YEOSHE

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High Efficient & Potential · Saving Power Technology

YEOSHE Insists on ...

Keeping Professional • Quality First • Efficiency Upgrading
Service Oriented • Sustainable Management

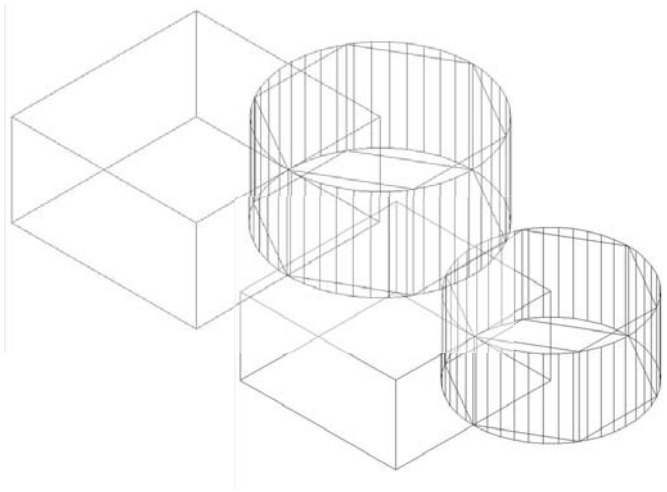
YEOSHE HYDRULICS CO.,LTD is funded in 1989 and located in Taichung Taiwan.
We are specialize in professional manufacturing Variable axial piston pump, Hydraulic machine, Hydraulic valves, Hydraulic system design, Piston pump components, cold forge pressing machine, High speed punching machine, Hydraulic broaching machine, Hand tool manufacturing line.

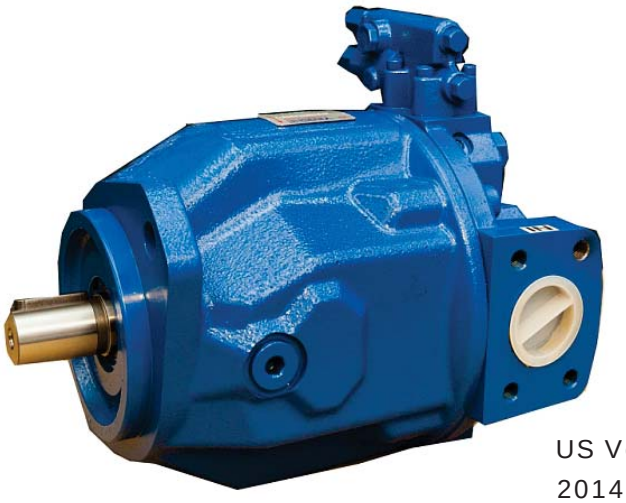
YEOSHE has perfect performance manufacturing process via our facilities, CNC lathing machine, CNC milling machine, precise grinding machine, mirror surface grinding machine etc.…

YEOSHE passed new vision of ISO 9001:2008 certificate, Strict quality control is our first mission, standard QC form and the most precise coordinate measuring machines, metallographic analyzers, ultra-micro sclerometer for ensuring product precision.

Also We have independent R&D capability, using new software CAD/CAM, SOLI EAGE to design products.
The strict QC inspection is carried out from R&D, quality control and endurance test before selling.

From following the step of Europe, America and Japan, to integrating and improving advantages of all countries, to innovating and developing products to satisfy market demands, with sustainable operating attitude, we manage locally and think globally.



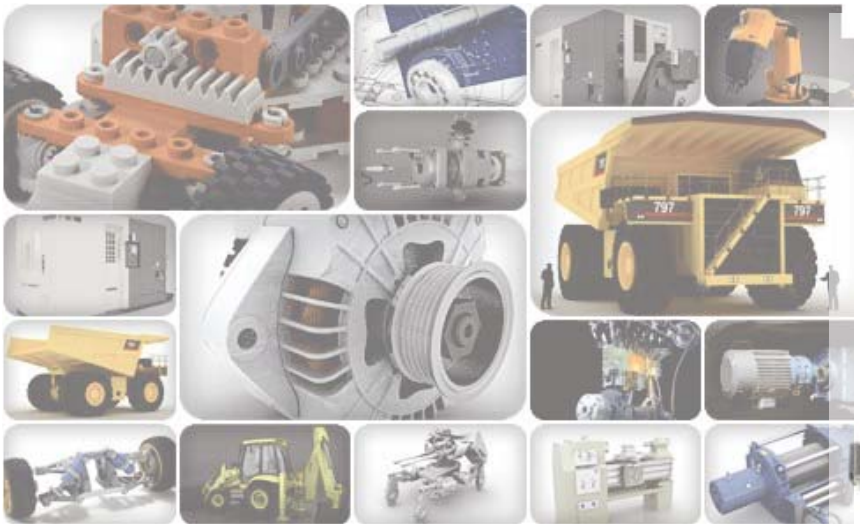


PA10VSO Series

Series 31

* Bent axial piston pump, open loop
* Long life , low noise
* Variable control options
* Drive thru , multi-pumps connection
* Long testing validation, reliable quality
* Application for industry & construction machinery

US Version
2014.02



Type code for standard program

	PA10VS	O			/	31		–	V					
01	02	03	04	05		06	07		08	09	10	11	12	13

	Version	18	28	45	71	100	140	
01	Standard version (without symbol)	●	●	●	●	●	●	
	HFA, HFB, HFC hydraulic fluid (except for Skydrol)	–	●	●	●	●	●	**E**
	High-speed version	–	–	●	●	●	●	**H**

	Axial piston unit							
02	Swashplate design, variable, nominal pressure 4000 psi (280 bar), maximum pressure 5100 psi (350 bar)	●	●	●	●	●	●	PA10VS

	Operation mode	
03	Pump, open circuit	**O**

	Size (NG)	18	28	45	71	100	140	
04	Geometric displacement, see table of values	**18**	**28**	**45**	**71**	**100**	**140**	

	Control device								
05	Two-point control, directly operated			●	●	●	●	●	●	**DG**
	Pressure control			●	●	●	●	●	●	**DR**
	with flow control, hydraulic									
		X-T open		●	●	●	●	●	●	**DFR**
		X-T closed		●	●	●	●	●	●	**DFR1**
		pressure and swivel-angle control, electric		●	●	●	●	●	●	**DFE1**[1)]
	with pressure cut-off, remotely operated									
	hydraulic			●	●	●	●	●	●	**DRG**
	electrical	negative characteristic	12V	●	●	●	●	●	●	**ED71**
			24V	●	●	●	●	●	●	**ED72**
		positive characteristic	12V	●	●	●	●	●	●	**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) 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 pressure reducing sandwich plate can be ordered from YEOSHE.

● = available ❍ = on request – = not available

Type code for standard program

	PA10VS	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
	Parallel keyed shaft ISO 3019-1	not for through drive	●	●	●	●	●	●	K

	Mounting flange		18	28	45	71	100	140	
10	ISO 3019-1	2-hole	●	●	●	●	●	–	C
		4-hole	–	–	–	–	–	●	D

	Service line port		18	28	45	71	100	140	
11	SAE flange ports on opposite side, UNC fastening thread		●	●	●	–	●	●	62
			–	–	–	●	–	–	92

	Through drive			18	28	45	71	100	140	
12	without through drive			●	●	●	●	●	●	N00
	Flange ISO 3019-1	coupling for splined shaft[1]								
	Diameter	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 solenoids[2]	18	28	45	71	100	140	
13	HIRSCHMANN connector – without suppressor diode	●	●	●	●	●	●	H

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

When using environmentally acceptable hydraulic fluids, the limitations regarding technical data and seals must be observed. Please contact us. When ordering, indicate the hydraulic fluid that is to be used.

Operating viscosity range

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

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

referred to reservoir temperature (open circuit).

Limits of viscosity range

For critical operating conditions the following values apply:

n_{min} = 60 SUS (10 mm²/s)
short-term (t ≤ 1 min)
at max perm. case drain temp. of 195 °F (90 °C).

Please also ensure that the max. case drain temperature of 195 °F (90 °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_{max} = 4640 SUS (1000 mm²/s)
short-term (t ≤ 1 min)
on cold start
(p ≤ 435 psi (30 bar), n ≤ 1000 rpm,
t_{min} -13 °F (-25 °C))

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

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 (ν_{opt}), see shaded section of the selection diagram. We recommend to select the higher viscosity grade in each case.

Example: at an ambient temperature of X °F (°C) the operating temperature is 140 °F (60 °C). In the optimum operating viscosity range (ν_{opt}; shaded area) this corresponds to viscosity grades VG 46 resp. VG 68; VG 68 should be selected.

Important:
The case drain temperature is influenced by pressure and input speed and is always higher than the reservoir temperature. However, at no point in the component may the temperature exceed 195 °F (90 °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.

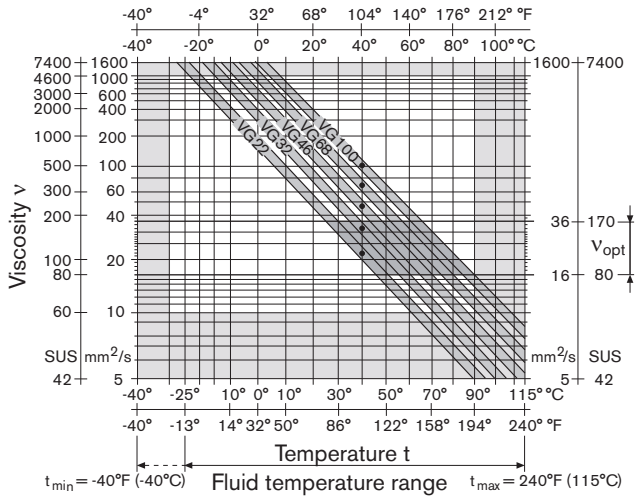
Filtration of the hydraulic fluid

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.

Selection diagram



Technical data

Operating pressure range

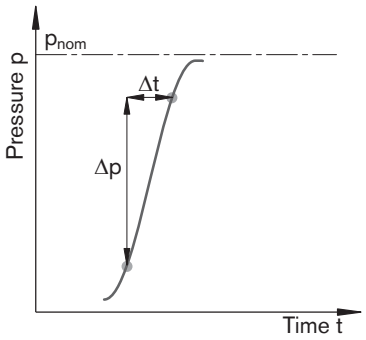
Pressure at service line port B

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

Maximum pressure p_{max} _____ 5100 psi (350 bar) absolute
Single operating period _____ 2.5 ms
Total operating period _____ 300 h

Min. pressure (high-pressure side) _ 145 psi (10 bar) absolute[1)]

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



Pressure at suction port S (inlet)

Minimum pressure $p_{S\ min}$ _____ 12 psi (0.8 bar) absolute
Maximum pressure $p_{S\ max}$ _____ 145 psi (10 bar)[1)] absolute

Note

Please contact us for values for other hydraulic fluids.

Case drain pressure

Maximum permissible case drain pressure (at port L, L_1):
Maximum 7 psi (0.5 bar) higher than the inlet pressure at port S, however not higher than 30 psi (2 bar) absolute.

$p_{L\ max\ abs}$ _____ 30 psi (2 bar) absolute[1)]

1) Other values on request

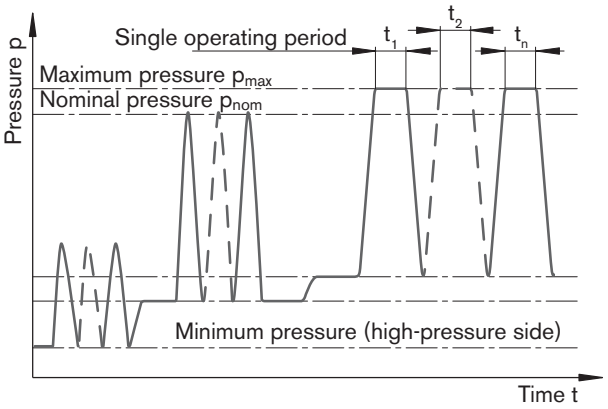
Definition

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

Maximum pressure p_{max}
The maximum pressure corresponds to the maximum 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 = $t_1 + t_2 + ... + t_n$

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								
	$V_{g\,max}$	in³ (cm³)	1.10 (18)	1.71 (28)	2.75 (45)	4.33 (71)	6.10 (100)	8.54 (140)
Speed[1]								
maximum at $V_{g\,max}$	n_{nom}	rpm	3300	3000	2600	2200	2000	1800
maximum at $V_g < V_{g\,max}$	$n_{max\,perm}$	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)	7.2 (32)	13.3 (59)	21.4 (81)	33.8 (128)	47.6 (180)	67 (252)
Power at $\Delta p = 4000$ psi (280 bar)								
at n_{nom}, $V_{g\,max}$	P_{max}	HP (kW)	36 (28)	51 (39)	72 (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)	91 (69)	111 (84)	156 (118)
Torque								
at $V_{g\,max}$ and $\Delta p = 4000$ psi (280 bar)	T_{max}	lb-ft (Nm)	58 (80)	91 (125)	146 (200)	230 (316)	324 (445)	453 (623)
at $V_{g\,max}$ and $\Delta p = 1450$ psi (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)
Rotary stiffness, drive shaft R	c	lb-ft/rad (Nm/rad)	10870 (14850)	19400 (26360)	30240 (41025)	56456 (76545)	– (–)	– (–)
Rotary stiffness, drive shaft U	c	lb-ft/rad (Nm/rad)	5946 (8090)	– (–)	– (–)	– (–)	67180 (91093)	– (–)
Rotary stiffness, drive shaft K	c	lb-ft/rad (Nm/rad)	9805 (13340)	19712 (26189)	32270 (43905)	60352 (82112)	99448 (135303)	144680 (188406)
Moment of inertial rotary group	J_{TW}	lbs-ft² (kgm²[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/s²	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 $p_{abs} = 15$ psi (1 bar) at suction port S
- within the optimum viscosity range from $\nu_{opt} = 80$ 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.

Determination of size

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

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

Power $P = \dfrac{2\pi \cdot T \cdot n}{33000\ (60000)} = \dfrac{q_V \cdot \Delta p}{1714\ (600) \cdot \eta_t}$ [HP (kW)]

V_g = Displacement per revolution in in³ (cm³)
Δp = Differential pressure in psi (bar)
n = Speed in rpm
η_V = Volumetric efficiency
η_{mh} = Mechanical-hydraulic efficiency
η_t = Total efficiency ($\eta_t = \eta_V \cdot \eta_{mh}$)

Technical data, high-speed version

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

Size		NG		45	71	100	140
Geometrical displacement per revolution		$V_{g\,max}$	in^3 (cm^3)	2.75 (45)	4.33 (71)	6.1 (100)	8.54 (140)
Speed[1]							
maximum at $V_{g\,max}$		n_{nom}	rpm	3000	2550	2300	2050
maximum at $V_g < V_{g\,max}$		$n_{max\,perm}$	rpm	3300	2800	2500	2200
Flow							
at n_{nom} and $V_{g\,max}$		$q_{v\,max}$	gpm (l/min)	35 (135)	48 (178)	61 (230)	76 (287)
Power at $\Delta p = 4000$ psi (280 bar)							
at n_{nom}, $V_{g\,max}$		P_{max}	HP (kW)	83 (63)	112 (83)	142 (107)	177 (134)
Torque							
at $V_{g\,max}$ and	$\Delta p = 4000$ psi (280 bar)	T_{max}	lb-ft (Nm)	146 (200)	230 (316)	324 (445)	453 (623)
	$\Delta p = 1450$ psi (100 bar)	T	lb-ft (Nm)	53 (72)	83 (113)	117 (159)	164 (223)
Rotary stiffness, drive shaft	S	c	lb-ft/rad (Nm/rad)	27560 (37500)	53018 (71884)	89348 (121142)	125042 (169537)
	R	c	lb-ft/rad (Nm/rad)	30240 (41025)	56456 (76545)	– (–)	– (–)
	U	c	lb-ft/rad (Nm/rad)	– (–)	– (–)	67180 (91093)	– (–)
	K	c	Nm/rad	32270 (43905)	60352 (82112)	99448 (135303)	144680 (188406)
Moment of inertial rotary group		J_{TW}	$lbs\text{-}ft^2$ (kgm^2)	0.0783 (0.0033)	0.1970 (0.0083)	0.3963 (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 $p_{abs} = 15$ psi (1 bar) at suction port S
- within the optimum viscosity range from $\nu_{opt} = 80$ to 170 SUS (16 to 36 mm^2/s)
- for mineral-oil based hydraulic fluid.

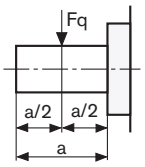
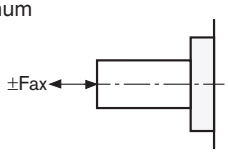
2) The scope of application lies between the minimum necessary and the maximum permissible drive speeds.
Valid for external excitation (e.g. diesel engine 2- to 8-fold rotary frequency, cardan shaft 2-fold rotary frequency).
The limiting value is only valid for a single pump.
The loading capacity of the connecting parts must be taken into account.

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

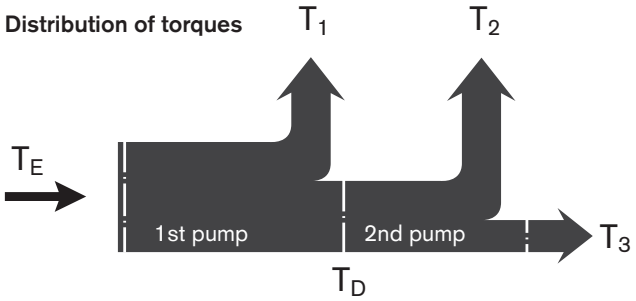
Size	NG		18	28	45	71	100	140
Radial force maximum at a/2 	$F_{q\ max}$	lbf (N)	79 (350)	270 (1200)	337 (1500)	427 (1900)	517 (2300)	630 (2800)
Axial force maximum 	$+ F_{ax\ max}$	lbf (N)	157 (700)	225 (1000)	337 (1500)	540 (2400)	900 (4000)	1080 (4800)

Permissible input and through-drive torques

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

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

Distribution of torques



T_E and T_D are made up as followed:

$T_E = T_1 + T_2 + T_3$

$T_D = T_2 + T_3$

$T_E < T_{E\ max}$

$T_D < T_{D\ max}$

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

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 $p_{st} \geq 725$ psi (50 bar) is required.

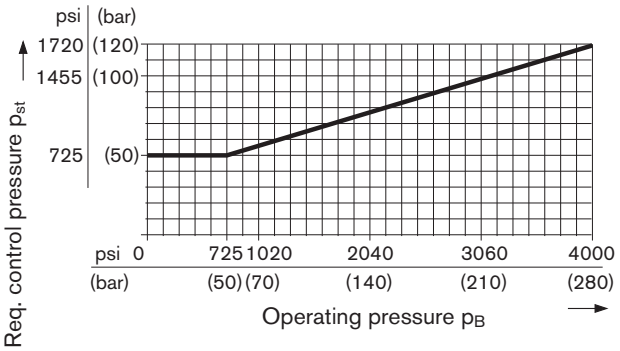
The variable pump can only be switched between $V_{g\,max}$ or $V_{g\,min}$.

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).

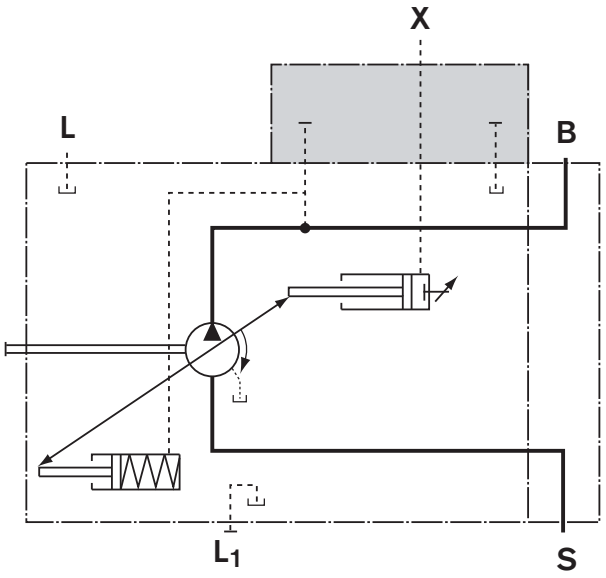
Control pressure p_{st} in X = 0 psi (0 bar) ≙ $V_{g\,max}$

Control pressure p_{st} in X ≥ 725 psi (50 bar) ≙ $V_{g\,min}$

Control pressure characteristic



Circuit diagram



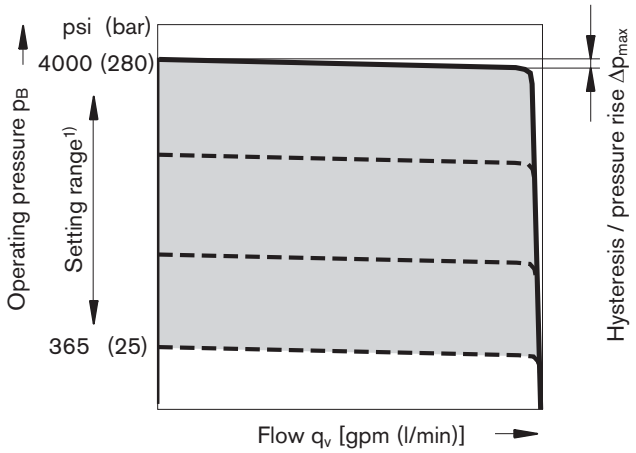
	Port for
B	Service line
S	Suction line
L, L_1	Case drain (L_1 plugged)
X	Pilot pressure

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.

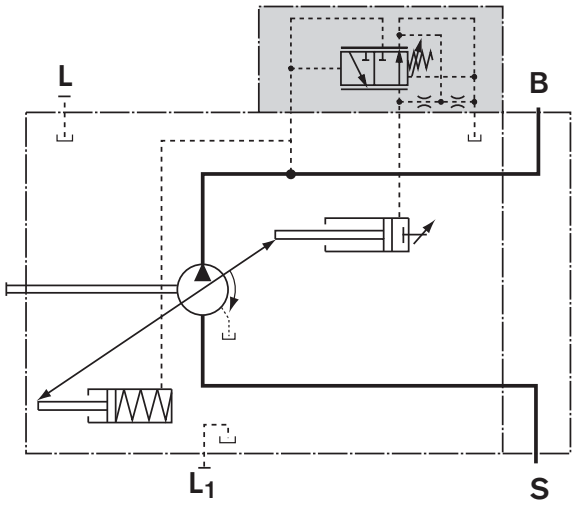
Static characteristic

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

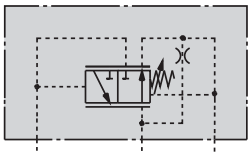


1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and must not be exceeded.
The range of possible settings at the valve are greater.

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 _____ max. 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)

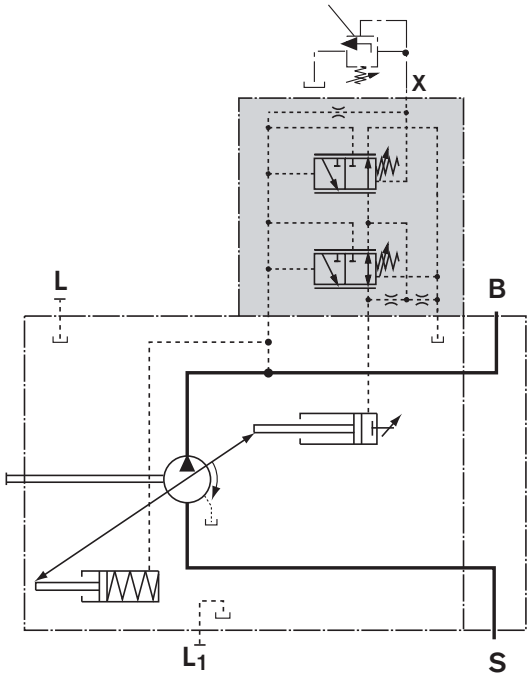
Control fluid consumption_____ max. approx. 0.8 gpm (3 l/min)

DRG – Pressure control, remotely operated

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 to 320 psi (10-22 bar)) please state in clear text.
The max. length of piping should not exceed 6.6 ft (2 m).

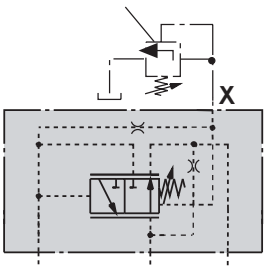
Circuit diagram, sizes 18 to 100

Not included in the delivery contents



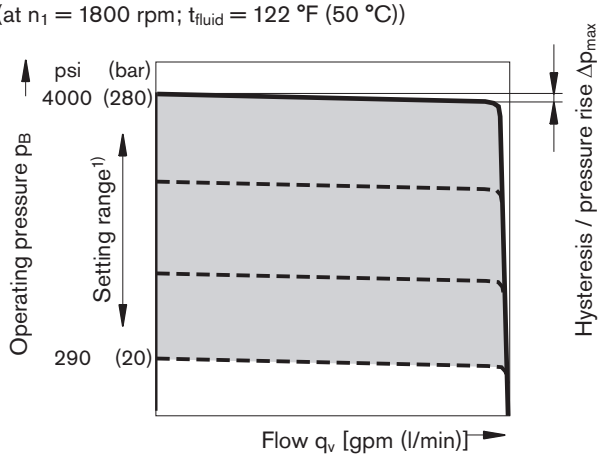
Circuit diagram, size 140

Not included in the delivery contents



Static characteristic

(at n_1 = 1800 rpm; t_{fluid} = 122 °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.

		Port for
B		Service line
S		Suction line
L, L_1		Case drain (L_1 plugged)
X	NG 18 to 100 **without** adapter	Pilot pressure
X	NG 140 **with** adapter	Pilot pressure

Control data

Hysteresis and repeatability Δp _____ max. 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)

DFR/DFR1 – Pressure and flow control

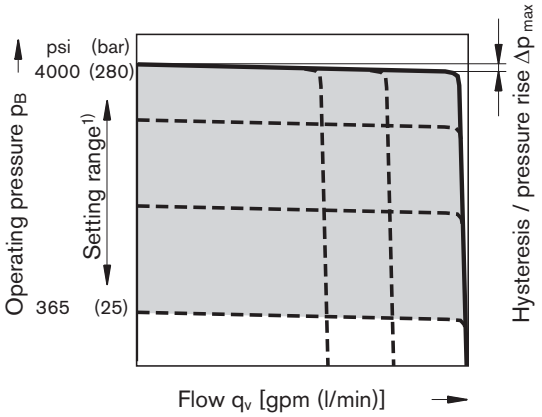
In addition to the pressure control function, the pump flow may be varied by means of a differential pressure over an adjustable orifice (e.g. directional valve) installed in the service line to the actuator. The pump flow is equal to the actual required flow by the actuator, regardless of changing pressure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

The pressure control overrides the flow control function.

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.

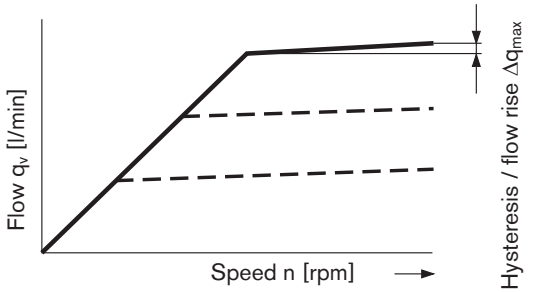
Static characteristic

Flow control at n_1 = 1800 rpm; t_{fluid} = 122°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.

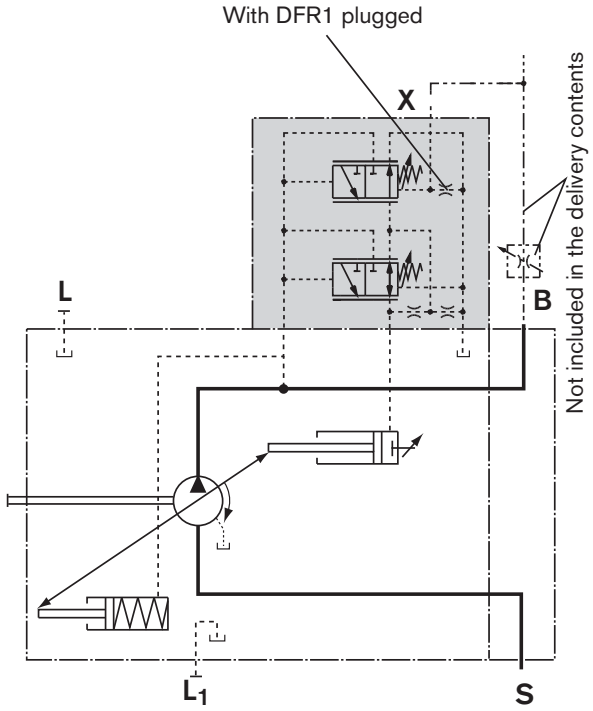
Static characteristic at variable speed



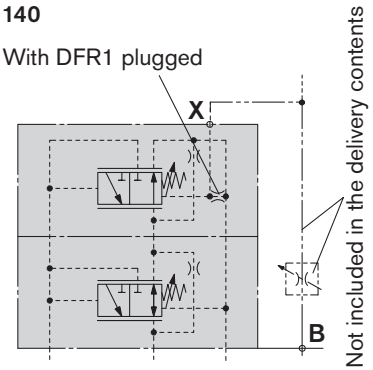
Differential pressure Δp

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
Maximum flow deviation measured at drive speed n = 1500 rpm.

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

Contr. fluid consum. DFR _____ max. approx. 0.8...1.2 gpm (3...4.5 l/min)
Control fluid consum. DFR1 ___ max. approx. 0.8 gpm (3 l/min)

DFLR – Pressure, flow and power control

Execution of the pressure control like DR(G)
Execution of the flow control like DFR, DFR1

In order to achieve a constant drive torque with varying 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.

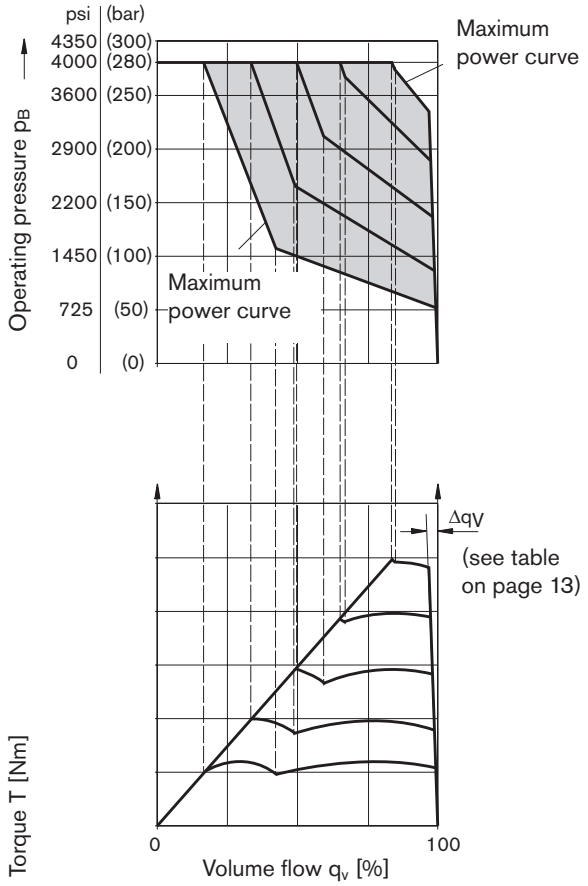
Flow control is possible below the power control curve.

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

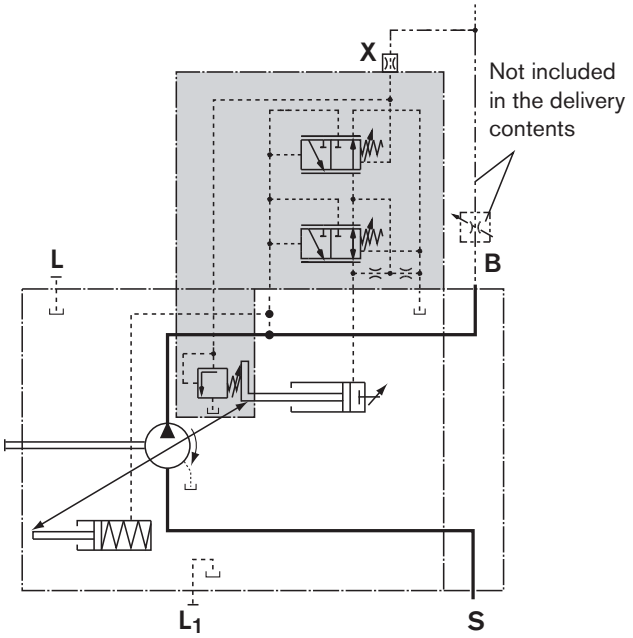
Control data

For pressure control DR data
For flow control FR data

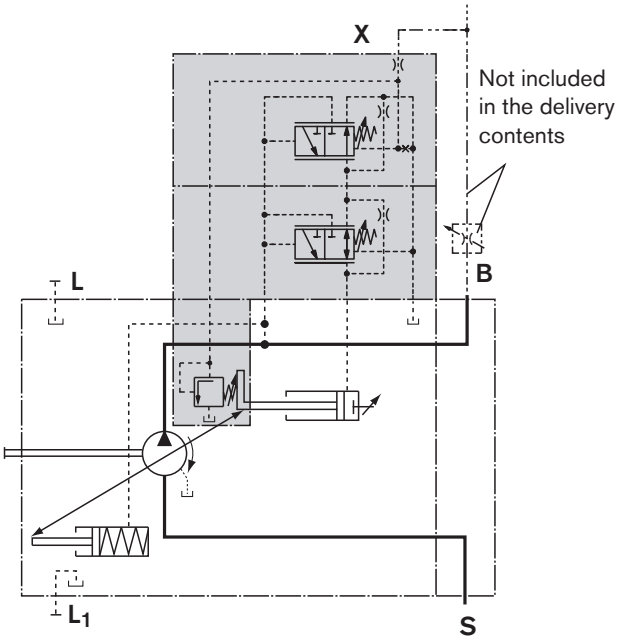
Static curves and torque characteristic



Circuit diagram, sizes 28 to 100



Circuit diagram, size 140



Control data

Beginning of control _____ 735 psi (50 bar)
Control fluid consumption_ max. approx. 1.45 gpm (5.5 l/min)

Flow loss at qv max, see DG control

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

ED – Electro-hydraulic pressure control

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

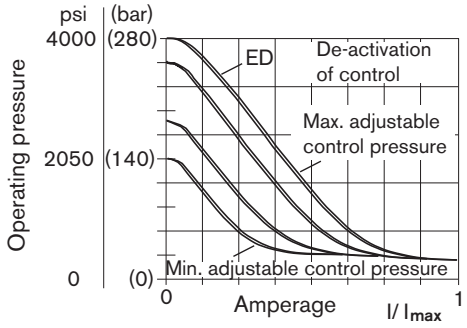
If there is a change at the consumer (load pressure), the position of the control piston changes.

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.

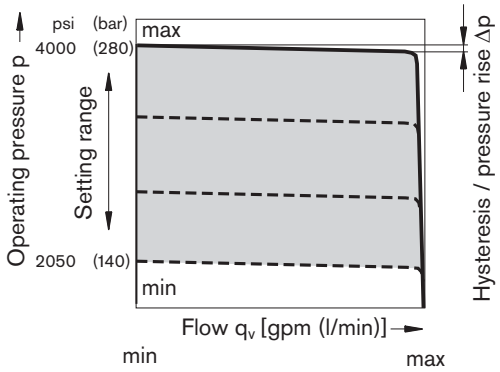
When the solenoid current signal drops towards a zero value, the maximum output pressure is limited to p_{max} by an adjustable hydraulic pressure cut-off (secure fail safe function in case of a loss of power e.g. for use as fan drives).
The response time characteristic of the ED-control was optimized 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 static current-press. characteristic < 45 psi 3 bar

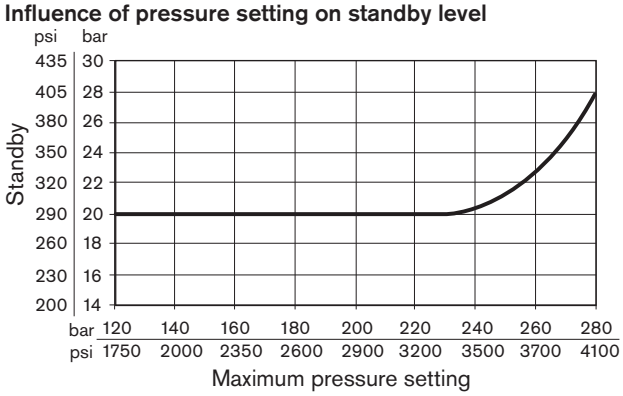
Static flow-pressure characteristic
(at n= 1800 rpm; t_{fluid} = 122 °F (50 °C))



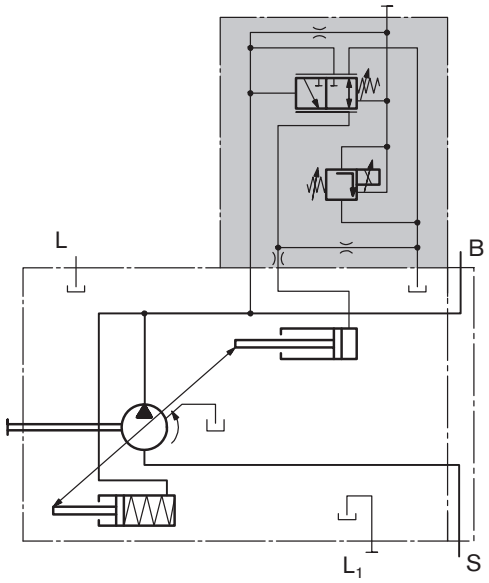
Control data
Stand-by standard setting 290 psi (20 bar), other values on request.

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

Influence of pressure setting on standby level



Circuit diagram ED..



	Port for
B	Service line
S	Suction line
L, L1	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 specific pressure by a specified, variable solenoid current.

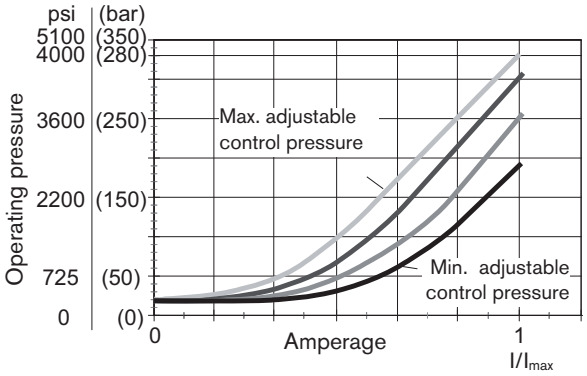
If there is a change at the consumer (load pressure), the position of the control piston changes.

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).

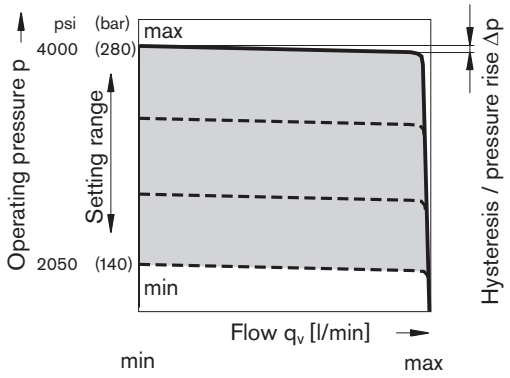
Static current-pressure characteristic ER
(measured at pump in zero stroke – positive characteristic)



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

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

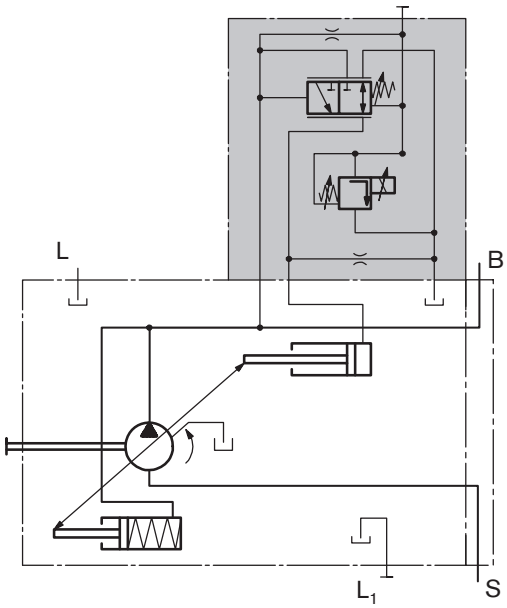
Static flow-pressure characteristic
(at n= 1800 rpm; t_{fluid} = 122 °F (50 °C))



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

Hysteresis and pressure increase _____ Δp < 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		
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 %
For type of protection, see plug design on page 39		

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

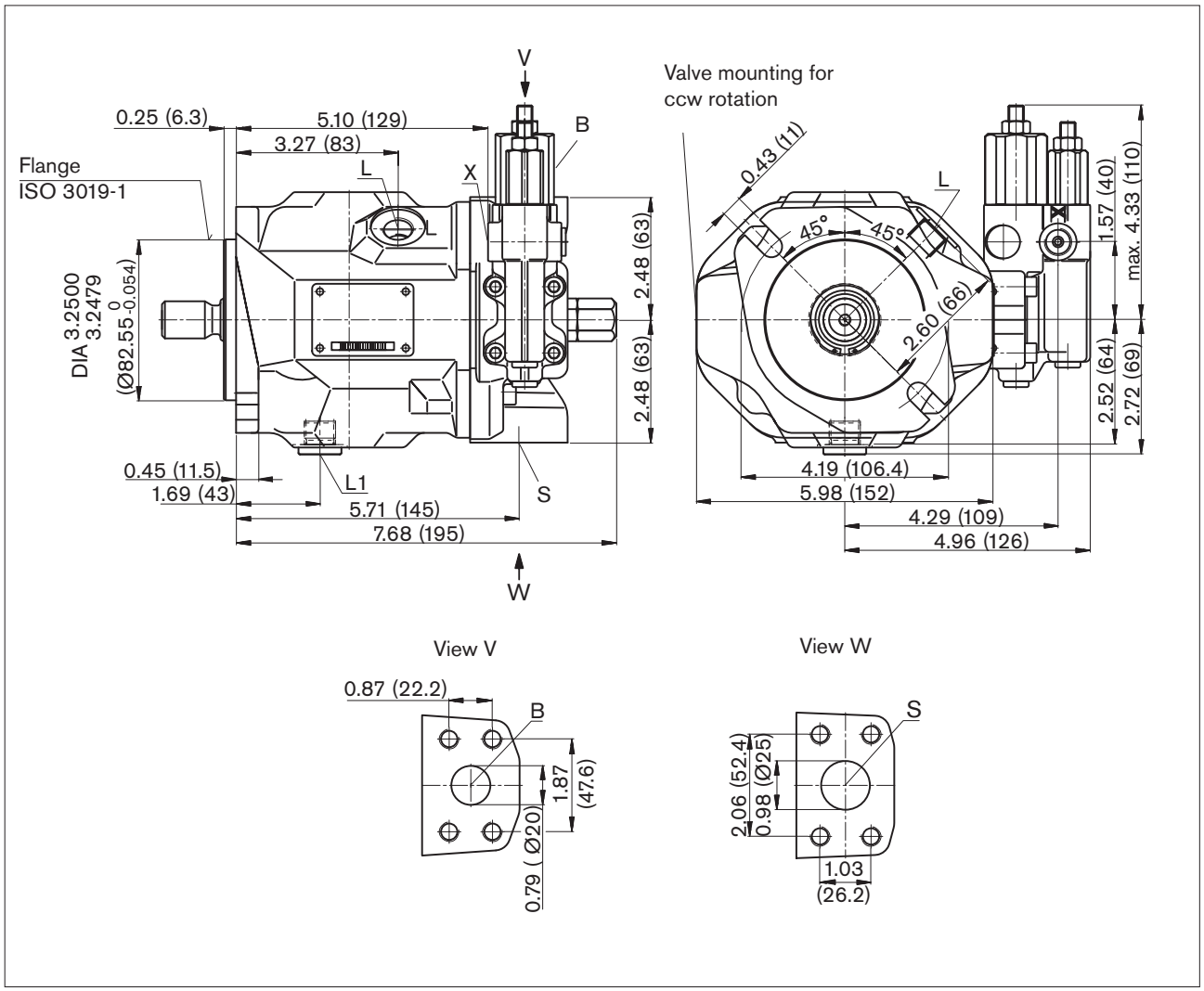
1) Power outlets for 2 valves, can be actuated separately
2) Only 24V nominal voltage

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)]	Maximum pressure [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 (10)	O
L	Case drain fluid	ISO 11926[3)]	9/16-18 UNF-2B; 0.47 (12) deep	30 (2)	O[4)]
L_1	Case drain fluid	ISO 11926[3)]	9/16-18 UNF-2B; 0.47 (12) deep	30 (2)	X[4)]
X	Pilot pressure	ISO 11926[3)]	7/16-20 UNF-2B; 0.45 (12) deep	5100 (350)	O
X	Pilot press. with DG-control	DIN ISO 228[3)]	G 1/4 in; 0.47 (12) deep	5100 (350)	O

1) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.
2) Depending on the application, short-term pressure spikes can occur. Keep this in mind when selecting measuring equipment and fittings. Pressure values in bar absolute.
3) The spot face can be deeper than as specified in the standard
4) Depending on the installation position, L or L_1 must be connected

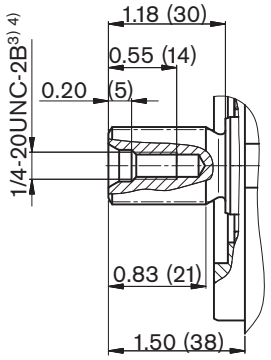
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 18

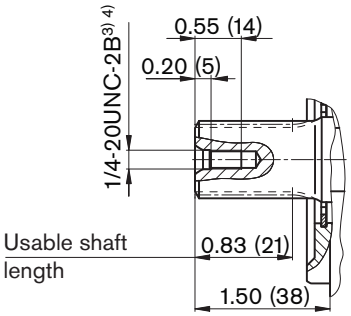
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

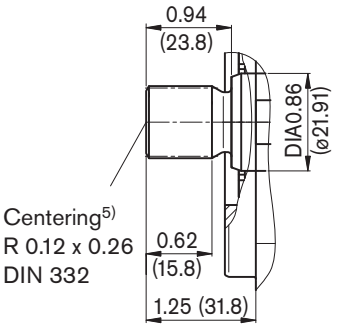
S Splined shaft 3/4 in
11T 16/32DP[1] (SAE J744)



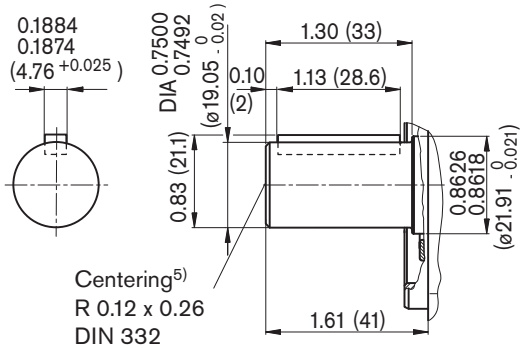
R Splined shaft 3/4 in
11T 16/32DP[1][2] (SAE J744)



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



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

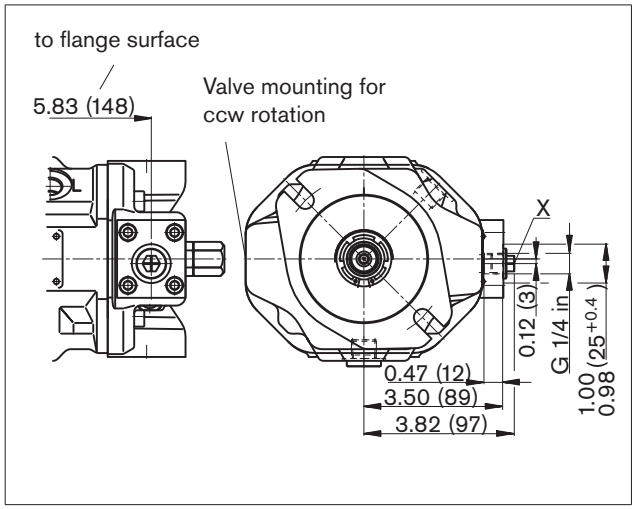


1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard
3) Thread according to ASME B1.1
4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.
5) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw

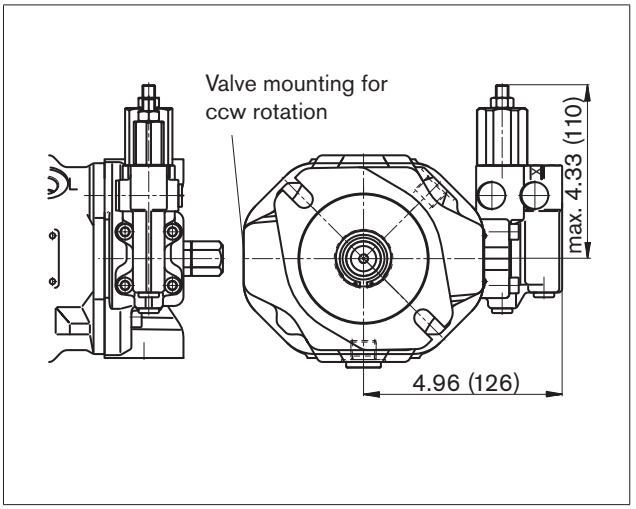
Dimensions size 18

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

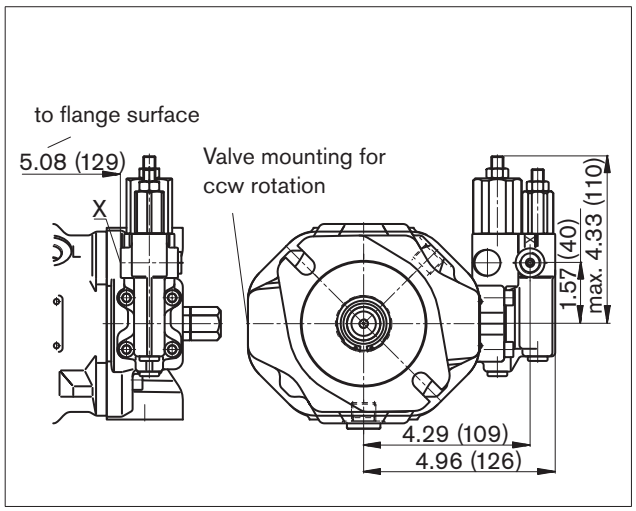
DG
Two-point control, directly operated



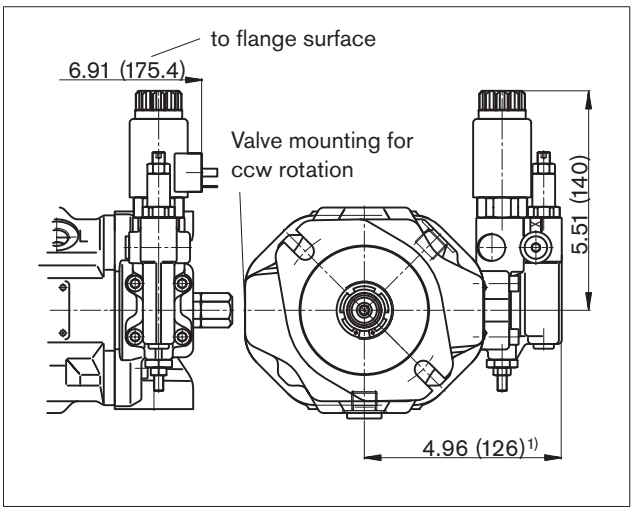
DR
Pressure control



DRG
Pressure control, remotely operated



ED7., ER7.
Electro-hydraulic pressure control



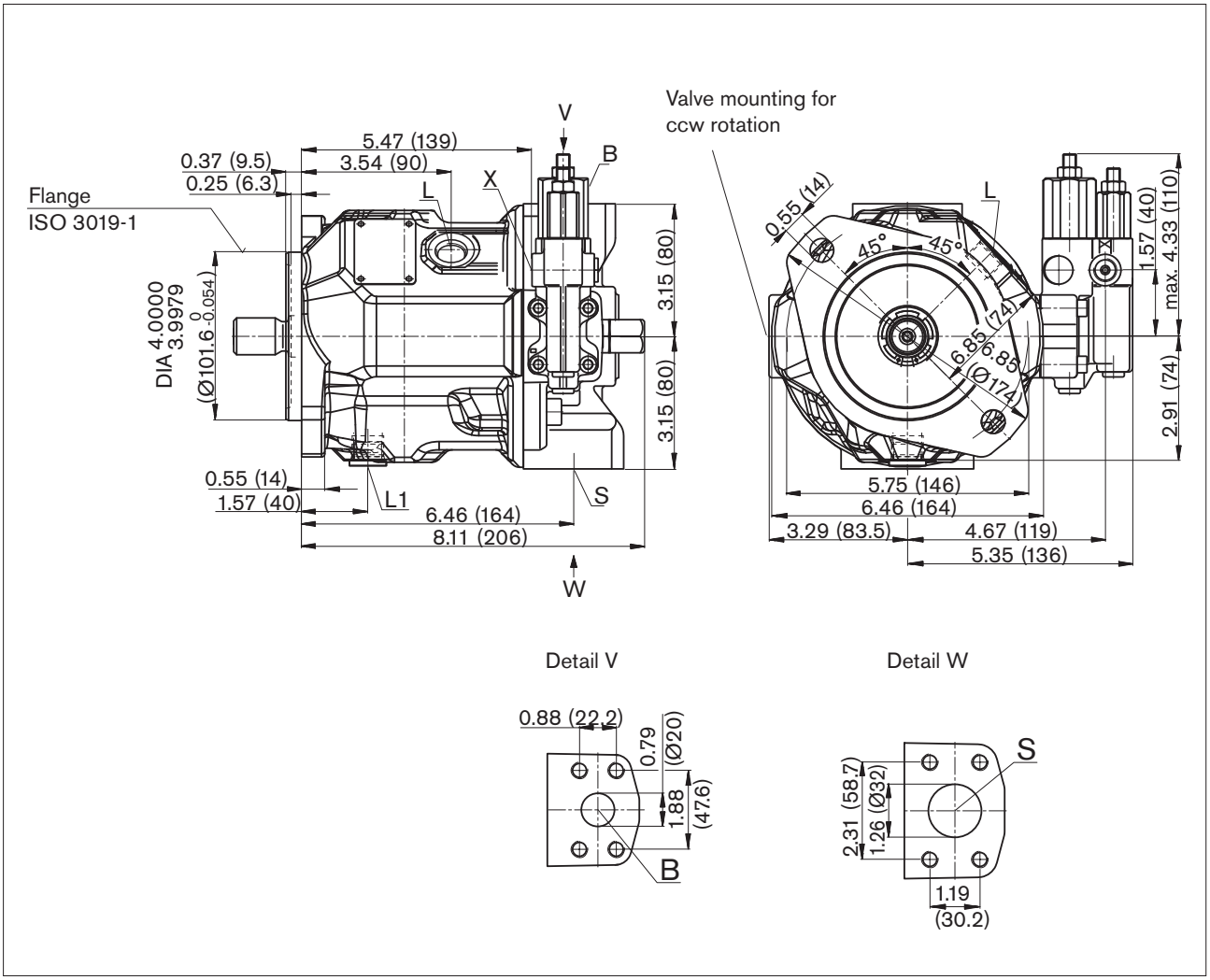
1) ER7.: 6.34 inches (161 mm) if using a sandwich plate pressure reducing valve.

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



Ports

Designation	Port for	Standard	Size[1)]	Maximum pressure [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 1/4 in 7/16-14 UNC-2B; 0.94 (24) deep	145 (10)	O
L	Case drain fluid	ISO 11926[3)]	3/4-16 UNF-2B; 0.47 (12) deep	30 (2)	O[4)]
L_1	Case drain fluid	ISO 11926[3)]	3/4-16 UNF-2B; 0.47 (12) deep	30 (2)	X[4)]
X	Pilot pressure	ISO 11926[3)]	7/16-14 UNC-12B; 0.47 (12) deep	5100 (350)	O
X	Pilot press. with DG-control	DIN ISO 228[3)]	G 1/4in; 0.47 (12) deep	5100 (350)	O

1) For the maximum tightening torques the general instructions on FINAL PAGE 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 bar absolute.
3) The spot face can be deeper than as specified in the standard.
4) Depending on the installation position, L or L_1 must be connected

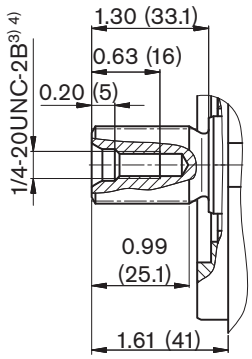
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 28

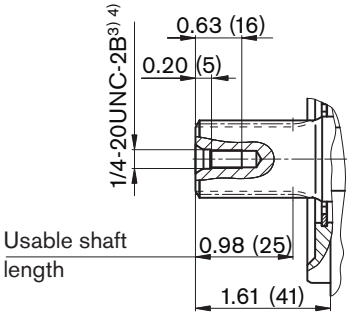
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

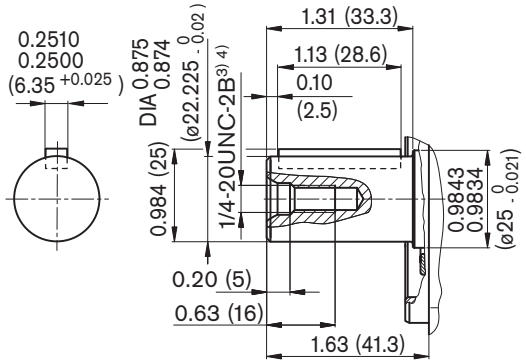
S Splined shaft 7/8 in
13T 16/32DP[1] (SAE J744)



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



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

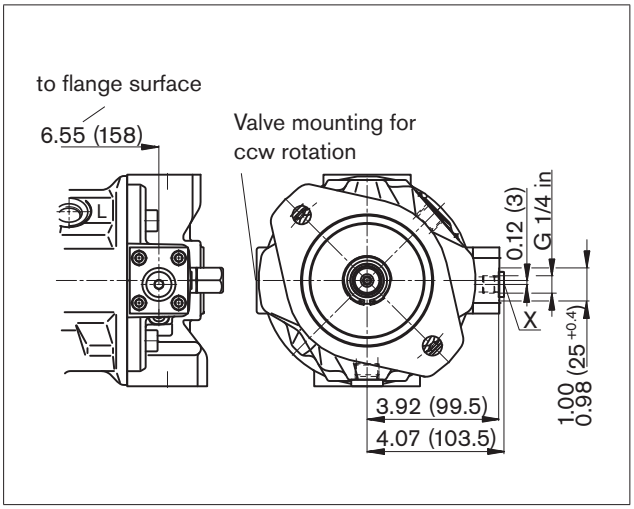


1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Spline according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Thread according to ASME B1.1
4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

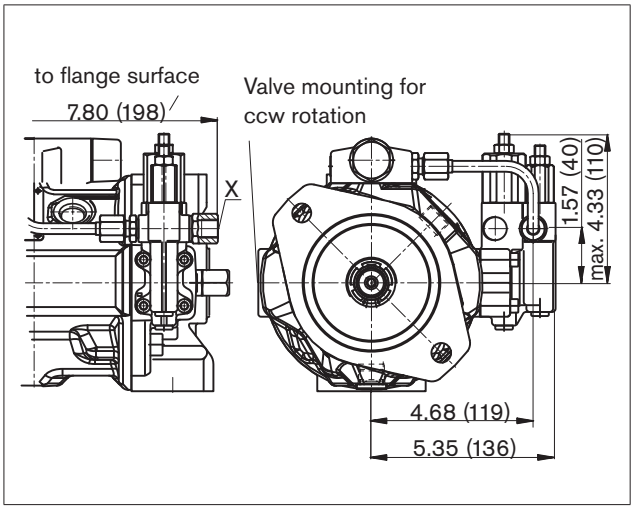
Dimensions size 28

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

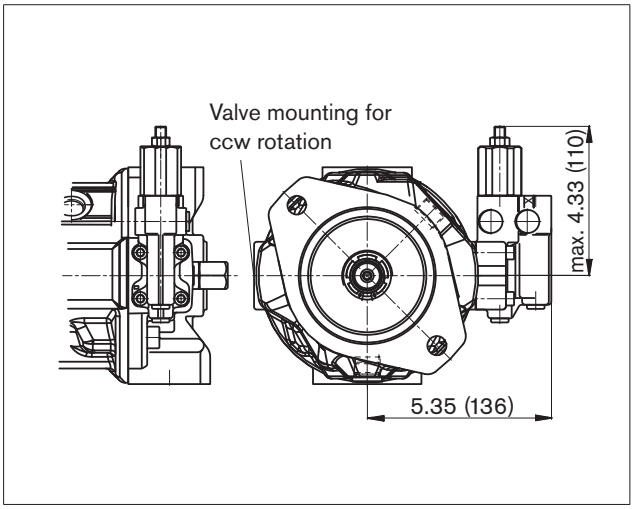
DG
Two-point control, directly operated



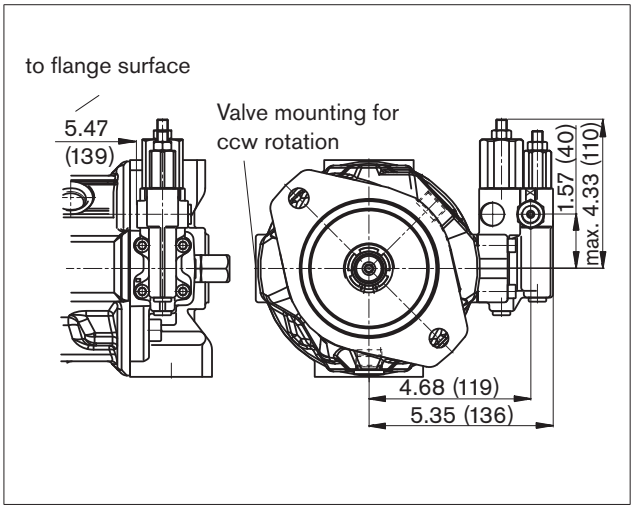
DFLR
Pressure, flow and power control



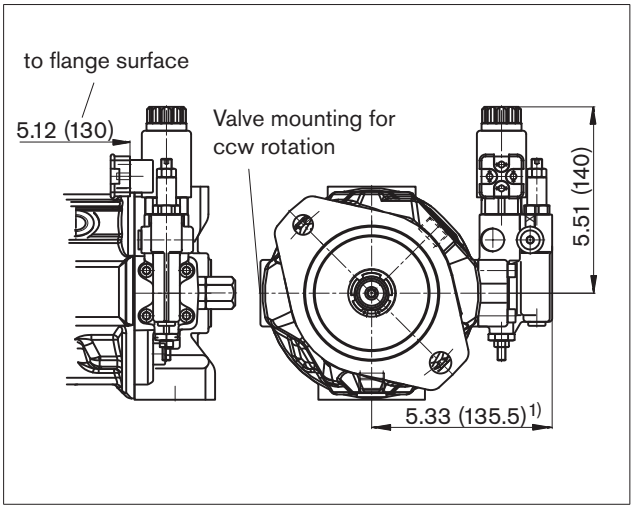
DR
Pressure control



DRG
Pressure control, remotely operated



ED7. / ER7.
Electro-hydraulic pressure control



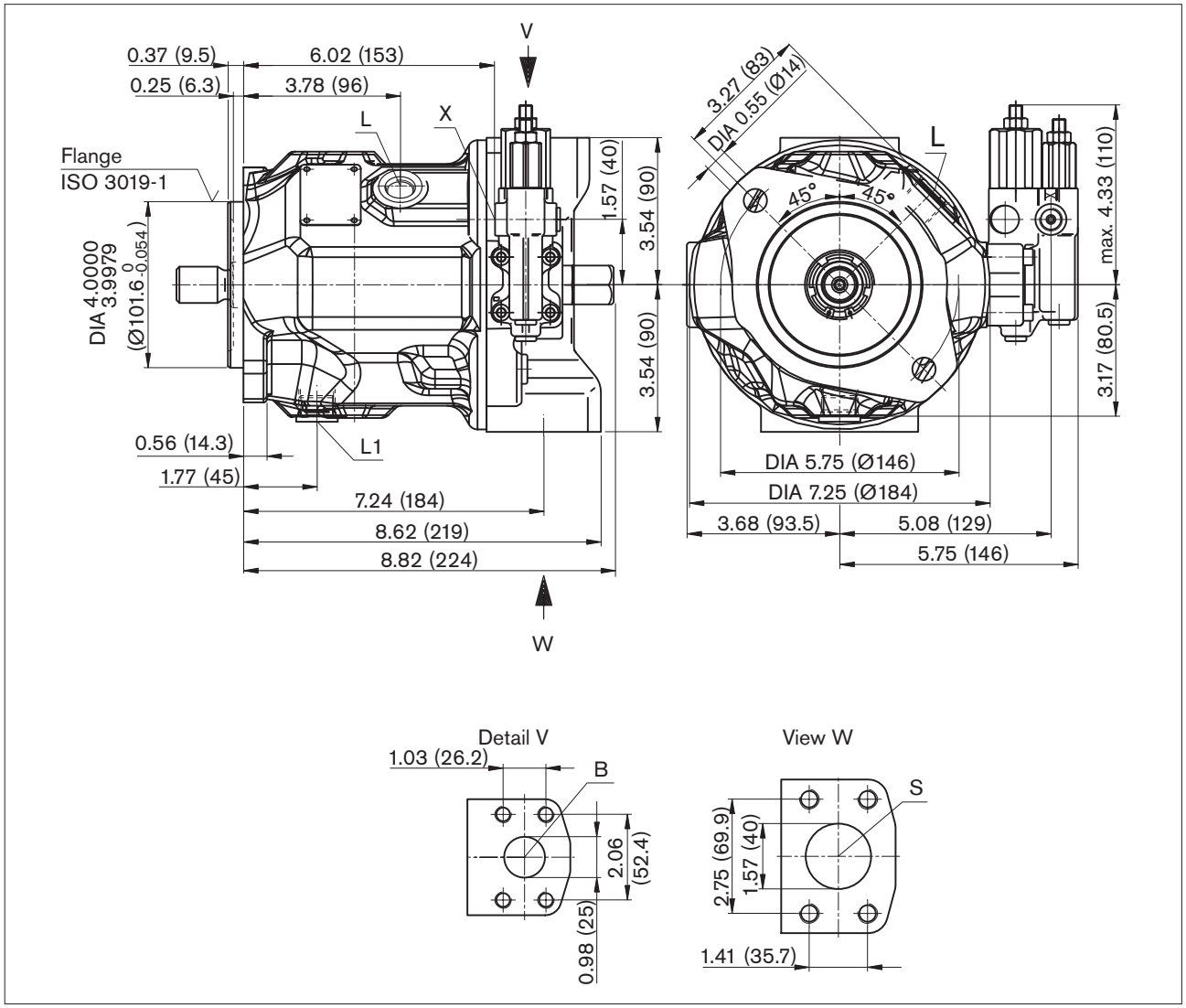
1) ER7.: 6.71 inches (170.5 mm) when using a sandwich plate pressure reducing valve.

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



Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [psi (bar)][2]	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	1 1/2 in 1/2-13 UNC-2B; 0.87 (22) deep	145 (10)	O
L	Case drain fluid	ISO 11926[3]	7/8-14 UNF-2B; 0.55 (14) deep	30 (2)	O[4]
L_1	Case drain fluid	ISO 11926[3]	7/8-14 UNF-2B; 0.55 (14) deep	30 (2)	X[4]
X	Pilot pressure	ISO 11926[3]	7/16-20 UNF-2B; 0.45 (12) deep	5100 (350)	O
X	Pilot press. with DG-control	DIN ISO 228[3]	G 1/4 in	5100 (350)	O

1) For the maximum tightening torques the general instructions on FINAL PAGE 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 bar absolute.
3) The spot face can be deeper than as specified in the standard.
4) Depending on the installation position, L or L_1 must be connected

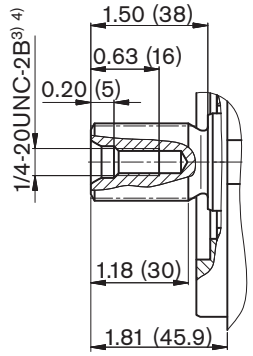
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 45

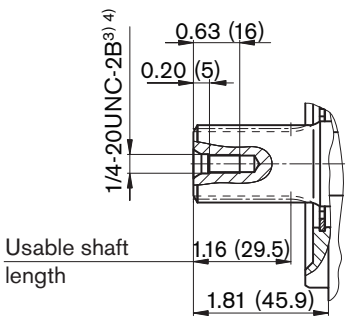
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

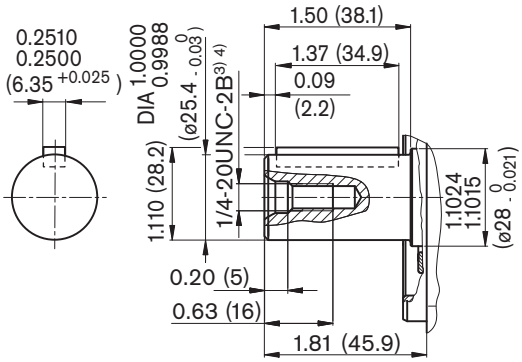
S Splined shaft 1 in
15T 16/32DP[1] (SAE J744)



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



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

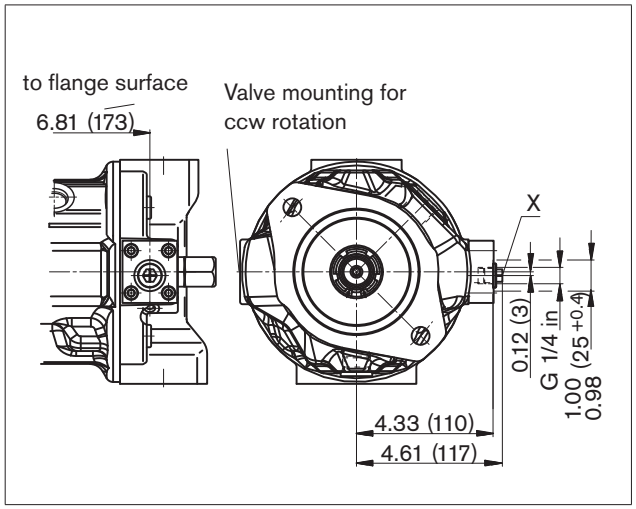


1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Spline according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Thread according to ASME B1.1
4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

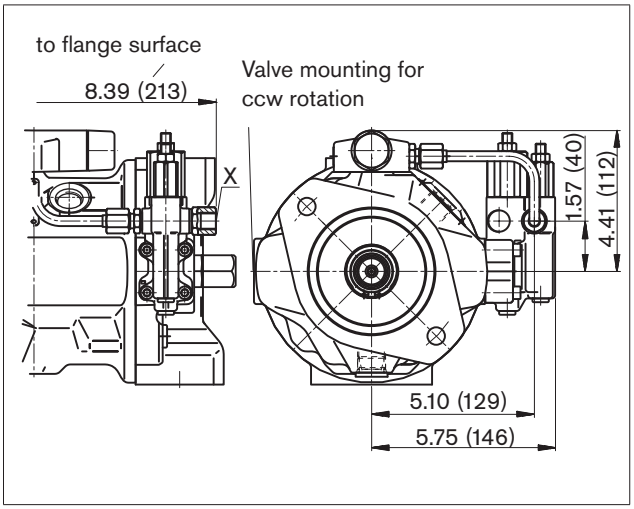
Dimensions size 45

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

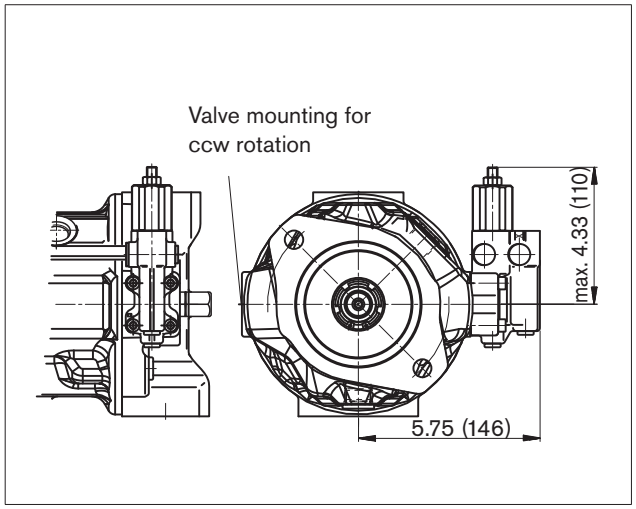
DG
Two-point control, directly operated



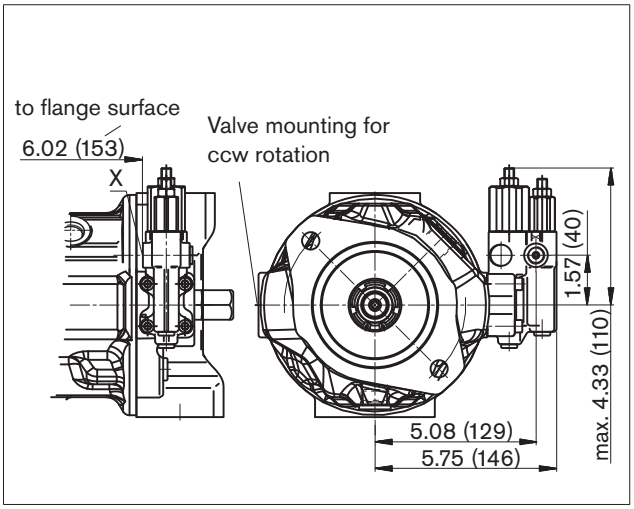
DFLR
Pressure, flow and power control



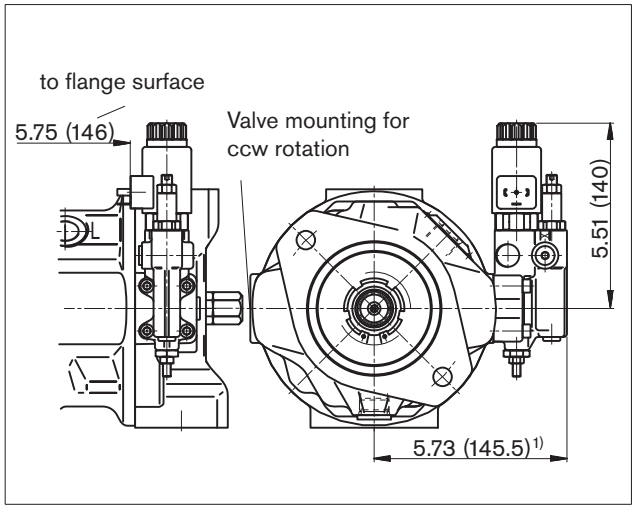
DR
Pressure control



DRG
Pressure control, remotely operated



ED7. / ER7.
Electro-hydraulic pressure control



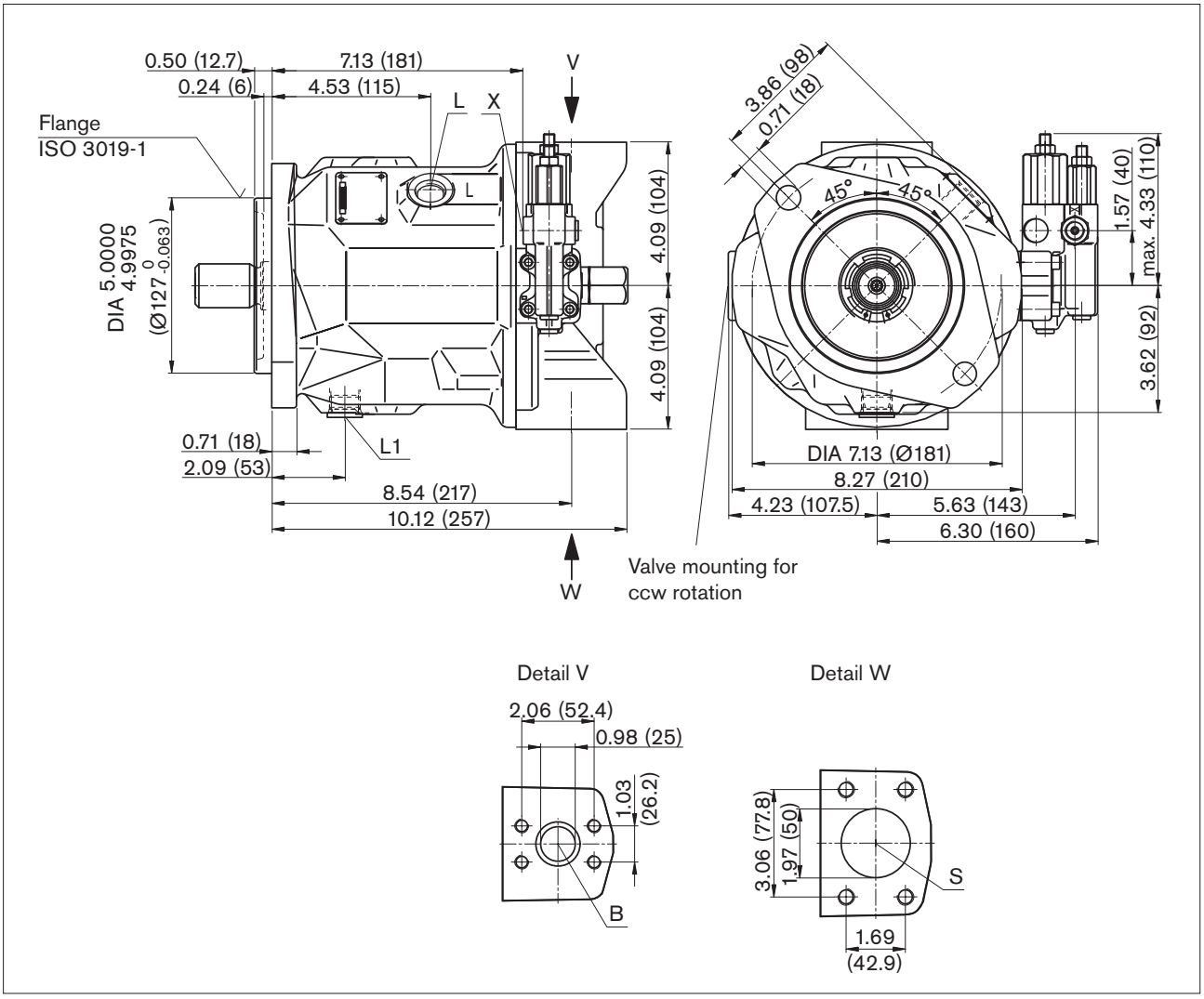
1) ER7.: 7.11 inches (180.5 mm) if using a sandwich plate pressure reducing valve.

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



Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [psi (bar)][2]	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[3]	7/8-14 UNF-2B; 0.55 (14) deep	30 (2)	O[4]
L_1	Case drain fluid	ISO 11926[3]	7/8-14 UNF-2B; 0.55 (14) deep	30 (2)	X[4]
X	Pilot pressure	ISO 11926[3]	7/16-20 UNF-2B; 0.45 (12) deep	5100 (350)	O
X	Pilot press. with DG-control	DIN ISO 228[3]	G 1/4 in	5100 (350)	O

1) For the maximum tightening torques the general instructions on FINAL PAGE 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 bar absolute.
3) The spot face can be deeper than as specified in the standard.
4) Depending on the installation position, L or L_1 must be connected

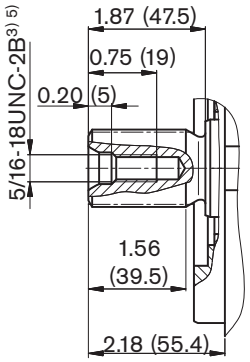
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 71

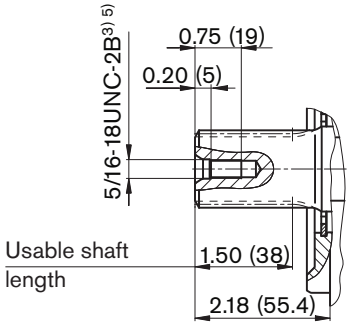
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

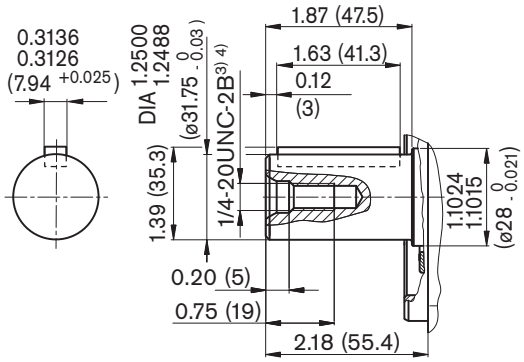
S Splined shaft 1 1/4 in
14T 12/24DP[1] (SAE J744)



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



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

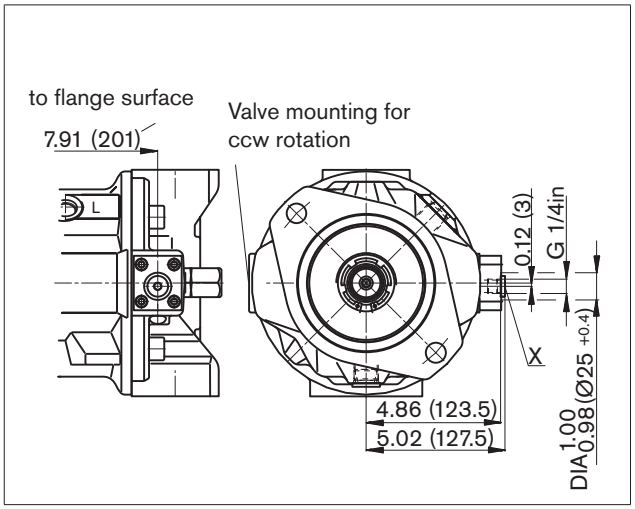


1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Spline according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Thread according to ASME B1.1
4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

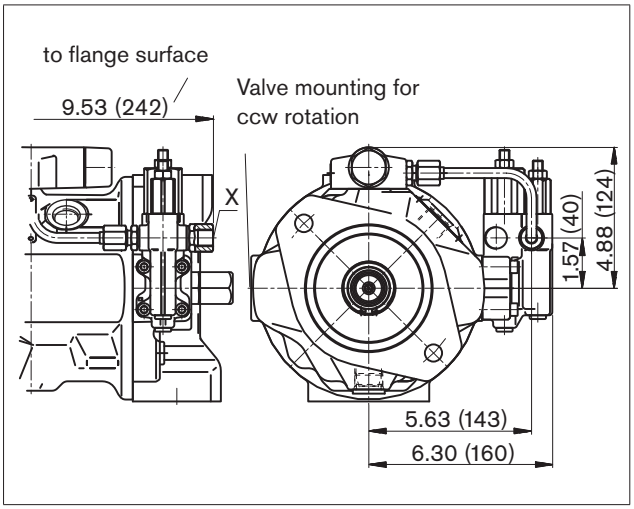
Dimensions size 71

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

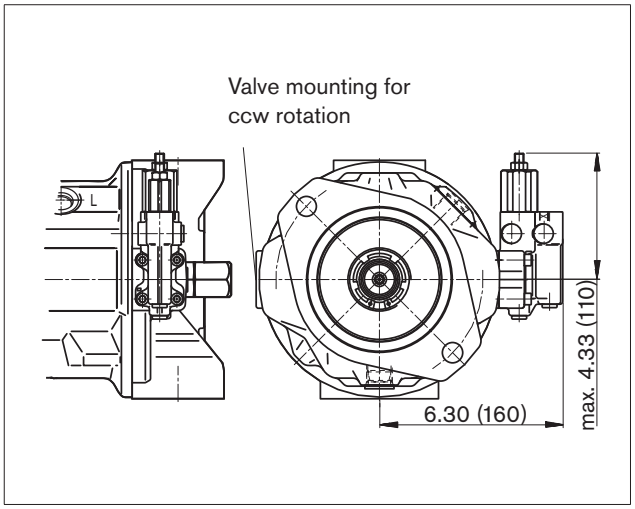
DG
Two-point control, directly operated



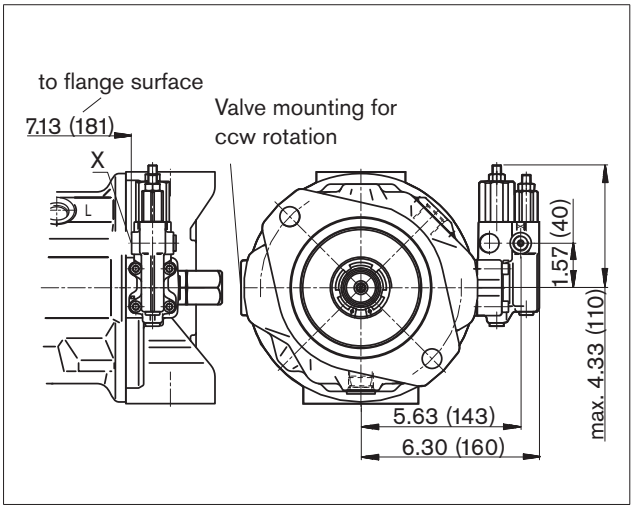
DFLR
Pressure, flow and power control



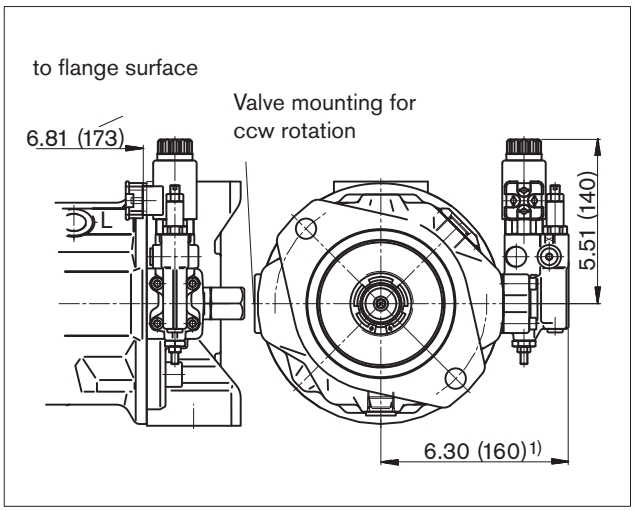
DR
Pressure control



DRG
Pressure control, remotely operated



ED7. / ER7.
Electro-hydraulic pressure control



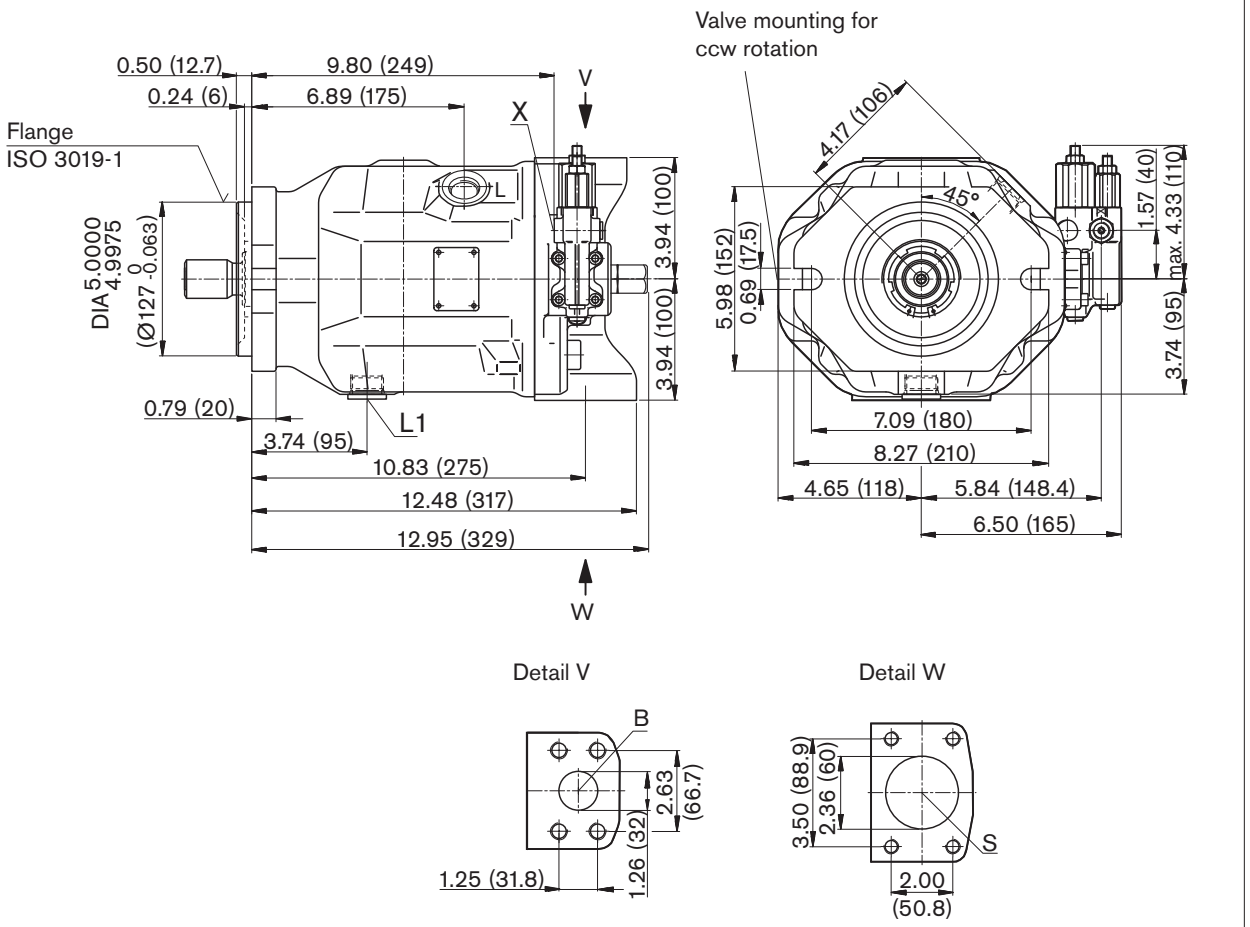
1) ER7.: 7.68 inches (195 mm) if using a sandwich plate pressure reducing valve.

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



Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [psi (bar)][2]	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; 1.06 (27) deep	145 (10)	O
L	Case drain fluid	ISO 11926[3]	1 1/16-12 UNF-2B; 0.63 (16) deep	30 (2)	O[4]
L_1	Case drain fluid	ISO 11926[3]	1 1/16-12 UNF-2B; 0.63 (16) deep	30 (2)	X[4]
X	Pilot pressure	ISO 11926[3]	7/16-20 UNF-2B; 0.45 (12) deep	5100 (350)	O
X	Pilot press. with DG-control	DIN ISO 228[3]	G 1/4 in	5100 (350)	O

1) For the maximum tightening torques the general instructions on FINAL PAGE 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 bar absolute.
3) The spot face can be deeper than as specified in the standard.
4) Depending on the installation position, L or L_1 must be connected

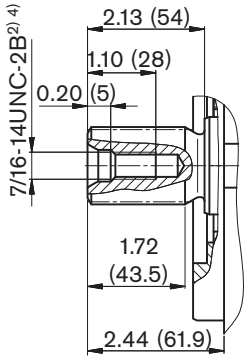
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 100

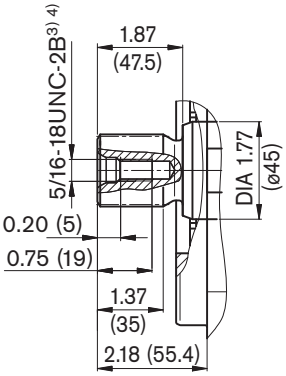
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

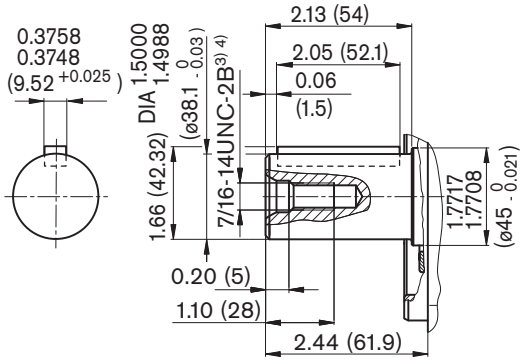
S Splined shaft 1 1/2 in
17T 12/24DP[1] (SAE J744)



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



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

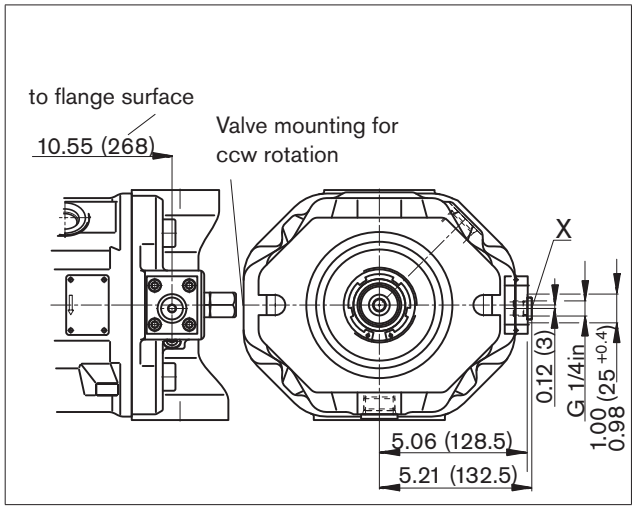


1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Spline according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Thread according to ASME B1.1
4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

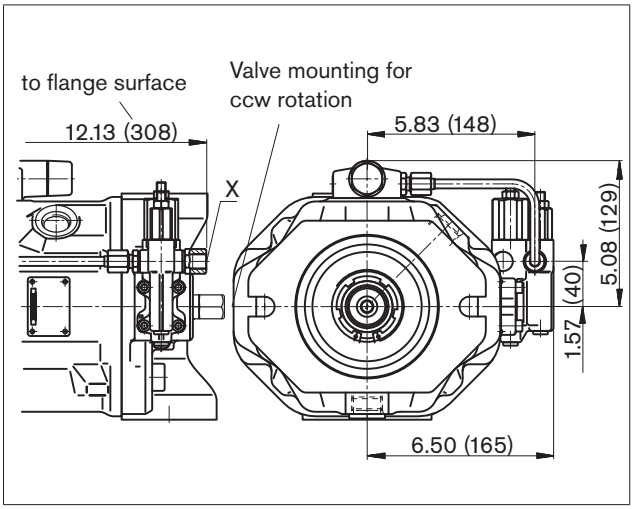
Dimensions size 100

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

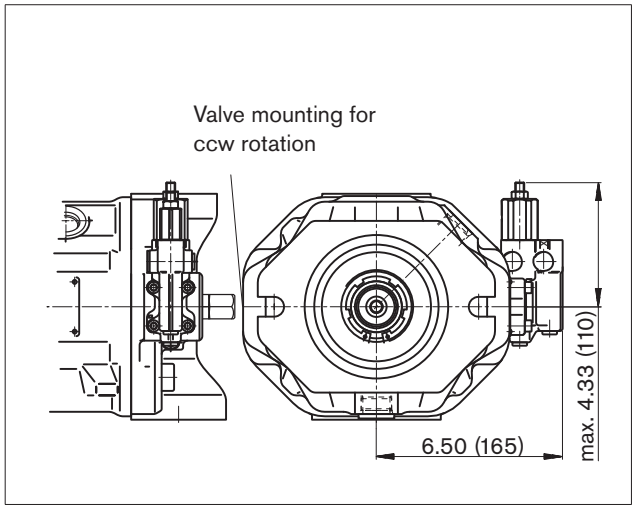
DG
Two-point control, directly operated



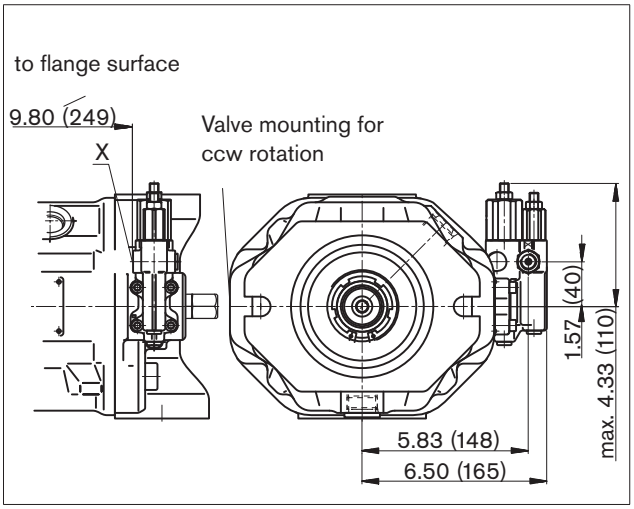
DFLR
Pressure, flow and power control



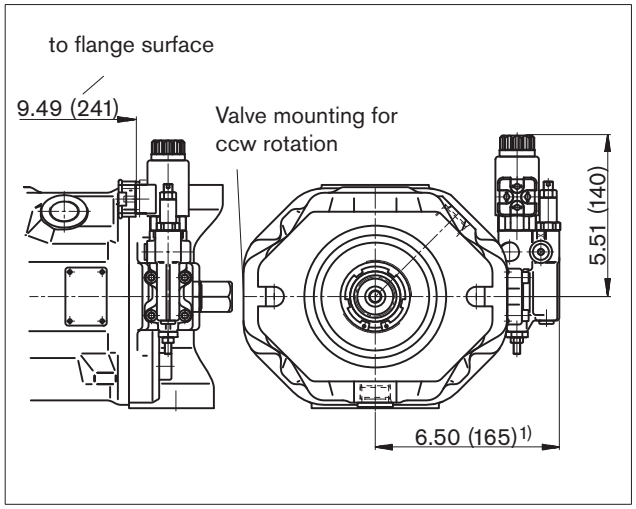
DR
Pressure control



DRG
Pressure control, remotely operated



ED7. / ER7.
Electro-hydraulic pressure control



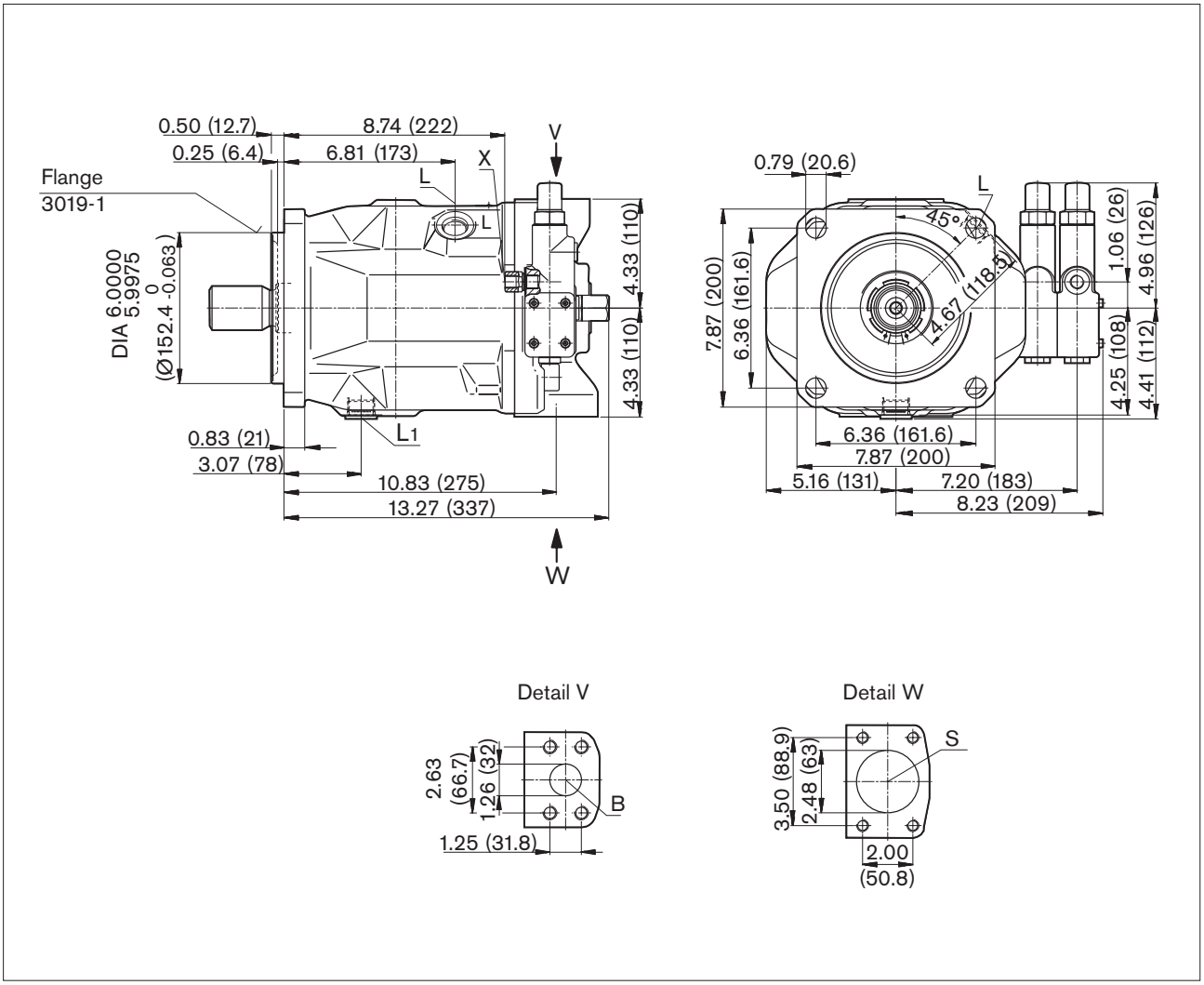
1) ER7.: 7.87 inches (200 mm) when using a sandwich plate pressure reducing valve.

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



Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [psi (bar)][2]	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[3]	1 1/16-12 UNF-2B; 0.63 (16) deep	30 (2)	O[4]
L_1	Case drain fluid	ISO 11926[3]	1 1/16-12 UNF-2B; 0.63 (16) deep	30 (2)	X[4]
X	Pilot pressure	ISO 11926[3]	9/16-18 UNF-2B; 0.51 (13) deep	5100 (350)	O
X	Pilot press. with DG-control	DIN ISO 228[3]	M14 x 1.5; 0.47 (12) deep	5100 (350)	O
M_H	Gauge port, high pressure	DIN 3852	M14 x 1.5, 0.47 (12) deep	5100 (350)	X

1) For the maximum tightening torques the general instructions on FINAL PAGE 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 bar absolute.
3) The spot face can be deeper than as specified in the standard.
4) Depending on the installation position, L or L_1 must be connected

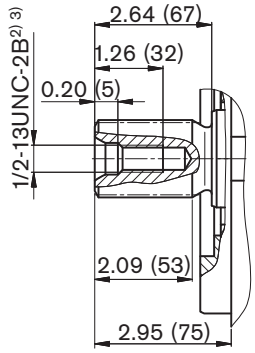
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 140

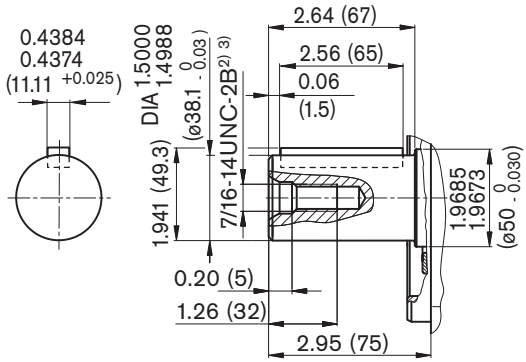
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

Drive shaft

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



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

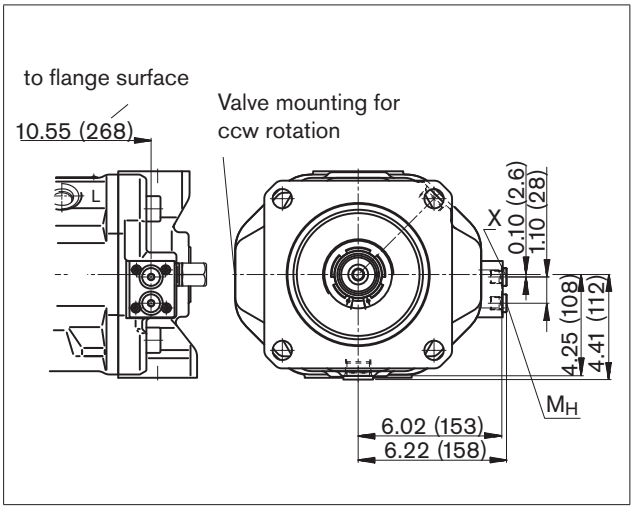


1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

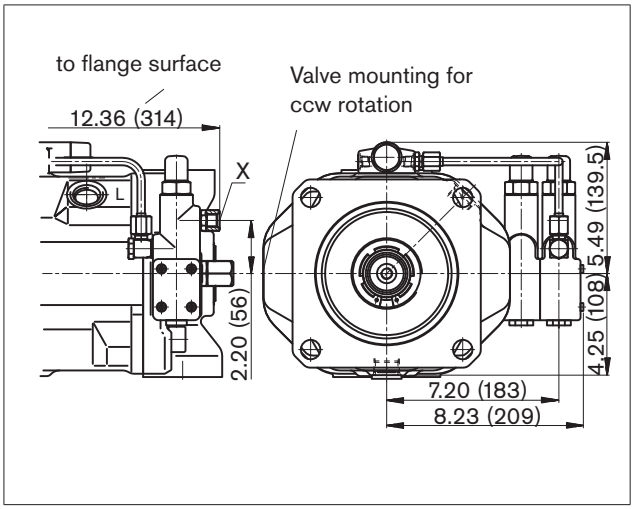
Dimensions size 140

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

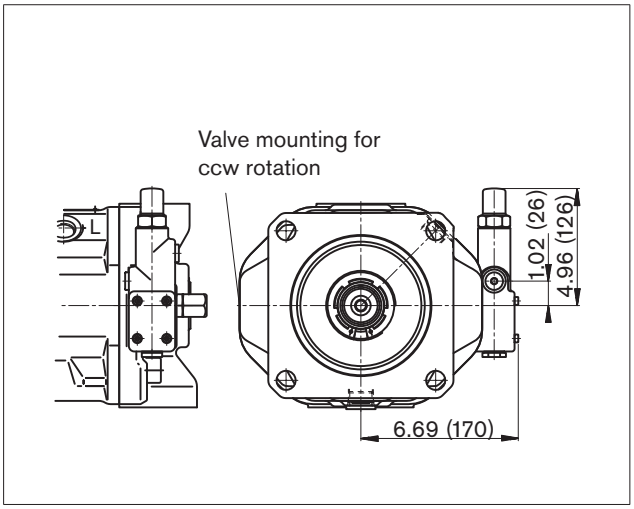
DG
Two-point control, directly operated



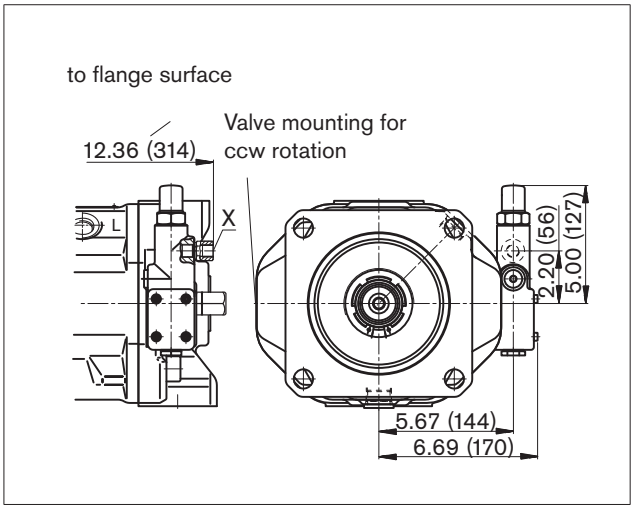
DFLR
Pressure, flow and power control



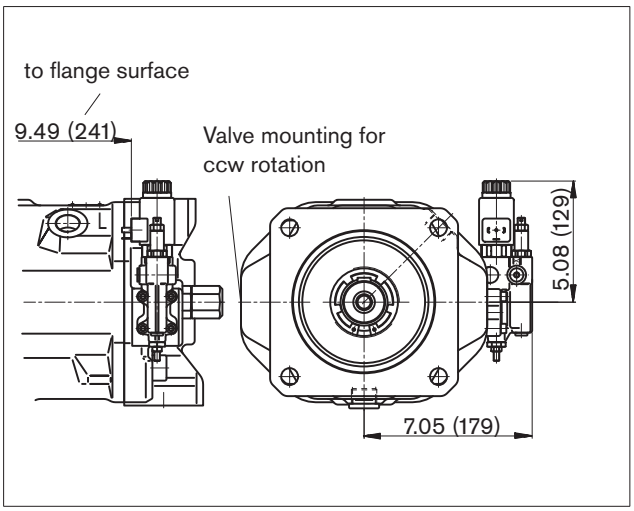
DR
Pressure control



DRG
Pressure control, remotely operated



ED7. / ER7.
Electro-hydraulic pressure control

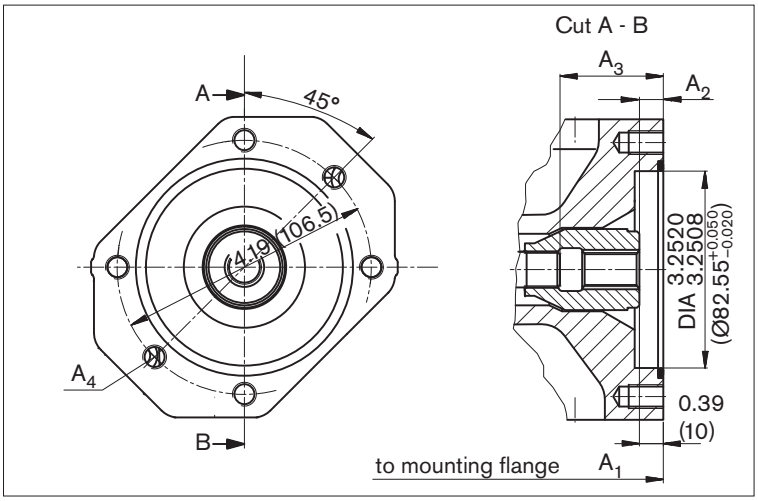


1) ER7.: 214 mm when using a sandwich plate pressure reducing valve.

Dimensions through drive

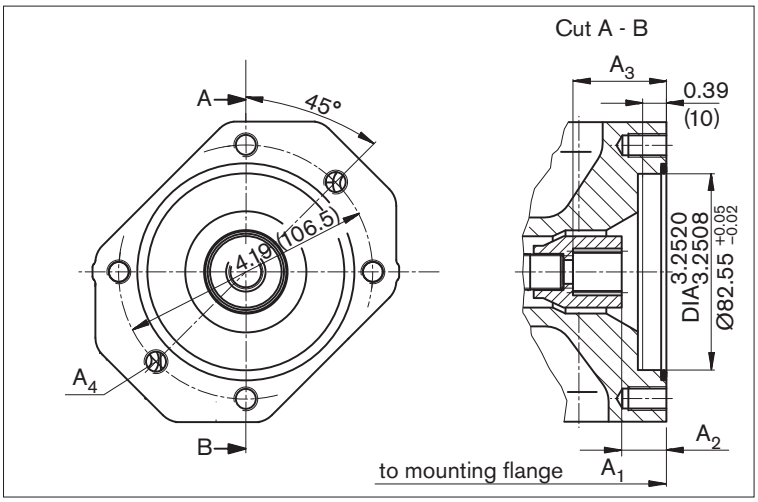
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

K01 flange ISO 3019-1 (SAE J744 - 82-2 (A))
Coupling for splined shaft according to ANSI B92.1a 5/8 in 9T 16/32 DP[1] (SAE J744 - 16-4 (A))



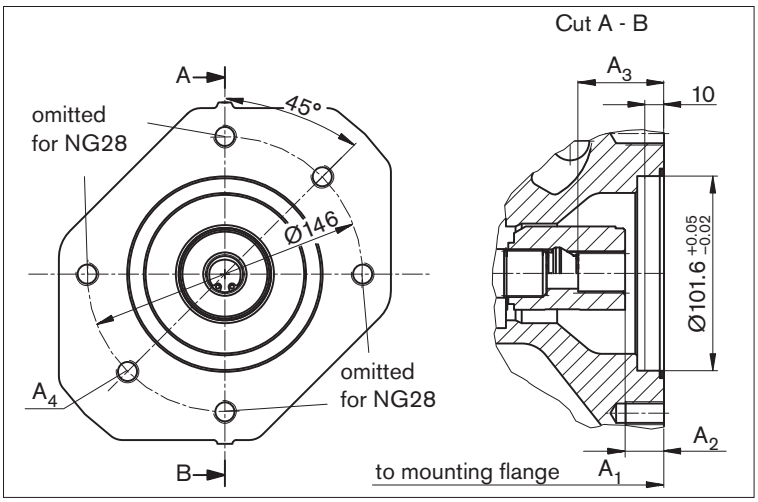
NG	A_1	A_2	A_3	A_4[2]
18	7.16 (182)	0.39 (10)	1.70 (43.3)	M10 x 1.5, 0.57 (14.5) deep
28	8.03 (204)	0.39 (10)	1.33 (33.7)	M10 x 1.5, 0.62 (16) deep
45	9.02 (229)	0.42 (10.7)	2.10 (53.4)	M10 x 1.5, 0.62 (16) deep
71	10.51 (267)	0.46 (11.8)	2.41 (61.3)	M10 x 1.5, 0.78 (20) deep
100	13.31 (338)	0.41 (10.5)	2.56 (65)	M10 x 1.5, 0.62 (16) deep
140	13.78 (350)	0.43 (10.8)	3.04 (77.3)	M10 x 1.5, 0.62 (16) deep

K52 flange ISO 3019-1 (SAE J744 - 82-2 (A))
Coupling for splined shaft according to ANSI B92.1a 3/4 in 11T 16/32 DP[1] (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, 0.62 (16) deep
45	9.02 (229)	0.744 (18.9)	1,52 (38.7)	M10 x 1.5, 0.62 (16) deep
71	10.51 (267)	0.84 (21.3)	1.63 (41.4)	M10 x 1.5, 0.78 (20) deep
100	13.31 (338)	0.75 (19)	1.53 (38.9)	M10 x 1.5, 0.62 (16) deep
140	13.78 (350)	0.744 (18.9)	1.52 (38.6)	M10 x 1.5, 0.62 (16) deep

K68 flange ISO 3019-1 (SAE J744 - 101-2 (B))
Coupling for splined shaft according to ANSI B92.1a 7/8 in 13T 16/32 DP[1] (SAE J744 - 22-4 (B))



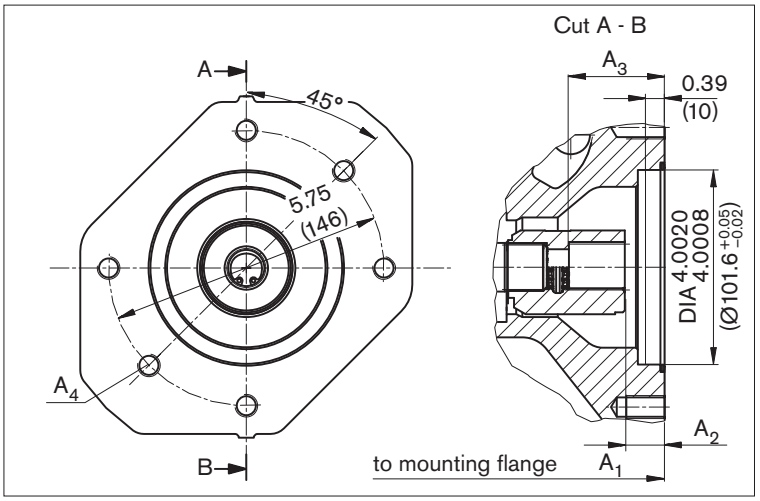
NG	A_1	A_2	A_3	A_4[2]
28	8.03 (204)	0.70 (17.8)	1.64 (41.7)	M12 x 1.75, continuous
45	9.02 (229)	0.704 (17.9)	1.64 (41.7)	M12 x 1.75, 0.71 (18) deep
71	10.51 (267)	0.80 (20.3)	1.74 (44.1)	M12 x 1.75, 0.78 (20) deep
100	13.31 (338)	0.71 (18)	1.65 (41.9)	M12 x 1.75, 0.78 (20) deep
140	13.78 (350)	0.70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

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

Dimensions through drive

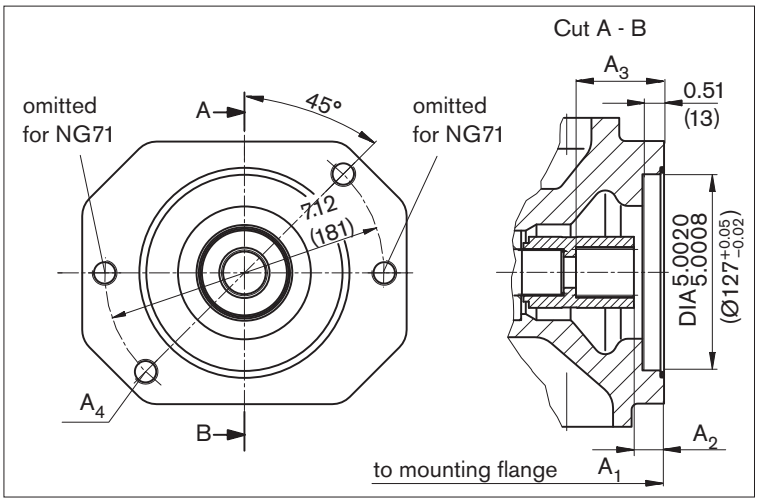
Before finalizing your design request a certified installation drawing.
Dimensions in inches and (mm).

K04 flange ISO 3019-1 (SAE J744 - 101-2 (B))
Coupling for splined shaft according to ANSI B92.1a 1 in 15T 16/32 DP[1] (SAE J744 - 25-4 (B-B))



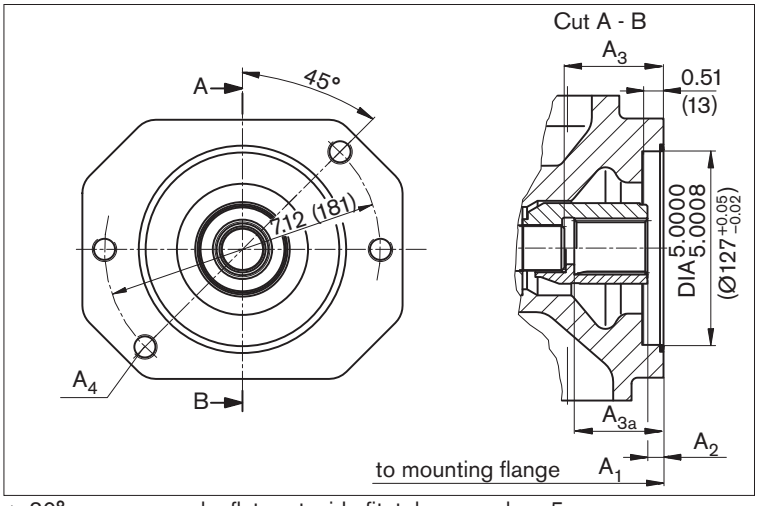
NG	A_1	A_2	A_3	A_4[2]
45	9.02 (229)	0.724 (18.4)	1.84 (46.7)	M12 x 1.75, 0.71 (18) deep
71	10.51 (267)	0.82 (20.8)	1.93 (49.1)	M12 x 1.75, 0.78 (20) deep
100	13.31 (338)	0.716 (18.2)	1.83 (46.6)	M12 x 1.75, 0.78 (20) deep
140	13.78 (350)	0.72 (18.3)	1.81 (45.9)	M12 x 1.75, 0.78 (20) deep

K07 flange ISO 3019-1 (SAE J744 - 127-2 (C))
Coupling for splined shaft according to ANSI B92.1a 1 1/4 in 14T 12/24 DP[1] (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	13.78 (350)	0.76 (19.3)	2.21 (56.1)	M16 x 2, 0.94 (24) deep

K24 flange ISO 3019-1 (SAE J744 - 127-2 (C))
Coupling for splined shaft according to ANSI B92.1a 1 1/2 in 17T 12/24 DP[1] (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	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

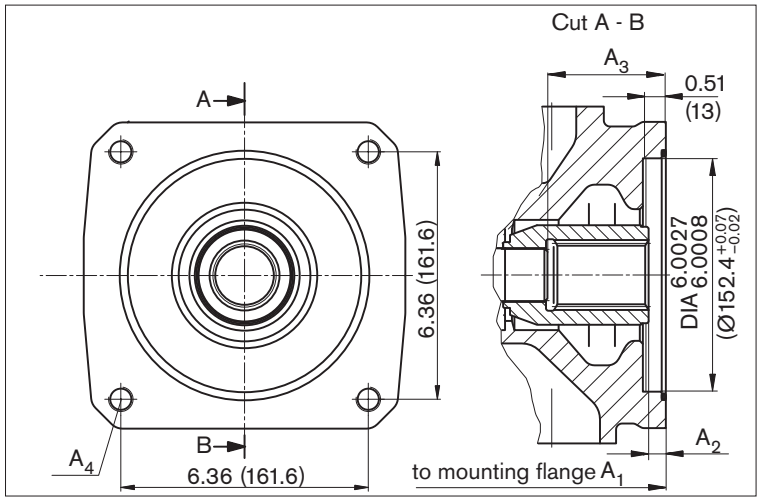
[3] Coupling **without** stop
[4] Coupling **with** stop

[1] 30° pressure angle, flat root, side fit, tolerance class 5
[2] Thread according to DIN 13, observe the general instructions on FINAL PAGE must be observed.

Dimensions through drive

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

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



NG	A_1	A_2	A_3	A_4[2]
140	13.78 (350)	0.43 (11)	3.04 (77.3)	M6 x 2, continuous

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

Summary mounting options

SAE – mounting flange

Through-drive[1]			Mounting option – 2nd pump			
Flange ISO 3019-1	Coupling for splined shaft	Short des.	PA10VO/31 NG (shaft)	PA10V(S)O/5x NG (shaft)	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

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:
PA10VSO100DFR1/31R-VSB62K04+
PA10VSO45DFR/31R-VSA62N00

If no further pumps are to be factory-mounted, the simple type code is sufficient.Included in the delivery contents of the pump with through drive are then: coupling and seal, with plastic cover to prevent penetration by dust and dirt.

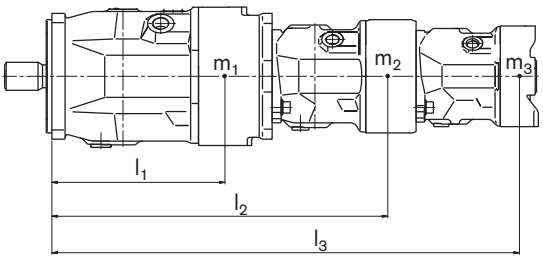
It is permissible to use a combination of two single pumps of the same size (tandem pump), considering a dynamic mass acceleration force of maximum 10 *g* (= 98.1 m/s^2) without an additional support bracket.

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



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

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

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

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 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 $h_{S\ max} = 31.50$ inch (800 mm). The minimum suction pressure at port S must also not fall below 12 psi (0.8 bar) absolute during operation.

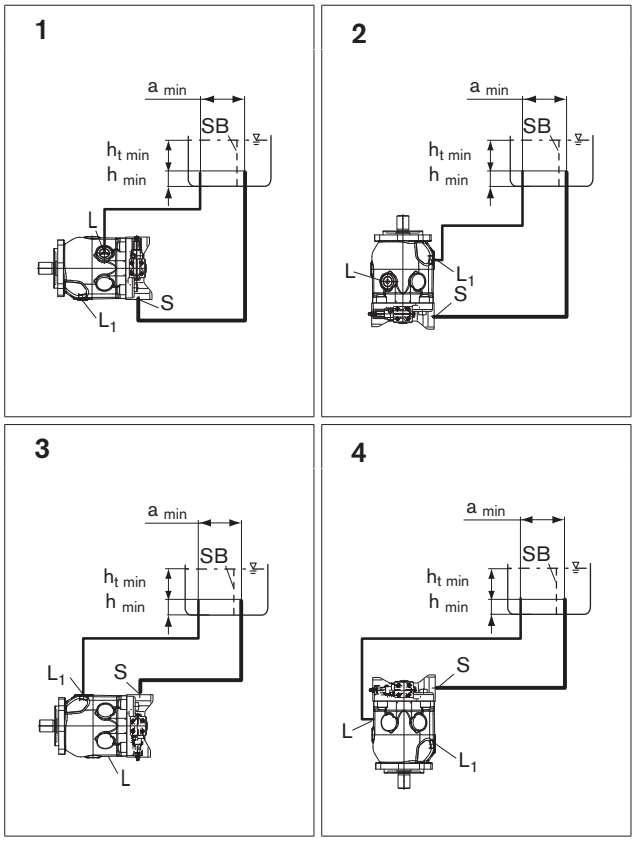
Installation position

See the following examples 1 to 12.
Additional installation positions are available upon request.

Recommended installation positions: 1 and 3.

Below-reservoir installation (standard)

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



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

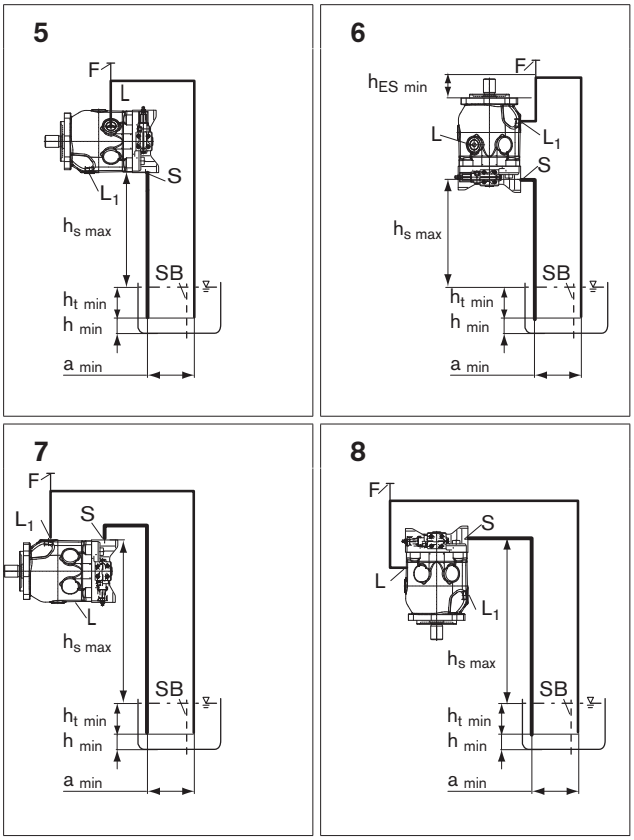
Installation instructions

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 inch (25 mm) at port L_1 is required in installation position 6.

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

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



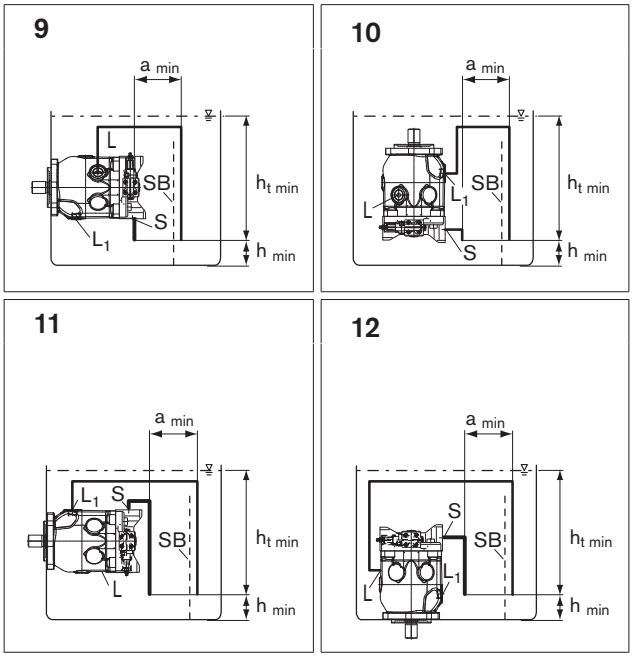
Installation position	Air bleed	Filling
5	F	L (F)
6	F	L_1 (F)
7	F	S + L_1 (F)
8	F	S + L (F)

Inside-reservoir installation

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

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

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



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 inch (200 mm))
h_{min}	Minimum necessary spacing to reservoir bottom (3.94 inch (100 mm))
$h_{ES\ min}$	Minimum necessary height needed to protect the axial piston unit from draining (0.98 inches (25 mm)).
$h_{S\ max}$	Maximum permissible suction height (31.50 inch (800 mm))
a_{min}	When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Tightening torques

- 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
- 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			
DIN 3852[1)]	G1/4	52 lb-ft	–	–
		70 Nm	–	–
	M14 x 1.5	59 lb-ft	26 lb-ft	0.24 inch
		80 Nm	35 Nm	6 mm
DIN ISO 228	G1/4	52 lb-ft	22 lb-ft	0.24 inch
		70 Nm	30 Nm	6 mm
ISO 11926	7/16-20UNF-2B	29 lb-ft	13 lb-ft	3/16 in
		40 Nm	18 Nm	
	9/16-18UNF-2B	59 lb-ft	26 lb-ft	1/4 in
		80 Nm	35 Nm	
	3/4-16UNF-2B	118 lb-ft	52 lb-ft	5/16 in
		160 Nm	70 Nm	
	7/8-14UNF-2B	177 lb-ft	81 lb-ft	3/8 in
		240 Nm	110 Nm	
	1 1/16-12UN-2B	266 lb-ft	125 lb-ft	9/16 in
		360 Nm	170 Nm	

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

General instructions

– The PA10VSO 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 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.

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