Axial Piston Variable Double Pump A20VG/A22VG

RA 93220-A/10.10 1/28
Replaces: 05.09

Data sheet

Series 11
Sizes 45
A20VG Nominal pressure 4350 psi (300 bar)
Maximum pressure 5100 psi (350 bar)
A22VG Nominal pressure 5100 psi (350 bar)
Maximum pressure 6100 psi (420 bar)
Closed circuit

Contents

Features

- Variable double pump with two axial piston rotary groups with swashplate design for hydrostatic drives in closed circuit
- The flow is proportional to the drive speed and displacement.
- The flow increases as the angle of the swashplate is adjusted from zero to its maximum value.
- Flow direction changes smoothly when the swashplate is moved through the neutral position.
- Only one shared port for case drain fluid for both circuits
- Service line ports alternatively left or right (viewed from drive shaft)
- Compact design for tight installation conditions

Note

Only for series no smaller than 200 units per year.

Please consult us regarding smaller series.

Ordering code for standard program

	G	045							/	11	A		N	B2					A	
01	02	03	04	05	06	07	08	09		10	11	12	13	14	15	16	17	18	19	20

Axial piston unit

01	Swashplate design, variable	Nominal pressure 4350 psi (300 bar), maximum pressure 5100 psi (350 bar)	**A20V**
		Nominal pressure 5100 psi (350 bar), maximum pressure 6100 psi (420 bar)	**A22V**

Operation mode

02	Double pump, closed circuit	**G**

Size (NG)

03	Theoretical displacement see table of values on page 7	in cm^3	**045**
		in in^3/rev	**2.81**

Control device

04	Proportional control hydraulic mechanical servo, hexagon shaft	without neutral position switch	●	**HW1**
		with neutral position switch	●	**HW7**
	Proportional control electric	U = 12 V DC	●	**EP1**
		U = 24 V DC	●	**EP2**
	Hydraulic control, direct controlled		●	**HT1**
	Electric control, direct controlled, two pressure reduction valves (DRE) per circuit	U = 12 V DC	❍	**ET1**
		U = 24 V DC	❍	**ET2**

Connector for solenoids[1)]

05	Without	**0**
	DEUTSCH - molded connector, 2-pin – without suppressor diode	**P**

Swivel angle indicator

06	Without	**0**
	Electric swivel angle sensor[2)]	**R**

Auxiliary function 1 (pilot pressure port)

07	With ports X_1 and X_2	**1**
	With ports X_3 and X_4	**3**
	With ports X_1, X_2 and X_3, X_4	**4**

Auxiliary function 2 (mechanical stroke limiter)

08	Without	**0**
	With mechanical stroke limiter on one side, externally variable, on the same side as the service line ports	**E**
	With mechanical stroke limiter on both sides, externally variable	**M**

DA control valve

		HW	HT	EP	ET	
09	Without	●	●	●	❍	**0**
	With DA control valve fixed setting	❍	●	❍	–	**1**

Series

10	Series 1, Index 1	**11**

Version of port and fixing threads

11	ANSI	**A**

● = Available ❍ = On request – = Not available

1) Connectors for other electric components can deviate.

2) See page 24

Ordering code for standard program

	G	045							/	11	A		N	B2					A	
01	02	03	04	05	06	07	08	09		10	11	12	13	14	15	16	17	18	19	20

Direction of rotation

12	Viewed from drive shaft	clockwise	**R**
		counter-clockwise	**L**

Seals

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

Mounting flange

14	SAE J744	101-2 (B)	**B2**

Drive shaft

15	Splined shaft ANSI B92.1a-1976	1 in	15T 16/32DP	❍	**S5**
		1 1/4 in	14T 12/24DP	●	**S7**

Service line ports

16	SAE threaded ports A and B, left (viewed from drive shaft)	**3**
	SAE threaded ports A and B, right (viewed from drive shaft)	**4**

Boost pump

17	Without boost pump (standard)[3]	**U**
	With boost pump[3]	**F**

Through drive

	Flange SAE J744	Mounting variant		Coupling for splined shaft[4]				
	Diameter	Symbol[5]	Designation	Diameter		Designation		
18	Without						❍	**0000**
	82-2 (A)	o-o	A2	5/8 in	9T 16/32DP	S2	●	**A2S2**
	101-2 (B)	o-o	B2	7/8 in	13T 16/32DP	S4	●	**B2S4**
				1 in	15T 16/32DP	S5	●	**B2S5**

High-pressure valves

			Setting range	
19	With high-pressure relief valve, direct controlled	without bypass	3600 to 4650 psi (250 to 320 bar) (A20VG)	**A**
			3600 to 5650 psi (250 to 390 bar) (A22VG)	

Standard / special version

20	Standard version		**-0**
		combined with attachment part or attachment pump	**-K**
	Special version		**-S**
		combined with attachment part or attachment pump	**-T**

Note
This unit is only available "without pressure cut-off".
Short designation X on a feature refers to a special version not covered by the ordering code.

● = Available ❍ = On request – = Not available

3) For pressure filtration, the feed is performed via port G.
Pressure or suction filtration to be provided by the customer.
4) Coupling for splined shaft acc. ANSI B92.1a-1976
5) Order of fixing bores viewed from through drive

Technical data

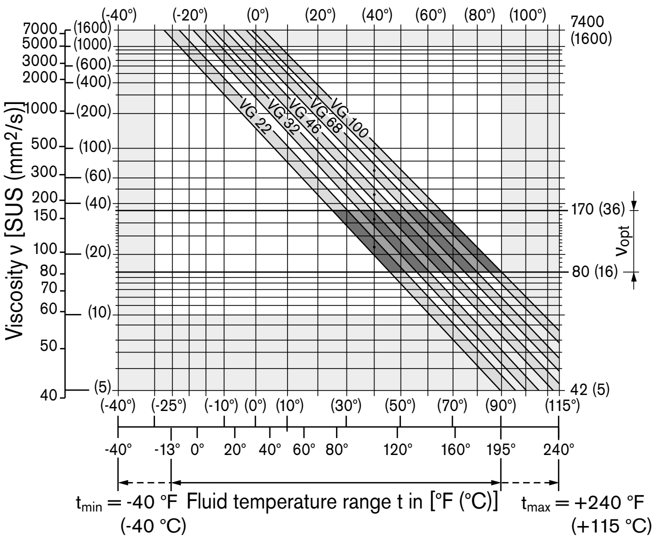
Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil) and RE 90221 (environmentally acceptable hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

The A20VG/A22VG variable pump is not suitable for operation with HFA, HFB and HFC hydraulic fluid. If HFD or environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and seals must be observed.
Please contact us.

When ordering, indicate the hydraulic fluid that is to be used.

Selection diagram



Details regarding the choice of hydraulic fluid

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

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}), see shaded area of the selection diagram. We recommended that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X °F (X °C), an operating temperature of 140 °F (60 °C) is set in the circuit. In the optimum operating viscosity range ($\nu_{opt.}$ shaded area), this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note
The case drain temperature, which is affected by pressure and speed, is always higher than the circuit temperature. At no point of the component may the temperature be higher than 240 °F (115 °C), however. The temperature difference specified below is to be taken into account when determining the viscosity in the bearing.

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

Viscosity and temperature

	Viscosity [SUS (mm²/s)]	Temperature	Comment
Transport and storage		$T_{min} \geq$ -58 °F (-50 °C) T_{opt} = +41 °F to +68 °F (+5 °C to +20 °C)	up to 12 months with standard factory preservation up to 24 months with long-term factory preservation
(Cold) start-up[1]	ν_{max} = 7400 (1600)	$T_{St} \geq$ -40 °F (-40 °C)	t ≤ 3 min, without load (p ≤ 725 psi (50 bar)), n ≤ 1000 rpm
Permissible temperature difference		ΔT ≤ 45 °F (25 °C)	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 7400 to 1850 (1600 to 400)	T = -40 °F to -13 °F (-40 °C to -25 °C)	at p_{nom}, 0.5 • n_{nom} and t ≤ 15 min
Operating phase			
Temperature difference		ΔT = approx. 9 °F (5 °C)	between hydraulic fluid in the bearing and the case drain fluids at port T.
Maximum temperature		240 °F (115 °C)	in bearing
		230 °F (110 °C)	measured at port T
Continuous operation	ν = 1850 to 60 (400 to 10) ν_{opt} = 80 to 170 (16 to 36)	T = -13 °F to +195 °F (-25 °C to +90 °C)	measured at port T, no restriction within the permissible data
Short-term operation	ν_{min} = < 60 to 42 (10 to 5)	T_{max} = +230 °F (+110 °C)	measured at port T, t < 3 min, p < 0.3 • p_{nom}
Shaft seal ring FKM[1]		T ≤ +240 °F (+115 °C)	see page 5

1) At temperatures below -13 °F (-25 °C), an NBR shaft seal ring is required (permissible temperature range: -40 °F to +195 °F (-40 °C to +90 °C)).

Technical data

Filtration of the hydraulic fluid

Filtration improves the cleanliness level of the hydraulic fluid, which, in turn, increases the service life of the axial piston unit.

To ensure the functional reliability of the axial piston unit, a gravimetric evaluation is necessary for the hydraulic fluid to determine the amount of contamination by solid matter and to determine the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 is to be maintained.

Depending on the system and the application, for the A20VG and A22VG, we recommend

Filter cartridges $\beta_{20} \geq 100$.

With an increasing differential pressure at the filter cartridges, the β-value must not deteriorate.

At very high hydraulic fluid temperatures 195 °F to maximum 240 °F (90 °C to maximum 115 °C), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

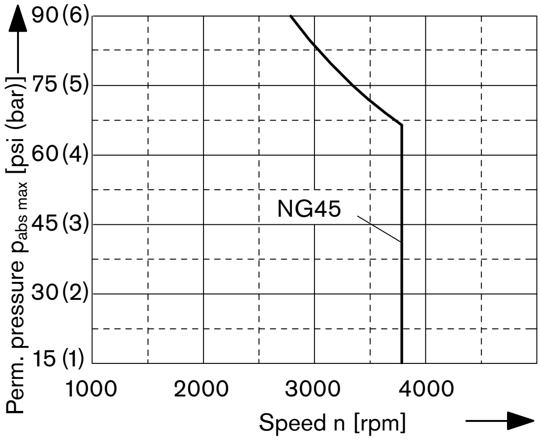
If the above classes cannot be achieved, please contact us.

Shaft seal ring

Permissible pressure loading

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

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



Temperature range

The FKM shaft seal ring may be used for case drain temperatures from -13 °F to +240 °F (-25 °C to +115 °C).

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

Technical data

Operating pressure range

Variable double pump A20VG

Pressure at service line port A or B

Nominal pressure p_{nom}	4350 psi (300 bar) absolute
Maximum pressure p_{max}	5100 psi (350 bar) absolute
Single operating period	10 s
Total operating period	300 h

Variable double pump A22VG

Pressure at service line port A or B

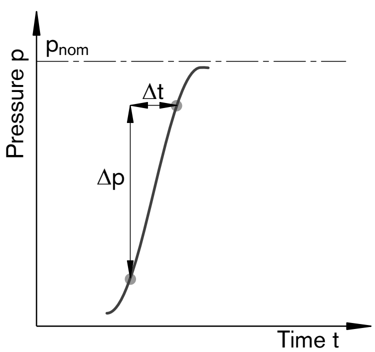
Nominal pressure p_{nom}	5100 psi (350 bar) absolute
Maximum pressure p_{max}	6100 psi (420 bar) absolute
Single operating period	10 s
Total operating period	300 h

Variable double pump A20VG and A22VG

Minimum pressure (high-pressure side) 365 psi (25 bar)

Minimum pressure (inlet) 145 psi (10 bar)
(boost pressure setting must be higher depending on system)

Rate of pressure change $R_{A\ max}$ 130000 psi/s (9000 bar/s)



Boost pump

Pressure at suction port S

Duration $p_{S\ min}$ ($\nu \leq 140$ SUS)	≥ 12 psi absolute
(($\nu \leq 30$ mm²/s)	≥ 0.8 bar absolute)
at cold starts, short-term ($t < 3$ min)	≥ 7.5 psi (0.5 bar) absolute
Maximum $p_{S\ max}$	≤ 75 psi (5 bar) absolute

Nominal pressure $p_{Sp\ nom}$	365 psi (25 bar)
Maximum pressure $p_{Sp\ max}$	580 psi (40 bar)

Control pressure
To ensure the function of the control, the following control pressure is required depending on the speed and operating pressure:

For controls EP and HW
Minimum control pressure
$p_{St\ min}$ (at n = 2000 rpm) 260 psi (18 bar)

For controls ET and HT
Minimum control pressure
$p_{St\ min}$ (at n = 2000 rpm) 365 psi (25 bar)

Definition

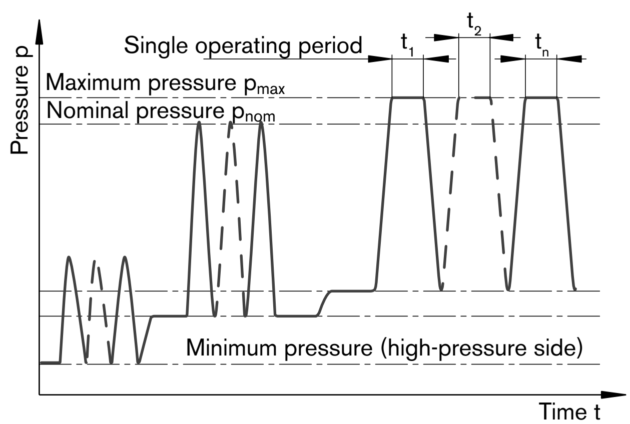
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating period must not exceed the total operating period.

Minimum pressure (high-pressure side)
Minimum pressure on the high-pressure side (A or B) that is required in order to prevent damage to the axial piston unit.

Minimum pressure (inlet)
Minimum pressure in inlet (A or B) that is required in order to prevent damage to the axial piston unit.

Rate of pressure change R_A
Maximum permissible rate of pressure build-up and pressure reduction during a pressure change over the entire pressure range.



Total operating period = t1 + t2 + ... + tn

Technical data

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

Size				NG		45
Displacement geometrical, per revolution	variable pump (for each rotary group)			$V_{g\,max}$	in^3	2.81
					cm^3	46
	boost pump (at p = 290 psi (20 bar))			$V_{g\,Sp}$	in^3	0.91
					cm^3	14.9
Speed	at $V_{g\,max}$			n_{nom}	rpm	3300
	limited maximum[1)]			$n_{max\,limited}$	rpm	3550
	intermittent maximum[2)]			$n_{max\,interm.}$	rpm	3800
	minimum			n_{min}	rpm	500
Flow	at n_{nom} and $V_{g\,max}$			$q_{v\,max}$	gpm	2 x 40
					l/min	2 x 152
Power[3)]	at n_{nom}, $V_{g\,max}$ and					
		for A20VG	$\Delta p = 4350$ psi	P_{max}	hp	204
			$\Delta p = 300$ bar	P_{max}	kW	152
		for A22VG	$\Delta p = 5100$ psi	P_{max}	hp	239
			$\Delta p = 350$ bar	P_{max}	kW	177
Torque[3)]	at $V_{g\,max}$ and					
		for A20VG	$\Delta p = 4350$ psi	T_{max}	lb-ft	324
			$\Delta p = 300$ bar	T_{max}	Nm	439
		for A22VG	$\Delta p = 5100$ psi	T_{max}	lb-ft	380
			$\Delta p = 350$ bar	T_{max}	Nm	512
			$\Delta p = 1450$ psi	T	lb-ft	108
			$\Delta p = 100$ bar	T	Nm	146
Rotary stiffness	drive shaft S7			c	lb-ft/rad	54435
					Nm/rad	73804
Moment of inertia	rotary group 1			J_{GR}	$lb\text{-}ft^2$	0.078951
					kgm^2	0.003327
	rotary group 2			J_{GR}	$lb\text{-}ft^2$	0.078144
					kgm^2	0.003293
Maximum angular acceleration for each rotary group[4)]				α	rad/s^2	4000
Filling capacity				V	gal	0.4
					L	1.7
Mass approx. (without through drive)				m	lbs	121
					kg	55

1) Limited maximum speed: At half corner power (e. g. at $V_{g\,max}$ and p_{nom} /2)

2) Intermittent maximum speed:
- At high idle speed
- At overspeed: $\Delta p = 1000$ to 2200 psi (70 to 150 bar) and $V_{g\,max}$
- At reversing peaks: $\Delta p < 4350$ psi (300 bar) and $t < 5$ sec.

3) Without boost pump

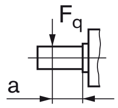
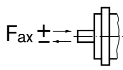
4) The area of validity lies between the minimum required and maximum permissible speed.
It applies for external stimuli (e. g. engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency).
The limit value applies for a single pump only.
The load capacity of the connection parts must be considered.

Note

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.

Technical data

Permissible radial and axial loading on drive shaft

Size		NG		45
Drive shaft			in	1 1/4
Radial force maximum at distance a (from shaft collar)		$F_{q\,max}$	lb	717
			N	3190
		a	in	0.94
			mm	24
Axial force maximum		$\pm F_{ax\,max}$	lb	337
			N	1500

Note

Special requirements apply in the case of belt drives. Please contact us.

Force-transfer direction of the permissible axial force:

$+ F_{ax\,max}$ = Increase in service life of bearings

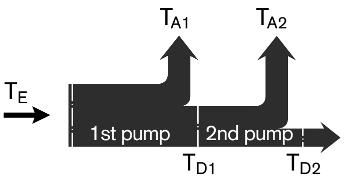
$- F_{ax\,max}$ = Reduction in service life of bearings (avoid)

Permissible input and through-drive torques

Size			NG		45
Torque[1] at $V_{g\,max}$ and	for A20VG	$\Delta p = 4350$ psi	T_{max}	lb-ft	324
		($\Delta p = 300$ bar)		Nm	439
	for A22VG	$\Delta p = 5100$ psi	T_{max}	lb-ft	378
		($\Delta p = 350$ bar)		Nm	512
Input torque at drive shaft maximum[2]					
	S7	1 1/4 in	$T_{E\,max}$	lb-ft	444
				Nm	602
Maximum through-drive torque			$T_{D1\,max}$	lb-ft	221
				Nm	300
			$T_{D2\,max}$	lb-ft	$T_{D2\,perm} = 221 - T_{A2}$
				Nm	$T_{D2\,perm} = 300 - T_{A2}$

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

Torque distribution



Determining the size

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

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

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

V_g = Displacement per revolution in in³ (cm³)

Δ_p = Differential pressure in psi (bar)

n = Speed in rpm

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

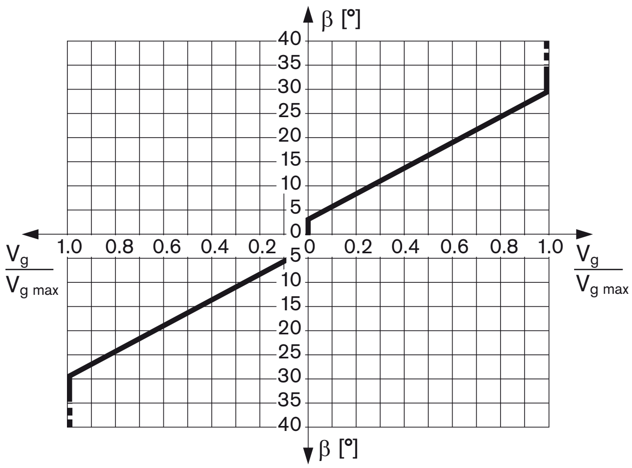
η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

HW – Proportional control hydraulic, mechanical servo

The output flow of the pump can be steplessly varied in the range between 0 to 100 %, proportional to the rotation of the control lever between 0° and ±29°.

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

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



Swivel angle β at the control lever for deflection:

Start of control at β = 3°

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

Mechanical stop for β: ±40°

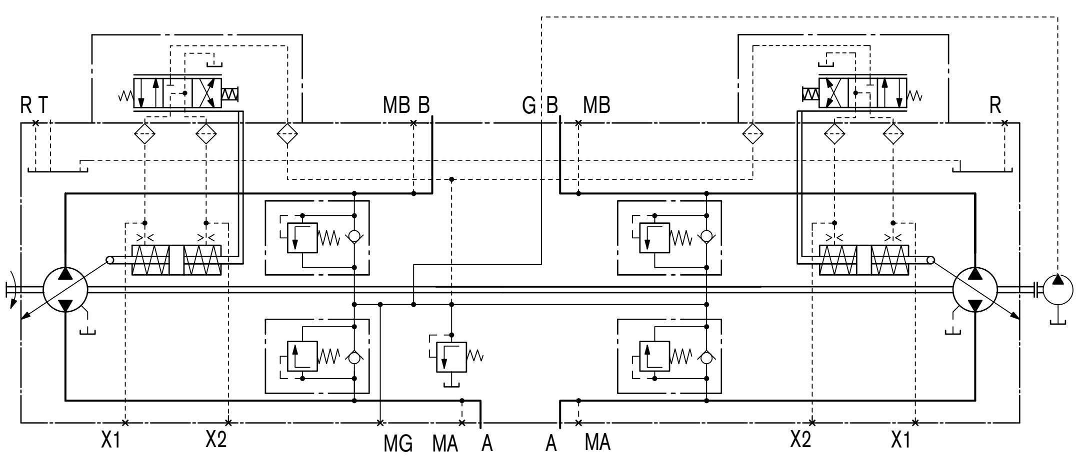
The maximum required torque at the lever is 15 lb-in (170 Ncm). To prevent damage to the HW control unit, a positive mechanical stop must be provided for the HW control lever.

Note
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 unit (regardless of deflection angle).

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

Technical data, neutral position switch	
Load capacity	20 A (continuous), without switching operating
Switching capacity	15 A / 32 V (ohmic load)
	4 A / 32 V (inductive load)
Connector version	DEUTSCH DT04-2P-EP04 (for mating connector, see page 25)

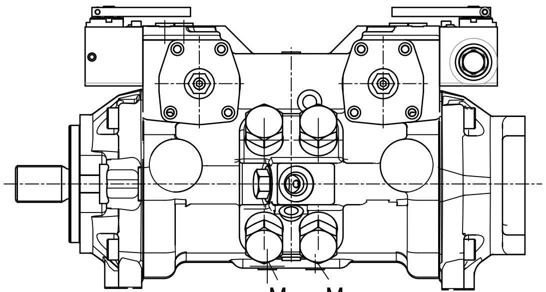
Circuit diagram

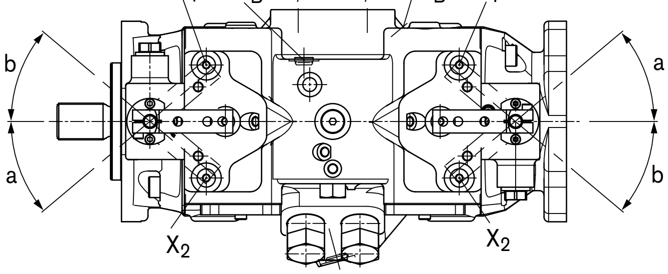


HW – Proportional control hydraulic, mechanical servo

Assignment
Direction of rotation - Control - Flow direction

	Pump 1				Pump 2			
Direction of rotation	clockwise		counter-clockwise		clockwise		counter-clockwise	
Lever direction	a	b	a	b	a	b	a	b
Control pressure	X_2	X_1	X_2	X_1	X_1	X_2	X_1	X_2
Flow direction	B to A	A to B	A to B	B to A	A to B	B to A	B to A	A to B
Operating pressure	M_A	M_B	M_B	M_A	M_B	M_A	M_A	M_B





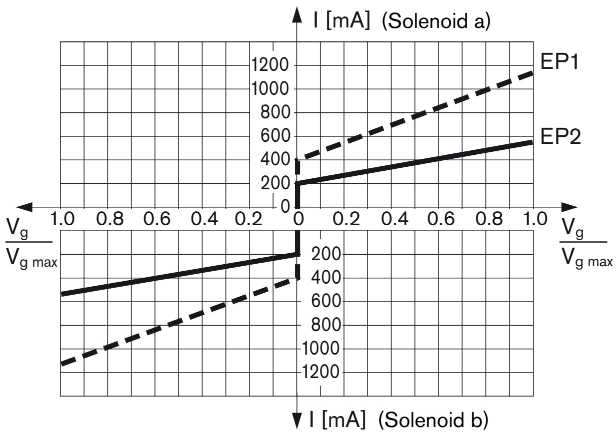
EP – Proportional control electric

The output flow of the pump can be steplessly varied in the range between 0 to 100 %, in proportional to the electrical current supplied to solenoid a or b.

The electrical energy is converted into a force acting on the control piston. This control piston then directs control hydraulic fluid into and out of the stroke cylinder to adjust pump displacement as required.

A feedback lever connected to the stroke piston maintains the pump flow for any given current within the control range.

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



Standard
Proportional solenoid without emergency actuation.

On request
Proportional solenoid with emergency actuation and spring return.

Technical data, solenoid	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Start of control at $V_{g\,0}$	400 mA	200 mA
End of control at $V_{g\,max}$	1115 mA	560 mA
Limiting current	1.54 A	0.77 A
Nominal resistance at 68 °F (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection see connector design, page 25		

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

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

– Analog amplifier RA ______ RE 95230

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

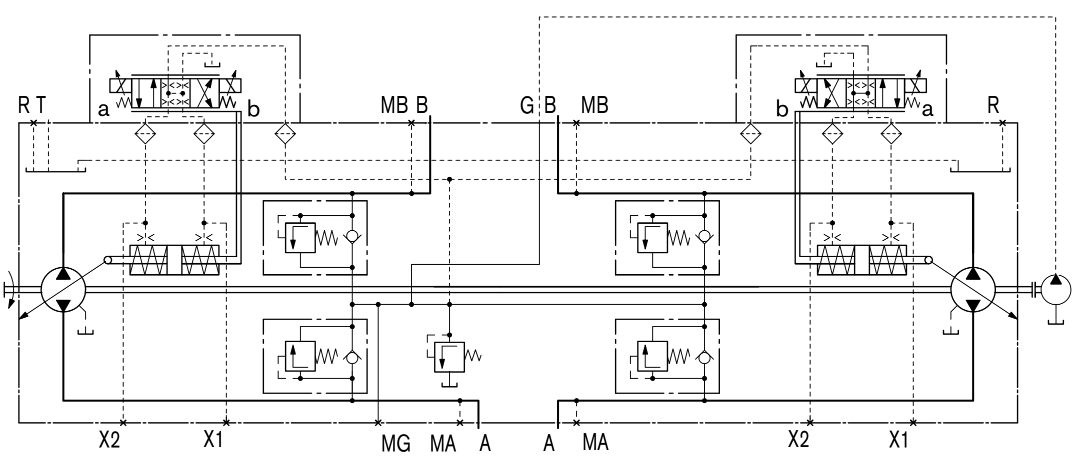
Note

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

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

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

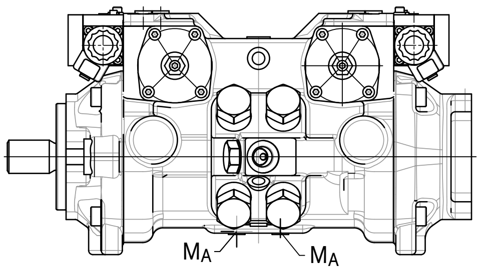
Circuit diagram

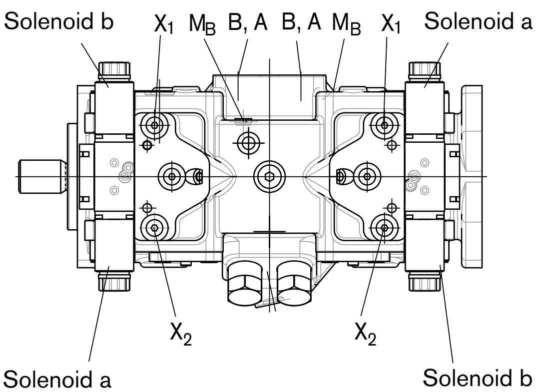


EP – Proportional control electric

Assignment
Direction of rotation - Control - Flow direction

	Pump 1				Pump 2			
Direction of rotation	clockwise		counter-clockwise		clockwise		counter-clockwise	
Actuation of solenoid	a	b	a	b	a	b	a	b
Control pressure	X_2	X_1	X_2	X_1	X_1	X_2	X_1	X_2
Flow direction	A to B	B to A	B to A	A to B	B to A	A to B	A to B	B to A
Operating pressure	M_B	M_A	M_A	M_B	M_A	M_B	M_B	M_A





HT – Hydraulic control, direct controlled

With the direct-controlled hydraulic control (HT), pump displacement is influenced by a hydraulic control pressure applied directly to the stroke piston through either port X_1 or X_2.

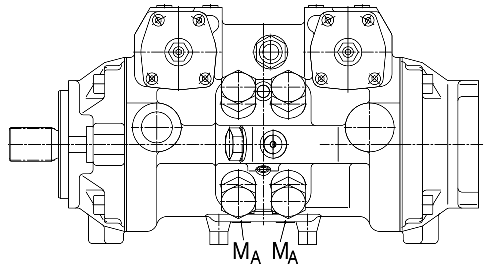
The flow direction is dependent on which control pressure port is pressurized.

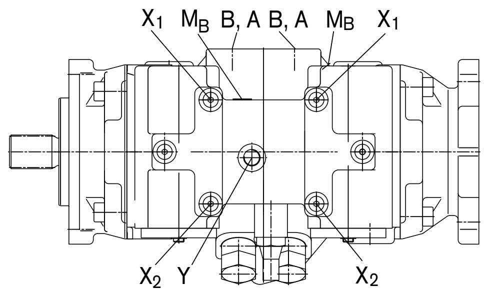
Pump displacement is steplessly variable and proportional to the applied control pressure, but is also influenced by system pressure and pump drive speed.

Maximum permissible control pressure: 580 psi (40 bar)

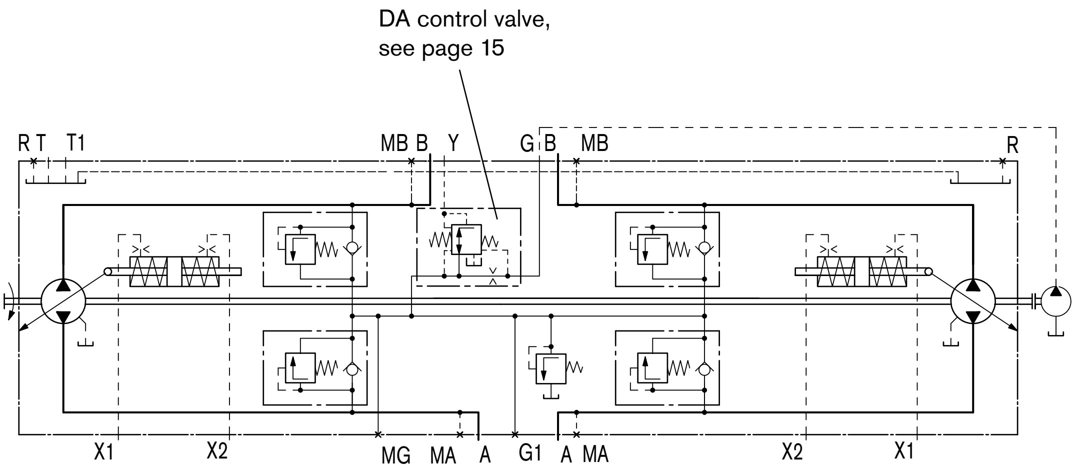
Use of the HT control requires a review of the engine and vehicle parameters to ensure that the pump is set up correctly. We recommend that all HT applications be reviewed by a Rexroth application engineer.

The DA control valve is only effective if the pilot control device for actuating the HT control is powered from port Y.





Circuit diagram



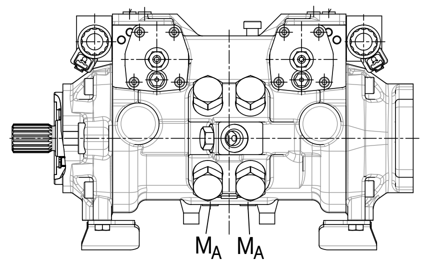
Assignment
Direction of rotation - Control - Flow direction

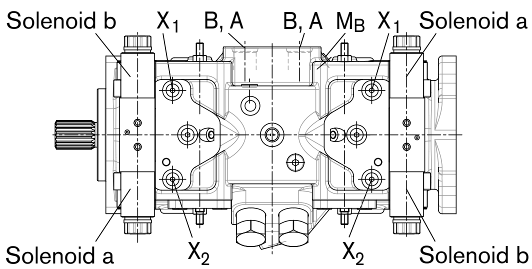
	Pump 1				Pump 2			
Direction of rotation	clockwise		counter-clockwise		clockwise		counter-clockwise	
Control pressure	X_1	X_2	X_1	X_2	X_1	X_2	X_1	X_2
Flow direction	B to A	A to B	A to B	B to A	B to A	A to B	A to B	B to A
Operating pressure	M_A	M_B	M_B	M_A	M_A	M_B	M_B	M_A
Mechanical stroke limiter for forward drive on the side of		X_1		X_1		X_1		X_1

Note
Port for forward drive via X_2 for clockwise rotation.

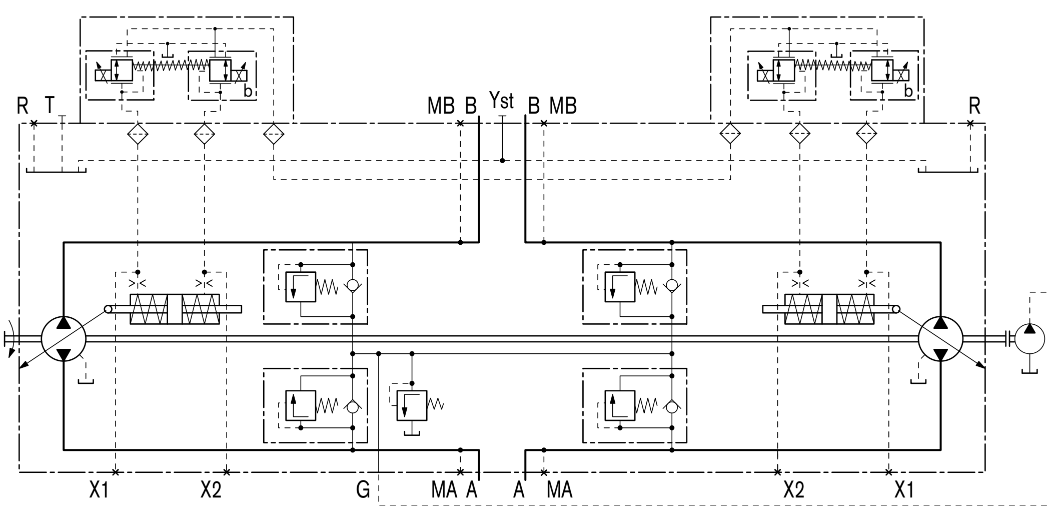
ET – Electric control, direct controlled

The output flow of the pump can be steplessly varied in the range between 0 to 100 %. Depending on the preselected current I (mA) at the solenoids a and b of the pressure reduction valve, the stroke cylinder of the pump is supplied proportional with control pressure. The pump displacement that results from a certain control current is dependent on the speed and operating pressure of the pump. A different flow direction is associated with each pressure reduction valve.





Circuit diagram



Assignment
Direction of rotation - Control - Flow direction

	Pump 1				Pump 2			
Direction of rotation	clockwise		counter-clockwise		clockwise		counter-clockwise	
Actuation of solenoid	a	b	a	b	a	b	a	b
Control pressure	X_1	X_2	X_1	X_2	X_1	X_2	X_1	X_2
Flow direction	B to A	A to B	A to B	B to A	B to A	A to B	A to B	B to A
Operating pressure	M_A	M_B	M_B	M_A	M_A	M_B	M_B	M_A
Mechanical stroke limiter for forward drive on the side of		X_1		X_1		X_1		X_1

Note
Port for forward drive via X_2 for clockwise rotation.

DA control valve, fixed setting

Speed related pilot pressure supply

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 stroke cylinder of the pump by an electromagnetically actuated 4/3-directional valve. The pump displacement can be steplessly varied in each flow direction and is influenced by both the speed of the pump drive and the system pressure. The flow direction (i. e. machine moving forwards or backwards) is determined by either solenoid a or b being activated.

Increasing the drive speed of the pump generates a higher pilot pressure from the DA control valve resulting in increased flow and/or delivery pressure from the pump.

Depending on the selected operating characteristics of the pump, increasing the system pressure (i. e. machine load) will have the effect of swiveling the pump back to a smaller displacement. An overload protection circuit 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.

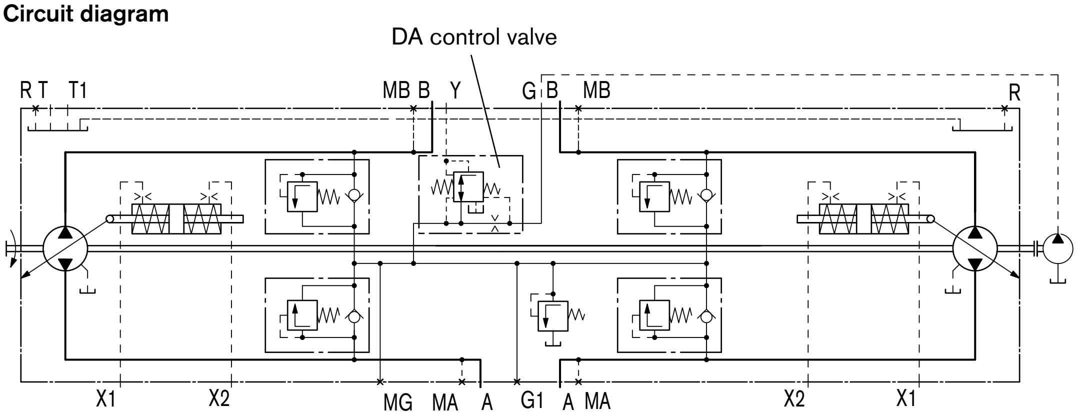
Any additional power requirement, e. g. hydraulic functions from attachments, could cause the speed of the engine to drop further. This will cause a further reduction in pilot pressure and thus of the pump displacement. Automatic power distribution and full exploitation of the available power are achieved 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 the DA control function to allow controlled operation of the implement hydraulics with high rpm at reduced vehicle speed.

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

DA closed loop control is only suitable for certain types of drive system 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 Rexroth application engineer.

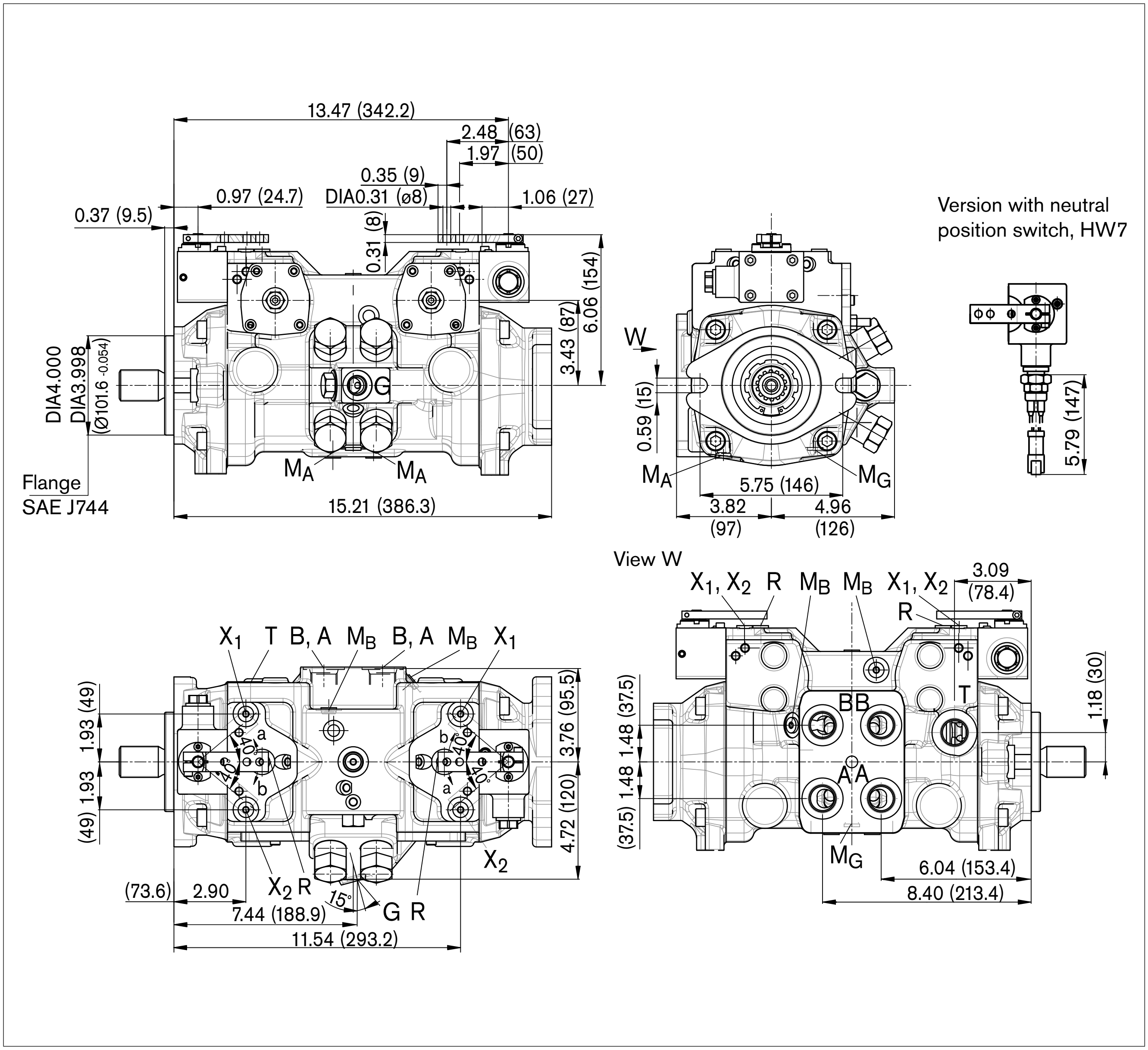
Circuit diagram



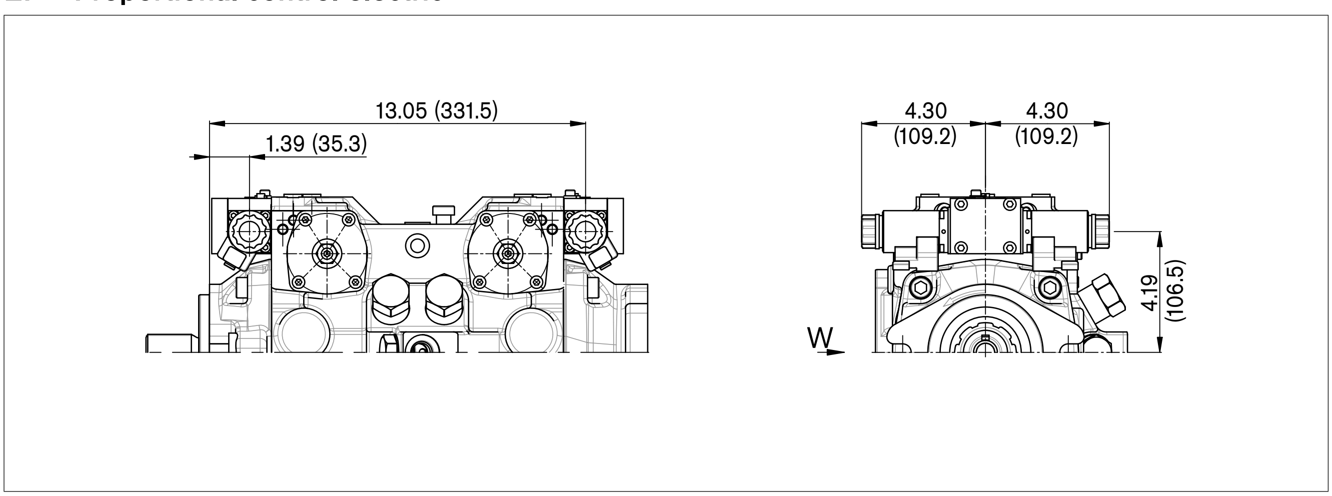
Dimensions size 45

Before finalizing your design, request a binding installation drawing. Dimensions in in (mm).

HW – Proportional control hydraulic, mechanical servo



EP – Proportional control electric

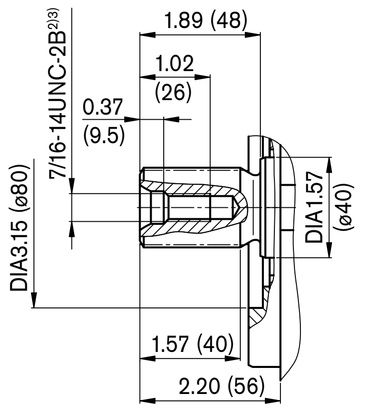


Dimensions size 45

Before finalizing your design, request a binding installation drawing. Dimensions in in (mm).

Drive shaft

S7 Splined shaft 1 1/4 in
14T 12/24DP[1] (SAE J744)



Ports

Designation	Port for	Standard[6)]	Size [in][3)]	Maximum pressure [psi (bar)][4)]		State
				A20VG	A22VG	
A, B	Service line	ISO 11926	1 1/16-12 UN-2B; 0.79 deep	5100 (350)	6100 (420)	O
T	Case drain fluid	ISO 11926	1 1/16-12 UN-2B; 0.79 deep	45 (3)	45 (3)	O
R	Air bleed	ISO 11926	9/16-18 UNF-2B; 0.51 deep	45 (3)	45 (3)	X
X_1, X_2	Control pressure (upstream of orifice)	ISO 11926	9/16-18 UNF-2B; 0.51 deep	580 (40)	580 (40)	X
X_3, X_4[5)]	Stroking chamber pressure	ISO 11926	7/16-20 UNF-2B; 0.47 deep	580 (40)	580 (40)	X
G	Pressure port for auxiliary circuits	ISO 11926	3/4-16 UNF-2B; 0.59 deep	580 (40)	580 (40)	O
M_G	Measuring service line G	ISO 11926	9/16-18 UNF-2B; 0.51 deep	580 (40)	580 (40)	X
M_A, M_B	Measuring pressure A, B	ISO 11926	9/16-18 UNF-2B; 0.51 deep	5100 (350)	6100 (420)	X

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ISO 68
3) Observe the general instructions on page 28 for the maximum tightening torques.
4) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Optional, see page 23
6) The spot face can be deeper than specified in the appropriate standard.

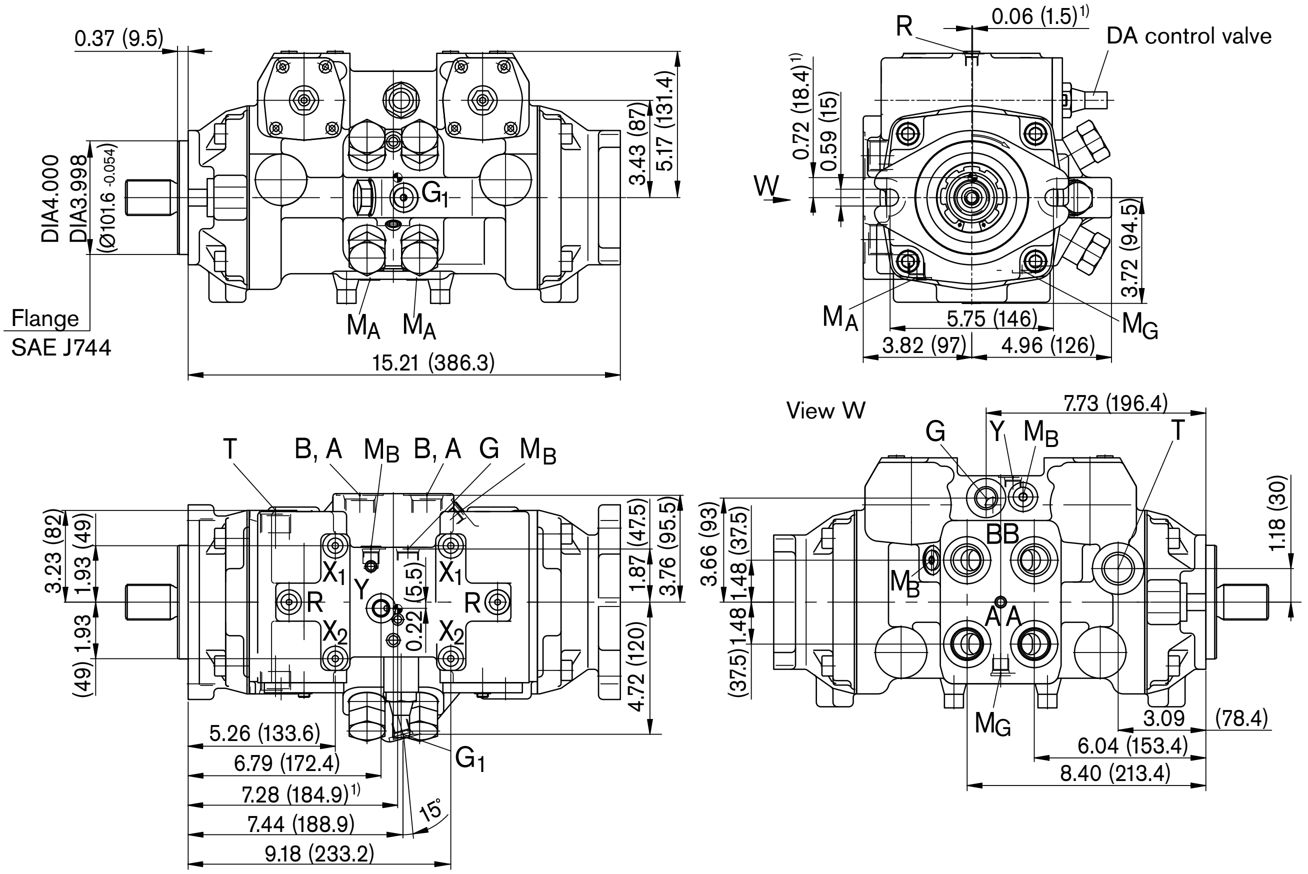
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 45

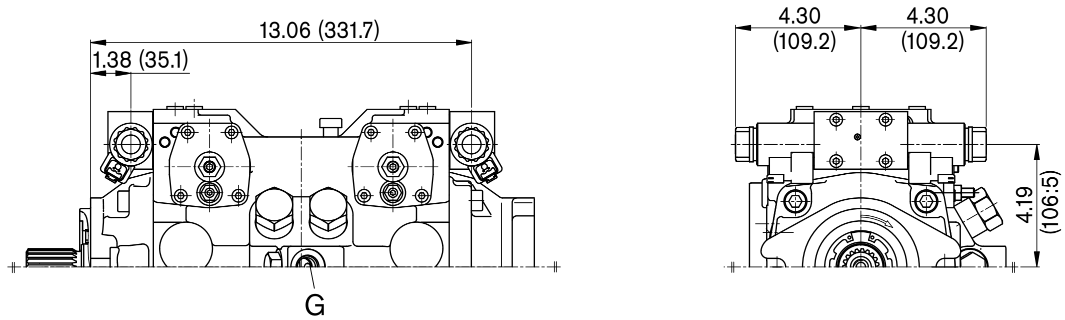
Before finalizing your design, request a binding installation drawing. Dimensions in in (mm).

HT – Hydraulic control, direct controlled, with DA control valve

1) Center of gravity



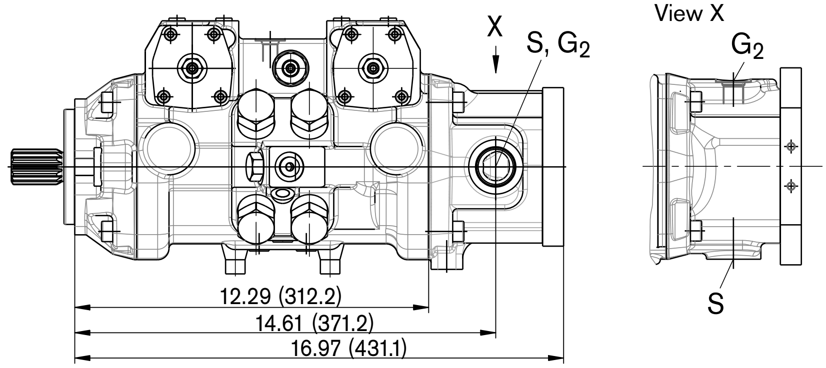
ET – Electric control, direct controlled



Dimensions size 45

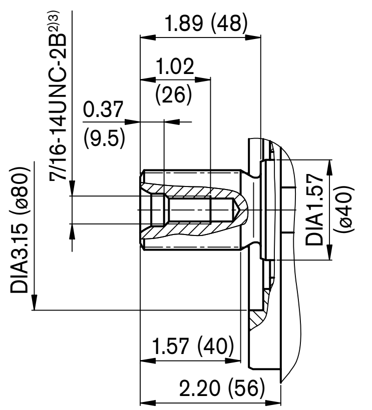
Before finalizing your design, request a binding installation drawing. Dimensions in in (mm).

Version with boost pump



Drive shaft

S7 Splined shaft 1 1/4 in
14T 12/24DP[1] (SAE J744)



Ports

Designation	Port for	Standard[6]	Size [in][3]	Maximum pressure [psi (bar)][4]		State
				A20VG	A22VG	
A, B	Service line	ISO 11926	1 1/16-12 UN-2B; 0.79 deep	5100 (350)	6100 (420)	O
S	Suction line	ISO 11926	1 5/16-12 UN-2B; 0.79 deep	75 (5)	75 (5)	O
T	Case drain fluid	ISO 11926	1 1/16-12 UN-2B; 0.79 deep	45 (3)	45 (3)	O
R	Air bleed	ISO 11926	7/16-20 UNF-2B; 0.47 deep	45 (3)	45 (3)	X
X_1, X_2	Control pressure (upstream of orifice)	ISO 11926	7/16-20 UNF-2B; 0.47 deep	580 (40)	580 (40)	O
X_3, X_4[5]	Stroking chamber pressure	ISO 11926	7/16-20 UNF-2B; 0.47 deep	580 (40)	580 (40)	X
G, G_2	Pressure port for auxiliary circuits	ISO 11926	3/4-16 UNF-2B; 0.59 deep	580 (40)	580 (40)	O
G_1	Pressure port for auxiliary circuits	ISO 11926	9/16-18 UNF-2B; 0.51 deep	580 (40)	580 (40)	X
M_G	Measuring service line G	ISO 11926	9/16-18 UNF-2B; 0.51 deep	580 (40)	580 (40)	X
M_A, M_B	Measuring pressure A, B	ISO 11926	9/16-18 UNF-2B; 0.51 deep	5100 (350)	6100 (420)	X
Y	Pilot pressure port	ISO 11926	9/16-18 UNF-2B; 0.51 deep	580 (40)	580 (40)	X

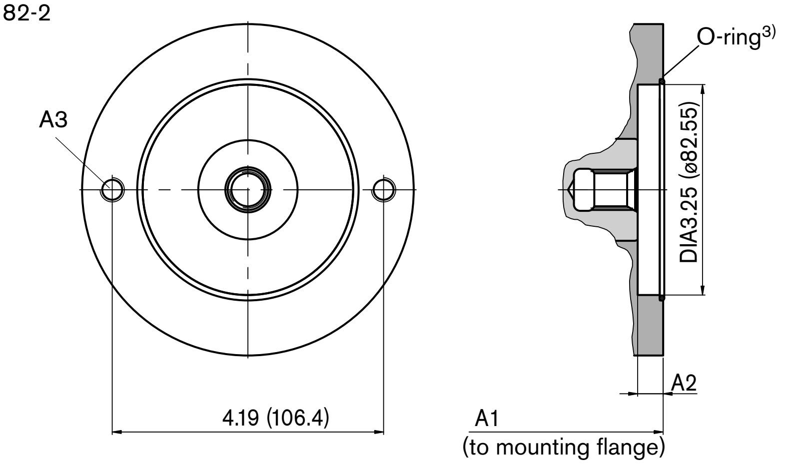
1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ISO 68
3) Observe the general instructions on page 28 for the maximum tightening torques.
4) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Optional, see page 23
6) The spot face can be deeper than specified in the appropriate standard.
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Through drive dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in in (mm).

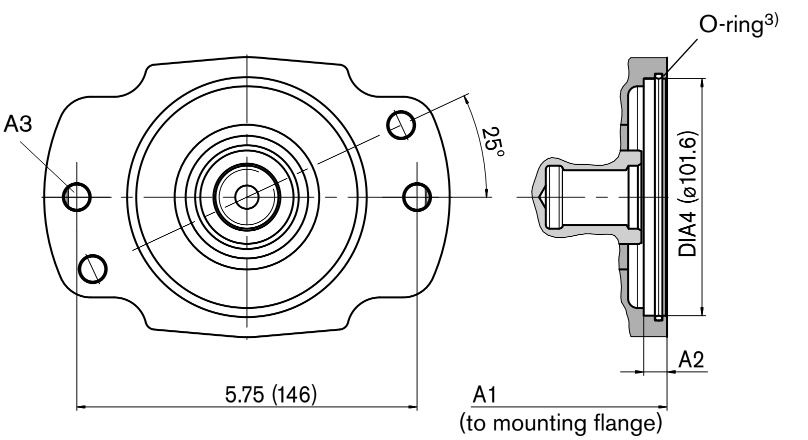
Flange SAE J744	Mounting variant		Coupling for splined shaft[1]				
Diameter	Symbol[2]	Designation	Diameter	Designation			
Without						–	**0000**
82-2 (A)	⚯	A2	5/8 in 9T 16/32DP	S2		●	**A2S2**
101-2 (B)	⚯	B2	7/8 in 13T 16/32DP	S4		●	**B2S4**
			1 in 15T 16/32DP	S5		●	**B2S5**

82-2



NG		A1	A2	A3 [in][4]
45	in	14.85	0.39	3/8-16 UNC-2B; 0.69 deep
	mm	377.2	10	

101-2



NG		A1	A2	A3 [in][4]
45	in	15.21	0.39	1/2-13 UNC-2B; 0.73 deep
	mm	386.3	10	

1) Coupling for splined shaft according to ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Order of fixing bores viewed from through drive
3) O-ring included in the delivery contents
4) Thread according to ISO 68, observe the general instructions on page 28 for the maximum tightening torques.

Overview of attachments

Through drive			**Attachment – 2nd pump**		
Flange	Coupling for splined shaft	Short code	AA10VG NG (shaft)	A10V(S)O/53 NG (shaft)	External gear pump
82-2 (A)	5/8 in	A2S2	–	10 (U)	Size F NG4 to 22[1)]
101-2 (B)	7/8 in	B2S4	18 (S)	28 (S, R) 45 (U, W)	Size N NG20 to 32[1)] Size G NG38 to 45[1)]
	1 in	B2S5	28 (S), 45 (S)	45 (S, R) 60 (U, W)	–

1) Rexroth recommends special versions of the gear pumps. Please contact us.

Combination pumps

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:
A20VG045HT100100/11ARNB2S73UB2S4A-0 + AZPN....

The A20VG/A22VG variable double pump is permissible without additional supports where the dynamic acceleration does not exceed maximum 10 $g = 322$ ft/s^2 (= 98.1 m/s^2). When mounting another pump on the A20VG/A22VG, the mounting flange must be rated for the permissible mass torque.

Boost pump

The boost pump permanently feeds a sufficient volume of fluid (feed volume) from the reservoir to the low-pressure side of the closed circuit via a check valve to compensate for internal leakage within the variable pump and consumers.

The boost pump is an internal gear pump that is driven directly via the drive shaft.

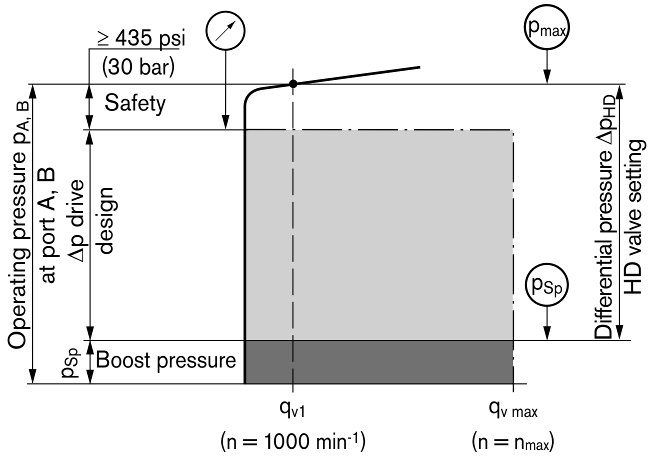
The pressure port G_2 on the boost pump must be externally connected by pipe with port G by the customer. Suction or pressure filtration must be provided by the customer.

High-pressure relief valves

The two high-pressure relief valves protect the hydrostatic transmission (pump and motor) from overload. 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 spikes or high rates of pressure change.

Setting diagram



When ordering, state differential pressure setting in plain text:
The differential pressure setting is preset in the range
$\Delta p = 3600$ to 4650 psi (250 to 320 bar) (A20VG) and
$\Delta p = 3600$ to 5650 psi (250 to 390 bar) (A22VG)
in steps of 145 psi (10 bar).
If not specified in the order, the valves are set to
$\Delta p = 4100$ psi (280 bar) (A20VG) and
$\Delta p = 4800$ psi (330 bar) (A22VG).

High-pressure relief valve A (for pump 1 and 2)
Differential pressure setting ____________ Δp_{HD} = ... psi (bar)

Opening pressure of the HD valve (at $q_{V\,1}$)__ p_{max} = ... psi (bar)
($p_{max} = \Delta p_{HD} + p_{Sp}$)

High-pressure relief valve B (for pump 1 and 2)
Differential pressure setting ____________ Δp_{HD} = ... psi (bar)

Opening pressure of the HD valve (at $q_{V\,1}$)__ p_{max} = ... psi (bar)
($p_{max} = \Delta p_{HD} + p_{Sp}$)

Note
The valve settings are made at **n = 1000 rpm** and at **$V_{g\,max}$ ($q_{v\,1}$)**. There may be deviations in the opening pressures with other operating parameters.

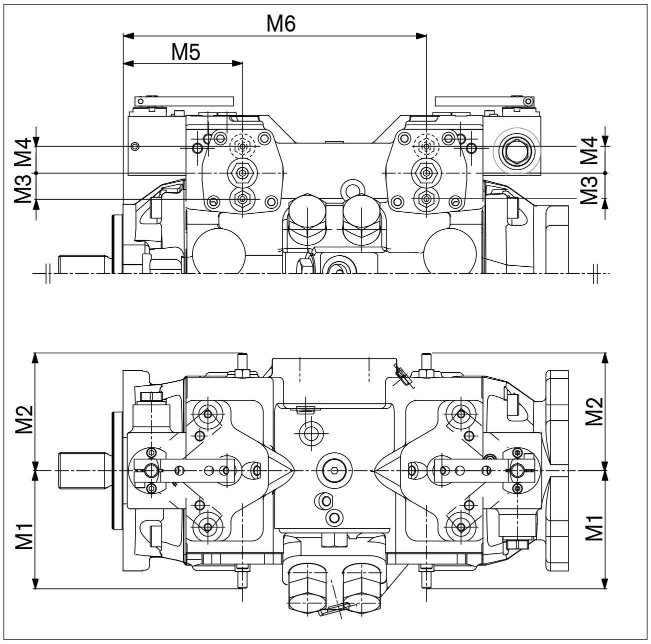
Mechanical stroke limiter

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

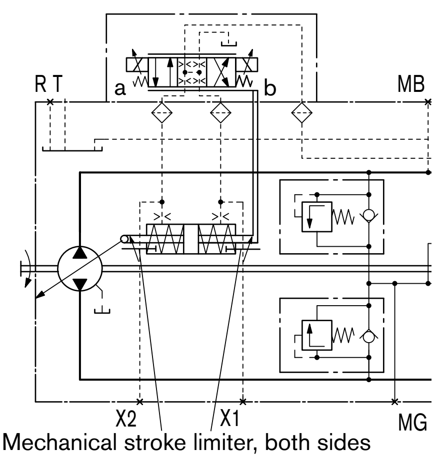
The stroke of the stroke cylinder and hence the maximum swivel angle of the pump are limited by means of two adjusting screws.

Dimensions

NG		M1	M2	M3	M4	M5	M6
45	in	3.82	4	0.89	0.89	4.08	10.36
	mm	97	101.5	22.5	22.5	103.6	263.2



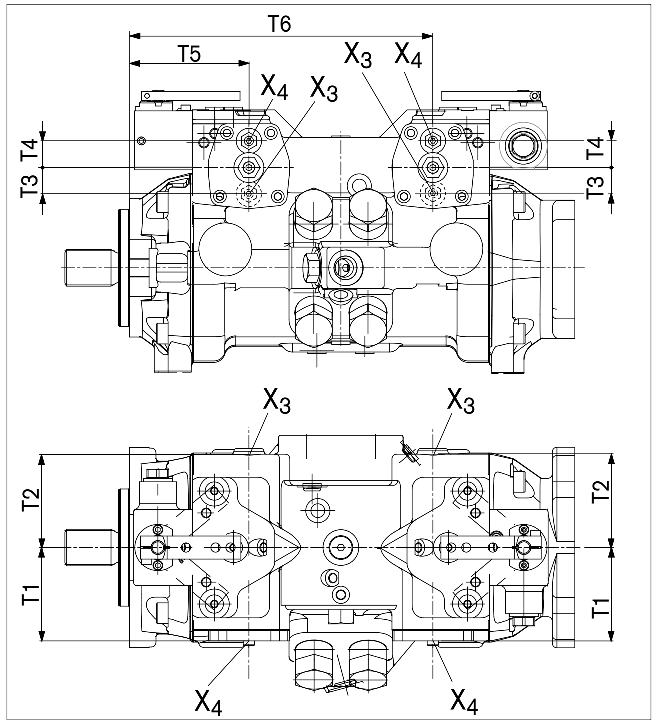
Circuit diagram



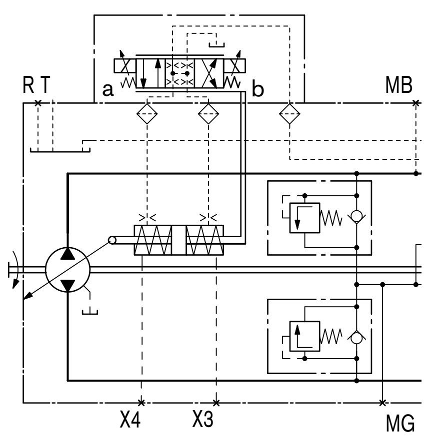
Mechanical stroke limiter, both sides

Ports X_3 and X_4 for stroking chamber pressure

NG		T1	T2	T3	T4	T5	T6
45	in	3.13	3.11	0.93	0.83	4.08	10.36
	mm	79.5	79	23.5	21	103.6	263.2



Circuit diagram



Designation	Port for	Standard[3]	Size [in][1]	Maximum pressure [psi (bar)][2]		State
				A20VG	A22VG	
X_3, X_4	Stroking chamber pressure	ISO 11926	7/16-20 UNF-2B; 0.47 deep	580 (40)	580 (40)	X

1) Observe the general instructions on page 28 for the maximum tightening torques.
2) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) The spot face can be deeper than specified in the appropriate standard.

Before finalizing your design, request a binding installation drawing. Dimensions in in (mm).

Sensors

Before finalizing your design, request a binding installation drawing. Dimensions in in (mm).

Electric swivel angle sensor

For the swivel angle indicator, the pump swivel position is measured by an electric swivel angle sensor.

As an output parameter, the Hall effect swivel angle sensor delivers a voltage proportional to the swivel angle (see table of output voltages).

The swivel angle sensor is suitable for swivel angle monitoring. Please contact us if the swivel angle sensor is used for control.

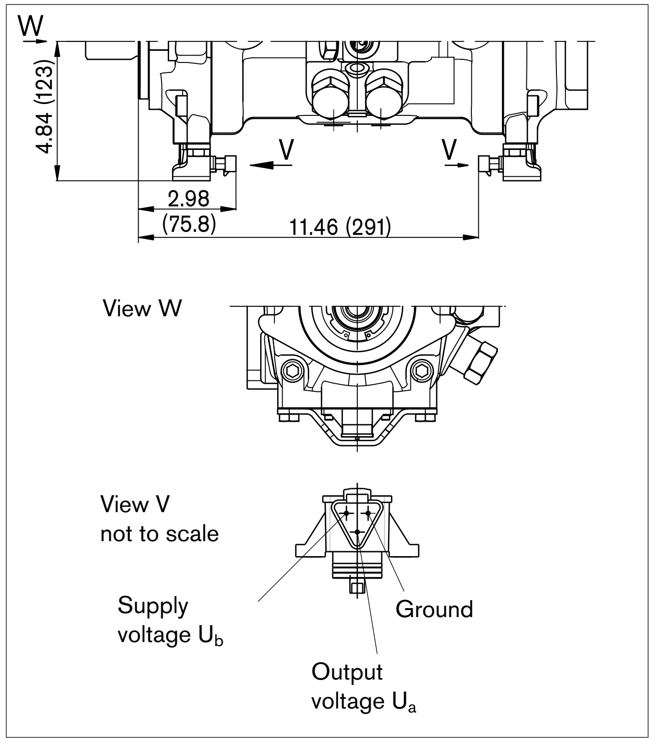
Characteristics			
Supply voltage U_b	10 to 30 V DC		
Output voltage U_a	1 V ($V_{g\,max}$)	2.5 V ($V_{g\,0}$)	4 V ($V_{g\,max}$)
Reverse-connect protection	Short circuit-resistant		
EMC resistance	Details on request		
Operating temperature range	-40 °F to +240 °F (-40 °C to +115 °C)		
Vibration resistance sinusoidal vibration EN 60068-2-6	10*g* / 5 to 2000 Hz		
Shock resistance continuous shock IEC 68-2-29	25*g*		
Resistance to salt spray DIN 50 021-SS	96h		
Type of protection DIN/EN 60529	IP67 and IP69K		
Case material	Plastic		

Output voltage

Direction of rotation	Flow direction[1]	Operating pressure	Output voltage
cw	B to A	M_A	> 2.5 V
cw	A to B	M_B	< 2.5 V
ccw	A to B	M_B	> 2.5 V
ccw	B to A	M_A	< 2.5 V

1) For flow direction, see controls

Dimensions



Mating connector

DEUTSCH DT06-3S-EP04,
Rexroth Mat. No. R902603524

Consisting of: DT designation

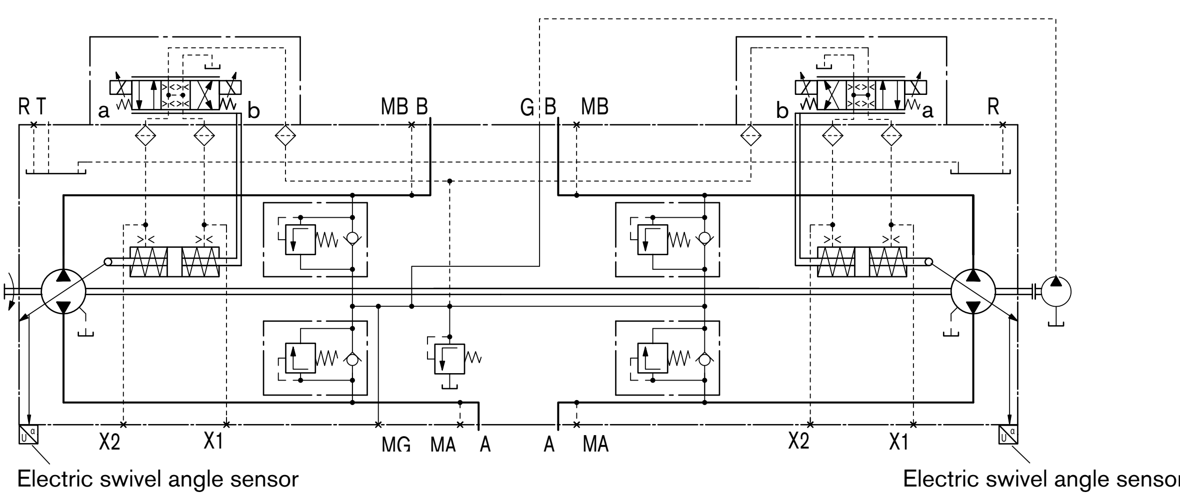
– 1 case ______ DT06-3S-EP04

– 1 wedge ______ W3S

– 3 female connectors ______ 0462-201-16141

The mating connector is not included in the delivery contents. This can be supplied by Rexroth on request.

Circuit diagram



Installation situation for coupling assembly

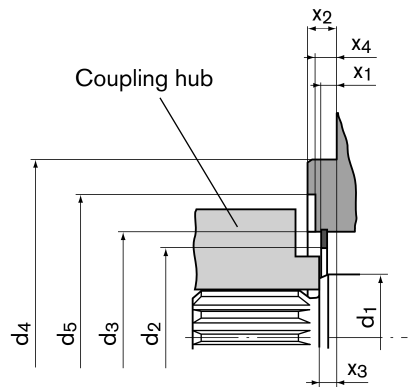
Before finalizing your design, request a binding installation drawing. Dimensions in in (mm).

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

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

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

Please observe diameter d_5 of the free turning.



NG	Mounting flange		$ød_1$	$ød_{2\ min}$	$ød_3$	$ød_4$	$ød_5$	x_1	x_2	x_3 (approx.)	x_4
45	101-2 (B)	in	1.57	2.02	2.48 ±0.004	4	3.15	0.169	0.374 $_{-0.02}$	0.28	0.315 $_{-0.024}$
		mm	40	51.4	63 ±0.1	101.6	80	4.3	9.5 $_{-0.5}$	7	8 $_{-0.6}$

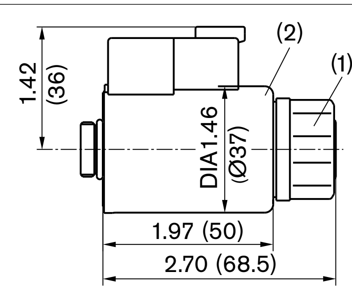
Connector for solenoids

DEUTSCH DT04-2P-EP04, 2-pin

Molded, without bidirectional suppressor diode ____________ P

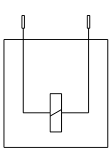
Type of protection according to DIN/EN 60529 ________ IP67

Type of protection according to DIN 40050-9 ________ IP69K



Circuit symbol

Without bidirectional suppressor diode



Mating connector

DEUTSCH DT06-2S-EP04
Rexroth Mat. No. R902601804

Consisting of: DT designation

– 1 case ________________________________ DT06-2S-EP04

– 1 wedge ____ W2S

– 2 female connectors ___________________ 0462-201-16141

The mating connector is not included in the delivery contents. This can be supplied by Rexroth on request.

Changing connector position

If necessary, you can change the position of the connector by turning the solenoid.

To do this, proceed as follows:

1. Loosen the fixing nut (1) of the solenoid. To do this, turn the fixing nut (1) one turn counter-clockwise.
2. Turn the solenoid body (2) to the desired position.
3. Retighten the fixing nut. Tightening torque of the fixing nut: 3.7+0.7 lb-ft (5+1 Nm) (WAF1.02 (26), 12-sided DIN 3124)

On delivery, the position of the connector may differ from that shown in the brochure or drawing.

Installation instructions

General

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

The case drain fluid in the pump case must be directed to the tank via the highest tank port (T).

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

In all operating conditions, the suction and case drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure, it must not, however, be higher than $h_{S\,max} = 31.5$ in (800 mm). The minimum suction pressure at port S must also not fall below 12 psi (0.8 bar) absolute during operation (cold start 7.5 psi (0.5 bar) absolute).

Installation Position

See the following examples 1 to 16.
Additional installation positions are available upon request.

Recommended installation position:

- Without boost pump 1 and 2.
- With boost pump 5 and 6

Note

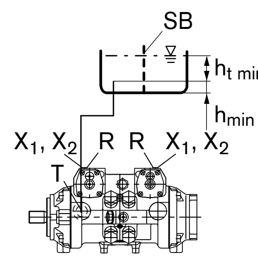
– If a filling of the stroking chambers via X1 to X4 in the finalinstallation position is not possible, then this must be effected before installation.

– To prevent unexpected actuation and damage, the stroking chambers must be air bled via the ports X1, X2, and/or X3, X4 in accordance with the installation positions.

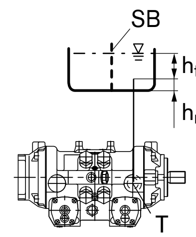
Below-tank installation (standard)

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

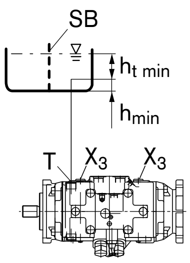
1 Without boost pump



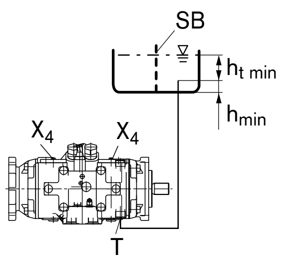
2 Without boost pump



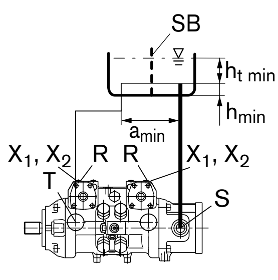
3 Without boost pump



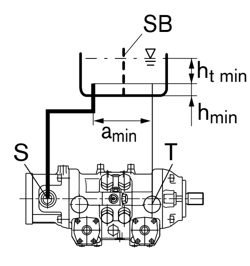
4 Without boost pump



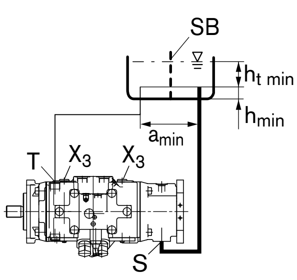
5 With boost pump



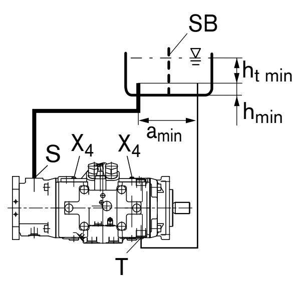
6 With boost pump



7 With boost pump



8 With boost pump



Installation Position	Air bleed case	Air bleed stroking chamber	Filling
1	R	X_1, X_2	$T + X_1 + X_2$
2	–	–	T
3	–	X_3	$T + X_3$
4	–	X_4	$T + X_4$
5	R	X_1, X_2	$S + T + X_1 + X_2$
6	–	–	S + T
7	–	X_3	$S + T + X_3$
8	–	X_4	$S + T + X_4$

Observe the notes!

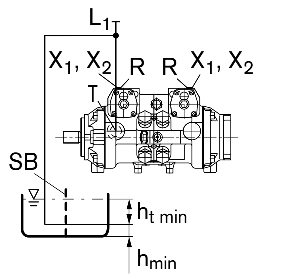
Installation instructions

Above-tank installation

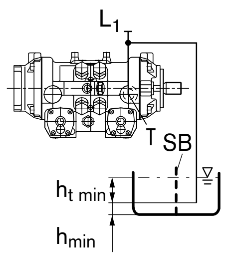
Above-tank installation is when the axial piston unit is installed above the minimum fluid level of the tank.

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

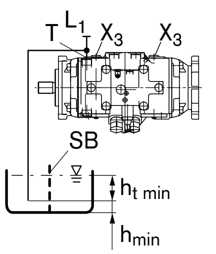
9 Without boost pump



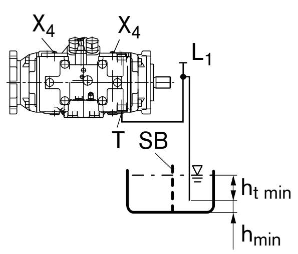
10 Without boost pump



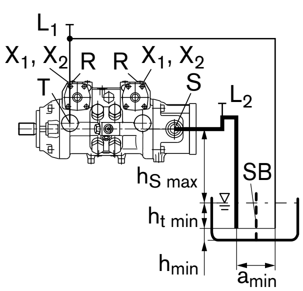
11 Without boost pump



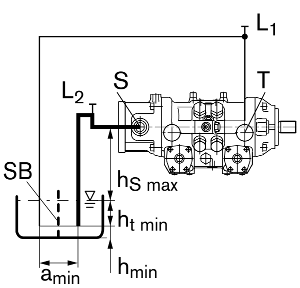
12 Without boost pump



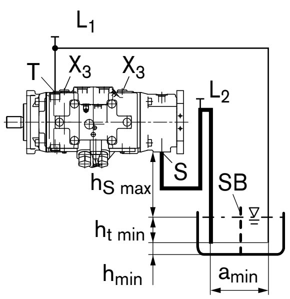
13 With boost pump



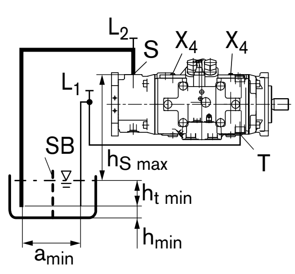
14 With boost pump



15 With boost pump



16 With boost pump



Installation Position	Air bleed case	Air bleed stroking chamber	Filling
9	R	X_1, X_2	$L_1 + X_1 + X_2$
10	L_1	–	L_1
11	L_1 (T)	X_3	L_1 (T) + X_3
12	L_1	X_4	$L_1 + X_4$
13	R + L_2 (S)	X_1, X_2	$L_1 + L_2$ (S) + $X_1 + X_2$
14	$L_1 + L_2$ (S)	–	$L_1 + L_2$ (S)
15	L_1 (T) + L_2	X_3	L_1 (T) + $L_2 + X_3$
16	$L_1 + L_2$ (S)	X_4	$L_1 + L_2$ (S) + X_4

Observe the notes on page 26!

L Filling / air bleed

R Air bleed port

S Suction port

T Tank port

SB Baffle (baffle plate)

$h_{t\,min}$ Minimum permissible immersion depth (7.87 in (200 mm))

h_{min} Minimum permissible spacing to tank base (3.94 in (100 mm))

$h_{S\,max}$ Maximum permissible suction height (31.5 in (800 mm))

a_{min} When designing the tank, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

General instructions

– The A20VG/A22VG pump is designed to be used in a closed circuit.

– Project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.

– Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Rexroth.

– During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).

– Depending on the operational state of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.

– Service line ports:

- The ports and fixing 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 operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.

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

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

– The product is not approved as a component for the safety concept of a general machine according to DIN EN ISO13849.

– The following tightening torques apply:

- Fittings:
  Observe the manufacturer's instruction regarding the tightening torques of the used fittings.

- Fixing screws:
  For fixing screws according to DIN 13/ ISO 68 , we recommend checking the tightening torque individually according to VDI 2230.

- Threaded hole for axial piston unit:
  The maximum permissible tightening torques $M_{G\ max}$ are maximum values for the threaded holes and must not be exceeded. For values, see the following table.

- Locking screws:
  For the metal locking screws supplied with the axial piston unit, the required tightening torques of the locking screws M_V apply. For values, see the following table.

Ports Standard	Threaded sizes	Maximum permissible tightening torque of the threaded holes $M_{G\ max}$	Required tightening torque of the locking screws M_V	WAF hexagon socket for the locking screws
ISO 11926	7/16-20 UNF-2B	30 lb-ft	11 lb-ft	3/16 in
		40 Nm	15 Nm	
	9/16-18 UNF-2B	59 lb-ft	18 lb-ft	1/4 in
		80 Nm	25 Nm	
	3/4-16 UNF-2B	118 lb-ft	46 lb-ft	5/16 in
		160 Nm	62 Nm	
	1 1/16-12 UN-2B	266 lb-ft	108 lb-ft	9/16 in
		360 Nm	147 Nm	
	1 5/16-12 UN-2B	398 lb-ft	146 lb-ft	5/8 in
		540 Nm	198 Nm	

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