Axial Piston Variable Pump AA10VG

RA 92750-A/06.09 1/44
Replaces: 03.09

Data sheet

Series 10
Size 18 ... 63
Nominal pressure 4350 psi (300 bar)
Peak pressure 5100 psi (350 bar)
Closed circuit

Contents

Features

- Variable axial piston pump of swashplate design for hydrostatic closed circuit transmission
- Flow is proportional to drive speed and displacement and is infinitely variable
- Output flow increases with the swivel angle of the swashplate from 0 to its maximum value
- Flow direction changes smoothly when the swashplate is moved through the neutral position
- A wide range of highly adaptable control devices is available for different control and regulating functions
- The pump is equipped with two pressure relief valves on the high pressure ports to protect the hydrostatic transmission (pump and motor) from overload
- The pressure relief valves also function as boost valves
- The integrated boost pump acts as a feed and control oil pump
- The maximum boost pressure is limited by a built-in boost pressure relief valve

Ordering Code / Standard Program

AA10V	G								/	10		–	N		C							
01	02	03	04	05	06	07	08	09		10	11		12	13	14	15	16	17	18	19	20	21

Axial piston unit

01	Variable swashplate design, nominal pressure 4350 psi (300 bar), peak pressure 5100 psi (350 bar)	**AA10V**

Operation mode

02	Pump in closed circuit	**G**

Size

03	≈ Displacement $V_{g\,max}$ in cm³	in³/rev.	**1.10**	**1.71**	**2.81**	**3.84**
		cm³/rev.	**18**	**28**	**45**	**63**

	Control device			**18**	**28**	**45**	**63**	
04	Mechanical pivot control			●	–	–	–	**MD**
	Hydraulic control	pilot-pressure related, with supply filtration		●	●	●	●	**HD3**
		mechanical servo		●	●	●	●	**HW**
		direct operated		●	●	●	●	**DG**
		speed related (Description DA control valve in Pos. 09)	U = 12 V DC	–	●	●	●	**DA1**
			U = 24 V DC	–	●	●	●	**DA2**
	Electric control	with proportional solenoid with supply filtration	U = 12 V DC	●	●	●	●	**EP3**
			U = 24 V DC	●	●	●	●	**EP4**
		with switching solenoid	U = 12 V DC	●	●	●	●	**EZ1**
			U = 24 V DC	●	●	●	●	**EZ2**

	Pressure cut-off	**18**	**28**	**45**	**63**	
05	Without pressure cut-off (not for DA, no code)	●	●	●	●	
	With pressure cut-off	–	●	●	●	**D**

	Neutral position switch (only for HW)	**18**	**28**	**45**	**63**	
06	Without neutral position switch (no code)	●	●	●	●	
	With neutral position switch (with DEUTSCH connector)	●	●	●	●	**L**

	Mechanical stroke limiter	**18**	**28**	**45**	**63**	
07	Without mechanical stroke limiter (no code)	●	●	●	●	
	With mechanical stroke limiter, external variable	●	●	●	●	**M**

	Spring centering of neutral position (only MD)	**18**	**28**	**45**	**63**	
08	Without spring centering of neutral position (no code)	●	–	–	–	
	With spring centering of neutral position	●	–	–	–	**N**

Ordering Code / Standard Program

AA10V	G								/	10		–	N		C							
01	02	03	04	05	06	07	08	09		10	11		12	13	14	15	16	17	18	19	20	21

DA control valve (only for size 28-63)

			HD	HW	DG	DA	EP	EZ	
09	Without DA control valve		●	●	●	–	●	●	1
	With DA control valve, fixed setting		●	●	●	●	●	–	2
	With DA control valve, mech. adjustable with position lever	actuating direction clockwise	●	●	●	●	●	–	3R
		actuating direction counter-clockwise	●	●	●	●	●	–	3L
	With DA control valve, fixed setting and hydraulic inch valve mounted, control with brake fluid according to ISO 4925, **no** mineral oil		–	–	–	●	–	–	4
	With DA control valve, fixed setting and ports for pilot control device		●	●	●	●	●	–	7
	With DA control valve, fixed setting and hydraulic inch valve mounted, control with brake fluid based on mineral oil		–	–	–	●	–	–	8

Series

10	Series 1, Index 0	10

Direction of rotation

11	Viewed from shaft end	clockwise	R
		counter-clockwise	L

Seals

12	NBR (nitrile-caoutchouc), shaft seal ring in FKM (fluor-caoutchouc)	N

Shaft end (permissible input torque see page 8)

			18	28	45	63	
13	Splined shaft ANSI B92.1a–1976	for single pump	●	●	●	●	S
		for combination pump	–	–	●	●	T

Mounting flange

14	SAE J744 – 2-bolt	C

Service line ports (UN fixing thread)

		18	28	45	63	
	SAE flange ports A/B same side left, suction port S bottom	–	●	●	●	60
	A/B threaded ports, same side right, suction port S bottom	●	–	–	–	66

Boost pump

			18	28	45	63	
16	Without integrated boost pump	without through drive	●	●	●	●	N00
		with through drive	●	●	●	●	K..
	With integrated boost pump	without through drive	●	●	●	●	F00
		with through drive	●	●	●	●	F..

Through drive (mounting options, see page 36)

	Flange SAE J744 [1]	Hub for splined shaft		18	28	45	63	
17	82-2 (A)	5/8 in	9T 16/32DP [2]	●	●	●	●	.01
	101-2 (B)	7/8 in	13T 16/32DP [2]	●	●	●	●	.02
		1 in	15T 16/32DP [2]	–	●	●	●	.04
	127-2 (C)	1 1/4 in	14T 12/24DP [2]	–	–	–	●	.07

Ordering Code / Standard Program

AA10V	G								/	10		–	N		C							
01	02	03	04	05	06	07	08	09		10	11		12	13	14	15	16	17	18	19	20	21

	Valves	setting range Δp		**18**	**28**	**45**	**63**	
18	With high-pressure relief valve, direct operated (fixed setting)	3600...4650 psi (250...320 bar)	without bypass	●	●	●	●	**3**
			with bypass	●	●	●	●	**5**
		1450...3600 psi (100...250 bar)	without bypass	●	●	●	●	**4**
			with bypass	●	●	●	●	**6**

	Filtration	**18**	**28**	**45**	**63**	
19	Filtration in the suction line of boost pump (filter not included in supply)	●	●	●	●	**S**
	Filtration in pressure line of boost pump ports for external boost circuit filtration, (F_e and G (F_a))	–	● [3]	● [3]	●	**D**
	External supply (version without integral boost pump - N00, K..)	●	●	●	●	**E**

	Connector for solenoids (only for EP, EZ, DA)		**18**	**28**	**45**	**63**	
20	DEUTSCH connector molded, 2-pin	without suppressor diode	●	●	●	●	**P**
		with suppressor diode (only for EZ and DA)	❍	❍	❍	❍	**Q**

	Standard / special version		
21	Standard version	no code	
		combined with attachment part or attachment pump	**-K**
	Special version		**-S**
		combined with attachment part or attachment pump	**-SK**

[1]) 2 = 2-bolt

[2]) Hub for splined shaft acc. to ANSI B92.1a-1976 (splined shaft assignment acc. to SAE J744, see page 34-35)

[3]) Pressure filtration is not possible in conjunction with DA control valve

● = 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 90223 (HF hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

The variable pump AA10VG is unsuitable for operation with HFA, HFB and HFC. If HFD or environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and seals mentioned in RE 90221 and RE 90223 must be observed.

When ordering, please indicate the hydraulic fluid used.

Operating viscosity range

For optimum efficiency and service life, select an operating viscosity (at operating temperature) within the optimum range of

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

depending on the circuit temperature (closed circuit).

Limits of viscosity range

The limiting values for viscosity are as follows:

ν_{min} = 42 SUS (5 mm²/s)
short term (t < 3 min)
at max. perm. temperature of t_{max} = +240 °F (+115 °C)

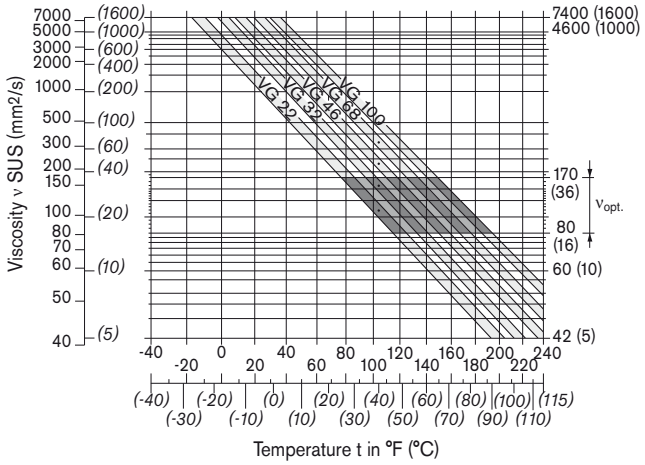
ν_{max} = 7400 SUS (1600 mm²/s)
short term (t < 3 min)
at cold start (p ≤ 435 psi / 30 bar, n ≤ 1000 rpm, t_{min} = -40 °F / -40 °C).
Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Note that the maximum hydraulic fluid temperature of 240 °F (115 °C) must not be exceeded locally either (e.g. in the bearing area). The temperature in the bearing area is - depending on pressure and speed - up to 9 °F (5 K) higher than the average case drain temperature.

Special measures are necessary in the temperature range from -40 °F to -13 °F (-40 °C to -25 °C) (cold start phase), please contact us.

For detailed information about use at low temperatures, see RE 90300-03-B.

Selection diagram



Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in a closed circuit the circuit temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}) - the shaded area of the selection diagram. We recommended that the higher viscosity class be selected in each case.
Example: At an ambient temperature of X °F (X °C) an operating temperature of 140 °F (60 °C) is set in the circuit. In the optimum operating viscosity range (ν_{opt}; shaded area) this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Please note: The case drain temperature, which is affected by pressure and speed, is always higher than the circuit temperature. At no point in the system may the temperature be higher than 240 °F (115 °C).

If the above conditions cannot be maintained due to extreme operating parameters, please consult us.

Technical Data

Filtration

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

To ensure functional reliability of the axial piston unit the hydraulic fluid must have a cleanliness level of at least

20/18/15 according to ISO 4406.

Depending on the system and the application, for the AA10VG, we recommend

Filter elements $\beta_{20} \geq 100$

With a rising differential pressure at the filter elements, the β-value must not deteriorate.

At very high hydraulic fluid temperatures (195 °F to max. 240 °F / 90 °C to max. 115 °C) at least cleanliness level

19/17/14 according to ISO 4406 is required.

If the above classes cannot be observed, please contact us.
For notes on filtration types, see page 38.

Operating pressure range

Input

Variable pump (with external supply, E):

For control EP, EZ, HW and HD
boost pressure (at n = 2000 rpm) p_{Sp} _____ 260 psi (18 bar)

For control DA, DG
boost pressure (at n = 2000 rpm) p_{Sp} _____ 365 psi (25 bar)

Boost pump:
suction pressure $p_{s\,min}$:
($\nu \leq 140$ SUS / 30 mm^2/s) _____ ≥ 12 psi a (0.8 bar abs.)
at cold start, short term (t < 3 min) _____ ≥ 7.5 psi a (0.5 bar abs.)

Output

Variable pump:
pressure at port A or B
(pressure data according to DIN 24312)

Nominal pressure p_N _____ 4350 psi (300 bar)
Peak pressure p_{max} _____ 5100 psi (350 bar)

Boost pump:
peak pressure $p_{Sp\,max}$ size 18 _____ 365 psi (25 bar)
peak pressure $p_{Sp\,max}$ size 28, 45, 63 _____ 580 psi (40 bar)

Nominal pressure: Max. design pressure at which fatigue strength is ensured.

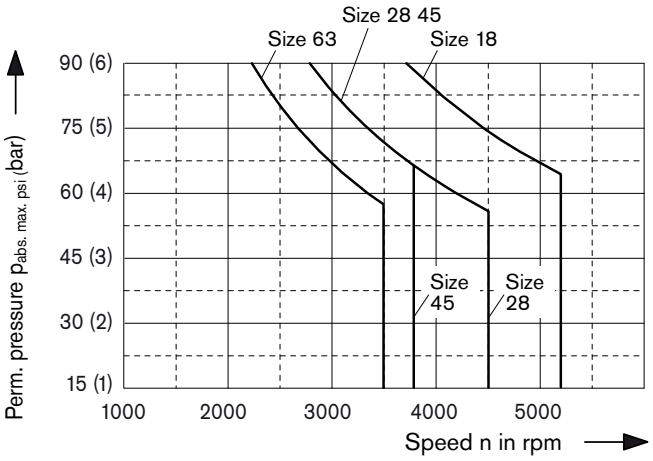
Peak pressure: Max. operating pressure which is permissible for short term (t<1s).

Shaft seal ring

Permissible pressure loading

The service life of the shaft seal ring is affected by the speed of the pump and the case drain pressure. It is recommended that the average, continuous case drain pressure at operating temperature 45 psi (3 bar) absolute not be exceeded (max. permissible case drain pressure 90 psi (6 bar) absolute at reduced speed, see diagram). Short term (t < 0.1 s) pressure spikes of up to 145 psi (10 bar) absolute are permitted. The service life of the shaft seal ring decreases with an increase in the frequency of pressure spikes.

The case pressure must be equal to or greater than the external pressure on the shaft seal ring.



Temperature range

The FKM shaft seal ring is permissible for case temperatures of -13 °F to +240 °F (-25 °C to +115 °C).

Note:
For application cases below -13 °F (-25 °C), an NBR shaft seal ring is necessary (permissible temperature range: -40 °F to +195 °F / -40 °C to +90 °C). Please state NBR shaft seal ring in plain text when ordering. Please contact us.

Technical Data

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

Size				18	28	45	63
Displacement		$V_{g\,max}$	in^3	1.10	1.71	2.81	3.84
variable pump			cm^3	18	28	46	63
boost pump (at p = 290 psi / 20 bar)		$V_{g\,Sp}$	in^3	0.34	0.37	0.53	0.91
			cm^3	5.5	6.1	8.6	14.9
Speed							
maximum at $V_{g\,max}$		$n_{max\,continuous}$	rpm	4000	3900	3300	3000
limited maximum [1]		$n_{max\,limited}$	rpm	4850	4200	3550	3250
intermittent maximum [2]		$n_{max\,interm.}$	rpm	5200	4500	3800	3500
minimum		n_{min}	rpm	500	500	500	500
Flow		$q_{v\,max}$	gpm	19	28.8	40.2	49.9
at $n_{max\,continuous}$ and $V_{g\,max}$			l/min	72	109	152	189
Power [3]	Δp = 4350 psi	P_{max}	hp	48.3	73.2	101.8	126.7
at $n_{max\,continuous}$ and $V_{g\,max}$	Δp = 300 bar		kW	36	54.6	75.9	94.5
Torque [3]	Δp = 4350 psi	T_{max}	lb-ft	63.5	99	162	222
at $V_{g\,max}$	Δp = 300 bar		Nm	86	134	220	301
	Δp = 1450 psi	T	lb-ft	14.6	32.9	54	74
	Δp = 100 bar		Nm	28.6	44.6	73.2	100.3
Rotary stiffness	shaft end S	c	lb-ft/rad	14960	23707	39388	57802
			Nm/rad	20284	32143	53404	78370
	shaft end T	c	lb-ft/rad	–	–	54435	68127
			Nm/rad	–	–	73804	92368
Moment of inertia		J_{GR}	$lb\text{-}ft^2$	0.0221	0.0403	0.0738	0.1252
for rotary group			kgm^2	0.00093	0.0017	0.0033	0.0056
Angular acceleration, max. [4]		α	rad/s^2	6800	5500	4000	3300
Filling capacity		V	gal	0.12	0.17	0.20	0.29
			L	0.45	0.64	0.75	1.1
Weight approx. (without through drive)		m	lbs	31(40) [5]	55	60	86
			kg	14(18) [5]	25	27	39

[1] Restricted maximum speed: – at half corner power (e.g. at $V_{g\,max}$ and p_N /2)

[2] Intermittent maximum speed:
- at high idle speed
- at overspeed: Δp = 1000...2200 psi (70...150 bar) and $V_{g\,max}$
- at reversing peaks: Δp < 4350 psi (300 bar) and t < 0.1 s.

[3] Without boost pump

[4] – The area of validity is situated between the minimum required and maximum permissible speed. It applies for external stimuli (e.g. engine 2-8 times rotary frequency, cardan shaft twice the rotary frequency).

– The limit value applies for a single pump only.

– The load capacity of the connection parts has to be considered.

[5] 31 lbs (14 kg): MD control, 40 lbs (18 kg): HD control

Caution: Exceeding the permissible limit values may result in a loss of function, a reduction in service life or in the destruction of the axial piston unit.
A calculation can be performed to determine the permissible values.

Determining the size

Flow $q_v = \frac{V_g \cdot n \cdot \eta_v}{231}$ gpm $\left(\frac{V_g \cdot n \cdot \eta_v}{1000} \text{ l/min} \right)$

Torque $T = \frac{V_g \cdot \Delta p}{24 \cdot \pi \cdot \eta_{mh}}$ lb-ft $\left(\frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}} \text{ Nm} \right)$

Power $P = \frac{2\pi \cdot T \cdot n}{33000} = \frac{q_v \cdot \Delta p}{1714 \cdot \eta_t}$ HP $\left(\frac{q_v \cdot \Delta p}{600 \cdot \eta_t} = \frac{2\pi \cdot T \cdot n}{60000} \text{ kW} \right)$

V_g = displacement volume per revolution in in^3 (cm^3)

Δp = differential pressure in psi (bar)

n = speed in rpm

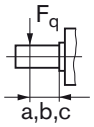
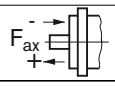
η_v = volumetric efficiency

η_{mh} = mechanical-hydraulic efficiency

η_t = total efficiency

Technical Data

Permissible axial and radial loading on drive shaft

Size			18	28	45	63
Radial force, max. at distance (from shaft collar)	$F_{q\,max}$	lb	292	562	809	1124
		N	1300	2500	3600	5000
	a	in	0.65	0.69	0.69	0.69
		mm	16.5	17.5	17.5	17.5
	$F_{q\,max}$	lb	225	450	650	910
		N	1000	2000	2891	4046
	b	in	1.14	1.18	1.18	1.18
		mm	29	30	30	30
	$F_{q\,max}$	lb	198	382	543	764
		N	880	1700	2416	3398
	c	in	1.63	1.67	1.67	1.67
		mm	41.5	42.5	42.5	42.5
Axial force, max. 		lb	219	222	337	495
		N	973	987	1500	2200

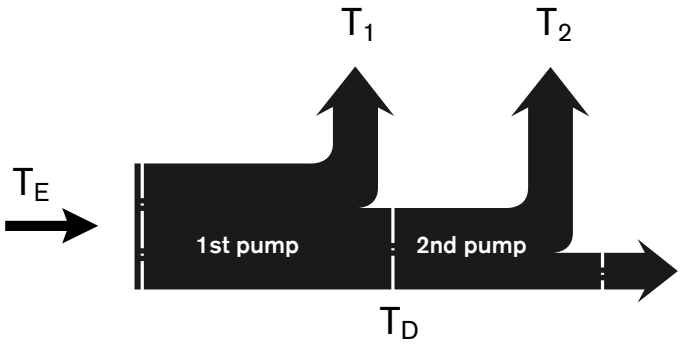
Note: special requirements apply in the case of belt drives. Please contact us.

Permissible input and through-drive torques

Size			18	28	45	63
Torque (at $V_{g\,max}$ and Δp = 4350 psi / 300 bar) [1]	T_{max}	lb-ft	63.5	99	162	222
		Nm	86	134	220	301
Input torque, max. [2]	$T_{E\,perm.}$	lb-ft	142	232	232	444
at shaft end S		Nm	192	314	314	602
ANSI B92.1a-1976 (SAE J744)			7/8 in	1 in	1 in	1 1/4 in
at shaft end T	$T_{E\,perm.}$	lb-ft	–	–	444	715
		Nm	–	–	602	970
ANSI B92.1a-1976 (SAE J744)			–	–	1 1/4 in	1 3/8 in
Through-drive torque, max.	$T_{D\,perm.}$	lb-ft	83	162	232	324
		Nm	112	220	314	439

[1]) Efficiency not considered
[2]) For drive shafts with no radial force

Torque distribution



High-Pressure Relief Valves

Setting ranges

High-pressure relief valve, direct operated	Differential pressure setting Δp_{HP}
Setting range for valve **3, 5** Δp 3600 - 4650 psi (Δp 250 - 320 bar) (refer to ordering code)	4650 psi (320 bar)
	4350 psi (300 bar) [1]
	3900 psi (270 bar)
Setting range for valve **4, 6** Δp 1450 - 3600 psi (Δp 100 - 250 bar) (refer to ordering code)	3600 psi (250 bar)
	3350 psi (230 bar) [1]
	2900 psi (200 bar)
	2200 psi (150 bar)
	1450 psi (100 bar)

[1] Standard differential pressure setting. The valves will be set to this value if the differential pressure is not specified on ordering.

Please state in plain text when ordering:
(only the Δp_{HP} values shown in the table are possible)

High-pressure relief valve A

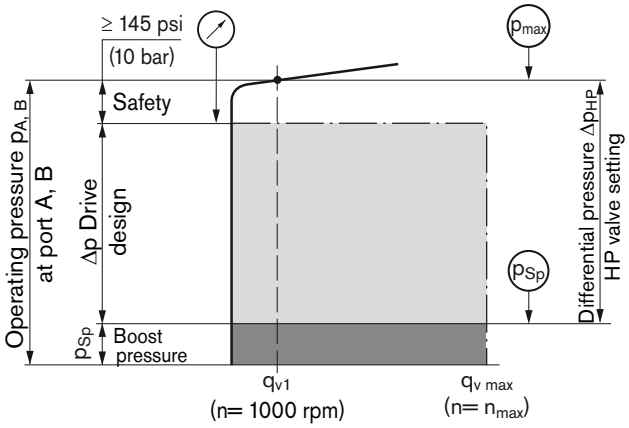
Differential pressure setting : Δp_{HP} = ... psi (bar)
opening pressure of the HP valve (at $q_{V\,1}$): p_{max} = ... psi (bar)
($p_{max} = \Delta p_{HP} + p_{Sp}$)

High-pressure relief valve B

Differential pressure setting : Δp_{HP} = ... psi (bar)
opening pressure of the HP valve (at $q_{V\,1}$): p_{max} = ... psi (bar)
($p_{max} = \Delta p_{HP} + p_{Sp}$)

Setting diagram

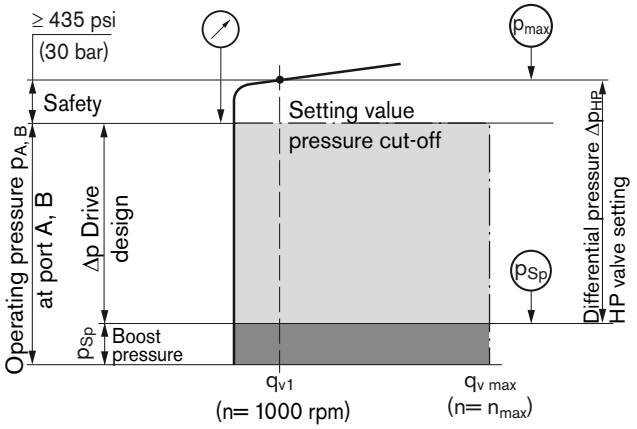
Version without pressure cut-off



Example: boost pressure 290 psi (20 bar);
operating pressure 4200 psi (290 bar)

Operating pres. $p_{A,B}$	-	boost pres. p_{Sp}	=	differential pres. Δp_{HP}
4200 psi	-	290 psi	=	**3910 psi**
(290 bar	-	20 bar	=	**270 bar**)

Version with pressure cut-off



Example: boost pressure 290 psi (20 bar);
operating pressure 4200 psi (290 bar)

Operating pres. $p_{A,B}$	-	boost pres. p_{Sp}	+	safety	=	differential pres. Δp_{HP}
4200 psi	-	290 psi	+	435 psi	=	**4345 psi**
(290 bar	-	20 bar	+	30 bar	=	**300 bar**)

Note: valve is set at
n = 1000 rpm and $V_{g\,max}$ ($q_{v\,1}$)

Bypass function

The bypass function can only be used for short periods with reduced displacement, e.g. to tow a vehicle out of an immediate danger zone.

Note:
The bypass function is not shown in these circuit diagrams.

Pressure Cut-Off, D

The pressure cut-off corresponds to a pressure regulation which, after reaching the set pressure, adjusts the displacement of the pump to $V_{g\ min}$.

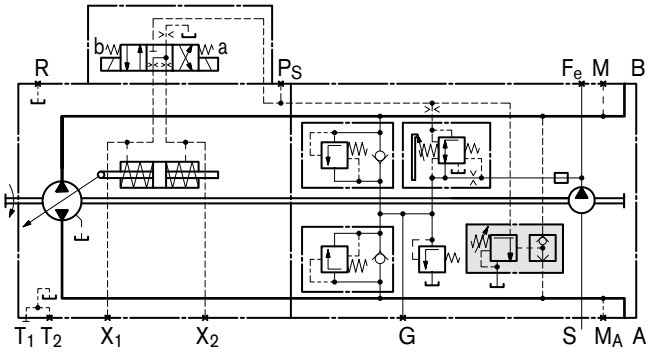
This valve prevents the operation of the high-pressure relief valves when accelerating or decelerating.

Both the pressure peaks occurring when the swashplate is swiveled rapidly and also the maximum pressure in the system are safeguarded by the high-pressure relief valves.

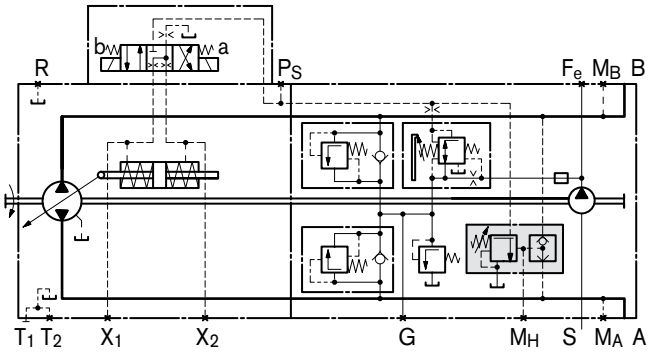
The setting range of the pressure cut-off may be anywhere within the entire operating pressure range. However, it must be set 435 psi (30 bar) lower than the setting of the high-pressure relief valves (see setting diagram, page 9).

Please state the setting value of the pressure cut-off in plain text when ordering.

Circuit diagram with pressure cut-off
Hydraulic control, speed related, DA.D3
Size 28 and 45



Size 63



DG - Hydraulic Control, Direct Operated

With the direct operated hydraulic control (DG), pump displacement is controlled by a hydraulic pilot pressure applied directly to the stroking piston through either the X_1 or X_2 port.

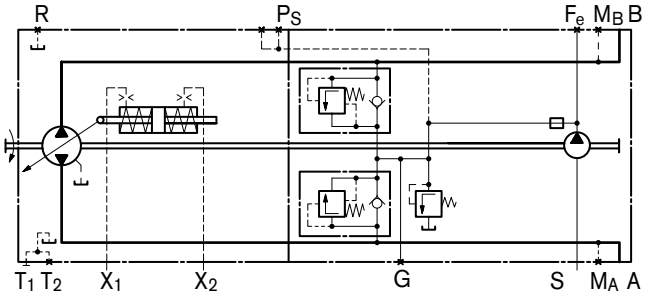
Flow direction is determined by which pilot port is pressurized (please refer to the data table at the top of page 9; control pressure column- X_1; X_2).

Pump displacement is infinitely variable and proportional to the applied pilot pressure, but is also influenced by system pressure and pump drive speed.

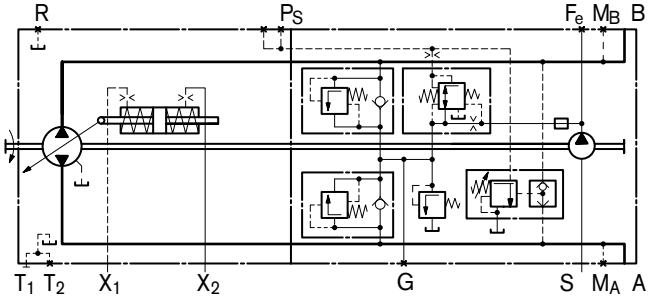
The P_s port must be used as the pilot pressure source for the selected control device, to enable the function of the built-in pressure cut-off valve. Please refer to page 8 for a description of the pressure cut-off function.

Application of the DG Control requires a review of the engine and vehicle parameters to ensure that the pump is set up correctly. All DG applications must be reviewed by a Rexroth Application Engineer.

Standard version

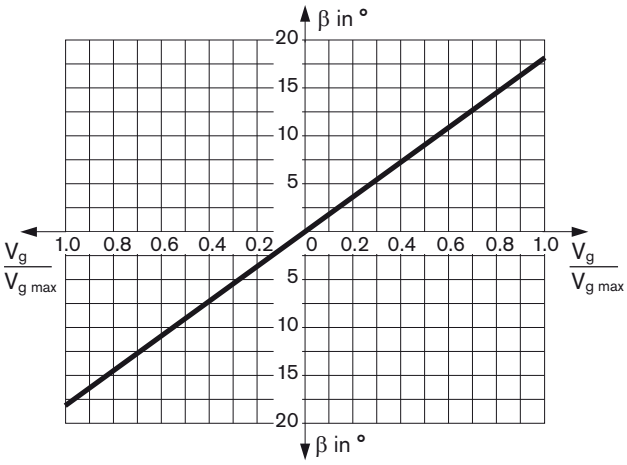


Version with DA control valve and pressure cut-off



MD - Mechanical Pivot Control (Size 18 only)

The swashplate is adjusted directly and thus the displacement of the pump is continuously varied depending on the position of the pivot. A swivel direction of the pivot is assigned to each flow direction.



Swivel angle β at the control lever for deflection:

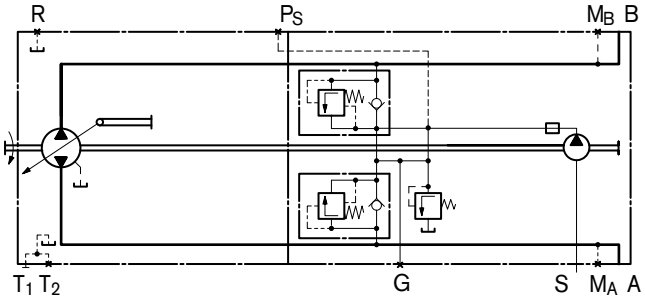
Start of control at $\beta = 0°$

End of control at $\beta = 17.79°$ (max. displacement $V_{g\,max}$)

The required actuating torque is independent of the operating pressure, speed, displacement, design of the control plate and its torsion.

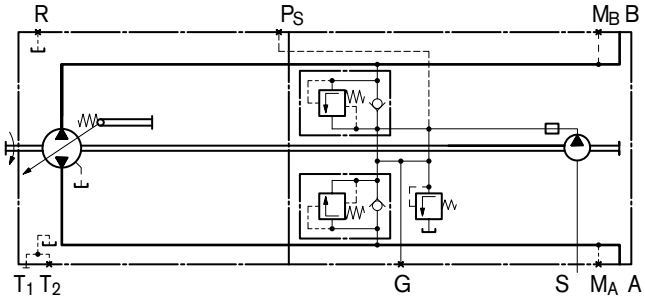
Higher operating pressure	➔	higher actuating torque
Higher speed	➔	higher actuating torque
Larger displacement	➔	lower actuating torque

Standard version (MD)



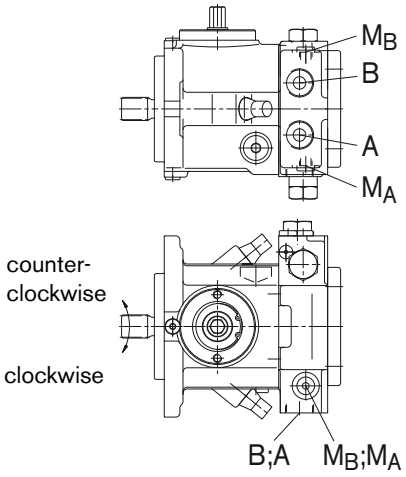
Variation: Spring neutral position centering (MDN)

Spring neutral position centering automatically sets the pump to swivel angle 0 as soon as there is no actuating torque at the pivot pin.



Assignment
Direction of rotation - Control - Direction of through put flow

		Lever direction	Through put flow	Operating pressure
Direction of rotation	cw	a	B to A	M_A
		b	A to B	M_B
	ccw	a	A to B	M_B
		b	B to A	M_A



HD - Hydraulic Control, Pilot-Pressure Related

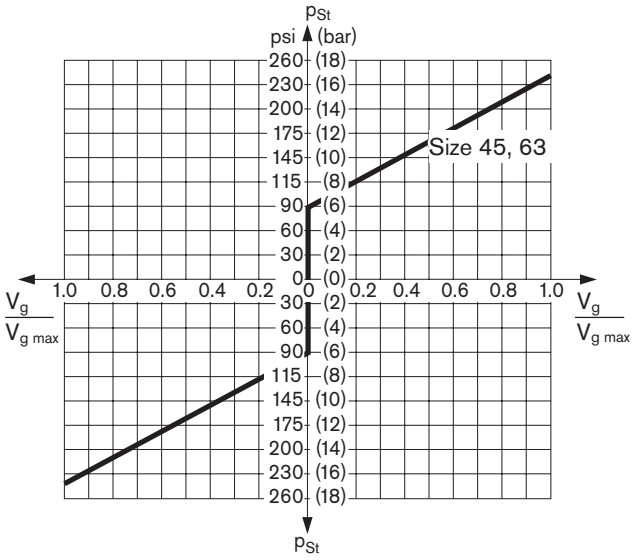
The flow output of the pump is infinitely varied between 0 and 100%, proportional to the difference in pilot pressure applied to the two control ports (Y_1 and Y_2).

The pilot signal, which originates from an external, remote source, is pressure only. Flow is negligible as the pilot signal is only acting on the spool of the control valve.

This spool then directs control oil into and out of the stroking cylinder to adjust pump displacement as required.

A feedback lever, connected to the stroking piston, maintains the pump flow for any given pilot signal.

If the pump is also equipped with a DA control valve (see page 15), automotive operation is possible for travel drives.



Size		18	28	45	63
Start of control ($V_{g\,0}$) p_{St}	psi	90	90	90	90
	bar	6	6	6	6
End of control ($V_{g\,max}$) p_{St}	psi	228	232	242	242
	bar	15.7	16	16.7	16.7

p_{St} : pilot pressure at port Y_1, Y_2

Please note:
The external control device must vent the Y_1 and Y_2 ports to tank pressure in neutral.

Note

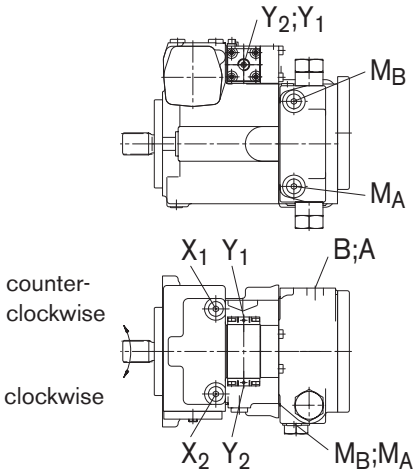
The spring return feature in the control unit is not a safety device

The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

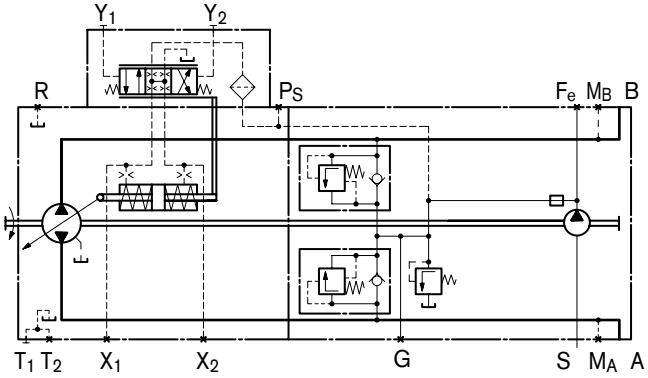
Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).

Assignment
Direction of rotation - Control - Direction of through put flow

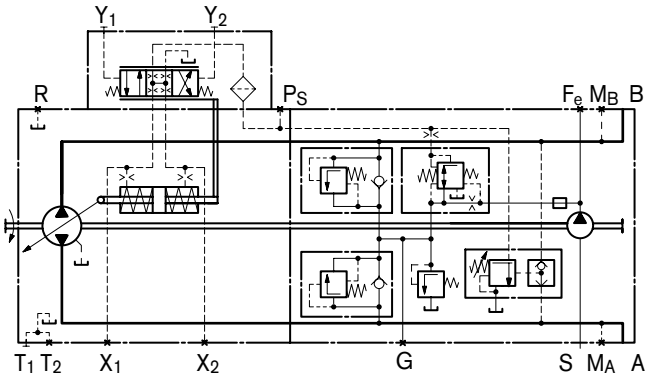
Direction of rotation		Pilot pressure	Control pressure	Through put flow	Operating pressure
cw		Y_1	X_1	A to B	M_B
		Y_2	X_2	B to A	M_A
ccw		Y_1	X_1	B to A	M_A
		Y_2	X_2	A to B	M_B



Standard version



Version with DA control valve and pressure cut-off

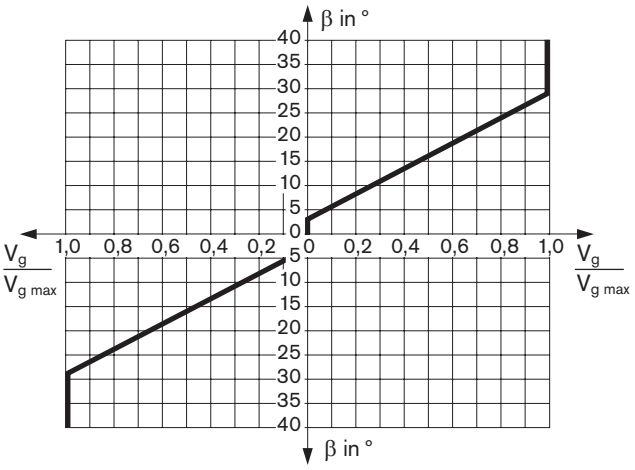


HW - Hydraulic Control, Mechanical Servo

The flow output of the pump is infinitely varied in the range of 0 to 100%, proportional to the rotation of the control lever between 0° and ±29° from the spring centered zero flow position.

A feedback lever, connected to the stroking piston, maintains the pump flow for any given position of the control lever between 0° and 29°.

If the pump is also equipped with a DA control valve (see page 15), automotive operation is possible for travel drives.



Swivel angle β at the control lever for deflection:

Start of control at β = 3°

End of control at β = 29° (max. displacement $V_{g\,max}$)

Mech. stop: ±40°

The maximum required torque at the lever is 15 lb-in (170 Ncm). To prevent damage to the HW control module a positive mechanical stop must be provided for the HW control linkage.

Note:
Spring centering enables the pump to move automatically into neutral position ($V_g = 0$) as soon as there is no longer any torque on the control lever of the HW control unit (regardless of deflection angle).

Variation: Neutral position switch, L

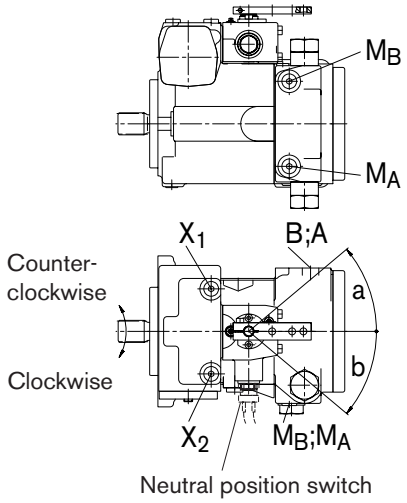
The switch contact in the neutral position is closed when the control lever on the HW control unit is in its neutral position. The switch opens if the control lever is moved out of neutral in either direction.

The neutral position switch provides a safety function for drive units that require zero flow under certain operating conditions (e.g. starting engine).

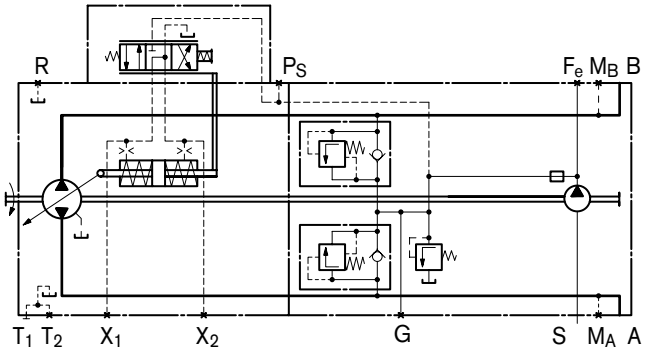
Technical data of neutral position switch	
Load capacity	20 A (continuous), without switching operating
Switching capacity	15 A / 32 V (ohm´s load)
	4 A / 32 V (inductive load)
Connector version	DEUTSCH connector DT04-2P-EP04 (mating connector see page 39)

Assignment
Direction of rotation - Control - Direction of through put flow

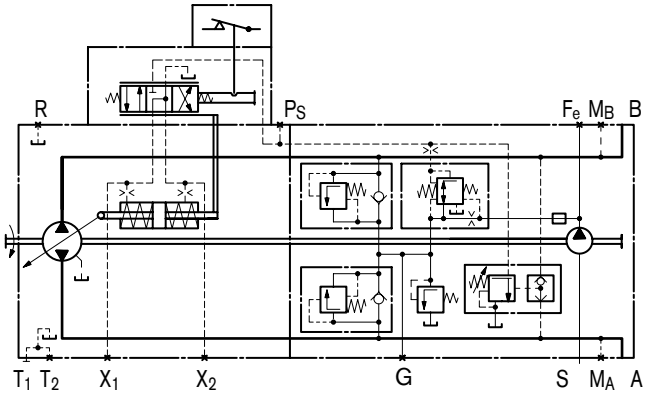
		Lever direction	Control pressure	Through put flow	Operating pressure
Direction of rotation	cw	a	X_2	B to A	M_A
		b	X_1	A to B	M_B
	ccw	a	X_2	A to B	M_B
		b	X_1	B to A	M_A



Standard version



Version with DA control valve, neutral position switch and pressure cut-off



DA - Hydraulic Control, Speed Related

The DA control is an engine speed-dependent, or automotive, type control system. The built-in DA regulating cartridge generates a pilot pressure that is proportional to pump (engine) drive speed. This pilot pressure is directed to the positioning cylinder of the pump by a solenoid actuated 4/3 way directional valve. Pump displacement is infinitely variable in each direction of flow, and is influenced by both pump drive speed and discharge pressure. Flow direction (i.e. machine forward or reverse) is controlled by energizing solenoid a or b.

Increasing pump drive speed generates a higher pilot pressure from the DA cartridge, with a subsequent increase in pump flow and/or pressure.

Dependent on the selected pump operating characteristics, increasing system pressure (i.e. machine load) causes the pump to swivel back towards a smaller displacement. Engine overload (anti-stall) protection is achieved by the combination of this pressure-related pump de-stroking, and the reduction of pilot pressure as the engine speed drops.

Any additional power requirement, such as implement hydraulics, may result in further engine pull down. This causes a further reduction in pilot pressure and therefore pump displacement. Automatic power division and full utilization of available power is thus achived for both the vehicle transmission and the implement hydraulics, with priority given to the implement hydraulics.

To provide controllable reduced vehicle speed operation when high engine speeds are required for fast implement hydraulics, various inching options are available.

The DA regulating cartridge can also be used in pumps with conventional control devices, such as EP, HW or HD, to provide an engine anti-stall function, or as a combination of automotive and displacement control functions.

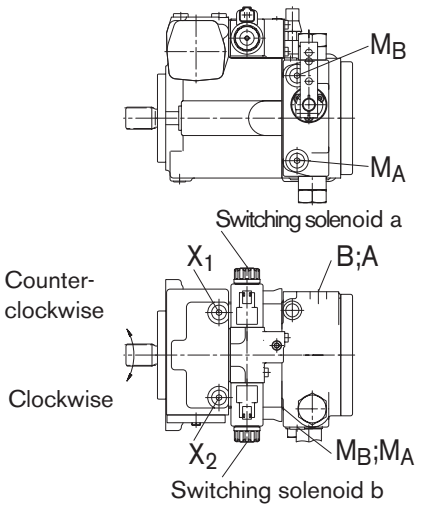
Application of the DA control is only appropriate on certain types of vehicle drive systems, and requires a review of the engine and vehicle parameters to ensure proper application of the pump, and safe and efficient machine operation. All DA applications must therefore be reviewed by a Rexroth Application Engineer.

Solenoid technical data	DA1	DA2
Voltage	12 V DC (±20 %)	24 V DC (±20 %)
Neutral position $V_{g\,0}$	de-energized	de-energized
Position $V_{g\,max}$	current energized	current energized
Nominal resistance (at 68 °F / 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Current required, minimum effective	1.32 A	0.67 A
Actuated time	100 %	100 %
Type of protection	see range of connectors on page 39	

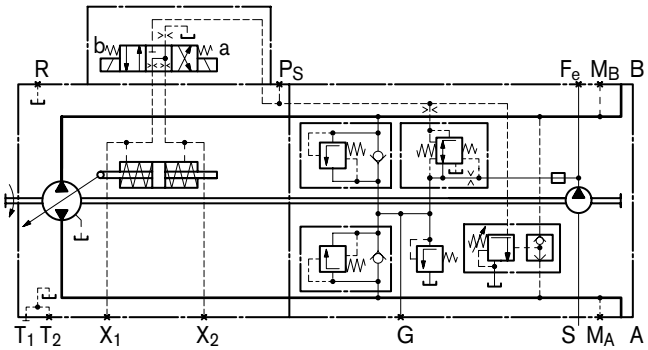
Standard: switching solenoid without manual emergency operation.
On request: manual emergency operation with spring reset available.

Assignment
Direction of rotation - Control - Direction of through put flow

Direction of rotation		Actuation of solenoid	Control pressure	Through put flow	Operating pressure
cw		a	X_2	B to A	M_A
		b	X_1	A to B	M_B
ccw		a	X_2	A to B	M_B
		b	X_1	B to A	M_A



Hydraulic control, speed related,
DA control valve, fixed setting, DA1D2/DA2D2



DA - Hydraulic Control, Speed Related

Function and control of DA control Valves

DA control valve, fixed setting (2)

Pilot pressure is generated in relation to drive speed. When ordering, please state in plain text: Start of control (set at factory).

DA control valve, mechanically adjustable with position lever, (3)

Pilot pressure is generated in relation to drive speed. When ordering, please state in plain text: Start of control (set at factory).

Pilot pressure may be reduced, independently of drive speed, through mechanical operation of the position lever (inch function).

Max. perm. operating torque at the position lever ___ T_{max} = 3 lb-ft (4 Nm)

Max. angle of rotation 70°, lever position: any.

Variation 3R_____ Acutating direction of position lever clockwise

Variation 3L _____ Acutating direction of position lever counter-clockwise

DA control valve, fixed setting and hydraulic inch valve mounted, (4, 8)
(only for pumps with DA control unit)

Permits the pilot pressure to be reduced independently of the drive speed via hydraulic control (port Z).

Variation 4:
Control at port Z by means of brake fluid according to ISO 4925 (**no** mineral oil) from the vehicle braking system (hydraulically linked with the service brake).

Variation 8:
Control at port Z by means of brake fluid based on mineral oil.

DA control valve with fixed setting, ports for pilot control device as inch valve (7)

Any reduction of pilot pressure, independent from the drive speed through the mechanical operation of the pilot control device.

The pilot control device is installed separately from the pump (for example in the driver's cabin) and connected with the pump by 2 hydraulic control lines via ports P_S and Y.

A suitable pilot control device must be ordered separately and is not included in supply.

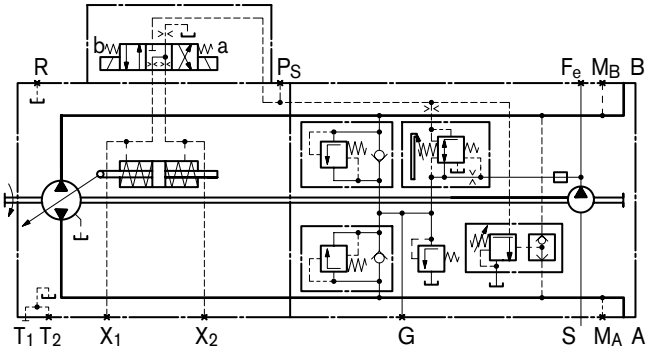
Detailed information is available from our sales department and on our website www.boschrexroth.com/da-control. Use our computer program to work out the input design that meets your needs. A DA control must be approved by Rexroth.

Note: see page 40 for rotary inch valves.

Circuit diagrams:

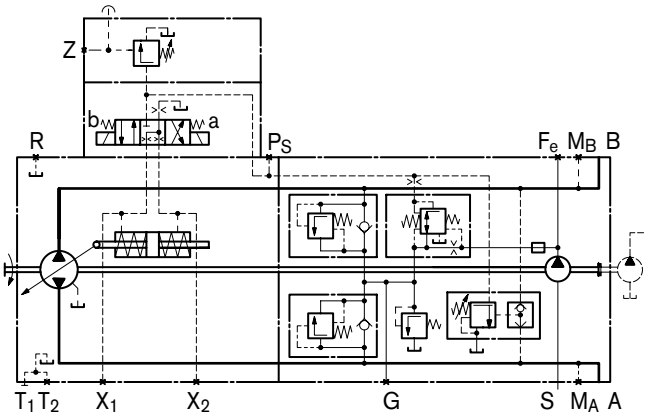
DA1D3/DA2D3

Hydraulic control, speed related, DA control valve, mech. adjustable with position lever



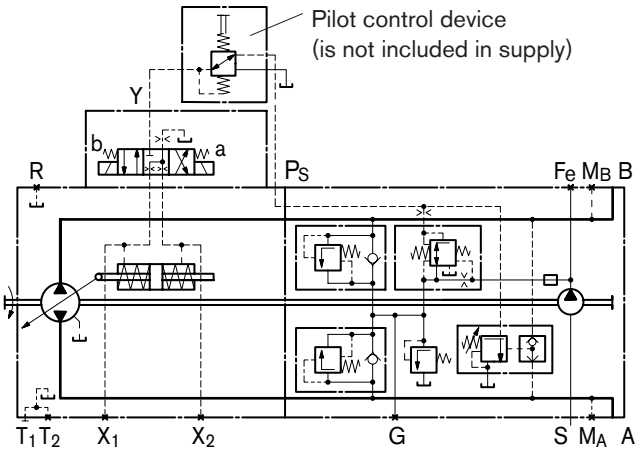
DA1D4/DA2D4

Hydraulic control, speed related,
DA control valve, fixed setting, with hydraulic inch valve



DA1D7/DA2D7

Hydraulic control, speed related, DA
DA control valve, fixed setting, with separately installed pilot control device as inch valve

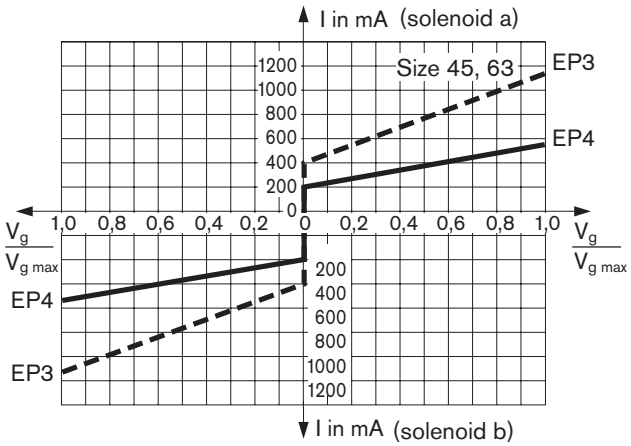


EP - Electric Control, With Proportional Solenoid

The flow output of the pump is infinitely varied in the range of 0 to 100%, proportional to an electrical current, supplied to solenoid a or b.

The electrical energy is converted to a force acting on the control spool. The spool then directs control oil in and out of the stroking piston to stroke the pump as required. A feedback lever, connected to the stroking piston, maintains the pump flow for any given current within the control range.

If the pump is also equipped with a DA control valve (see page 15), automotive operation is possible for travel drives.



Control current					
EP3	**Size**	**18**	**28**	**45**	**63**
Start of control	mA	400	400	400	400
End of control	mA	1050	1060	1115	1115
EP4	**Size**	**18**	**28**	**45**	**63**
Start of control	mA	200	200	200	200
End of control	mA	525	530	560	560

Solenoid technical data	EP3	EP4
Voltage	12 V DC (±20 %)	24 V DC (±20 %)
Limiting current	1.54 A	0.77 A
Nominal resistance (at 68 °F / 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection	see range of connectors on page 39	

The following electronic controllers and amplifiers are available for actuating the proportional solenoids (details also available at www.boschrexroth.com/mobile-electronics):

– BODAS controller RC
  series 20 RE 95200
  series 21 RE 95201
  series 22 RE 95202
  aeries 30 RE 95203
  and application software

– Analog amplifier RA RE 95230

Note

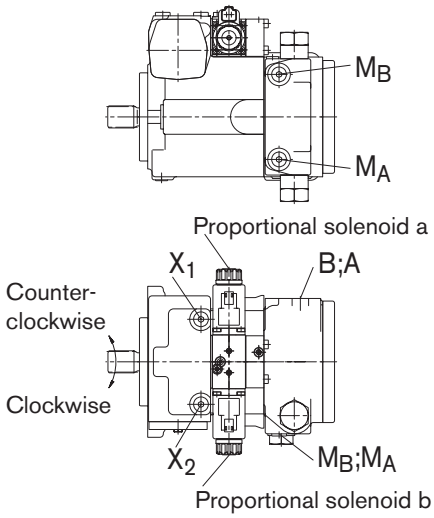
The spring return feature in the control unit is not a safety device

The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).

Assignment
Direction of rotation - Control - Direction of through put flow

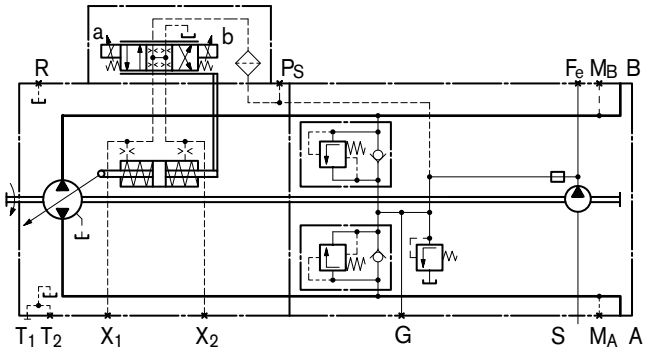
		Actuation of solenoid	Control pressure	Through put flow	Operating pressure
Direction of rotation	cw	a	X_1	A to B	M_B
		b	X_2	B to A	M_A
	ccw	a	X_1	B to A	M_A
		b	X_2	A to B	M_B



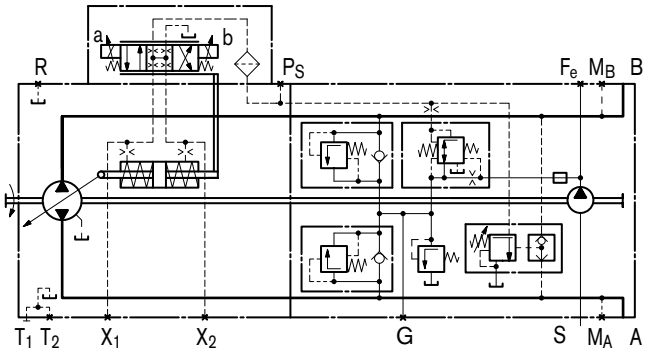
Standard: proportional solenoid without manual emergency operation.
On request: manual emergency operation with spring reset available.

EP - Electric Control, With Proportional Solenoid

Standard version



Version with DA control valve and pressure cut-off



EZ - Electric Two-Point Control, With Switching Solenoid

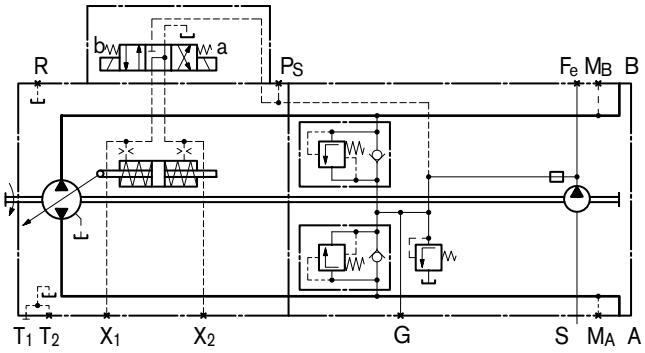
By energizing or de-energizing a control current to either switching solenoid a or b, the stroke cylinders of the pump are supplied with control pressure by the EZ control unit. In this way, the swashplate and thus the displacement is switchable without intermediate settings from $V_g = 0$ to $V_{g\,max}$. Each direction of through put flow is assigned to a switching solenoid.

Solenoid technical data	EZ1	EZ2
Voltage	12 V DC (±20 %)	24 V DC (±20 %)
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_{g\,max}$	current energized	current energized
Nominal resistance (at 68°F /20°C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Current required, minimum effective	1.32 A	0.67 A
Actuated time	100 %	100 %
Type of protection	see range of connectors on page 39	

Standard: switching solenoid without manual emergency operation.
On request: manual emergency operation with spring reset available.

Assignment direction of rotation - Control - Direction of through put flow DA control see page 14.

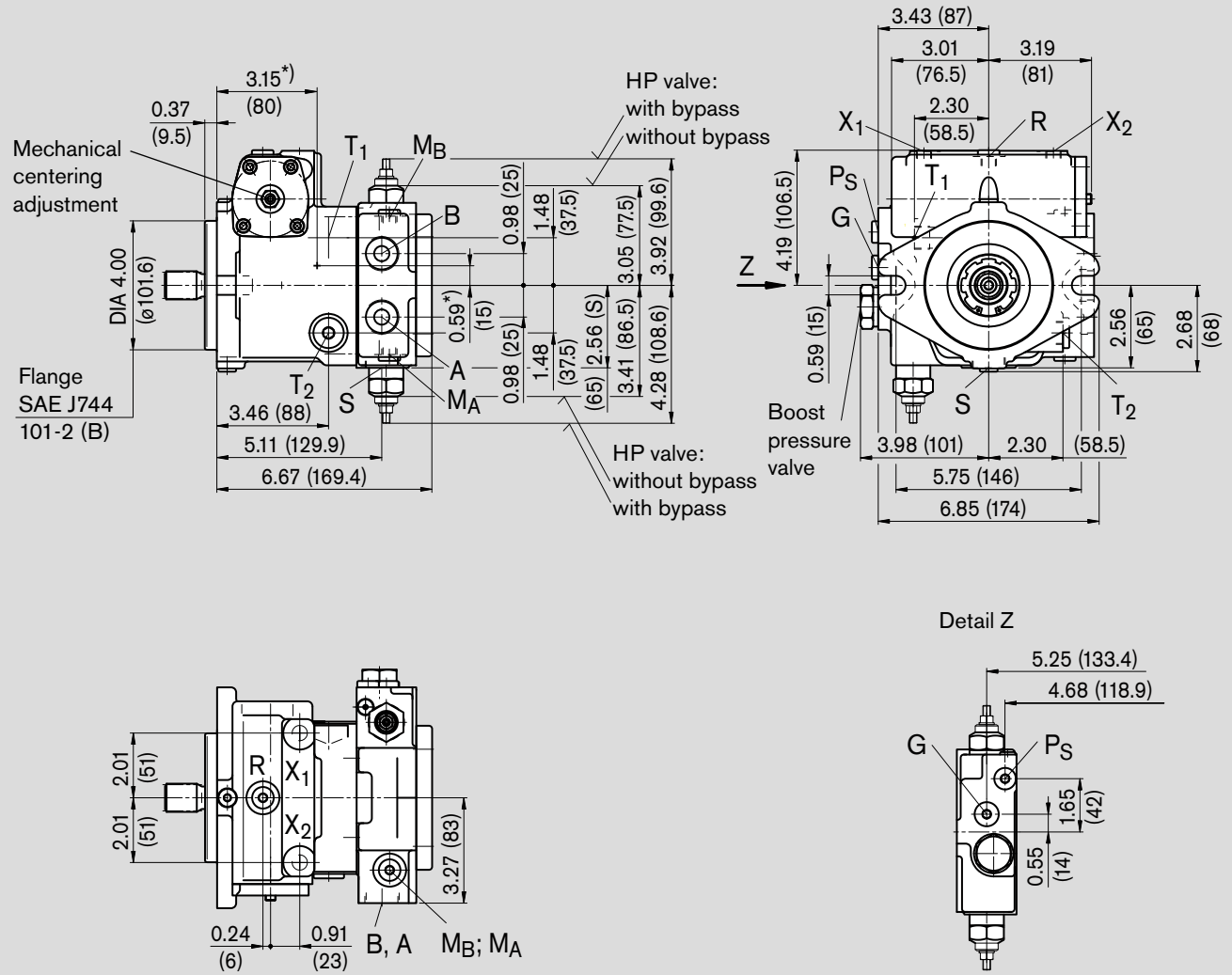
Standard version



Unit Dimensions, Size 18

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Hydraulic control, direct operated, DG



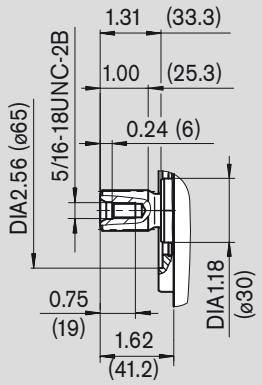
*) Center of gravity

Unit Dimensions, Size 18

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Shaft end

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



Ports

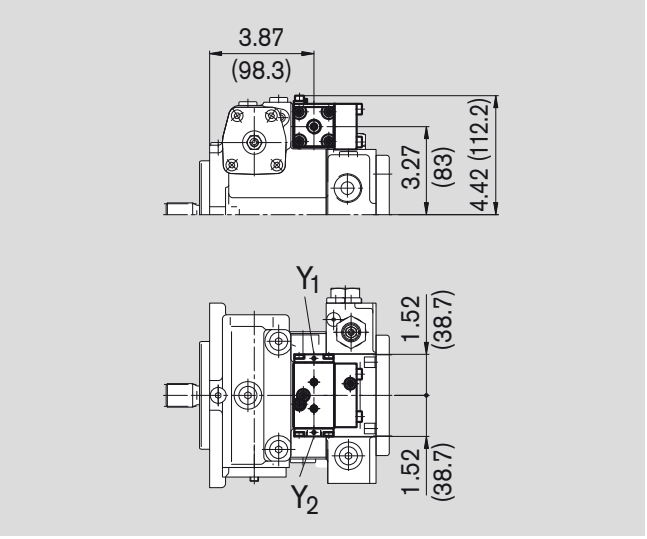
A, B	service line ports	ISO 11926	1 1/16 in -12 UN-2B; 0.79 (20) deep	265 lb-ft	(360 Nm) [2])
T_1	case drain or fill	ISO 11926	3/4 in -16 UNF-2B; 0.59 (15) deep	120 lb-ft	(160 Nm) [2])
T_2	case drain [3])	ISO 11926	3/4 in -16 UNF-2B; 0.59 (15) deep	120 lb-ft	(160 Nm) [2])
M_A, M_B	pressure gauge - operating pressure A, B [3])	ISO 11926	7/16 in -20 UNF-2B; 0.47 (12) deep	30 lb-ft	(40 Nm) [2])
R	air bleed [3])	ISO 11926	7/16 in -20 UNF-2B; 0.47 (12) deep	30 lb-ft	(40 Nm) [2])
S	boost suction port	ISO 11926	1 1/16 in -12 UN-2B; 0.79 (20) deep	265 lb-ft	(360 Nm) [2])
X_1, X_2	ports for control pressure (before orifice) [3])	ISO 11926	7/16 in -20 UNF-2B; 0.47 (12) deep	30 lb-ft	(40 Nm) [2])
G	pressure port for auxiliary circuit [3])	ISO 11926	9/16 in -18 UNF-2B; 0.51 (13) deep	60 lb-ft	(80 Nm) [2])
P_S	control pressure supply [3])	ISO 11926	9/16 in -18 UNF-2B; 0.51 (13) deep	60 lb-ft	(80 Nm) [2])
Y_1, Y_2	remote control ports (only HD)	ISO 11926	9/16 in -18 UNF-2B; 0.51 (13) deep	60 lb-ft	(80 Nm) [2])

[1]) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
[2]) Please observe the general notes for the max. tightening torques on page 44
[3]) Plugged

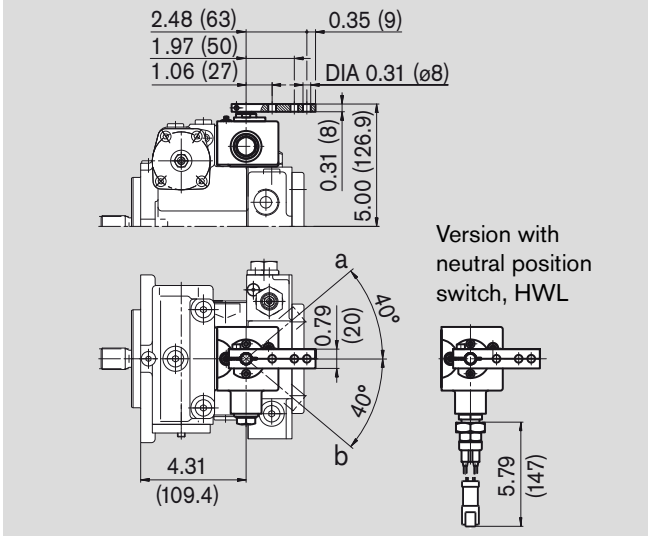
Unit Dimensions, Size 18

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

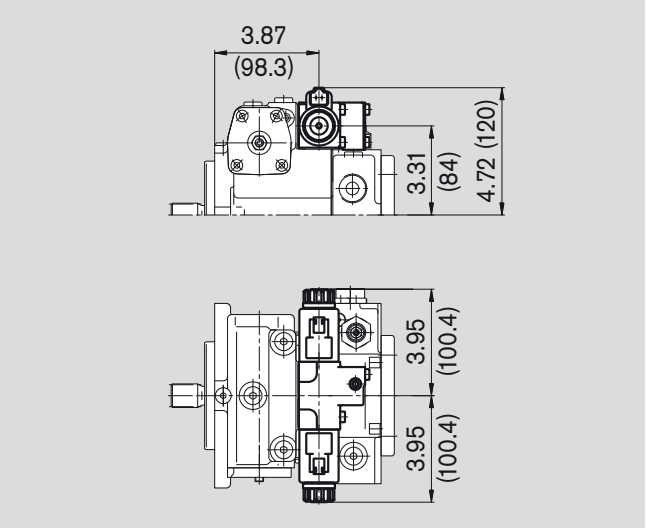
Hydraulic control, pilot-pressure related, HD



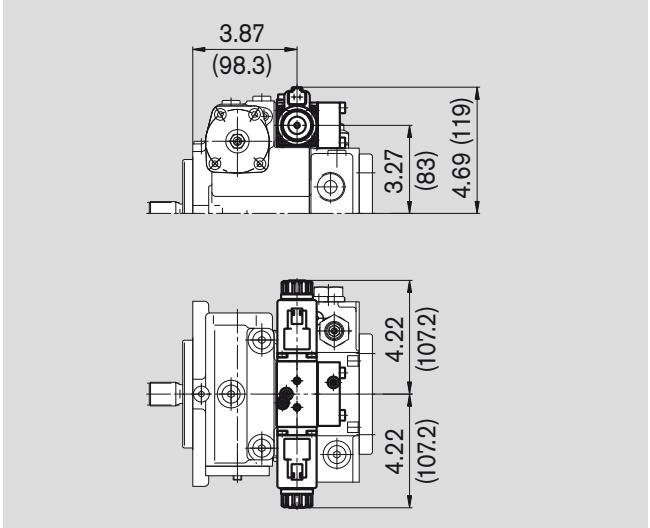
Hydraulic control, mechanical servo, HW



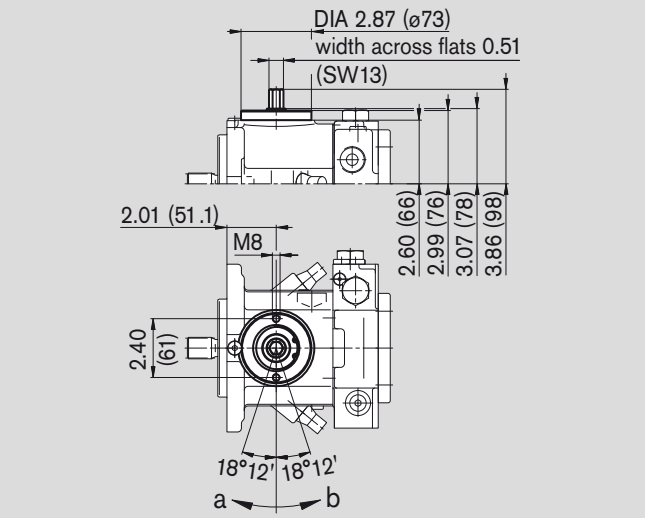
Electric two-point control with switching solenoid, EZ



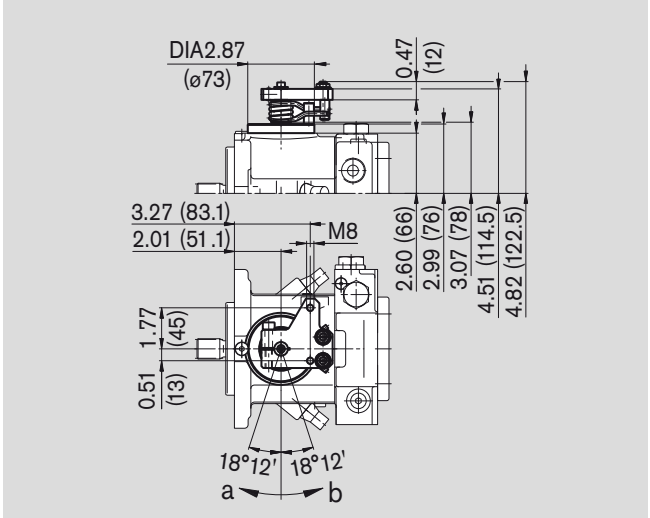
Electric control with proportional solenoid, EP



Mechanical pivot control, MD



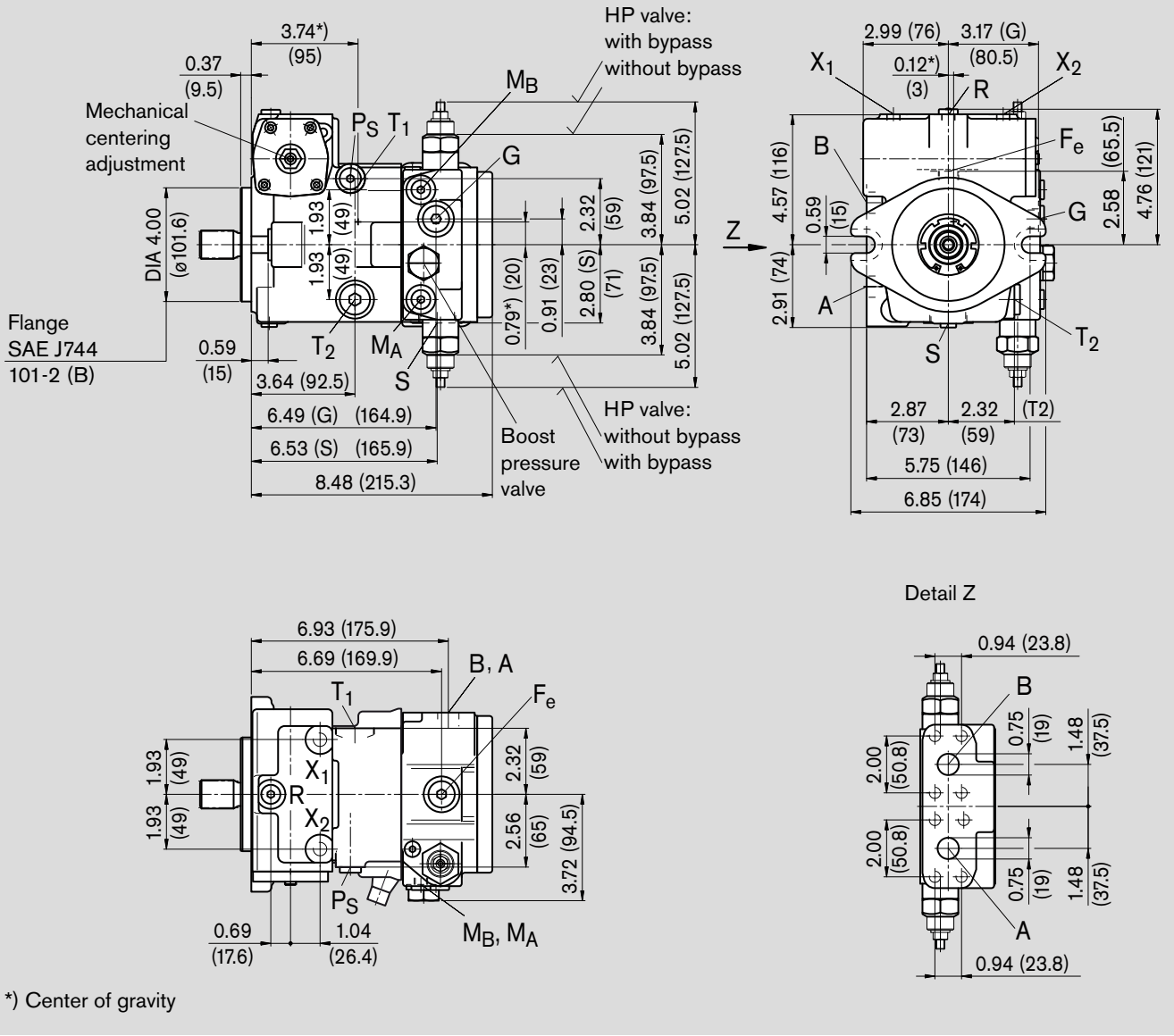
Mechanical pivot control, spring neutral position centering, MDN



Unit Dimensions, Size 28

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Hydraulic control, direct operated, DG

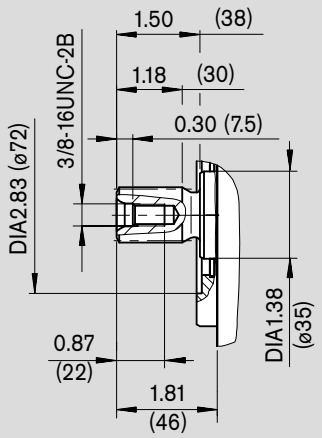


Unit Dimensions, Size 28

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Shaft end

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



Ports

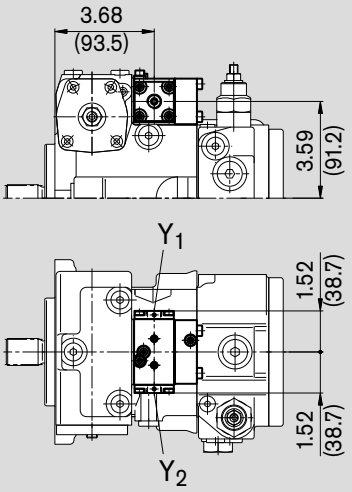
A, B	service line ports (high-pressure series)	SAE J518	3/4 in			
	fixing thread A/B	ISO 68	3/8 in -16 UNC-2B;	0.67 (17) deep [2])		
T_1	case drain or fill	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft	(240 Nm) [2])
T_2	case drain [3])	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft	(240 Nm) [2])
M_A, M_B	pressure gauge - operating pressure A, B [3])	ISO 11926	7/16 in -20 UNF-2B;	0.47 (12) deep	30 lb-ft	(40 Nm) [2])
R	air bleed [3])	ISO 11926	7/16 in -20 UNF-2B;	0.47 (12) deep	30 lb-ft	(40 Nm) [2])
S	boost suction port	ISO 11926	1 5/16 in -12 UN-2B;	0.79 (20) deep	400 lb-ft	(540 Nm) [2])
X_1, X_2	ports for control pressure (before orifice) [3])	ISO 11926	7/16 in -20 UNF-2B;	0.47 (12) deep	30 lb-ft	(40 Nm) [2])
G (F_a)	pressure port for auxiliary circuits [3]) (without control cartridge)	ISO 11926	3/4 in -16 UNF-2B;	0.59 (15) deep	120 lb-ft	(160 Nm) [2])
P_S	control pressure supply, boost pressure [3])	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft	(80 Nm) [2])
F_e	filter input [3])	ISO 11926	3/4 in -16 UNF-2B;	0.59 (15) deep	120 lb-ft	(160 Nm) [2])
Y_1, Y_2	remote control ports (only HD)	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft	(80 Nm) [2])
Z	pilot pressure port (only DA4/8) [3])	DIN 3852	M10x1;	0.31 (8) deep	22 lb-ft	(30 Nm) [2])
Y	pilot pressure port (only DA7)	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft	(80 Nm) [2])

[1]) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
[2]) Please observe the general notes for the max. tightening torques on page 44
[3]) Plugged

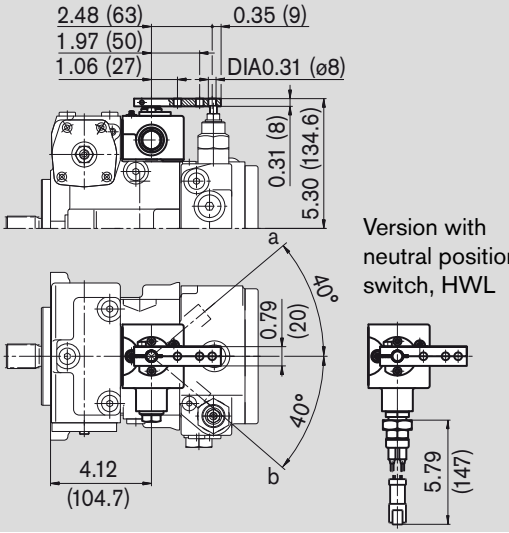
Unit Dimensions, Size 28

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

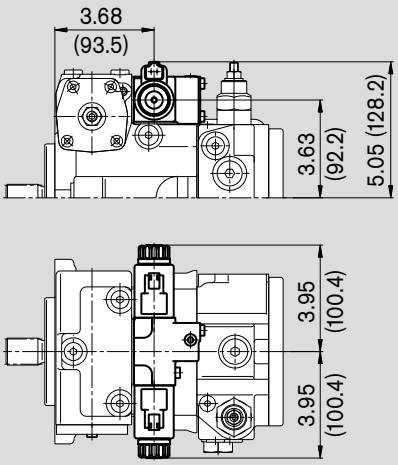
Hydraulic control, pilot-pressure related, HD



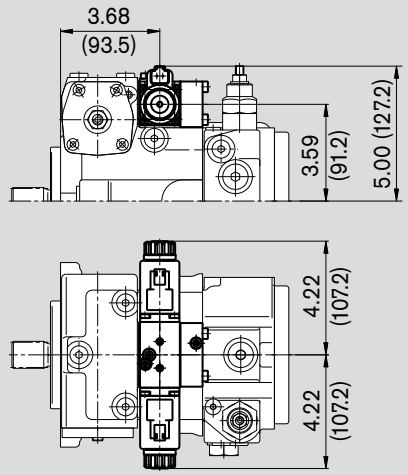
Hydraulic control, mechanical servo, HW



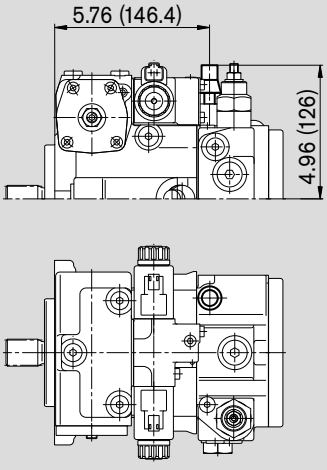
Electric two-point control with switching solenoid, EZ



Electric control with proportional solenoid, EP



Pressure cut-off, D

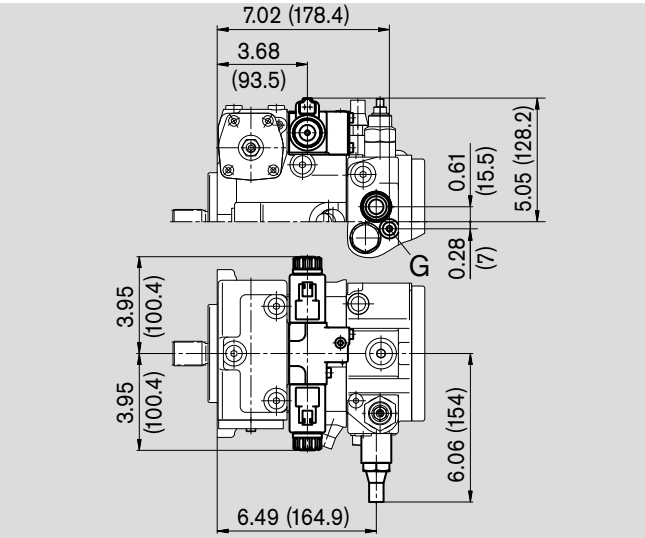


Unit Dimensions, Size 28

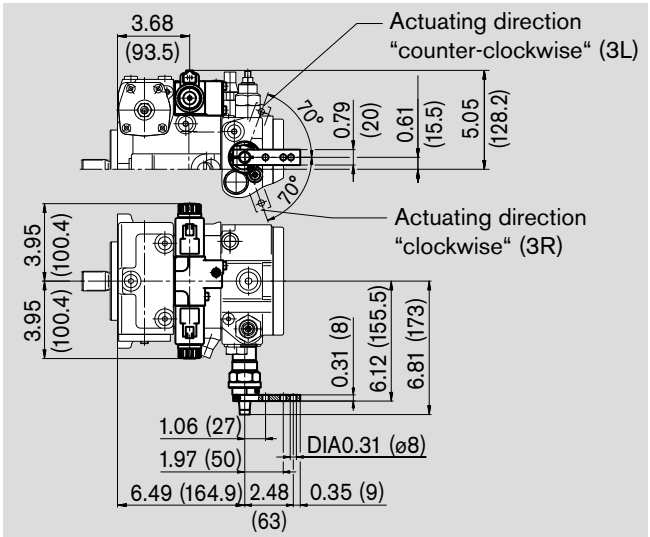
Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Hydraulic control, speed related, DA

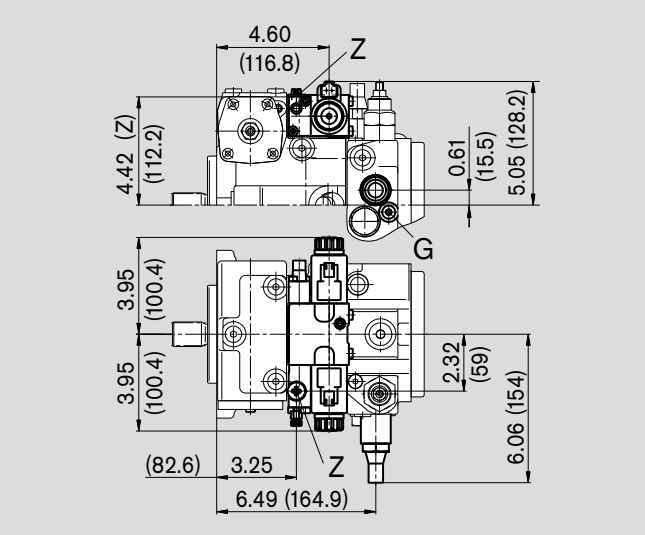
Control valve, fixed setting, DA2



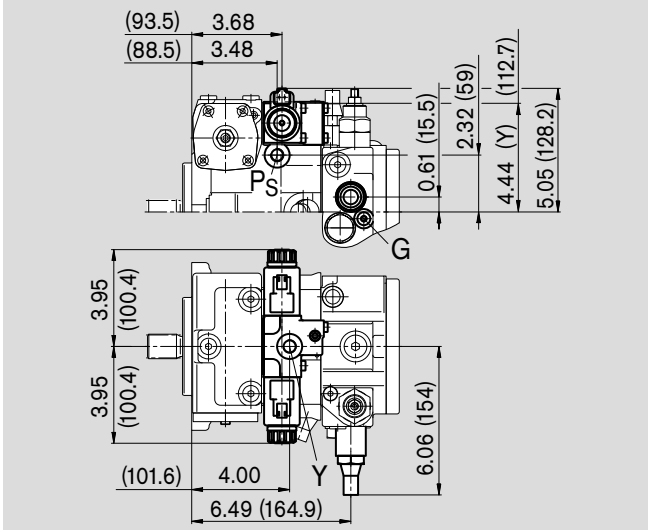
Control valve, mech. adjustable with position lever, DA3



Control valve, fixed setting and hydraulic inch valve mounted, DA4/DA8



Control valve, fixed setting and ports for pilot control device, DA7



Important:
Position and size of port G on version with DA control valve

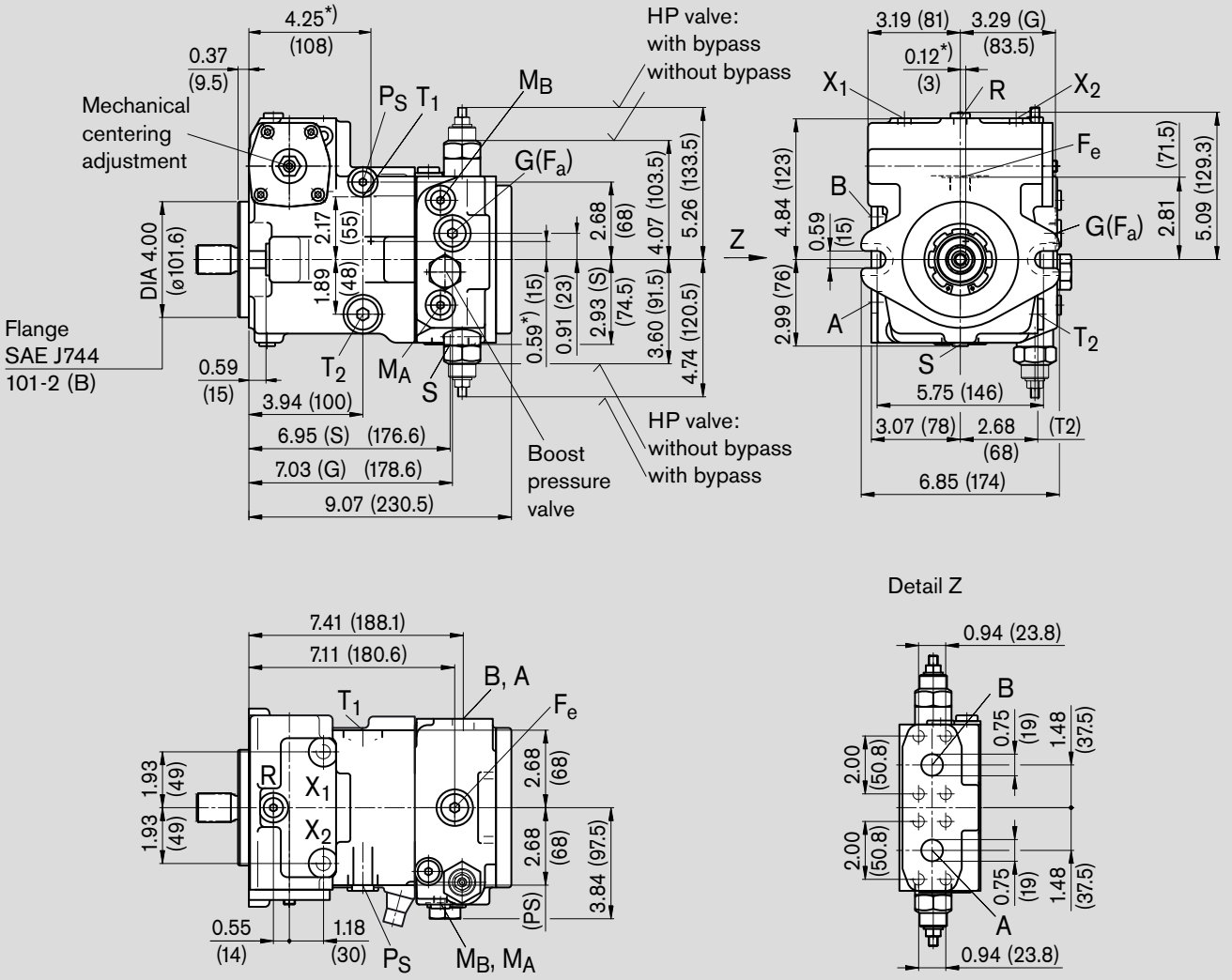
G	ISO 11926	3/8 in-24 UNF-2B; 0.39 (10) deep	15 lb-ft (20 Nm) [1]

[1]) Please observe the general notes for the max. tightening torques on page 44

Unit Dimensions, Size 45

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Hydraulic control, direct operated, DG



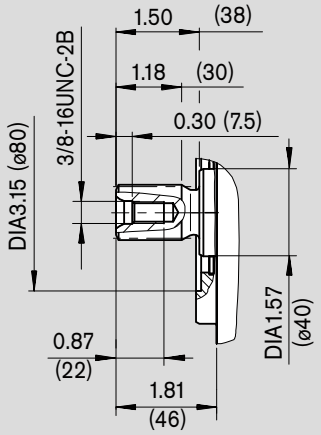
*) Center of gravity

Unit Dimensions, Size 45

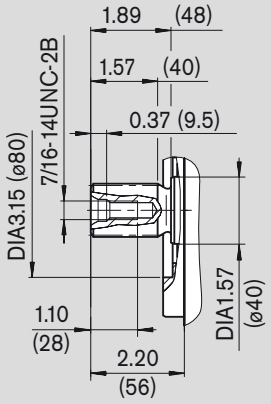
Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Shaft ends

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



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



Ports

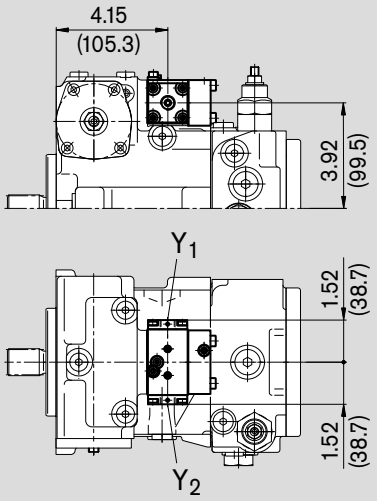
A, B	service line ports (high-pressure series)	SAE J518	3/4 in			
	fixing thread A/B	ISO 68	3/8 in -16 UNC-2B;	0.67 (17) deep [2])		
T_1	case drain or fill	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft	(240 Nm) [2])
T_2	case drain [3])	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft	(240 Nm) [2]))
M_A, M_B	pressure gauge - operating pressure A, B [3])	ISO 11926	7/16 in -20 UNF-2B;	0.47 (12) deep	30 lb-ft	(40 Nm) [2])
R	air bleed [3])	ISO 11926	7/16 in -20 UNF-2B;	0.47 (12) deep	30 lb-ft	(40 Nm) [2])
S	boost suction port	ISO 11926	1 5/16 in -12 UN-2B;	0.79 (20) deep	400 lb-ft	(540 Nm) [2]))
X_1, X_2	ports for control pressure (before orifice) [3])	ISO 11926	7/16 in -20 UNF-2B;	0.47 (12) deep	30 lb-ft	(40 Nm) [2])
G (F_a)	pressure port for auxiliary circuits [3])	ISO 11926	3/4 in -16 UNF-2B;	0.59 (15) deep	120 lb-ft	(160 Nm) [2])
P_S	control pressure supply, boost pressure [3])	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft	(80 Nm) [2])
F_e	filter input [3])	ISO 11926	3/4 in -16 UNF-2B;	0.59 (15) deep	120 lb-ft	(160 Nm) [2])
Y_1, Y_2	remote control ports (only HD)	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft	(80 Nm) [2])
Z	pilot pressure port (only DA4/8) [3])	DIN 3852	M10x1;	0.31 (8) deep	22 lb-ft	(30 Nm) [2])
Y	pilot pressure port (only DA7)	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft	(80 Nm) [2])

[1]) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
[2]) Please observe the general notes for the max. tightening torques on page 44
[3]) Plugged

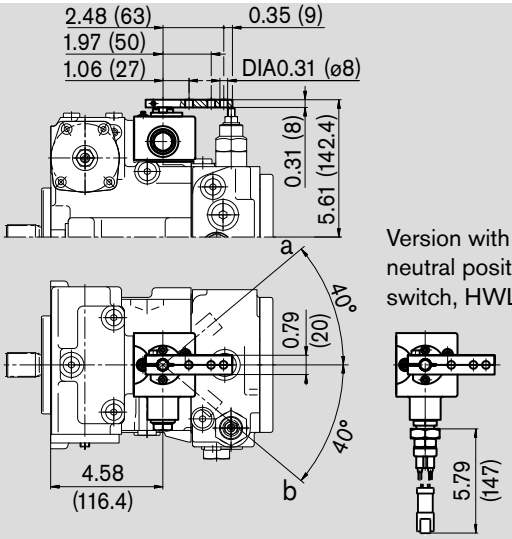
Unit Dimensions, Size 45

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

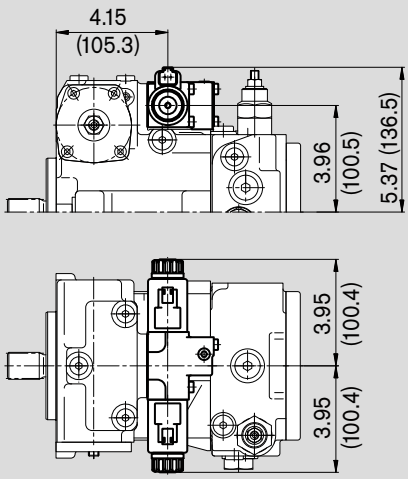
Hydraulic control, pilot-pressure related, HD



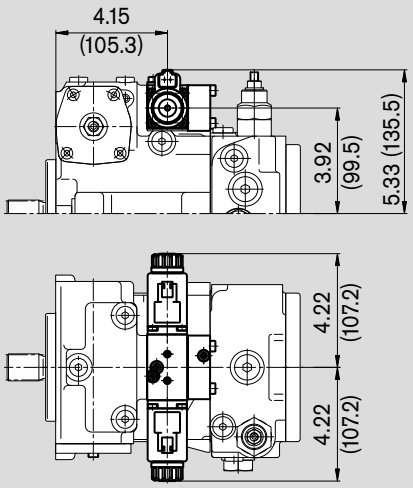
Hydraulic control, mechanical servo, HW



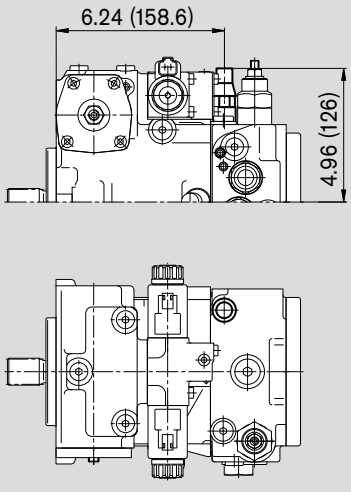
Electric two-point control with switching solenoid, EZ



Electric control with proportional solenoid, EP



Pressure cut-off, D

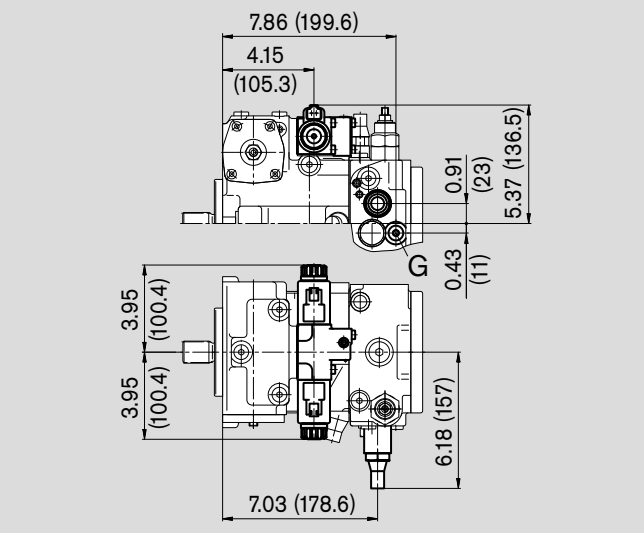


Unit Dimensions, Size 45

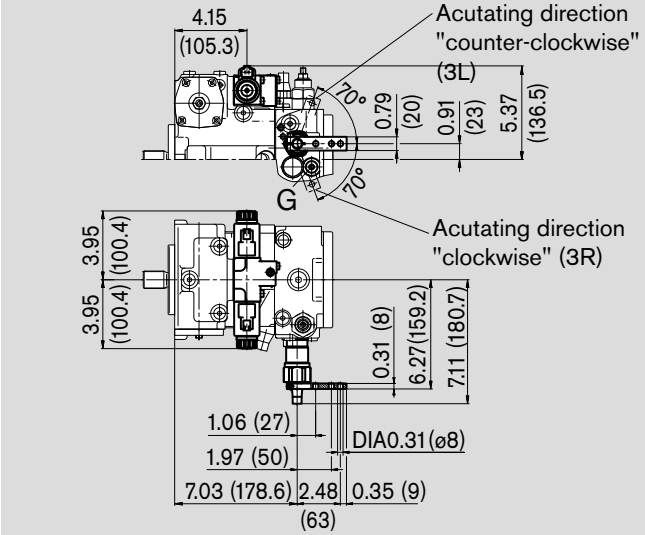
Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Hydraulic control, speed related, DA

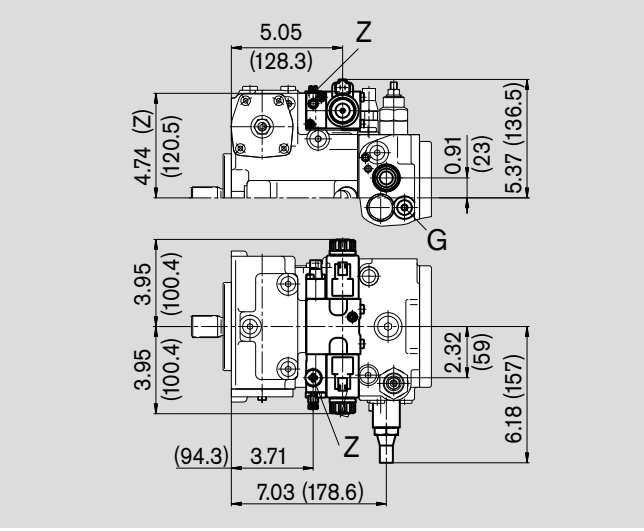
Control valve, fixed setting, DA2



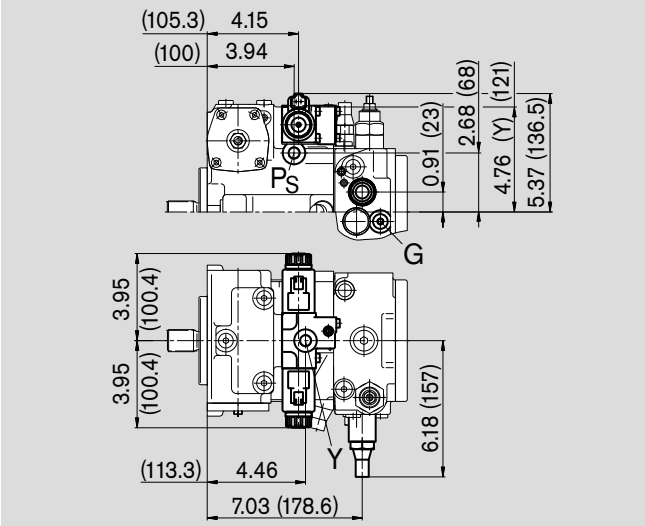
Control valve, mech. adjustable with position lever, DA3



Control valve, fixed setting and hydraulic inch valve mounted, DA4/DA8



Control valve, fixed setting and ports for pilot control device DA7



Important:
Position and size of port G on version with DA control valve

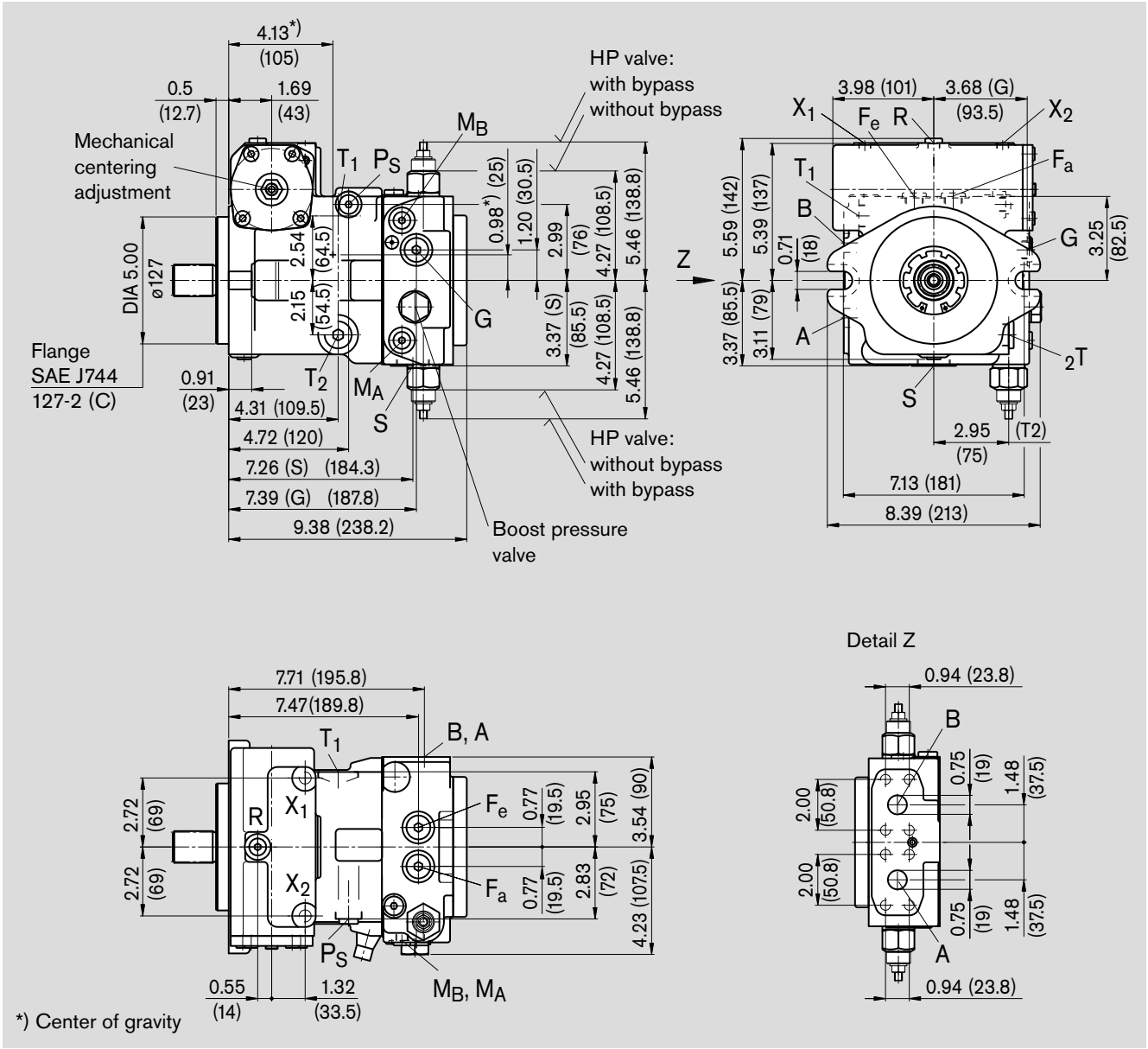
G	ISO 11926	7/16 in-20 UNF-2B; 0.47 (12) deep	30 lb-ft (40 Nm) [1]

[1]) Please observe the general notes for the max. tightening torques on page 44

Unit Dimensions, Size 63

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Hydraulic control, direct operated, DG



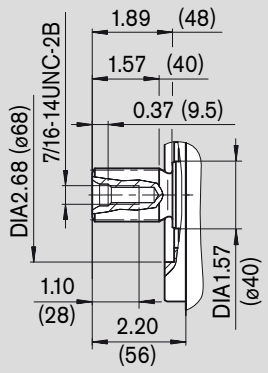
*) Center of gravity

Unit Dimensions, Size 63

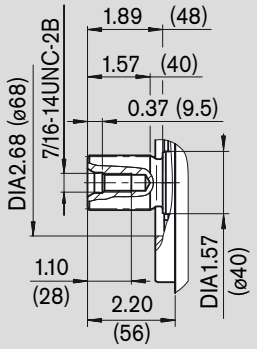
Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Shaft ends

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



T Splined shaft 1 3/8in
21T 16/32DP [1])



Ports

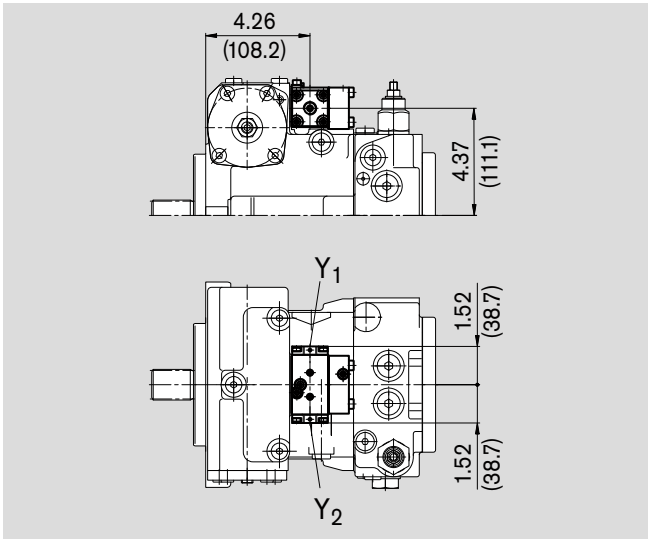
A, B	service line ports (high-pressure series)	SAE J518	3/4 in			
	fixing thread A/B	ISO 68	3/8 in -16 UNC-2B;	0.67 (17) deep [2])		
T_1	case drain or fill	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft	(240 Nm) [2])
T_2	case drain [3])	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft	(240 Nm) [2]))
M_A, M_B	pressure gauge - operating pressure A, B [3])	ISO 11926	7/16 in -20 UNF-2B;	0.47 (12) deep	30 lb-ft	(40 Nm) [2])
R	air bleed [3])	ISO 11926	7/16 in -20 UNF-2B;	0.47 (12) deep	30 lb-ft	(40 Nm) [2])
S	boost suction port	ISO 11926	1 5/16 in -12 UN-2B;	0.79 (20) deep	400 lb-ft	(540 Nm) [2]))
X_1, X_2	ports for control pressure (before orifice) [3])	ISO 11926	7/16 in -20 UNF-2B;	0.47 (12) deep	30 lb-ft	(40 Nm) [2])
G (F_a)	pressure port for auxiliary circuits [3])	ISO 11926	3/4 in -16 UNF-2B;	0.59 (15) deep	120 lb-ft	(160 Nm) [2])
P_S	control pressure supply, boost pressure [3])	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft	(80 Nm) [2])
F_a	filter output [3])	ISO 11926	3/4 in -16 UNF-2B;	0.59 (15) deep	120 lb-ft	(160 Nm) [2])
F_e	filter input [3])	ISO 11926	3/4 in -16 UNF-2B;	0.59 (15) deep	120 lb-ft	(160 Nm) [2])
M_H	port for balanced high pressure [3]) (only with pressure cut-off)	ISO 11926	7/16 in -20 UNF-2B;	0.47 (12) deep	30 lb-ft	(40 Nm) [2])
Y_1, Y_2	remote control ports (only HD)	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft	(80 Nm) [2])
Z	pilot pressure port (only DA4/8) [3])	DIN 3852	M10x1;	0.31 (8) deep	22 lb-ft	(30 Nm) [2])
Y	pilot pressure port (only DA7)	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft	(80 Nm) [2])

[1]) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
[2]) Please observe the general notes for the max. tightening torques on page 44
[3]) Plugged

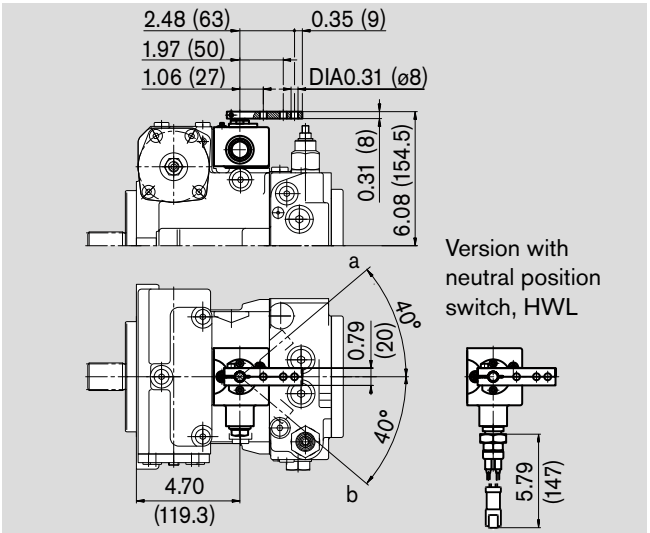
Unit Dimensions, Size 63

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

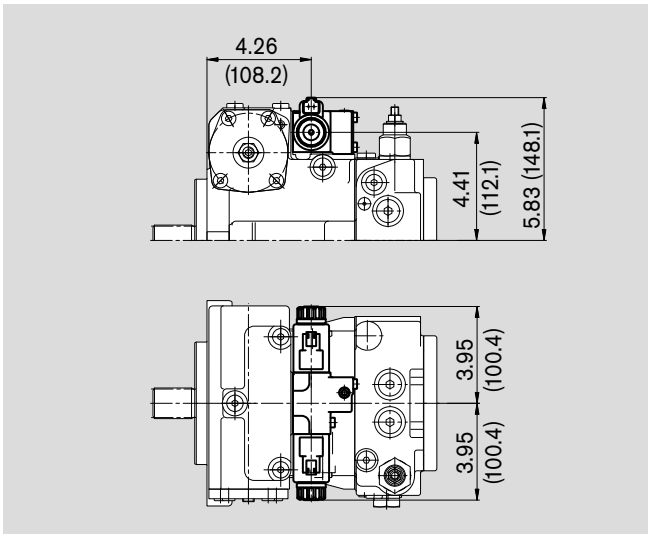
Hydraulic control, pilot-pressure related, HD



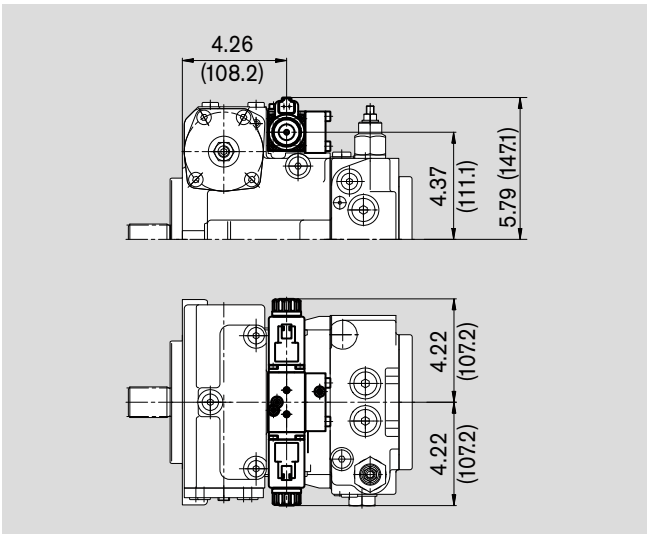
Hydraulic control, mechanical servo, HW



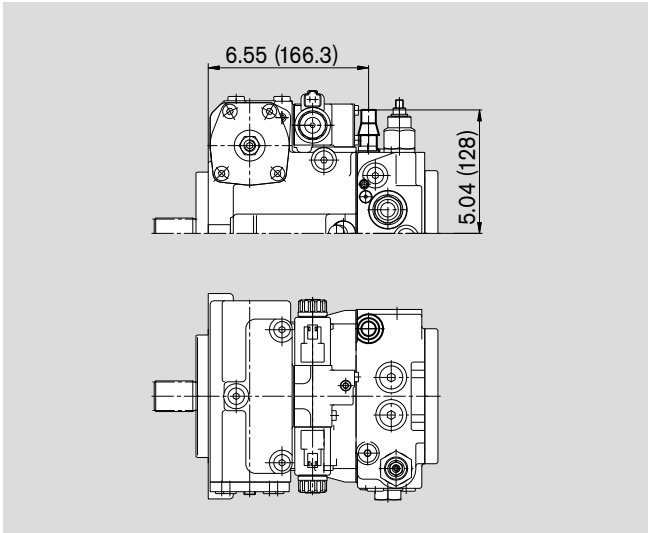
Electric two-point control with switching solenoid, EZ



Electric control with proportional solenoid, EP



Pressure cut-off, D

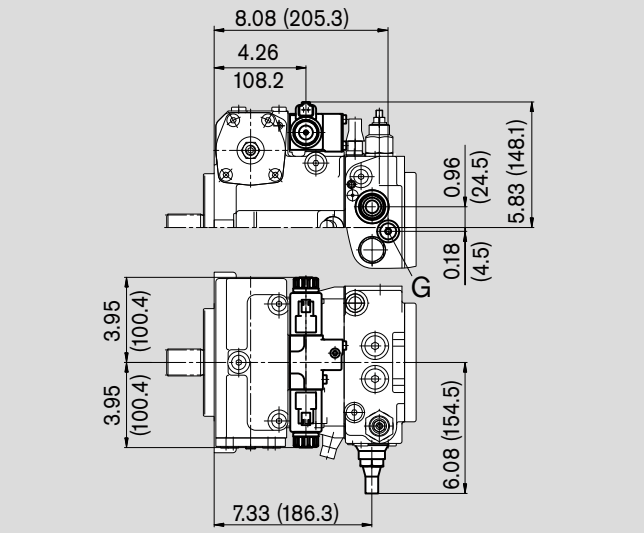


Unit Dimensions, Size 63

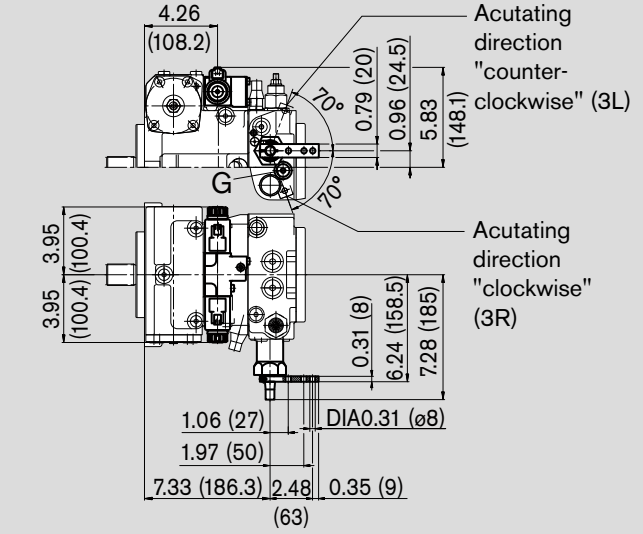
Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Hydraulic control, speed related, DA

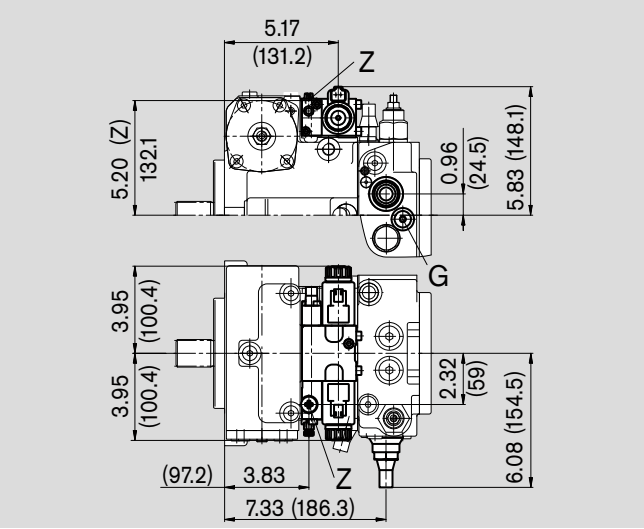
Control valve, fixed setting, DA2



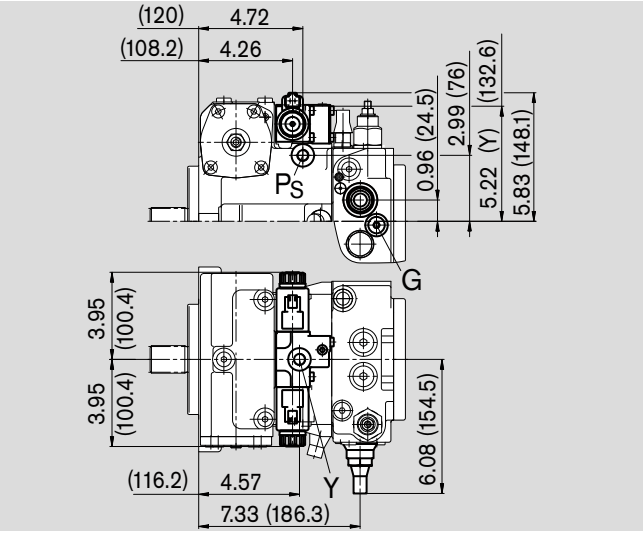
Control valve, mech. adjustable with position lever, DA3



Control valve, fixed setting and hydraulic inch valve mounted, DA4/DA8



Control valve, fixed setting and ports for pilot control device, DA7



Important:
Position and size of port G on version with DA control valve

G	ISO 11926	9/16 in-18 UNF-2B; 0.51 (13) deep	60 lb-ft (80 Nm) [1]

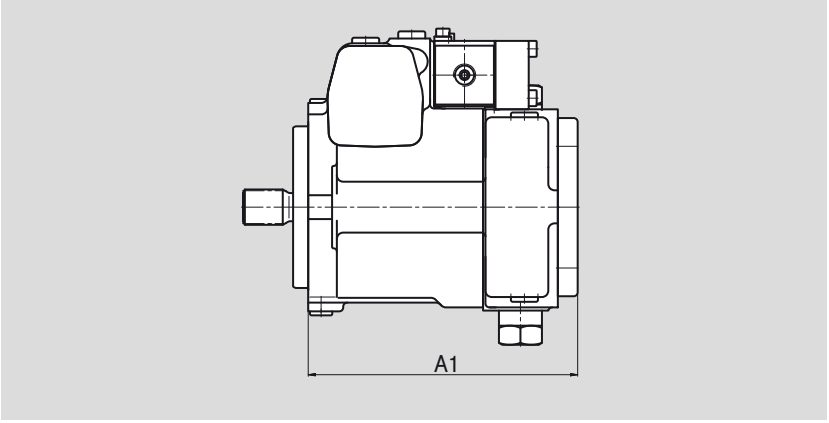
[1]) Please observe the general notes for the max. tightening torques on 44

Through Drive Dimensions

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

N00 **Without boost pump, without through drive**

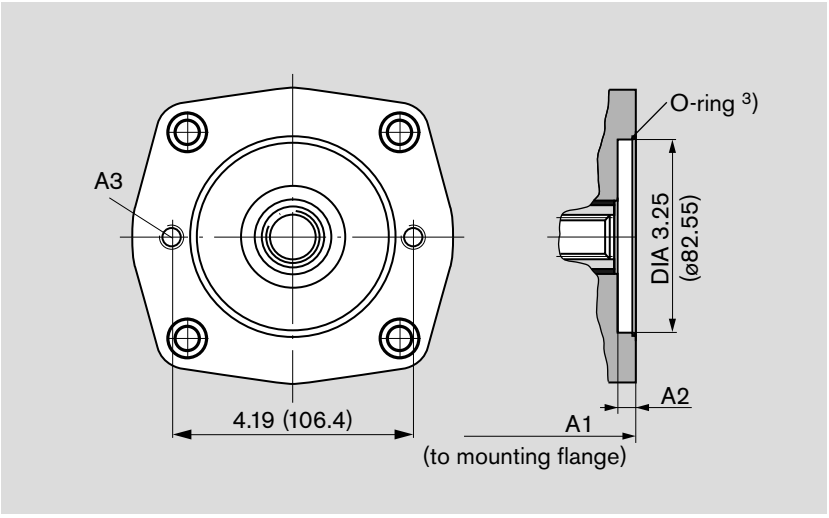
F00 **With boost pump, without through drive**



Size	A1 (N00)	A1 (F00)
18	6.67	6.67
	(169.4)	(169.4)
28	7.94	8.48
	(201.7)	(215.3)
45	8.54	9.07
	(216.8)	(230.5)
63	8.84	9.38
	(224.5)	(238.2)

F01/K01 **Flange** SAE J744 – 82-2 (A)

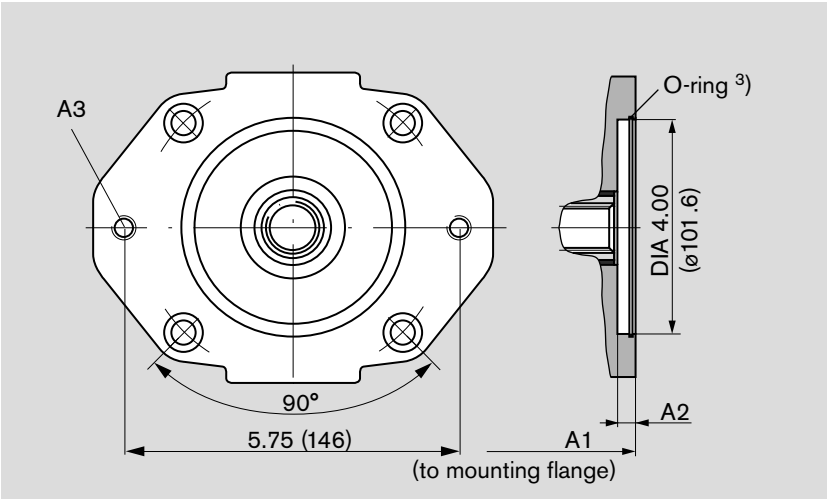
Hub for splined shaft according to ANSI B92.1a-1976 5/8 in 9T 16/32DP [1] (SAE J744 – 16-4 (A))



Size	A1	A2	A3 [2]
18	7.02	0.35	3/8 in -16 UNC-2B
	(178.4)	(9)	0.67 (17) deep
28	8.63	0.35	3/8 in -16 UNC-2B
	(219.2)	(9)	0.67 (17) deep
45	9.23	0.35	3/8 in -16 UNC-2B
	(234.5)	(9)	0.67 (17) deep
63	9.54	0.35	3/8 in -16 UNC-2B
	(242.2)	(9)	0.67 (17) deep

F02/K02 **Flange** SAE J744 – 101-2 (B)

Hub for splined shaft according to ANSI B92.1a-1976 7/8 in 13T 16/32DP [1] (SAE J744 – 22-4 (B))



Size	A1	A2	A3 [2]
18	7.38	0.39	1/2 in -13 UNC-2B
	(187.4)	(10)	0.71 (18) deep
28	8.67	0.39	1/2 in -13 UNC-2B
	(220.2)	(10)	0.71 (18) deep
45	9.27	0.39	1/2 in -13 UNC-2B
	(235.5)	(10)	0.71 (18) deep
63	9.57	0.39	1/2 in -13 UNC-2B
	(243.2)	(10)	0.71 (18) deep

[1] 30° pressure angle, flat root; side fit, tolerance class 5

[2] Thread acc. to ISO 68, please observe the general notes for the max. tightening torques on page 44

[3] O-ring included in supply

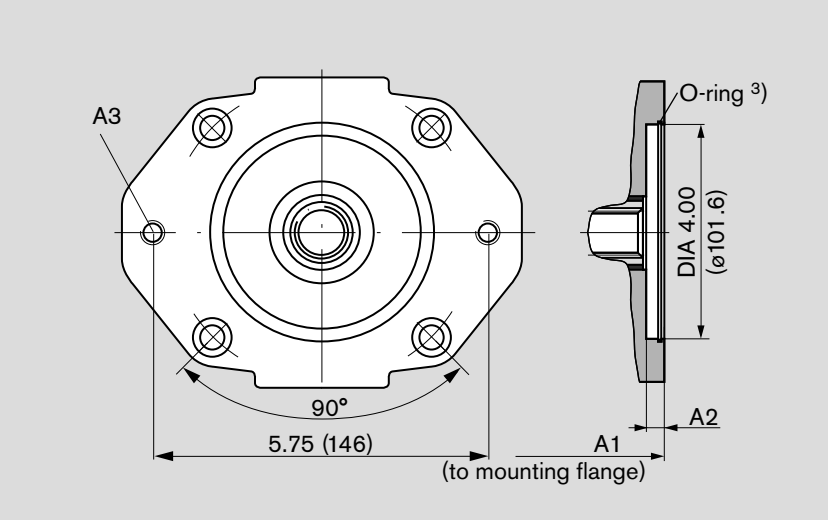
Note: the mounting flange can be turned through 90°. Standard position is shown. Please state in plain text if required.

Through Drive Dimensions

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

F04/K04 **Flange** SAE J744 – 101-2 (B)

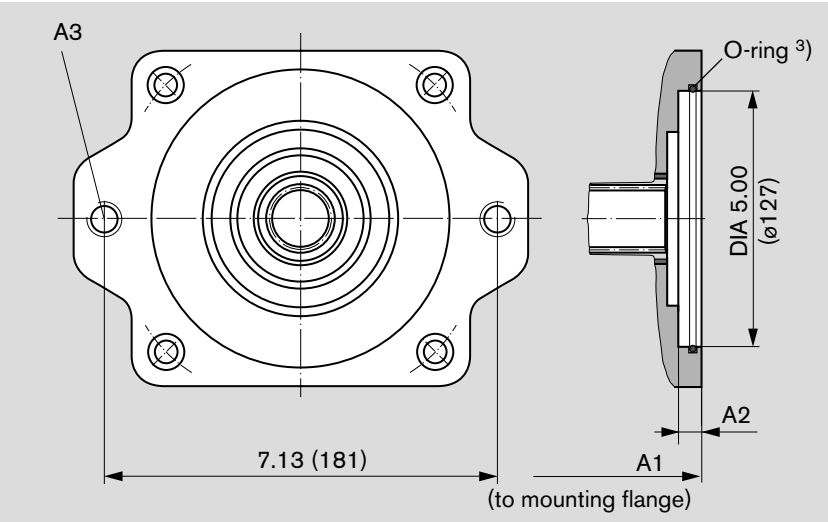
Hub for splined shaft according to ANSI B92.1a-1976 1 in 15T 16/32DP [1] (SAE J744 – 25-4 (B-B))



Size	A1	A2	A3 [2]
28	8.67	0.39	1/2 in -13 UNC-2B
	(220.2)	(10)	0.71 (18) deep
45	9.27	0.39	1/2 in -13 UNC-2B
	(235.5)	(10)	0.71 (18) deep
63	9.57	0.39	1/2 in -13 UNC-2B
	(243.2)	(10)	0.71 (18) deep

F07/K07 **Flange** SAE J744 – 127-2 (C)

Hub for splined shaft according to ANSI B92.1a-1976 1 1/4in 14T 12/24DP [1] (SAE J744 – 32-4 (C))



Size	A1	A2	A3 [2]
63	9.82	0.55	5/8 in -11 UNC-2B
	(249.5)	(14)	0.94 (24) deep

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

[2] Thread acc. to ISO 68, please observe the general notes for the max. tightening torques on page 44

[3] O-ring included in supply

Note: the mounting flange can be turned through 90°. Standard position is shown. Please state in plain text if required.

Overview of Attachments on AA10VG

Through drive – AA10VG			Attachment for 2nd pump							Through drive
Flange	Hub for splined shaft	Code	AA10VG Size (shaft)	AA4VG Size (shaft)	AA10V(S)O/31 Size (shaft)	A10V(S)O/53 Size (shaft)	A4FO Size (shaft)	AA11VO Size (shaft)	External gear pump	Available for size
82-2 (A)	5/8 in	**F/K01**	–	–	18 (U)	10 (U)	–	–	Model F Size 4-22 [1]	18...63
101-2 (B)	7/8 in	**F/K02**	18 (S)	–	28 (S,R) 45 (U)	28 (S,R) 45 (U,W)	16 (S) 22 (S) 28 (S)	–	Model N Size 20-32 [1] Model G Size 38-45 [1]	18...63
	1in	**F/K04**	28 (S) 45 (S)	28 (S)	45 (S,R)	45 (S,R) 60 (U,W)	–	40 (S)	–	28...63
127-2 (C)	1 1/4 in	**F/K07**	63 (S)	40 (S), 56 (S) 71 (S)	71 (S,R) 100 (U)	85 (U)	–	60 (S)	–	63

[1]) Rexroth recommends special gear pump versions. Please contact us.

Combination Pumps AA10VG + AA10VG

Overall length A

AA10VG (1st pump)		AA10VG (2nd pump) [1]			
		Size 18	**Size 28**	**Size 45**	**Size 63**
Size 18	in	14.05	–	–	
	mm	(356.8)	–	–	–
Size 28	in	15.34	17.15	–	
	mm	(389.6)	(435.5)	–	–
Size 45	in	15.94	17.75	18.35	
	mm	(404.9)	(450.8)	(466.0)	–
Size 63	in	16.24	18.05	18.65	19.20
	mm	(412.6)	(458.5)	(473.7)	(487.7)

[1]) 2nd pump without through drive and with boost pump, F00

Combination pumps make it possible to have independent circuits without the need to fit splitter gearboxes.

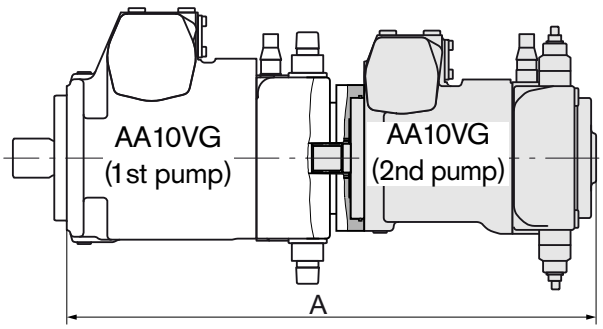
When ordering combination pumps, the type designations of the 1st and 2nd pumps must be linked by a "**+**".

Example of order:

AA10VG45HW1/10R-N**T**C60**F04**5S + AA10VG45HW1/10R-N**S**C60F005S

A tandem pump combined of two equal sizes is permissible without additional supports where the dynamic acceleration does not exceed max. 0.022 lbs (= 322 ft/s$^{2)}$ {10 *g* (= 98.1 m/s$^{2)}$}.

For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible mass torque.



Mechanical Stroke Limiter, M

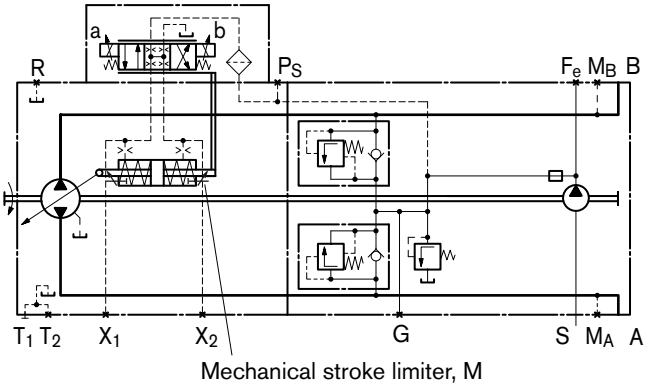
The mechanical stroke limiter is an additional function allowing continuous reduction of the maximum displacement of the pump, regardless of the control unit used.

The stroke of the stroke cylinder and hence the maximum swivel angle of the pump are limited by means of two adjusting screws.

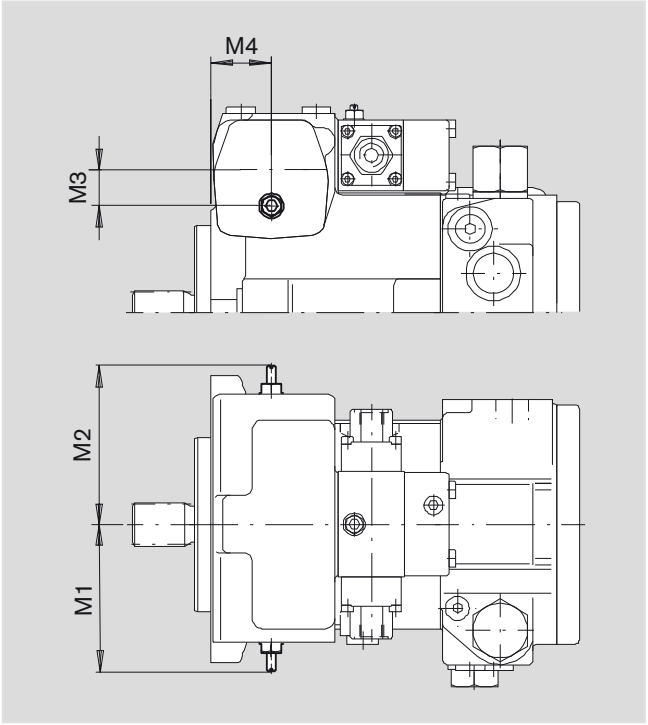
Dimensions

Size	M1	M2	M3	M4
18	3.74	3.81	0.71	1.66
	(94.9)	(96.9)	(18)	(42.1)
28	3.90	3.90	0.85	1.38
	(99)	(99)	(21.5)	(35)
45	4.00	4.00	0.89	1.40
	(101.6)	(101.6)	(22.5)	(35.5)
63	4.88	4.88	1.04	1.69
	(124)	(124)	(26.5)	(43)

Circuit diagram



Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).



Filtration Types

Standard: Filtration in the suction line of the boost pump, S

Standard version (preferred)

Filter type: _____ filter **without** bypass
Recommendation: _____ **with** contamination indicator

Flow resistance at the filter element:

at ν = 140 SUS, $n = n_{max}$ _____ $\Delta p \leq 1.5$ psi
(30 mm²/s, $n = n_{max}$ _____ $\Delta p \leq 0.1$ bar)

at ν = 4600 SUS, $n = n_{max}$ _____ $\Delta p \leq 4.5$ psi
(1000 mm²/s, $n = n_{max}$ _____ $\Delta p \leq 0.3$ bar)

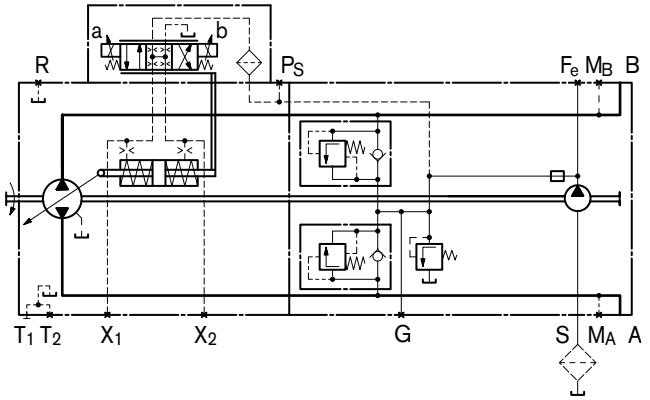
Pressure at port S of the boost pump:

at ν = 140 SUS, $n = n_{max}$ _____ $\Delta p \geq 12$ psi
(30 mm²/s, $n = n_{max}$ _____ $\Delta p \geq 0.8$ bar)

at cold start ν = 7400 SUS, $n \leq 1000$ rpm) ____ $p \geq 7.5$ psi
(ν = 1600 mm2/s, $n \leq 1000$ rpm) __ $p \geq 0.5$ bar

Filter is not included in supply.

Circuit diagram - standard version S



Variation: External supply, E

This variation should be used in versions **without** integral boost pump (N00 or K..). The supply is provided as follows:

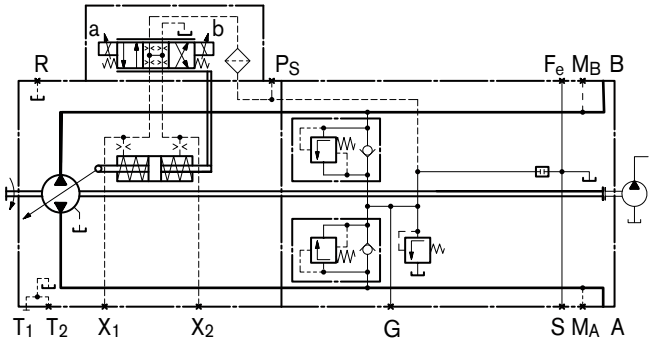
Size 18 _____ port S
Size 28, 45 (without DA control valve) _____ port G
Size 28, 45 (with DA control valve) _____ port F_e
Size 63 _____ port F_a

With size 28, 45 and 63, port S is closed.

Filter arrangement: _____ separate

For functional reliability ensure required cleanliness level for the boost pressure fluid (see page 6).

Circuit diagram variation E (external supply)



Variation:
Filtration in the pressure line of the boost pump, ports for external boost circuit filter, D

Filter input:		Port F_e
Filter output:	Size 63	Port F_a
	Size 28, 45	Port G (F_a)
Filter type:	Filter with bypass are **not recommended**. When applying with bypass please consult us.	

Recommendation: **with** contamination indicator

Note:
- In conjunction with a DA control valve, no pressure filtration is possible with size 28, 45 (refer to ordering code, page 4).
- With sizes 28, 45, port G serves as "filter output F_a".

Note:
For versions with **DG** control (with pilot pressure not from boost circuit), the following filter type should be employed:

Filter **with** bypass and **with** contamination indicator

Filter arrangement: separately in the pressure line (line filter)

Flow resistance at the filter element:

at ν = 140 SUS (30 mm²/s) _____ $\Delta p \leq 15$ psi (1 bar)

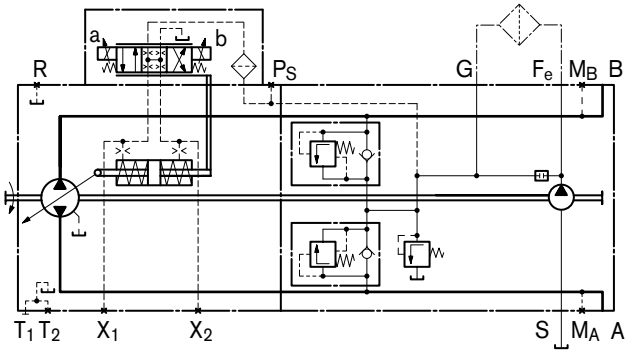
for cold start _____ $\Delta p \leq 45$ psi (3 bar)

(valid for entire speed range $n_{min} - n_{max}$)

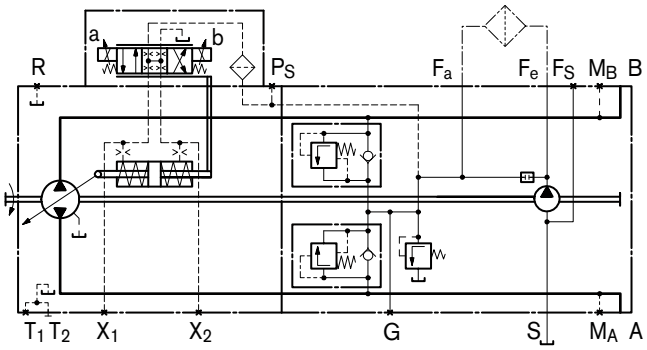
Filter is not included in supply.

Circuit diagram variation D

Size 28, 45



Size 63



Connector for Solenoids (only for EP, EZ, DA)

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

DEUTSCH DT04-2P-EP04, 2-pin

Molded, without bi-directional suppressor diode (standard) **_P**

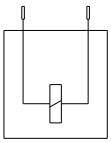
Molded, with bi-directional suppressor diode
(only for switching solenoids on control unit EZ1/2, DA) **___Q**

Type of protection according to DIN/EN 60529: IP67 and IP69K

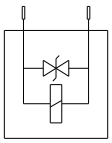
The protection circuit with a bi-directional suppressor diode is necessary for limiting overvoltages. Overvoltages are generated by disconnecting the current using switches, relay contacts or by unplugging an energized mating connector.

Circuit symbol

without bi-directional suppressor diode



with bi-directional suppressor diode

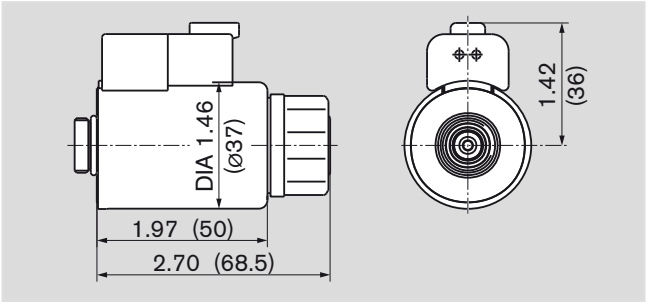


Mating connector

DEUTSCH DT06-2S-EP04
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 supply.
This can be supplied by Rexroth on request.



Note for round solenoids:

The position of the connector can be changed by turning the solenoid body.

Proceed as follows:

1. Loosen the fixing nut (1)
2. Turn the solenoid body (2) to the desired position
3. Tighten the fixing nut
   Tightening torque of the fixing nut: $3.69^{+0.74}$ lb-ft (5^{+1} Nm)
   (width across flats WAF26, 12-sided DIN 3124)

Rotary Inch Valve

The rotary inch valve permits the control pressure to be reduced independent from the drive speed through the mechanical operation of the actuating lever. Maximum rotation angle 90°. The lever may be fixed in any position.

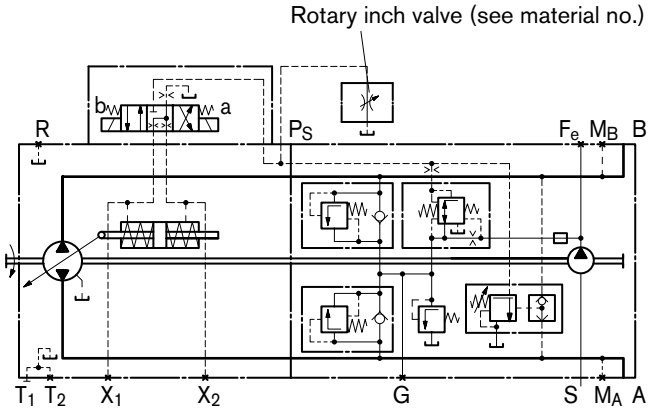
The valve is mounted separately from the pump and connected with a pump by the hydraulic control line at port P_S (max. line length approximately 6.5 ft / 2 meters).

The rotary inch valve must be ordered separately.

Size	Material no.	Direction of actuation of position lever
18, 28, 45, 63	R902048738 R902048739	clockwise counter-clockwise

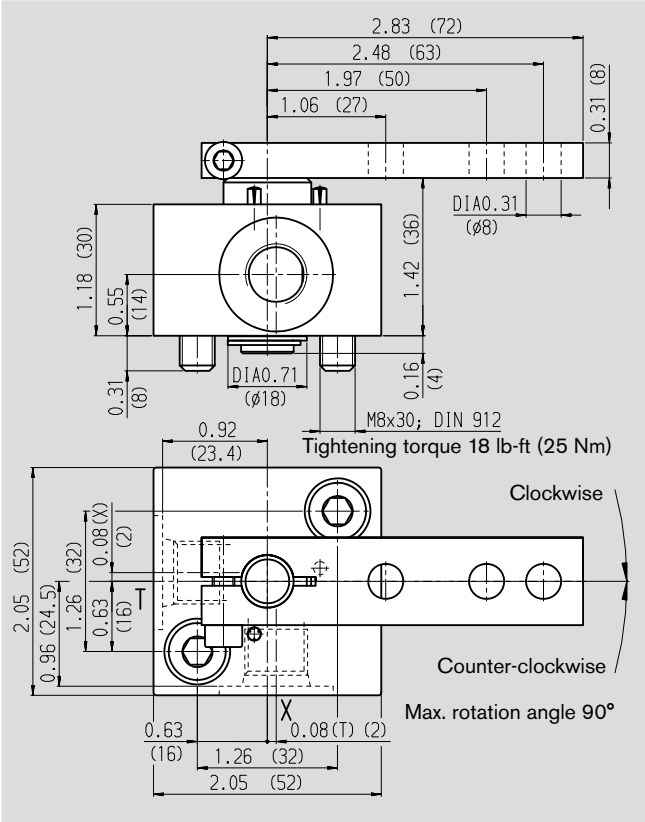
Attention:
The rotary inch valve can be used independently from the control unit.

Circuit diagram:
hydraulic control, speed related, DA
with separate rotary inching valve



Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

Unit dimensions



Ports

X pressure port
ISO 11926 — 9/16 in-18 UNF-2B; 0.51 (13 deep) — 60 lb-ft (80 Nm) [1]

T drain tank
ISO 11926 — 9/16 in-18 UNF-2B; 0.51 (13 deep) — 60 lb-ft (80 Nm) [1]

[1]) Please observe the general notes for the max. tightening torques on page 44

Installation Situation for Coupling Assembly

Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters).

To ensure that rotating components (coupling hub) and fixed components (case, retaining ring) do not come into contact with each other, the installation conditions described here must be observed. This depends on the size and the splined shaft.

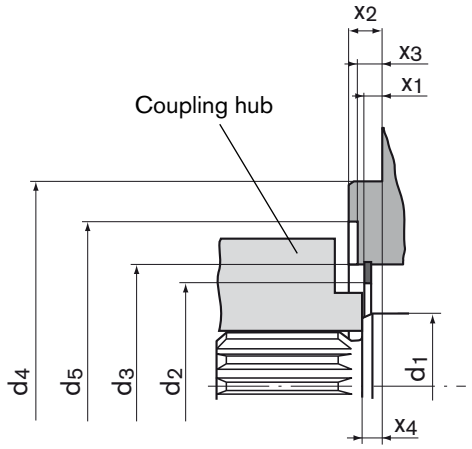
Size 18 and 45 (with free turning):

– Please observe diameter of the free turning.

Size 63 (without free turning):

– The outer diameter of the coupling hub must be smaller than the inner diameter of the retaining ring $\mathbf{d}_2$ at the zone of the drive shaft collar (measure $x_2 - x_4$).

SAE splined shaft (spline acc. to ANSI B92.1a-1976)



Size	ød$_1$	ød$_{2\,min}$	ød$_3$	ød$_4$	ød$_5$	x$_1$	x$_2$	x$_3$	x$_4$
18	1.18	1.42	1.93 ±0.004	4.00	2.56	0.23 $^{+0.008}$	0.37 $_{-0.019}$	0.28	
	(30)	(36.1)	(49 ±0.1)	(101.6)	(65)	(5.9 $^{+0.2}$)	(9.5 $_{-0.5}$)	(7)	
28	1.38	1.71	2.17 ±0.004	4.00	2.83	0.15 $^{+0.008}$	0.37 $_{-0.019}$	0.28	
	(35)	(43.4)	(55 ±0.1)	(101.6)	(72)	(3.9 $^{+0.2}$)	(9.5 $_{-0.5}$)	(7)	0.31 $^{+0.035}_{-0.023}$
45	1.57	2.02	2.48 ±0.004	4.00	3.15	0.17 $^{+0.008}$	0.37 $_{-0.019}$	0.28	(8 $^{+0.9}_{-0.6}$)
	(40)	(51.4)	(63 ±0.1)	(101.6)	(80)	(4.3 $^{+0.2}$)	(9.5 $_{-0.5}$)	(7)	
63	1.57	2.14	2.68 ±0.004	5.00	–	0.28 $^{+0.008}$	0.5 $_{-0.019}$	–	
	(40)	(54.4)	(68 ±0.1)	(127)	–	(7.0 $^{+0.2}$)	(12.7 $_{-0.5}$)	–	

Installation Notes

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This is also to be observed following a relatively long standstill as the system may empty via the hydraulic lines.

The pump case drain connection (i.e.-T_1/T_2) must be directed to the tank via the highest case drain port. The minimum suction pressure at port S must not fall below 12 psi (0.8 bar) abs. (cold start 7.5 psi / 0.5 bar absolute).

In all operating conditions, the suction line and case drain line must flow into the tank below the minimum fluid level.

Installation position

See examples below. Additional installation positions are available upon request.

Below-tank installation (standard)

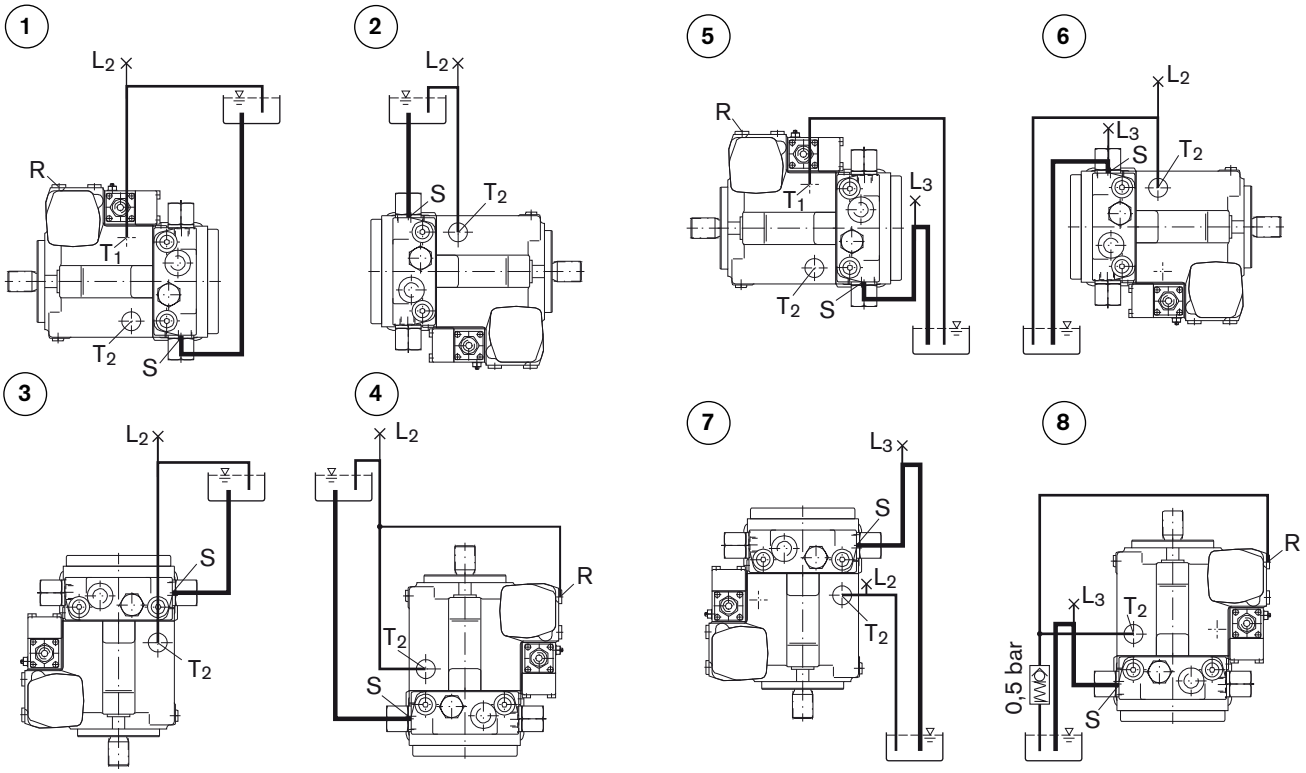
Pump below the minimum fluid level of the tank.

Recommended installation positions: 1 and 2.

Above-tank installation

Pump above the min. fluid level of the tank

Observe the maximum permissible suction height $h_{max} = 31.5$in (800 mm).
Recommendation for installation position 8 (shaft upwards): A check valve in the case drain line (opening pressure 7.5 psi / 0.5 bar) can prevent draining of the case interior.



Installation position	Air bleeding	Filling
1	R	S + T_1 (L_2)
2	L_2	S + T_2 (L_2)
3	L_2	S + T_2 (L_2)
4	R + L_2	S + T_2 (L_2)

Installation position	Air bleeding	Filling
5	R	T_1 + (L_3)
6	L_2	S (L_3) + T_2 (L_2)
7	L_2 + L_3	S (L_3) + T_2 (L_2)
8	R + L_3	S (L_3) + T_2

Notice

General Notes

– The AA10VG pump is designed to be used in closed circuits.

– Project planning, assembly and commissioning of the pump require the involvement of qualified personnel.

– The service line ports and function ports are only designed to accommodate hydraulic lines.

– During and shortly after operation, there is a risk of burns on the pump and especially on the solenoids. Take suitable safety precautions, e.g. wear protective clothing

– There may be shifts in the characteristic depending on the operating state of the pump (operating pressure, fluid temperature).

– Tightening torques:
  - The tightening torques specified in this data sheet are maximum values and must not be exceeded (maximum values for screw thread).
    Manufacturer´s instruction for the max. permissible tightening torques of the used fittings must be observed!
  - For ISO 68 / DIN 13 fixing screws, we recommend checking the tightening torque individually according to VDI 2230 Edition 2003.

– The data and information contained herein must be adhered to.

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