

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 45 60¹⁾ 63 85 100

01	nominal pressure 3600 psi (250 bar), maximum pressure 4600 psi (315 bar)												PA10V
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Operation mode

02	Pump, open circuit												O
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Size (NG)

03	Geometric displacement, see table of values												
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Control device

04

Pressure control													DR
with flow control, hydraulic													
X-T open													
X-T plugged													
Electrically overridable (negative characteristic)													
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		

04

		18	28	45	60 ¹⁾	63	85	100		
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 control- ler cut-off, X-T open (load sensing)	U = 12 V	●	●	●	–	●	●	○	EK1DF
		U = 24 V	●	●	●	–	●	●	○	EK2DF
	Pressure and flow control with control- ler 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
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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 85⁶⁾ only in series 52
3) Control DR, DRF, DRS, DRG, ED and ER: delivery with size 18, 63, 85⁵⁾ 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

	ISO 3019-1 (SAE)	2-bolt
		4-bolt

18 28 45 60¹⁾ 63 85 100

●	●	●	●	●	●	●	C
-	-	-	●	●	● ²⁾	●	D

Service line port

10	SAE flange port at rear, UNC fixing thread (not for through drive)	
	SAE flange port on opposite side, UNF fixing thread (for through drive)	
	UNF threaded ports, rear (not for through drive)	

18 28 45 60¹⁾ 63 85 100

●	●	●	●	●	●	●	61
●	●	●	●	●	●	●	62
-	-	-	-	-	-	-	64

Through drive

11	Without through drive, standard for versions 61 and 64	
	SAE J744 flange	coupling for splined shaft ³⁾
	Diameter	diameter
	82-2 (A)	5/8 in 9T 16/32DP
		3/4 in 11T 16/32DP
	101-2 (B)	7/8 in 13T 16/32DP
		1 in 15T 16/32DP
	127-4 (C)	1 1/4 in 14T 12/24DP
		1 1/2 in 17T 12/24DP
	127-2 (C)	1 1/4 in 14T 12/24DP
		1 1/2 in 17T 12/24DP

18 28 45 60¹⁾ 63 85 100

●	●	●	●	●	●	●	N00
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●	●	●	●	●	●	●	K01
●	●	●	●	●	●	●	K52
-	●	●	●	●	●	●	K68
-	-	●	●	●	●	●	K04
-	-	-	●	●	●	●	K15
-	-	-	-	-	●	●	K16
-	-	-	-	-	●	●	K07
-	-	-	-	-	●	●	K24

Connector for solenoids

12	DEUTSCH molded connector, 2-pin – without suppressor diode	
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18 28 45 60¹⁾ 63 85 100

●	●	●	●	●	●	●	P
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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.

Hydraulic fluid

Technical data

Operating pressure range

Pressure at service line port B

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

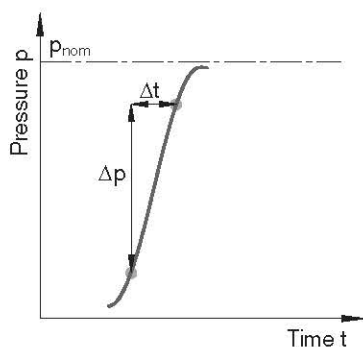
Maximum pressure p_{max} _____ 4600 psi (315 bar) absolute

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

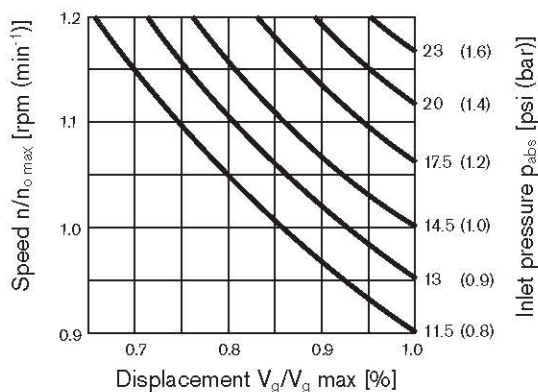
(at port L, L₁):

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)

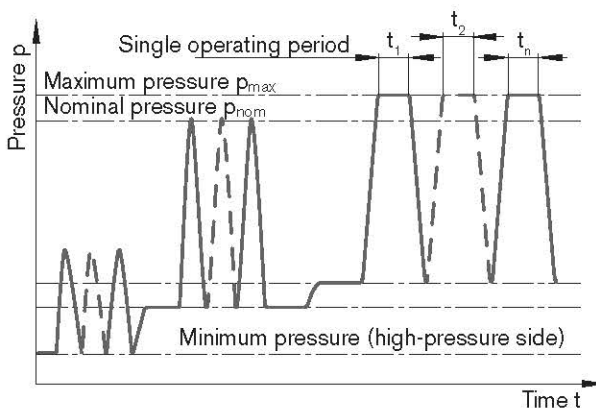
Minimum pressure on the high-pressure side (B) that is required in order to prevent damage to the axial piston unit.

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 = $t_1 + t_2 + \dots + t_n$

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 (cm ³)	0.64 (10.5)	1.10 (18)	1.75 (28)	2.75 (45)	3.66 (60)	3.84 (63)	5.18 (85)	6.10 (100)
Speed ³⁾									
maximum at $V_{g \max}$	n_{nom} rpm	3600	3300	3000	2600 ⁴⁾	2600	2600	2500	2300
maximum at $V_g < V_{g \max}$	$n_{\text{max perm}}$ rpm	4320	3960	3600	3120	3140	3140	3000	2500
Flow at n_{nom} and $V_{g \max}$	$q_{v \max}$ gpm (l/min)	9.7 (37)	15.6 (59)	22 (84)	31 (117)	41 (156)	43 (163)	55 (212)	60 (230)
at $n_E = 1500$ rpm and $V_{g \max}$	$q_{vE \max}$ gpm (l/min)	4 (15)	7.1 (27)	1.1 (42)	18 (68)	24 (90)	25.1 (95)	34 (128)	39 (150)
Power at $\Delta p = 3600$ 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 (kW)	9.4 (7)	15 (11)	24 (18)	38 (28)	50 (37)	52 (39)	71 (53)	84 (62)
Torque at $V_{g \max}$ and $\Delta p = 3600$ psi (250 bar)	T_{max} lb-ft (Nm)	31 (42)	52 (71)	82 (111)	132 (179)	175 (238)	184 (250)	247 (338)	293 (398)
$\Delta p = 1440$ psi (100 bar)	T lb-ft (Nm)	13 (17)	21 (29)	33 (45)	53 (72)	70 (95)	74 (100)	102 (135)	117 (159)
Rotary stiffness, drive shaft	S	C	lb-ft/rad (Nm/rad)	6760 (9200)	8082 (11000)	16400 (22300)	37500 (37500)	48100 (65500)	105100 (143000)
	R	C	lb-ft/rad (Nm/rad)	– (–)	10870 (14800)	19400 (26300)	30240 (41000)	51200 (69400)	– (–)
	U	C	lb-ft/rad (Nm/rad)	5020 (6800)	5870 (8000)	– (–)	22130 (30000)	36290 (49200)	75900 (102900)
	W	C	lb-ft/rad (Nm/rad)	– (–)	– (–)	– (–)	25370 (34400)	39830 (54000)	86960 (117900)
	K/C	C	lb-ft/rad (Nm/rad)	7965 (10800)	– (–)	19770 (26800)	32380 (43900)	54506 (73900)	– (–)
Moment of inertia rotary group	J_{TW} lbs-ft ² (kgm ²)	0.0142 (0.0006)	0.2207 (0.00093)	0.0403 (0.0017)	0.0783 (0.0033)	0.1329 (0.0056)	0.1329 (0.0056)	0.2848 (0.012)	0.2848 (0.012)
Angular accel., max. ⁵⁾	α rad/s ²	8000	6800	5500	4000	3300	3300	2700	2700
Filling capacity	V gal (L)	0.05 (0.2)	0.06 (0.25)	0.08 (0.3)	0.13 (0.5)	0.21 (0.8)	0.21 (0.8)	0.26 (1)	0.26 (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 $p_{\text{abs}} = 15$ psi (1 bar) at the suction port S
- for the optimum viscosity range of $\nu_{\text{opt}} = 80$ to 170 SUS (16 to 36 mm²/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.



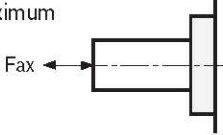
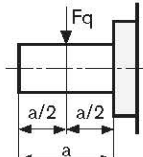
Technical data

Determination of size

Flow	$q_v = \frac{V_g \cdot n \cdot \eta_v}{231 (1000)}$	[gpm (l/min)]	V_g = Geometric displ. per revolution in in ³ (cm ³)
			Δp = Differential pressure in psi (bar)
Torque	$T = \frac{V_g \cdot \Delta p}{24 (20) \cdot \pi \cdot \eta_{mh}}$	[lb-ft (Nm)]	n = Speed in rpm
			η_v = Volumetric efficiency
Power	$P = \frac{2\pi \cdot T \cdot n}{33.000 (60000)} = \frac{q_v \cdot \Delta p}{1.714 (600) \cdot \eta_t}$	[HP (kW)]	η_{mh} = Mechanical-hydraulic efficiency
			η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

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		56 (250)	78 (350)	270 (1200)	337 (1500)	382 (1700)	450 (2000)	450 (2000)
Axial force maximum		90 (400)	157 (700)	225 (1000)	337 (1500)	450 (2000)	675 (3000)	675 (3000)

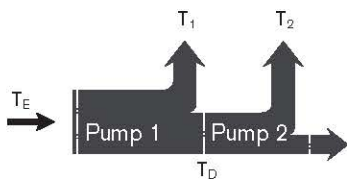
Permissible input and through-drive torques

Size	NG	10	18	28	45	60/63	85	100
Torque at $V_{g \max}$ and $\Delta p = 3600 \text{ psi (250 bar)}^1$	$T_{\max}$ 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

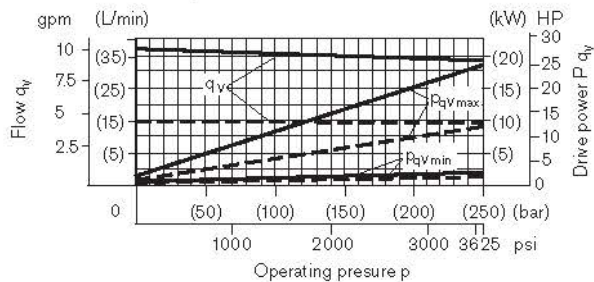
Operating material:

Hydraulic fluid ISO VG 46 DIN 51519, $t = 50\text{ }^{\circ}\text{C}$

Size 10

--- $n = 1500\text{ rpm}$

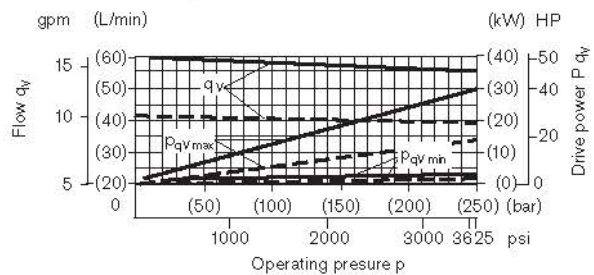
— $n = 3600\text{ rpm}$



Size 18

--- $n = 1500\text{ rpm}$

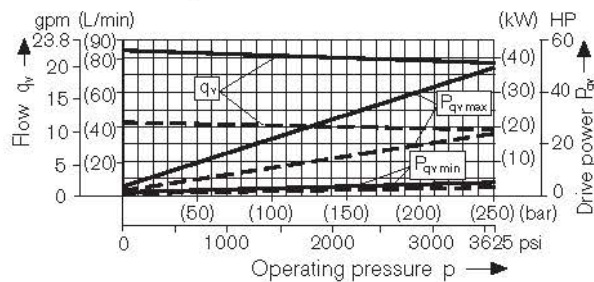
— $n = 3300\text{ rpm}$



Size 28

--- $n = 1500\text{ rpm}$

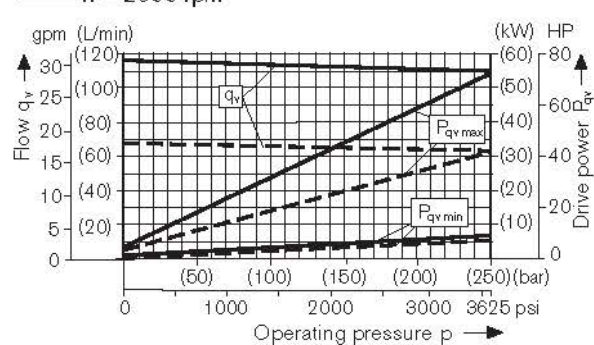
— $n = 3000\text{ rpm}$



Size 45

--- $n = 1500\text{ rpm}$

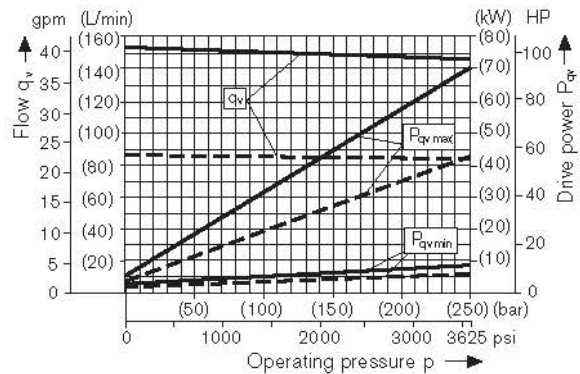
— $n = 2600\text{ rpm}$



Size 60/63

--- $n = 1500\text{ rpm}$

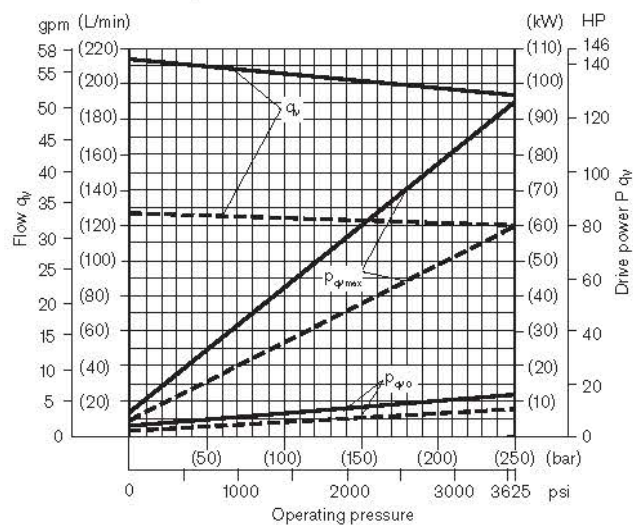
— $n = 2600\text{ rpm}$



Size 85

--- $n = 1500\text{ rpm}$

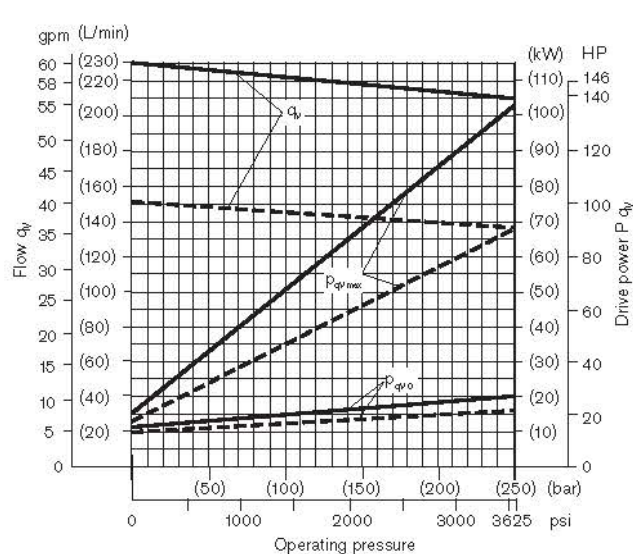
— $n = 2500\text{ rpm}$



Size 100

--- $n = 1500\text{ rpm}$

— $n = 2300\text{ rpm}$

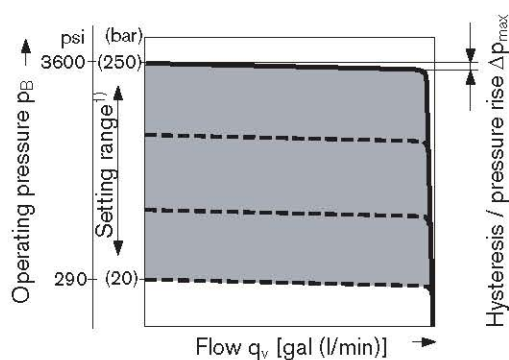


DR – Pressure control

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

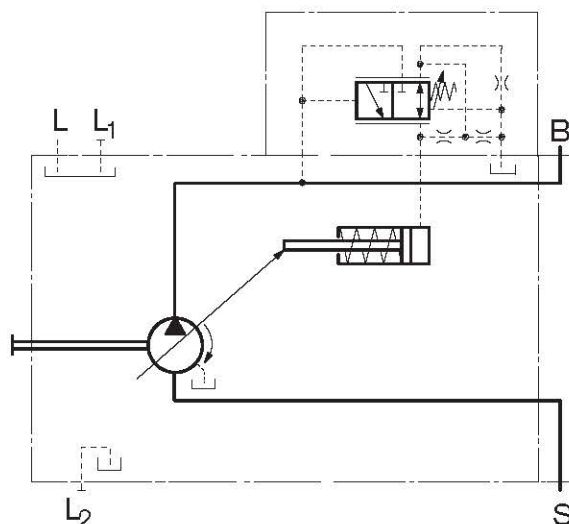
(at $n_1 = 1500 \text{ rpm}$; $t_{\text{fluid}} = 120^\circ\text{F}$ (50°C))



- 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

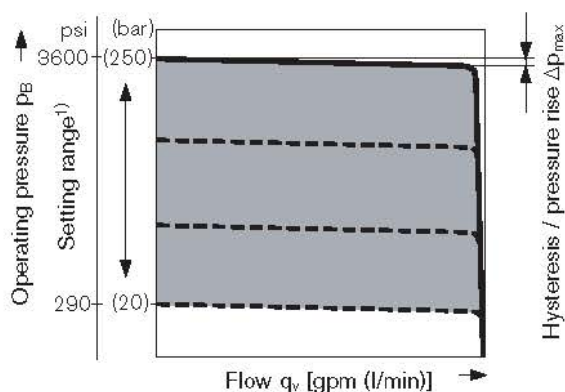
The DRG control valve overrides the function of the DR pressure controller

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.

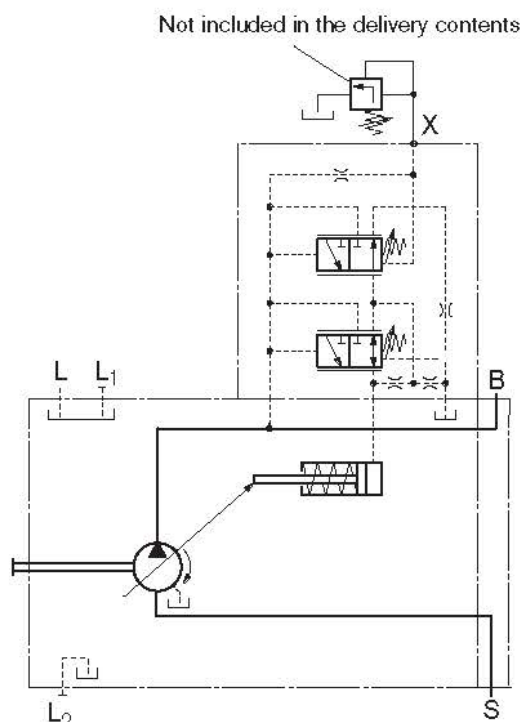
Static characteristic

(at $n_1 = 1500 \text{ rpm}$; $t_{\text{fluid}} = 120^\circ\text{F}$ (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, L1,2	Case drain fluid (L1,2 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.

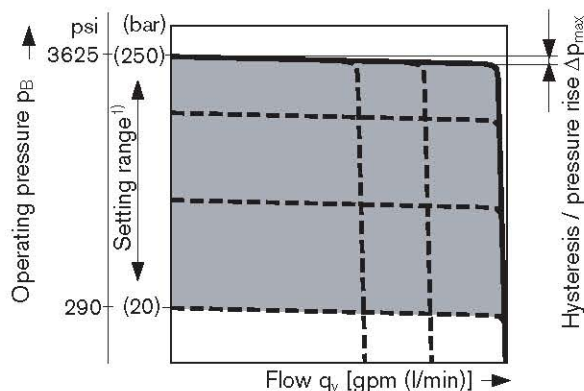
Note

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

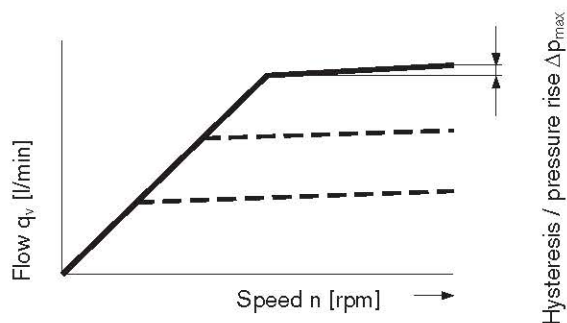
Flow control at $n_1 = 1500 \text{ rpm}$; $t_{\text{fluid}} = 120 \text{ °F (50 °C)}$



- 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.

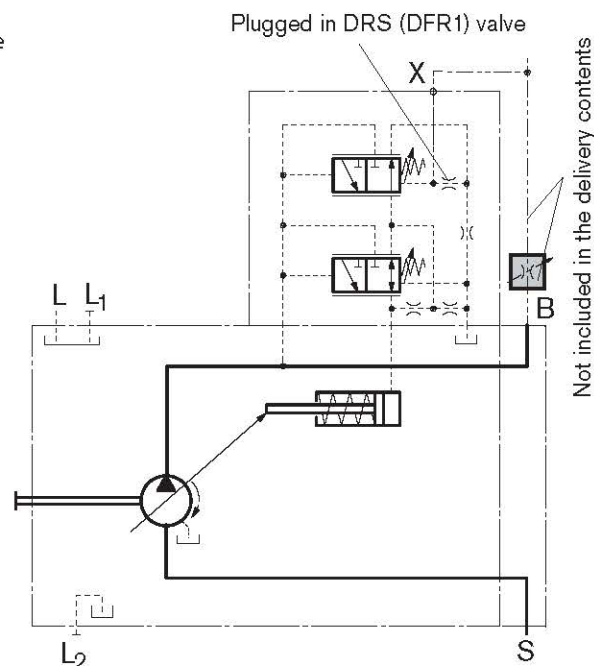
Static characteristic at variable speed



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 $n = 1500 \text{ rpm}$.

NG	10	18	28	45	60/ 63	85	100
$\Delta q_{v \text{ max}}$ 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

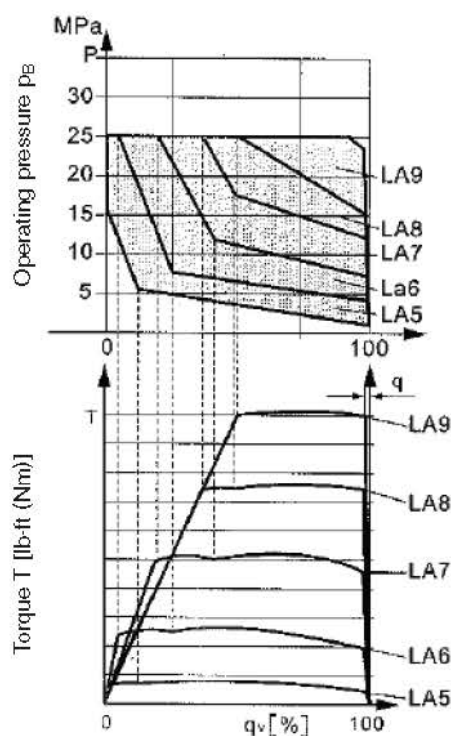
Maximum control fluid consumption.

Start of control [psi ((bar))]	Torque T [lb-ft (Nm)] for size						Order code
	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

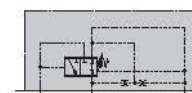
Conversion of the torque values in power [kW]:

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

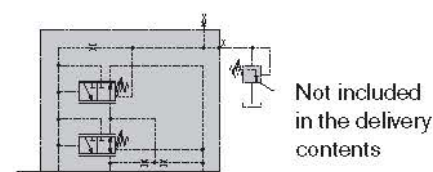
Static curves and torque characteristic



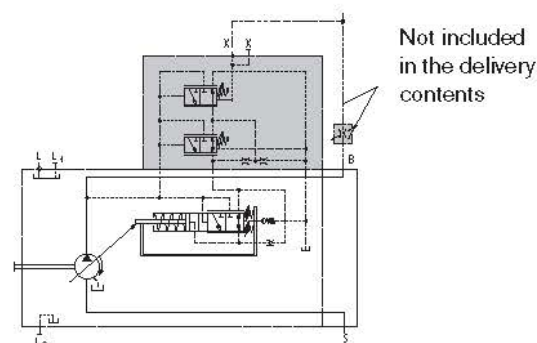
Circuit diagram (LAXD) with pressure cut-off



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



Circuit diagram (LAXDS) with pressure and flow control



EP – Electro-proportional control

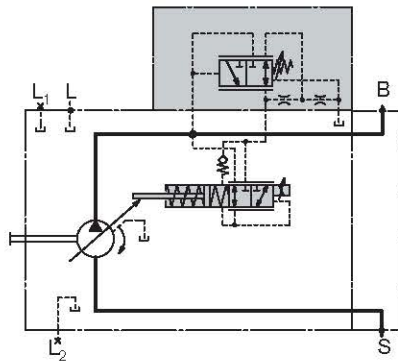
Electro-proportional control makes a stepless and reproducible setting of the pump displacement possible directly via the swashplate. The control force of the control piston is applied by a proportional solenoid. The control is proportional to the current (for start of control, see table right).

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



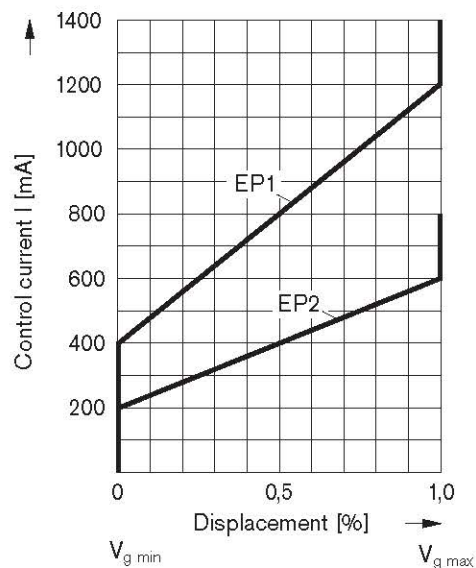
	Port for
B	Service line
S	Suction line
L, L_{1,2}	Case drain fluid (L _{1,2} plugged)
X	Control pressure

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...

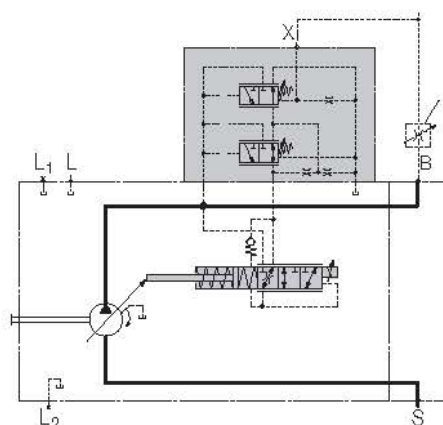
In addition to the electro-proportional control function, a controller cut-off is integrated in the electric characteristic. The pump then swivels to $V_{g \max}$ if the control signal is lost (e.g. cable break) and then works with the DRF settings (see page 14). The controller cut-off is only intended 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}).

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

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.

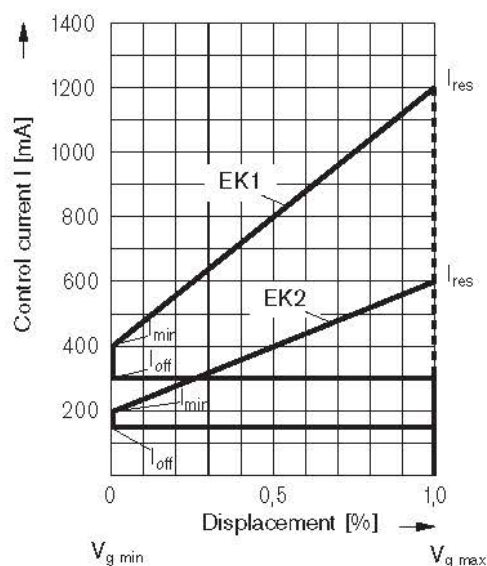
Check whether remedial measures for your application are needed on your machine in order to put the driven consumer in a safe state (e.g. immediate stop).

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 %



	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.

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.

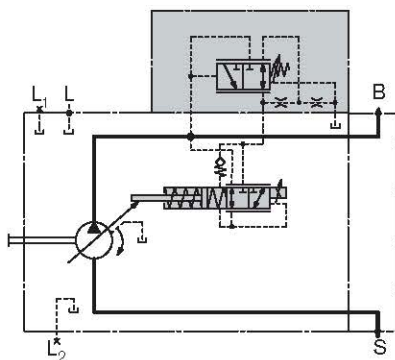
Setting range from 290 to 3600 psi (20 to 250 bar). For the pressure flow control

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).

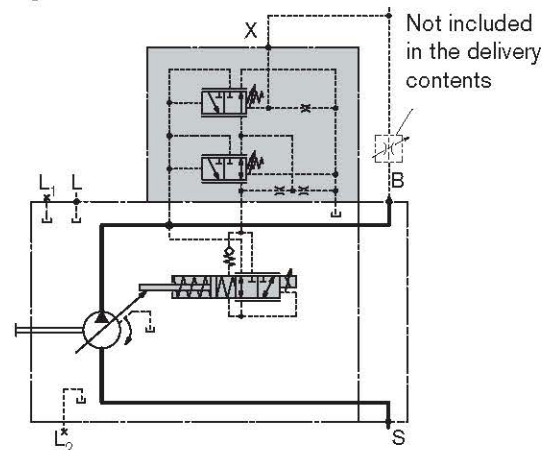
The EP.DS or EK.DS version has no connection between X and the reservoir (load sensing)

Circuit diagram EP.D



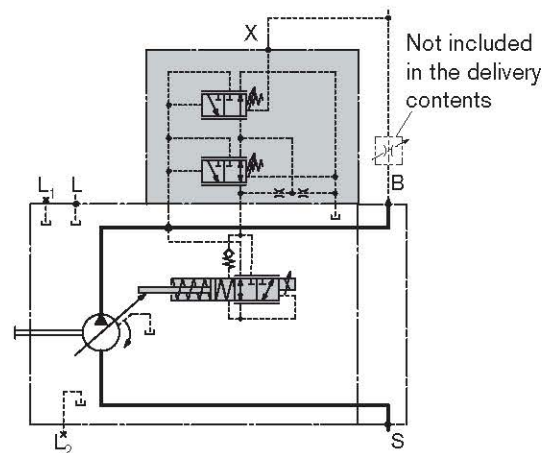
	Port for
B	Service line
S	Suction line
L, L_{1,2}	Case drain fluid (L _{1,2} plugged)

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.

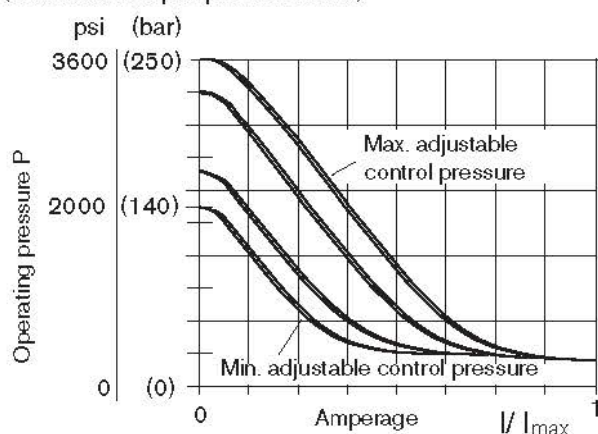
This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

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)

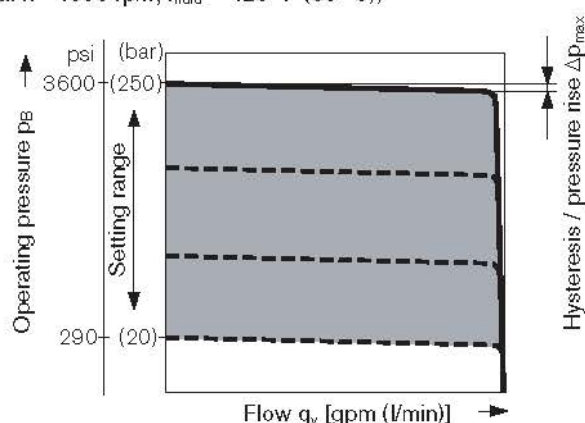
(measured with pump in zero stroke)



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

Static flow-pressure characteristic

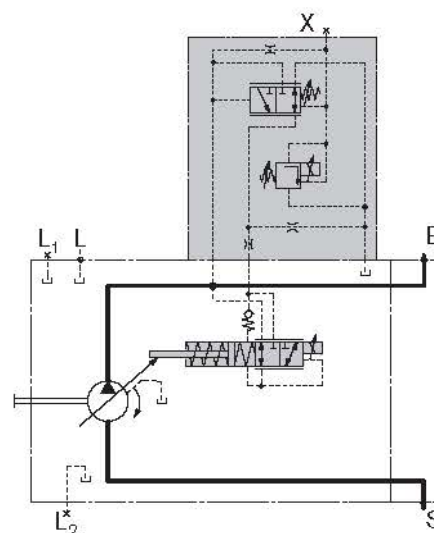
(at $n = 1500 \text{ rpm}$; $t_{fluid} = 120 \text{ °F}$ (50 °C))



Controller data

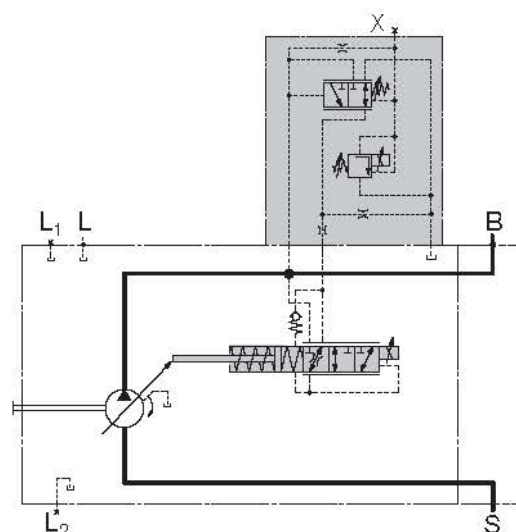
Standby standard setting: 290 psi (20 bar). Other values on request. Hysteresis / pressure rise Δp 60 psi (4 bar)

Circuit diagram EP.ED



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

Circuit diagram EK.ED



	Port for
B	Service line
S	Suction line
L, L _{1,2}	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.

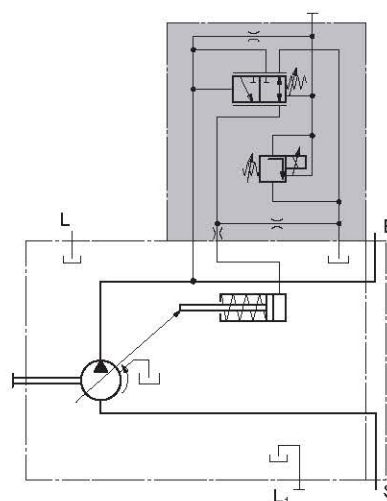
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.

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.

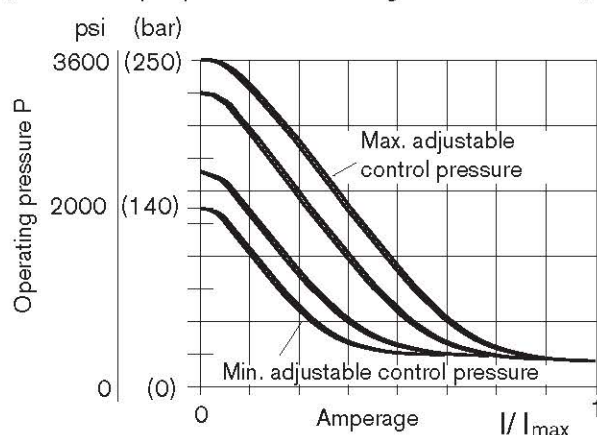
When ordering, state the type of application in clear text.

Circuit diagram ED..



Static current-pressure characteristic ED

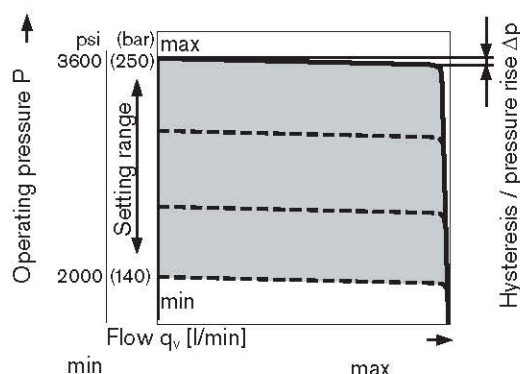
(measured at pump in zero stroke – negative characteristic)



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 _____ $\Delta p < 60$ psi (4 bar).

Control flow consumption _____ 0.8 to 1.2 gpm (3 to 4.5 l/min).

	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.

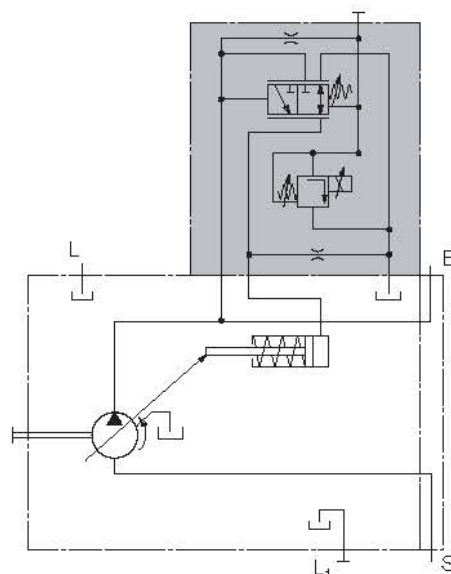
When a change is made at the consumer (load pressure), the position of the control piston will shift.

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

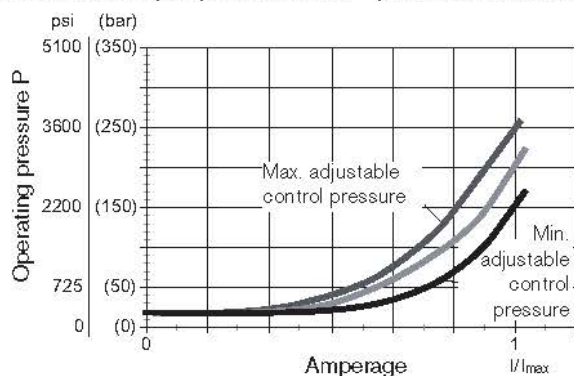
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.

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

Circuit diagram ER..



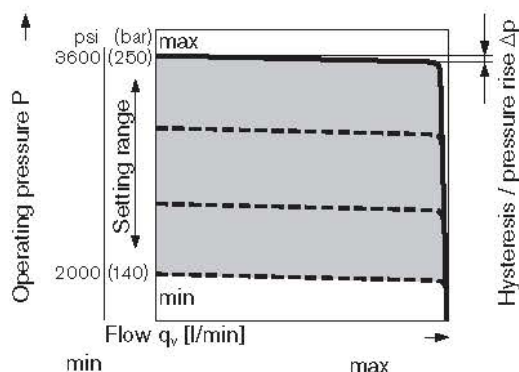
Static current-pressure characteristic ER
(measured with pump in zero stroke – positive characteristic)



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; $t_{\text{fluid}} = 120$ °F (50°C))



Controller data

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

Hysteresis and pressure rise $\Delta p < 60$ psi (4 bar).

Control flow consumption 0.8 to 1.2 gpm (3 to 4.5 l/min).

	Port for
B	Service line
S	Suction line
L, L1	Case drain (L1 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 %

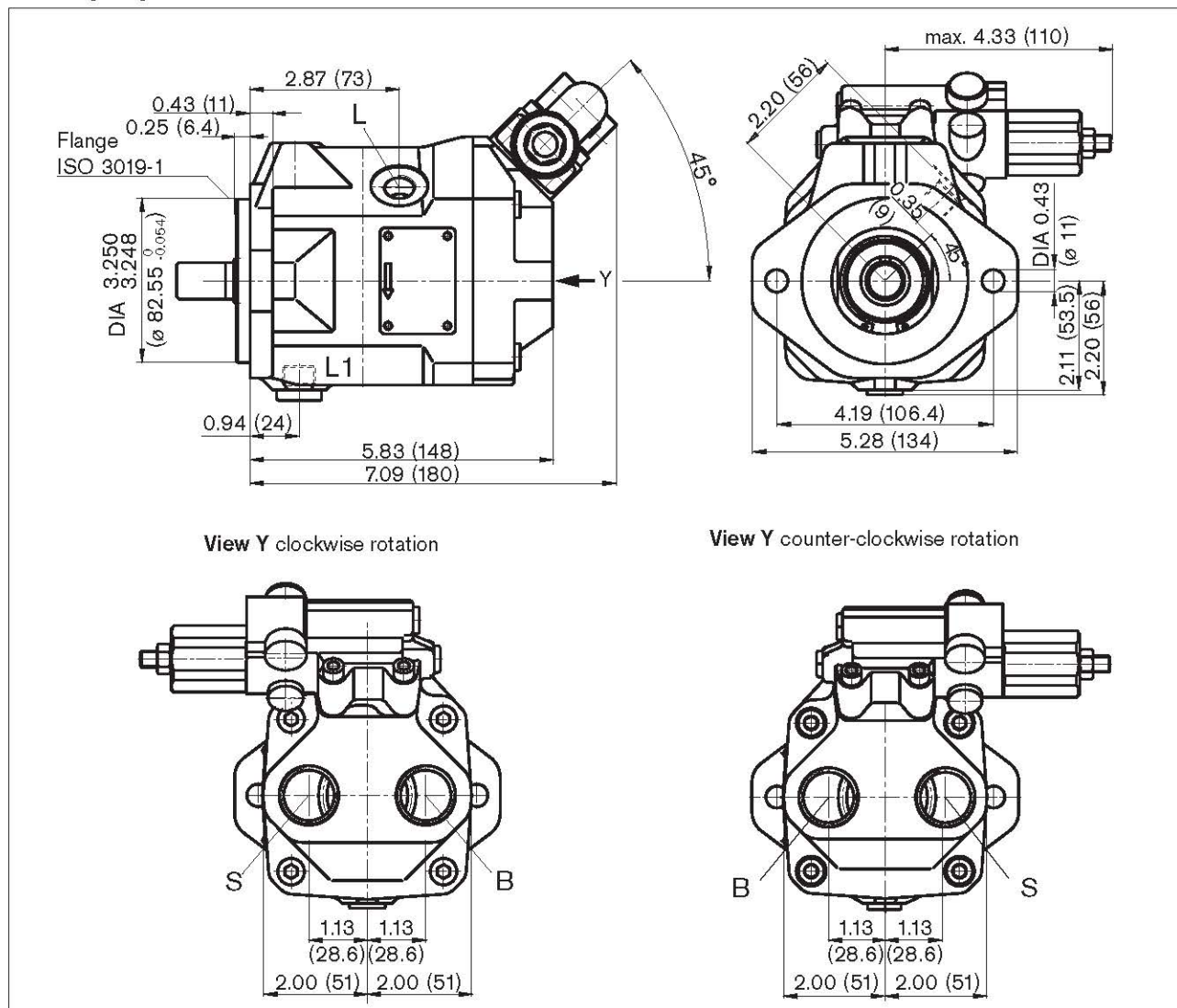
Operating temperature range at valve -4 °F to 239 °F
(-20 °C to +115 °C)

Dimensions, size 10

DR – Hydraulic pressure controller

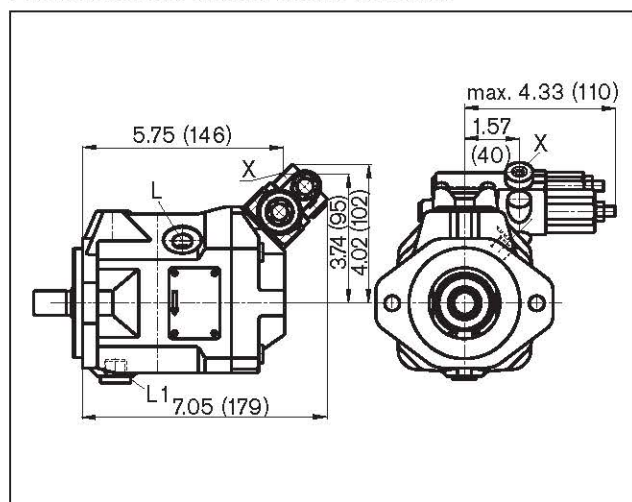
Centering flange SAE version; series 52

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



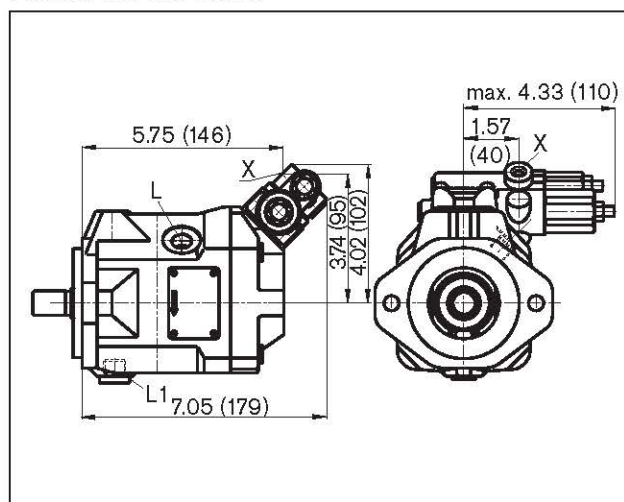
DRG

Pressure and flow control, remote controlled



DFR / DFR1

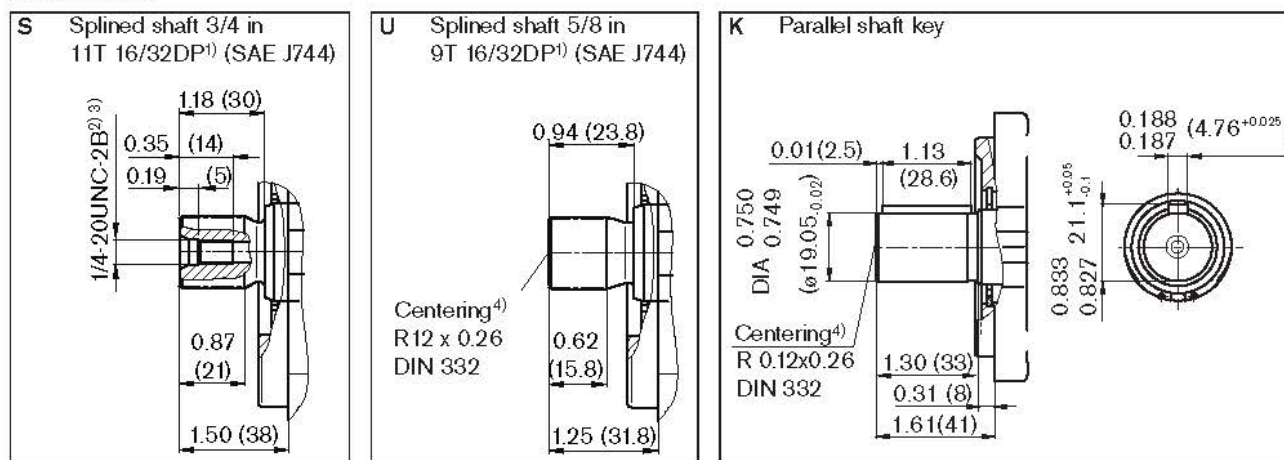
Pressure and flow control



Dimensions, size 10

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

Drive shaft



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 L₁ must be connected

O = Must be connected (plugged on delivery)

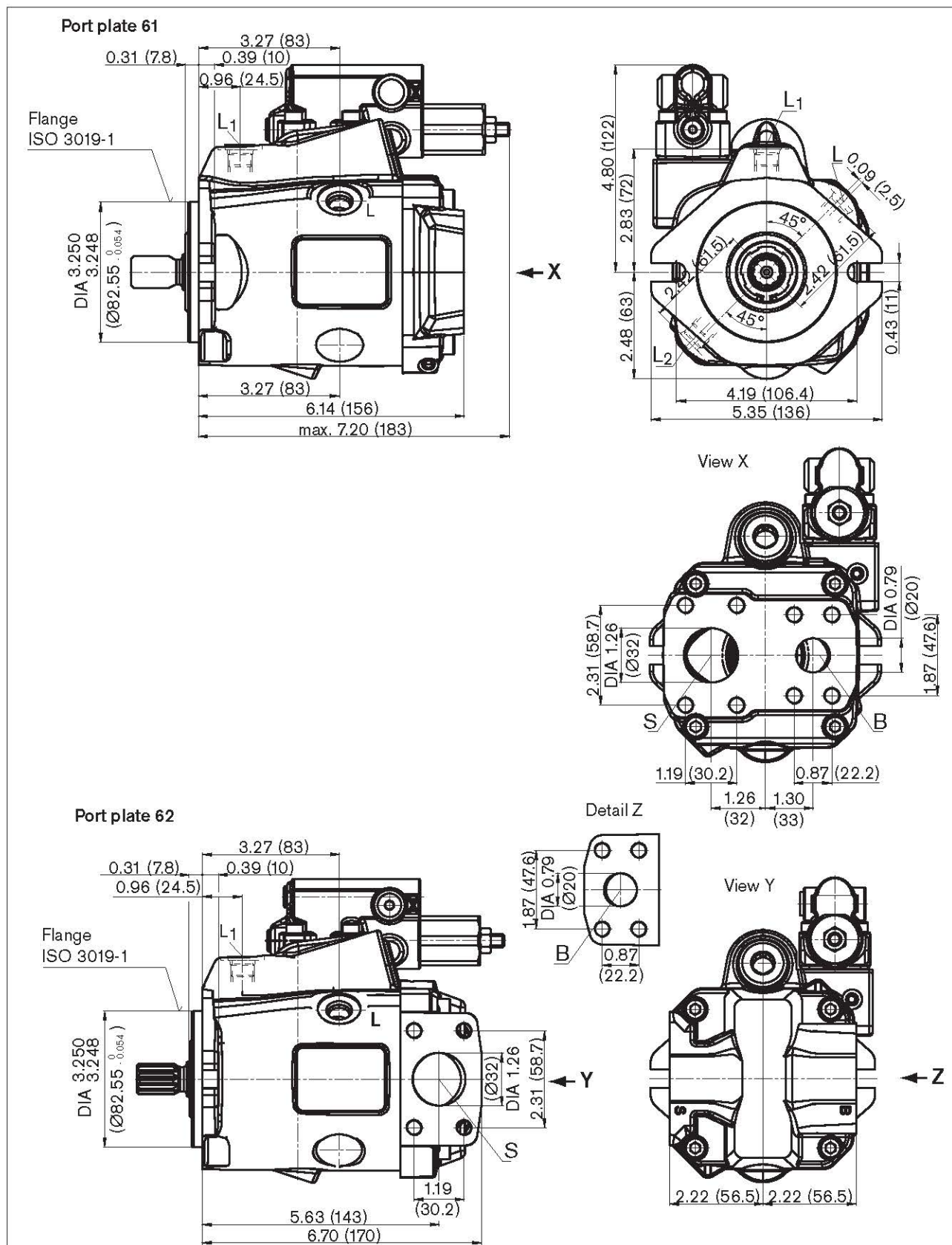
X = Plugged (in normal operation)

Dimensions, size 18¹⁾

DR – Hydraulic pressure controller

Clockwise rotation, series 53

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

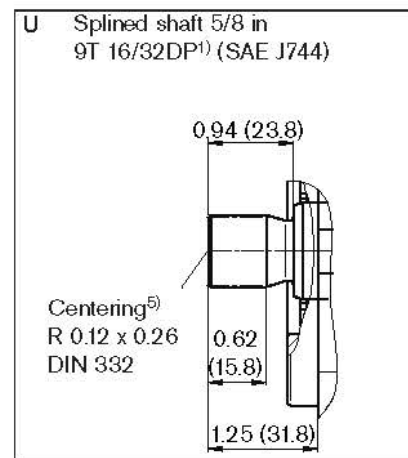
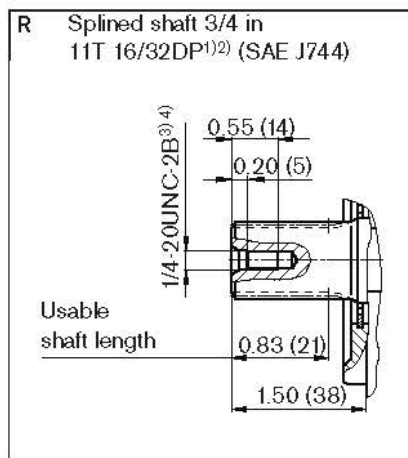
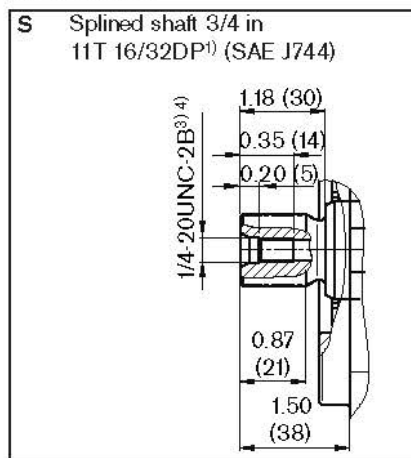


¹⁾ Dimensions of service line ports turned through 180° for counter-clockwise rotation
For details of connection options and drive shafts

Dimensions, size 18

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

Drive shaft



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, L₁ or L₂ must be connected

O = Must be connected (plugged on delivery)

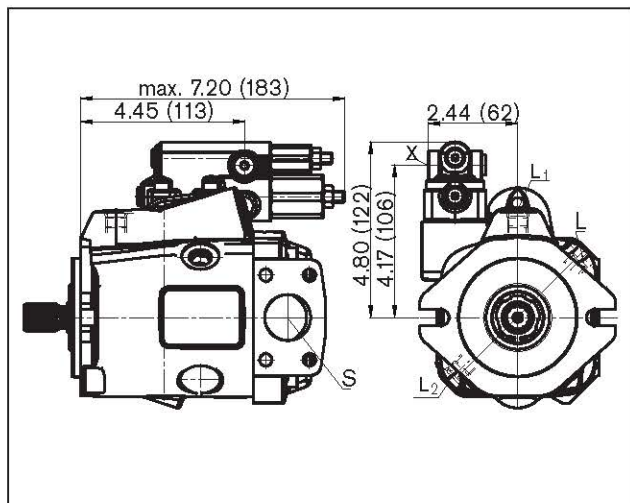
X = Plugged (in normal operation)

Dimensions, size 18

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

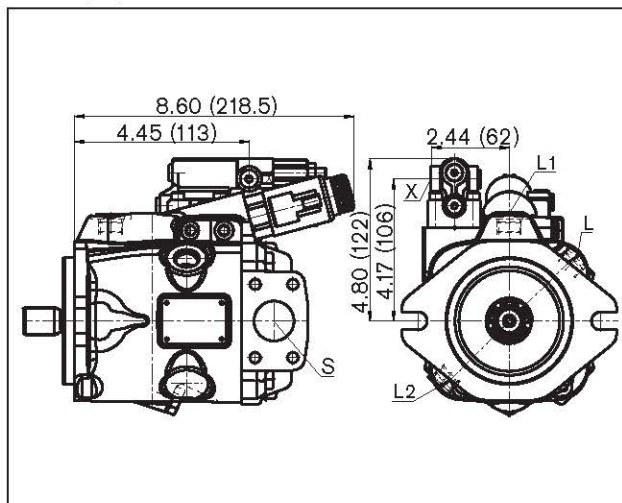
DRG

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



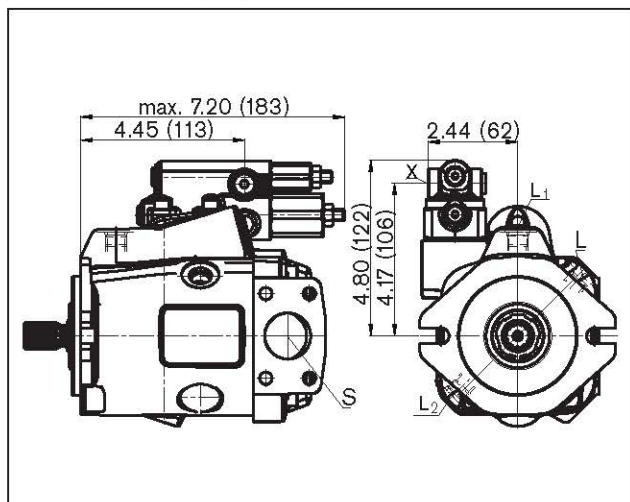
EP.D. / EK.D.

Electro-proportional control, **series 53**



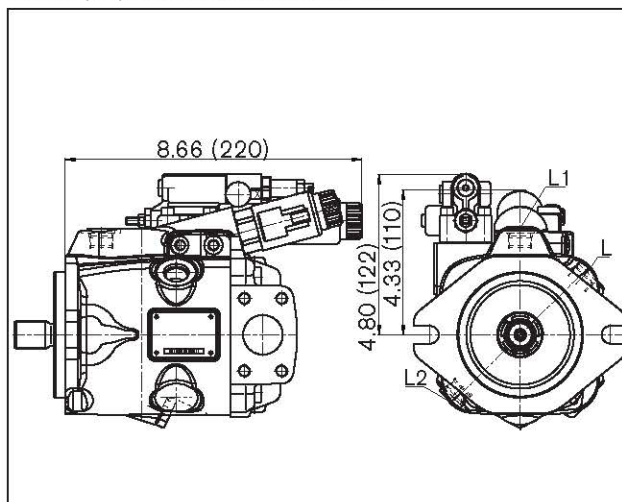
DRF/DRS

Pressure and flow control, **series 53**



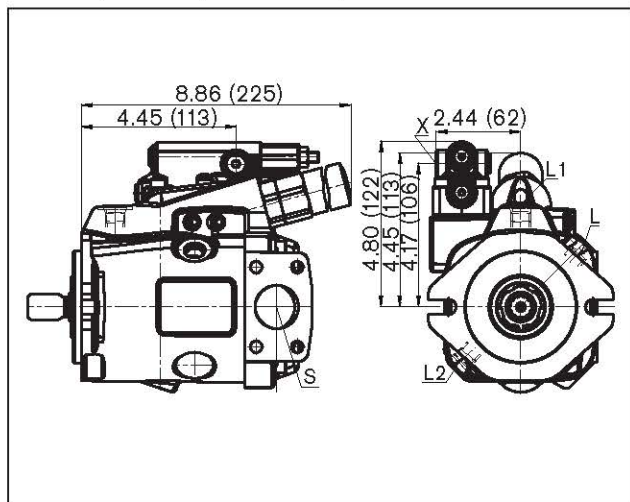
EP.ED / EK.ED

Electro-proportional control, **series 53**



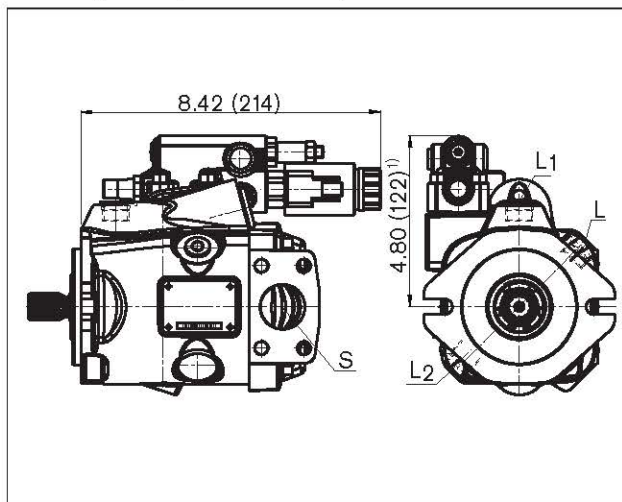
LA.D.

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



ED7. / ER7.

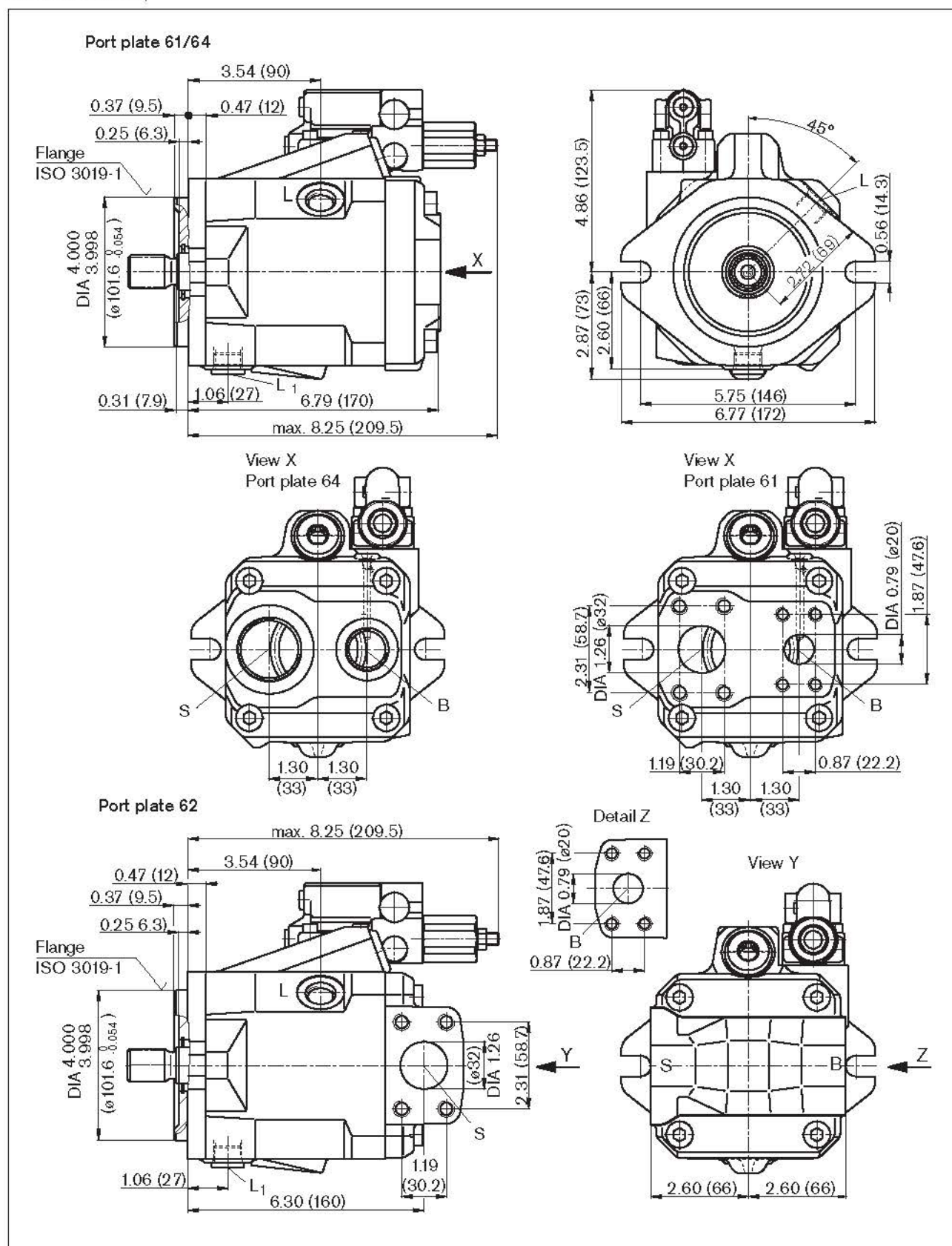
Electro-hydraulic pressure control, **series 53**



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

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

Clockwise rotation.



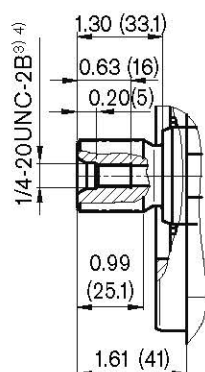
1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

Dimensions, size 28

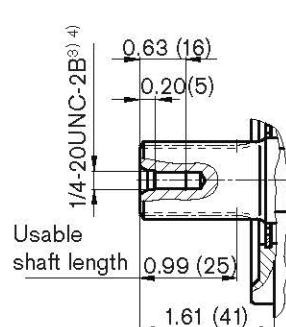
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

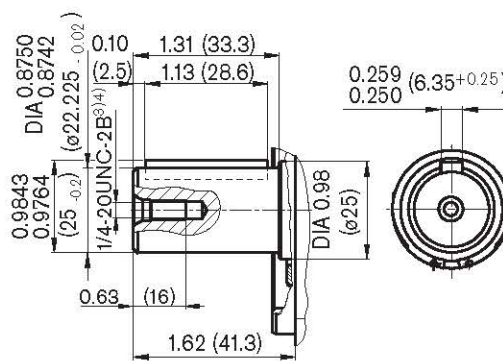
S Splined shaft 7/8 in
13T 16/32DP¹⁾ (SAE J744)



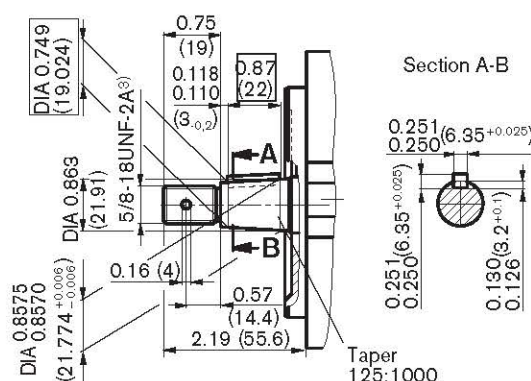
R Splined shaft 7/8 in
13T 16/32DP¹⁾²⁾ (SAE J744)



K⁵⁾ Parallel keyed shaft



C⁵⁾ 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; 079 (20) deep	75 (5)	O
S; Port plate 64	threaded	ISO 11926 ⁷⁾	1 5/8-12UN-2B; 079 (20) deep	75 (5)	O
L	Case drain fluid	ISO 11926 ⁷⁾	3/4-16UNF-2B; 047 (12) deep	30 (2)	O ⁹⁾
L ₁ , L ₂ ⁸⁾	Case drain fluid	ISO 11926 ⁷⁾	3/4-16UNF-2B; 047 (12) deep	30 (2)	X ⁹⁾
X	Control pressure	ISO 11926 ⁷⁾	7/16-20UNF-2B; 045 (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, L₁ or L₂ must be connected

O = Must be connected (plugged on delivery)

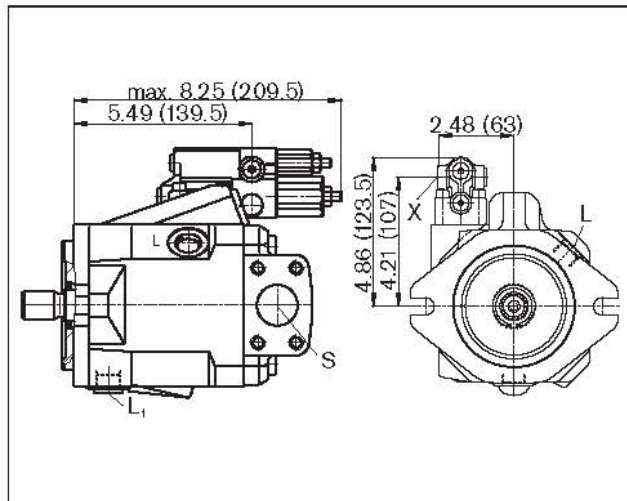
X = Plugged (in normal operation)

Dimensions, size 28

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

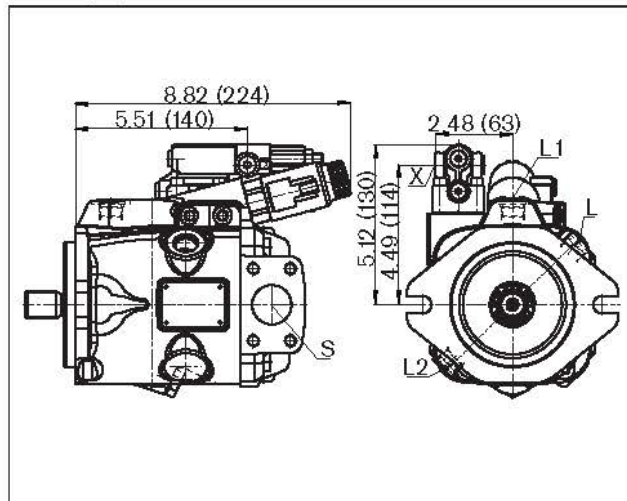
DRG

Pressure controller, remote controlled



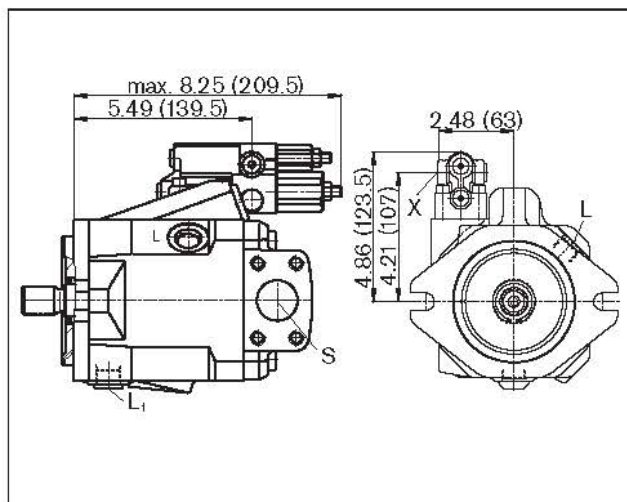
EP.D / EK.D.

Electro-proportional control



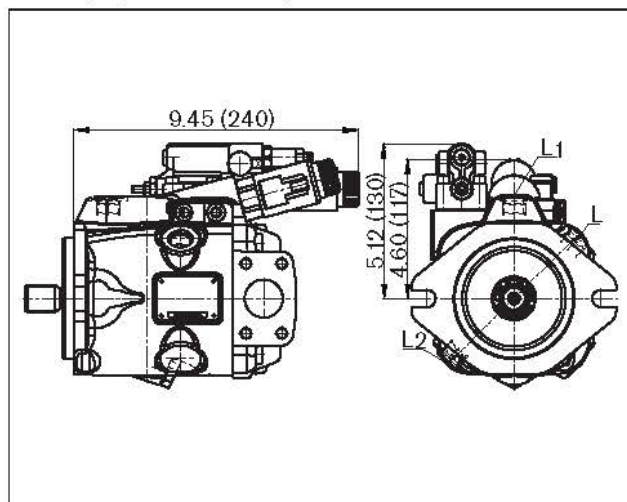
DFR / DFR1

Pressure and flow control



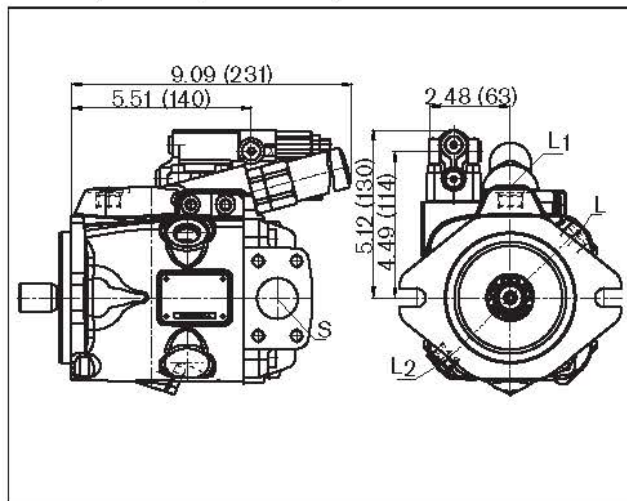
EP.ED / EK.ED

Electro-proportional control



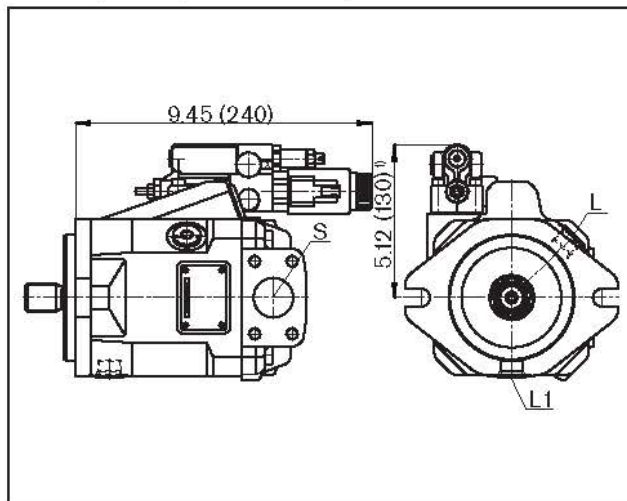
LA.D.

Pressure, flow and power control, series 53



ED7. / ER7.

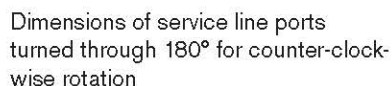
Electro-hydraulic pressure control, series 52



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

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

Dimensions in inches and (mm).

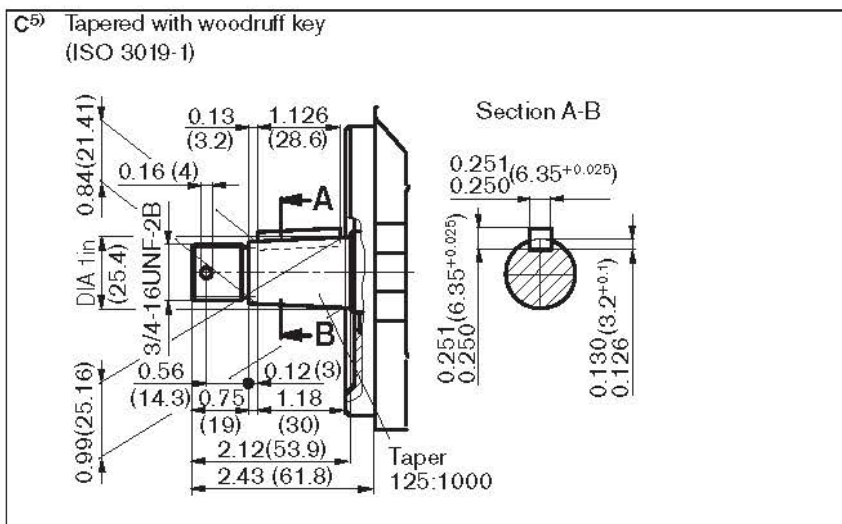
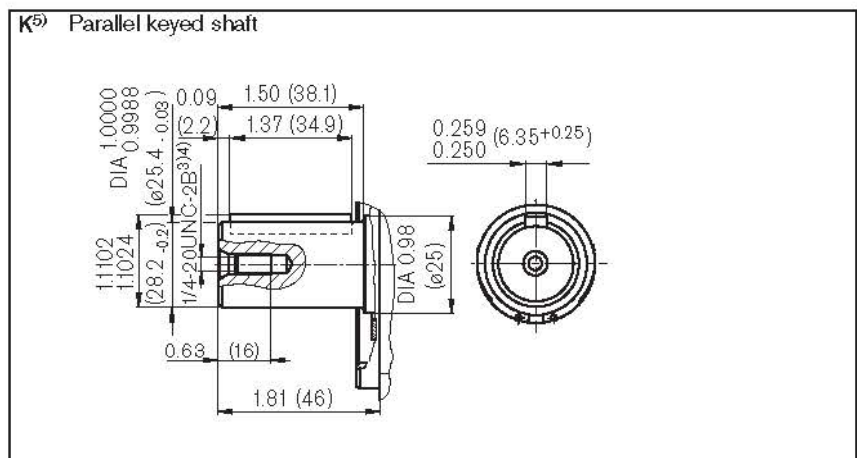
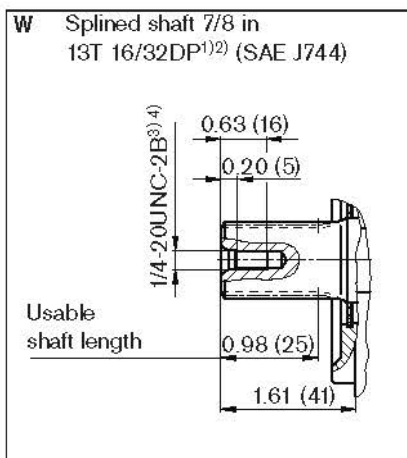
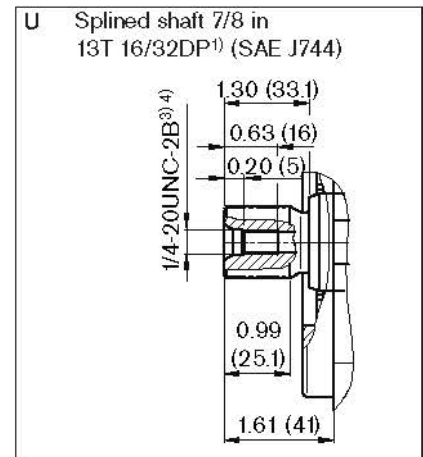
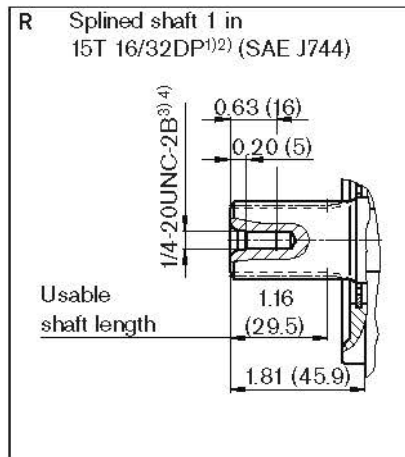
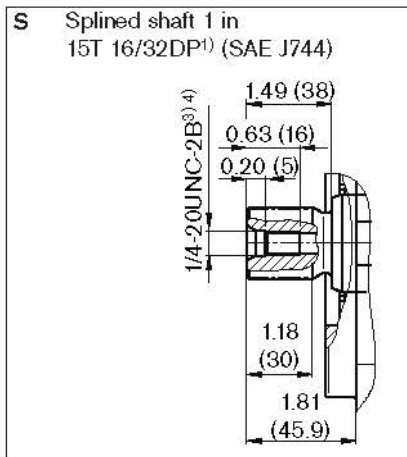


1) Primary dimensions for pump apply for series 52 and 53

Dimensions, size 45

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

Drive shaft



- 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, L₁ or L₂ must be connected

O = Must be connected (plugged on delivery)

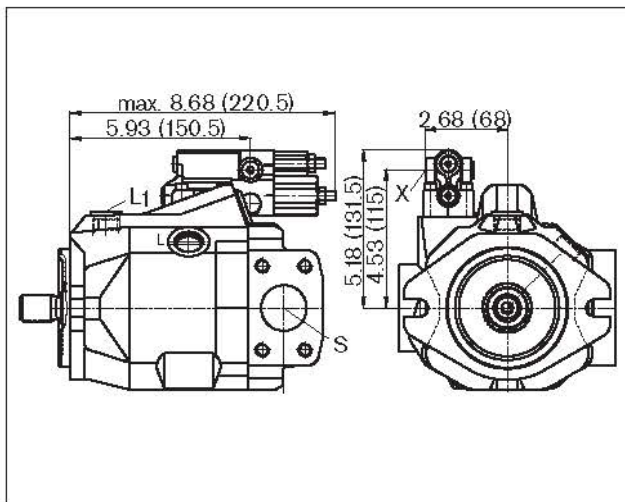
X = Plugged (in normal operation)

Dimensions, size 45

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

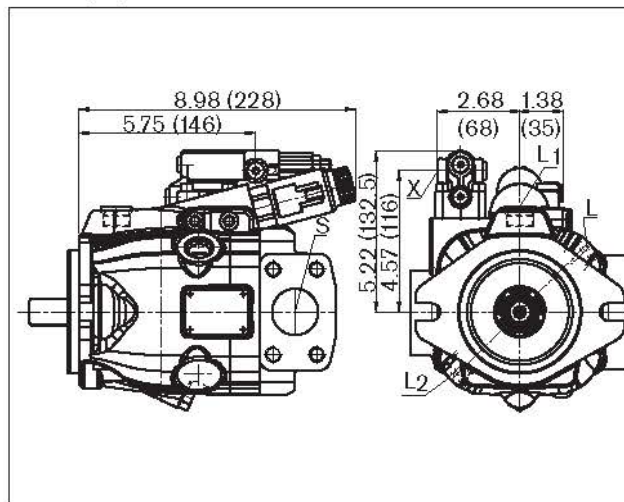
DRG

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



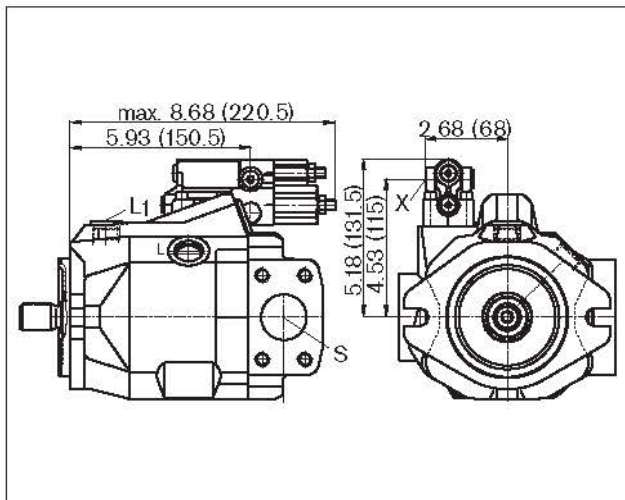
EP.D. / EK.D.

Electro-proportional control, **series 53**



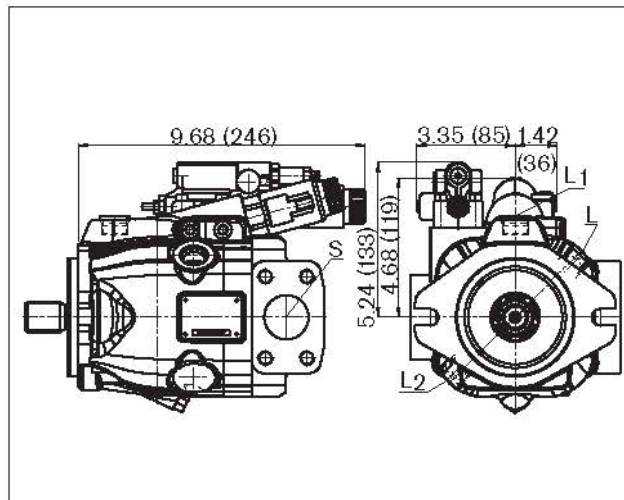
DFR / DFR1

Pressure and flow control, **series 52**



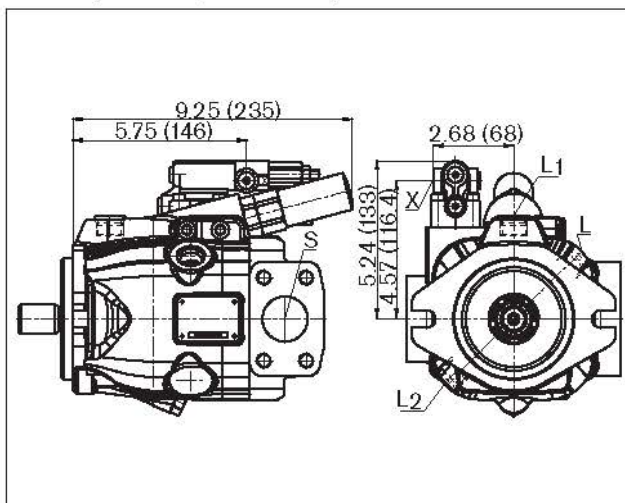
EP.ED / EK.ED

Electro-proportional control, **series 53**



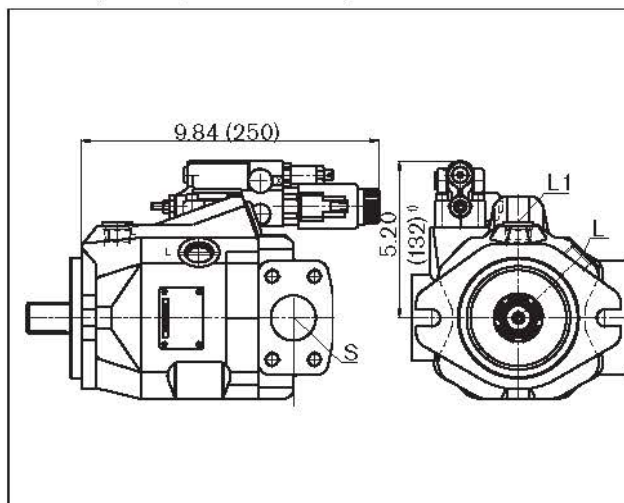
LA.D.

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



ED7. / ER7.

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



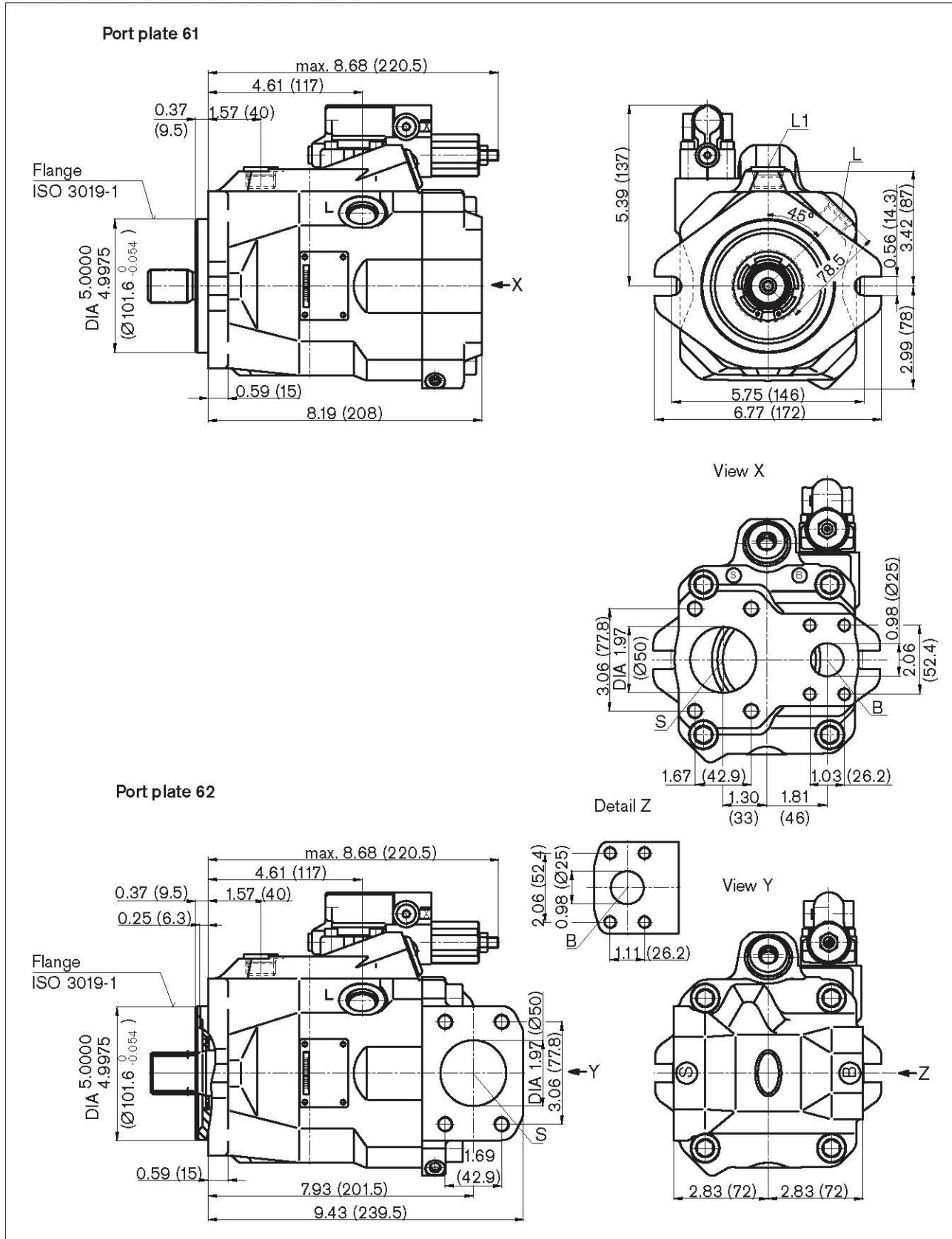
1) ER7.: 6.57 inches (167 mm) if using an intermediate plate pressure controller.

Dimensions, size 60

DR – Hydraulic pressure controller

Mounting flange C, clockwise rotation, series 52

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



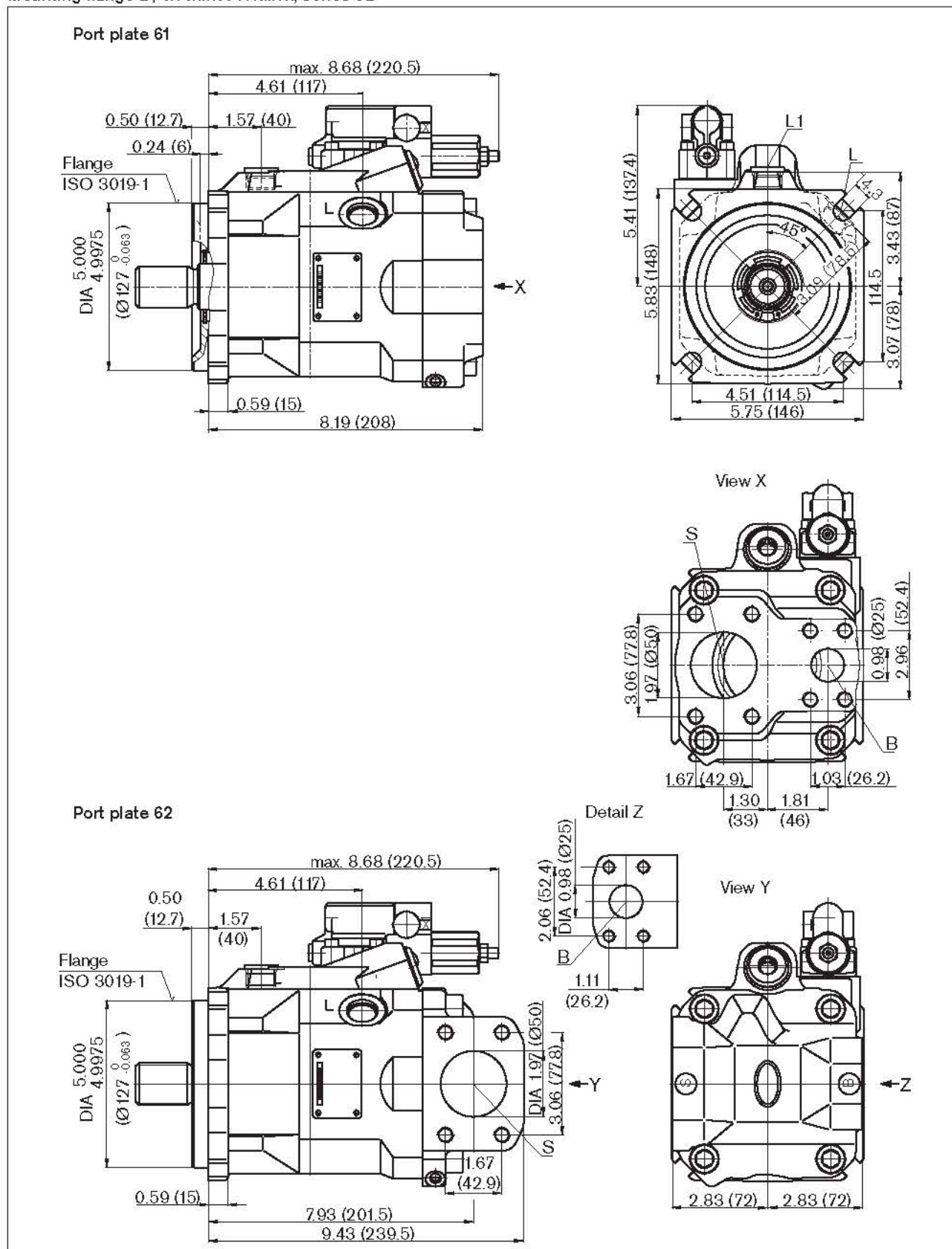
1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

Dimensions, size 60

DR – Hydraulic pressure controller

Mounting flange D, clockwise rotation, series 52

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



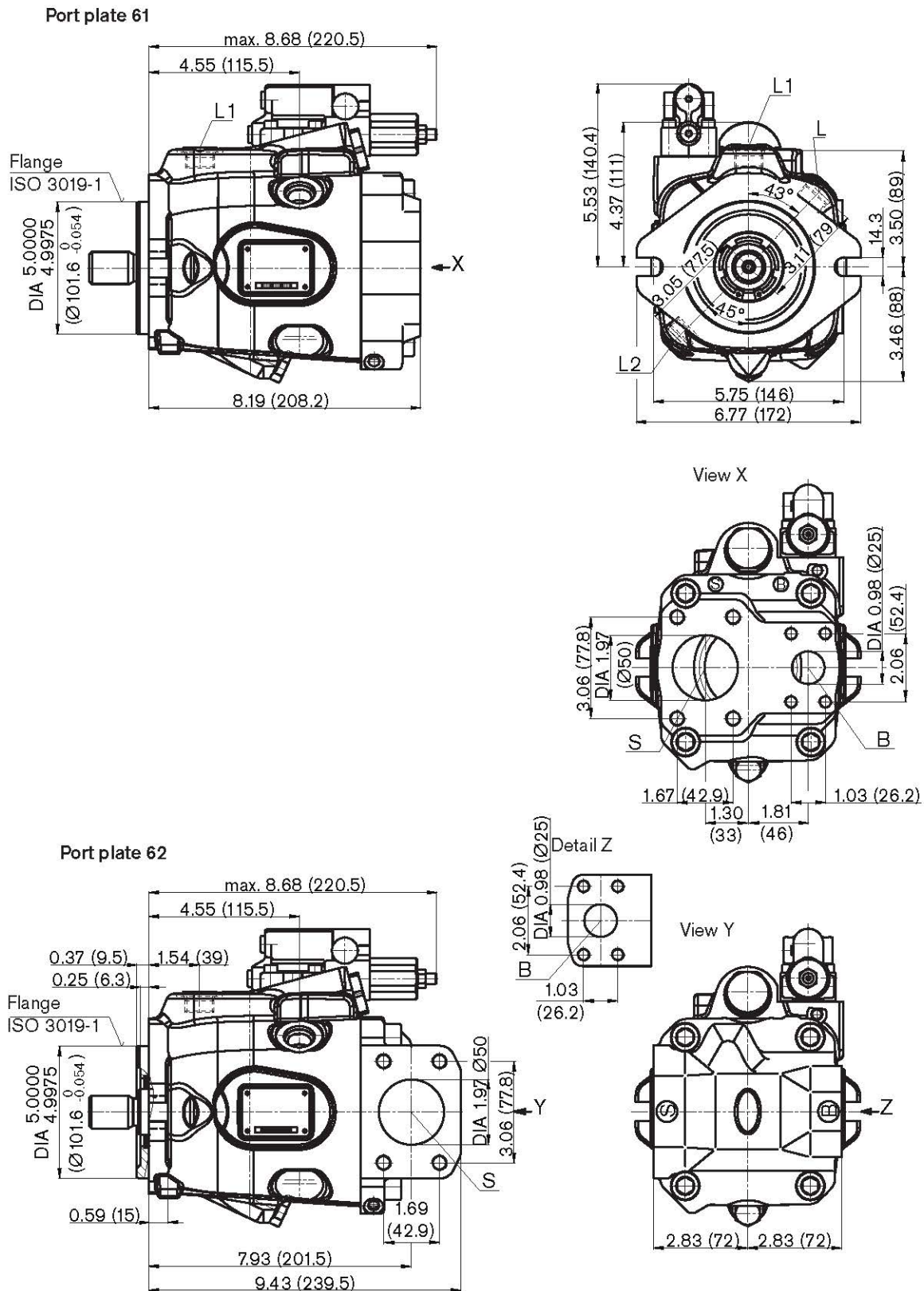
1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

Dimensions, size 63¹⁾

DR – Hydraulic pressure controller

Mounting flange C, clockwise rotation, series 53

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



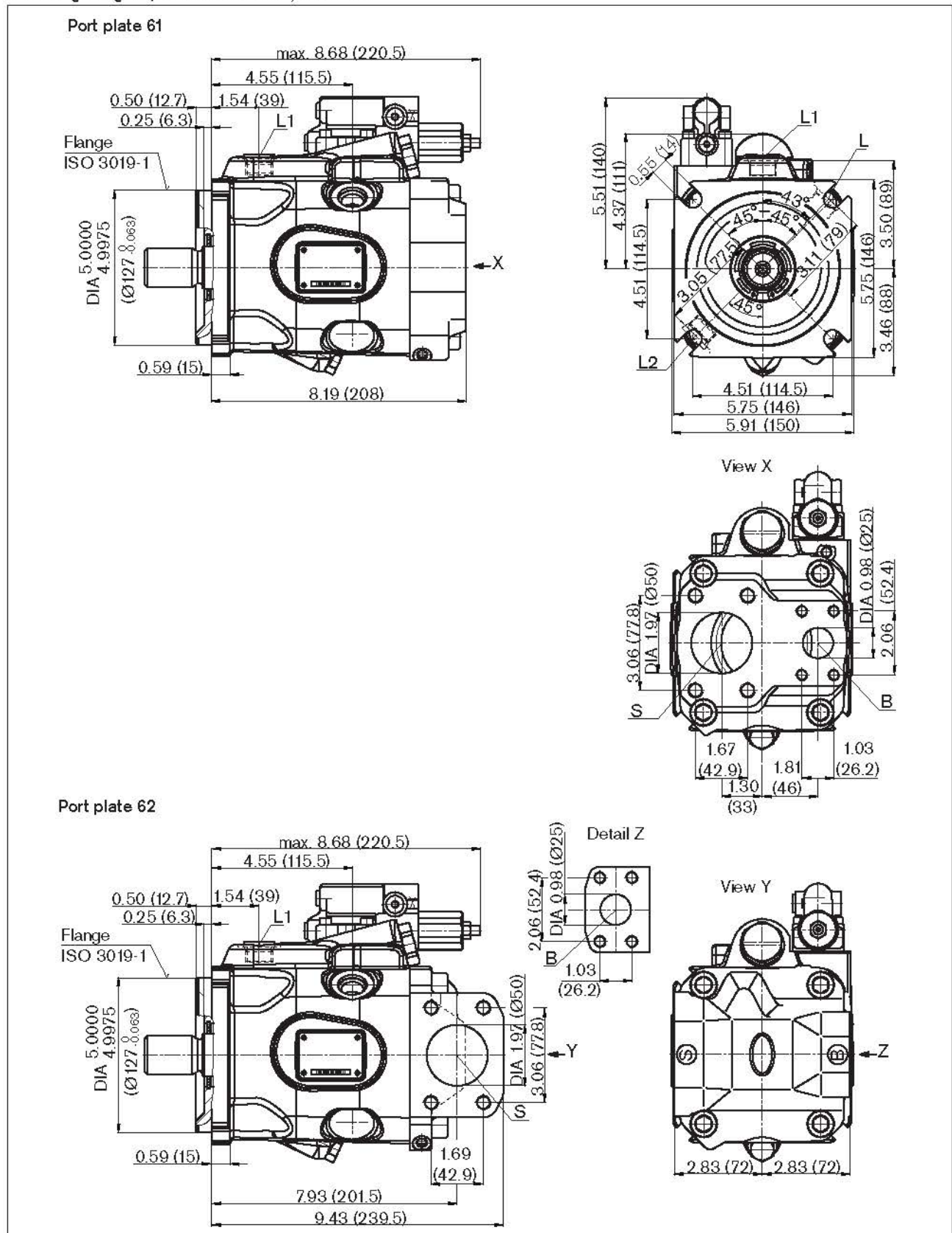
¹⁾ Dimensions of service line ports turned through 180° for counter-clockwise rotation

Dimensions, size 63¹⁾

DR – Hydraulic pressure controller

Mounting flange D, clockwise rotation, series 53

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

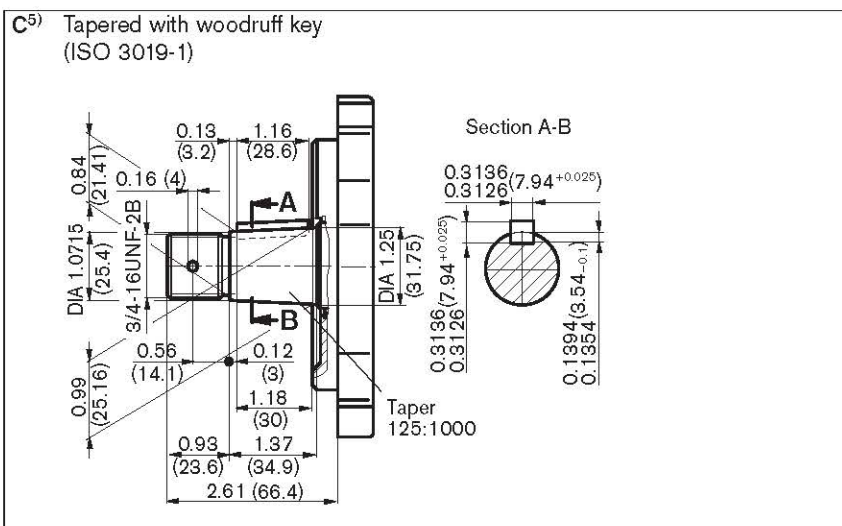
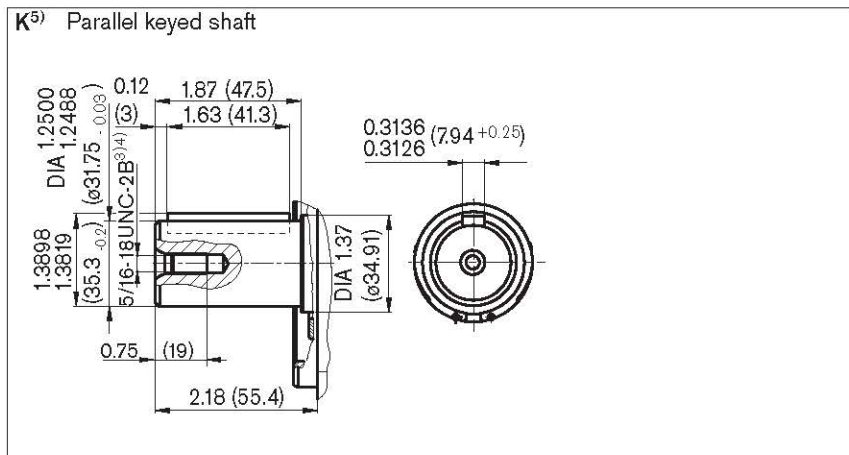
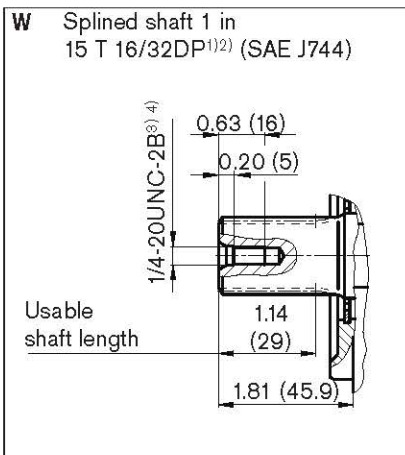
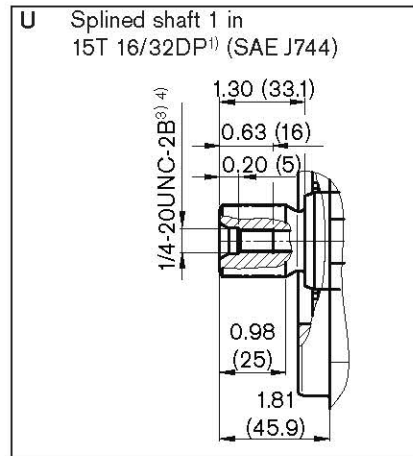
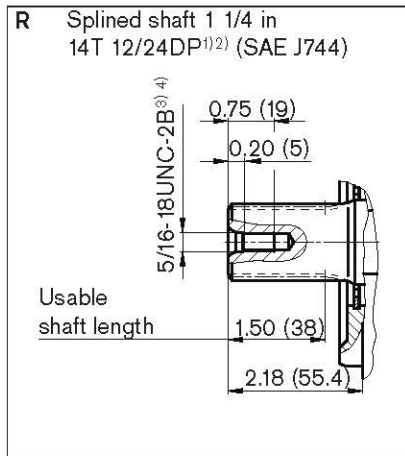
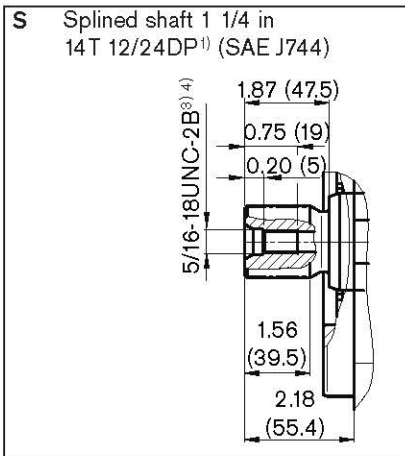


¹⁾ Dimensions of service line ports turned through 180° for counter-clockwise rotation

Dimensions, size 60 / 63

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

Drive shaft



- 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, L₁ or L₂ must be connected

O = Must be connected (plugged on delivery)

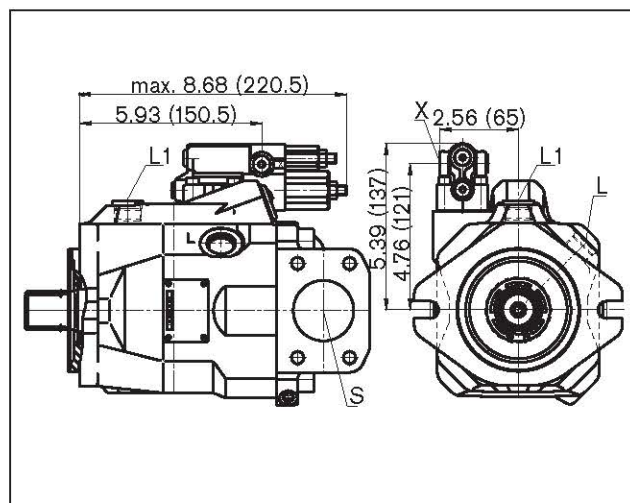
X = Plugged (in normal operation)

Dimensions, size 60 / 63

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

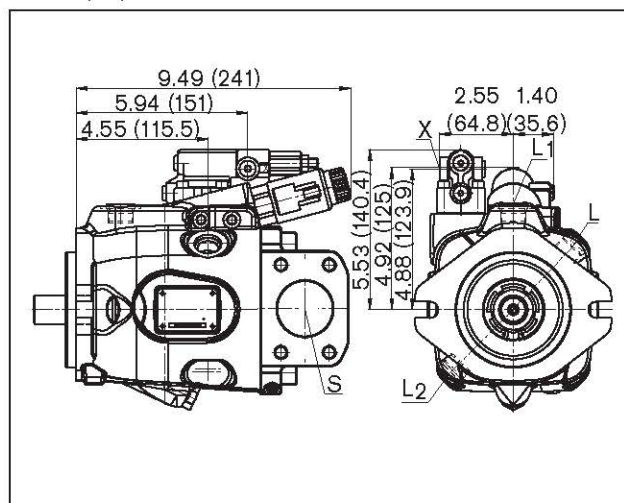
DRG

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



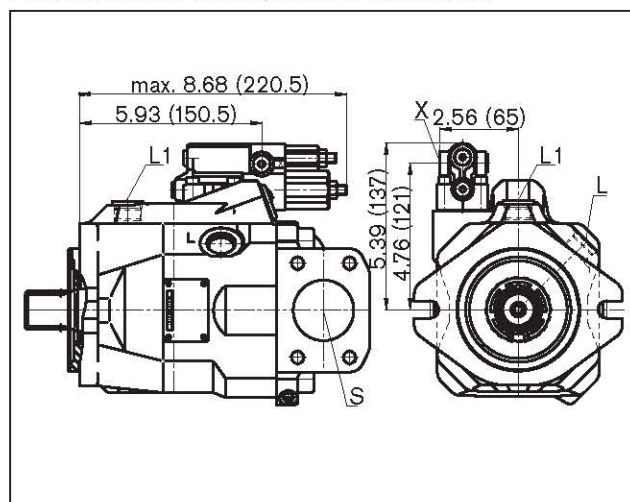
EP.D. / EK.D.

Electro-proportional control, **series 53**



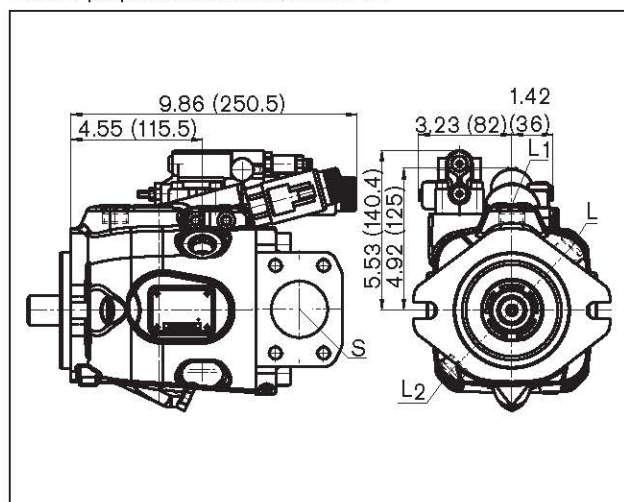
DFR / DFR1 (DRF/DRS)

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



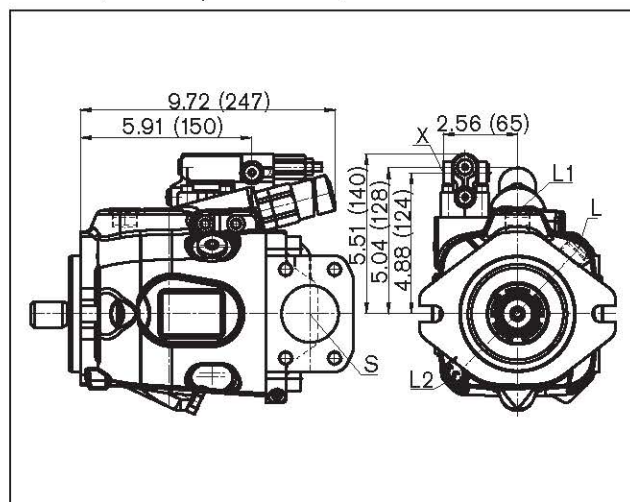
EP.ED / EK.ED

Electro-proportional control, **series 53**



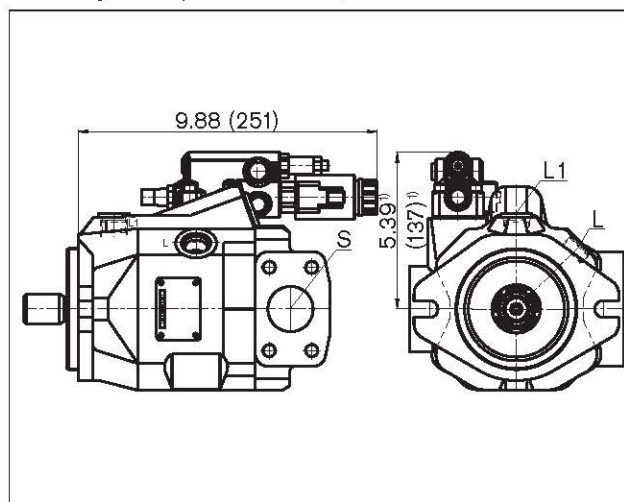
LA.D.

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



ED7. / ER7.

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



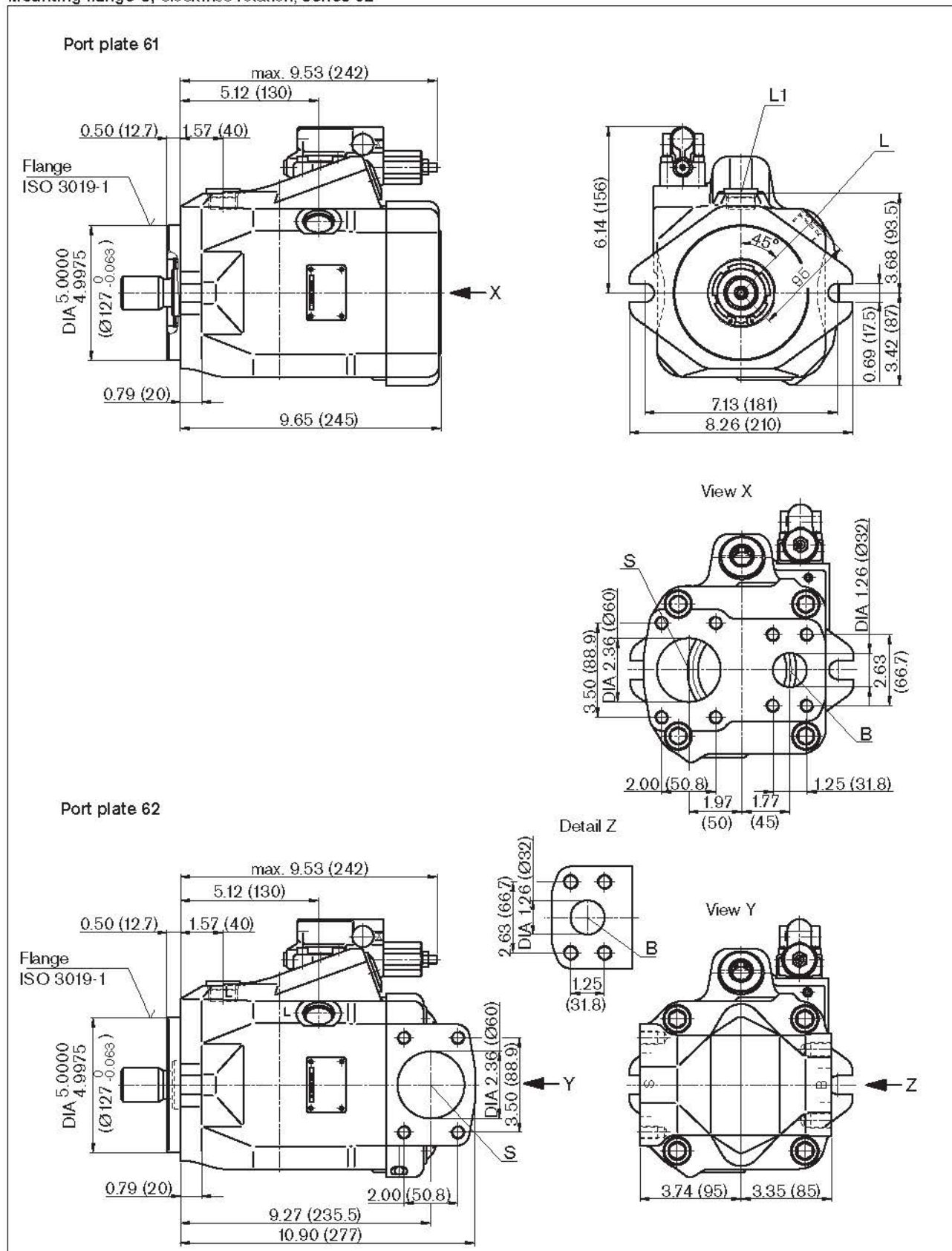
1) ER7.: 6.77 inches (172 mm) if using an intermediate plate pressure controller.

Dimensions, size 85¹⁾

DR – Hydraulic pressure controller

Mounting flange C, clockwise rotation, series 52

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



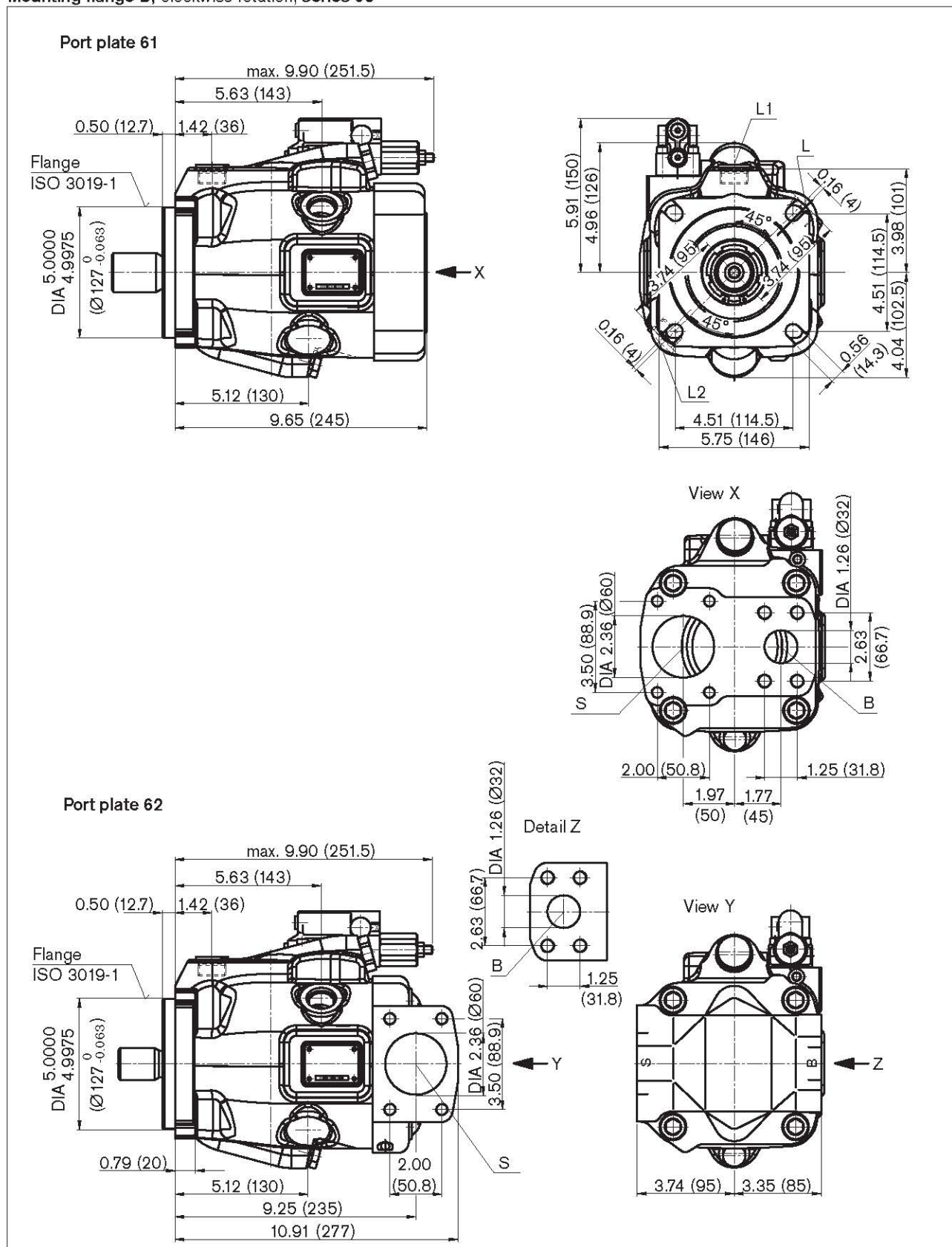
¹⁾ Dimensions of service line ports turned through 180° for counter-clockwise rotation
For details of connection options and drive shafts

Dimensions, size 85¹⁾

DR – Hydraulic pressure controller

Mounting flange D, clockwise rotation, series 53

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

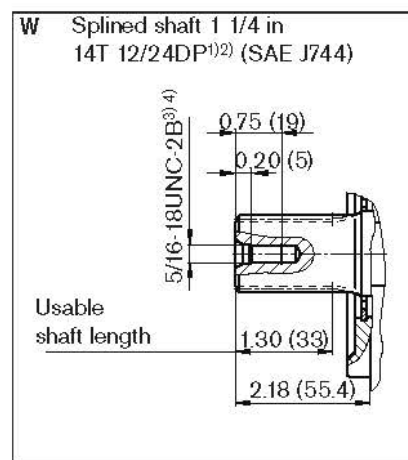
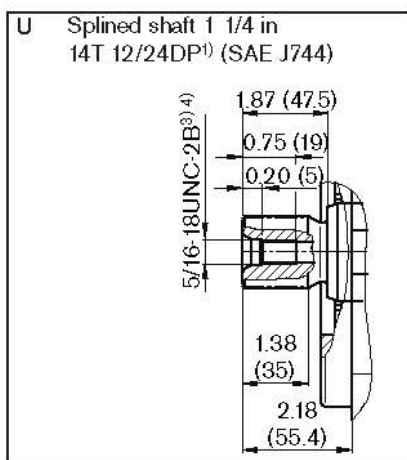
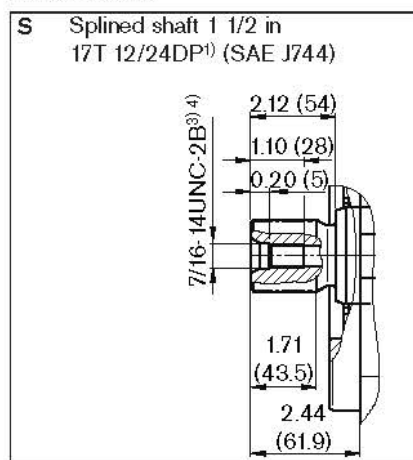


¹⁾ Dimensions of service line ports turned through 180° for counter-clockwise rotation
For details of connection options and drive shafts

Dimensions, size 85

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

Drive shaft



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, L₁ or L₂ must be connected

O = Must be connected (plugged on delivery)

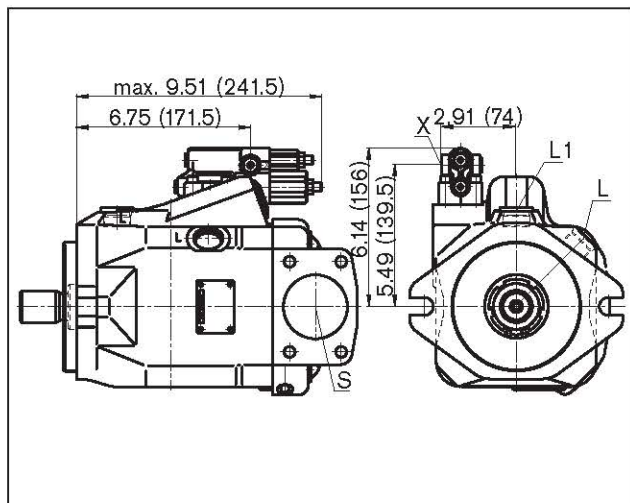
X = Plugged (in normal operation)

Dimensions, size 85, mounting flange C

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

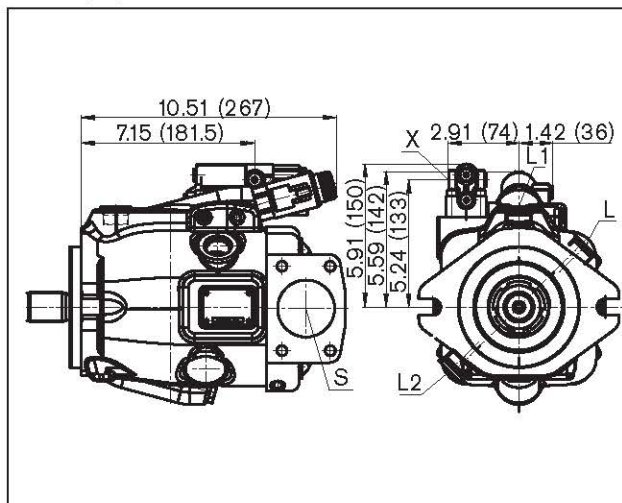
DRG

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



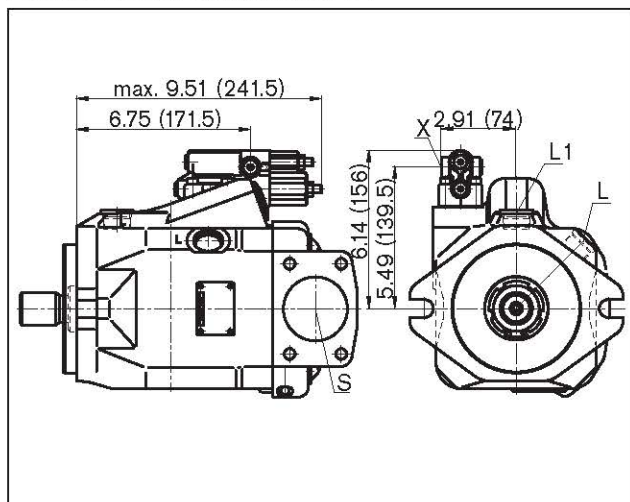
EP.D. / EK.D.

Electro-proportional control, **series 53**



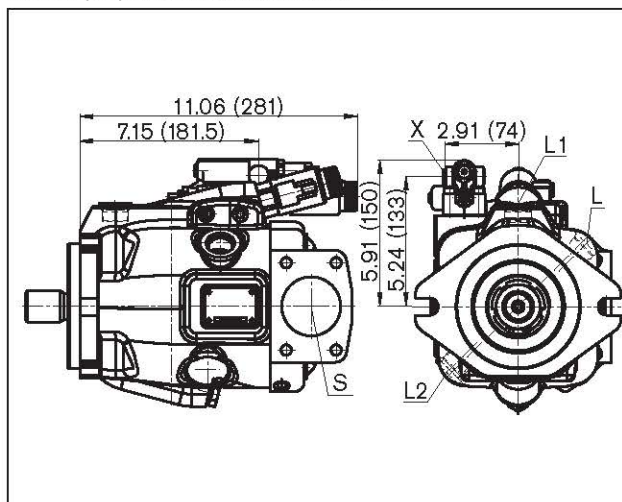
DFR / DFR1

Pressure and flow control, **series 52**



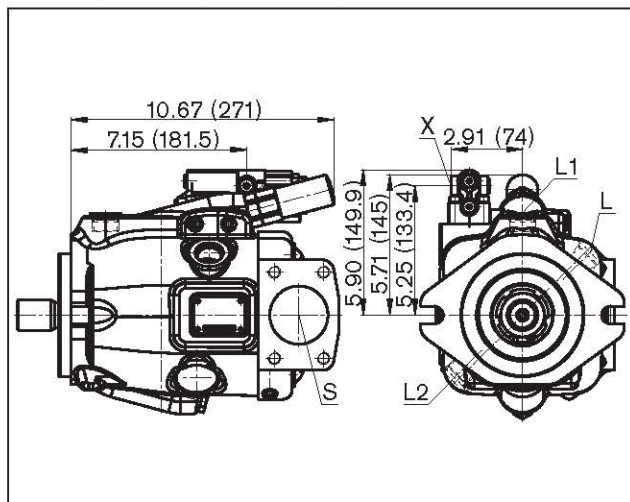
EP.ED / EK.ED

Electro-proportional control, **series 53**



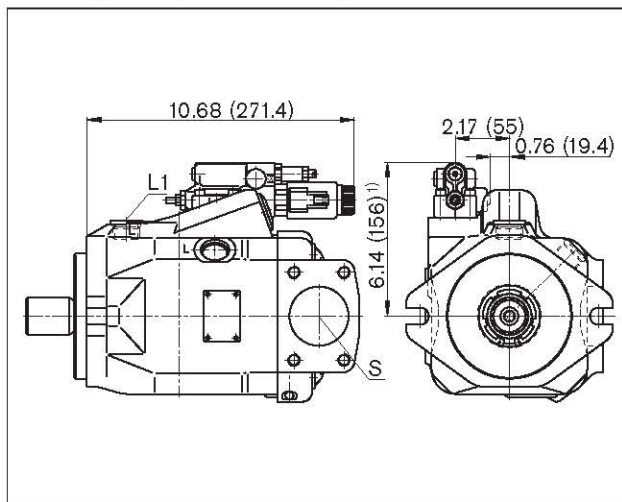
LA.D.

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



ED../ ER..

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



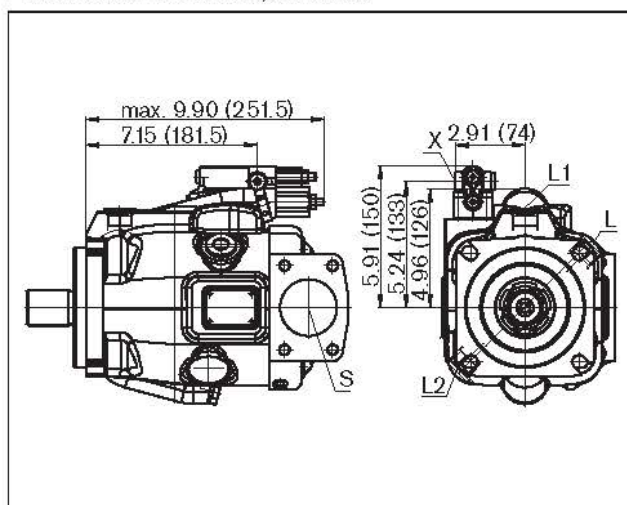
¹⁾ ER7.: 191 mm if using an intermediate plate pressure controller.

Dimensions, size 85, mounting flange D

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

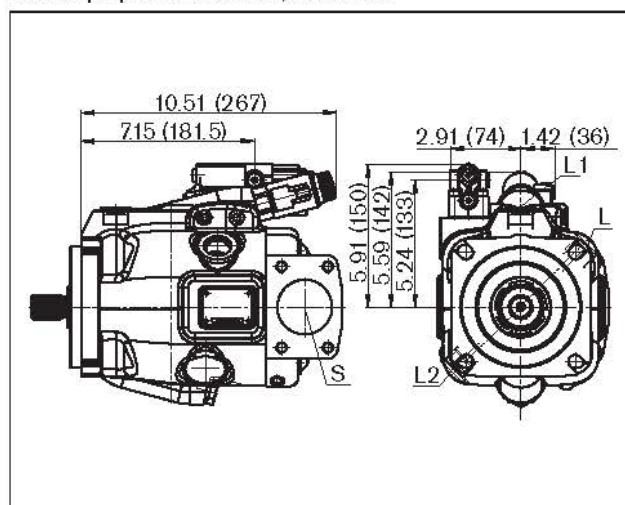
DRF/DRS

Pressure and flow control, **series 53**



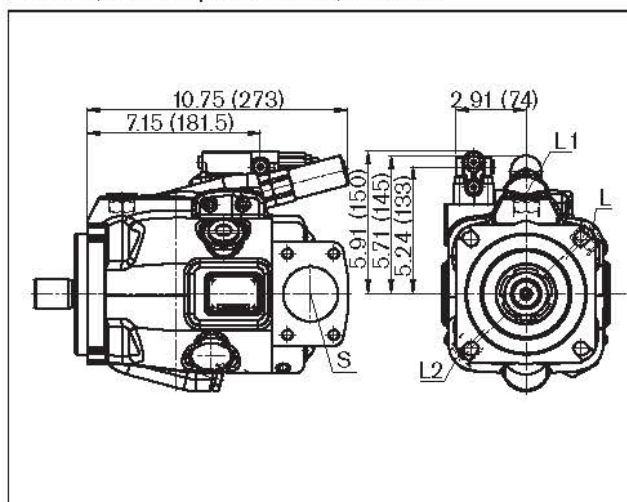
EP.D. / EK.D.

Electro-proportional control, **series 53**



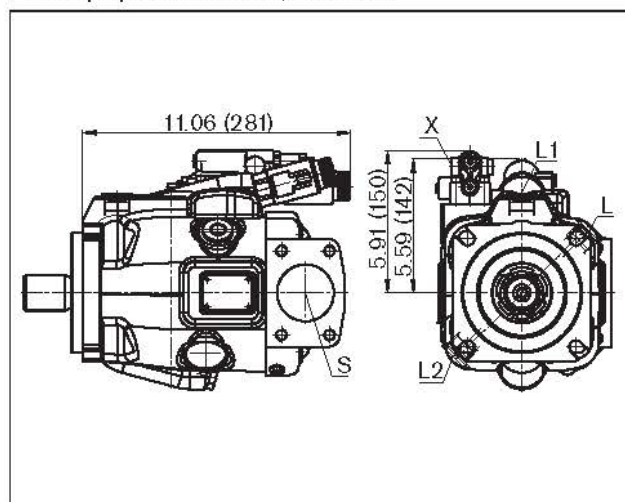
LA.D.

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



EP.ED / EK.ED

Electro-proportional control, **series 53**



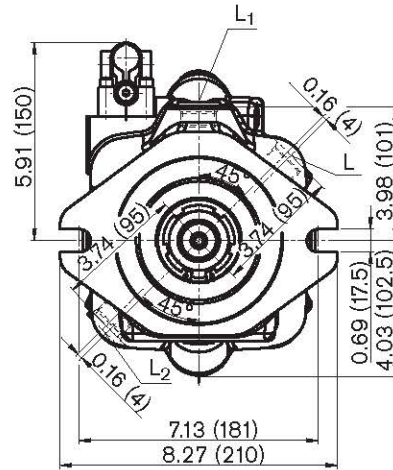
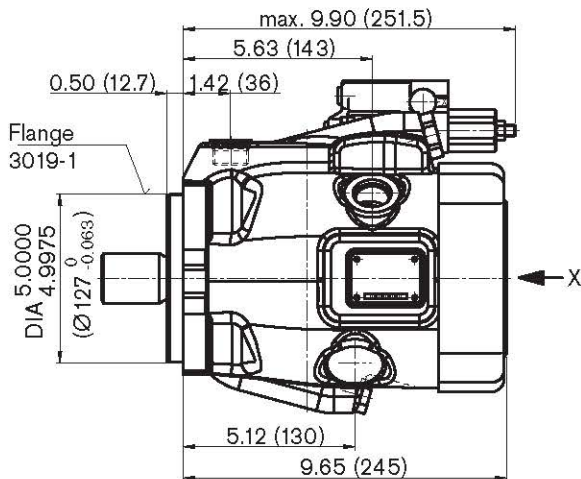
Dimensions, size 100¹⁾

DR – Hydraulic pressure controller

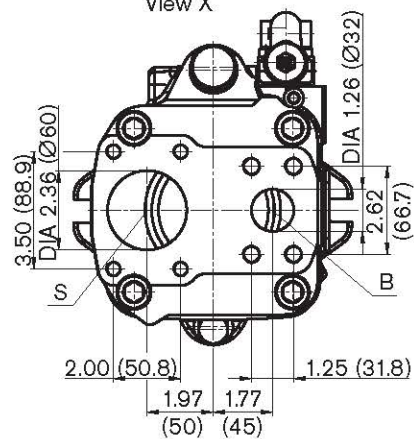
Mounting flange C, clockwise rotation, series 53

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

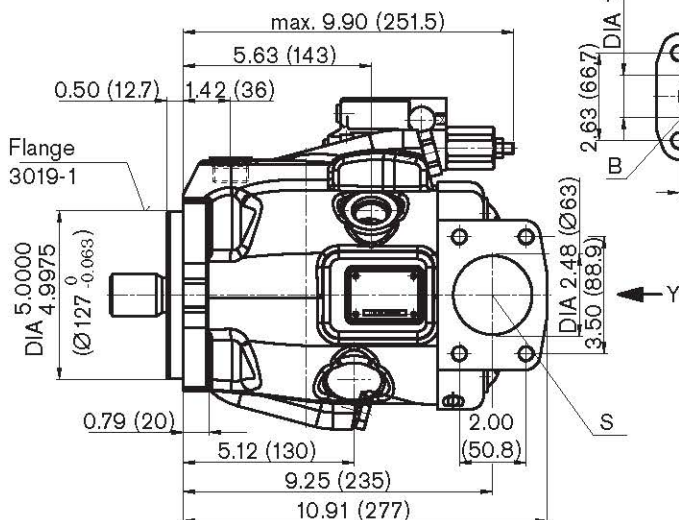
Port plate 61



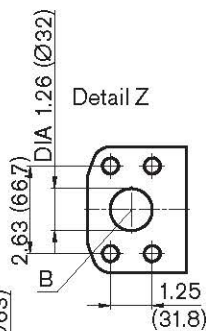
View X



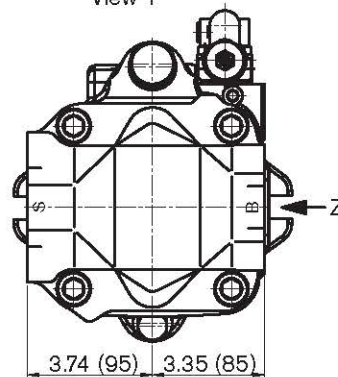
Port plate 62



Detail Z



View Y



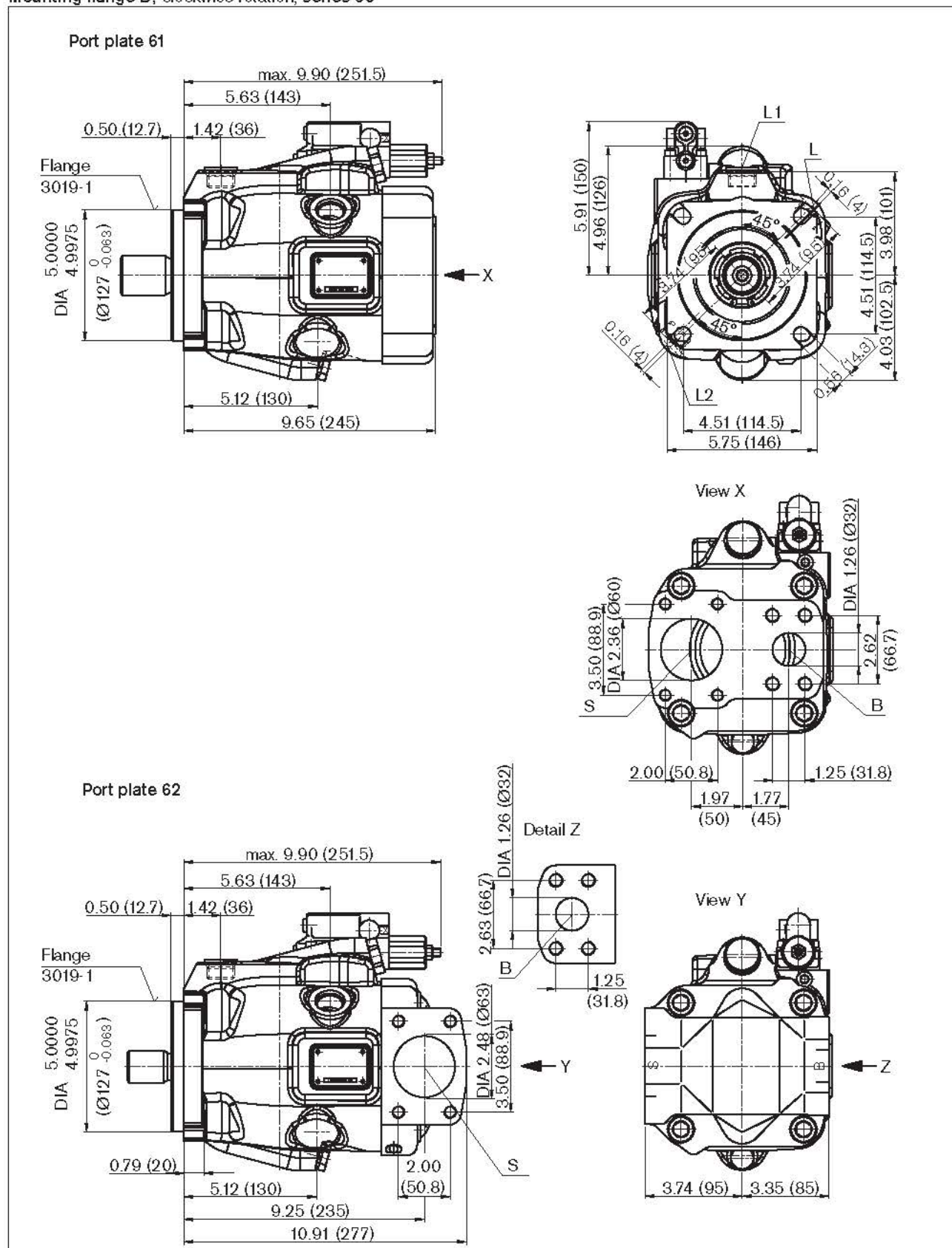
¹⁾ Dimensions of service line ports turned through 180° for counter-clockwise rotation
For details of connection options and drive shafts

Dimensions, size 100¹⁾

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



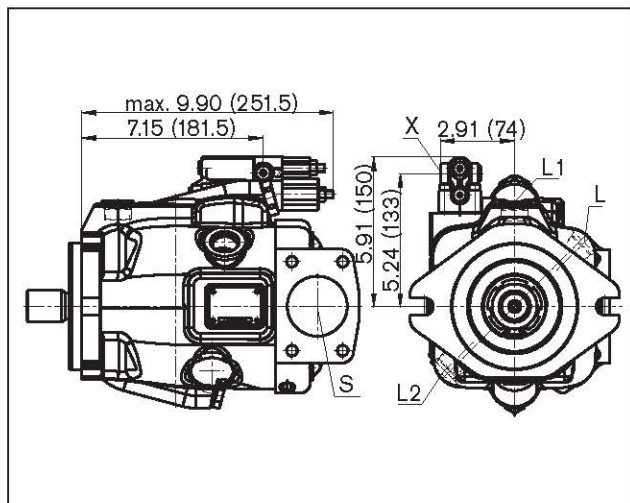
¹⁾ Dimensions of service line ports turned through 180° for counter-clockwise rotation
For details of connection options and drive shafts.

Dimensions, size 100

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

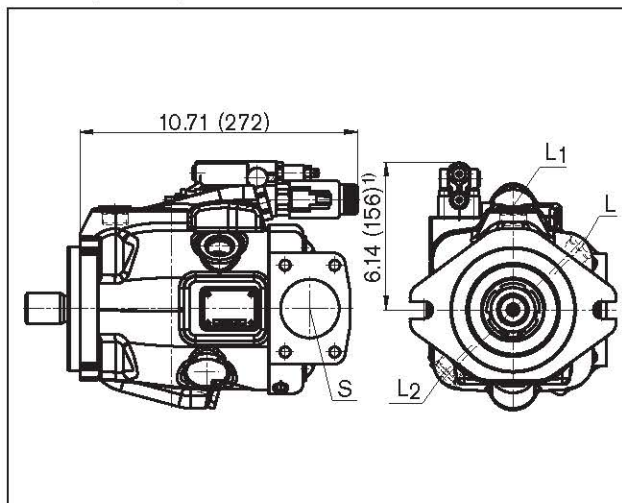
DRG

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



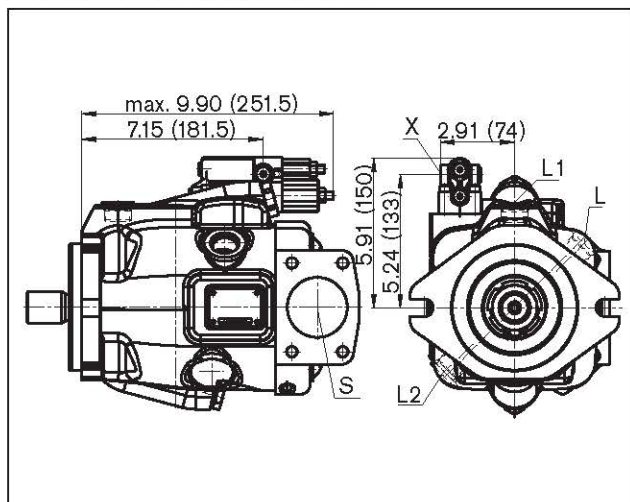
ED../ ER..

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



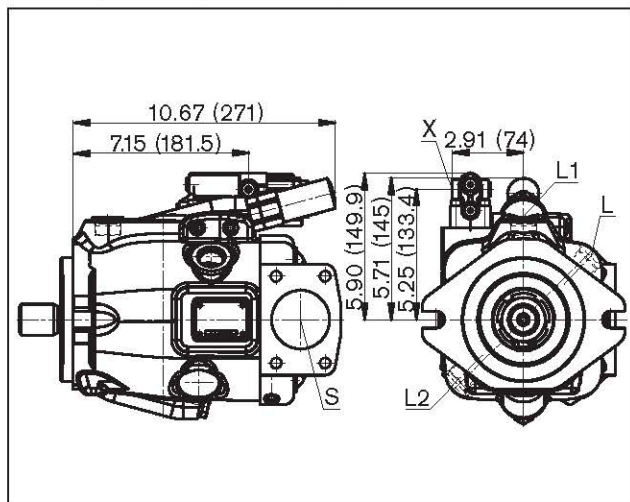
DRF/DRS

Pressure and flow control, **series 53**



L.A.D.

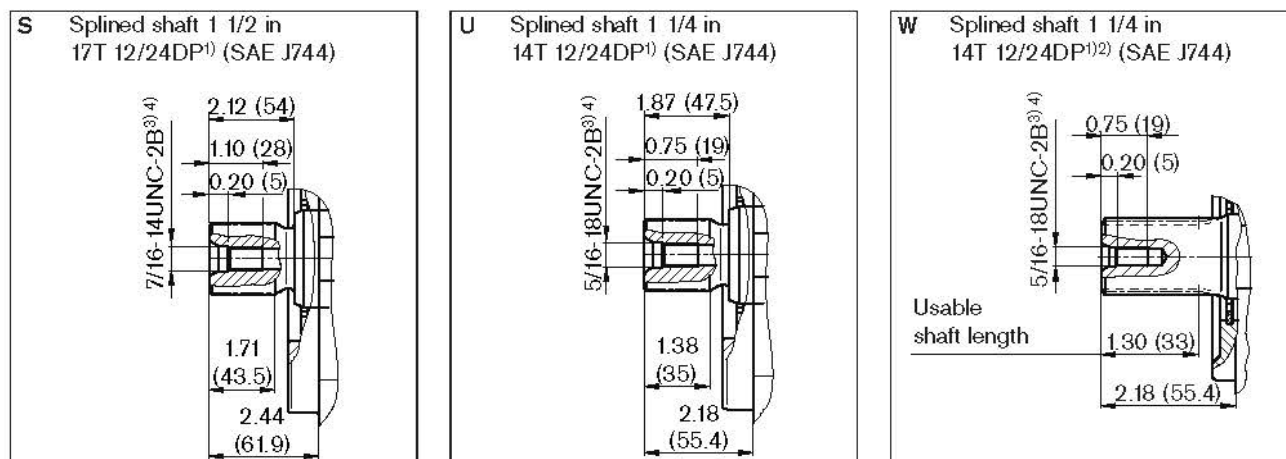
Pressure, flow and power control, **series 53**



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

Dimensions, size 100

Drive shaft



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, L₁ or L₂ must be connected

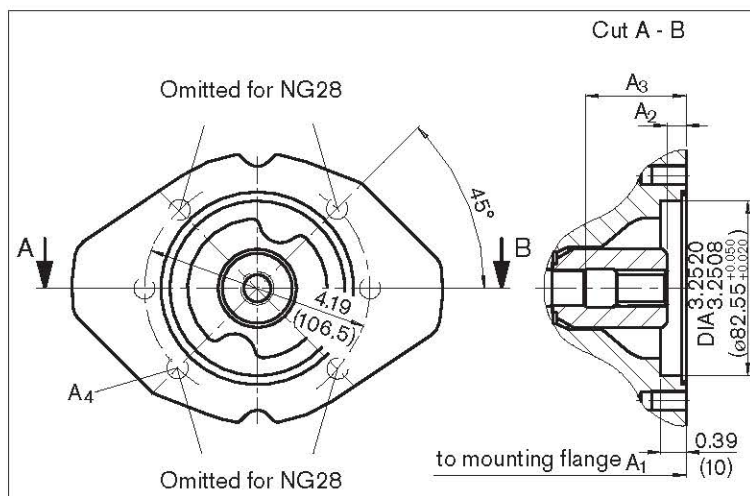
O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

Dimensions through drive

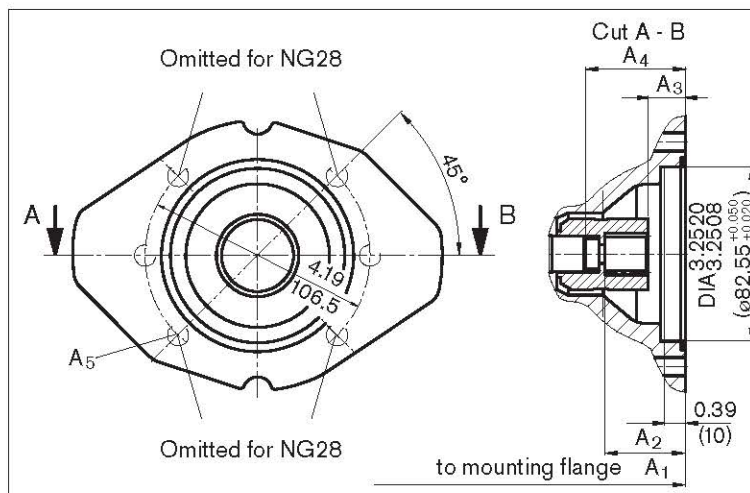
K01 flange SAE J744 - 82-2 (A)

Coupling for splined shaft in accordance with ANSI B92.1a-1996



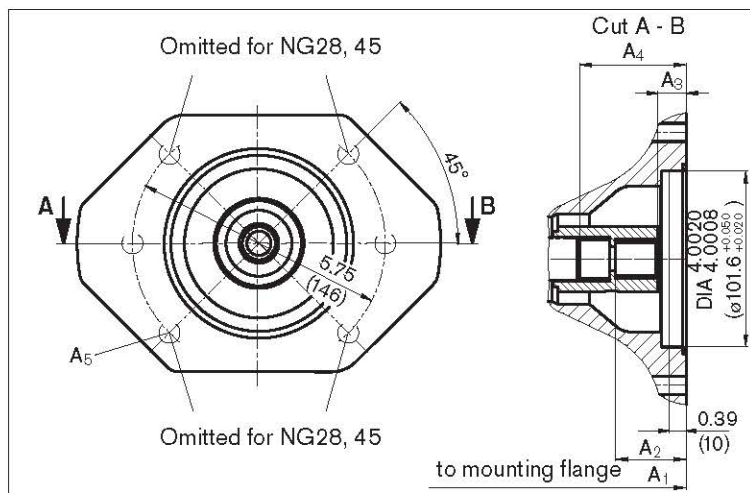
K52 flange SAE J744 - 82-2 (A)

Coupling for splined shaft in accordance with ANSI B92.1a-1996



K68 flange SAE J744 - 101-2 (B)

Coupling for splined shaft in accordance with ANSI B92.1a-1996



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

5/8 in 9T 16/32 DP¹⁾ (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

3/4 in 11T 16/32 DP¹⁾ (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

7/8 in 13T 16/32 DP¹⁾ (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

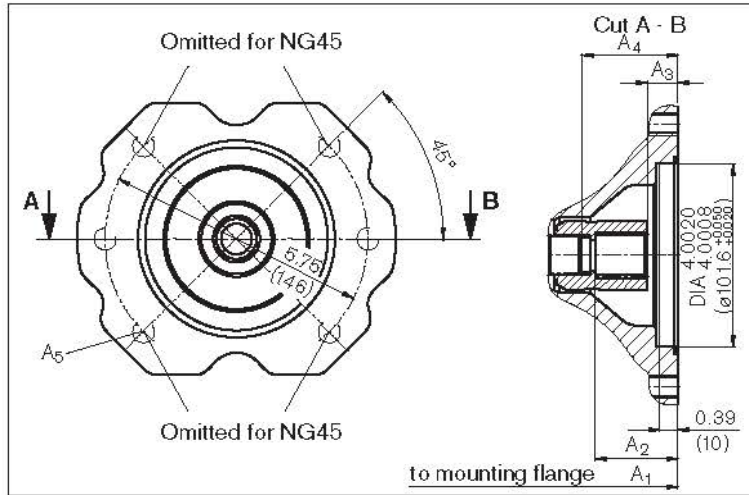
1) 30° pressure angle, flat base, flank centering, tolerance class 5

2) Thread according to DIN 13, observe the general instructions on FINAL PAGE must be observed.

Dimensions through drive

K04 flange SAE J744 - 101-2 (B)

Coupling for splined shaft in accordance with ANSI B92.1a-1996



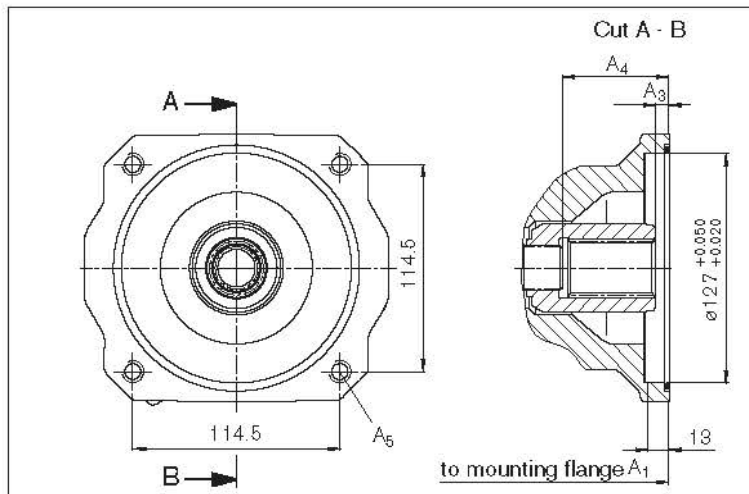
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

1 in 15T 16/32 DP¹⁾ (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

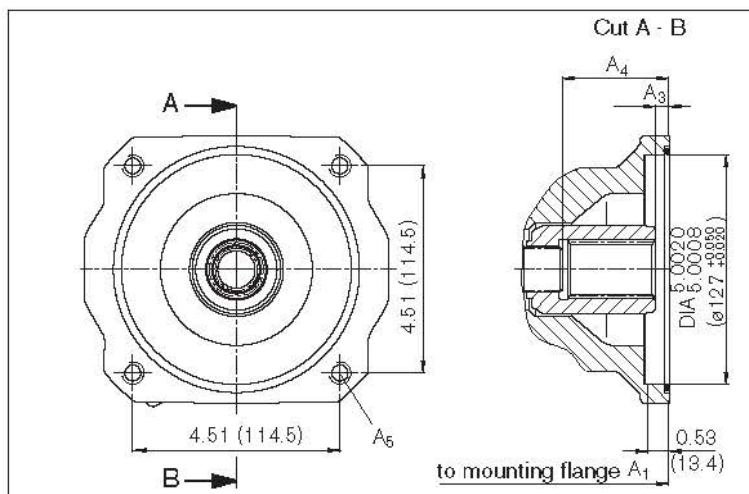


1 1/4 in 14T 12/24 DP¹⁾ (SAE J744 - 32-4 (C))

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 DP¹⁾ (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

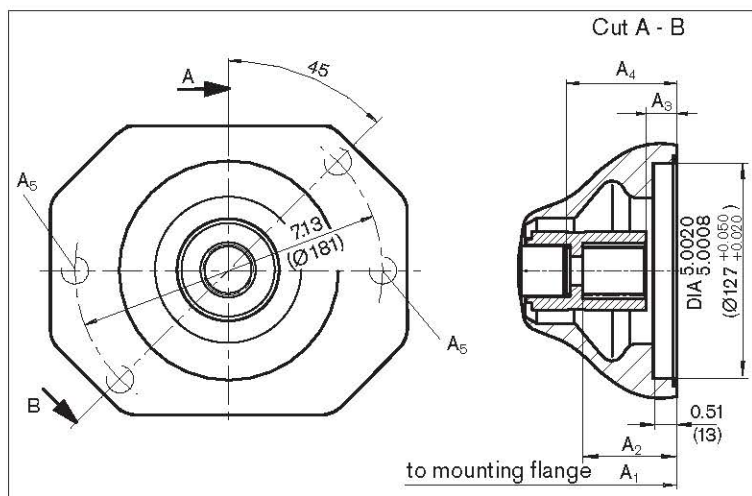
1) 30° pressure angle, flat base, flank centering, tolerance class 5

2) Thread according to DIN 13, observe the general instructions on FINAL PAGE must be observed.

Dimensions through drive

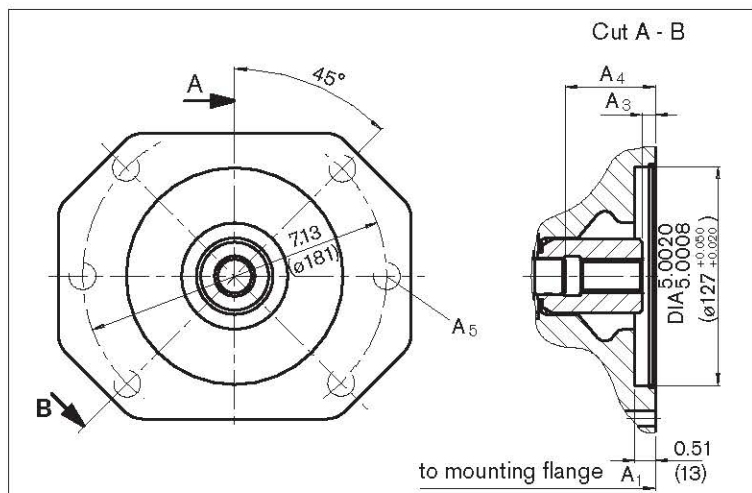
K07 flange SAE J744 - 127-2 (C)

Coupling for splined shaft in accordance with ANSI B92.1a-1996



K24 flange SAE J744 - 127-2 (C)

Coupling for splined shaft in accordance with ANSI B92.1a-1996



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

1 1/4 in 14T 12/24 DP¹⁾ (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 1/2 in 17T 12/24 DP¹⁾ (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			Through drive available for NG
Flange	Coupling for splined shaft	Short des.	PA10V(S)O/5x NG (shaft)	PA10VO/31 NG (shaft)	Gear pump design (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+

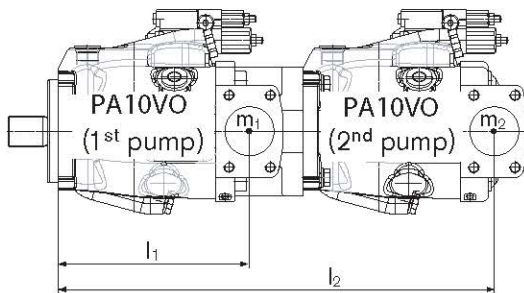
PA10VO45DRF/53R-VSC11N00

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/s ²)	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. 2 nd 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)]

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

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

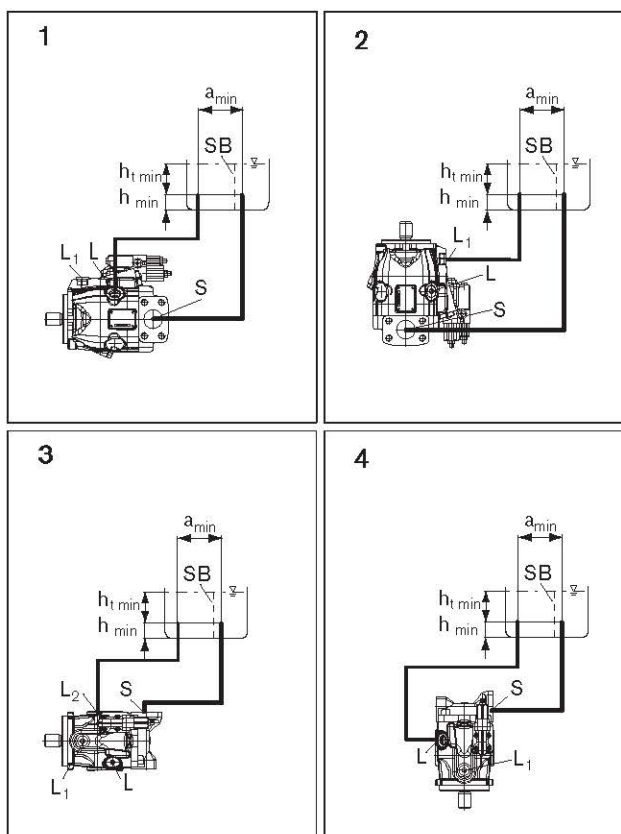
See the following examples 1 to 12.

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

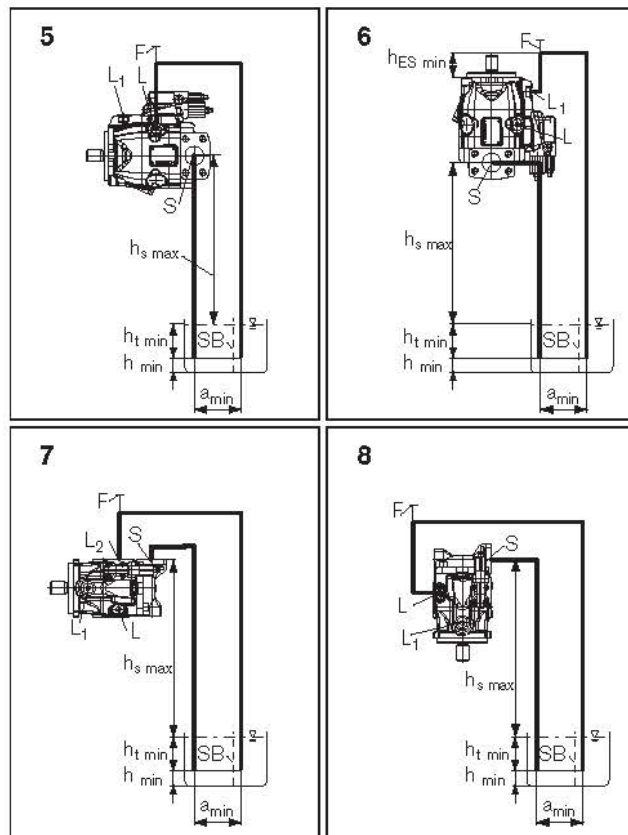
Above-reservoir installation

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.



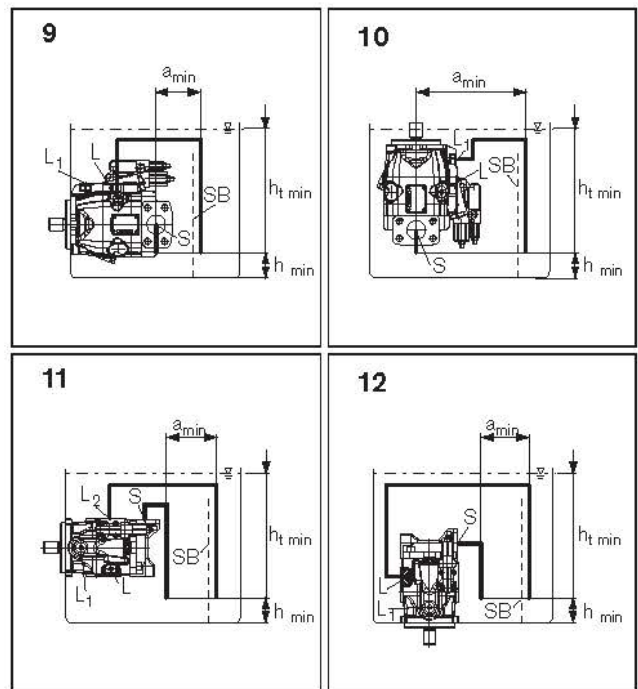
Installation position	Air bleed	Filling
5	F	L, L ₁ (F)
6	F	L ₁ (F)
7 ¹⁾	F	S + L ₂ (F)
8	F	S + L (F)

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, L₁** Case drain port
- SB** Baffle (baffle plate)
- ht min** Minimum necessary immersion depth (7.87 in (200 mm))
- h min** Minimum necessary spacing to reservoir base (3.94 in (100 mm))
- hES min** Minimum necessary height needed to protect the axial piston unit from draining (0.98 in (25 mm)).
- hS 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_W 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_W	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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