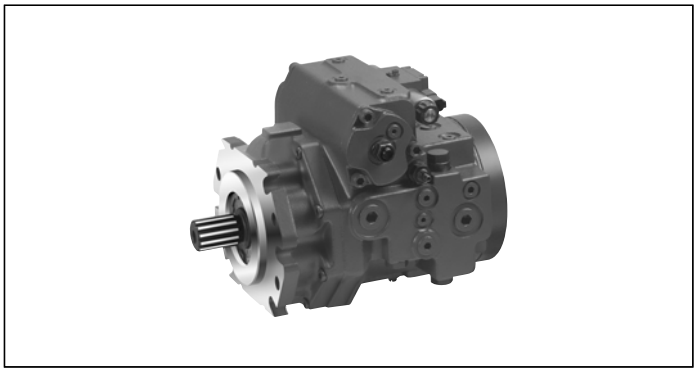
Axial piston variable pump
A4VG Series 40

RE 92004
Edition: 09.2017
Replaces: 02.2017



- High-pressure pump for applications in a closed circuit up to 500 bar
- Size 110 ... 280
- Nominal pressure 450 bar
- Maximum pressure 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

Contents

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**	**M**		**N**						**A**		**0**		**–**	

Axial piston unit

01	Swashplate design, variable, nominal pressure 450 bar, maximum pressure 500 bar	**A4V**

Operating mode

02	Pump, closed circuit	**G**

Size (NG)

03	Geometric displacement, see “Technical data” on page 9	**110**	**125**	**145**	**175**	**210**	**280**

Control device

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

Pressure cut-off

			110 ... 280	
05	Without pressure cut-off	without bypass	○	**0**
		with bypass	○	**C**
	Pressure cut-off, with bypass	Fixed setting, hydraulic, mechanical	●	**D**

Connector for solenoids[1)]

		110 ... 280	
06	Without connector (only for purely hydraulic control)	●	**0**
	DEUTSCH molded connector, 2-pin – without suppressor diode	●	**P**

Swivel angle sensor

		110 ... 280	
07	Without swivel angle sensor	●	**0**
	Electric swivel angle sensor (DWS20-1, 3-pin)[2)]	○	**R**

● = Available ○ = On request – = Not available = Preferred program

1) Connectors for other electric components may deviate.
2) 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**	**M**		**N**						**A**		**0**		**–**	

Additional function

			110 ... 280	
08	Without additional function		●	**0**
	Mechanical stroke limiter, externally adjustable		●	**M**
	Stroking chamber pressure port X_3, X_4		●	**T**
	Mechanical stroke limiter and stroking chamber pressure port X_3, X_4		●	**B**
	Neutral valve U = 12 V[3]		●	**N**
		and mechanical stroke limiter, externally adjustable	●	**P**
		and ports X_3, X_4 for stroking chamber pressure	●	**R**
		and mechanical stroke limiter and ports X_3, X_4	●	**S**
	Neutral valve U = 24 V[3]		●	**U**
		and mechanical stroke limiter, externally adjustable	●	**V**
		and ports X_3, X_4 for stroking chamber pressure	●	**W**
		and mechanical stroke limiter and ports X_3, X_4	●	**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 mounted, control with brake fluid[4] based on mineral oil	–	–	–	●	–	–	–	**5**
	DA control valve, fixed setting, ports for pilot control device	●	●	●	●	●	–	–	**6**

Series

		110 ... 280	
10	Series 4, index 0	●	**40**

Configuration of port and fastening threads

		110 ... 280	
11	Metric, ISO 6149 with O-ring seal	●	**M**

Direction of rotation

			110 ... 280	
12	Viewed on drive shaft	clockwise	●	**R**
		counter-clockwise	●	**L**

Sealing material

		110 ... 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	●	●	–	–	–	–	**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**
	Splined shaft DIN 5480	W40×2×18×9		●	–	–	–	–	–	**Z9**
		W45×2×21×9		●	●	●	●	●	–	**A1**
		W50×2×24×9		–	–	●	●	–	–	**A2**
		W55×2×26×9		–	–	–	–	●	●	**A3**

● = Available ○ = On request – = Not available = Preferred program

3) Cannot be combined with brake inch valve
4) Cannot be combined with neutral valve

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**	**M**		**N**						**A**		**0**		**–**	

Working port

		110 ... 280	
16	SAE working port **A** and **B**, on left side (45° left)	●	**1**
	SAE working port **A** and **B**, on right side (45° right)[5]	●	**2**

Boost pump and rotary group configuration

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

Through drive[6]

							110	125	145	175	210	280	
18	Without through drive						●	●	●	●	●	●	**0000**
	Flange SAE J744			Hub for splined shaft[7]									
	Diameter	Mounting[8]	Code	Diameter		Code							
	82-2 (A)	⚷	A1	5/8 in	9T 16/32DP	S2	●	–	●	●	●	○	**A1S2**
			A1	3/4 in	11T 16/32DP	S3	●	–	●	●	●	○	**A1S3**
		⚯	A2	5/8 in	9T 16/32DP	S2	●	●	●	●	●	●	**A2S2**
			A2	3/4 in	11T 16/32DP	S3	●	–	●	●	●	○	**A2S3**
	101-2 (B)	⚷	B1	7/8 in	13T 16/32DP	S4	●	●	●	●	●	●	**B1S4**
			B1	1 in	15T 16/32DP	S5	●	–	●	●	●	●	**B1S5**
		⚯	B2	7/8 in	13T 16/32DP	S4	●	●	●	●	●	●	**B2S4**
			B2	1 in	15T 16/32DP	S5	●	○	●	●	●	●	**B2S5**
		⚲	B5	7/8 in	13T 16/32DP	S4	●	–	●	○	○	○	**B5S4**
			B5	1 in	15T 16/32DP	S5	●	–	○	○	●	●	**B5S5**
	101-4 (B)	⚴	B4	7/8 in	13T 16/32DP	S4	○	–	●	○	●	●	**B4S4**
			B4	1 in	15T 16/32DP	S5	●	–	●	●	○	○	**B4S5**
	127-2 (C)	⚷	C1	1 in	15T 16/32DP	S5	–	–	○	–	–	–	**C1S5**
			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**
		⚲	C5	1 1/4 in	14T 12/24DP	S7	●	○	●	○	–	–	**C5S7**
	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**
	165-4 (E)	⚴	E4	1 3/4 in	13T 8/16DP	T1	–	–	–	●	●	●	**E4T1**
				2 in	15T 8/16DP	T2	–	–	–	–	●	●	**E4T2**

● = Available ○ = On request – = Not available ▭ = Preferred program

5) Only possible without attachment filter.

6) Specifications for version with integrated standard gear pump, please contact us for version with integrated large gear pump or without boost pump.

7) Hub for splined shaft according to ANSI B92.1a-1976 (drive shaft allocation according to SAE J744)

8) Mounting hole pattern viewed on through drive

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**	**M**		**N**						**A**		**0**		**–**	

High-pressure relief valve — **110 … 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 … 280**

20	Filtration in the boost pump suction line	●	**S**
	Filtration in the boost pump pressure line Ports for external boost circuit filtration ($\mathbf{F}_e$ and $\mathbf{F}_a$)	●	**D**
	Attachment filter with cold start valve[9)]	●	**F**
	Attachment filter[9)] with cold start valve and electric contamination indicator – DEUTSCH connector	●	**B**
	External boost pressure supply (on version without integrated boost pump)	●	**E**

Pressure sensor

		110	125	145	175	210	280	
21	Without pressure sensor	●	●	●	●	●	●	**0**
	High-pressure at measuring port $\mathbf{M}_A$ and $\mathbf{M}_B$[10)]	●	●	○	○	○	○	**4**

Other sensors

		110	125	145	175	210	280	
22	Without sensor	●	●	●	●	●	●	**0**
	Speed sensor DSM, DSA[11)]	○	–	○	○	○	○	**V**

Standard / special version — **110 … 280**

23	Standard version	●	**0**
	Standard version with installation variants, e.g. **T** ports against standard open or closed	●	**Y**
	Special version	●	**S**

● = Available ○ = On request – = Not available = Preferred program

Notice

- ▶ Note the project planning notes on page 67!
- ▶ In addition to the type code, please specify the relevant technical data when placing your order.

9) Only available for working ports located on left

10) Specify type code of sensor acc. to data sheet (PR4 - 95156) separately and observe the requirements on the electronics

11) 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:

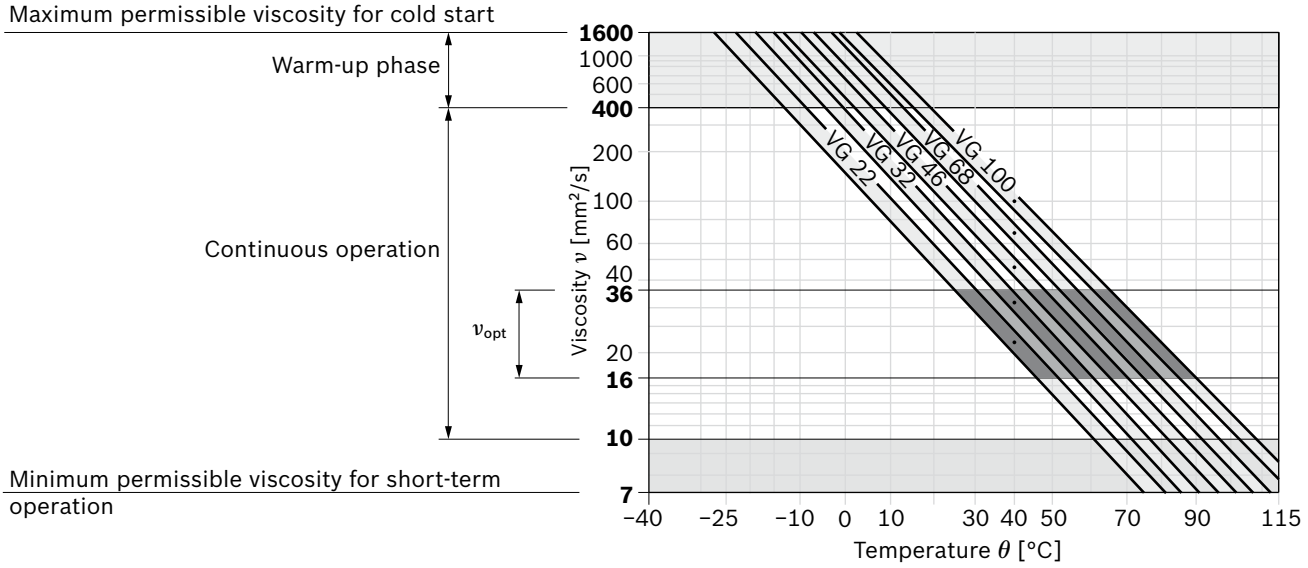
- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)
- 90225: Limited technical data for operation with water-free and water-containing fire-resistant hydraulic fluids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

Notes on selection of hydraulic fluid
The hydraulic fluid should be selected so that the operating viscosity in the operating temperature range is within the optimum range (vopt see selection diagram).

Viscosity and temperature of hydraulic fluids

	Viscosity	Shaft seal	Temperature[3]	Comment
Cold start	ν_{max} ≤ 1600 mm²/s	NBR[2]	θ_{St} ≥ −40 °C	t ≤ 3 min, without load (p ≤ 50 bar), n ≤ 1000 rpm Permissible temperature difference between axial piston unit and hydraulic fluid in the system maximum 25 K
		FKM	θ_{St} ≥ −25 °C	
Warm-up phase	ν = 1600 ... 400 mm²/s			t ≤ 15 min, p ≤ 0.7 × p_{nom} and n ≤ 0.5 × n_{nom}
Continuous operation	ν = 400 ... 10 mm²/s[1]	NBR[2]	θ ≤ +85 °C	measured at port **T**
		FKM	θ ≤ +110 °C	
	ν_{opt} = 36 ... 16 mm²/s			Range of optimum operating viscosity and efficiency
Short-term operation	ν_{min} = 10 ... 7 mm²/s	NBR[2]	θ ≤ +85 °C	t ≤ 3 min, p ≤ 0.3 × p_{nom} , measured at port **T**
		FKM	θ ≤ +110 °C	

▼ **Selection diagram**



1) Corresponds e.g. for VG 46 to a temperature range of +4 °C to +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.

Depending on the system and the application, for the A4VG we recommend: Filter elements $\beta_{20} \geq 100$.

At a hydraulic fluid viscosity of less than 10 mm²/s (e.g. due to high temperatures in short-term operation) at the drain port, a cleanliness level of at least 19/17/14 according to ISO 4406 is required.

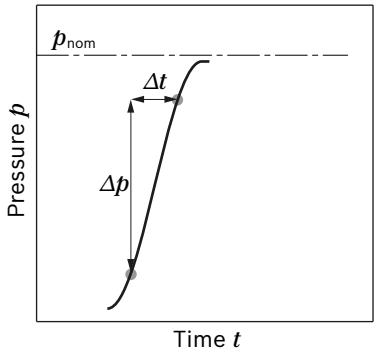
For example, the viscosity is 10 mm²/s at:

- HLP 32 a temperature of 73 °C
- HLP 46 a temperature of 85 °C

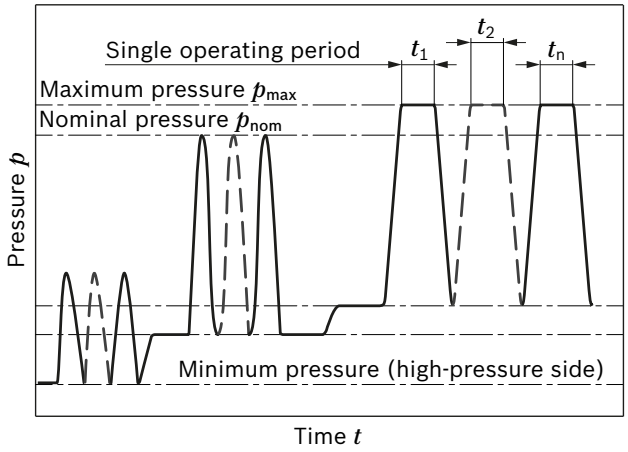
Working pressure range

Pressure at working port A or B		**Definition**
Nominal pressure p_{nom}	450 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	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 (high-pressure side)	25 bar	Minimum pressure at the high-pressure side (**A** or **B**) which is required to prevent damage to the axial piston unit.
Minimum pressure (low-pressure side)	10 bar above case pressure	Minimum pressure at the low-pressure side (**A** or **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 $R_{A\ max}$	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 $p_{Sp\ nom}$	25 bar	
Maximum pressure $p_{Sp\ max}$	40 bar	
Pressure at suction port **S** (inlet)		
Continuous $p_{S\ min}$	≥0.8 bar absolute	$\nu \leq 30$ mm²/s
Short-term, at a cold start	≥0.5 bar absolute	$t < 3$ min
Maximum pressure $p_{S\ max}$	≤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 and working pressure.
Controls HP, HW, EP	20 bar above case pressure	
Controls HT, DA, EZ, ET	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 $p_{T\ peak}$	10 bar	$t < 0.1$ s, maximum 1000 pressure peaks permissible

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

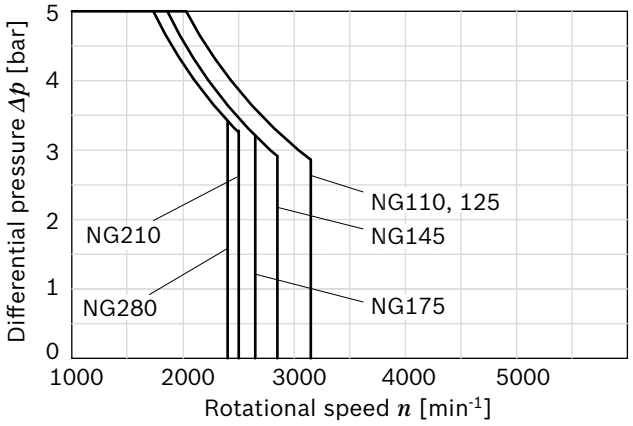


▼ **Pressure definition**



Total operating period = $t_1 + t_2 + ... + t_n$

▼ **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 (at p = 20 bar)		$V_{g\,max}$	cm³	110.4	125	145.3	175.4	210.6	280.3
	standard boost pump (at p = 20 bar)		$V_{g\,Sp}$	cm³	24.5	31	32	39	46	60
	large boost pump (at p = 20 bar)[1]		$V_{g\,Sp}$	cm³	31	–	39	47	60	–
Torque[2]	at $V_{g\,max}$ and	Δp = 430 bar	T	Nm	756	856	994	1200	1441	1918
		Δp = 100 bar	T	Nm	176	200	231	279	335	446
Rotary stiffness of drive shaft		V8	c	kNm/rad	173	–	–	–	–	–
		T1	c	kNm/rad	214	193	248	266	–	–
		T2	c	kNm/rad	246	219	293	–	394	411
		T3	c	kNm/rad	–	–	340	374	483	510
		Z9	c	kNm/rad	219	–	–	–	–	–
		A1	c	kNm/rad	251	222	300	326	407	–
		A2	c	kNm/rad	–	–	326	357	–	–
		A3	c	kNm/rad	–	–	–	–	516	546
Moment of inertia for rotary group			J_{TW}	kgm²	0.0218	0.0232	0.0330	0.0570	0.0632	0.0975
Maximum angular acceleration[3]			α	rad/s²	14500	13000	12000	10000	8000	5000
Case volume			V	l	2.5	2.3	3.3	3.1	4.9	5.4
Weight (without through drive) approx.			m	kg	88	84	106	115	152	160
Standard rotary group										
Rotational speed[4]	maximum at $V_{g\,max}$		$n_{nom\,S}$	rpm	3150	3000	2850	2650	2500	2400
	at Δp ≥ 40 bar (t < 15 s)		$n_{max\,40}$	rpm	3350	3150	3000	2800	2650	2550
	minimum		n_{min}	rpm	500	500	500	500	500	500
Flow	at n_{nom} and $V_{g\,max}$		q_v	l/min	348	375	414	465	527	673
Power[2]	at n_{nom}, $V_{g\,max}$ and Δp = 430 bar		P	kW	249	269	297	333	377	482
High-speed rotary group										
Rotational speed[4]	maximum at $V_{g\,max}$		$n_{nom\,H}$	rpm	3400	–	3050	3000	–	–
	at Δp ≥ 40 bar (t < 15 s)		$n_{max\,40}$	rpm	3600	–	3200	3100	–	–
	minimum		n_{min}	rpm	500	–	500	500	–	–
Flow	at n_{nom} and $V_{g\,max}$		q_v	l/min	375	–	443	526	–	–
Power[2]	at n_{nom}, $V_{g\,max}$ and Δp = 430 bar		P	kW	269	–	318	377	–	–

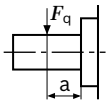
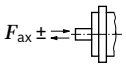
Notice

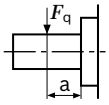
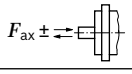
- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommend testing the loads by means of experiment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

1) The version with a large internal gear pump can result in maximum rotational speed limitations. Please contact us.
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 n_{opt} = 36 to 16 mm²/s
   – for hydraulic fluid based on mineral oils (for HF hydraulic fluids, observe the technical data in 90225)

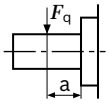
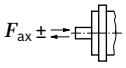
Permissible radial and axial forces of the drive shafts

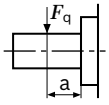
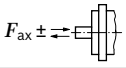
▼ Splined shaft ANSI B92.1a

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)		$F_{q\,max}$	N	9524	7483	6548	6500	5800	9241	8086
		a	mm	24	33.5	40	33.5	40	33.5	40
Maximum axial force		$+ F_{ax\,max}$	N	6305	6305	6305	6411	6411	6763	6763
		$- F_{ax\,max}$	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)		$F_{q\,max}$	N	8086	4800	4400	11185	10059	14562	13256
		a	mm	40	33.5	40	40	40	40	40
Maximum axial force		$+ F_{ax\,max}$	N	6763	7252	7252	7760	7760	8450	8450
		$- F_{ax\,max}$	N	4437	4748	4748	5040	5040	5150	5150

▼ Splined shaft DIN 5480

Size		NG		110	110	125	145	145	175	175
Drive shaft				W40	W45	W45	W45	W50	W45	W50
Maximum radial force at distance a (from shaft collar)		$F_{q\,max}$	N	11000	10500	7200	9000	8500	5500	5000
		a	mm	22.5	25	25	25	27.5	25	27.5
Maximum axial force		$+ F_{ax\,max}$	N	6305	6305	6411	6763	6763	7252	7252
		$- F_{ax\,max}$	N	4095	4095	3989	4437	4437	4748	4748

Size		NG		210	210	280
Drive shaft				W45	W55	W55
Maximum radial force at distance a (from shaft collar)		$F_{q\,max}$	N	13500	12500	14500
		a	mm	25	29	29
Maximum axial force		$+ F_{ax\,max}$	N	7760	7760	8450
		$- F_{ax\,max}$	N	5040	5040	5150

Determining the operating characteristics				
Flow	q_v	$= \frac{V_g \times n \times \eta_v}{1000}$		[l/min]
Torque	T	$= \frac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$		[Nm]
Power	P	$= \frac{2 \pi \times T \times n}{60000}$	$= \frac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g	Displacement per revolution [cm³]
Δp	Differential pressure [bar]
n	Rotational speed [rpm]
η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

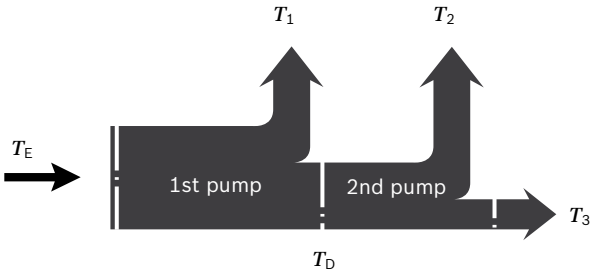
Notice

- 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 Δp = 430 bar[1)]			T	Nm	756	856	994	1200	1441	1918
Maximum input torque at drive shaft[2)]										
ANSI B92.1a–1976	**V8**	1 3/8 in	$T_{E\,max}$	Nm	970	–	–	–	–	–
	T1	1 3/4 in	$T_{E\,max}$	Nm	1640	1640	1640	1640	–	–
	T2	2 in	$T_{E\,max}$	Nm	2670	2670	2670	–	2670	2670
	T3	2 1/4 in	$T_{E\,max}$	Nm	–	–	4070	4070	4070	4070
DIN 5480	**Z9**	W40	$T_{E\,max}$	Nm	On request	–	–	–	–	–
	A1	W45	$T_{E\,max}$	Nm	2190	2190	2190	2190	2190	–
	A2	W50	$T_{E\,max}$	Nm	–	–	3140	3140	–	–
	A3	W55	$T_{E\,max}$	Nm	–	–	–	–	4350	4350
Maximum through-drive torque			$T_{D\,max}$	Nm	934	1110	1760	1760	2641	2641

▼ Distribution of torques



Torque at 1st pump	T_1		
Torque at 2nd pump	T_2		
Torque at 3rd pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\,max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\,max}$

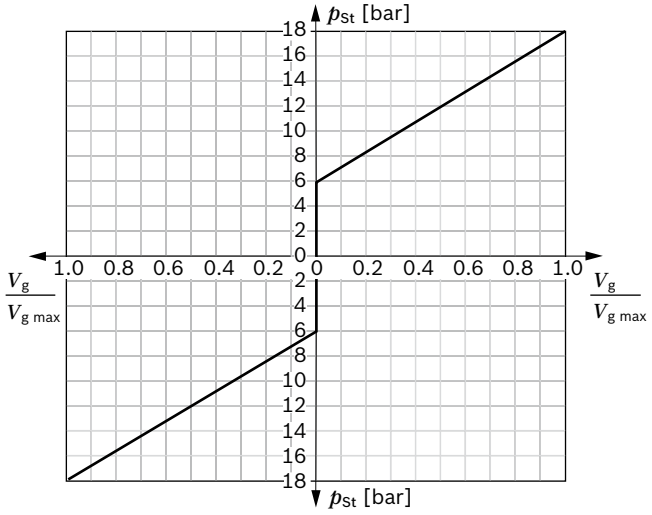
1) Efficiency not considered

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**$_1$ and **Y**$_2$).
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.

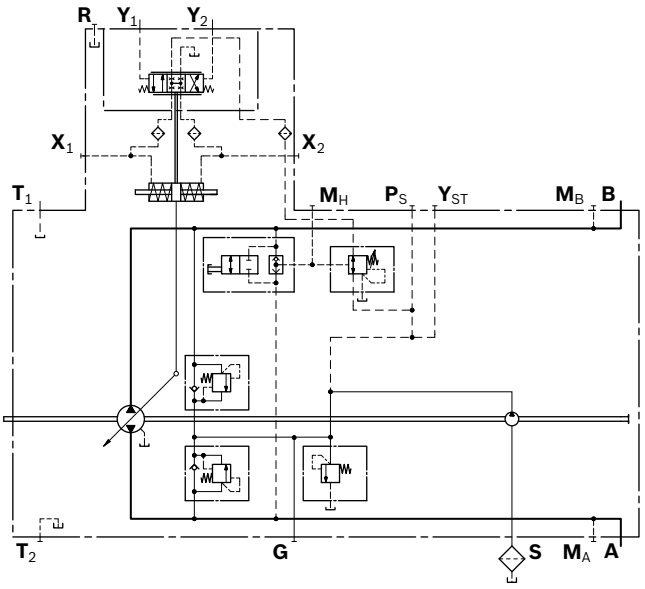
If the pump is also equipped with a DA control valve (see page 16), automotive operation is possible for travel drives.

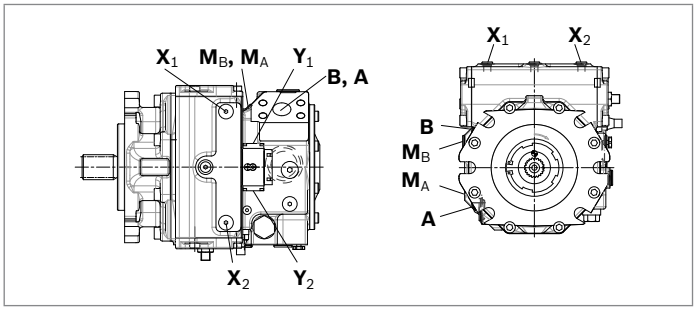


- V_g = Displacement at p_{St}
  $V_{g\,max}$ = Displacement at p_{St} = 18 bar
- Pilot signal p_{St} = 6 to 18 bar (at port **Y**$_1$, **Y**$_2$)
- Start of control at 6 bar
- End of control at 18 bar (maximum displacement $V_{g\,max}$)

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

▼ **Circuit diagram, standard version**



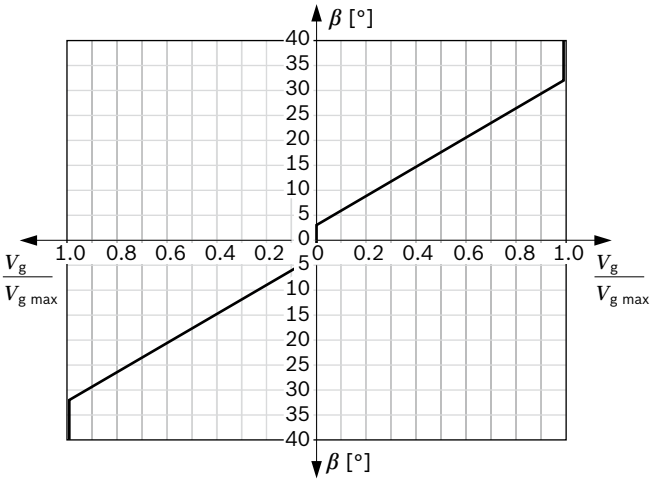


Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Pilot signal	**Y**$_1$	**Y**$_2$	**Y**$_1$	**Y**$_2$
Control pressure	**X**$_1$	**X**$_2$	**X**$_1$	**X**$_2$
Flow direction	**B** to **A**	**A** to **B**	**A** to **B**	**B** to **A**
Working pressure	**M**$_A$	**M**$_B$	**M**$_B$	**M**$_A$

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.



Swivel angle β at the control lever for pump displacement change:

- Start of control at β = ±3°
- End of control at β (maximum displacement $V_{g\,max}$) at ±32°
- Rotational limit β of the control lever (internal) ±38°

The maximum required torque at the lever is 170 Ncm. To prevent damage to the HW control module, a positive mechanical stop of 36.5°±1 must be provided for the HW control lever on the customer side.

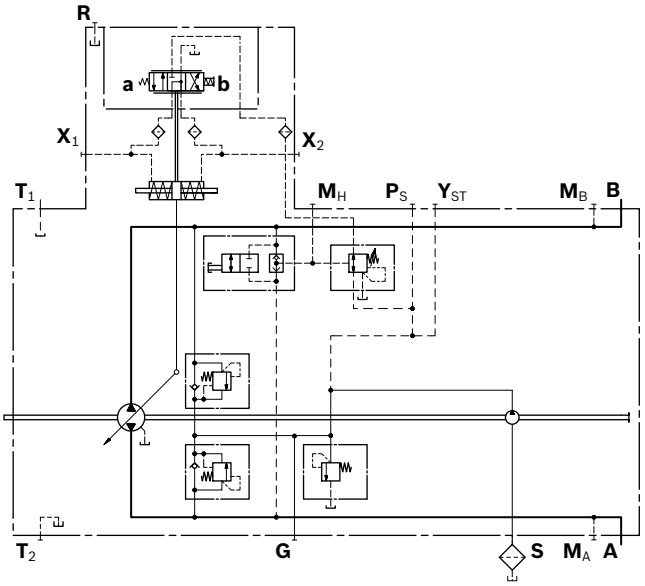
Notice

- Spring centering enables the pump, depending on pressure and 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.

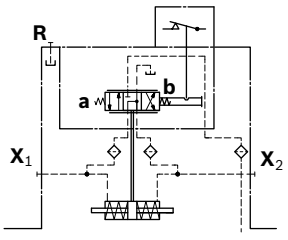
Option: Neutral position switch
The switch contact in the neutral position switch is closed when the control lever on the HW control module is in its neutral position. The switch opens when the control lever is moved out of the central position in either direction. Thus, the neutral position switch provides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

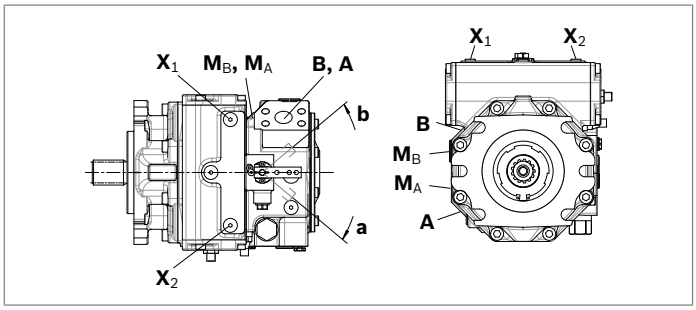
Technical data	
Load capacity	20 A (continuous), without switching operations
Switching capacity	15 A / 32 V (resistive load)
	4 A / 32 V (inductive load)
Connector version	DEUTSCH DT04-2P-EP04 (mating connector, see page 61)

▼ **Circuit diagram, standard version**



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



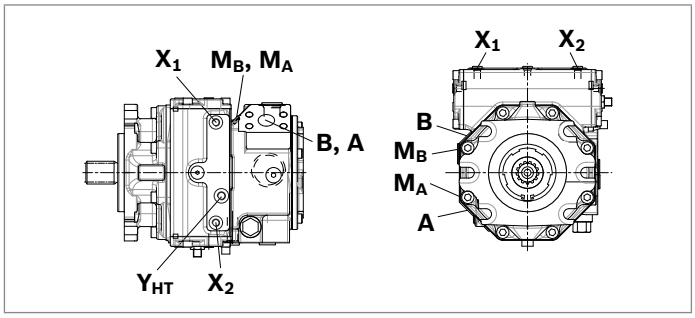


Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Lever direction	**a**	**b**	**a**	**b**
Control pressure	X_1	X_2	X_1	X_2
Flow direction	**B** to **A**	**A** to **B**	**A** to **B**	**B** to **A**
Working pressure	M_A	M_B	M_B	M_A

HT – Hydraulic control, direct operated

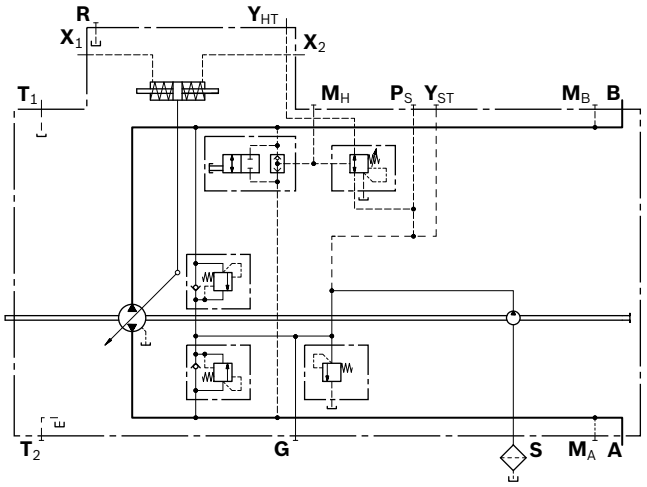
With the direct operated hydraulic control, the output flow of the pump is controlled by a hydraulic control pressure, applied directly to the stroking piston through either port $\mathbf{X_1}$ or $\mathbf{X_2}$.
Flow direction is determined by which control pressure port is pressurized (refer to table 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 $\mathbf{Y_{HT}}$ must be used as the control pressure source for the selected control module. See page 52 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	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$
Flow direction	**B** to **A**	**A** to **B**	**A** to **B**	**B** to **A**
Working pressure	$\mathbf{M_A}$	$\mathbf{M_B}$	$\mathbf{M_B}$	$\mathbf{M_A}$

▼ **Circuit diagram**



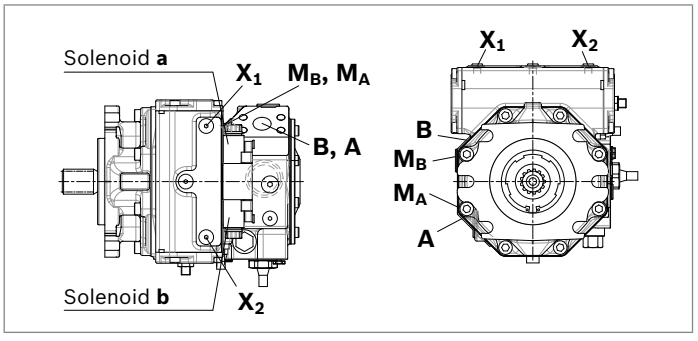
DA – Automatic control, speed related

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, 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 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 61		

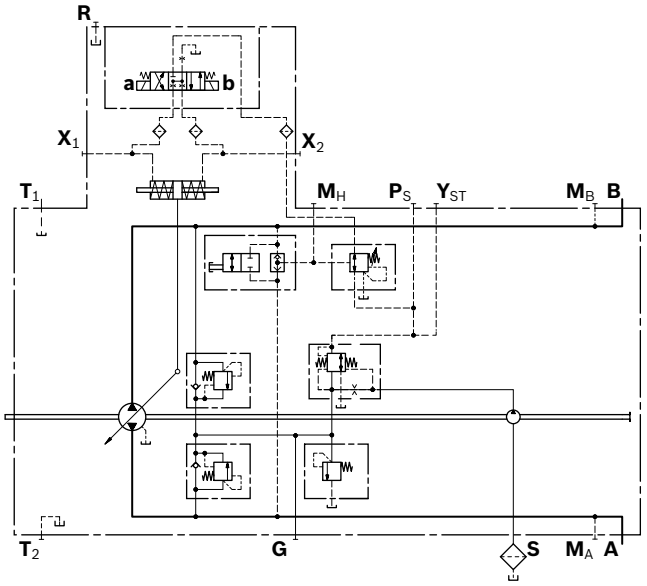


Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Actuation of solenoid	**a**	**b**	**a**	**b**
Control pressure	X_2	X_1	X_2	X_1
Flow direction	**A** to **B**	**B** to **A**	**B** to **A**	**A** to **B**
Working pressure	M_B	M_A	M_A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

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.

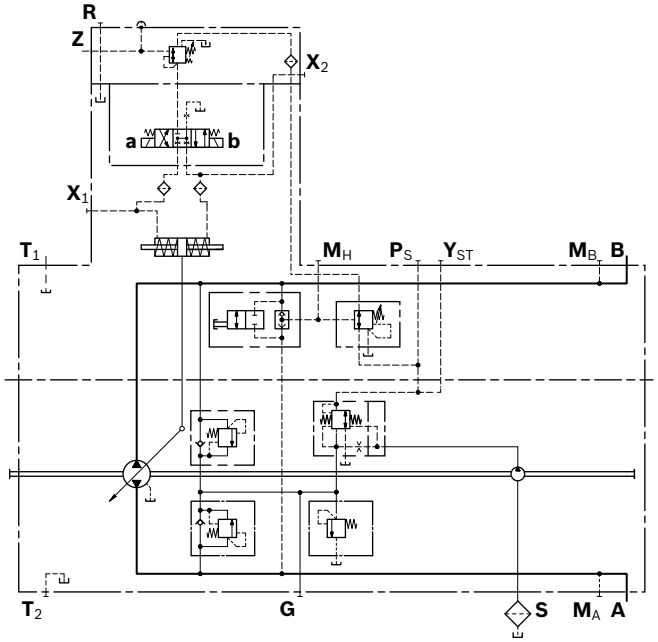
Version with pressure reducing valve.

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**: 80 bar

▼ **Circuit diagram**



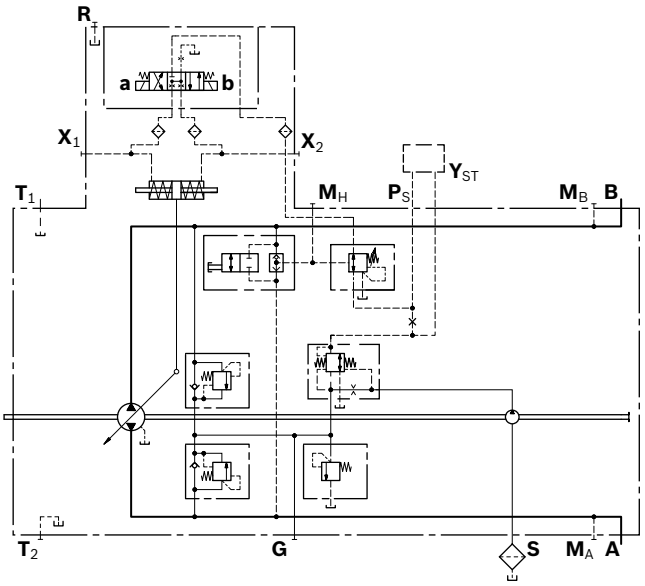
DA..6 – DA control valve, fixed setting, ports for pilot control device as inch valve

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 $\mathbf{P}_S$ and $\mathbf{Y}_{ST}$.

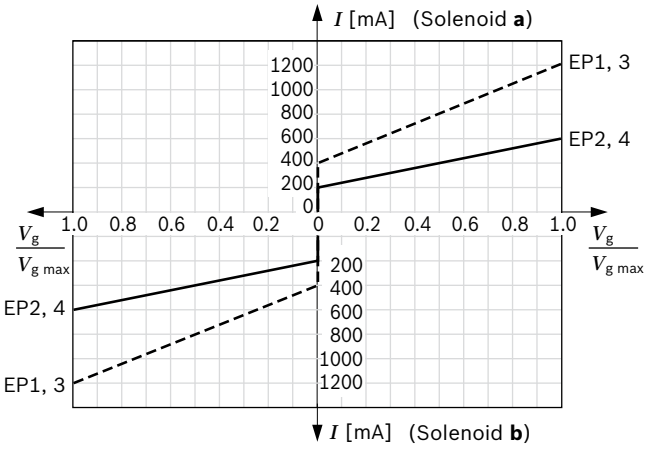
A suitable pilot control device must be ordered separately and is not included in the scope of delivery.

▼ **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.

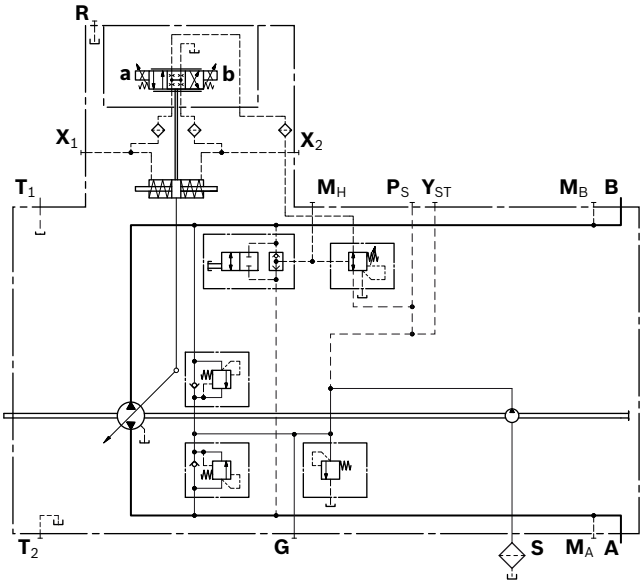


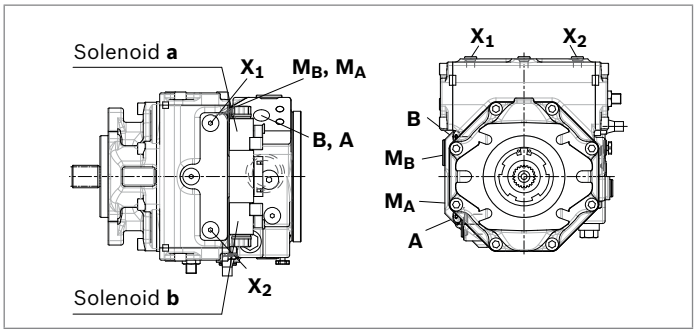
Notice
The proportional solenoids in version EP1/EP2 do not have manual override. Proportional solenoids with manual override and spring return are available on request (version EP3/EP4).

Technical data, solenoid	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 20 °C)	5.5 Ω	22.7 Ω
Dither		
Frequency	100 Hz	100 Hz
minimum oscillation range[1)]	240 mA	120 mA
Duty cycle	100%	100%
Type of protection: see connector version page 61		

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

▼ **Circuit diagram**





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

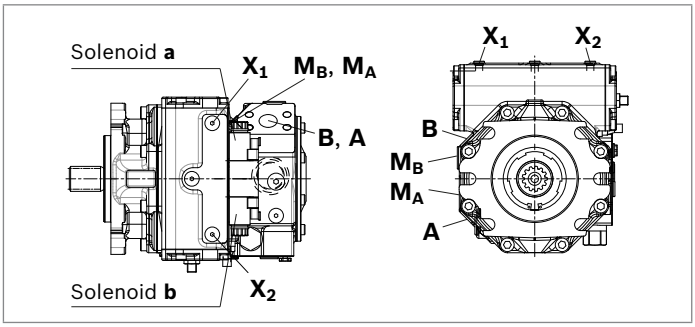
1) Minimum required oscillation range of the control current $\Delta I_{p\text{-}p}$ (peak to peak) within the respective control range (start of control to end of control)

EZ – Two-point control, electric

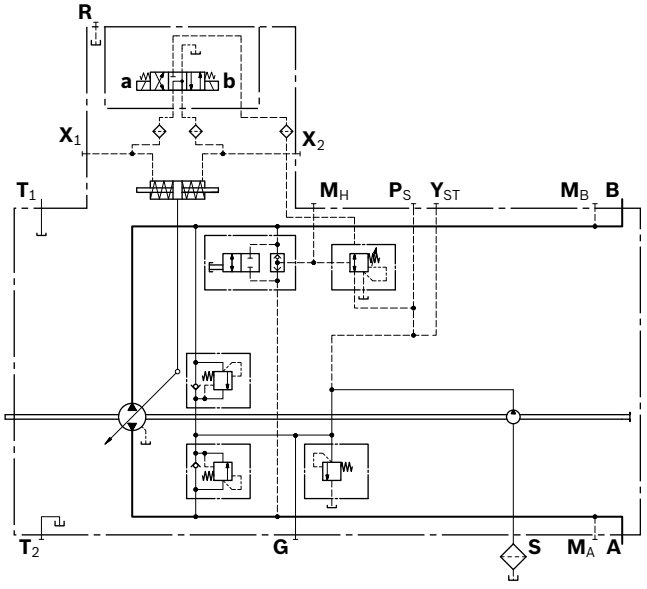
By actuating either switching solenoid **a** or **b**, internal control pressure is applied directly to the stroking piston and the pump swivels to maximum displacement. The EZ control enables pump flow to be switched between V_g = 0 and $V_{g\,max}$.
Flow direction is determined by which solenoid is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

Technical data, solenoid	EZ1	EZ2
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 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 61		

Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Actuation of 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**

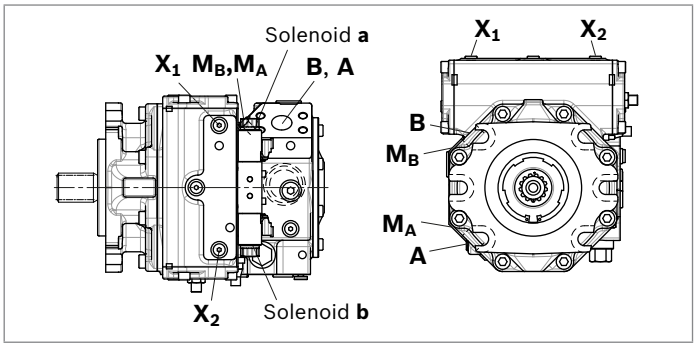


ET – Electric control, direct operated

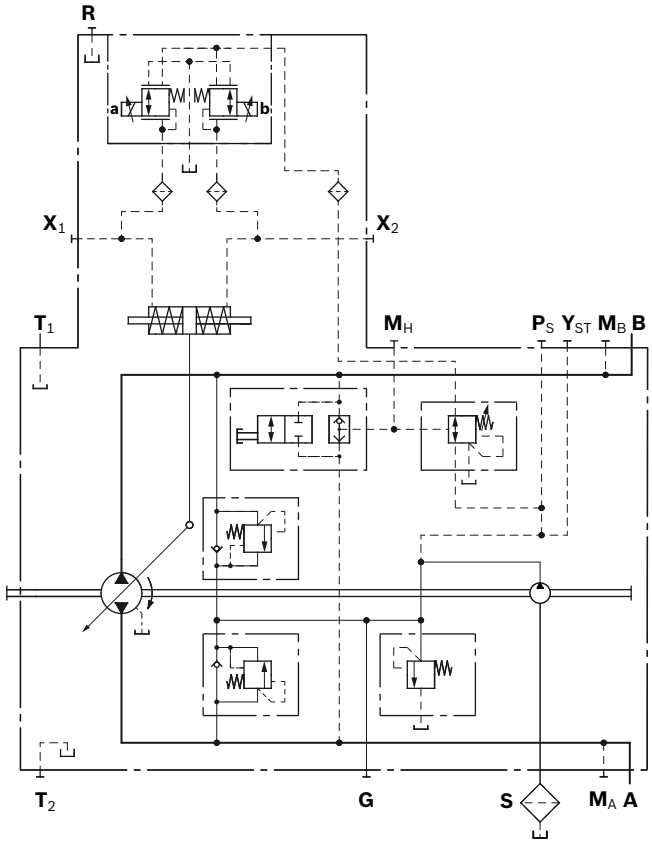
The output flow of the pump is infinitely variable between 0 and 100%. Depending on the preselected current I at solenoids **a** and **b** of the pressure reducing valves, the stroking cylinder of the pump is proportionally supplied with control pressure. The pump displacement that arises at a certain 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: 40 bar.

Technical data, solenoid	**ET5**	**ET6**
Voltage	12 V (±20%)	24 V (±20%)
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither		
Frequency	100 Hz	100 Hz
minimum oscillation range[1)]	240 mA	120 mA
Duty cycle	100%	100%
Type of protection: see connector version page 61		

Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Actuation of solenoid	**a**	**b**	**a**	**b**
Control pressure (in X_3, X_4 optional)	X_1	X_2	X_1	X_2
	X_3	X_4	X_3	X_4
Flow direction	**B** to **A**	**A** to **B**	**A** to **B**	**B** to **A**
Working pressure	M_A	M_B	M_B	M_A



▼ **Circuit diagram**

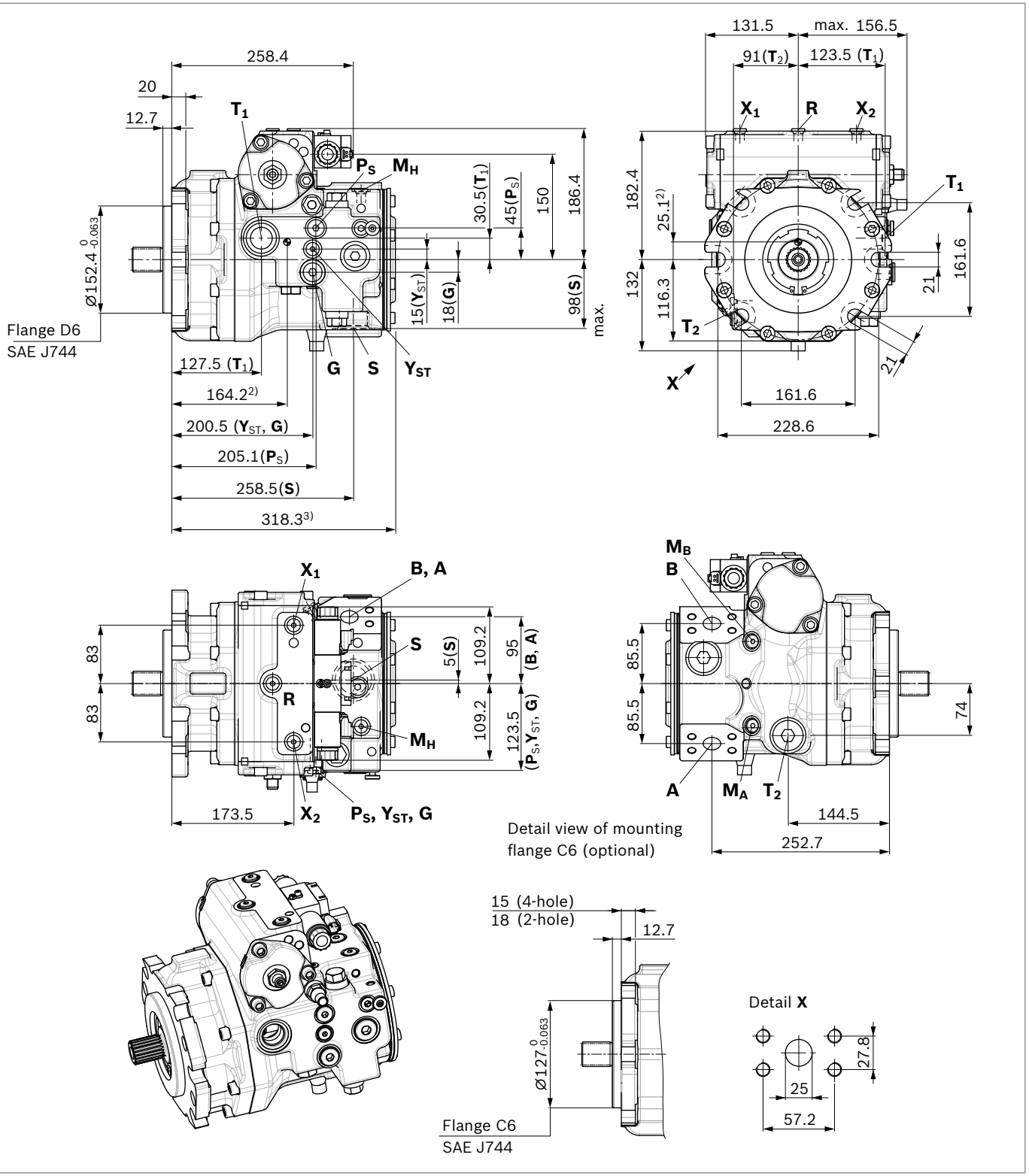


1) Minimum required oscillation range of the control current $\Delta I_{p\text{-}p}$ (peak to peak) within the respective control range (start of control to end of control)

Dimensions, size 110

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1)]



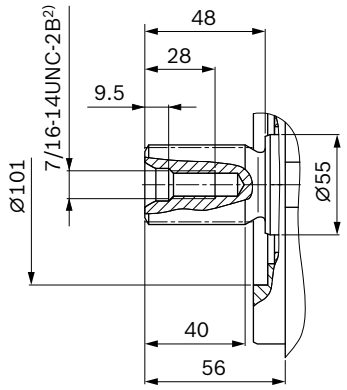
1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

2) Center of gravity

3) Valid for version with standard internal gear pump, overall length without boost pump and with large internal gear pump, see through drive, page 45

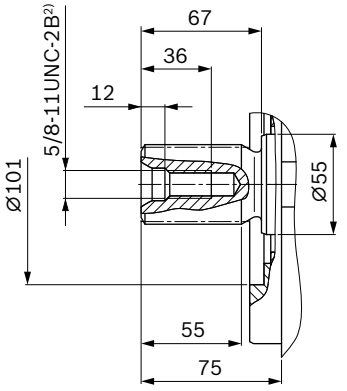
▼ Splined shaft ANSI B92.1a–1976

V8 – 1 3/8 in 21T 16/32DP[1)]



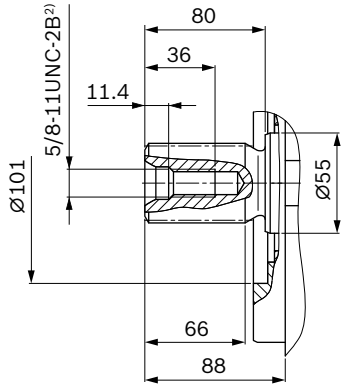
▼ Splined shaft ANSI B92.1a

T1 – 1 3/4 in 13T 8/16DP[1)]



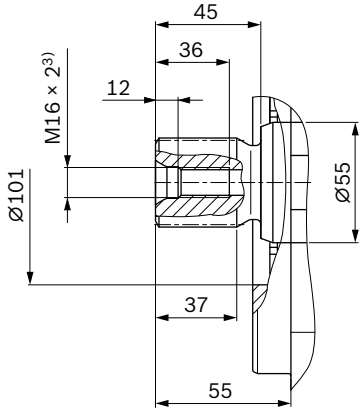
▼ Splined shaft ANSI B92.1a

T2 – 2 in 15T 8/16DP[1)]



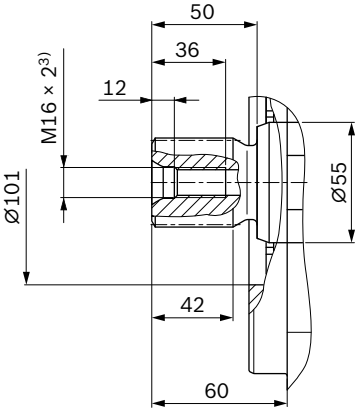
▼ Splined shaft DIN 5480

Z9 – W40×2×18×9



▼ Splined shaft DIN 5480

A1 – W45×2×21×9



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

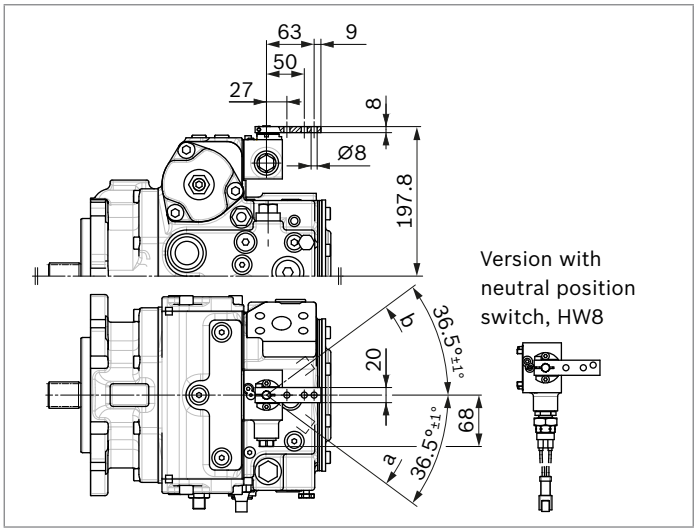
2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

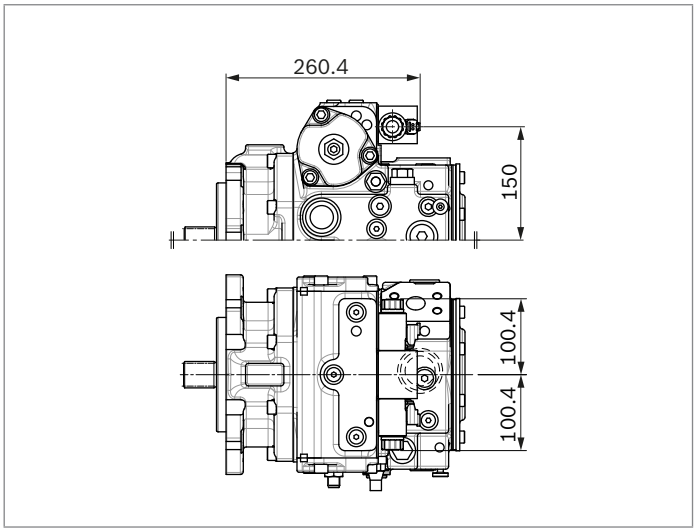
Ports		Standard	Size	p_{max} [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 in M12 × 1.75; 17 deep	500	O
S	Suction port	ISO 6149[8]	M42 × 2; 19.5 deep	5	O[6]
T_1	Drain port	ISO 6149[8]	M33 × 2; 19 deep	3	O[7]
T_2	Drain port	ISO 6149[8]	M33 × 2; 19 deep	3	X[7]
R	Air bleed port	ISO 6149[8]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Control pressure port (upstream of orifice)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
X_3, X_4[9]	Stroking chamber pressure port	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149[8]	M22 × 1.5; 15.5 deep	40	X
P_S	Pilot pressure port inlet	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	X
P_S	Pilot pressure port inlet (DA..6 only)	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	O
Y_{ST}	Pilot pressure port outlet	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
Y_{ST}	Pilot pressure port outlet (DA..6 only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
M_A, M_B	Measuring port pressure A, B	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
M_H	Measuring port, high pressure	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149[8]	M10 × 1; 8 deep	80	O

4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
6) Plugged for external boost pressure supply.
7) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 64).
8) The countersink can be deeper than as specified in the standard.
9) Optional, see page 55
10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

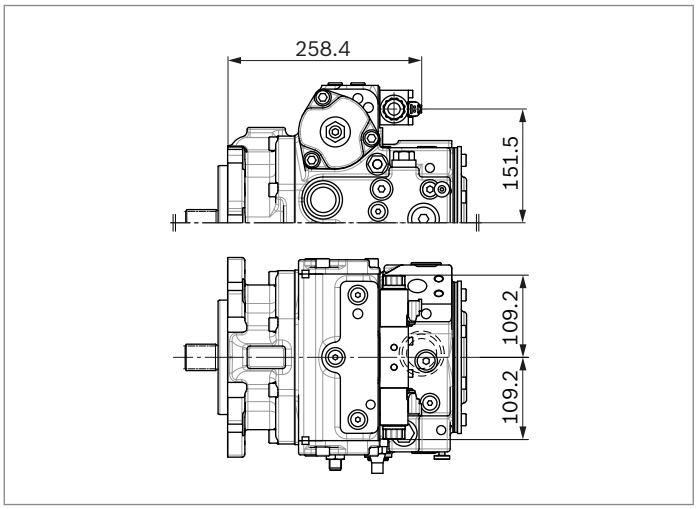
▼ **HW** – Proportional control, hydraulic, mechanical servo



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

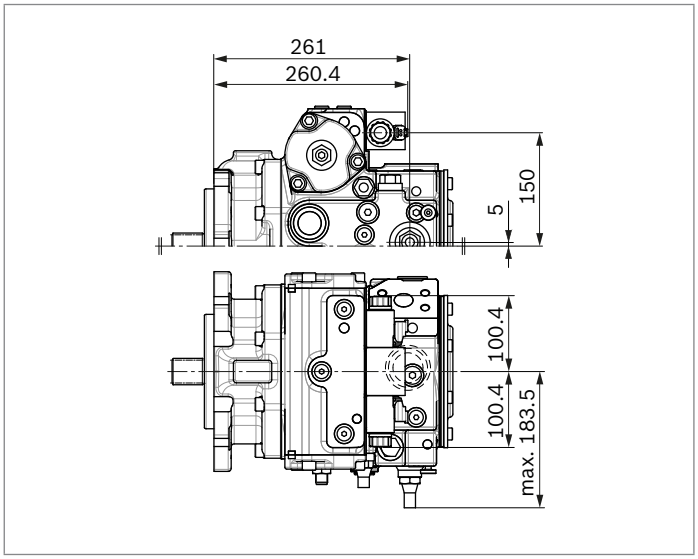


▼ **ET** – Electric control, direct operated, two DRE

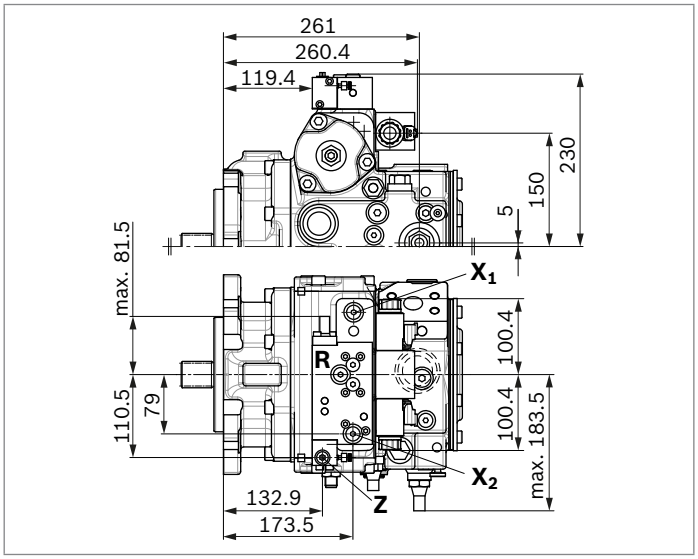


DA control valve

▼ **DA..1** – fixed setting



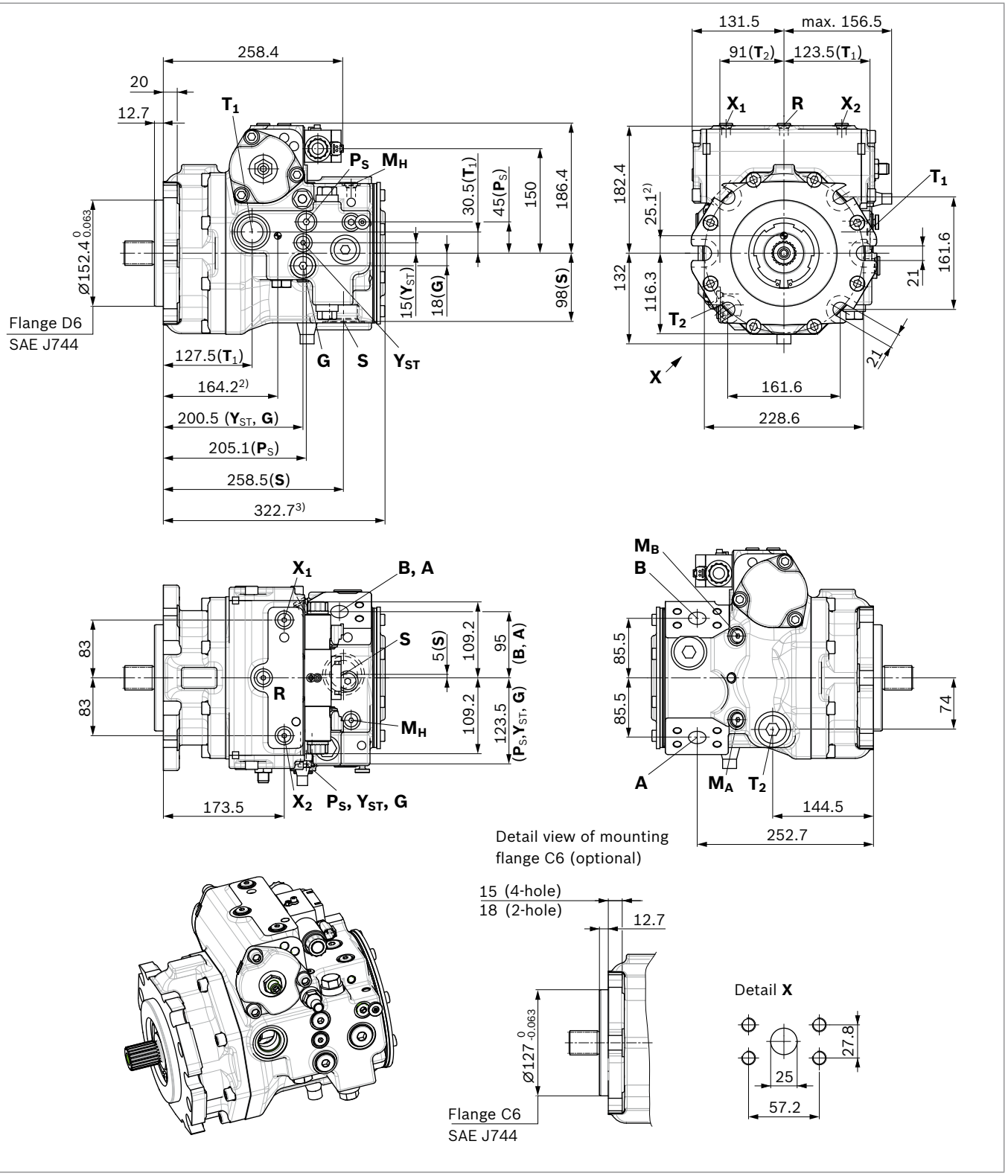
▼ **DA..5** – fixed setting and inch valve mounted



Dimensions, size 125

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1)]



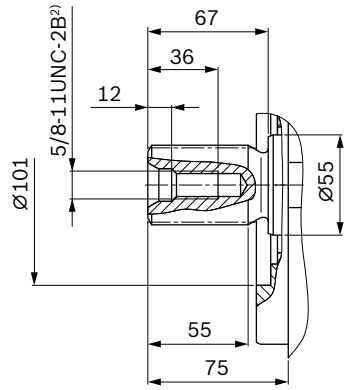
1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

2) Center of gravity

3) Valid for version with standard internal gear pump, overall length without boost pump see through drive, page 45

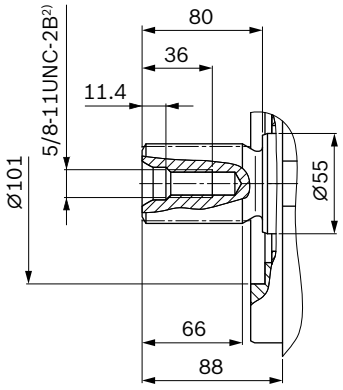
▼ **Splined shaft ANSI B92.1a**

T1 – 1 3/4 in 13T 8/16DP[1)]



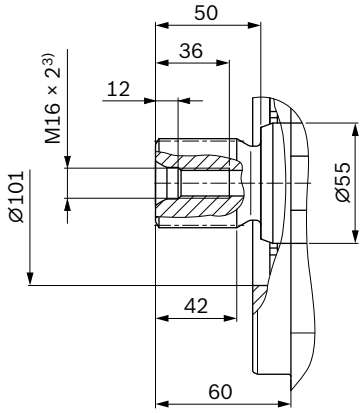
▼ **Splined shaft ANSI B92.1a**

T2 – 2 in 15T 8/16DP[1)]



▼ **Splined shaft DIN 5480**

A1 – W45×2×21×9



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

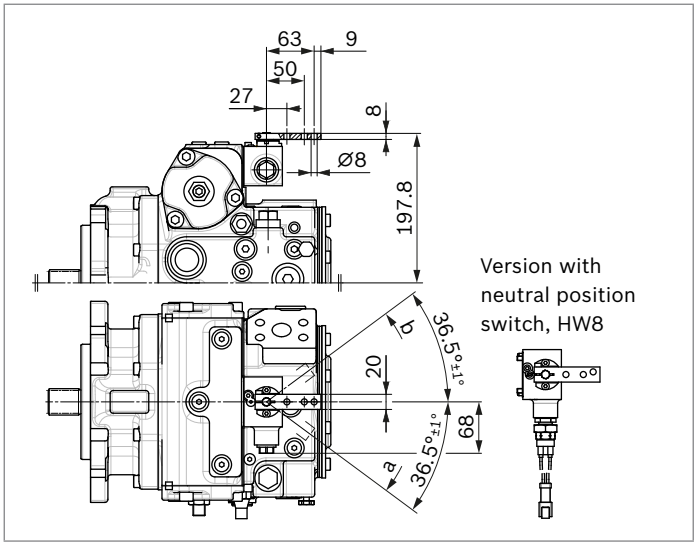
2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

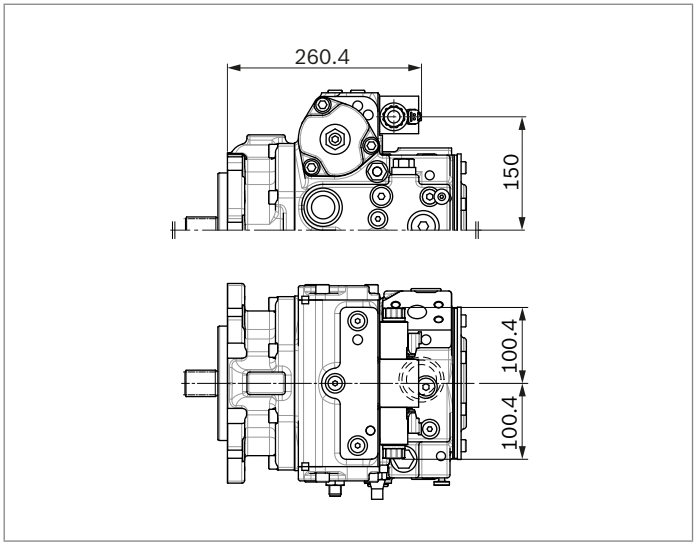
Ports		Standard	Size	p_{max} [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 in M12 × 1.75; 17 deep	500	O
S	Suction port	ISO 6149[8]	M42 × 2; 19.5 deep	5	O[6]
T_1	Drain port	ISO 6149[8]	M33 × 2; 19 deep	3	O[7]
T_2	Drain port	ISO 6149[8]	M33 × 2; 19 deep	3	X[7]
R	Air bleed port	ISO 6149[8]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Control pressure port (upstream of orifice)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
X_3, X_4[9]	Stroking chamber pressure port	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149[8]	M22 × 1.5; 15.5 deep	40	X
P_S	Pilot pressure port inlet	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	X
P_S	Pilot pressure port inlet (DA..6 only)	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	O
Y_{ST}	Pilot pressure port outlet	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
Y_{ST}	Pilot pressure port outlet (DA..6 only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
M_A, M_B	Measuring port pressure A, B	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
M_H	Measuring port, high pressure	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149[8]	M10 × 1; 8 deep	80	O

4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
6) Plugged for external boost pressure supply.
7) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 64).
8) The countersink can be deeper than as specified in the standard.
9) Optional, see page 55
10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

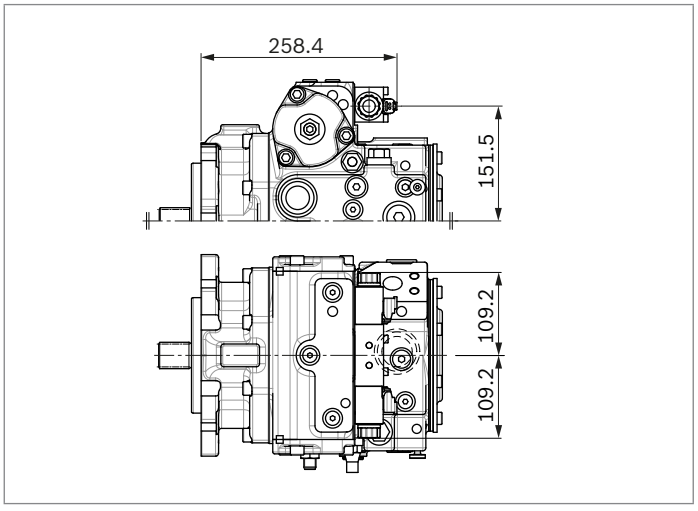
▼ **HW** – Proportional control, hydraulic, mechanical servo



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

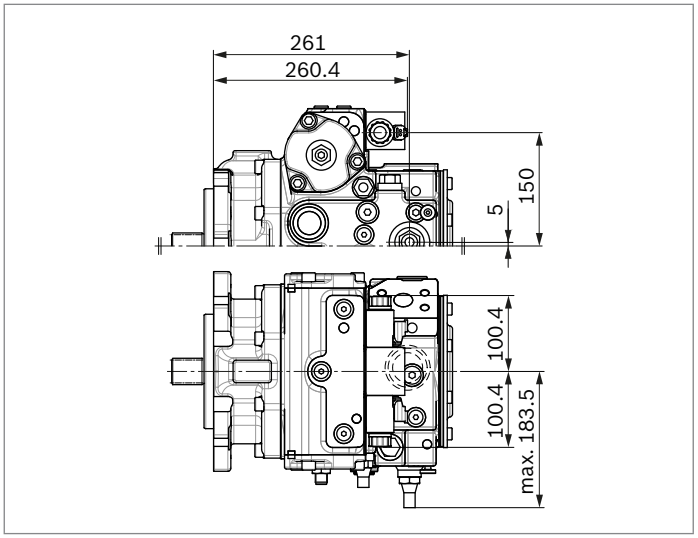


▼ **ET** – Electric control, direct operated, two DRE



DA control valve

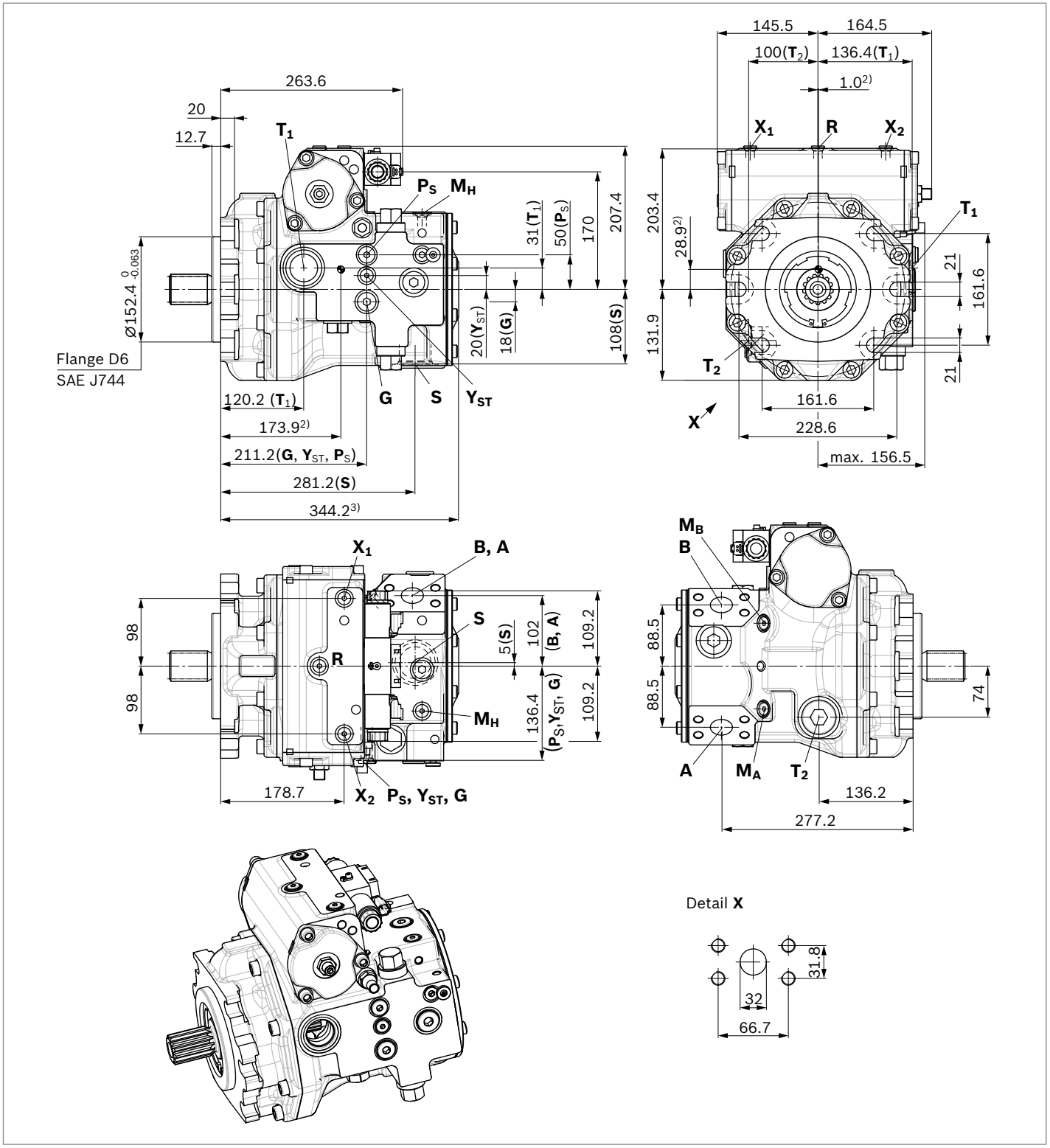
▼ **DA..1** – fixed setting



Dimensions, size 145

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1)]



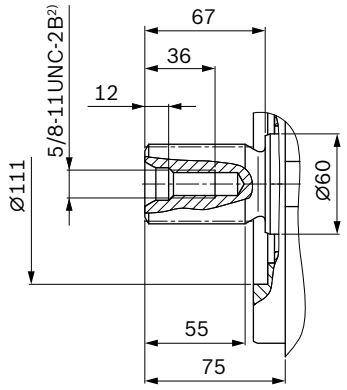
1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

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 45.

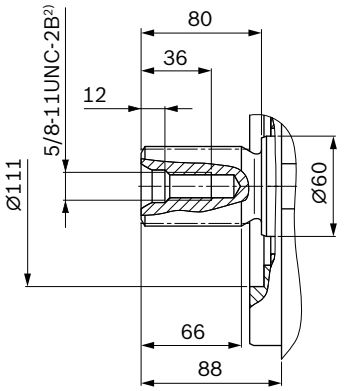
▼ **Splined shaft ANSI B92.1a**

T1 – 1 3/4 in 13T 8/16DP[1)]



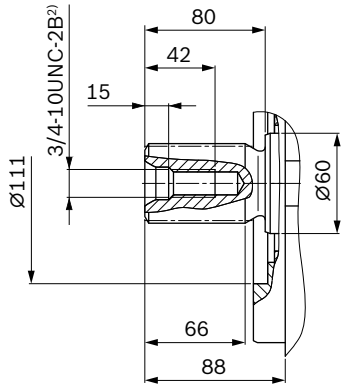
▼ **Splined shaft ANSI B92.1a**

T2 – 2 in 15T 8/16DP[1)]



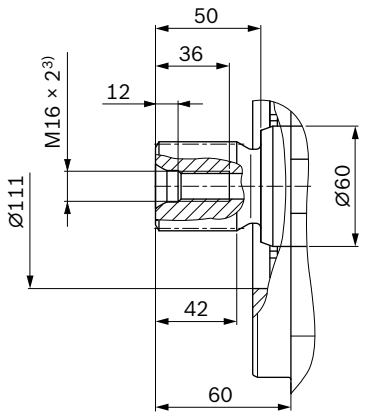
▼ **Splined shaft ANSI B92.1a**

T3 – 2 1/4 in 17T 8/16DP[1)]



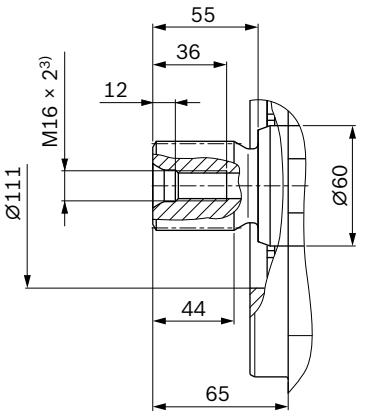
▼ **Splined shaft DIN 5480**

A1 – W45×2×21×9



▼ **Splined shaft DIN 5480**

A2 – W50×2×24×9



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

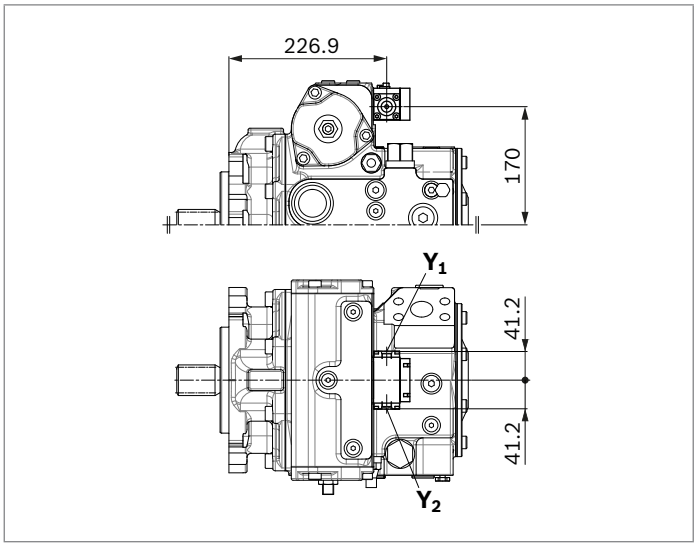
2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

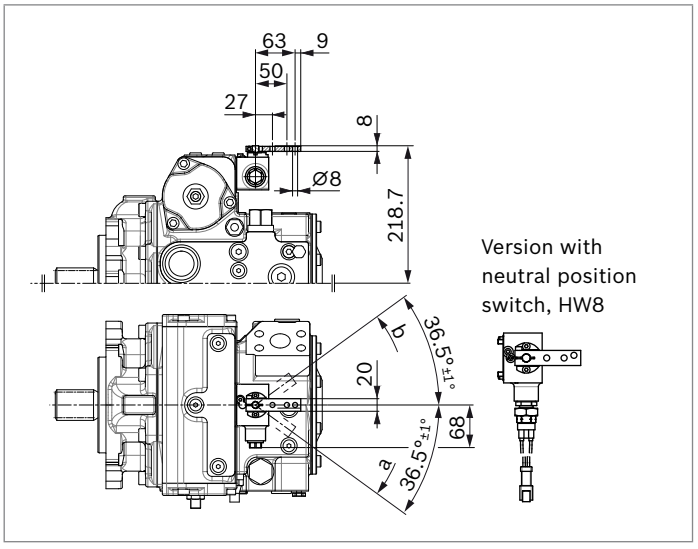
Ports		Standard	Size	p_{max} [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 1/4 in M14 × 2; 19 deep	500	O
S	Suction port	ISO 6149[8]	M48 × 2; 22 deep	5	O[6]
T_1	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	O[7]
T_2	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	X[7]
R	Air bleed port	ISO 6149[8]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Control pressure port (upstream of orifice)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
X_1, X_2	Control pressure port (upstream of orifice, HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
X_3, X_4[9]	Stroking chamber pressure port	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149[8]	M22 × 1.5; 15.5 deep	40	X
P_S	Pilot pressure port inlet	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	X
P_S	Pilot pressure port inlet (DA..6 only)	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	O
Y_{ST}	Pilot pressure port outlet	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
Y_{ST}	Pilot pressure port outlet (DA..6 only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Y_{HT}	Pilot pressure port outlet (HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
M_A, M_B	Measuring port pressure A, B	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
M_H	Measuring port, high pressure	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
Y_1, Y_2	Pilot pressure port (pilot signal HP only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149[8]	M10 × 1; 8 deep	80	O

4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
6) Plugged for external boost pressure supply.
7) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 64).
8) The countersink can be deeper than as specified in the standard.
9) Optional, see page 55
10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

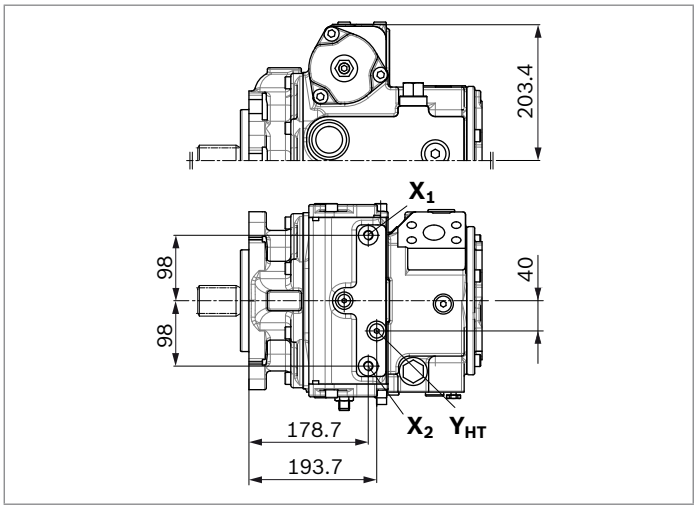
▼ **HP** – Proportional control, hydraulic, pilot-pressure related



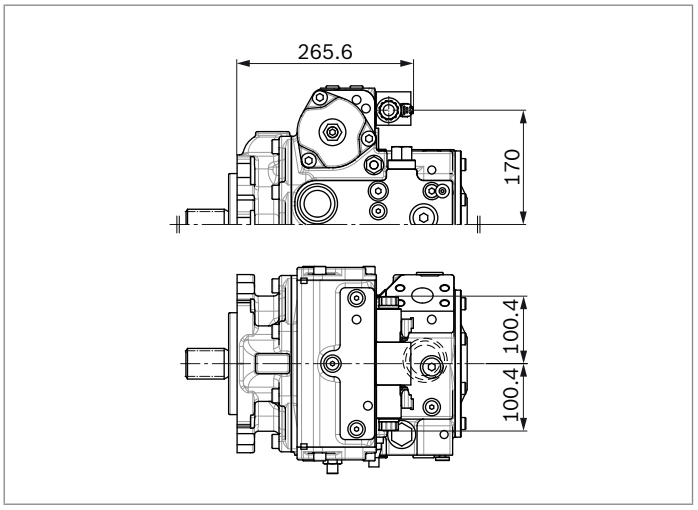
▼ **HW** – Proportional control, hydraulic, mechanical servo



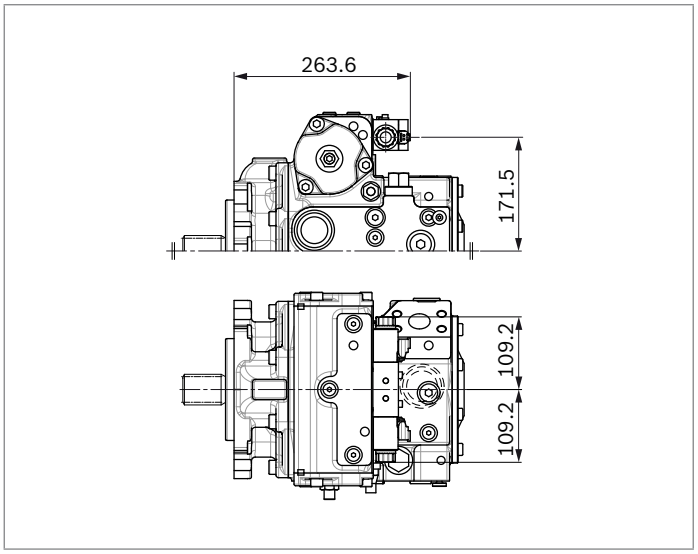
▼ **HT** – Hydraulic control, direct operated



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



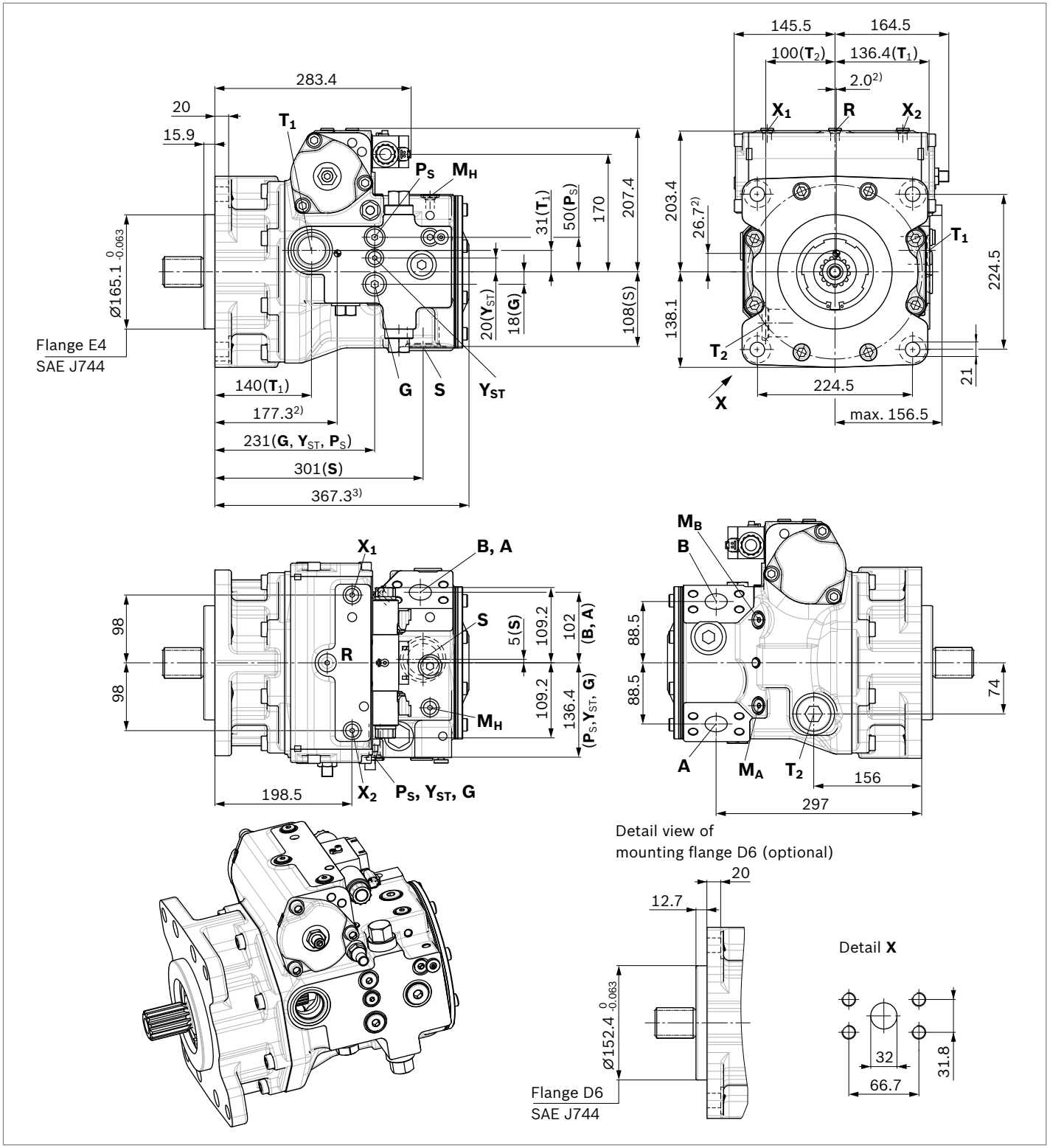
▼ **ET** – Electric control, direct operated, two DRE



Dimensions, size 175

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1)]



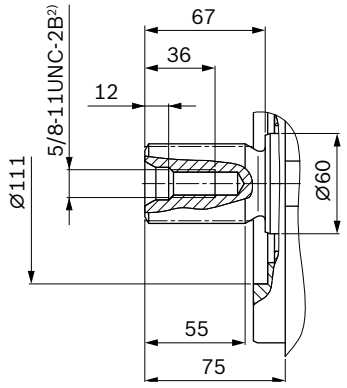
1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

2) Center of gravity

3) Valid for version with standard internal gear pump, overall length without boost pump and with large internal gear pump, see through drive, page 45.

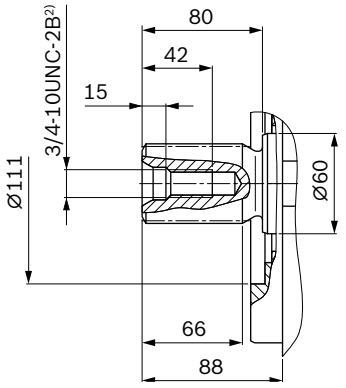
▼ **Splined shaft ANSI B92.1a**

T1 – 1 3/4 in 13T 8/16DP[1)]



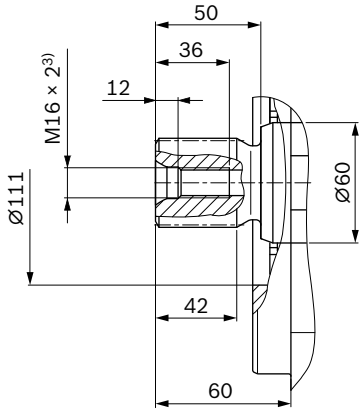
▼ **Splined shaft ANSI B92.1a**

T3 – 2 1/4 in 17T 8/16DP[1)]



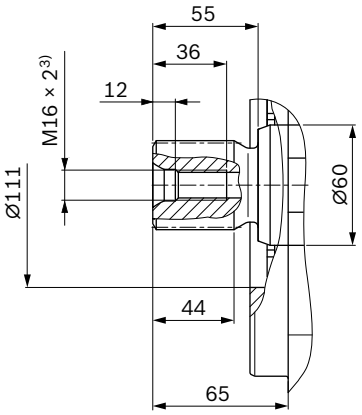
▼ **Splined shaft DIN 5480**

A1 – W45×2×21×9



▼ **Splined shaft DIN 5480**

A2 – W50×2×24×9



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

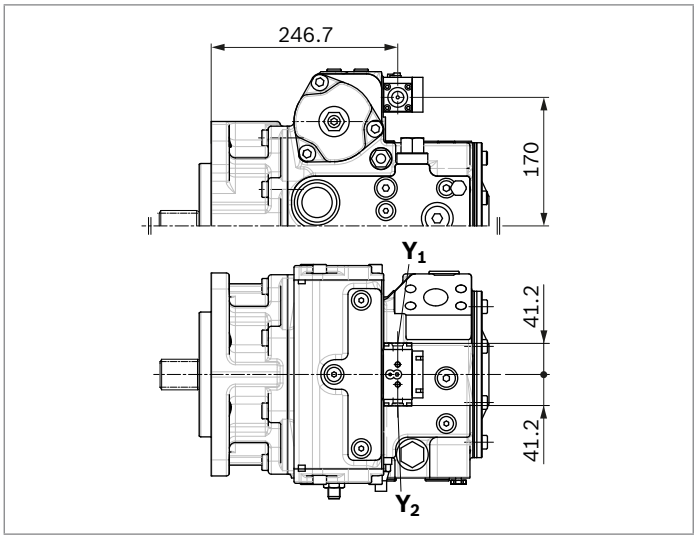
2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

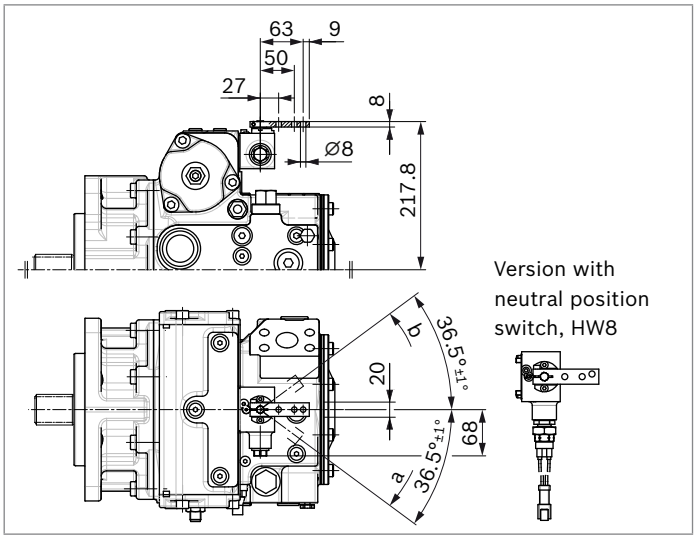
Ports		Standard	Size	p_{max} [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 1/4 in M14 × 2; 19 deep	500	O
S	Suction port	ISO 6149[8]	M48 × 2; 22 deep	5	O[6]
T_1	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	O[7]
T_2	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	X[7]
R	Air bleed port	ISO 6149[8]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Control pressure port (upstream of orifice)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
X_1, X_2	Control pressure port (upstream of orifice, HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
X_3, X_4[9]	Stroking chamber pressure port	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149[8]	M22 × 1.5; 15.5 deep	40	X
P_S	Pilot pressure port inlet	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	X
P_S	Pilot pressure port inlet (DA..6 only)	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	O
Y_{ST}	Pilot pressure port outlet	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
Y_{ST}	Pilot pressure port outlet (DA..6 only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Y_{HT}	Pilot pressure port outlet (HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
M_A, M_B	Measuring port pressure A, B	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
M_H	Measuring port, high pressure	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
Y_1, Y_2	Pilot pressure port (pilot signal HP only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149[8]	M10 × 1; 8 deep	80	O

4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
6) Plugged for external boost pressure supply.
7) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 64).
8) The countersink can be deeper than as specified in the standard.
9) Optional, see page 55
10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

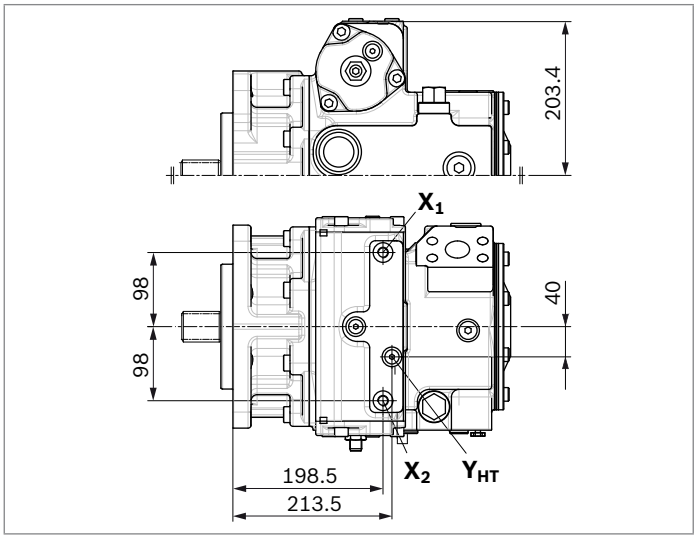
▼ **HP** – Proportional control, hydraulic, pilot-pressure related



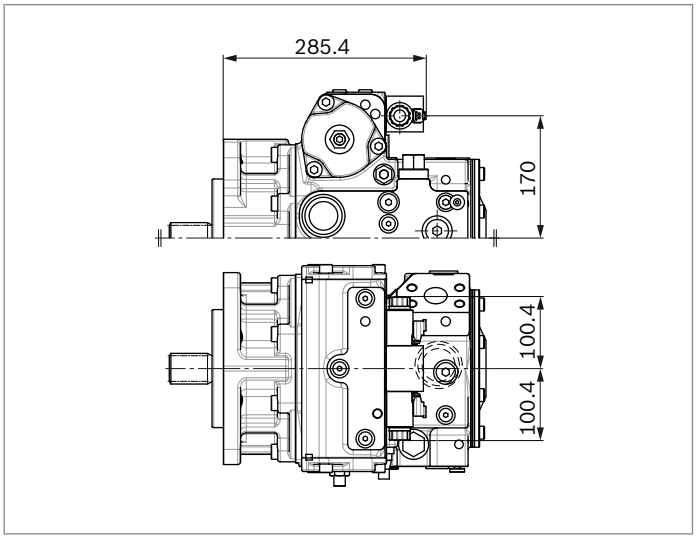
▼ **HW** – Proportional control, hydraulic, mechanical servo



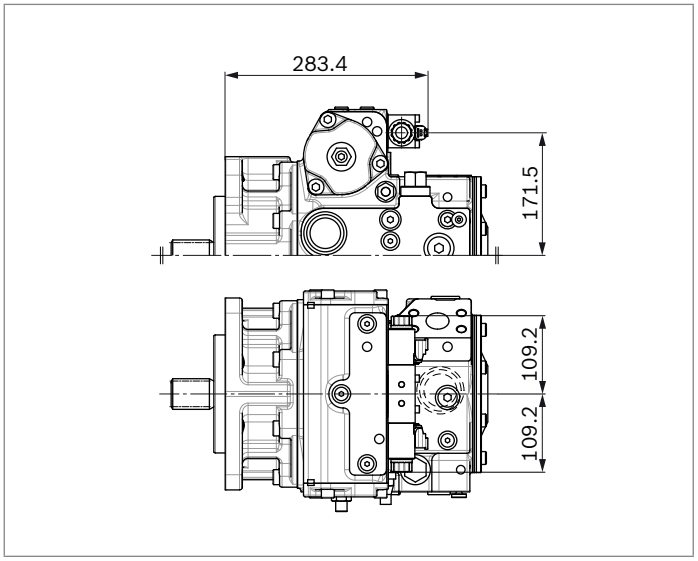
▼ **HT** – Hydraulic control, direct operated



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



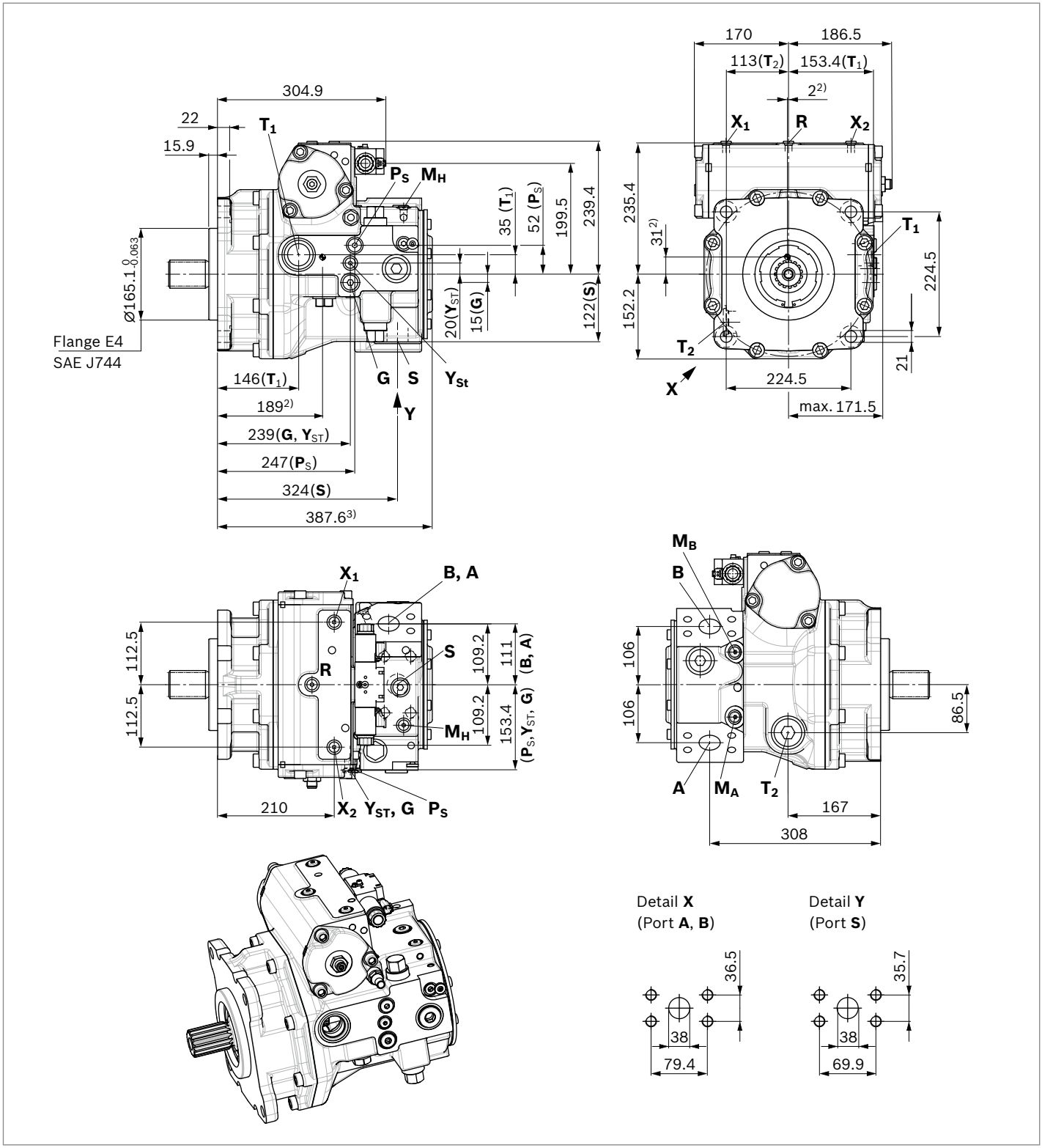
▼ **ET** – Electric control, direct operated, two DRE



Dimensions, size 210

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1)]



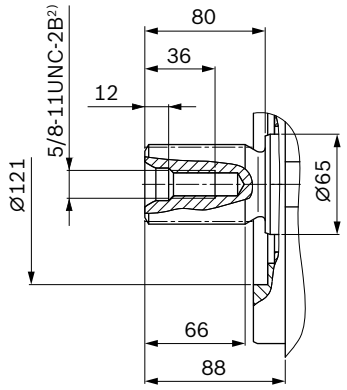
1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

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 45.

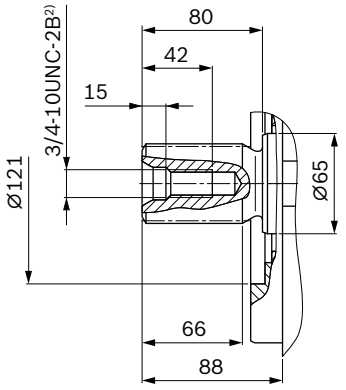
▼ **Splined shaft ANSI B92.1a**

T2 – 2 in 15T 8/16DP[1)]



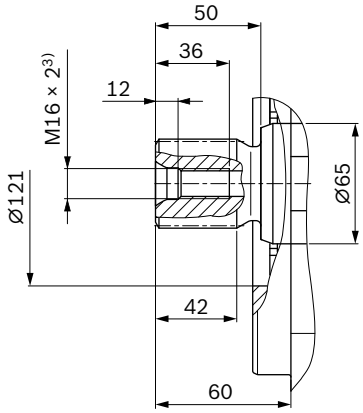
▼ **Splined shaft ANSI B92.1a**

T3 – 2 1/4 in 17T 8/16DP[1)]



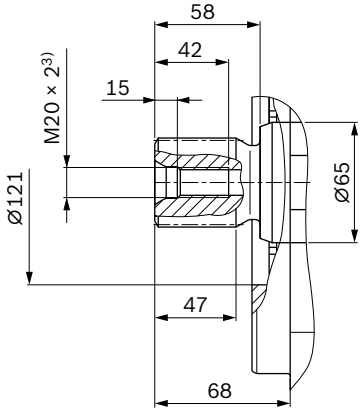
▼ **Splined shaft DIN 5480**

A1 – W45×2×21×9



▼ **Splined shaft DIN 5480**

A3 – W55×2×26×9



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

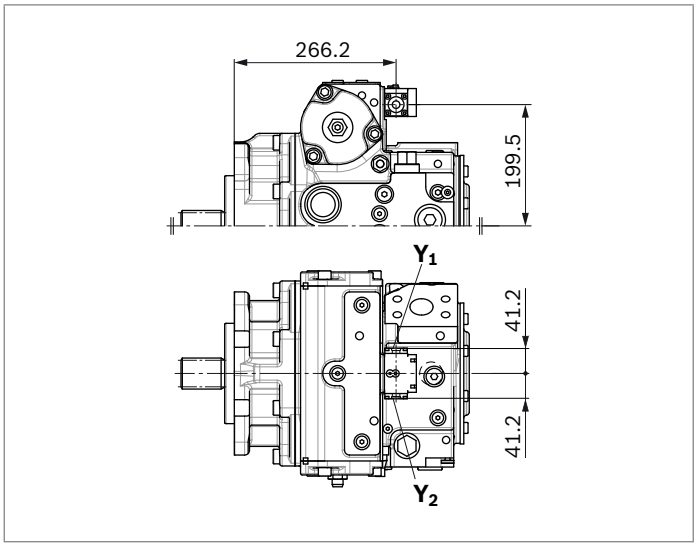
2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

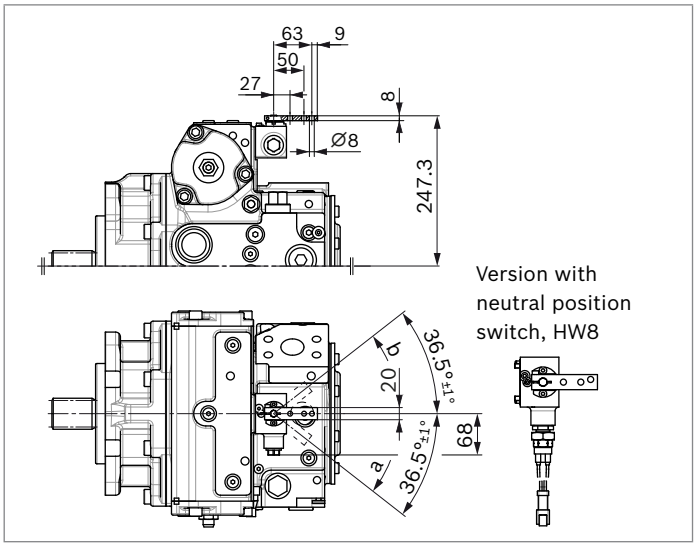
Ports		Standard	Size	p_{max} [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 1/2 in M16 × 2; 21 deep	500	O
S	Suction port Fastening thread	SAEJ518[5] DIN 13	1 1/2 in M12 × 1.75; 20 deep	5	O[6]
T_1	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	O[7]
T_2	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	X[7]
R	Air bleed port	ISO 6149[8]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Control pressure port (upstream of orifice)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
X_1, X_2	Control pressure port (upstream of orifice, HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
X_3, X_4[9]	Stroking chamber pressure port	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149[8]	M22 × 1.5; 15.5 deep	40	X
P_S	Pilot pressure port inlet	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	X
P_S	Pilot pressure port inlet (DA..6 only)	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	O
Y_{ST}	Pilot pressure port outlet	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
Y_{ST}	Pilot pressure port outlet (DA..6 only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
M_A, M_B	Measuring port pressure A, B	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
M_H	Measuring port, high pressure	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
Y_1, Y_2	Pilot pressure port (pilot signal HP only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149[8]	M10 × 1; 8 deep	80	O

4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
6) Plugged for external boost pressure supply.
7) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 64).
8) The countersink can be deeper than as specified in the standard.
9) Optional, see page 55
10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

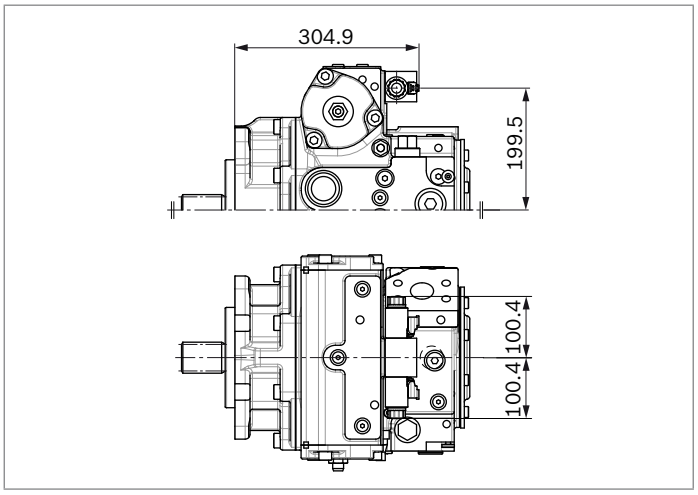
▼ **HP** – Proportional control, hydraulic, pilot-pressure related



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



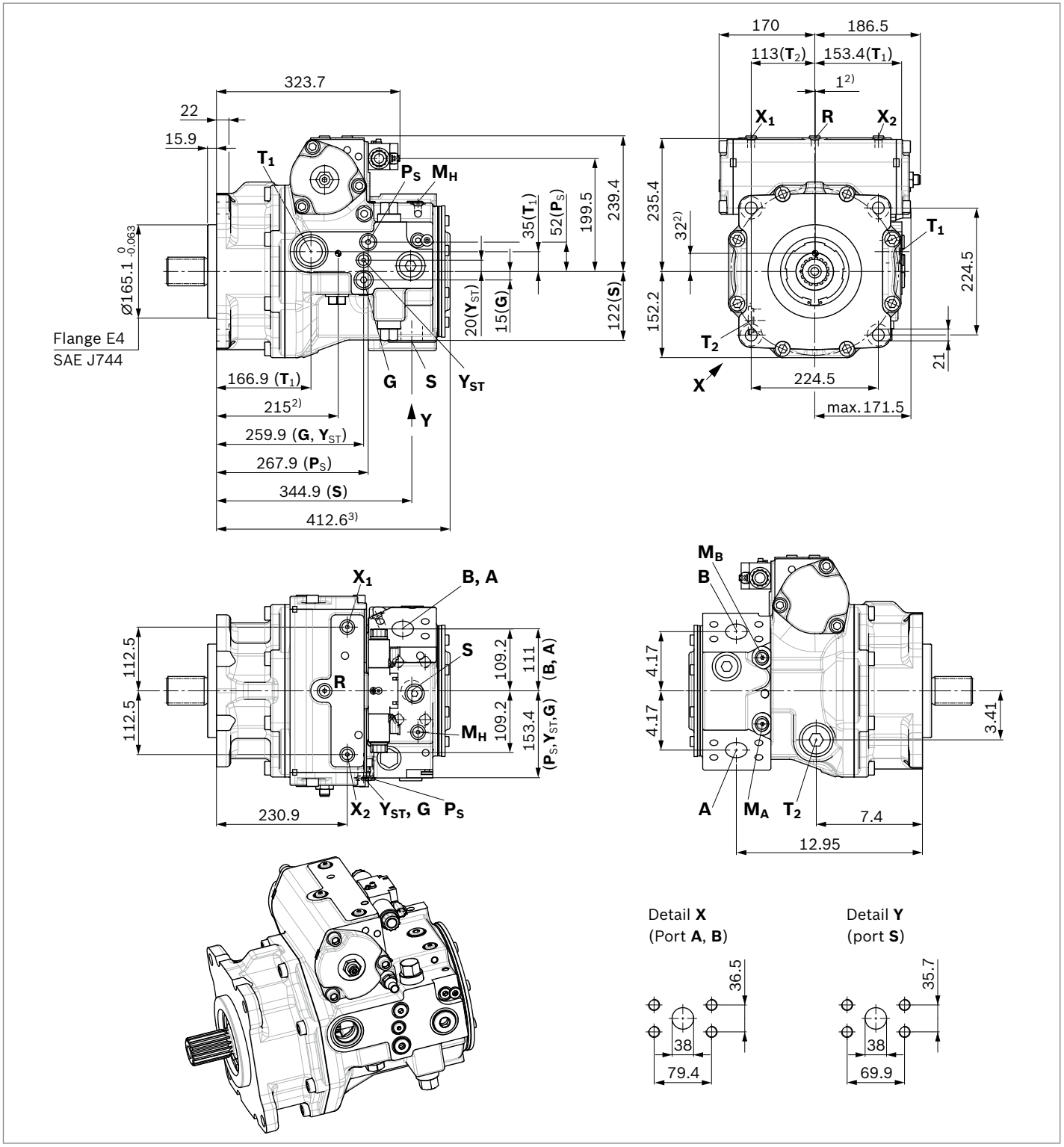
▼ **EZ** – Two-point control, electric



Dimensions, size 280

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1)]



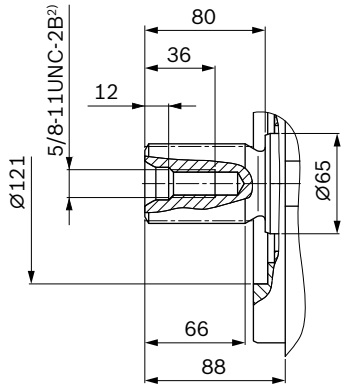
1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

2) Center of gravity

3) Valid for version with standard internal gear pump, overall length without boost pump see through drive, page 45.

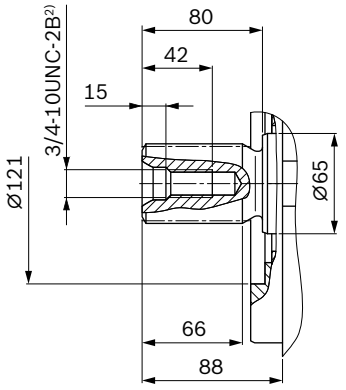
▼ **Splined shaft ANSI B92.1a**

T2 – 2 in 15T 8/16DP[1)]



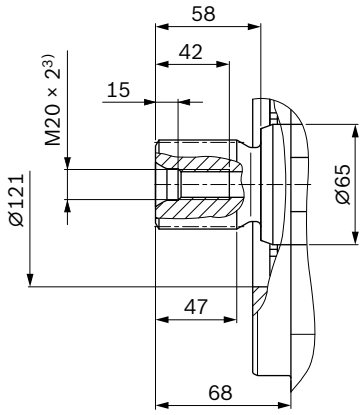
▼ **Splined shaft ANSI B92.1a**

T3 – 2 1/4 in 17T 8/16DP[1)]



▼ **Splined shaft DIN 5480**

A3 – W55×2×26×9



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

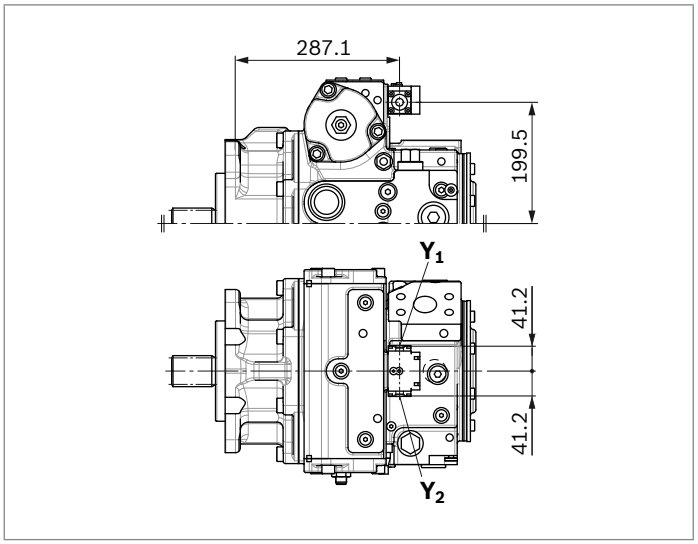
2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

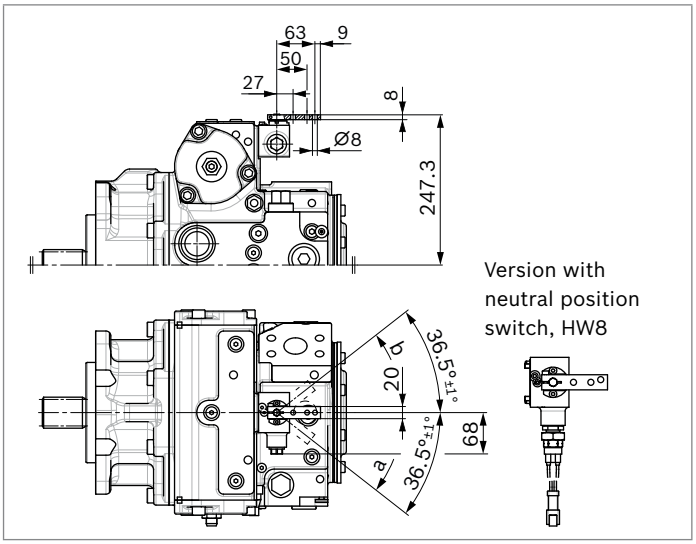
Ports		Standard	Size	p_{max} [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 1/2 in M16 × 2; 21 deep	500	O
S	Suction port fastening thread	SAEJ518[5] DIN 13	1 1/2 in M12 × 1.75; 20 deep	5	O[6]
$\mathbf{T_1}$	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	O[7]
$\mathbf{T_2}$	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	X[7]
R	Air bleed port	ISO 6149[8]	M14 × 1.5; 11.5 deep	3	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Control pressure port (upstream of orifice)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Control pressure port (upstream of orifice, HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{X_3}$, $\mathbf{X_4}$[9]	Stroking chamber pressure port	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149[8]	M22 × 1.5; 15.5 deep	40	X
$\mathbf{P_S}$	Pilot pressure port inlet	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	X
$\mathbf{P_S}$	Pilot pressure port inlet (DA..6 only)	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	O
$\mathbf{Y_{ST}}$	Pilot pressure port outlet	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
$\mathbf{Y_{ST}}$	Pilot pressure port outlet (DA..6 only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{M_A}$, $\mathbf{M_B}$	Measuring port pressure A, B	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
$\mathbf{M_H}$	Measuring port, high pressure	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
$\mathbf{Y_1}$, $\mathbf{Y_2}$	Pilot pressure port (pilot signal HP only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149[8]	M10 × 1; 8 deep	80	O

4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
6) Plugged for external boost pressure supply.
7) Depending on installation position, $\mathbf{T_1}$ or $\mathbf{T_2}$ must be connected (see also installation instructions on page 64).
8) The countersink can be deeper than as specified in the standard.
9) Optional, see page 55
10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

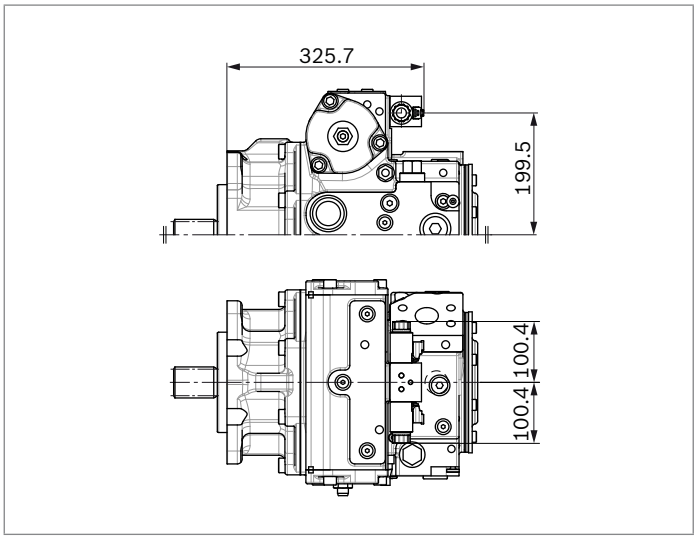
▼ **HP** – Proportional control, hydraulic, pilot-pressure related



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



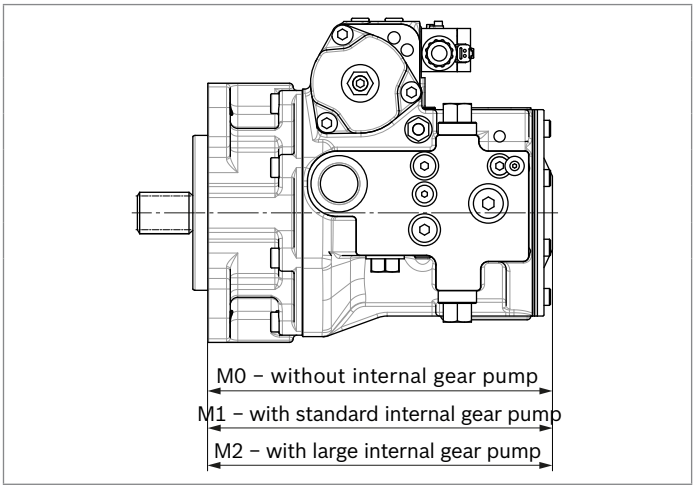
▼ **EZ** – Two-point control, electric



Dimensions, through drive

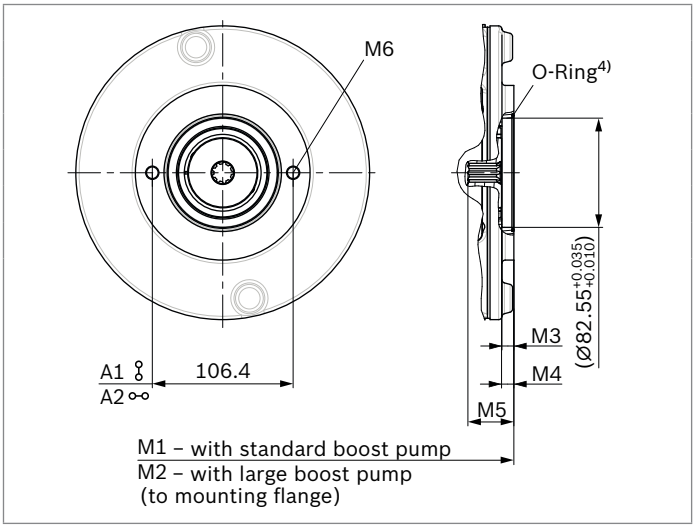
Flange SAE J744[1]			Hub for splined shaft[2]									
Diameter	**Mounting[3]**	**Code**	**Diameter**		**Code**	**110**	**125**	**145**	**175**	**210**	**280**	
Without through drive						●	●	●	●	●	●	**0000**
82-2 (A)	⚷	A1	5/8 in	9T 16/32DP	S2	●	–	●	●	–	○	**A1S2**
		A1	3/4 in	11T 16/32DP	S3	●	–	●	●	●	●	**A1S3**
	⚯	A2	5/8 in	9T 16/32DP	S2	●	●	●	●	○	●	**A2S2**
		A2	3/4 in	11T 16/32DP	S3	●	–	●	●	●	●	**A2S3**

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



NG	M0	M1	M2
110	314.3	318.3	322.7
125	314.3	322.7	–
145	344.2	344.2	347.5
175	363.8	367.3	370.1
210	387.6	387.6	392.7
280	407.3	412.6	–

▼ 82-2

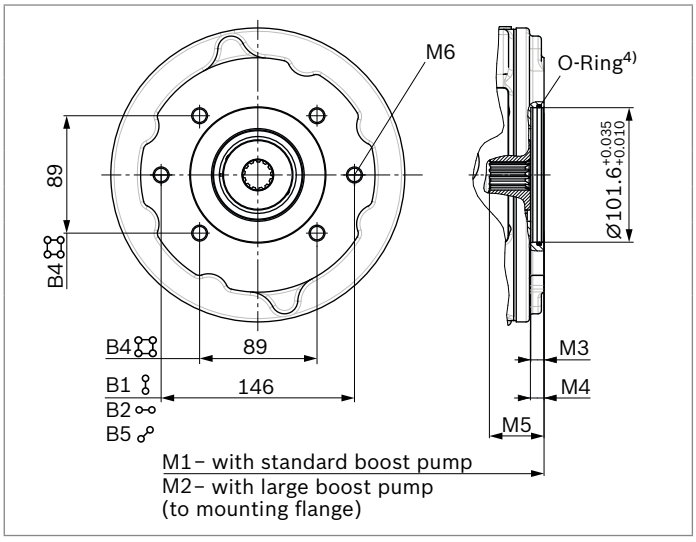


NG	M1	M2	M3	M4	M5	M6[5]
110	324.3	328.3	9	9.4	34.6	M10 × 1.5; 13 deep
125	328.3	–	9	10	35	
145	346.2	349.5	9	9.3	34.7	
175	369.3	372.1	9	9.1	33.4	
210	389.6	394.7	9	7.3	33	
280	415.6	–	9.7	9.4	34.1	

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 DIN 13

Flange SAE J744[1]			Hub for splined shaft[2]									
Diameter	**Mounting[3]**	**Code**	**Diameter**		**Code**	**110**	**125**	**145**	**175**	**210**	**280**	
101-2 (B)		B1	7/8 in	13T 16/32DP	S4	●	●	●	●	●	●	**B1S4**
		B1	1 in	15T 16/32DP	S5	●	–	●	●	●	●	**B1S5**
		B2	7/8 in	13T 16/32DP	S4	●	●	●	●	●	●	**B2S4**
		B2	1 in	15T 16/32DP	S5	●	–	●	●	○	○	**B2S5**
		B5	7/8 in	13T 16/32DP	S4	●	–	●	○	○	○	**B5S4**
		B5	1 in	15T 16/32DP	S5	○	–	●	○	●	●	**B5S5**
101-4 (B)		B4	7/8 in	13T 16/32DP	S4	○	–	●	○	●	○	**B4S4**
		B4	1 in	15T 16/32DP	S5	●	–	●	○	○	○	**B4S5**

▼ 101-2, 101-4

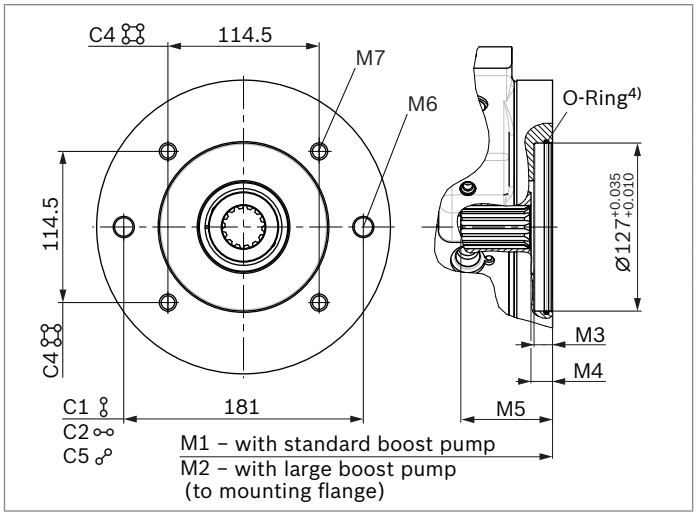


NG	M1	M2	M3	M4	M5	M6[5]
110	327.3	331.2	10	10.9	48.9	M12 × 1.75; 16 deep
125	331.2	–	10	11	48	
145	349.2	352.5	10	10.3	40.3	
175	372.3	375.1	10	10.3	40.3	
210	392.6	397.7	10	9.8	45.8	M12 × 1.75; 13 deep
280	418.6	–	10	10.5	48.5	M12 × 1.75; 16 deep

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 DIN 13

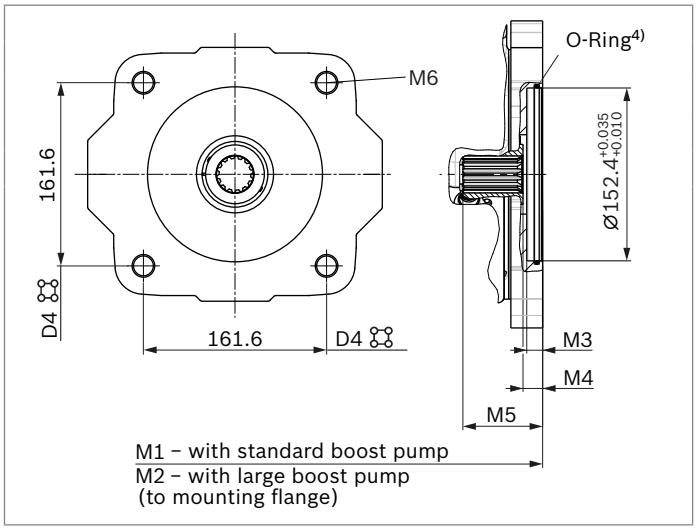
Flange SAE J744[1]			**Hub for splined shaft**[2]									
Diameter	**Mounting**[3]	**Code**	**Diameter**		**Code**	**110**	**125**	**145**	**175**	**210**	**280**	
127-2 (C)	⚷	C1	1 in	15T 16/32DP	S5	–	–	○	–	–	–	**C1S5**
		C1	1 1/4 in	14T 12/24DP	S7	●	–	●	○	○	○	**C1S7**
	⚯	C2	1 1/4 in	14T 12/24DP	S7	●	●	●	●	●	●	**C2S7**
		C2	1 3/8 in	21T 16/32DP	V8	○	–	●	●	–	–	**C2V8**
		C2	1 3/4 in	13T 8/16DP	T1	–	–	●	●	–	–	**C2T1**
	⚲	C5	1 1/4 in	14T 12/24DP	S7	●	–	●	○	○	○	**C5S7**
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**[5] **2-hole**	**M7**[5] **4-hole**
110	333.3	337.3	14	16.9	54.9	M16 × 2; 21 deep	M12 × 1.75; 16 deep
125	On request		14	10.9	59.9		
145	355.2	358.5	14	16.3	63.3	M16 × 2; 21 deep	M12 × 1.75; 19 deep
175	378.3	381.1	14	16.3	61.3		
210	403.7	408.8	27	14.2	56.4		
280	424.6	–	27	14.4	58.6		

▼ 152-4

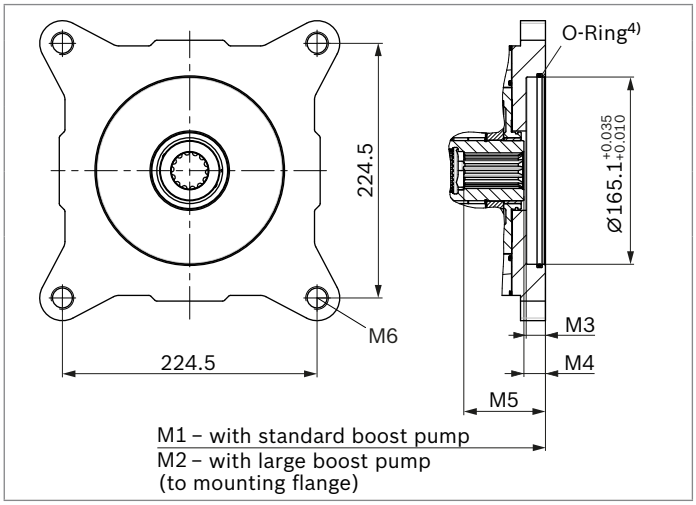


NG	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**[5]
145	356.2	359.5	14	10	74.4	M20 × 2.5; 22 deep
175	379.3	382.1	14	17.8	76.3	
210	411.6	416.7	26	14.3	78.8	
280	432.5	–	26	14.5	84	

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 DIN 13

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

▼ **165-4**



NG	M1	M2	M3	M4	M5	M6[5]
175	381	383.8	17	19.4	77.9	M20 × 2.5; 22 deep
210	407.3	412.4	On request			M20 × 2.5; 27 deep
280	447.3	–	On request			M20 × 2.5; 22 deep

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 DIN 13

Overview of mounting options

Through drive[1]			**Mounting option – 2nd pump**						
Flange	**Hub for splined shaft**	**Code**	**A4VG/40 NG (shaft)**	**A4VG/32 NG (shaft)**	**A10VG NG (shaft)**	**A10VO/3x NG (shaft)**	**A10V(S)O/5x NG (shaft)**	**A11VO/1 NG (shaft)**	**External gear pump**[2]
82-2 (A)	5/8 in	**A_S2**	–	–	–	18 (U)	10, 18 (U)	–	AZPF, AZPS NG4 ... 28 AZPW NG5 ... 22
	3/4 in	**A_S3**	–	–	–	18 (S)	10, 18 (S)	–	AZPF NG4 ... 28[3]
101-2 (B)	7/8 in	**B_S4**	–	–	18 (S)	28 (S) 45 (U)	28 (S) 45 (U)	–	AZPN-11 NG20 ... 25 AZPG-22 NG28 ... 100
	1 in	**B_S5**	–	28 (S)	28, 45 (S)	45 (S)	45 (S) 60, 63, 72 (U)	40 (S)	–
101-4 (B)	7/8 in	**B4S4**	–	–	–	–	–	–	
	1 in	**B4S5**	–	–	–	–	–	–	
127-2 (C)	1 in	**C1S5**	–	40 (U)	–	71 (U)	–	–	–
	1 1/4 in	**C_S7**	–	40, 56, 71 (S)	63 (S)	71 (S) 100 (U)	85, 100 (U)	60 (S)	–
	1 3/8 in	**C2V8**	110 (V8)	56, 71 (T)	63 (T)	–	–	60 (T)	
	1 3/4 in	**C2T1**	110, 125 (T1)	–	–	–	–	–	
127-4 (C)	1 1/4 in	**C4S7**	–	–	–	–	60, 63, 72 (S) 85, 100 (U)	–	
	1 3/8 in	**C4V8**	110 (V8)	–	–	–	–	–	
152-4 (D)	1 3/4 in	**D4T1**	110, 125, 145, 175 (T1)	90, 125 (S)	–	140, 180 (S)	–	95, 130, 145 (S)	–
165-4 (E)	1 3/4 in	**E4T1**	175 (T1)	180 (S)	–	–	–	190, 260 (S)	–
	2 in	**E4T2**	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.

1) Availability of the individual sizes, see type code on page 4.
2) Bosch Rexroth recommends special versions of the gear pumps. Please contact us.
3) On request

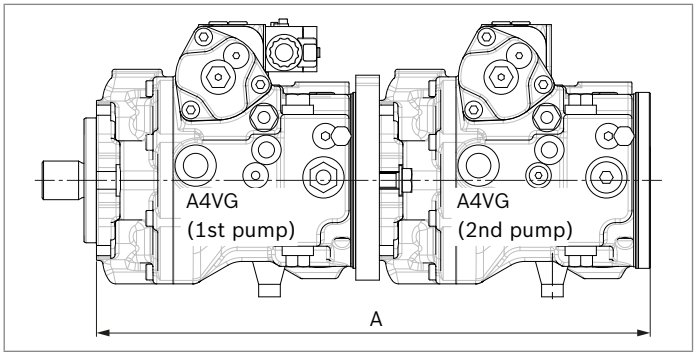
Combination pumps A4VG + A4VG

Total length A[1] with standard mounting flange

A4VG	A4VG 2nd pump[2]					
1st pump	**NG110**	**NG125**	**NG145**	**NG175**	**NG210**	**NG280**
NG110	652.6	–	–	–	–	–
NG125	On request	On request	–	–	–	–
NG145	674.5	On request	700.4	–	–	–
NG175	697.6	On request	723.5	748.3	–	–
NG210	729.9	On request	755.8	On request	807.9	–
NG280	755.9	On request	781.8	On request	On request	On request

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* (= 98.1 m/s²).
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.



1) Overall length is valid for standard mounting flange and integrated boost pump.
2) 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.

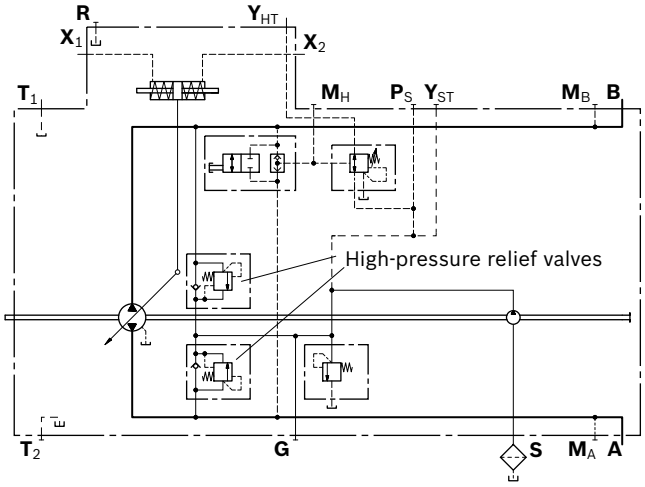
Setting ranges

High-pressure relief valve A and B	Differential pressure setting Δp_{HD}
Preferred values	400 bar
	410 bar
	420 bar
	430 bar
	440 bar
	450 bar
	460 bar
	470 bar
Optional values	300 bar
	320 bar
	340 bar
	360 bar
	380 bar

Settings on high-pressure relief valve A and B	
Differential pressure setting	Δp_{HD} = ... bar
Cracking pressure of the HD valve (at q_{V1}) ($p_{max} = \Delta p_{HD} + p_{Sp}$)	p_{max} = ... bar

- The valve settings are made at n = 1000 rpm and at $V_{g\,max}$ ($q_{v\,1}$). There may be deviations in the cracking pressures with other operating parameters.
- When ordering, state differential pressure setting in plain text.

Circuit diagram

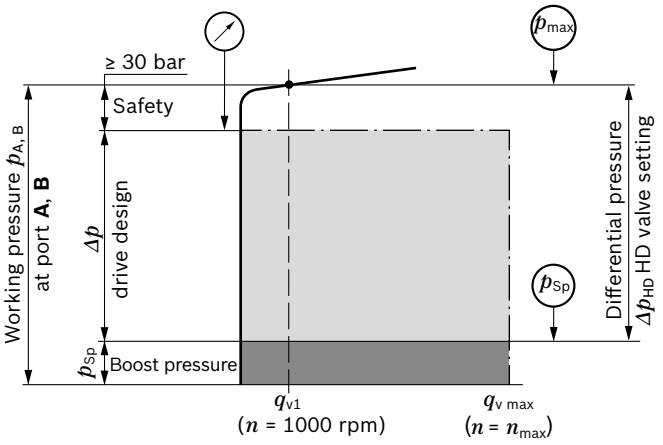


High-pressure relief valve without pressure cut-off

Example

Working pressure		Boost pressure		Differential pressure
$p_{A,B}$		p_{Sp}		Δp_{HD}
450 bar	–	20 bar	=	**430 bar**

Setting diagram

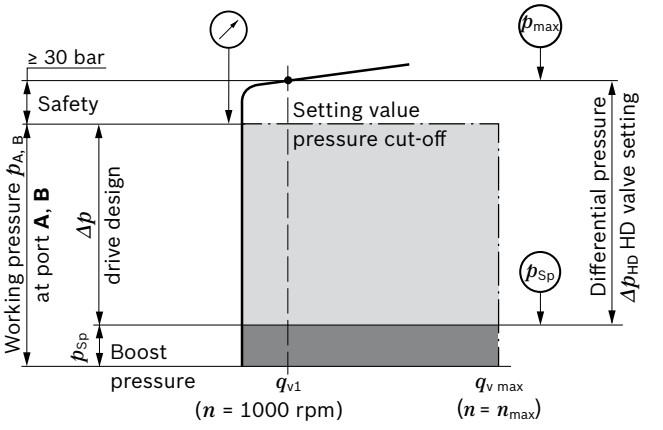


High-pressure relief valve with pressure cut-off

Example

Working pressure		Boost pressure		Safety		Differential pressure
$p_{A,B}$		p_{Sp}				Δp_{HD}
450 bar	–	20 bar	+	30 bar	=	**460 bar**

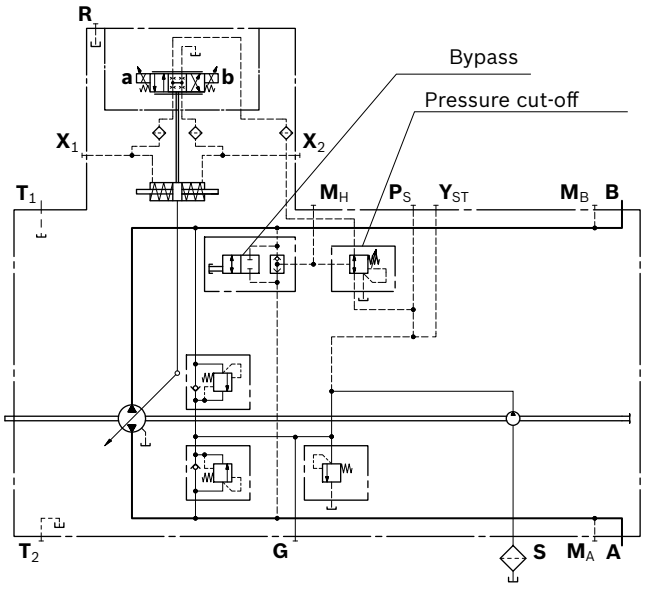
Setting diagram



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 swashplate 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 30 bar lower than the setting value of the high-pressure relief valves (see setting diagram, page 51).
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 channels **A** and **B** can be established using the bypass valve (e.g. for machine towing).

Towing speed
The maximum towing speed is dependent on the gear ratio in the vehicle and must be calculated by the vehicle manufacturer. The corresponding flow of q_V = 30 l/min may not be exceeded.

Towing distance
The vehicle may only be towed out of the immediate danger zone.

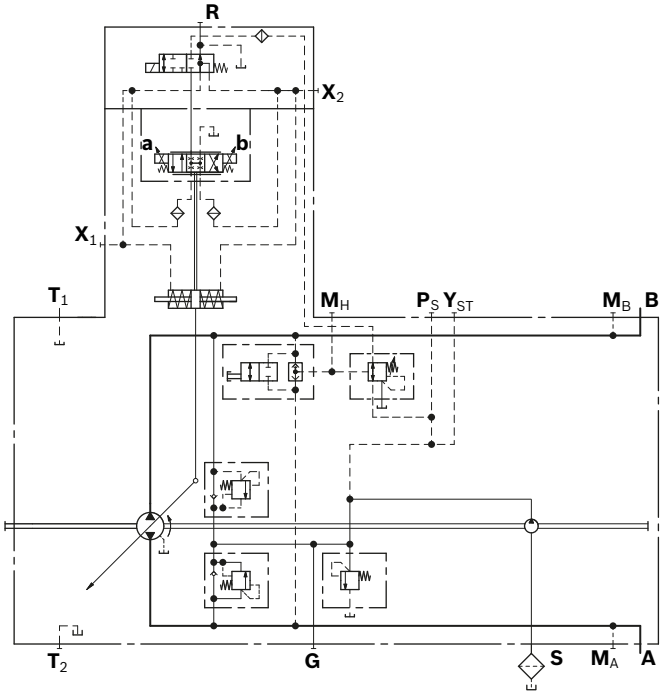
Neutral valve

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.

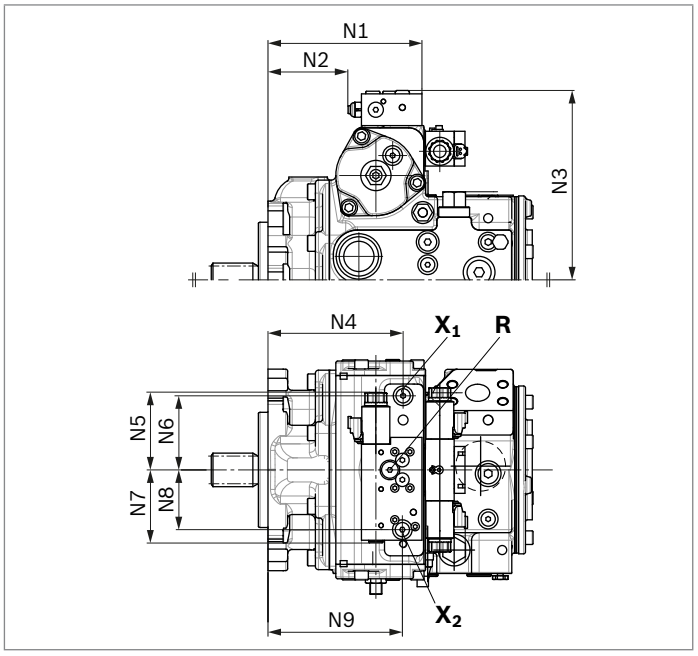
The return swivel times can be specifically and precisely adapted to the respective customer application. A second capability for deactivation and therefore making the pump torque-free is therefore realized when the neutral valve is used in safety-critical applications.

Technical data		
Voltage	12 V (±20%)	24 V (±20%)
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_{g\ max}$	Current switched on	Current switched on
Nominal resistance (at 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 61		

▼ Circuit diagram



Dimensions

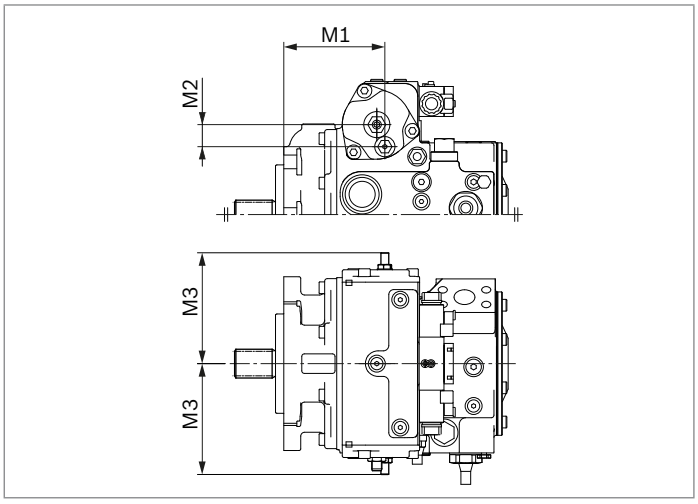


NG	110	125	145	175	210	280
N1	198.4	198.4	203.6	223.4	237.9	258.8
N2	100.7	100.7	105.9	125.7	140.2	161.1
N3	229.8	229.8	250.5	250.5	283	283
N4	173.5	173.5	178.7	198.5	210	230.9
N5	102.5	102.5	102.5	102.5	102.5	102.5
N6	83	83	98	98	112.5	112.5
N7	96.5	96.5	96.5	96.5	96.5	96.5
N8	79	79	79	79	79	79
N9	172.5	172.5	177.7	197.5	212	232.9

Mechanical stroke limiter

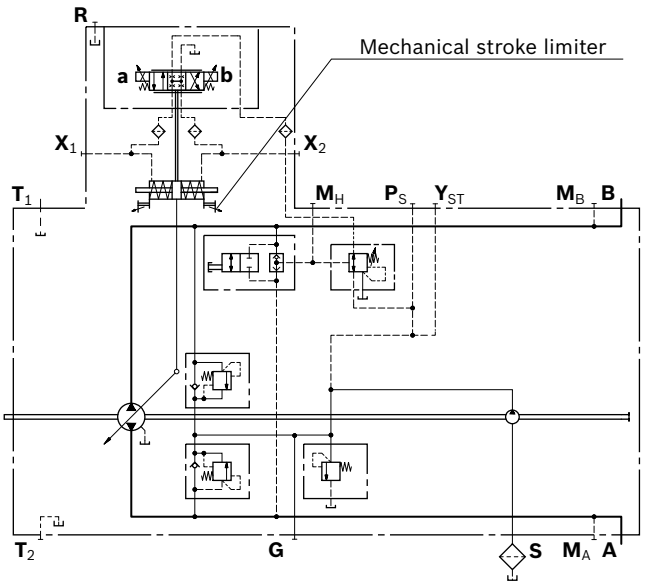
The mechanical stroke limiter is an auxiliary function allowing the maximum displacement of the pump to be steplessly reduced, regardless of the control module used.
By means of two threaded pins, the stroke of the stroking piston and thus the maximum swivel angle of the pump can be limited.

Dimensions



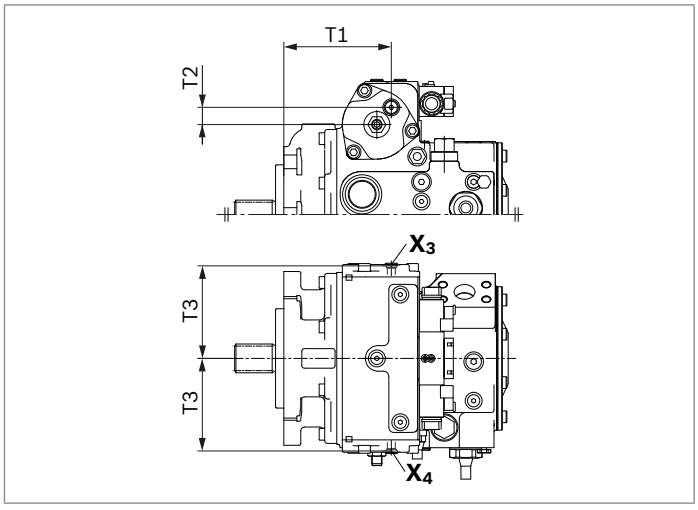
NG	M1	M2	M3
110	153.6	27.7	157.3
125	153.6	27.7	157.3
145	155	33.8	170.1
175	174.8	33.8	170.1
210	183.9	38.1	199.6
280	204.7	38.1	199.6

▼ **Circuit diagram**



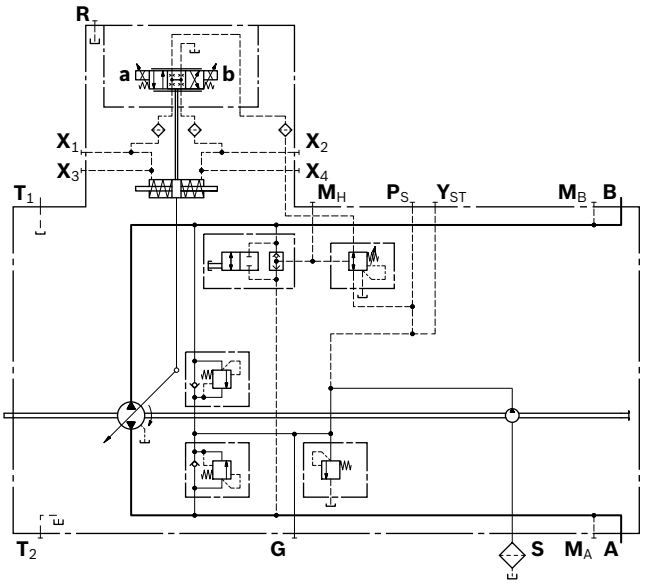
Stroking chamber pressure port X_3 and X_4

Dimensions



NG	T1	T2	T3
110	161.8	21.8	128
125	161.8	21.8	128
145	164.9	26.4	142
175	184.7	26.4	142
210	195.7	30.6	166
280	216.6	30.6	166

▼ Circuit diagram



Ports		Standard[1)]	Size	p_{max} [bar][2)]	State[3)]
X_3, X_4	Stroking chamber pressure port	ISO 6149	M14 × 1.5; 11.5 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

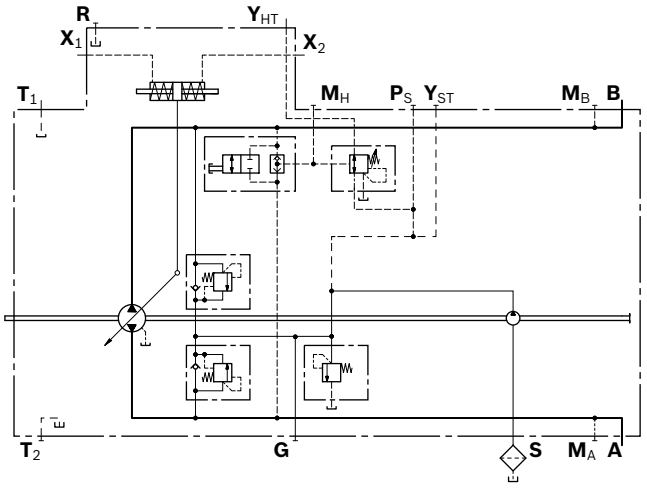
Version S

Filter version	Suction filter
Recommendation	With contamination indicator with cold start valve
Recommended flow resistance at filter element	
At ν = 30 mm²/s, $n = n_{max}$	$\Delta p \leq 0.1$ bar
At ν = 1000 mm²/s, $n = n_{max}$	$\Delta p \leq 0.3$ bar
Pressure at suction port S	
Continuous $p_{S\ min}$ ($\nu \leq 30$ mm²/s)	≥ 0.8 bar absolute
Short-term, at a cold start (t < 3 min)	≥ 0.5 bar absolute
Maximum pressure $p_{S\ max}$	≤ 5 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

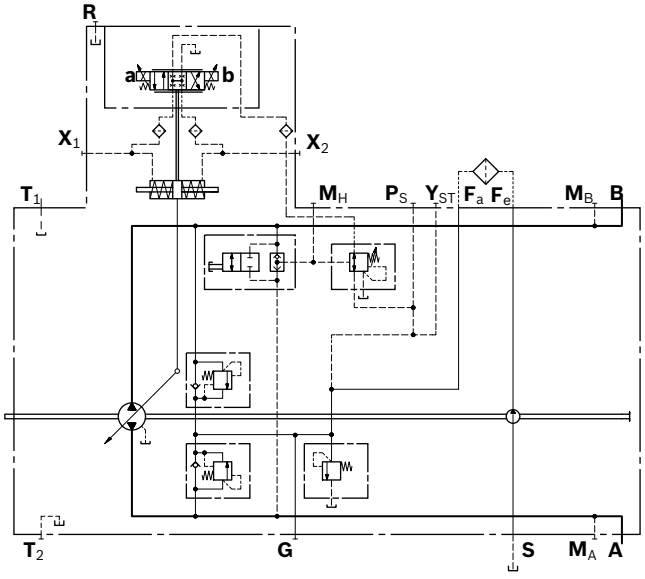
Ports	
Boost pressure inlet	Port F_a
Boost pressure outlet	Port F_e
Filter version	**Boost pressure filter**
Recommendation	With contamination indicator with cold start valve
Filter arrangement	Separate in the pressure line (inline filter)
Permissible flow resistance at filter element[1)]	
At ν = 30 mm²/s	$\Delta p \leq 1$ bar
For cold start	$\Delta p \leq 3$ bar

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

▼ **Circuit diagram**



Notice

Bosch Rexroth has a comprehensive filter range. 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.

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

Version F[1)]

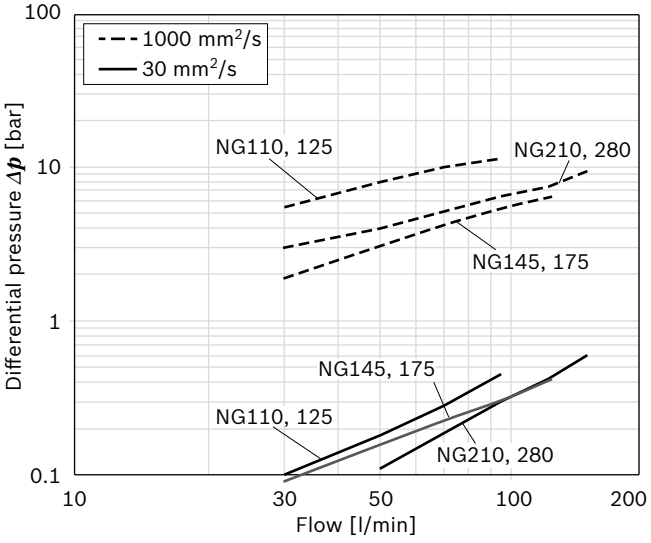
Attachment filter with cold start valve

Filter version	Attachment filter without bypass
Recommendation	Version with contamination indicator, see B (differential pressure Δp = 5 bar)
Filter grade (absolute)	20 µm
Filter material	Glass fiber
Pressure rating	100 bar
Filter arrangement	Mounted on pump

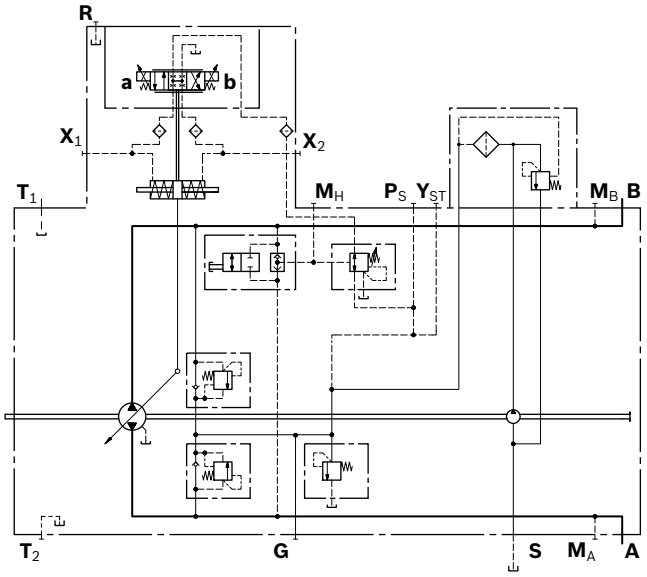
The attachment filter is equipped with a cold start valve and thereby protects the pump from damage. The valve opens at flow resistance of Δp ≥ 6 bar.

▼ Filter characteristics

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



▼ Circuit diagram



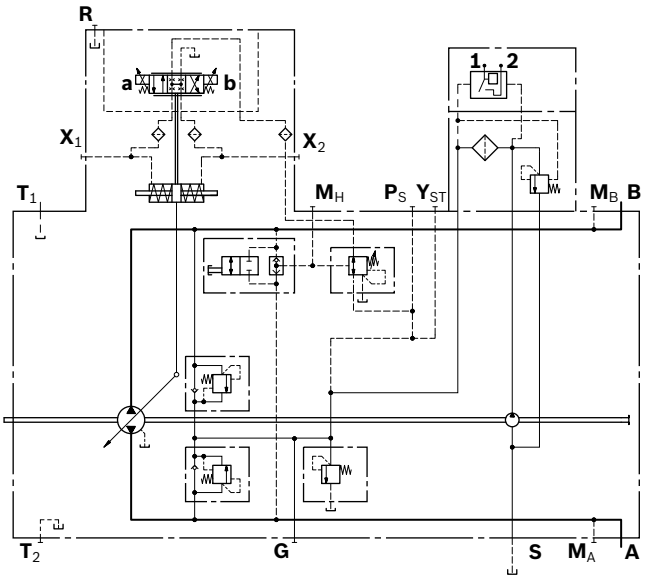
Version B[1)]

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 (mating connector, see page 61)	DEUTSCH DT04-2P-EP04	
Differential pressure (switching pressure)	Δp = 5 bar	
Maximum switching capacity	12 V DC	24 W
	24 V DC	48 W
Type of protection IP67	DIN EN 60529	

▼ Circuit diagram



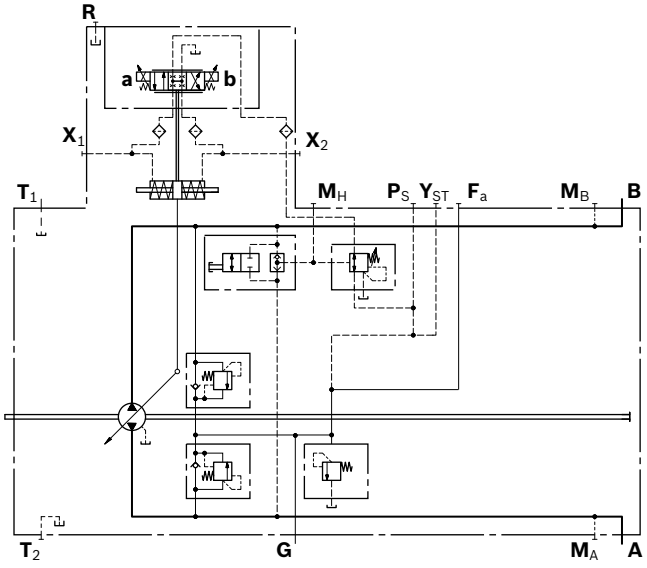
1) If using the filter versions F and B, make sure that a hydraulic fluid with a minimum electrical conductance of 300 pS/m is used. Please contact us if this value cannot be observed.

External boost pressure supply

Version E

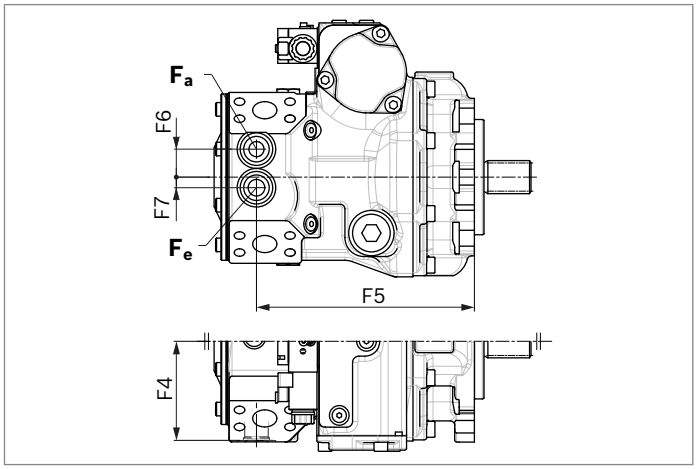
This variant should be used in versions without integrated boost pump (**U**).
Port **S** is plugged.
The boost pressure supply comes from port **G**.
The filter should be installed separately at port **G** before the boost pressure supply.
To ensure the functional reliability, maintain the required cleanliness level for the boost fluid fed in at port **G** (see page 7).

▼ **Circuit diagram**



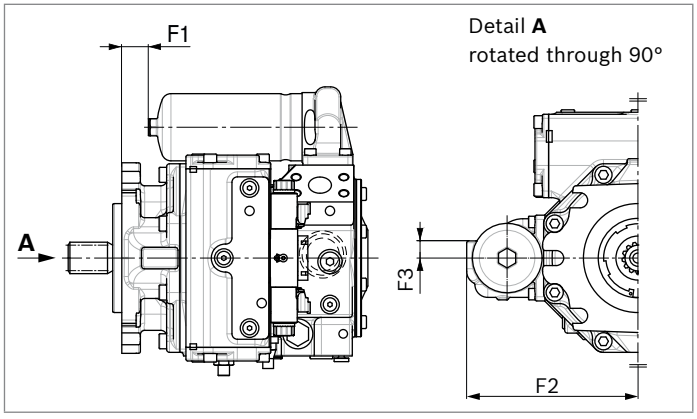
Dimensions with mounted filter

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

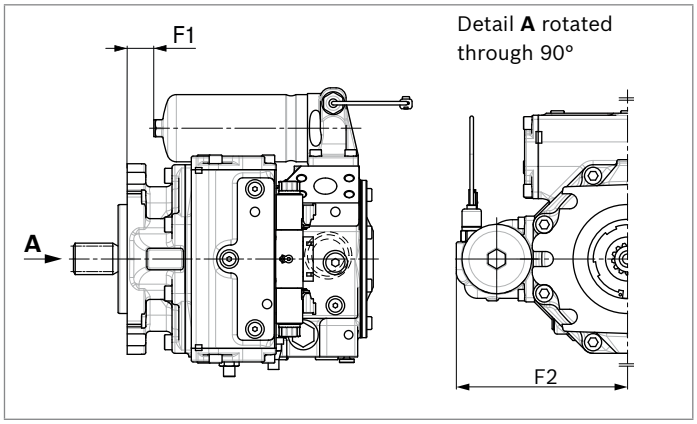


NG	F1	F2	F3	F4	F5	F6	F7	F_a, F_e[1)]
110	76.5	229.5	22	121	264.5	37	14	M33 × 2; 19 deep Accord- ing to ISO6149
125	76.5	229.5	22	121	264.5	37	14	
145	37.2	239.5	22	131	288.2	37	14	
175	57	239.5	22	131	308	37	14	
210	69	266.5	22	146.3	325	43	10	
280	89.9	266.5	22	146.3	345.9	43	10	

▼ **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.

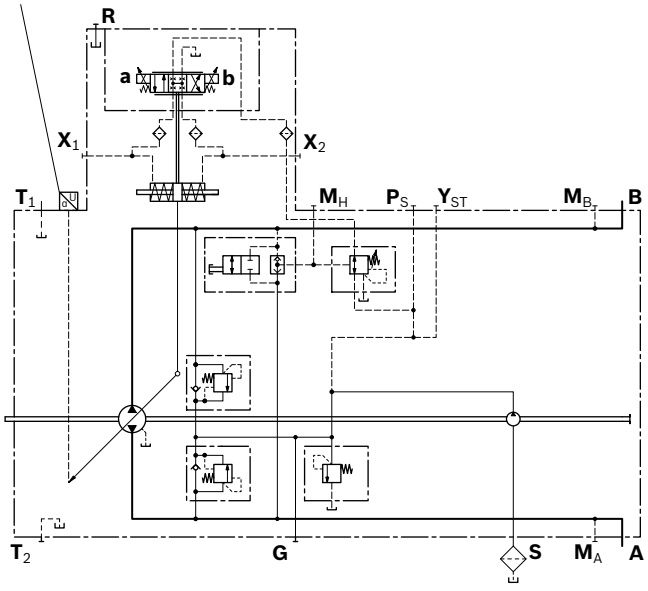
Characteristics	
Supply voltage U_b	10 to 30 V DC
Output voltage U_a	1 V ($V_{g\,max}$) 2.5 V ($V_{g\,0}$) 4 V ($V_{g\,max}$)
Reverse polarity protection	Short-circuit resistant
EMC resistance	Details on request
Operating temperature range	-40 °C to +115 °C
Vibration resistance sinusoidal vibration EN 60068-2-6	10 g / 5 to 2000 Hz
Shock resistance: continuous shock IEC 68-2-29	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

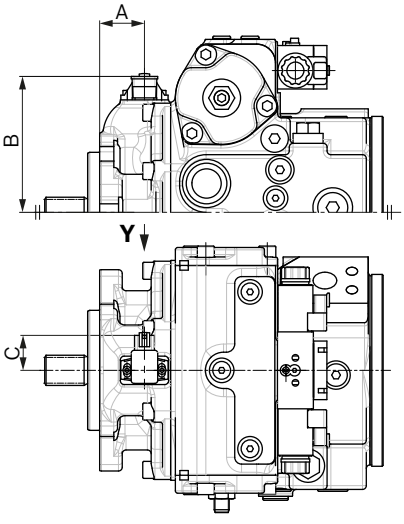
Direction of rotation[1]	**Flow direction**	**Working pressure**	**Output voltage at $V_{g\,0}$**
Clockwise	**B** to **A**	M_A	>2.5 V
	A to **B**	M_B	<2.5 V
Counter-clockwise	**A** to **B**	M_B	>2.5 V
	B to **A**	M_A	<2.5 V

▼ Circuit diagram

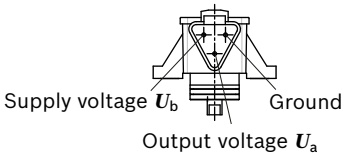
Electric swivel angle sensor



Dimensions



Detail **Y**
Connector DT04-3P-EP04



NG	**A**	**B**	**C**
110	51.5	148.8	37
125	51.5	148.8	37
145	53.1	160.8	37
175	64.4	160.8	37
210	69	173.8	37
280	75.1	173.8	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

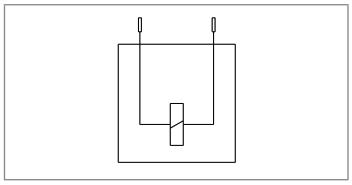
DEUTSCH DT04-2P-EP04

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.

Pressure Sensor

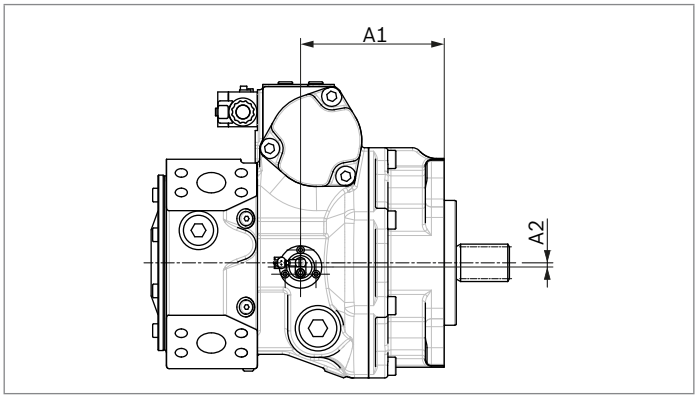
The pressure on the working ports A and B can be recorded using the mounted PR4 pressure sensors (version M; 0 to 600 bar) in MA and MB. Type code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet 95156.

Notice
Due to the working pressure range of the A4VG series 40 from a nominal pressure of 450 bar and maximum pressure of 500 bar, only version M of the PR4 pressure sensor is approved.

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



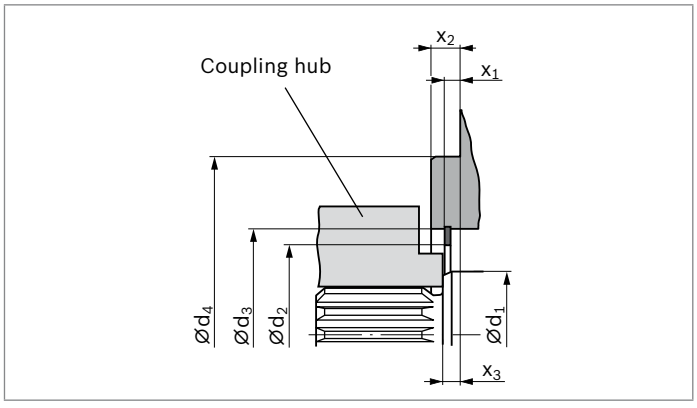
NG	110	125	145	175	210	280
A1	161.5	161.5	181.2	201.0	190	210.9
A2	5.5	5.5	5.5	5.5	5.5	5.5
Number of teeth	53	On request	58	61	64	71

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

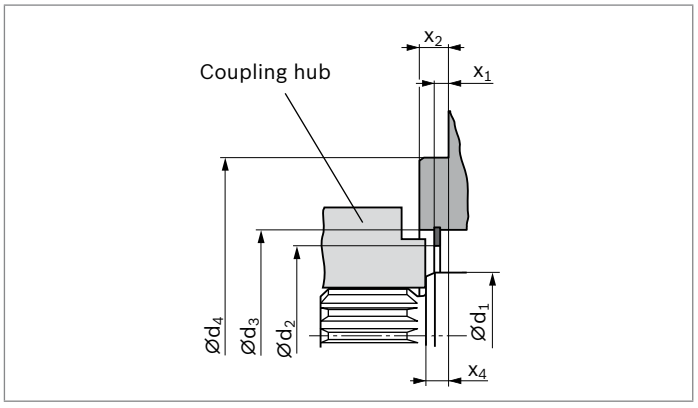
Installation dimensions for coupling assembly

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 $x_2 - x_3$).



DIN splined shaft (spline according to DIN 5480)
Splined shaft **Z** or **A**
The outer diameter of the coupling hub must be smaller than the case diameter d_3 in the area near the drive shaft collar (dimension $x_2 - x_4$).



NG	Mounting flange	Ød$_1$	Ød$_{2\ min}$	Ød$_3$	Ød$_4$	x$_1$	x$_2$	x$_3$	x$_4$
110	127-2/4	55	74.4	101±0.1	127 $^{0}_{-0,063}$	6.0	12.7$_{-0.5}$	8 $^{+0.9}_{-0.6}$	10 $^{+0.9}_{-0.6}$
	152-2/4	55	74.4	101±0.1	152.4 $^{0}_{-0,063}$	6.0	12.7$_{-0.5}$	8 $^{+0.9}_{-0.6}$	10 $^{+0.9}_{-0.6}$
125	127-2/4	55	74.4	101±0.1	127 $^{0}_{-0,063}$	6.0	12.7$_{-0.5}$	8 $^{+0.9}_{-0.6}$	10 $^{+0.9}_{-0.6}$
	152-2/4	55	74.4	101±0.1	152.4 $^{0}_{-0,063}$	6.0	12.7$_{-0.5}$	8 $^{+0.9}_{-0.6}$	10 $^{+0.9}_{-0.6}$
145	152-2/4	60	84.4	111±0.1	152.4 $^{0}_{-0,063}$	7.4	12.7$_{-0.5}$	8 $^{+0.9}_{-0.6}$	10 $^{+0.9}_{-0.6}$
175	152-2/4	60	84.4	111±0.1	152.4 $^{0}_{-0,063}$	7.0	12.7$_{-0.5}$	8 $^{+0.9}_{-0.6}$	10 $^{+0.9}_{-0.6}$
	165-4	60	84.4	111±0.1	165.1 $^{0}_{-0,063}$	7.0	15.9$_{-0.5}$	8 $^{+0.9}_{-0.6}$	10 $^{+0.9}_{-0.6}$
210	165-4	65	94.4	121±0.1	165.1 $^{0}_{-0,063}$	5.5	15.9$_{-0.5}$	8 $^{+0.9}_{-0.6}$	10 $^{+0.9}_{-0.6}$
280	165-4	65	94.4	121±0.1	165.1 $^{0}_{-0,063}$	7.0	15.9$_{-0.5}$	8 $^{+0.9}_{-0.6}$	10 $^{+0.9}_{-0.6}$

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_1**, **T_2**).
For combination pumps, the leakage must be drained off at each 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_S results from the overall loss of pressure. However, it must not be higher than $h_{S\ max}$ = 800 mm.
The suction pressure at port **S** must also not fall below the minimum value of 0.8 bar absolute during operation (cold start 0.5 bar absolute).

Installation position

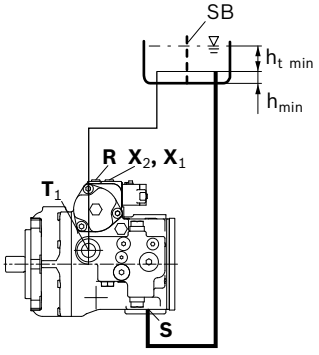
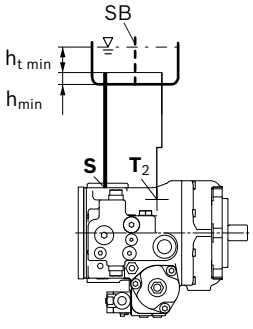
See the following examples 1 to 12.
Further installation positions are available upon request.
Recommended installation position: 1 and 2.

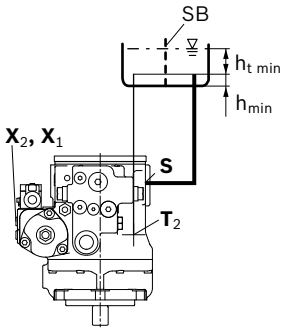
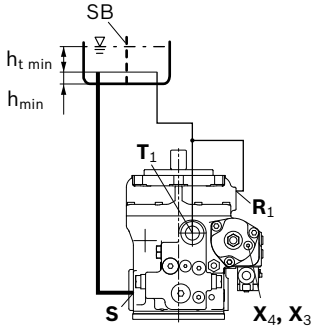
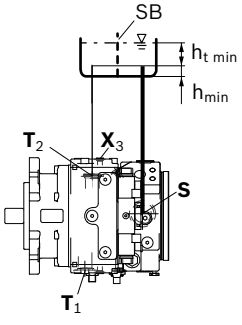
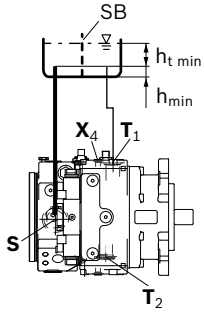
Notice

- If filling the stroking chambers via **X_1** to **X_4** 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_1**, **X_2**, or **X_3**, **X_4** 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_1**, **X_2**	**S** + **T_1** + **X_1** + **X_2**
			
2	–	–	**S** + **T_2**
			

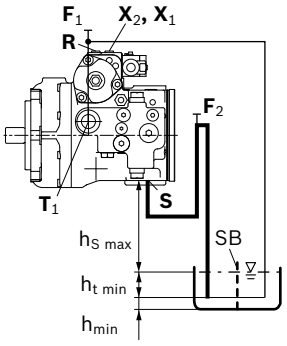
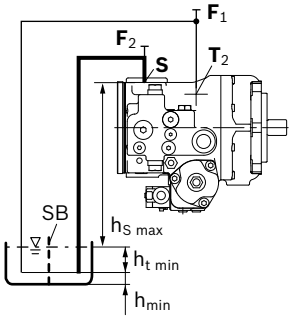
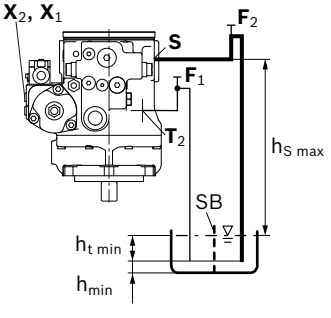
Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
3	–	**X_1, X_2**	**S + T_2 + X_1 + X_2**
			
4	**R_1**	**X_3, X_4**	**S + T_1 + X_3 + X_4**
			
5	–	**X_3**	**S + T_2 + X_3**
			
6	–	**X_4**	**S + T_1 + X_4**
			

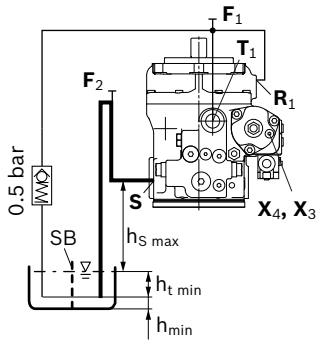
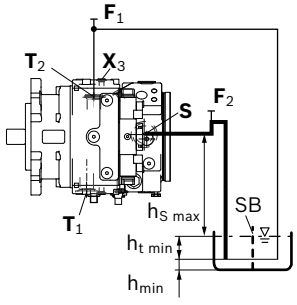
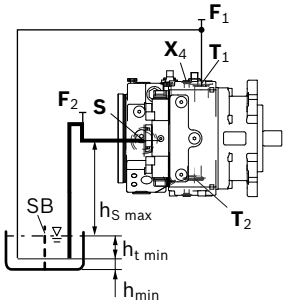
Above-reservoir installation

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 $h_{S\,max}$ = 800 mm.

Recommendation for installation position 10 (drive shaft upward): A check valve in the drain line (cracking pressure 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 (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

Notice

Ports F_1 and F_2 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 A4VG 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. $MTTF_D$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. Applying the recommended 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 ×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.

Bosch Rexroth AG
Glockeraustraße 4
89275 Elchingen, Germany
Tel. +49 7308 82-0
info.ma@boschrexroth.de
www.boschrexroth.com