Beijing Huade Hydraulic Industrial Group Co., Ltd	HD-A10VSO Open Circuit Axial Piston Variable Pump		HDPT140601A YUP6502
	Series 31; Sizes 18～140	Peak Pressure 35 MPa	

■ Product Description：

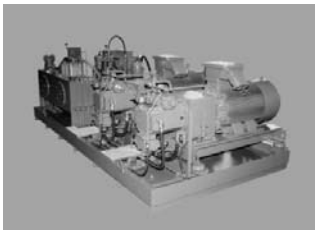
- HD-A10VSO Variable pump in axial piston swashplate design for hydrostatic drives in an open circuit
- The flow is proportional to the drive speed and the displacement, The flow can be steplessly varied by adjustment of the swashplate angle.

■ Features：

- Excellent suction characteristics
- Axial and radial load capacity of drive shaft
- Short control time
- The through drive is suitable for adding gear pumps and axial piston pumps up to the same size, i.e., 100% through drive.
- Low noise level,Long service life.
- Favorable power/weight ratio
- Versatile controller range

■ Applications:

- Metallurgical and Mining Machinery
- Engineering machinery and Industry Equipment
- Ship and Civil Aviation Ground Equipment
- Petroleum and Petrochemical Machinery
- Building and Move Machines



■ Contents：

■ Type Code For Standard Program：

HD	-		(A)A10VS	O	100	DR	/	31	R	-	V	S	A	12	N00
0		1	2		3	4	5	6	7		8	9	10	11	12

0. Manufacturer：

HD HUADE HYDRAULIC

1. Version：

Oil types / Specifications：	18	28	45	71	100	140	Code
Standard version (without symbol)	■	■	■	■	■	■	-
HFA, HFB, HFC hydraulic fluid (except for Skydrol)	-	■	■	■	■	■	E
High-speed version	-	-	□	□	□	■	H

2. Axial piston unit：

Axial piston unit / Size：	18	28	45	71	100	140	Code
Swashplate design, variable, nominal pressure 4000 psi (280 bar);	■	-	-	-	-	-	A10VS
maximum pressure 5100 psi (350 bar) US-Version	-	■	■	■	■	■	AA10VS

3. Operation mode：

Operation mode / Size：	18	28	45	71	100	140	Code
Pump, open circuit	■	■	■	■	■	■	O

4. Size (NG)：

Displacement / Size：	18	28	45	71	100	140	Code
Geometric displacement ≙ V_{gmax}（cm^3/r）	18	28	45	71	100	140	-

5. Control device：

Control device / Size：				18	28	45	71	100	140	Code
Two-point control, directly operated				-	■	■	■	■	■	DG
Pressure control				■	■	■	■	■	■	DR
	With flow control, hydraulic									
			X-T open	■	■	■	■	■	■	DFR
			X-T closed	■	■	■	■	■	■	DFR1
	pressure and swivel-angle control, electric			■	■	■	■	■	■	DFE1
	With pressure cut-off, remotely operated									
	hydraulic,			■	■	■	■	■	■	DRG
	electrical	negative characteristic	12V	■	■	■	■	■	■	ED71
			24V	■	■	■	■	■	■	ED72
		positive characteristic	12V	■	■	■	■	■	■	ER71
			24V	■	■	■	■	■	■	ER72
Power control		pressure, flow and power control		-	■	■	■	■	■	DFLR

■ Type Code For Standard Program：

HD	-		(A)A10VS	O	100	DR	/	31	R	-	V	S	A	12	N00
0		1	2		3	4	5	6	7		8	9	10	11	12

6. Series：

Series / Size：	18	28	45	71	100	140	Code
Series 3, Index 1	■	■	■	■	■	■	31

7. Direction of rotation：

Viewed：	Direction of rotation	Code
Viewed on drive shaft	clockwise	R
	counter clockwise	L

8. Seals：

Seals / Size：	18	28	45	71	100	140	Code
FKM（fluor-caoutchouc）	■	■	■	■	■	■	V

9. Drive shaft：

Drive shaft / Size：		18	28	45	71	100	140	Code
Splined shaft	standard shaft	■	■	■	■	■	■	S
ANSI B92.1a	similar to shaft S,however for higher input torque.	■	■	■	■	-	-	R
	reduced diameter, not for through drive	■	-	-	-	■	-	U
Parallel keyed shaft ISO 3019-1	not for through drive	■	■	■	■	■	■	K

10. Mounting flange：

Flange / Size：		18	28	45	71	100	140	Code
ISO 3019-1	2 hole	■	■	■	■	■	-	C
	4 hole	-	-	-	-	-	■	D

11. Service line port：

Port / Size：	18	28	45	71	100	140	Code
SAE flange ports on opposite side,UNC fastening thread.	■	■	■	-	■	■	62
	-	-	-	■	-	-	92

■ Type Code For Standard Program：

HD	-		(A)A10VS	O	100	DR	/	31	R	-	V	S	A	12	N00
0		1	2		3	4	5	6	7		8	9	10	11	12

12. Through drive：

Through drive / Size：			18	28	45	71	100	140	Code
without through drive			■	■	■	■	■	■	N00
Flange (ISO 3019-1)	coupling for splined shaft (ANSI B92.1a)								
82-2 （A）	5/8 in	9T 16/32 DP	■	■	■	■	■	■	K01
	3/4 in	11T 16/32 DP	■	■	■	■	■	■	K52
101-2（B）	7/8 in	13T 16/32 DP	-	■	■	■	■	■	K68
	1 in	15T 16/32 DP	-	-	■	■	■	■	K04
127-2（C）	1-1/4 in	14T 12/24 DP	-	-	-	■	■	■	K07
	1-1/2 in	17T 12/24 DP	-	-	-	-	■	■	K24
152-4（D）	1-3/4 in	13T 8/16 DP	-	-	-	-	-	■	K17

■ = Optimization scheme (shorter delivery time)

■ = available

□ = on request

\- = not available

■ Hydraulic fluid：

- Before starting project planning, please refer to our data sheets mineral oil and environmentally acceptable hydraulic fluids for detailed information regarding the choice of hydraulic fluid and application conditions.
- When using environmentally acceptable hydraulic fluids, the limitations regarding technical data and seals must be observed. Please contact us. When ordering, indicate the hydraulic fluid that is to be used.

■ Operating viscosity range：

- For optimum efficiency and service life we recommend that the operating viscosity (at operating temperature) be selected in the range.

  V_{opt}= opt. operating viscosity 80-170 SUS(16 ... 36 mm^2/s)
- referred to reservoir temperature (open circuit).

■ Limits of viscosity range：

- For critical operating conditions the following values apply：

  n_{min}= 60 SUS(10 mm^2/s)

  short-term (t ≤1 min)

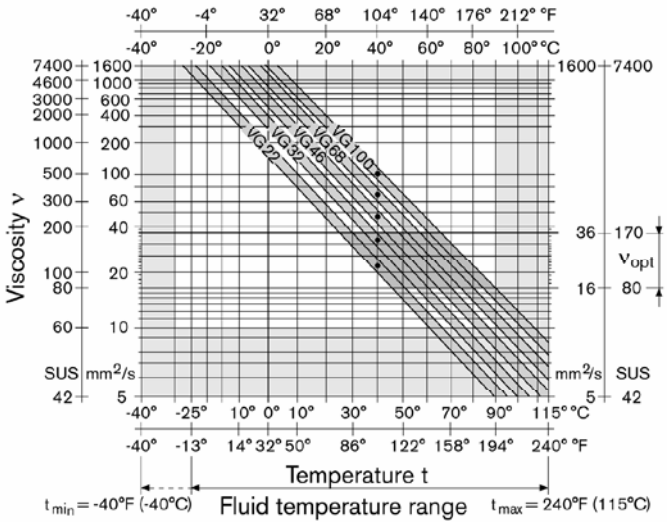
  at max perm. case drain temperature of 195 °F(90℃).
- Please also ensure that the max. case drain temperature of 195 °F(90℃) is not exceeded in localized areas (for instance, in the bearing area).The fluid temperature in the bearing area is approx. 7 °F (5 K) higher than the average case drain temperature.

  n_{max}= 4640 SUS(1000 mm^2/s)

  short-term (t ≤1 min)

  on cold start (p ≤30 bar, n ≤1000 rpm, t_{min} -13°F(-25℃))
- Depending on the installation situation, special measures are necessary at temperatures between -40 °F(-40℃) and -13 °F (-25℃). Please contact us.
- For detailed information on operation with low temperatures see other data sheet.

■ Selection diagram：



■ Notes on the choice of hydraulic fluid：

- In order to select the correct hydraulic fluid, it is necessary to know the operating temperature in the reservoir (open circuit) in relation to the ambient temperature.
- The hydraulic fluid should be selected so that within the operating temperature range, the viscosity lies within the optimum range (nopt), see shaded section of the selection diagram. We recommend to select the higher viscosity grade in each case.
- Example: at an ambient temperature of X °F (℃) the operating temperature is 140 °F (60℃). In the optimum operating viscosity range (V_{opt}; shaded area) this corresponds to viscosity grades VG 46 resp. VG 68; VG 68 should be selected.

■ Important：

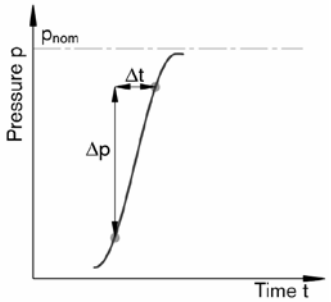
- The case drain temperature is influenced by pressure and input speed and is always higher than the reservoir temperature. However, at no point in the component may the temperature exceed 195 °F (90℃). The temperature difference specified on the left is to be taken into account when determining the viscosity in the bearing.
- If the above conditions cannot be met, due to extreme operating parameters please contact us.

■ Filtration of the hydraulic fluid：

- The finer the filtration the better the cleanliness level of the hydraulic fluid and the longer the service life of the axial piston unit.
- In order to guarantee the functional reliability of the axial piston unit it is necessary to carry out a gravimetric evaluation of the hydraulic fluid to determine the particle contamination and the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 must be maintained.
- At very high hydraulic fluid temperatures (195 °F (90℃) to maximum 239 °F (115℃)), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.
- If the above cleanliness levels cannot be maintained, please contact us.

■ Operating pressure range：

- Pressure at service line port B：
  Nominal pressure P_{nom} ----------4000 psi (280 bar) absolute
  Maximum pressure P_{max} ----------5100 psi (350 bar) absolute
- Single operating period 2.5 ms,Total operating period 300 h
- Mini. pressure (high-pressure side) ---145 psi (10 bar) absolute[1)]
- Rate of pressure change $R_{A\,max}$-----232060 psi/s (16000 bar/s)



- Pressure at suction port S (inlet)：
  Minimum pressure $P_{S\,min}$ ----------12 psi (0.8 bar) absolute
  Maximum pressure $P_{S\,max}$ ----------45 psi (10 bar)[1)]absolute

■ Note：

- Please contact us for values for other hydraulic fluids.

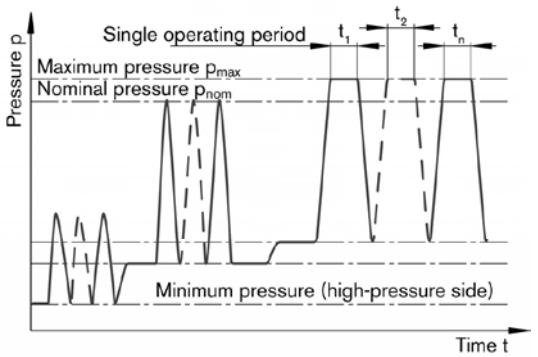
■ Case drain pressure：

- Maximum permissible case drain pressure (at port L, L_1)：
- Maximum 7 psi (0.5 bar) higher than the inlet pressure at port S，however not higher than 30 psi (2 bar) absolute.
  $P_{L\,max}$ ----------30 psi (2 bar) absolute[1)]

1) Other values on request

■ Definition：

- Nominal pressure P_{nom}
  The nominal pressure corresponds to the maximum design pressure.
- Maximum pressure P_{max}
  The maximum pressure corresponds to the maximum operat-ing pressure within the single operating period. The total of the single operating periods must not exceed the total operating period。
- Minimum pressure (high-pressure side)：
  Minimum pressure in the high-pressure side (port B) that is required in order to prevent damage to the axial piston unit. The minimum pressure depends on the speed and displace-ment of the axial piston unit.。
- Rate of pressure change R_A
  Maximum permissible pressure build-up and pressure reduc-tion speed with a pressure change over the entire pressure range.



- Total operating period = $t_1 + t_2 + t_3$ ……+ t_n

■ Technical Data：

□ Standard Unit ;for mineraloil based hydraulic fluid.

■ Table of values（theoretical values, without efficiencies and tolerances: values rounded）：

Size		NG		18	28	45	71	100	140
Geometrical displacement per revolution		$V_{g\,max}$	$In^3(cm^3)$	1.10(18)	1.71(28)	2.75(45)	4.33(71)	6.10(100)	8.54(140)
Speed 1)	maximum at $V_{g\,max}$	n_{nom}	rpm	3300	3000	2600	2200	2000	1800
	maximum at $V_g < V_{g\,max}$	n_{max}	rpm	3900	3600	3100	2600	2400	2100
Flow	at $n_{0\,max}$ and $V_{g\,max}$	$q_{V0\,max}$	gpm(l /min)	15.7(59)	22(84)	31(117)	41(156)	53(200)	67(252)
	at n_E=1500 rpm and $V_{g\,max}$	$q_{VE\,max}$	gpm(l /min)	7.2(32)	13.3(59)	21.4(81)	33.8(128)	47.6(180)	67(253)
Power	at $n_{0\,max}$ and $V_{g\,max}$	P_{max}	HP(KW)	36(28)	51(39)	72(55)	96(73)	124(93)	156(118)
at ⊿p=280 bar	at n_E=1500 rpm and $V_{g\,max}$	$P_{E\,max}$	HP(KW)	19(15)	31(24)	50(38)	91(69)	111(84)	156(118)
Torque	⊿p=280 bar	T_{max}	lb-ft(Nm)	58(80)	91(125)	146(200)	230(316)	324(445)	453(623)
at $V_{g\,max}$ and	⊿p=100 bar	T	lb-ft(Nm)	14.6(30)	33(45)	53(72)	83(113)	117(159)	164(223)
Rotary stiffness drive shaft	S	c	lb-ft /rad	8082	16400	27560	53018	89348	125042
			(Nm/rad)	(11087)	(22317)	(37500)	(71884)	(121142)	(169537)
	R	c	lb-ft /rad	10870	19400	30240	56456	-	-
			(Nm/rad)	(14850)	(26360)	(41025)	(76545)	(-)	(-)
	U	c	lb-ft /rad	5946	-	-	-	67180	
			(Nm/rad)	(8090)	(-)	(-)	(-)	(91093)	(-)
	K	c	lb-ft /rad	9805	19712	32270	60352	99448	144680
			(Nm/rad)	(13340)	(26189)	(43905)	(82112)	(135303)	(188406)
Moment of inertial rotary group		J_{TW}	$lbs\text{-}ft^2$	0.022	0.0403	0.0783	0.1970	0.3963	0.5743
			(kgm^2)	(0.00093)	(0.0017)	(0.0033)	(0.0083)	(0.0167)	(0.0242)
Angular acceleration, maximum 2)		α	rad/s^2	6800	5500	4000	3300	2700	2700
Filling capacity		Gal(L)	L	0.1(0.4)	0.2(0.7)	0.26(1.0)	0.4(1.6)	0.6(2.2)	0.8(3.0)
Weight（without through drive）approx		m	lbs(kg)	26.5(12)	33(15)	46(21)	73(33)	99(45)	132(60)

□ Note：

1）The values are applicable：

- for an absolute pressure P_{abs}=15 psi(1 bar) at suction port S
- within the optimum viscosity range from V_{opt} = 80 to 170 SUS(16 to 36 mm^2/s)
- for mineraloil based hydraulic fluid

2）The scope of application lies between the minimum necessary and the maximum permissible drive speeds

- Valid for external excitation (e.g. diesel engine 2to 8fold rotary frequency, cardan shaft 2fold rotary frequency)
- The limiting value is only valid for a single pump.
- The loading capacity of the connecting parts must be taken into account.

■ Note：

□ Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit. We recommend to check the loading through tests or calculation / simula-tion and comparison with the permissible values.

■ Determination of size：

Flow $q_V = \frac{V_g \cdot n \cdot \eta_V}{1000}$ [l/min]

Torque $T = \frac{V_g \cdot \Delta p}{20 \cdot p \cdot h_{mh}}$ [Nm]

Power $P = \frac{2\pi \cdot T \cdot n}{60000} = \frac{q_V \cdot \Delta p}{600 \cdot \eta_t}$ [kW]

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

η_V = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Total efficiency($\eta_t = \eta_V \cdot \eta_{mh}$)

■ Technical Data：

□ high-speed version,for mineraloil based hydraulic fluid.

■ Table of values（theoretical values, without efficiencies and tolerances: values rounded）：

Size		NG		45	71	100	140
Geometrical displacement per revolution		$V_{g\,max}$	$In^3(cm^3)$	2.75(45)	4.33(71)	6.1(100)	8.54(140)
Speed 1)	maximum at $V_{g\,max}$	n_{nom}	rpm	3000	2550	2300	2050
	maximum at $V_g < V_{g\,max}$	$n_{max\,perm}$	rpm	3300	2800	2500	2200
Flow at n_{nom} and $V_{g\,max}$		$q_{V\,max}$	gpm(l /min)	35	48	61	76
				(135)	(178)	(230)	(287)
Power at n_{max} and $V_{g\,max}$	at ⊿p=4000 psi(280 bar)	P_{max}	HP(KW)	83	112	142	177
				(63)	(83)	(107)	(134)
Torque at $V_{g\,max}$ and	⊿p=4000 psi(280 bar)	T_{max}	lb-ft(Nm)	146(200)	230(316)	324(445)	453(623)
	⊿p=1450 psi(100 bar)	T	lb-ft(Nm)	53(72)	83(113)	117(159)	164(223)
Rotary stiffness drive shaft	S	c	lb-ft /rad	27560	53018	89348	125042
			(Nm/rad)	(37500)	(71884)	(121142)	(169537)
	R	c	lb-ft /rad	30240	56456	-	-
			(Nm/rad)	(41025)	(76545)	(-)	(-)
	U	c	lb-ft /rad	-	-	67180	-
			(Nm/rad)	(-)	(-)	(91093)	(-)
	K	c	lb-ft /rad	32270	60352	99480	144680
			(Nm/rad)	(43095)	(82112)	(135303)	(188406)
Moment of inertial rotary group		J_{TW}	$lbs\text{-}ft^2(kgm^2)$	0.0783	0.1970	0.3963	0.5743
				(0.0033)	(0.0083)	(0.0167)	(0.0242)
Angular acceleration, maximum 2)		α	rad/s^2	4000	3300	2700	2700
Filling capacity		V	Gal(L)	0.26(1.0)	0.4(1.6)	0.6(2.2)	0.8(3.0)
Weight（without through drive）approx.		m	lbs(kg)	46(21)	73(33)	99(45)	132(60)

□ Note：

1）The values are applicable：

- for an absolute pressure P_{abs}=15 psi(1 bar) at suction port S
- within the optimum viscosity range from V_{opt} = 80 to 170 SUS(16 to 36 mm^2/s)
- for mineral-oil based hydraulic fluid

2）The scope of application lies between the minimum necessary and the maximum permissible drive speeds

- Valid for external excitation (e.g. diesel engine 2-to 8-fold rotary frequency, cardan shaft 2-fold rotary frequency)
- The limiting value is only valid for a single pump.
- The loading capacity of the connecting parts must be taken into account.

■ Note：

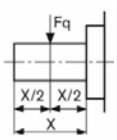
□ Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit. We recommend to check the loading through tests or calculation / simula-tion and comparison with the permissible values.

□ Sizes 45,71,100 and 140 are optionally available in high-speed version.

□ External dimensions are not affected by this option.

■ Technical Data：

□ Permissible radial and axial loading on the drive shaft：

Size		NG		18	28	45	71	100	140
Radial force maximum		$F_{q\,max}$	lbf	79	270	337	427	517	630
at a/2			(N)	(350)	(1200)	(1500)	(1900)	(2300)	(2800)
Axial force maximum		$F_{ax\,max}$	lbf	157	225	337	540	900	1080
			(N)	(700)	(1000)	(1500)	(2400)	(4000)	(4800)

□ Permissible input and through-drive torques：

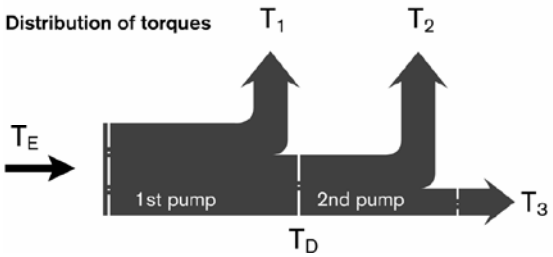
Size		NG		18	28	45	71	100	140
Torque（at $V_{g\,max}$ and ⊿p=4000 psi (280 bar)[1)]）		T_{max}	lb-ft(Nm)	58(80)	91(125)	146(200)	230(316)	324(445)	453(623)
Input torque for drive shaft, maximum[2)]	S	$T_{E\,max}$	lb-ft(Nm)	92(124)	146(198)	235(319)	462(626)	814(1104)	1195(1620)
		Φ	in	3/4	7/8	1	1-1/4	1-1/2	1-3/4
	R	$T_{E\,max}$	lb-ft(Nm)	118(160)	184(250)	295(400)	475(644)	-(-)	-(-)
		Φ	in	3/4	7/8	1	1-1/4	-	-
	U	$T_{E\,max}$	lb-ft(Nm)	43(59)	-(-)	-(-)	-(-)	439(595)	-(-)
		Φ	in	5/8	-	-	-	1-1/4	-
	K	$T_{E\,max}$	lb-ft(Nm)	77(104)	107(145)	156(212)	319(433)	553(750)	875(1186)
		Φ	in	0.7500	0.8750	1.0000	1.2500	1.5000	1.7500
			(mm)	(19.05)	(22.225)	(25.4)	(31.75)	(38.1)	(44.45)
Maximum through-drive torque for drive shaft	S	$T_{D\,max}$	lb-ft(Nm)	80(108)	118(160)	235(319)	363(492)	574(778)	934(1266)
	R	$T_{D\,max}$	lb-ft(Nm)	88(120)	130(176)	269(365)	404(548)	-(-)	-(-)
	K	$T_{D\,max}$	lb-ft(Nm)	77(104)	107(145)	156(212)	319(433)	553(750)	875(1186)

□ Note：

1）Without considering efficiency。

2）For drive shafts free of radial load

■ Distribution of torques：



T_E and T_D are made up as followed:

$T_E = T_1 + T_2 + T_3$

$T_D = T_2 + T_3$

$T_E < T_{E\,max}$

$T_D < T_{D\,max}$

□ A through drive with U shaft is also possible if these conditions are observed and technical data is reduced, whereby $T_{E\,max}$ apuals $T_{D\,max}$, please contact us.

■ Control Device DG

- Two-point control, directly operated.

■ Overview of the features：

- The variable pump can be set to a minimum swivel angle by connecting an external control pressure to port X.
- This will supply control fluid directly to the stroke piston; a minimum control pressure of $p_{st} \geqslant$ 725 psi (50 bar) is required.
- The variable pump can only be switched between $V_{g\,max}$ or $V_{g\,min.}$

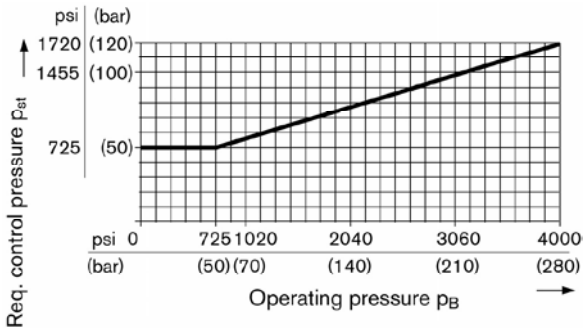
■ Control adjustment：

- Please note, that the required control pressure at port X is directly dependent on the actual operating pressure p_B in port B. (See control pressure characteristic).

Control pressure in X P_{st} = 0 bar ≙ $V_{g\,max}$

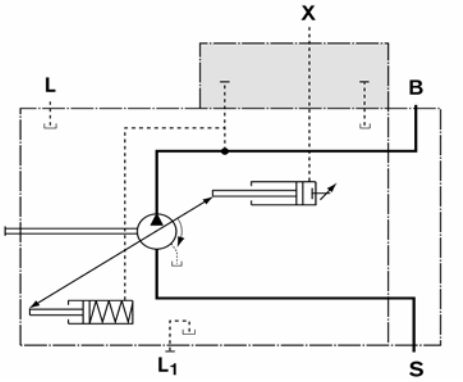
Control pressure in X $P_{st} \geqslant$ 50 bar ≙ $V_{g\,min}$

■ Control pressure characteristic：



■ Circuit diagram：

- Control device schematic (gray background areas in the images)



- Connect oil export：

Name	Port for
B	Service line
S	Suction line
L, L_1	Case drain (L_1 plugged)
X	Pilot pressure

■ Control Device DR：

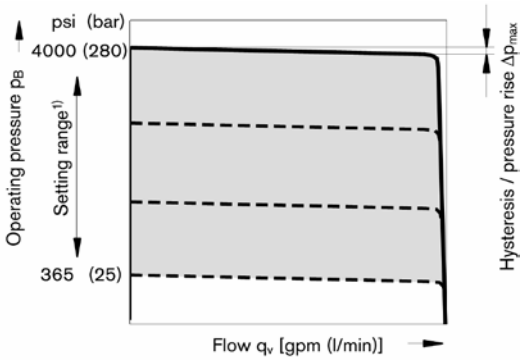
- □ Pressure control

■ Overview of the features：

- □ The pressure control limits the maximum pressure at the pump output within the pump control range. The variable pump only supplies as much hydraulic fluid as is required by the consumers.
- □ If the operating pressure exceeds the pressure setpoint set at the integrated pressure valve, the pump will adjust towards a smaller displacement and the control deviation will be reduced. The pressure can be set steplessly at the control valve.

■ Static characteristic：

- □ at n=1800 rpm t_{oil} = 122°F(50℃)



1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and must not be exceeded.The range of possible settings at the valve are greater.

■ Control data：

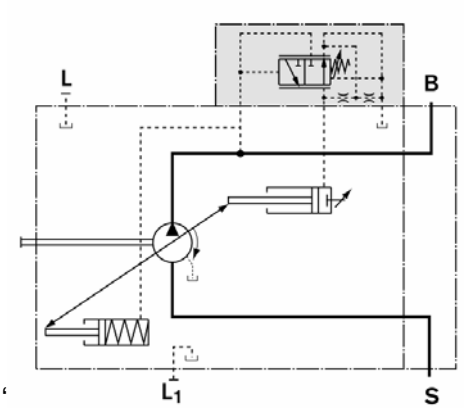
- □ Hysteresis and repeatability ⊿p.....…max. 45 psi (3 bar)
- □ Pressure rise, maximum：

Size	18	28	45	71	100	140
⊿p psi	60	60	90	115	145	175
(bar)	(4)	(4)	(6)	(8)	(10)	(12)

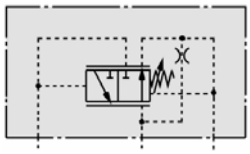
- □ Control fluid consumption…max. approx. 0.8 gpm (3 l/min)

■ Circuit diagram：

- □ Control device schematic (gray background areas in the images)
- □ Circuit diagram, sizes 18 to 100



- □ Circuit diagram, size 140



- □ Connect oil export：

Name	Port for
B	Service line
S	Suction line
L, L_1	Case drain (L1plugged)

■ Control Device DRG

- Pressure control, remotely operated.

■ Overview of the features：

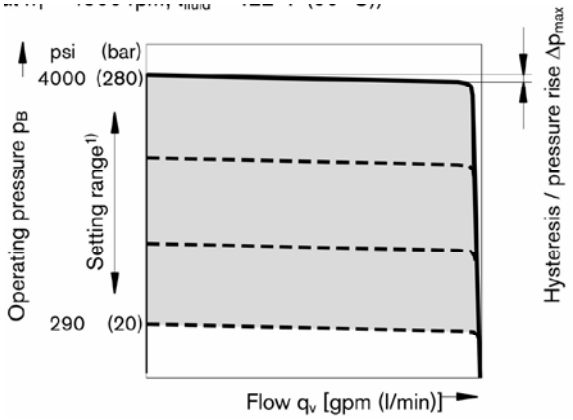
- The DR-control valve is overriding this DRG remote setting of max. outlet pressure.
- A pressure relief valve can be externally piped to port X for remote setting of pressure below the setting of the DR control valve spool. This relief valve is not included in the delivery contents of the DRG control.

■ Control adjustment：

- The differential pressure at the DRG control valve is set as standard to 290 psi (20 bar). This results in a pilot oil flow to the relief valve of approx. 0.4 gpm (1.5 l/min) at port X. If another setting is required (range from 145 to 320 psi (10-22 bar)) please state in clear text.
- The max. length of piping should not exceed 6.6 ft (2 m).
- As a separate pressure relief valve we can recommend：
  HUAHD DBDH 6 (hydraulic valve)

■ Static characteristic：

- at n=1800 rpm t_{oil} = 122°F(50℃)



1) In order to prevent damage to the pump and the system,this setting range is the permissible etting range and mustnot be exceeded. The range of possible settings at the valve are greater.

■ Control data：

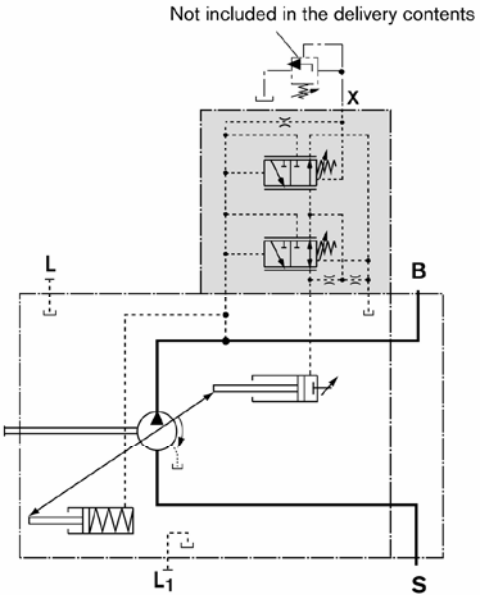
- Hysteresis and repeatability ⊿p..... max. 45 psi (3 bar)
- Pressure rise, maximum：

Size	18	28	45	71	100	140
⊿p psi	60	60	90	115	145	175
(bar)	(4)	(4)	(6)	(8)	(10)	(12)

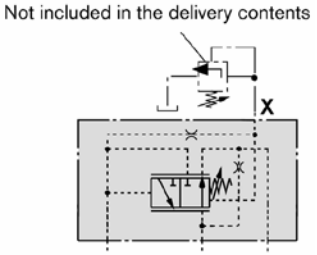
- Control fluid consumption…max. approx. 1.2 gpm (4.5 l/min)

■ Circuit diagram：

- Control device schematic (gray background areas in the images)
- Circuit diagram, sizes 18 to 100



- Circuit diagram, size 140



- Connect oil export：

Name	Port for
B	Service line
S	Suction line
L, L_1	Case drain (L_1 plugged)
X	Pilot pressure Size18…100 without adapter
X	Pilot pressure Size140 with adapter

■ Control Device DFR/DFR1：

- Pressure and flow control

■ Overview of the features：

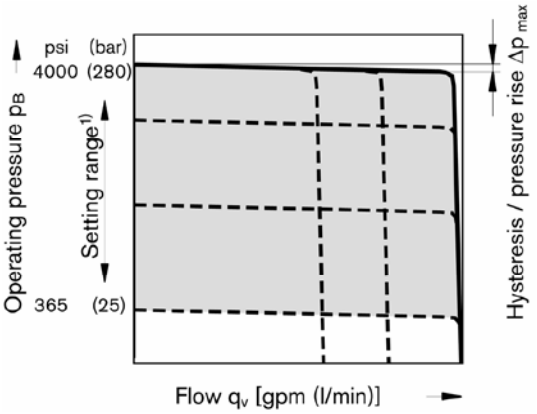
- In addition to the pressure control function, the pump flow may be varied by means of a differential pressure over an adjustable orifice (e.g. directional valve) installed in the service line to the actuator. The pump flow is equal to the actual required flow by the actuator, regardless of changing pressure levels.
- The pressure control overrides the flow control function.

■ Control adjustment：

- The DFR1 version has no connection between X and the reservoir. Unloading the LS-pilot line must be possible in the valve system.。
- Because of the flushing function sufficient unloading of the X-line must also be provided.

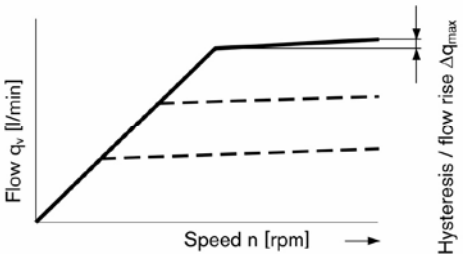
■ Static characteristic：

- Flow control at n=1800 rpm t_{oil} = 122°F(50℃)



1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and must not be exceeded.
The range of possible settings at the valve are greater.

■ Static characteristic at variable speed：



- Differential pressure ⊿p Standard setting: 200 to 320 psi (14 to 22 bar).If another setting is required, please state in clear text.
- Relieving the load on port X to the reservoir results in a zero stroke ("standby") pressure which lies about 15 to 30 psi (1 to 2 bar) higher than the differential pressure ⊿p. System influences are not taken into account.

■ Control data：

- Hysteresis and repeatability ⊿p.....max. 45 psi (3 bar)
- Pressure rise, maximum：

Size	18	28	45	71	100	140
⊿p psi	60	60	90	115	145	175
(bar)	(4)	(4)	(6)	(8)	(10)	(12)

- Control fluid consumption…max. approx. 0.8 gpm (3 l/min)

■ Maximum flow deviation：

- at drive speed n = 1500 rpm.

Size	18	28	45	71	100	140
⊿q_{max} gpm	0.24	0.26	0.48	0.75	1.06	1.60
(l/min)	(0.9)	(1.0)	(1.8)	(2.8)	(4.0)	(6.0)

- Contr. fluid consum. DFR…....max. approx. 0.8...1.2 gpm (3...4.5 l/min)
- Contr. fluid consum. DFR1…max. approx. 0.8 gpm (3 l/min)

■ Control Device DFR/DFR1：

□ Pressure and flow control

■ Circuit diagram：

□ Control device schematic (gray background areas in the images)

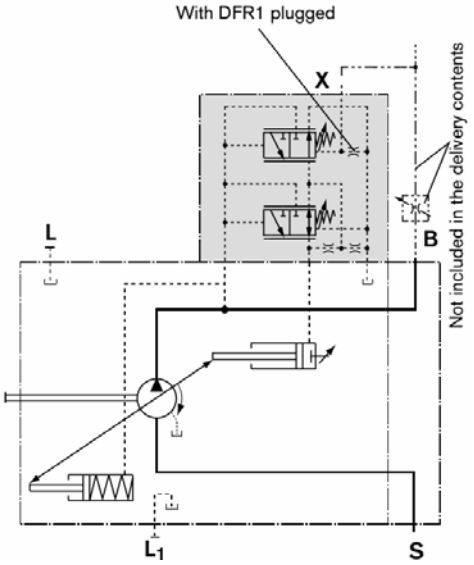
□ Connect oil export：

Name	Port for
B	Service line
S	Suction line
L, L_1	Case drain (L_1 plugged)
X	Pilot pressure

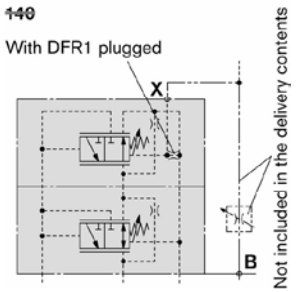
■ Circuit diagram：

□ Control device schematic (gray background areas in the images)

□ Circuit diagram, sizes 18 to 100



□ Circuit diagram, size 140



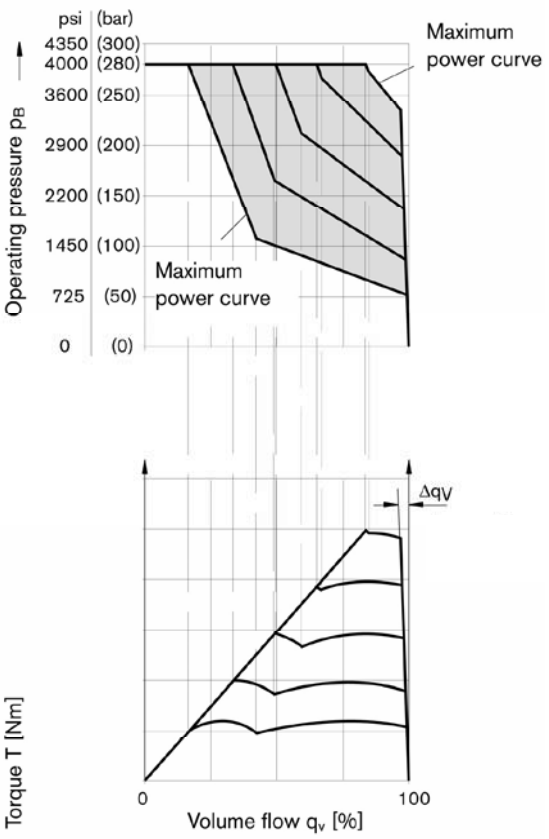
■ Control Device DFLR：

- Pressure, flow and power control

■ Overview of the features：

- Execution of the pressure control like DR(G)
- Execution of the flow control like DFR, DFR1
- In order to achieve a constant drive torque with varying ope rating pressures, the swivel angle and with it the output flow from the axial piston pump is varied so that the product of flow and pressure remains constant.
- Flow control is possible below the power control curve.

■ Static curves and torque characteristic：



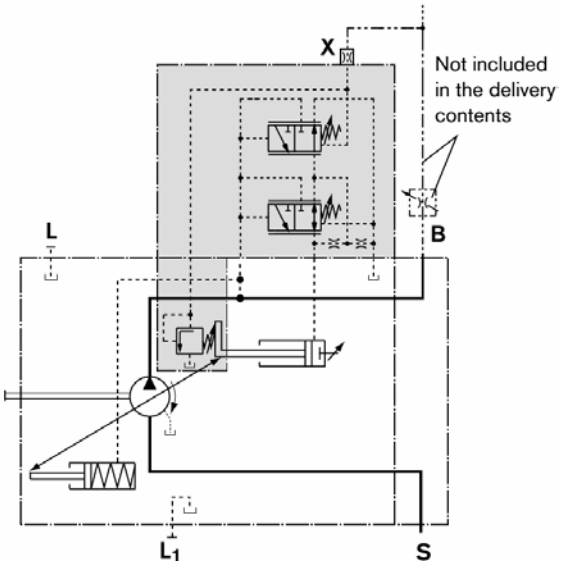
- The power characteristic is set in the factory; when ordering, please state in clear text, e.g. 27 HP (20 kW) at 1800 rpm.

■ Control data：

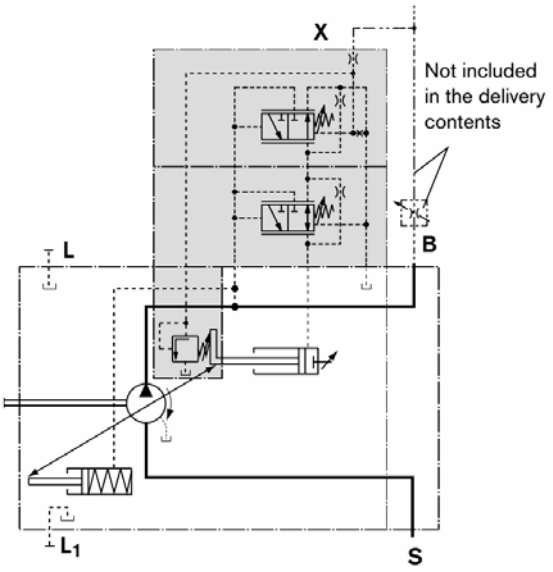
- Beginning of control.....……..……735 psi (50 bar)
- Control fluid consumption…max. approx. 1.45 gpm (5.5 l/min)
- For pressure control see DR data
- For flow control see FR data

■ Circuit diagram：

- Control device schematic (gray background areas in the images)
- Circuit diagram, sizes 28 to 100



- Circuit diagram, size 140



- Connect oil export：

Name	Port for
B	Service line
S	Suction line
L, L_1	Case drain (L_1 plugged)
X	Pilot pressure

■ Control Device ED：

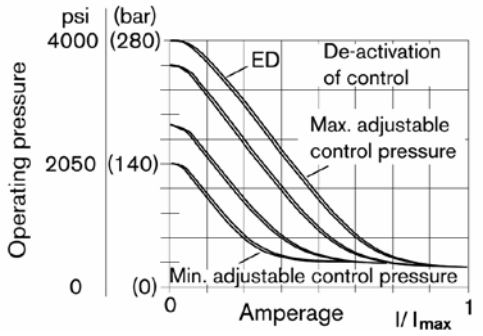
- Electro-hydraulic pressure control

■ Overview of the features：

- The ED valve is set to a certain pressure by a specified, variable solenoid current.If there is a change at the consumer (load pressure), the posi tion of the control piston changes.
- This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.
- The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.
- When the solenoid current signal drops towards a zero value, the maximum output pressure is limited to p_{max} by an adjustabe hydraulic pressure cut-off (secure fail safe function in case of a loss of power e.g. for use as fan drives).
- The response time characteristic of the ED-control was optimized for the use as a fan drive system.
- When ordering, state the type of application in clear text.

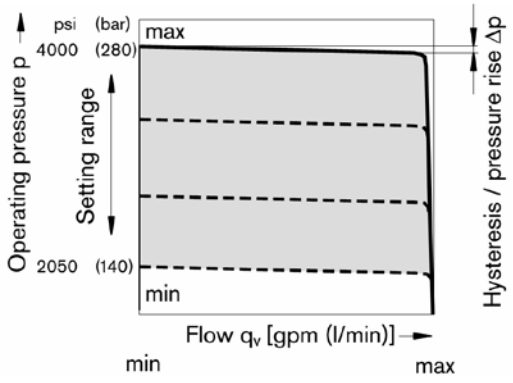
■ Static current-pressure characteristic ED：

- measured at pump in zero stroke – negative characteristic
- Hysteresis static current-press. characteristic ＜45 psi (3 bar)



■ Static flow-pressure characteristic：

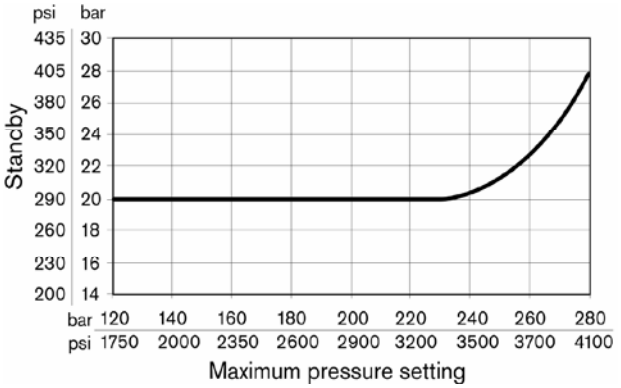
- at n=1800 rpm; t_{oil} = 122°F(50℃)



■ Control data：

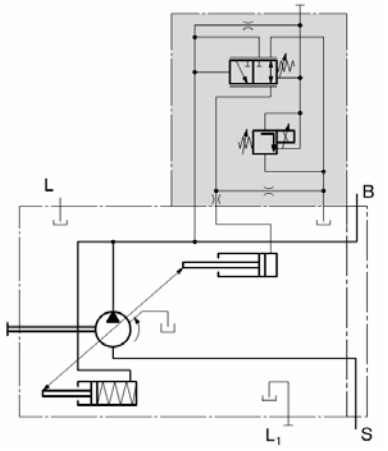
- Stand-by standard setting 290 psi (20 bar), other values on request.
- Hysteresis and pressure rise……..... ⊿p＜60 psi (4 bar)
- Control fluid consumption……0.8 to 1.2 gpm (3 to 4.5 l/min)

■ Influence of pressure setting on standby level：



■ Circuit diagram：

- Control device schematic (gray background areas in the images)
- Circuit diagram ED..



- Connect oil export：

Name	Port for
B	Service line
S	Suction line
L, L_1	Case drain (L_1 plugged)

■ Technical data：

- Operating temperature range at valve -4°F to 239°F(-20℃～+115℃)

Solenoid	ED71	ED72
Voltage	12 V（±20%）	24 V（±20%）
Control current		
…Control begin at $q_{v\,min}$	100 mA	50 mA
…End of control at $q_{v\,max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance	5.5Ω	22.7Ω
(at 68 °F(20℃))		
Dither frequency	100～200 Hz	100～200 Hz
Actuated time	100%	100%
For type of protection, see following plug design data.		
For details on the control electronics,see following data.		

■ Control Device ER：

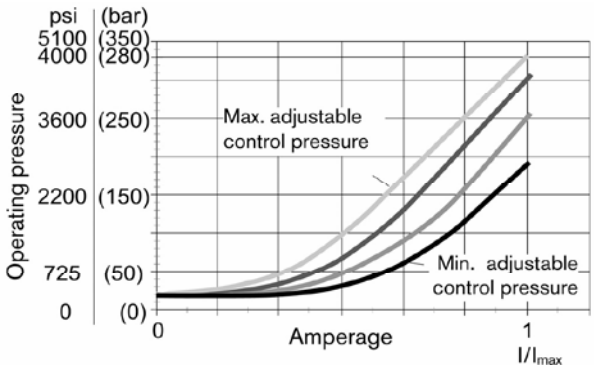
- Electro-hydraulic pressure control

■ Overview of the features：

- The ER valve is set to a specific pressure by a specified, variable solenoid current.
- If there is a change at the consumer (load pressure), the position of the control piston changes.
- This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.
- The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.
- If the solenoid current drops to zero, the pressure is limited to pmin (stand-by).

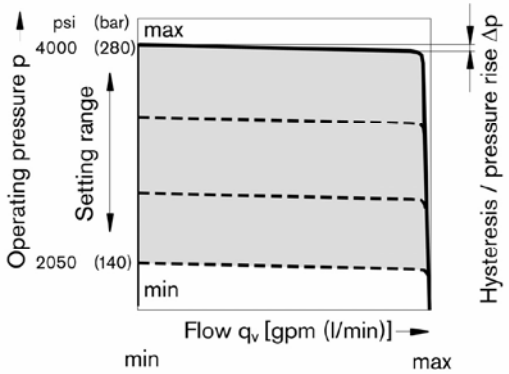
■ Static current-pressure characteristic ER：

- measured at pump in zero stroke - positive characteristic
- Hysteresis static current-press. characteristic＜ 45 psi (3 bar)
- Influence of pressure setting on stand-by±30 psi (±2 bar)



■ Static flow-pressure characteristic：

- at n=1800 rpm; t_{oil} = 122°F(50℃)

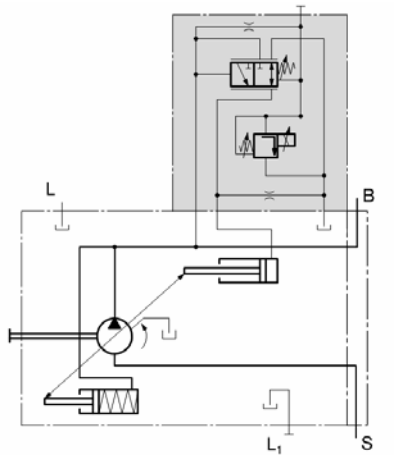


■ Control data：

- Stand-by standard setting 290 psi (20 bar), other values on request.
- Hysteresis and pressure rise……..... ⊿p＜60 psi (4 bar)
- Control fluid consumption……0.8 to 1.2 gpm (3 to 4.5 l/min)

■ Circuit diagram：

- Control device schematic (gray background areas in the images)
- Circuit diagram ER..



- Connect oil export：

Name	Port for
B	Service line
S	Suction line
L, L_1	Case drain (L_1 plugged)

■ Technical data：

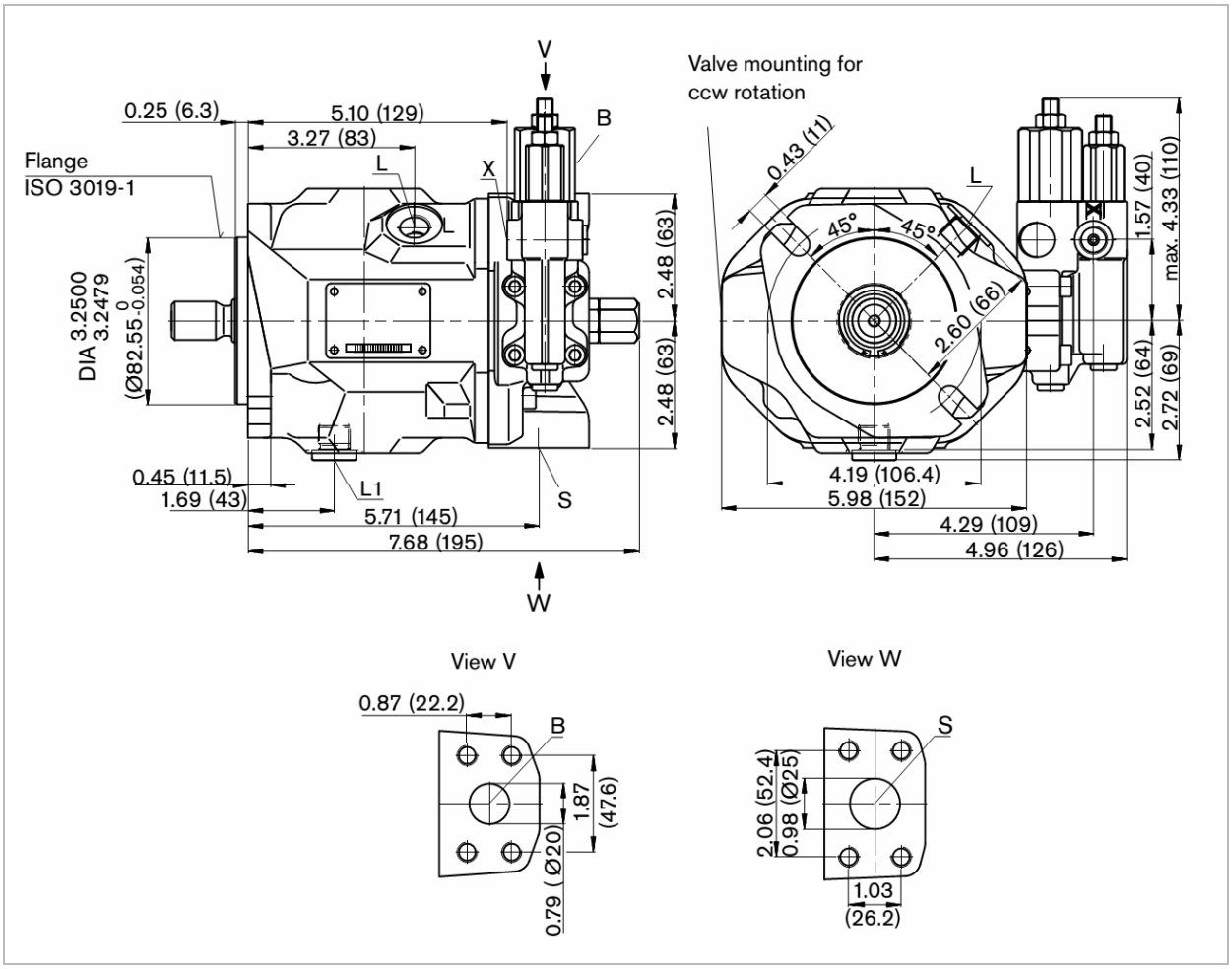
- Operating temperature range at valve -4°F to 239°F(-20℃～+115℃)

Solenoid	ER71	ER72
Voltage	12 V（±20%）	24 V（±20%）
Control current		
…Control begin at $q_{v\,min}$	100 mA	50 mA
…End of control at $q_{v\,max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance	5.5Ω	22.7Ω
(at 68 °F(20℃))		
Dither frequency	100～200 Hz	100～200 Hz
Actuated time	100%	100%
For type of protection, see following plug design data.		

■ Dimensions Size18

□ DFR, DFR1 - Pressure and flow control, hydraulic：

□ Clockwise rotation,Dimensions in inches and (mm)



□ Ports：

Designation	Port for	Standard	Size[1)]	Maximum pressure [psi (bar)] [2)]	State [6)]
B	Service line	SAE J518	3/4 in	5100(350)	O
	fastening thread	ASME B1.1	3/8-16 UNC-2B; 0.79 (20) deep		
S	Suction line	SAE J518	1 in	145(10)	O
	fastening thread	ASME B1.1	3/8-16 UNC-2B; 0.79 (20) deep		
L	Case drain fluid	ISO 11926 [3)]	9/16-18 UNF-2B; 0.47 (12) deep	30 (2)	O [4)]
L_1	Case drain fluid	ISO 11926 [3)]	9/16-18 UNF-2B; 0.47 (12) deep	30 (2)	X [4)]
X	Pilot pressure	ISO 11926 [3)]	7/16-20 UNF-2B; 0.45 (12) deep	5100(350)	O
X	Pilot press. with DG-control	DIN ISO 228 [3)]	G 1/4 in; 0.47 (12) deep	5100(350)	O

□ Note：

1）For the maximum tightening torques the general instructions must be observed

2）Depending on the application, short-term pressure spikes can occur. Keep this in mind when selecting measuring equipmen and fittings. Pressure values in bar absolute.

3）The spot face can be deeper than as specified in the standard

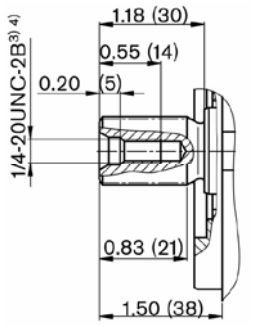
4）Depending on the installation position, L or L_1 must be connected (see also installation instructions following data)

O=Must be connected (plugged on delivery) X=plugged (in normal operation)

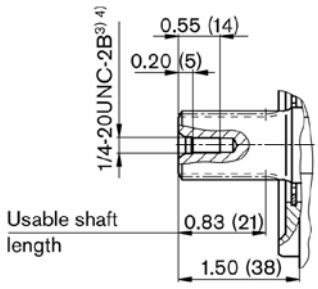
■ Dimensions Size18

□ Drive shaft (Dimensions in inches and (mm)):

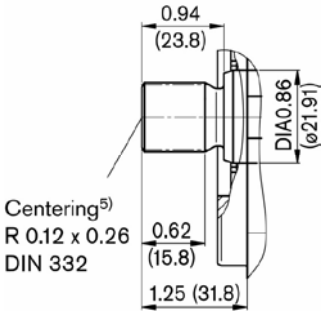
S Splined shaft 3/4 in SAE J744
11T 16/32DP[1)]



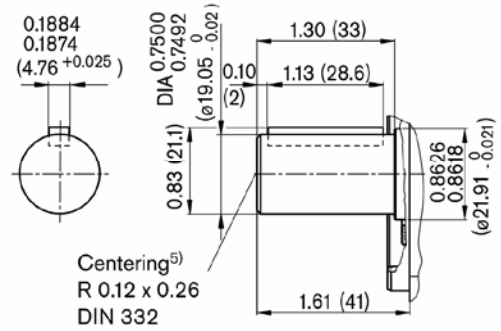
R Splined shaft 3/4 in SAE J744
11T 16/32DP[1) 2)]



U Splined shaft 5/8 in SAE J744
9T 16/32DP[1)]



K Parallel shaft key ISO 3019-1,19-1



□ Note:

1）ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

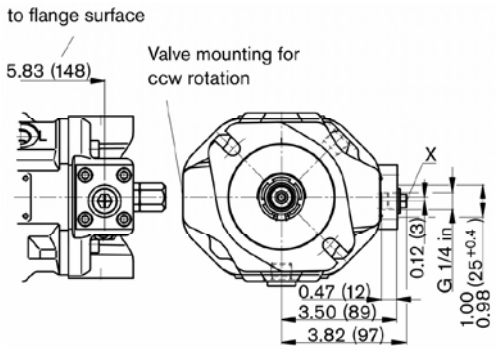
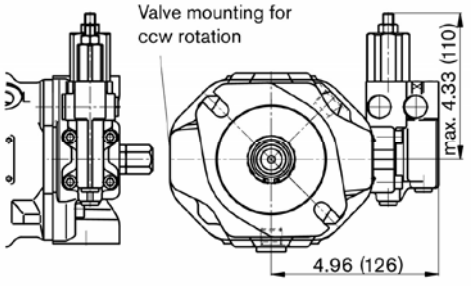
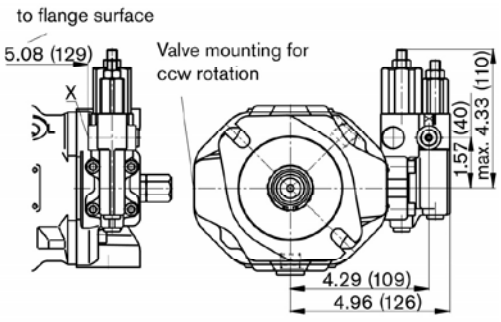
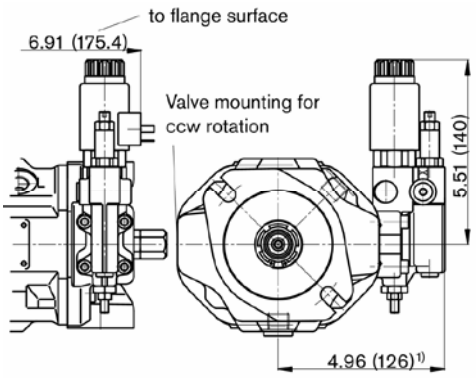
2）Splines according to ANSI B92.1a, run out of spline is a deviation from standard

3）Thread according to ASME B1.1

4）For the maximum tightening torques the general instructions must be observed

5）Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw.

■ Dimensions Size18

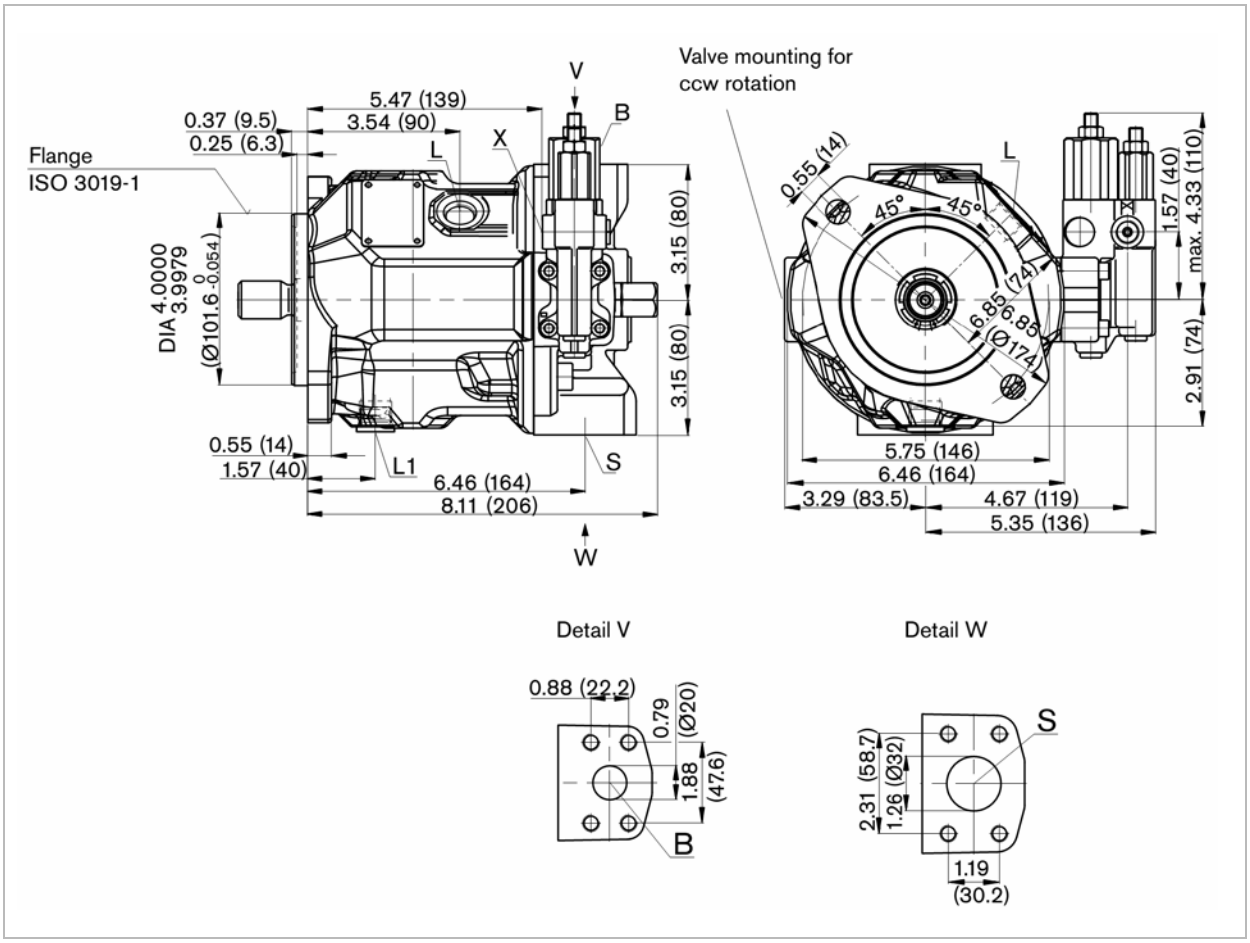
■ Control Device DG	■ Control Device DR
□ Two-point control, directly operated.	□ Pressure control
	
■ Control Device DRG	■ Control Device ED7 ER7
□ Pressure control, remotely operated.	□ Electro-hydraulic pressure control
	

1）ER7.: 6.34 inches (161 mm) if using a sandwich plate pressure reducing valve.

■ Dimensions Size28

□ DFR,DFR1-Pressure and flow control, hydraulic：

□ Clockwise rotation,Dimensions in inches and (mm)



□ Ports：

Designation	Port for	Standard	Size[1)]	Maximum pressure [psi (bar)] [2)]	State [6)]
B	Service line	SAE J518	3/4 in	5100(350)	O
	fastening thread	ASME B1.1	3/8-16 UNC-2B; 0.79 (20) deep		
S	Suction line	SAE J518	1-1/4 in	145(10)	O
	fastening thread	ASME B1.1	7/16-14 UNC-2B; 0.94 (24) deep		
L	Case drain fluid	ISO 11926 [3)]	3/4-16 UNF-2B; 0.47 (12) deep	30 (2)	O [4)]
L_1	Case drain fluid	ISO 11926 [3)]	3/4-16 UNF-2B; 0.47 (12) deep	30 (2)	X [4)]
X	Pilot pressure	ISO 11926 [3)]	7/16-14 UNC-12B; 0.47 (12) deep	5100(350)	O
X	Pilot press. with DG-control	DIN ISO 228 [3)]	G 1/4 in; 0.47 (12) deep	5100(350)	O

□ Note：

1）For the maximum tightening torques the general instructions must be observed

2）Depending on the application, short-term pressure spikes can occur. Keep this in mind when selecting measuring equipmen and fittings. Pressure values in bar absolute.

3）The spot face can be deeper than as specified in the standard

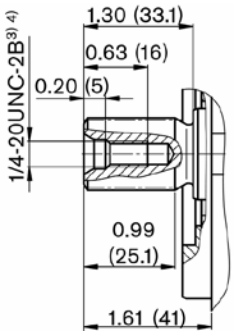
4）Depending on the installation position, L or L_1 must be connected (see also installation instructions following data)

O=Must be connected (plugged on delivery) X=plugged (in normal operation)

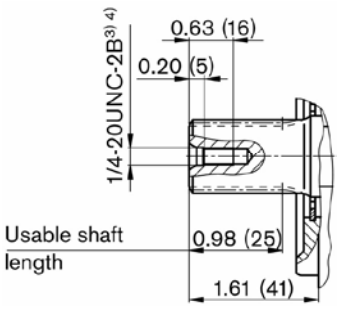
■ Dimensions Size28

□ Drive shaft (Dimensions in inches and (mm)):

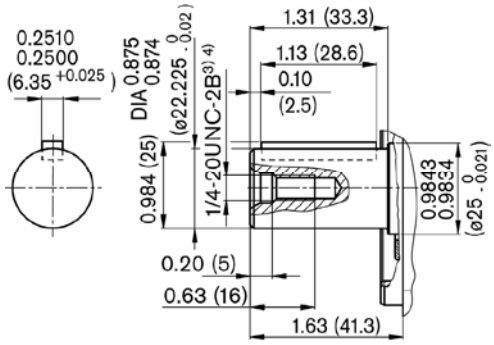
S Splined shaft 7/8 in SAE J744
13T 16/32DP[1)]



R Splined shaft 7/8 in SAE J744
13T 16/32DP[1) 2)]



K Parallel shaft key ISO 3019-1,22-1



□ Note:

1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard

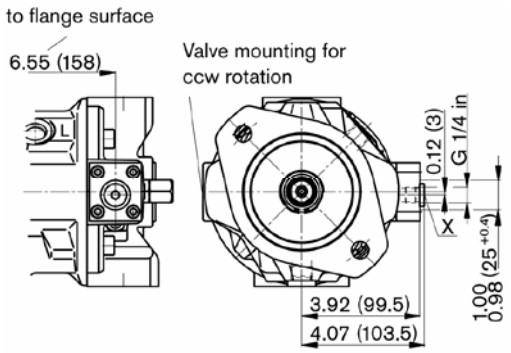
3) Thread according to ASME B1.1

4) For the maximum tightening torques the general instructions must be observed

■ Dimensions Size28

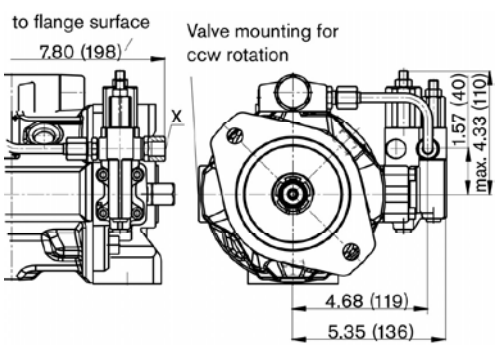
■ Control Device DG

□ Two-point control, directly operated.



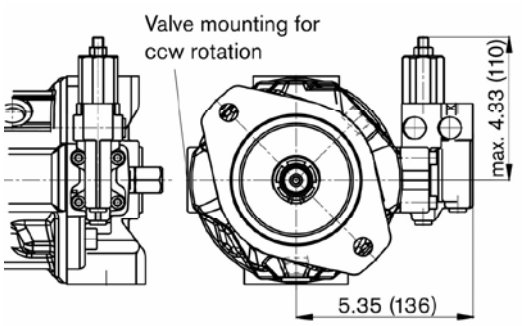
■ Control Device DFLR

□ Pressure, flow and power control.



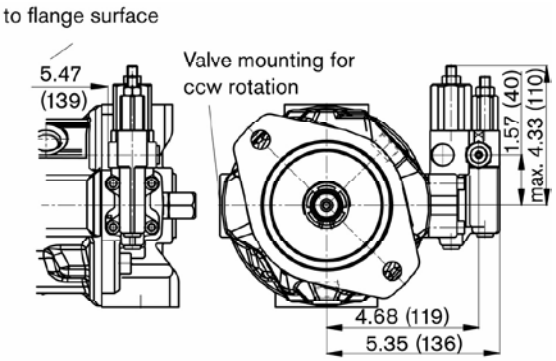
■ Control Device DR

□ Pressure control



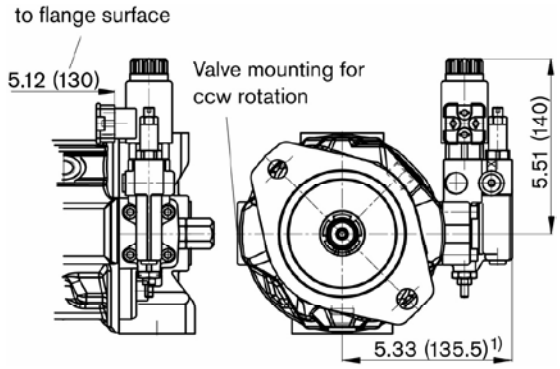
■ Control Device DRG

□ Pressure control, remotely operated.



■ Control Device ED7. / ER7.

□ Electro-hydraulic pressure control

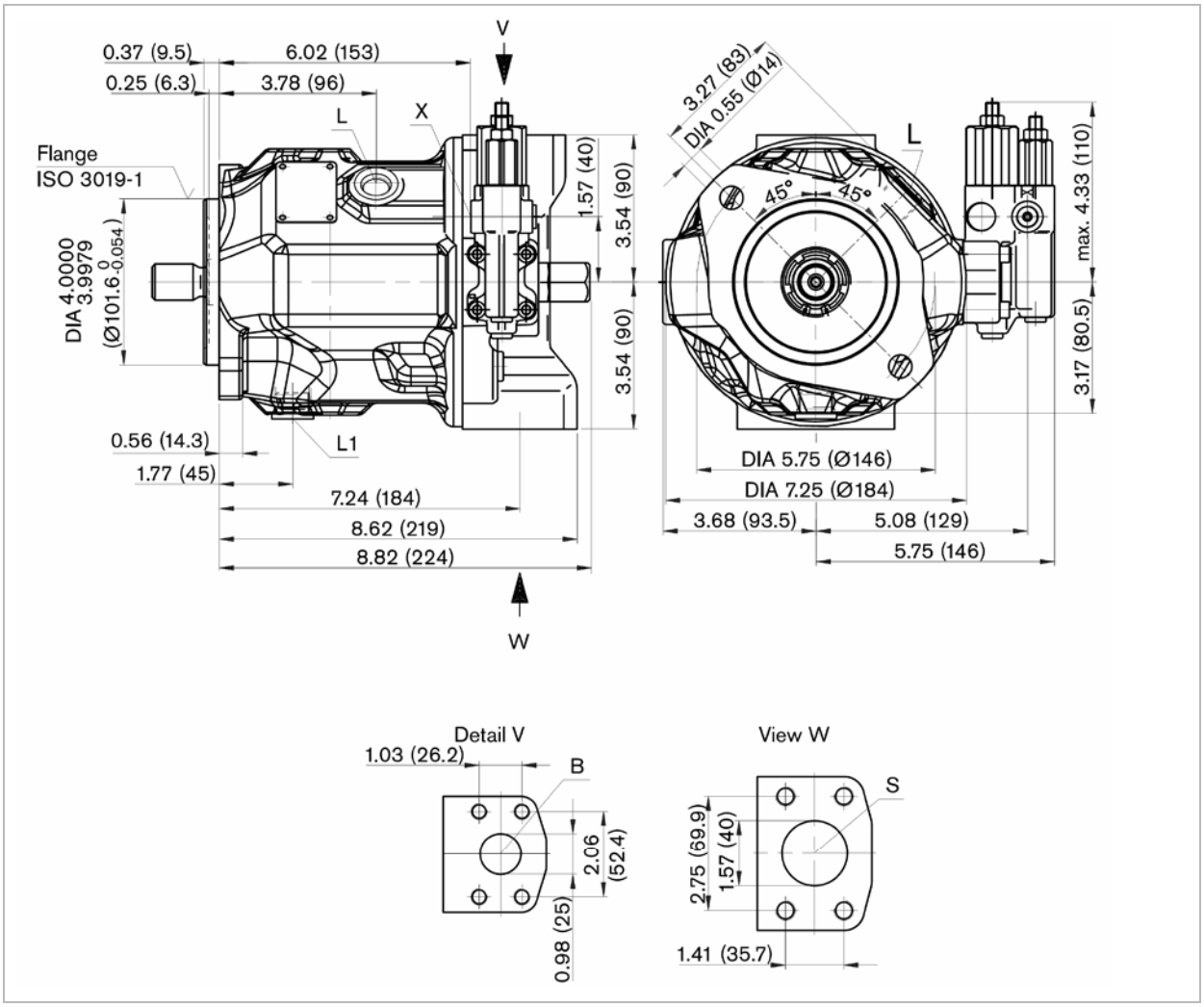


1）ER7.: 6.71 inches (170.5 mm) when using a sandwich plate pressure reducing valve.
For details of connection options and drive shafts, see also above data.

■ Dimensions Size45

□ DFR,DFR1-Pressure and flow control, hydraulic：

□ Clockwise rotation,Dimensions in inches and (mm)



□ Ports：

Designation	Port for	Standard	Size[1)]	Maximum pressure [psi (bar)] [2)]	State [6)]
B	Service line	SAE J518	1 in	5100(350)	O
	fastening thread	ASME B1.1	3/8-16 UNC-2B; 0.71 (18) deep		
S	Suction line	SAE J518	1-1/2 in	145(10)	O
	fastening thread	ASME B1.1	1/2-13 UNC-2B; 0.87 (22) deep		
L	Case drain fluid	ISO 11926 [3)]	7/8-14 UNF-2B; 0.55 (14) deep	30 (2)	O [4)]
L_1	Case drain fluid	ISO 11926 [3)]	7/8-14 UNF-2B; 0.55 (14) deep	30 (2)	X [4)]
X	Pilot pressure	ISO 11926 [3)]	7/16-20 UNF-2B; 0.45 (12) deep	5100(350)	O
X	Pilot press. with DG-control	DIN ISO 228 [3)]	G 1/4 in; 0.47 (12) deep	5100(350)	O

□ Note：

1）For the maximum tightening torques the general instructions must be observed

2）Depending on the application, short-term pressure spikes can occur. Keep this in mind when selecting measuring equipmen and fittings. Pressure values in bar absolute.

3）The spot face can be deeper than as specified in the standard

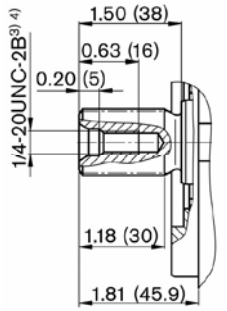
4）Depending on the installation position, L or L_1 must be connected (see also installation instructions following data)

O=Must be connected (plugged on delivery) X=plugged (in normal operation)

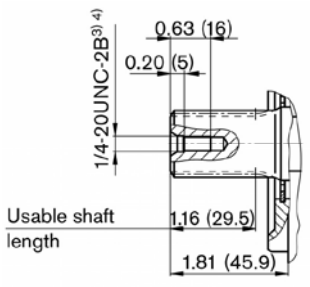
■ Dimensions Size45

□ Drive shaft (Dimensions in inches and (mm)):

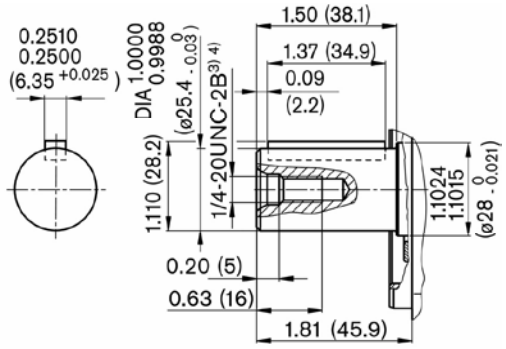
S Splined shaft 1 in SAE J744
15T 16/32DP[1)]



R Splined shaft 1 in SAE J744
15T 16/32DP[1) 2)]



K Parallel shaft key ISO 3019-1,25-1



□ Note:

1）ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2）Splines according to ANSI B92.1a, run out of spline is a deviation from standard

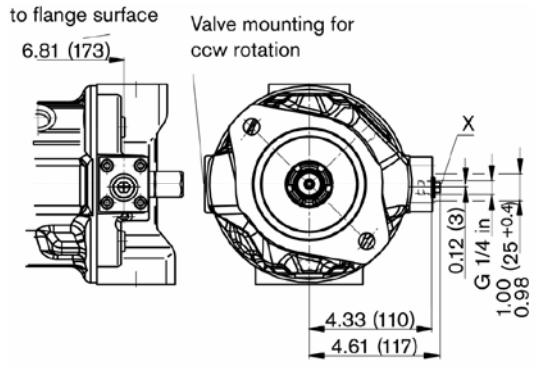
3）Thread according to ASME B1.1

4）For the maximum tightening torques the general instructions must be observed

■ Dimensions（mm）：Size45

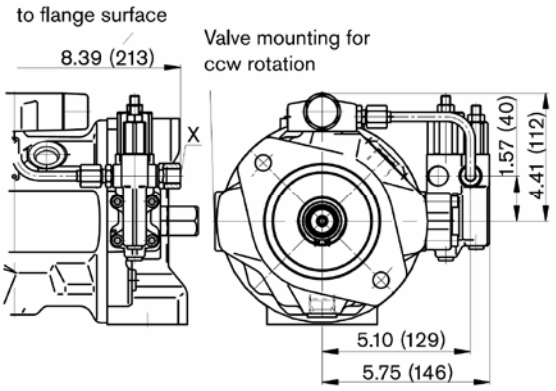
■ Control Device DG

□ Two-point control, directly operated.



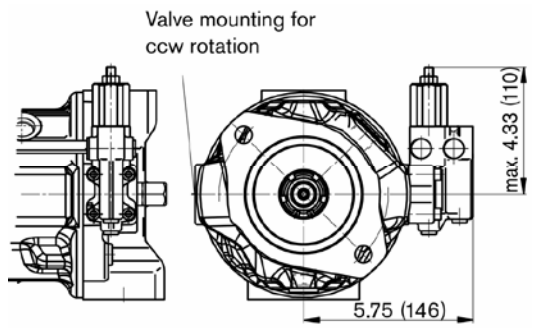
■ Control Device DFLR

□ Pressure, flow and power control.



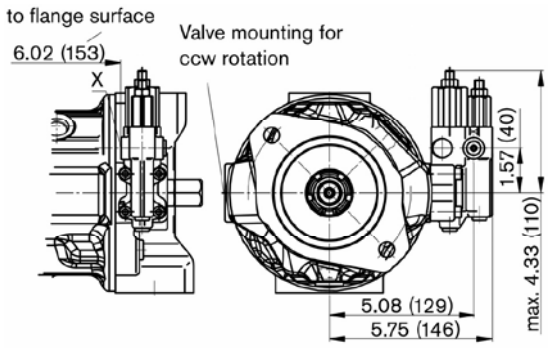
■ Control Device DR

□ Pressure control



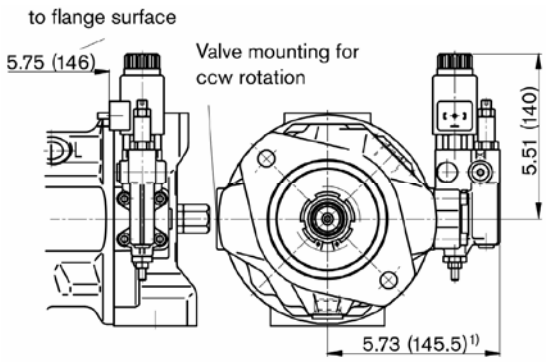
■ Control Device DRG

□ Pressure control, remotely operated.



■ Control Device ED7. / ER7.

□ Electro-hydraulic pressure control

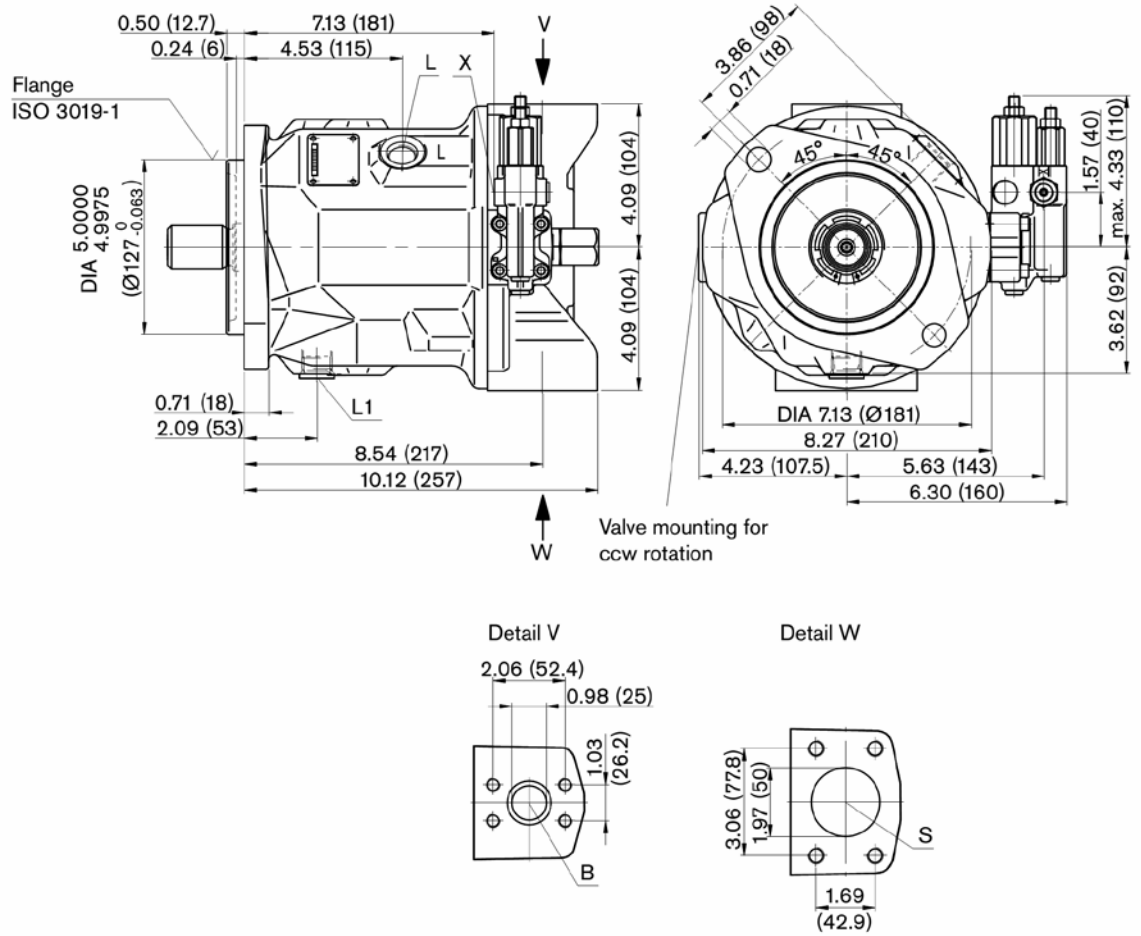


1）ER7.: 7.11 inches (180.5 mm) if using a sandwich plate pressure reducing valve.

■ Dimensions Size71

□ DFR,DFR1-Pressure and flow control, hydraulic：

□ Clockwise rotation,Dimensions in inches and (mm)



□ Ports：

Designation	Port for	Standard	Size[1)]	Maximum pressure [psi (bar)] [2)]	State [6)]
B	Service line	SAE J518	1 in	5100(350)	O
	fastening thread	ASME B1.1	3/8-16 UNC-2B; 0.71 (18) deep		
S	Suction line	SAE J518	2 in	145(10)	O
	fastening thread	ASME B1.1	1/2-13 UNC-2B; 0.87 (22) deep		
L	Case drain fluid	ISO 11926 [3)]	7/8-14 UNF-2B; 0.55 (14) deep	30 (2)	O [4)]
L_1	Case drain fluid	ISO 11926 [3)]	7/8-14 UNF-2B; 0.55 (14) deep	30 (2)	X [4)]
X	Pilot pressure	ISO 11926 [3)]	7/16-20 UNF-2B; 0.45 (12) deep	5100(350)	O
X	Pilot press. with DG-control	DIN ISO 228 [3)]	G 1/4 in; 0.47 (12) deep	5100(350)	O

□ Note：

1）For the maximum tightening torques the general instructions must be observed

2）Depending on the application, short-term pressure spikes can occur. Keep this in mind when selecting measuring equipmen and fittings. Pressure values in bar absolute.

3）The spot face can be deeper than as specified in the standard

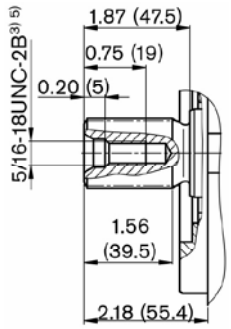
4）Depending on the installation position, L or L_1 must be connected (see also installation instructions following data)

O=Must be connected (plugged on delivery) X=plugged (in normal operation)

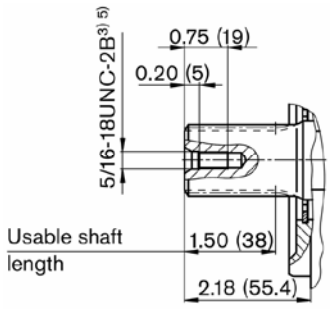
■ Dimensions Size71

□ Drive shaft (Dimensions in inches and (mm)):

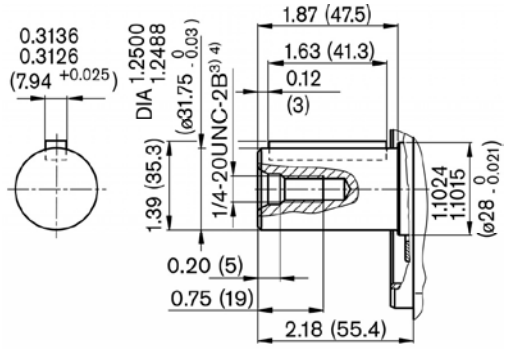
S Splined shaft 1-1/4 in SAE J744
14T 12/24DP[1)]



R Splined shaft 1-1/4 in SAE J744
14T 12/24DP[1) 2)]



K Parallel shaft key ISO 3019-1,32-1



□ Note:

1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard

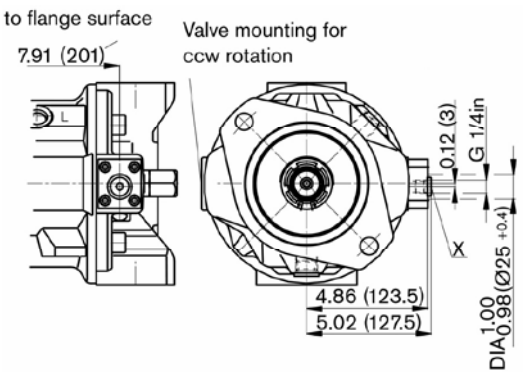
3) Thread according to ASME B1.1

4) For the maximum tightening torques the general instructions must be observed

■ Dimensions Size71

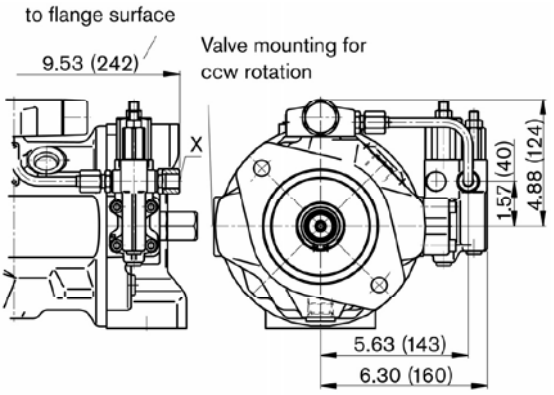
■ Control Device DG

□ Two-point control, directly operated.



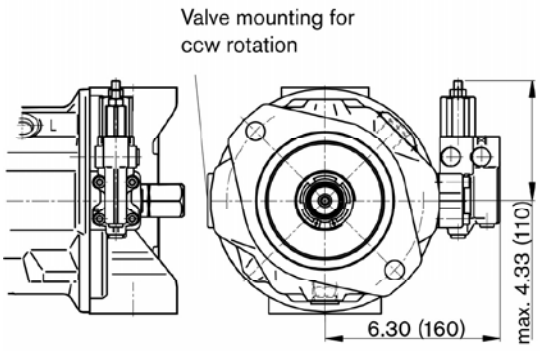
■ Control Device DFLR

□ Pressure, flow and power control.



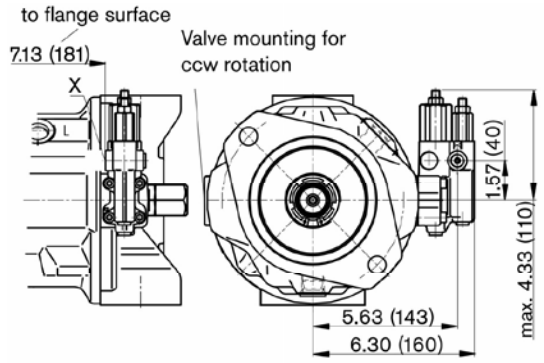
■ Control Device DR

□ Pressure control



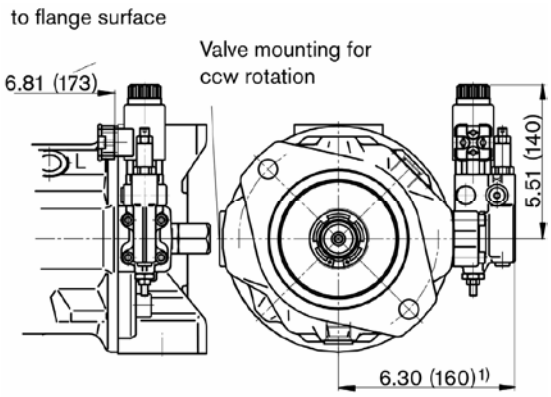
■ Control Device DRG

□ Pressure control, remotely operated.



■ Control Device ED7. / ER7.

□ Electro-hydraulic pressure control

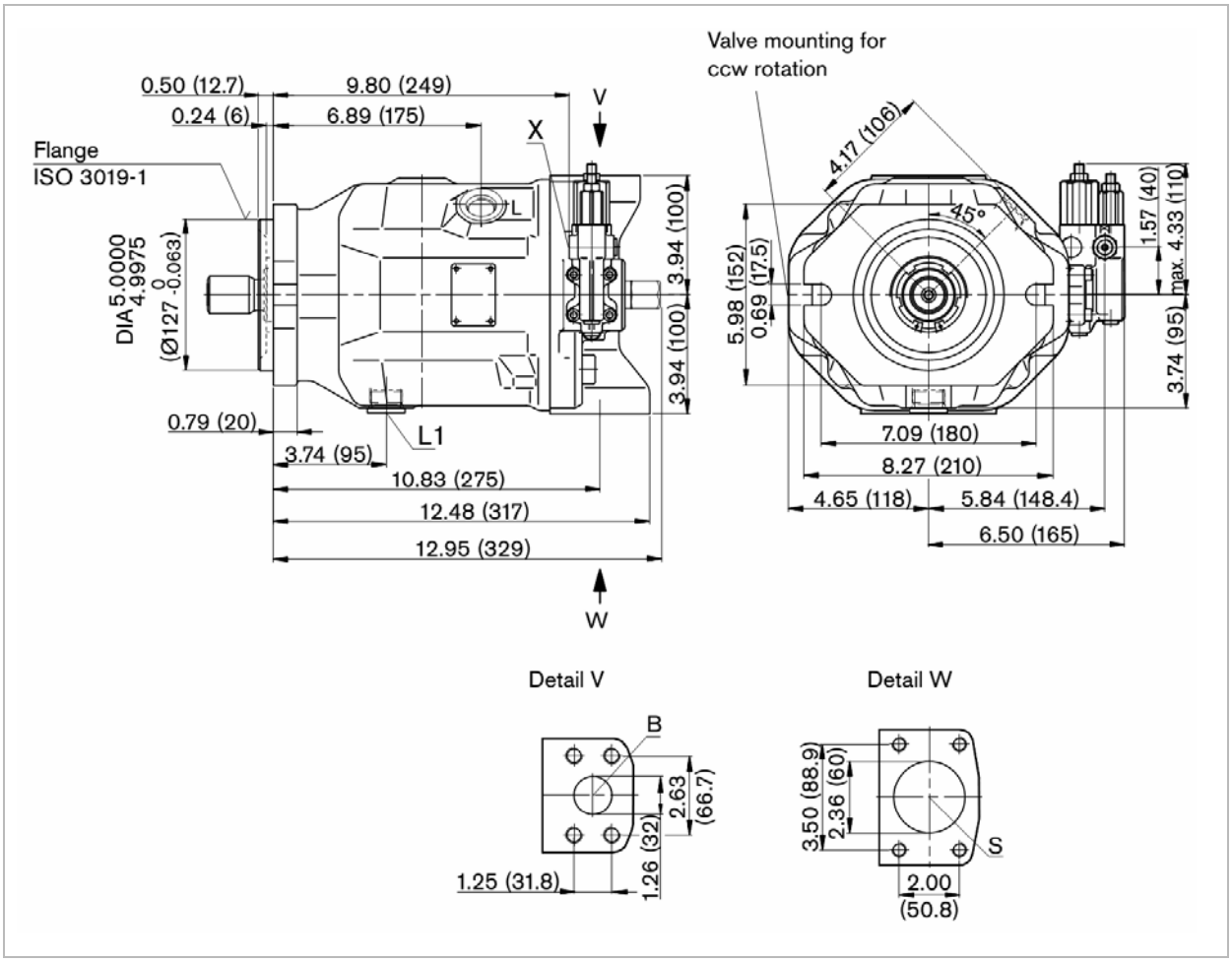


1）ER7.: 7.68 inches (195 mm) if using a sandwich plate pressure reducing valve.

■ Dimensions Size100

□ DFR,DFR1-Pressure and flow control, hydraulic：

□ Clockwise rotation,Dimensions in inches and (mm)



□ Ports：

Designation	Port for	Standard	Size[1)]	Maximum pressure [psi (bar)] [2)]	State [6)]
B	Service line	SAE J518	1-1/4 in	5100(350)	O
	fastening thread	ASME B1.1	1/2-13 UNC-2B; 0.75 (19) deep		
S	Suction line	SAE J518	2-1/2 in	145(10)	O
	fastening thread	ASME B1.1	1/2-13 UNC-2B; 1.06 (27) deep		
L	Case drain fluid	ISO 11926 [3)]	1-1/16-12 UNF-2B; 0.63 (16) deep	30 (2)	O [4)]
L_1	Case drain fluid	ISO 11926 [3)]	1-1/16-12 UNF-2B; 0.63 (16) deep	30 (2)	X [4)]
X	Pilot pressure	ISO 11926 [3)]	7/16-20 UNF-2B; 0.45 (12) deep	5100(350)	O
X	Pilot press. with DG-control	DIN ISO 228 [3)]	G 1/4 in; 0.47 (12) deep	5100(350)	O

□ Note：

1）For the maximum tightening torques the general instructions must be observed

2）Depending on the application, short-term pressure spikes can occur. Keep this in mind when selecting measuring equipmen and fittings. Pressure values in bar absolute.

3）The spot face can be deeper than as specified in the standard

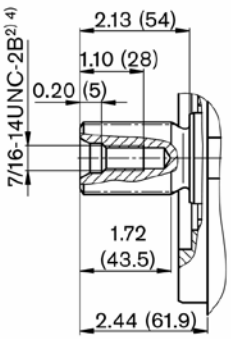
4）Depending on the installation position, L or L_1 must be connected (see also installation instructions following data)

O=Must be connected (plugged on delivery) X=plugged (in normal operation)

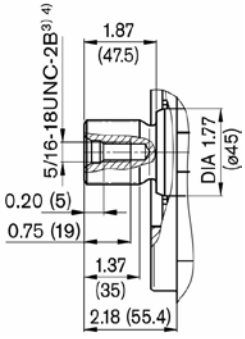
■ Dimensions Size100

□ Drive shaft (Dimensions in inches and (mm)):

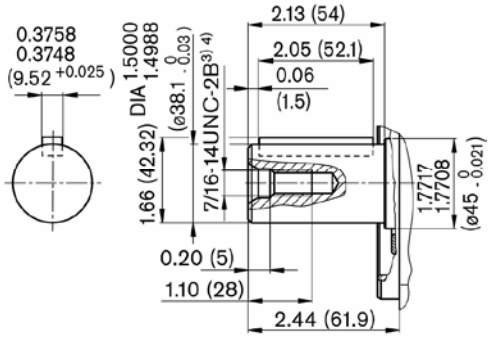
S Splined shaft 1-1/2 in SAE J744
17T 12/24DP[1)]



R Splined shaft 1-1/4 in SAE J744
14T 12/24DP[1) 2)]



K Parallel shaft key ISO 3019-1,38-1



□ Note:

1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard

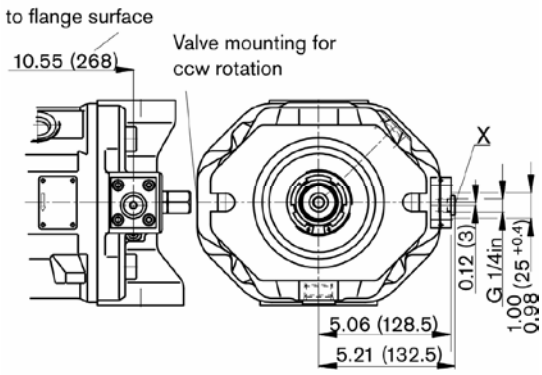
3) Thread according to ASME B1.1

4) For the maximum tightening torques the general instructions must be observed

■ Dimensions（mm）：Size100

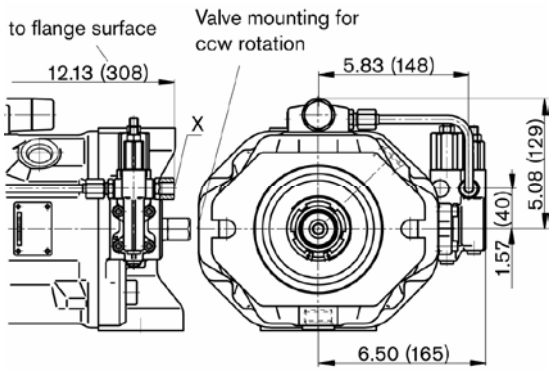
■ Control Device DG

□ Two-point control, directly operated.



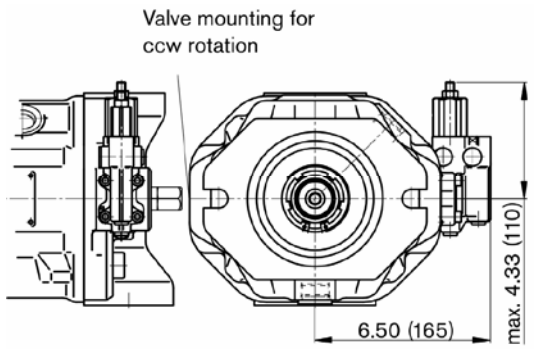
■ Control Device DFLR

□ Pressure, flow and power control.



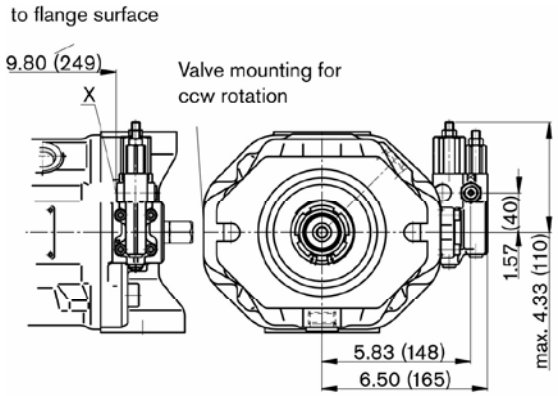
■ Control Device DR

□ Pressure control



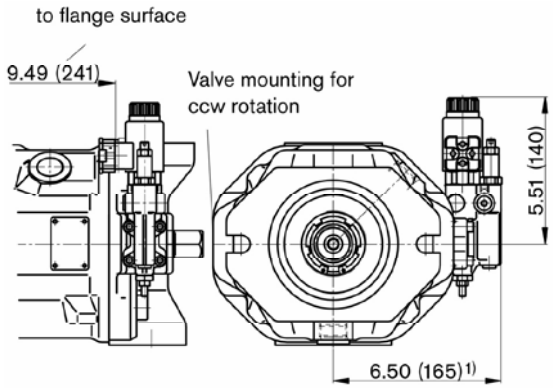
■ Control Device DRG

□ Pressure control, remotely operated.



■ Control Device ED7. / ER7.

□ Electro-hydraulic pressure control

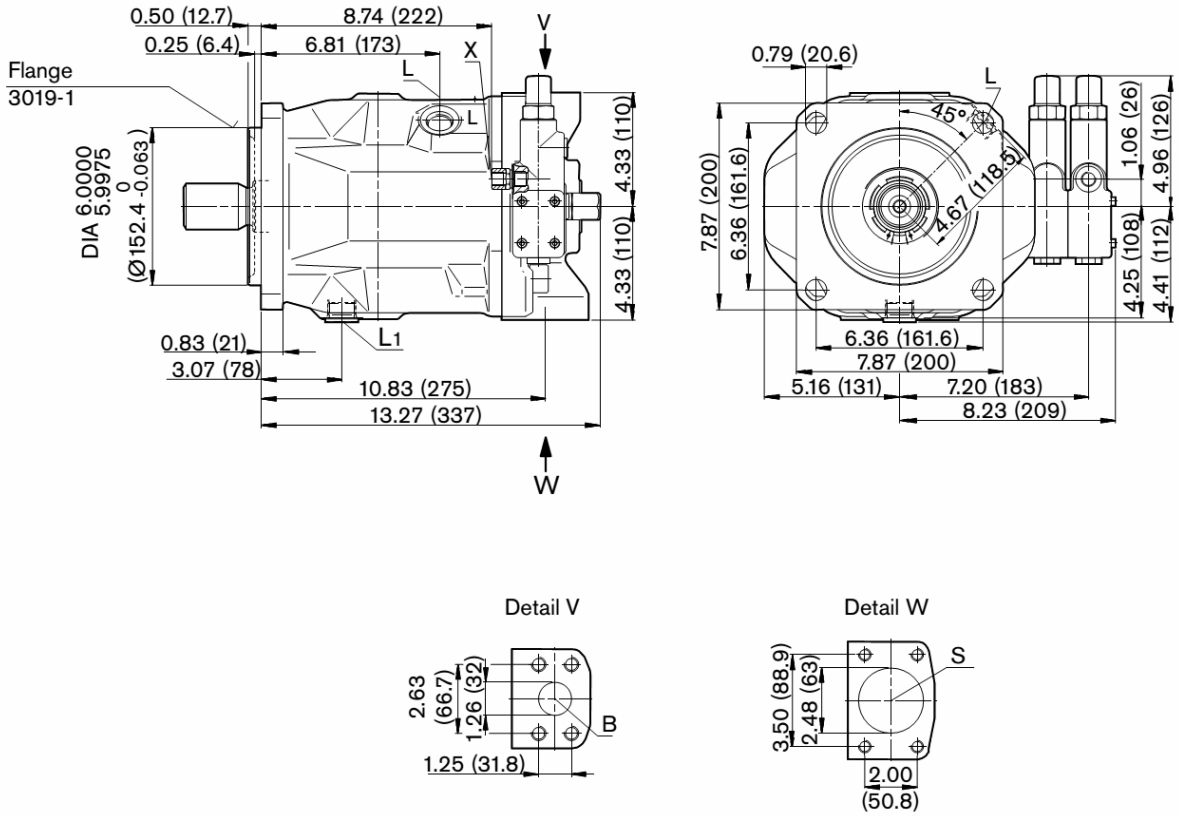


1）ER7.: 7.87 inches (200 mm) when using a sandwich plate pressure reducing valve.

■ Dimensions Size140

□ DFR,DFR1-Pressure and flow control, hydraulic：

□ Clockwise rotation,Dimensions in inches and (mm)



□ Ports：

Designation	Port for	Standard	Size[1)]	Maximum pressure [psi (bar)] [2)]	State [6)]
B	Service line	SAE J518	1-1/4 in	5100(350)	O
	fastening thread	ASME B1.1	1/2-13 UNC-2B; 0.94 (24) deep		
S	Suction line	SAE J518	2-1/2 in	145(10)	O
	fastening thread	ASME B1.1	1/2-13 UNC-2B; 0.94 (24) deep		
L	Case drain fluid	ISO 11926 [3)]	1-1/16-12 UNF-2B; 0.63 (16) deep	30 (2)	O [4)]
L_1	Case drain fluid	ISO 11926 [3)]	1-1/16-12 UNF-2B; 0.63 (16) deep	30 (2)	X [4)]
X	Pilot pressure	ISO 11926 [3)]	9/16-18 UNF-2B; 0.51 (13) deep	5100(350)	O
X	Pilot press. with DG-control	DIN ISO 228 [3)]	M14 x 1.5; 0.47 (12) deep	5100(350)	O
M_H	Gauge port, high pressure	DIN 3852	M14 x 1.5; 0.47 (12) deep		

□ Note：

1）For the maximum tightening torques the general instructions must be observed

2）Depending on the application, short-term pressure spikes can occur. Keep this in mind when selecting measuring equipmen and fittings. Pressure values in bar absolute.

3）The spot face can be deeper than as specified in the standard

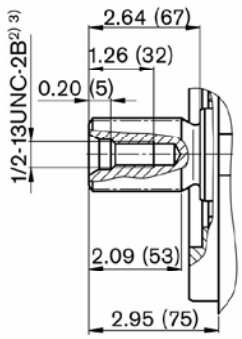
4）Depending on the installation position, L or L_1 must be connected (see also installation instructions following data)

O=Must be connected (plugged on delivery) X=plugged (in normal operation)

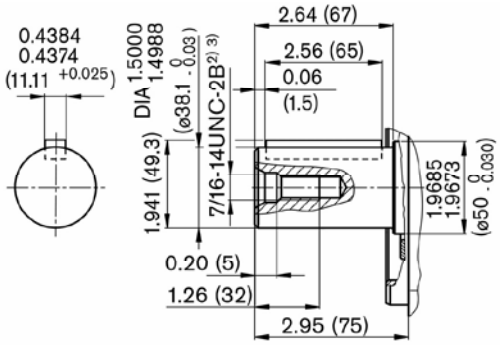
■ Dimensions Size140

□ Drive shaft (Dimensions in inches and (mm))：

S Splined shaft 3/4 in SAE J744
13T 8/16DP[1)]



K Parallel shaft key ISO 3019-1,44-1



□ Note：

1）ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

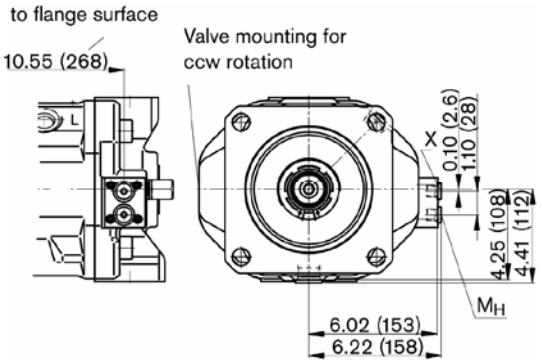
2）Thread according to ASME B1.1

3）For the maximum tightening torques the general instructions must be observed

■ Dimensions（mm）：Size140

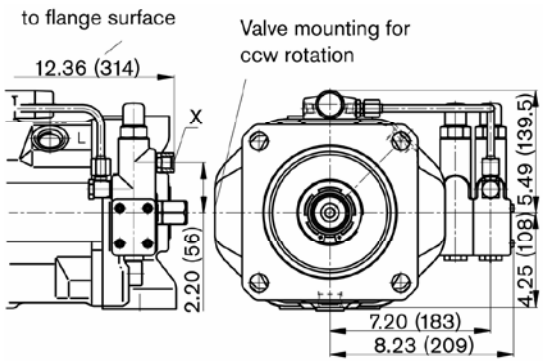
■ Control Device DG

□ Two-point control, directly operated.



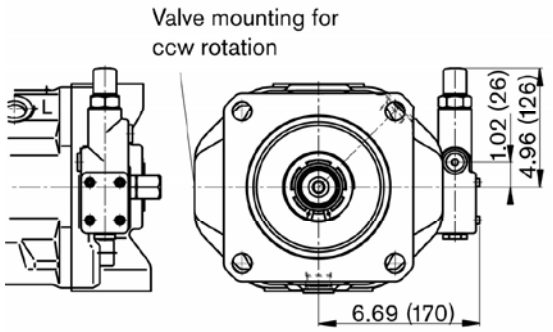
■ Control Device DFLR

□ Pressure, flow and power control.



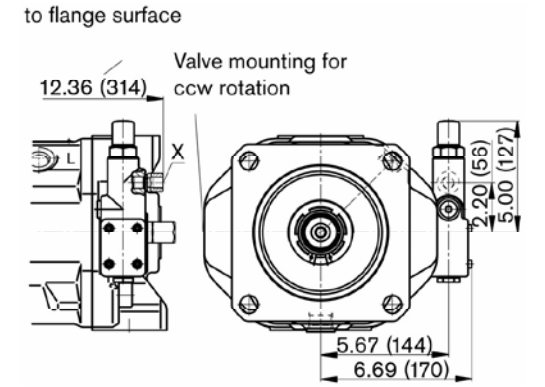
■ Control Device DR

□ Pressure control



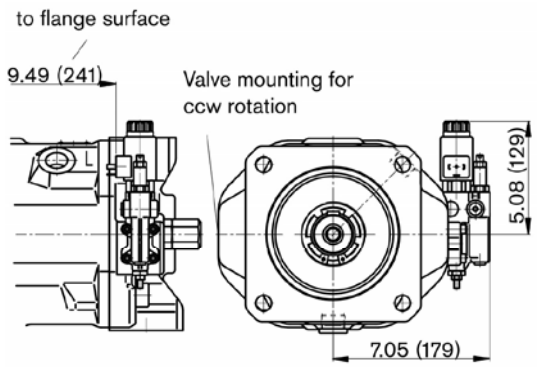
■ Control Device DRG

□ Pressure control, remotely operated.



■ Control Device ED7. / ER7.

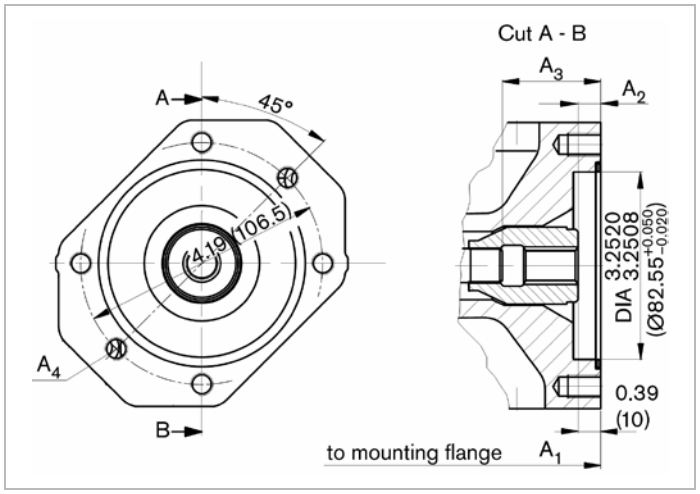
□ Electro-hydraulic pressure control



1）ER7.: 214 mm when using a sandwich plate pressure reducing valve.

■ Dimensions through drive…K01：

- Flange ISO 3019-1 （SAE J744-82-2 A）
- Coupling for splined shaft according to ANSI B92.1a-1996
- 5/8 in 9T 16/32 DP[1)]（SAE J744-16-4 A）



- Dimensions in inches and (mm).：

Size	A_1	A_2	A_3	A_4 [2)]
18	7.16	0.39	1.7	M10 X 1.5
	(182)	(10)	(43.3)	0.57 (14.5) deep
28	8.03	0.39	1.33	M10 X 1.5
	(204)	(10)	(33.7)	0.62 (16) deep
45	9.02	0.42	2.10	M10 X 1.5
	(229)	(10.7)	(53.4)	0.62 (16) deep
71	10.51	0.46	2.41	M10 X 1.5
	(267)	(11.8)	(61.3)	0.78 (20) deep
100	13.31	0.41	2.56	M10 X 1.5
	(338)	(10.5)	(65)	0.62 (16) deep
140	13.78	0.43	3.04	M10 X 1.5
	(350)	(10.8)	(77.3)	0.62 (16) deep

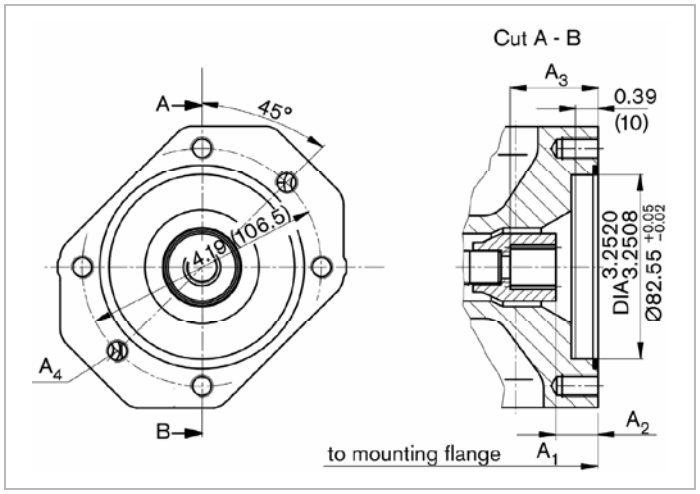
- Note：

1）30° pressure angle, flat root, side fit, tolerance class 5

2）Thread according to DIN 13, observe the general instructions for the maximum tightening torques.

■ Dimensions through drive…K52：

- Flange ISO 3019-1（SAE J744-82-2 A）
- Coupling for splined shaft according to ANSI B92.1a-1996
- 3/4 in 11T 16/32 DP[1)]（SAE J744-19-4 A-B）



- Dimensions in inches and (mm).：

Size	A_1	A_2	A_3	A_4 [2)]
18	7.16	0.74	1.52	M10 X 1.5
	(182)	(18.8)	(38.7)	0.57 (14.5) deep
28	8.03	0.74	1.52	M10 X 1.5
	(204)	(18.8)	(38.7)	0.62 (16) deep
45	9.02	0.744	1.52	M10 X 1.5
	(229)	(18.9)	(38.7)	0.62 (16) deep
71	10.51	0.84	1.63	M10 X 1.5
	(267)	(21.3)	(41.4)	0.78 (20) deep
100	13.31	0.75	1.53	M10 X 1.5
	(338)	(19)	(38.9)	0.62 (16) deep
140	13.78	0.744	1.52	M10 X 1.5
	(350)	(18.9)	(38.6)	0.62 (16) deep

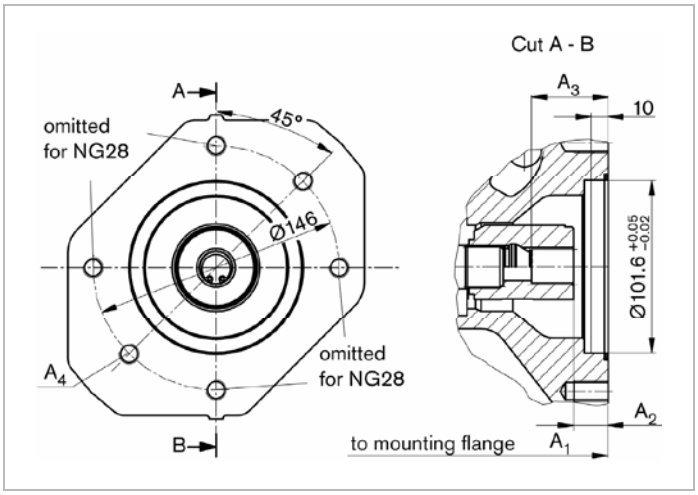
- Note：

1）30° pressure angle, flat root, side fit, tolerance class 5

2）Thread according to DIN 13, observe the general instructions for the maximum tightening torques.

■ Dimensions through drive…K68：

- Flange ISO 3019-1（SAE J744-101-2 B）
- Coupling for splined shaft according to ANSI B92.1a-1996
- 7/8 in 13T 16/32 DP[1)]（SAE J744-22-4 B）



- Dimensions in inches and (mm).：

Size	A_1	A_2	A_3	A_4 [2)]
28	8.03	0.70	1.64	M12 X 1.75
	(204)	(17.8)	(41.7)	continuous
45	9.02	0.704	1.64	M12 X 1.75
	(229)	(17.9)	(41.7)	0.71 (18) deep
71	10.51	0.80	1.74	M12 X 1.75
	(267)	(20.3)	(44.1)	0.78 (20) deep
100	13.31	0.71	1.65	M12 X 1.75
	(338)	(18)	(41.9)	0.78 (20) deep
140	13.78	0.70	1.64	M12 X 1.75
	(350)	(17.8)	(41.6)	0.78 (20) deep

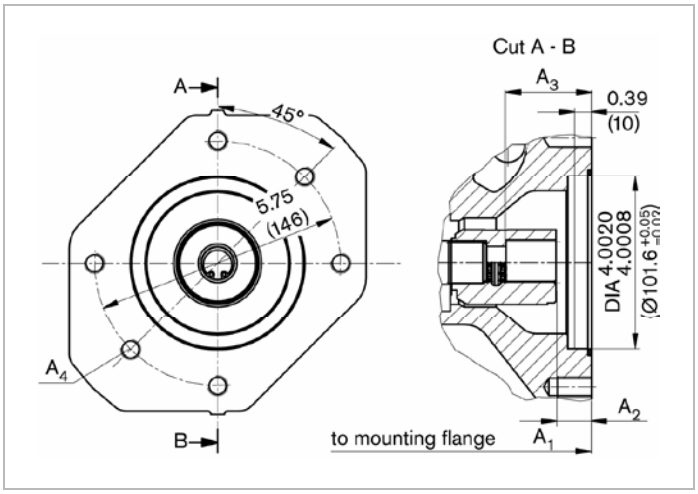
- Note：

1）30° pressure angle, flat root, side fit, tolerance class 5

2）Thread according to DIN 13, observe the general instructions for the maximum tightening torques.

■ Dimensions through drive…K04：

- Flange ISO 3019-1（SAE J744-101-2 B）
- Coupling for splined shaft according to ANSI B92.1a-1996
- 1 in 15T 16/32 DP[1)]（SAE J744-25-4 B-B）



- Dimensions in inches and (mm).：

Size	A_1	A_2	A_3	A_4 [2)]
45	9.02	0.724	1.84	M12 X 1.75
	(229)	(18.4)	(46.7)	0.71 (18) deep
71	10.51	0.82	1.93	M12 X 1.75
	(267)	(20.8)	(49.1)	0.78 (20) deep
100	13.31	0.716	1.83	M12 X 1.75
	(338)	(18.2)	(46.6)	0.78 (20) deep
140	13.78	0.72	1.81	M12 X 1.75
	(350)	(18.3)	(45.9)	0.78 (20) deep

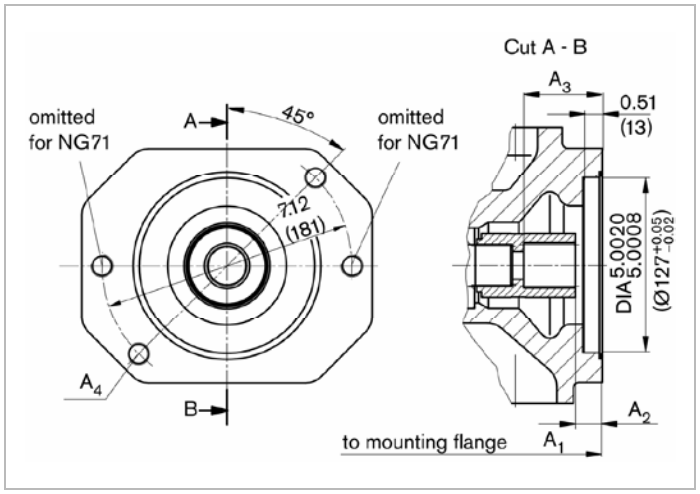
- Note：

1）30° pressure angle, flat root, side fit, tolerance class 5

2）Thread according to DIN 13, observe the general instructions for the maximum tightening torques.

■ Dimensions through drive…K07：

- Flange ISO 3019-1（SAE J744-127-2 C）
- Coupling for splined shaft according to ANSI B92.1a-1996
- 1-1/4 in 14T 12/24 DP[1)]（SAE J744-32-4 C）



- Dimensions in inches and (mm).：

Size	A_1	A_2	A_3	A_4 [2)]
71	10.51	0.86	2.31	M16 X 2
	(267)	(21.8)	(58.6)	continuous
100	13.31	0.77	2.22	M16 X 2
	(338)	(19.5)	(56.4)	continuous
140	13.78	0.76	2.21	M16 X 2
	(350)	(19.3)	(56.1)	0.94 (24) deep

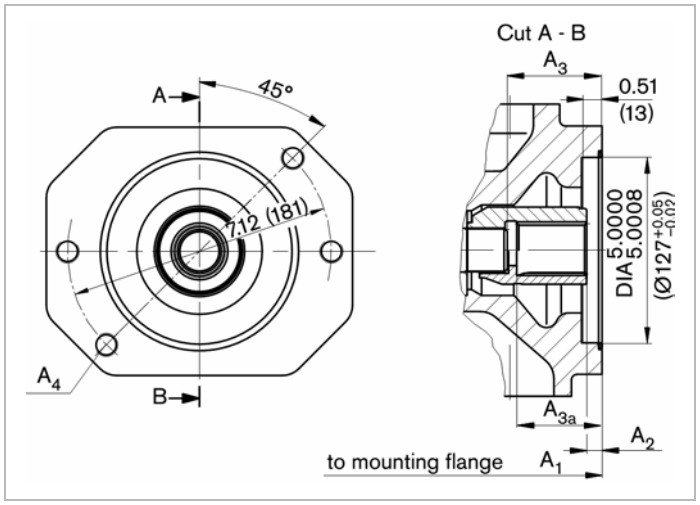
- Note：

1）30° pressure angle, flat root, side fit, tolerance class 5

2）Thread according to DIN 13, observe the general instructions for the maximum tightening torques.

■ Dimensions through drive…K24：

- Flange ISO 3019-1（SAE J744-127-2 C）
- Coupling for splined shaft according to ANSI B92.1a-1996
- 1-1/2 in 17T 12/24 DP[1)]（SAE J744-38-4 C-C）



- Dimensions in inches and (mm).：

Size	A_1	A_2	A_3 [3)]	A_{3a} [4)]	A_4 [2)]
100	13.31	0.41	2.56	-	M16 X 2
	(338)	(10.5)	(65)	(-)	continuous
140	13.78	0.42	2.95	-	M16 X 2
	(350)	(10.8)	(75)	(-)	0.94(24) deep
	13.78	0.40	-	2.72	M16 X 2
	(350)	(10.3)	(-)	(69.1)	0.94(24) deep

- Note：

1）30° pressure angle, flat root, side fit, tolerance class 5

2）Thread according to DIN 13, observe the general instructions for the maximum tightening torques.

3）Coupling withoutstop

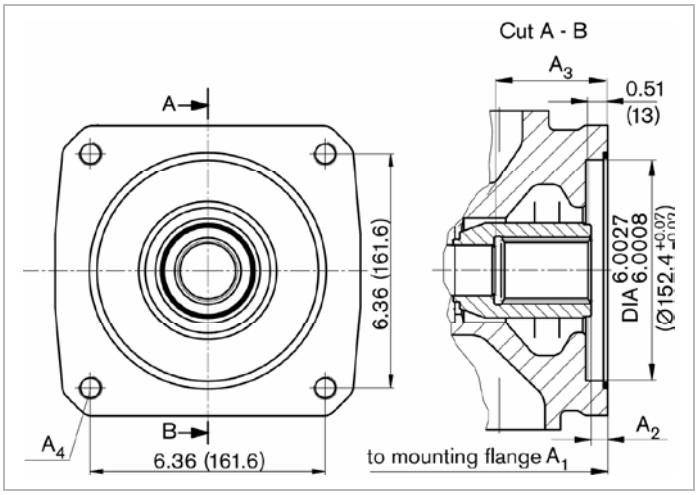
4）Coupling withstop

■ Dimensions through drive…K17：

□ Flange ISO 3019-1（SAE J744-152-4 A）

□ Coupling for splined shaft according to ANSI B92.1a-1996

□ 1-3/4 in 13T 8/16 DP[1)]（SAE J744-44-4 D）



□ Dimensions in inches and (mm).：

Size	A_1	A_2	A_3	A_4 [2)]
140	13.78	0.43	3.04	M16 X 2
	(350)	(10.8)	(77.3)	continuous

□ Note：

1）30° pressure angle, flat root, side fit, tolerance class 5

2）Thread according to DIN 13, observe the general instructions for the maximum tightening torques.

■ Summary mounting options：

□ SAE - mounting flange：

Through-drive[1)]			Mounting option - 2nd pump			
Flange ISO3019-1	Coupling for splined shaft	Short des.	A10V…/31 NG(shaft)	A10V…/52 NG(shaft)	Gear pump design (NG)	Through drive available for NG
82-2(A)	5/8 in	K01	18(U)	10(U)	F(5～22)	18～140
	3/4 in	K52	18(S,R)	10(S)	-	18～140
				18(U)		
				18(S,R)		
101-2(B)	7/8 in	K68	28(S,R)	28(S,R)	N/G(26～49)	28～140
			45(U,W)[1)]	45(U,W)[1)]		
	1 in	K04	45(S,R)	45(S,R)	-	45～140
			-	60,63(U,W)[2)]		
127-2(C)	1-1/4 in	K07	71(S,R)	85(U,W)[3)]	-	71～140
			100(U)[3)]	100(U,W)		
	1-1/2 in	K24	100(S)	85(S)	-	100～140
				100(S)		
152-4(4-hole D)	1-3/4 in	K17	140(S)	-	-	140

□ Note：

1）Not for main pump NG28 with K68

2）Not for main pump NG45 with K04

3）Not for main pump NG71 with K07

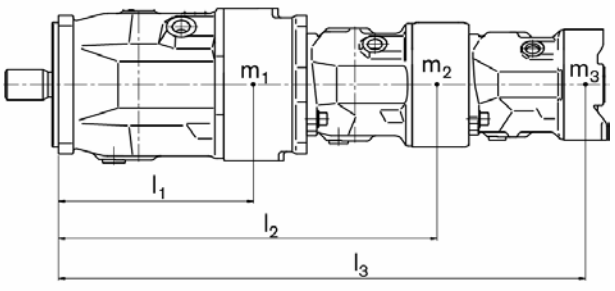
■ Combination pumps：

- When using combination pumps it is possible to have multiple, mutually independent circuits without the need for a splitter gearbox.
- When ordering combination pumps the model codes for the first and the second pump must be joined by a "+".
- Order example：

  HD-A10VSO100DFR1/31R-VSB62K04 + HD-A10VSO45DFR/31R-VSA62N00
- If no further pumps are to be factory-mounted, the simple type code is sufficient.Included in the delivery contents of the pump with through drive are then：coupling and seal, with plastic cover to prevent penetration by dust and dirt.
- It is permissible to use a combination of two single pumps of the same size (tandem pump), considering a dynamic masacceleration force of maximum 10g(= 98.1 m/s^2)without an additional support bracket.
- Each through drive is plugged with a non-pressure-resistantcover. Before commissioning the units, they must therefore be equipped with a pressure-resistant cover.
- Through drives can also be ordered with pressure-resistant covers. Please specify in clear text.
- For combination pumps comprising more than two pumps, the mounting flange must be calculated for the permissible moment of inertia.

■ Permissible mass moment of inertia：

NG				18	28	45	71	100	140
Permissible mass moment	static	T_m	lb-ft	369	649	1010	1593	2213	3319
of inertia			(Nm)	(500)	(880)	(1370)	(2160)	(3000)	(4500)
	dynamic at 10g（98.1 m/s^2）	T_m	lb-ft	37	65	101	159	221	332
			(Nm)	(50)	(88)	(137)	(216)	(300)	(450)
Mass	with through-drive plate	m	lbs	30.8	41.9	55	86	119	150
			(kg)	(14)	(19)	(25)	(39)	(54)	(68)
	without through-drive	m	lbs	26.5	33	46	73	99	132
	(e.g. 2nd pump)		(kg)	(12)	(15)	(21)	(33)	(45)	(60)
Distance center of gravity		l	in	3.54	4.33	5.12	5.91	6.30	6.30
			(mm)	(90)	(110)	(130)	(150)	(160)	(160)



m_1, m_2, m_3 Mass of pumps [lbs (kg)]

l_1, l_2, l_3 Distance center of gravity [in (mm)]

$$T_m = (m_1 \cdot l_1 + m_2 \cdot l_2 + m_3 \cdot l_3) \cdot \frac{1}{12\ (102)}$$ [lb-ft (Nm)]

■ General：

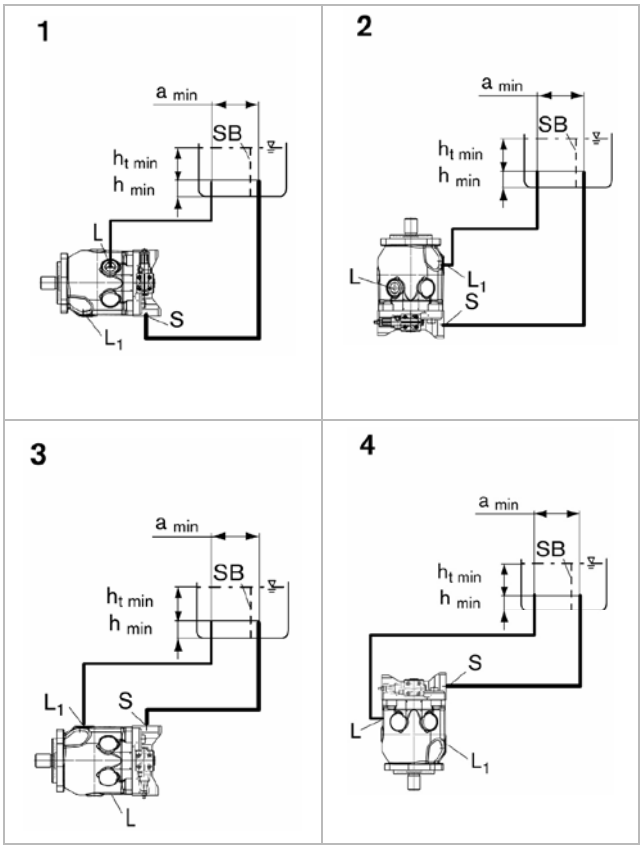
- The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit empty via the hydraulic lines.
- Especially with the installation position "drive shaft upwards" or "drive shaft downward", attention must be paid to a complete filling and air bleeding since there is a risk, for example, of dry running.
- The case drain fluid in the motor housing must be directed to the reservoir via the highest case drain port (L_1, L_2, L_3).
- For combinations of multiple units, make sure that the respective case pressure in each unit is not exceeded. In the event of pressure differences at the case drain ports of the units, the shared case drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate case drain lines must be laid if necessary.
- To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.
- In all operating conditions, the suction line and case drain line must flow into the reservoir below the minimum fluid level. The permissible suction height hSis a result of the overall pressure loss, but may not be greater than h_{Smax}= 31.50 inch (800 mm). The minimum suction pressure at port S must also not fall below 12 psi (0.8 bar) absolute during operation.

■ Installation position：

- See the following examples 1 to 12.
- Additional installation positions are available upon request.
- Recommended installation positions: 1 and 3.

■ Below-reservoir installation (standard)：

- Below-reservoir installation means the axial piston unit is installed outside of the reservoir below the minimum fluid level.

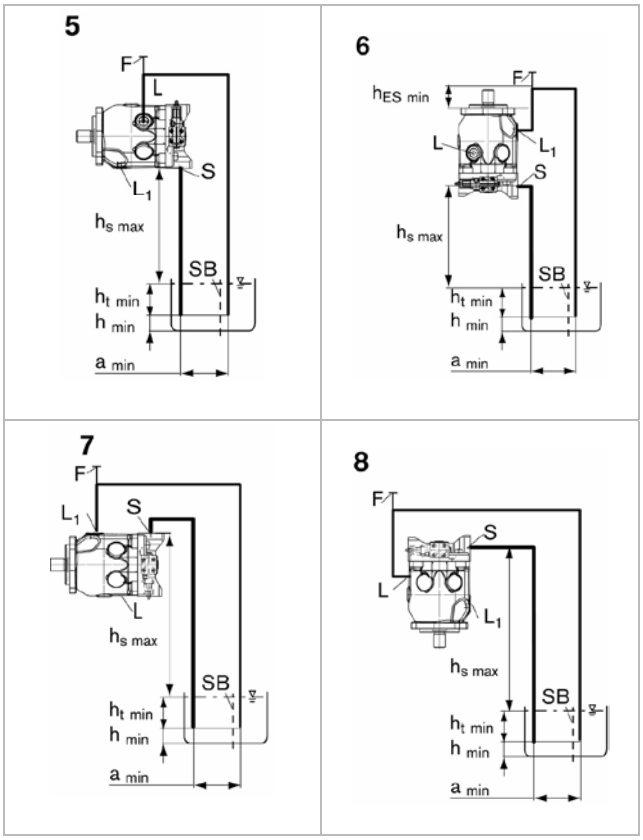


- Below-reservoir installation：

Installation position	Air bleed	Filling
1	L	S+L_1
2	L_1	S+ L
3	L_1	S+ L
4	L	S+L_1

■ Above-reservoir installation：

- Above-reservoir installation means the axial piston unit is installed above the minimum fluid level of the reservoir.
- To prevent the axial piston unit from draining, a height difference hES minof at least 0.98 inch (25 mm) at port L 1is required in installation position 6.
- Observe the maximum permissible suction height hS max = 31.50 inches (800 mm).
- A check valve in the case drain line is only permissible in individual cases. Consult us for approval.

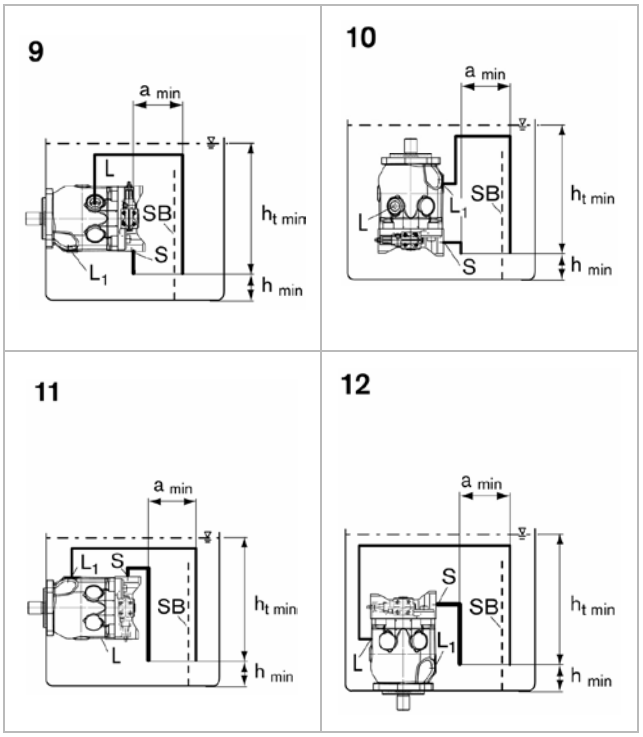


- Above-reservoir installation：

Installation position	Air bleed	Filling
5	F	L(F)
6	F	L_1(F)
7	F	S+L_1(F)
8	F	S+ L(F)

■ Inside-reservoir installation：

- Inside-reservoir installation is when the axial piston unit is nstalled in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid.
- If the minimum fluid level is equal to or below the upper edge of the pump, see chapter "Above-reservoir installation".
- Axial piston units with electrical components (e.g. electric control, sensors) may not be installed in a reservoir below the fluid level.



- Inside-reservoir installation：

Installation position	Air bleed	Filling
9	L	L,L_1
10	L_1	L,L_1
11	L_1	S+ L,L_1
12	L	S+ L,L_1

- Note：

L,L_1	Case drain port
S	Suction port
F	Filling / air bleeding
SB	Baffle (baffle plate)
$h_{t\,min}$	Minimum necessary immersion depth (7.87 inch (200 mm))
h_{min}	Minimum necessaryspacing to reservoir bottom(3.94 inch (100 mm))
$h_{ES\,min}$	Minimum necessary height needed to protect the axial piston unit from draining (0.98 inches (25 mm)).
$h_{S\,max}$	Maximum permissible suction height (31.50 inch (800 mm))
a_{min}	When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

■ Fittings：

□ Observe the manufacturer‘s instruction regarding the tightening torques of the used fittings.

■ Mounting bolts：

□ For mounting bolts with metric ISO thread according to DIN 13 or thread according to ASME B1.1, we recommend checking the tightening torque individuallyaccording to VDI 2230.

■ Female threads in axial piston unit：

□ The maximum permissible tightening torques MG maxare maximum values for the female threads and must not be exceeded. For values, see the following table.

■ Threaded plugs：

□ For the metal threaded plugs supplied with the axial piston unit, the required tightening torques of the threaded plugs M_V apply. For values, see the following table.

■ Tightening Torques：

Ports		Maximum permissible tightening torque for female threads $M_{G\,max}$	Required tightening torque for threaded plugs M_V	Size of hexagon socket of threaded plugs
Standard	Thread size			
DIN 3852[1)]	G1/4	52 lb-ft	–	–
		70 Nm	–	–
	M14 x 1.5	59 lb-ft	26 lb-ft	0.24 inch
		80 Nm	35 Nm	6 mm
DIN ISO 228	G1/4	52 lb-ft	22 lb-ft	0.24 inch
		70 Nm	30 Nm	6 mm
ISO 11926	7/16-20UNF-2B	29 lb-ft	13 lb-ft	3/16 in
		40 Nm	18 Nm	
	9/16-18UNF-2B	59 lb-ft	26 lb-ft	1/4 in
		80 Nm	35 Nm	
	3/4-16UNF-2B	118 lb-ft	52 lb-ft	5/16 in
		160 Nm	70 Nm	
	7/8-14UNF-2B	177 lb-ft	81 lb-ft	3/8 in
		240 Nm	110 Nm	
	1 1/16-12UN-2B	266 lb-ft	125 lb-ft	9/16 in
		360 Nm	170 Nm	

□ Note：

1）The tightening torques of the threaded plugs MVapply for screws in the „dry“ state as received on delivery and in the„lightly oiled“ state for installation.

■ General Instructions：

- The A10VSO pump is designed to be used in open circuit.
- Project planning, installation and commissioning of the axial piston unit requirethe involvement of qualified personnel.
- Before operating the axial piston unit, please read the appropriate instruction manual thoroughly and completely. If necessary, request these from HUADE.
- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristics may shift.
- Service line ports：
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The service line ports and function ports are only designed to accommodate hydraulic lines.
- Pressure cut-off and pressure control do not provide security against pressure overload. A separate pressure relief valve is to be provided in the hydraulic system.
- The data and notes contained herein must be adhered to.
- The product is not approved as a component for the safety concept of a general machine according to ISO 13849..