

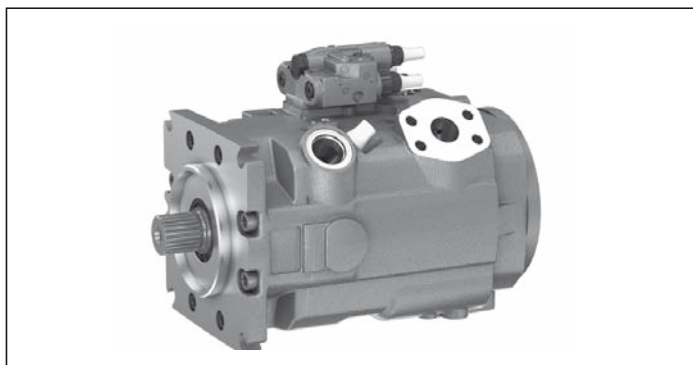
Axial piston variable pump

A11V(L)O Series 41

RE 92511

Edition: 03.2018

Replaces: 07.2017



- ▶ Sizes 110 to 280
- ▶ Nominal pressure 350 bar (5100 psi)
- ▶ Maximum pressure 420 bar (6100 psi)
- ▶ Open circuit

Features

- ▶ Variable pump with axial piston rotary group in swashplate design for hydrostatic drives in open circuit.
- ▶ For use in mobile applications
- ▶ Flow is proportional to the drive speed and displacement.
- ▶ The flow can be infinitely varied by adjusting the swashplate angle.
- ▶ The pump can work either self-priming or with a charge pump.
- ▶ Special control device program with dynamic control behavior and swivel angle sensor with hall effect for fully electronified pump control.
- ▶ Noise-optimized throughout the entire operating range.
- ▶ The robust and low-wear swivel angle positioning allows for a long service life.
- ▶ Ready for Hybrid: $\pm 100\%$ swivel angles allow for regenerative operation in the motor quadrant area up to nominal pressure.
- ▶ Compact design
- ▶ High efficiency
- ▶ High power density
- ▶ Low noise level

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Type code

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
									/	41			V					0	-

Axial piston unit

01	Variable swashplate design, nominal pressure 350 bar (5100 psi), maximum pressure 420 bar (6100 psi)														Unpainted		A11V		
															painted		LA11V		

Operating mode

			110	145	175	210	280	
02	Pump, open circuit	without charge pump	o	•	•	•	•	O
		with charge pump	-	•	•	•	•	LO

Size (NG)

03	Geometric displacement, see table of values on page 9	110	145	175	210	280
----	---	-----	-----	-----	-----	-----

Swiveling range

			110	145	175	210	280	
04	One-sided swiveling	$V_{g \text{ max:}}$ + 50% to + 100% $V_{g \text{ min:}}$ - 5% to + 30%	o	•	•	•	•	
	Two-sided swiveling ¹⁾	$V_{g \text{ max:}}$ + 50% to + 100% $V_{g \text{ min:}}$ - 100% to - 50%	o	•	•	•	•	M

Position 05, 06, 07 with the relevant control axis combination option, controller group a) to e) is described below

Type code position	05	06	07
Combination options	a) Power controller Not for swiveling range “M”	No other controller, without code	
		b) Pressure controller	No other controller, without code
			c) Stroke control
			d) Override and unloading
			e) Load sensing
		c) Stroke control	No other controller, without code
	b) Pressure controller	e) Load sensing	No other controller, without code
		No other controller, without code	
		b) Pressure controller ²⁾	No other controller, without code
			d) Override and unloading
			e) Load sensing
		e) Load sensing	No other controller, without code
	c) Stroke control Not for swiveling range “M”	No other controller, without code	
		b) Pressure controller	No other controller, without code
			d) Override and unloading
		e) Load sensing	No other controller, without code

• = Available o = On request - = Not available

¹⁾ Not possible with charge pump (VLO).
²⁾ Cannot be combined with the same pressure controller

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
									/	41			V					0	-

Control devices: Controller group a)										110	145	175	210	280	
a)	Power controller	fixed setting								○	●	●	●	●	LR
		override electric-proportional		negative control	$U = 12\text{ V}$					○	●	●	●	●	L3
					$U = 24\text{ V}$					○	●	●	●	●	L4
		hydraulic-proportional,		negative control						○	●	●	●	●	L5
				positive control						○	●	●	●	●	L6
	Summation power controller	override hydraulic proportional, high pressure		negative control	with stop					○	●	●	●	●	CR
					without stop					○	●	○	○	●	PR

Controller group b)					110	145	175	210	280	
b)	Without additional control (without symbol)				○	●	●	●	●	
	Pressure controller with one-side swiveling	fixed setting			○	●	●	●	●	DR
		remote controlled hydraulically	positive control		○	●	●	●	●	DG
		electric-proportional with integrated pilot valve for external pilot pressure supply	positive control	$U = 24\text{ V}$	○	○	○	○	●	D2
Not combinable with other controllers										

Controller group c)										110	145	175	210	280	
c)	Without additional controller (without symbol)									○	●	●	●	●	
	Stroke control	electric-proportional		positive control	$U = 12\text{ V}$					○	●	●	●	●	E1
					$U = 24\text{ V}$					○	●	●	●	●	E2
		hydraulic-proportional, Pilot pressure		negative control						○	●	●	●	●	H3
				positive control						○	●	●	●	●	H4

Controller group d)										110	145	175	210	280	
d)	Without additional control (without symbol)									○	●	●	●	●	
	Override electric-proportional	with integrated pilot control valve and only in combination with pressure controller		positive control	$U = 24\text{ V}$					○	●	●	●	●	T6
				negative control	$U = 24\text{ V}$					○	●	●	●	●	T8

Controller group e)										110	145	175	210	280	
e)	Without additional control (without symbol)									○	●	●	●	●	
	Load-sensing, pump pressure, internal	fixed setting								○	●	●	●	●	S0
		electric-proportional		positive control	$U = 12\text{ V}$					○	●	●	●	●	S3
				positive control	$U = 24\text{ V}$					○	●	●	●	●	S4

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01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
									/	41			V					0	-

Depressurized basic position and external control pressure supply ¹⁾										110	145	175	210	280
08	Basic position maximum swivel angle ($V_{g \max}$)													
	Without external control pressure supply (standard for power and pressure controllers)									○	●	●	●	●
	With external control pressure supply (integrated shuttle valve, standard for negative stroke control)									○	●	●	●	●
	Basic position minimum swivel angle ($V_{g \min}$)													
	With external control pressure supply (integrated shuttle valve, standard for positive stroke control)									○	●	●	●	●

Connectors for solenoids ²⁾										110	145	175	210	280
09	Without connector (without solenoid, only for hydraulic control)									○	●	●	●	●
	DEUTSCH - molded connector, 2-pin, without suppressor diode									○	●	●	●	●

Swivel angle sensor										110	145	175	210	280
10	Without swivel angle sensor									○	●	●	●	●
	With electric swivel angle sensor ³⁾ Power supply 5 V DC									○	●	●	●	●
	(as per data sheet 95150) Power supply 8 V – 32 V DC									○	●	●	●	●

Series														
11	Series 4, Index 1													41

Version of port and fastening threads										110	145	175	210	280
12	Metric, all fastening threads according to DIN 13, all port threads with O-ring seal according to ISO 6149									○	●	●	●	●
	ANSI, all fastening threads according to ASME B1.1, all port threads with O-ring seal according to ISO 11926									○	●	●	●	●

Direction of rotation										110	145	175	210	280
13	Viewed on drive shaft clockwise									○	●	●	●	●
	counter-clockwise									○	●	●	●	●

Sealing material														
14	FKM (fluoroelastomer)													V

Mounting flange										110	145	175	210	280
15	SAE J744				152-4					○	●	-	-	-
					165-4					-	-	●	●	●
	SAE J617				409-12					-	●	●	●	-

Drive shaft (permissible input torque, see page 12)										110	145	175	210	280
16	Splined shaft ANSI B92.1a	1 3/4 in 13T 8/16 DP								○	●	●	●	○
		2 in 15T 8/16 DP								-	●	●	●	●
		2 1/4 in 17T 8/16 DP								-	-	-	-	●
	Splined shaft DIN 5480	W45x2x21x9g								○	-	-	-	-
		W50x2x24x9g								-	●	●	●	-
		W60x2x28x9g								-	-	-	-	●

Rotary group version										110	145	175	210	280
17	Standard version without charge pump									○	●	●	●	●
	Premium version, efficiency and speed optimized (version with and without charge pump)									-	●	●	●	●

● = Available ○ = On request - = Not available











1) For description, please refer to “Control device” and the tables from page 12

2) Connectors for other electric components may deviate

3) 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
									/	41			V					0	-

Through drives (for mounting options, see page 66)

18	Flange SAE J744			Hub for splined shaft ¹⁾								
	Diameter	Attach- ment ²⁾	Designation	Diameter		Designation	110	145	175	210	280	
82-2 (A)		A1 ⁴⁾	5/8 in	9T 16/32DP	S2	○	●	●	●	●	A1S2	
		A3	5/8 in	9T 16/32DP	S2	○	●	●	●	●	A3S2	
		3/4 in	11T 16/32DP	S3	○	●	●	●	●	●	A3S3	
101-2 (B)		B1 ⁴⁾	7/8 in	13T 16/32DP	S4	○	●	●	●	●	B1S4	
			1 in	15T 16/32DP	S5	○	●	●	●	●	●	B1S5
			B3	7/8 in	13T 16/32DP	S4	○	●	●	●	●	B3S4
	1 in			15T 16/32DP	S5	○	●	●	●	●	●	B3S5
		B5	7/8 in	13T 16/32DP	S4	○	●	●	●	●	B5S4	
			1 in	15T 16/32DP	S5	○	○	●	●	○	B5S5	
127-2 (C)		C1 ⁴⁾	1 1/4 in	14T 12/24DP	S7	○	●	●	●	●	C1S7	
			1 1/2 in	17T 12/24DP	S9	○	●	●	●	●	●	C1S9
		C3	1 1/4 in	14T 12/24DP	S7	○	●	●	●	●	C3S7	
			1 1/2 in	17T 12/24DP	S9	○	●	●	●	●	●	C3S9
		C5	1 1/4 in	14T 12/24DP	S7	○	○	●	●	●	C5S7	
127-4 (C)		C4	1 1/4 in	14T 12/24DP	S7	○	●	●	●	○	C4S7	
			1 3/8 in	21T 16/32 DP	V8	○	●	○	○	○	C4V8	
152-4 (D)		D4	1 1/4 in	14T 12/24DP	S7	○	●	○	○	○	D4S7	
			1 3/8 in	21T 16/32 DP	V8	○	○	○	○	○	D4V8	
			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	
			2 1/4 in	17T 8/16DP	T3	–	–	–	–	●	E4T3	
			W60x2x28x9g ³⁾	A4	–	–	–	–	●	E4A4		
Prepared for through drive, with pressure-proof plugged cover (also see data sheet 95581)						○	●	●	●	●	U000	

Pressure sensors and other sensors

19	Without sensor	0
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Standard / special version

20	Standard version	0
	Special version	S

• = Available o = On request - = Not available

Notice

- Note the project planning notes on page 71.
- In addition to the type code, please specify the relevant technical data when placing your order.
- For details of the mounting situation of combination pumps, see page 67.

- 1) According to ANSI B92.1a
- 2) The through drives A3, B3, C3 are equipped with universal through drives. For painting units, observe the mounting holes pattern viewed on through drive with control at top.
- 3) Hub N60x2x28x8H according to DIN 5480
- 4) Only for painting units, see position 01
- 5) See also "Mounting situation of combination pumps in relation to each other" on page 66.

Hydraulic fluids

The A11V(L)O variable pump is designed for operation with HLP mineral oil according to DIN 51524.

Application instructions and requirements for hydraulic fluids 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/HFUD)

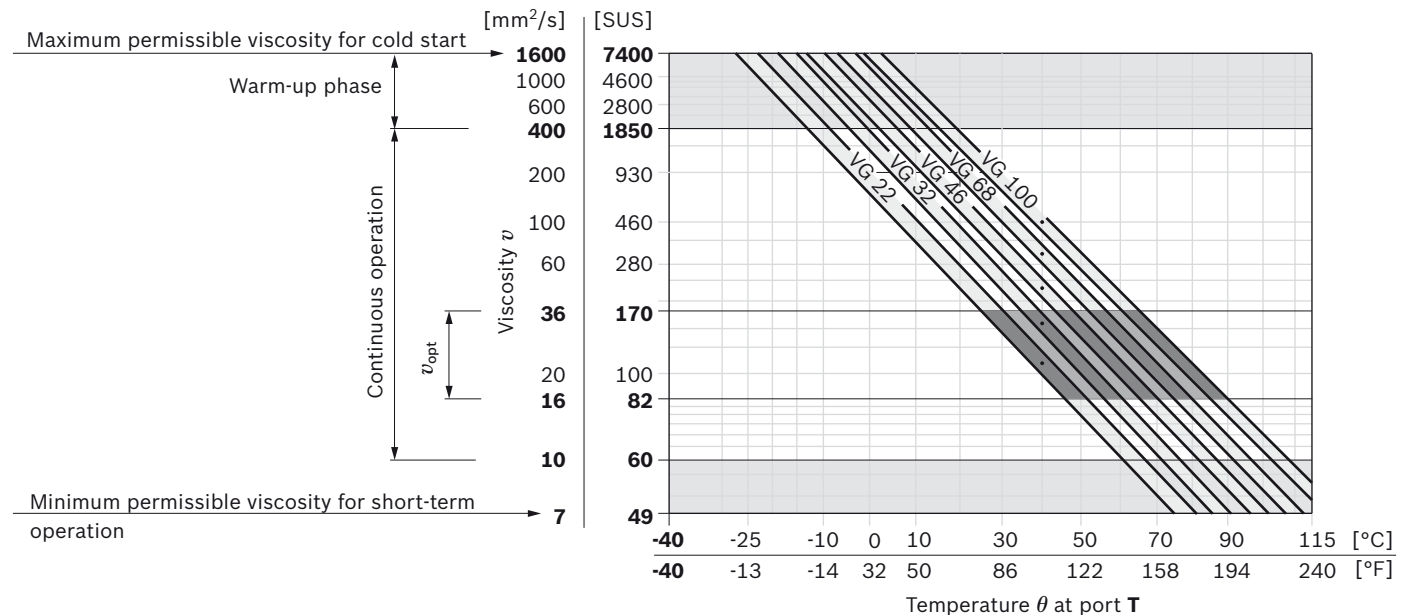
Notes on selection of hydraulic fluid

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

Viscosity and temperature of hydraulic fluids

	Viscosity	Shaft seal	Temperature ³⁾	Comment
Cold start	$v_{max} \leq 1600 \text{ mm}^2/\text{s}$ ($v_{max} \leq 7400 \text{ SUS}$)	NBR ²⁾	$\theta_{St} \geq -40 \text{ °C} (-40 \text{ °F})$	$t \leq 3 \text{ min}$, without load ($p \leq 50 \text{ bar (725 psi)}$), $n \leq 1000 \text{ min}^{-1}$ Permissible temperature difference between the axial piston unit and hydraulic fluid in the system max. 25 K (45 °F)
		FKM	$\theta_{St} \geq -25 \text{ °C} (-13 \text{ °F})$	
Warm-up phase	$v = 1600 \dots 400 \text{ mm}^2/\text{s}$ ($v = 7400 \text{ to } 1850 \text{ SUS}$)			$t \leq 15 \text{ min}$, $p \leq 0.7 \times p_{nom}$ and $n \leq 0.5 \times n_{nom}$
Continuous operation	$v = 400 \dots 10 \text{ mm}^2/\text{s}^{1)}$ ($v = 1850 \text{ to } 60 \text{ SUS}$)	NBR ²⁾	$\theta \leq +85 \text{ °C} (+185 \text{ °F})$	measured at port T
		FKM	$\theta \leq +110 \text{ °C} (+230 \text{ °F})$	
	$v_{opt} = 36 \dots 16 \text{ mm}^2/\text{s}$ ($v_{opt} = 170 \text{ to } 82 \text{ SUS}$)			Range of optimum operating viscosity and efficiency
Short-term operation	$v_{min} = 10 \dots 7 \text{ mm}^2/\text{s}$ ($v_{min} = 60 \dots 49 \text{ SUS}$)	NBR ²⁾	$\theta \leq +85 \text{ °C} (+185 \text{ °F})$	$t \leq 3 \text{ min}$, $p \leq 0.3 \times p_{nom}$, measured at port T
		FKM	$\theta \leq +110 \text{ °C} (+230 \text{ °F})$	

▼ Selection diagram



1) Corresponds e.g. for VG 46 to a temperature range of 39 °F to +185 °F (+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.

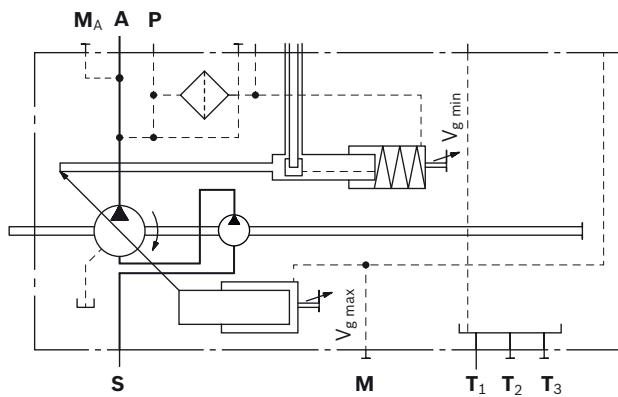
At a hydraulic fluid viscosity of less than 10 mm²/s (60 SUS) (e.g. due to high temperatures in short-term operation) at the drain port, a cleanliness level of at least 19/17/14 according to ISO 4406 is required.

For example, the viscosity is 10 mm²/s (60 SUS) at:

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

Charge pump (impeller)

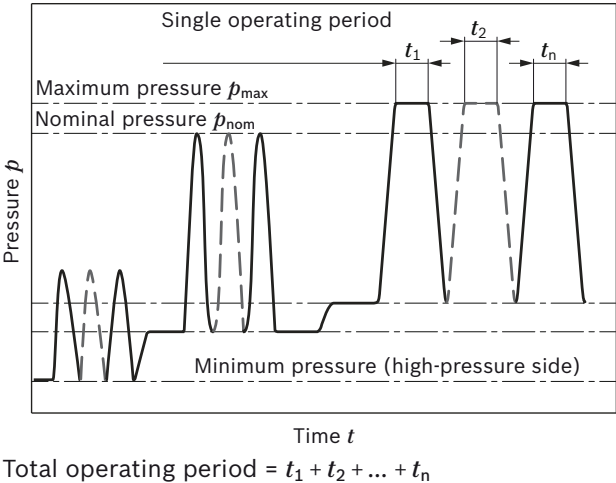
The charge pump is a centrifugal pump with which the A11VLO is filled and therefore can be operated at higher speeds. This also simplifies cold starting at low temperatures and high viscosity of the hydraulic fluid. Externally increasing the inlet pressure is therefore unnecessary in most cases. Charging the reservoir with compressed air is not permissible.



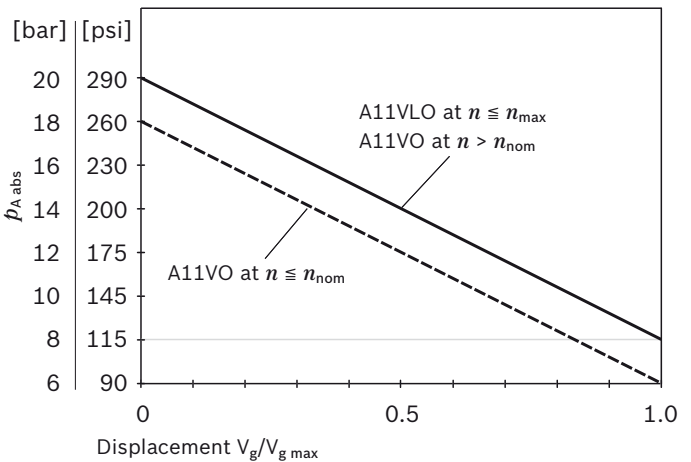
Working pressure range

Pressure at working port A		Definition
Nominal pressure p_{nom}	350 bar (5100 psi)	The nominal pressure corresponds to the maximum design pressure. 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 (maximum number of cycles: approx. 1 million).
Maximum pressure p_{max}	420 bar (6100 psi)	
Single operating period	1 s	
Total operating period	300 h	
Minimum pressure $p_{A abs}$ (High-pressure side)	15 bar ¹⁾	Minimum pressure at the high-pressure side (A) which is required in order to prevent damage to the axial piston unit. The minimum pressure depends on the rotational speed and the swivel angle (see diagram on page 11 and footnote ⁴⁾ technical data on page 9 and 10).
Rate of pressure change $R_{A max}$	16000 bar/s (232000 psi/s)	Maximum permissible speed of pressure build-up and reduction during a pressure change across the entire pressure range.
Pressure at suction port S (inlet)		
Version without charge pump (A11VO)		Minimum pressure at suction port S (inlet) which is required to prevent damage to the axial piston unit. The minimum pressure depends on the rotational speed and displacement of the axial piston unit.
Minimum pressure $p_{S min}$	≥ 0.8 bar (12 psi) absolute	
Maximum pressure $p_{S max}$	≤ 30 bar (435 psi)	
Version with charge pump (A11VLO)		
Minimum pressure $p_{S min}$	≥ 0.7 bar (10.5 psi) absolute	
Maximum pressure $p_{S max}$	≤ 2 bar (30 psi) absolute	
Case pressure at port T ₁ , T ₂ , T ₃		
Maximum static pressure $p_{L max}$	3 bar (45 psi)	Maximum 1.2 bar (18 psi) higher than inlet pressure at port S , but not higher than $p_{L max}$. A drain line to the reservoir is required.
Pressure peaks $p_{L peak}$	6 bar (90 psi)	t < 0.1 s

▼ Pressure definition



▼ Minimum pressure (high-pressure side)



Notice

Working pressure range valid when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.

1) See also footnote 4 on page 9 and 10

Technical data

Without charge pump (A11VO) rotary group version E and P

Size			NG	110	145	175	210	280	
Displacement, geometric, per revolution			$V_{g \max}$	cm ³	110.0	145.0	175.0	210.0	280.0
				in ³	6.71	8.85	10.68	12.81	17.09
			$V_{g \min}$	cm ³	0	0	0	0	0
				in ³	0	0	0	0	0
Rotational speed maximum ¹⁾	at $V_{g \max}^{2)}$ version E and P		n_{nom}	min ⁻¹	2400	2300	2150	2000	1800
	at $V_g \leq V_{g \max}^{3)}$ version E		n_{max}	min ⁻¹	2400	2300	2150	2000	1800
	at $V_g \leq V_{g \max}^{3)}$ version P				–	2600	2500	2350 ⁴⁾	2150 ⁴⁾
Flow	at n_{nom} and $V_{g \max}$		q_v	l/min	264	334	376	420	504
			q_v	gpm	70	88	99	110	133
Power	at n_{nom} , $V_{g \max}$ and $\Delta p = 350$ bar (5100 psi)		P	kW	154	195	219	245	294
			P	hp	207	261	294	345	394
Torque	at $V_{g \max}$ and $\Delta p = 350$ bar (5100 psi) ²⁾		M	Nm	613	808	975	1170	1560
				lb-ft	452	596	719	863	1151
Rotary stiffness of drive shaft	1 3/4 in 13T 8/16 DP	T1	c	kNm/rad	–	235	243	254	–
				lb-ft/rad	–	173327	179227	187340	–
	2 in 15T 8/16 DP	T2	c	kNm/rad	–	286	298	314	–
				lb-ft/rad	–	210942	219794	231595	–
	2 1/4 in 17T 8/16 DP	T3	c	kNm/rad	–	–	–	–	519
				lb-ft/rad	–	–	–	–	382795
	W45x2x21x9g	A1	c	kNm/rad	242	–	–	–	–
				lb-ft/rad	178489	–	–	–	–
	W50x2x24x9g	A2	c	kNm/rad	–	334	357	381	–
				lb-ft/rad	–	246345	263309	281011	–
	W60x2x28x9g	A4	c	kNm/rad	–	–	–	–	645
				lb-ft/rad	–	–	–	–	475727
Moment of inertia rotary group		version E	J_{TW}	kgm ²	0.022	0.035	0.045	0.06	0.105
				lb-ft ²	0.5221	0.8306	1.0679	1.4238	3.3222
		version P	J_{TW}	kgm ²	–	0.035	0.045	0.06	0.097
				lb-ft ²	–	0.8306	1.0679	1.4238	2.3019
Maximum angular acceleration ⁵⁾		version E	α	rad/s ²	7465	6298	5609	5014	3900
		version P	α	rad/s ²	–	6298	5609	5014	4200
Case volume			V	l	2.2	2.7	3.6	4	6.5
				gal	0.58	0.71	0.95	1.06	1.72
Weight (without through drive) approx.			m	kg	64	79	97	111	143
				lbs	141	174	214	245	315

- 1) The values are applicable:
- for the optimum viscosity range from $\nu_{\text{opt}} = 36$ to $16 \text{ mm}^2/\text{s}$ (170 to 74 SUS)
 - with hydraulic fluid based on mineral oils
- 2) The values apply at absolute pressure $p_{\text{abs}} = 1$ bar (15 psi) at suction port **S**.
- 3) Maximum rotational speed (rotational speed limit) in the case of increasing the inlet pressure p_{abs} at suction port **S** and $V_g < V_{g \max}$, see diagram on page 11.

- 4) Under following conditions the rotational speed can increase:

NG	Speed [min ⁻¹ (rpm)]	Pressure at port A $p_{\text{A abs}}$ [bar (psi)]	Swivel angle [%]
280	2300	minimum 35 (510)	minimum 10
210	2500	minimum 35 (510)	minimum 10

- 5) 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.

With charge pump (A11VLO) rotary group version P

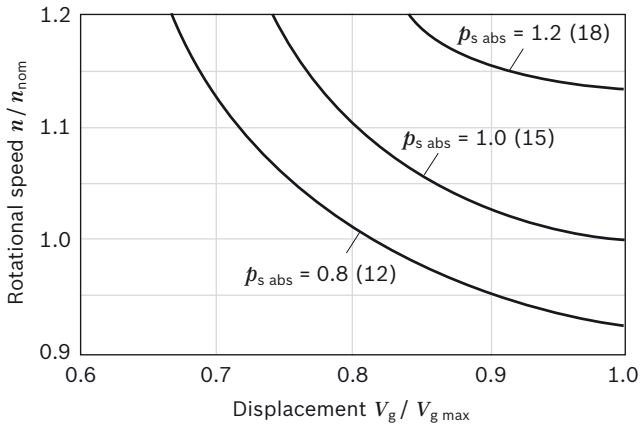
Size			NG		145	175	210	280
Displacement, geometric, per revolution	$V_{g \max}$	cm ³			145.0	175.0	210.0	280.0
				in ³	8.85	10.68	12.81	17.09
	$V_{g \min}$	cm ³			0	0	0	0
				in ³	0	0	0	0
Rotational speed maximum ¹⁾	at $V_{g \max}$ ²⁾		n_{nom}	rpm	2600	2500	2350	2150
	at $V_g \leq V_{g \max}$		n_{max}	rpm	2600 ³⁾	2500 ³⁾	2350 ⁴⁾	2150 ⁴⁾
Flow	at n_{nom} and $V_{g \max}$		q_v	l/min	377	438	493	602
				gpm	100	116	130	159
Power	at n_{nom} , $V_{g \max}$ and $\Delta p = 350$ bar (5100 psi)		P	kW	220	255	288	351
				hp	295	342	386	471
Torque	at $V_{g \max}$ and $\Delta p = 350$ bar (5100 psi) ²⁾		M	Nm	808	975	1170	1560
				lb-ft	596	719	863	1151
Rotary stiffness of drive shaft	1 3/4 in 13T 8/16 DP	T1	c	kNm/rad	235	243	254	–
				lb-ft/rad	173327	179227	187340	–
	2 in 15T 8/16 DP	T2	c	kNm/rad	286	298	314	–
				lb-ft/rad	210942	219794	231595	–
	2 1/4 in 17T 8/16 DP	T3	c	kNm/rad	–	–	–	519
				lb-ft/rad	–	–	–	382795
	W50x2x24x9g	A2	c	kNm/rad	334	357	381	–
				lb-ft/rad	246345	263309	281011	–
	W60x2x28x9g	A4	c	kNm/rad	–	–	–	645
				lb-ft/rad	–	–	–	475727
Moment of inertia			J_{TW}	kgm ²	0.035	0.047	0.063	0.1
				lb-ft ²	0.8306	1.0679	1.4238	2.3730
Maximum angular acceleration ⁵⁾			α	rad/s ²	6298	5609	5014	4100
Case volume			V	l	2.9	3.6	3.7	5.6
				gpm	0.77	0.95	0.98	1.48
Weight (without through drive) approx.			m	kg	92	110	125	148
				lbs	203	243	276	326

- 1) The values are applicable:
- for the optimum viscosity range from $\nu_{\text{opt}} = 36$ to $16 \text{ mm}^2/\text{s}$ (170 to 74 SUS)
 - with hydraulic fluid based on mineral oils
- 2) The values apply at absolute pressure $p_{\text{abs}} = 1$ bar (15 psi) at suction port **S**.
- 3) Maximum rotational speed (rotational speed limit) in the case of increasing the inlet pressure p_{abs} at suction port **S** and $V_g < V_{g \max}$, see diagram on page 11.
- 4) Under following conditions the rotational speed can increase:

NG	Speed [min ⁻¹ (rpm)]	Pressure at port A $p_{A \text{ abs}}$ [bar (psi)]	Swivel angle [%]
280	2300	minimum 35 (510)	minimum 10
210	2500	minimum 35 (510)	minimum 10

- 5) 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.

▼ **Maximum permissible rotational speed (rotational speed limit)**
($p_{s\ abs}$ = inlet pressure [bar (psi)])



Notice

- The maximum permissible rotational speed n_{max} must not be exceeded (see table of values on page 9 and 10).

Determining the characteristics

Flow	$q_v = \frac{V_g \times n \times \eta_v}{1000}$	[l/min]
	$q_v = \frac{V_g \times n \times \eta_v}{231}$	[gpm]
Torque	$M = \frac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$	[Nm]
	$M = \frac{V_g \times \Delta p}{24 \times \pi \times \eta_{hm}}$	[lb-ft]
Power	$P = \frac{2 \pi \times M \times n}{60000} = \frac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]
	$P = \frac{2 \pi \times M \times n}{33000} = \frac{q_v \times \Delta p}{1714 \times \eta_t}$	[hp]
Key		
V_g	=	Displacement per revolution [cm^3 (in^3)]
Δp	=	Differential pressure [bar (psi)]
n	=	Rotational speed [rpm]
η_v	=	Volumetric efficiency
η_{hm}	=	Hydraulic-mechanical efficiency
η_t	=	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

Permissible radial and axial forces of the drive shafts

Size	NG	110	110	145	145	145	175	175	175	210	210	210	280	280
Drive shaft		1 3/4 in W45	1 3/4 in W45	2 in W50	2 in W50	2 in W50	2 1/4 in W50	2 1/4 in W50	2 1/4 in W50	2 1/4 in W50	2 1/4 in W50	2 1/4 in W50	2 1/4 in W50	2 1/4 in W50
Maximum radial force at distance a (from shaft collar)	$F_{q\ max}$	N	8000	8000	11000	11000	11000	12300	12300	14000	16925	16925	17000	23600
		lb	1798	1798	2473	2473	2473	2765	2765	3147	3805	3805	3822	5305
	a	mm	33.5	25	33.5	40	27.5	33.5	40	27	33.5	40	27	40
		in	1.32	0.98	1.32	1.57	1.08	1.32	1.57	1.06	1.32	1.57	1.06	1.14
Maximum axial force	$+ F_{ax\ max}$	N	1200	1200	1350	1350	1350	1400	1400	1400	1450	1450	1450	1800
		lb	270	270	304	304	304	315	315	315	326	326	326	405
F_{ax}	$- F_{ax\ max}$	N	500	500	600	600	600	650	650	650	700	700	700	850
		lb	112	112	135	135	135	146	146	146	157	157	157	191

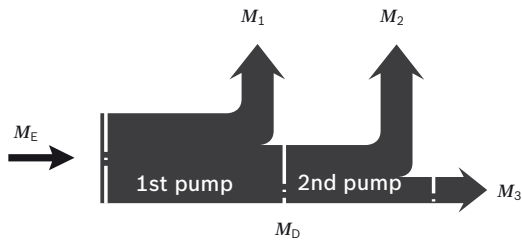
Notice

- 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. We recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.
- Special requirements apply in the case of belt drives. Please contact us.

Permissible input and through-drive torques

Size			NG	110	145	175	210	280	
Torque at $V_{g \text{ max}}$ and $\Delta p = 350 \text{ bar (5100 psi)}^{1)}$			M_{max}	Nm	610	808	975	1170	1560
				lb-ft	452	596	719	863	1151
Maximum input torque at drive shaft ²⁾									
T1	1 3/4 in		$M_{E \text{ max}}$	Nm	1640	1640	1640	1640	–
				lb-ft	1210	1210	1210	1210	–
T2	2 in		$M_{E \text{ max}}$	Nm	–	2670	2670	2670	–
				lb-ft	–	1969	1969	1969	–
T3	2 1/4 in		$M_{E \text{ max}}$	Nm	–	–	–	–	4380
				lb-ft	–	–	–	–	3231
A1	W45		$M_{E \text{ max}}$	Nm	2190	–	–	–	–
				lb-ft	1615	–	–	–	–
A2	W50		$M_{E \text{ max}}$	Nm	–	3140	3140	3140	–
				lb-ft	–	2316	2316	2316	–
A4	W60		$M_{E \text{ max}}$	Nm	–	–	–	–	5780
				lb-ft	–	–	–	–	4263
Maximum through-drive torque			$M_{D \text{ max}}$	Nm	960	1110	1340	1915	2225
				lb-ft	708	819	988	1412	1641

▼ Distribution of torques



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

External control pressure supply

(type code position 08 B and C)

Control systems with external control pressure supply need a flow appropriate to the adjustment time and size. See also page 20

Size	Flow [l/min (gpm)] at 100 ms swivel time
110	10 (2.64)
145	13 (3.43)
175	14 (3.70)
210	17 (4.49)
280	22 (5.81)

1) Efficiency not considered

2) For drive shafts free of radial force

Power controller

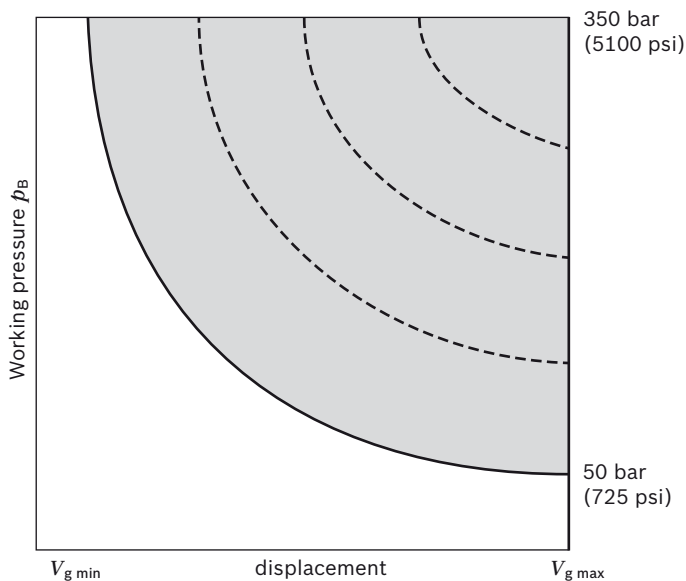
LR – Power controller, fixed setting

The power controller regulates the displacement of the pump depending on the working pressure so that a given drive power is not exceeded at constant drive speed. The precise control with a hyperbolic characteristic curve, provides an optimum utilization of available power. The working pressure acts on a rocker via a measuring spool moved together with the control. An externally adjustable spring force counteracts this, it determines the power setting. The depressurized basic position is $V_{g \max}$. If the working pressure exceeds the set spring force, the control valve will be actuated by the rocker and the pump will swivel back from the basic setting $V_{g \max}$ toward $V_{g \min}$. Here, the leverage at the rocker may be shortened and the working pressure may rise in the same relation as the displacement is reduced ($p_B \times V_g = \text{constant}$; p_B = working pressure; V_g = displacement). The hydraulic output power (characteristic curve LR) is influenced by the efficiency of the pump. Setting range for beginning of control 50 bar (725 psi) to 350 bar (5100 psi), see table on the right. When ordering, state in plain text:

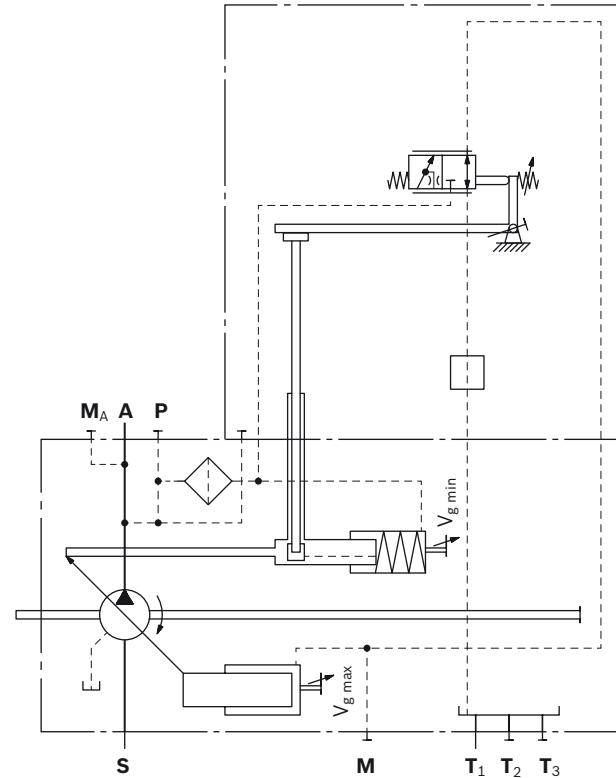
- ▶ Drive power P [kW (HP)]
- ▶ Drive speed n [rpm]
- ▶ Maximum flow $q_{V \max}$ [l/min (gpm)]

Please contact us if you need a power diagram.

▼ Characteristic curve LR



▼ Circuit diagram LR



Size	Rotational speed (rpm)		
	1000	1500	1800
	Minimum adjustable drive power [kW(hp)] (at 50 bar (725 psi) beginning of control)		
110	11 (15)	17 (23)	20 (27)
145	14 (19)	21 (29)	25 (34)
175	17 (23)	25 (34)	30 (41)
210	20 (27)	30 (41)	36 (49)
280	26 (35)	29 (53)	47 (64)

L3/L4 – Power controller, electric-proportional override (negative control)

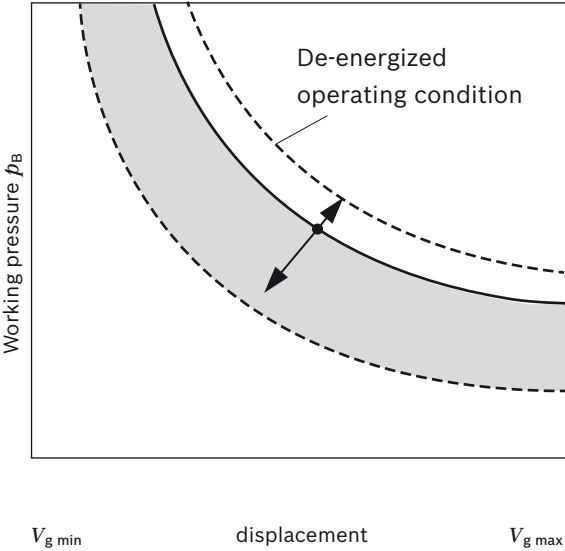
A control current acts against the adjustment spring of the power controller via a proportional solenoid. The mechanically adjusted basic power setting can be reduced by means of different control current settings. Increasing control current = reduced power. If the control current signal is variably controlled via a load limiting control, the power draw of all consumers is adjusted to the power draw possible for the diesel engine (e.g. electronic load limiting control LLC (data sheet 95310) in BODAS controller RC2-2).

Technical data, solenoid	L3	L4
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Beginning of control	400 mA	200 mA
End of control	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C (68 °F))	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 68		

When ordering, state in plain text:

- ▶ Drive power P [kW (hp)] at beginning of control
- ▶ Drive speed n [rpm]
- ▶ Maximum flow $q_{V\ max}$ [l/min (gpm)]

▼ Effect of power override through current increase or de-energized operating condition

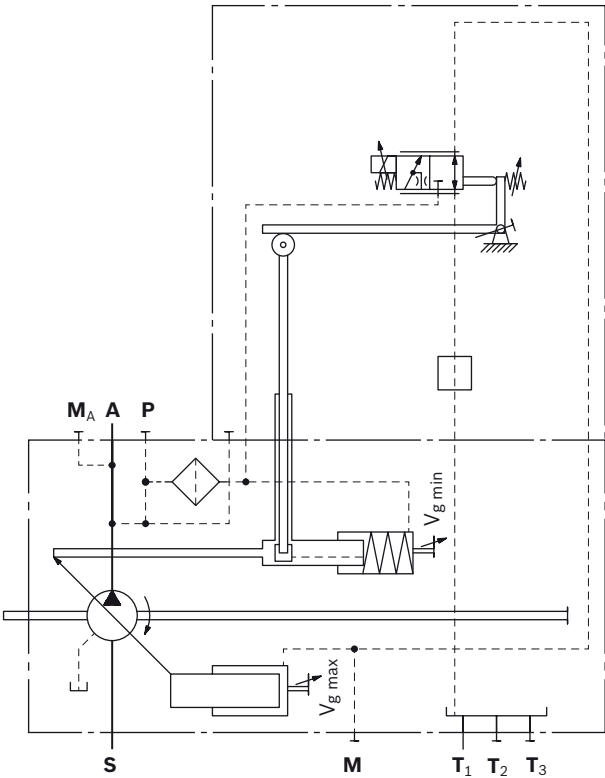


Notice

In operating condition **L3** de-energized (jump 400 to 0 mA): Power increase by a factor of 2 of the table values.

In operating condition **L4** de-energized (jump 200 to 0 mA): Power increase by a factor of 1 of the table values.

▼ Circuit diagram L3/L4



Reduction of power by control current to the proportional solenoids with **L3¹⁾**

Power reduction/control current [kW (hp)/100 mA]

Size	Rotational speed [rpm]		
	1000	1500	1800
110	6.1 (8.2)	9.2 (12.3)	11.0 (14.7)
145	7.4 (9.9)	11.1 (14.9)	13.3 (17.8)
175	8.4 (11.3)	12.6 (16.9)	15.1 (20.2)
210	9.4 (12.6)	14.1 (18.9)	16.9 (22.7)
280	11.4 (15.3)	17.1 (22.9)	20.5 (27.5)

Reduction of power by control current to the proportional solenoids with **L4¹⁾**

Power reduction/control current [kW (hp)/100 mA]

Size	Rotational speed [rpm]		
	1000	1500	1800
110	12.3 (16.5)	18.5 (24.8)	22.1 (29.6)
145	14.8 (19.8)	22.2 (29.8)	26.6 (35.7)
175	16.8 (22.5)	25.2 (33.8)	30.2 (40.5)
210	18.9 (25.3)	28.4 (38.1)	34.0 (45.6)
280	22.9 (30.7)	34.4 (46.1)	41.2 (55.3)

¹⁾ Values in the tables are reference points. Determination of the exact power override on request.

L5 – Power controller, hydraulic-proportional override (negative control)

A pilot pressure acts against the adjustment spring of the power controller via a valve.

The mechanically adjusted basic power setting can be reduced by means of different pilot pressure settings.

Increasing pilot pressure = reduced power.

- ▶ Maximum permissible pilot pressure

$$p_{st \max} = 100 \text{ bar (1450 psi)}$$

If the pilot pressure signal is adjusted by a load limiting control, the power reduction of all consumers is reduced to match the available power from the diesel engine.

Reduction of power by pilot pressure at port **L5**

Power reduction/pilot pressure [kW (hp)/bar (psi)]

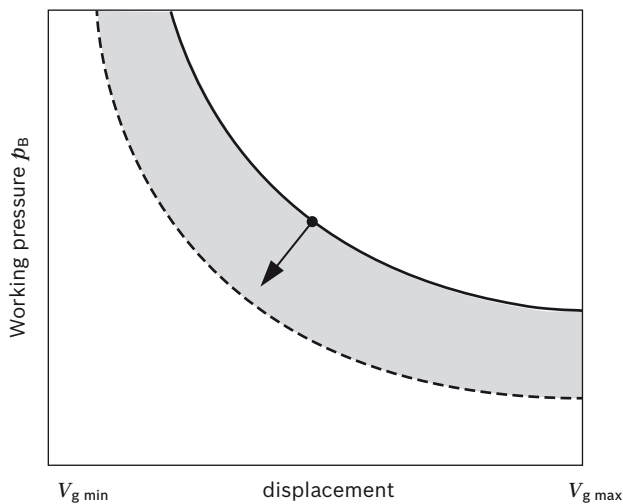
Size	Rotational speed [rpm]		
	1000	1500	1800
110	2.3 (3.1)	3.5 (4.7)	4.1 (5.5)
145	2.8 (3.8)	4.2 (5.6)	5.0 (6.7)
175	3.2 (4.3)	4.8 (6.4)	5.8 (7.8)
210	3.6 (4.8)	5.4 (5.9)	6.5 (8.7)
280	4.4 (5.9)	6.6 (8.9)	7.9 (10.6)

Values in the tables are reference points. Determination of the exact power override on request.

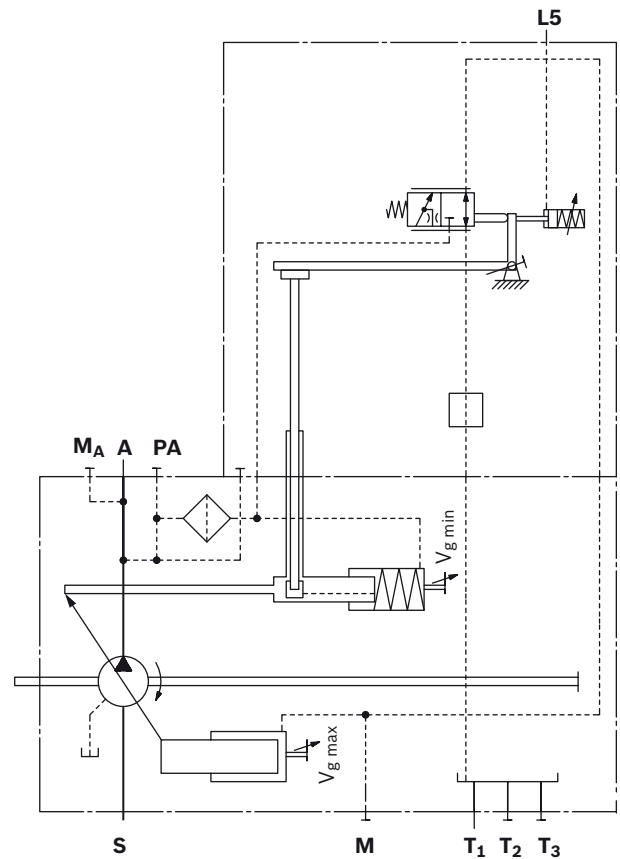
When ordering, state in plain text:

- ▶ Drive power P [kW (hp)] at a pilot pressure of p_{st} in **L5** of 5 bar (75 psi)
- ▶ Drive speed n [rpm]
- ▶ Maximum flow $q_{V \max}$ [l/min (gpm)]

▼ Effect of power override through pilot pressure increase



▼ Circuit diagram L5



L6 – Power controller, hydraulic-proportional override (positive control)

A pilot pressure acts together with the adjustment spring of the power controller via a valve.

The mechanically adjusted basic power setting can be increased by means of different pilot pressure settings.

Increasing pilot pressure = increased power.

- Maximum permissible pilot pressure

$$p_{St \max} = 100 \text{ bar (1450 psi)}$$

If the pilot pressure signal is adjusted by a load limiting control, the power increase of all consumers is increased to match the available power from the diesel engine.

Power increase by pilot pressure at port **L6**

Power increase/pilot pressure [kW (hp)/bar (psi)]

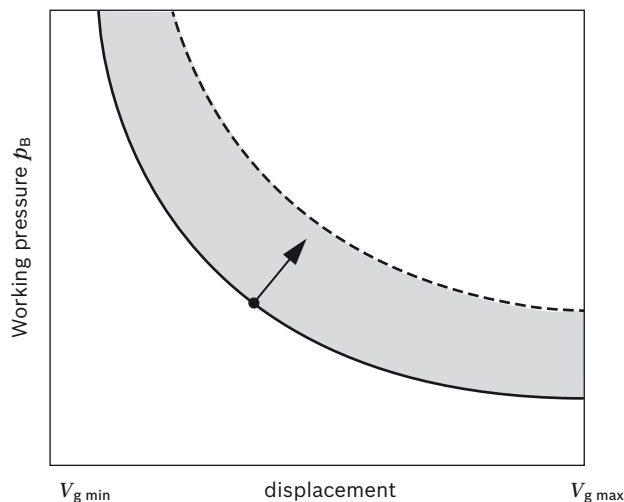
Size	Rotational speed [rpm]		
	1000	1500	1800
110	2.4 (3.2)	3.6 (4.8)	4.3 (5.8)
145	2.9 (3.9)	4.3 (5.8)	5.2 (7.0)
175	3.3 (4.4)	4.9 (6.6)	5.9 (7.9)
210	3.7 (5.0)	5.6 (7.5)	6.7 (9.0)
280	4.5 (6.0)	6.8 (9.1)	8.1 (10.9)

Values in the tables are reference points. Determination of the exact power override on request.

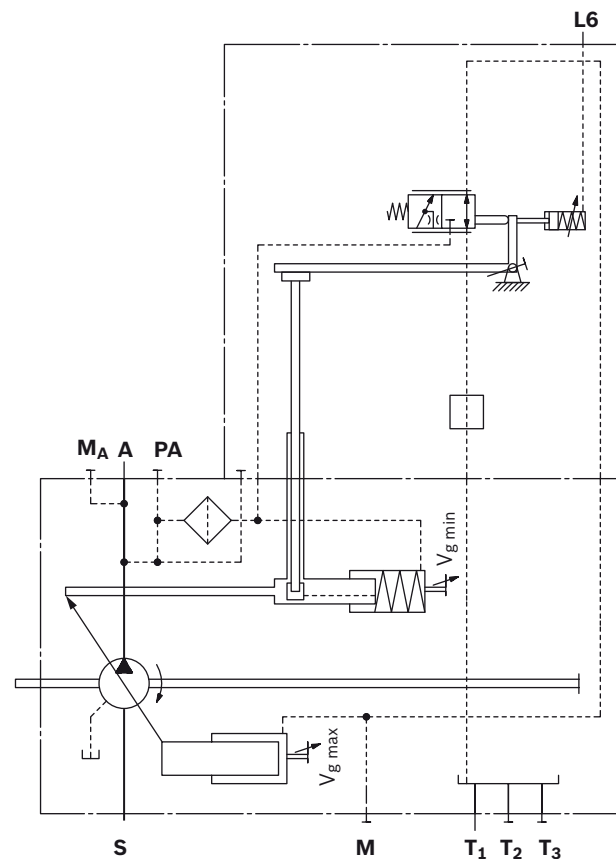
When ordering, state in plain text:

- Drive power P [kW (hp)] at a pilot pressure of p_{st} in **L6** of 5 bar (75 psi)
- Drive speed n [rpm]
- Maximum flow $q_{V \max}$ [l/min (gpm)]

▼ Effect of power override through pilot pressure increase



▼ Circuit diagram L6



CR – Summation hp-control of two power-controlled pumps, high-pressure-related override (with stop)

With two pumps of the same size working in different operating circuits, the CR controller limits the overall power.

The CR works like the normal LR with a fixed maximum power setting along the power hyperbola. The high-pressure-related override reduces the power setpoint in dependence on the working pressure of the other pump. That happens proportionally below the beginning of control and is blocked by a stop when the minimum power is reached. Here, the **CR** port of the one pump has to be connected to the **M_A** port of the other pump.

The maximum power of the first pump is reached when the second pump is working at idle when depressurized. When defining the maximum power, the idle power of the second pump has to be taken into account.

The minimum power of each pump is reached when both pumps are working at high pressure. The minimum power usually equates to 50% of the total power.

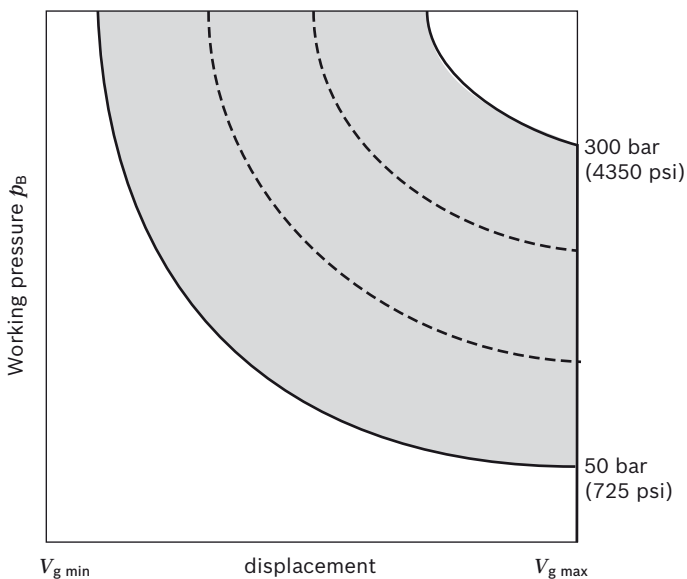
Power that is released by the pressure controller or other overrides remains unconsidered.

Setting range for beginning of control 50 bar (725 psi) to 300 bar (4350 psi).

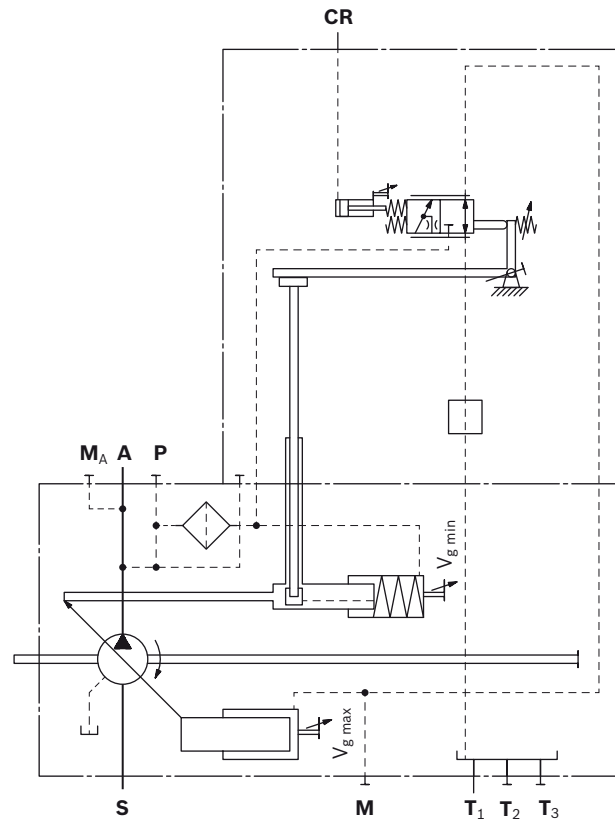
When ordering, please specify separately for each pump:

- ▶ Maximum drive power P_{\max} [kW (hp)]
- ▶ Minimum drive power P_{\min} [kW (hp)]
- ▶ Drive speed n [rpm]
- ▶ Maximum flow $q_{V \max}$ [l/min (gpm)]

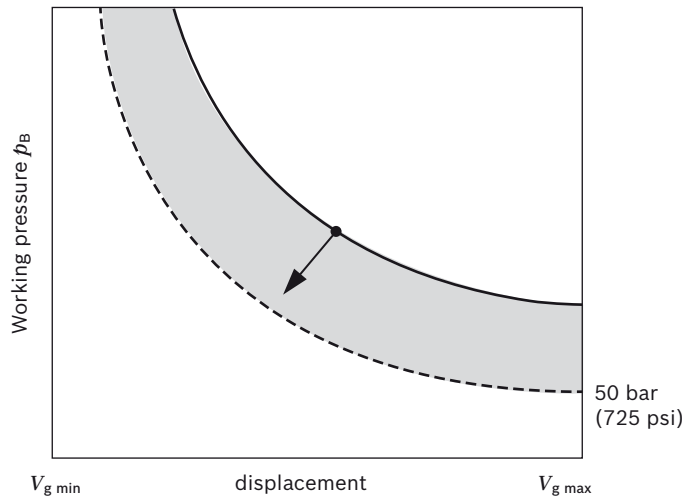
▼ Characteristic curve CR



▼ Circuit diagram CR



▼ Effect of power override of a pump with increasing pressure in the 2nd Pump



PR – Summation hp-control of two power-controlled pump and a constant pump

Together with the mounted fixed pump, the PR controller on an A11V(L)O effects a limitation of the overall power. The PR works like the normal LR with a fixed maximum power setting along the power hyperbola. The high-pressure-dependent override reduces the power specification in proportion to the working pressure of the fixed pump. Here, port **PR** of the A11V(L)O must be connected to the working pressure of the fixed pump. The power of the controlled pump can then be reduced to zero in a border-line case.

The maximum power of the controlled pump is reached when the fixed pump works at idle when depressurized. When defining the maximum power, the idle power of the fixed pump has to be taken into account.

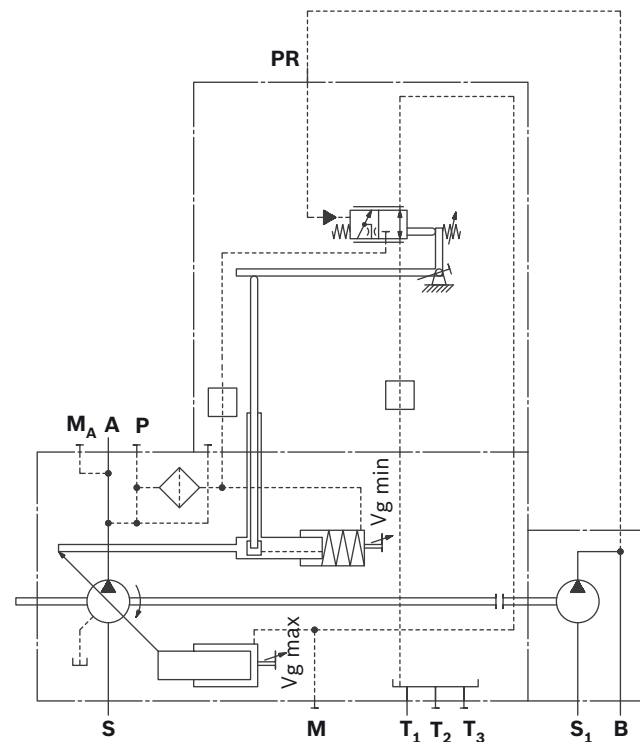
Power that is released by the pressure controller or other overrides remains unconsidered.

Setting range for beginning of control 50 bar (725 psi) to 350 bar (5100 psi).

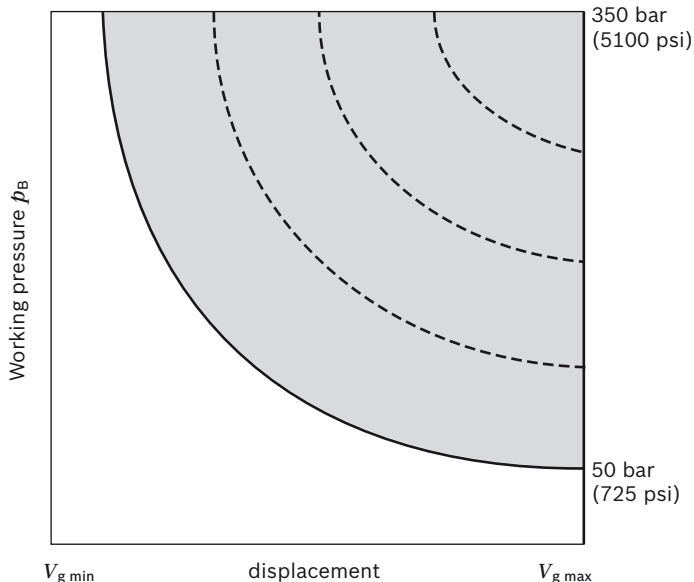
When ordering, state in plain text:

- ▶ Maximum drive power P_{\max} [kW (hp)]
- ▶ Drive speed n [rpm]
- ▶ Maximum flow $q_{V \max}$ [l/min (gpm)]
- ▶ Size of the fixed pump

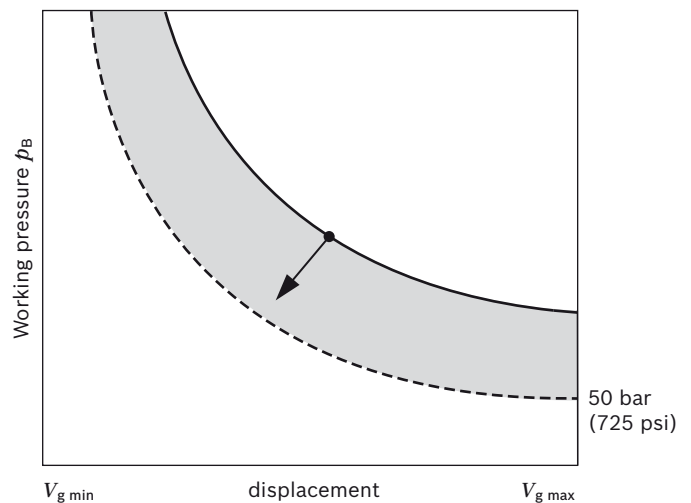
▼ Circuit diagram PR



▼ Characteristic curve PR



▼ Effect of power override of a pump with increasing pressure in the 2nd Pump



Stroke control

E1/E2 – Stroke control, electric, proportional (positive control)

With the electrical stroke control with proportional solenoid, the pump displacement is steplessly adjusted in proportion to the current via the magnetic force.

Basic position without pilot signal is $V_{g \min}$. Mechanically depressurized basic position is $V_{g \min}$ (see type code position 08, letter C).

With increasing control current the pump swivels to a higher displacement (from $V_{g \min}$ to $V_{g \max}$).

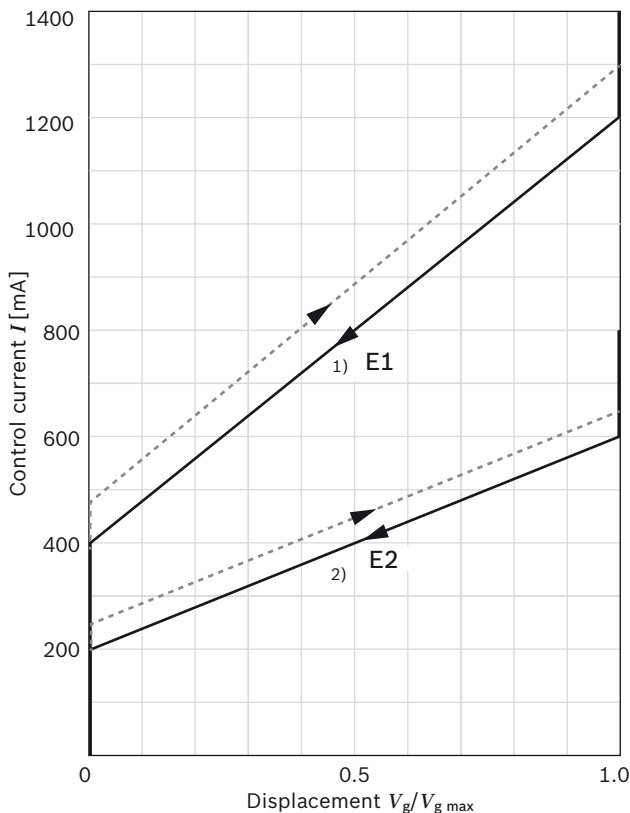
The necessary control fluid is taken from the working pressure or the external control pressure applied to port **P**.

If the pump is to be adjusted from the basic position $V_{g \min}$ or from a low working pressure, port **P** must be supplied with an external control pressure of at least 30 bar (435 psi), maximum 50 bar (725 psi).

Notice

If there is no external control pressure applied to **P**, the version “Maximum swivel angle ($V_{g \max}$), without external control pressure supply” must be ordered (see type code position 08, A).

▼ Characteristic curve E1/E2



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

- RC series 30, data sheet 95204
- RC series 30, data sheet 95205
- RC series 31, data sheet 95206

Further information can also be found on the Internet at www.boschrexroth.com/mobile-electronics.

Technical data, solenoid	E1	E2
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at $V_{g \min}$	400 mA	200 mA
End of control at $V_{g \max}$	1200 mA ¹⁾	600 mA ²⁾
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C (68 °F))	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 68		

When ordering, state in plain text:

- Drive speed n [rpm]
- Maximum flow $q_{V \max}$ [l/min (gpm)]
- Minimum flow $q_{V \min}$ [l/min (gpm)]

See circuit diagram on page 20

Notice!

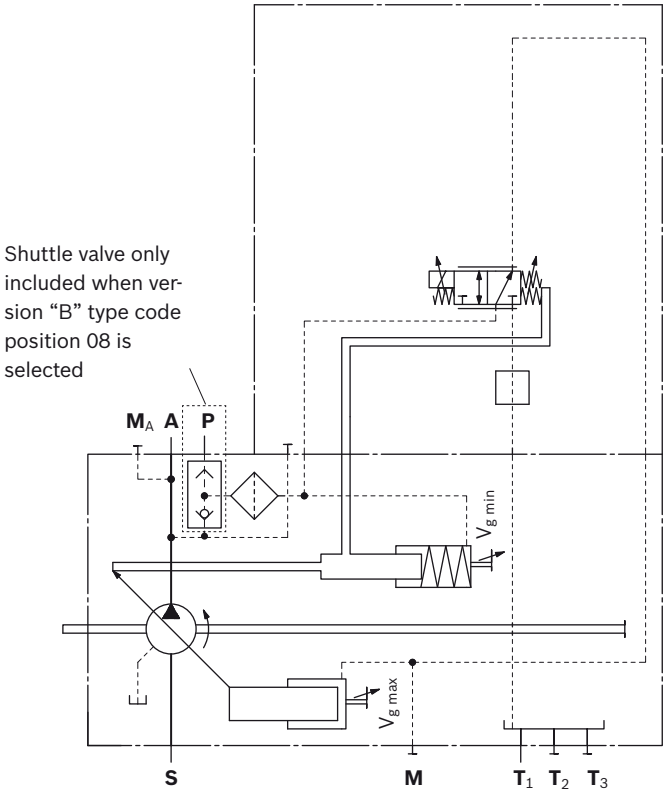
The spring feedback in the controller is not a safety device.

The controller can stick in an undefined position due to internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the flow of the axial piston unit will no longer respond correctly to the operator's commands. Check whether the application on your machine requires additional safety measures, in order to bring the driven consumer into a safe position (immediate stop). If necessary, make sure that these are properly implemented.

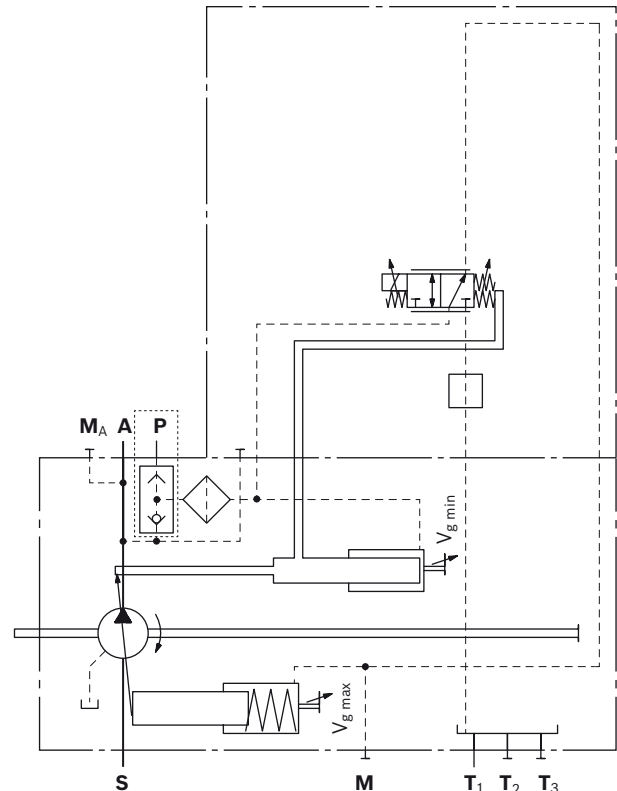
1) Because of the control hysteresis, a control current of up to 1300 mA may be required for the $V_{g \max}$ position.

2) Because of the control hysteresis, a control current of up to 650 mA may be required for the $V_{g \max}$ position.

▼ **Circuit diagram E1/E2**
basic setting A/B, depressurized at maximum swivel angle ($V_{g\ max}$)



▼ **Circuit diagram E1/E2**
basic setting C, depressurized at minimum swivel angle ($V_{g\ min}$)



H3 – Stroke control, hydraulic-proportional, pilot pressure (negative control)

With pilot-pressure-related control, the pump displacement is adjusted in proportion to the pilot pressure applied at port **H3**.

Basic position without pilot signal is $V_{g \max}$. Mechanically depressurized basic position is $V_{g \max}$ (see type code position 08, letter B).

- ▶ Adjustment from $V_{g \max}$ to $V_{g \min}$; with increasing pilot pressure, the pump swivels to a smaller displacement.
- ▶ Setting range for beginning of control (at $V_{g \max}$) 5 bar (75 psi) to 10 bar (145 psi), standard is 10 bar (145 psi). State beginning of control in plain text in the order.
- ▶ Maximum permissible pilot pressure $p_{St \max} = 100$ bar (1450 psi)

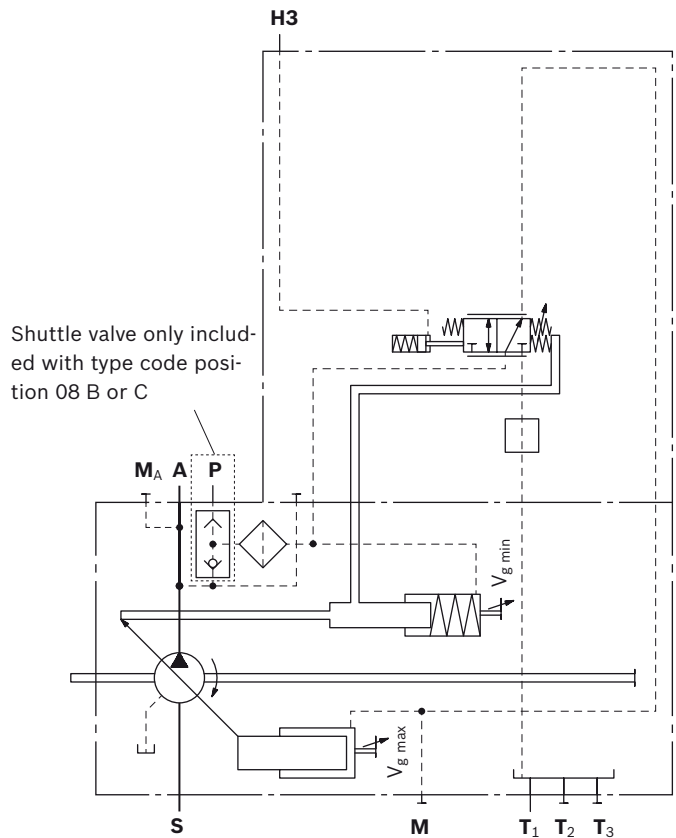
The necessary control fluid is taken from the working pressure or the external control pressure applied to port **P**.

If the pump is to be adjusted from the basic position $V_{g \min}$ or from a low working pressure, port **P** must be supplied with an external control pressure of at least 30 bar (435 psi), maximum 50 bar (725 psi).

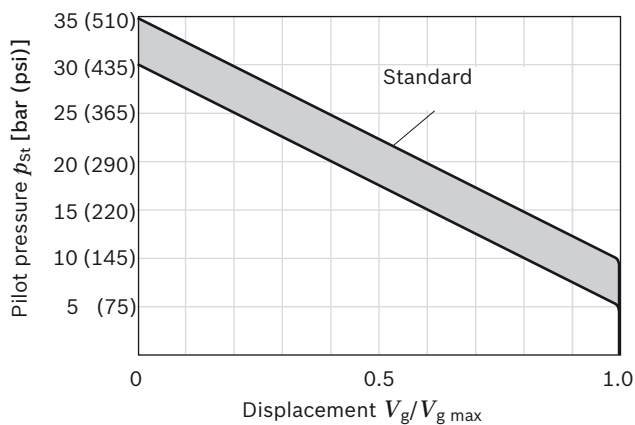
Notice

If there is no external control pressure applied to **P**, the version "Maximum swivel angle ($V_{g \max}$), without external control pressure supply" must be ordered (see type code position 08, letter A).

▼ Circuit diagram H3



▼ Characteristic curve H3 (negative)



Increase in pilot pressure $V_{g \max}$ to $V_{g \min}$: $\Delta p = 25$ bar (365 psi)

When ordering, state in plain text:

- ▶ Beginning of control [bar (psi)] at $V_{g \max}$

H4 – Stroke control, hydraulic-proportional, pilot pressure (positive control)

With pilot-pressure-related control, the pump displacement is adjusted in proportion to the pilot pressure applied at port **H4**.

Basic position without pilot signal is $V_{g \min}$. Mechanically depressurized basic position is $V_{g \min}$ (see type code position 08, letter C).

- Adjustment from $V_{g \min}$ to $V_{g \max}$; with increasing pilot pressure the pump swivels to a larger displacement.
- Setting range for beginning of control (at $V_{g \min}$) 5 bar (75 psi) to 10 bar (145 psi), standard is 10 bar (145 psi). State beginning of control in plain text in the order.
- Maximum permissible pilot pressure $p_{St \max} = 100$ bar (1450 psi)

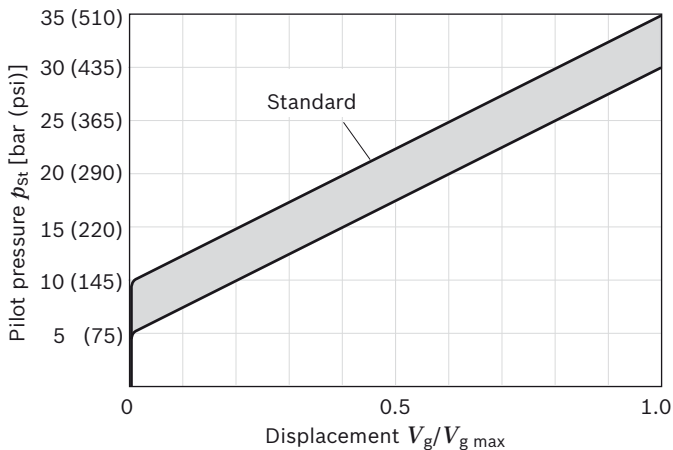
The necessary control fluid is taken from the working pressure or the external control pressure applied to port **P**.

If the pump is to be adjusted from the basic position $V_{g \min}$ or from a low working pressure, port **P** must be supplied with an external control pressure of at least 30 bar (435 psi), maximum 50 bar (725 psi).

Notice

If there is no external control pressure applied to **P**, the version “Maximum swivel angle ($V_{g \max}$), without external control pressure supply” must be ordered (see type code position 08, letter A).

▼ Characteristic curve H4 (positive)

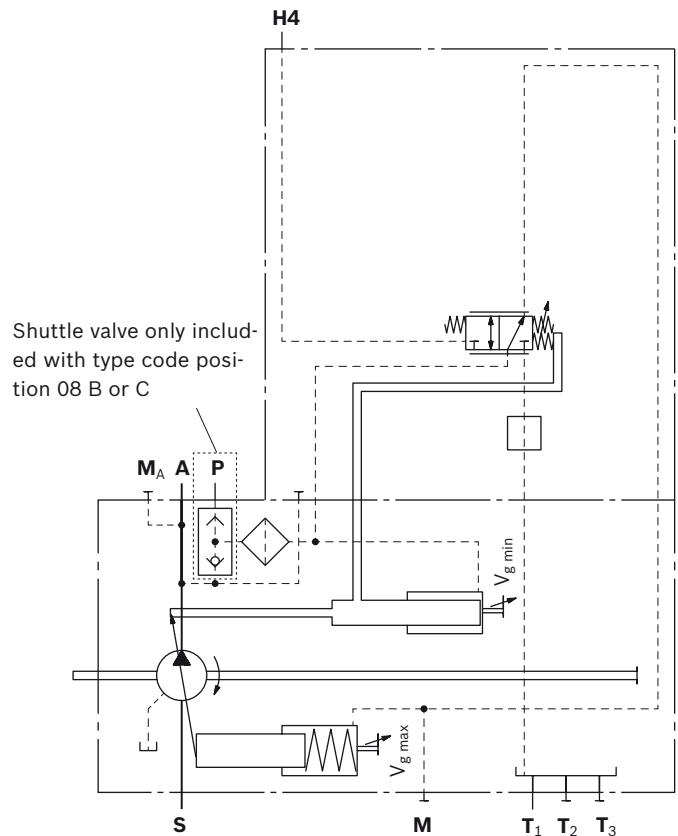


Increase in pilot pressure $V_{g \min}$ to $V_{g \max}$: $\Delta p = 25$ bar (365 psi)

When ordering, state in plain text:

- Beginning of control [bar (psi)] at $V_{g \min}$

▼ Circuit diagram H4



Notice!

The spring feedback in the controller is not a safety device.

The controller can stick in an undefined position due to internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the flow of the axial piston unit will no longer respond correctly to the operator's commands. Check whether the application on your machine requires additional safety measures, in order to bring the driven consumer into a safe position (immediate stop). If necessary, make sure that these are properly implemented.

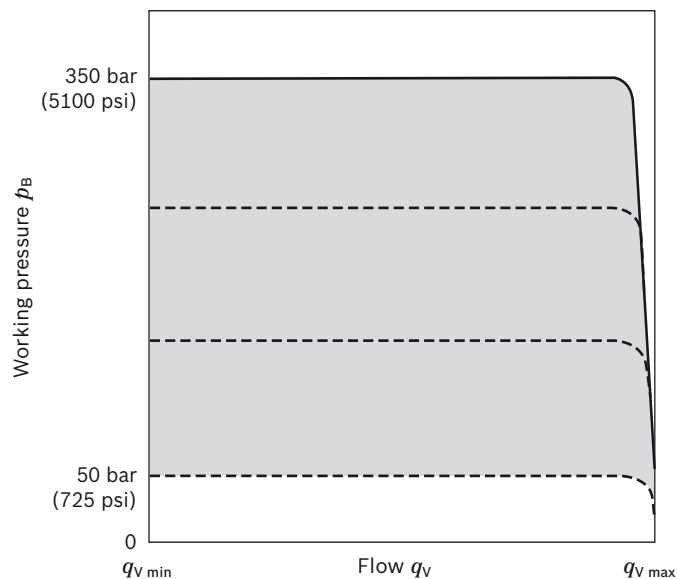
Pressure controller

DR – Pressure controller with one-sided swiveling, fixed setting

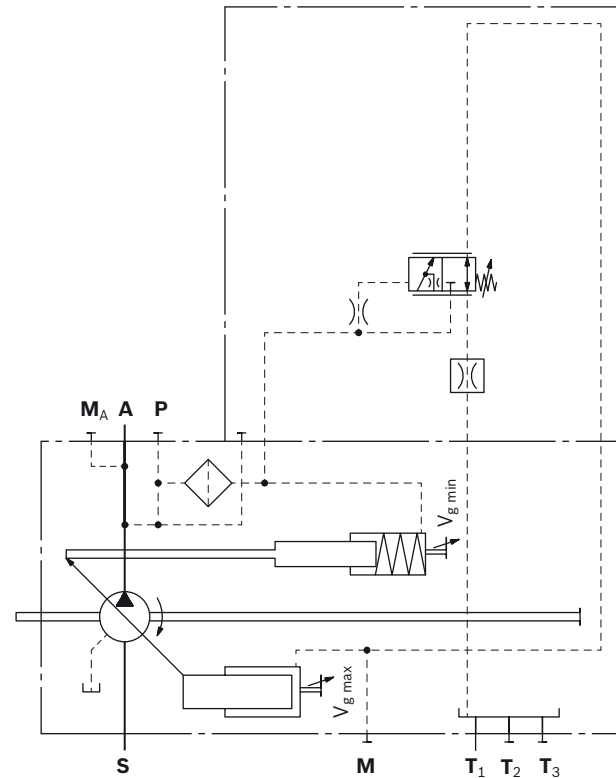
The pressure controller limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the working pressure exceeds the pressure command value at the pressure valve, the pump will regulate to a smaller displacement to reduce the control differential.

- ▶ Initial position in depressurized state: $V_{g \max}$
- ▶ Setting range for beginning of pressure control 50 bar (725 psi) to 350 bar (5100 psi), 350 bar (5100 psi) is standard.

▼ **Characteristic curve DR**



▼ **Circuit diagram DR**



DRS0 – Pressure controller with load sensing

The load sensing controller works as a load-pressure controlled flow controller and adjusts the displacement of the pump to the volume required by the consumer. The flow of the pump is then dependent on the cross section of the external metering orifice (1), which is located between the pump and the consumer. Below the setting of the pressure controller and within the control range of the pump, the flow is not dependent on the load pressure. The metering orifice is usually a separately located load-sensing directional valve (control block). The position of the directional valve spool determines the opening cross-section of the metering orifice and thus the flow of the pump.

The load sensing controller compares pressure before and after the metering orifice and keeps the pressure drop (differential pressure Δp) across the orifice – and therefore the flow – constant.

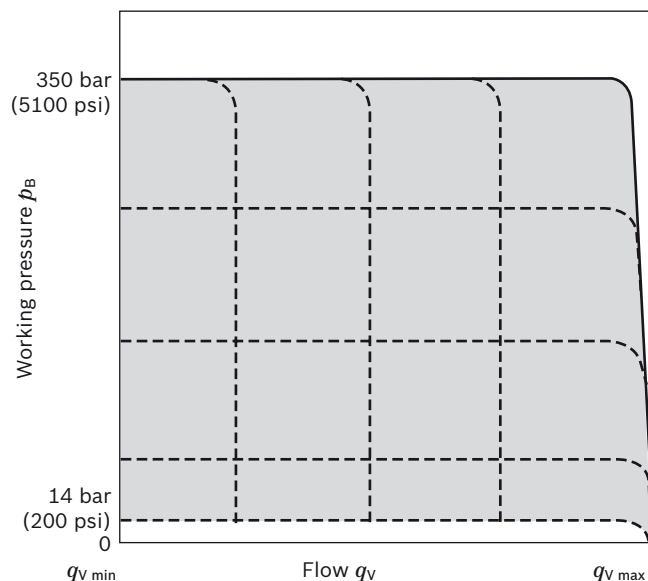
If the differential pressure Δp at the metering orifice rises, the pump is swiveled back (toward $V_{g \min}$). If the differential pressure Δp drops, the pump is swiveled out (toward $V_{g \max}$) until equilibrium at the metering orifice is restored.

$$\Delta p_{\text{metering orifice}} = p_{\text{pump}} - p_{\text{consumer}}$$

- Setting range for Δp 14 bar (200 psi) to 30 bar (435 psi) (please state in plain text)
- Standard adjustment 14 bar (200 psi)

The stand-by pressure in zero-stroke operation (metering orifice closed) is slightly higher than the Δp setting.

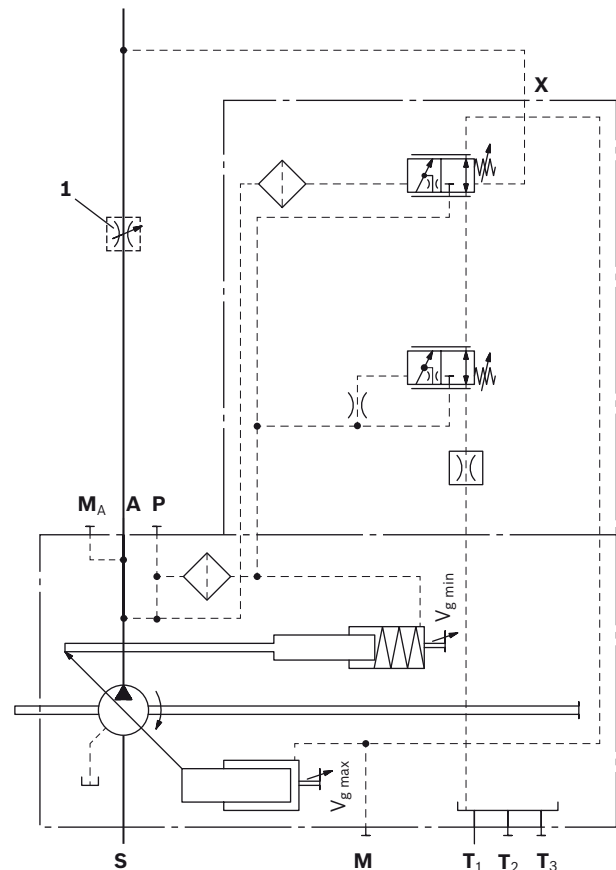
▼ Characteristic curve DRS0



When ordering, state in plain text:

- Pressure setting p [bar (psi)] at pressure controller DR
- Differential pressure Δp [bar (psi)] at load sensing controller S0

▼ Circuit diagram DRS0



- 1 The metering orifice (control block) is not included in the scope of delivery.

DG – Pressure controller with one-sided deflection, hydraulically remote controlled (positive control)

The remote controlled pressure controller has a fixed-setting Δp value. A separately connected pressure relief valve at port **X** (1) enables the pressure controller to be remotely controlled.

- ▶ Setting range Δp 14 bar (200 psi) to 25 bar (365 psi)
- ▶ Recommended value 20 bar (290 psi) (standard)
- ▶ Control volume at **X**: about 1.6 l/min (0.42 gpm) (static) at Δp 20 bar (290 psi)

In addition a separately configured 2/2 directional valve (2) can be operated to start the pump with low working pressure (standby pressure).

Both functions can be used individually or in combination (see circuit diagram).

The external valves are not included in the scope of delivery.

As a separate pressure relief valve (1) we recommend:

- ▶ For DBD.6, see data sheet 25402
- ▶ Working pressure p in bar (psi) (test pressure for DG)
- ▶ Differential pressure Δp in bar (psi)
- ▶ Drive speed n in rpm
- ▶ Maximum flow q_{Vmax} in l/min (gpm)

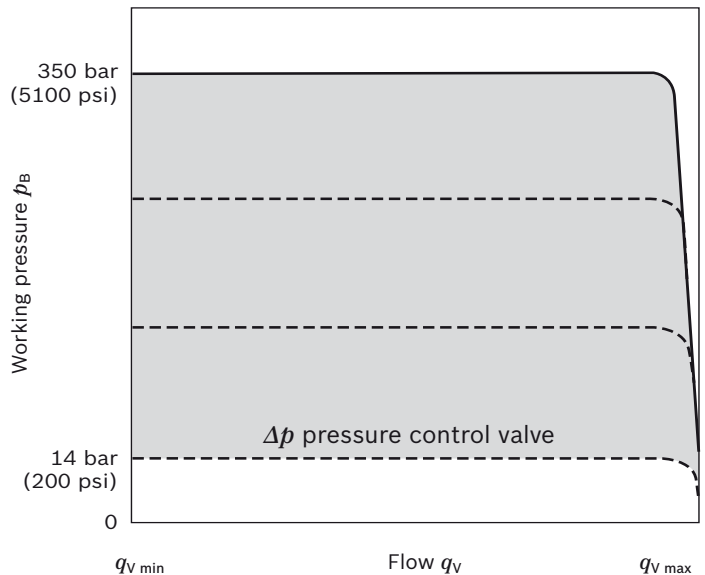
Note for setting remote-controlled pressure control

The setting value for the external pressure relief valve plus the differential pressure value at the pressure control valve determines the level of pressure control.

Example:

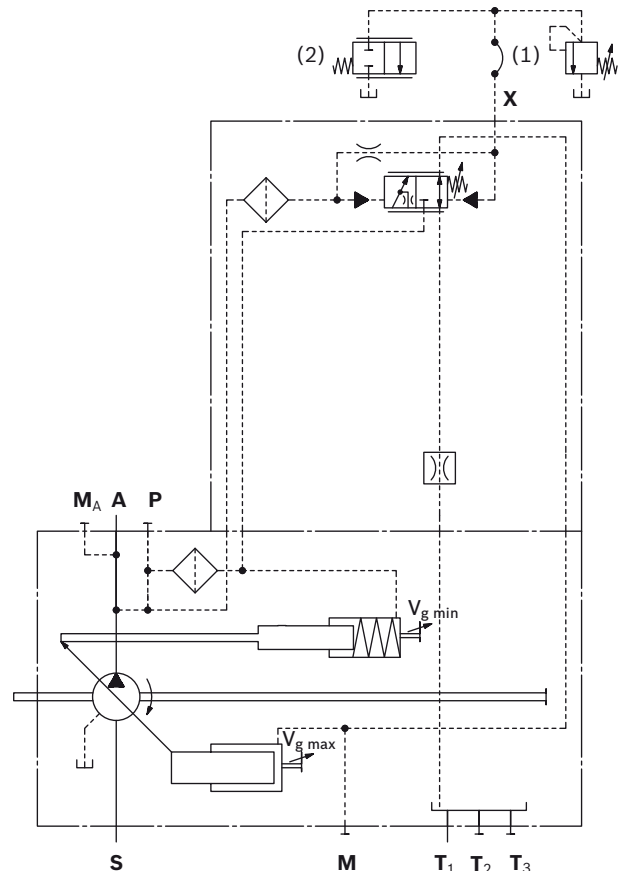
- ▶ external pressure relief valve 330 bar (4800 psi)
- ▶ Differential pressure at pressure control valve 20 bar (290 psi)
- ▶ resulting pressure control with 330 + 20 = 350 bar (4810 + 290 = 5100 psi)

▼ Characteristic curve DG



For function and description of pressure controller DR, see page 23

▼ Circuit diagram DG



- 1 Pressure-relief valve (not included in the scope of delivery)
- 2 2/2 directional valve (not included in the scope of delivery)

D2 – Proportional pressure controller with one-side swiveling, electric override (positive control)

The pressure controller keeps the pressure in a hydraulic system constant within its control range even under varying flow conditions. The variable pump only supplies as much hydraulic fluid as is required by the consumers.

If the working pressure exceeds the setting at the integrated pressure control valve, the pump is automatically swiveled back to reduce the control differential.

- ▶ Initial position in depressurized state: $V_{g \max}$
- ▶ Pressure controller basic setting: 32 bar (470 psi)/300 mA

The basic setting of the pressure controller can be overridden. The pressure controller value is proportional to the electrical current acting on the solenoids of the pressure reducing valve.

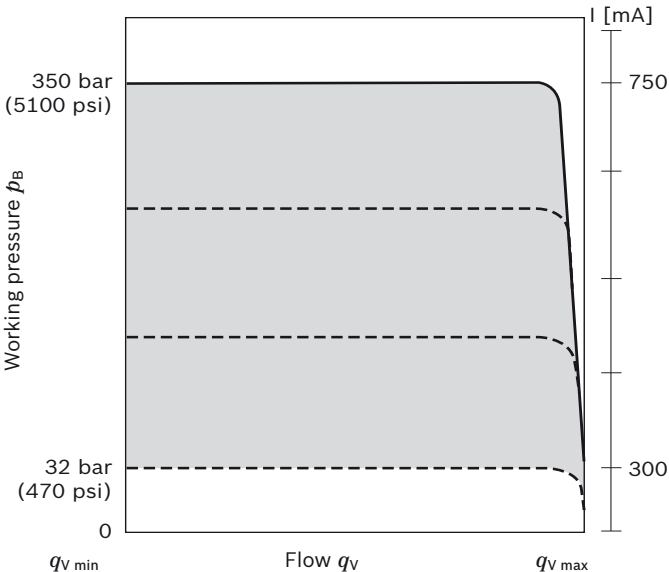
- ▶ Pressure setting overridden:
32 bar (470 psi)/300 mA to 350 bar (5100 psi)/750 mA
- ▶ Auxiliary pressure for controlling D2 at port **Y**:
 $p_{\min} = 40 \text{ bar (580 psi)}$; $p_{\max} = 50 \text{ bar (725 psi)}$.
Port **X** acts solely as a measuring port ($p_{\max} 50 \text{ bar (725 psi)}$). Pressurization leads to an impermissible increase in pressure.

Notice

Applying current above the limit of 750 mA to the proportional solenoid results in an impermissible increase in pressure.

Make sure that currents above the permissible limit are not applied to the proportional solenoid.

▼ **Characteristic curve D2**

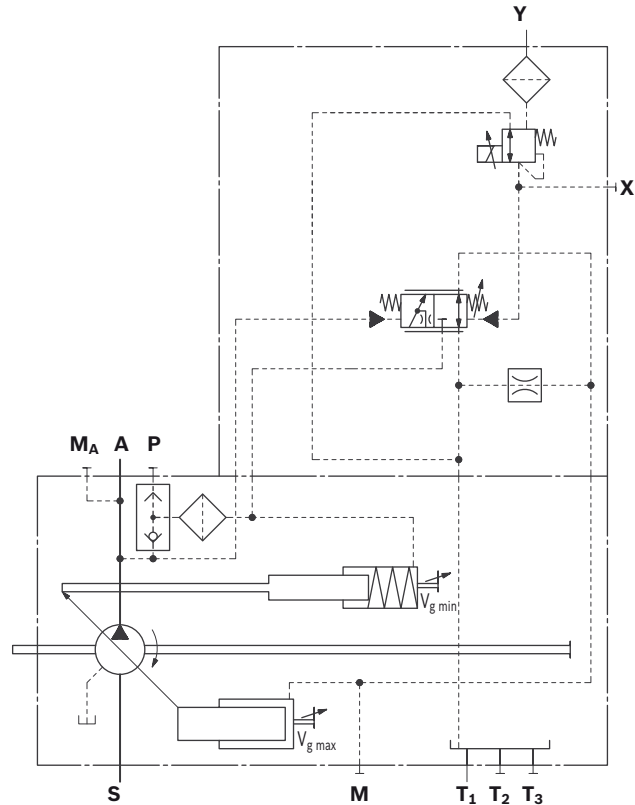


Technical data, solenoid	D2
Voltage	24 V
Control current	
Start of control at $V_{g \min}$	300 mA
End of control at $V_{g \max}$	750 mA
Current limit	750 mA
Nominal resistance (at 20 °C (68 °F))	12 Ω
Dither frequency	200 Hz
Duty cycle	100%
Type of protection: see connector version page 68	

The following electronic control units and amplifiers are available for controlling the proportional solenoids:

BODAS RC controllers Series	Data sheet
30	95204
30	95205
31	95206
and application software	
Analog amplifier RA	95230

▼ **Circuit diagram D2**



DGT6 – With integrated pilot control valve, electric-proportional override (positive control)

The remote controlled pressure controller has a fixed-setting Δp value. An electric pressure relief valve (pilot valve) integrated in the control valve enables remote pressure control.

- Fixed value at Δp 14 bar (200 psi).

When ordering, state in plain text:

- Maximum pressure p_{\max} [bar (psi)] (pressure on port **A**) with 1200 mA current.

Pilot valve T6

The electric-proportional pressure relief valve is directly controlled with a positive control as cartridge version (see data sheet 18139-08).

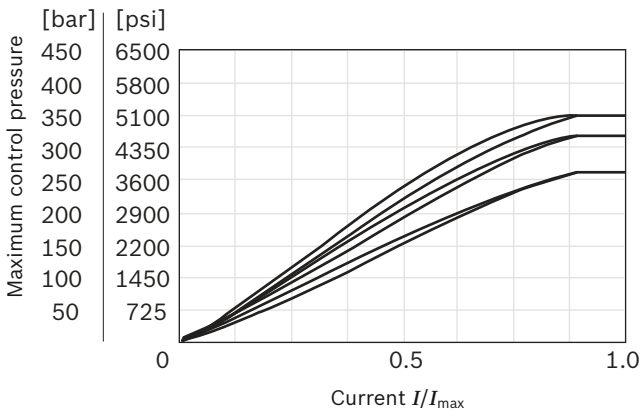
The following pressure settings are available: 250, 315 and 350 bar (3600, 4550 and 5100 psi) plus 14 bar (200 psi) Δp .

- Standard is 350 bar (5100 psi).

When ordering, the correct pressure value is selected by Rexroth.

Notes and explanations for the pressure controller can be found on page 25.

▼ Characteristic curve T6

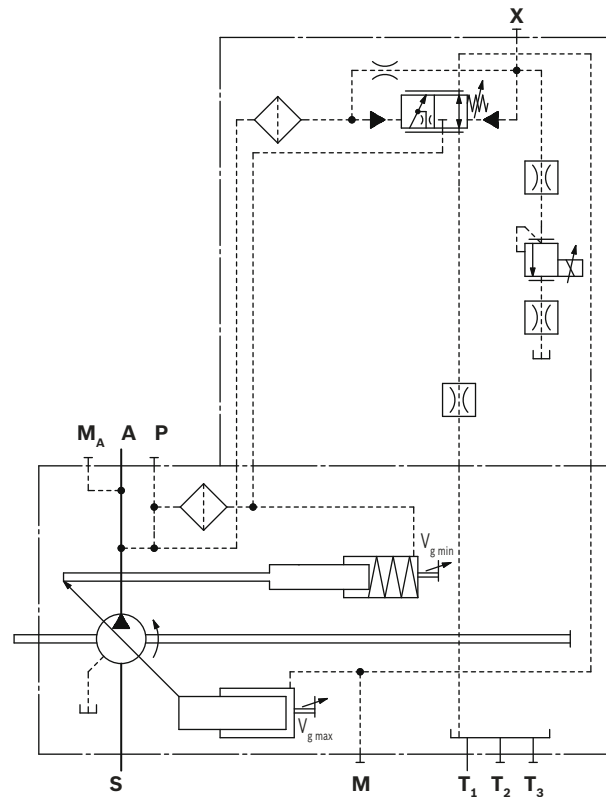


Technical data, solenoid	T6
Voltage	24 V
Control current	
Minimum pressure p_{\min}	0 mA
Maximum pressure p_{\max}	1200 mA
Maximum rated current	1200 mA
Nominal resistance (at 20 °C (68 °F))	4.8 Ω
Dither frequency	200 Hz
Duty cycle	100%
Type of protection: see connector version page 68	

The following electronic control units and amplifiers are available for controlling the proportional solenoids:

BODAS RC controllers Series	Data sheet
30	95204
30	95205
31	95206
and application software	
Analog amplifier RA	95230

▼ Circuit diagram DGT6



DGT8 – With integrated pilot control valve, electric-proportional override (negative control)

The remote controlled pressure controller has a fixed-setting Δp value. An electric pressure relief valve (pilot valve) integrated in the control valve enables remote pressure control.

- Fixed value at Δp 14 bar (200psi).

When ordering, state in plain text:

- Maximum pressure p_{\max} [bar (psi)] (pressure on port **A**) with 0 mA current.

Pilot valve T8

The electric-proportional pressure relief valve is directly controlled with a negative control as cartridge version (see data sheet 18139-07).

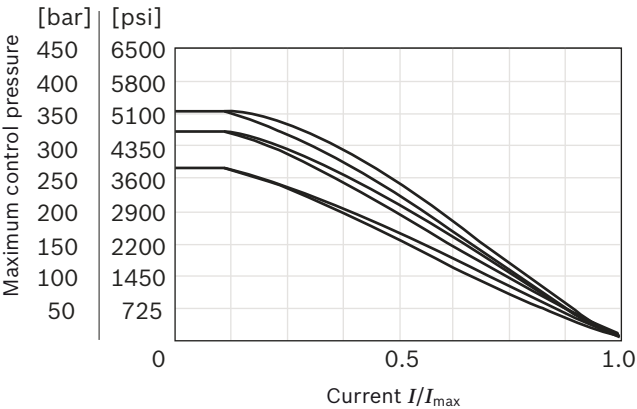
The following pressure settings are available: 250, 315 and 350 bar (3600, 4550 and 5100 psi) plus 14 bar (200 psi) Δp .

- Standard is 350 bar (5100psi).

When ordering, the correct pressure value is selected by Rexroth.

Notes and explanations for the pressure controller can be found on page 25.

▼ **Characteristic curve T8**

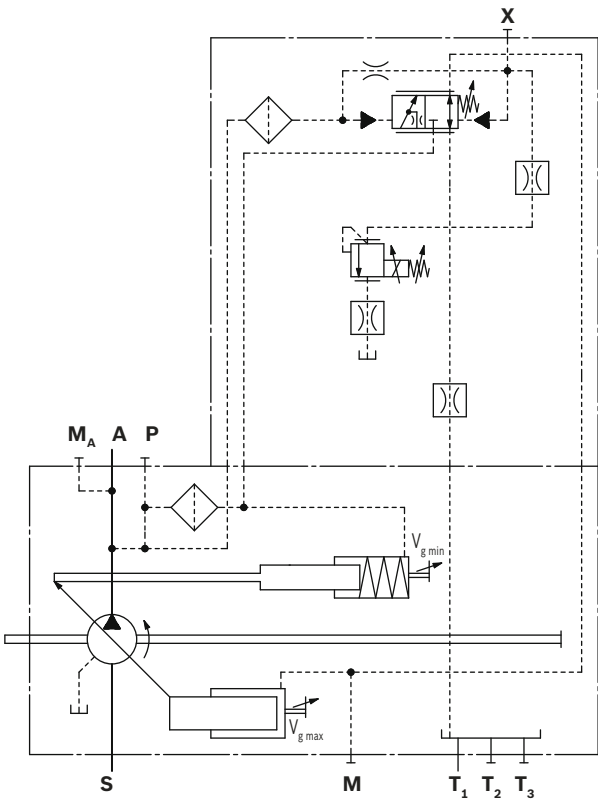


Technical data, solenoid	T8
Voltage	24 V
Control current	
Maximum pressure p_{\max}	0 mA
Minimum pressure p_{\min}	1200 mA
Maximum rated current	1200 mA
Nominal resistance (at 20 °C (68 °F))	4.8 Ω
Dither frequency	200 Hz
Duty cycle	100%
Type of protection: see connector version page 68	

The following electronic control units and amplifiers are available for controlling the proportional solenoids:

BODAS RC controllers Series	Data sheet
30	95204
30	95205
31	95206
and application software	
Analog amplifier RA	95230

▼ **Circuit diagram DGT8**



S3/S4 – Load-sensing controller, electric-proportional override (negative control)

A control current acts against the adjustment spring of the load-sensing controller via a proportional solenoid.

The mechanically adjusted differential pressure can be reduced by means of different control current settings.

Increasing control current = reduced differential pressure.

- Reduced differential pressure/control current =
At **S3** 3.1 bar (45 psi)/ 200 mA
At **S4** 3.1 bar (45 psi)/ 100 mA

Technical data, solenoid	S3	S4
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Beginning of control	400 mA	200 mA
End of control	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C (68 °F))	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 68		

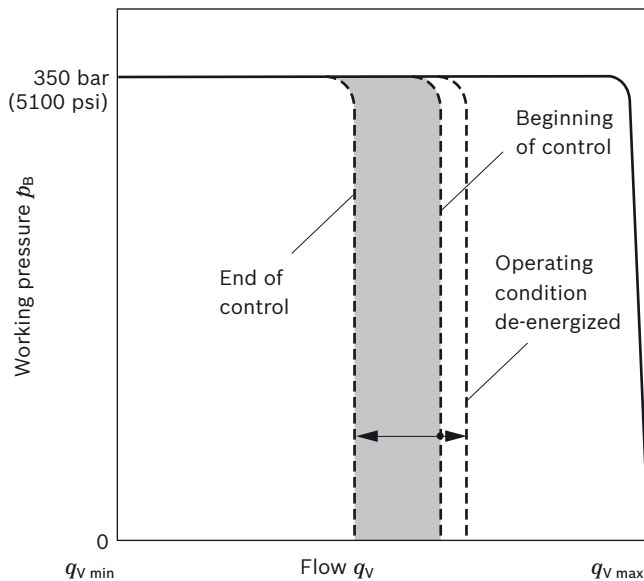
When ordering, state in plain text:

- Differential pressure setting Δp [bar] with control current 200 mA.

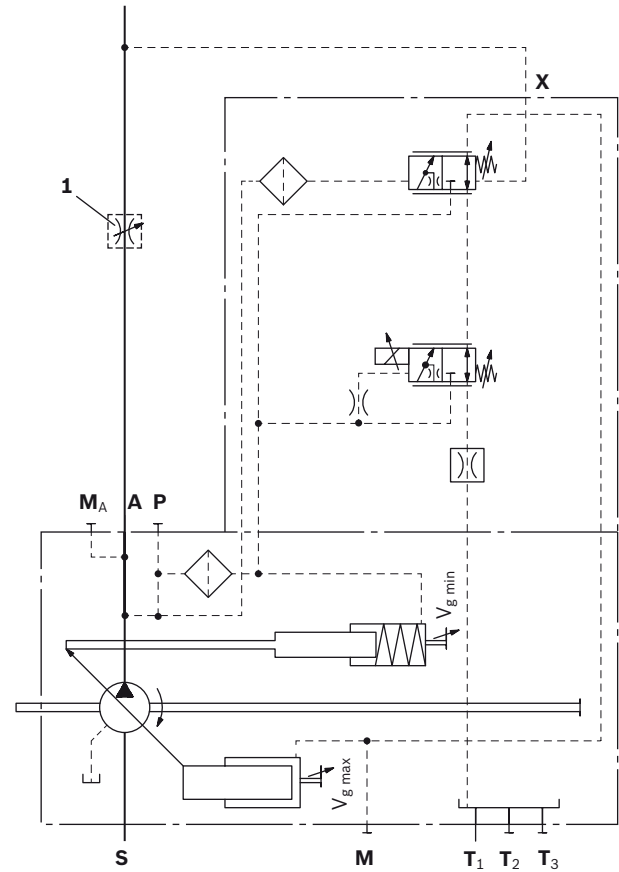
$$\Delta p_{\text{metering orifice}} = p_{\text{pump}} - p_{\text{consumer}}$$

- Setting range for Δp 20 bar (290 psi) to 30 bar (435 psi) at 200 mA
- Standard adjustment 20 bar (290 psi) at 200 mA

▼ Characteristic curve DRS4



Circuit diagram DRS4



- 1 The metering orifice (control block) is not included in the scope of delivery.

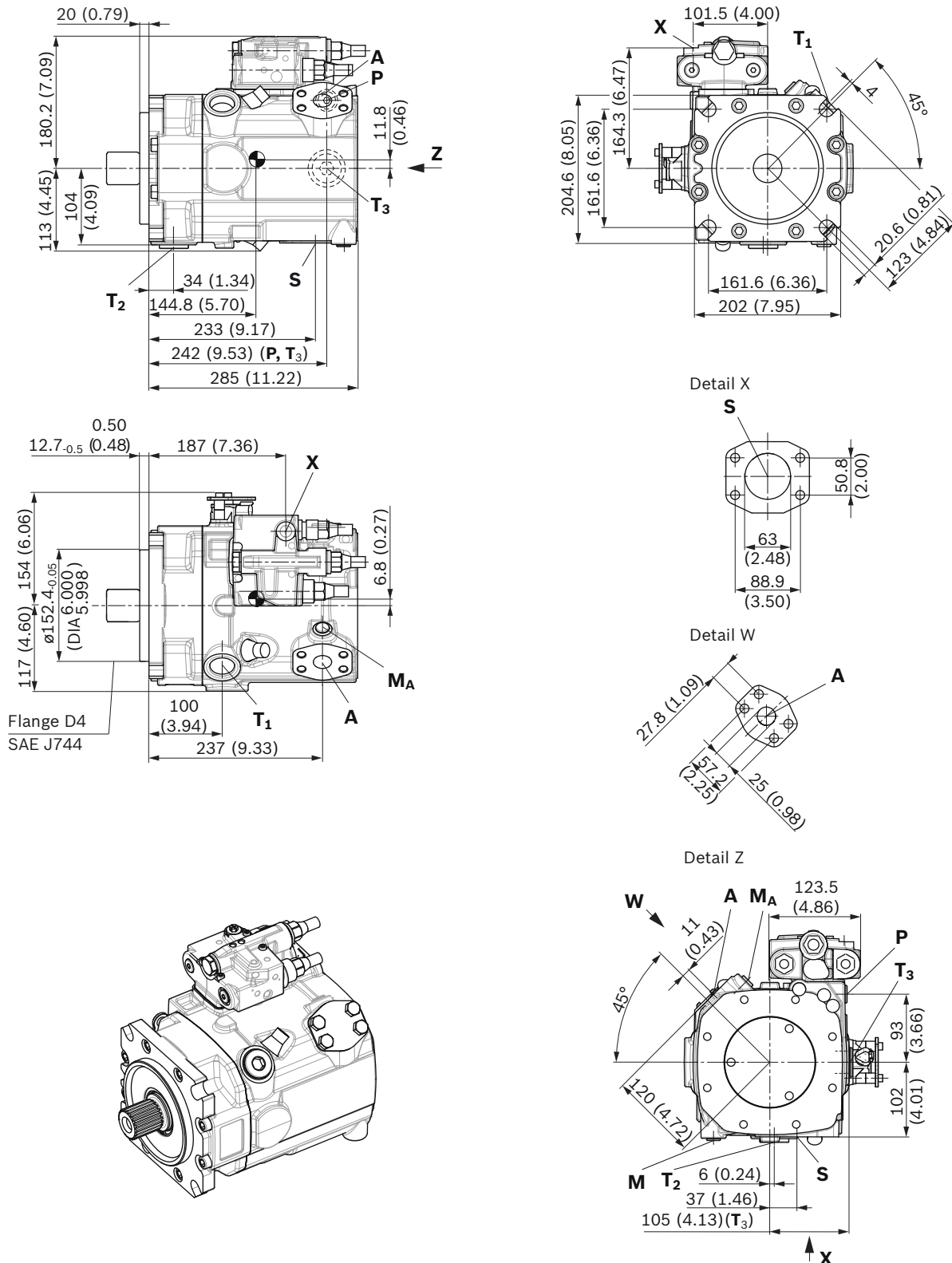
Notice

- In operating condition **S3** de-energized (jump 400 to 0 mA): Increased differential pressure by 3.2 bar (45 psi).
- In operating condition **S4** de-energized (jump 200 to 0 mA): Increased differential pressure by 3.2 bar (45 psi).

Dimensions, size 110

LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

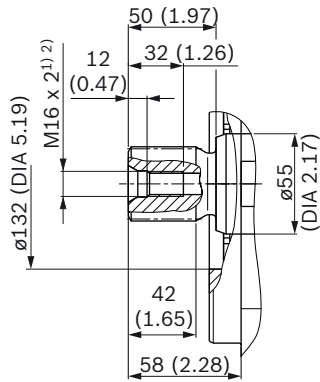
Without charge pump, clockwise rotation



Center of gravity

▼ **Splined shaft DIN 5480**

A1 - W45x2x21x9g

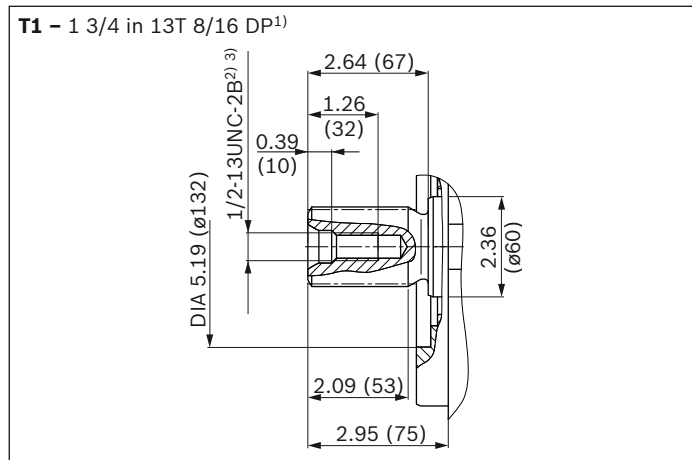


Ports – version “M” metric		Standard	Size ²⁾	$p_{\max \text{ abs}}$ [bar (psi)] ³⁾	State ⁷⁾
A	Working port	SAE J518 ⁴⁾	1 in	420 (6100)	O
	Fastening thread	DIN 13	M12 × 1.75; 18 deep		
S	Suction port	SAE J518 ⁴⁾	2 1/2 in	30 (435)	O
	fastening thread	DIN 13	M12 × 1.75; 18 deep		
T₁	Drain port	ISO 6149 ⁵⁾	M33 × 2; 19 deep	10 (145)	O ⁶⁾
T₂	Drain port	ISO 6149 ⁵⁾	M33 × 2; 19 deep	10 (145)	X ⁶⁾
T₃	Drain port	ISO 6149 ⁵⁾	M33 × 2; 19 deep	10 (145)	X ⁶⁾
CR	Pilot signal (CR only)	ISO 6149	M14 × 1.5; 11.5 deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 6149	M14 × 1.5; 11.5 deep	420 (6100)	O
H3, H4	Pilot signal (H3 and H4 only)	ISO 6149	M14 × 1.5; 11.5 deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	ISO 6149	M14 × 1.5; 11.5 deep	100 (1450)	O
X	Pilot signal (S0, S3/S4 and DG only)	ISO 6149 ⁵⁾	M14 × 1.5; 11.5 deep	420 (6100)	O
M	Measuring control pressure	ISO 6149 ⁵⁾	M14 × 1.5; 12 deep	420 (6100)	X
M_A	Measuring, pressure A	ISO 6149 ⁵⁾	M14 × 1.5; 12 deep	420 (6100)	X
P	External control pressure (Type code position 8 version B or C = with external control pressure supply)	ISO 6149 ⁵⁾	M14 × 1.5; 11.5 deep	50 (725)	O
	Port P is without function (Type code position 8 version A = without external control pressure supply)	ISO 6149 ⁵⁾	M18 × 1.5; 14.5 deep	420 (6100)	X

- 1) Center bore according to DIN 332 (thread according to DIN 13)
- 2) Observe the instructions in the instruction manual concerning the maximum tightening torques.
- 3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
- 4) Metric fastening thread is a deviation from standard.

- 5) The countersink can be deeper than as specified in the standard.
- 6) Depending on installation position, T₁, T₂ or T₃ must be connected (see also Installation instructions on pages 69 and 70).
- 7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

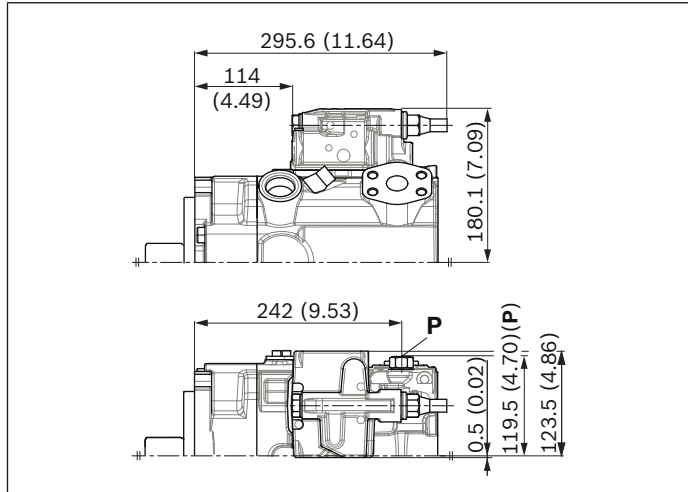
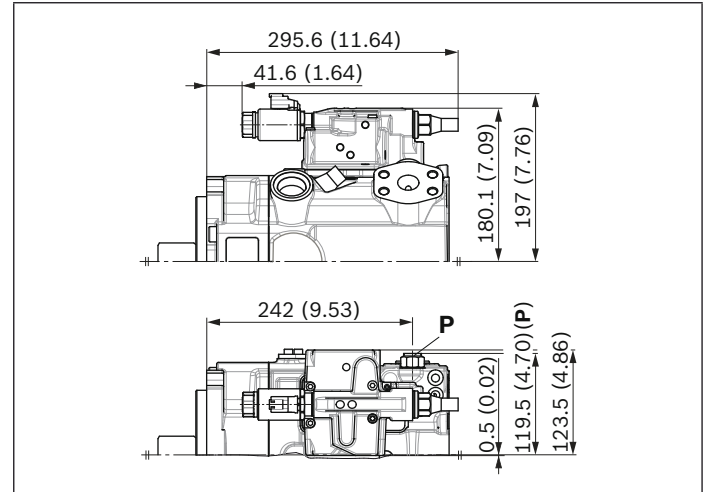
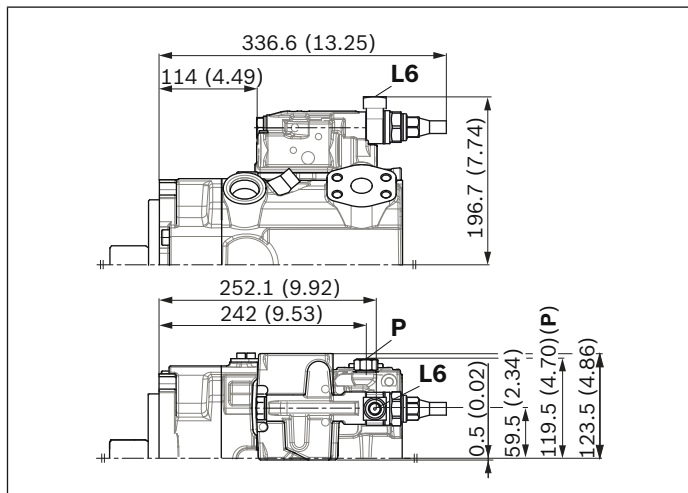
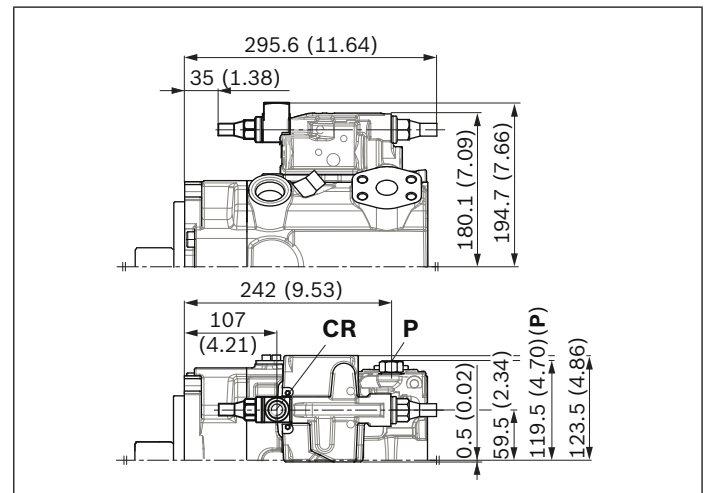
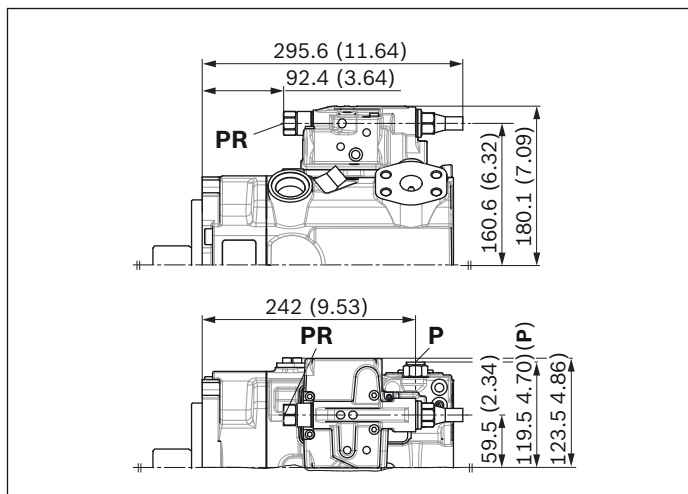
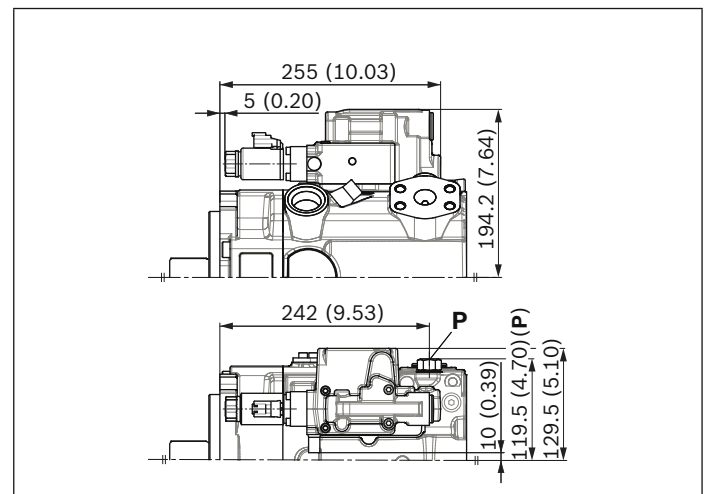
▼ Splined shaft SAE J744



Ports – version “A” SAE		Standard	Size ³⁾	$p_{\max \text{ abs}}$ [bar (psi)] ⁴⁾	State ⁷⁾
A	Working port Fastening thread	SAE J518 ASME B1.1	1 in 7/16-14UNC-2B; 19 (0.75) deep	420 (6100)	O
S	Suction port Fastening thread	SAE J518 ASME B1.1	2 1/2 in 1/2-13UNC-2B; 19 (0.75) deep	30 (435)	O
T₁	Drain port	ISO 11926 ⁵⁾	1 5/16UNF-2B; 20 (0.79) deep	10 (145)	O ⁶⁾
T₂	Drain port	ISO 11926 ⁵⁾	1 5/16UNF-2B; 20 (0.79) deep	10 (145)	X ⁶⁾
T₃	Drain port	ISO 11926 ⁵⁾	1 5/16UNF-2B; 20 (0.79) deep	10 (145)	X ⁶⁾
CR	Pilot signal (CR only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
H3, H4	Pilot signal (H3 and H4 only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	100 (1450)	O
X	Pilot signal (S0, S3/S4 and DG only)	ISO 11926 ⁵⁾	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
M	Measuring control pressure	ISO 11926 ⁵⁾	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	X
M_A	Measuring, pressure A	ISO 11926 ⁵⁾	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	X
P	External control pressure (Type code position 8 version B or C = with external control pressure supply)	ISO 11926 ⁵⁾	9/16-18 UNF-2B; 13 (0.51) deep	50 (725)	O
	Port P is without function (Type code position 8 version A = with- out external control pressure supply)	ISO 11926 ⁵⁾	3/4-16 UNF-2B; 12.6 (0.50) deep	420 (6100)	X

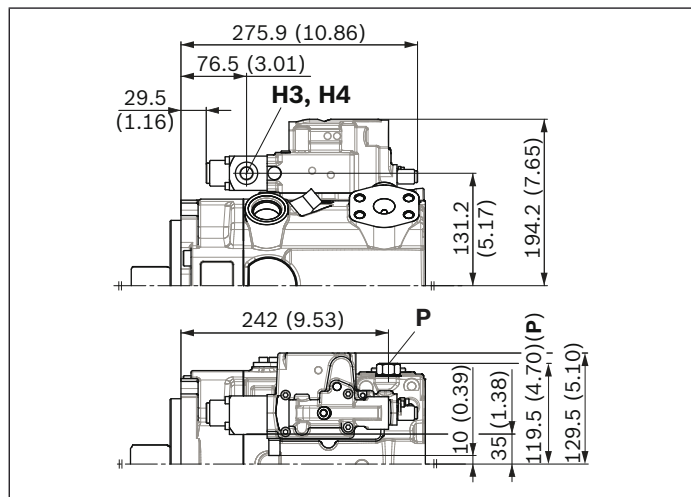
- 1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Center bore according to ASME B1.1
- 3) Observe the instructions in the instruction manual concerning the maximum tightening torques.
- 4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

- 5) The countersink can be deeper than as specified in the standard.
- 6) Depending on installation position, T₁, T₂ or T₃ must be connected (see also Installation instructions on pages 69 and 70).
- 7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

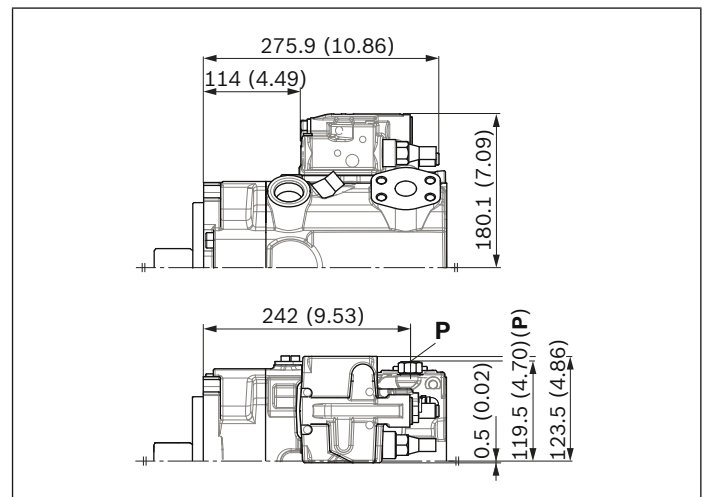
▼ **LR** – Power controller, fixed setting

▼ **L3/L4** – Power controller, electric-proportional override

▼ **L5/L6** – Power controller, hydraulic-proportional override

▼ **CR** – Power controller, hydraulic-proportional override, high pressure, with stop

▼ **PR** – Power controller, hydraulic-proportional override, high pressure, without stop

▼ **E1/E2** – Stroke control electric-proportional

Notice

All controllers described with shuttle valve in **P**
(some contrary to standard as per type code position 08)

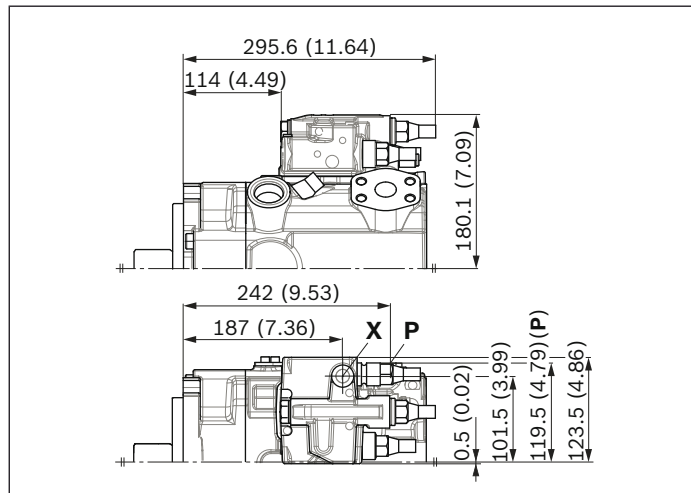
▼ **H3/H4** – Stroke control, hydraulic-proportional, pilot pressure



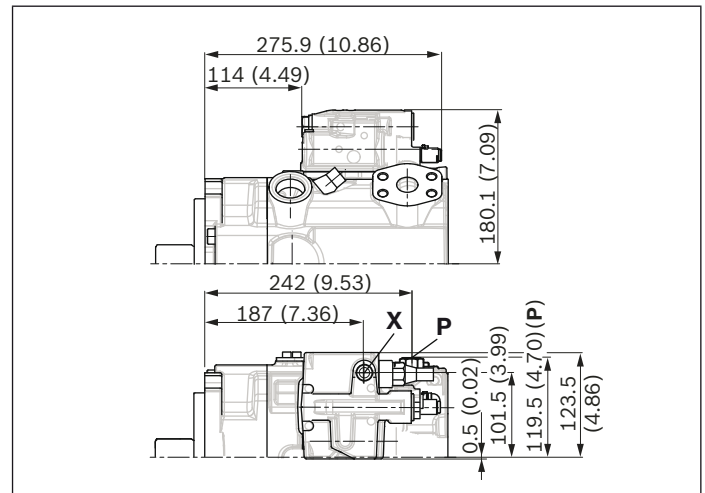
▼ **DR** – Pressure controller, fixed setting



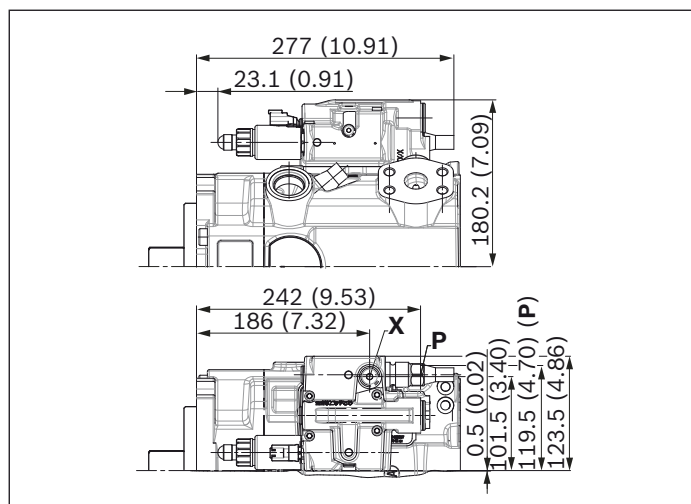
▼ **LRDRS0** – Power controller with pressure controller and load sensing, fixed setting



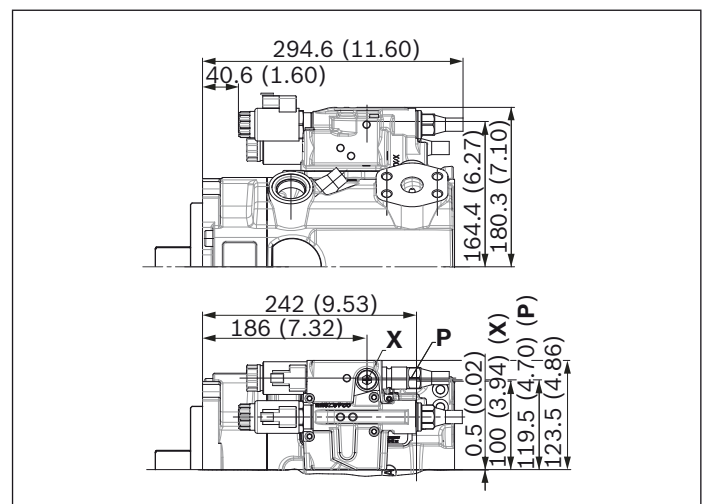
▼ **DG** – Pressure controller, hydraulic, remote controlled



▼ **DGT6/DGT8** – With integrated pilot control valve, electric-proportional override



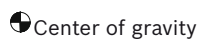
▼ **S3/S4** – Load-sensing, internal pressure, electric-proportional



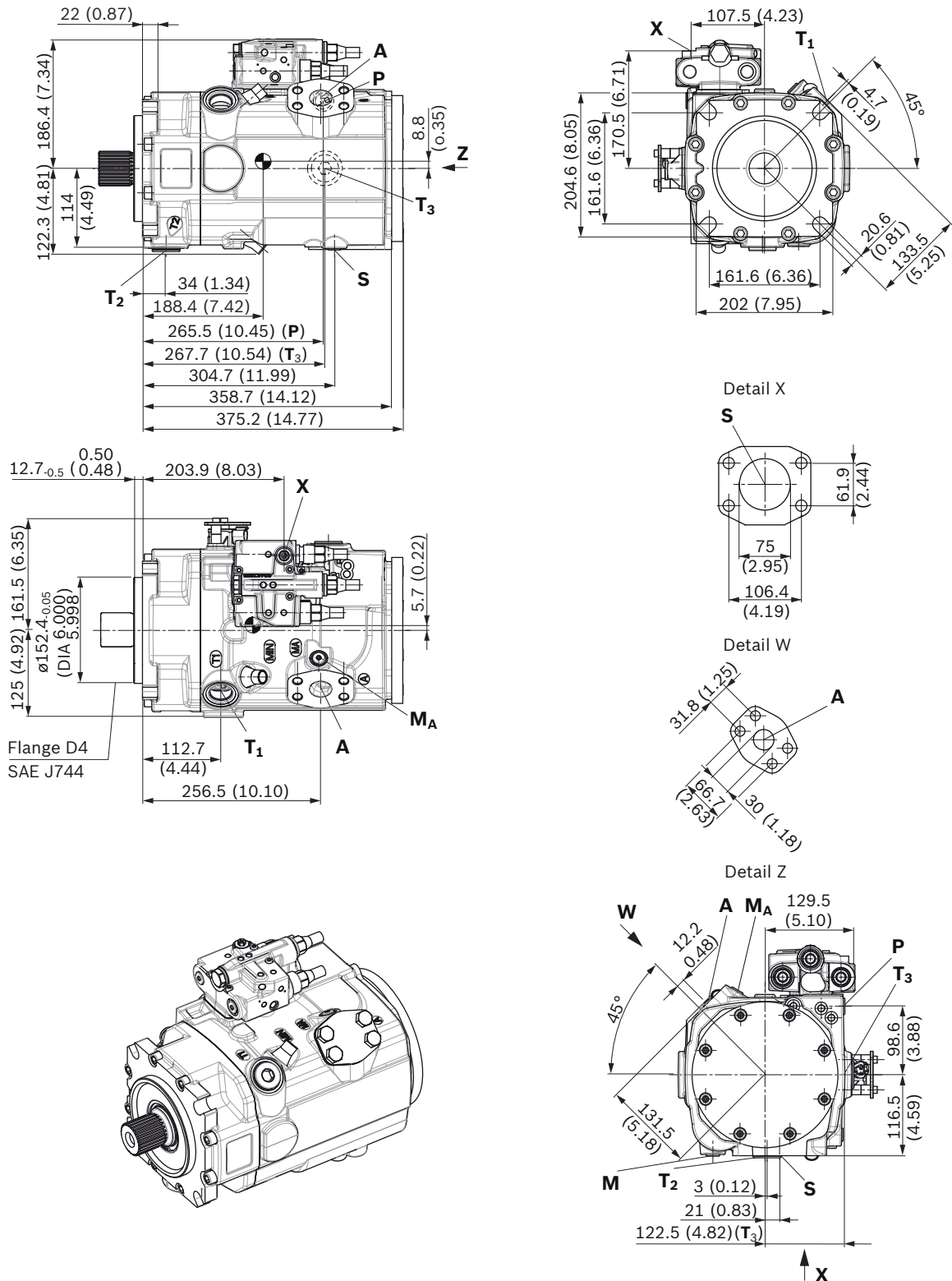
Notice

All controllers described with shuttle valve in **P** (some contrary to standard as per type code position 08)

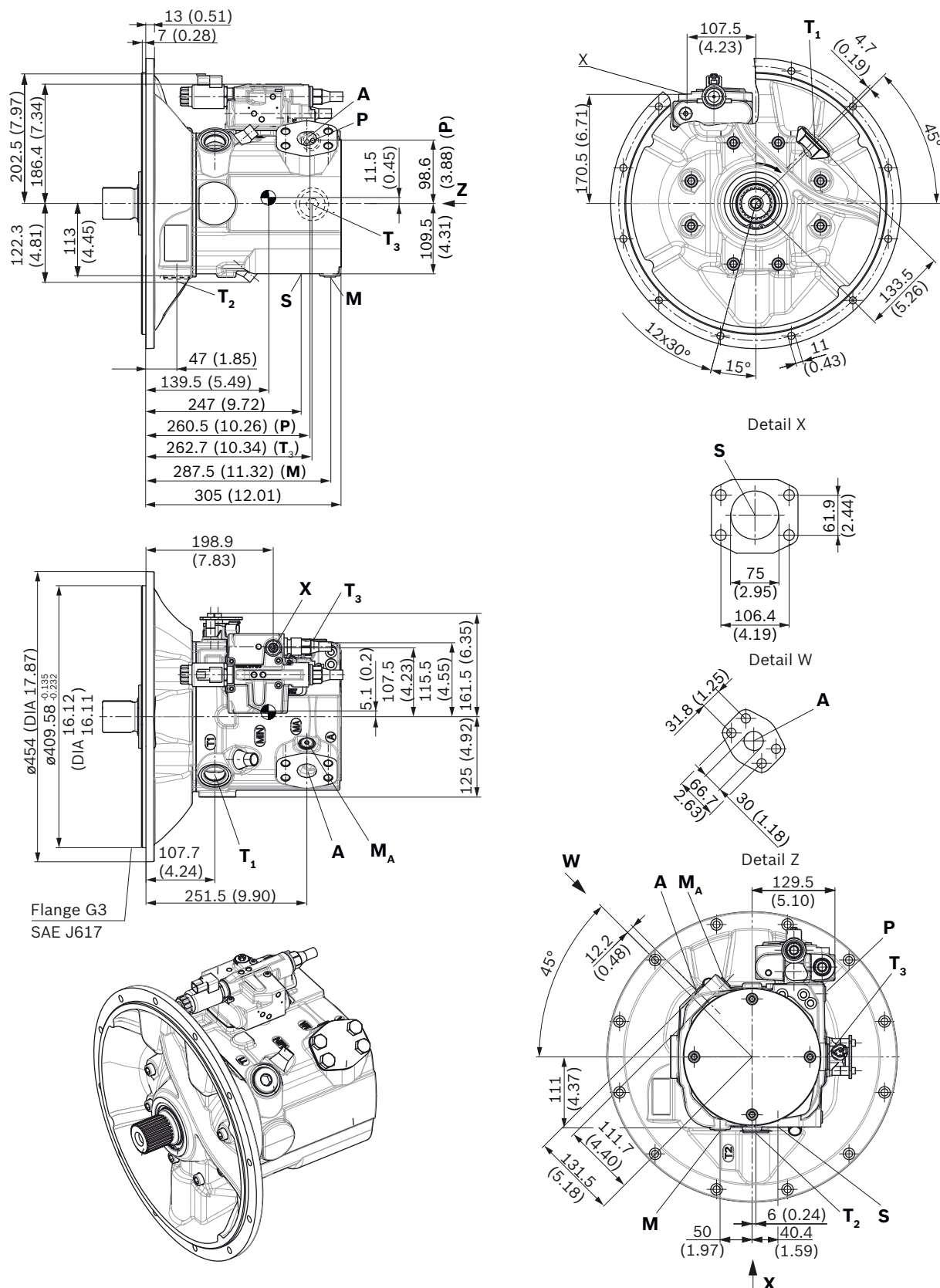
Without charge pump, clockwise rotation



With charge pump, clockwise rotation

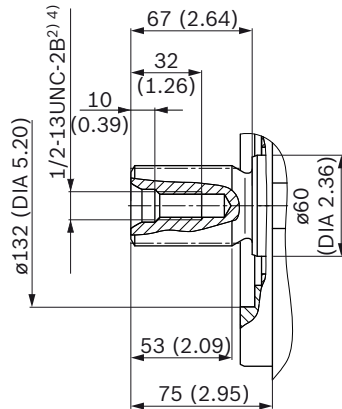


Mounting flange G3 according to SAE J617; 409-12; without charge pump

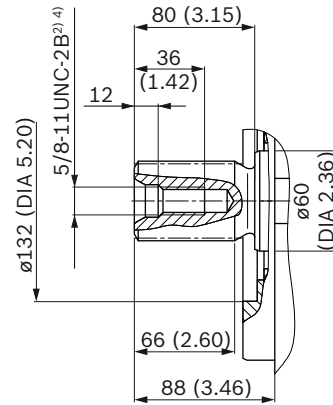


▼ **Splined shaft SAE J744**

T1 – 1 3/4 in 13T 8/16DP¹⁾

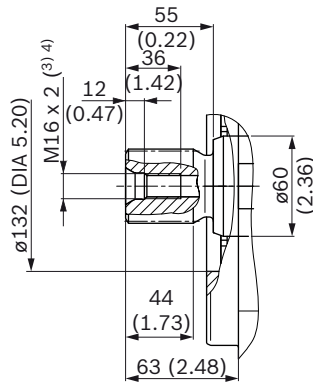


T2 – 2 in 15T 8/16 DP¹⁾



▼ **Splined shaft DIN 5480**

A2 – W50x2x24x9g



- 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)
- 4) Observe the instructions in the instruction manual concerning the maximum tightening torques.

Ports – version “M” metric		Standard	Size ⁴⁾	$p_{\max \text{ abs}}$ [bar (psi)] ⁵⁾	State ⁹⁾
A	Working port Fastening thread	SAE J518 ⁶⁾ DIN 13	1 1/4 in M14 × 2; 22 (0.87) deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518 ⁶⁾ DIN 13	3 in M16 × 2; 24 (0.94) deep	30 (435)	O
S	Suction port (with charge pump) Fastening threads	SAE J518 ⁶⁾ DIN 13	3 in M16 × 2; 24 (0.94) deep	2 (30)	O
T₁	Drain port	ISO 6149 ⁷⁾	M33 × 2; 19 (0.75) deep	10 (145)	O ⁸⁾
T₂	Drain port	ISO 6149 ⁷⁾	M33 × 2; 19 (0.75) deep	10 (145)	X ⁸⁾
T₃	Drain port	ISO 6149 ⁷⁾	M33 × 2; 19 (0.75) deep	10 (145)	X ⁸⁾
CR	Pilot signal (CR only)	ISO 6149	M14 × 1.5; 11.5 (0.45) deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 6149	M14 × 1.5; 11.5 (0.45) deep	420 (6100)	O
H3, H4	Pilot signal (H3 and H4 only)	ISO 6149	M14 × 1.5; 11.5 (0.45) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	ISO 6149	M14 × 1.5; 11.5 (0.45) deep	100 (1450)	O
X	Pilot signal (S0, S3/S4 and DG only)	ISO 6149 ⁷⁾	M14 × 1.5; 11.5 (0.45) deep	420 (6100)	O
M	Measuring control pressure	ISO 6149 ⁷⁾	M14 × 1.5; 12 (0.47) deep	420 (6100)	X
M_A	Measuring, pressure A	ISO 6149 ⁷⁾	M14 × 1.5; 12 (0.47) deep	420 (6100)	X
P	External control pressure (Type code position 8 version B or C = with external control pressure supply)	ISO 6149 ⁷⁾	M14 × 1.5; 11.5 (0.45) deep	50 (725)	O
	Port P is without function (Type code position 8 version A = without external control pressure supply)	ISO 6149 ⁷⁾	M18 × 1.5; 14.5 (0.57) deep	420 (6100)	X

Ports – version “A” SAE		Standard	Size ⁴⁾	$p_{\max \text{ abs}}$ [bar (psi)] ⁵⁾	State ⁹⁾
A	Working port Fastening thread	SAE J518 ASME B1.1	1 1/4 in 1/2-13 UNC-2B; 19 (0.75) deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518 ASME B1.1	3 in 5/8-11 UNC-2B; 24 (0.94) deep	30 (435)	O
S	Suction port (with charge pump) Fastening threads	SAE J518 ASME B1.1	3 in 5/8-11 UNC-2B; 24 (0.94) deep	2 (30)	O
T₁	Drain port	ISO 11926 ⁷⁾	1 5/16 UNF-2B; 20 (0.79) deep	10 (145)	O ⁸⁾
T₂	Drain port	ISO 11926 ⁷⁾	1 5/16 UNF-2B; 20 (0.79) deep	10 (145)	X ⁸⁾
T₃	Drain port	ISO 11926 ⁷⁾	1 5/16 UNF-2B; 20 (0.79) deep	10 (145)	X ⁸⁾
CR	Pilot signal (CR only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
H3, H4	Pilot signal (H3 and H4 only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	100 (1450)	O
X	Pilot signal (S0, S3/S4 and DG only)	ISO 11926 ⁷⁾	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
M	Measuring control pressure	ISO 11926 ⁷⁾	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	X
M_A	Measuring, pressure A	ISO 11926 ⁷⁾	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	X
P	External control pressure (Type code position 8 version B or C = with external control pressure supply)	ISO 11926 ⁷⁾	9/16-18 UNF-2B; 13 (0.51) deep	50 (725)	O
	Port P is without function (Type code position 8 version A = without external control pressure supply)	ISO 11926 ⁷⁾	3/4-16 UNF-2B; 12.6 (0.50) deep	420 (6100)	X

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

6) Metric fastening thread is a deviation from standard.

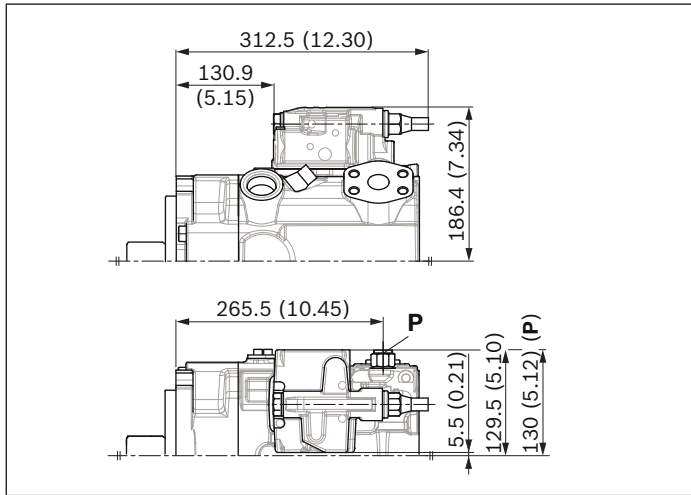
7) The countersink can be deeper than as specified in the standard.

8) Depending on installation position, T₁, T₂ or T₃ must be connected
(see also Installation instructions on pages 69 and 70).

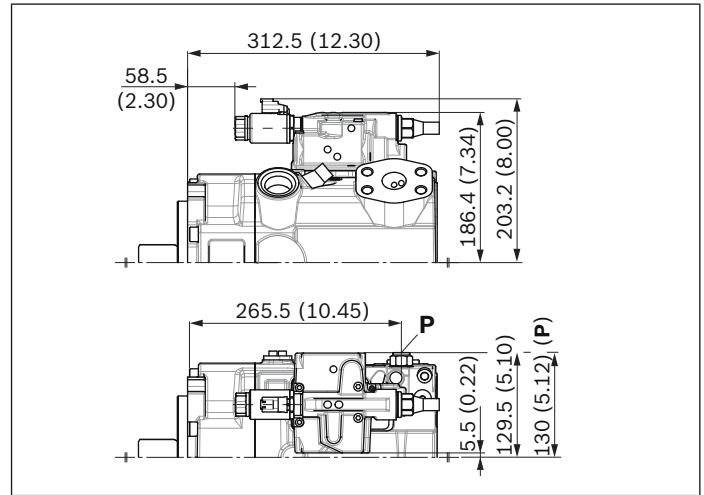
9) O = Must be connected (plugged when delivered)

X = Plugged (in normal operation)

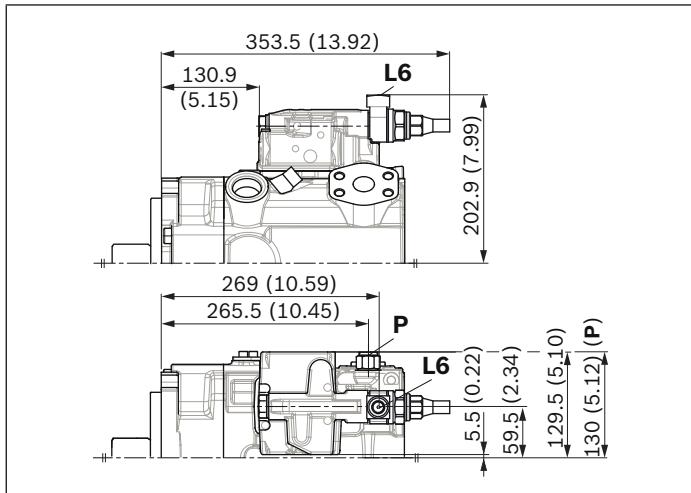
▼ **LR** – Power controller, fixed setting



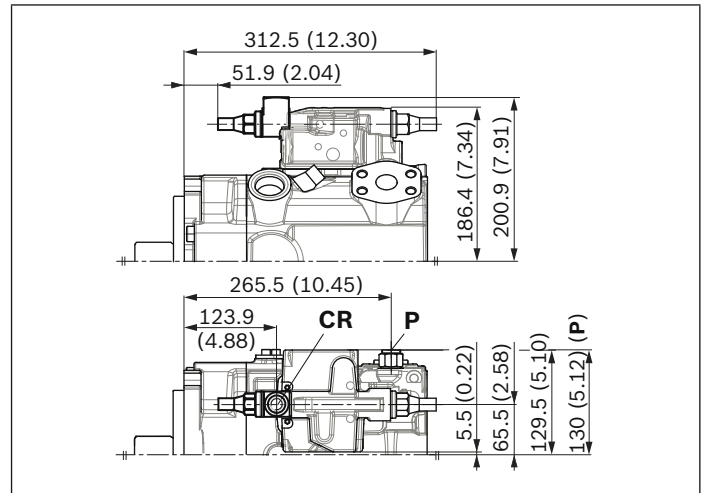
▼ **L3/L4** – Power controller, electric-proportional override



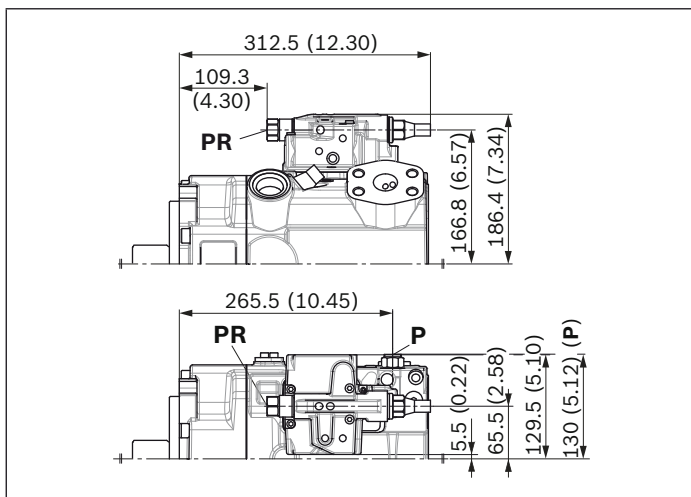
▼ **L5/L6** – Power controller, hydraulic override



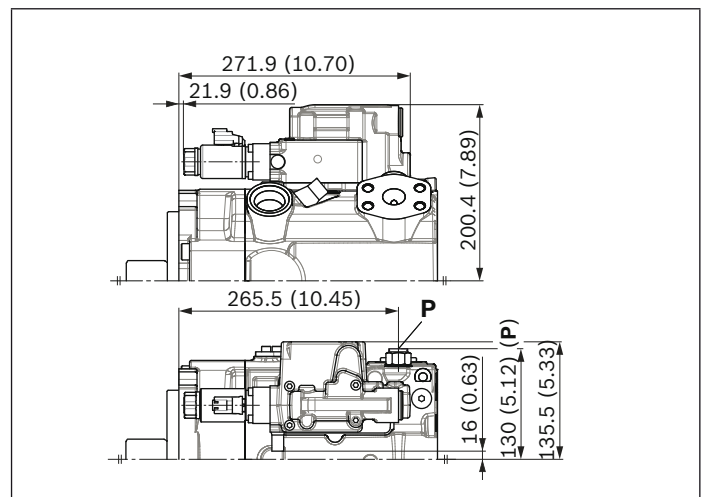
▼ **CR** – Power controller, hydraulic-proportional override, high pressure, with stop



▼ **PR** – Power controller, hydraulic-proportional override, high pressure, without stop

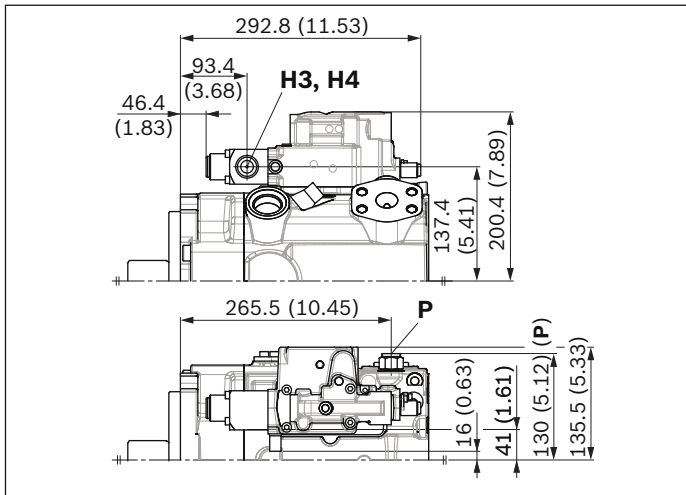
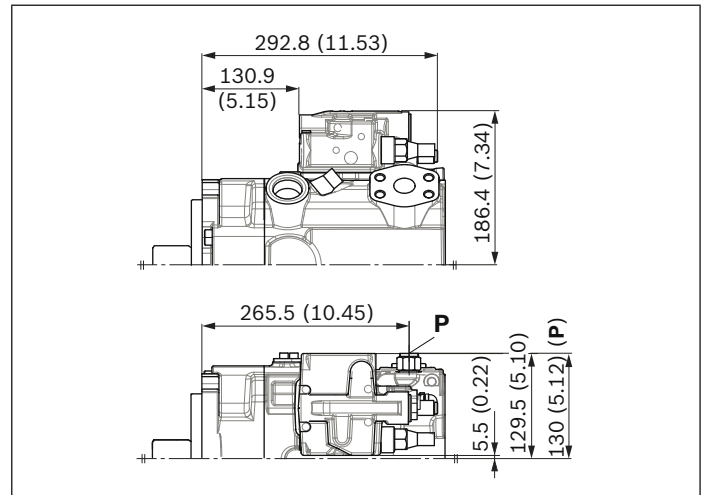
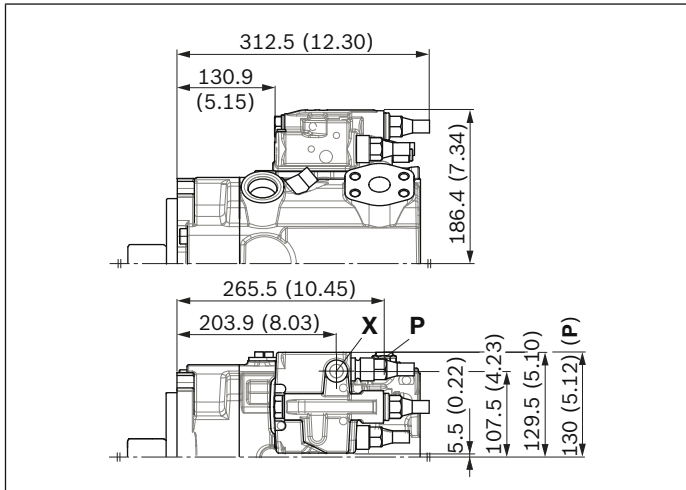
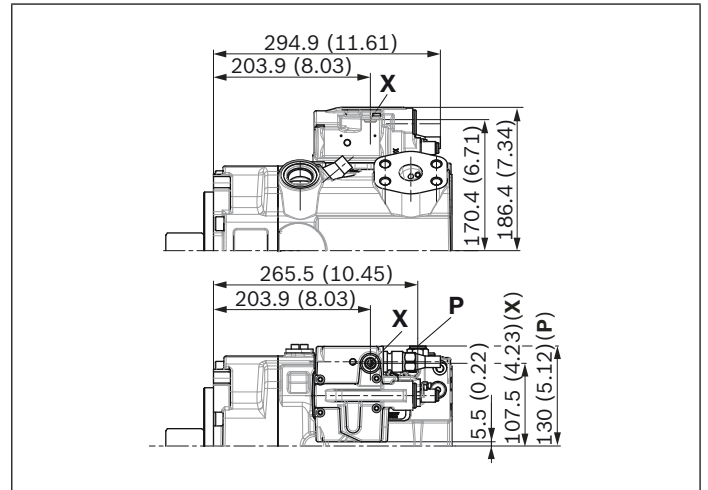
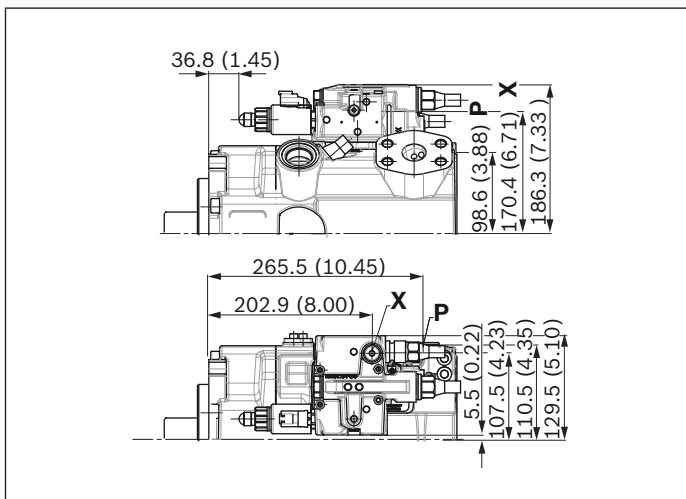
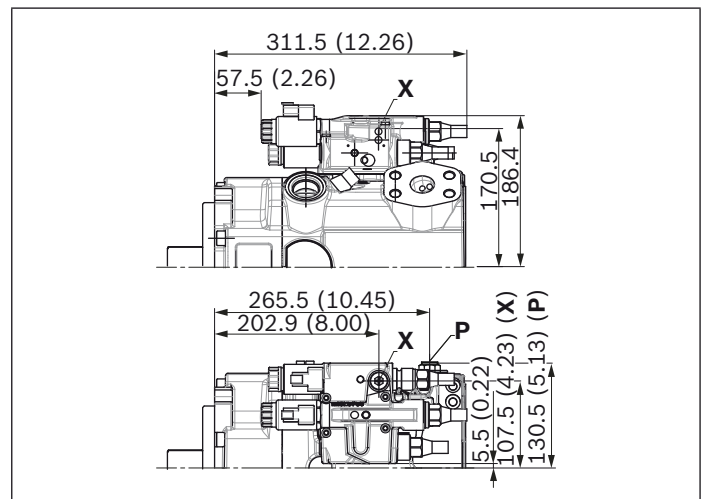


▼ **E1/E2** – Stroke control electric-proportional



Notice

All controllers described with shuttle valve in **P** (some contrary to standard as per type code position 08)

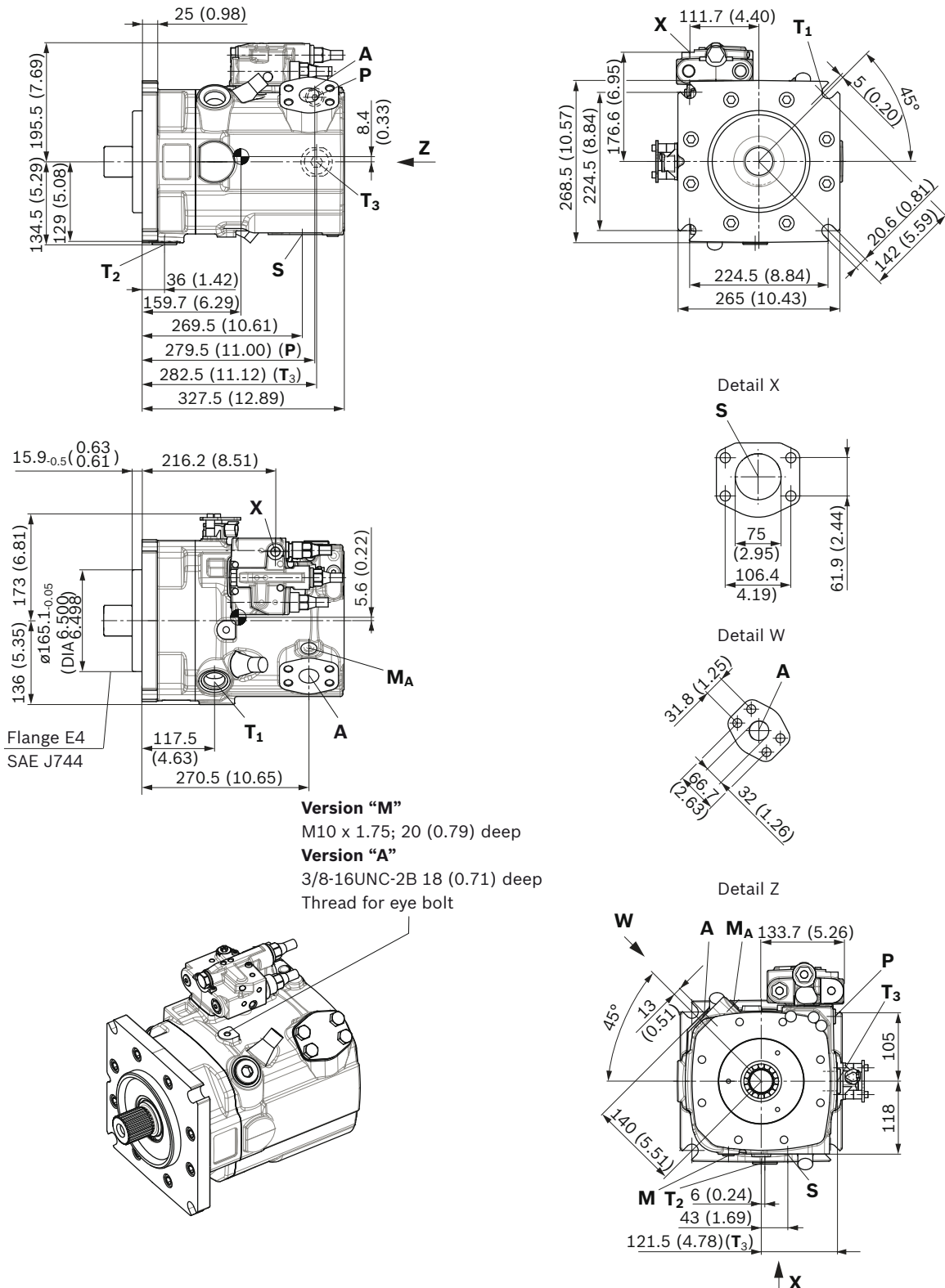
▼ **H3/H4** – Stroke control, hydraulic-proportional, pilot pressure

▼ **DR** – Pressure controller, fixed setting

▼ **LRDRS0** – Power controller with pressure controller and load sensing, fixed setting

▼ **DG** – Pressure controller, hydraulic, remote controlled

▼ **DGT6/DGT8** – With integrated pilot control valve, electric-proportional override

▼ **S3/S4** – Load-sensing, internal pressure, electric-proportional

Notice

All controllers described with shuttle valve in **P** (some contrary to standard as per type code position 08)

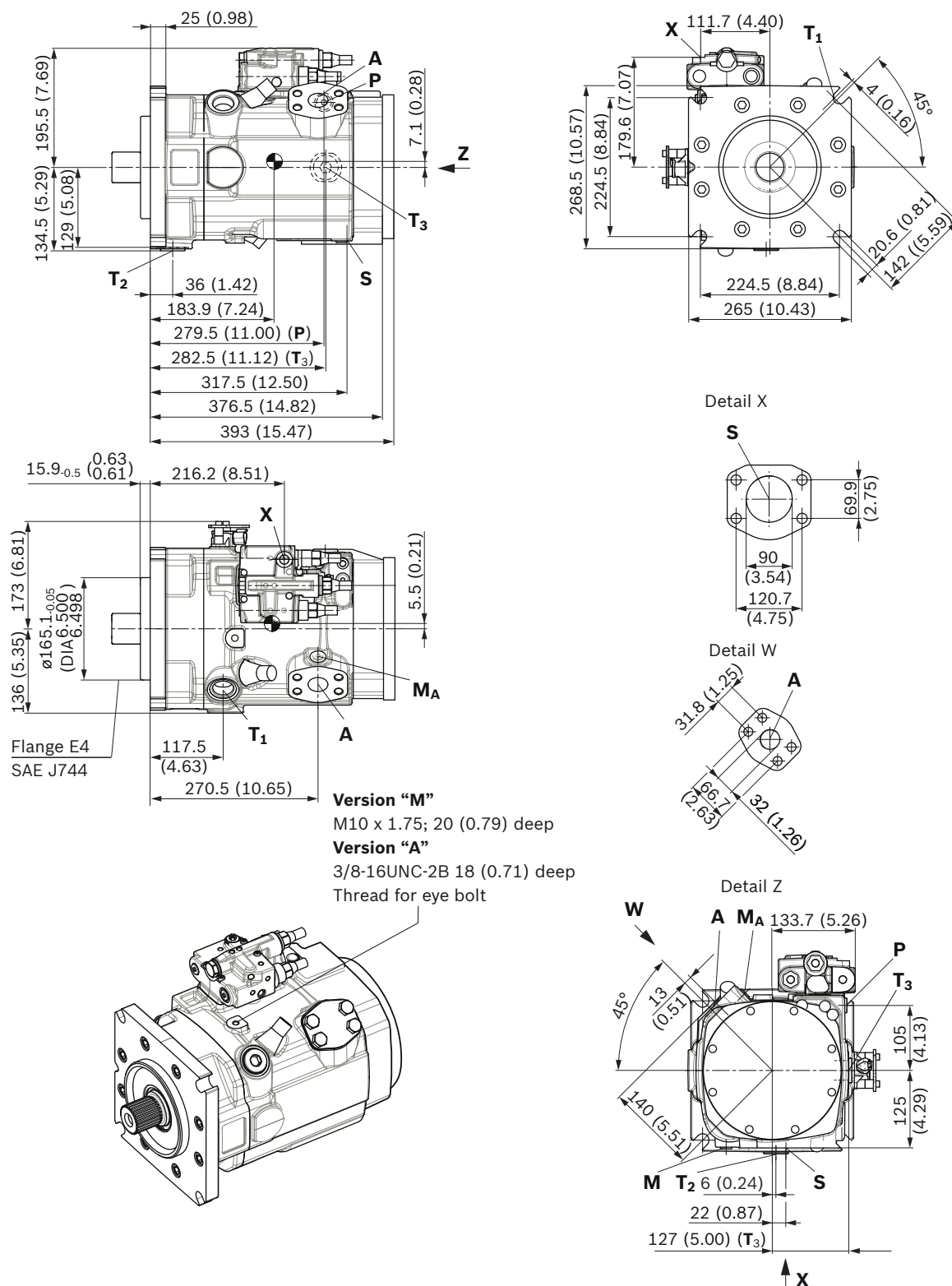
Dimensions, size 175

LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

Without charge pump, clockwise rotation

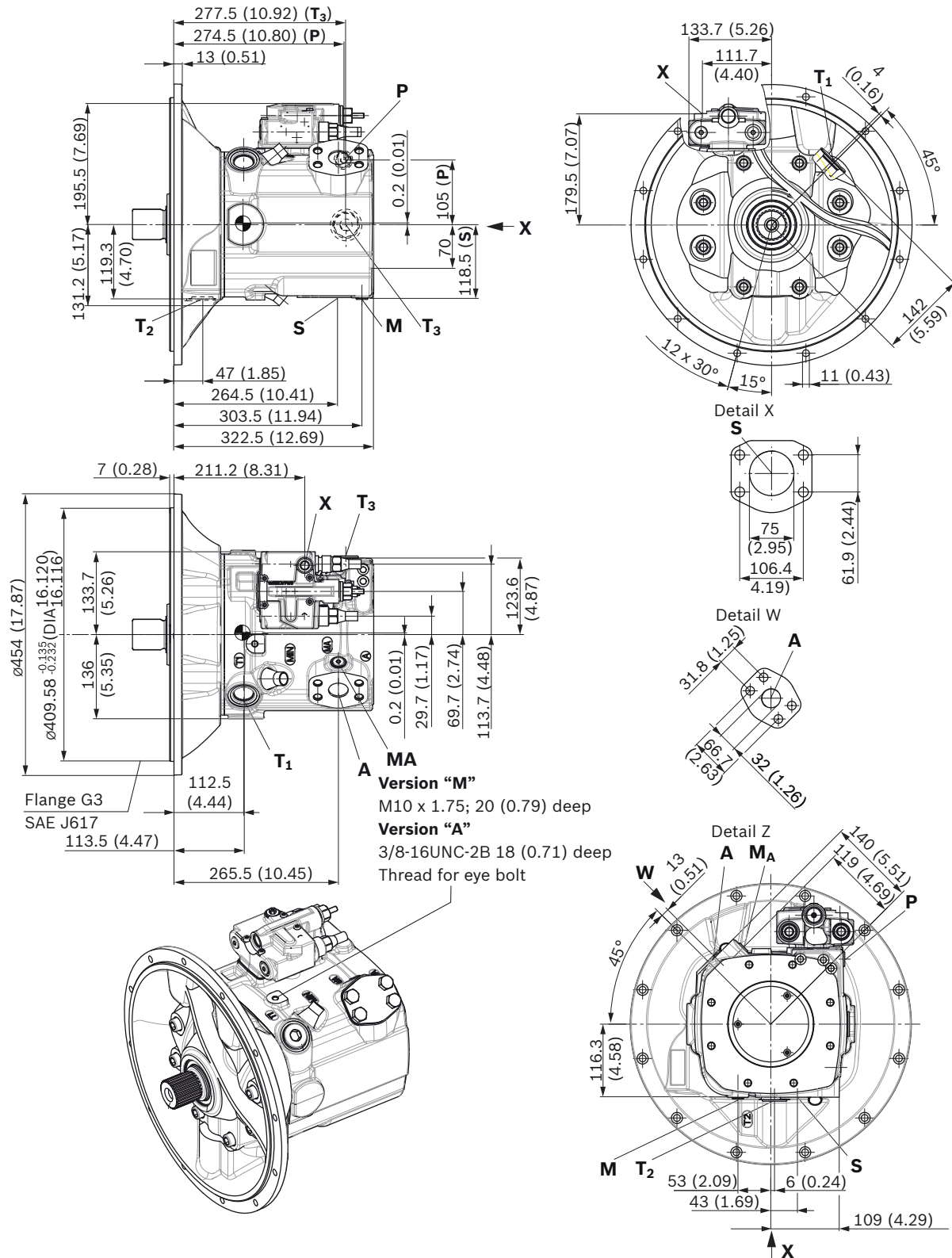


With charge pump, clockwise rotation

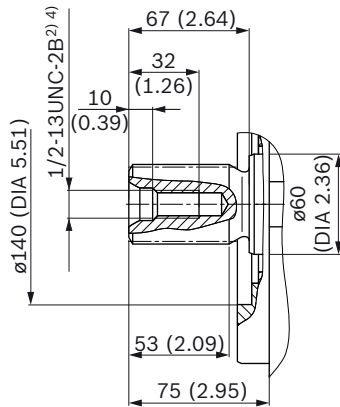
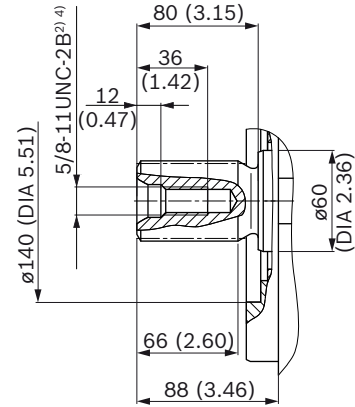


LRDRS0 – Power controller with pressure controller, load sensing and without electric swivel angle sensor

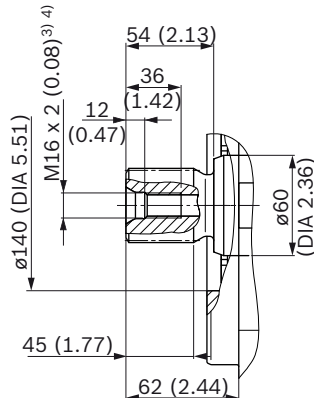
Mounting flange G3 according to SAE J617; 409-12; without charge pump



▼ Splined shaft SAE J744

T1 – 1 3/4 in 13T 8/16DP¹⁾**T2** – 2 in 15T 8/16DP¹⁾

▼ Splined shaft DIN 5480

A2 – W50x2x24x9g

- 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)
- 4) Observe the instructions in the instruction manual concerning the maximum tightening torques.