

Axial Piston Variable Pump A10V(S)O (US-Version)

RA-A 92701/03.12 1/52
Replaces: 12.09

Data sheet

Series 31
Size NG18 ((A)A10VSO)
Size NG28 to 140 (A10VO)
Nominal pressure 4000 psi (280 bar)
Maximum pressure 5100 psi (350 bar)
Open circuit



Contents

Type code for standard program	2
Technical data	4
DG – Two-point control, directly operated	10
DR – Pressure control	11
DRG – Pressure control, remotely operated	12
DFR/DFR1 – Pressure and flow control	13
DFLR – Pressure, flow and power control	14
ED – Electro-hydraulic pressure control	15
ER – Electro-hydraulic pressure control	16
Dimensions size 18 to 140	18
Dimensions through drive	42
Summary mounting options	45
Combination pumps A10VO + A10VO	46
Connector for solenoids	47
Installation instructions	48
General instructions	52

Features

- Variable pump in axial piston swashplate design for hydrostatic drives in an open circuit
- The flow is proportional to the drive speed and the displacement.
- The flow can be steplessly varied by adjustment of the swashplate angle.
- 2 case drain ports
- Excellent suction characteristics
- Low noise level
- Long service life
- Favorable power/weight ratio
- Versatile controller range
- Short control time
- The through drive is suitable for adding gear pumps and axial piston pumps up to the same size, i.e., 100% through drive.

Type code for standard program

		O			/	31		-	V					
01	02	03	04	05		06	07		08	09	10	11	12	13

Version

Version		18	28	45	71	100	140	
01	Standard version (without symbol)	●	●	●	●	●	●	
	High-speed version	—	—	●	●	●	●	H

Axial piston unit

02	Swashplate design, variable, nominal pressure 4000 psi (280 bar), maximum pressure 5100 psi (350 bar)	●	–	–	–	–	–	A10VS
		–	●	●	●	●	●	A10V

Operation mode

03	Pump, open circuit	0
----	--------------------	---

Size (NG)

04	Geometric displacement, see table of values on pages 6 and 7	18	28	45	71	100	140
----	--	----	----	----	----	-----	-----

Control device

	Two-point control, directly operated	●	●	●	●	●	●	DG
	Pressure control	●	●	●	●	●	●	DR
	with flow control, hydraulic							
	X-T open	●	●	●	●	●	●	DFR
	X-T closed	●	●	●	●	●	●	DFR1
	with flow and differential pressure control, electrically variable	○	●	●	●	●	-	EF ¹⁾
	with pressure cut-off, remotely operated							
	hydraulic	●	●	●	●	●	●	DRG
	electrical negative characteristic	●	●	●	●	●	●	ED71
	24V	●	●	●	●	●	●	ED72
	positive characteristic	●	●	●	●	●	●	ER71 ²⁾
	24V	●	●	●	●	●	●	ER72 ²⁾
	Pressure, flow and power control	-	●	●	●	●	●	DFLR

Series

06	Series 3, Index 1	31
----	-------------------	----

Direction of rotation

07	Viewed on drive shaft	clockwise	R
		counter clockwise	L

Seals

08	FKM (fluor-caoutchouc)	V
----	------------------------	---

1) See RE 92709

2) 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.

- A sandwich plate pressure reducing valve can be used to protect the pump in the event of overflow.

An accessory kit with sandwich plate pressure reducing valve can be ordered from Rexroth under part number R902490825.

Type code for standard program

		O			/	31		-	V					
01	02	03	04	05		06	07		08	09	10	11	12	13

Drive shaft

			18	28	45	71	100	140	
09	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
		same as "U", higher torque; not for through drive	-	●	●	●	●	○	W

Mounting flange

			18	28	45	71	100	140	
10	ISO 3019-1 (SAE)	2-hole	●	●	●	●	●	●	C
		4-hole	-	-	-	-	-	●	D

Service line port

			18	28	45	71	100	140	
11	SAE flange ports at rear, UNC fastening thread, not for through drive		-	●	●	-	●	●	61
			-	-	-	●	-	-	91
	SAE flange ports on opposite side, UNC fastening thread		●	●	●	-	●	●	62
			-	-	-	●	-	-	92

Through drive

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

Connectors for solenoids²⁾

			18	28	45	71	100	140	
13	DEUTSCH - molded connector, 2-pin – without suppressor diode		●	●	●	●	●	●	P

¹⁾ Coupling for splined shaft as per ANSI B92.1a

²⁾ Connectors for other electric components can deviate.

● = available

○ = on request

- = not available

Technical data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids) and RE 90222 (HFD hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

If environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and other seals must be observed. Please contact us.

Operating viscosity range

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

$$v_{\text{opt}} = \text{opt. operating viscosity } 80 - 170 \text{ SUS (16 ... 36 mm}^2\text{/s)}$$

referred to reservoir temperature (open circuit).

Limits of viscosity range

For critical operating conditions the following values apply:

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

short-term ($t \leq 1 \text{ min}$)
at max perm. case drain temperature of 239 °F (115 °C).

Please also ensure that the max. case drain temperature of 239 °F (115 °C) is not exceeded in localized areas (for instance, in the bearing area). The fluid temperature in the bearing area is approx. 7 °F (5 K) higher than the average case drain temperature.

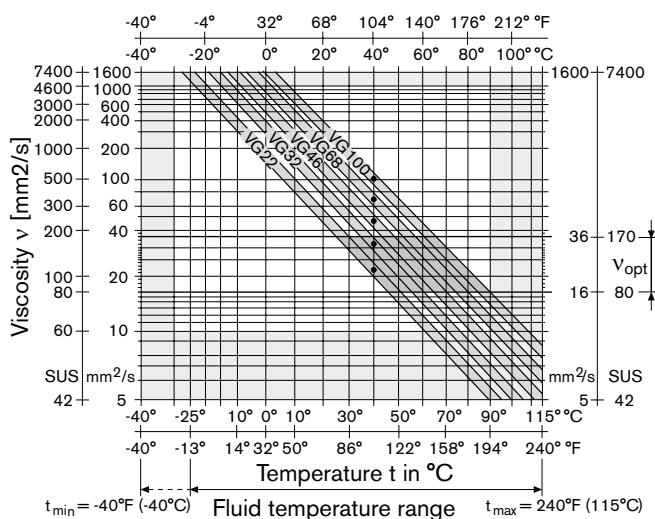
$$n_{\text{max}} = 7500 \text{ SUS (1600 mm}^2\text{/s)}$$

short-term ($t \leq 1 \text{ min}$)
on cold start
($p \leq 435 \text{ psi (30 bar)}$, $n \leq 1000 \text{ rpm}$, $t_{\text{min}} -13 \text{ °F (-25 °C)}$)

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

For detailed information on operation with low temperatures see data sheet RE 90300-03-B.

Selection diagram



Notes on the choice of hydraulic fluid

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

The hydraulic fluid should be selected so that within the operating temperature range, the viscosity lies within the optimum range (v_{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 is 140 °F (60 °C). In the optimum operating viscosity range (v_{opt} ; shaded area) this corresponds to viscosity grades VG 46 resp. VG 68; VG 68 should be selected.

Important:

The case drain temperature is influenced by pressure and input speed and is always higher than the reservoir temperature. However, at no point in the component may the temperature exceed 239 °F (115 °C). The temperature difference specified on the left is to be taken into account when determining the viscosity in the bearing.

If the above conditions cannot be met, due to extreme operating parameters please contact us.

Filtration of the hydraulic fluid

The finer the filtration the better the cleanliness level of the hydraulic fluid and the longer the service life of the axial piston unit.

In order to guarantee the functional reliability of the axial piston unit it is necessary to carry out a gravimetric evaluation of the hydraulic fluid to determine the particle contamination and the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 must be maintained.

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

If the above cleanliness levels cannot be maintained, please contact us.

Technical data

Operating pressure range

(when using mineral oil)

Pressure at service line port B

Nominal pressure p_{nom} _____ 4000 psi (280 bar) absolute

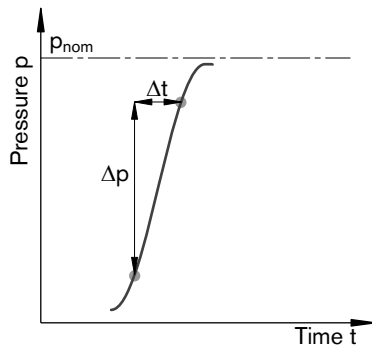
Maximum pressure p_{max} _____ 5100 psi (350 bar) absolute

Single operating period _____ 2.0 ms

Total operating period _____ 300 h

Minimum pressure (high-pressure side) _____ 145 psi
 _____ (10 bar) absolute¹⁾

Rate of pressure change $R_{A\ max}$ _____ 232060 psi/s (16000 bar/s)



Pressure at suction port S (inlet)

Minimum pressure $p_{S\ min}$ _____ 12 psi (0.8 bar) absolute

Maximum pressure $p_{S\ max}$ _____ 145 psi (10 bar) absolute¹⁾

Note

Please contact us for values for other hydraulic fluids.

Case drain pressure

Maximum permissible case drain pressure (at port L, L_1):

Maximum 0.5 bar higher than the inlet pressure at port S, however not higher than 2 bar absolute.

$p_{L\ max\ abs}$ _____ 30 psi (2 bar) absolute¹⁾

1) Other values on request

Definition

Nominal pressure p_{nom}

The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}

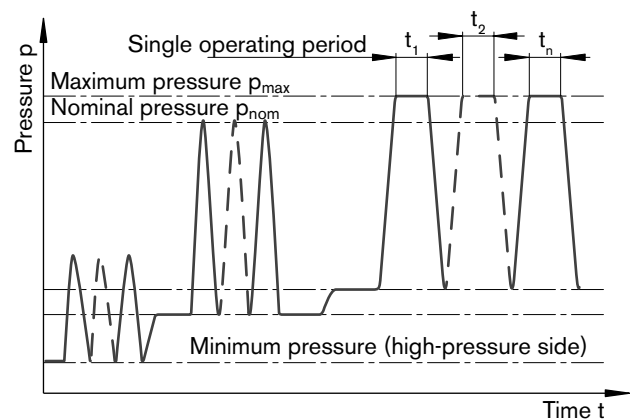
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The total of the single operating periods must not exceed the total operating period.

Minimum pressure (high-pressure side)

Minimum pressure in the high-pressure side (port B) that is required in order to prevent damage to the axial piston unit. The minimum pressure depends on the speed and 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, standard unit

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

Size	NG		18	28	45	71	100	140	
Geometrical displacement per revolution									
	V _{g max}	in ³ (cm ³)	1.10 (18)	1.71 (28)	2.75 (45)	4.33 (71)	6.1 (100)	8.54 (140)	
Maximum speed ¹⁾									
at V _{g max}	n _{nom}	rpm	3300	3000	2600	2200	2000	1800	
at V _g < V _{g max}	n _{max perm}	rpm	3900	3600	3100	2600	2400	2100	
Flow									
at n _{nom} and V _{g max}	q _{v max}	gpm (l/min)	15.7 (59)	22 (84)	31 (117)	41 (156)	53 (200)	67 (252)	
at n _E = 1800 rpm and V _{g max}	q _{vE max}	gpm (l/min)	8.5 (32)	13.3 (50)	21.4 (81)	33.8 (128)	47.6 (180)	67 (252)	
Power at Δp = 4000 psi (280 bar)									
at n _{nom} , V _{g max}	P _{max}	HP (kW)	40 (30)	51 (39)	74 (55)	96 (73)	124 (93)	156 (118)	
at n _E = 1800 rpm and V _{g max}	P _{E max}	HP (kW)	19 (15)	31 (24)	50 (38)	79 (69)	111 (84)	156 (118)	
Torque									
at V _{g max} and	Δp = 4000 psi Δp = (280 bar)	T _{max}	lb-ft (Nm)	58 (80)	91 (125)	146 (200)	230 (316)	324 (445)	453 (623)
	Δp = 1450 psi Δp = (100 bar)	T	lb-ft (Nm)	14.6 (30)	33 (45)	53 (72)	83 (113)	117 (159)	164 (223)
Rotary stiffness, drive shaft	S	c	lb-ft/rad (Nm/rad)	8082 (11087)	16400 (22317)	27560 (37500)	53018 (71884)	89348 (121142)	125042 (169537)
	R	c	lb-ft/rad (Nm/rad)	10870 (14850)	19400 (26360)	30241 (41025)	56456 (76545)	– (–)	– (–)
	U	c	lb-ft/rad (Nm/rad)	5946 (8090)	12310 (16695)	22107 (30077)	38920 (52779)	67180 (91093)	– (–)
	W	c	lb-ft/rad (Nm/rad)	– (–)	14670 (19898)	25330 (34463)	42360 (57460)	74858 (101847)	– (–)
Moment of inertial rotary group		J _{TW}	lbs-ft ² (kgm ²)	0.022 (0.00093)	0.0403 (0.0017)	0.0783 (0.0033)	0.1970 (0.0083)	0.3963 (0.0167)	0.5743 (0.0242)
Angular acceleration, maximum ²⁾		α	rad/s ²	6800	5500	4000	3300	2700	2700
Filling capacity		V	gal (L)	0.1 (0.4)	0.2 (0.7)	0.26 (1.0)	0.4 (1.6)	0.6 (2.2)	0.8 (3.0)
Weight (without through drive) approx.		m	lbs (kg)	26.5 (12)	33 (15)	46 (21)	73 (33)	99 (45)	132 (60)

1) The values are applicable:

- for an absolute pressure $p_{\text{abs}} = 15$ psi (1 bar) at suction port S
- within the optimum viscosity range from $\nu_{\text{opt}} = 80$ to 170 SUS (16 to 36 mm²/s)
- for mineral-oil based hydraulic fluid.

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

Valid for external excitation (e.g. diesel engine 2- to 8-fold rotary frequency, cardan shaft 2-fold rotary frequency).

The limiting value is only valid for a single pump.

The loading capacity of the connecting parts must be taken into account.

Note

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

Calculation of characteristics

Flow	$q_V = \frac{V_g \cdot n \cdot \eta_V}{231 (1000)}$	[gpm (l/min)]	V_g = Displacement per revolution in cm ³
			Δp = Pressure differential in 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	$P = \frac{2\pi \cdot T \cdot n}{33000 (60000)} = \frac{q_V \cdot \Delta p}{1714 (600) \cdot \eta_t}$	[HP (kW)]	η_{mh} = Mechanical-hydraulic efficiency
			η_t = Total efficiency ($\eta_t = \eta_V \cdot \eta_{mh}$)

Technical data, high-speed version

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

Size		NG	45	71	100	140
Geometrical displacement per revolution		$V_{g \max}$ in ³ (cm ³)	2.75 (45)	4.33 (71)	6.1 (100)	8.54 (140)
Maximum speed ¹⁾						
at $V_{g \max}$	n_{nom} rpm		3000	2550	2300	2050
at $V_g < V_{g \max}$	$n_{\text{max perm}}$ rpm		3300	2800	2500	2200
Flow						
at n_{nom} and $V_{g \max}$	$q_{V \max}$ gpm (l/min)		35 (135)	47 (178)	61 (230)	76 (287)
Power at $\Delta p = 4000$ psi (280 bar)						
at n_{nom} , $V_{g \max}$	$P_{\max}$ HP (kW)		84 (63)	112 (83)	143 (107)	177 (134)
Torque						
at $V_{g \max}$ and	$\Delta p = 4000$ psi $\Delta p = (280 \text{ bar})$	$T_{\max}$ lb-ft (Nm)	146 (200)	230 (316)	324 (445)	453 (623)
	$\Delta p = 1450$ psi $\Delta p = 100 \text{ bar}$	T lb-ft (Nm)	53 (72)	83 (113)	117 (159)	164 (223)
Rotary stiffness, drive shaft	S	c lb-ft/rad (Nm/rad)	27560 (37500)	53818 (71884)	89348 (121142)	125042 (169537)
	R	c lb-ft/rad (Nm/rad)	30240 (41025)	56456 (76545)	– (–)	– (–)
	U	c lb-ft/rad (Nm/rad)	22107 (30077)	– (–)	67180 (91093)	– (–)
	W	c lb-ft/rad (Nm/rad)	25330 (34463)	– (–)	74858 (101847)	– (–)
Moment of inertial rotary group		J_{TW} lbs-ft ² (kgm ²)	0.0783 (0.0033)	0.1970 (0.0083)	0.3968 (0.0167)	0.5743 (0.0242)
Angular acceleration, maximum ²⁾		α rad/s ²	4000	3300	2700	2700
Filling capacity		V gal (L)	0.26 (1.0)	0.4 (1.6)	0.6 (2.2)	0.8 (3.0)
Weight (without through drive) approx.		m lbs (kg)	46 (21)	73 (33)	99 (45)	132 (60)

1) The values are applicable:

- for an absolute pressure $p_{\text{abs}} = 15$ psi (1 bar) at suction port S
- within the optimum viscosity range from $v_{\text{opt}} = 80$ to 170 SUS (16 to 36 mm²/s)
- for mineral-oil based hydraulic fluid.

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

Valid for external excitation (e.g. diesel engine 2- to 8-fold rotary frequency, cardan shaft 2-fold rotary frequency).

The limiting value is only valid for a single pump.

The loading capacity of the connecting parts must be taken into account.

Note

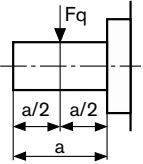
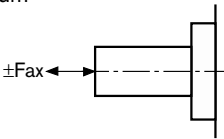
Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit. We recommend to check the loading through tests or calculation / simulation and comparison with the permissible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

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

External dimensions are not affected by this option.

Technical data

Permissible radial and axial loading on the drive shaft

Size	NG	18	28	45	71	100	140
Radial force maximum at a/2		80 (350)	270 (1200)	340 (1500)	427 (1900)	517 (2300)	630 (2800)
Axial force maximum		157 (700)	225 (1000)	340 (1500)	540 (2400)	900 (4000)	1080 (4800)

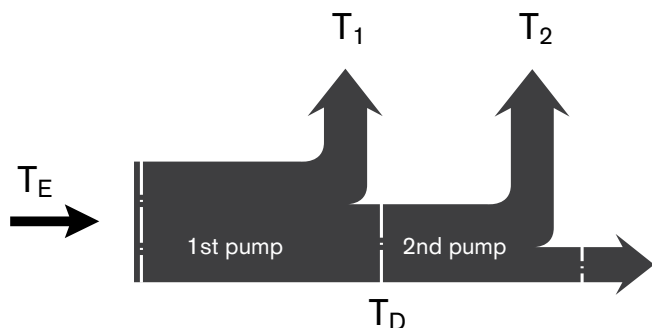
Permissible input and through-drive torques

Size	NG	18	28	45	71	100	140
Torque at $V_{g \max}$ and $\Delta p = 4000 \text{ psi (280 bar}^{1})$	$T_{\max}$	58 (80)	91 (125)	146 (200)	230 (316)	324 (445)	453 (623)
Input torque for drive shaft, maximum ²⁾							
S	$T_{E \max}$	92 (124)	146 (198)	235 (319)	462 (626)	814 (1104)	1195 (1620)
	$\emptyset$	3/4	7/8	1	1 1/4	1 1/2	1 3/4
R	$T_{E \max}$	118 (160)	184 (250)	295 (400)	475 (644)	– (–)	– (–)
	$\emptyset$	3/4	7/8	1	1 1/4	–	–
U	$T_{E \max}$	44 (59)	77 (105)	139 (188)	221 (300)	439 (595)	– (–)
	$\emptyset$	5/8	3/4	7/8	1	1 1/4	–
W	$T_{E \max}$	– (–)	103 (140)	162 (220)	291 (394)	469 (636)	– (–)
	$\emptyset$	–	3/4	7/8	1	1 1/4	–
Maximum through-drive torque for drive shaft							
S	$T_{D \max}$	80 (108)	118 (160)	235 (319)	363 (492)	574 (778)	934 (1266)
R	$T_{D \max}$	89 (120)	130 (176)	269 (365)	404 (548)	– (–)	– (–)

1) Without considering efficiency

2) For drive shafts free of radial force

Distribution of torques



Technical data

Drive power and flow

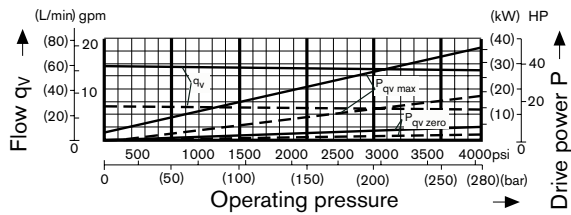
Operating material:

Hydraulic fluid ISO VG 46 DIN 51519, $t = 122\text{ }^{\circ}\text{F}$ ($50\text{ }^{\circ}\text{C}$)

Size 18

--- n = 1800 rpm

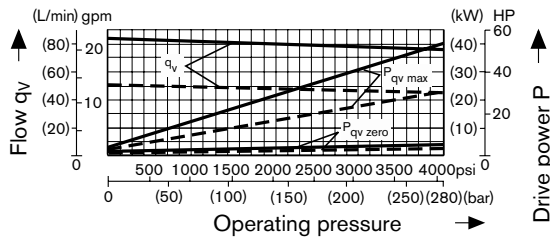
— n = 3300 rpm



Size 28

--- n = 1800 rpm

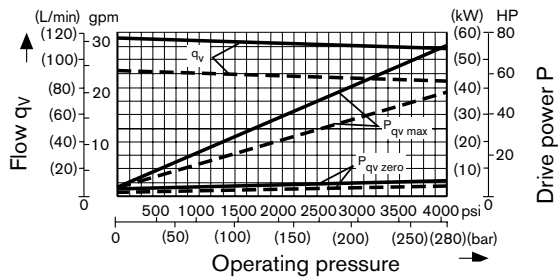
— n = 3000 rpm



Size 45

--- n = 1800 rpm

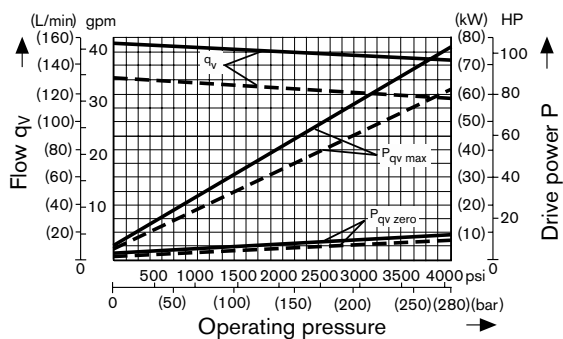
— n = 2600 rpm



Size 71

--- n = 1800 rpm

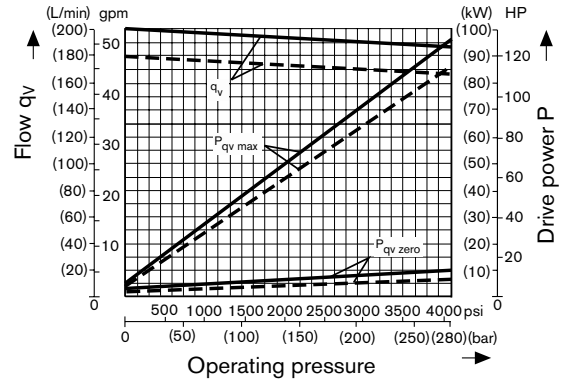
— n = 2200 rpm



Size 100

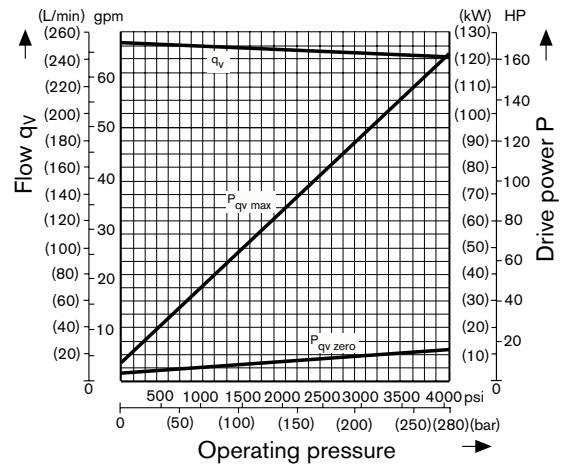
--- n = 1800 rpm

— n = 2000 rpm



Size 140

— n = 1800 rpm



DG – Two-point control, directly operated

The variable pump can be set to a minimum swivel angle by connecting an external control pressure to port X.

This will supply control fluid directly to the stroke piston; a minimum control pressure of $p_{st} \geq 725 \text{ psi}$ (50 bar) is required.

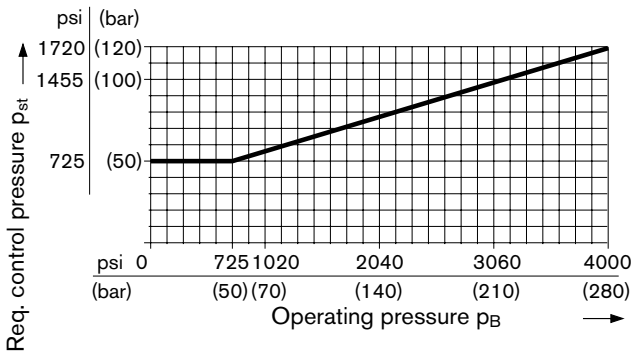
The variable pump can only be switched between $V_{g \text{ max}}$ or $V_{g \text{ min}}$.

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

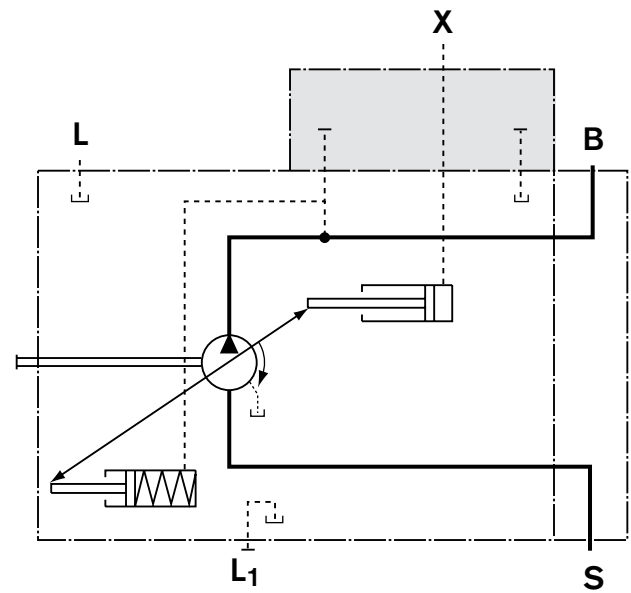
Control pressure p_{st} in X = 0 psi (0 bar) $\triangleq$ $V_{g \text{ max}}$

Control pressure p_{st} in X $\geq$ 725 psi (50 bar) $\triangleq$ $V_{g \text{ min}}$

Control pressure characteristic



Circuit diagram



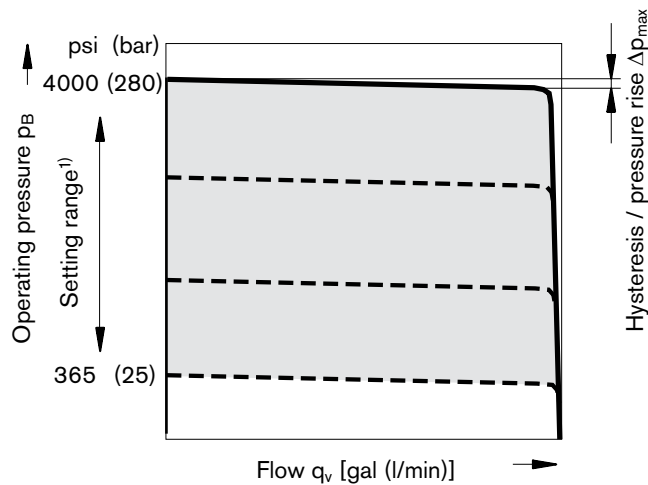
	Port for
B	Service line
S	Suction line
L, L ₁	Case drain (L ₁ plugged)
X	Pilot pressure

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 pressure setpoint set at the integrated pressure valve, the pump will adjust towards a smaller displacement and the control deviation will be reduced. The pressure can be set steplessly at the control valve.

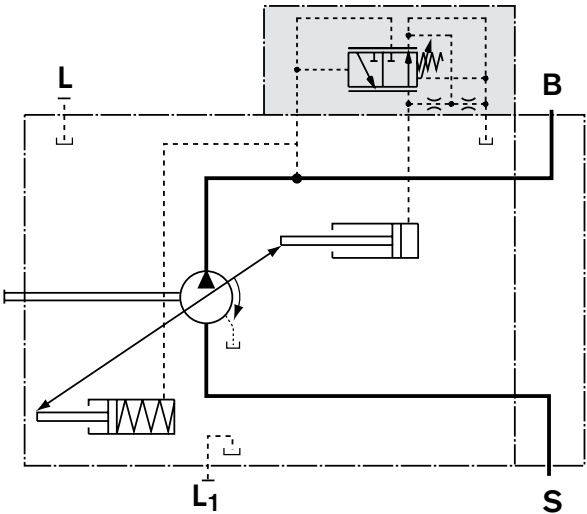
Static characteristic

(at $n_1 = 1800 \text{ rpm}$; $t_{\text{fluid}} = 122 \text{ °F}$ (50 °C))

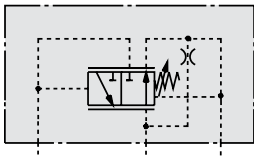


1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and must not be exceeded.
The range of possible settings at the valve are greater.

Circuit diagram, sizes 18 to 100



Circuit diagram, size 140



	Port for
B	Service line
S	Suction line
L, L ₁	Case drain (L ₁ plugged)

Control data

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

Pressure rise, maximum

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

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

Flow losses at $q_{v\text{max}}$ see page 9.

DRG – Pressure control, remotely operated

The DR-control valve (see page 11) is overriding this DRG-remote setting of max. outlet pressure.

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

The differential pressure at the DRG control valve is set as standard to 290 psi (20 bar). This results in a pilot oil flow to the relief valve of approx. 0.4 gpm (1.5 l/min) at port X. If another setting is required (range from 145-320 psi (10-22 bar)) please state in clear text.

As a separate pressure relief valve we can recommend:

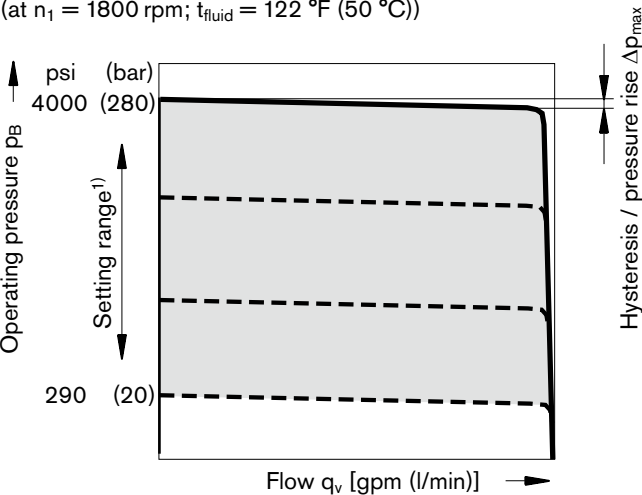
DBDH 6 (hydraulic) to RE 25402 or

DBETR-SO 381 with orifice dia 0.03 inch (Ø 0.8 mm) in P (electric) to RE 29166.

The max. length of piping should not exceed 6.5 ft (2 m).

Static characteristic

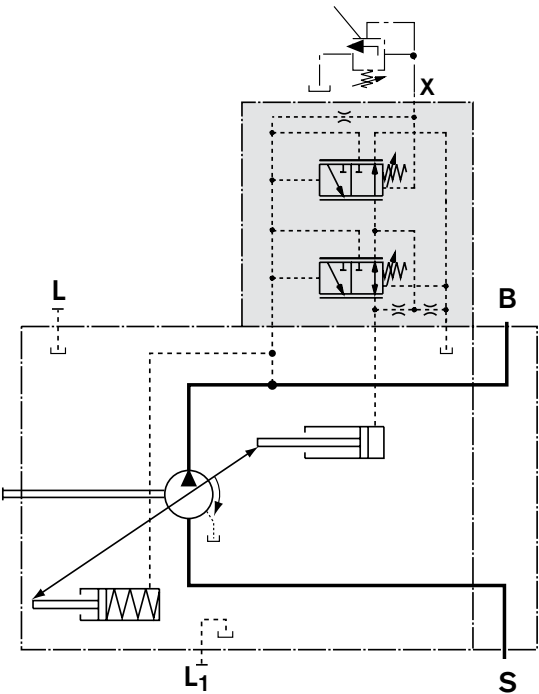
(at $n_1 = 1800 \text{ rpm}$; $t_{\text{fluid}} = 122 \text{ °F}$ (50 °C))



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

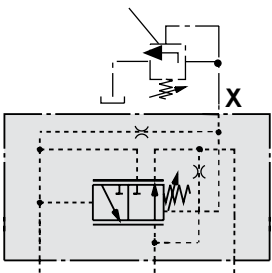
Circuit diagram, sizes 18 to 100

Not included in the delivery contents



Circuit diagram, size 140

Not included in the delivery contents



		Port for
B		Service line
S		Suction line
L, L1		Case drain (L1 plugged)
X	NG 18 to 100 with adapter	Pilot pressure
X	NG 140 without adapter	Pilot pressure

Control data

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

Pressure rise, maximum

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

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

Flow losses at $q_{V\text{max}}$ see page 9.

DFR/DFR1 – Pressure and flow control

In addition to the pressure control function (see page 11), the pump flow may be varied by means of a differential pressure over an adjustable orifice (e.g. directional valve) installed in the service line to the actuator. The pump flow is equal to the actual required flow by the actuator, regardless of changing pressure levels.

The pressure control overrides the flow control function.

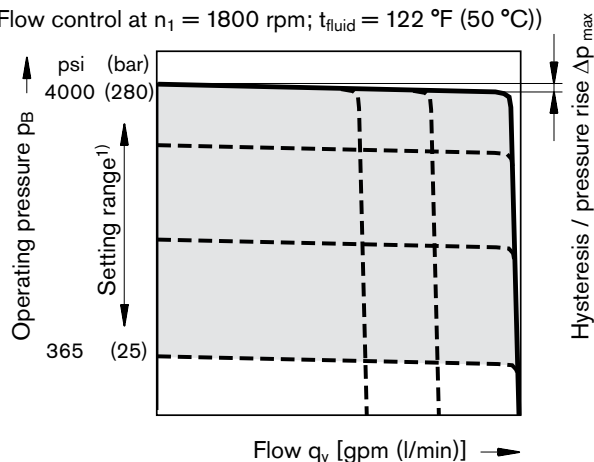
Note

The DFR1 version has no connection between X and the reservoir. Unloading the LS-pilot line must be possible in the valve system.

Because of the flushing function sufficient unloading of the X-line must also be provided.

Static characteristic

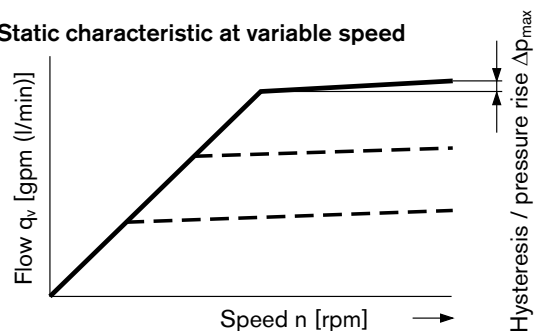
Flow control at $n_1 = 1800 \text{ rpm}$; $t_{\text{fluid}} = 122 \text{ °F}$ (50 °C)



- 1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and must not be exceeded.

The range of possible settings at the valve are greater.

Static characteristic at variable speed



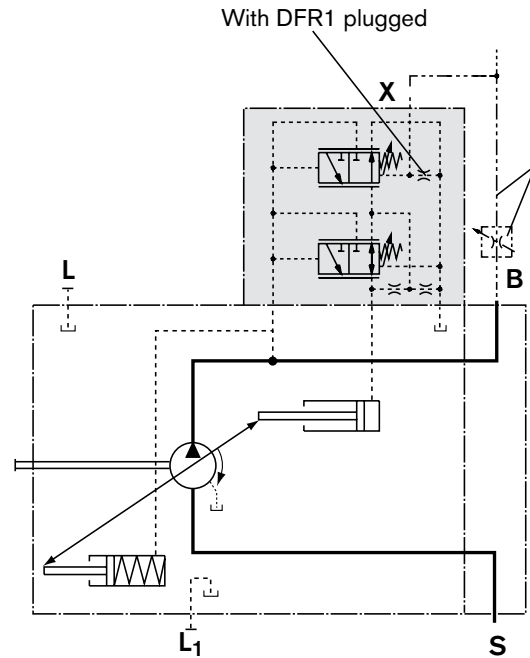
Differential pressure Δp

Standard setting: 200 to 320 psi (14 to 22 bar).

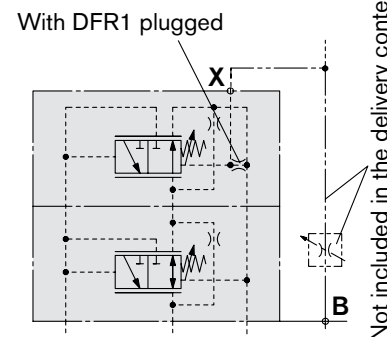
If another setting is required, please state in clear text.

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 . System influences are not taken into account.

Circuit diagram, sizes 18 to 100



Circuit diagram, size 140



	Port for
B	Service line
S	Suction line
L, L ₁	Case drain (L ₁ plugged)
X	Pilot pressure

Control data

Data for pressure control DR, see page 11.

Maximum flow deviation measured with drive speed $n = 1500 \text{ rpm}$.

NG	18	28	45	71	100	140
$\Delta q_{v \text{ max}}$ gpm	0.24	0.26	0.48	0.75	1.06	1.60
(l/min)	(0.9)	(1.0)	(1.8)	(2.8)	(4.0)	(6.0)

Control fluid consumption DFR __ max. approx. 0.8 to 1.2 gpm (3 to 4.5 l/min)

Control fluid consumption DFR1 __ maximum approx. 0.8 gpm (3 l/min) Volume flow loss at $q_{V \text{ max}}$, see page 9.

DFLR – Pressure, flow and power control

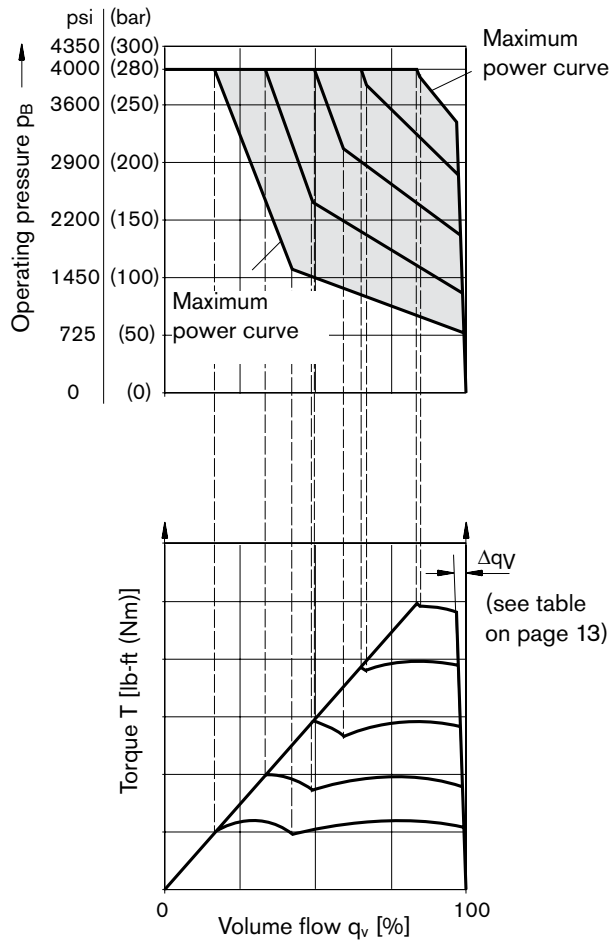
Execution of the pressure control like DR(G), see page 11 (12).
Execution of the flow control like DFR, DFR1, see page 13.

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.

The power characteristic is set in the factory; when ordering, please state in clear text, e.g. 40 HP (30 kW) at 1800 rpm.

Static curves and torque characteristic



Control data

Beginning of control _____ 725 psi (50 bar)

Control fluid consumption_ maxi. approx. 1.45 gpm (5.5 l/min)

Flow loss at q_v max, see page 9.

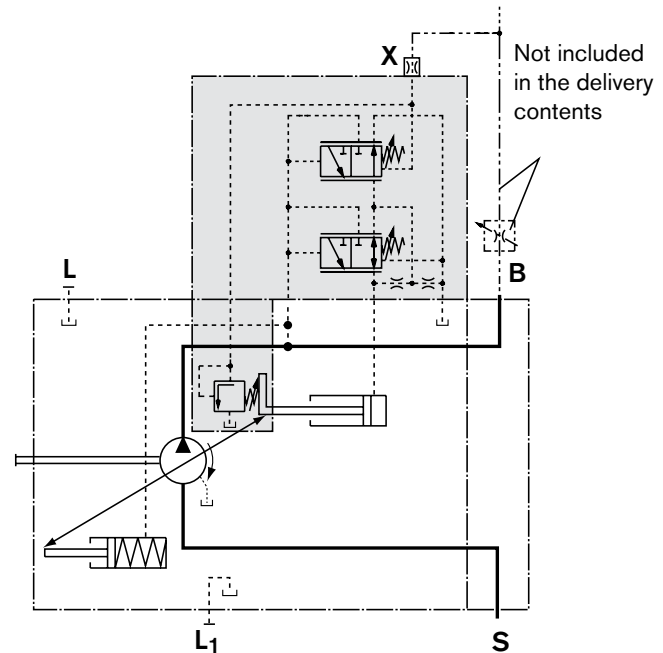
	Port for
B	Service line
S	Suction line
L, L₁	Case drain (L ₁ plugged)
X	Pilot pressure

Control data

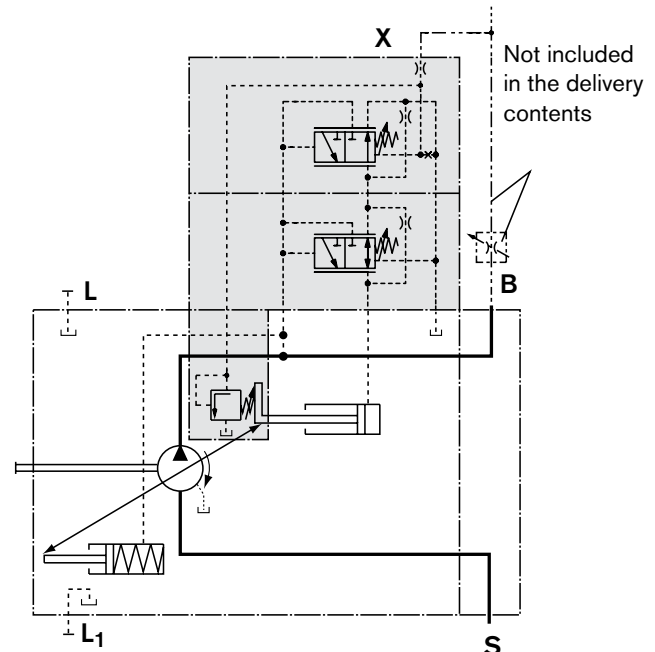
For pressure control DR data, see page 11.

For flow control FR data, see page 13.

Circuit diagram, sizes 28 to 100



Circuit diagram, size 140



ED – Electro-hydraulic pressure control

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

If there is a change at the consumer (load pressure), the position of the control piston changes.

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

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

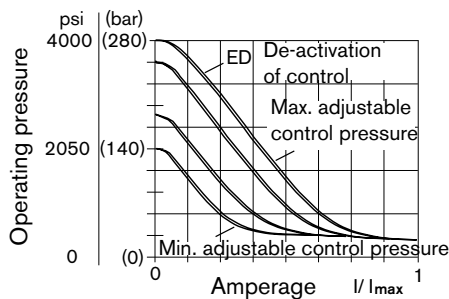
When the solenoid current signal drops towards a zero value, the maximum output pressure is limited to $p_{\max}$ by an adjustable hydraulic pressure cut-off (secure fail safe function in case of a loss of power e.g. for use as fan drives).

The response time characteristic of the ED-control was optimized for the use as a fan drive system.

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

Static current-pressure characteristic ED

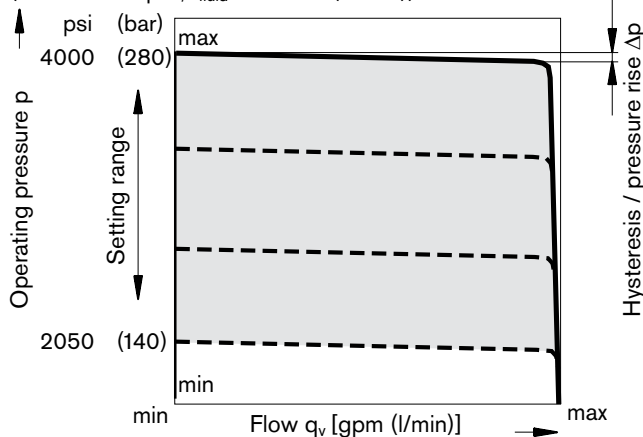
(measured at pump in zero stroke – negative characteristic)



Hysteresis of the static current-pressure characteristic
 $< 45 \text{ psi (3 bar)}$

Static flow-pressure characteristic

(at $n = 1800 \text{ rpm}$; $t_{\text{fluid}} = 122^\circ \text{F (50}^\circ \text{C)}$)

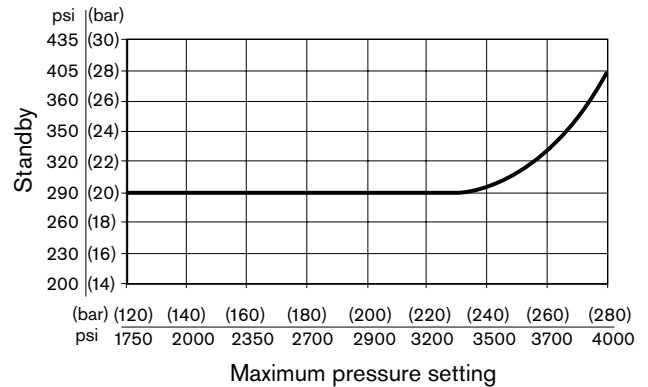


Control data

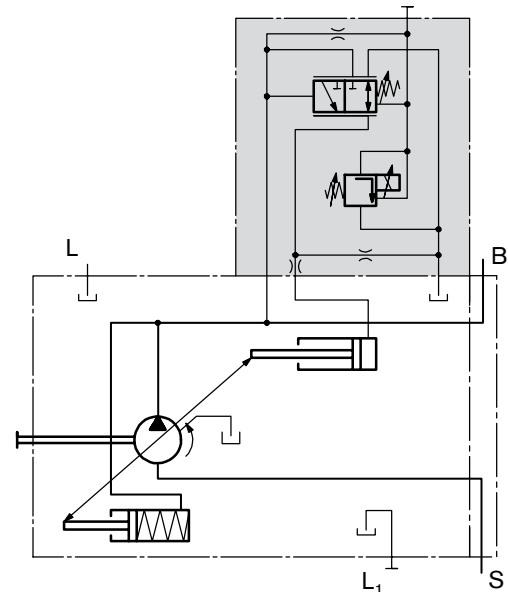
Standby standard settings (see diagram at right), other values on request.

Hysteresis and pressure increase _____ $\Delta p < 60 \text{ psi (4 bar)}$
 Control fluid consumption _____ 0.8 to 1.2 gpm (3 to 4.5 l/min)

Influence of pressure setting on standby level



Circuit diagram ED..



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

Technical data, solenoid	ED71	ED72
Voltage	12 V ($\pm 20\%$)	24 V ($\pm 20\%$)
Control current		
Start of control at $V_{g \min}$	100 mA	50 mA
End of control at $V_{g \max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20°C)	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %

For type of protection, see plug design on page 47

For details on the control electronics, see page 16

Operating temperature range at valve -4°F to 239°F (-20°C to $+115^\circ \text{C}$)

ER – Electro-hydraulic pressure control

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

If there is a change at the consumer (load pressure), the position of the control piston changes.

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

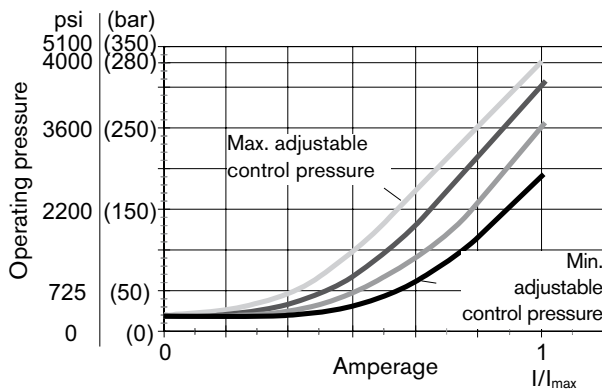
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.

If the solenoid current drops to zero, the pressure is limited to $p_{\min}$ (stand-by).

Observe the project planning note on page 2.

Static current-pressure characteristic ER

(measured at pump in zero stroke – positive characteristic)

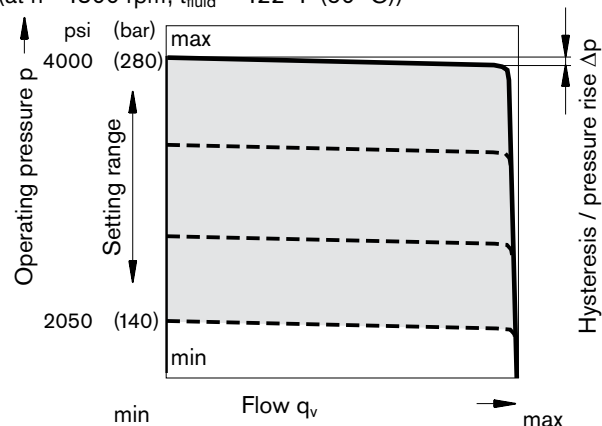


Hysteresis of the static current-pressure characteristic < 45 psi (3 bar)

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

Static flow-pressure characteristic

(at $n = 1800$ rpm; $t_{\text{fluid}} = 122$ °F (50 °C))



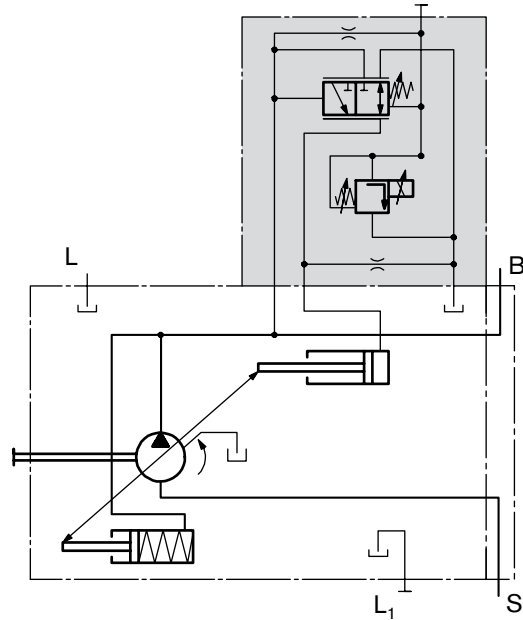
Control data

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

Hysteresis and pressure increase _____ $\Delta p < 60$ psi (4 bar)

Control fluid 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	ER71	ER72
Voltage	12 V (± 20 %)	24 V (± 20 %)
Control current		
Start of control at $V_{g \min}$	100 mA	50 mA
End of control at $V_{g \max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %
For type of protection, see plug design on page 47		

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

The following electric controllers and amplifiers are available for controlling the proportional solenoids:

Analog amplifier RA	RE 95230
Digital controller RC2-2/21 ¹⁾	RE 95201
Analog amplifier VT2000 ²⁾	RE 29904
Analog amplifier VT 11029/11030 ²⁾	RE 29741

1) Power outlets for 2 valves, can be actuated separately

2) Only 24V nominal voltage

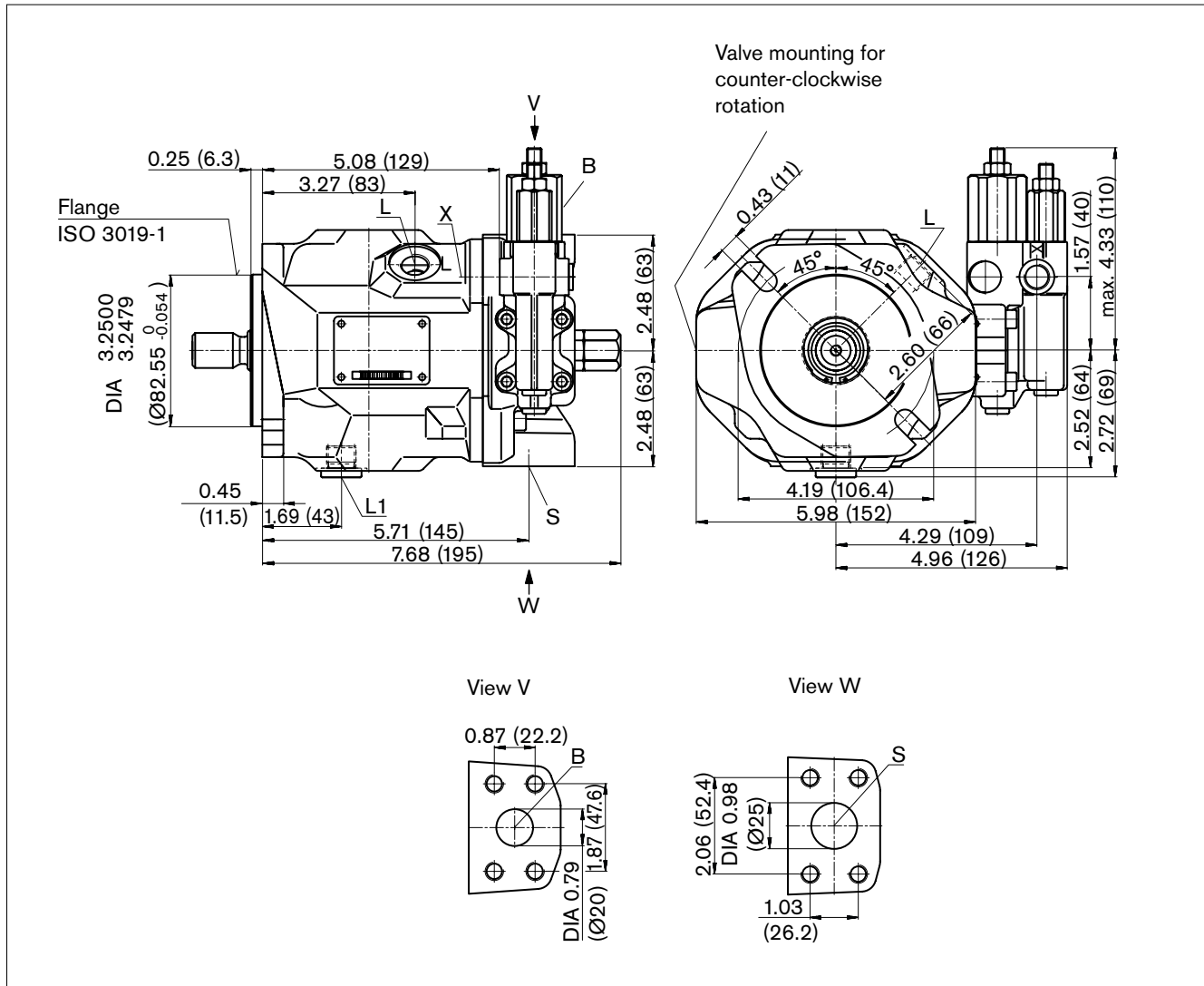
Notes

Dimensions size 18

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

DFR, DFR1 – Pressure and flow control, hydraulic

Clockwise rotation



Ports

Designation	Port for	Standard	Size ¹⁾	Max. press. [psi / (bar)] ²⁾	State
B	Service line, fastening thread	SAE J518 ASME B1.1	3/4 in 3/8-16 UNC-2B; 0.79 (20) deep	5100 (350)	O
S	Suction line, fastening thread	SAE J518 ASME B1.1	1 in 3/8-16 UNC-2B; 0.79 (20) deep	145 psi (10)	O
L	Case drain fluid	ISO 11926 ³⁾	9/16-18UNF-2B; 0.47 (12) deep	30 (2)	O ⁴⁾
L ₁	Case drain fluid	ISO 11926 ³⁾	9/16-18UNF-2B; 0.47 (12) deep	30 (2)	X ⁴⁾
X	Pilot pressure	ISO 11926 ³⁾	7/16-20UNF-2B; 0.45 (11.5) deep	5100 (350)	O
X	Pilot pressure with DG-control	DIN ISO 228 ³⁾	G 1/4 in; 0.47 (12) deep	5100 (350)	O

1) For the maximum tightening torques the general instructions on page 52 must be observed.

2) Depending on the application, short-term pressure spikes can occur. Consider this when selecting measuring equipment and fittings. Pressure values in psi (bar) absolute

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

4) Depending on the installation position, L or L₁ must be connected (see also installation instructions on pages 48, 49)

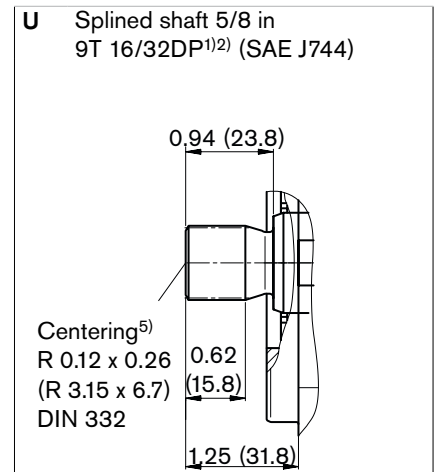
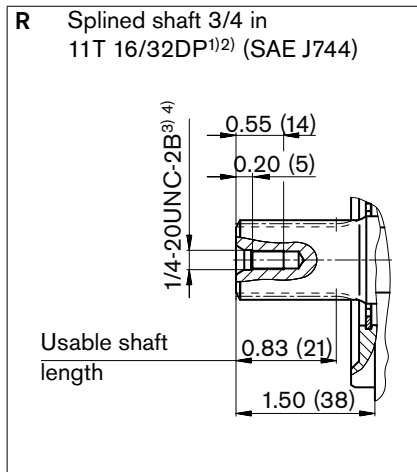
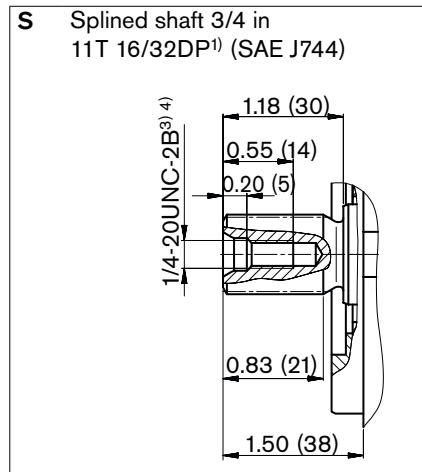
O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

Dimensions size 18

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

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

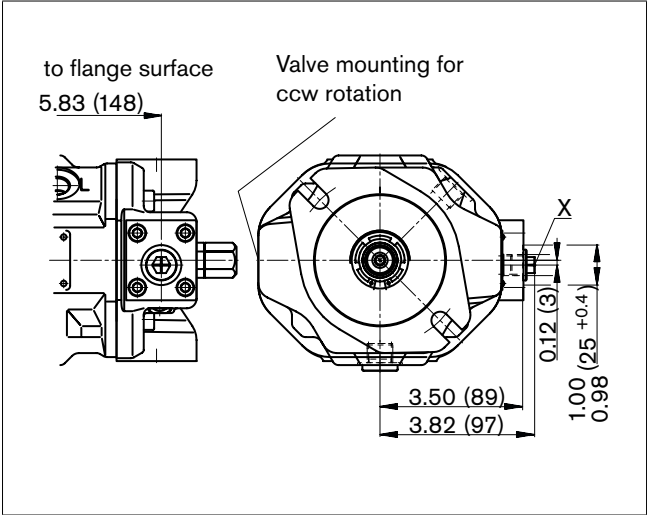
4) For the maximum tightening torques the general instructions on page 52 must be observed

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

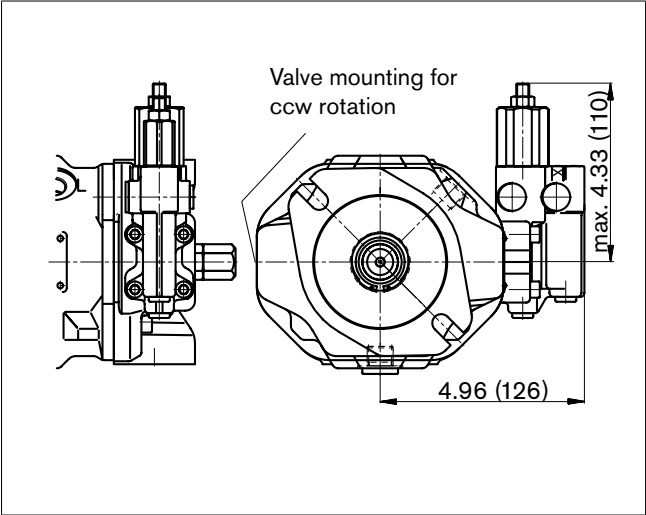
Dimensions size 18

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

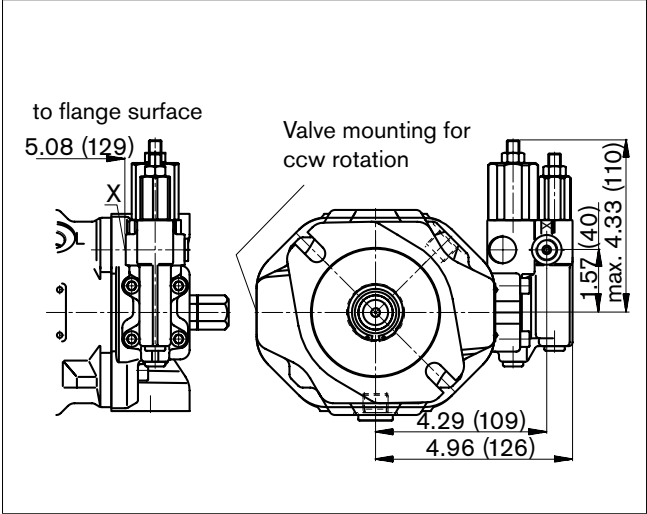
DG
Two-point control, directly operated



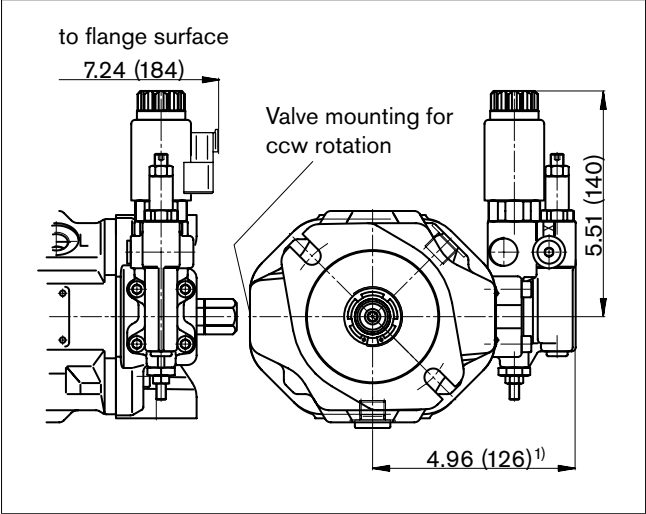
DR
Pressure control



DRG
Pressure control, remotely operated



ED7., ER7.
Electro-hydraulic pressure control



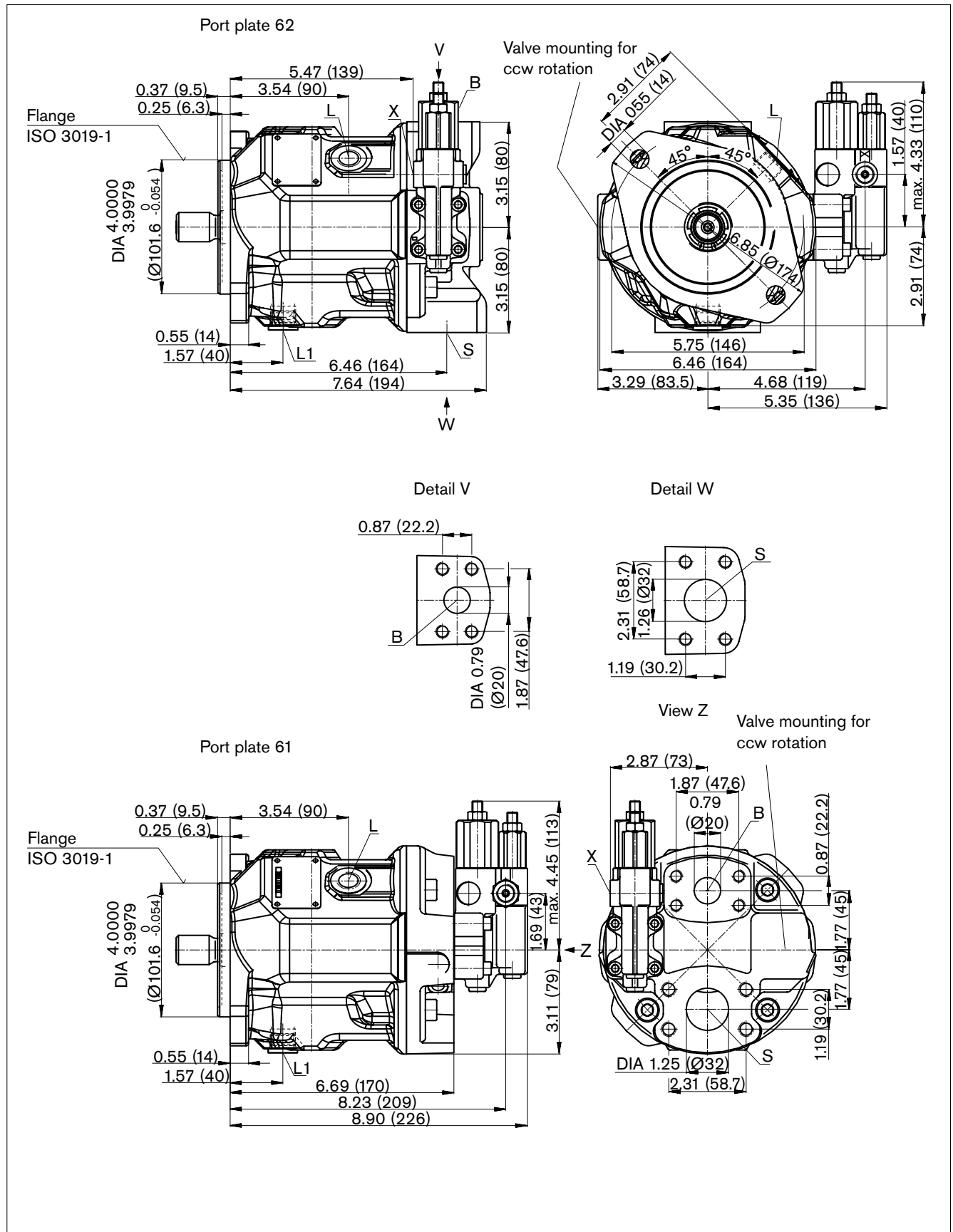
1) ER7.: 6.34 in (161 mm) if using a sandwich plate pressure reducing valve.

Dimensions size 28

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

DFR/DFR1 – Pressure and flow control, hydraulic

Clockwise rotation

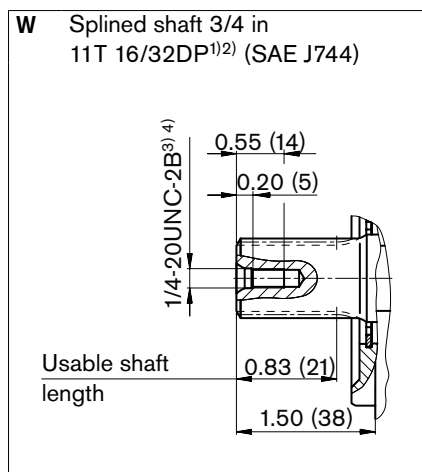
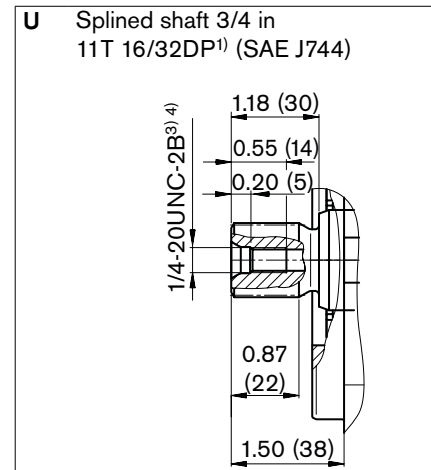
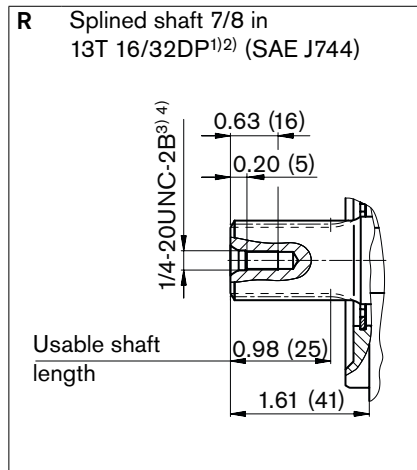
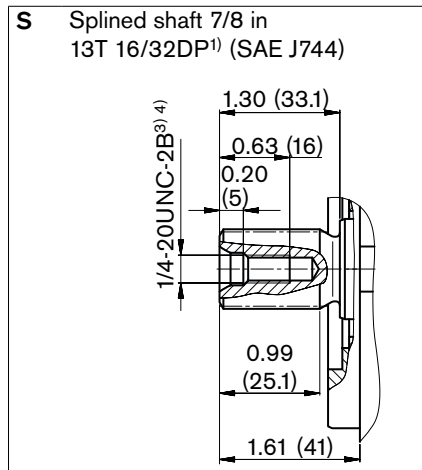


Details on connection options and shaft ends can be found on page 22

Dimensions size 28

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) Spline 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 page 52 must be observed.

Ports

Designation	Port for	Standard	Size ⁵⁾	Max. press. [psi (bar)] ⁶⁾	State
B	Service line, fastening thread	SAE J518 ASME B1.1	3/4 in 3/8-16 UNC-2B; 0.79 (20) deep	5100 (350)	O
S	Suction line, fastening thread	SAE J518 ASME B1.1	1 1/4 in 7/16-14 UNC-2B; 0.94 (24) deep	145 (10)	O
L	Case drain fluid	ISO 11926 ⁷⁾	3/4-16 UNF-2B; 0.55 (14) deep	30 (2)	O ⁸⁾
L ₁	Case drain fluid	ISO 11926 ⁷⁾	3/4-16 UNF-2B; 0.55 (14) deep	30 (2)	X ⁸⁾
X	Pilot pressure	ISO 11926 ⁷⁾	7/16-14UNC-2B; 0.45 (11.5) deep	5100 (350)	O
X	Pilot pressure with DG-control	DIN ISO 228 ⁷⁾	G 1/4in; 0.47 (12) deep	5100 (350)	O

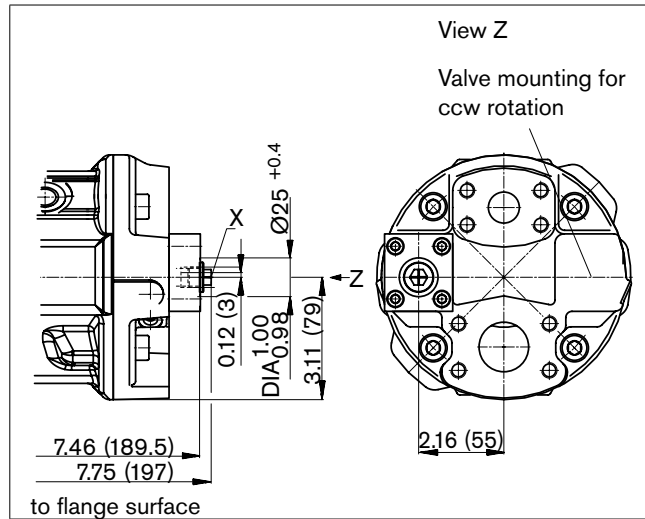
- 5) For the maximum tightening torques the general instructions on page 52 must be observed.
- 6) Depending on the application, short-term pressure spikes can occur. Consider this when selecting measuring equipment and fittings. Pressure values in psi (bar) absolute.
- 7) The spot face can be deeper than as specified in the standard.
- 8) Depending on the installation position, L or L₁ must be connected (see also installation instructions on pages 48, 49)
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).

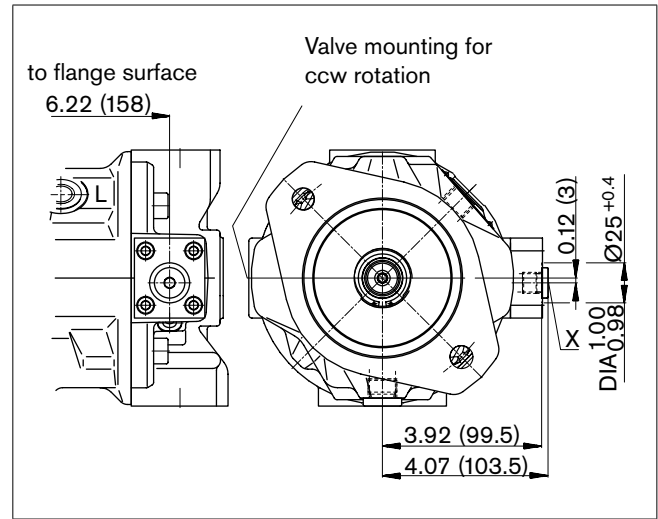
DG

Two-point control, directly operated, **port plate 61**



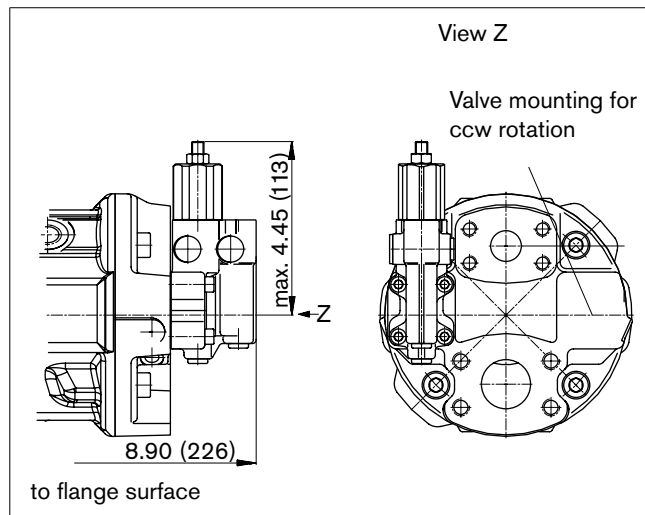
DG

Two-point control, directly operated, **port plate 62**



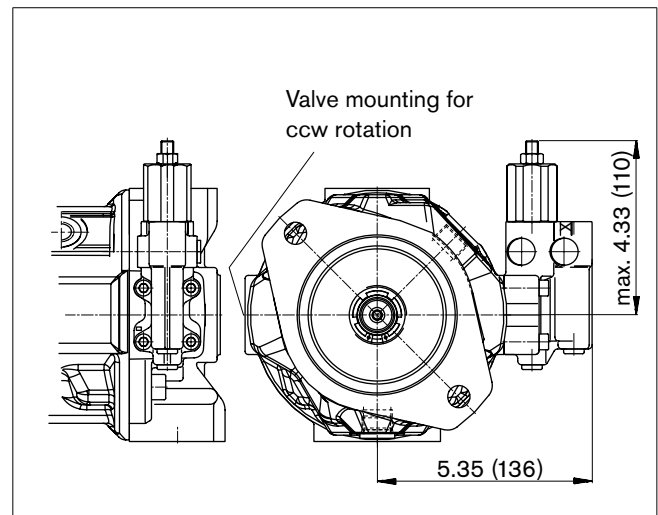
DR

Pressure control, **port plate 61**



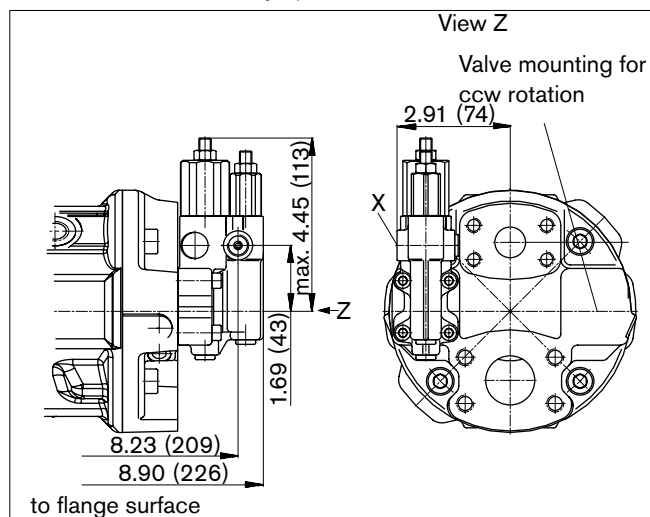
DR

Pressure control, **port plate 62**



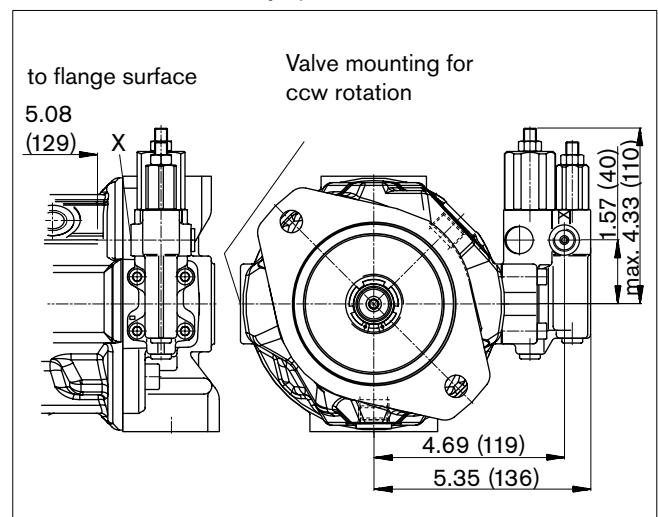
DRG

Pressure control, remotely operated, **port plate 61**



DRG

Pressure control, remotely operated, **port plate 62**



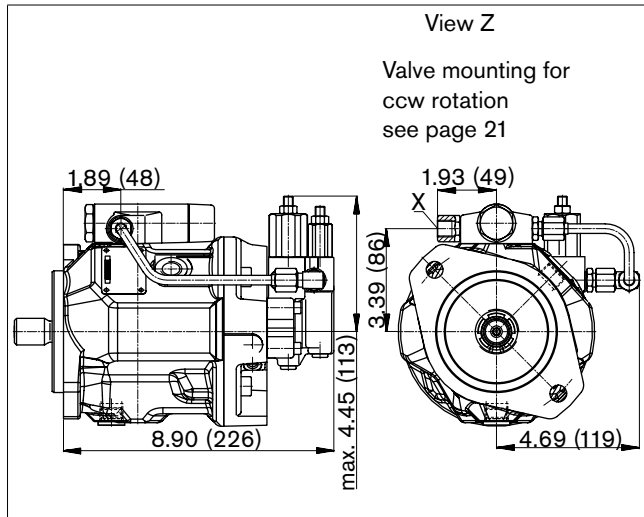
For details of connection options and drive shafts, see also pages 21 and 22

Dimensions size 28

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

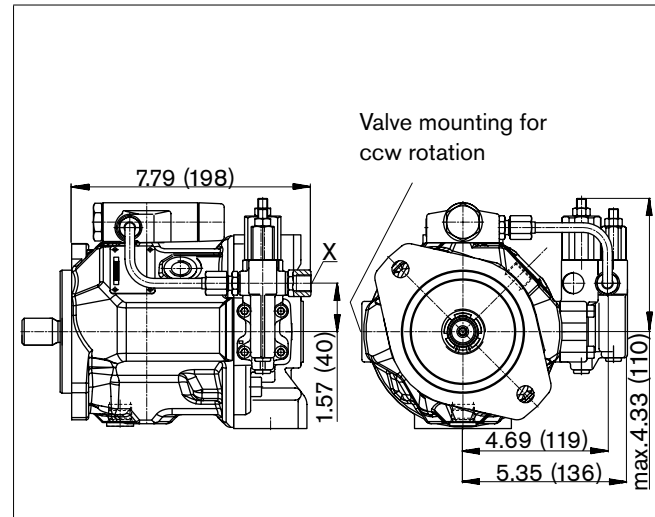
DFLR

Pressure, flow and power control, **port plate 61**



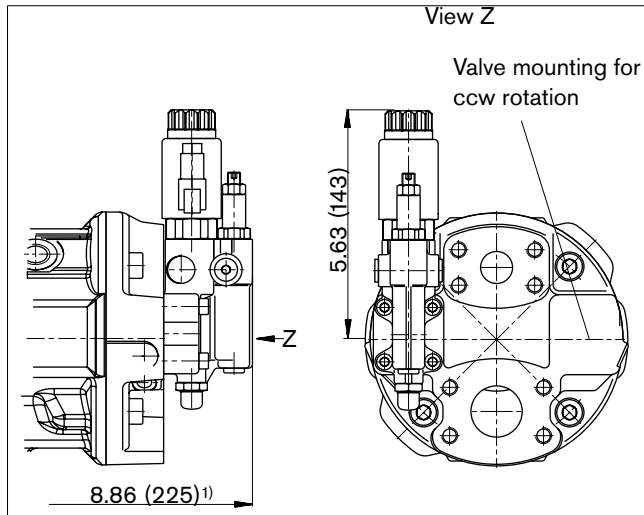
DFLR

Pressure, flow and power control, **port plate 62**



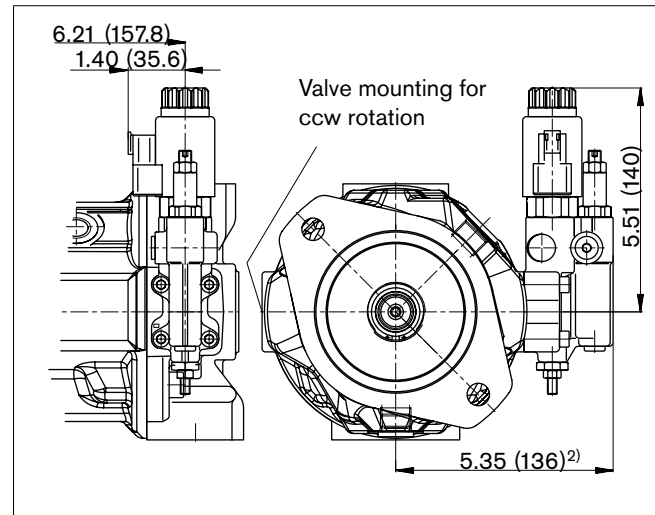
ED7. / ER7.

Electro-hydraulic pressure control, **port plate 61**



ED7. / ER7.

Electro-hydraulic pressure control, **port plate 62**



¹⁾ ER7.: 10.24 in (260 mm) when using a sandwich plate pressure reducing valve.

²⁾ ER7.: 6.83 in (170.9 mm) when using a sandwich plate pressure reducing valve.

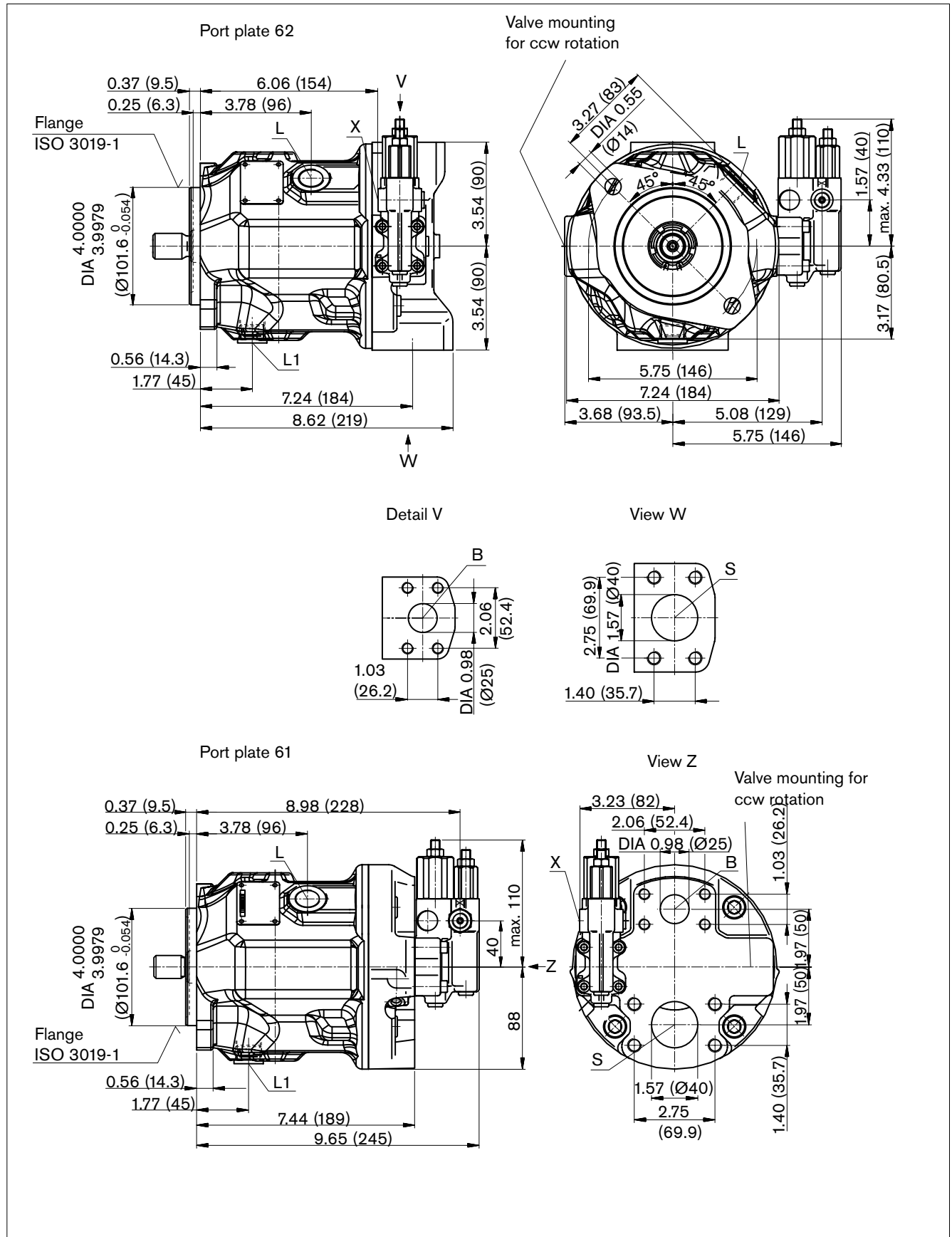
For details of connection options and drive shafts, see also pages 21 and 22

Dimensions size 45

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

DFR/DFR1 – Pressure and flow control, hydraulic

Clockwise rotation



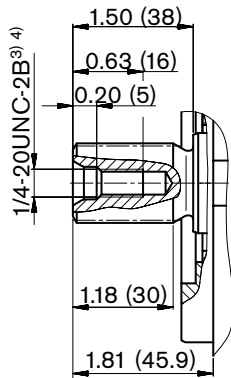
Details on connection options and shaft ends can be found on page 26

Dimensions size 45

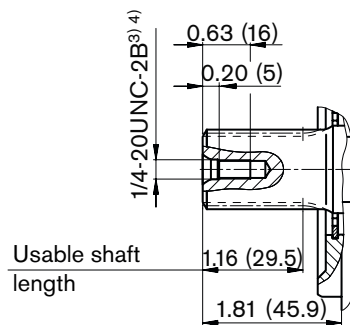
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

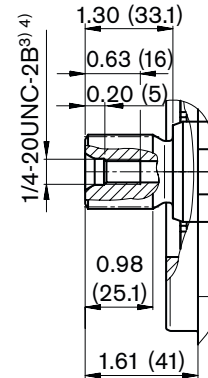
S Splined shaft 1 in
15T 16/32DP¹⁾ (SAE J744)



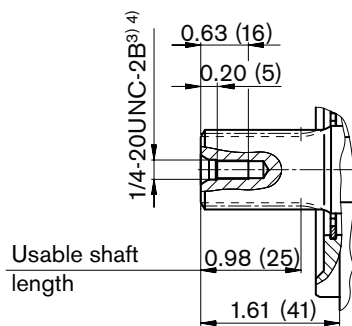
R Splined shaft 1 in
15T 16/32DP¹⁾²⁾ (SAE J744)



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



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



- 1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Spline 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 page 52 must be observed.

Ports

Designation	Port for	Standard	Size ⁵⁾	Max. press. [psi (bar)] ⁶⁾	State
B	Service line, fastening thread	SAE J518 ASME B1.1	1 in 3/8-16 UNC-2B; 0.71 (17) deep	5100 (350)	O
S	Suction line, fastening thread	SAE J518 ASME B1.1	1 1/2 in 1/2-13 UNC-2B; 0.87 (20) deep	145 (10)	O
L	Case drain fluid	ISO 11926 ⁷⁾	7/8-14 UNF-2B; 0.63 (16) deep	30 (2)	O ⁸⁾
L ₁	Case drain fluid	ISO 11926 ⁷⁾	7/8-14 UNF-2B; 0.63 (16) deep	30 (2)	X ⁸⁾
X	Pilot pressure	ISO 11926 ⁷⁾	7/16-20UNF-2B; 0.45 (11.5) deep	5100 (350)	O
X	Pilot pressure with DG-control	DIN ISO 228 ⁷⁾	G 1/4 in; 0.47 (12) deep	5100 (350)	O

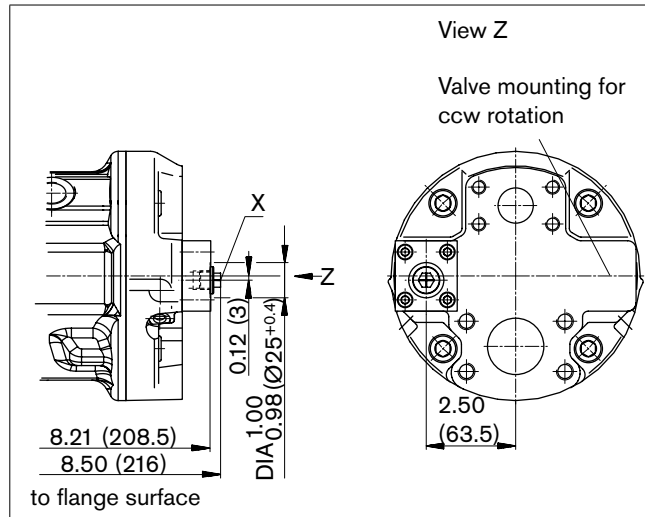
- 5) For the maximum tightening torques the general instructions on page 52 must be observed.
- 6) Depending on the application, short-term pressure spikes can occur. Consider this when selecting measuring equipment and fittings. Pressure values in psi (bar) absolute.
- 7) The spot face can be deeper than as specified in the standard.
- 8) Depending on the installation position, L or L₁ must be connected (see also installation instructions on pages 48, 49)
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).

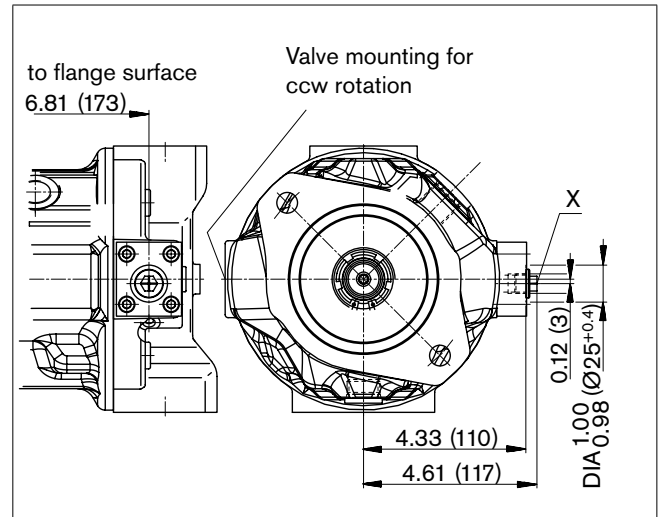
DG

Two-point control, directly operated, **port plate 61**



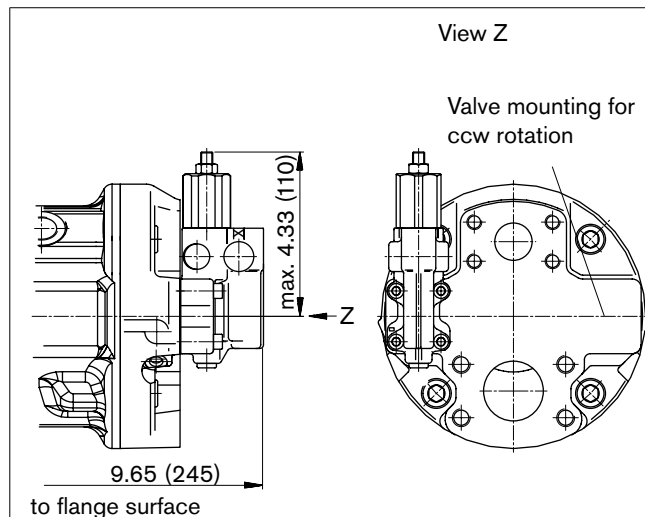
DG

Two-point control, directly operated, **port plate 62**



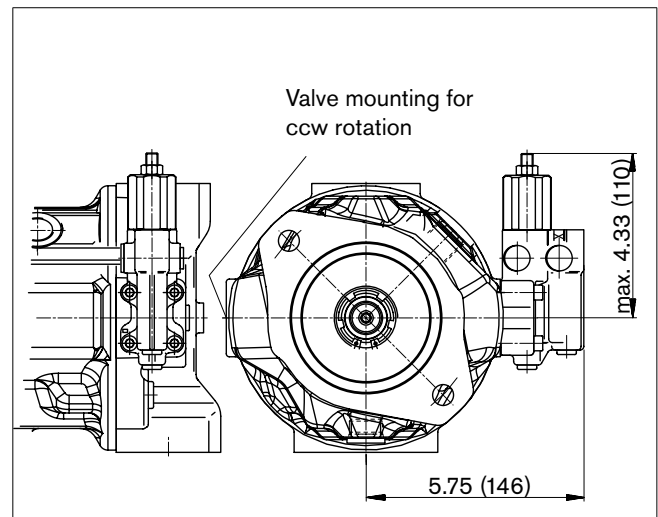
DR

Pressure control, **port plate 61**



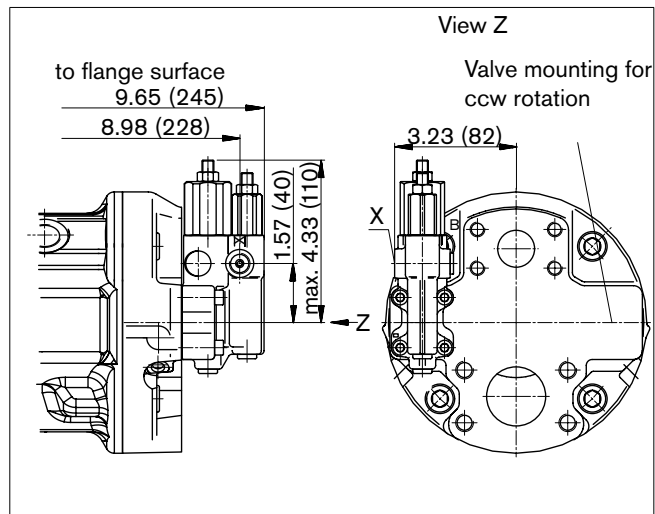
DR

Pressure control, **port plate 62**



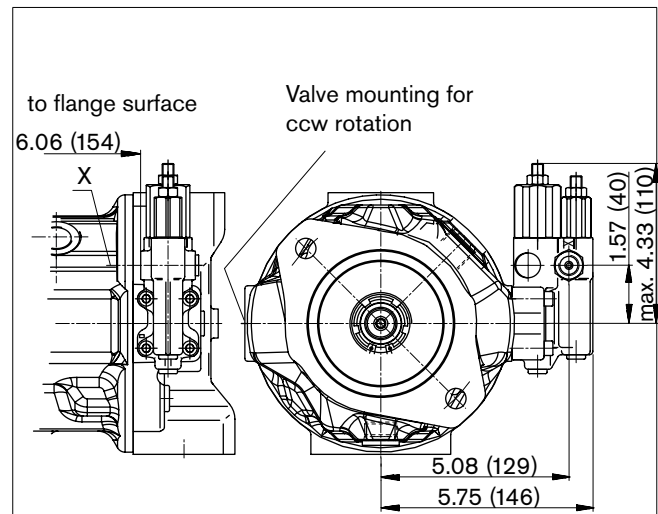
DRG

Pressure control, remotely operated, **port plate 61**



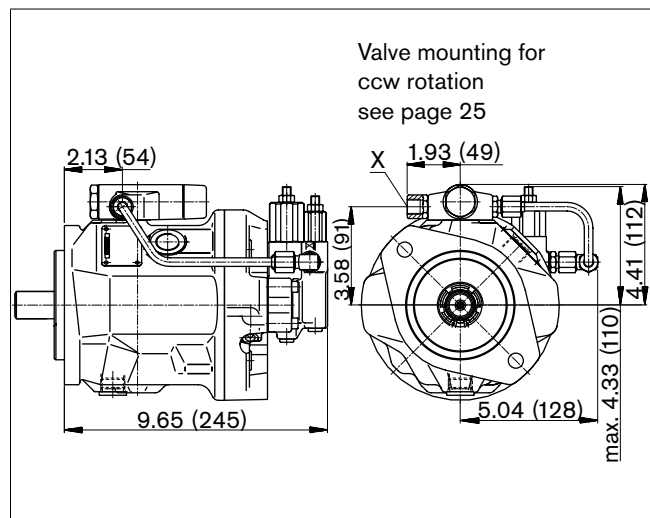
DRG

Pressure control, remotely operated, **port plate 62**

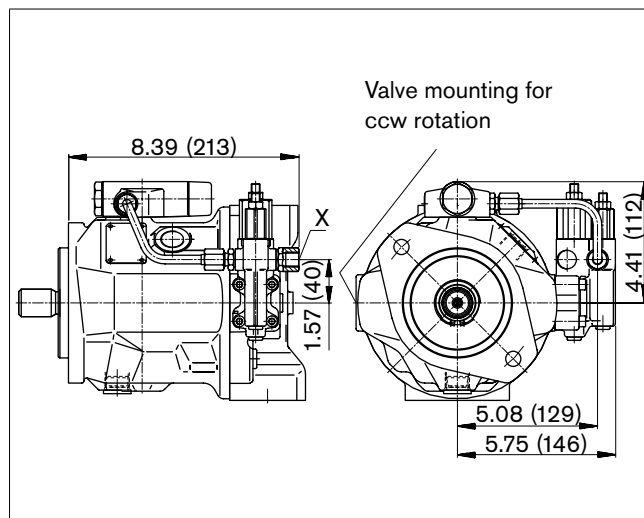


Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

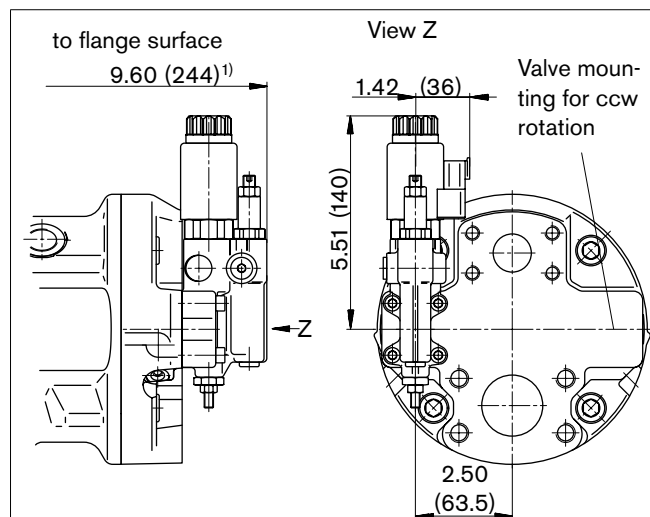
Pressure, flow and power control, port plate 61



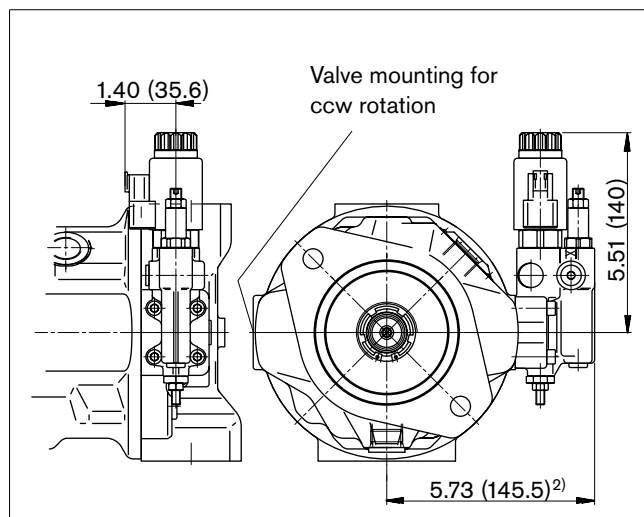
Pressure, flow and power control, port plate 62



Electro-hydraulic pressure control, **port plate 61**



Electro-hydraulic pressure control, **port plate 62**



2) ER7.: 7.11 in (180.5 mm) when using a sandwich plate pressure reducing valve.

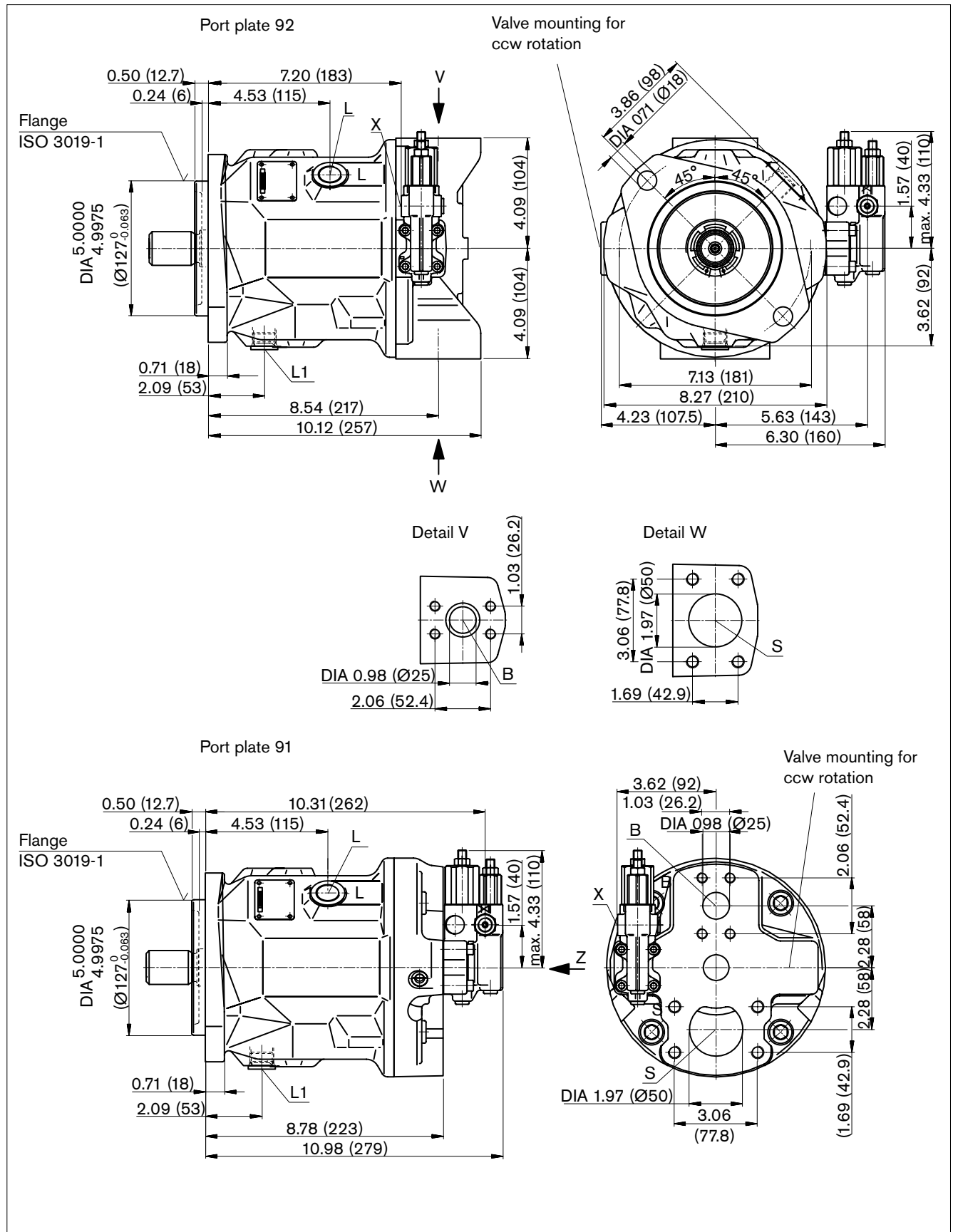
For details of connection options and drive shafts, see also pages 21 and 22

Dimensions size 71

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

DFR/DFR1 – Pressure and flow control, hydraulic

Clockwise rotation

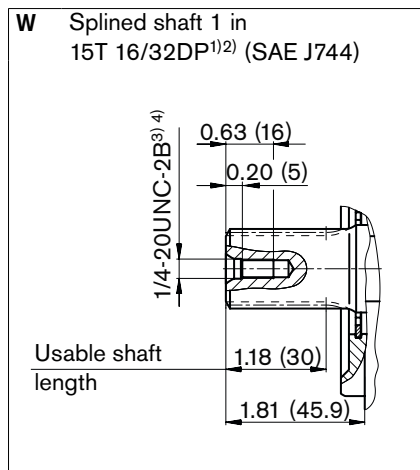
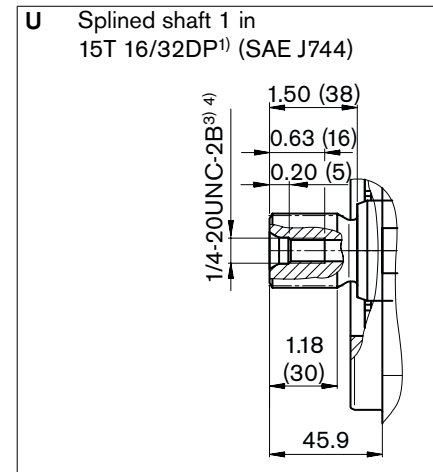
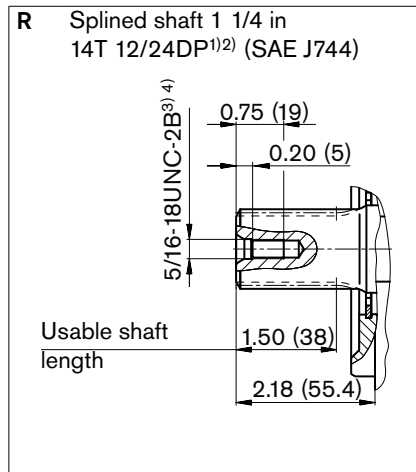
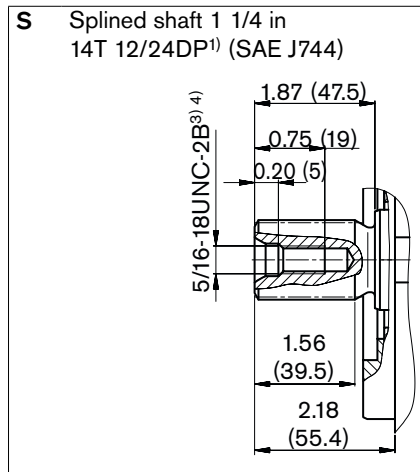


Details on connection options and shaft ends can be found on page 30

Dimensions size 71

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) Spline 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 page 52 must be observed.

Ports

Designation	Port for	Standard	Size ⁵⁾	Max. press. [psi (bar)] ⁶⁾	State
B	Service line, fastening thread	SAE J518 ASME B1.1	1 in 3/8-16 UNC-2B; 0.71 (18) deep	5100 (350)	O
S	Suction line, fastening thread	SAE J518 ASME B1.1	2 in 1/2-13 UNC-2B; 0.87 (22) deep	145 (10)	O
L	Case drain fluid	ISO 11926 ⁷⁾	7/8-14 UNF-2B; 0.63 (16) deep	30 (2)	O ⁸⁾
L ₁	Case drain fluid	ISO 11926 ⁷⁾	7/8-14 UNF-2B; 0.63 (16) deep	30 (2)	X ⁸⁾
X	Pilot pressure	ISO 11926 ⁷⁾	7/16-20 UNF-2B; 0.45 (11.5) deep	5100 (350)	O
X	Pilot pressure with DG-control	DIN ISO 228 ⁷⁾	G 1/4 in; 0.47 (12) deep	5100 (350)	O

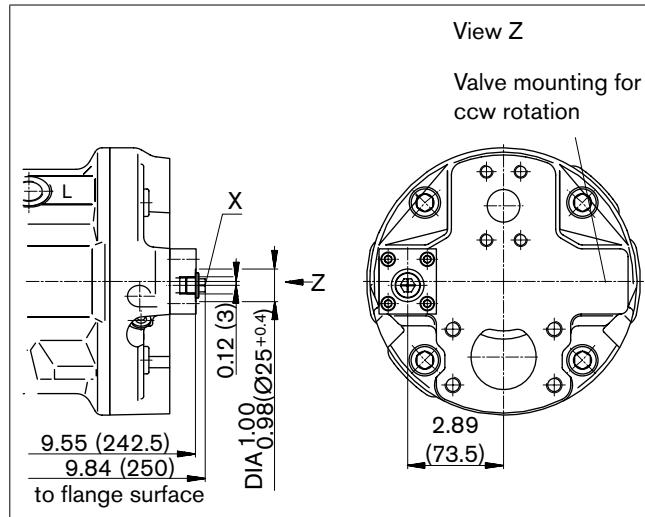
- 5) For the maximum tightening torques the general instructions on page 52 must be observed.
- 6) Depending on the application, short-term pressure spikes can occur. Consider this when selecting measuring equipment and fittings. Pressure values in psi (bar) absolute.
- 7) The spot face can be deeper than as specified in the standard.
- 8) Depending on the installation position, L or L₁ must be connected (see also installation instructions on pages 48, 49)
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 71

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

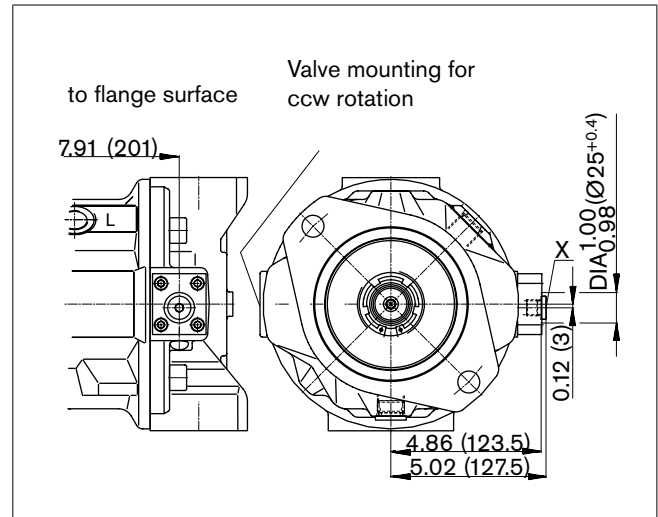
DG

Two-point control, directly operated, **port plate 91**



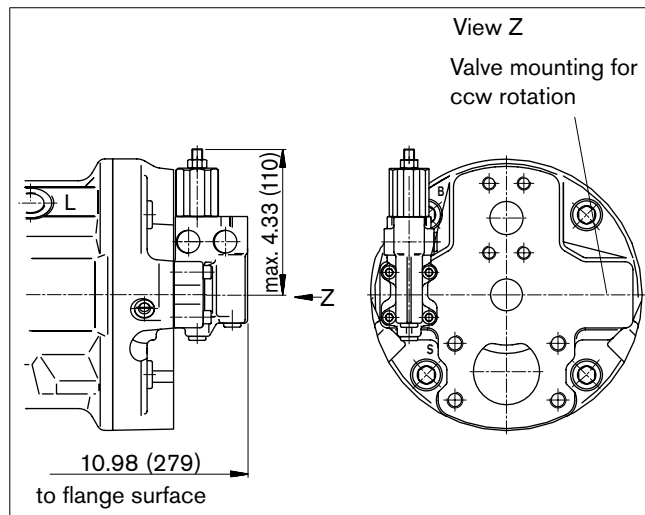
DG

Two-point control, directly operated, **port plate 92**



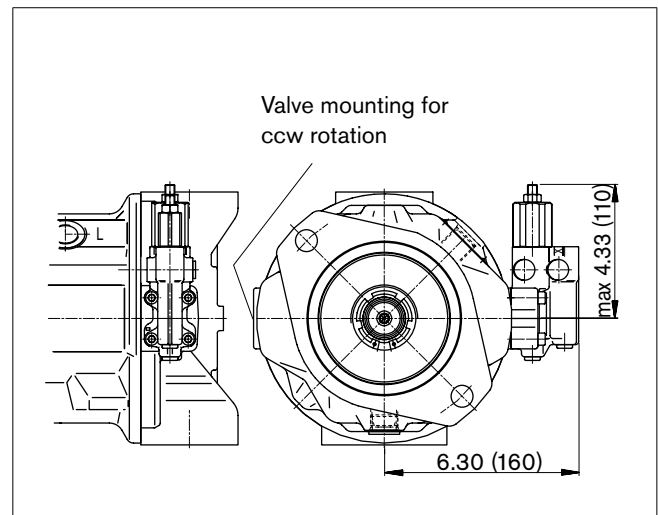
DR

Pressure control, **port plate 91**



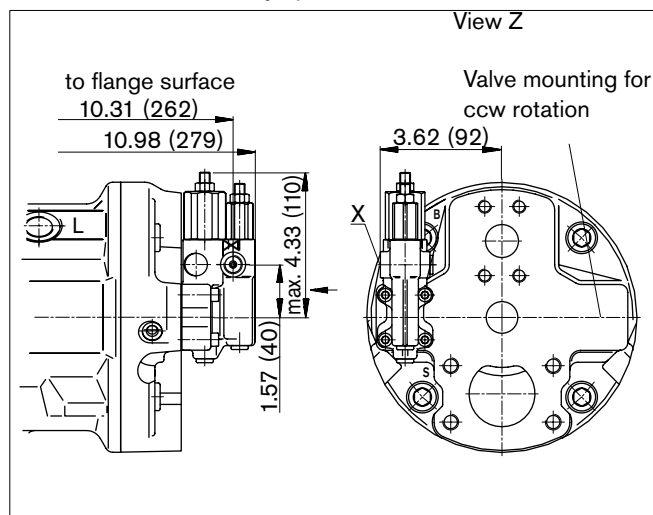
DR

Pressure control, **port plate 92**



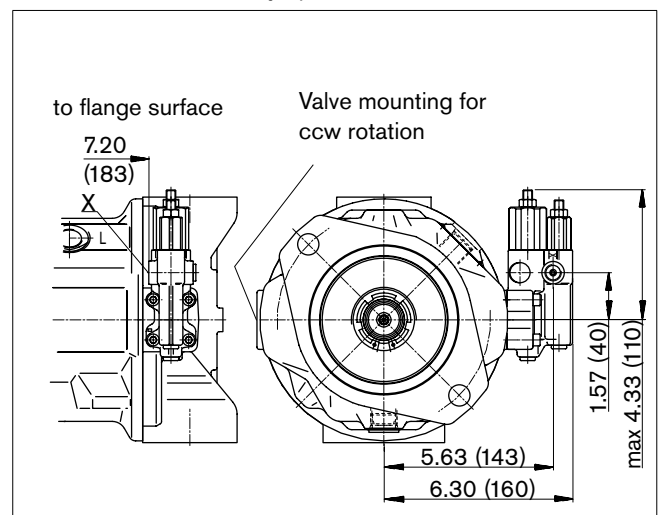
DRG

Pressure control, remotely operated, **port plate 91**



DRG

Pressure control, remotely operated, **port plate 92**



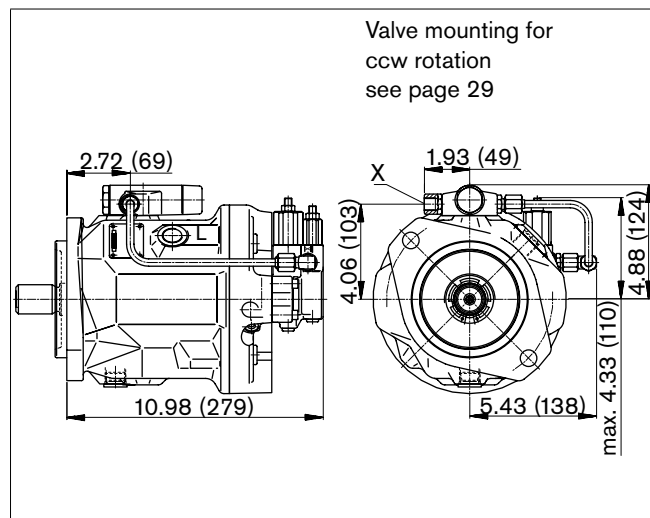
Details on connection options can be found on pages 29 and 30

Dimensions size 71

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

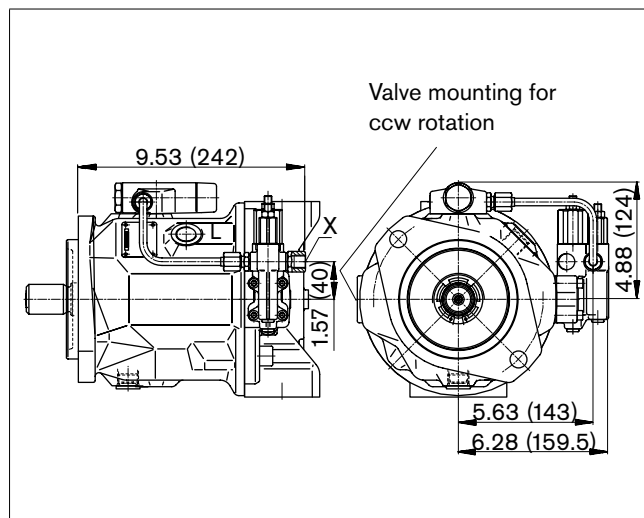
DFLR

Pressure, flow and power control, **port plate 91**



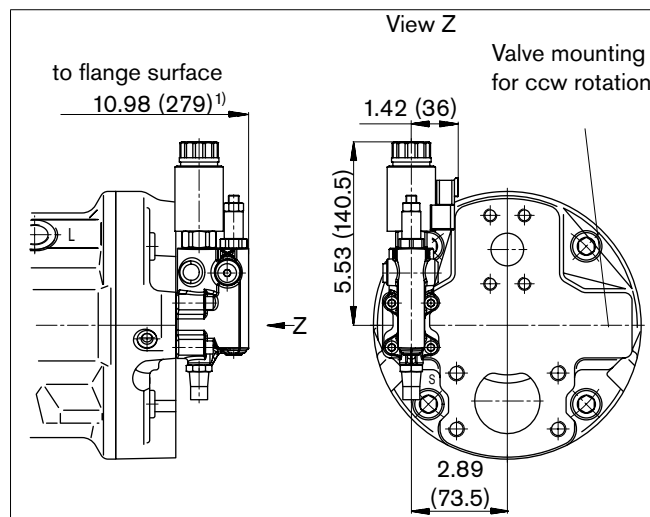
DFLR

Pressure, flow and power control, **port plate 92**



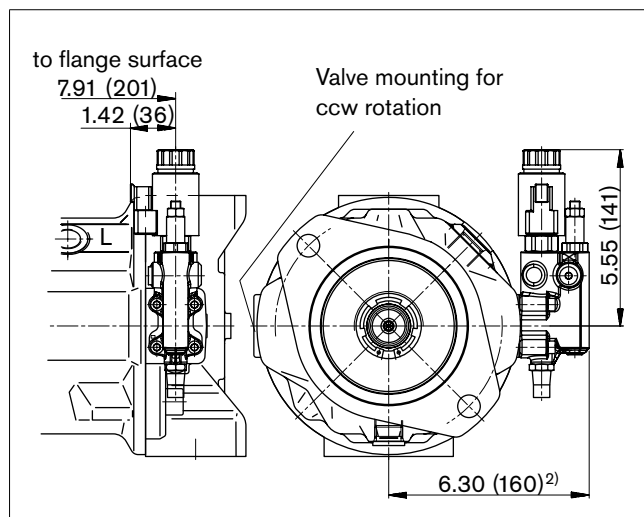
ED7. / ER7.

Electro-hydraulic pressure control, **port plate 91**



ED7. / ER7.

Electro-hydraulic pressure control, **port plate 92**



¹⁾ ER7.: 12.36 in (314 mm) when using a sandwich plate pressure reducing valve.

²⁾ ER7.: 7.68 in (195 mm) when using a sandwich plate pressure reducing valve.

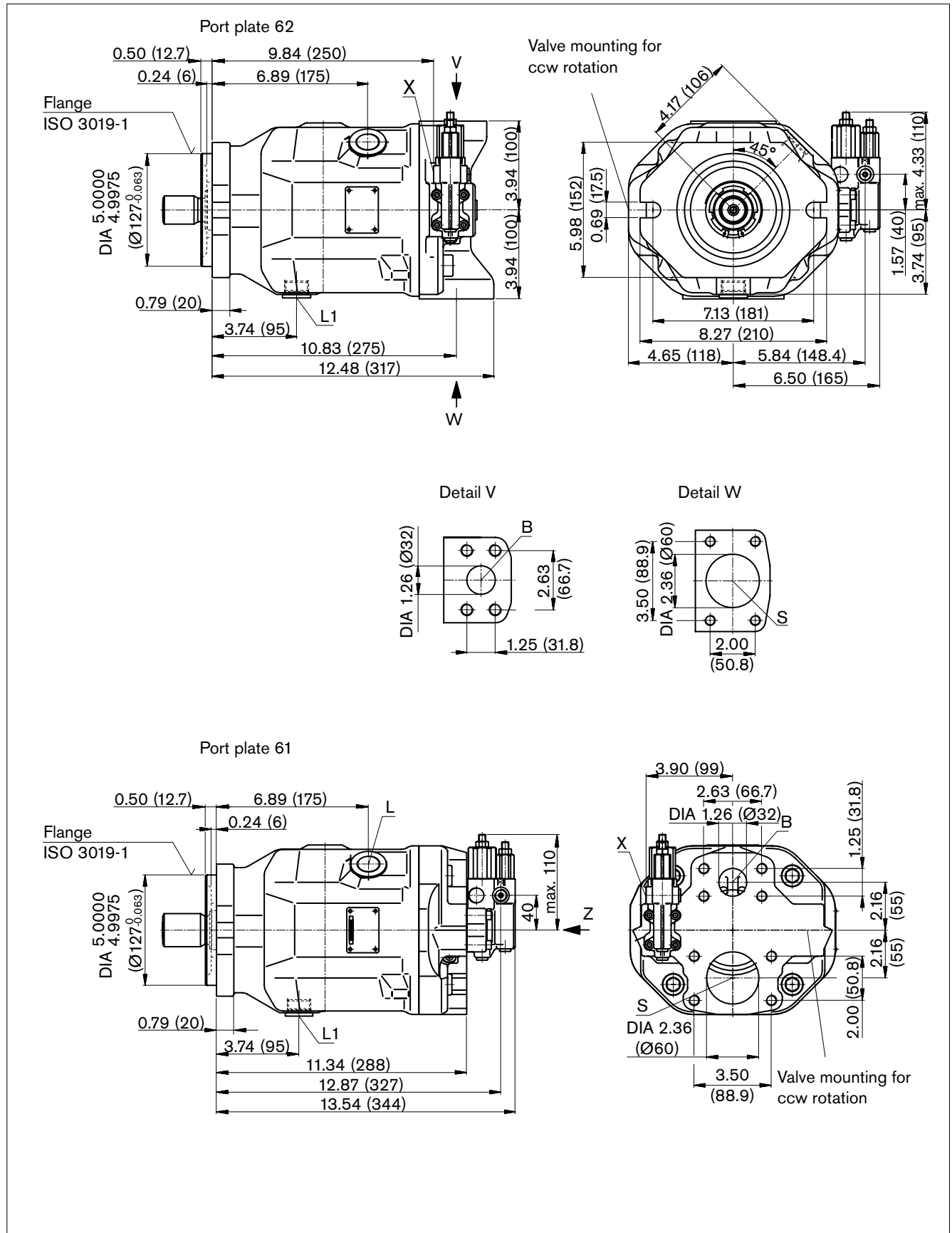
For details of connection options and drive shafts, see also pages 21 and 22

Dimensions size 100

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

DFR/DFR1 – Pressure and flow control, hydraulic

Clockwise rotation

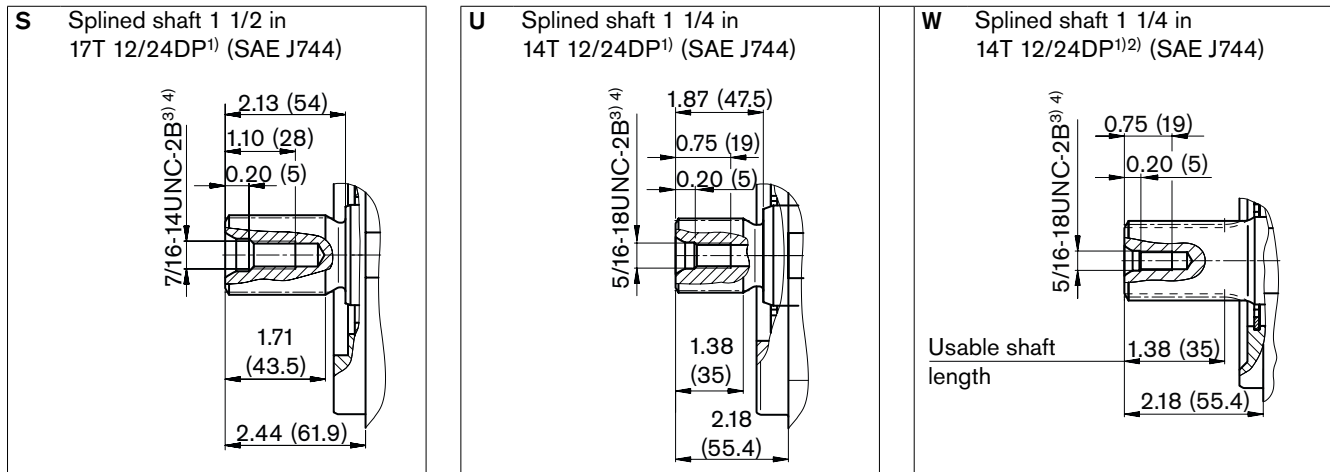


Details on connection options and shaft ends can be found on page 34

Dimensions size 100

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) Spline 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 page 52 must be observed.

Ports

Designation	Port for	Standard	Size ⁵⁾	Max. press. [psi (bar)] ⁶⁾	State
B	Service line, fastening thread	SAE J518 ASME B1.1	1 1/4 in 1/2-13 UNC-2B; 0.75 (19) deep	5100 (350)	O
S	Suction line, fastening thread	SAE J518 ASME B1.1	2 1/2 in 1/2-13 UNC-2B; 0.87 (22) deep	145 (10)	O
L	Case drain fluid	ISO 11926 ⁷⁾	1 1/16-12 UNF-2B; 0.71 (18) deep	30 (2)	O ⁸⁾
L ₁	Case drain fluid	ISO 11926 ⁷⁾	1 1/16-12 UNF-2B; 0.71 (18) deep	30 (2)	X ⁸⁾
X	Pilot pressure	ISO 11926 ⁷⁾	7/16-20 UNF-2B; 0.45 (11.5) deep	5100 (350)	O
X	Pilot pressure with DG-control	DIN ISO 228 ⁷⁾	G 1/4 in; 0.47 (12) deep	5100 (350)	O

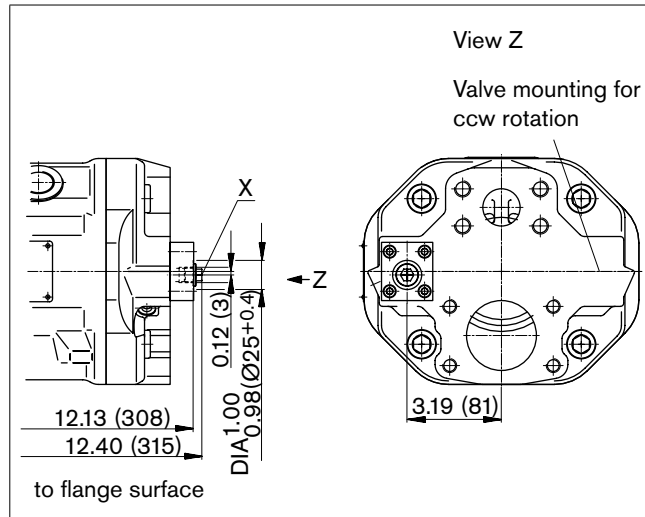
- 5) For the maximum tightening torques the general instructions on page 52 must be observed.
 6) Depending on the application, short-term pressure spikes can occur. Consider this when selecting measuring equipment and fittings. Pressure values in psi (bar) absolute.
 7) The spot face can be deeper than as specified in the standard.
 8) Depending on the installation position, L or L₁ must be connected (see also installation instructions on pages 48, 49)
 O = Must be connected (plugged on delivery)
 X = Plugged (in normal operation)

Dimensions size 100

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

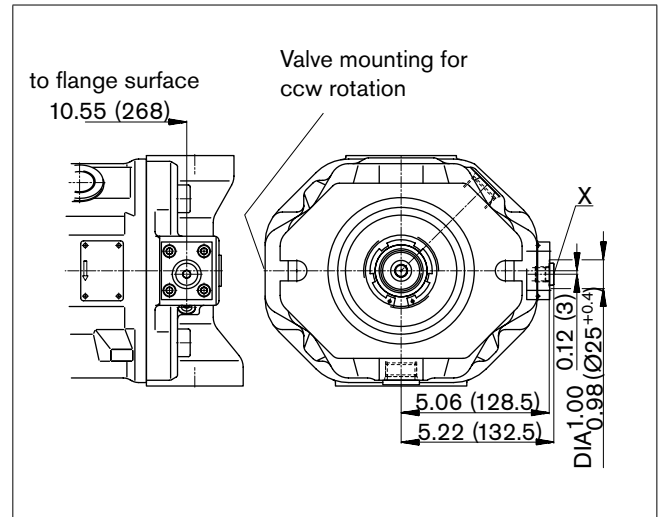
DG

Two-point control, directly operated, **port plate 61**



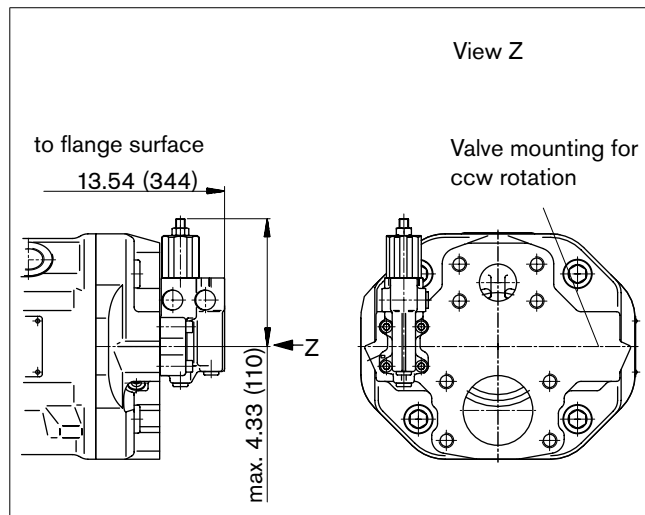
DG

Two-point control, directly operated, **port plate 62**



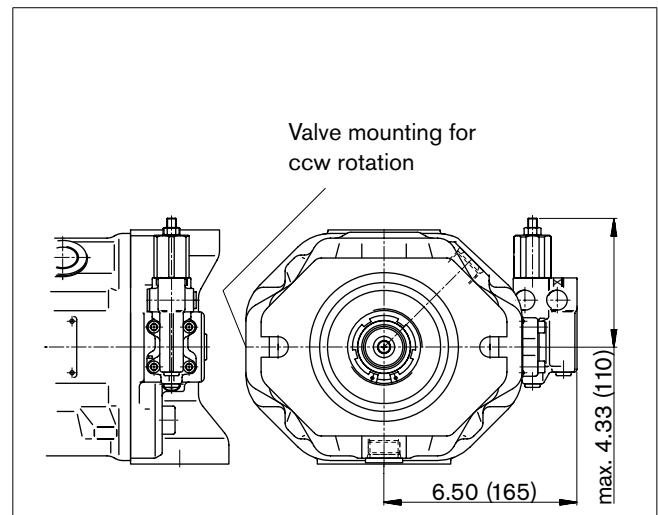
DR

Pressure control, **port plate 61**



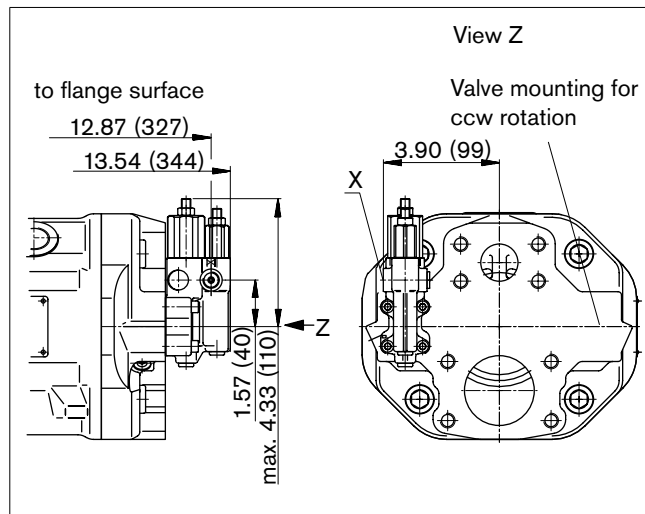
DR

Pressure control, **port plate 62**



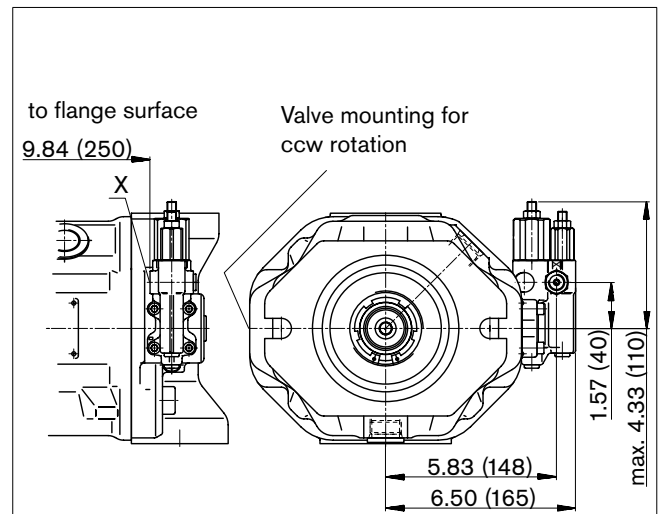
DRG

Pressure control, remotely operated, **port plate 61**



DRG

Pressure control, remotely operated, **port plate 62**



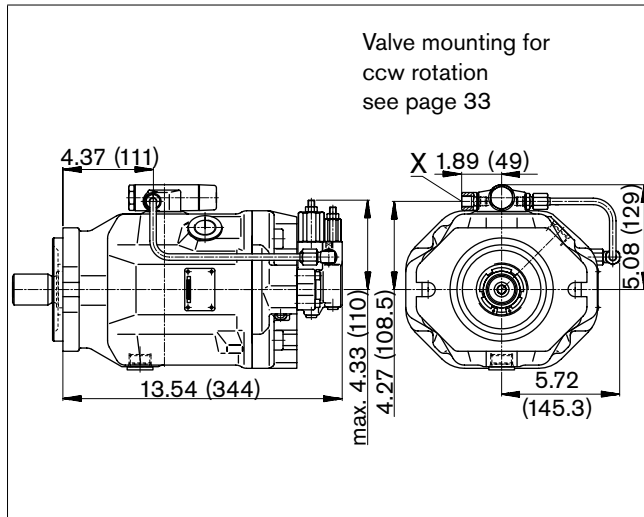
Details on connection options and shaft ends can be found on pages 33 and 34

Dimensions size 100

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

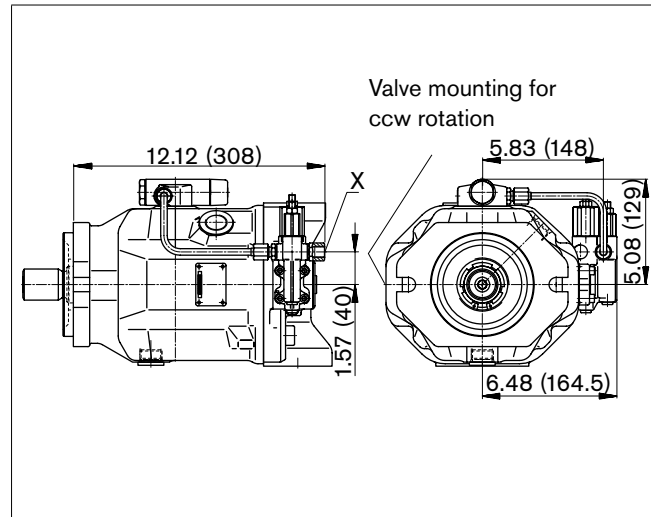
DFLR

Pressure, flow and power control, **port plate 61**



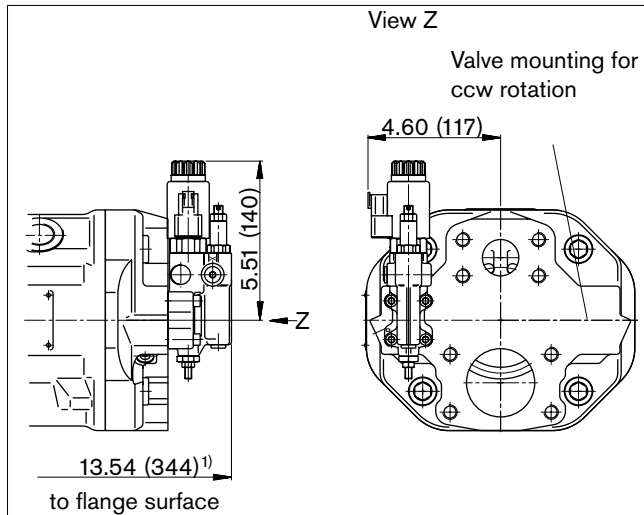
DFLR

Pressure, flow and power control, **port plate 62**



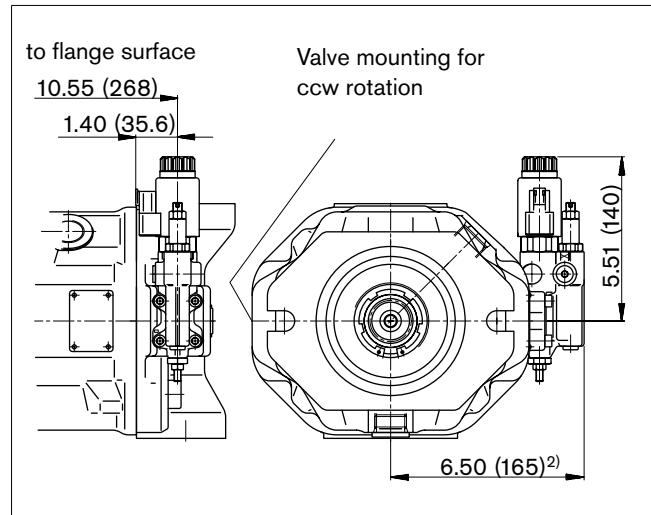
ED7./ER7.

Electro-hydraulic pressure control, **port plate 61**



ED7./ER7.

Electro-hydraulic pressure control, **port plate 62**



1) ER7.: 14.92 in (379 mm) when using a sandwich plate pressure reducing valve.

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

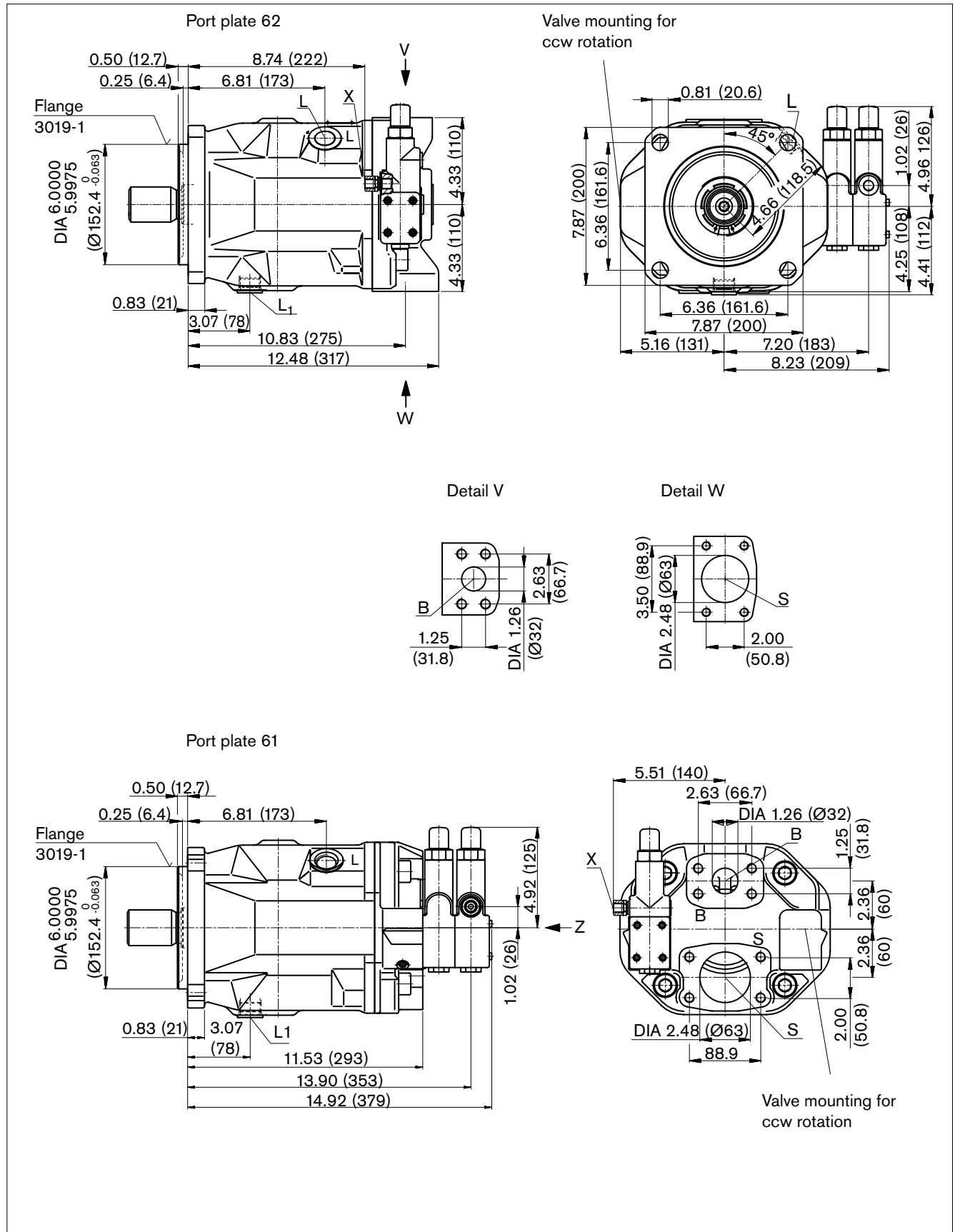
Details on connection options and shaft ends can be found on pages 33 and 34

Dimensions size 140

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

DFR/DFR1 – Pressure and flow control, hydraulic

Clockwise rotation, mounting flange D



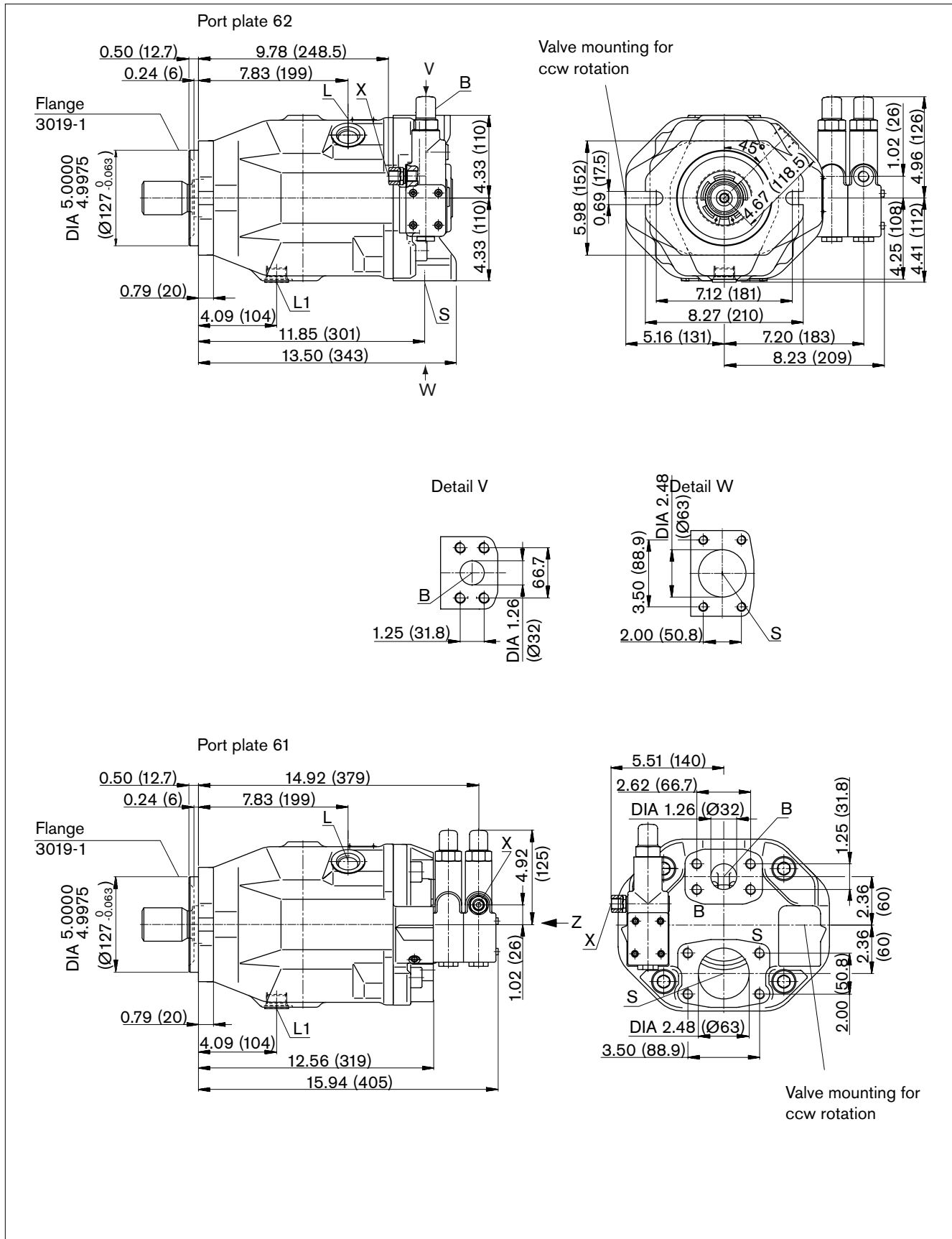
Details on connection options and shaft ends can be found on page 39

Dimensions size 140

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

DFR/DFR1 – Pressure and flow control, hydraulic

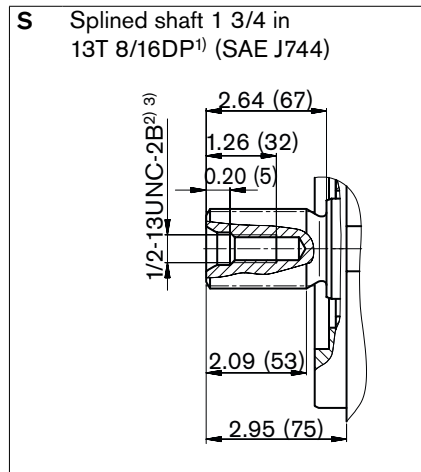
Clockwise rotation, mounting flange C



Dimensions size 140

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) Thread according to ASME B1.1
- 3) For the maximum tightening torques the general instructions on page 52 must be observed.

Ports

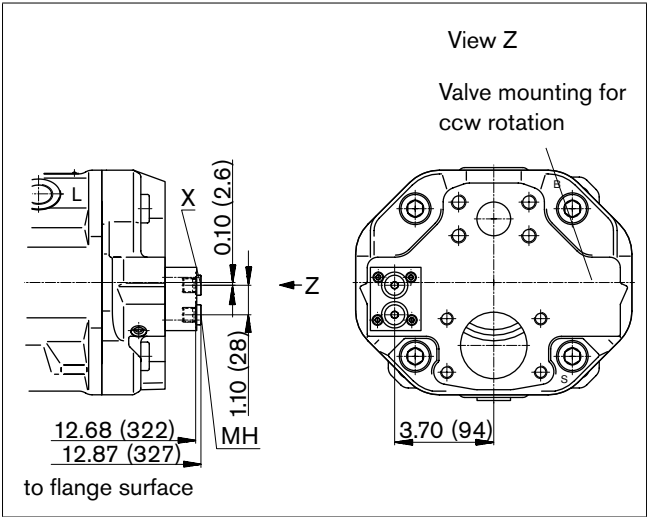
Designation	Port for	Standard	Size ⁴⁾	Max. press. [psi (bar)] ⁵⁾	State
B	Service line, fastening thread	SAE J518 ASME B1.1	1 1/4 in 1/2-13 UNC-2B; 0.94 (24) deep	5100 (350)	O
S	Suction line, fastening thread	SAE J518 ASME B1.1	2 1/2 in 1/2-13 UNC-2B; 0.94 (24) deep	145 (10)	O
L	Case drain fluid	ISO 11926 ⁶⁾	1 1/16-12 UNF-2B; 0.71 (18) deep	30 (2)	O ⁷⁾
L ₁	Case drain fluid	ISO 11926 ⁶⁾	1 1/16-12 UNF-2B; 0.71 (18) deep	30 (2)	X ⁷⁾
X	Pilot pressure	ISO 11926 ⁶⁾	9/16-18UNF-2B; 0.51 (13) deep	5100 (350)	O
X	Pilot pressure with DG-control	DIN ISO 228 ⁶⁾	M14 x 1.5; 12 deep	5100 (350)	O
M _H	Gauge port, high pressure	DIN 3852	M14 x 1.5, 12 deep	5100 (350)	X

- 4) For the maximum tightening torques the general instructions on page 52 must be observed.
 - 5) Depending on the application, short-term pressure spikes can occur. Consider this when selecting measuring equipment and fittings. Pressure values in psi (bar) absolute.
 - 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 (see also installation instructions on pages 48, 49)
- O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

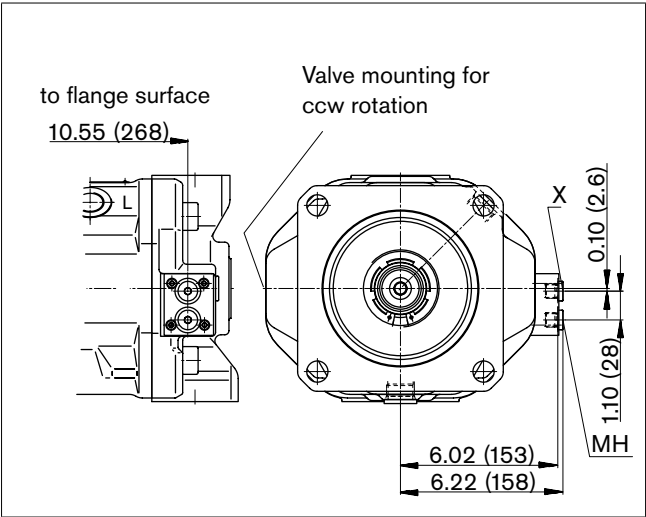
Dimensions size 140

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

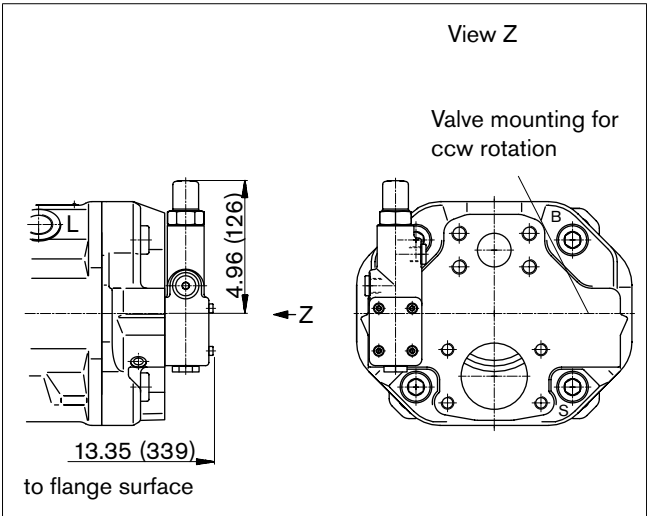
DG
Two-point control, directly operated, **port plate 61**



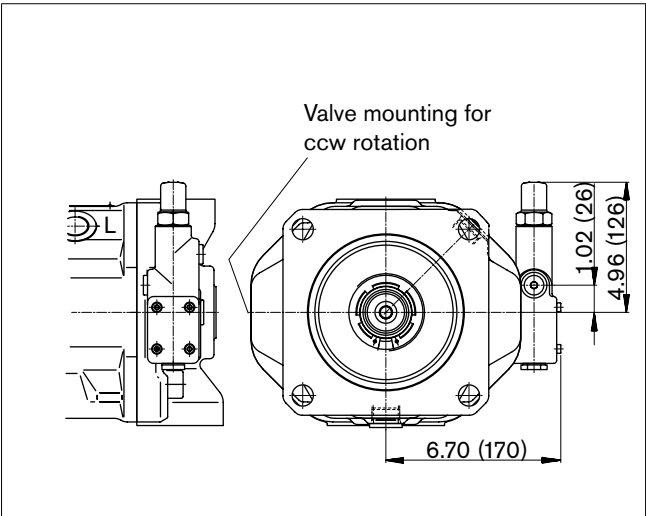
DG
Two-point control, directly operated, **port plate 62**



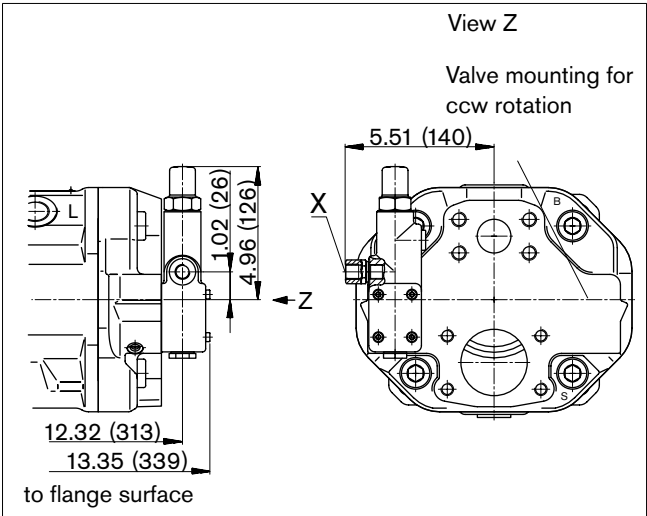
DR
Pressure control, **port plate 61**



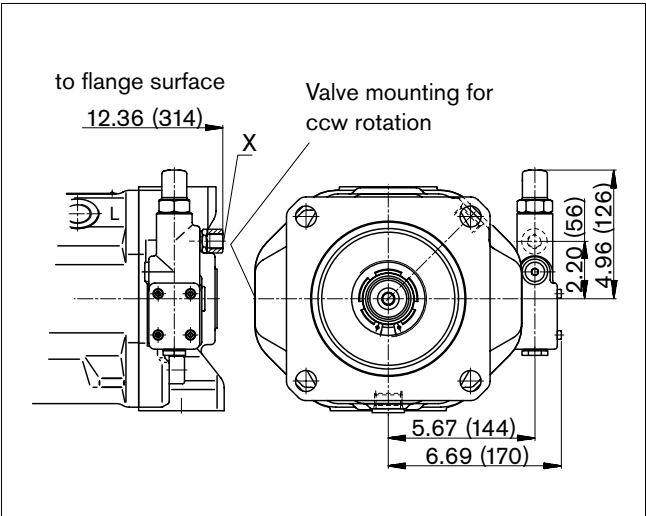
DR
Pressure control, **port plate 62**



DRG
Pressure control, remotely operated, **port plate 61**



DRG
Pressure control, remotely operated, **port plate 62**

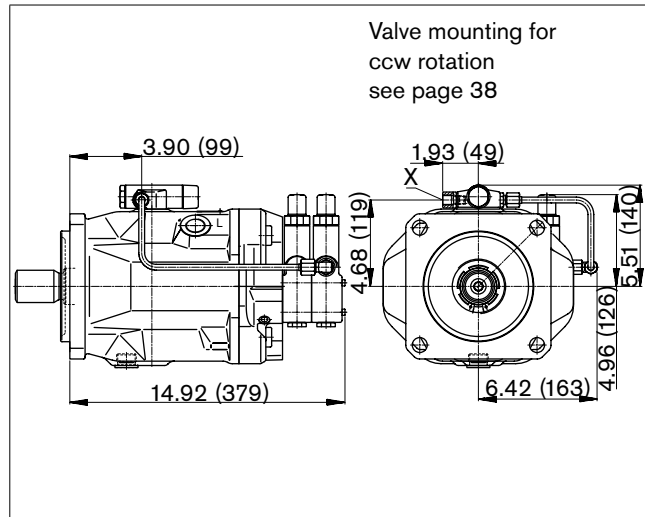


Dimensions size 140

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

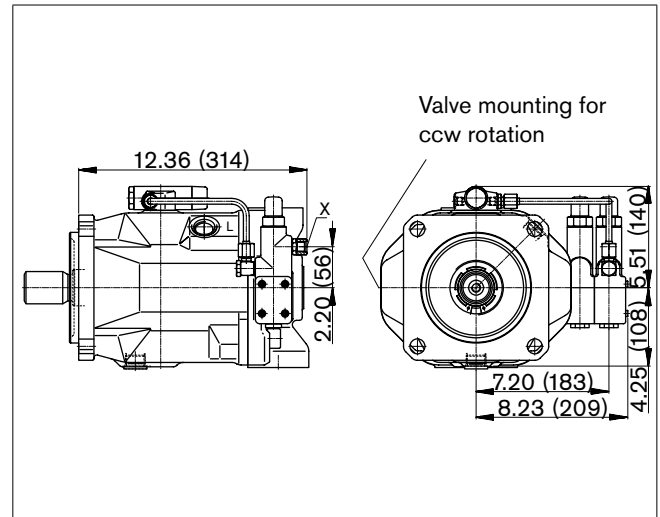
DFLR

Pressure, flow and power control, **port plate 61**



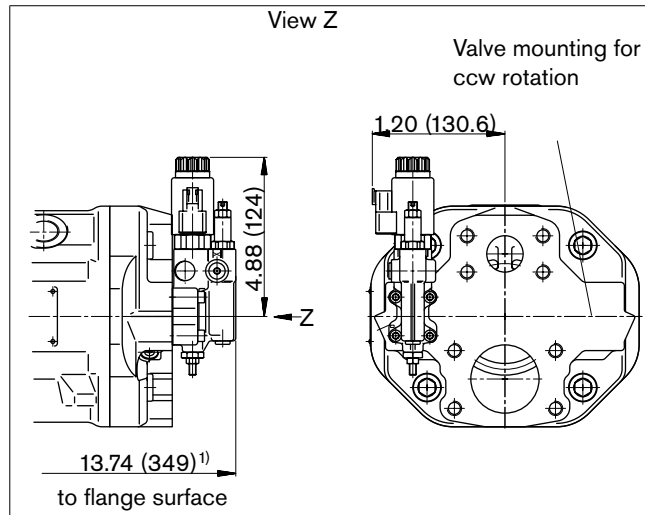
DFLR

Pressure, flow and power control, **port plate 62**



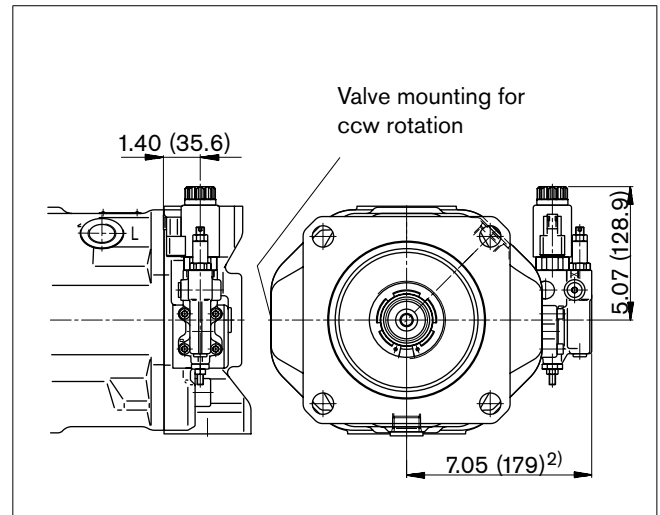
ED7. / ER7.

Electro-hydraulic pressure control, **port plate 61**



ED7. / ER7.

Electro-hydraulic pressure control, **port plate 62**



1) ER7.: 15.12 in (384 mm) when using a sandwich plate pressure reducing valve.

2) ER7.: 8.43 in (214 mm) when using a sandwich plate pressure reducing valve.

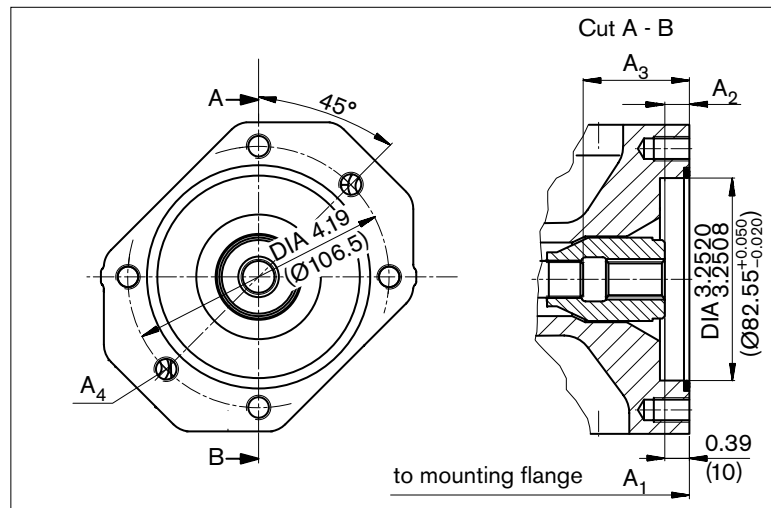
Details on connection options can be found on pages 37, 38 and 39

Dimensions through drive

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

K01 flange ISO 3019-2 (SAE J744 - 82-2 (A))

Coupling for splined shaft according to ANSI B92.1a-1996 5/8 in 9T 16/32 DP¹⁾ (SAE J744 - 16-4 (A))

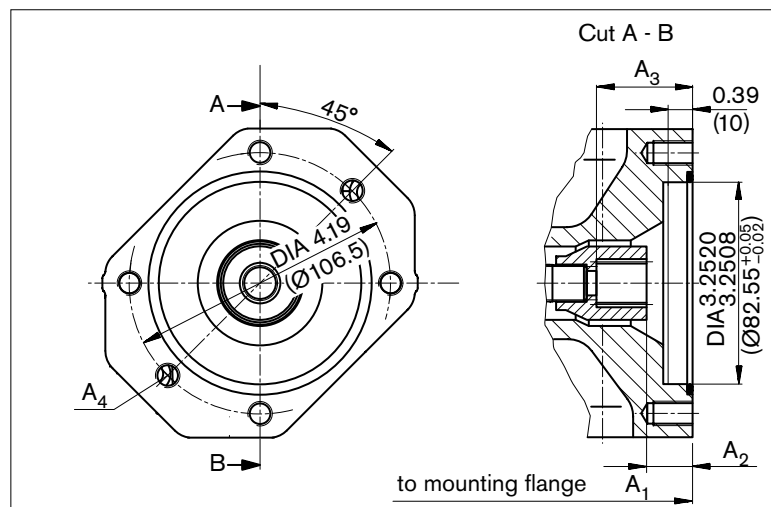


NG	A ₁	A ₂	A ₃	A ₄ ²⁾
18	7.16 (182)	0.39 (10)	1.70 (43.3)	M10 x 1.5, 0.57 (14.5) deep
28	8.03 (204)	0.39 (10)	1.33 (33.7)	M10 x 1.5, 0.63 (16) deep
45	9.02 (229)	0.42 (10.7)	2.10 (53.4)	M10 x 1.5, 0.63 (16) deep
71	10.51 (267)	0.46 (11.8)	2.41 (61.3)	M10 x 1.5, 0.79 (20) deep
100	13.31 (338)	0.41 (10.5)	2.56 (65)	M10 x 1.5, 0.63 (16) deep
140 ¹⁾	13.78 (350)	0.43 (10.8)	3.04 (77.3)	M10 x 1.5, 0.63 (16) deep

¹⁾ D-flange only

K52 flange ISO 3019-2 (SAE J744 - 82-2 (A))

Coupling for splined shaft according to ANSI B92.1a-1996 3/4 in 11T 16/32 DP¹⁾ (SAE J744 - 19-4 (A-B))

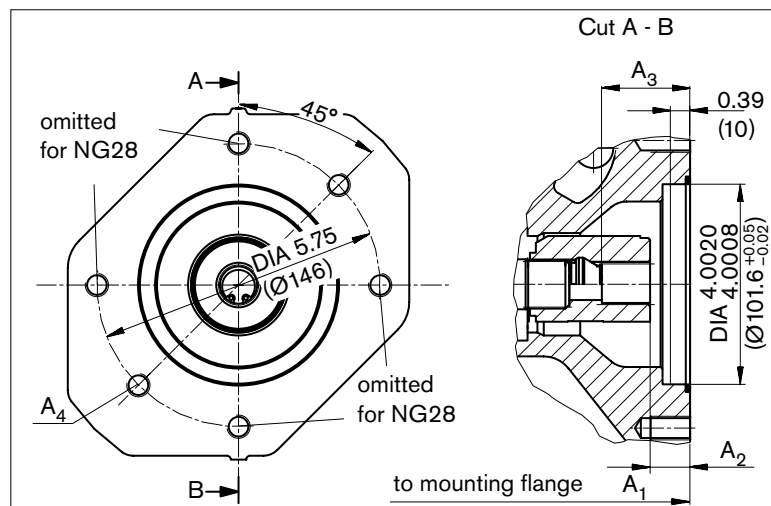


NG	A ₁	A ₂	A ₃	A ₄ ²⁾
18	7.16 (182)	0.74 (18.8)	1.52 (38.7)	M10 x 1.5, 0.57 (14.5) deep
28	8.03 (204)	0.74 (18.8)	1.52 (38.7)	M10 x 1.5, 0.63 (16) deep
45	9.02 (229)	0.744 (18.9)	1.52 (38.7)	M10 x 1.5, 0.63 (16) deep
71	10.51 (267)	0.84 (21.3)	1.63 (41.4)	M10 x 1.5, 0.79 (20) deep
100	13.31 (338)	0.75 (19)	1.53 (38.9)	M10 x 1.5, 0.63 (16) deep
140 ¹⁾	13.78 (350)	0.744 (18.9)	1.52 (38.6)	M10 x 1.5, 0.63 (16) deep

¹⁾ D-flange only

K68 flange ISO 3019-2 (SAE J744 - 101-2 (B))

Coupling for splined shaft according to ANSI B92.1a-1996 7/8 in 13T 16/32 DP¹⁾ (SAE J744 - 22-4 (B))



NG	A ₁	A ₂	A ₃	A ₄ ²⁾
28	8.03 (204)	0.70 (17.8)	1.64 (41.7)	M12 x 1.75, continuous
45	9.02 (229)	0.704 (17.9)	1.64 (41.7)	M12 x 1.75, 0.71 (18) deep
71	10.51 (267)	0.80 (20.3)	1.74 (44.1)	M12 x 1.75, 0.79 (20) deep
100	13.31 (338)	0.71 (18)	1.65 (41.9)	M12 x 1.75, 0.79 (20) deep
140 ¹⁾	13.78 (350)	0.70 (17.8)	1.64 (41.6)	M12 x 1.75, 0.79 (20) deep

¹⁾ D-flange only

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

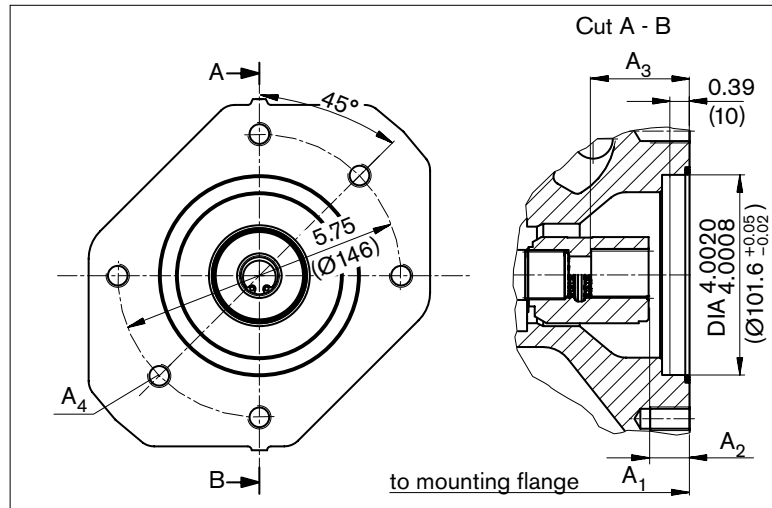
²⁾ Thread according to DIN 13, observe the general instructions on page 52 for the maximum tightening torques.

Dimensions through drive

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

K04 flange ISO 3019-2 (SAE J744 - 101-2 (B))

Coupling for splined shaft according to ANSI B92.1a-1996 1 in 15T 16/32 DP¹⁾ (SAE J744 - 25-4 (B-B))

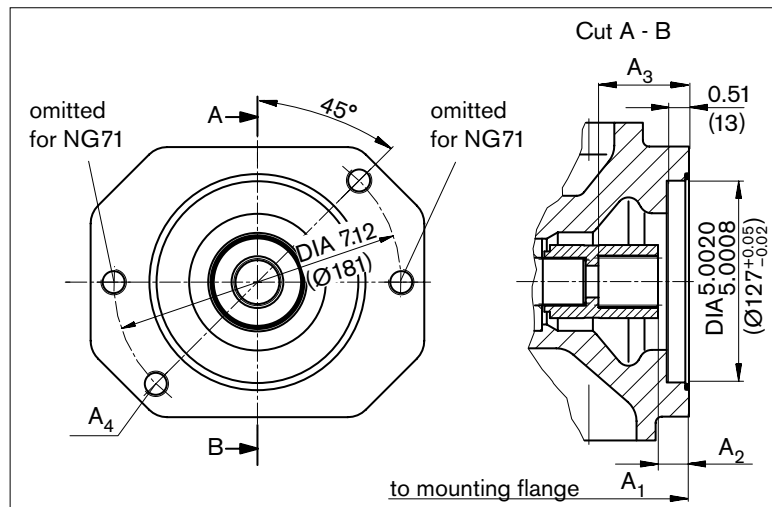


NG	A ₁	A ₂	A ₃	A ₄ ²⁾
45	9.02 (229)	0.724 (18.4)	1.84 (46.7)	M12 x 1.75, 0.71 (18) deep
71	10.51 (267)	0.82 (20.8)	1.93 (49.1)	M12 x 1.75, 0.79 (20) deep
100	13.31 (338)	0.716 (18.2)	1.83 (46.6)	M12 x 1.75, 0.79 (20) deep
140 ¹⁾	13.78 (350)	0.72 (18.3)	1.81 (45.9)	M12 x 1.75, 0.79 (20) deep

1) D-flange only

K07 flange ISO 3019-2 (SAE J744 - 127-2 (C))

Coupling for splined shaft according to ANSI B92.1a-1996 1 1/4 in 14T 12/24 DP¹⁾ (SAE J744 - 32-4 (C))

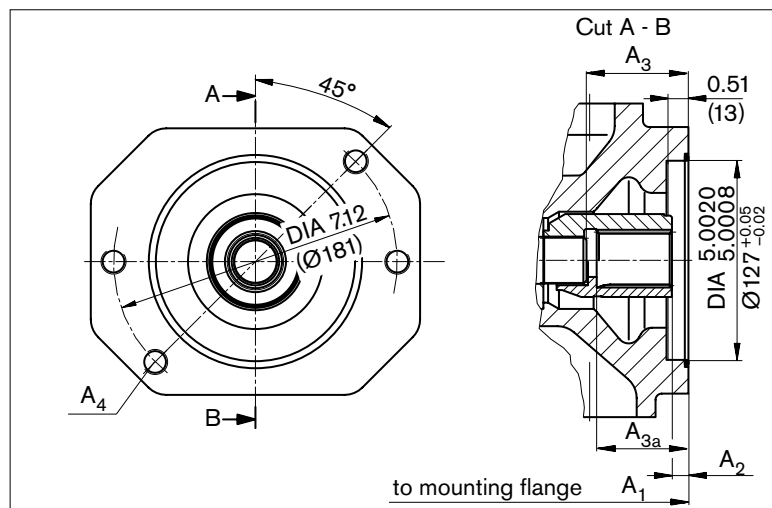


NG	A ₁	A ₂	A ₃	A ₄ ²⁾
71	10.51 (267)	0.86 (21.8)	2.31 (58.6)	M16 x 2, continuous
100	13.31 (338)	0.77 (19.5)	2.22 (56.4)	M16 x 2, continuous
140 ¹⁾	13.78 (350)	0.76 (19.3)	2.21 (56.1)	M16 x 2, 0.94 (24) deep

1) D-flange only

K24 flange ISO 3019-2 (SAE J744 - 127-2 (C))

Coupling for splined shaft according to ANSI B92.1a-1996 1 1/2 in 17T 12/24 DP¹⁾ (SAE J744 - 38-4 (C-C))



NG	A ₁	A ₂	A ₃ ³⁾	A _{3a} ⁴⁾	A ₄ ²⁾
100	13.31 (338)	0.41 (10.5)	2.56 (65)	— (—)	M16 x 2, continuous
140 ¹⁾	13.78 (350)	0.42 (10.8)	2.95 (75)	— (—)	M16 x 2, 0.94 (24) deep
	13.78 (350)	0.40 (10.3)	— (—)	2.72 (69.1)	M16 x 2, 0.94 (24) deep

1) D-flange only

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

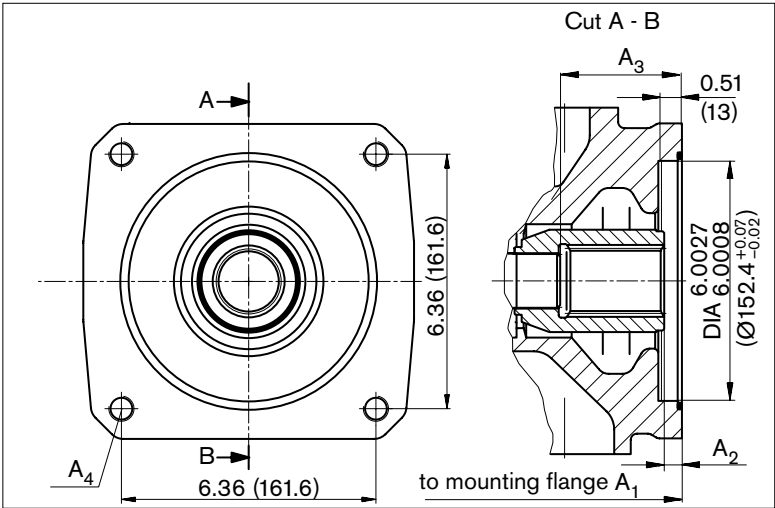
2) Thread according to DIN 13, observe the general instructions on page 52 for the maximum tightening torques.

3) Coupling without stop

Dimensions through drive

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

K17 flange ISO 3019-2 (SAE J744 - 152-4 (A))
Coupling for splined shaft according to ANSI B92.1a-1996 1 3/4 in 13T 8/16 DP¹⁾ (SAE J744 - 44-4 (D))



NG	A ₁	A ₂	A ₃	A ₄ ²⁾
140 ¹⁾	13.78 (350)	0.43 (11)	3.04 (77.3)	M16 x 2, continuous

¹⁾ D-flange only

¹⁾ 30° pressure angle, flat root, side fit, tolerance class 5
²⁾ Thread according to DIN 13, observe the general instructions on page 52 for the maximum tightening torques.

Summary mounting options

SAE – mounting flange

Through-drive ¹⁾			Mounting option – 2nd pump			
Flange ISO 3019-1	Coupling for splined shaft	Short des.	A10VO/31 NG (shaft)	A10V(S)O/5x NG (shaft)	External gear pump design (NG)	Through drive available for NG
82-2 (A)	5/8 in	K01	18 (U)	10 (U)	F (5 to 22)	18 to 140
	3/4 in	K52	18 (S, R)	10 (S) 18 (U) 18 (S, R)	–	18 to 140
101-2 (B)	7/8 in	K68	28 (S, R) 45 (U, W) ¹⁾	28 (S, R) 45 (U, W) ¹⁾	N/G (26 to 49)	28 to 140
	1 in	K04	45 (S, R) –	45 (S, R) 60, 63 (U, W) ²⁾	–	45 to 140
127-2 (C)	1 1/4 in	K07	71 (S, R) 100 (U) ³⁾	85 (U, W) ³⁾ 100 (U, W)	–	71 to 140
	1 1/2 in	K24	100 (S)	85 (S) 100 (S)	–	100 to 140
152-4 (4-hole D)	1 3/4 in	K17	140 (S)	–	–	140

1) Not for main pump NG28 with K68

2) Not for main pump NG45 with K04

3) Not for main pump NG71 with K07

Combination pumps A10VO + A10VO

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:
A10VSO100DFR1/31R-VSB12K04+
A10VSO45DFR/31R-VSA12N00

If no further pumps are to be factory-mounted, the simple type code is sufficient.

It is permissible to use a combination of two single pumps of the same size (tandem pump), considering a dynamic mass acceleration force of maximum 10 g (= 98.1 m/s²) without an additional support bracket.

Each through drive is plugged with a **non-pressure-resistant** cover. Before commissioning the units, they must therefore be equipped with a pressure-resistant cover.

Through drives can also be ordered with pressure-resistant covers. Please specify in clear text.

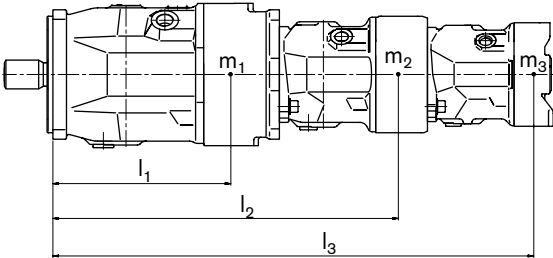
For combination pumps comprising more than two pumps, the mounting flange must be calculated for the permissible moment of inertia.

Permissible mass moment of inertia

NG			18	28	45	71	100	140
Permissible moment of inertia								
static	T _m	lb-ft	369 (500)	649 (880)	1010 (1370)	1593 (2160)	2213 (3000)	3319 ¹⁾
		(Nm)						2213 ²⁾ (3000) ²⁾
dynamic at 10 g (98.1 m/s ²)	T _m	lb-ft	37 (50)	65 (88)	101 (137)	159 (216)	221 (300)	332 ¹⁾
		(Nm)						132 ²⁾ (300) ²⁾
Mass with through-drive plate	m	lbs	30.8	41.9	55.1	86	119	150
Mass without through drive (e.g. 2nd pump)		(kg)	(14)	(19)	(25)	(39)	(54)	(68)
	m	lbs	26.5	33	46	73	99	132
		(kg)	(12)	(15)	(21)	(33)	(45)	(60)
Distance center of gravity	l	in	3.54	4.33	5.12	5.91	6.30	6.30
		(mm)	(90)	(110)	(130)	(150)	(160)	(160)

1) 4-hole flange (D)

2) 2-hole flange (C)



m₁, m₂, m₃
Mass of pumps

[lbs (kg)]

l₁, l₂, l₃
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)]

Connector for solenoids

DEUTSCH DT04-2P-EP04, 2-pin

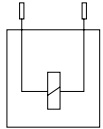
Molded, without bidirectional suppressor diode _____ P

The following type of protection is provided with installed mating connector:

IP67 _____ DIN/EN 60529
and IP69K _____ DIN 40050-9

Circuit symbol

Without bidirectional suppressor diode



Mating connector

DEUTSCH DT06-2S-EP04

Bosch Rexroth Mat. No. R902601804

Consisting of:

DT designation

– 1 case _____ DT06-2S-EP04

– 1 wedge _____ W2S

– 2 sockets _____ 0462-201-16141

The mating connector is not included in the delivery contents.
This can be supplied by Bosch Rexroth on request.

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

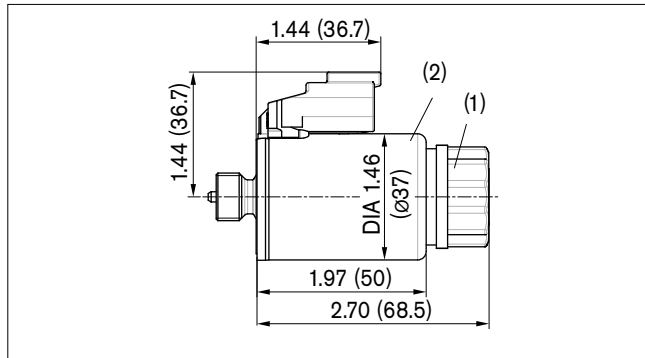
Changing connector position

If necessary, you can change the position of the connector by turning the solenoid.

To do this, proceed as follows:

1. Loosen the mounting nut (1) of the solenoid. To do this, turn the mounting nut (1) one revolution counter-clockwise.
2. Turn the solenoid body (2) to the desired position.
3. Retighten the mounting nut of the solenoid. Tightening torque: 4 +0.7 lb-ft (5+1 Nm) (size WAF 26, 12-pt DIN 3124).

On delivery, the position of the connector may differ from that shown in the brochure or drawing.



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.

Particularly with the "drive shaft up/down" installation position, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The case drain fluid in the motor housing must be directed to the reservoir via the highest case drain port (L_1 , L_2 , L_3).

For combinations of multiple units, make sure that the respective case pressure in each unit is not exceeded. In the event of pressure differences at the case drain ports of the units, the shared case drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate case drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction line and case drain line must flow into the reservoir below the minimum fluid level . The permissible suction height 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.

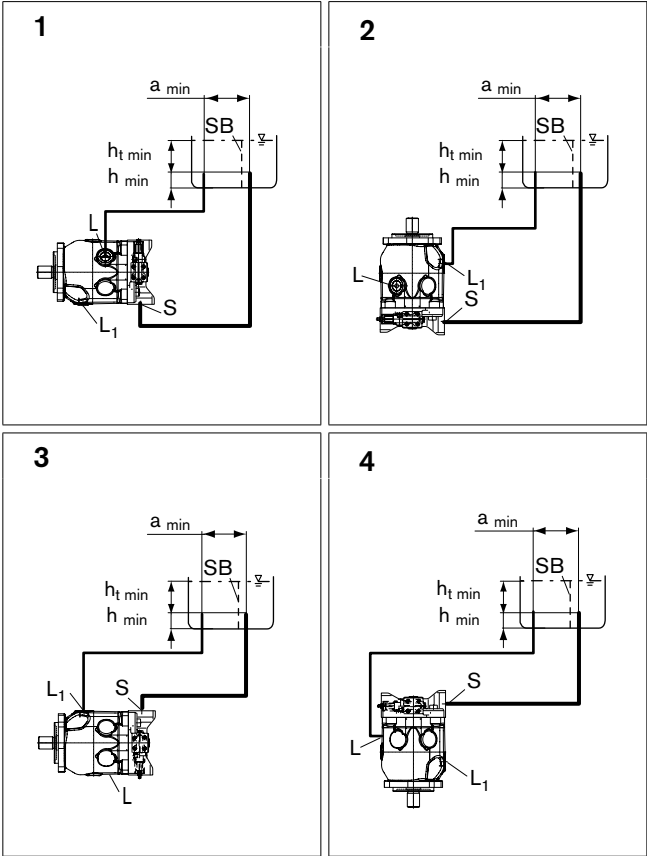
Recommended installation positions: 1 and 3.

Note

- You can expect certain installation positions to affect the control device. Because of gravity, unit weight and case pressure, minor characteristic displacements and response time changes may occur.

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 ₁
2	L ₁	S + L
3	L ₁	S + L
4	L	S + L ₁

Key, see page 49.

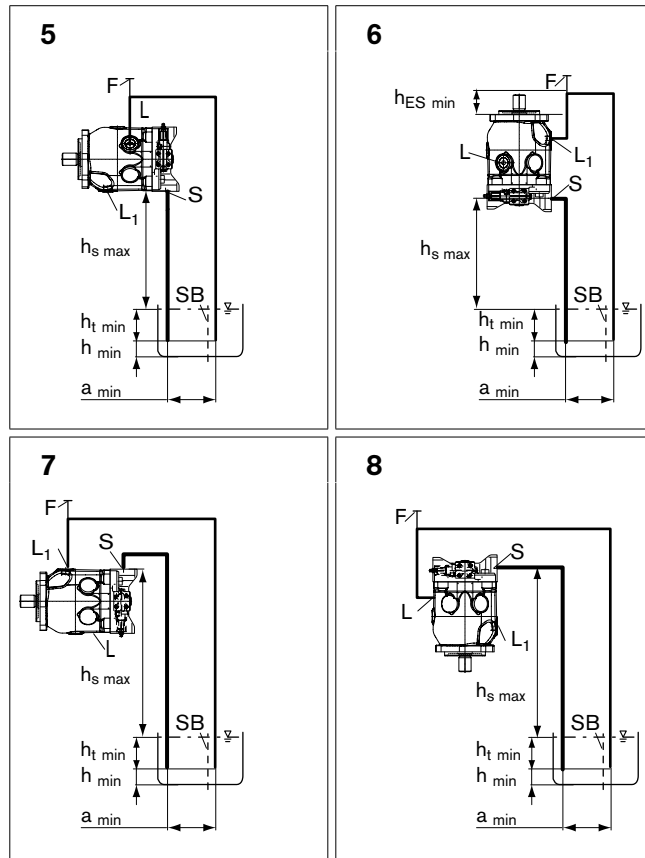
Installation instructions

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) at port L_1 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.



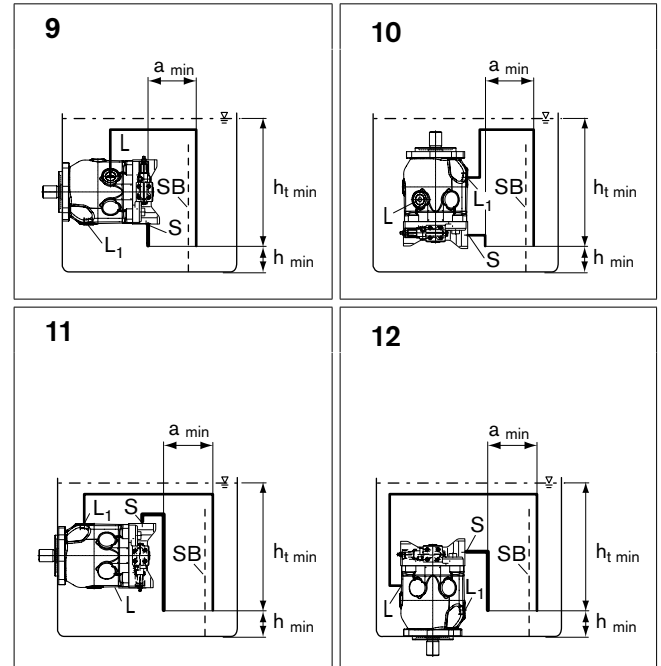
Installation position	Air bleed	Filling
5	F	L (F)
6	F	L_1 (F)
7	F	S + L_1 (F)
8	F	S + L (F)

Inside-reservoir installation

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid.

If the minimum fluid level is equal to or below the upper edge of the pump, see chapter "Above-reservoir installation".

Axial piston units with electrical components (e.g. electric control, sensors) may not be installed in a reservoir below the fluid level.



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

- 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 bottom (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 (31.50 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.

Notes

Notes

General instructions

- The A10VO / A10VSO 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 Bosch Rexroth.
- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristics may shift.
- Service line ports:
 - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
 - The service line ports and function ports are only designed to accommodate hydraulic lines.
- Pressure cut-off and pressure control do not provide security against pressure overload. A separate pressure relief valve is to be provided in the hydraulic system.
- The data and notes contained herein must be adhered to.
- The product is not approved as a component for the safety concept of a general machine according to ISO 13849.
- The following tightening torques apply:
 - Fittings:
Observe the manufacturer's instruction regarding the tightening torques of the used fittings.
 - Mounting bolts:
For mounting bolts with metric ISO thread according to DIN 13 or thread according to ASME B1.1, we recommend checking the tightening torque 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	7/16-20 UNF-2B	40 Nm	18 Nm	3/16 in
	3/4-16 UNF-2B	160 Nm	70 Nm	5/16 in
	9/16-18 UNF-2B	80 Nm	35 Nm	1/4 in
	7/8-14 UNF-2B	240 Nm	110 Nm	3/8 in
	1 1/16-12 UNF-2B	360 Nm	170 Nm	9/16 in
DIN 3852	M14 x 1.5	80 Nm	45 Nm ¹⁾	6 mm
DIN ISO 228	G 1/4 in	70 Nm	–	–

1) The tightening torques of the threaded plugs M_V apply for screws in the "dry" state as received on delivery and in the "lightly oiled" state for installation

Bosch Rexroth Corporation
Mobile Applications
8 Southchase Court
Fountain Inn, SC 29644-9018
USA
Telephone (864) 967-2777
Facsimile (864) 967-8900
www.boschrexroth-us.com

Bosch Rexroth Corporation
Industrial Applications
2315 City Lane Road
Bethlehem, PA 18017-2131
USA
Telephone (610) 694-8300
Facsimile (610) 694-8467
www.boschrexroth-us.com

© Bosch Rexroth Corporation

All rights reserved. Neither this document, nor any part of it, may be reproduced, duplicated, circulated or disseminated, whether by copy, electronic format or any other means, without the prior consent and authorization of Bosch Rexroth Corp.

The data and illustrations in this brochure/data sheet are intended only to describe or depict the products. No representation or warranty, either express or implied, relating to merchantability or fitness for intended use, is given or intended by virtue of the information contained in this brochure/data sheet. The information contained in this brochure/data sheet in no way relieves the user of its obligation to insure the proper use of the products for a specific use or application. All products contained in this brochure/data sheet are subject to normal wear and tear from usage.

Subject to change.