trial running, the pump body must be filled with fluid.

a) For mounting on the tank, see Figure 4.
Conditions: The minimum inlet pressure (absorption pressure) of the pump shall not be lower than 0.8 bar, the absolute pressure. If low noise running is required, the pump shall not be placed on the tank.

b) For mounting under the tank, port R/L and S must be connected with pipes, as shown in Figure 5.

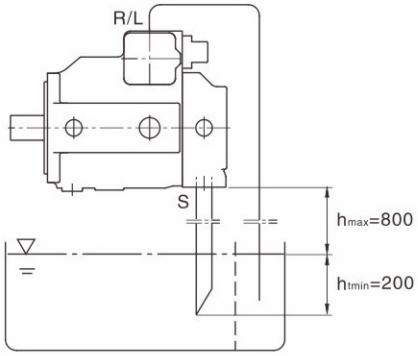


Figure 4

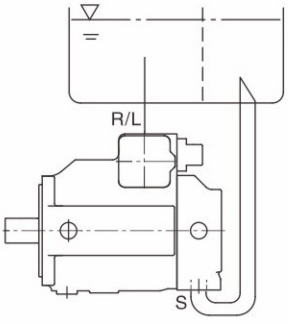


Figure 5