YEOSHE

Hydraulic Piston Pump

PA10VO Series

www.yeoshehydraulic.com

Efficient Performance

Innovative Technology

Reliable Quality and Service

YEOSHE HYDRAULICS CO.,LTD.

Type code for standard program

PA10V	O			/	5			–	V				
01	02	03	04		05	06	07		08	09	10	11	12

Axial piston unit

		18	28	45	60[1]	63	85	100	
01	nominal pressure 3600 psi (250 bar), maximum pressure 4600 psi (315 bar)	❍	❍	❍	❍	●	❍	❍	PA10V

Operation mode

02	Pump, open circuit	O

Size (NG)

		18	28	45	60[1]	63	85	100
03	Geometric displacement, see table of values							

Control device

					18	28	45	60[1]	63	85	100	
04	Pressure control				❍	❍	❍	❍	●	❍	❍	DR
	with flow control, hydraulic											
		X-T open			–	❍	❍	❍	–	❍[3]	–	DFR
					❍	–	–	–	●	❍[2]	❍	DRF
		X-T plugged			–	❍	❍	❍	–	❍[3]	–	DFR1
					❍	–	–	–	●	❍[2]	❍	DRS
		Electrically overridable (negative characteristic)			–	–	–	–	–	–	–	EF.D.[4]
	with pressure cut-off, remotely operated											
		hydraulic			❍	❍	❍	❍	●	❍	❍	DRG
		electrical	negative characteristic	U = 12 V	❍	❍	❍	❍	●	❍	❍	ED71
				U = 24 V	❍	❍	❍	❍	●	❍	❍	ED72
			positive characteristic	U = 12 V	❍	❍	❍	❍	●	❍	❍	ER71[5]
				U = 24 V	❍	❍	❍	❍	●	❍	❍	ER72[5]
	Power control with pressure cut-off											
		Start of control	145 to 510 psi	(10 to 35 bar)	❍	❍	❍	–	●	❍	❍	LA5D
			520 to 1015 psi	(36 to 70 bar)	❍	❍	❍	–	●	❍	❍	LA6D
			1030 to 1520 psi	(71 to 105 bar)	❍	❍	❍	–	●	❍	❍	LA7D
			1535 to 2030 psi	(106 to 140 bar)	❍	❍	❍	–	●	❍	❍	LA8D
			2045 to 3335 psi	(141 to 230 bar)	❍	❍	❍	–	●	❍	❍	LA9D
		remotely operated	Start of control	see LA.D	❍	❍	❍	–	❍	❍	❍	LA.DG
		Flow control, X-T plugged	Start of control	see LA.D	❍	❍	❍	–	❍	❍	❍	LA.DS
		Flow control, electrically overridable (negative characteristic), X-T plugged	Start of control	see LA.D	❍	❍	❍	–	❍	❍	❍	LA.S

1) Series 52 units are delivered as standard with 3.66 in³ (60 cm³). Higher values on request.
2) Series 53 only with D flange
3) Series 52 only with C flange
4) The following must be taken into account during project planning:
Excessive current levels (I > 1200 mA with 12 V or I > 600 mA with 24 V) to the ER solenoid can result in undesired increase of pressure which can lead to pump or system damage:
- Use I_{max} current limiter solenoids.
- An intermediate plate pressure controller can be used to protect the pump in the event of overflow.
An accessory kit with intermediate plate pressure controller can be ordered from Yeoshe

● = available ❍ = on request – = not available

Type code for standard program

PA10V	O			/	5			–	V				
01	02	03	04		05	06	07		08	09	10	11	12

			18	28	45	60[1]	63	85	100	
04	Electro-proportional control (positive characteristic) with									
	pressure control	U = 12 V	❍	❍	❍	–	❍	❍	❍	EP1D
		U = 24 V	❍	❍	❍	–	❍	❍	❍	EP2D
	Pressure and flow control, X-T open (load sensing)	U = 12 V	❍	❍	❍	–	❍	❍	❍	EP1DF
		U = 24 V	❍	❍	❍	–	❍	❍	❍	EP2DF
	Pressure and flow control, X-T plugged (load sensing)	U = 12 V	❍	❍	❍	–	❍	❍	❍	EP1DS
		U = 24 V	❍	❍	❍	–	❍	❍	❍	EP2DS
	Electrohydraulic pressure control	U = 12 V	❍	❍	❍	–	❍	❍	❍	EP1ED
		U = 24 V	❍	❍	❍	–	❍	❍	❍	EP2ED
	Pressure and flow control with controller cut-off, X-T open (load sensing)	U = 12 V	❍	❍	❍	–	❍	❍	❍	EK1DF
		U = 24 V	❍	❍	❍	–	❍	❍	❍	EK2DF
	Pressure and flow control with controller cut-off, X-T plugged (load sensing)	U = 12 V	❍	❍	❍	–	❍	❍	❍	EK1DS
		U = 24 V	❍	❍	❍	–	❍	❍	❍	EK2DS
	Electrohydraulic pressure control with controller cut-off	U = 12 V	❍	❍	❍	–	❍	❍	❍	EK1ED
		U = 24 V	❍	❍	❍	–	❍	❍	❍	EK2ED

Series

05	Series 5, index 2	–	❍	❍	❍	–	❍	–	52[2]
	Series 5, index 3	❍	❍	❍	–	●	❍	❍	53[3][4]

Direction of rotation

06	With view on drive shaft	clockwise	R
		counter clockwise	L

Seals

07	FKM (fluor-caoutchouc)	V

Drive shaft

			18	28	45	60[1]	63	85	100	
08	Splined shaft ANSI B92.1a	standard shaft	❍	❍	❍	❍	●	❍	❍	S
		similar to shaft „S“ however for higher input torque	❍	❍	❍	❍	●	–	–	R
		reduced diameter, not for through drive	❍	–	❍	❍	●	❍	❍	U
		similar to shaft "U", however for higher torque	–	–	❍	❍	●	❍	❍	W
	Parallel shaft SAE with key, not for through drive		–	–	–	–	–	–	–	K[7]
	Tapered with Woodruff key		–	–	–	–	–	–	–	C[7]

1) Series 52 units are delivered as standard with 3.66 in³ (60 cm³). Higher values on request.
2) Control DR, DFR, DFR1, DRG, ED and ER: delivery with size 10, 28, 45, 60 and 85[6] only in series 52
3) Control DR, DRF, DRS, DRG, ED and ER: delivery with size 18, 63, 85[5] and 100 only in series 53
4) Control EF., LA.., EP.. and EK.. Delivery with size 18 to 100 only in series 53
5) Control DRF and DRS: delivery with size 85 only with D flange in series 53
6) Control DFR, DFR1: delivery with size 85 only with C flange in series 52

● = available ❍ = on request – = not available

Type code for standard program

PA10V	O			/	5			–	V				
01	02	03	04		05	06	07		08	09	10	11	12

	Mounting flange		18	28	45	60[1]	63	85	100	
	ISO 3019-1 (SAE)	2-bolt	❍	❍	❍	❍	●	❍	❍	C
		4-bolt	❍	–	–	❍	●	❍[2]	❍	D

	Service line port	18	28	45	60[1]	63	85	100	
10	SAE flange port at rear, UNC fixing thread (not for through drive)	❍	❍	❍	❍	●	❍	❍	61
10	SAE flange port on opposite side, UNF fixing thread (for through drive)	❍	❍	❍	❍	●	❍	❍	62
10	UNF threaded ports, rear (not for through drive)	–	–	–	–	–	–	–	64

	Through drive			18	28	45	60[1]	63	85	100	
11	Without through drive, standard for versions 61 and 64			❍	❍	❍	❍	●	❍	❍	N00
11	SAE J744 flange	coupling for splined shaft[3]									
11	Diameter	diameter									
11	82-2 (A)	5/8 in	9T 16/32DP	❍	❍	❍	❍	●	❍	❍	K01
11		3/4 in	11T 16/32DP	❍	❍	❍	❍	●	❍	❍	K52
11	101-2 (B)	7/8 in	13T 16/32DP	–	❍	❍	❍	●	❍	❍	K68
11		1 in	15T 16/32DP	–	–	❍	❍	●	❍	❍	K04
11	127-4 (C)	1 1/4 in	14T 12/24DP	–	–	–	❍	●	❍	❍	K15
11		1 1/2 in	17T 12/24DP	–	–	–	–	–	❍	❍	K16
11	127-2 (C)	1 1/4 in	14T 12/24DP	–	–	–	–	–	❍	❍	K07
11		1 1/2 in	17T 12/24DP	–	–	–	–	–	❍	❍	K24

	Connector for solenoids	18	28	45	60[1]	63	85	100	
12	DEUTSCH molded connector, 2-pin – without suppressor diode	❍	❍	❍	❍	●	❍	❍	P

1) Series 52 units are delivered as standard with 3.66 in³ (60 cm³). Higher values on request.
2) Only available in series 53. For controller designation and series assignment, please refer to positions 04, 05, including footnotes.

● = available ❍ = on request – = not available

Technical data

Hydraulic fluid

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 the range

ν_{opt} = opt. operating viscosity 80 to 170 SUS (16 to 36 mm²/s)

referred to reservoir temperature (open circuit).

Limits of viscosity range

For critical operating conditions the following values apply:

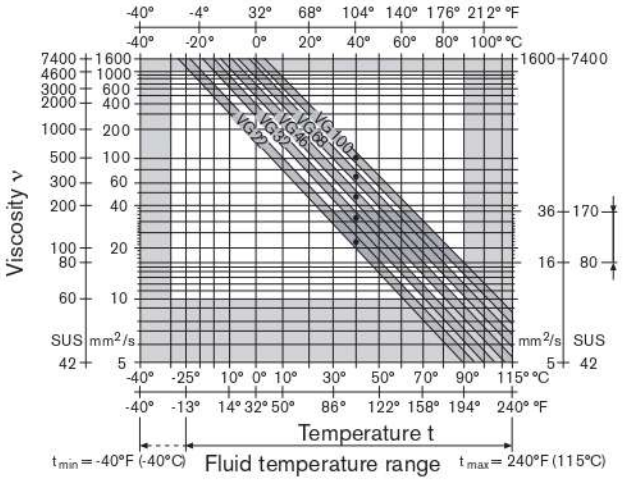
ν_{min} = 60 SUS (10 mm²/s)
for short periods (t ≤ 1 min)
at max. perm. case drain temperature of 239 °F (115 °C).

Please note that the max. case drain temperature of 115 °C is also not exceeded in certain areas (for instance bearing area). The fluid temperature in the bearing area is approx. 7 °F (5 K) higher than the average case drain temperature.

ν_{max} = 7500 SUS (1600 mm²/s)
for short periods (t ≤ 1 min)
on cold start
(p ≤ 435 psi (30 bar), n ≤ 1000 rpm,
t_{min} -13 °F (-25 °C))

Depending on the installation situation, special measures are necessary at temperatures between -40 °F (-40°C) and -13 °F (-25°C). Please contact us.

Selection diagram



Notes on the selection of the hydraulic fluid

In order to select the correct hydraulic fluid, it is necessary to know the operating temperature in relation to the ambient temperature. In an open circuit this is the reservoir temperature.

The fluid should be selected so that within the operating temperature range, the viscosity lies within the optimum range (ν_{opt}), 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 (°C) the operating temperature in the reservoir is 140 °F (60 °C) . In the optimum operating viscosity range (ν_{opt}; shaded area) this corresponds to viscosity grades VG 46 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 239 °F (115 °C). The temperature difference specified on the left is to be taken into account when determining the viscosity in the bearing.

Please contact us if the above conditions cannot be met due to extreme operating parameters.

Filtration of the fluid

The finer the filtration the better the fluid cleanliness class 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 fluid to determine the particle contamination and the cleanliness class according to ISO 4406. A cleanliness class of at least 20/18/15 must be achieved.

At very high hydraulic fluid temperatures (195 °F (90 °C) to maximum 239 °F (115 °C)), a cleanliness class of at least 19/17/14 according to ISO 4406 is necessary.

Please contact us if the above classes cannot be observed.

Technical data

Operating pressure range

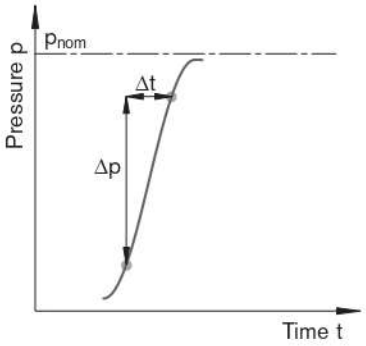
Pressure at service line port B

Nominal pressure p_{nom} _____ 3600 psi (250 bar) absolute

Maximum pressure p_{max} _____ 4600 psi (315 bar) absolute
Single operating period_____ 2.5 ms
Total operating period _____ 300 h

Minimum pressure (high-pressure side) ___145 psi (10 bar)

Rate of pressure change $R_{A\,max}$_ 235000 psi/s (16000 bar/s)



Pressure at suction port S (inlet)
Minimum pressure $p_{S\,min}$_____ 10 psi (0.8 bar) absolute
Maximum pressure $p_{S\,max}$ _____75 psi (5 bar) absolute

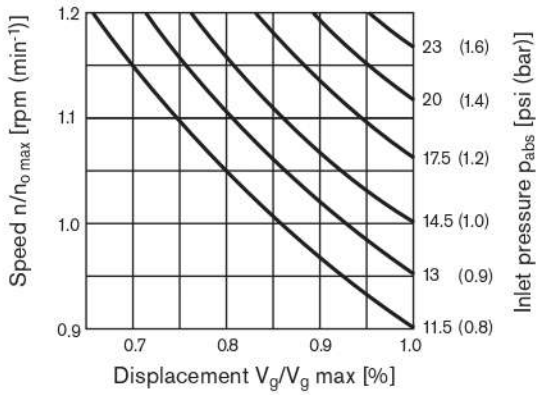
Case drain pressure

Maximum permissible case drain pressure
(at port L, L_1):
Maximum 7.5 psi (0.5 bar) higher than the inlet pressure at port S, however not higher than 30 psi (2 bar) absolute.

$p_{L\,max\,abs}$ _____ 30 psi (2 bar)

Maximum permissible speed (limit speed)

Permissible speed by increasing inlet pressure p_{abs} at suction opening S or at $V_g \leq V_{g\,max}$.



Definition

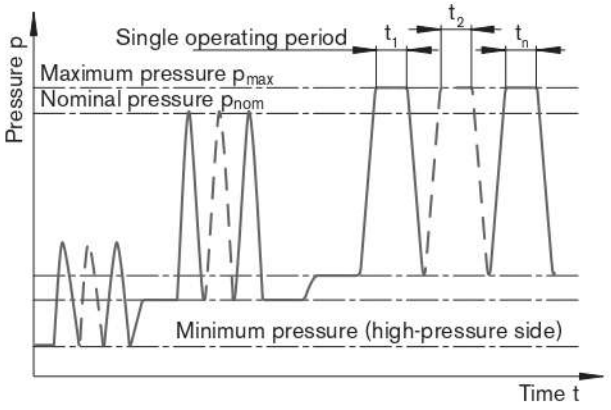
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}
The maximum pressure corresponds to the operating 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 on the high-pressure side (B) that is required in order to prevent damage to the axial piston unit.

Minimum pressure (inlet) open circuit
Minimum pressure at suction port S (inlet) that is required to prevent damage to the axial piston unit. The minimum pressure depends on the speed and displacement of the axial piston unit.

Rate of pressure change R_A
Maximum permissible pressure build-up and pressure reduction speed with a pressure change over the entire pressure range.



Total operating period = $t_1 + t_2 + ... + t_n$

Technical data

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

Size		NG		10	18	28	45	60[1]	63[2]	85	100
Geometrical displacement per revolution		$V_{g\,max}$	in^3	0.64	1.10	1.75	2.75	3.66	3.84	5.18	6.10
			(cm^3)	(10.5)	(18)	(28)	(45)	(60)	(63)	(85)	(100)
Speed[3]											
maximum at $V_{g\,max}$		n_{nom}	rpm	3600	3300	3000	2600[4]	2600	2600	2500	2300
maximum at $V_g < V_{g\,max}$		$n_{max\,perm}$	rpm	4320	3960	3600	3120	3140	3140	3000	2500
Flow at n_{nom} and $V_{g\,max}$		$q_{v\,max}$	gpm	9.7	15.6	22	31	41	43	55	60
			(l/min)	(37)	(59)	(84)	(117)	(156)	(163)	(212)	(230)
at n_E = 1500 rpm and $V_{g\,max}$		$q_{vE\,max}$	gpm	4	7.1	1.1	18	24	25.1	34	39
			(l/min)	(15)	(27)	(42)	(68)	(90)	(95)	(128)	(150)
Power at Δp = 3600 psi (250 bar)											
at n_{nom}, $V_{g\,max}$		P_{max}	HP (kW)	22 (16)	34 (25)	47 (35)	65 (49)	88 (65)	90 (68)	119 (89)	130 (96)
at n_E = 1500 rpm and $V_{g\,max}$		$P_{E\,max}$	HP	9.4	15	24	38	50	52	71	84
			(kW)	(7)	(11)	(18)	(28)	(37)	(39)	(53)	(62)
Torque at $V_{g\,max}$ and	Δp = 3600 psi (250 bar)	T_{max}	lb-ft	31	52	82	132	175	184	247	293
			(Nm)	(42)	(71)	(111)	(179)	(238)	(250)	(338)	(398)
	Δp = 1440 psi (100 bar)	T	lb-ft	13	21	33	53	70	74	102	117
			(Nm)	(17)	(29)	(45)	(72)	(95)	(100)	(135)	(159)
Rotary stiffness, drive shaft	S	c	lb-ft/rad	6760	8082	16400	37500	48100	48100	105100	105100
			(Nm/rad)	(9200)	(11000)	(22300)	(37500)	(65500)	(65500)	(143000)	(143000)
	R	c	lb-ft/rad	–	10870	19400	30240	51200	51200	–	–
			(Nm/rad)	–	(14800)	(26300)	(41000)	(69400)	(69400)	–	–
	U	c	lb-ft/rad	5020	5870	–	22130	36290	36390	75900	75900
			(Nm/rad)	(6800)	(8000)	–	(30000)	(49200)	(49200)	(102900)	(102900)
	W	c	lb-ft/rad	–	–	–	25370	39830	39830	86960	86960
			(Nm/rad)	–	–	–	(34400)	(54000)	(54000)	(117900)	(117900)
	K/C	c	lb-ft/rad	7965	–	19770	32380	54506	–	–	–
			(Nm/rad)	(10800)	–	(26800)	(43900)	(73900)	–	–	–
Moment of inertia rotary group		J_{TW}	$lbs\text{-}ft^2$	0.0142	0.2207	0.0403	0.0783	0.1329	0.1329	0.2848	0.2848
			(kgm^2)	(0.0006)	(0.00093)	(0.0017)	(0.0033)	(0.0056)	(0.0056)	(0.012)	(0.012)
Angular accel., max.[5]		α	rad/s^2)	8000	6800	5500	4000	3300	3300	2700	2700
Filling capacity		V	gal	0.05	0.06	0.08	0.13	0.21	0.21	0.26	0.26
			(L)	(0.2)	(0.25)	(0.3)	(0.5)	(0.8)	(0.8)	(1)	(1)
Weight (without through drive) approx.		m	lbs (kg)	17 (8)	25 (11.5)	31 (14)	40 (18)	48.5 (22)	48.5 (22)	75 (34)	75 (34)

1) The values are applicable:
- for absolute pressure p_{abs} = 15 psi (1 bar) at the suction port S
- for the optimum viscosity range of ν_{opt} = 80 to 170 SUS (16 to 36 mm^2/s)
- for mineral-based operating materials with a specific mass of 0.88 kg/l.

2) Please contact us regarding higher speeds

3) 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.

Technical data

Determination of size

Flow $q_V = \dfrac{V_g \cdot n \cdot \eta_V}{231\ (1000)}$ [gpm (l/min)]

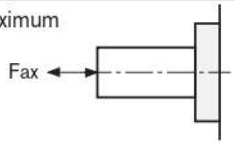
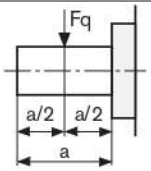
Torque $T = \dfrac{V_g \cdot \Delta p}{24\ (20) \cdot \pi \cdot \eta_{mh}}$ [lb-ft (Nm)]

Power $P = \dfrac{2\pi \cdot T \cdot n}{33.000\ (60000)} = \dfrac{q_V \cdot \Delta p}{1.714\ (600) \cdot \eta_t}$ [HP (kW)]

V_g = Geometric displ. per revolution in in^3 (cm^3)
Δp = Differential pressure in psi (bar)
n = Speed in rpm
η_V = Volumetric efficiency
η_{mh} = Mechanical-hydraulic efficiency
η_t = Total efficiency ($h_t = h_V \cdot h_{mh}$)

Technical data

Permissible radial and axial forces on the drive shaft

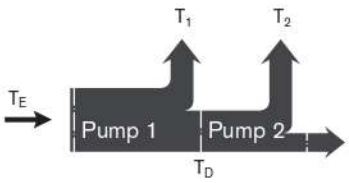
Size	NG		10	18	28	45	60/63	85	100
Radial force maximum at a/2 	$F_{q\,max}$	lbf (N)	56 (250)	78 (350)	270 (1200)	337 (1500)	382 (1700)	450 (2000)	450 (2000)
Axial force maximum 	$+ F_{ax\,max}$	lbf (N)	90 (400)	157 (700)	225 (1000)	337 (1500)	450 (2000)	675 (3000)	675 (3000)

Permissible input and through-drive torques

Size	NG		10	18	28	45	60/63	85	100
Torque at $V_{g\,max}$ and Δp = 3600 psi (250 bar)[1]	T_{max}	lb-ft (Nm)	31 (42)	52 (71)	82 (111)	132 (179)	184 (250)	293 (338)	293 (398)
Input torque for drive shaft, maximum[2]									
S	$T_{E\,max}$	lb-ft (Nm)	93 (126)	91 (124)	198	319	630	1157	1157
	DIA	in	3/4	3/4	7/8	1	1 1/4	1 1/2	1 1/2
R	$T_{E\,max}$	lb-ft (Nm)	–	110 (150)	166 (225)	295 (400)	479 (650)	–	–
	DIA	in	–	3/4	7/8	1	1 1/4	–	–
U	$T_{E\,max}$	lb-ft (Nm)	44 (60)	43 (59)	–	139 (188)	226 (306)	463 (628)	463 (628)
	DIA	in	5/8	5/8	–	7/8	1	1 1/4	1 1/4
W	$T_{E\,max}$	lb-ft (Nm)	–	–	–	162 (220)	292 (396)	447 (650)	447 (650)
	DIA	in	–	–	–	7/8	1	1 1/4	1 1/4
K	$T_{E\,max}$	lb-ft (Nm)	78 (106)	–	107 (145)	156 (212)	325 (441)	–	–
	DIA	in (mm)	0.750 (19.05)	–	0.8750 (22.225)	1.000 (25.4)	1.2500 (31.75)	–	–
C[3]	$T_{E\,max}$	lb-ft (Nm)	–	–	107 (145)	156 (212)	325 (441)[4]		
Maximum through-drive torque for drive shaft									
S	$T_{D\,max}$	lb-ft (Nm)	–	80 (108)	118 (160)	235 (319)	357 (484)	515 (698)	515 (698)
R	$T_{D\,max}$	lb-ft (Nm)	–	89 (120)	130 (176)	270 (365)	357 (484)	–	–

1) Without considering efficiency
2) For drive shafts free of radial load

Distribution of torques



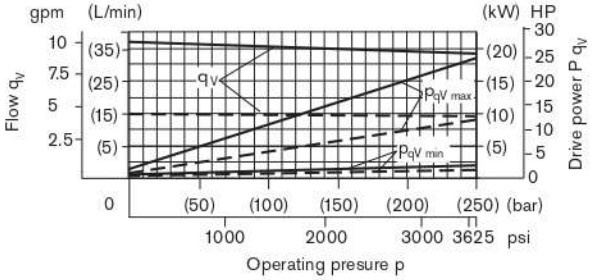
Technical data

Drive power and flow

Operating material:
Hydraulic fluid ISO VG 46 DIN 51519, t = 50 °C

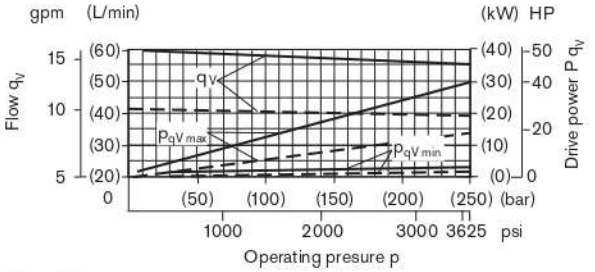
Size 10

- - - - n = 1500 rpm
——— n = 3600 rpm



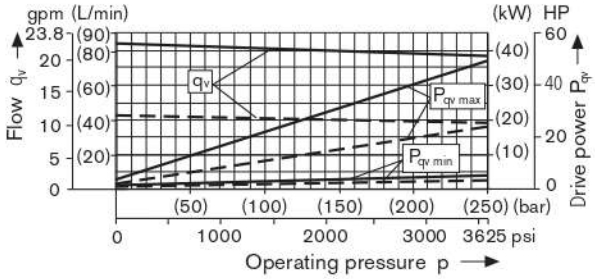
Size 18

- - - - n = 1500 rpm
——— n = 3300 rpm



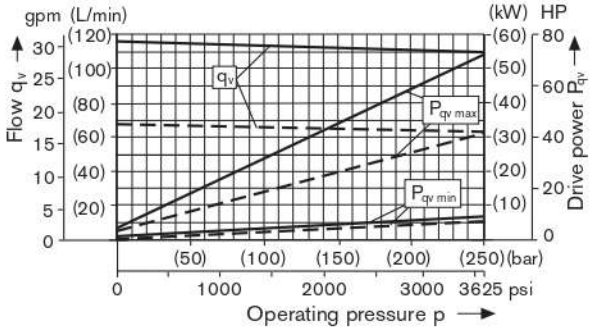
Size 28

- - - - n = 1500 rpm
——— n = 3000 rpm



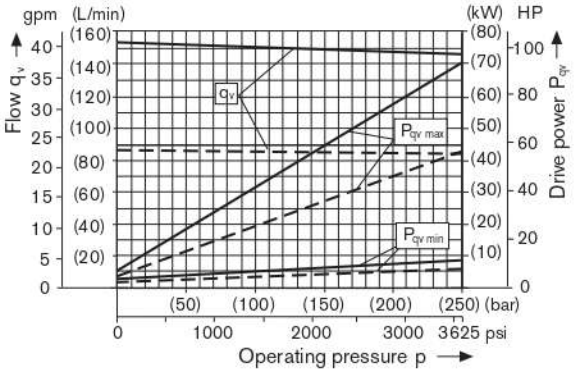
Size 45

- - - - n = 1500 rpm
——— n = 2600 rpm



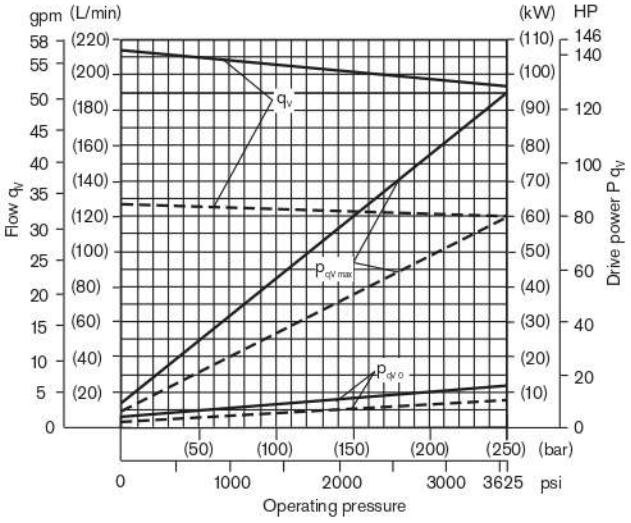
Size 60/63

- - - - n = 1500 rpm
——— n = 2600 rpm



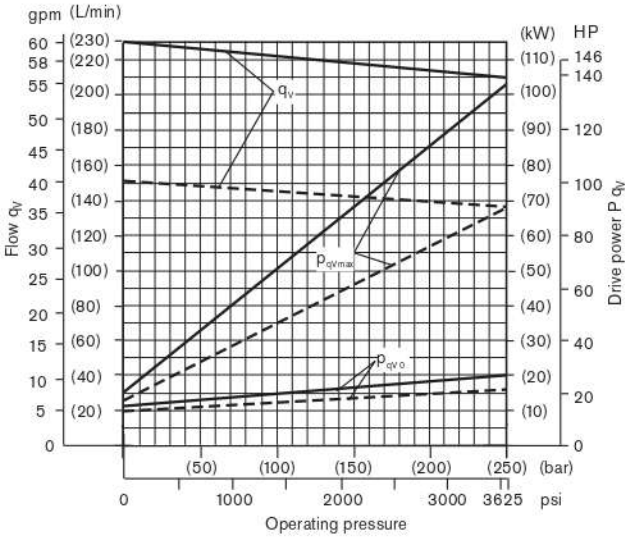
Size 85

- - - - n = 1500 rpm
——— n = 2500 rpm



Size 100

- - - - n = 1500 rpm
——— n = 2300 rpm

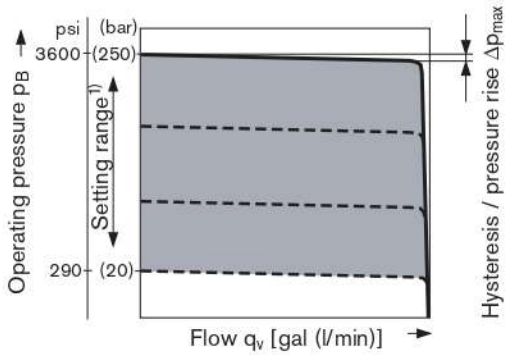


DR – Pressure control

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 target pressure set at the pressure valve, the pump will regulate towards a smaller displacement. The pressure can be set steplessly at the control valve.

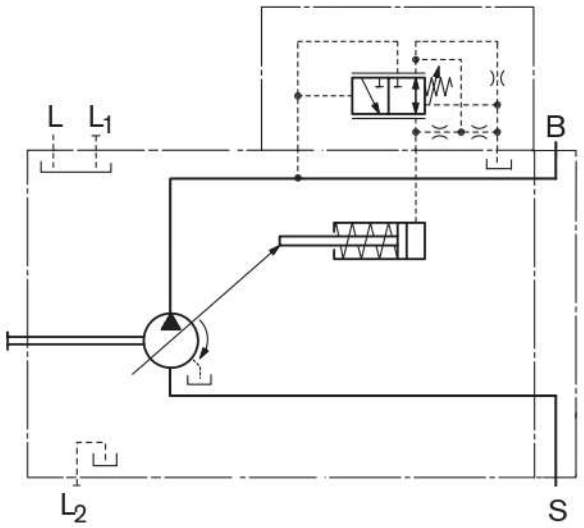
Static characteristic

(at n_1 = 1500 rpm; t_{fluid} = 120 °F (50 °C))



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

Circuit diagram



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)

Controller data

Hysteresis and repeatability Δp _____ maximum 45 psi (3 bar)

Pressure rise, maximum

NG		10	18	28	45	60/63	85	100
Δp	psi	90	90	90	90	115	175	200
	(bar)	(6)	(6)	(6)	(6)	(8)	(12)	(14)

Control fluid consumption_____ max. approx. 0.8 gpm (3 l/min)

DRG – Pressure control remotely operated

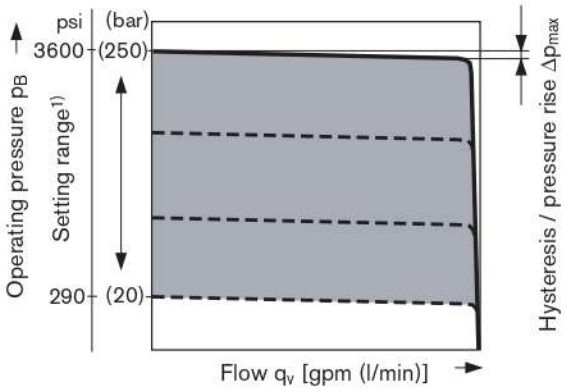
The DRG control valve overrides the function of the DR pressure controller

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 pump.

The differential pressure at the control valve is set as standard to 290 psi (20 bar). The control fluid volume at port X is approx. 0.4 gpm (1.5 l/min). If another setting is required (range from 145 to 320 psi (10 to 22 bar)) please state this in clear text.

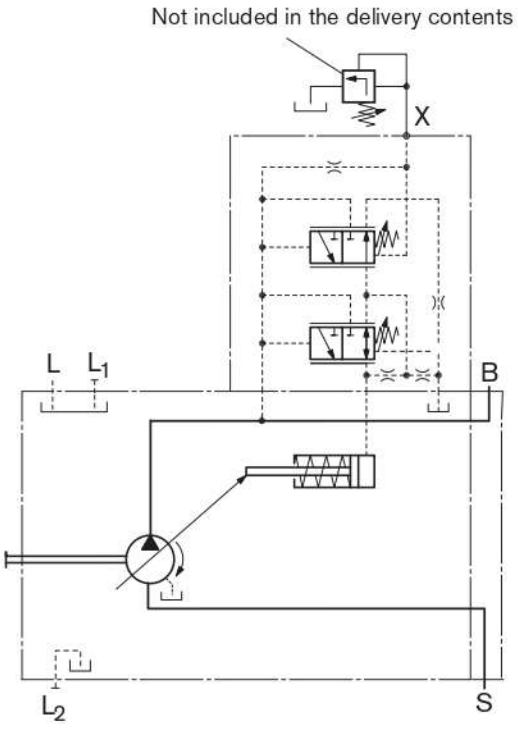
Static characteristic

(at n_1 = 1500 rpm; t_{fluid} = 120 °F (50 °C))



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

Circuit diagram



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Pilot pressure

Controller data

Hysteresis and repeatability Δp _____ maximum 45 psi (3 bar)

Pressure rise, maximum

NG		10	18	28	45	60/63	85	100
Δp	psi	90	90	90	90	115	175	200
	(bar)	(6)	(6)	(6)	(6)	(8)	(12)	(14)

Control fluid consumption____max. approx. 1.2 gpm (4.5 l/min)

DRF (DFR) DRS (DFR1) – Pressure and flow control

In addition to the pressure control function , a variable orifice (e.g. directional valve) is used to adjust the differential pressure upstream and downstream of the orifice. This is used to control the pump flow. The pump flow is equal to the actual required flow by the consumer, regardless of changing pressure levels.

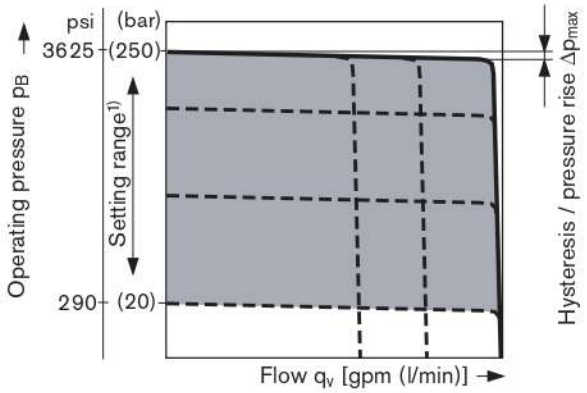
The pressure control overrides the flow control function.

Note

The DRS (DFR1) valve 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.

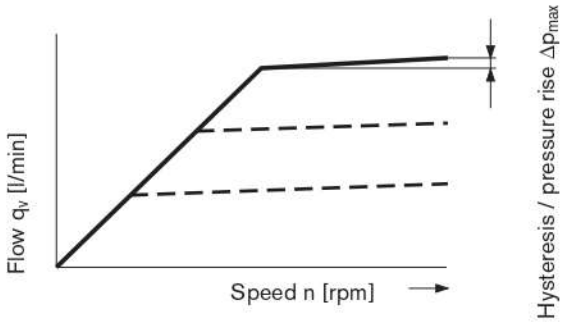
Static characteristic

Flow control at n_1 = 1500 rpm; t_{fluid} = 120 °F (50 °C))



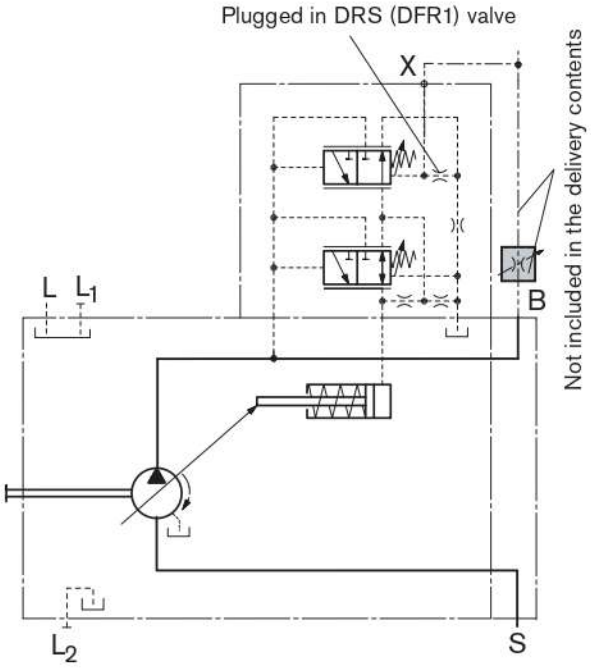
1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and it is not allowed to be exceeded.
The range of possible settings at the valve is higher.

Static characteristic at variable speed



Possible connections at port B
(not included in the delivery, order separately)

Circuit diagram



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Pilot pressure

Differential pressure Δp

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 Δp). No account is taken of system influences.

Controller data

Data pressure control DR,
Maximum flow deviation measured with drive speed n = 1500 rpm.

NG		10	18	28	45	60/ 63	85	100
$\Delta q_{v\,max}$	gpm	0.13	0.24	0.26	0.48	0.66	0.83	0.83
	(l/min)	(0.5)	(0.9)	(1.0)	(1.8)	(2.5)	(3.1)	(3.1)

Control fluid consumption
DRF (DFR) __ maximum approx. 0.8 to 1.2 gpm (3 to 4.5 l/min)
DRS (DFR1) _____ maximum approx. 0.8 gpm (3 l/min)

LA... – Pressure, flow and power control

Pressure control equipped as DR(G)
Flow control equipped as DRF, DRS.

In order to achieve a constant drive torque with varying operating 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.

When ordering please state the power characteristics to be set ex works in clear text, e.g. 27 HP (20 kW) at 1500 rpm.

Controller data

For pressure controller DR data
For flow control FR data.

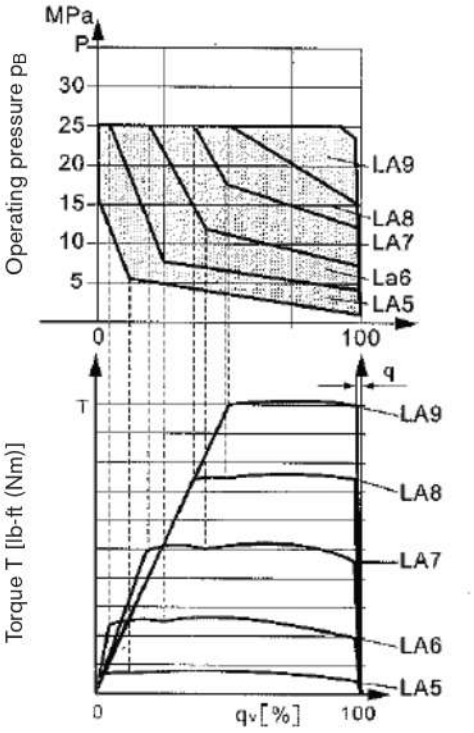
Controller data
Maximum control fluid consumption.

Start of control	Torque T [lb-ft (Nm)] for size						Order code
[psi ((bar)]	18	28	45	63	85	100	
145 to 510 (10 to 35)	2.80 - 8.92 (3.8 - 12.1)	4.4 - 14 (6 - 19)	7.4 - 22.1 (10 - 30)	11 - 32 (15 - 43)	15 - 42 (20 - 57)	18 - 49.5 (24 - 68)	**LA5**
520 to 1015 (36 to 70)	8.92 - 17.2 (12.2 - 23.3)	14 - 26.5 (19.1 - 36)	22.2 - 43.5 (30.1 - 59)	32 - 61 (43.1 - 83)	42 - 83 (57.1 - 112)	49.5 - 97.1 (68.1 - 132)	**LA6**
1030 to 1520 (71 to 105)	17.2 - 24.9 (23.4 - 33.7)	26.6 - 38.4 (36.1 - 52)	43.6 - 62 (59.1 - 84)	61 - 88 (83.1 - 119)	83 - 118) (112.1 - 160)	97.1 - 139.4 (132.1 - 189)	**LA7**
1535 to 2030 (106 to 140)	24.9 - 33.2 (33.8 - 45)	38.4 - 51.6 (52.1 - 70)	62 - 83 (84.1 - 112)	88 - 116 (119.1 - 157)	118 - 156 (160.1 - 212)	139.4 - 183.6 (189.1 - 249)	**LA8**
2045 to 3335 (141 to 230)	33.2 - 55.2 (45.1 - 74.8)	51.7 - 86.3 (70.1 - 117)	83 - 139 (112.1 - 189)	116 - 195 (157.1 - 264)	156 - 263 (212.1 - 357)	183.3 - 309 (249.1 - 419)	**LA9**

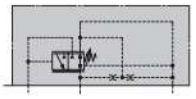
Conversion of the torque values in power [kW]:

$$P = \frac{T}{3.5\ (6.4)}\ \text{[HP (kW)]}\ (\text{at 1500 rpm}) \quad \text{or} \quad P = \frac{2\pi \cdot T \cdot n}{33.000\ (60000)}\ \text{[HP (kW)]}$$

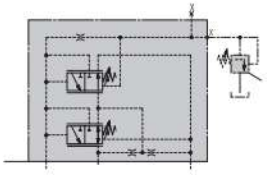
Static curves and torque characteristic



Circuit diagram (LAXD) with pressure cut-off

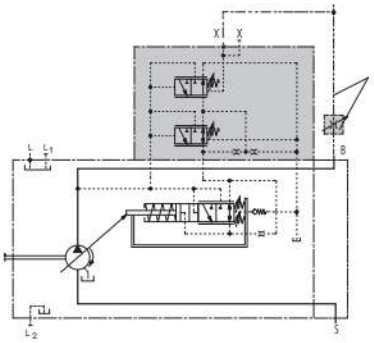


Circuit diagram (LAXDG) with pressure cut-off, remotely operated



Not included in the delivery contents

Circuit diagram (LAXDS) with pressure and flow control



Not included in the delivery contents

EP – Electro-proportional control

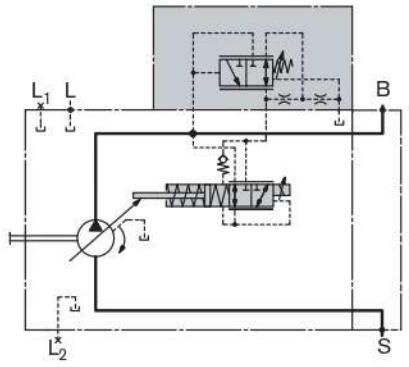
Electro-proportional control makes a stepless and reproducible setting of the pump displacement possible directly via the swashplate. The control force of the control piston is applied by a proportional solenoid. The control is proportional to the current (for start of control, see table right).

In a depressurized state, the pump is swiveled to its initial position ($V_{g\,max}$) by an adjusting spring. If the operating pressure exceeds 200 psi (14 bar), the pump will swivel from $V_{g\,max}$ to $V_{g\,min}$ without control by the solenoid (control current < start of control). A PWM signal is used to control the solenoid.

EP.D: The pressure control regulates the pump displacement back to $V_{g\,min}$ after the set target pressure has been reached.

A minimum operating pressure of 200 psi (14 bar) is needed for control. The necessary control fluid is taken from the high pressure.

Circuit diagram EP.D



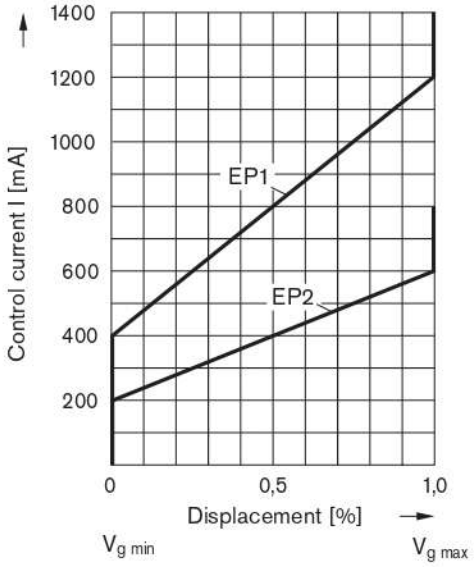
	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

Technical data, solenoid	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at $V_{g\,min}$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %
For protection rating, please refer to "Socket version" on page 55		

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

Characteristic EP1/2

Hysteresis < 5 %



Note

The spring return at the controller is not a safety device

Dirt contamination (contaminated hydraulic fluid, wear or residual dirt from system components) could cause the controller to stick in an undefined position. The volume flow of the axial piston unit will then no longer follow the commands of the operator.

Check whether remedial measures for your application are needed on your machine in order to put the driven consumer in a safe state (e.g. immediate stop).

EK – Electro-proportional control with controller cut-off

The variant EK... is based completely on the variant EP...

In addition to the electro-proportional control function, a controller cut-off is integrated in the electric characteristic.
The pump then swivels to $V_{g\,max}$ if the control signal is lost (e.g. cable break) and then works with the DRF settings (see page 14). The controller cut-off is only intended for short-term use and not for permanent use if the control signal is lost. If the control signal is lost, the pump swivel times will be reduced by the EK valve.
A PWM signal is used to control the solenoid.

A minimum operating pressure of 200 psi (14 bar) is needed for control. The necessary control fluid is taken from the high pressure.

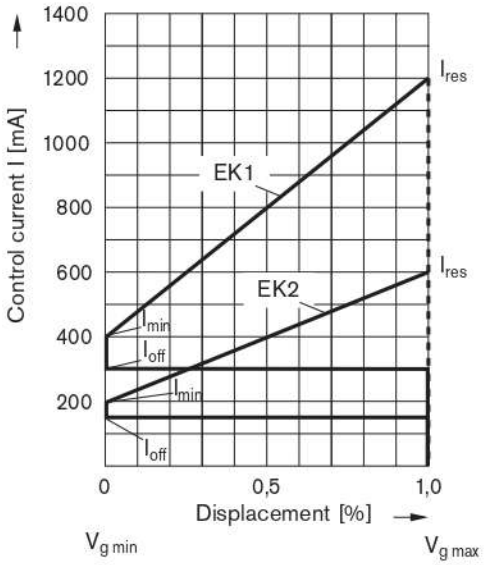
The $V_{g\,max}$ position is maintained by the force of the adjusting spring. To overcome the force of this spring, the solenoid must be subjected to excessive current (I_{res}).

Technical data, solenoid	EK1	EK2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at $V_{g\,min}$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %
For protection rating, please refer to "Socket version" on page 55		

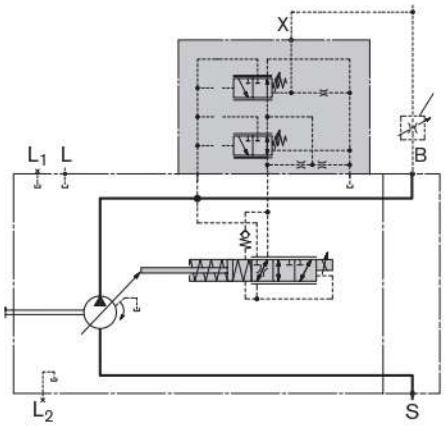
Operating temperature range at valve -4 °F to 239 °F (-20 °C to +115 °C)

Characteristic EK

Hysteresis < 5 %



Circuit diagram EK.DF



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

	EK1.	EK2.
I_{min} [mA]	400	200
I_{max} [mA]	1200	600
I_{off} [mA]	< 300	< 150
I_{res} [mA]	> 1200	> 600

For changes in current, ramp times of > 200 ms must be observed.

Note

The spring return at the controller is not a safety device

Dirt contamination (contaminated hydraulic fluid, wear or residual dirt from system components) could cause the controller to stick in an undefined position. The volume flow of the axial piston unit will then no longer follow the commands of the operator.

Check whether remedial measures for your application are needed on your machine in order to put the driven consumer in a safe state (e.g. immediate stop).

EP(K).DF / EP(K).DS – EP(K) with pressure and flow control

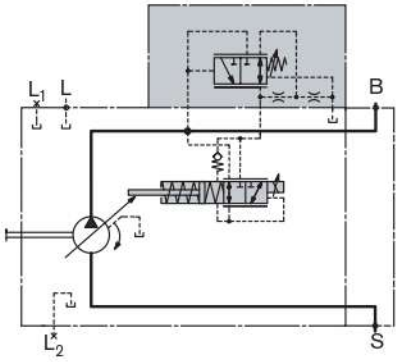
A hydraulic pressure flow control is superimposed on the electro-proportional control.
The pressure control regulates the pump displacement back to $V_{g\,min}$ after the set target pressure has been reached.
This function is super-imposed on the EP or EK control, i.e. the control-current dependent function is executed below the target pressure.
Setting range from 290 to 3600 psi (20 to 250 bar). For the pressure flow control.

Pressure control has priority over electro-proportional control and flow control.

With flow control, the pump flow can be influenced in addition to pressure control. The pump flow is thus equal to the actual amount of hydraulic fluid required by the consumer. This is achieved using the differential pressure at the consumer (e.g. orifice).

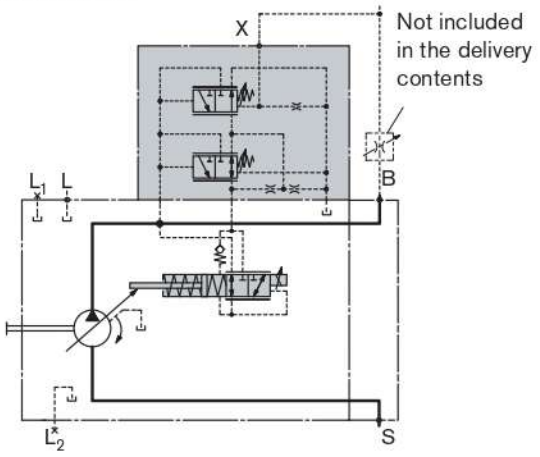
The EP.DS or EK.DS version has no connection between X and the reservoir (load sensing).

Circuit diagram EP.D



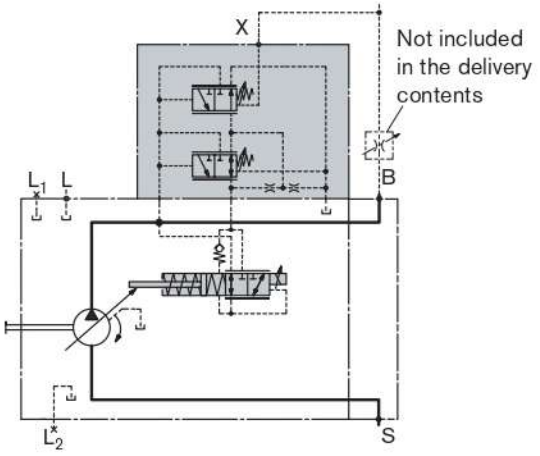
	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)

Circuit diagram EP.DF



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

Circuit diagram EP.DS



	Port for
B	Service line
S	Suction line
L, $L_{1,2}$	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

EP(K).ED – EP(K) with electro-hydraulic pressure control

The ED valve is set to a certain pressure by a specified variable solenoid current.

When a change is made at the consumer (load pressure), the position of the control piston will shift.

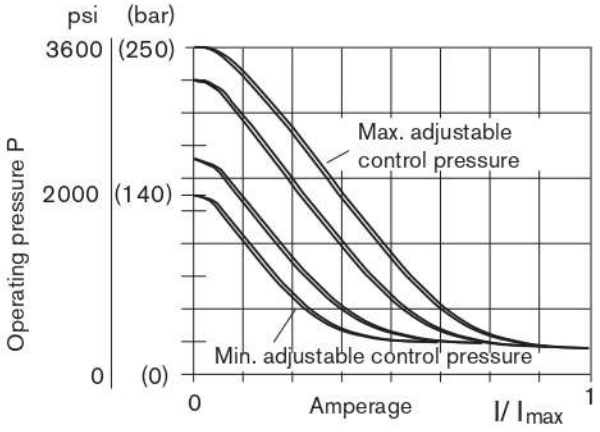
This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

The pump thus only delivers as much hydraulic fluid as the consumers can take. The pressure can be set steplessly by the solenoid current.

As the solenoid current signal drops towards zero, the pressure will be limited to p_{max} by an adjustable hydraulic pressure cut-off (negative characteristic, e.g. for fan drives). A PWM signal is used to control the solenoid.

Static current-pressure characteristic ED
(negative characteristic)

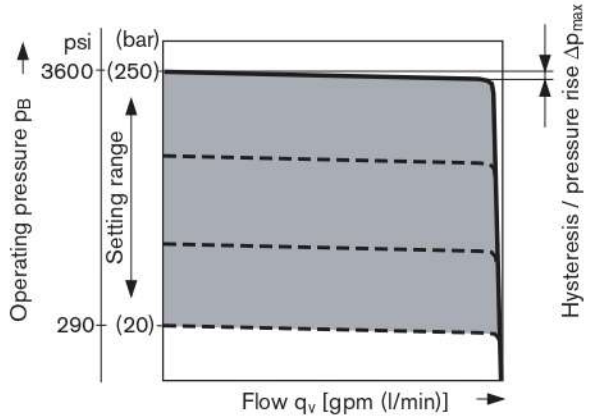
(measured with pump in zero stroke)



Hysteresis static current-pressure characteristic
< 45 psi (3 bar).

Static flow-pressure characteristic

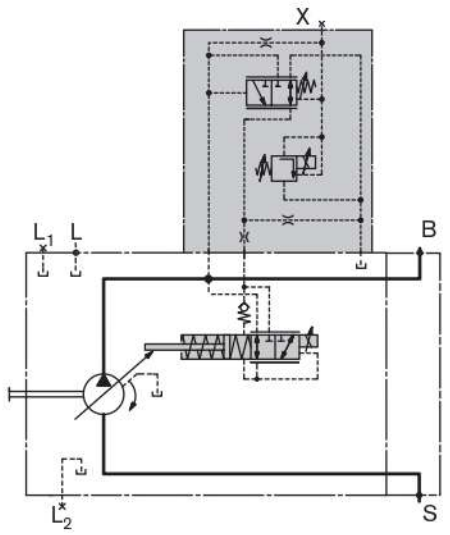
(at n= 1500 rpm; t_{fluid} = 120 °F (50 °C))



Controller data

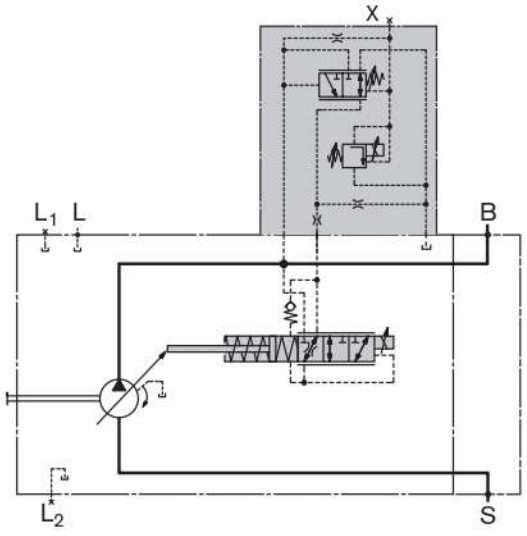
Standby standard setting: 290 psi (20 bar). Other values on request. Hysteresis / pressure rise Δp 60 psi (4 bar)

Circuit diagram EP.ED



	Port for
B	Service line
S	Suction line
L, L1,2	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

Circuit diagram EK.ED



	Port for
B	Service line
S	Suction line
L, L1,2	Case drain fluid ($L_{1,2}$ plugged)
X	Control pressure

ED – Electro-hydraulic pressure control

The ED valve is set to a certain pressure by a specified variable solenoid current.

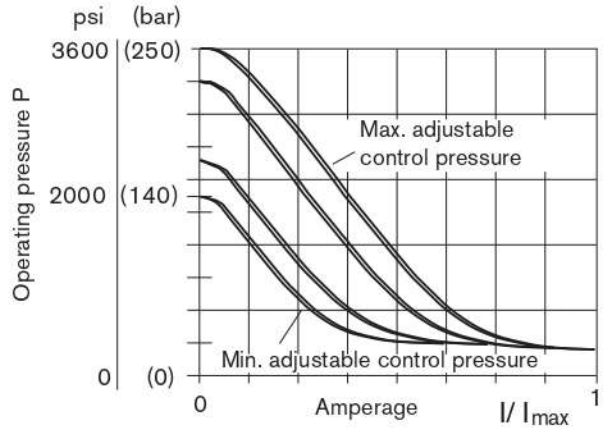
When a change is made at the consumer (load pressure), the position of the control piston will shift.

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.

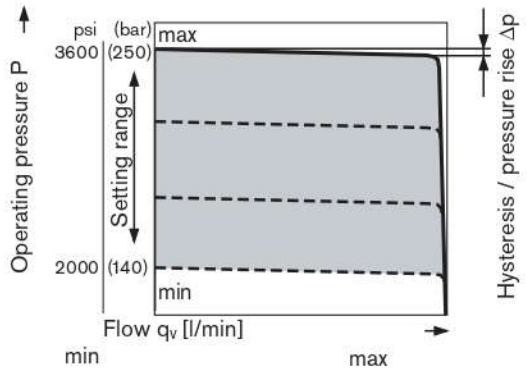
As the solenoid current signal drops towards zero, the pressure will be limited to p_{max} by an adjustable hydraulic pressure cut-off (secure fail safe function in case of a loss of power, e.g. for fan drives).
The response time characteristic of the ED-control was optimized for the use as a fan drive 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)

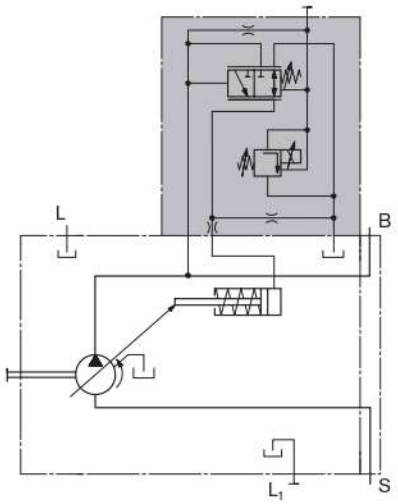
Static flow-pressure characteristic
(at n= 1500 rpm; t_{fluid} = 120 °F (50 °C))



Controller data
Standby standard setting 290 psi (20 bar), other values on request.

Hysteresis and pressure rise _____ Δp < 60 psi (4 bar).
Control flow consumption____ 0.8 to 1.2 gpm (3 to 4.5 l/min).

Circuit diagram ED..



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

Technical data, 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 (at 68 °F (20 °C))	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %

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

ER – Electro-hydraulic pressure control

The ER valve is set to a certain pressure by a specified variable solenoid current.

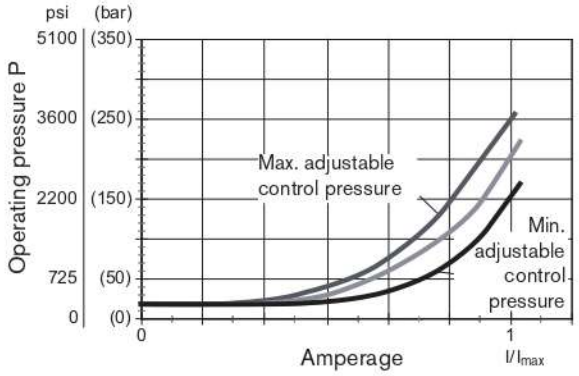
When a change is made at the consumer (load pressure), the position of the control piston will shift.

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.

As the solenoid current signal drops towards zero, the pressure will be limited to p_{min} (stand by).

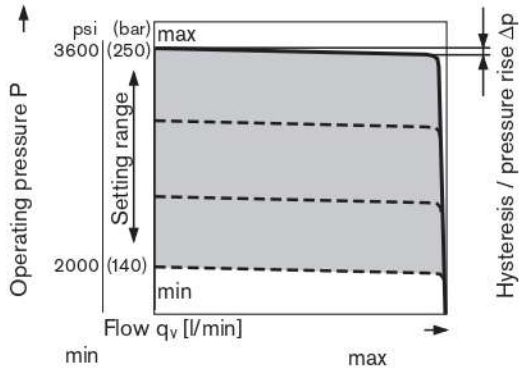
Static current-pressure characteristic ER
(measured with pump in zero stroke – positive characteristic)



Hysteresis static current-pressure characteristic < 45 psi (3 bar)

Influence of pressure setting on stand by ± 30 psi (2 bar)

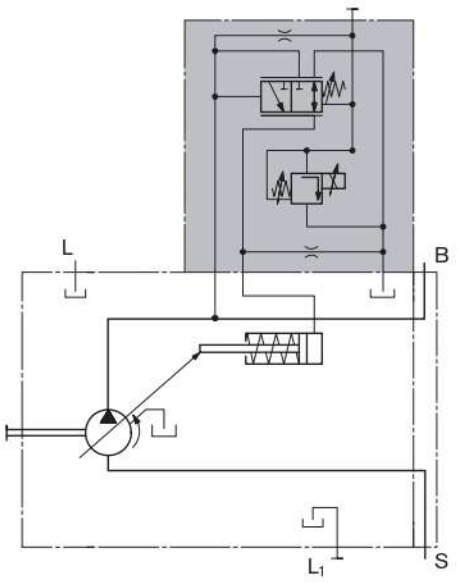
Static flow-pressure characteristic
(at n= 1500 rpm; t_{fluid} = 120 °F (50°C))



Controller data
Standby standard setting 200 psi (14 bar), other values on request.

Hysteresis and pressure rise _____ Δp < 60 psi (4 bar).
Control flow consumption_____ 0.8 to 1.2 gpm (3 to 4.5 l/min).

Circuit diagram ER..



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

Technical data, 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 (at 68 °F (20 °C))	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %

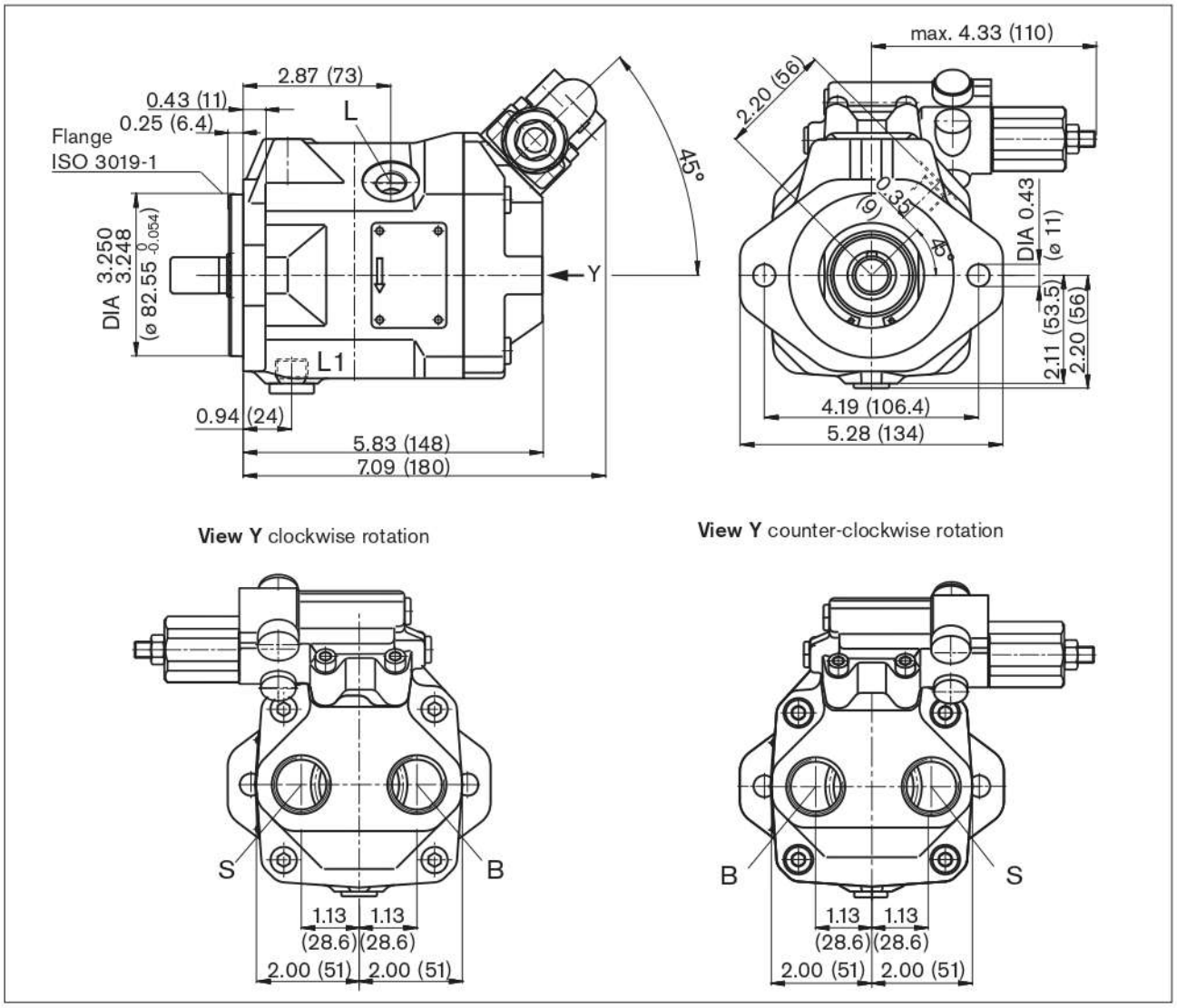
Operating temperature range at valve -4 °F to 239 °F (-20 °C to +115 °C)

Dimensions, size 10

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

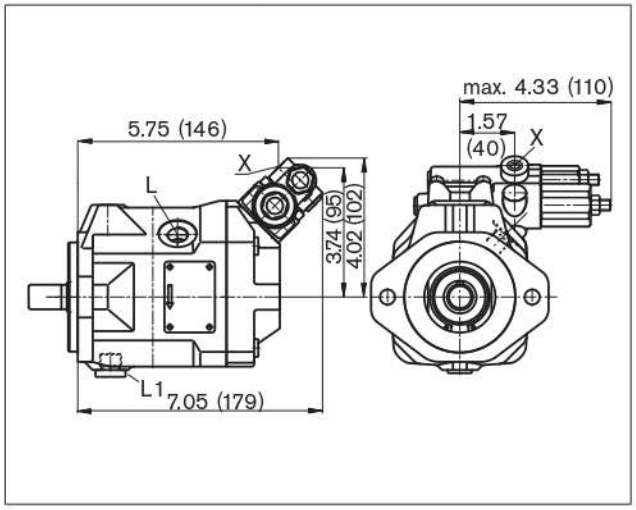
DR – Hydraulic pressure controller

Centering flange **SAE** version; series 52



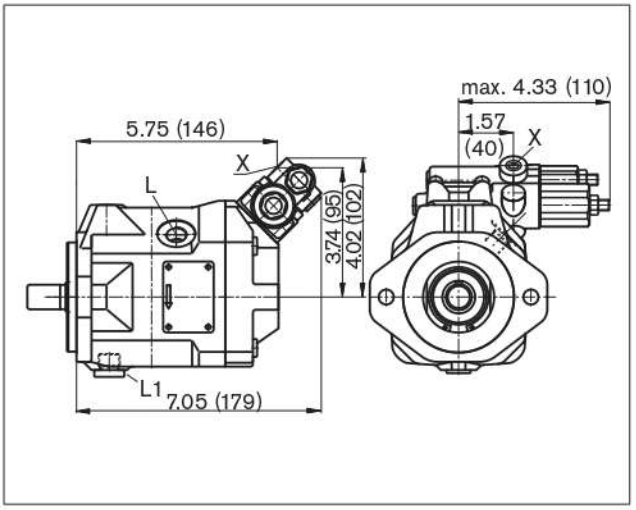
DRG

Pressure and flow control, remote controlled



DFR / DFR1

Pressure and flow control

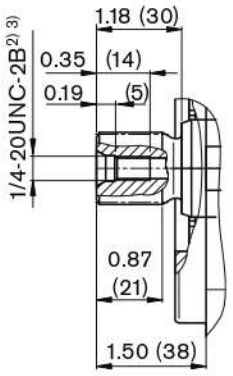


Dimensions, size 10

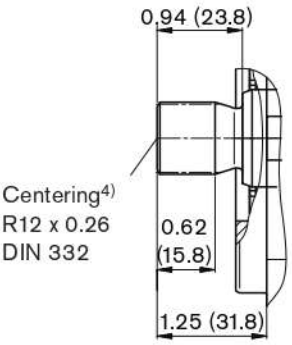
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

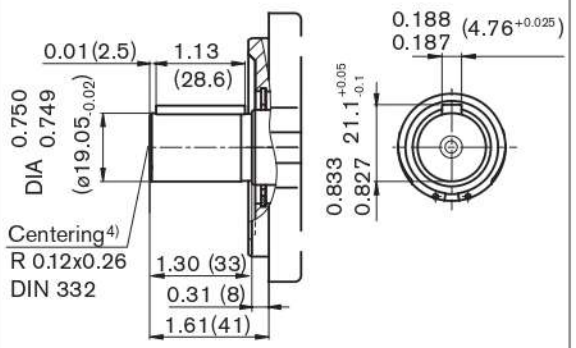
S Splined shaft 3/4 in
11T 16/32DP[1] (SAE J744)



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



K Parallel shaft key



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [psi (bar)][5]	State
B	Service line	ISO 11926	1 1/16-12UNF-2B; 0.79 (20) deep	4600 (315)	O
S	Suction line	ISO 11926	1 1/16-12UNF-2B; 0.79 (20) deep	75 (5)	O
L	Case drain fluid	ISO 11926[6]	9/16-18UNF-2B; 0.47 (12) deep	30 (2)	O[7]
L_1	Case drain fluid	ISO 11926[6]	9/16-18UNF-2B; 0.47 (12) deep	30 (2)	X[7]
X	Pilot pressure	ISO 11926[5]	7/16-20UNF-2B; 0.45 (11.5) deep	4600 (315)	O

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 on FINAL PAGE must be observed.
4) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw
5) Depending on the application, momentary pressure spikes can occur. Consider this when selecting measuring equipment and fittings.
6) The spot face can be deeper than as specified in the standard.
7) Depending on the installation position, L or L_1 must be connected

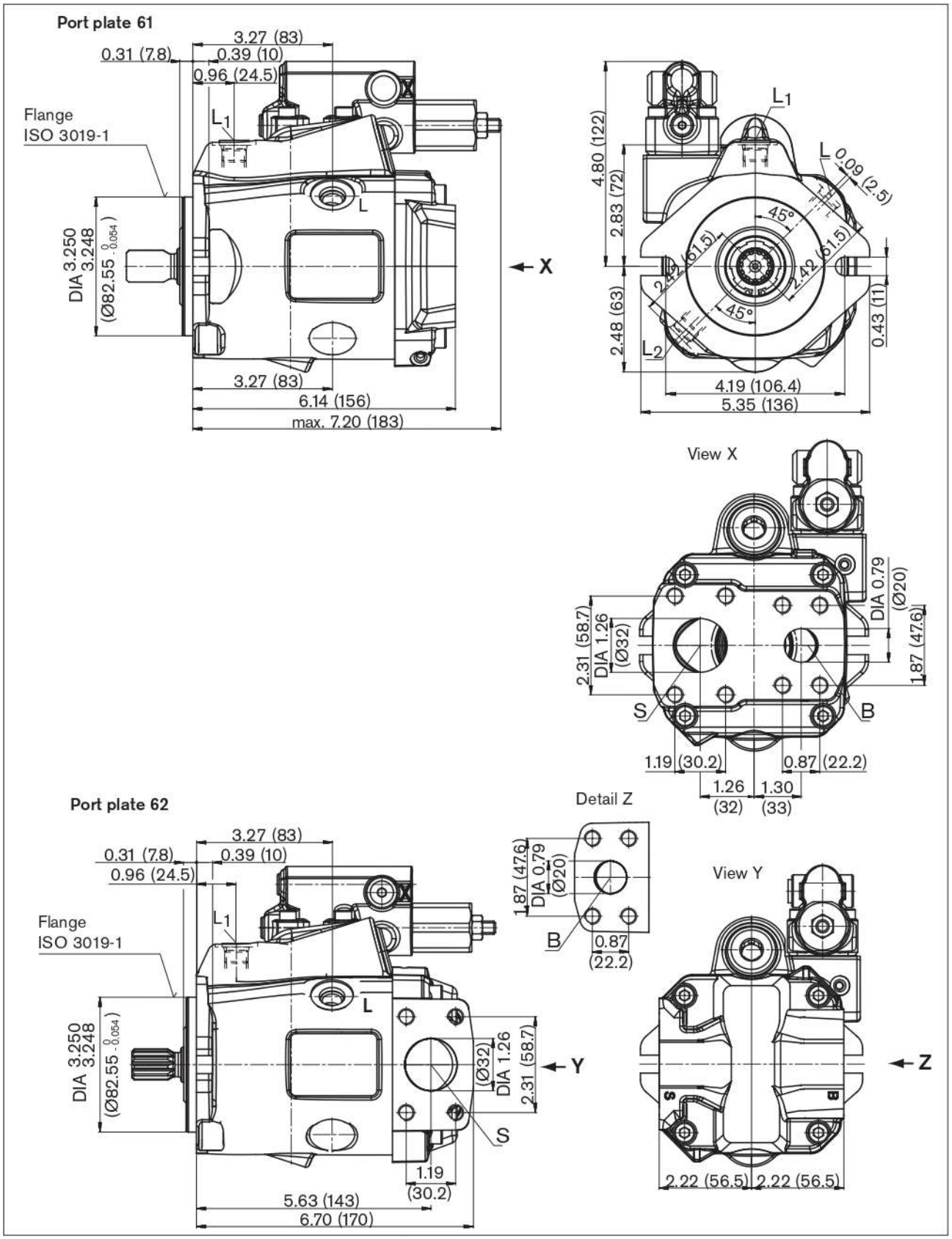
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions, size 18[1)]

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

DR – Hydraulic pressure controller

Clockwise rotation, series 53



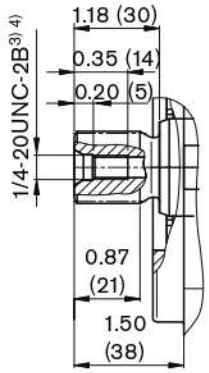
1) Dimensions of service line ports turned through 180° for counter-clockwise rotation
For details of connection options and drive shafts.

Dimensions, size 18

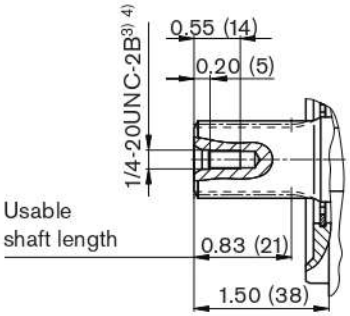
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

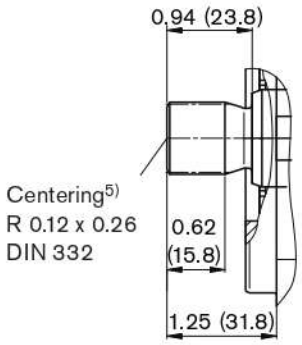
S Splined shaft 3/4 in
11T 16/32DP[1] (SAE J744)



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



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



Ports

Designation	Port for	Standard	Size[4]	Maximum pressure [psi (bar)][6]	State
B	Service line, fixing thread	SAE J518 ASME B1.1	3/4 in 3/8-16UNC-2B; 0.75 (19) deep	4600 (315)	O
S	Suction line, fixing thread	SAE J518 ASME B1.1	1 1/4 in 7/16-14UNC-2B; 0.79 (20) deep	75 (5)	O
L	Case drain fluid	ISO 11926[7]	3/4-16UNF-2B; 0.47 (12) deep	30 (2)	O[8]
L_1, L_2	Case drain fluid	ISO 11926[7]	3/4-16UNF-2B; 0.47 (12) deep	30 (2)	X[8]
X	Pilot pressure	ISO 11926[7]	7/16-20UNF-2A; 0.45 (11.5) deep	4600 (315)	O

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 on FINAL PAGE must be observed.
5) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw
6) Depending on the application, momentary pressure spikes can occur. Keep this in mind when selecting measuring equipment and fittings
7) The spot face can be deeper than as specified in the standard
8) Depending on the installation position, L, L_1 or L_2 must be connected

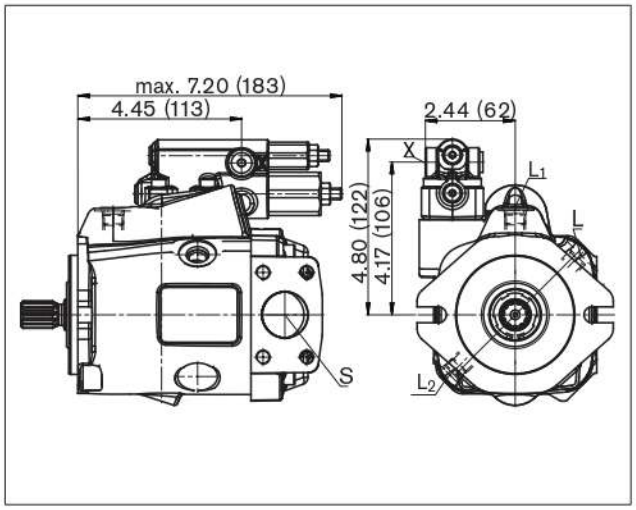
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions, size 18

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

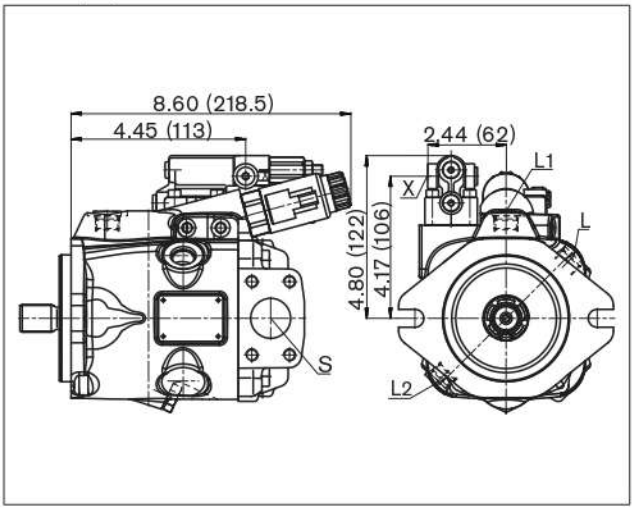
DRG

Pressure controller, remote controlled, **series 53**



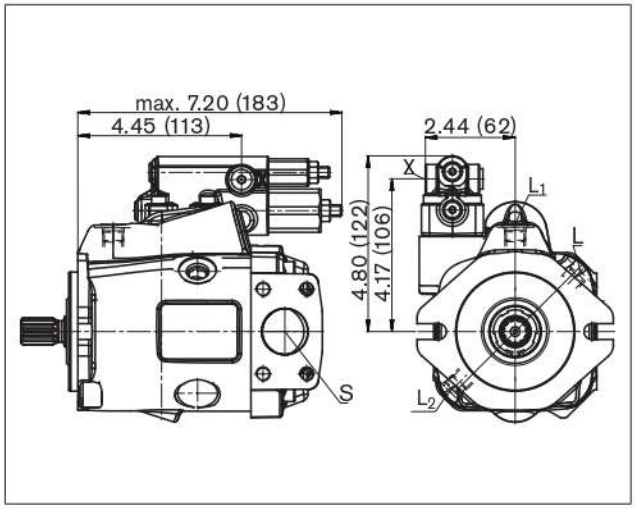
EP.D. / EK.D.

Electro-proportional control, **series 53**



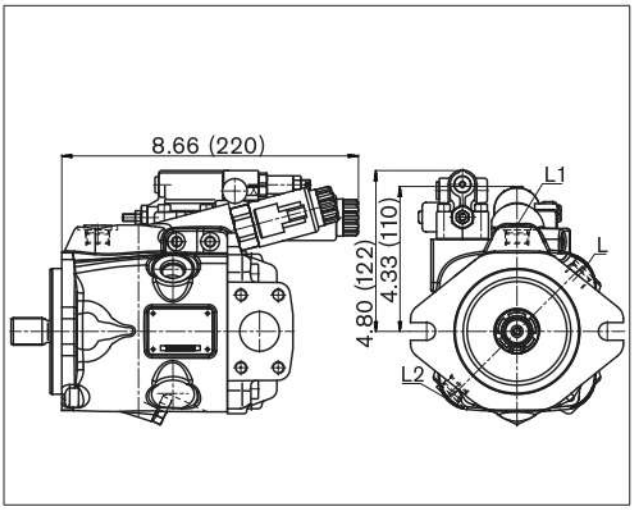
DRF/DRS

Pressure and flow control, **series 53**



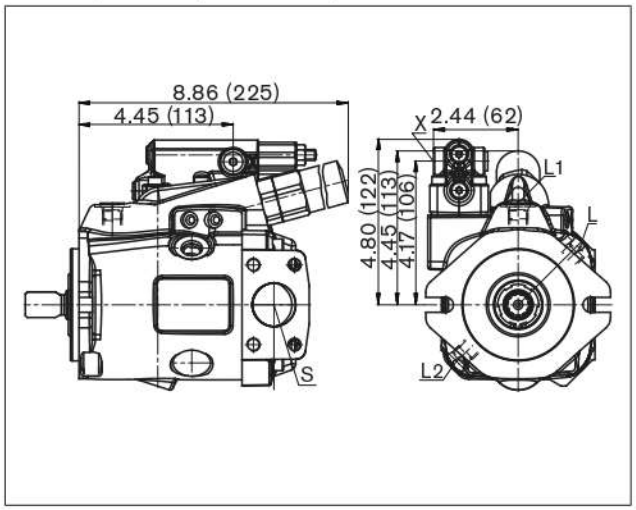
EP.ED / EK.ED

Electro-proportional control, **series 53**



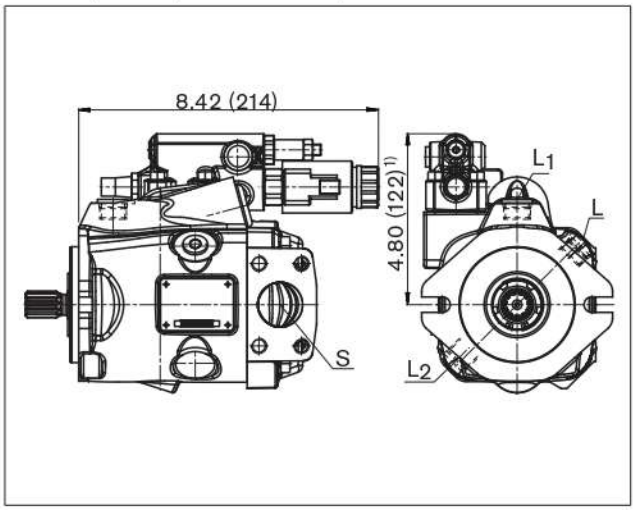
LA.D.

Pressure, flow and power control, **series 53**



ED7. / ER7.

Electro-hydraulic pressure control, **series 53**



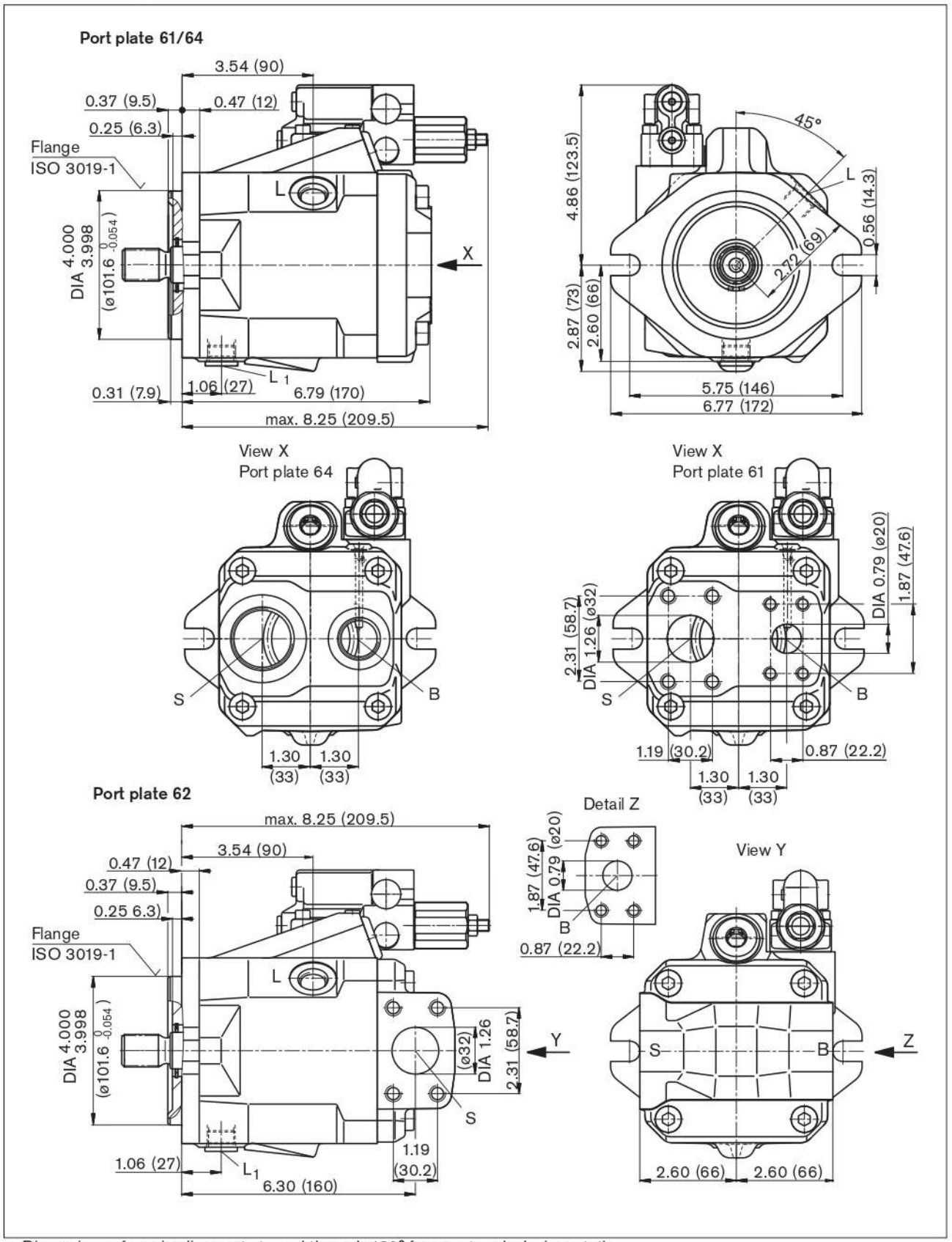
1) ER7.: 6.18 inches (157 mm) if using an intermediate plate pressure controller.

Dimensions, size 28[1)2)]

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

DR – Hydraulic pressure controller

Clockwise rotation,



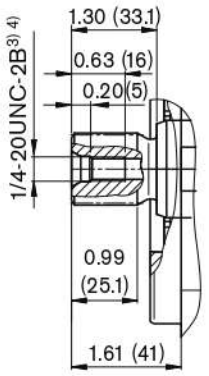
1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

Dimensions, size 28

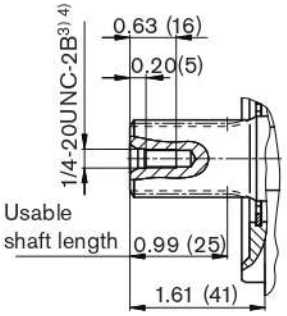
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

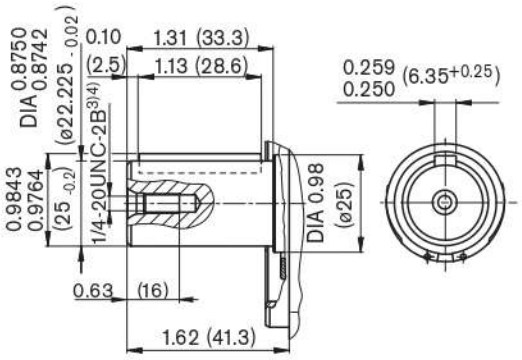
S Splined shaft 7/8 in
13T 16/32DP[1] (SAE J744)



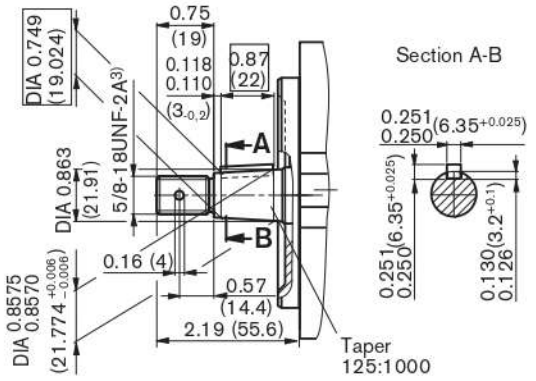
R Splined shaft 7/8 in
13T 16/32DP[1][2] (SAE J744)



K[5] Parallel keyed shaft



C[5] Tapered with woodruff key
(ISO 3019-1)



Ports

Designation	Port for	Standard	Size[4]	Maximum pressure [psi (bar)][6]	State
B; Port plate 61/62	Service line, fixing thread	SAE J518 ASME B1.1	3/4 in 3/8-16UNC-2B; 075 (19) deep	4600 (315)	O
B; Port plate 64	threaded	ISO 11926[7]	1 1/16-12UNF-2B; 079 (20) deep	4600 (315)	O
S; Port plate 61/62	Suction line, fixing thread	SAE J518 ASME B1.1	1 1/4 in 7/16-14UNC-2B; 0.79 (20) deep	75 (5)	O
S; Port plate 64	threaded	ISO 11926[7]	1 5/8-12UN-2B; 0.79 (20) deep	75 (5)	O
L	Case drain fluid	ISO 11926[7]	3/4-16UNF-2B; 0.47 (12) deep	30 (2)	O[9]
L_1, L_2[8]	Case drain fluid	ISO 11926[7]	3/4-16UNF-2B; 0.47 (12) deep	30 (2)	X[9]
X	Control pressure	ISO 11926[7]	7/16-20UNF-2B; 0.45 (11.5) deep	4600 (315)	O

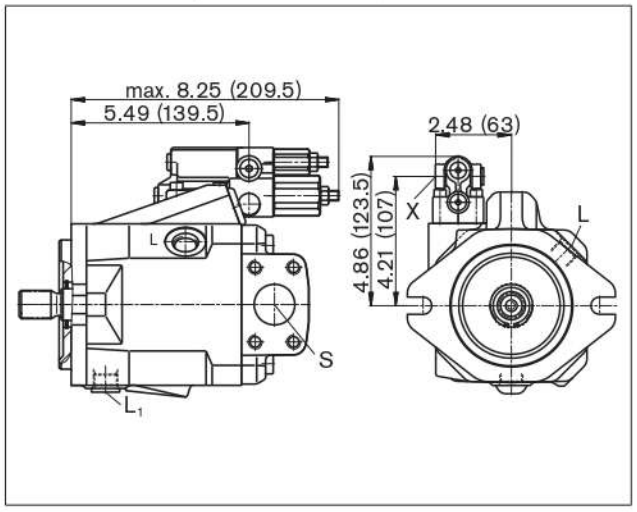
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Thread according to ASME B1.1
4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.
5) Only series 52
6) Depending on the appl., momentary press. spikes can occur. Consider this when selecting measuring equipment and fittings.
7) The spot face can be deeper than as specified in the standard.
8) Only series 53
9) Depending on the installation position, L, L_1 or L_2 must be connected

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

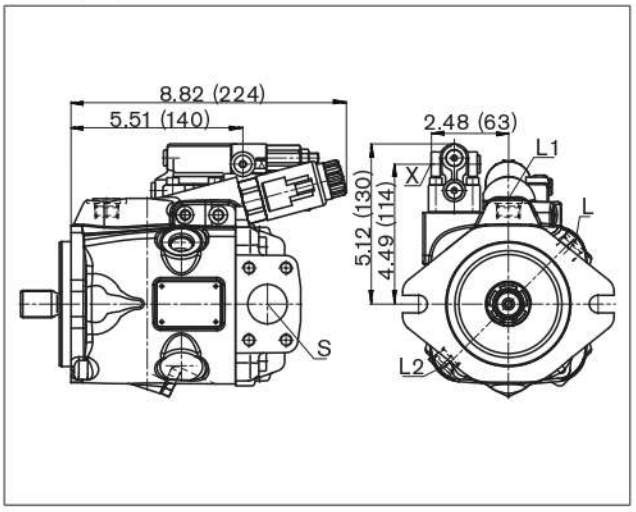
Dimensions, size 28

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

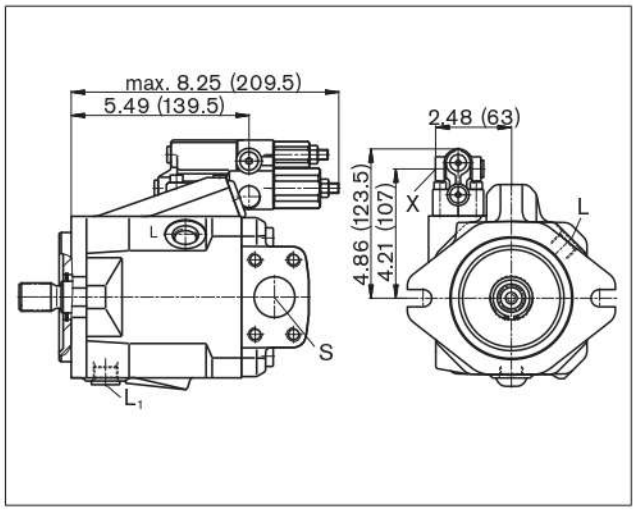
DRG
Pressure controller, remote controlled



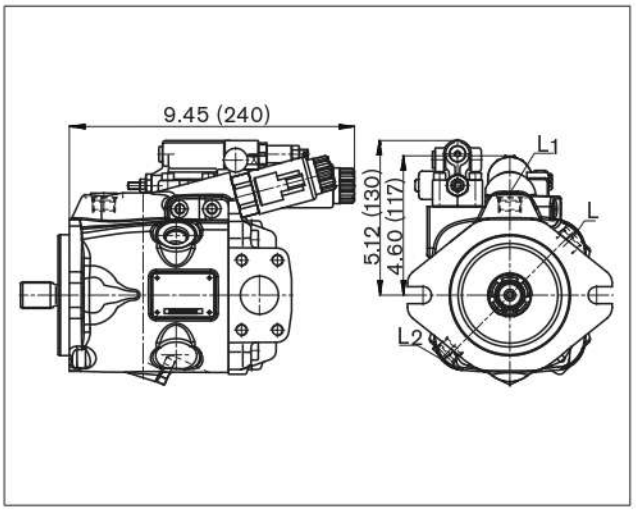
EP.D. / EK.D.
Electro-proportional control



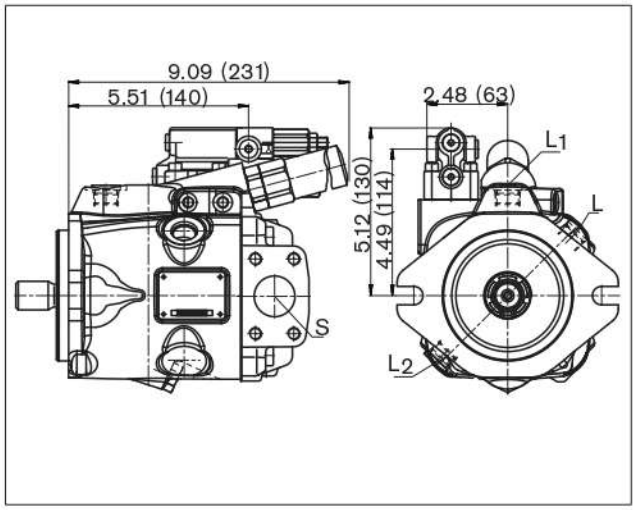
DFR / DFR1
Pressure and flow control



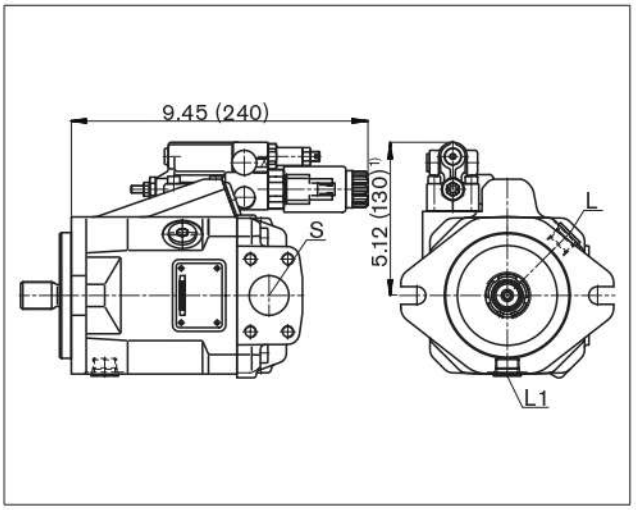
EP.ED / EK.ED
Electro-proportional control,



LA.D.
Pressure, flow and power control, **series 53**



ED7. / ER7.
Electro-hydraulic pressure control, **series 52**



1) ER7.: 6.26 inches (159 mm) if using an intermediate plate pressure controller.

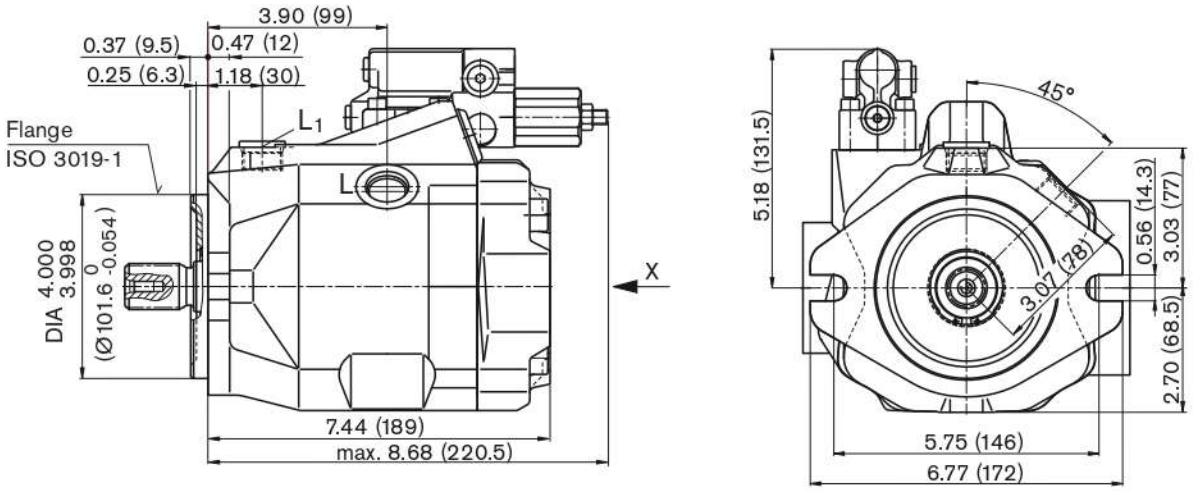
Dimensions, size 45[1)]

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

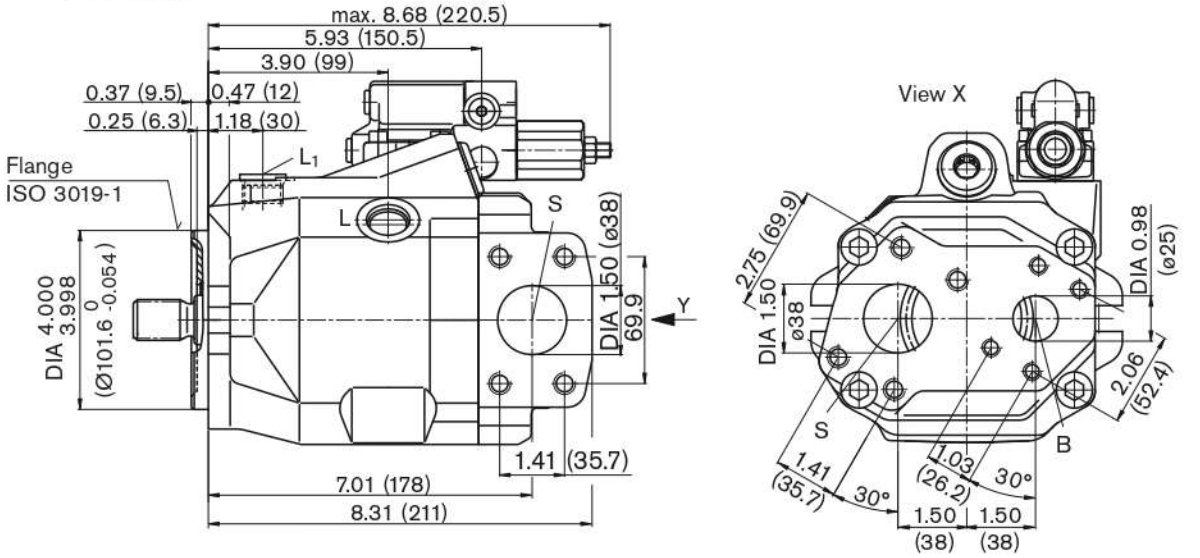
DR – Hydraulic pressure controller

Clockwise rotation, **series 52**

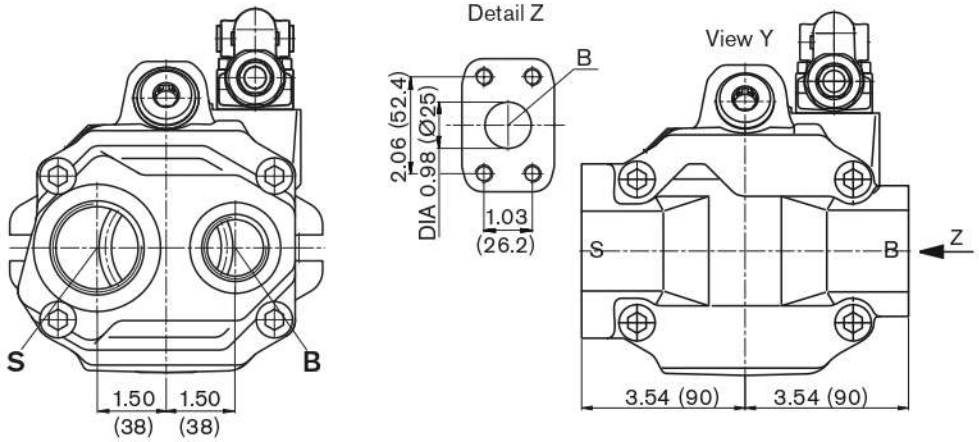
Port plate 61



Port plate 62



Port plate 64



Dimensions of service line ports turned through 180° for counter-clockwise rotation

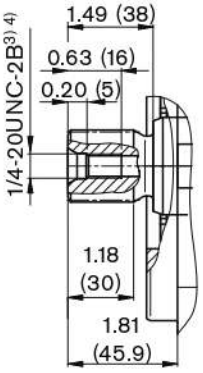
1) Primary dimensions for pump apply for series 52 and 53

Dimensions, size 45

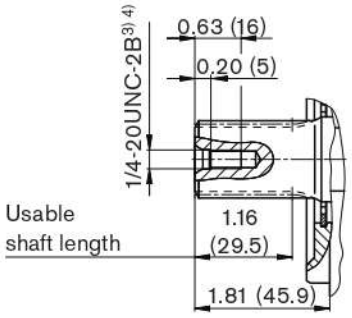
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

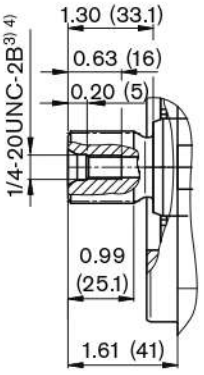
S Splined shaft 1 in
15T 16/32DP[1] (SAE J744)



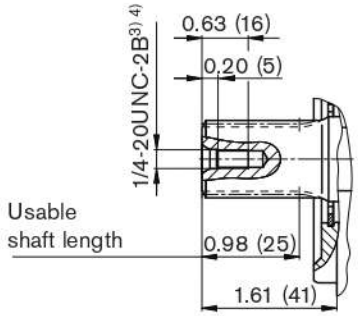
R Splined shaft 1 in
15T 16/32DP[1][2] (SAE J744)



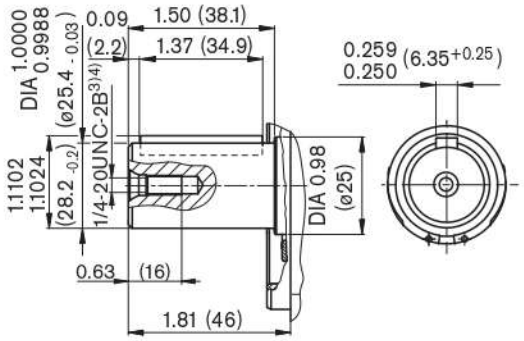
U Splined shaft 7/8 in
13T 16/32DP[1] (SAE J744)



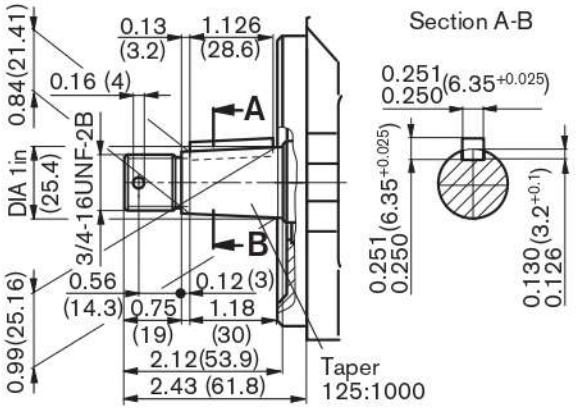
W Splined shaft 7/8 in
13T 16/32DP[1][2] (SAE J744)



K[5] Parallel keyed shaft



C[5] Tapered with woodruff key
(ISO 3019-1)



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 on FINAL PAGE must be observed.
5) Only series 52

Dimensions, size 45

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [psi (bar)][2]	State
B Port plate 61/62	Service line, fixing thread	SAE J518 ASME B1.1	1 in 3/8-16UNC-2B; 0.71 (18) deep	4600 (315)	O
B; Port plate 64	Fixing thread	ISO 11926	1 5/16-12UN-2B; 0.79 (20) deep	4600 (315)	O
S	Suction line, fixing thread	SAE J518 ASME B1.1	1 1/2 in 1/2-13UNC-2B; 0.87 (22) deep	75 (5)	O
S; Port plate 64	Fixing thread	ISO 11926	1 7/8-12UN-2B; 0.79 (20) deep	75 (5)	O
L	Case drain fluid	ISO 11926[3]	7/8-14UNF-2B; 13 deep	30 (2)	O[5]
L_1, L_2[4]	Case drain fluid	ISO 11926[3]	7/8-14UNF-2B; 13 deep	30 (2)	X[5]
X	Control pressure	ISO 11926[3]	7/16-20UNF-2A; 11.5 deep	4600 (315)	O

1) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.
2) Depending on the application, momentary pressure spikes can occur. Consider this when selecting measuring equipment and fittings.
3) The spot face can be deeper than as specified in the standard.
4) Only for series 53
5) Depending on the installation position, L, L_1 or L_2 must be connected

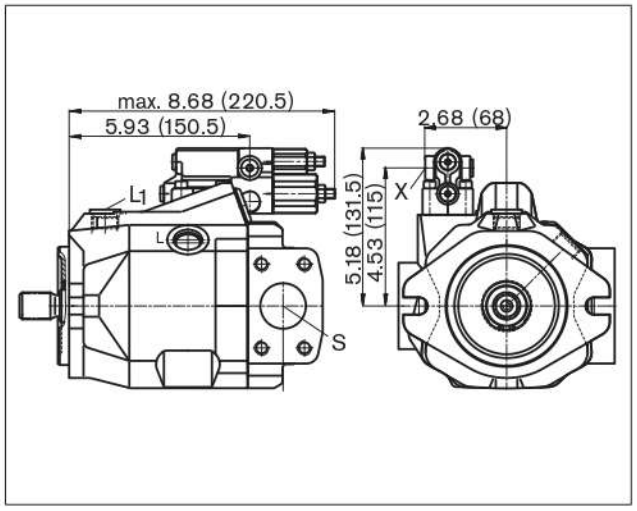
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions, size 45

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

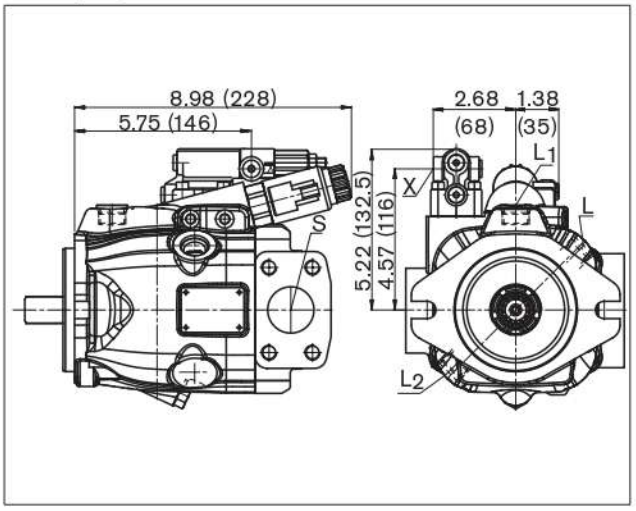
DRG

Pressure controller, remote controlled, **series 52**



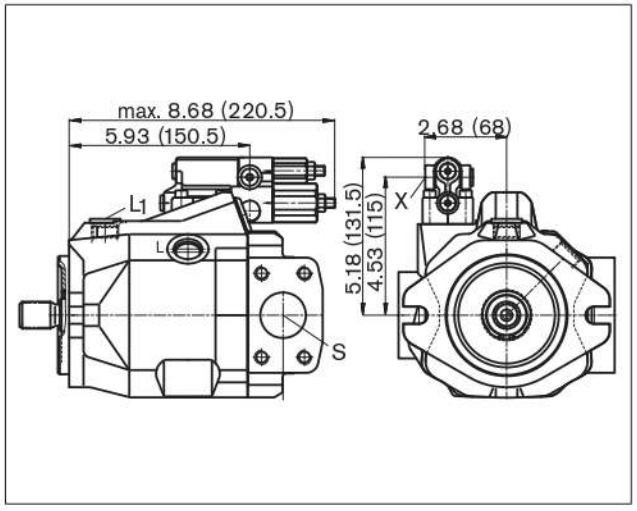
EP.D. / EK.D.

Electro-proportional control, **series 53**



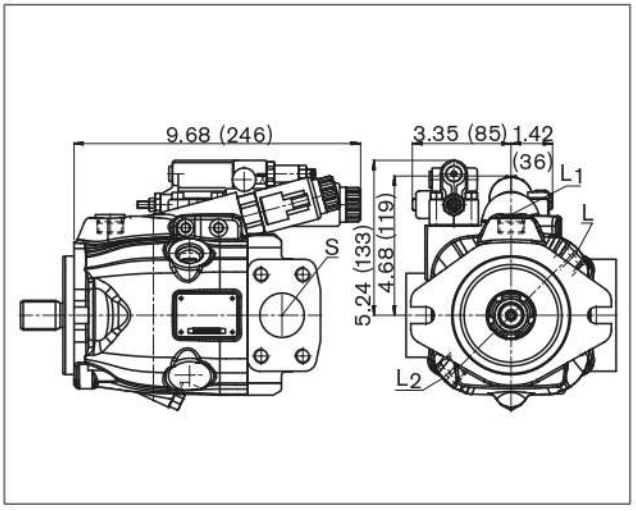
DFR / DFR1

Pressure and flow control, **series 52**



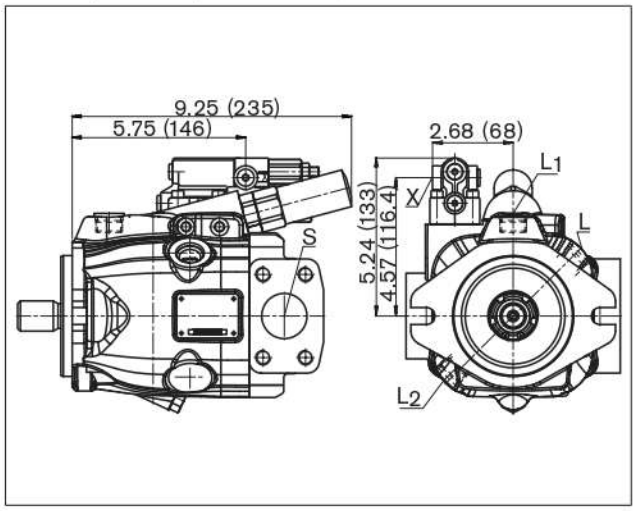
EP.ED / EK.ED

Electro-proportional control, **series 53**



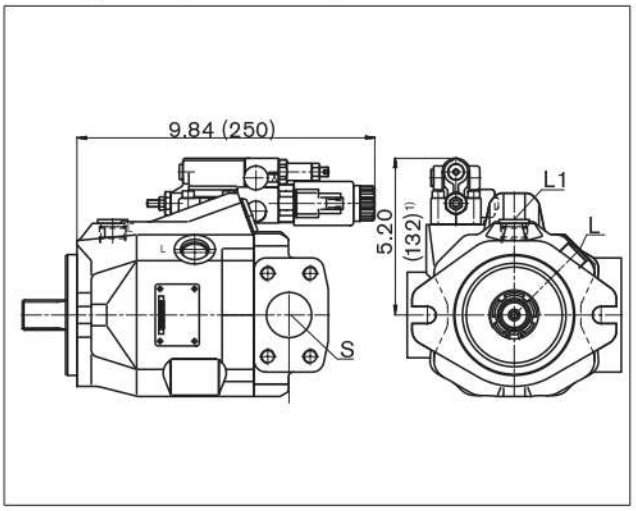
LA.D.

Pressure, flow and power control, **series 53**



ED7. / ER7.

Electro-hydraulic pressure control, **series 52**



1) ER7.: 6.57 inches (167 mm) if using an intermediate plate pressure controller.

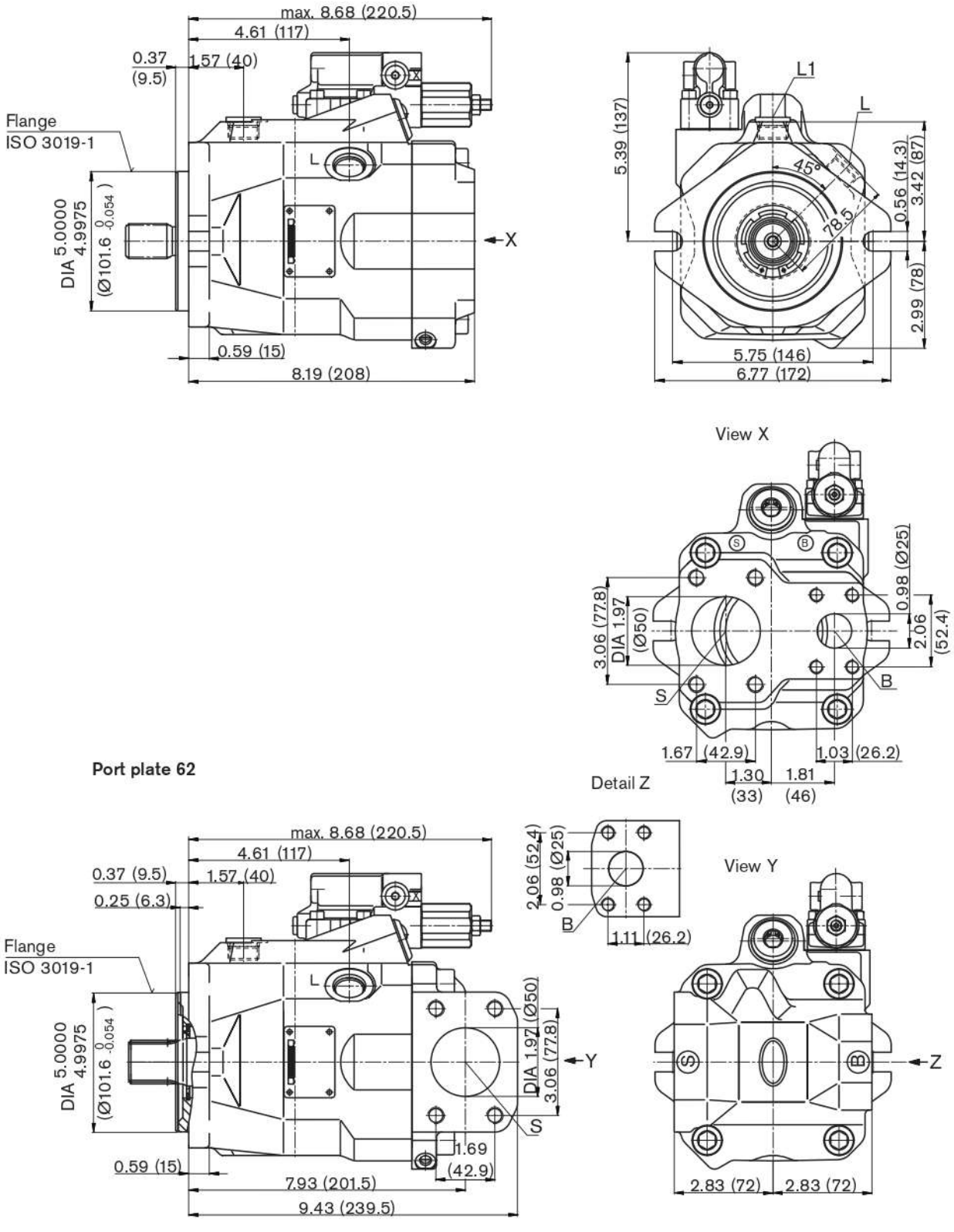
Dimensions, size 60

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

DR – Hydraulic pressure controller

Mounting flange C, clockwise rotation, **series 52**

Port plate 61



Port plate 62

1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

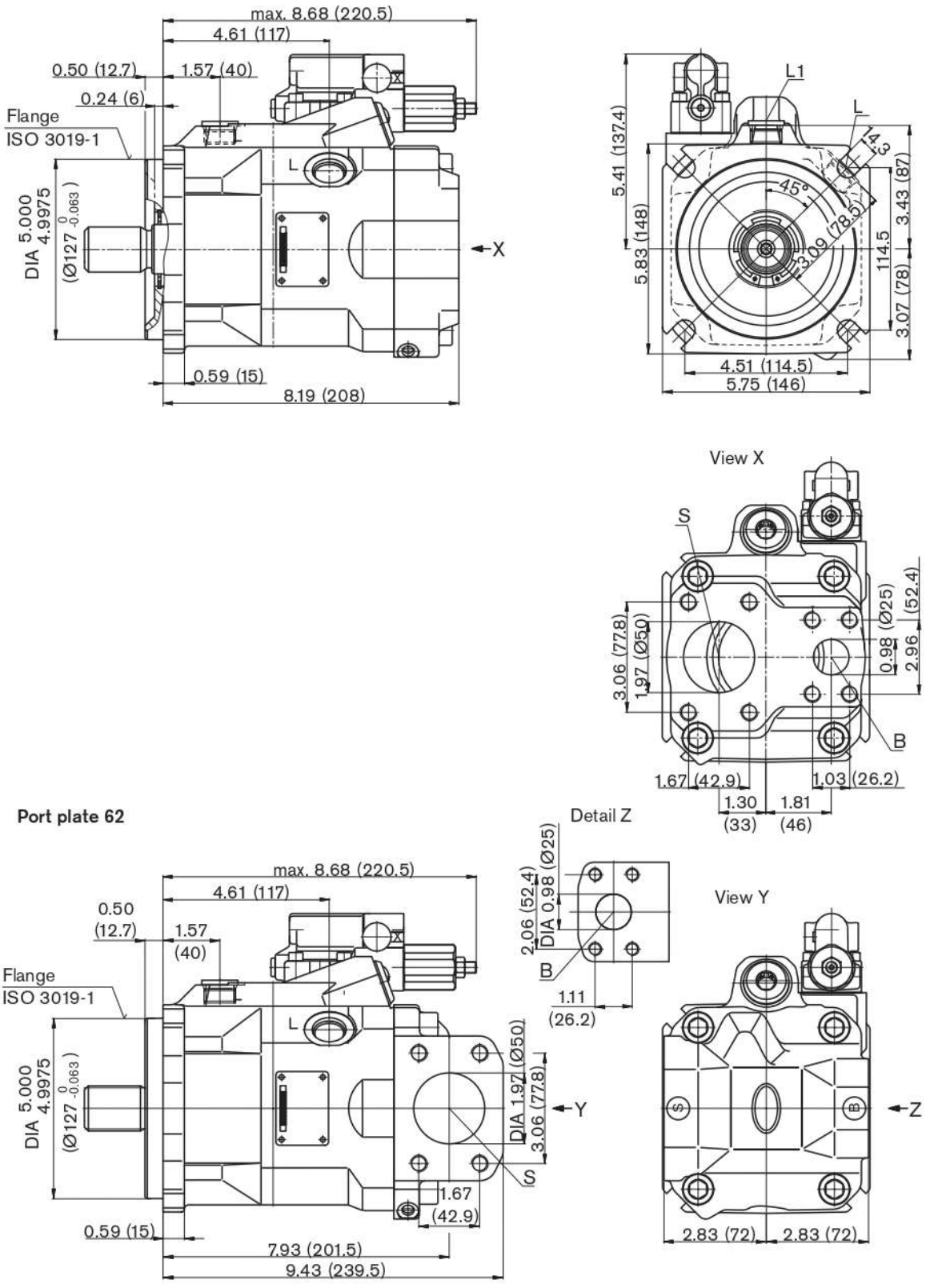
Dimensions, size 60

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

DR – Hydraulic pressure controller

Mounting flange D, clockwise rotation, **series 52**

Port plate 61



1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

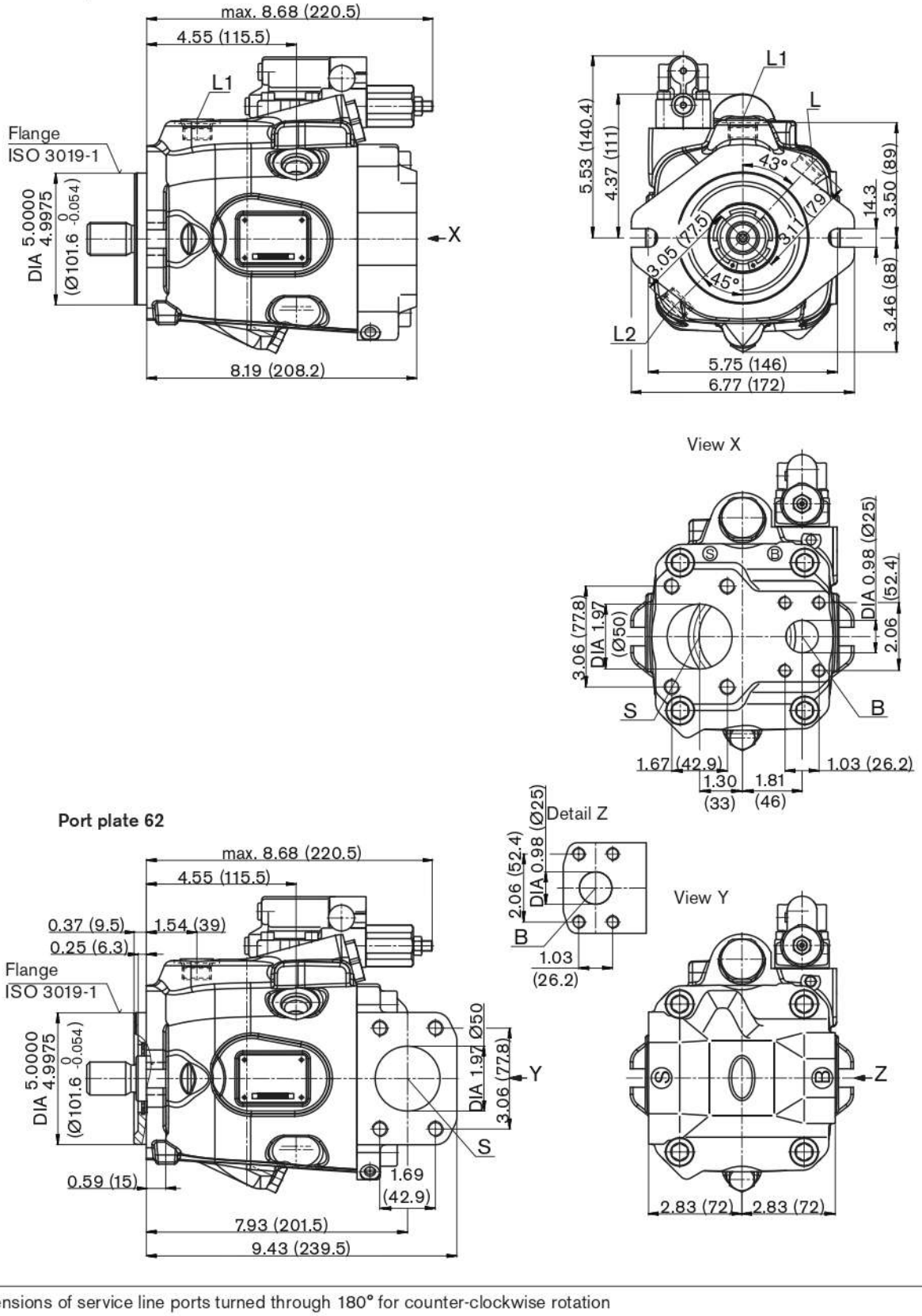
Dimensions, size 63[1)]

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

DR – Hydraulic pressure controller

Mounting flange C, clockwise rotation, **series 53**

Port plate 61



1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

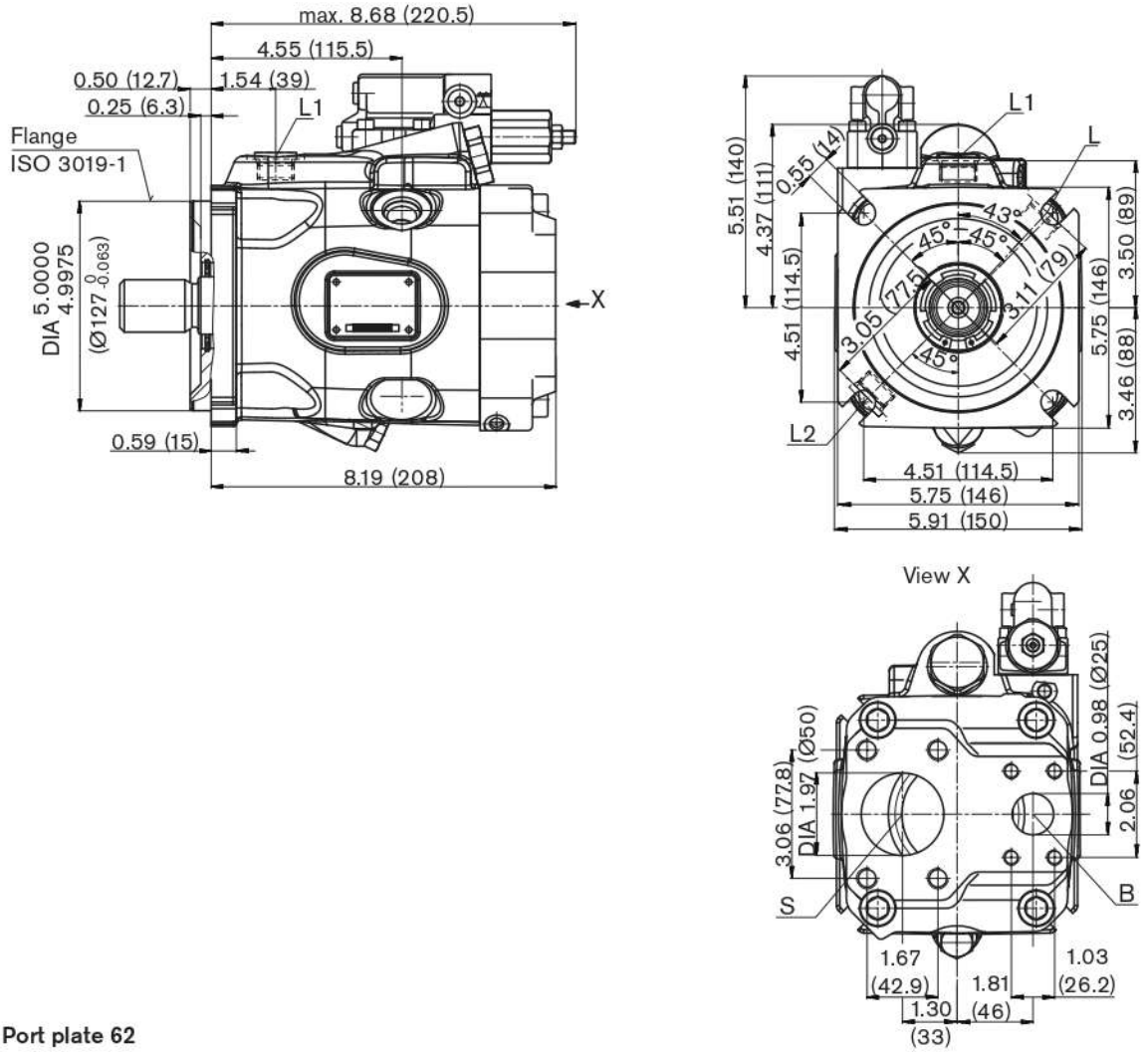
Dimensions, size 63[1)]

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

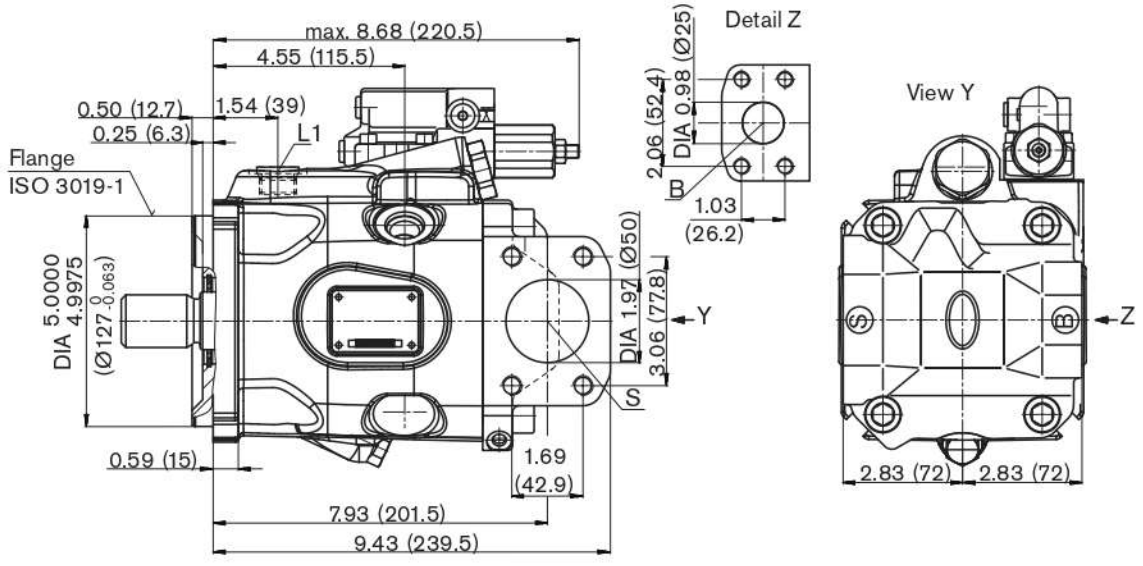
DR – Hydraulic pressure controller

Mounting flange D, clockwise rotation, **series 53**

Port plate 61



Port plate 62



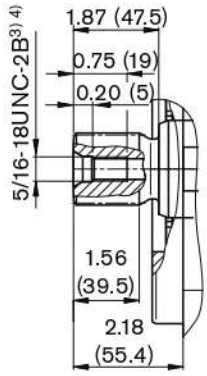
1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

Dimensions, size 60 / 63

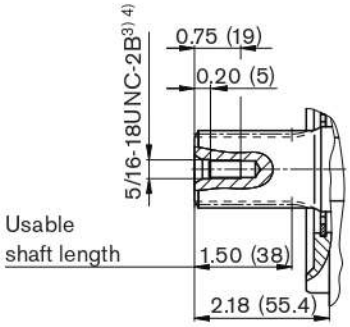
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

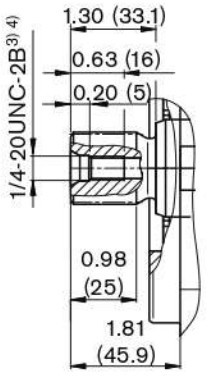
S Splined shaft 1 1/4 in
14T 12/24DP[1] (SAE J744)



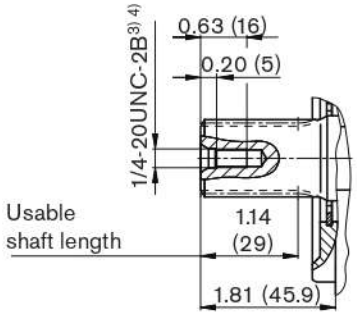
R Splined shaft 1 1/4 in
14T 12/24DP[1)2)] (SAE J744)



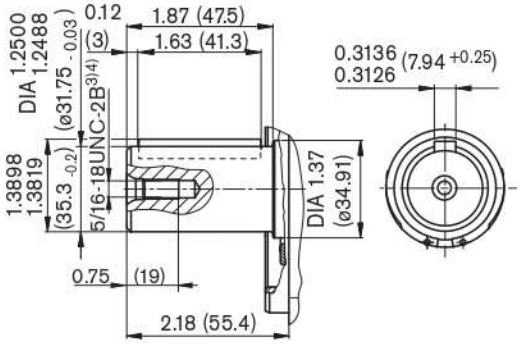
U Splined shaft 1 in
15T 16/32DP[1] (SAE J744)



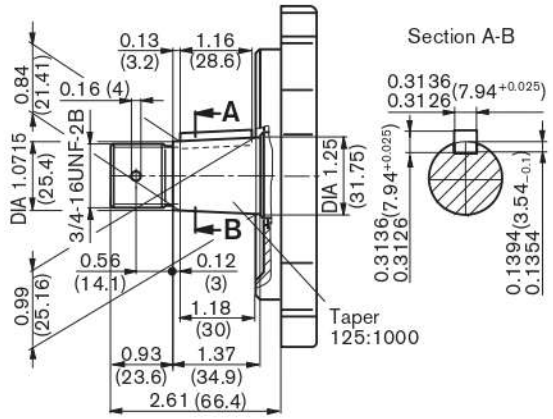
W Splined shaft 1 in
15 T 16/32DP[1)2)] (SAE J744)



K[5)] Parallel keyed shaft



C[5)] Tapered with woodruff key
(ISO 3019-1)



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 on FINAL PAGE must be observed.
5) Only series 52

Dimensions, size 60 / 63

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [psi (bar)][2]	State
B	Service line, fixing thread	SAE J518 ASME B1.1	1 in 3/8-16UNC-2B; 0.71 (18) deep	4600 (315)	O
S	Suction line, fixing thread	SAE J518 ASME B1.1	2 in 1/2-13UNC-2B; 0.87 (22) deep	75 (5)	O
L	Case drain fluid	ISO 11926[3]	7/8-14UNF-2B; 0.51 (13) deep	30 (2)	O[5]
L_1, L_2[4]	Case drain fluid	ISO 11926[3]	7/8-14UNF-2B; 0.51 (13) deep	30 (2)	X[5]
X	Control pressure	ISO 11926[3]	7/16-20UNF-2A; 0.45 (11.5) deep	4600 (315)	O

1) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.
2) Depending on the application, momentary pressure spikes can occur. Consider this when selecting measuring equipment and fittings.
3) The spot face can be deeper than as specified in the standard.
4) Only for series 53
5) Depending on the installation position, L, L_1 or L_2 must be connected

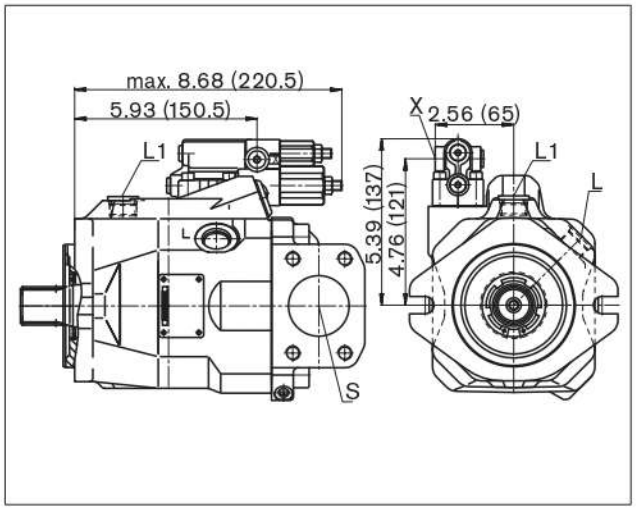
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions, size 60 / 63

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

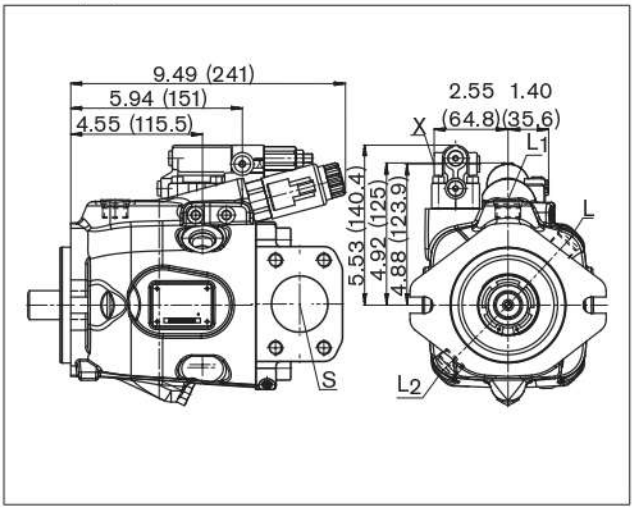
DRG

Pressure controller, remote controlled, **series 52**



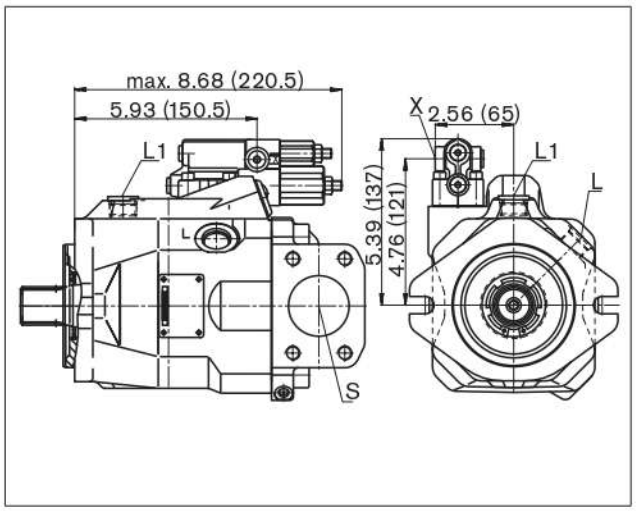
EP.D. / EK.D.

Electro-proportional control, **series 53**



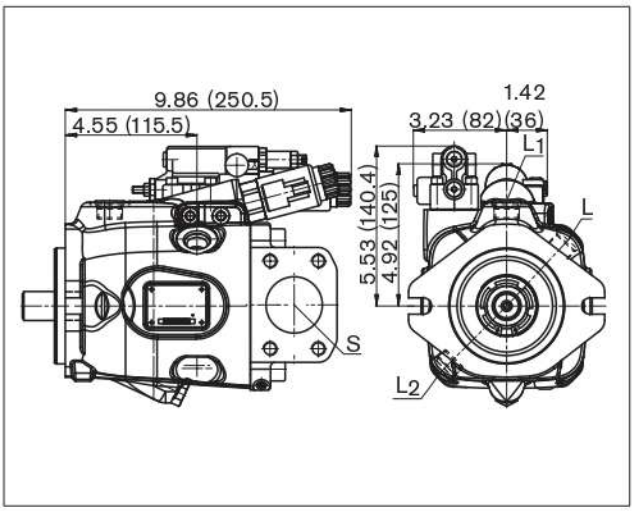
DFR / DFR1 (DRF/DRS)

Pressure and flow control, **series 52 (series 53)**



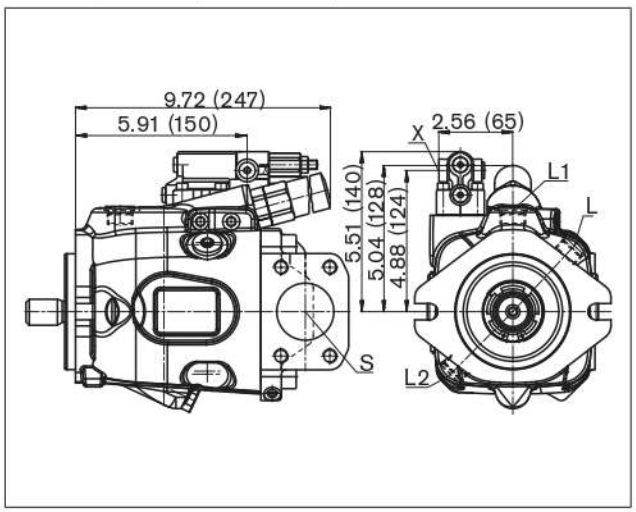
EP.ED / EK.ED

Electro-proportional control, **series 53**



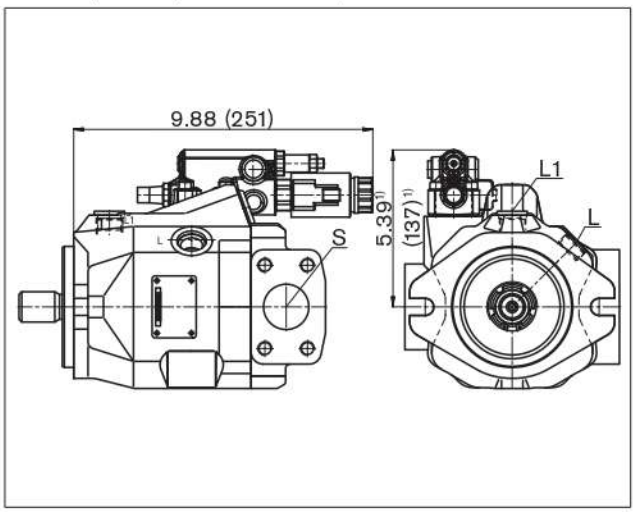
LA.D.

Pressure, flow and power control, **series 53**



ED7. / ER7.

Electro-hydraulic pressure control, **series 52**



1) ER7.: 6.77 inches (172 mm) if using an intermediate plate pressure controller.

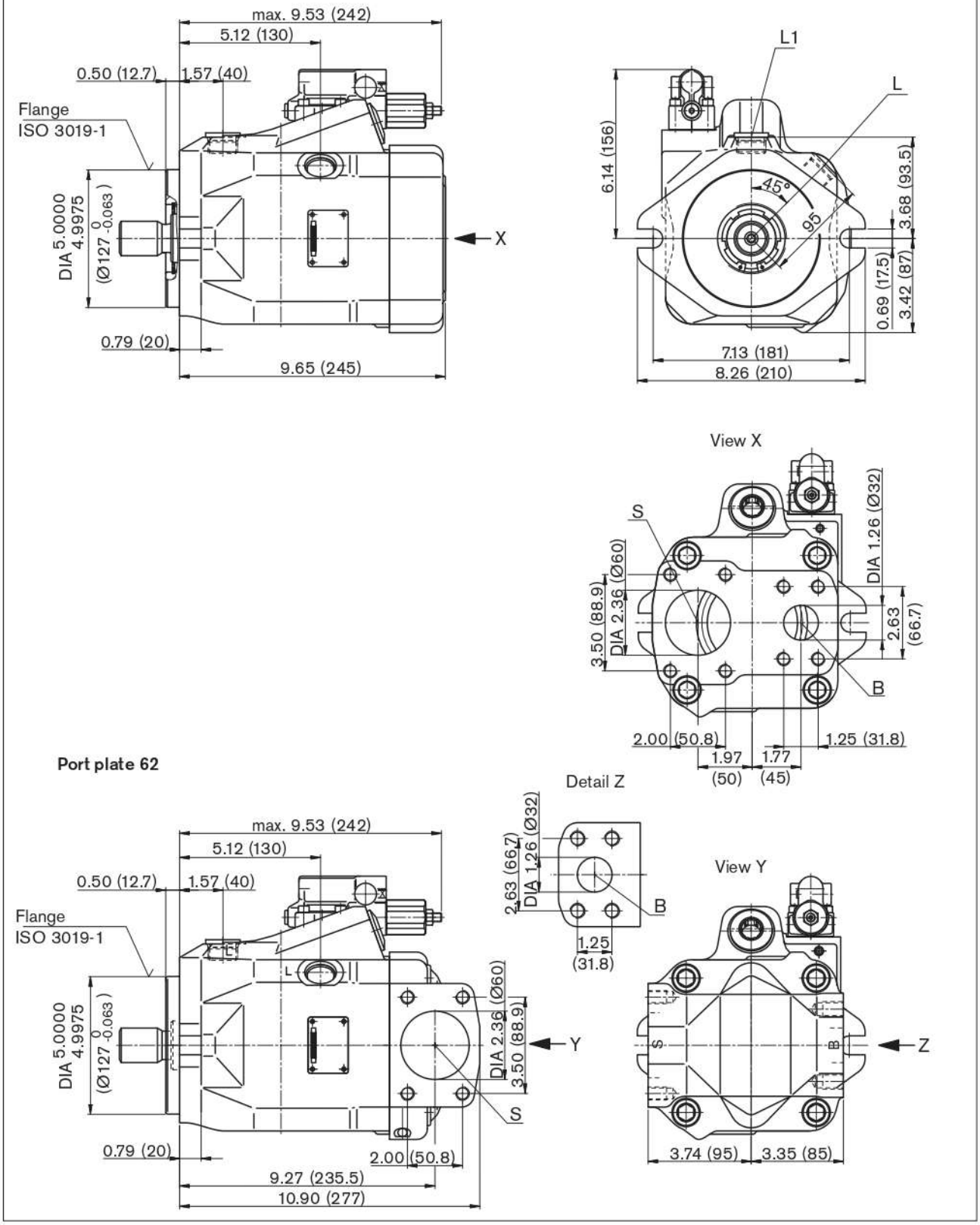
Dimensions, size 85[1)]

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

DR – Hydraulic pressure controller

Mounting flange C, clockwise rotation, **series 52**

Port plate 61



1) Dimensions of service line ports turned through 180° for counter-clockwise rotation
For details of connection options and drive shafts.

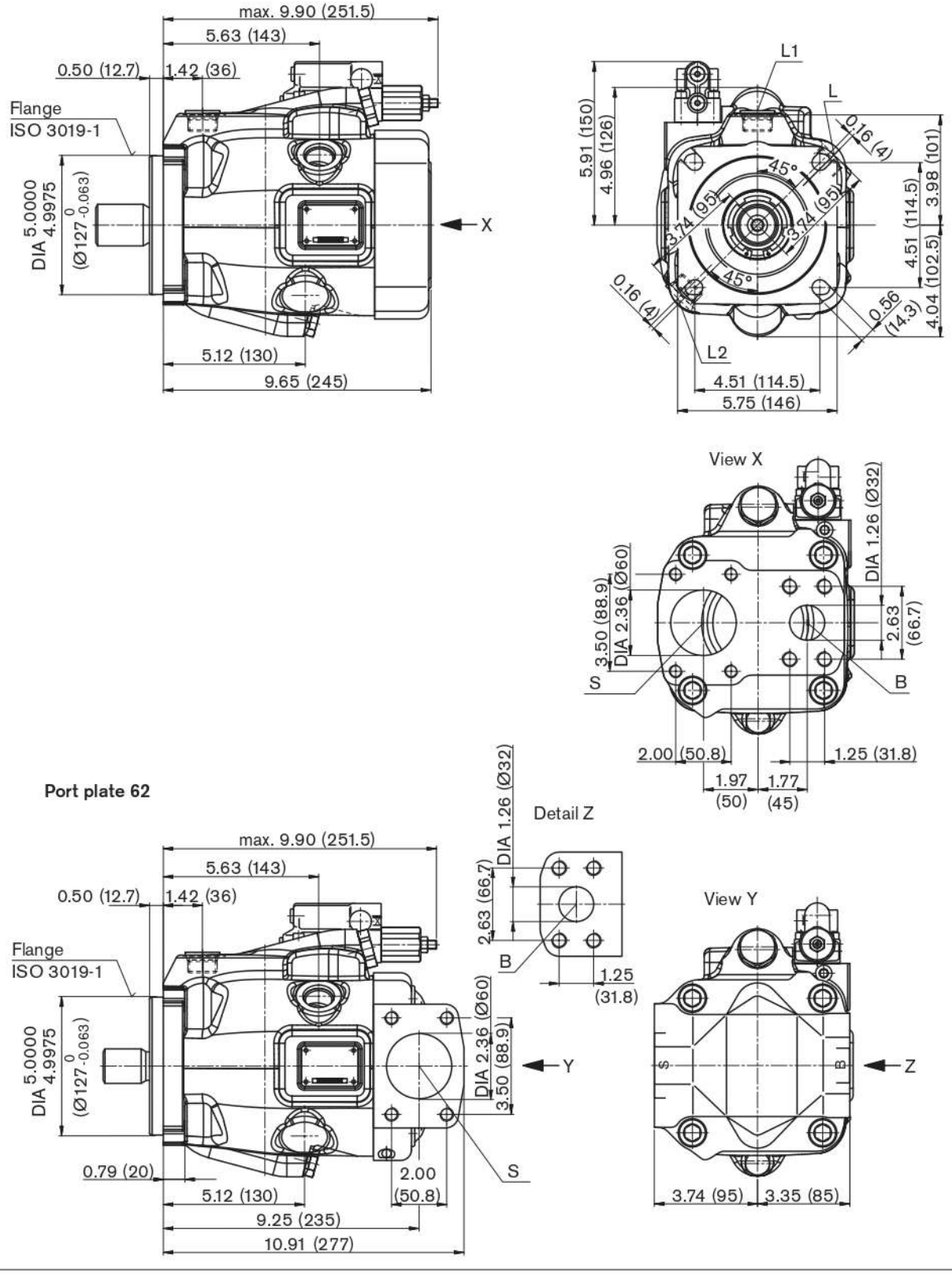
Dimensions, size 85[1)]

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

DR – Hydraulic pressure controller

Mounting flange D, clockwise rotation, **series 53**

Port plate 61



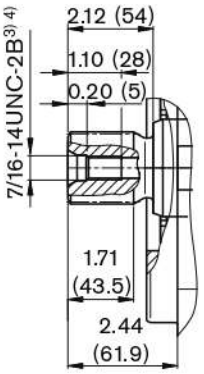
1) Dimensions of service line ports turned through 180° for counter-clockwise rotation
For details of connection options and drive shafts

Dimensions, size 85

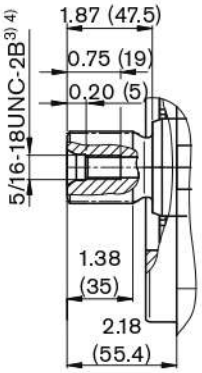
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

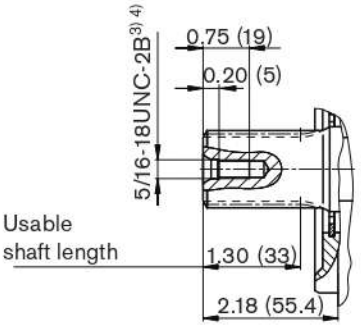
S Splined shaft 1 1/2 in
17T 12/24DP[1] (SAE J744)



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



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



Ports

Designation	Port for	Standard	Size[4]	Maximum pressure [psi (bar)][5]	State
B	Service line, fixing thread	SAE J518 ASME B1.1	1 1/4 in 1/2-13UNC-2B; 0.75 (19) deep	4600 (315)	O
S	Suction line, fixing thread	SAE J518 ASME B1.1	2 1/2 in 1/2-13UNC-2B; 1.07 (27) deep	75 (5)	O
L	Case drain fluid	ISO 11926[6]	1 1/16-12UNF-2B; 0.59 (15) deep	30 (2)	O[8]
L_1, L_2[7]	Case drain fluid	ISO 11926[6]	1 1/16-12UNF-2B; 0.59 (15) deep	30 (2)	X[8]
X	Control pressure	ISO 11926[6]	7/16-20UNF-2A; 0.45 (11.5) deep	4600 (315)	O

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 on FINAL PAGE must be observed.
5) Depending on the application, momentary pressure spikes can occur. Consider this when selecting measuring equipment and fittings.
6) The spot face can be deeper than as specified in the standard.
7) Only for series 53
8) Depending on the installation position, L, L_1 or L_2 must be connected

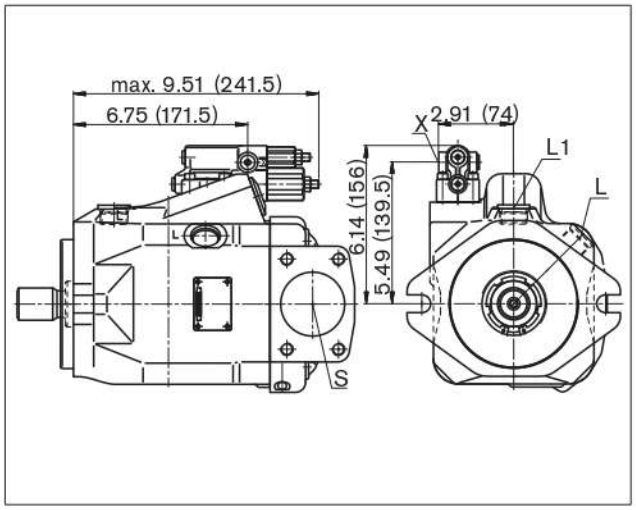
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions, size 85, mounting flange C

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

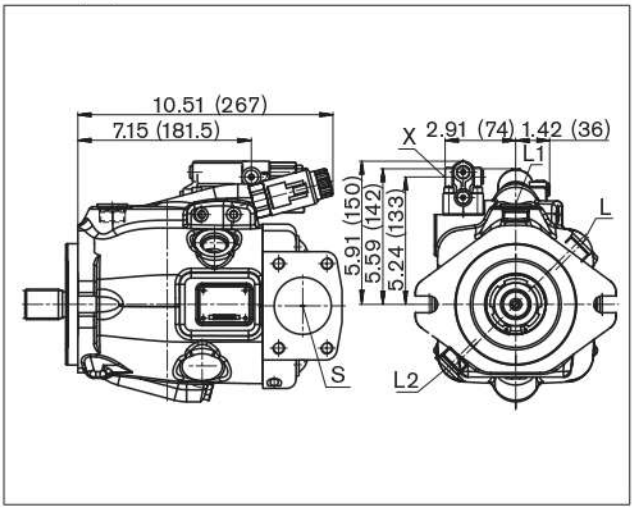
DRG

Pressure controller, remote controlled, **series 52**



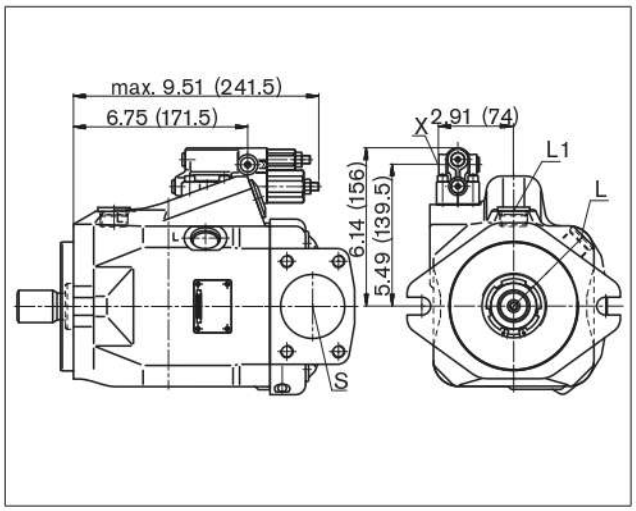
EP.D. / EK.D.

Electro-proportional control, **series 53**



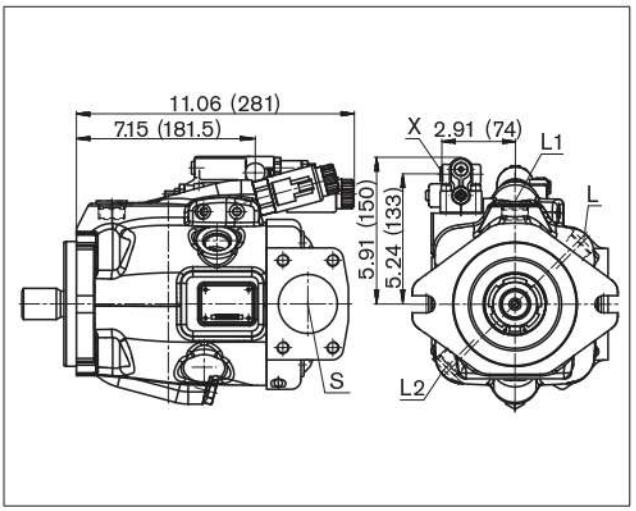
DFR / DFR1

Pressure and flow control, **series 52**



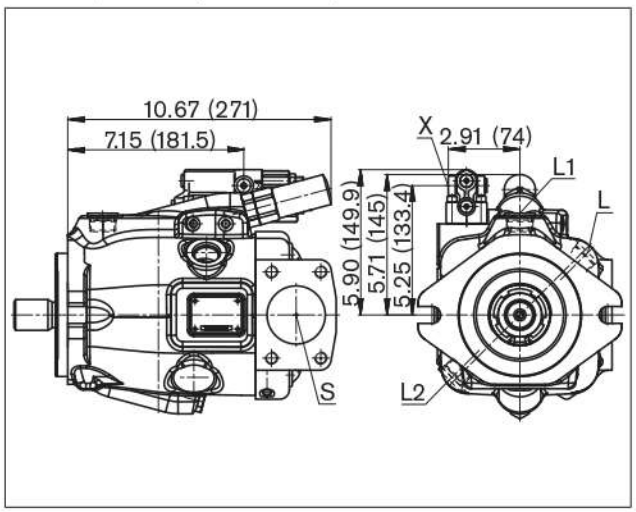
EP.ED / EK.ED

Electro-proportional control, **series 53**



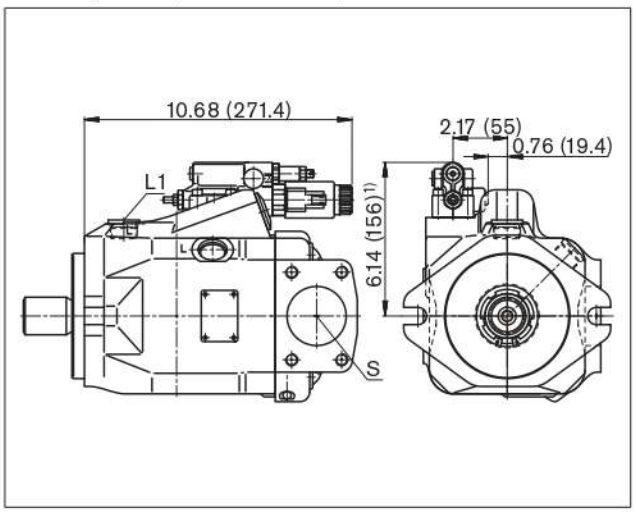
LA.D.

Pressure, flow and power control, **series 53**



ED../ ER..

Electro-hydraulic pressure control, **series 52**



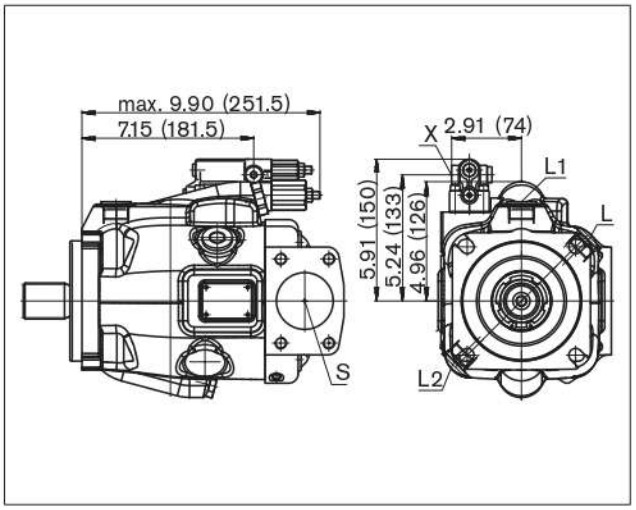
1) ER7.: 191 mm if using an intermediate plate pressure controller.

Dimensions, size 85, mounting flange D

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

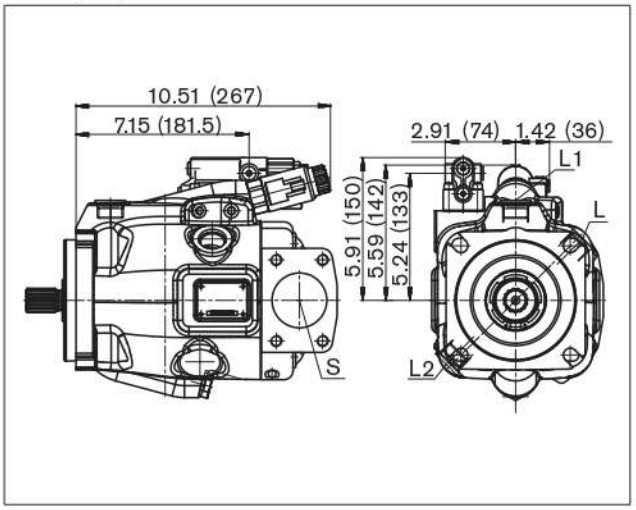
DRF/DRS

Pressure and flow control, **series 53**



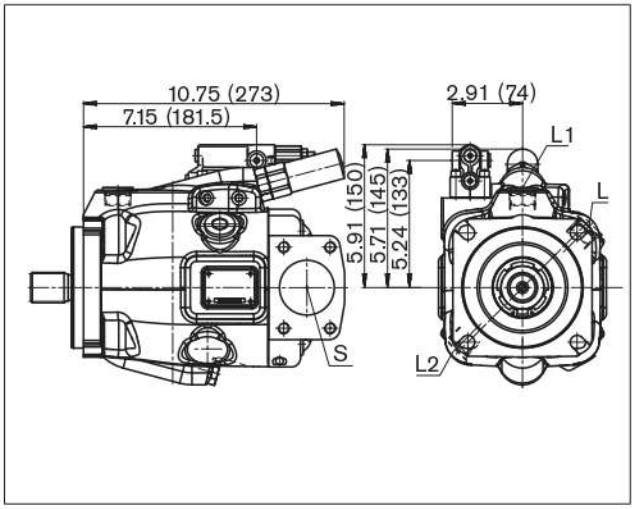
EP.D. / EK.D.

Electro-proportional control, **series 53**



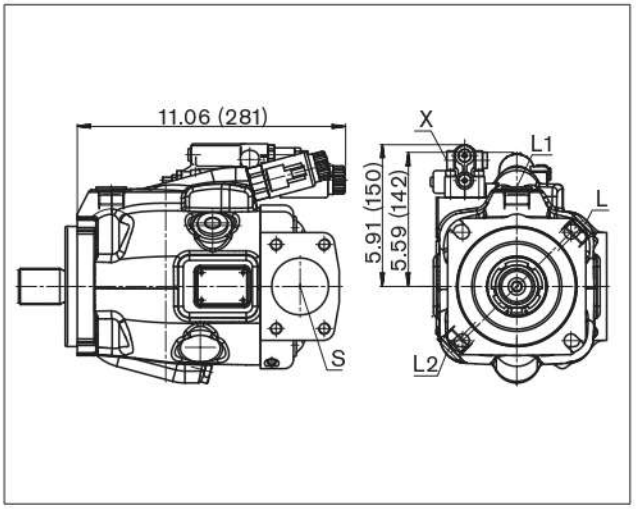
LA.D.

Pressure, flow and power control, **series 53**



EP.ED / EK.ED

Electro-proportional control, **series 53**



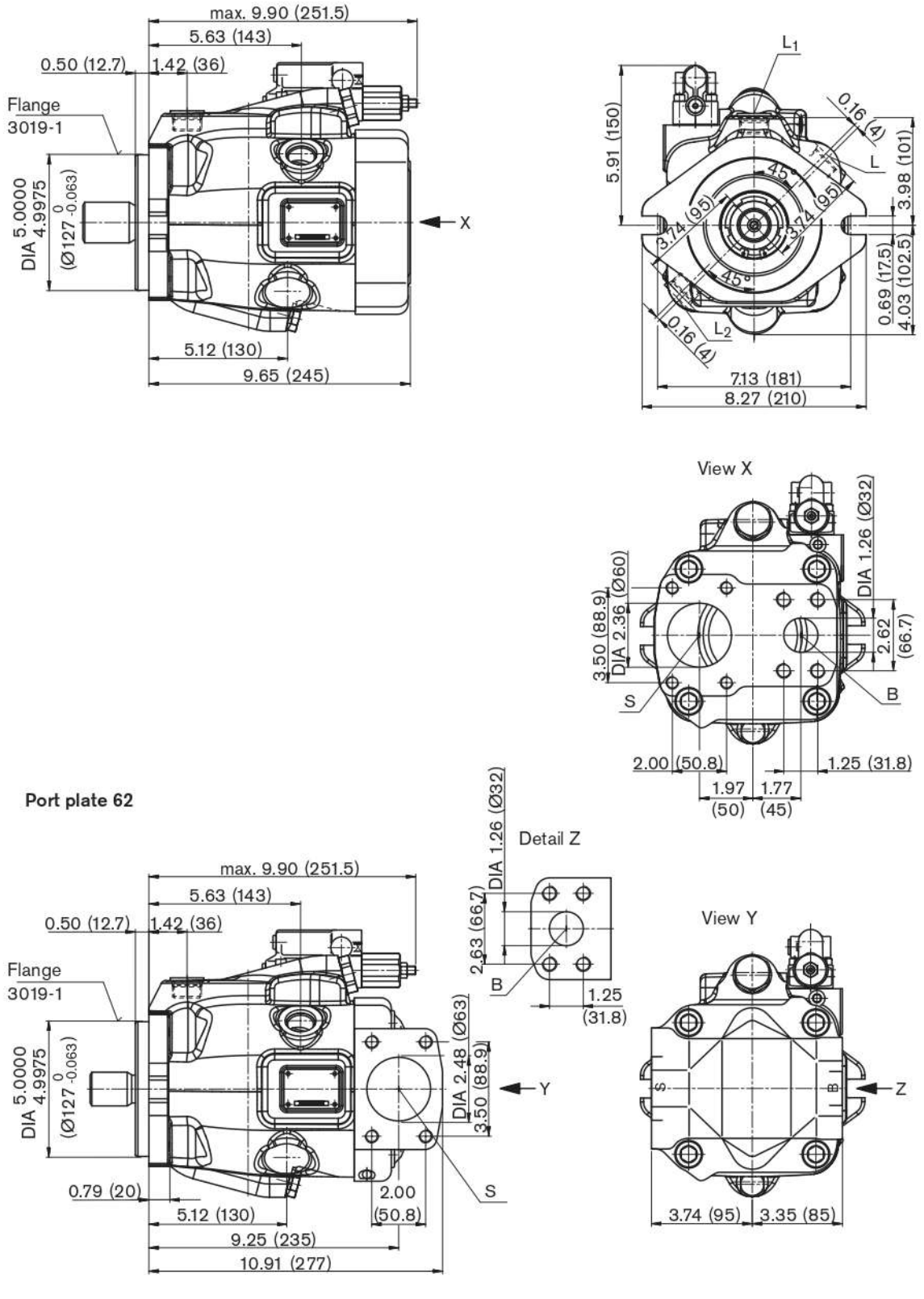
Dimensions, size 100[1)]

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

DR – Hydraulic pressure controller

Mounting flange C, clockwise rotation, **series 53**

Port plate 61



Port plate 62

1) Dimensions of service line ports turned through 180° for counter-clockwise rotation
For details of connection options and drive shafts

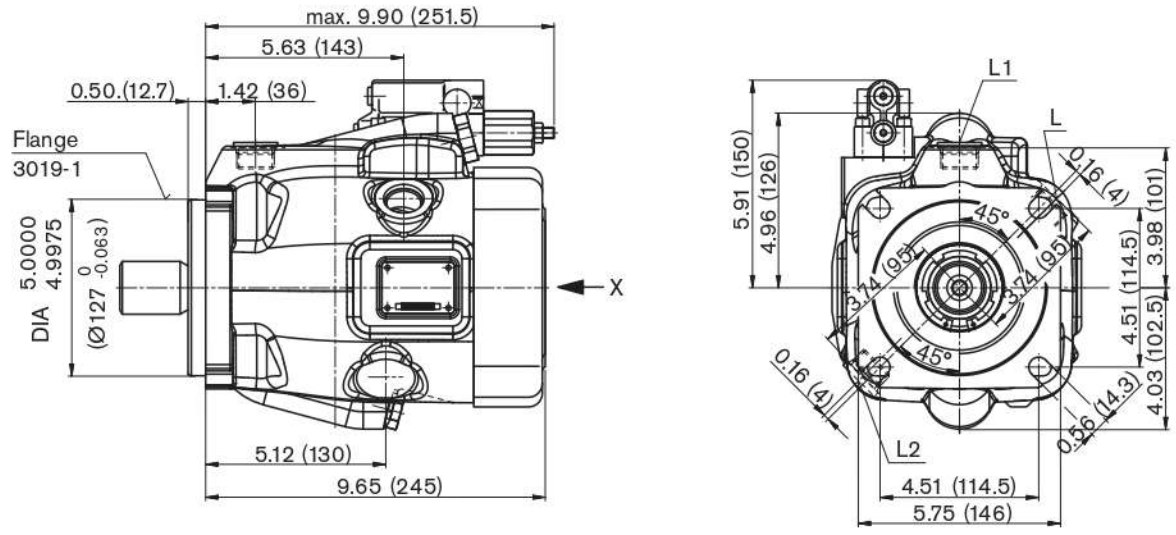
Dimensions, size 100[1)]

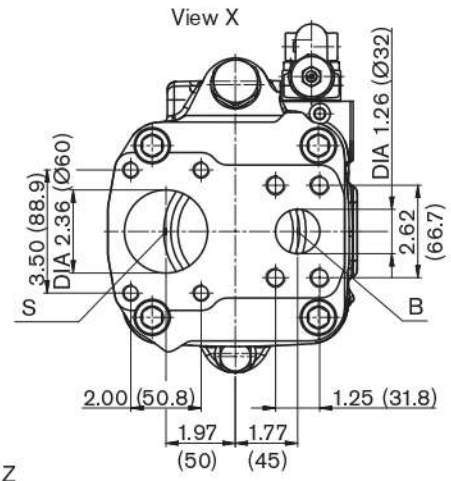
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

DR – Hydraulic pressure controller

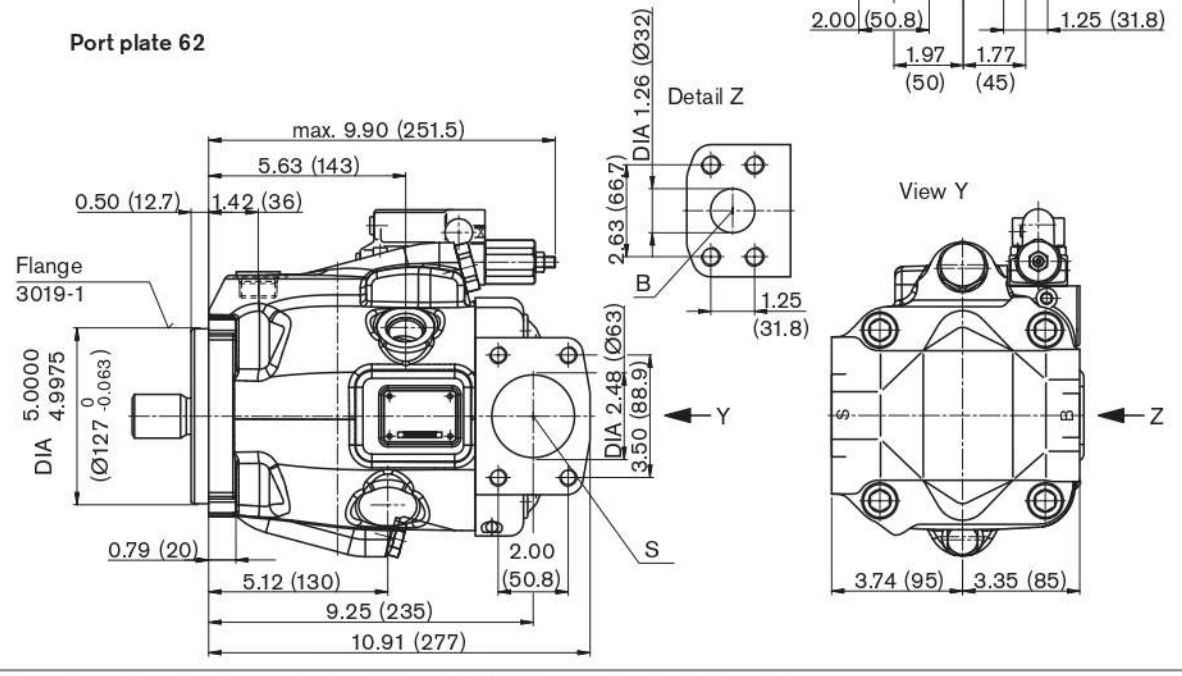
Mounting flange D, clockwise rotation, **series 53**

Port plate 61





Port plate 62



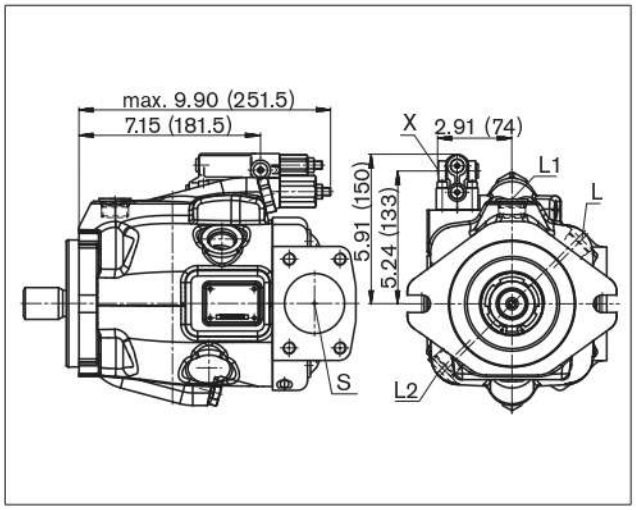
1) Dimensions of service line ports turned through 180° for counter-clockwise rotation
For details of connection options and drive shafts,

Dimensions, size 100

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

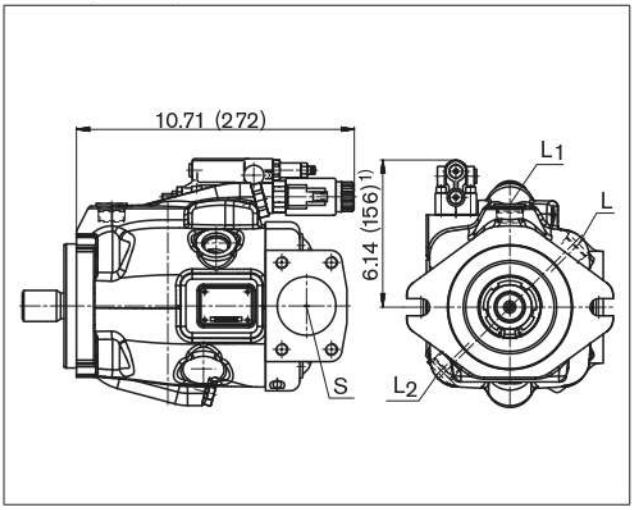
DRG

Pressure controller, remote controlled, **series 53**



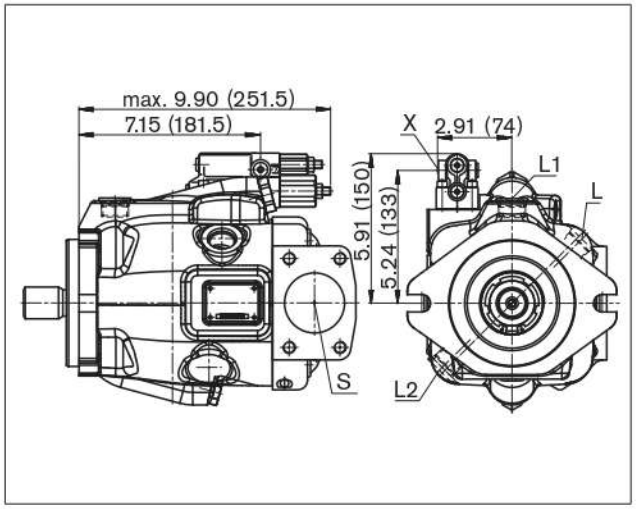
ED../ ER..

Electro-hydraulic pressure control, **series 53**



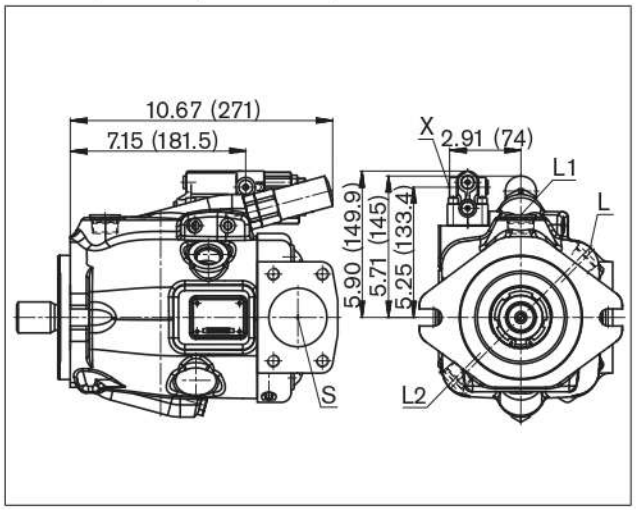
DRF/DRS

Pressure and flow control, **series 53**



LA.D.

Pressure, flow and power control, **series 53**

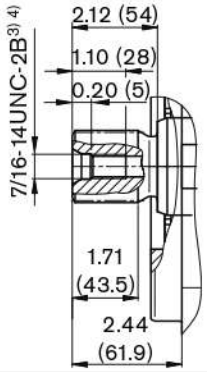


1) ER7.: 7.52 inches (191 mm) if using an intermediate plate pressure controller.

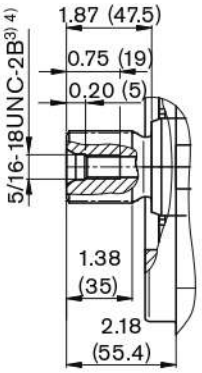
Dimensions, size 100

Drive shaft

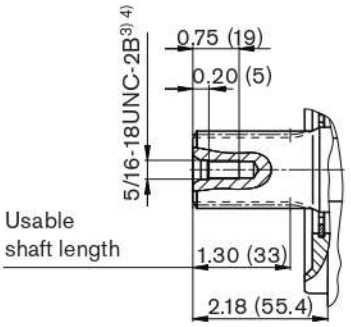
S Splined shaft 1 1/2 in
17T 12/24DP[1] (SAE J744)



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



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



Ports

Designation	Port for	Standard	Size[4]	Maximum pressure [bar][5]	State
B	Service line, fixing thread	SAE J518 ASME B1.1	1 1/4 in 1/2-13UNC-2B; 0.75 (19) deep	4600 (315)	O
S	Suction line, fixing thread	SAE J518 ASME B1.1	2 1/2 in 1/2-13UNC-2B; 1.07 (27) deep	75 (5)	O
L	Case drain fluid	ISO 11926[6]	1 1/16-12UNF-2B; 0.59 (15) deep	30 (2)	O[8]
L_1, L_2	Case drain fluid	ISO 11926[6]	1 1/16-12UNF-2B; 0.59 (15) deep	30 (2)	X[8]
X	Control pressure	ISO 11926[6]	7/16-20UNF-2A; 0.45 (11.5) deep	4600 (315)	O

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 on FINAL PAGE must be observed.
5) Depending on the application, momentary pressure spikes can occur. Consider this when selecting measuring equipment and fittings.
6) Metric fixing thread is a deviation from standard.
7) The spot face can be deeper than as specified in the standard.
8) Depending on the installation position, L, L_1 or L_2 must be connected

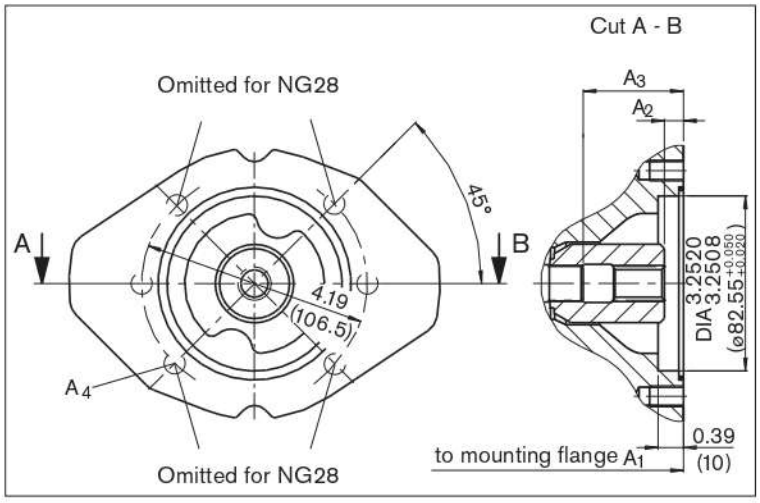
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions through drive

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

K01 flange SAE J744 - 82-2 (A)
Coupling for splined shaft in accordance with ANSI B92.1a-1996

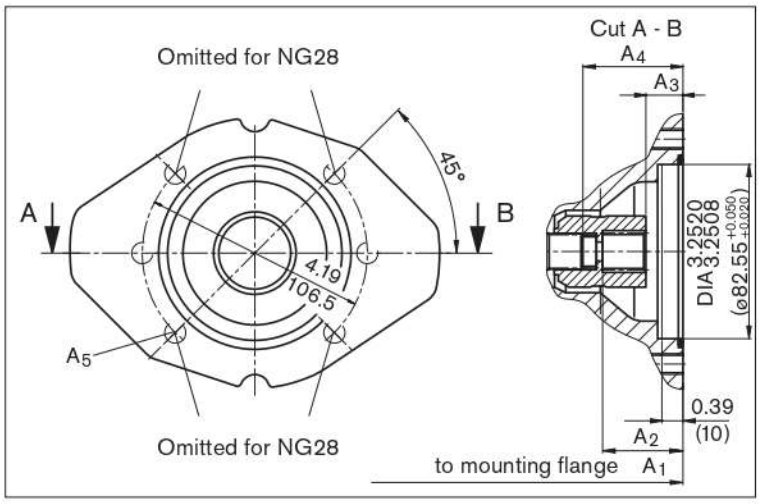
5/8 in 9T 16/32 DP[1] (SAE J744 - 16-4 (A))



NG	A_1	A_2	A_3	A_4[2]
18	7.17 (182)	0.37 (9.3)	1.70 (43.3)	M10 x 1.5, 0.57 (14.5) deep
28	8.03 (204)	0.39 (9.9)	1.85 (47)	M10 x 1.5, 0.63 (16) deep
45	9.02 (229)	0.42 (10.7)	2.09 (53)	M10 x 1.5, 0.63 (16) deep
60/ 63	10.03 (255)	0.37 (9.5)	2.32 (59)	M10 x 1.5, 0.63 (16) deep
85	11.89 (302)	0.53 (13.4)	2.68 (68)	M10 x 1.5, 0.79 (20) deep
100	11.89 (302)	0.53 (13.4)	2.68 (68)	M10 x 1.5, 0.79 (20) deep

K52 flange SAE J744 - 82-2 (A)
Coupling for splined shaft in accordance with ANSI B92.1a-1996

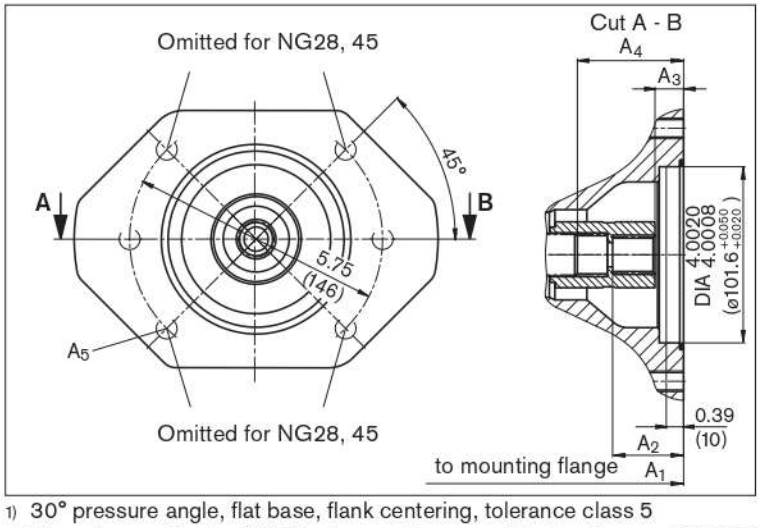
3/4 in 11T 16/32 DP[1] (SAE J744 - 19-4 (A-B))



NG	A_1	A_2	A_3	A_4	A_5[2]
18	7.17 (182)		0.37 (9.3)	1.70 (43.3)	M10 x 1.5, 0.57 (14.5) deep
28	8.03 (204)	1.54 (39.3)	0.74 (18.8)	1.85 (47)	M10 x 1.5, 0.63 (16) deep
45	9.02 (229)	1.55 (39.4)	0.75 (18.9)	2.09 (53)	M10 x 1.5, 0.63 (16) deep
60/ 63	10.03 (255)	1.55 (39.4)	0.75 (18.9)	2.40 (61)	M10 x 1.5, 0.63 (16) deep
85	11.89 (302)	1.74 (44.1)	0.93 (23.6)	2.56 (65)	M10 x 1.5, 0.79 (20) deep
100	11.89 (302)	1.74 (44.1)	0.93 (23.6)	2.56 (65)	M10 x 1.5, 0.79 (20) deep

K68 flange SAE J744 - 101-2 (B)
Coupling for splined shaft in accordance with ANSI B92.1a-1996

7/8 in 13T 16/32 DP[1] (SAE J744 - 22-4 (B))



NG	A_1	A_2	A_3	A_4	A_5[2]
28	8.03 (204)	1.66 (42.3)	0.70 (17.8)	1.85 (47)	M12 x 1.75, 0.71 (18) deep
45	9.02 (229)	1.67 (42.4)	0.71 (17.9)	2.09 (53)	M12 x 1.75, 0.71 (18) deep
60/ 63	10.03 (255)	1.67 (42.4)	0.71 (17.9)	2.32 (59)	M12 x 1.75, 0.71 (18) deep
85	11.89 (302)	1.83 (46.5)	0.87 (22)	2.72 (69)	M12 x 1.75, 0.79 (20) deep
100	11.89 (302)	1.83 (46.5)	0.87 (22)	2.72 (69)	M12 x 1.75, 0.79 (20) deep

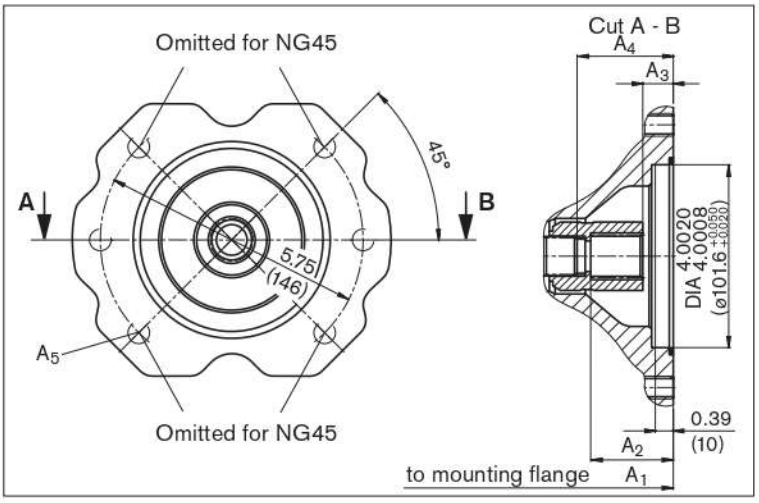
1) 30° pressure angle, flat base, flank centering, tolerance class 5
2) Thread according to DIN 13, observe the general instructions on FINAL PAGE must be observed.

Dimensions through drive

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

K04 flange SAE J744 - 101-2 (B)
Coupling for splined shaft in accordance with ANSI B92.1a-1996

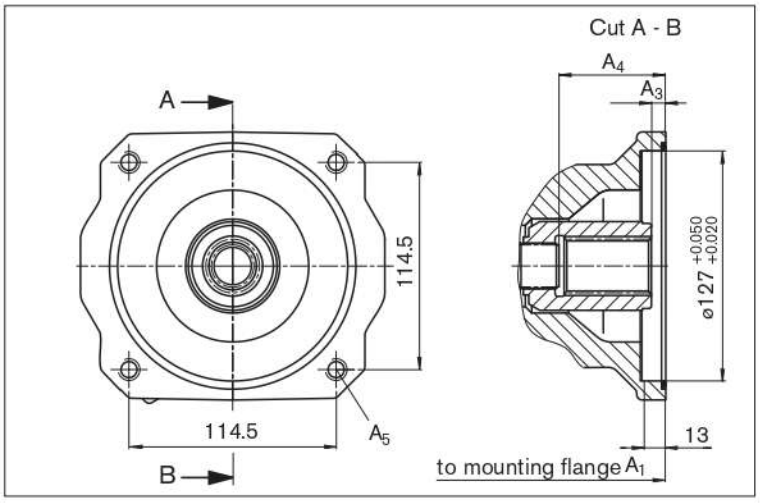
1 in 15T 16/32 DP[1] (SAE J744 - 25-4 (B-B))



NG	A_1	A_2	A_3	A_4	A_5[2]
45	9.02 (229)	1.88 (47.9)	0.74 (18.9)	2.10 (53.4)	M12 x 1.75, 0.71 (18) deep
60/ 63	10.03 (255)	1.87 (47.4)	0.72 (18.4)	2.32 (58.9)	M12 x 1.75, 0.71 (18) deep
85	11.89 (302)	2.01 (51.2)	0.87 (22.2)	2.72 (69)	M12 x 1.75, 0.79 (20) deep
100	11.89 (302)	2.01 (51.2)	0.87 (22.2)	2.72 (69)	M12 x 1.75, 0.79 (20) deep

K15 flange SAE J744 - 127-4 (C)
Coupling for splined shaft in accordance with ANSI B92.1a-1996

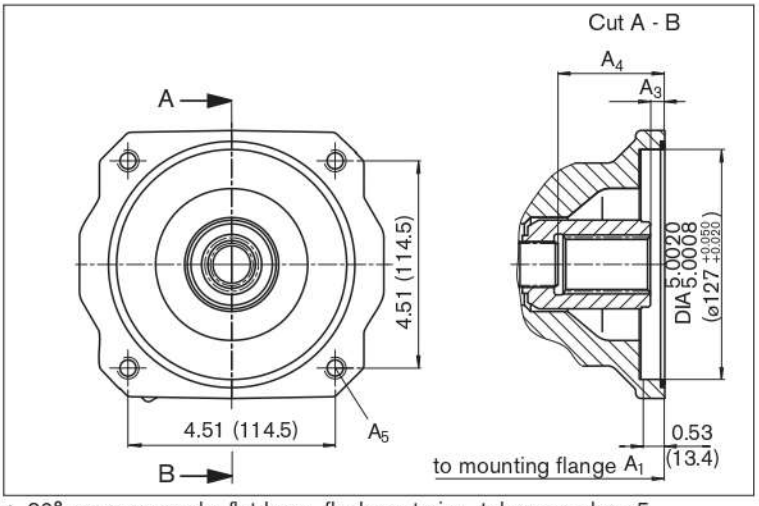
1 1/4 in 14T 12/24 DP[1] (SAE J744 - 32-4 (C))



NG	A_1	A_2	A_3	A_4[2]
60/ 63	10.03 (255)	0.31 (8)	2.32 (59)	M12 x 1.75, 0.63 (16) deep
85	11.87 (301.5)	0.51 (13)	2.67 (67.9)	M12 x 1.75, through
100	11.87 (301.5)	0.51 (13)	2.67 (67.9)	M12 x 1.75, through

K16 flange SAE J744 - 127-4 (C)
Coupling for splined shaft in accordance with ANSI B92.1a-1996

1 1/2 in 17T 12/24 DP[1] (SAE J744 - 32-4 (C))



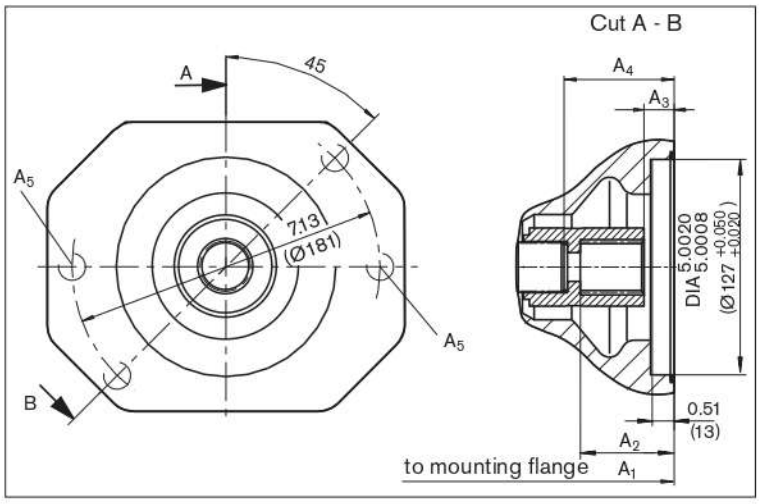
NG	A_1	A_2	A_3	A_4[2]
85	11.87 (301.5)	0.51 (13)	2.67 (67.9)	M12 x 1.75, through
100	11.87 (301.5)	0.51 (13)	2.67 (67.9)	M12 x 1.75, through

1) 30° pressure angle, flat base, flank centering, tolerance class 5
2) Thread according to DIN 13, observe the general instructions on FINAL PAGE must be observed.

Dimensions through drive

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

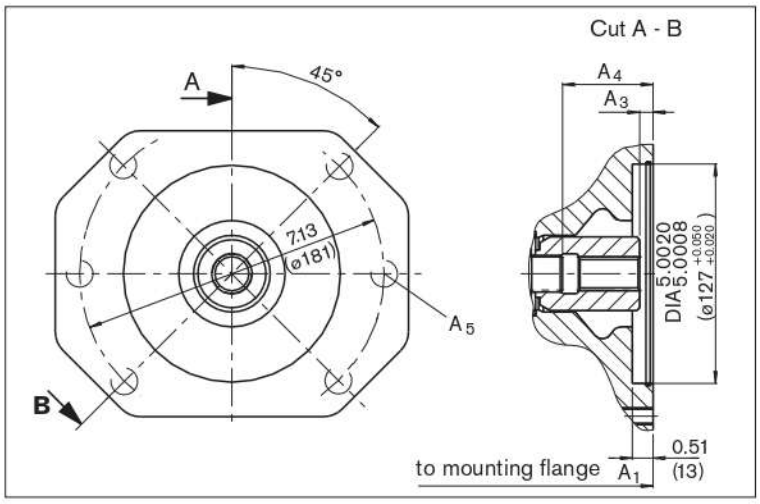
K07 flange SAE J744 - 127-2 (C)
Coupling for splined shaft in accordance with ANSI B92.1a-1996



1 1/4 in 14T 12/24 DP[1] (SAE J744 - 32-4 (C))

NG	A_1	A_2	A_3	A_4[2]
85	11.87 (301.5)	0.51 (13)	2.67 (67.9)	M12 x 1.75, through
100	11.87 (301.5)	0.51 (13)	2.67 (67.9)	M12 x 1.75, through

K24 flange SAE J744 - 127-2 (C)
Coupling for splined shaft in accordance with ANSI B92.1a-1996



1 1/2 in 17T 12/24 DP[1] (SAE J744 - 38-4 (C-C))

NG	A_1	A_2	A_3	A_4[2]
85	11.89 (302)	0.31 (8)	2.68 (68)	M16 x 2, 0.94 (24) deep
100	11.89 (302)	0.31 (8)	2.68 (68)	M16 x 2, 0.94 (24) deep

1) 30° pressure angle, flat base, flank centering, tolerance class 5
2) Thread according to DIN 13, observe the general instructions on FINAL PAGE must be observed.

Summary mounting options

Through-drive[1]			Mounting option – 2nd pump			
Flange	Coupling for splined shaft	Short des.	PA10V(S)O/5x NG (shaft)	PA10VO/31 NG (shaft)	Gear pump design (NG)	**Through drive available for NG**
82-2 (A)	5/8 in	**K01**	10 (U)	18 (U)	F (5 to 22)	18 to 100
	3/4 in	**K52**	10 (S) 18 (U) 18 (S, R)	18 (S, R)	–	18 to 100
101-2 (B)	7/8 in	**K68**	28 (S, R) 45 (U, W)[1]	28 (S, R) 45 (U, W)	N/G (26 to 49)	28 to 100
	1 in	**K04**	45 (S, R) 60, 63 (U, W) [2]	45 (S, R) –	–	45 to 100
127-4 (C)	1 1/4 in	**K15**	60, 63 (S, R)	–	–	63 to 100
	1 1/2 in	**K16**	85 (S) 100 (S)	–	–	85 to 100
127-2 (C)	1 1/4 in	**K07**	85 (U, W) 100 (U, W)	71 (S, R)	–	85 to 100
	1 1/2 in	**K24**	85 (S) 100 (S)	–	–	85 to 100

1) Not for NG28 with K68
2) Not for NG28 with K04

Combination pumps PA10VO + PA10VO

Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

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 "**+**".

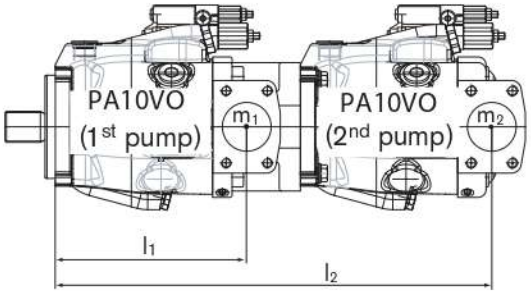
Order example:
PA10VO85DRS/53R-VSC12K04+
PA10VO45DRF/53R-VSC11N00

The tandem pump comprising two identical sizes is permissible without additional supports taking into account a maximum dynamic mass acceleration of 10 *g* (= 98.1 m/s²).

For combination pumps comprising more than two pumps, the mounting flange must be calculated for the permissible moment of inertia.

Permissible moment of inertia

NG			10	18	28	45	60/63	85	100
Permissible moment of inertia									
static	T_m	lb-ft	–	–	656	664	1010	2270	2270
		(Nm)	–	–	(890)	(900)	(1370)	(3080)	(3080)
dynamic at 10 *g* (98.1 m/s²)	T	lb-ft	–	–	65	66	101	227	227
		(Nm)	–	–	(89)	(90)	(137)	(308)	(308)
Mass with through-drive plate	m_1	lbs	–	–	37.5	53	62	99	99
		(kg)	–	–	(17)	(24)	(28)	(45)	(45)
Mass without through drive (e.g. 2nd pump)	m	lbs	18	25	31	40	48.5	75	75
		(kg)	(8)	(11.5)	(14)	(18)	(22)	(34)	(34)
Distance center of gravity	l_1	in	–	3.23	3.19	3.74	3.94	4.80	4.80
		(mm)	–	(82)	(81)	(95)	(100)	(122)	(122)



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)]

Installation instructions

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 case interior 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 drain ports of the units, the shared 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 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 h_S is a result of the overall pressure loss, but may not be greater than $h_{S\,max}$ = 31.50 in (800 mm). The minimum suction pressure at port S must also not fall below 12 psi (0.8 bar) absolute during operation.

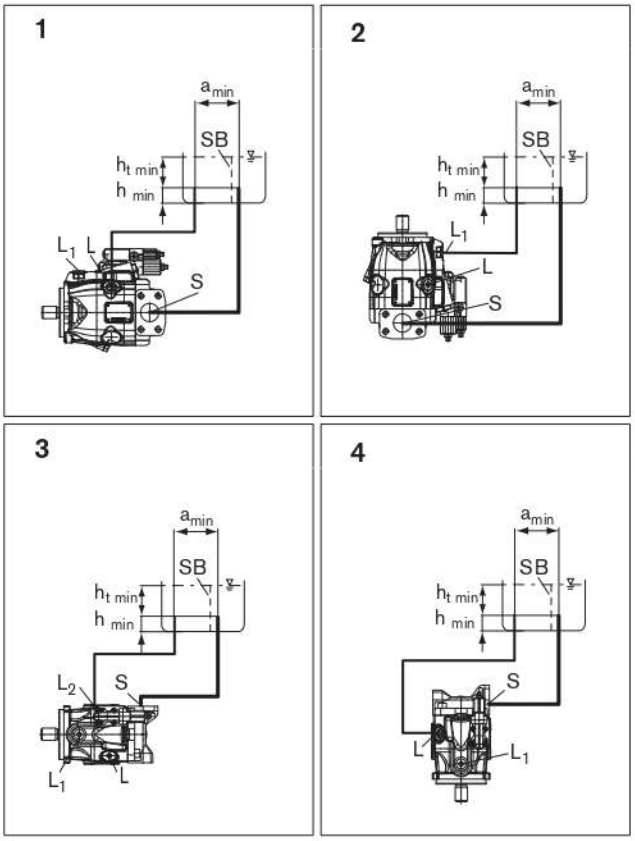
Installation position

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.



Installation position	Air bleed	Filling
1	L	S + L
2	L_1	S + L_1
3[1)]	L_2	S + L_2
4	L	S + L

1) Only series 53

Installation instructions

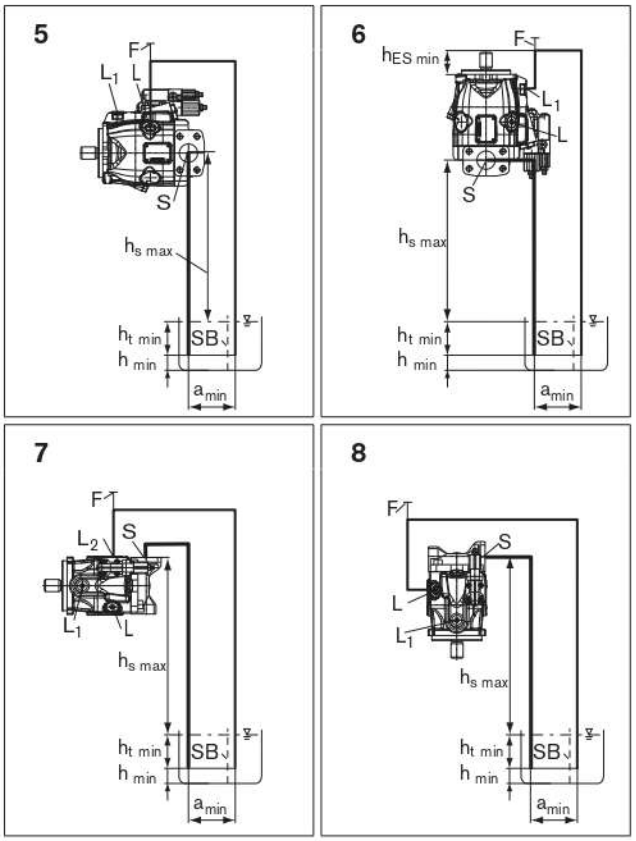
Above-reservoir installation

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 $h_{ES\ min}$ of at least 0.98 in (25 mm) is required in installation position 6.

Observe the maximum permissible suction height $h_{S\ max}$ = 31.50 in (800 mm).

A check valve in the case drain line is only permissible in individual cases. Consult us for approval.

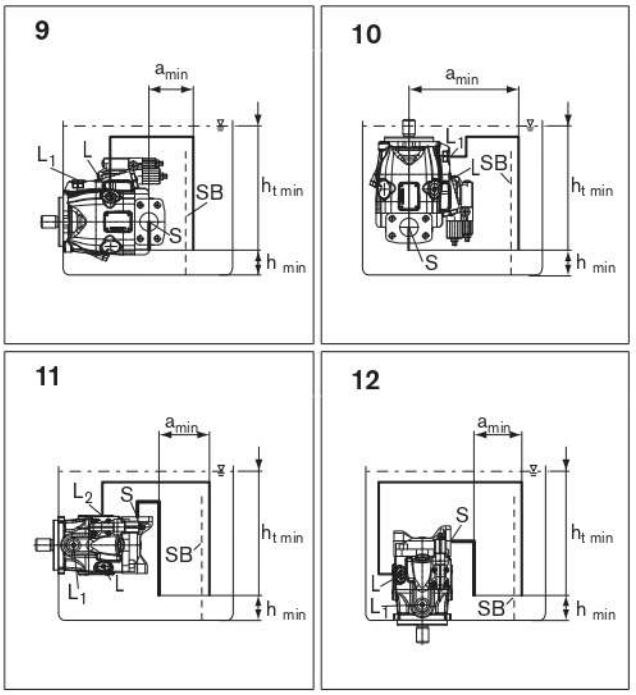


Installation position	Air bleed	Filling
5	F	L, L_1 (F)
6	F	L_1 (F)
7[1)]	F	S + L_2 (F)
8	F	S + L (F)

1) Only series 53

Inside-reservoir installation

Inside-reservoir installation means the pump is installed within the minimum reservoir fluid level.
Axial piston units with electrical components (e.g. electric control, sensors) may not be installed in a reservoir below the fluid level.



Installation position	Air bleed	Filling
9	L_1	L, L_1
10	L_1	L, L_1
11[1)]	L_2	S
12	L	S + L

S	Suction port
F	Filling / air bleeding
L, L_1	Case drain port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum necessary immersion depth (7.87 in (200 mm))
h_{min}	Minimum necessary spacing to reservoir base (3.94 in (100 mm))
$h_{ES\ min}$	Minimum necessary height needed to protect the axial piston unit from draining (0.98 in (25 mm)).
$h_{S\ max}$	Maximum permissible suction height (21.50 in (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.

General instructions

–The PA10VO pump is designed to be used in open circuit.
–Project planning, installation and commissioning of the axial piston unit require the involvement of qualified personnel.
–Before operating the axial piston unit, please read the appropriate instruction manual thoroughly and completely. If necessary, request these from YEOSHE.
–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 fixing 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 DIN EN ISO 13849.
–The following tightening torques apply:
--Fittings:
Observe the manufacturer's instruction regarding the tightening torques of the used fittings.
--Fixing screws:
For fixing screws with metric ISO thread according to DIN 13 or thread according to ASME B1.1, we recommend checking the tightening torque individually according to VDI 2230.
--Female threads in axial piston unit:
The maximum permissible tightening torques $M_{G\,max}$ are 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

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			
ISO 11926	7/16-20UNF-2B	40 Nm	18 Nm	3/16 in
	9/16-18UNF-2B	80 Nm	35 Nm	1/4 in
	3/4-16UNF-2B	160 Nm	70 Nm	5/16 in
	7/8-14UNF-2B	240 Nm	110 Nm	3/8 in
	1 1/16-12UN-2B	360 Nm	170 Nm	9/16 in

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