

# Axial piston variable pump

## A4VG Series 40

### Americas



- ▶ High-pressure pump for applications in a closed circuit up to 7250 psi (500 bar)
- ▶ Size 110 ... 280
- ▶ Nominal pressure 6500 psi (450 bar)
- ▶ Maximum pressure 7250 psi (500 bar)
- ▶ Closed circuit

#### Features

- ▶ High power density owing to a very high pressure level
- ▶ Integrated auxiliary pump for boost and pilot oil supply
- ▶ Flow direction changes smoothly when the swashplate is moved through the neutral position
- ▶ High-pressure relief valves with integrated boost function
- ▶ With adjustable pressure cut-off as standard
- ▶ Boost-pressure relief valve
- ▶ Through drive for mounting of further pumps up to same nominal size
- ▶ High total efficiency
- ▶ Large variety of controls
- ▶ Swashplate design

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## Type code

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
A4V	G								/	40	A		N					A		0		-	

### Axial piston unit

01	Swashplate design, variable, nominal pressure 6500 psi (450 bar), maximum pressure 7250 psi (500 bar)	<b>A4V</b>
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### Operating mode

02	Pump, closed circuit	<b>G</b>
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### Size (NG)

03	Geometric displacement, see "Technical data" on page 9	in <sup>3</sup> /rev.	<b>6.71</b>	<b>7.63</b>	<b>8.85</b>	<b>10.68</b>	<b>12.81</b>	<b>17.09</b>
		cm <sup>3</sup> /rev.	<b>110</b>	<b>125</b>	<b>145</b>	<b>175</b>	<b>210</b>	<b>280</b>

### Control device

			110	125	145	175	210	280	
04	Proportional control, hydraulic	pilot-pressure related $p = 87$ to 260 psi (6 to 18 bar)	-	-	○	○	○	○	<b>HP1</b>
		mechanical servo, hexagon shaft	-	-	●	●	●	●	<b>HW2</b>
		with lever	●	●	●	●	●	●	<b>HW8</b>
		with neutral position switch	●	●	●	●	●	●	<b>HW8</b>
	Hydraulic control, direct operated		-	-	●	●	○	○	<b>HT1</b>
	Automatic control, speed related	$U = 12$ V	●	●	-	-	-	-	<b>DA1</b>
		$U = 24$ V	●	●	-	-	-	-	<b>DA2</b>
	Proportional control, electric	$U = 12$ V	●	●	●	●	●	●	<b>EP1</b>
		$U = 24$ V	●	●	●	●	●	●	<b>EP2</b>
		with manual override and spring return	●	●	●	●	●	●	<b>EP3</b>
		$U = 24$ V	●	●	●	●	●	●	<b>EP4</b>
	Two-point control, electric	$U = 12$ V	●	●	●	●	●	●	<b>EZ1</b>
		$U = 24$ V	●	●	●	●	●	●	<b>EZ2</b>
	Electric control, direct operated, two pressure reducing valves (DRE)	$U = 12$ V	●	●	●	●	○	○	<b>ET5</b>
		$U = 24$ V	●	●	●	●	○	○	<b>ET6</b>

### Pressure cut-off

			110	125	145	175	210	280	
05	Without pressure cut-off	without bypass	○	○	○	○	○	○	<b>0</b>
		with bypass	○	○	○	○	○	○	<b>C</b>
	Pressure cut-off, with bypass	Fixed setting, hydraulic, mechanical	●	●	●	●	●	●	<b>D</b>

### Connector for solenoids<sup>1)</sup>

			110	125	145	175	210	280	
06	Without connector (only for purely hydraulic control)		●	●	●	●	●	●	<b>0</b>
	DEUTSCH molded connector, 2-pin – without suppressor diode		●	●	●	●	●	●	<b>P</b>

### Swivel angle sensor

			110	125	145	175	210	280	
07	Without swivel angle sensor		●	●	●	●	●	●	<b>0</b>
	Electric swivel angle sensor (DWS20-1, 3-pin) <sup>2)</sup>		○	○	○	○	○	○	<b>R</b>

● = Available    ○ = On request    - = Not available

= Preferred program

<sup>1)</sup> Connectors for other electric components may deviate.

<sup>2)</sup> Please contact us if the swivel angle sensor is used for control

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
A4V	G								/	40	A		N					A		0		-	

Additional function		110	125	145	175	210	280
08	Without additional function	●	●	●	●	●	0
	Mechanical stroke limiter, externally adjustable	●	●	●	●	●	M
	Stroking chamber pressure port <b>X<sub>3</sub></b> , <b>X<sub>4</sub></b>	●	●	●	●	●	T
	Mechanical stroke limiter and stroking chamber pressure port <b>X<sub>3</sub></b> , <b>X<sub>4</sub></b>	●	●	●	●	●	B
	Neutral valve <i>U</i> = 12 V <sup>3)</sup>	●	●	●	●	●	N
	and mechanical stroke limiter, externally adjustable	●	●	●	●	●	P
	and ports <b>X<sub>3</sub></b> , <b>X<sub>4</sub></b> for stroking chamber pressure	●	●	●	●	●	R
	and mechanical stroke limiter and ports <b>X<sub>3</sub></b> , <b>X<sub>4</sub></b>	●	●	●	●	●	S
	Neutral valve <i>U</i> = 24 V <sup>3)</sup>	●	●	●	●	●	U
	and mechanical stroke limiter, externally adjustable	●	●	●	●	●	V
	and ports <b>X<sub>3</sub></b> , <b>X<sub>4</sub></b> for stroking chamber pressure	●	●	●	●	●	W
	and mechanical stroke limiter and ports <b>X<sub>3</sub></b> , <b>X<sub>4</sub></b>	●	●	●	●	●	Y

DA control valve (only for NG110 and 125)				HP	HW	HT	DA	EP	EZ	ET	
09	Without DA control valve			●	●	●	–	●	●	●	0
	DA control valve, fixed setting			●	●	●	●	●	–	–	1
	DA control valve, fixed setting and brake inch valve based on mineral oil mounted, control with brake fluid <sup>4)</sup>			–	–	–	●	–	–	–	5
	DA control valve, fixed setting, ports for pilot control device			●	●	●	●	●	–	–	6

## Series

10	Series 4, index 0																							40
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Configuration of port and fastening threads		110	125	145	175	210	280
11	Ports according to ISO 11926 with O-ring seal (ANSI), fastening thread according to ASME B1.1	●	●	●	●	●	A


Direction of rotation				110	125	145	175	210	280	
12	Viewed on drive shaft	clockwise		●	●	●	●	●	●	R
		counter-clockwise		●	●	●	●	●	●	L

Sealing material		110	125	145	175	210	280	
13	NBR (nitrile rubber), shaft seal in FKM (fluoroelastomer)	●	●	●	●	●	●	N

Mounting flange				110	125	145	175	210	280	
14	SAE J744	127-2/4 <sup>5)</sup>		●	●	–	–	–	–	C6
		152-2/4		●	●	●	●	–	–	D6
		165-4		–	–	–	●	●	●	E4

Drive shaft					110	125	145	175	210	280	
15	Splined shaft ANSI B92.1a-1976	1 3/8 in	21T 16/32DP	●	-	-	-	-	-	V8	
		1 3/4 in	13T 8/16DP	●	●	●	●	-	-	T1	
		2 in	15T 8/16DP	●	●	●	-	●	●	T2	
		2 1/4 in	17T 8/16DP	-	-	●	●	●	●	T3	

• = Available    ◦ = On request    - = Not available

 = Preferred program

<sup>3)</sup> Cannot be combined with brake inch valve

<sup>4)</sup> Cannot be combined with neutral valve

<sup>5)</sup> Flange is not suitable for tandem design

4 **A4VG Series 40** | Axial piston variable pump  
Type code

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
A4V	G								/	40	A		N					A		0		-	

**Working port**

		110	125	145	175	210	280	
16	SAE working port <b>A</b> and <b>B</b> , on left side (45° left)	●	●	●	●	●	●	1
	SAE working port <b>A</b> and <b>B</b> , on right side (45° right) <sup>6)</sup>	●	●	●	●	●	●	2

**Boost pump and rotary group configuration**

		110	125	145	175	210	280	
17	Standard rotary group	●	●	●	●	●	●	F
	boost pump integrated, standard internal gear pump	●	-	●	●	●	-	B
	boost pump integrated, large internal gear pump	●	●	●	●	●	●	U
	without boost pump	●	-	●	●	-	-	V
	High-speed rotary group	●	-	●	●	-	-	W
	boost pump integrated, standard internal gear pump	●	-	●	●	-	-	
	without boost pump	●	-	●	●	-	-	

**Through drive<sup>7)</sup>**

		110	125	145	175	210	280	
18	Without through drive	●	●	●	●	●	●	0000
	Flange SAE J744							
	Diameter							
	Mounting <sup>9)</sup>							
	Code							
	Hub for splined shaft <sup>8)</sup>							
	Diameter							
	Code							
	82-2 (A)	○	-	●	●	-	-	A1S2
	○	●	○	○	○	○	○	A2S2
	101-2 (B)	○	○	●	●	-	-	B1S4
	○	●	-	○	○	-	-	B1S5
	○	●	●	●	●	○	●	B2S4
	○	●	●	○	●	○	○	B2S5
	○	-	-	○	-	-	-	B5S4
	127-2 (C)	●	-	○	○	○	○	C1S7
	○	●	○	●	●	●	○	C2S7
	○	●	-	○	○	-	-	C2V8
	○	-	-	●	○	-	-	C2T1
	127-4 (C)	●	-	○	●	-	-	C4S7
	○	○	-	-	-	-	-	C4V8
	152-4 (D)	-	-	●	●	●	○	D4T1
	○	-	-	-	●	○	○	E4T1
	165-4 (E)	-	-	-	-	●	○	E4T2
	○	-	-	-	-	●	○	E4T2

**High-pressure relief valve**

		110	125	145	175	210	280	
19	High-pressure relief valve, direct operated, fixed setting, with low-pressure relief valve, fixed setting	●	●	●	●	●	●	A

**Filtration boost circuit/external boost pressure supply**

		110	125	145	175	210	280	
20	Filtration in the boost pump suction line	●	●	●	●	●	●	S
	Filtration in the boost pump pressure line	●	●	●	●	●	●	D
	Ports for external boost circuit filtration ( <b>F<sub>a</sub></b> and <b>F<sub>b</sub></b> )	●	●	●	●	●	●	F
	Attachment filter with cold start valve <sup>10)</sup>	●	●	●	●	●	●	B
	Attachment filter <sup>10)</sup> with cold start valve and electric contamination indicator – DEUTSCH connector	●	●	●	●	●	●	E
	External boost pressure supply (on version without integrated boost pump)	●	●	●	●	●	●	

● = Available    ○ = On request    - = Not available

■ = Preferred program

<sup>6)</sup> Only possible without attachment filter.

<sup>7)</sup> Specifications for version with integrated standard gear pump, please contact us for version with integrated large gear pump or without boost pump.

<sup>8)</sup> Hub for splined shaft according to ANSI B92.1a-1976 (drive shaft allocation according to SAE J744)

<sup>9)</sup> Mounting hole pattern viewed on through drive

<sup>10)</sup> Only available for working ports located on left

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
A4V	G							/	40	A		N						A		0		-	

Pressure sensor							110	125	145	175	210	280	
21	Without pressure sensor						●	●	●	●	●	●	0

Other sensors				110	125	145	175	210	280	
22	Without sensor			●	●	●	●	●	●	0
	Speed sensor DSM, DSA <sup>11)</sup>			○	–	○	○	○	○	V

Standard / special version																						
23	Standard version																					0
	Standard version with installation variants, e.g. <b>T</b> ports against standard open or closed																					Y
	Special version																					S

• = Available    o = On request    - = Not available     = Preferred program

#### Notice

- ▶ Note the project planning notes on page 63!
- ▶ In addition to the type code, please specify the relevant technical data when placing your order.
- ▶ Please note that not all type code combinations are available although the individual functions are marked as being available.

<sup>11)</sup> Specify type code of sensor acc. to data sheet (DSM - 95132, DSA 95133) separately and observe the requirements on the electronics

## Hydraulic fluid

The axial piston unit is designed for operation with HLP mineral oil according to DIN 51524.

Application instructions and requirements for hydraulic fluid selection, behavior during operation as well as disposal and environmental protection should be taken from the following data sheets before the start of project planning:

- ▶ 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- ▶ 90221: Environmentally acceptable hydraulic fluids
- ▶ 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)
- ▶ 90225: Limited technical data for operation with water-free and water-containing fire-resistant hydraulic fluids (HFDR, HFDU, HFAE, HFAS, HFB, HFC)

### Selection of hydraulic fluid

Bosch Rexroth evaluates hydraulic fluids on the basis of the Fluid Rating according to the technical data sheet 90235.

Hydraulic fluids with positive evaluation in the Fluid Rating are provided in the following technical data sheet:

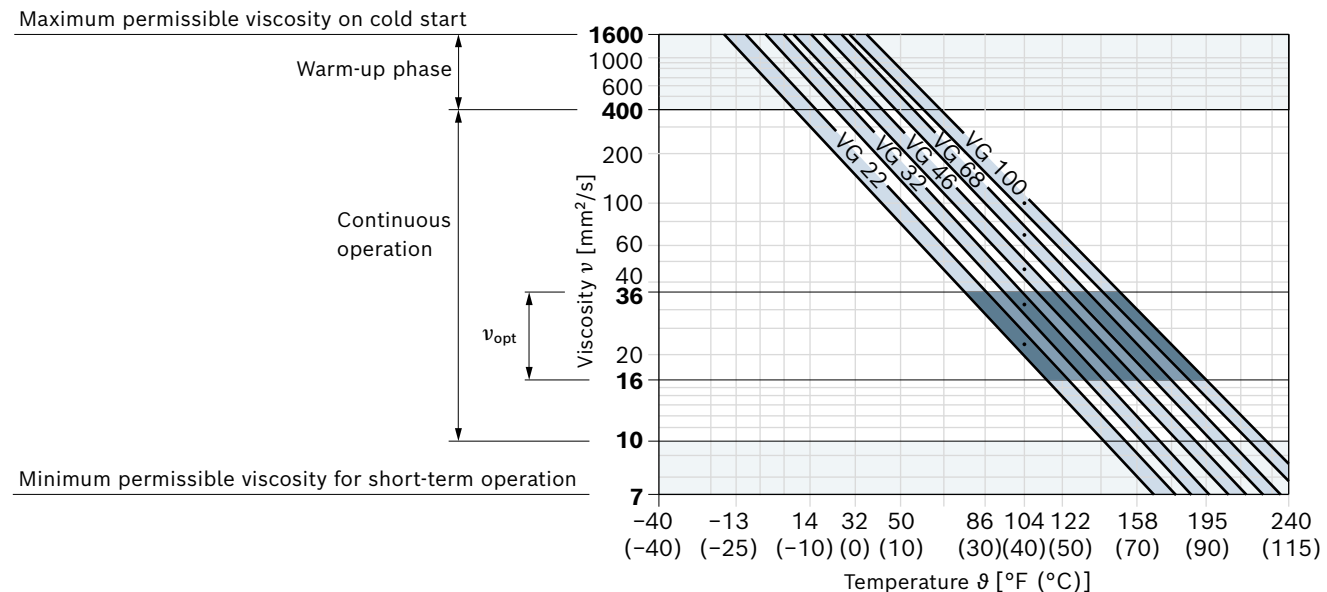
- ▶ 90245: Bosch Rexroth Fluid Rating List for Rexroth hydraulic components (pumps and motors)

The hydraulic fluid should be selected so that the operating viscosity in the operating temperature range is within the optimum range ( $v_{opt}$ ; see selection diagram).

### Viscosity and temperature of hydraulic fluids

	Viscosity	Shaft seal	Temperature <sup>3)</sup>	Comment
Cold start	$v_{max} = 1600 \text{ cSt (mm}^2/\text{s)}$	NBR <sup>2)</sup> FKM	$\vartheta_{st} \geq -40 \text{ °F (-40 °C)}$ $\vartheta_{st} \geq -13 \text{ °F (-25 °C)}$	$t \leq 3 \text{ min}$ , without load ( $p \leq 725 \text{ psi (50 bar)}$ ), $n \leq 1000 \text{ rpm}$ Permissible temperature difference between axial piston unit and hydraulic fluid in the system maximum 45 °F (25 K).
Warm-up phase	$v = 1600 \dots 400 \text{ cSt (mm}^2/\text{s)}$			$t \leq 15 \text{ min}$ , $p \leq 0.7 \times p_{nom}$ and $n \leq 0.5 \times n_{nom}$
Continuous operation	$v = 400 \dots 10 \text{ cSt (mm}^2/\text{s})^{1)}$	NBR <sup>2)</sup>	$\vartheta \leq +185 \text{ °F (+85 °C)}$	measured at port T
		FKM	$\vartheta \leq +230 \text{ °F (+110 °C)}$	
	$v_{opt} = 36 \dots 16 \text{ cSt (mm}^2/\text{s)}$			Range of optimum operating viscosity and efficiency
Short-term operation	$v_{min} = 10 \dots 7 \text{ cSt (mm}^2/\text{s)}$	NBR <sup>2)</sup>	$\vartheta \leq +185 \text{ °F (+85 °C)}$	$t \leq 3 \text{ min}$ , $p \leq 0.3 \times p_{nom}$ , measured at port T
		FKM	$\vartheta \leq +230 \text{ °F (+110 °C)}$	

### ▼ Selection diagram



1) This corresponds, for example on the VG 46, to a temperature range of +39 °F (+4 °C) ... +185 °F (+85 °C) (see selection diagram)

2) Special version, please contact us

3) If the temperature at extreme operating parameters cannot be adhered to, please contact us.

### Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

At a hydraulic fluid viscosity of less than 10 cSt (mm<sup>2</sup>/s) (e.g. due to high temperatures during short-term operation) at the drain port, a cleanliness level of at least 19/17/14 according to ISO 4406 is required.

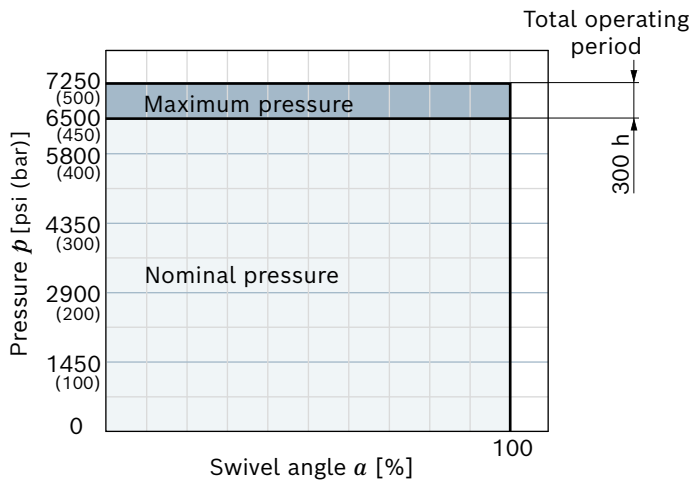
For example, the viscosity is 10 cSt (mm<sup>2</sup>/s) at:

- ▶ HLP 32 a temperature of 163 °F (73°C)
- ▶ HLP 46 a temperature of 185 °F (85°C)

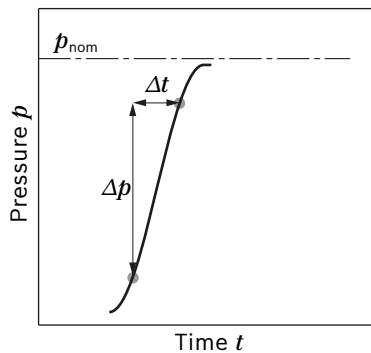
### Working pressure range

Pressure at working port A or B		Definition
Nominal pressure $p_{nom}$	6500 psi (450 bar)	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure $p_{max}$	7250 psi (500 bar)	The maximum pressure corresponds to the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (low-pressure side)	145 psi (10 bar) above case pressure	Minimum pressure at the low-pressure side ( <b>A</b> or <b>B</b> ) which is required to prevent damage to the axial piston unit. Boost pressure setting must be higher depending on system.
Rate of pressure change $R_{A\ max}$	130000 psi/s (9000 bar/s)	Maximum permissible speed of pressure build-up and reduction during a pressure change across the entire pressure range.
Boost pump		
Nominal pressure $p_{Sp\ nom}$	365 psi (25 bar)	
Maximum pressure $p_{Sp\ max}$	580 psi (40 bar)	
Pressure at suction port <b>S</b> (inlet)		
Continuous $p_{S\ min}$	≥ 12 psi absolute (≥ 0.8 bar absolute)	$\nu \leq 30$ cSt (mm²/s)
Short-term, at a cold start	≥ 7.5 psi (0.5 bar) absolute	$t < 3$ min
Maximum pressure $p_{S\ max}$	≤ 75 psi (5 bar) absolute	
Control pressure		
Required control pressure $p_{St\ min}$ at $n = 2000$ rpm		Required control pressure $p_{St}$ to ensure the function of the control. The required control pressure is depending on the rotational speed, working pressure and the spring assembly of the stroking piston.
Controls HP, HW, EP	290 psi (20 bar) above case pressure	
Controls HT, DA, EZ, ET	365 psi (25 bar) above case pressure	
Case pressure at port T		
Maximum differential pressure $\Delta p_{T\ max}$	See the diagram	Permissible differential pressure at the shaft seal (case to ambient pressure)
Pressure peak $p_{T\ peak}$	145 psi (10 bar)	$t < 0.1$ s, maximum 1000 pressure peaks permissible

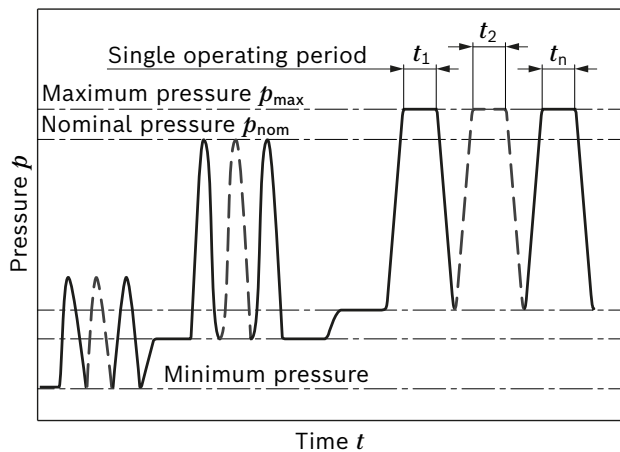
▼ **Maximum pressure  $p_{\max}$  up to 7250 psi (500 bar) and total operating period**



▼ **Rate of pressure change  $R_{A \max}$**

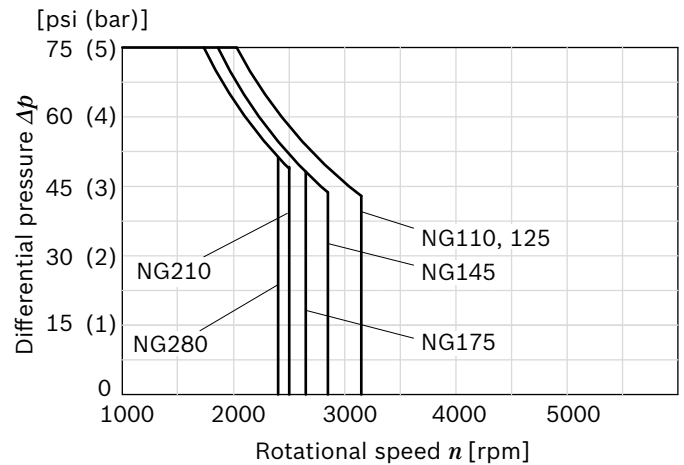


▼ **Pressure definition**



▼ Total operating period =  $t_1 + t_2 + \dots + t_n$

▼ **Maximum differential pressure at the shaft seal**



**Notice**

- ▶ Working pressure range valid when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.
- ▶ In addition to the hydraulic fluid and the temperature, the service life of the shaft seal is influenced by the rotational speed of the axial piston unit and the case pressure.
- ▶ The service life of the shaft seal decreases with increasing frequency of pressure peaks and increasing mean differential pressure.
- ▶ The case pressure must be greater than the ambient pressure.



## Technical data

Size			NG		110	125	145	175	210	280	
Displacement, geometric, per revolution variable pump boost pump (at $p$ = 290 psi (20 bar))			$V_{\text{g max}}$	in <sup>3</sup>	6.74	7.63	8.87	10.7	2.85	17.1	
				cm <sup>3</sup>	110.4	125	145.3	175.4	210.6	280.3	
			$V_{\text{g Sp}}$	in <sup>3</sup>	1.5	1.89	1.95	2.38	2.81	3.66	
				cm <sup>3</sup>	24.5	31	32	39	46	60	
boost pump large (at $p$ = 290 psi (20 bar)) <sup>1)</sup>			$V_{\text{g Sp}}$	in <sup>3</sup>	1.89	–	2.38	2.87	3.66	–	
				cm <sup>3</sup>	31	–	39	47	60	–	
Torque <sup>2)</sup>	at $V_{\text{g max}}$ and	$\Delta p$ = 6250 psi	$M$	lb-ft	558	631	631	885	1063	1415	
		$\Delta p$ = 430 bar	$M$	Nm	756	856	994	1200	1441	1918	
		$\Delta p$ = 1450 psi	$M$	lb-ft	130	148	170	206	247	329	
		$\Delta p$ = 100 bar	$M$	Nm	176	200	231	279	335	446	
Rotary stiffness of drive shaft		V8	$c$	lb-ft/rad	127598	–	–	–	–	–	
				kNm/rad	173	–	–	–	–	–	
		T1	$c$	lb-ft/rad	157838	142349	182315	196192	–	–	
				kNm/rad	214	193	248	266	–	–	
		T2	$c$	lb-ft/rad	181440	161526	216106	–	290599	303138	
				kNm/rad	246	219	293	–	394	411	
		T3	$c$	lb-ft/rad	–	–	250771	275848	356243	376157	
				kNm/rad	–	–	340	374	483	510	
		Moment of inertia for rotary group		$J_{\text{TW}}$	lbs-ft <sup>2</sup>	0.517	0.551	0.783	1.353	1.5	2.314
					kgm <sup>2</sup>	0.0218	0.0232	0.0330	0.0570	0.0632	0.0975
		Maximum angular acceleration <sup>3)</sup>		$\alpha$	rad/s <sup>2</sup>	14500	13000	12000	10000	8000	5000
		Case volume		$V$	gal	0.66	0.61	0.87	0.82	1.29	1.43
l	2.5				2.3	3.3	3.1	4.9	5.4		
Weight (without through drive) approx.		$m$	lbs-ft <sup>2</sup>	194	185	234	254	335	353		
			kg	88	84	106	115	152	160		
Standard rotary group											
Rotational speed <sup>4)</sup>	maximum at $V_{\text{g max}}$	$n_{\text{nom S}}$	rpm	3150	3000	2850	2650	2500	2400		
	at $\Delta p \geq 580$ psi (40 bar) ( $t < 15$ s)	$n_{\text{max 40}}$	rpm	3350	3150	3000	2800	2650	2550		
	minimum	$n_{\text{min}}$	rpm	500	500	500	500	500	500		
Flow	at $n_{\text{nom}}$ and $V_{\text{g max}}$	$q_v$	gpm	91.9	99.1	109.4	122.8	139	178		
			l/min	348	375	414	465	527	673		
Power <sup>2)</sup>	at $n_{\text{nom}}$ , $V_{\text{g max}}$ and	$\Delta p$ = 6250 psi	$P$	hp	334	361	398	447	506	646	
		$\Delta p$ = 430 bar	$P$	kW	249	269	297	333	377	482	
High-speed rotary group											
Rotational speed <sup>5)</sup>	maximum at $V_{\text{g max}}$	$n_{\text{nom H}}$	rpm	3400	–	3050	3000	–	–		
	at $\Delta p \geq 580$ psi (40 bar) ( $t < 15$ s)	$n_{\text{max 40}}$	rpm	3600	–	3200	3100	–	–		
	minimum	$n_{\text{min}}$	rpm	500	–	500	500	–	–		
Flow	at $n_{\text{nom}}$ and $V_{\text{g max}}$	$q_v$	gpm	99.1	–	117	139	–	–		
			l/min	375	–	443	526	–	–		
Power <sup>2)</sup>	at $n_{\text{nom}}$ , $V_{\text{g max}}$ and	$\Delta p$ = 6250 psi	$P$	hp	361	–	426	506	–	–	
		$\Delta p$ = 430 bar	$P$	kW	269	–	318	377	–	–	

### Notice

- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommend testing the loads by means of experiment or calculation/simulation and comparison with the permissible values.

2) Without boost pump

3) The data are valid for values between the minimum required and maximum permissible rotational speed.  
Valid for external excitation (e.g. diesel engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency).  
The limit value is only valid for a single pump.  
The load capacity of the connecting parts must be considered.

4) The values are applicable:

- for the optimum viscosity range from  $\nu_{\text{opt}} = 36 \dots 16$  cSt (mm<sup>2</sup>/s)
- for hydraulic fluid based on mineral oils (for HF hydraulic fluids, observe the technical data in 90225)

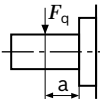
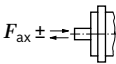
5) The values are applicable:

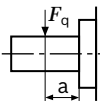
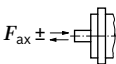
- for a limited viscosity range, please contact us
- for hydraulic fluid based on mineral oils

1) The version with a large internal gear pump can result in maximum rotational speed limitations. Please contact us.

## Permissible radial and axial forces of the drive shafts

### ▼ Splined shaft ANSI B92.1a

Size	NG	110	110	110	125	125	145	145	
Drive shaft		in 1 3/8	1 3/4	2	1 3/4	2	1 3/4	2	
Maximum radial force at distance a (from shaft collar)		$F_q \text{ max}$	lbf 2141	1682	1472	1461	1304	2077	1818
			N 9524	7483	6548	6500	5800	9241	8086
		a	in 0.94	1.32	1.57	1.32	1.57	1.32	1.57
			mm 24	33.5	40	33.5	40	33.5	40
Maximum axial force		$+ F_{ax \text{ max}}$	lbf 1417	1417	1417	1441	1441	1520	1520
			N 6305	6305	6305	6411	6411	6763	6763
		$- F_{ax \text{ max}}$	lbf 921	921	921	897	897	997	997
			N 4095	4095	4095	3989	3989	4437	4437

Size	NG	145	175	175	210	210	280	280	
Drive shaft		in 2 1/4	1 3/4	2 1/4	2	2 1/4	2	2 1/4	
Maximum radial force at distance a (from shaft collar)		$F_q \text{ max}$	lbf 1818	1079	989	2514	2261	3274	2980
			N 8086	4800	4400	11185	10059	14562	13256
		a	in 1.57	1.32	1.57	1.57	1.57	1.57	1.57
			mm 40	33.5	40	40	40	40	40
Maximum axial force		$+ F_{ax \text{ max}}$	lbf 1520	1630	1630	1745	1745	1900	1900
			N 6763	7252	7252	7760	7760	8450	8450
		$- F_{ax \text{ max}}$	lbf 997	1067	1067	1133	1133	1158	1158
			N 4437	4748	4748	5040	5040	5150	5150

### Determining the operating characteristics

$$\text{Flow } q_v = \frac{V_g \times n \times \eta_v}{231} \quad [\text{gpm}] \quad \left( \frac{V_g \times n \times \eta_v}{1000} \right) [\text{L/min}]$$

$$\text{Torque } M = \frac{V_g \times \Delta p}{24 \times \pi \times \eta_{hm}} \quad [\text{lb-ft}] \quad \left( \frac{V_g \times \Delta p}{24 \times \pi \times \eta_{hm}} \right) [\text{Nm}]$$

$$\text{Power } P = \frac{2 \pi \times M \times n}{33000} = \frac{q_v \times \Delta p}{1714 \times \eta_t} [\text{HP}] \quad \left( \frac{2 \pi \times M \times n}{60000} = \frac{q_v \times \Delta p \times \eta_t}{600} \right) [\text{kW}]$$

#### Key

$V_g$	Displacement per revolution [in <sup>3</sup> (cm <sup>3</sup> )]
$\Delta p$	Differential pressure [psi (bar)]
$n$	Rotational speed [rpm]
$\eta_v$	Volumetric efficiency
$\eta_{mh}$	Hydraulic-mechanical efficiency
$\eta_t$	Total efficiency ( $\eta_t = \eta_v \times \eta_{mh}$ )

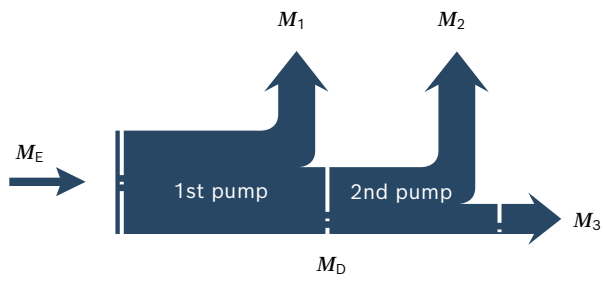
#### Notice

- The axial and radial forces generally influence the service life of the bearings.
- Special requirements apply in the case of belt drive and cardan shaft. Please contact us.

### Permissible input and through-drive torques

Size		NG		110	125	145	175	210	280
Torque at $V_{g \max}$ and	$\Delta p = 6250 \text{ psi}^{1)}$	$M$	lb-ft	558	631	733	885	1063	1415
	$\Delta p = 430 \text{ bar}^{1)}$	$M$	Nm	756	856	994	1200	1441	1918
Maximum input torque at drive shaft <sup>2)</sup> ANSI B92.1a-1976	<b>V8</b> 1 3/8 in	$M_{E \max}$	lb-ft	715	–	–	–	–	–
			Nm	970	–	–	–	–	–
	<b>T1</b> 1 3/4 in	$M_{E \max}$	lb-ft	1210	1210	1210	1210	–	–
			Nm	1640	1640	1640	1640	–	–
	<b>T2</b> 2 in	$M_{E \max}$	lb-ft	1969	1969	1969	–	1969	1969
			Nm	2670	2670	2670	–	2670	2670
	<b>T3</b> 2 1/4 in	$M_{E \max}$	lb-ft	–	–	3002	3002	3002	3002
			Nm	–	–	4070	4070	4070	4070
Maximum through-drive torque		$M_{D \max}$	lb-ft	689	819	1298	1298	1948	1948
			Nm	934	1110	1760	1760	2641	2641

### ▼ Distribution of torques



Torque at 1st pump	$M_1$
Torque at 2nd pump	$M_2$
Torque at 3rd pump	$M_3$
Input torque	$M_E = M_1 + M_2 + M_3$
	$M_E < M_{E \max}$
Through-drive torque	$M_D = M_2 + M_3$
	$M_D < M_{D \max}$

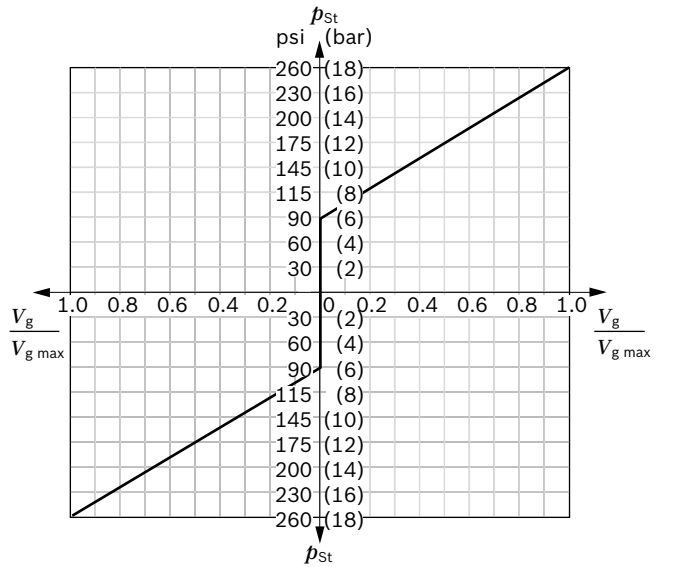
1) Efficiency not considered

2) For drive shafts free of radial force

HP – Proportional control, hydraulic, pilot-pressure related

The output flow of the pump is infinitely variable between 0 and 100%, proportional to the difference in pilot pressure applied to the two pilot pressure ports (**Y<sub>1</sub>** and **Y<sub>2</sub>**). The pilot signal, coming from an external source, is a pressure signal. Flow is negligible, as the pilot signal acts only on the control spool of the control valve. This control 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 within the control range.

If the pump is also equipped with a DA control valve (see page 16), automotive operation is possible for travel drives.



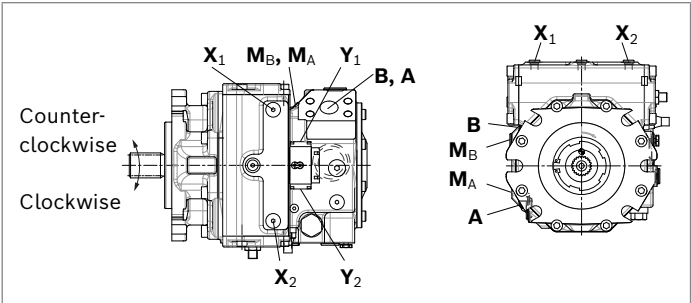
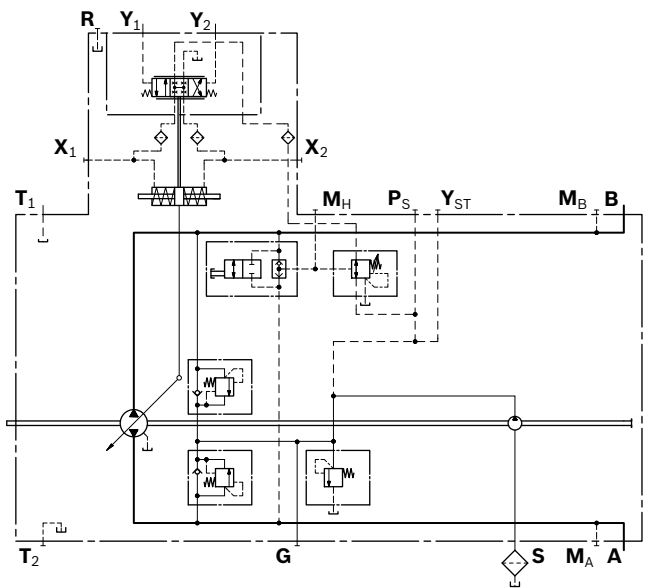
Size			
Beginning of control ( $V_{g0}$ )	$p_{St}$	87 psi (6 bar)	
End of control ( $V_{gmax}$ )	$p_{St}$	260 psi (18 bar)	

- Key**
- $V_g$  Displacement
  - $V_{g0}$  Displacement in neutral position
  - $V_{gmax}$  Maximum displacement
  - $p_{St}$  Pilot signal at port **Y<sub>1</sub>**, **Y<sub>2</sub>**

**Notice**

In the neutral position, the HP control module must be unloaded to reservoir via the external pilot control device.

▼ Circuit diagram, standard version

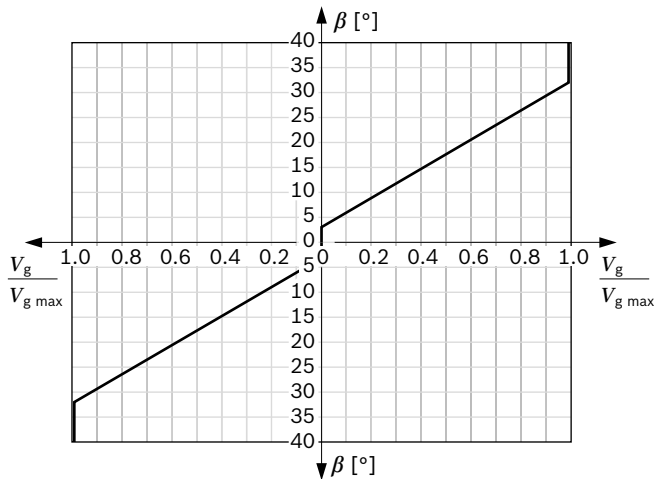


Correlation of direction of rotation, control and flow direction				
Direction of rotation	Clockwise		Counter-clockwise	
Pilot signal	<b>Y<sub>1</sub></b>	<b>Y<sub>2</sub></b>	<b>Y<sub>1</sub></b>	<b>Y<sub>2</sub></b>
Control pressure	<b>X<sub>1</sub></b>	<b>X<sub>2</sub></b>	<b>X<sub>1</sub></b>	<b>X<sub>2</sub></b>
Flow direction	<b>B to A</b>	<b>A to B</b>	<b>A to B</b>	<b>B to A</b>
Working pressure	<b>M<sub>A</sub></b>	<b>M<sub>B</sub></b>	<b>M<sub>B</sub></b>	<b>M<sub>A</sub></b>

## HW – Proportional control, hydraulic, mechanical servo

The output flow of the pump is infinitely variable between 0 and 100%, proportional to the swivel angle of the control lever. A feedback lever connected to the stroking piston maintains the pump flow for any given position of the control lever.

If the pump is also equipped with a DA control valve (see page 16), automotive operation is possible for travel drives.



### Size

Beginning of control ( $V_{g0}$ )	$\beta$	$\pm 3^\circ$
End of control ( $V_{g \max}$ )	$\beta$	$32^\circ$
Rotational limiter control lever (internal)	$\beta$	$\pm 38^\circ$

The maximum required torque at the control lever is 15 lb-in (170 Ncm). To prevent damage to the HW control module, a positive mechanical stop of  $36.5^\circ \pm 1$  must be provided for the HW control lever on the customer side.

### Key

$V_g$	Displacement
$V_{g0}$	Displacement in neutral position
$V_{g \max}$	Maximum displacement
$\beta$	Swivel angle at the control lever

### Notice

- ▶ Spring-centering enables the pump, depending on pressure and rotational speed, to move automatically to the neutral position ( $V_g = 0$ ) as soon as there is no longer any torque on the control lever of the HW control module.
- ▶ As standard delivery, the control lever is oriented toward the thru drive (see dimensions).
- ▶ If necessary, the position of the control lever can be changed. The procedure is defined in the instruction manual.
- ▶ The position of the control lever can deviate from the installation drawing.

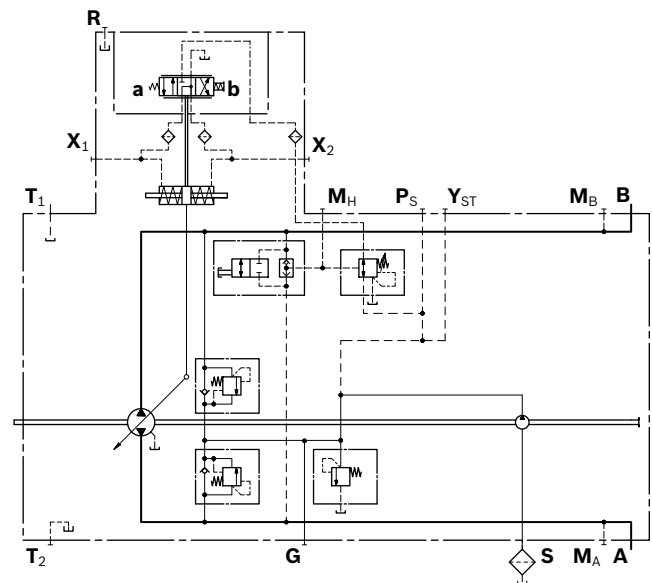
### Option: Neutral position switch

The switch contact in the neutral position switch is closed when the control lever on the HW control module is in its neutral position. The switch opens when the control lever is moved out of the central position in either direction. Thus, the neutral position switch provides a monitoring function for drive units that require the control lever at the HW control module to be in the neutral position during certain operating conditions (e.g. starting diesel engines).

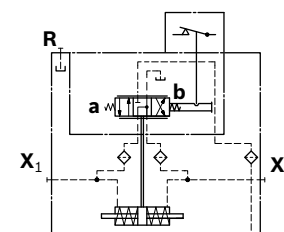
### Technical data

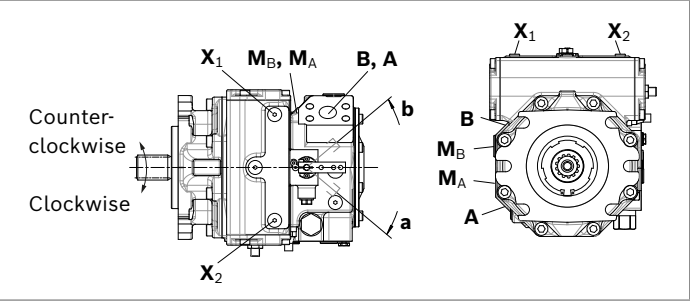
Load capacity	20 A (continuous), without switching operations
Switching capacity	15 A / 32 V (resistive load) 4 A / 32 V (inductive load)
Connector version	DEUTSCH DT04-2P-EP04 (mating connector, see page 57)

### ▼ Circuit diagram, standard version



### ▼ Circuit diagram, version with neutral position switch





Correlation of direction of rotation, control and flow direction				
Direction of rotation	Clockwise		Counter-clockwise	
Lever direction	a	b	a	b
Control pressure	X1	X2	X1	X2
Flow direction	B to A	A to B	A to B	B to A
Working pressure	MA	MB	MB	MA

## HT – Hydraulic control, direct operated

With the direct operated hydraulic control, the output flow of the pump is controlled by a hydraulic control pressure, applied directly to the stroking piston through either port **X<sub>1</sub>** or **X<sub>2</sub>**.

Flow direction is determined by which control pressure port is pressurized (refer to table below).

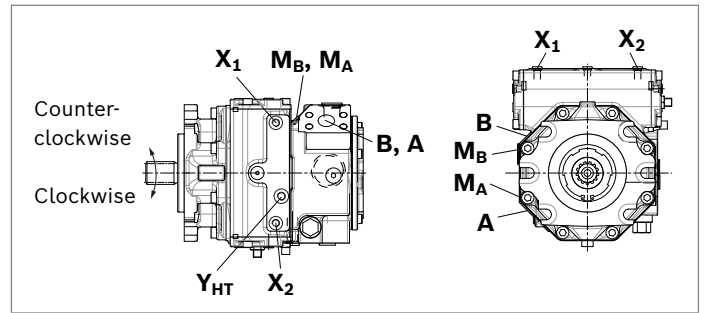
Pump displacement is infinitely variable and proportional to the applied control pressure, but is also influenced by system pressure and pump drive speed.

In order to use the optional built-in pressure cut-off, port **Y<sub>HT</sub>** must be used as source of the control pressure **X<sub>1</sub>**, **X<sub>2</sub>** generated on the customer side. See page 48 for a functional description of the pressure cut-off.

Maximum permissible control pressure: 40 bar

Use of the HT control requires a review of the engine and vehicle parameters to ensure that the pump is set up correctly. We recommend that all HT applications be reviewed by a Bosch Rexroth application engineer.

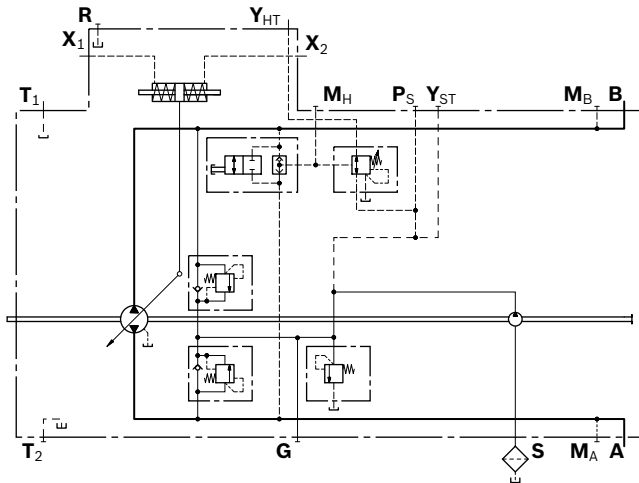
If the pump is also equipped with a DA control valve (see page 16), automotive operation is possible for travel drives.



**Correlation of direction of rotation, control and flow direction**

Direction of rotation	Clockwise		Counter-Clockwise	
Control pressure	<b>X<sub>1</sub></b>	<b>X<sub>2</sub></b>	<b>X<sub>1</sub></b>	<b>X<sub>2</sub></b>
Flow direction	<b>B to A</b>	<b>A to B</b>	<b>A to B</b>	<b>B to A</b>
Working pressure	<b>M<sub>A</sub></b>	<b>M<sub>B</sub></b>	<b>M<sub>B</sub></b>	<b>M<sub>A</sub></b>

### ▼ Circuit diagram



DA – Automatic control, speed related

The DA closed loop control is an engine speed-dependent system for travel drives. The built-in DA control valve generates a pilot pressure that is proportional to pump (engine) drive speed. This pilot pressure is directed to the stroking cylinder of the pump by an electromagnetically actuated 4/3-way directional valve. The pump displacement is infinitely variable in each flow direction and is influenced by both pump drive speed and system pressure. The flow direction (e.g. machine moving forward or backward) is determined by either solenoid **a** or **b** being activated.

Increasing the pump drive speed generates a higher pilot pressure from the DA control valve, with a subsequent increase in pump flow.

Depending on the selected pump operating characteristics, increasing system pressure (e.g. machine load) causes the pump to swivel back towards a smaller displacement. An overload protection for the engine (against stalling) is achieved by combining this pressure-dependent reduction in pump stroke with a reduction in pilot pressure as the engine speed drops.

Any additional power requirement, e.g. for hydraulic functions from attachments, could cause the engine speed to drop further. This will cause a further reduction in pilot pressure and thus of the pump displacement. Automatic power distribution and full exploitation of the available power are achieved in this way, both for the travel drive and for the implement hydraulics, with priority given to the implement hydraulics.

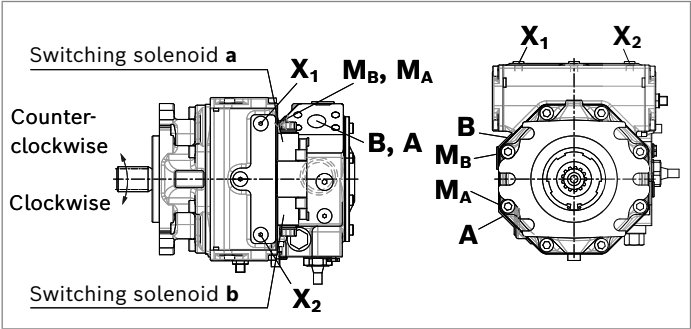
Various override options are available for DA control function to allow controlled operation of the implement hydraulics with high rpm at reduced travel speed.

The DA control valve can also be used in pumps with HP, HW, HT, DA and EP control modules to protect the combustion engine against overload.

**Notice**

- Our Sales department will provide you detailed information. Use our computer program to work out the input design that meets your needs. All DA applications must be approved by a Bosch Rexroth application engineer.
- DA closed loop control is only suitable for certain types of travel drive systems and requires review of the engine and vehicle parameters to ensure that the pump is used correctly and that machine operation is safe and efficient. We recommend that all DA applications be reviewed by a Bosch Rexroth application engineer.

Technical data, switching solenoid	DA1	DA2
Voltage	12 V (±20%)	24 V (±20%)
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_{g \max}$	Current switched on	Current switched on
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum active current required	1.32 A	0.67 A
Duty cycle	100%	100%
Type of protection: see connector version page 57		



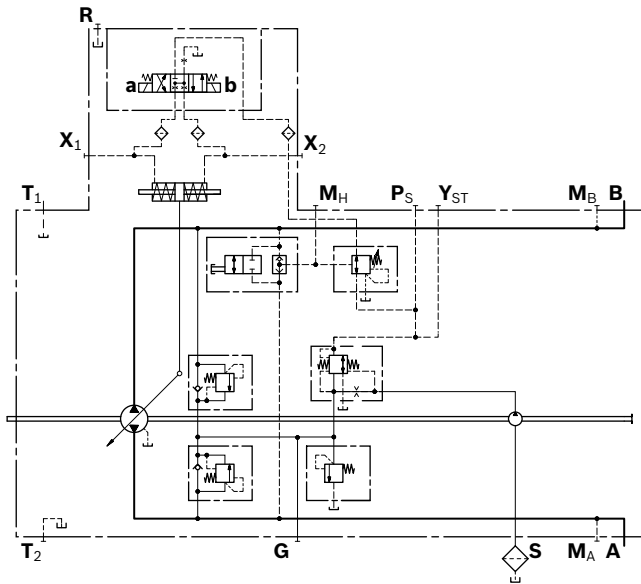
Correlation of direction of rotation, control and flow direction				
Direction of rotation	Clockwise		Counter-clockwise	
Actuation of switching solenoid	<b>a</b>	<b>b</b>	<b>a</b>	<b>b</b>
Control pressure	<b>X<sub>2</sub></b>	<b>X<sub>1</sub></b>	<b>X<sub>2</sub></b>	<b>X<sub>1</sub></b>
Flow direction	<b>A to B</b>	<b>B to A</b>	<b>B to A</b>	<b>A to B</b>
Working pressure	<b>M<sub>B</sub></b>	<b>M<sub>A</sub></b>	<b>M<sub>A</sub></b>	<b>M<sub>B</sub></b>



### DA..1 – DA control valve, fixed setting

Pilot pressure is generated in relation to drive speed.

#### ▼ Circuit diagram



### DA..5 – DA control valve, fixed setting and brake inch valve mounted

Only for pumps with DA control module.

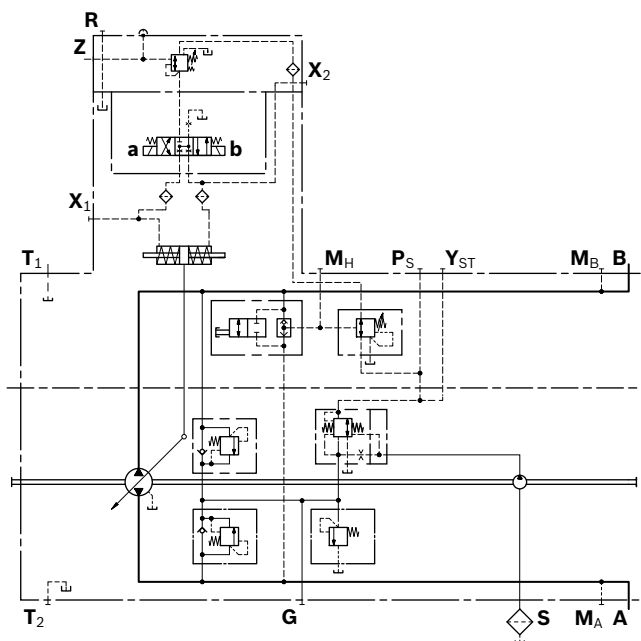
Version with pressure reducing valve.

Permits reduction of the pilot pressure, independently of the drive speed via hydraulic control (port Z).

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

Maximum permissible pilot pressure at port Z: 1150 psi (80 bar)

#### ▼ Circuit diagram



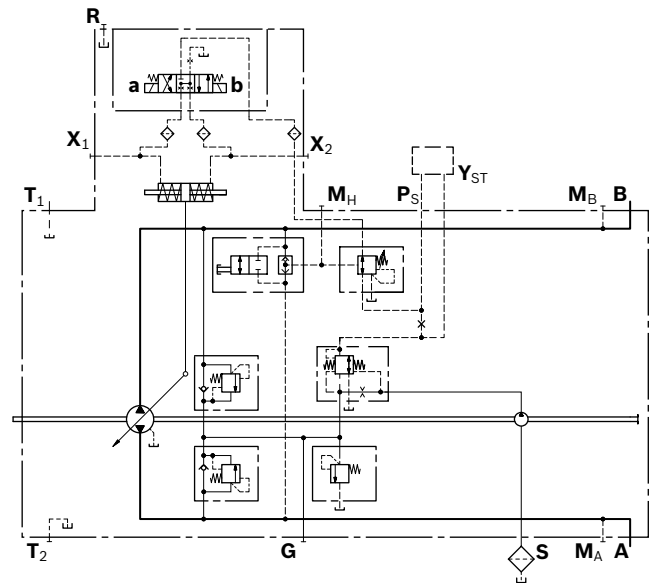
### DA..6 – DA control valve, fixed setting, ports for pilot control device as inch valve

Any reduction of the pilot pressure possible, independent of the drive speed is achieved by the mechanical actuation of the pilot control device.

The pilot control device is installed separately from the pump (for example in the driver's cabin) and connected to the pump by two hydraulic control lines via ports P<sub>S</sub> and Y<sub>ST</sub>.

A suitable pilot control device must be ordered separately and is not included in the scope of delivery.

#### ▼ Circuit diagram



EP – Proportional control, electric

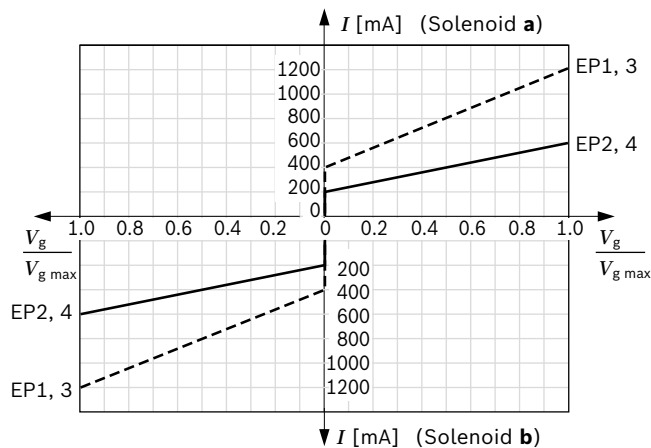
The output flow of the pump is infinitely variable between 0 and 100%, proportional to the electrical current supplied to solenoid **a** or **b**.

The electrical energy is converted into a force acting on the control spool.

This control 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 current within the control range.

If the pump is also equipped with a DA control valve (see page 16), automotive operation is possible for travel drives.



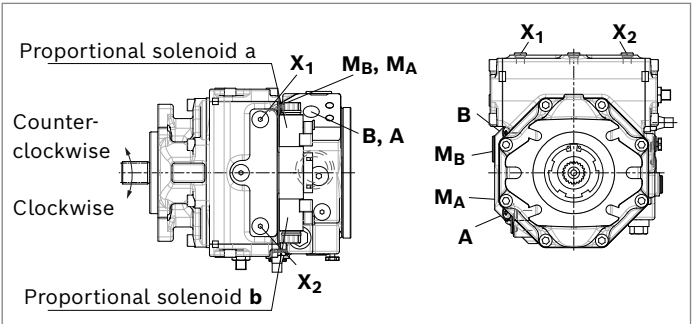
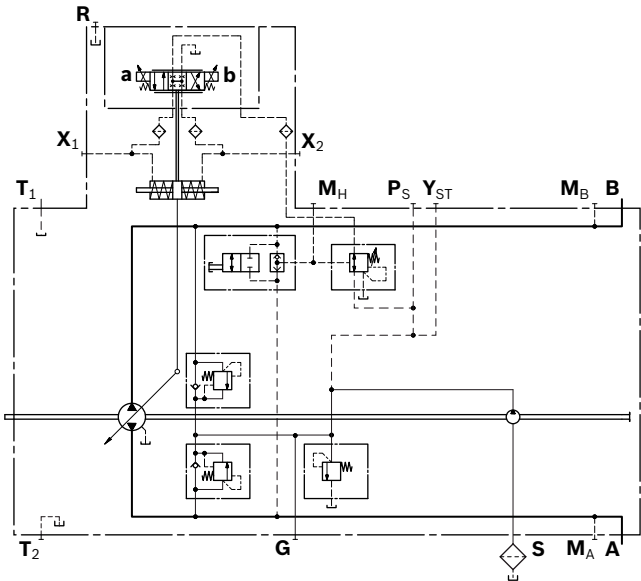
**Notice**  
 The proportional solenoids in version EP1/EP2 do not have manual override. Proportional solenoids with manual override and spring return are available on request (version EP3/EP4).

Technical data, solenoid, proportional solenoid	EP1, 3	EP2, 4
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at $V_g = 0$	400 mA	200 mA
End of control at $V_{g\ max}$	1200 mA	600 mA
Current limit	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
minimum oscillation range <sup>1)</sup>	240 mA	120 mA
Duty cycle	100%	100%
Type of protection: see connector version page 57		

Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.

Further information can also be found on the Internet at [www.boschrexroth.com/mobile-electronics](http://www.boschrexroth.com/mobile-electronics)

▼ Circuit diagram



Correlation of direction of rotation, control and flow direction				
Direction of rotation	Clockwise		Counter-clockwise	
Actuation of proportional solenoid	a	b	a	b
Control pressure	X <sub>1</sub>	X <sub>2</sub>	X <sub>1</sub>	X <sub>2</sub>
Flow direction	B to A	A to B	A to B	B to A
Working pressure	M <sub>A</sub>	M <sub>B</sub>	M <sub>B</sub>	M <sub>A</sub>

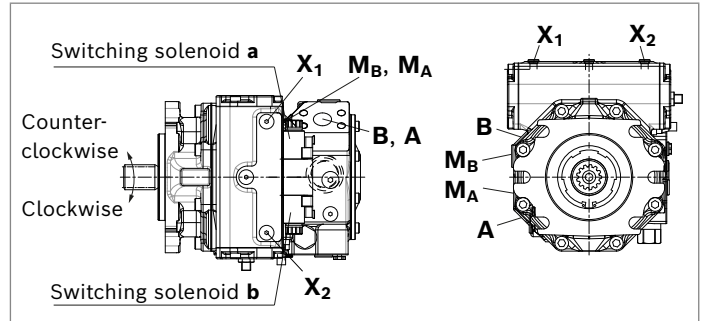
1) Minimum required oscillation range of the control current  $\Delta I_{p-p}$  (peak to peak) within the respective control range (start of control to end of control)

## EZ – Two-point control, electric

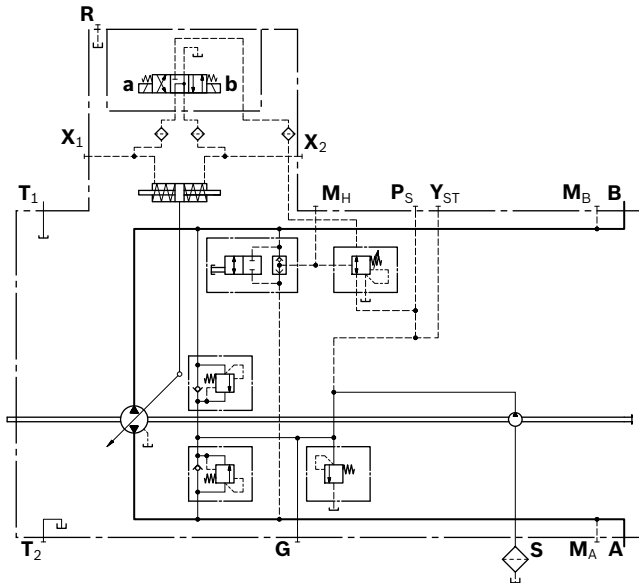
By actuating either switching solenoid **a** or **b**, internal control pressure is applied directly to the stroking piston and the pump swivels to maximum displacement. The EZ control enables pump flow to be switched between  $V_g = 0$  and  $V_{g \max}$ . Flow direction is determined by which solenoid is energized.

Technical data, switching solenoid	EZ1	EZ2
Voltage	12 V ( $\pm 20\%$ )	24 V ( $\pm 20\%$ )
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_{g \max}$	Current switched on	Current switched on
Nominal resistance (at 68 °F (20 °C))	5.5 $\Omega$	21.7 $\Omega$
Nominal power	26.2 W	26.5 W
Minimum active current required	1.32 A	0.67 A
Duty cycle	100%	100%
Type of protection: see connector version page 57		

Correlation of direction of rotation, control and flow direction				
Direction of rotation	Clockwise		Counter-clockwise	
Actuation of switching solenoid	a	b	a	b
Control pressure	$X_2$	$X_1$	$X_2$	$X_1$
Flow direction	A to B	B to A	B to A	A to B
Working pressure	$M_B$	$M_A$	$M_A$	$M_B$



### ▼ Circuit diagram

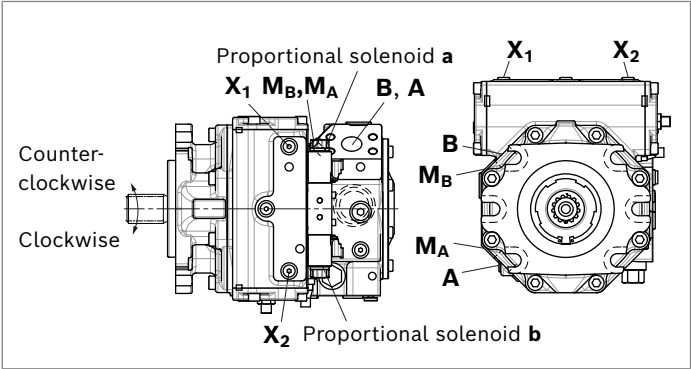


ET – Electric control, direct operated

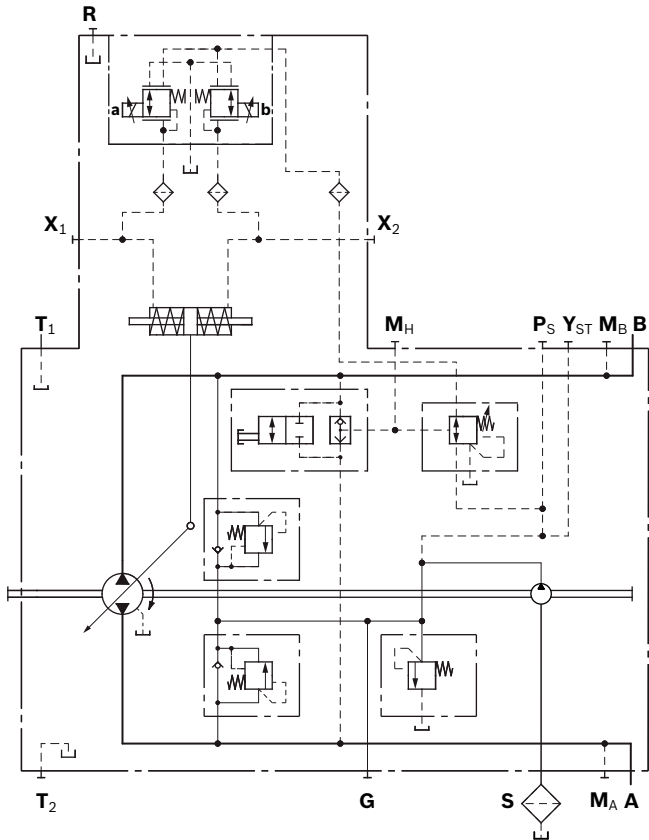
The output flow of the pump is infinitely variable between 0 and 100%. Depending on the preselected current *I* at solenoids **a** and **b** of the pressure reducing valves, the stroking cylinder of the pump is proportionally supplied with control pressure. The pump displacement that arises at a certain control current is dependent on the speed and working pressure of the pump. A different flow direction is associated with each pressure reducing valve. Maximum permissible control pressure: 580 psi (40 bar).

Technical data, proportional solenoid	ET5	ET6
Voltage	12 V (±20%)	24 V (±20%)
Current limit	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
minimum oscillation range <sup>1)</sup>	240 mA	120 mA
Duty cycle	100%	100%
Type of protection: see connector version page 57		

Correlation of direction of rotation, control and flow direction				
Direction of rotation	Clockwise		Counter-clockwise	
Actuation of proportional solenoid	a	b	a	b
Control pressure (in X <sub>3</sub> , X <sub>4</sub> optional)	X <sub>1</sub>	X <sub>2</sub>	X <sub>1</sub>	X <sub>2</sub>
	X <sub>3</sub>	X <sub>4</sub>	X <sub>3</sub>	X <sub>4</sub>
Flow direction	B to A	A to B	A to B	B to A
Working pressure	M <sub>A</sub>	M <sub>B</sub>	M <sub>B</sub>	M <sub>A</sub>



▼ Circuit diagram

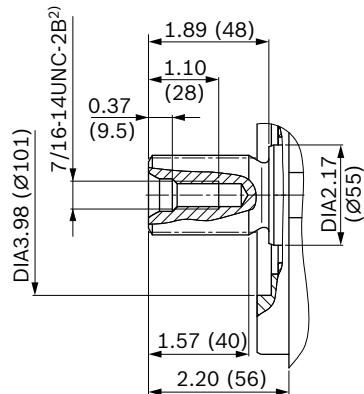


1) Minimum required oscillation range of the control current  $\Delta I_{p-p}$  (peak to peak) within the respective control range (start of control to end of control)



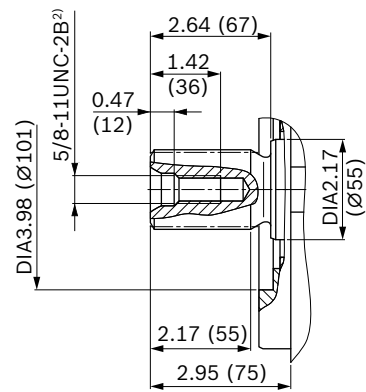
▼ **Splined shaft ANSI B92.1a-1976**

**V8 – 1 3/8 in 21T 16/32DP<sup>1)</sup>**



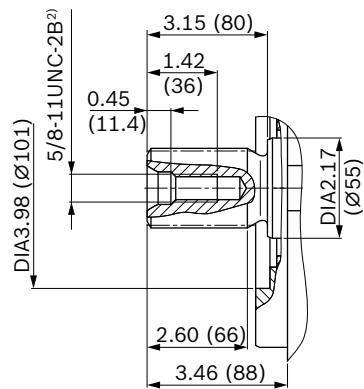
▼ **Splined shaft ANSI B92.1a**

**T1 – 1 3/4 in 13T 8/16DP<sup>1)</sup>**



▼ **Splined shaft ANSI B92.1a**

**T2 – 2 in 15T 8/16DP<sup>1)</sup>**



1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

Ports		Standard	Size	$p_{\max}$ [psi (bar)] <sup>3)</sup>	State <sup>10)</sup>
<b>A, B</b> <sup>9)</sup>	Working port Fastening thread, screw grade 8 with hardened washer	SAEJ518 <sup>4)</sup> ASME B1.1	1 in 7/16-14UNC; 0.87 (22) deep	7250 (500)	O
<b>S</b>	Suction port	ISO 11926 <sup>7)</sup>	1 5/8-12UN-2B; 0.79 (20) deep	75 (5)	O <sup>5)</sup>
<b>T<sub>1</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/16-12UN-2B; 0.79 (20) deep	45 (3)	O <sup>6)</sup>
<b>T<sub>2</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/16-12UN-2B; 0.79 (20) deep	45 (3)	X <sup>6)</sup>
<b>R</b>	Air bleed port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	45 (3)	X
<b>X<sub>1</sub>, X<sub>2</sub></b>	Control pressure port (upstream of orifice)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>X<sub>3</sub>, X<sub>4</sub></b> <sup>8)</sup>	Stroking chamber pressure port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>G</b>	Boost pressure port inlet	ISO 11926 <sup>7)</sup>	7/8-14UNF-2B; 0.67 (17) deep	580 (40)	X
<b>P<sub>S</sub></b>	Pilot pressure port inlet	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40)	X
<b>P<sub>S</sub></b>	Pilot pressure port inlet (DA..6 only)	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40)	O
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet (DA..6 only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	O
<b>M<sub>A</sub>, M<sub>B</sub></b>	Measuring port pressure A, B	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500)	X
<b>M<sub>H</sub></b>	Measuring port, high pressure	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500)	X
<b>Z</b>	Pilot pressure port (inch signal DA..5 only)	ISO 11926 <sup>7)</sup>	3/8-24UNF-2B; 0.39 (10) deep	1150 (80)	O

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518.

5) Plugged for external boost pressure supply.

6) Depending on installation position, **T<sub>1</sub>** or **T<sub>2</sub>** must be connected (see also installation instructions on page 60).

7) The countersink can be deeper than as specified in the standard.

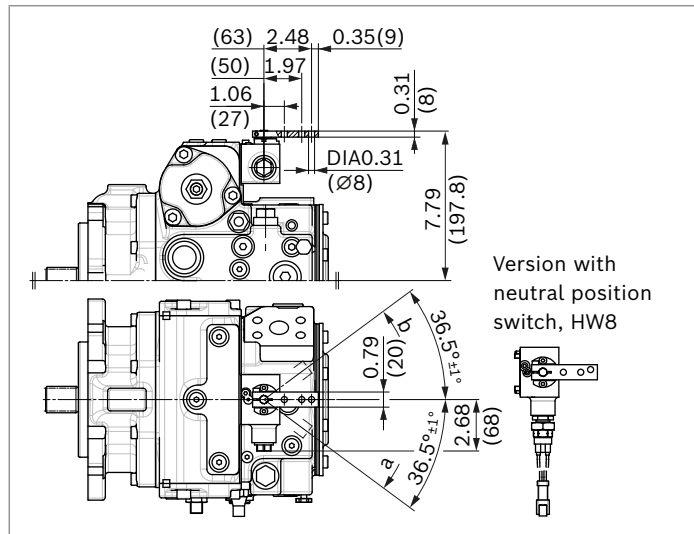
8) Optional, see page 51

9) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.

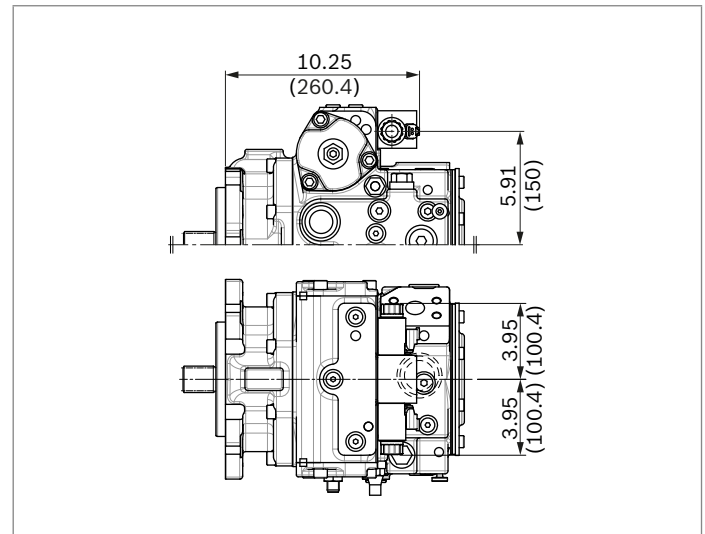
10) O = Must be connected (plugged when delivered)

X = Plugged (in normal operation)

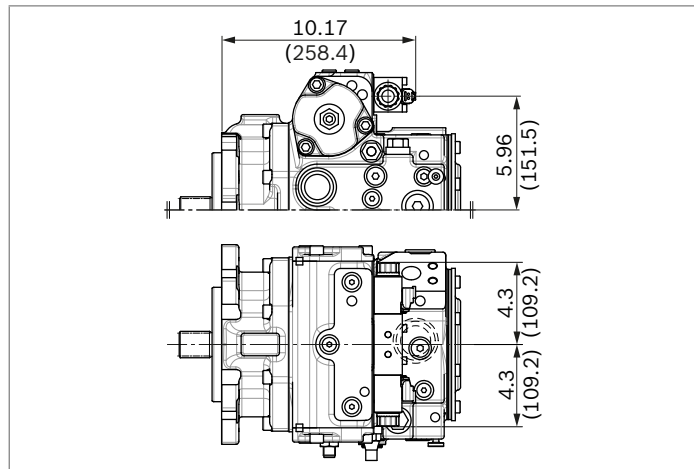
▼ **HW** – Proportional control, hydraulic, mechanical servo



▼ **EZ** – Two-point control, electric

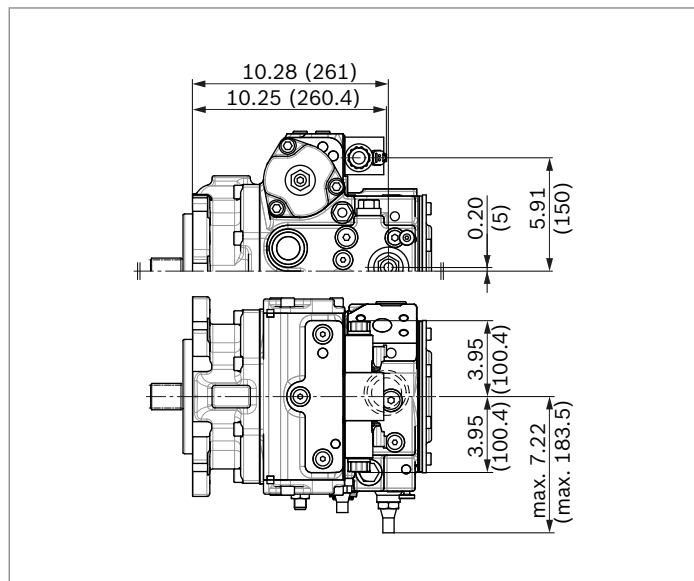


▼ **ET** – Electric control, direct operated, two DRE

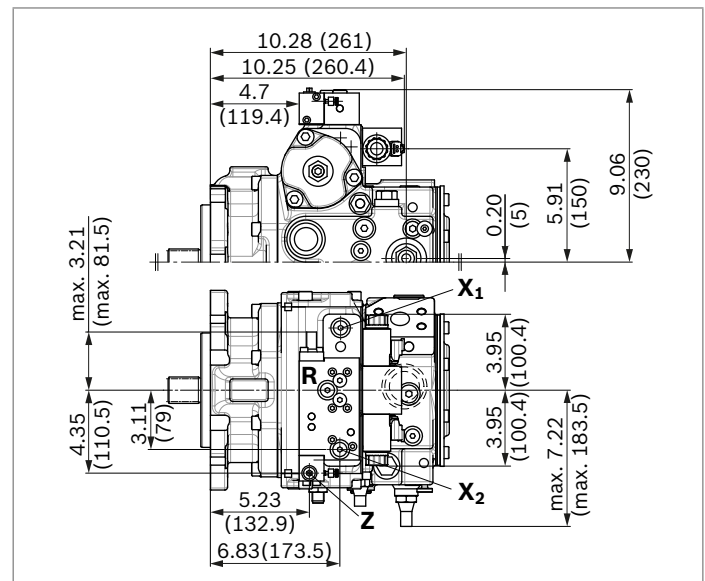


**DA control valve**

▼ **DA..1** – fixed setting



▼ **DA..5** – fixed setting and inch valve mounted

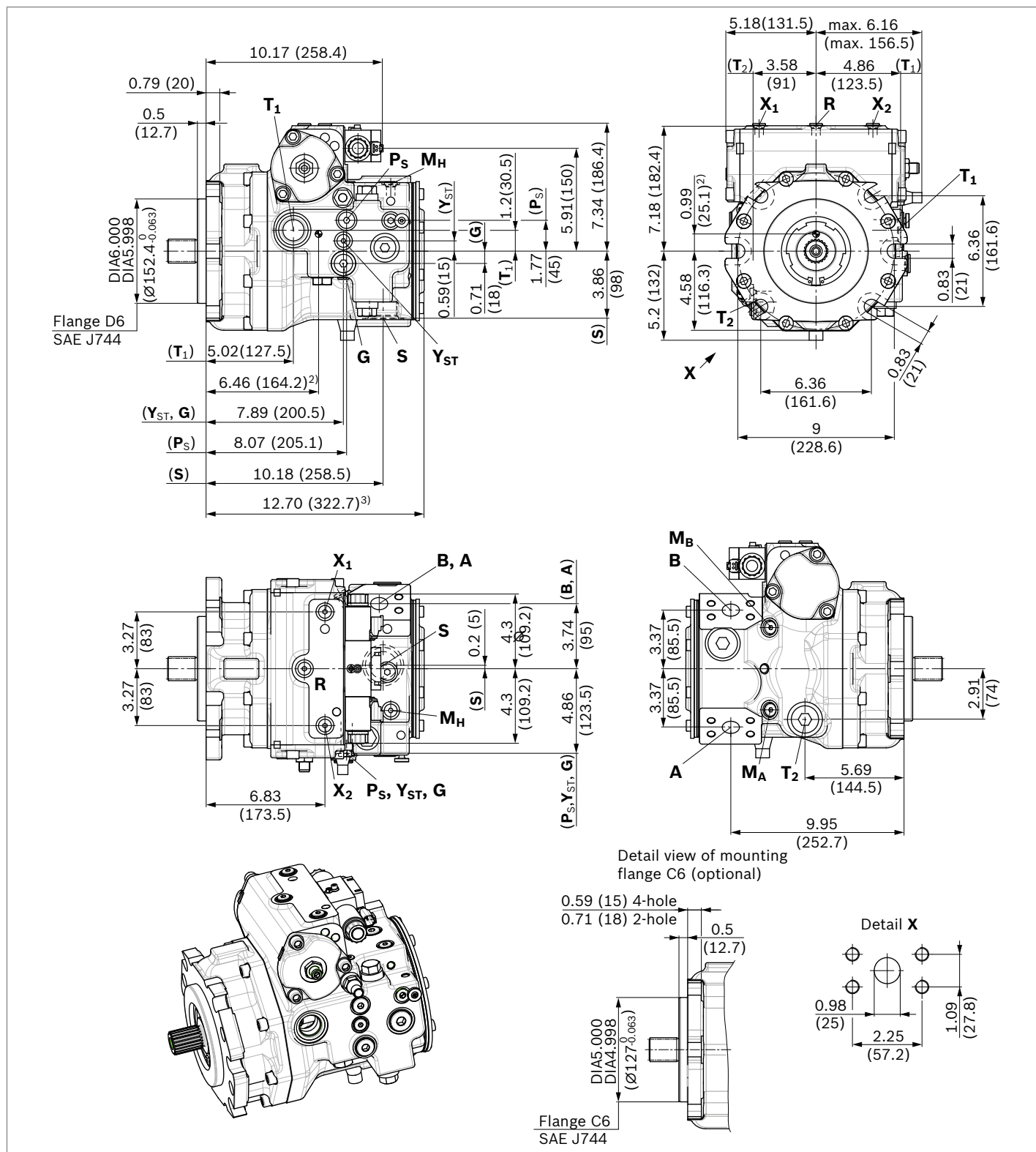




### Dimensions, size 125

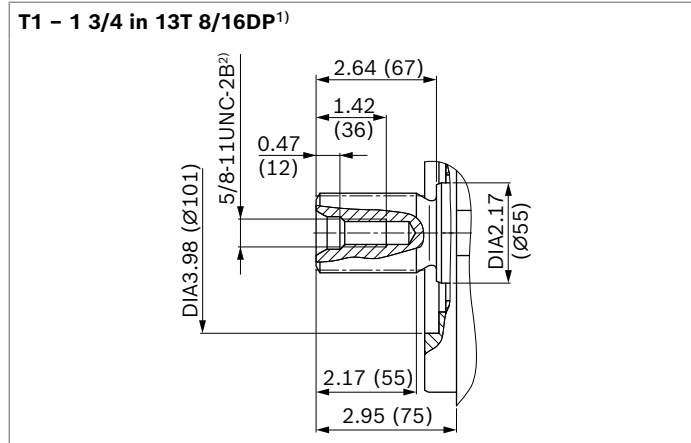
**EP – Proportional control, electric**

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)<sup>1)</sup>

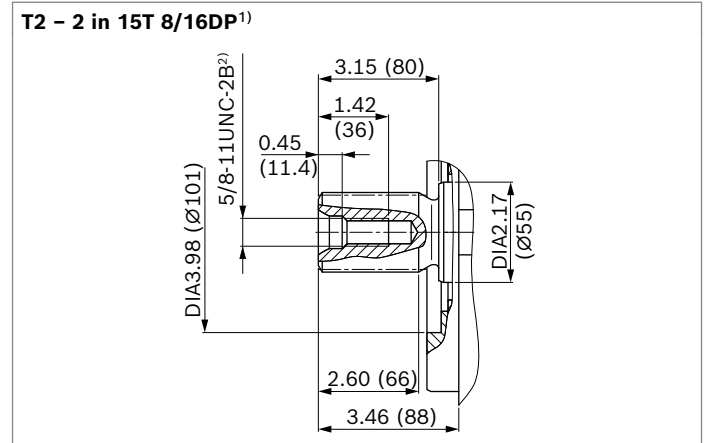


- 1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.
- 2) Center of gravity
- 3) Valid for version with standard internal gear pump, overall length without boost pump see through drive, page 41.

▼ **Splined shaft ANSI B92.1a**



▼ **Splined shaft ANSI B92.1a**



Ports		Standard	Size	$p_{max}$ [psi (bar)] <sup>3)</sup>	State <sup>10)</sup>
<b>A, B<sup>9)</sup></b>	Working port Fastening thread, screw grade 8 with hardened washer	SAEJ518 <sup>4)</sup> ASME B1.1	1 in 7/16-14UNC; 0.87 (22) deep	7250 (500)	O
<b>S</b>	Suction port	ISO 11926 <sup>7)</sup>	1 5/8-12UN-2B; 0.79 (20) deep	75 (5)	O <sup>5)</sup>
<b>T<sub>1</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/16-12UN-2B; 0.79 (20) deep	45 (3)	O <sup>6)</sup>
<b>T<sub>2</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/16-12UN-2B; 0.79 (20) deep	45 (3)	X <sup>6)</sup>
<b>R</b>	Air bleed port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	45 (3)	X
<b>X<sub>1</sub>, X<sub>2</sub></b>	Control pressure port (upstream of orifice)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>X<sub>3</sub>, X<sub>4</sub><sup>8)</sup></b>	Stroking chamber pressure port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>G</b>	Boost pressure port inlet	ISO 11926 <sup>7)</sup>	7/8-14UNF-2B; 0.67 (17) deep	580 (40)	X
<b>P<sub>S</sub></b>	Pilot pressure port inlet	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40)	X
<b>P<sub>S</sub></b>	Pilot pressure port inlet (DA..6 only)	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40)	O
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet (DA..6 only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	O
<b>M<sub>A</sub>, M<sub>B</sub></b>	Measuring port pressure A, B	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500)	X
<b>M<sub>H</sub></b>	Measuring port, high pressure	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500)	X
<b>Z</b>	Pilot pressure port (inch signal DA..5 only)	ISO 11926 <sup>7)</sup>	3/8-24UNF-2B; 0.39 (10) deep	1150 (80)	O

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518.

5) Plugged for external boost pressure supply.

6) Depending on installation position, **T<sub>1</sub>** or **T<sub>2</sub>** must be connected (see also installation instructions on page 60).

7) The countersink can be deeper than as specified in the standard.

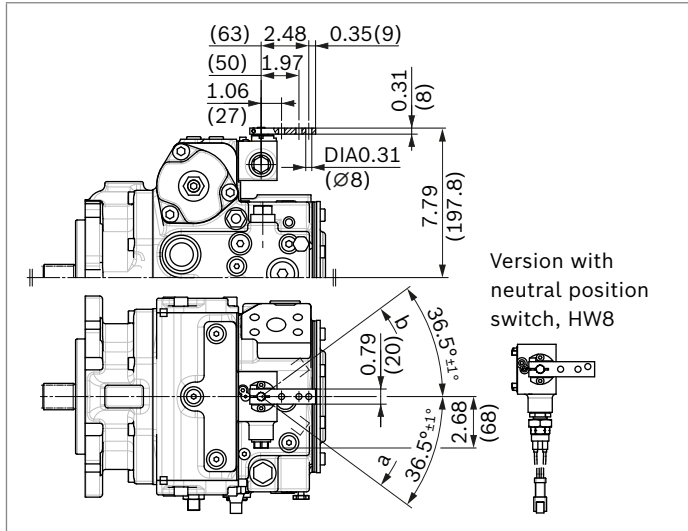
8) Optional, see page 51

9) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.

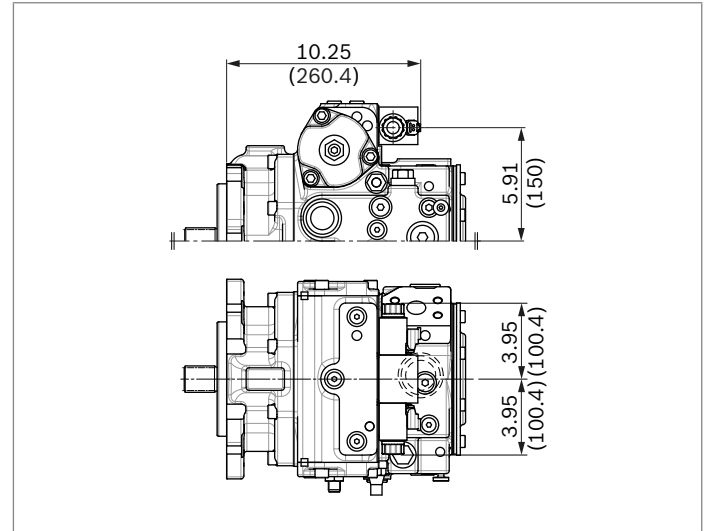
10) O = Must be connected (plugged when delivered)

X = Plugged (in normal operation)

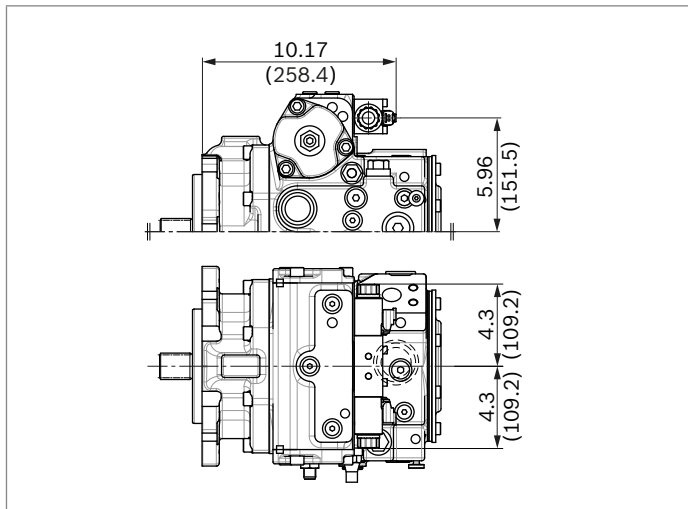
▼ **HW** – Proportional control, hydraulic, mechanical servo



▼ **EZ** – Two-point control, electric

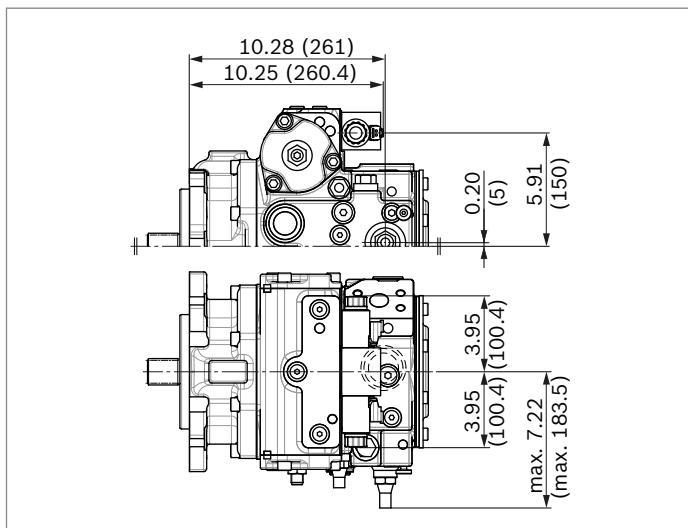


▼ **ET** – Electric control, direct operated, two DRE



**DA control valve**

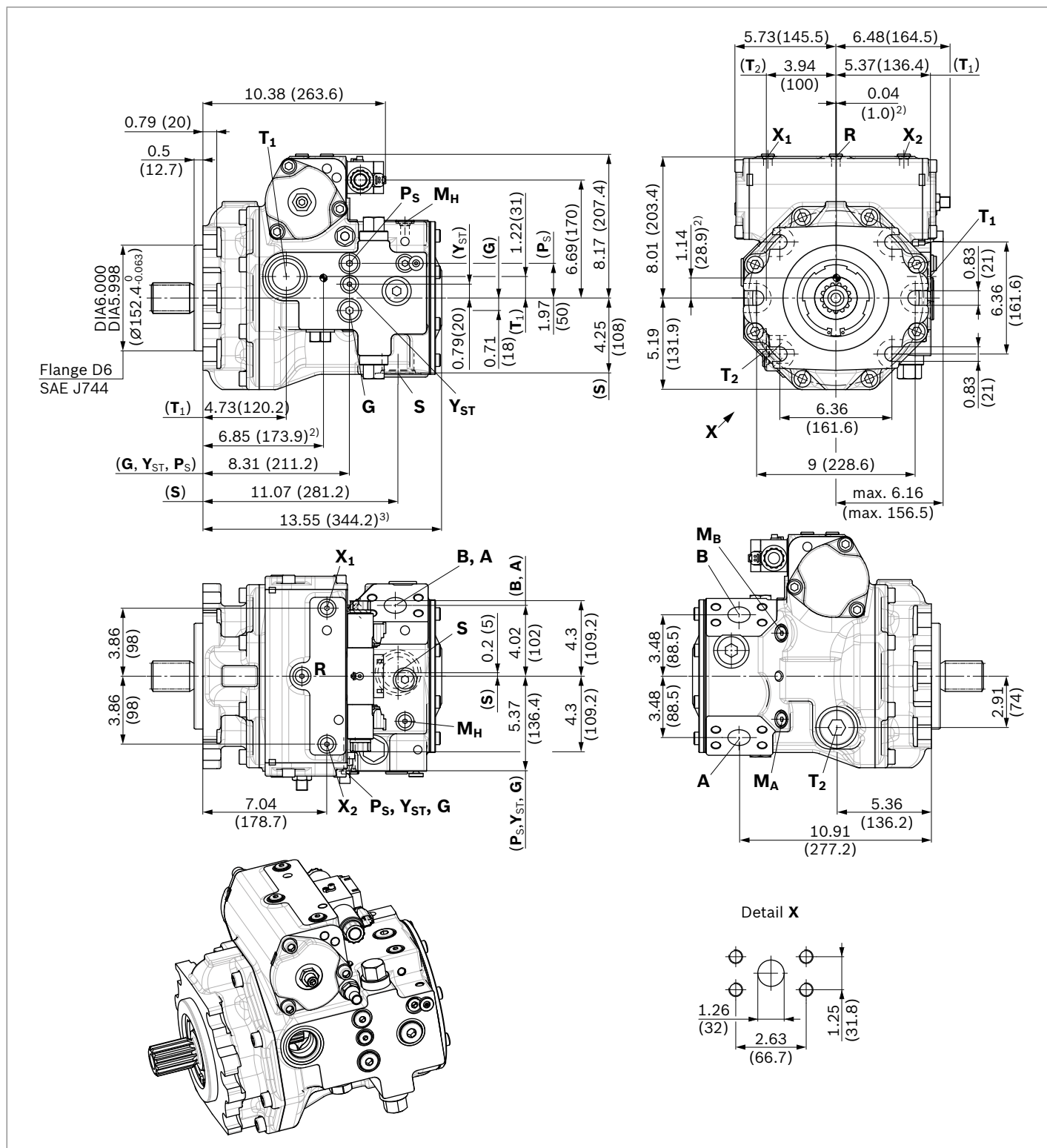
▼ **DA..1** – fixed setting



## Dimensions, size 145

### EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)<sup>1)</sup>



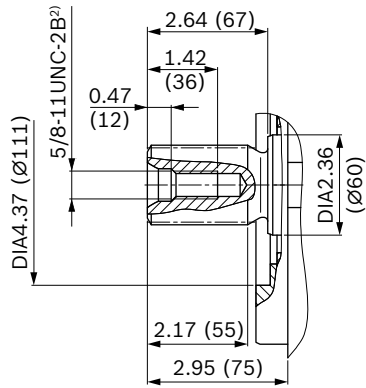
1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

2) Center of gravity

3) Valid for version without boost pump and for standard internal gear pump, overall length with large internal gear pump, see through drive, page 41.

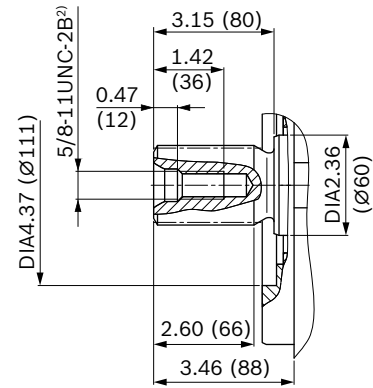
▼ Splined shaft ANSI B92.1a

T1 – 1 3/4 in 13T 8/16DP<sup>1)</sup>



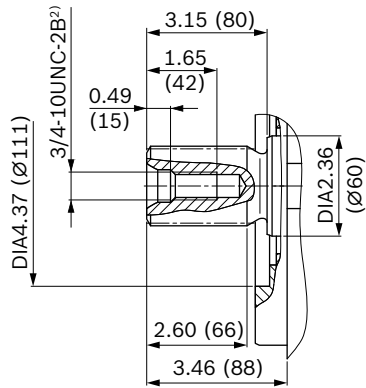
▼ Splined shaft ANSI B92.1a

T2 – 2 in 15T 8/16DP<sup>1)</sup>



▼ Splined shaft ANSI B92.1a

T3 – 2 1/4 in 17T 8/16DP<sup>1)</sup>



1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

Ports		Standard	Size	$p_{\max}$ [psi (bar)] <sup>3)</sup>	State <sup>10)</sup>
<b>A, B<sup>9)</sup></b>	Working port	SAEJ518 <sup>4)</sup>	1 1/4 in	7250 (500)	O
	Fastening thread, screw grade 8 with hardened washer	ASME B1.1	1/2-13UNC; 0.75 (19) deep		
<b>S</b>	Suction port	ISO 11926 <sup>7)</sup>	1 7/8-12UN-2B; 0.79 (20) deep	75 (5)	O <sup>5)</sup>
<b>T<sub>1</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/8-12UN-2B; 0.77 (19.5) deep	45 (3)	O <sup>6)</sup>
<b>T<sub>2</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/8-12UN-2B; 0.77 (19.5) deep	45 (3)	X <sup>6)</sup>
<b>R</b>	Air bleed port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	45 (3)	X
<b>X<sub>1</sub>, X<sub>2</sub></b>	Control pressure port (upstream of orifice)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>X<sub>1</sub>, X<sub>2</sub></b>	Control pressure port (upstream of orifice, HT only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	O
<b>X<sub>3</sub>, X<sub>4</sub><sup>8)</sup></b>	Stroking chamber pressure port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>G</b>	Boost pressure port inlet	ISO 11926 <sup>7)</sup>	7/8-14UNF-2B; 0.67 (17) deep	580 (40)	X
<b>P<sub>S</sub></b>	Pilot pressure port inlet	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40)	X
<b>P<sub>S</sub></b>	Pilot pressure port inlet (DA..6 only)	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40)	O
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet (DA..6 only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	O
<b>Y<sub>HT</sub></b>	Pilot pressure port outlet (HT only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	O
<b>M<sub>A</sub>, M<sub>B</sub></b>	Measuring port pressure A, B	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500)	X
<b>M<sub>H</sub></b>	Measuring port, high pressure	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500)	X
<b>Y<sub>1</sub>, Y<sub>2</sub></b>	Pilot pressure port (pilot signal HP only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	O
<b>Z</b>	Pilot pressure port (inch signal DA..5 only)	ISO 11926 <sup>7)</sup>	3/8-24UNF-2B; 0.39 (10) deep	1150 (80)	O

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518.

5) Plugged for external boost pressure supply.

6) Depending on installation position, **T<sub>1</sub>** or **T<sub>2</sub>** must be connected (see also installation instructions on page 60).

7) The countersink can be deeper than as specified in the standard.

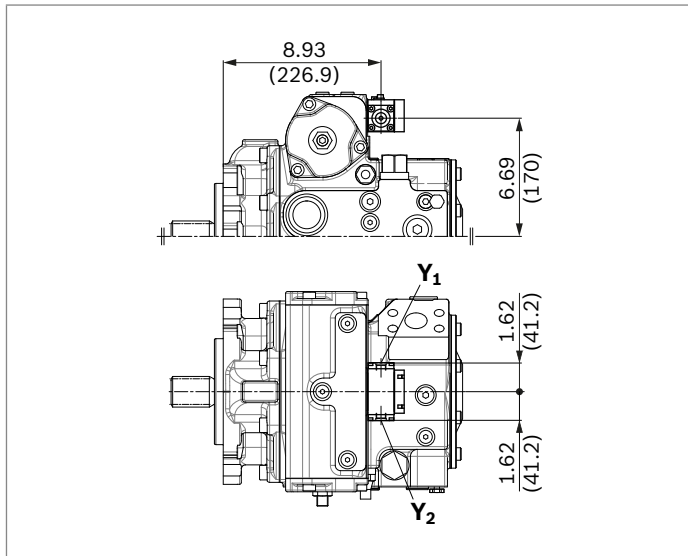
8) Optional, see page 51

9) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.

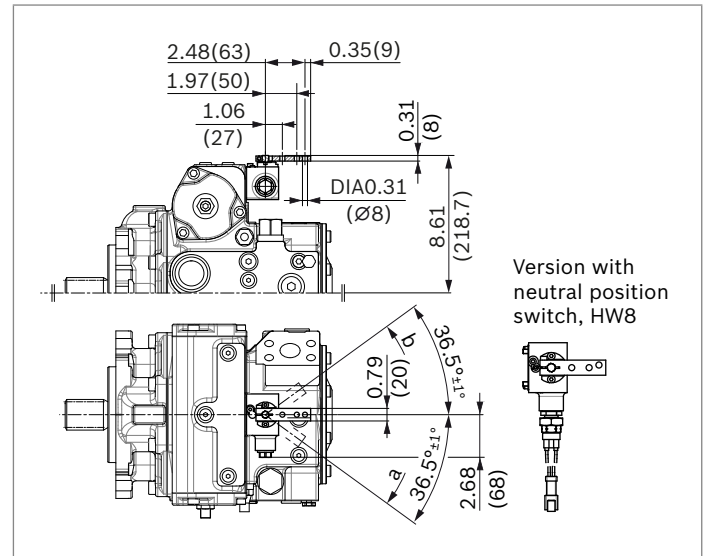
10) O = Must be connected (plugged when delivered)

X = Plugged (in normal operation)

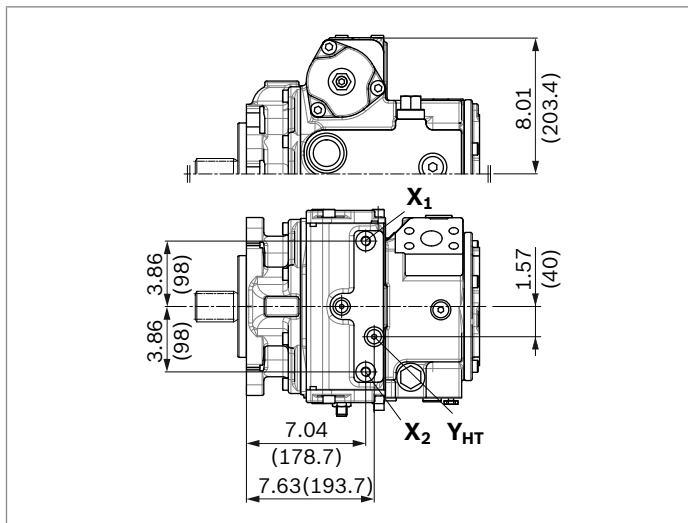
▼ **HP** – Proportional control, hydraulic, pilot-pressure related



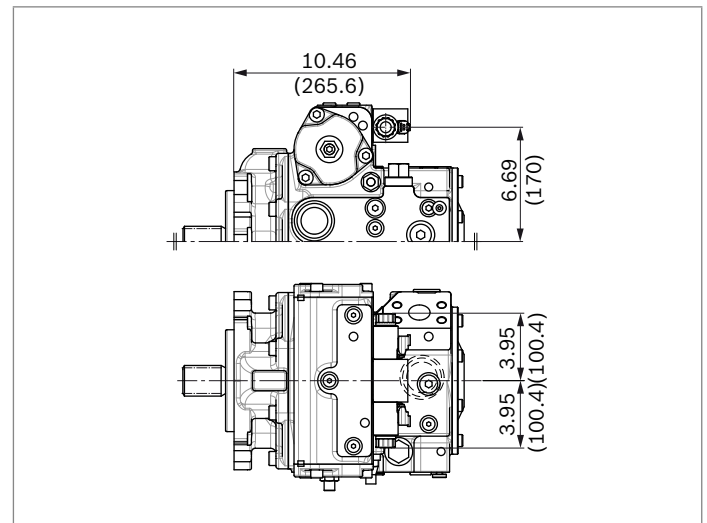
▼ **HW** – Proportional control, hydraulic, mechanical servo



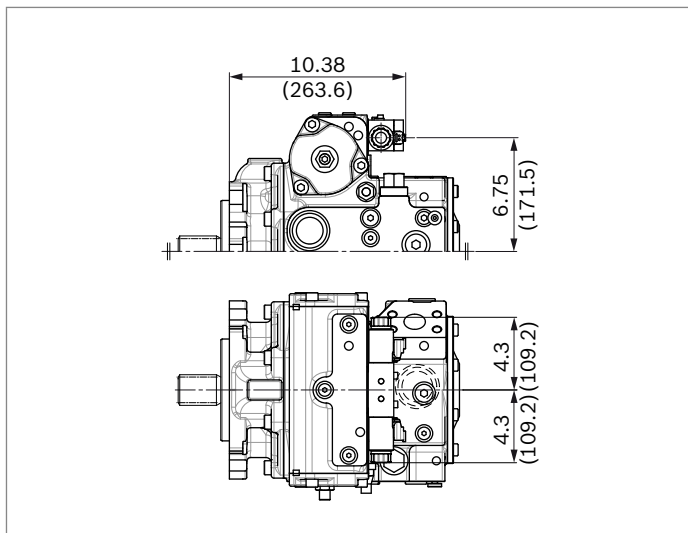
▼ **HT** – Hydraulic control, direct operated



▼ **EZ** – Two-point control, electric



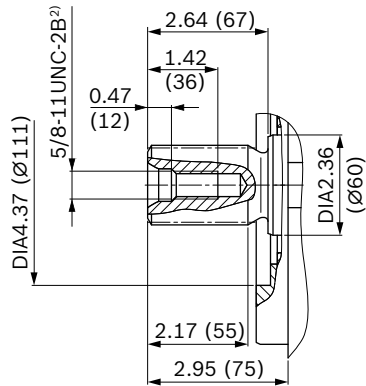
▼ **ET** – Electric control, direct operated, two DRE



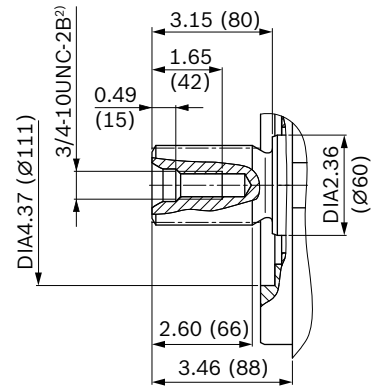




## ▼ Splined shaft ANSI B92.1a

**T1 – 1 3/4 in 13T 8/16DP<sup>1)</sup>**

## ▼ Splined shaft ANSI B92.1a

**T3 – 2 1/4 in 17T 8/16DP<sup>1)</sup>**

Ports	Standard	Size	$p_{max}$ [psi (bar)] <sup>3)</sup>	State <sup>10)</sup>
<b>A, B<sup>9)</sup></b>	Working port Fastening thread, screw grade 8 with hardened washer	SAEJ518 <sup>4)</sup> ASME B1.1	1 1/4 in 1/2-13UNC; 0.75 (19) deep	7250 (500) O
<b>S</b>	Suction port	ISO 11926 <sup>7)</sup>	1 7/8-12UN-2B; 0.79 (20) deep	75 (5) O <sup>5)</sup>
<b>T<sub>1</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/8-12UN-2B; 0.77 (19.5) deep	45 (3) O <sup>6)</sup>
<b>T<sub>2</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/8-12UN-2B; 0.77 (19.5) deep	45 (3) X <sup>6)</sup>
<b>R</b>	Air bleed port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	45 (3) X
<b>X<sub>1</sub>, X<sub>2</sub></b>	Control pressure port (upstream of orifice)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40) X
<b>X<sub>1</sub>, X<sub>2</sub></b>	Control pressure port (upstream of orifice, HT only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40) O
<b>X<sub>3</sub>, X<sub>4</sub><sup>8)</sup></b>	Stroking chamber pressure port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40) X
<b>G</b>	Boost pressure port inlet	ISO 11926 <sup>7)</sup>	7/8-14UNF-2B; 0.67 (17) deep	580 (40) X
<b>P<sub>S</sub></b>	Pilot pressure port inlet	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40) X
<b>P<sub>S</sub></b>	Pilot pressure port inlet (DA..6 only)	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40) O
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40) X
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet (DA..6 only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40) O
<b>Y<sub>HT</sub></b>	Pilot pressure port outlet (HT only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40) O
<b>M<sub>A</sub>, M<sub>B</sub></b>	Measuring port pressure A, B	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500) X
<b>M<sub>H</sub></b>	Measuring port, high pressure	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500) X
<b>Y<sub>1</sub>, Y<sub>2</sub></b>	Pilot pressure port (pilot signal HP only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40) O
<b>Z</b>	Pilot pressure port (inch signal DA..5 only)	ISO 11926 <sup>7)</sup>	3/8-24UNF-2B; 0.39 (10) deep	1150 (80) O

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518.

5) Plugged for external boost pressure supply.

6) Depending on installation position, **T<sub>1</sub>** or **T<sub>2</sub>** must be connected (see also installation instructions on page 60).

7) The countersink can be deeper than as specified in the standard.

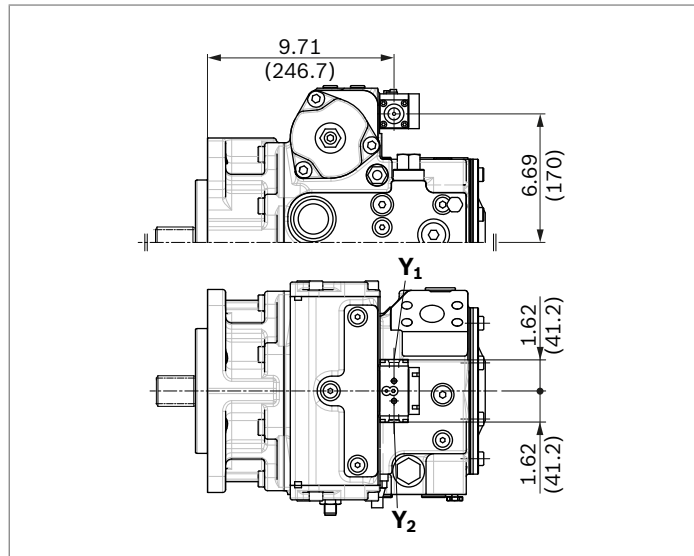
8) Optional, see page 51

9) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.

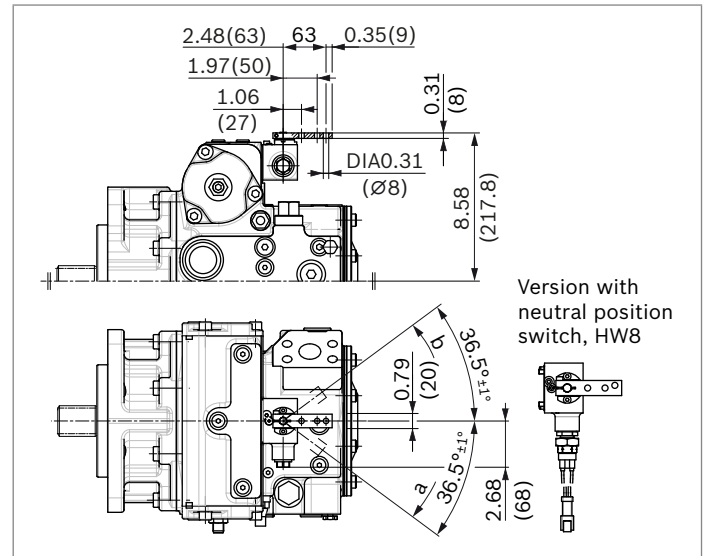
10) O = Must be connected (plugged when delivered)

X = Plugged (in normal operation)

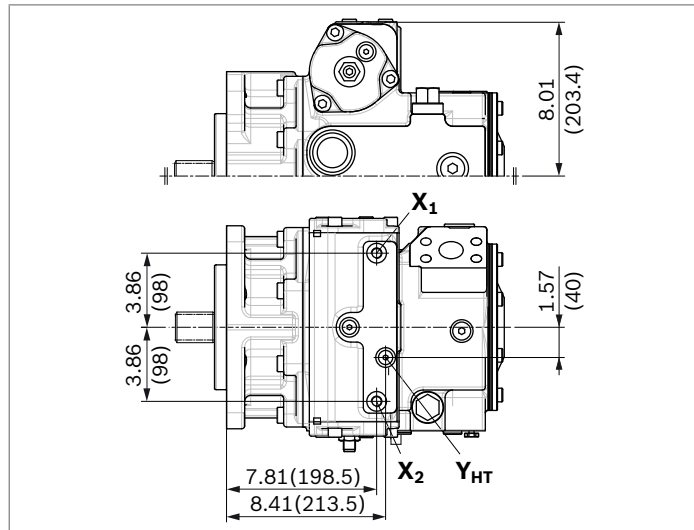
▼ **HP** – Proportional control, hydraulic, pilot-pressure related



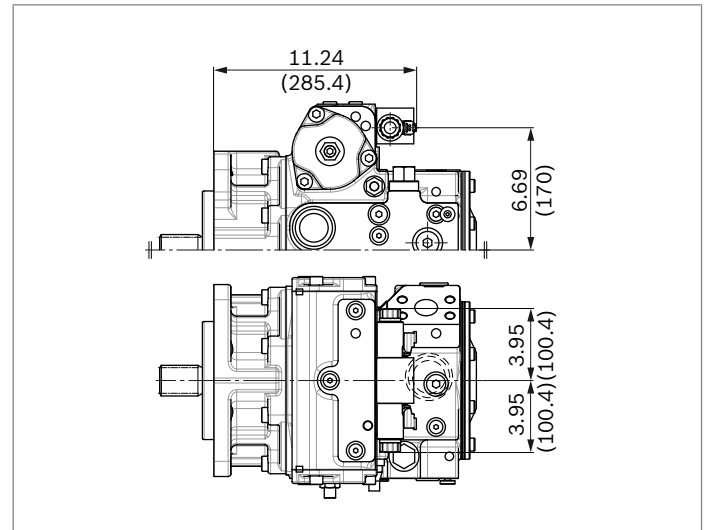
▼ **HW** – Proportional control, hydraulic, mechanical servo



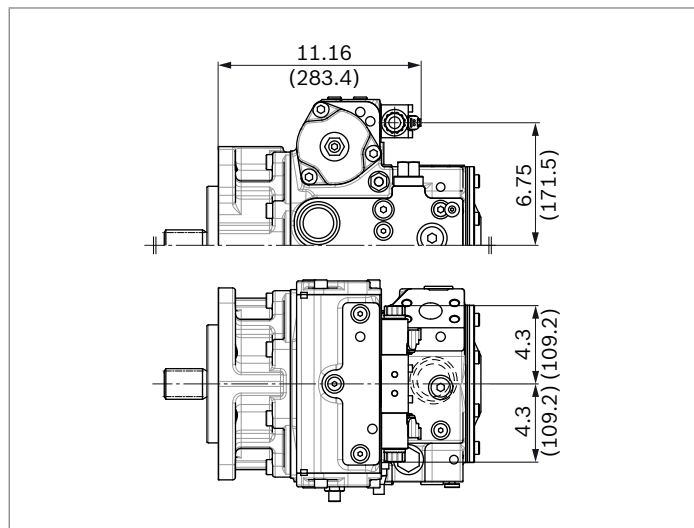
▼ **HT** – Hydraulic control, direct operated

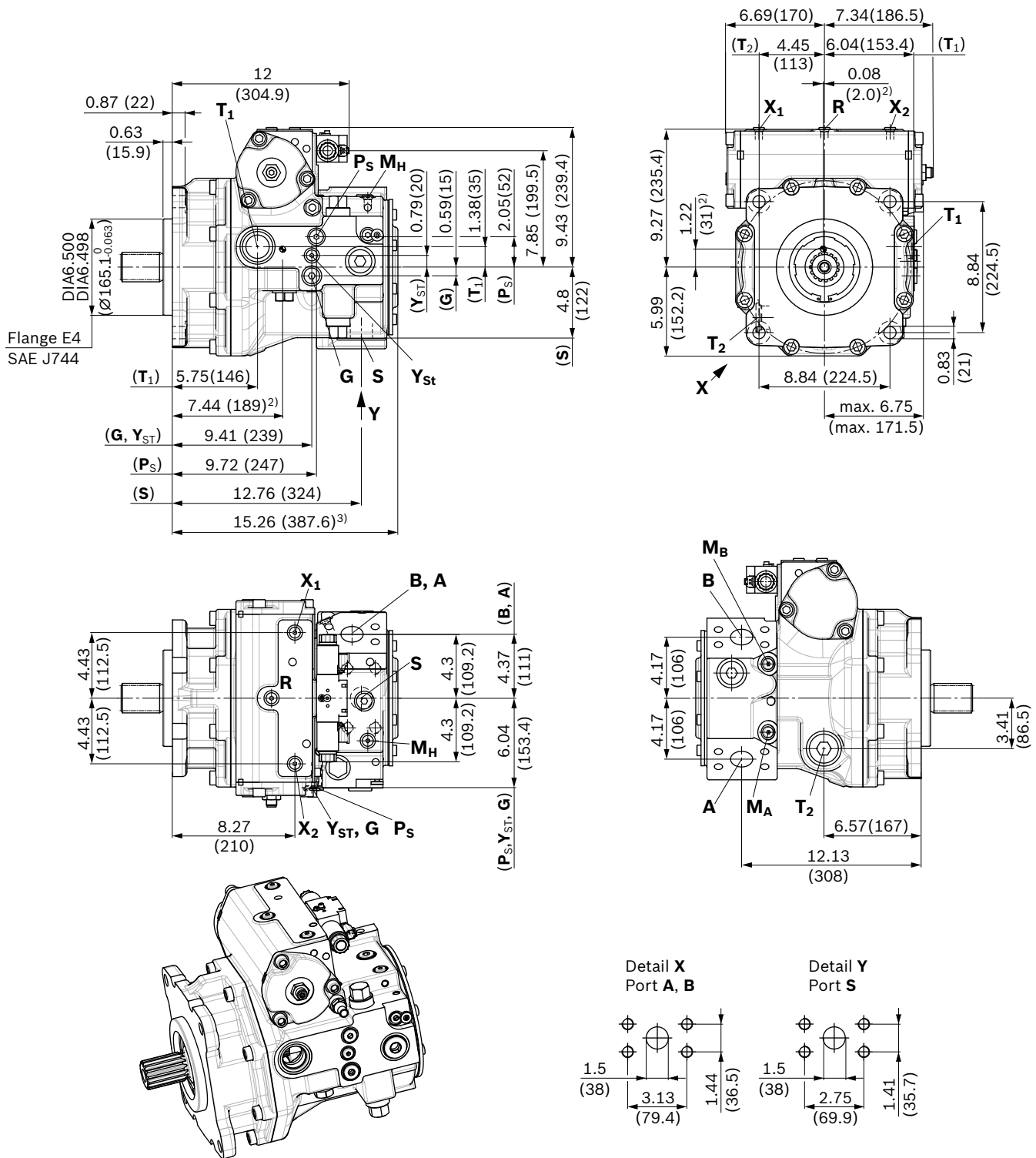


▼ **EZ** – Two-point control, electric



▼ **ET** – Electric control, direct operated, two DRE



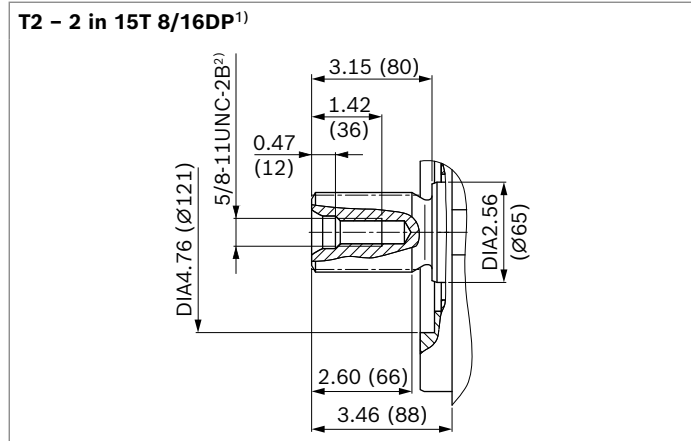
**Dimensions, size 210****EP – Proportional control, electric**SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)<sup>1)</sup>

1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

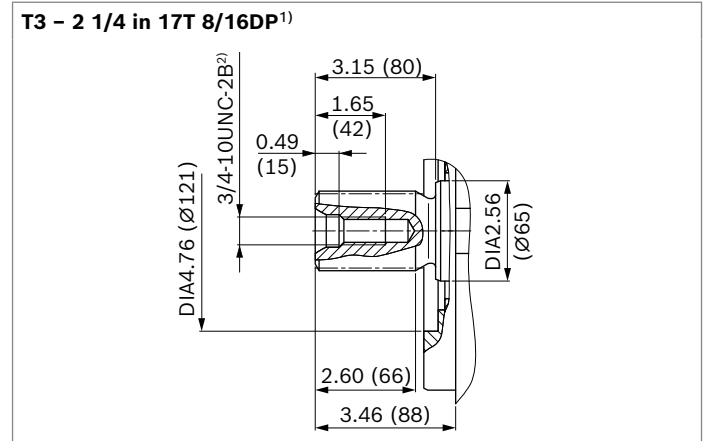
2) Center of gravity

3) Valid for version without boost pump and for standard internal gear pump, overall length with large internal gear pump, see through drive, page 41.

▼ Splined shaft ANSI B92.1a



▼ Splined shaft ANSI B92.1a

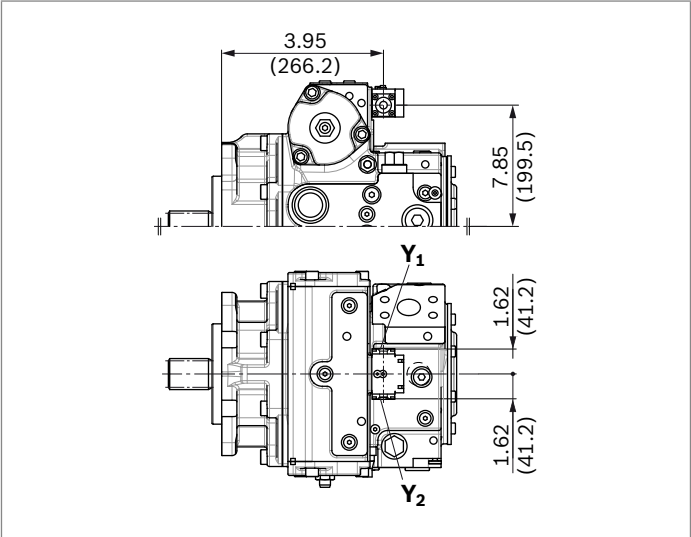


Ports		Standard	Size	$p_{\max}$ [psi (bar)] <sup>3)</sup>	State <sup>10)</sup>
<b>A, B<sup>9)</sup></b>	Working port Fastening thread, screw grade 8 with hardened washer	SAEJ518 <sup>4)</sup> ASME B1.1	1 1/2 in 5/8-11UNC; 1.14 (29) deep	7250 (500)	O
<b>S</b>	Suction port Fastening thread	SAEJ518 <sup>4)</sup> ASME B1.1	1 1/4 in 1/2-13UNC; 0.94 (24) deep	75 (5)	O <sup>5)</sup>
<b>T<sub>1</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/8-12UN-2B; 0.77 (19.5) deep	45 (3)	O <sup>6)</sup>
<b>T<sub>2</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/8-12UN-2B; 0.77 (19.5) deep	45 (3)	X <sup>6)</sup>
<b>R</b>	Air bleed port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	45 (3)	X
<b>X<sub>1</sub>, X<sub>2</sub></b>	Control pressure port (upstream of orifice)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>X<sub>3</sub>, X<sub>4</sub><sup>8)</sup></b>	Stroke chamber pressure port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>G</b>	Boost pressure port inlet	ISO 11926 <sup>7)</sup>	7/8-14UNF-2B; 0.67 (17) deep	580 (40)	X
<b>P<sub>S</sub></b>	Pilot pressure port inlet	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40)	X
<b>P<sub>S</sub></b>	Pilot pressure port inlet (DA..6 only)	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40)	O
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet (DA..6 only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	O
<b>M<sub>A</sub>, M<sub>B</sub></b>	Measuring port pressure A, B	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500)	X
<b>M<sub>H</sub></b>	Measuring port, high pressure	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500)	X
<b>Y<sub>1</sub>, Y<sub>2</sub></b>	Pilot pressure port (pilot signal HP only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	O
<b>Z</b>	Pilot pressure port (inch signal DA..5 only)	ISO 11926 <sup>7)</sup>	3/8-24UNF-2B; 0.39 (10) deep	1150 (80)	O

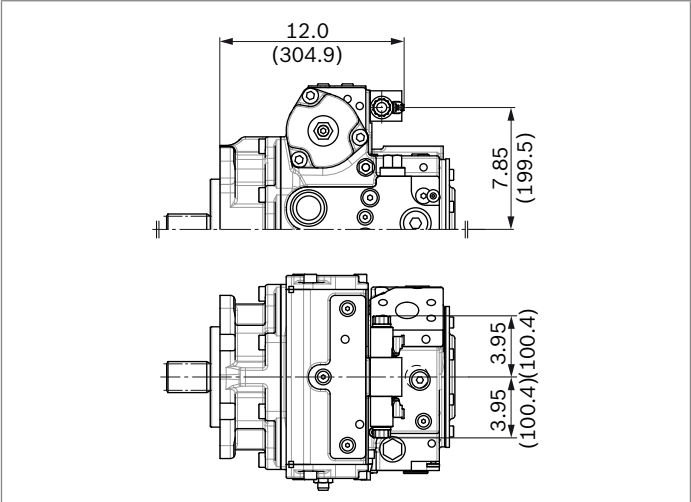
- 1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Thread according to ASME B1.1
- 3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
- 4) Only dimensions according to SAE J518.
- 5) Plugged for external boost pressure supply.

- 6) Depending on installation position, **T<sub>1</sub>** or **T<sub>2</sub>** must be connected (see also installation instructions on page 60).
- 7) The countersink can be deeper than as specified in the standard.
- 8) Optional, see page 51
- 9) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.
- 10) O = Must be connected (plugged when delivered)  
X = Plugged (in normal operation)

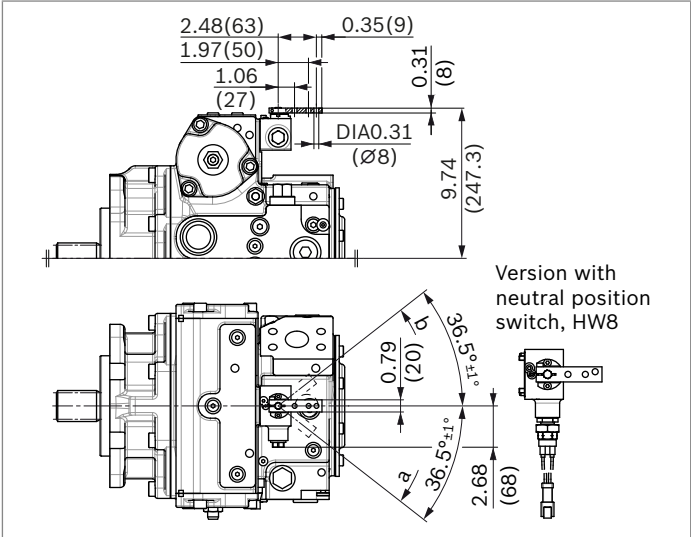
▼ **HP** – Proportional control, hydraulic, pilot-pressure related



▼ **EZ** – Two-point control, electric



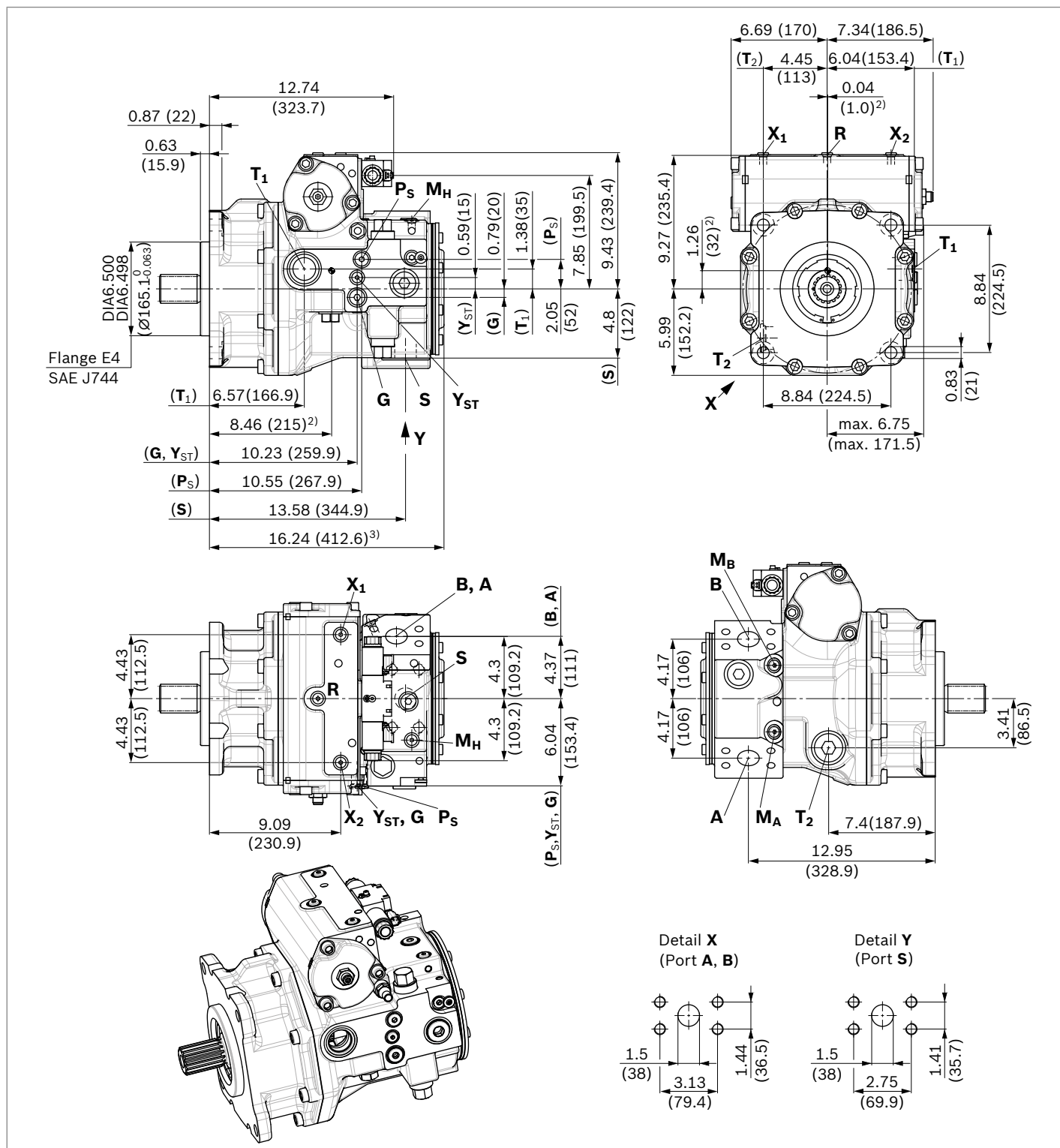
▼ **HW** – Proportional control, hydraulic, mechanical servo



## Dimensions, size 280

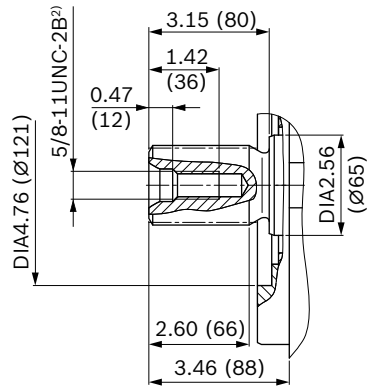
**EP – Proportional control, electric**

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)<sup>1)</sup>

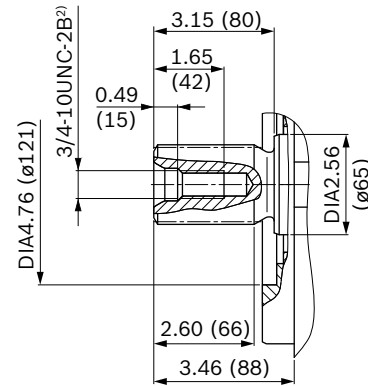


- 1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.
- 2) Center of gravity
- 3) Valid for version with standard internal gear pump, overall length without boost pump see through drive, page 41.

## ▼ Splined shaft ANSI B92.1a

T2 – 2 in 15T 8/16DP<sup>1)</sup>

## ▼ Splined shaft ANSI B92.1a

T3 – 2 1/4 in 17T 8/16DP<sup>1)</sup>

Ports		Standard	Size	$p_{\max}$ [psi (bar)] <sup>3)</sup>	State <sup>10)</sup>
<b>A, B<sup>9)</sup></b>	Working port Fastening thread, screw grade 8 with hardened washer	SAEJ518 <sup>4)</sup> ASME B1.1	1 1/2 in 5/8-11UNC; 1.14 (29) deep	7250 (500)	O
<b>S</b>	Suction port fastening thread	SAEJ518 <sup>4)</sup> ASME B1.1	1 1/2 in 1/2-13UNC; 0.94 (24) deep	75 (5)	O <sup>5)</sup>
<b>T<sub>1</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/8-12UNC-2B; 0.77 (19.5) deep	45 (3)	O <sup>6)</sup>
<b>T<sub>2</sub></b>	Drain port	ISO 11926 <sup>7)</sup>	1 5/8-12UNC-2B; 0.77 (19.5) deep	45 (3)	X <sup>6)</sup>
<b>R</b>	Air bleed port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	45 (3)	X
<b>X<sub>1</sub>, X<sub>2</sub></b>	Control pressure port (upstream of orifice)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>X<sub>3</sub>, X<sub>4</sub><sup>8)</sup></b>	Stroking chamber pressure port	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>G</b>	Boost pressure port inlet	ISO 11926 <sup>7)</sup>	7/8-14UNF-2B; 0.67 (17) deep	580 (40)	X
<b>P<sub>S</sub></b>	Pilot pressure port inlet	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40)	X
<b>P<sub>S</sub></b>	Pilot pressure port inlet (DA..6 only)	ISO 11926 <sup>7)</sup>	3/4-16UNF-2B; 0.59 (15) deep	580 (40)	O
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	X
<b>Y<sub>ST</sub></b>	Pilot pressure port outlet (DA..6 only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	O
<b>M<sub>A</sub>, M<sub>B</sub></b>	Measuring port pressure A, B	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500)	X
<b>M<sub>H</sub></b>	Measuring port, high pressure	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	7250 (500)	X
<b>Y<sub>1</sub>, Y<sub>2</sub></b>	Pilot pressure port (pilot signal HP only)	ISO 11926 <sup>7)</sup>	9/16-18UNF-2B; 0.51 (13) deep	580 (40)	O
<b>Z</b>	Pilot pressure port (inch signal DA..5 only)	ISO 11926 <sup>7)</sup>	3/8-24UNF-2B; 0.39 (10) deep	1150 (80)	O

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518.

5) Plugged for external boost pressure supply.

6) Depending on installation position, **T<sub>1</sub>** or **T<sub>2</sub>** must be connected (see also installation instructions on page 60).

7) The countersink can be deeper than as specified in the standard.

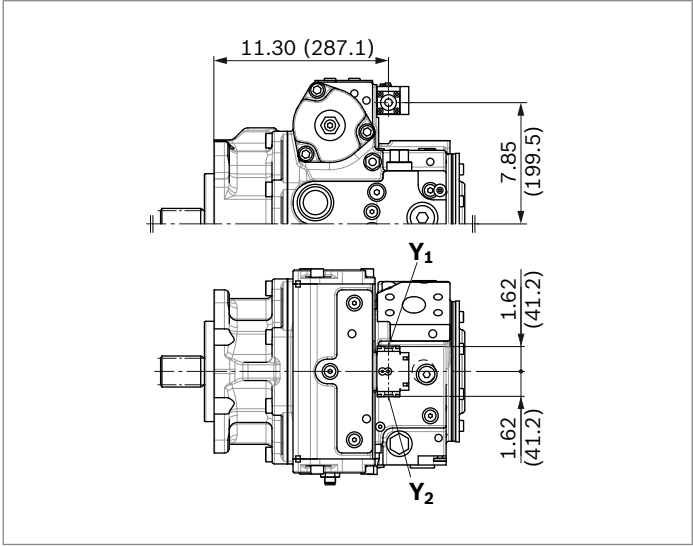
8) Optional, see page 51

9) For the maximum utilization of pressure, only grade 8 screws and hardened washers are to be used to tighten the SAE flange shells.

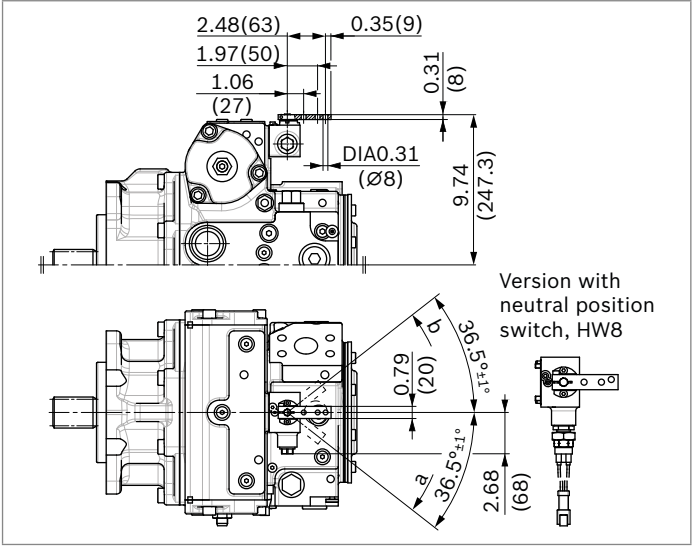
10) O = Must be connected (plugged when delivered)

X = Plugged (in normal operation)

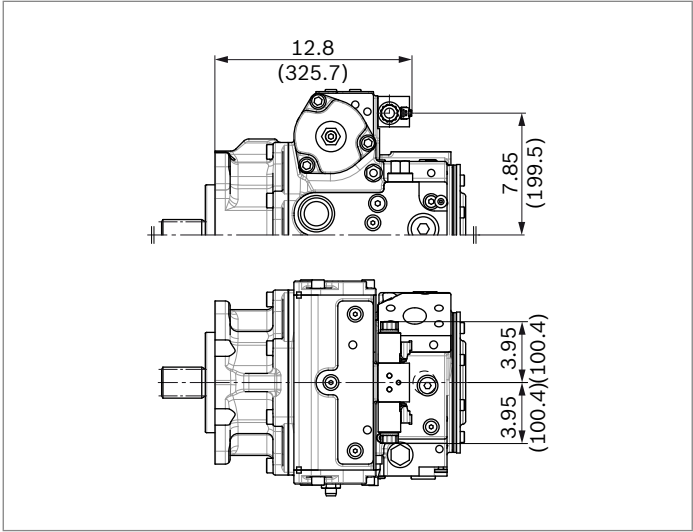
▼ **HP** – Proportional control, hydraulic, pilot-pressure related



▼ **HW** – Proportional control, hydraulic, mechanical servo



▼ **EZ** – Two-point control, electric

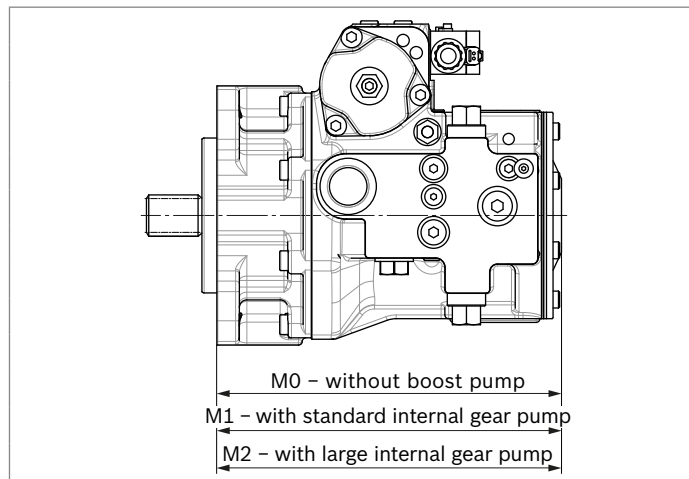




## Dimensions, through drive

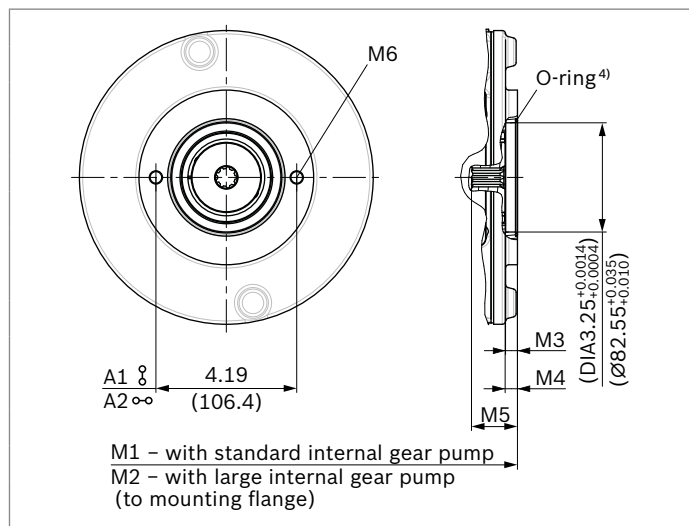
Flange SAE J744 <sup>1)</sup>			Hub for splined shaft <sup>2)</sup>			110	125	145	175	210	280
Diameter	Mounting <sup>3)</sup>	Code	Diameter		Code						
Without through drive						●	●	●	●	●	0000
82-2 (A)	$\frac{8}{16}$	A1	5/8 in	9T 16/32DP	S2	○	–	●	○	–	A1S2
	$\infty$	A2	5/8 in	9T 16/32DP	S2	●	○	○	○	○	A2S2

### ▼ Without through drive, without boost pump, with standard internal gear pump or with large internal gear pump



NG	M0	M1	M2
<b>110</b>	12.37 (314.3)	12.53 (318.3)	12.70 (322.7)
<b>125</b>	12.37 (314.3)	12.70 (322.7)	–
<b>145</b>	13.55 (344.2)	13.55 (344.2)	13.68 (347.5)
<b>175</b>	14.32 (363.8)	14.46 (367.3)	14.57 (370.1)
<b>210</b>	15.26 (387.6)	15.26 (387.6)	15.46 (392.7)
<b>280</b>	16.04 (407.3)	16.24 (412.6)	–

### ▼ 82-2



NG	M1	M2	M3	M4	M5	M6 <sup>5)</sup>
<b>110</b>	12.77 (324.3)	12.93 (328.3)	0.35 (9)	0.37 (9.4)	1.36 (34.6)	3/8-16UNC-2B; 0.51 (13) deep
<b>125</b>	12.93 (328.3)	–	0.35 (9)	0.39 (10)	1.38 (35)	
<b>145</b>	13.63 (346.2)	13.76 (349.5)	0.35 (9)	0.37 (9.3)	1.37 (34.7)	3/8-16UNC-2B; 0.51 (13) deep
<b>175</b>	14.54 (369.3)	14.65 (372.1)	0.35 (9)	0.36 (9.1)	1.31 (33.4)	
<b>210</b>	15.34 (389.6)	15.54 (394.7)	0.35 (9)	0.29 (7.3)	1.30 (33)	On request
<b>280</b>	16.36 (415.6)	–	0.38 (9.7)	0.37 (9.4)	1.34 (34.1)	

1) The through-drive shaft is only supplied with the fastening thread corresponding to the ordering code designation.

2) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

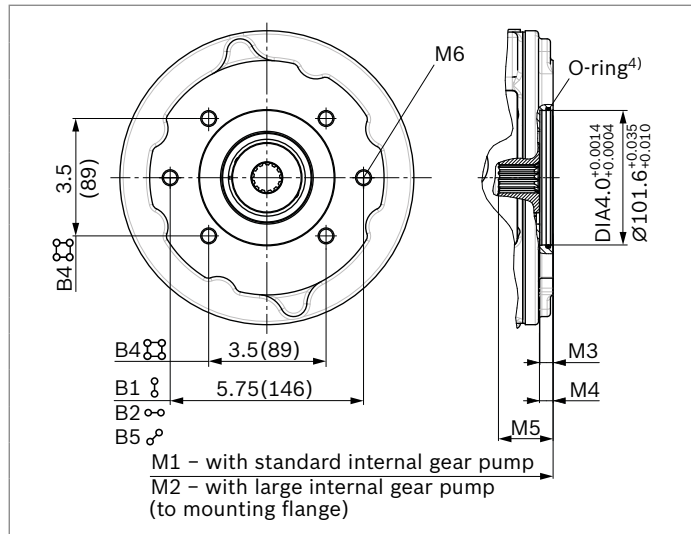
3) Mounting hole pattern viewed on through drive with control at top

4) O-ring included in the scope of delivery

5) Thread according to ASME B1.1

Flange SAE J744 <sup>1)</sup>			Hub for splined shaft <sup>2)</sup>									
Diameter	Mounting <sup>3)</sup>	Code	Diameter		Code	110	125	145	175	210	280	
101-2 (B)	⌘	B1	7/8 in	13T 16/32DP	S4	○	–	●	○	–	–	<b>B1S4</b>
		B1	1 in	15T 16/32DP	S5	○	–	○	○	–	–	<b>B1S5</b>
	∞	B2	7/8 in	13T 16/32DP	S4	●	●	●	○	○	○	<b>B2S4</b>
		B2	1 in	15T 16/32DP	S5	●	●	○	○	○	○	<b>B2S5</b>
	♂	B5	7/8 in	13T 16/32DP	S4	–	–	○	–	–	–	<b>B5S4</b>

▼ 101-2

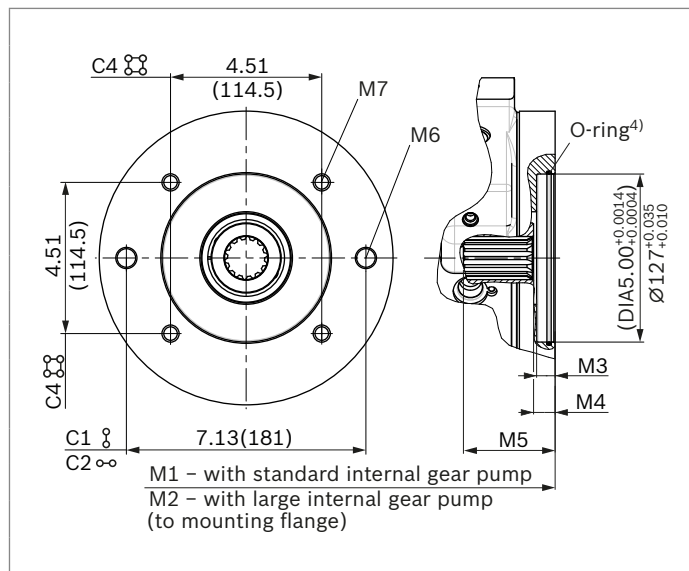


NG	M1	M2	M3	M4	M5	M6 <sup>5)</sup>
<b>110</b>	12.89 (327.3)	13.04 (331.2)	0.39 (10)	0.43 (10.9)	1.93 (48.9)	1/2-13UNC-2B; 0.63 (16) deep
<b>125</b>	13.04 (331.2)	–	0.39 (10)	0.43 (11)	1.89 (48)	
<b>145</b>	13.75 (349.2)	13.88 (352.5)	0.39 (10)	0.41 (10.3)	1.59 (40.3)	
<b>175</b>	14.66 (372.3)	14.77 (375.1)	0.39 (10)	0.41 (10.3)	1.59 (40.3)	
<b>210</b>	15.46 (392.6)	15.66 (397.7)	0.39 (10)	0.39 (9.8)	1.80 (45.8)	1/2-13UNC-2B; 0.63 (16) deep
<b>280</b>	16.48 (418.6)	–	0.39 (10)	0.41 (10.5)	1.91 (48.5)	

- 1) The through-drive shaft is only supplied with the fastening thread corresponding to the ordering code designation.
- 2) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 3) Mounting hole pattern viewed on through drive with control at top
- 4) O-ring included in the scope of delivery
- 5) Thread according to ASME B1.1

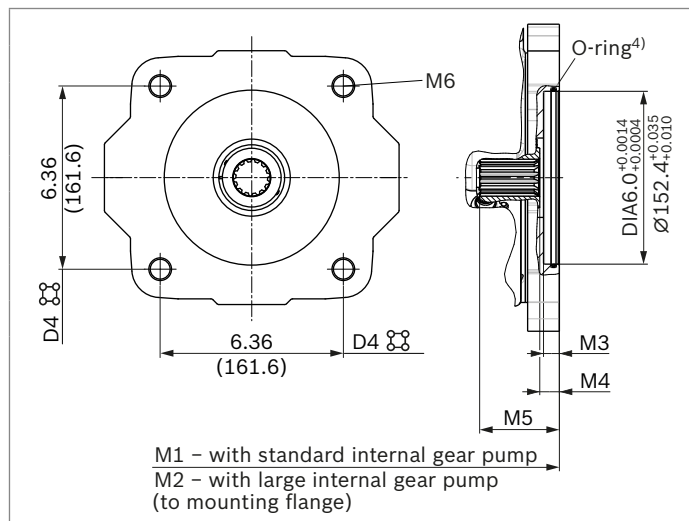
Flange SAE J744 <sup>1)</sup>			Hub for splined shaft <sup>2)</sup>									
Diameter	Mounting <sup>3)</sup>	Code	Diameter		Code	110	125	145	175	210	280	
127-2 (C)		C1	1 1/4 in	14T 12/24DP	S7	●	–	○	○	○	○	C1S7
		C2	1 1/4 in	14T 12/24DP	S7	●	○	●	●	●	○	C2S7
		C2	1 3/8 in	21T 16/32DP	V8	●	–	○	○	–	–	C2V8
		C2	1 3/4 in	13T 8/16DP	T1	–	–	●	○	–	–	C2T1
127-4 (C)		C4	1 1/4 in	14T 12/24DP	S7	○	–	○	●	–	–	C4S7
		C4	1 3/8 in	21T 16/32DP	V8	○	–	–	–	–	–	C4V8
152-4 (D)		D4	1 3/4 in	13T 8/16DP	T1	–	–	●	●	●	○	D4T1

## ▼ 127-2, 127-2/4




NG	M1	M2	M3	M4	M5	M6 <sup>5)</sup> 2-hole
<b>110</b>	13.12 (333.3)	13.28 (337.3)	0.55 (14)	0.67 (16.9)	2.29 (54.9)	5/8-11UNC-2B; 0.83(21) deep
<b>125</b>	On request		0.55 (14)	0.43 (10.9)	2.36 (59.9)	On request
<b>145</b>	13.98 (355.2)	14.11 (358.5)	0.55 (14)	0.64 (16.3)	2.49 (63.3)	5/8-11UNC-2B; 0.83(21) deep
<b>175</b>	14.89 (378.3)	15.0 (381.1)	0.55 (14)	0.64 (16.3)	2.41 (61.3)	
<b>210</b>	15.89 (403.7)	16.09 (408.8)	1.06 (27)	0.56 (14.2)	2.22 (56.4)	
<b>280</b>	16.72 (424.6)	–	1.06 (27)	0.57 (14.4)	2.31 (58.6)	
NG	M7 <sup>5)</sup> 4-hole					
<b>110</b>	On request					
<b>145, 175</b>	1/2-13UNC-2B; 0.83(21) deep					

## ▼ 152-4

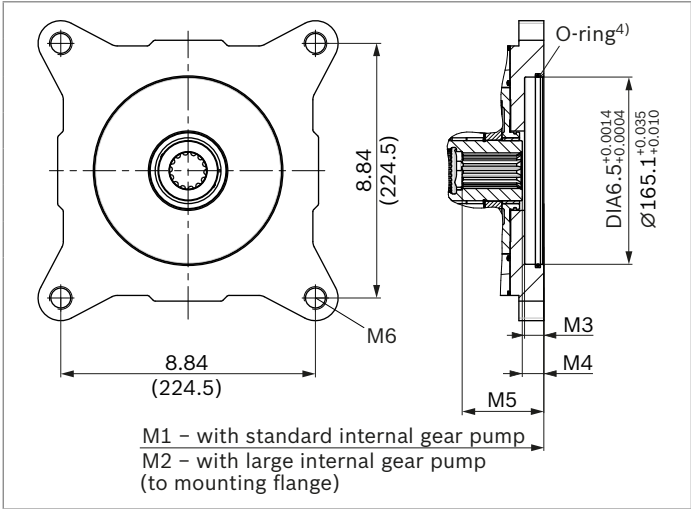


NG	M1	M2	M3	M4	M5	M6 <sup>5)</sup>
<b>145</b>	14.02 (356.2)	14.15 (359.5)	0.55 (14)	0.39 (10)	2.93 (74.4)	3/4-10UNC-2B; 0.87 (22) deep
<b>175</b>	14.93 (379.3)	15.04 (382.1)	0.55 (14)	0.70 (17.8)	3.00 (76.3)	
<b>210</b>	16.20 (411.6)	16.41 (416.7)	1.02 (26)	0.56 (14.3)	3.10 (78.8)	
<b>280</b>	17.03 (432.5)	–	1.02 (26)	0.57 (14.5)	3.31 (84)	

- 1) The through-drive shaft is only supplied with the fastening thread corresponding to the ordering code designation.
- 2) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 3) Mounting hole pattern viewed on through drive with control at top
- 4) O-ring included in the scope of delivery
- 5) Thread according to ASME B1.1

Flange SAE J744 <sup>1)</sup>			Hub for splined shaft <sup>2)</sup>									
Diameter	Mounting <sup>3)</sup>	Code	Diameter		Code	110	125	145	175	210	280	
165-4 (E)		E4	1 3/4 in	13T 8/16DP	T1	–	–	–	o	o	o	E4T1
			2 in	15T 8/16DP	T2	–	–	–	–	o	o	E4T2

▼ 165-4



NG	M1	M2	M3	M4	M5	M6 <sup>5)</sup>
175	15.00	15.11	0.67	0.76	3.07	3/4-10UNC-2B; 0.87 (22) deep
	(381)	(383.8)	(17)	(19.4)	(77.9)	
210	16.04	16.24	On request			
	(407.3)	(412.4)				
280	17.61	–	On request			
	(447.3)	–				

1) The through-drive shaft is only supplied with the fastening thread corresponding to the ordering code designation.

2) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

3) Mounting hole pattern viewed on through drive with control at top

4) O-ring included in the scope of delivery

5) Thread according to ASME B1.1

## Overview of mounting options

Through drive <sup>1)</sup>			Mounting option – 2nd pump						
Flange	Hub for splined shaft	Code	A4VG/40 NG (shaft)	A4VG/32 NG (shaft)	A10VG/10 NG (shaft)	A10VO/3x NG (shaft)	A10V(S)O/5x NG (shaft)	A11VO/1 NG (shaft)	External gear pump <sup>2)</sup>
82-2 (A)	5/8 in	<b>A_S2</b>	–	–	–	18 (U)	10, 18 (U)	–	AZPF, AZPS NG4 ... 28 AZPW NG5 ... 22
101-2 (B)	7/8 in	<b>B_S4</b>	–	–	18 (S)	28 (S) 45 (U)	28 (S) 45 (U)	–	AZPN-11 NG20 ... 25 AZPG-22 NG28 ... 100
	1 in	<b>B_S5</b>	–	28 (S)	28, 45 (S)	45 (S)	45 (S) 60, 63, 72 (U)	40 (S)	–
127-2 (C)	1 1/4 in	<b>C_S7</b>	–	40, 56, 71 (S)	63 (S)	71 (S) 100 (U)	85, 100 (U)	60 (S)	–
	1 3/8 in	<b>C2V8</b>	110 (V8)	56, 71 (T)	63 (T)	–	–	60 (T)	
	1 3/4 in	<b>C2T1</b>	110, 125 (T1)	–	–	–	–	–	
127-4 (C)	1 1/4 in	<b>C4S7</b>	–	–	–	–	60, 63, 72 (S) 85, 100 (U)	–	
	1 3/8 in	<b>C4V8</b>	110 (V8)	–	–	–	–	–	
152-4 (D)	1 3/4 in	<b>D4T1</b>	110, 125, 145, 175 (T1)	90, 125 (S)	–	140, 180 (S)	–	95, 130, 145 (S)	–
165-4 (E)	1 3/4 in	<b>E4T1</b>	175 (T1)	180 (S)	–	–	–	190, 260 (S)	–
	2 in	<b>E4T2</b>	210, 280 (T2)	–	–	–	–	190 (T)	

### Notice

The mounting options listed only apply for drive shaft versions with undercut. Please contact us for drive shafts without undercut.

<sup>1)</sup> Availability of the individual sizes, see type code on page 4.

<sup>2)</sup> Bosch Rexroth recommends special versions of the gear pumps. Please contact us.

## Combination pumps A4VG + A4VG

### Total length A<sup>1)</sup> with standard mounting flange

A4VG		A4VG 2nd pump <sup>2)</sup>					
1st pump		NG110	NG125	NG145	NG175	NG210	NG280
NG110	in	25.7	–	–	–	–	–
	mm	652.6	–	–	–	–	–
NG125	in	On request	On request	–	–	–	–
	mm			–	–	–	–
NG145	in	26.6	On request	27.6	–	–	–
	mm	674.5		700.4	–	–	–
NG175	in	27.5	On request	28.5	29.5	–	–
	mm	697.6		723.5	748.3	–	–
NG210	in	28.7	On request	29.8	On request	31.8	–
	mm	729.9		755.8		807.9	–
NG280	in	29.8	On request	30.8	On request	On request	On request
	mm	755.9		781.8			

By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of the 1st and 2nd pumps must be linked by a “+”.

Order example:

**A4VG145EP1DP000/40MRNC6S71FC2S7AS00-0 + A4VG110EP1DP000/40MRNC2S71F0000AS00-0**

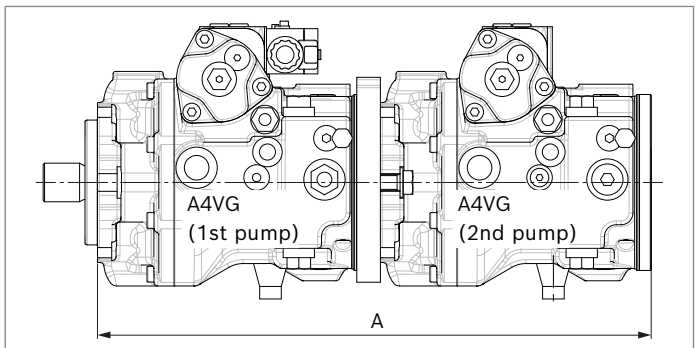
A tandem pump, with two pumps of equal size, is permissible without additional supports, assuming that the dynamic acceleration does not exceed maximum 10 g (= 322 ft/s<sup>2</sup> (98.1 m/s<sup>2</sup>)).

We recommend using the 4-hole mounting flanges.

For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible moment of inertia, please contact us.

#### Notice

- The combination pump type code is shown in shortened form in the order confirmation.
- The permissible through-drive torques are to be observed (see page 11).



<sup>1)</sup> Overall length is valid for standard mounting flange and integrated boost pump.

<sup>2)</sup> 2nd pump without through drive and with boost pump, F0000/V0000

## High-pressure relief valves

The two high-pressure relief valves protect the hydrostatic transmission (pump and motor) from overloading. They limit the maximum pressure in the respective high-pressure line and serve simultaneously as boost valves. High-pressure relief valves are not working valves and are only suitable for pressure peaks or high rates of pressure change.

### Setting ranges

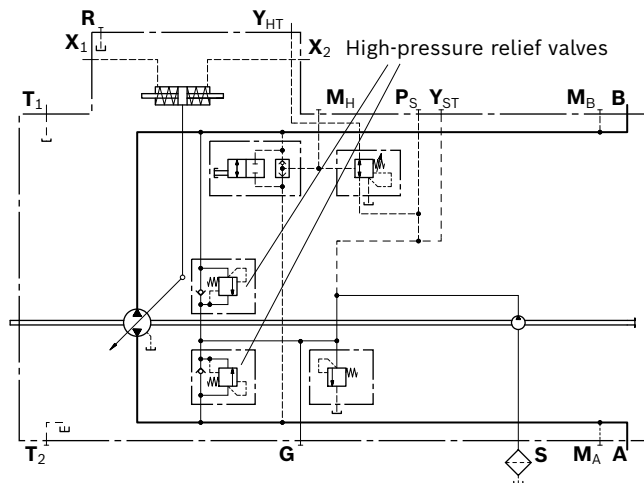
High-pressure relief valve A and B	Differential pressure setting $\Delta p_{HD}$
Preferred values	5800 psi (400 bar)
	5950 psi (410 bar)
	6100 psi (420 bar)
	6250 psi (430 bar)
	6400 psi (440 bar)
	6500 psi (450 bar)
	6650 psi (460 bar)
	6800 psi (470 bar)
Optional values	4350 psi (300 bar)
	4650 psi (320 bar)
	4950 psi (340 bar)
	5200 psi (360 bar)
	5500 psi (380 bar)

### Settings on high-pressure relief valve A and B

Differential pressure setting	$\Delta p_{HD} = \dots$ psi
Cracking pressure of the HD valve (at $q_{V1}$ )	$p_{max} = \dots$ psi
$(p_{max} = \Delta p_{HD} + p_{Sp})$	

- The valve settings are made at  $n = 1000$  rpm and at  $V_{g\ max}$  ( $q_{V1}$ ). There may be deviations in the cracking pressures with other operating parameters.
- When ordering, state differential pressure setting  $\Delta p_{HD}$  in plain text.

### ▼ Circuit diagram

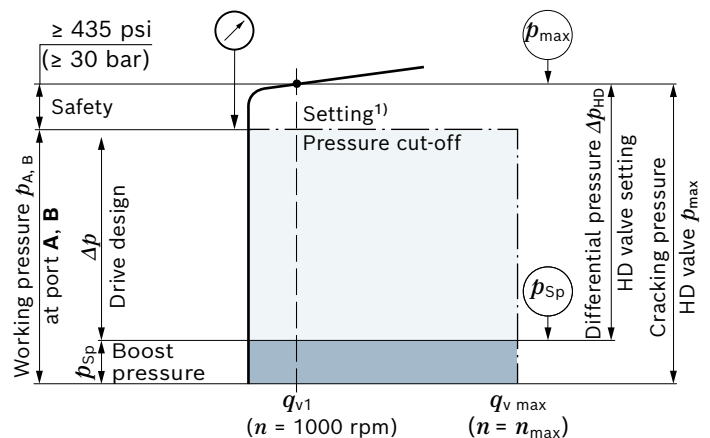


### Example: $\Delta p$ drive design = 6250 psi (430 bar) ( $p_{A, B} - p_{Sp}$ )

Working pressure $p_{A, B}$	-	Boost pressure $p_{Sp}$	+	Safety	=	Differential pressure $\Delta p_{HD}$
6500 psi (450 bar)	-	290 psi (20 bar)	+	435 psi (30 bar)	=	6645 psi (460 bar)

- Cracking pressure of the HD valve (at  $q_{V1}$ ):  
 $p_{max} = 6960$  psi (480 bar) ( $p_{max} = \Delta p_{HD} + p_{Sp}$ )

### ▼ Setting diagram



### Key

HD valve	High-pressure relief valve
Cracking pressure HD valve $p_{max}$	When the set pressure value is reached, the HD valve opens and thus protects the hydrostatic gear (pump and motor) from overloading
Differential pressure HD valve $\Delta p_{HD}$	Cracking pressure HD valve (abs.) minus the boost pressure setting
Working pressure $p_{A, B}$	The total design of the customer machine is based on this pressure value. It comprises the boost pressure setting and the $\Delta p$ drive design.
$\Delta p$ drive design	Differential pressure value determining the available torque at the hydraulic motor ( $p_{A, B} - p_{Sp}$ ).
Boost pressure $p_{Sp}$	Boost pressure setting of the low-pressure valve
Safety	Required distance between working pressure (and/or pressure cut-off) and cracking pressure of the high-pressure relief valve to ensure the intended function of the high-pressure relief valve.

### Notice

Upon response of the high-pressure relief valve, the permissible temperature and viscosity must be complied with.

1) Omitted with version without pressure cut-off

## Pressure cut-off

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

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

The high-pressure relief valves protect against the pressure peaks which occur during fast swiveling of the swash-plate and limit the maximum pressure in the system.

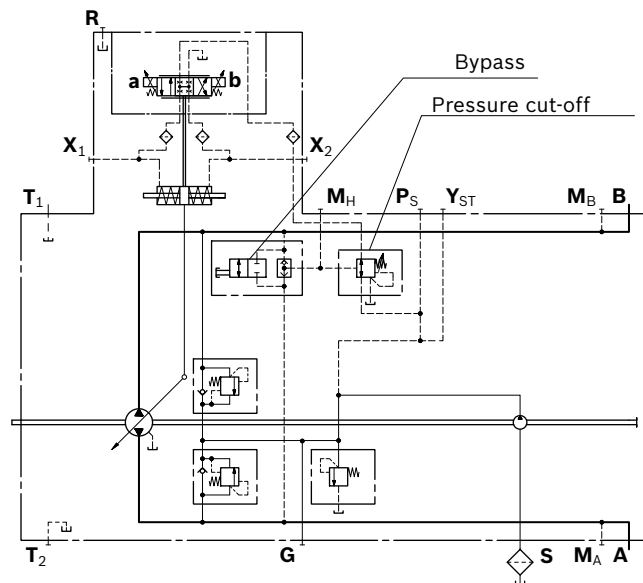
The setting range of the pressure cut-off may be anywhere within the entire working pressure range. However, it must be set 435 psi (30 bar) lower than the setting value of the high-pressure relief valves (see setting diagram, page 47).

The function of the pressure cut-off in combination with a HT control is described on page 15.

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

### ▼ Circuit diagram with pressure cut-off

Example: electric control, EP\_D



## Bypass function

A connection between the two high-pressure passages **A** and **B** can be established using the bypass valve (e.g. for machine towing).

### ► Towing speed

The maximum towing speed depends on the gear ratio in the vehicle and must be calculated by the vehicle manufacturer. The corresponding flow of  $q_v = 7.9$  gpm (= 30 l/min) may not be exceeded.

### ► Towing distance

Only tow the vehicle out of the immediate danger zone. For further information on the bypass function, see the instruction manual.



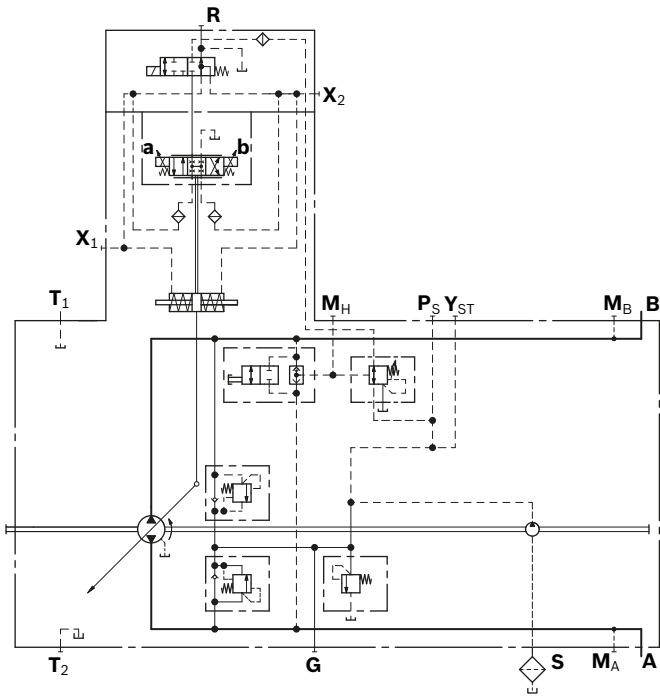
Neutral valve

Actuation of the switching solenoid enables pilot pressure through-flow into the control device of the pump. The pump can be swiveled out. When the solenoid is de-energized, this connection is interrupted and simultaneously the two stroking chambers are connected to each other and relieved to the pump housing. This ensures the pump is torque-free.

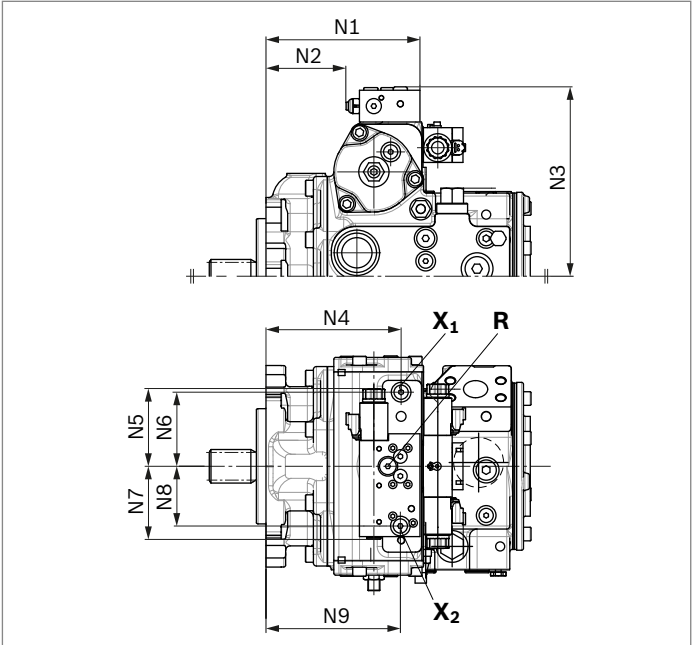
The return swivel times can be specifically and precisely adapted to the respective customer application. A second capability for deactivation and therefore making the pump torque-free is therefore realized when the neutral valve is used in safety-critical applications.

Technical data		
Voltage	12 V (±20%)	24 V (±20%)
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_g \text{ max}$	Current switched on	Current switched on
Nominal resistance (at 68 °F (20 °C))	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum active current required	1.2 A	0.6 A
Duty cycle	100%	100%
Type of protection: see connector version page 57		

▼ Circuit diagram



Dimensions



NG	110	125	145	175	210	280
N1	7.81 (198.4)	7.81 (198.4)	8.02 (203.6)	8.80 (223.4)	9.37 (237.9)	10.19 (258.8)
N2	3.96 (100.7)	3.96 (100.7)	4.17 (105.9)	4.95 (125.7)	5.52 (140.2)	6.34 (161.1)
N3	9.05 (229.8)	9.05 (229.8)	9.86 (250.5)	9.86 (250.5)	11.14 (283)	11.14 (283)
N4	6.83 (173.5)	6.83 (173.5)	7.04 (178.7)	7.81 (198.5)	8.27 (210)	9.09 (230.9)
N5	4.04 (102.5)	4.04 (102.5)	4.04 (102.5)	4.04 (102.5)	4.04 (102.5)	4.04 (102.5)
N6	3.27 (83)	3.27 (83)	3.86 (98)	3.86 (98)	4.43 (112.5)	4.43 (112.5)
N7	3.8 (96.5)	3.8 (96.5)	3.8 (96.5)	3.8 (96.5)	3.8 (96.5)	3.8 (96.5)
N8	3.11 (79)	3.11 (79)	3.11 (79)	3.11 (79)	3.11 (79)	3.11 (79)
N9	6.79 (172.5)	6.79 (172.5)	7.0 (177.7)	7.78 (197.5)	8.35 (212)	9.17 (232.9)

Mechanical stroke limiter

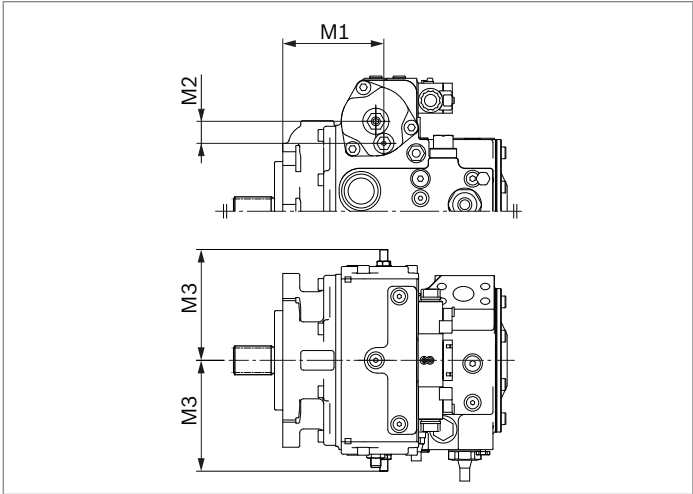
The mechanical stroke limiter is an auxiliary function allowing the maximum displacement of the pump to be steplessly reduced, regardless of the control module used.

By means of two threaded pins, the stroke of the stroking piston and thus the maximum swivel angle of the pump can be limited.

**Notice**

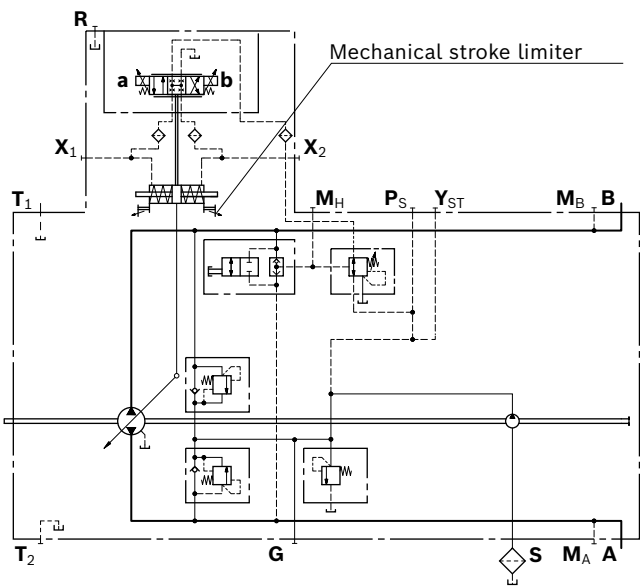
Threaded pins are mounted from the inside (screw-out protection) and can no longer be removed from the outside.

Dimensions



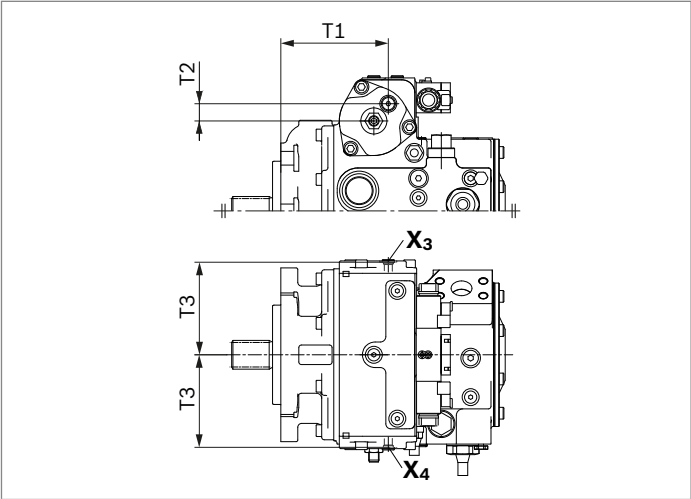
NG	M1	M2	M3
110	6.05 (153.6)	1.09 (27.7)	6.19 (157.3)
125	6.05 (153.6)	1.09 (27.7)	6.19 (157.3)
145	6.10 (155)	1.33 (33.8)	6.70 (170.1)
175	6.88 (174.8)	1.33 (33.8)	6.70 (170.1)
210	7.24 (183.9)	1.50 (38.1)	7.86 (199.6)
280	8.06 (204.7)	1.50 (38.1)	7.86 (199.6)

▼ Circuit diagram



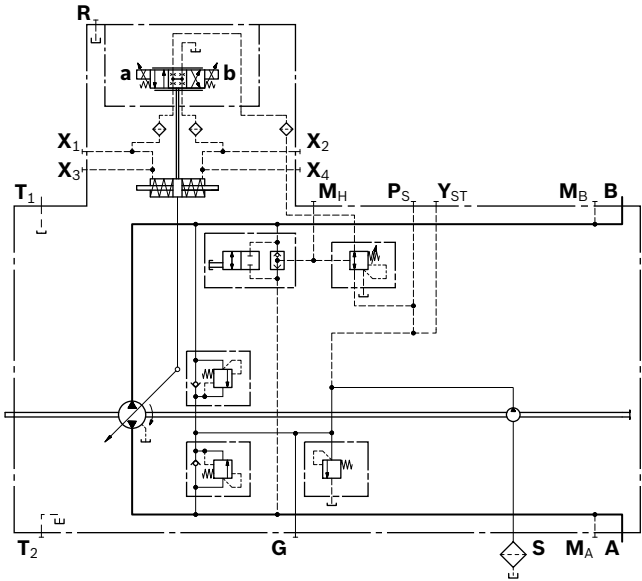
Stroking chamber pressure port X3 and X4

Dimensions



NG	T1	T2	T3
110	6.37 (161.8)	0.86 (21.8)	5.04 (128)
125	6.37 (161.8)	0.86 (21.8)	5.04 (128)
145	6.49 (164.9)	1.04 (26.4)	5.59 (142)
175	7.27 (184.7)	1.04 (26.4)	5.59 (142)
210	7.70 (195.7)	1.20 (30.6)	6.54 (166)
280	8.53 (216.6)	1.20 (30.6)	6.54 (166)

▼ Circuit diagram



Ports		Standard <sup>1)</sup>	Size	$p_{\max}$ [bar] <sup>2)</sup>	State <sup>3)</sup>
X <sub>3</sub> , X <sub>4</sub>	Stroking chamber pressure port	ISO 11926	9/16-18UNF-2B; 0.51 (13) deep	40	X

1) The countersink can be deeper than as specified in the standard.  
 2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.  
 3) X = Plugged (in normal operation)

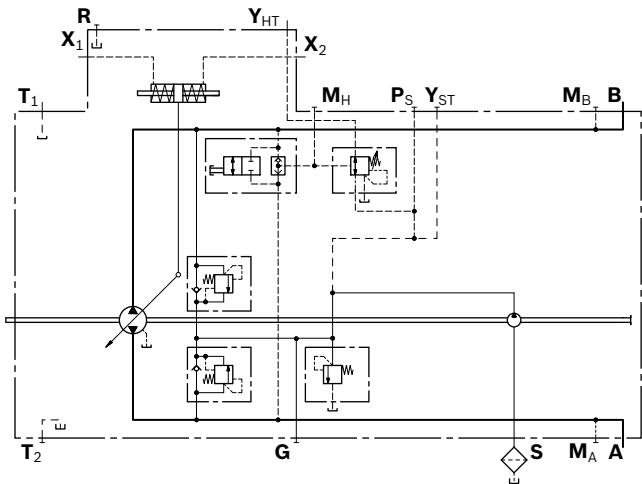
Filtration in the boost pump suction line

Version S

Filter version	Suction filter
Recommendation	With contamination indicator, with cold start valve
Recommended flow resistance at filter element	
At $v = 30 \text{ cSt (mm}^2\text{/s)}$ , $n = n_{\text{max}}$	$\Delta p \leq 1.5 \text{ psi } (\Delta p \leq 0.1 \text{ bar})$
At $v = 1000 \text{ cSt (mm}^2\text{/s)}$ , $n = n_{\text{max}}$	$\Delta p \leq 4.5 \text{ psi } (\Delta p \leq 0.3 \text{ bar})$
Pressure at suction port S	
Continuous $p_{\text{S min}}$ ( $v \leq 30 \text{ cSt (mm}^2\text{/s)}$ )	$\geq 12 \text{ psi } (\geq 0.8 \text{ bar})$ absolute
Short-term, at a cold start ( $t < 3 \text{ min}$ )	$\geq 7.5 \text{ psi } (\geq 0.5 \text{ bar})$ absolute
Maximum pressure $p_{\text{S max}}$	$\leq 75 \text{ psi } (\leq 5 \text{ bar})$ absolute

Use of version S is preferred.  
The suction filter is not included in the scope of delivery.

▼ Circuit diagram



Filtration in the boost pump pressure line

Version D

Ports for external boost circuit filtration

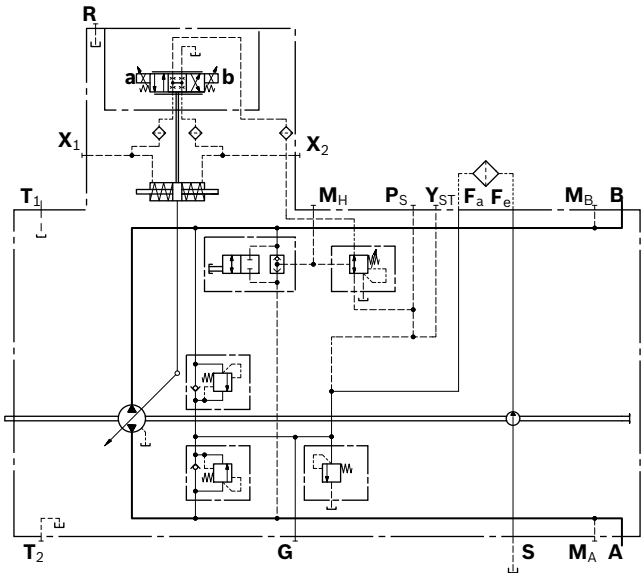
Ports	
Boost pressure inlet	Port <b>F<sub>a</sub></b>
Boost pressure outlet	Port <b>F<sub>e</sub></b>
Filter version	Boost pressure filter
Recommendation	With contamination indicator, with cold start valve
Filter arrangement	Separate in the pressure line (inline filter)

The boost pressure filter is not included in the scope of delivery.

Notice

- ▶ Filters with a bypass **not recommended**. Please contact us for applications with a bypass.
- ▶ On versions with HT control (with pilot pressure not from a boost circuit) a filter must be used that fulfills the requirement with regard to filtration of the hydraulic fluid (see page 7).
- ▶ The pressure drop at the filter is viscosity- and contamination-dependent. Note the maximum permissible pressure of the boost pump in combination with the set feed pressure.

▼ Circuit diagram



Notice

Bosch Rexroth has a comprehensive filter range on offer. An inline filter such as the 110 LEN (see data sheet 51448) is suitable for charge pressure filtration. Further informations can also be found at [www.boschrexroth.com/filter](http://www.boschrexroth.com/filter).

1) Valid for entire speed range  $n_{\text{min}} - n_{\text{max}}$

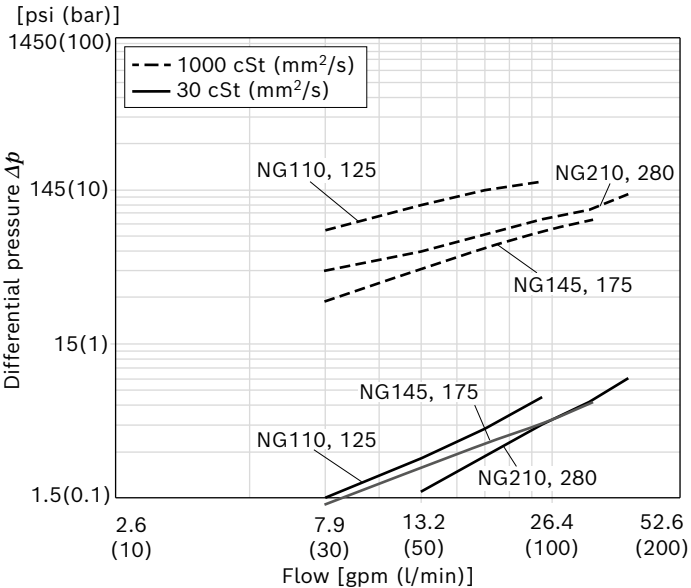
**Version F<sup>1)</sup>**  
**Attachment filter with cold start valve**

Filter version	Attachment filter
Recommendation	Version with contamination indicator, see B (differential pressure $\Delta p = 75 \text{ psi (5 bar)}$ )
Filter grade (absolute)	20 microns
Filter material	Glass fiber
Pressure rating	1450 psi (100 bar)
Filter arrangement	Mounted on pump

The attachment filter is equipped with a cold start valve and thereby protects the pump from damage. The valve opens at flow resistance of  $\Delta p \geq 87 \text{ psi (6 bar)}$ .

**▼ Filter characteristics**

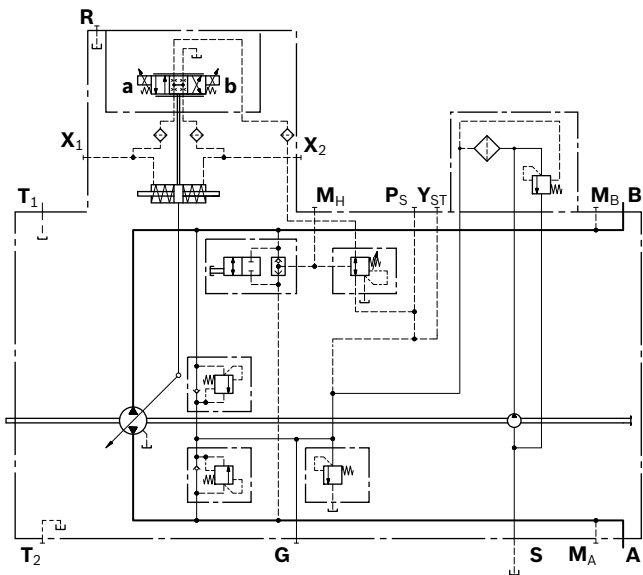
Differential pressure/flow characteristics to ISO 3968 (valid for clean filter element).



**Notice**

The pressure drop at the filter is viscosity- and contamination-dependent. Note the maximum permissible pressure of the boost pump in combination with the set feed pressure.

**▼ Circuit diagram**



1) To protect the filter element against electrostatic charge, the hydraulic fluid must have a minimum conductivity of 300 pS/m on versions with attachment filter F, P and B. Please contact us if this value cannot be observed.

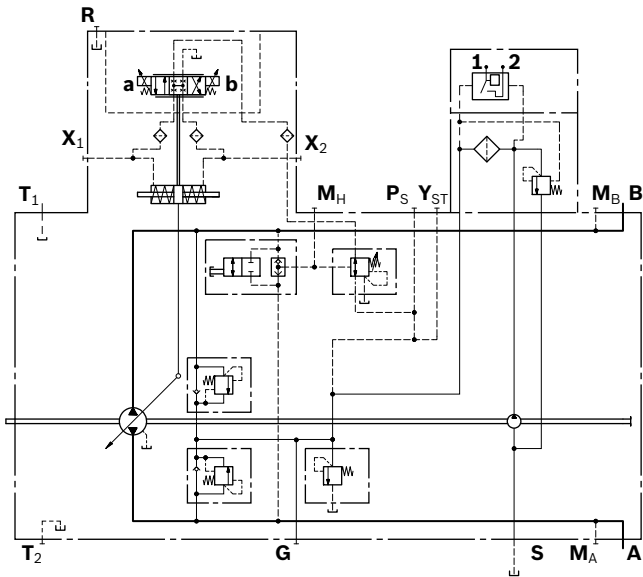
Version B<sup>1)</sup>

Attachment filter with cold start valve and electric contamination indicator

Filtration similar to version F, however with additional electric contamination indicator.

Technical data		
Display type	electrical	
Connector version	DEUTSCH DT04-2P-EP04 (mating connector, see page 57)	
Differential pressure (switching pressure)	$\Delta p = 75 \text{ psi (5 bar)}$	
Maximum switching capacity	12 V DC	24 W
	24 V DC	48 W
Type of protection	IP67	
	DIN EN 60529	

▼ Circuit diagram



External boost pressure supply

Version E

This variant should be used in versions without integrated boost pump (U).

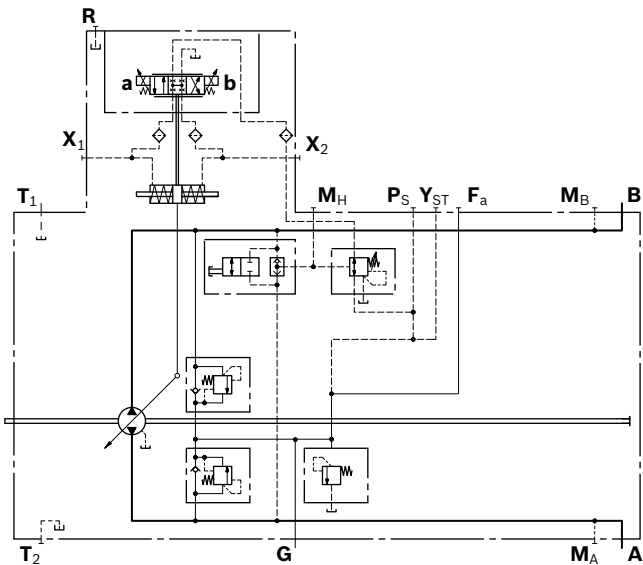
Port S is plugged.

The boost pressure supply comes from port G.

The filter should be installed separately on port G before the boost pressure supply.

To ensure the functional reliability, maintain the required cleanliness level for the boost fluid fed in at port G (see page 7).

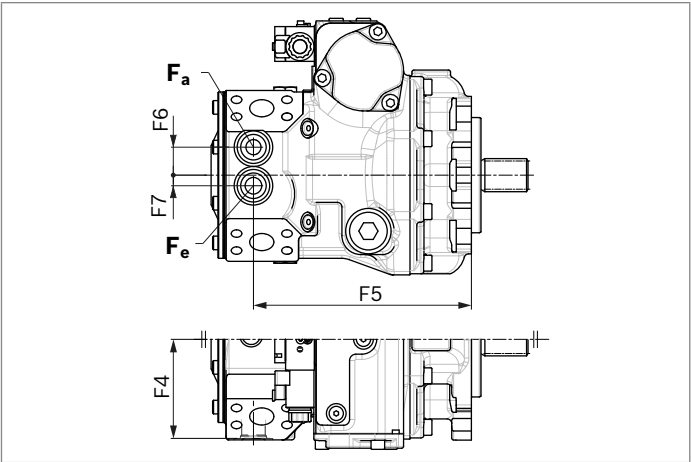
▼ Circuit diagram



1) To protect the filter element against electrostatic charge, the hydraulic fluid must have a minimum conductivity of 300 pS/m on versions with attachment filter F, P and B. Please contact us if this value cannot be observed.

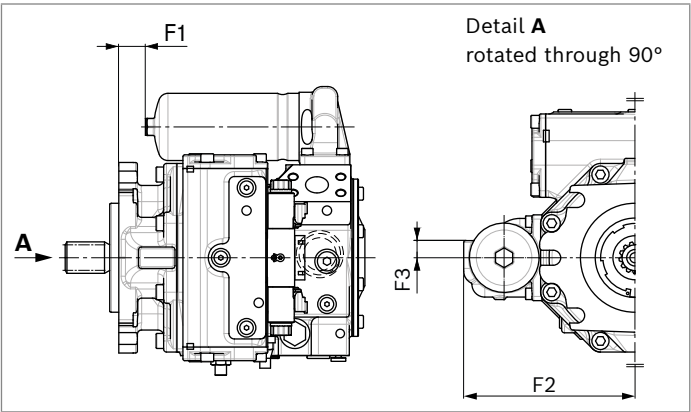
Dimensions with mounted filter

▼ **Version D**  
Ports for external boost circuit filtration

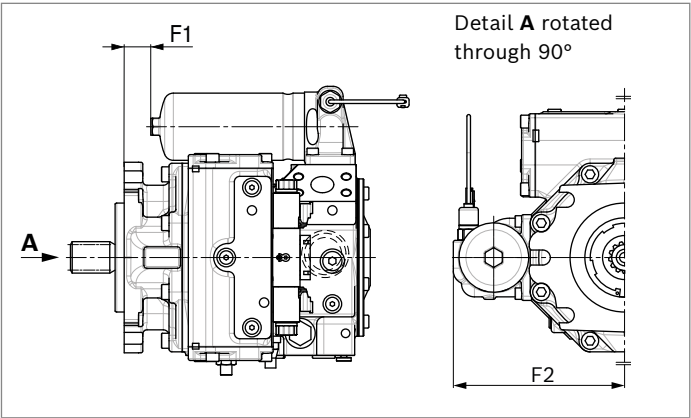


NG	F1	F2	F3	F4	F5	F6	F7
<b>110</b>	3.01 (76.5)	9.04 (229.5)	0.87 (22)	4.76 (121)	10.41 (264.5)	1.46 (37)	0.55 (14)
<b>125</b>	3.01 (76.5)	9.04 (229.5)	0.87 (22)	4.76 (121)	10.41 (264.5)	1.46 (37)	0.55 (14)
<b>145</b>	1.46 (37.2)	9.43 (239.5)	0.87 (22)	5.16 (131)	11.35 (288.2)	1.46 (37)	0.55 (14)
<b>175</b>	2.24 (57)	9.43 (239.5)	0.87 (22)	5.16 (131)	12.13 (308)	1.46 (37)	0.55 (14)
<b>210</b>	2.72 (69)	10.49 (266.5)	0.87 (22)	5.76 (146.3)	12.80 (325)	1.69 (43)	0.39 (10)
<b>280</b>	3.54 (89.9)	10.49 (266.5)	0.87 (22)	5.76 (146.3)	13.62 (345.9)	1.69 (43)	0.39 (10)
<b>F<sub>a</sub>, F<sub>e</sub><sup>1)</sup></b> 1 5/16-12UN-2B; 0.79 (20) deep, according to ISO 11926							

▼ **Version F**  
Attachment filter without contamination indicator



▼ **Version B**  
Attachment filter with cold start valve and electric contamination indicator



1) The countersink can be deeper than as specified in the standard.

Swivel angle sensor

The swivel angle sensor is used to detect the swivel angle of axial piston units and thus the displacement using a Hall-effect based sensor IC. The determined measurement value is converted into an analog signal.  
Please contact us if the swivel angle sensor is used for control.

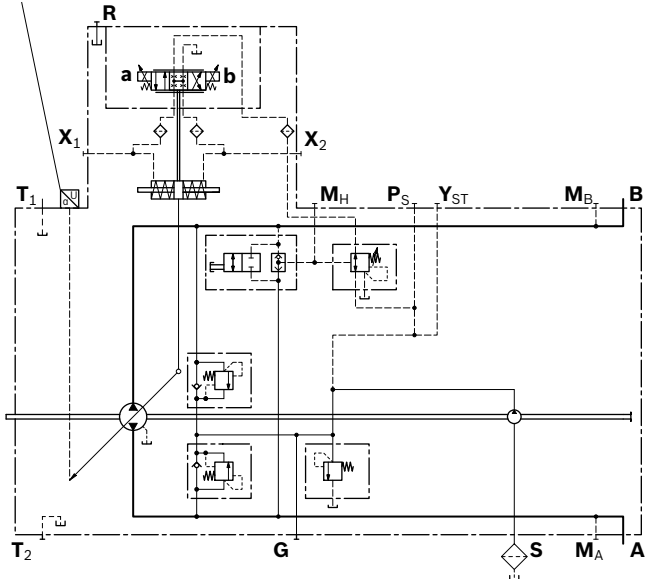
Characteristics	
Supply voltage $U_b$	10 to 30 V DC
Output voltage $U_a$	1 V      2.5 V      4 V ( $V_{g \max}$ ) ( $V_{g 0}$ ) ( $V_{g \max}$ )
Reverse polarity protection	Short-circuit resistant
EMC resistance	Details on request
Operating temperature range	-40 °F to +240 °F (-40 °C to +115 °C)
Vibration resistance sinusoidal vibration EN 60068-2-6	322 ft/s <sup>2</sup> (10 g) / 5 to 2000 Hz
Shock resistance: continuous shock IEC 68-2-29	805 ft/s <sup>2</sup> (25 g)
Salt spray resistance (DIN 50 021-SS)	96 h
Type of protection with installed mating connector	IP67 – DIN EN 60529 IP69K – DIN 40050-9
Housing material	Plastic

Output voltage

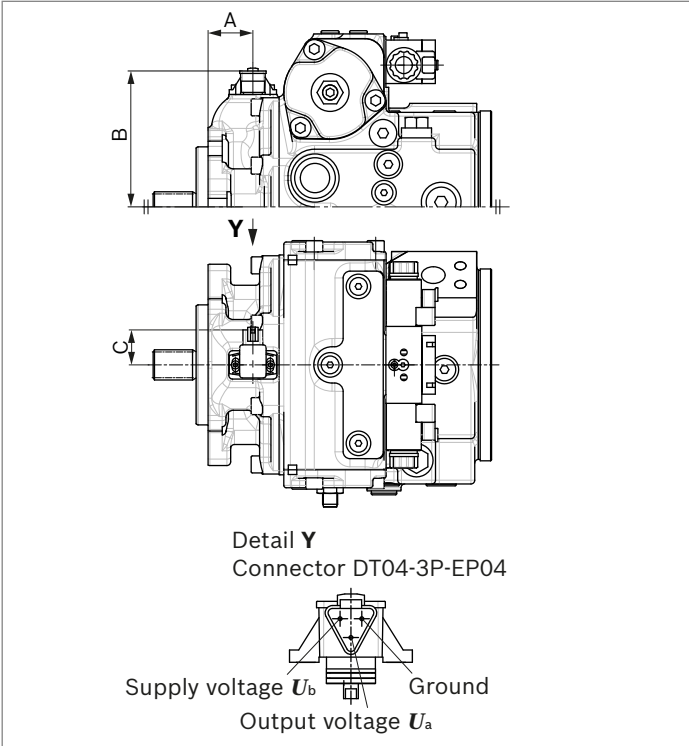
Direction of rotation <sup>1)</sup>	Flow direction	Working pressure	Output voltage at $V_{g 0}$
Clockwise	B to A	$M_A$	>2.5 V
	A to B	$M_B$	<2.5 V
Counter-clockwise	A to B	$M_B$	>2.5 V
	B to A	$M_A$	<2.5 V

▼ Circuit diagram

Electric swivel angle sensor



Dimensions



NG	A	B	C
110	2.03 (51.5)	5.86 (148.8)	1.46 (37)
125	2.03 (51.5)	5.86 (148.8)	1.46 (37)
145	2.09 (53.1)	6.33 (160.8)	1.46 (37)
175	2.54 (64.4)	6.33 (160.8)	1.46 (37)
210	2.72 (69)	6.84 (173.8)	1.46 (37)
280	2.96 (75.1)	6.84 (173.8)	1.46 (37)

Mating connector DEUTSCH DT06-3S-EP04

Consisting of	DT designation
1 housing	DT06-3S-EP04
1 wedge	W3S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902603524).

Notice

It is not possible to retrofit existing units with a swivel angle sensor.

1) For flow direction, see controls



## Connector for solenoids

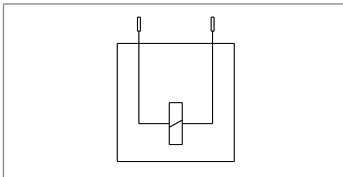
### DEUTSCH DT04-2P-EP04

Molded, 2-pin, without bidirectional suppressor diode (standard).

The following type of protection ensues with an installed mating connector:

- ▶ IP67 (DIN EN 60529) and
- ▶ IP69K (DIN 40050-9)

#### ▼ Switching symbol



#### ▼ Mating connector DEUTSCH DT06-2S-EP04

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).

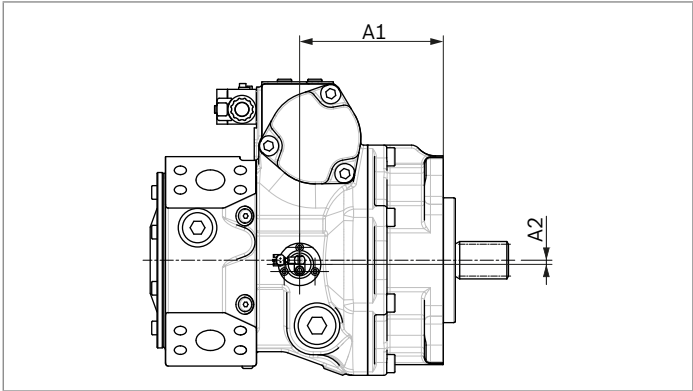
#### Notice

- ▶ If necessary, you can change the position of the connector by turning the solenoid.
- ▶ The procedure is defined in the instruction manual.

### Speed sensor

With the speed sensor DSA/DSM mounted, a signal proportional to pump speed can be generated. The DSA/DSM sensor measures the speed and direction of rotation. Type code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet 95133 – DSA or 95132 – DSM. The sensor is mounted on the port provided for this purpose with a mounting bolt.

#### Dimensions



NG	110	125	145	175	210	280
A1	6.36	6.36	7.13	7.91	7.48	8.30
	161.5	161.5	181.2	201.0	190	210.9
A2	0.22	0.22	0.22	0.22	0.22	0.22
	5.5	5.5	5.5	5.5	5.5	5.5
Number of teeth	2.09	On request	2.28	2.40	2.52	2.80
	53		58	61	64	71

#### Notice

It is not possible to retrofit existing units with a speed sensor.

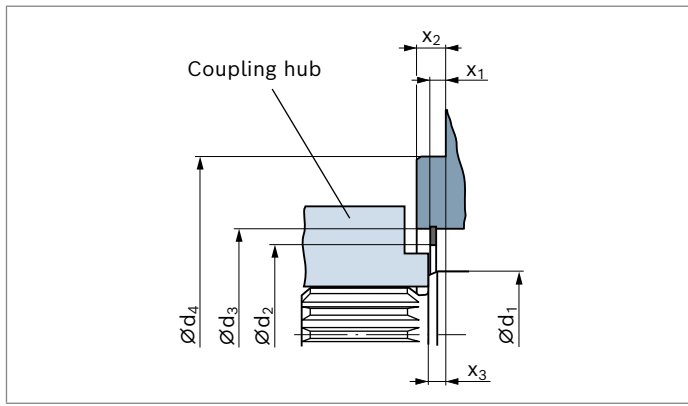
## Installation dimensions for coupling assembly

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

### SAE splined shaft (spline according to ANSI B92.1a)

Splined shaft **V** or **T**

The outer diameter of the coupling hub must be smaller than the inner diameter of the snap ring (dimension  $d_2$ ) in the area near the drive shaft collar (dimension  $x_2 - x_3$ ).



NG	Mounting flange	Ød <sub>1</sub>	Ød <sub>2 min</sub>	Ød <sub>3</sub>	Ød <sub>4</sub>	x <sub>1</sub>	x <sub>2</sub>	x <sub>3</sub>
<b>110</b>	127-2/4	2.17	2.93	3.976±0.004	5.00 <sup>0</sup> <sub>-0.002</sub>	0.236	0.5 <sup>0</sup> <sub>-0.02</sub>	0.315 <sup>+0.035</sup> <sub>-0.024</sub>
		(55)	(74.4)	(101±0.1)	(127 <sup>0</sup> <sub>-0.063</sub> )	(6.0)	(12.7 <sup>0</sup> <sub>-0.5</sub> )	(8 <sup>+0.9</sup> <sub>-0.6</sub> )
	152-2/4	2.17	2.93	3.976±0.004	6.00 <sup>0</sup> <sub>-0.002</sub>	0.236	0.5 <sup>0</sup> <sub>-0.02</sub>	0.315 <sup>+0.035</sup> <sub>-0.024</sub>
		(55)	(74.4)	(101±0.1)	(152.4 <sup>0</sup> <sub>-0.063</sub> )	(6.0)	(12.7 <sup>0</sup> <sub>-0.5</sub> )	(8 <sup>+0.9</sup> <sub>-0.6</sub> )
<b>125</b>	127-2/4	2.17	2.93	3.976±0.004	5.00 <sup>0</sup> <sub>-0.002</sub>	0.236	0.5 <sup>0</sup> <sub>-0.02</sub>	0.315 <sup>+0.035</sup> <sub>-0.024</sub>
		(55)	(74.4)	(101±0.1)	(127 <sup>0</sup> <sub>-0.063</sub> )	(6.0)	(12.7 <sup>0</sup> <sub>-0.5</sub> )	(8 <sup>+0.9</sup> <sub>-0.6</sub> )
	152-2/4	2.17	2.93	3.976±0.004	6.00 <sup>0</sup> <sub>-0.002</sub>	0.236	0.5 <sup>0</sup> <sub>-0.02</sub>	0.315 <sup>+0.035</sup> <sub>-0.024</sub>
		(55)	(74.4)	(101±0.1)	(152.4 <sup>0</sup> <sub>-0.063</sub> )	(6.0)	(12.7 <sup>0</sup> <sub>-0.5</sub> )	(8 <sup>+0.9</sup> <sub>-0.6</sub> )
<b>145</b>	152-2/4	2.36	3.32	4.370±0.004	6.00 <sup>0</sup> <sub>-0.002</sub>	0.291	0.5 <sup>0</sup> <sub>-0.02</sub>	0.315 <sup>+0.035</sup> <sub>-0.024</sub>
		(60)	(84.4)	(111±0.1)	(152.4 <sup>0</sup> <sub>-0.063</sub> )	(7.4)	(12.7 <sup>0</sup> <sub>-0.5</sub> )	(8 <sup>+0.9</sup> <sub>-0.6</sub> )
<b>175</b>	152-2/4	2.36	3.32	4.370±0.004	6.00 <sup>0</sup> <sub>-0.002</sub>	0.276	0.5 <sup>0</sup> <sub>-0.02</sub>	0.315 <sup>+0.035</sup> <sub>-0.024</sub>
		(60)	(84.4)	(111±0.1)	(152.4 <sup>0</sup> <sub>-0.063</sub> )	(7.0)	(12.7 <sup>0</sup> <sub>-0.5</sub> )	(8 <sup>+0.9</sup> <sub>-0.6</sub> )
	165-4	2.36	3.32	4.370±0.004	6.50 <sup>0</sup> <sub>-0.002</sub>	0.276	0.63 <sup>0</sup> <sub>-0.02</sub>	0.315 <sup>+0.035</sup> <sub>-0.024</sub>
		(60)	(84.4)	(111±0.1)	(165.1 <sup>0</sup> <sub>-0.063</sub> )	(7.0)	(15.9 <sup>0</sup> <sub>-0.5</sub> )	(8 <sup>+0.9</sup> <sub>-0.6</sub> )
<b>210</b>	165-4	2.56	3.72	4.764±0.004	6.50 <sup>0</sup> <sub>-0.002</sub>	0.22	0.63 <sup>0</sup> <sub>-0.02</sub>	0.315 <sup>+0.035</sup> <sub>-0.024</sub>
		(65)	(94.4)	(121±0.1)	(165.1 <sup>0</sup> <sub>-0.063</sub> )	(5.5)	(15.9 <sup>0</sup> <sub>-0.5</sub> )	(8 <sup>+0.9</sup> <sub>-0.6</sub> )
<b>280</b>	165-4	2.56	3.72	4.764±0.004	6.50 <sup>0</sup> <sub>-0.002</sub>	0.276	0.63 <sup>0</sup> <sub>-0.02</sub>	0.315 <sup>+0.035</sup> <sub>-0.024</sub>
		(65)	(94.4)	(121±0.1)	(165.1 <sup>0</sup> <sub>-0.063</sub> )	(7.0)	(15.9 <sup>0</sup> <sub>-0.5</sub> )	(8 <sup>+0.9</sup> <sub>-0.6</sub> )

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 may empty via the hydraulic lines. Particularly in the installation position “drive shaft upwards”, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The leakage in the housing area must be directed to the reservoir via the highest drain port (**T**<sub>1</sub>, **T**<sub>2</sub>).

For combination pumps, the leakage must be drained off at each single pump.

If a shared drain line is used for several units, make sure that the respective case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating conditions, specifically on cold start. If this is not possible, separate drain lines must be laid if necessary.

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

Under all operating conditions, the suction line and drain line must flow into the reservoir below the minimum fluid level. The permissible suction height *h*<sub>s</sub> results from the overall loss of pressure. However, it must not be higher than *h*<sub>S max</sub> = 31.5 in (800 mm).

The suction pressure at port **S** must also not fall below the minimum value of 12 psi (0.8 bar) absolute during operation (cold start 7.5 psi (0.5 bar) absolute).

Installation position

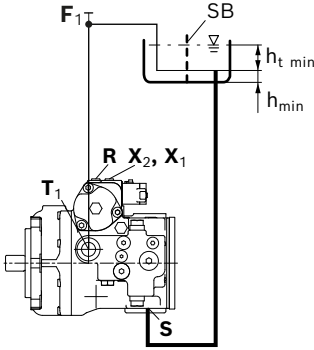
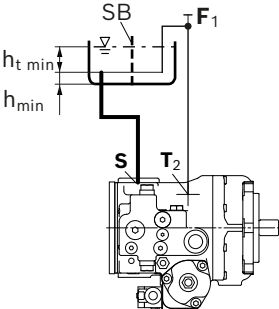
See the following examples 1 to 12. Further installation positions are available upon request. Recommended installation position: 1 and 2.

Notice

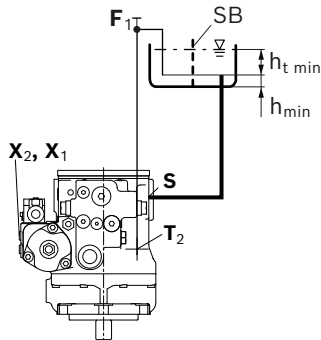
- ▶ If filling the stroking chambers via **X**<sub>1</sub> to **X**<sub>4</sub> is not possible in the final installation position, then this must take place before installation, e.g. in installation position 2.
- ▶ To prevent unexpected actuation and damage, the stroking chambers must be air bled via the ports **X**<sub>1</sub>, **X**<sub>2</sub>, or **X**<sub>3</sub>, **X**<sub>4</sub> depending on the installation position.
- ▶ In certain installation positions, an influence on the control or closed loop control can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristic curves and changes in response time.

Below-reservoir installation (standard)

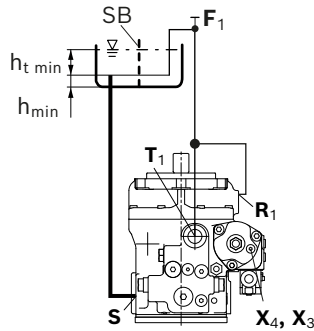
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir and below the minimum fluid level of the reservoir.

Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
1	R	X <sub>1</sub> , X <sub>2</sub>	S + T <sub>1</sub> + X <sub>1</sub> + X <sub>2</sub>
			
2	-	-	S + T <sub>2</sub>
			

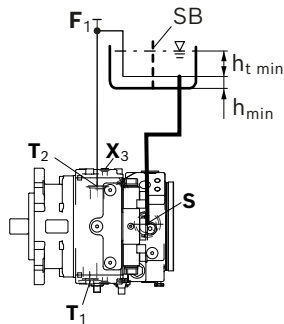
Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
3	–	$X_1, X_2$	$S + T_2 + X_1 + X_2$



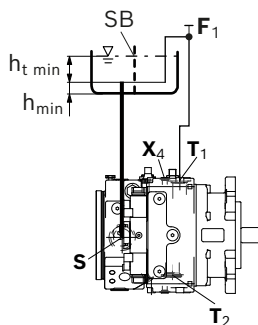
4	$R_1$	$X_3, X_4$	$S + T_1 + X_3 + X_4$
---	-------	------------	-----------------------



5	–	$X_3$	$S + T_2 + X_3$
---	---	-------	-----------------



6	–	$X_4$	$S + T_1 + X_4$
---	---	-------	-----------------



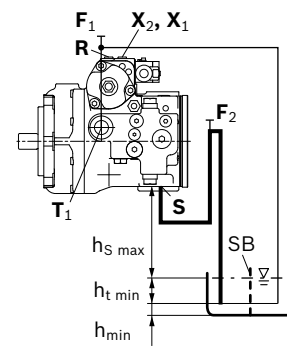
### Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.

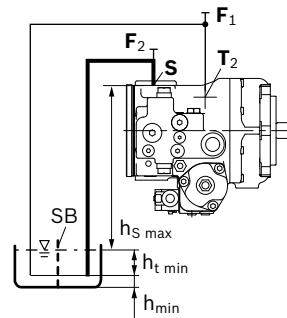
Observe the maximum permissible suction height  $h_{S \max} = 31.5 \text{ in (800 mm)}$ .

Recommendation for installation position 10 (drive shaft upward): A check valve in the drain line (cracking pressure 7.5 psi (0.5 bar)) can prevent the housing area from draining.

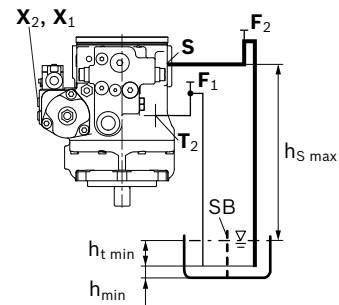
Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
7	$F_2 + R$	$X_1, X_2$	$F_1 + F_2 + X_1 + X_2$



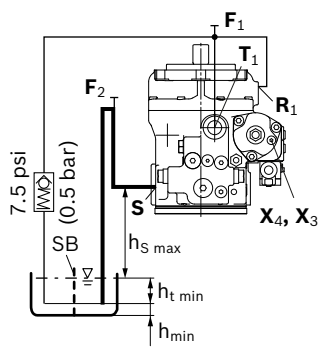
8	$F_2 (S) + F_1 (T_2)$	–	$F_2 (S) + F_1 (T_2)$
---	-----------------------	---	-----------------------



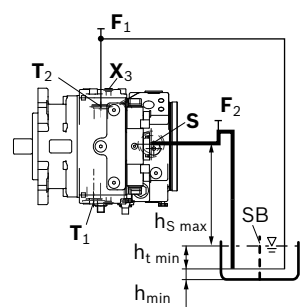
9	$F_2 (S) + F_1 (T_2)$	$X_1, X_2$	$F_2 (S) + F_1 (T_2) + X_1 + X_2$
---	-----------------------	------------	-----------------------------------



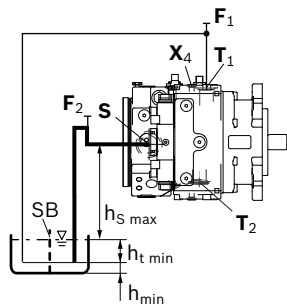
Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
10	$F_2 + R_1$	$X_3, X_4$	$F_1 + F_2 + X_3 + X_4$



11	$F_2 (S) + F_1 (T_2)$	$X_3$	$F_2 (S) + F_1 (T_2) + X_3$
----	-----------------------	-------	-----------------------------



12	$F_2 (S) + F_1 (T_1)$	$X_4$	$F_2 (S) + F_1 (T_1) + X_4$
----	-----------------------	-------	-----------------------------



Key	
$F_1, F_2$	Filling / air bleeding
R	Air bleed port
$R_1$	Air bleed port (special version)
S	Suction port
$T_1, T_2$	Drain port
$X_1, X_2$	Control pressure port
$X_3, X_4$	Stroking chamber pressure port
SB	Baffle (baffle plate)
$h_{t \min}$	Minimum required immersion depth 7.87 in (200 mm)
$h_{\min}$	Minimum required distance to reservoir bottom 3.94 in (100 mm)
$h_{S \max}$	Maximum permissible suction height 31.5 in (800 mm)

**Notice**

Ports **F<sub>1</sub>** and **F<sub>2</sub>** are part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

## Project planning notes

- ▶ The pump is designed to be used in closed circuit.
- ▶ The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified skilled personnel.
- ▶ Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- ▶ Before finalizing your design, please request a binding installation drawing.
- ▶ The specified data and notes contained herein must be observed.
- ▶ Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- ▶ Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- ▶ Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. MTTF<sub>D</sub>) for functional safety.
- ▶ Depending on the type of control used, electromagnetic effects can be produced when using solenoids. Applying a direct voltage signal (DC) to solenoids does not create electromagnetic interference (EMI) nor is the solenoid affected by EMI. Electromagnetic interference (EMI) potential exists when operating and controlling a solenoid with a modulated direct voltage signal (e.g. PWM signal). Appropriate testing and measures should be taken by the machine manufacturer to ensure other components or operators (e.g. with pacemaker) are not affected by this potential.
- ▶ The pressure cut-off is not a safeguard against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- ▶ With dynamic power flow (switch of pumps to operation as a motor) a maximum of 95%  $V_{g \max}$  is permissible. We recommend configuring the software accordingly.
- ▶ For drives that are operated for a long period with constant rotational speed, the natural frequency of the hydraulic system can be excited by the excitation frequency of the pump (rotational speed frequency  $\times 9$ ). This can be prevented with suitably designed hydraulic lines.
- ▶ Please note the details regarding the tightening torques of port threads and other threaded joints in the instruction manual.
- ▶ Working 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 working ports and function ports are only intended to accommodate hydraulic lines.

## Safety instructions

- ▶ During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- ▶ Moving parts in control equipment (e.g. valve spools) can, under certain circumstances get stuck in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filtration) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.
- ▶ Moving parts in high-pressure relief valves may in certain circumstances become stuck in an undefined position due to contamination (e.g. impure hydraulic fluid). This can result in restriction or loss of the load holding function in lifting winches.  
The machine/system manufacturer must check whether additional measures are required on the machine for the relevant application in order to keep the load in a safe position and ensure they are properly implemented.

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