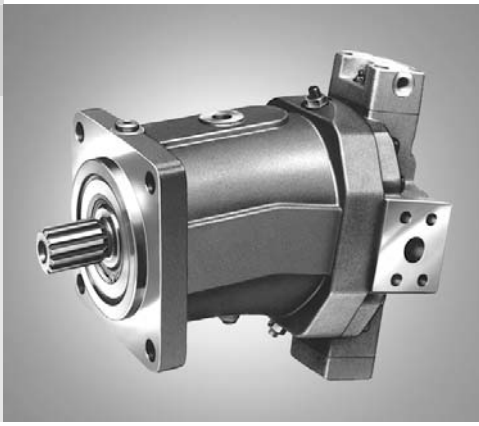
Axial Piston Variable Motor AA6VM (A6VM)

RA 91604-A/07.09 1/76
Replaces: 03.09

Data sheet



Series 6

Size	Nominal pressure/Peak pressure
28 to 200	5800 ps (400 bar) / 6500 psi (450 bar)
250 to1000	5100 psi (350 bar) / 5800 psi (400 bar)

Open and closed circuits

Contents

Features

- Variable motor with an axial tapered piston rotary group of bent-axis design for hydrostatic drives in open and closed circuits
- For use in mobile and stationary application areas
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The displacement is infinitely variable from $V_{g\,max}$ to $V_{g\,min} = 0$.
- The output speed depends on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high and low pressure side and with increasing displacement.
- Wide control range with hydrostatic transmission
- Wide selection of control devices
- Cost savings through elimination of gear shifts and possibility of using smaller pumps
- Compact, robust bearing system with long service life
- High power density
- Good starting characteristics
- Low moment of inertia

Ordering code / Standard program

	AA6V		M					/	63	W		–	V								–	
01	02	03	04	05	06	07	08		09	10	11		12	13	14	15	16	17	18	19		20

Hydraulic fluid

01	Mineral oil and HFD. HFD for sizes 250 to 1000 only in combination with long-life bearing "L" (without code)		
	HFB, HFC hydraulic fluid	Sizes 28 to 200 (without code)	
		Sizes 250 to 1000 (only in combination with long-life bearing "L")	**E**

Axial piston unit

			28	55	80	107	140	160	200	250	355	500	1000	
02	Bent-axis design, variable	Version SAE	–	●	●	●	–	●	●	●	–	–	–	**AA6V**
		Version ISO	●	1)	1)	1)	●	1)	1)	1)	●	●	●	**A6V**

Drive shaft bearing

		28...200	250	355	500	1000	
03	Standard bearing (without code)	●	●	●	●	–	
	Long-life bearing	–	●	●	●	●	**L**

Operation mode

04	Motor (plug-in-motor A6VE see RE 91606)	**M**

Size

05	≈ Displacement $V_{g\,max}$	in^3 / rev	**1.71**	**3.34**	**4.88**	**6.53**	**8.54**	**9.76**	**12.20**	**15.25**	**21.66**	**30.51**	**61.02**
		in cm^3 / rev	**28**	**55**	**80**	**107**	**140**	**160**	**200**	**250**	**355**	**500**	**1000**

Control device

			28	55	80	107	140	160	200	250	355	500	1000	
06	Hydraulic control, pilot-pressure related	Δp = 145 psi (10 bar)	●	●	●	●	●	●	●	●	●	●	●	**HD1**
		Δp = 365 psi (25 bar)	●	●	●	●	●	●	●	●	●	●	●	**HD2**
		Δp = 510 psi (35 bar)	–	–	–	–	–	–	–	●	●	●	●	**HD3**
	Hydraulic two-point control		–	–	–	–	–	–	–	●	●	●	●	**HZ**
			●	–	–	–	●	●	●	–	–	–	–	**HZ1**
			–	●	●	●	–	–	–	–	–	–	–	**HZ3**
	Electric control, proportional	12V	●	●	●	●	●	●	●	●	●	●	●	**EP1**
		24V	●	●	●	●	●	●	●	●	●	●	●	**EP2**
	Electric two-point control	12V	●	–	–	–	●	●	●	●	●	●	●	**EZ1**
		24V	●	–	–	–	●	●	●	●	●	●	●	**EZ2**
		12V	–	●	●	●	–	–	–	–	–	–	–	**EZ3**
		24V	–	●	●	●	–	–	–	–	–	–	–	**EZ4**
	Automatic control, high-pressure related	Without pressure increase	●	●	●	●	●	●	●	●	●	●	●	**HA1**
		With pressure increase Δp = 1450 psi (100 bar)	●	●	●	●	●	●	●	●	●	●	●	**HA2**
	Hydraulic control, speed related p_{St}/p_{HD} = 3/100,	Hydraulic travel direction valve	–	–	–	–	–	–	–	●	●	●	❍	**DA**
	p_{St}/p_{HD} = 5/100,	Hydraulic travel direction valve	●	●	●	●	●	●	●	–	–	–	–	**DA1**
		Electric travel direction valve + el. $V_{g\,max}$ control 12V	●	●	●	●	●	●	●	–	–	–	–	**DA2**
		Electric travel direction valve + el. $V_{g\,max}$ control 24V	●	●	●	●	●	●	●	–	–	–	–	**DA3**
	p_{St}/p_{HD} = 8/100,	Hydraulic travel direction valve	●	●	●	●	●	●	●	–	–	–	–	**DA4**
		Electric travel direction valve + el. $V_{g\,max}$ control 12V	●	●	●	●	●	●	●	–	–	–	–	**DA5**
		Electric travel direction valve + el. $V_{g\,max}$ control 24V	●	●	●	●	●	●	●	–	–	–	–	**DA6**

Pressure control (only for HD, EP)

			28	55	80	107	140	160	200	250	355	500	1000	
07	Without pressure control (without code)		●	●	●	●	●	●	●	●	●	●	●	
	Pressure control,	Direct	●	●	●	●	●	●	●	●	●	●	●	**D**
		Direct, with 2nd pressure setting	●	●	●	●	●	●	●	2)	2)	2)	2)	**E**
		Remote	–	–	–	–	–	–	–	●	●	●	●	**G**

Ordering code / Standard program

	AA6V		M					/	63	W		–	V								–	
01	02	03	04	05	06	07	08		09	10	11		12	13	14	15	16	17	18	19		20

Overriding HA control (for HA1, HA2 only)

			28	55	80	107	140	160	200	250	355	500	1000	
08	Without override (without code)		●	●	●	●	●	●	●	●	●	●	●	
	Hydraulic override		●	●	●	●	●	●	●	●	●	●	●	T
	Electric override	12V	●	●	●	●	●	●	●	–	–	–	–	U1
		24V	●	●	●	●	●	●	●	–	–	–	–	U2
	Electric override + electric travel direction valve	12V	●	●	●	●	●	●	●	–	–	–	–	R1
		24V	●	●	●	●	●	●	●	–	–	–	–	R2

Series

09	Series 6, index 3	63

Direction of rotation

10	Viewed from shaft end, alternating	W

Setting range for displacement [3]

			28	55	80	107	140	160	200	250	355	500	1000	
11	$V_{g\,min} = 0$ to 0.7 $V_{g\,max}$ (without code)		●	●	●	●	●	●	●	–	–	–	–	
	$V_{g\,min} = 0$ to 0.4 $V_{g\,max}$	$V_{g\,max} = V_{g\,max}$ to 0.8 $V_{g\,max}$	–	–	–	–	–	–	–	●	●	●	●	1
	$V_{g\,min} > 0.4\ V_{g\,max}$ to 0.8 $V_{g\,max}$	$V_{g\,max} = V_{g\,max}$ to 0.8 $V_{g\,max}$	–	–	–	–	–	–	–	●	●	●	●	2

Seals

12	FKM (fluor-caoutchouc)	V

Shaft end

			28	55	80	107	140	160	200	250	355	500	1000	
13	Version SAE (AA6VM)	Splined shaft ANSI B92.1a-1976	–	●	●	●	–	●	●	●	–	–	–	S
	Version ISO (A6VM)	Splined shaft DIN 5480	●	–	–	–	–	–	–	–	–	–	–	A
			●	–	–	–	●	–	–	–	●	●	●	Z
		Parallel keyed DIN 6885	–	–	–	–	–	–	–	–	●	●	●	P

Mounting flange

			28	55	80	107	140	160	200	250	355	500	1000	
14	Version SAE (AA6VM)	SAE J744 – 2-bolt	–	–	●	–	–	–	–	–	–	–	–	C
		SAE J744 – 4-bolt	–	●	–	●	–	●	●	●	–	–	–	D
	Version ISO (A6VM)	ISO 3019-2 – 4-hole	●	–	–	–	●	–	–	–	–	–	–	B
		ISO 3019-2 – 8-hole	–	–	–	–	–	–	–	–	●	●	●	H

Service line port [4]

					28	55	80	107	140	160	200	250	355	500	1000	
15	Version SAE (AA6VM)	SAE flange ports A/B, rear (UN threads)	51	0	–	●	●	●	–	●	●	●	–	–	–	510
				7	–	●	●	●	–	●	●	●	–	–	–	517
		SAE flange ports A/B side, opposite (UN threads)	52	0	–	●	●	●	–	●	●	●	–	–	–	520
				7	–	●	●	●	–	●	●	●	–	–	–	527
		Port plate with pressure-relief valves,	37	0	–	–	–	●	–	–	–	–	–	–	–	370
		For mounting a counterbalance valve [5][6]	38	0	–	●	●	●	●	●	–	–	–	–	–	380
	Version ISO (A6VM)	SAE flange ports A/B, rear (metric threads)	01	0	●	–	–	–	●	–	–	–	●	●	●	010
				7	●	–	–	–	●	–	–	–	●	●	●	017
		SAE flange ports A/B side, opposite (metrics threads)	02	0	●	–	–	–	●	–	–	–	●	●	●	020
				7	●	–	–	–	●	–	–	–	●	●	●	027
		SAE flange ports A/B side, opposite + rear	15	0	–	–	–	–	–	–	–	–	●	●	●	150

Valves

Without valve	0
With flush and boost pressure valve	7

Ordering code / Standard program

	AA6V		M					/	63	W		–	V								–	
01	02	03	04	05	06	07	08		09	10	11		12	13	14	15	16	17	18	19		20

	Speed measurement	**28**	**55**	**80**	**107**	**140**	**160**	**200**	**250**	**355**	**500**	**1000**	
16	Without speed measurement (without code)	●	●	●	●	●	●	●	●	●	●	●	
	Prepared for speed measurement (ID) [7]	●	●	●	●	●	●	●	–	–	–	–	**D**
	Prepared for speed measurement (HDD) [7]	–	●	●	●	●	●	●	●	●	●	❍	**F**

	Swivel angle indicator	**28**	**55**	**80**	**107**	**140**	**160**	**200**	**250**	**355**	**500**	**1000**	
17	Without swivel angle indicator (without code)	●	●	●	●	●	●	●	●	●	●	–	
	With optical swivel angle indicator	–	–	–	–	–	–	–	●	●	●	●	**V**
	With Electric swivel angle indicator	–	–	–	–	–	–	–	●	●	●	●	**E**

	Connector for solenoids (only sizes 28 to 200) [8]	**EP1/2**	**EZ1/2**	**EZ3/4**	**HA.U.**	**HA.R.[9]**	**DA.**	
18	DEUTSCH - molded connector, 2-pin – without suppressor diode	●	●	❍	❍	●	●	**P**
	DEUTSCH - molded connector, 2-pin – with suppressor diode	–	❍	–	–	–	❍	**Q**
	HIRSCHMANN - connector – without suppressor diode	▲	▲	▲	▲	▲	▲	**H**

	Start of control	**28**	**55**	**80**	**107**	**140**	**160**	**200**	**250**	**355**	**500**	**1000**	
19	At $V_{g\,min}$ (standard for HA)	●	●	●	●	●	●	●	●	●	●	●	**A**
	At $V_{g\,max}$ (standard for HD, HZ, EP, EZ, DA)	●	●	●	●	●	●	●	●	●	●	●	**B**

Standard / special version[9])

20	Standard version	(without code)	
		With attachment part combined	**-K**
	Special version		**-S**
		With attachment part combined	**-SK**

1) ISO-Version see RE 91604
2) Supplied as standard with version D (sizes 250 to 1000)
3) Please specify precise setting for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering: $V_{g\,min}$ = ... cm^3, $V_{g\,max}$ = ... cm^3
4) Metric fixing thread
5) Only possible in combination with HD, EP, HA control
6) Complete order recommended, counterbalance valve pages 68...70
7) Complete order recommended, speed sensor page 72...73
8) The HIRSCHMANN connector – without suppressor diode is only standard with sizes 250 to 1000 (without code)
9) With HA.R1 and HA.R2 for the 2nd solenoid (DIA 45), the version with DEUTSCH molded connector is available on request.
9) Adjustment data are included in the material number

● = available ❍ = on request ▲ = not for new projects – = not available

= preferred program

Technical data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids) and RE 90223 (HF hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

The (A)A6VM variable motor is not suitable for operation with HFA. If HFB, HFC and HFD or environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and seals mentioned in RE 90221 and RE 90223 must be observed.

When ordering, please indicate the used hydraulic fluid.

Operating viscosity range

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

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

depending on the circuit temperature (closed circuit) and tank temperature (open circuit).

Limits of viscosity range

The limiting values for viscosity are as follows:

Sizes 28 to 200:

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

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

Sizes 250 to 1000:

ν_{min} = 60 SUS (10 mm²/s)
short-term (t < 3 min)
at max. perm. temperature of t_{max} = +195°F (+90°C)

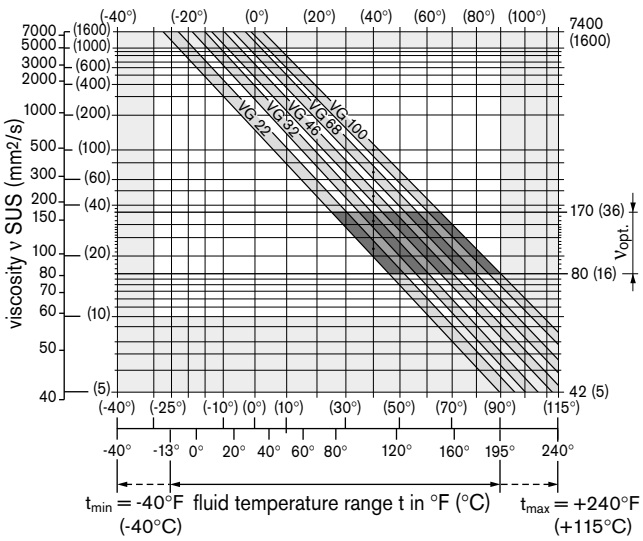
ν_{max} = 4600 SUS (1000 mm²/s)
short-term (t < 3 min)
at cold start (p ≤ 435 psi / 30 bar, n ≤ 1000 rpm, t_{min} = -13°F / -25°C)
Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Note that the maximum hydraulic fluid temperature of 240°F (115°C) (+195°F / +90°C for size 250 to 1000) must not be exceeded locally either (e.g. in the bearing area). The temperature in the bearing area is - depending on pressure and speed - up to 22°F (12 K) higher than the average case drain temperature.

Special measures are necessary in the temperature range from -40°F and -13°F (-40°C and -25°C). Please contact us.

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

Selection diagram



Details regarding the choice of hydraulic fluid

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

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

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

Please note:
The case drain temperature, which is affected by pressure and speed, is always higher than the circuit temperature or tank temperature. At no point in the system may the temperature be higher than 240°F (115°C) for sizes 28 to 200 or 195°F (90°C) for sizes 250 to 1000.

If the above conditions cannot be maintained due to extreme operating parameters, we recommend flushing the case at port U or using a flush and boost pressure valve (see pages 66-67).

Technical data

Filtration

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

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

20/18/15 according to ISO 4406.

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

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

If the classes specified above cannot be maintained, please contact us.

Operating pressure range

Maximum pressure on port A or B
(pressure data in according to DIN 24312)

for sizes 28 to 200

Nominal pressure p_N _____ 5800 psi (400 bar)*
Peak pressure p_{max} _____ 6500 psi (450 bar)*
Total pressure (press. A + press. B) p_{max} __ 10150 psi (700 bar)

*) Size 80: p_N = 5100 psi (350 bar), p_{max} = 5800 psi (400 bar)

for sizes 250 to 1000

Nominal pressure p_N _____ 5100 psi (350 bar)
Peak pressure p_{max} _____ 5800 psi (400 bar)
Total pressure (press. A + press. B) p_{max} __ 10150 psi (700 bar)

Please note:
Sizes 28 to 200: With shaft end S or Z, a nominal pressure of p_N = 4550 psi (315 bar) (p_{max} = 5100 psi (p_{max} = 350 bar)) is permissible for drives with radial loading of the drive shaft (pinions, V-belts)!

Size 80: p_N = 2900 psi (200 bar). Please contact us.
Sizes 250 to 1000: Please contact us.

In cases of pulsating loading above 4550 psi (315 bar), we recommend the version with splined shaft Z (sizes 250 to 1000).

Direction of flow

Direction of rotation, viewed from shaft end	
clockwise	counter-clockwise
A to **B**	**B** to **A**

Speed range

No limit to minimum speed n_{min}. If uniformity of motion is required, speed n_{min} must not be less than 50 rpm. See table of values on page 7 for maximum speed.

Long-Life bearing (sizes 250 to 1000)

For long service life and use with HF hydraulic fluids. Same external dimensions as motor with standard bearing. A long-life bearing can be specified. Flushing of bearing and case via port U recommended.

Flushing volumes (recommended)

Size		250	355	500	1000
$q_{v\ flush}$	(gpm)	2.6	4.2	4.2	4.2
	(l/min)	10	16	16	16

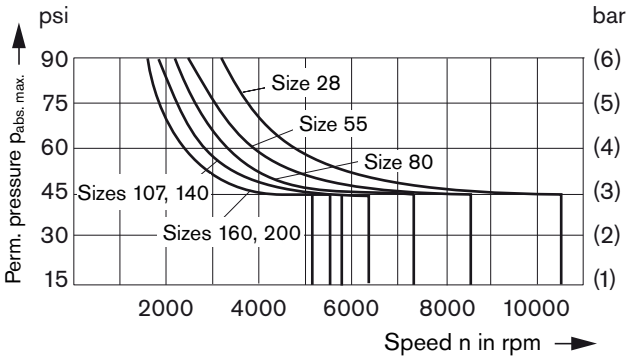
Shaft seal ring

Permissible pressure load

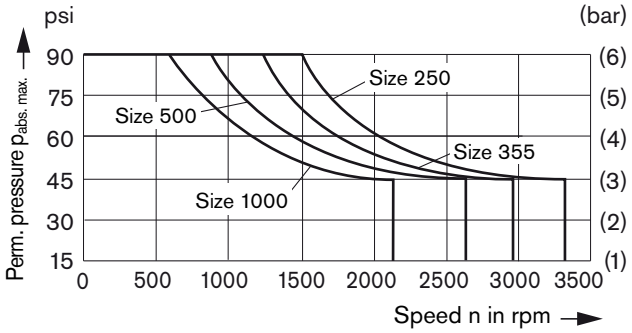
The service life of the shaft seal ring is affected by the speed of the motor and the case drain pressure. It is recommended that the average, continuous case drain pressure at operating temperature 45 psi (3 bar) absolute not be exceeded (max. permissible case drain pressure 90 psi (6 bar) absolute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

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

Sizes 28 to 200



Sizes 250 to 1000



Temperature range

The FKM shaft seal ring is permissible for case temperatures of -13 °F to 240 °F (-25 °C to +115 °C) for sizes 28 to 200 and -13 °F to 195 °F (-25 °C to +90 °C) for sizes 250 to 1000

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

Effect of case pressure on start of control

An increase in the case pressure has an effect on the following controls when control of the variable motor begins:

HA1T (sizes 28 to 200) _____ increase
HD, EP, HA, HA.R, HA.U, HA.T (sizes 250 to 1000) __ increase
DA _____ decrease

The start of control is set in the factory at a case pressure of p_{abs} = 30 psi (2 bar) for sizes 28 to 200 and p_{abs} = 15 psi (1 bar) for sizes 250 to 1000.

Technical Data

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

Size		NG	28	55	80	107	140	160	200	250	355	500	1000
Displacement [1]	$V_{g\,max}$	in^3	1.71	3.34	4.88	6.53	8.54	9.76	12.20	15.25	21.66	30.51	
		cm^3	28.1	54.8	80	107	140	160	200	250	355	500	1000
	$V_{g\,0}$	in^3	0	0	0	0	0	0	0	0	0	0	0
		cm^3	0	0	0	0	0	0	0	0	0	0	0
Max. speed (while adhering to max. permissible flow)	n_{max} at $V_{g\,max}$	rpm	5550	4450	3900	3550	3250	3100	2900	2700	2240	2000	1600
	n_{max} at $V_g < V_{g\,x}$	rpm	8750	7000	6150	5600	5150	4900	4600	3600	2950	2650	2100
	$V_{g\,x} = 0.63 \times V_{g\,max}$	in^3	1.10	2.14	3.11	4.15	5.37	6.16	7.69	11.47 [2]	16.48 [2]	23.00 [2]	46.50 [2]
		cm^3	18	35	51	68	88	101	126	188 [2]	270 [2]	377 [2]	762 [2]
	$n_{max\,0}$ at $V_{g\,0}$	rpm	10450	8350	7350	6300	5750	5500	5100	3600	2950	2650	2100
Max. flow	$q_{V\,max}$	gpm	41	64	82	100	120	131	153	178	210	264	423
		l/min	156	244	312	380	455	496	580	675	795	1000	1600
Max. torque	T_{max} at $V_{g\,max}$ [3]	lb-ft	132	257	375	502	657	752	939	1026	1459	2054	4109
		Nm	179	349	509	681	891	1019	1273	1391	1978	2785	5571
Rotary stiffness $V_{g\,max}$ to $V_{g/2}$	c_{min}	lb-ft/rad	4182	7671	11432	15489	25003	26036	32305	43885	55170	84820	207255
		Nm/rad	5670	10400	15500	21000	33900	35300	43800	59500	74800	115000	281000
$V_{g/2}$ to $0_{(interpolated)}$	c_{max}	lb-ft/rad	13350	23602	35329	48089	68888	77444	95883	133499	193241	288387	604801
		Nm/rad	18100	32000	47900	65200	93400	105000	130000	181000	262000	391000	820000
Moment of inertia for rotary group	J_{TW}	$lb\text{-}ft^2$	0.033	0.100	0.190	0.301	0.491	0.600	0.838	1.448	2.420	4.224	13.05
		kgm^2	0.0014	0.0042	0.0080	0.0127	0,0207	0.0253	0.0353	0.061	0.102	0.178	0.550
Angular acceleration maximum	a	rad/s^2	47000	31500	24000	19000	11000	11000	11000	10000	8300	5500	4000
Filling capacity	V	Gal	0.13	0.2	0.32	0.4	0.48	0.63	0.71	0.79	1.32	1.85	4.23
		L	0.5	0.75	1.2	1.5	1.8	2.4	2.7	3.0	5.0	7.0	16.0
Mass (approx.)	m	lbs	35	57	75	104	132	141	176	220	375	463	948
		kg	16	26	34	47	60	64	80	100	170	210	430

[1] the minimum and maximum displacements are infinitely variable, see ordering code on page 3.
(default settings for sizes 250 to 1000 unless specified in the order: $V_{g\,min} = 0.2 \bullet V_{g\,max}$, $V_{g\,max} = V_{g\,max}$).

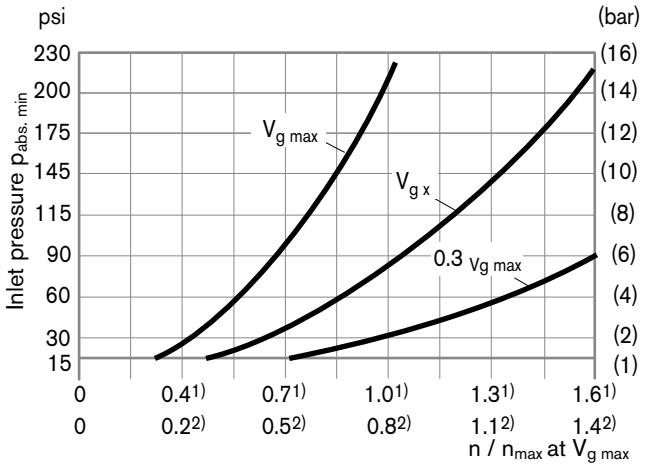
[2] $V_{g\,x} = 0.75 \times V_{g\,max}$ (appr.)

[3] sizes 28 to 200: $\Delta p = 5800$ psi (400 bar); sizes 250 to 1000: $\Delta p = 5100$ psi (350 bar)

Caution: Exceeding the permissible limit values may result in a loss of function, a reduction in service life or in the destruction of the axial piston unit.
Other permissible limit values with respect to speed variation, reduced angular accelaration as a function of the frequency and the permissible startup angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

Technical data

Minimum inlet pressure on service line port A(B)

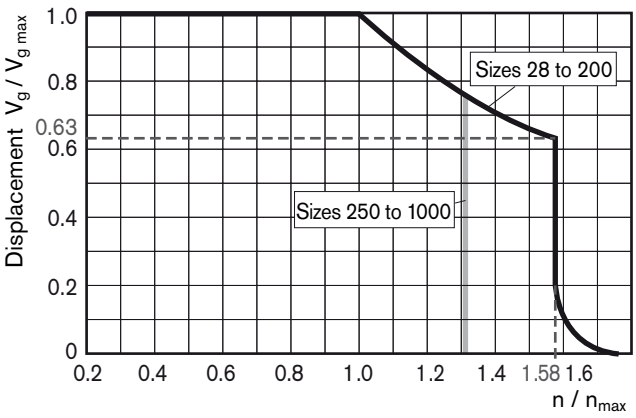


1) for NG 28 to 200
2) for NG 250 to 1000

To prevent damage to the variable motor, there must be a minimum inlet pressure in the inlet area. The minimum inlet pressure is dependent on the speed and swivel angle (displacement) of the variable motor.

Please contact us if these conditions cannot be satisfied.

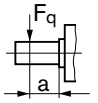
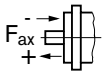
Permissible displacement in relation to speed



Technical data

Permissible radial and axial loading on the drive shaft

The specified values are maximum values and do not apply to continuous operation.

Size			NG	28	55	80	107	140	160	200	250	355	500	1000
Radial force, max.[1] at distance a (from shaft collar)		$F_{q\,max}$	lb	1280	2347	2948	3434	4003	4568	5147	270[2]	337[2]	427[2]	584[2]
			N	5696	10440	13114	15278	17808	20320	22896	1200[2]	1500[2]	1900[2]	2600[2]
			in	0.49	0.59	0.69	0.79	0.89	0.89	0.98	1.61	2.07	2.07	2.66
		a	mm	12.5	15	17.5	20	22.5	22.5	25	41	52.5	52.5	67.5
Axial force, max.[3]		$-F_{ax\,max}$	lb	71	112	160	202	231	252	281	270	337	427	584
			N	315	500	710	900	1030	1120	1250	1200	1500	1900	2600
		$+F_{ax\,max}$	lb	71	112	160	202	231	252	281	899	1124	1405	2248
			N	315	500	710	900	1030	1120	1250	4000	5000	6250	10000
Permissible axial force/bar operating pressure		$-F_{ax\,per.}$/psi	lb/psi	0.07	0.12	0.15	0.18	0.21	0.23	0.26	[4]	[4]	[4]	[4]
		$-F_{ax\,per.}$/bar	N/bar	4.6	7.5	9.6	11.3	13.3	15.1	17.0	[4]	[4]	[4]	[4]

[1]) during intermittent operation (sizes 28 to 200).
[2]) when at a standstill or when axial piston unit operating in depressurized condition. Higher forces are permissible when under pressure. Please contact us.
[3]) max. permissible axial force when at a standstill or when axial piston unit operating in depressurized condition.
[4]) please contact us.

When considering the permissible axial force, the force-transfer direction must be taken into account.

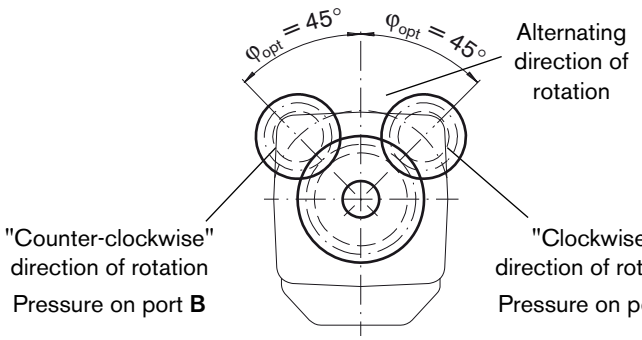
$-F_{ax\,max}$ = increase in service life of bearings

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

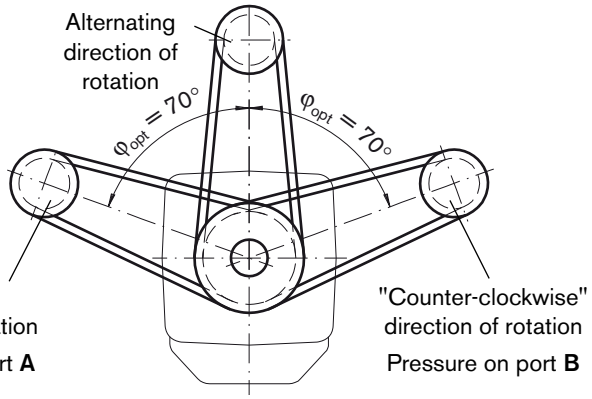
Effect of radial force F_q on the service life of bearings

By selecting a suitable force-transfer direction of F_q, the stress on the bearings caused by the internal transmission forces can be reduced, thus achieving the optimum service life of the bearings. Recommended position of mating gear is dependent on direction of rotation. Examples:

Toothed gear drive



V-belt drive



Determining the size

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

Speed $n = \dfrac{q_v \cdot 231 \cdot \eta_v}{V_g}$ rpm $\left(\dfrac{q_v \cdot 1000 \cdot \eta_v}{V_g} \text{ rpm} \right)$

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

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

V_g = Displacement per revolution in in^3 (cm^3)

Δp = Differential pressure in psi (bar)

n = Speed in rpm

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Overall efficiency

HD - Hydraulic control, pilot-pressure related

The pilot-pressure related hydraulic control permits infinite control of the displacement according to the pilot-pressure signal. The displacement is proportional to the pilot pressure applied to port X.

Standard configuration:

– Start of control at $V_{g\,max}$ (max. torque, min. speed)

– End of control at $V_{g\,min}$ (min. torque, max. permitted speed)

Please note:

– Maximum permissible pilot pressure: 1450 psi (100 bar)

– For reliable control, an operating pressure of at least 435 psi (30 bar) is necessary in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) must be applied at port G via an external check valve. Lower pressures may be adequate in individual cases.

– Please state the desired start of control in plain text when ordering, e.g.: start of control at 145 psi (10 bar).

The following only applies to sizes 250 to 1000:

– The start of control and the HD characteristic are influenced by the case pressure. An increase in the case pressure causes an increase in the start of control (see page 6) and thus a parallel displacement of the characteristic.

– Fluid escapes from port X at the rate of max. 0.08 gpm (0.3 l/min) due to internal leakage (operating pressure > pilot pressure). To prevent a build-up in pilot pressure, port X must be vented to tank.

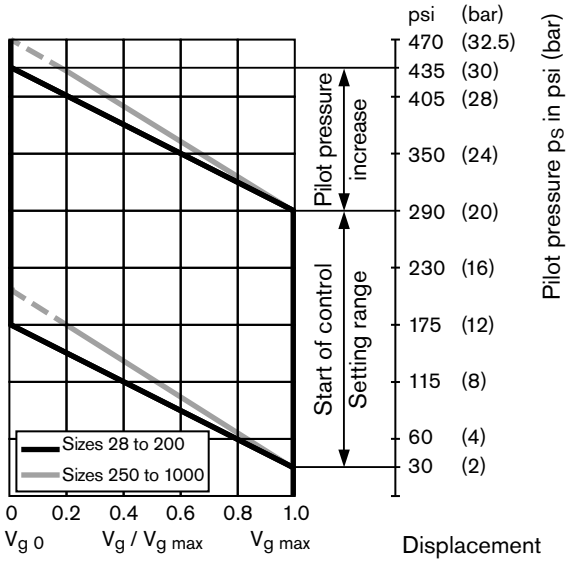
HD1 pilot pressure increase Δp_S = 145 psi (10 bar)

An increase in pilot pressure of 145 psi (10 bar) on port X causes a reduction in the displacement from $V_{g\,max}$ to 0 cm³ (sizes 28 to 200) or from $V_{g\,max}$ to 0.2 $V_{g\,max}$ (sizes 250 to 1000).

Start of control (setting range) ____ 30 – 290 psi (2 – 20 bar)

Default setting:
start of control at 45 psi (3 bar) (end of control at 190 psi (13 bar))

Characteristic HD1



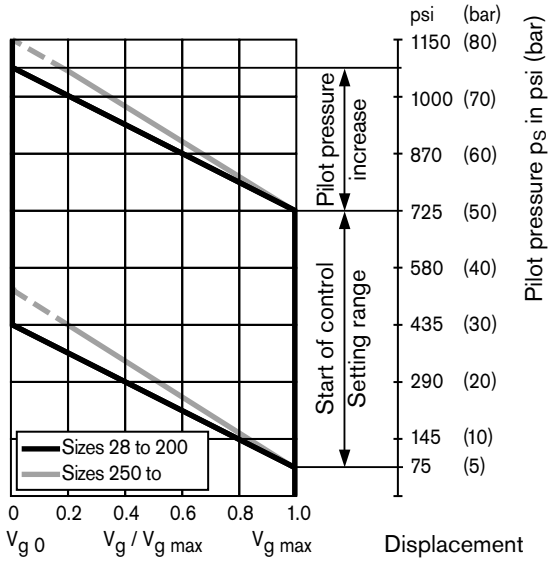
HD2 pilot pressure increase Δp_S = 365 psi (25 bar)

An increase in pilot pressure of 365 psi (25 bar) on port X causes a reduction in the displacement from $V_{g\,max}$ to 0 cm³ (sizes 28 to 200) or from $V_{g\,max}$ to 0.2 $V_{g\,max}$ (sizes 250 to 1000).

Start of control, setting range ____ 75 – 725 psi (5 – 50 bar)

Default setting:
start of control at 145 psi (10 bar) (end of control at 510 psi (35 bar))

Characteristic HD2



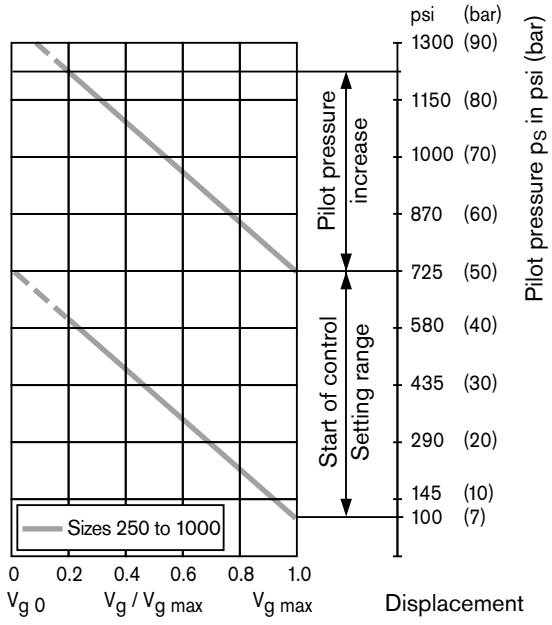
HD3 pilot pressure increase Δp_S = 510 psi (35 bar)

An increase in pilot pressure of 510 psi (35 bar) on port X causes a reduction in the displacement from $V_{g\,max}$ to 0.2 $V_{g\,max}$ (sizes 250 to 1000).

Start of control, setting range ____ 100 – 725 psi (7 – 50 bar)

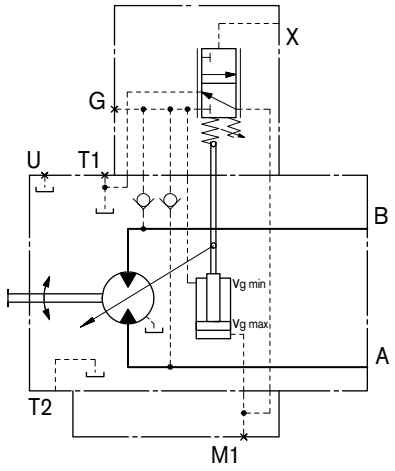
Default setting:
start of control at 145 psi (10 bar) (end of control at 650 psi (45 bar))

Characteristic HD3

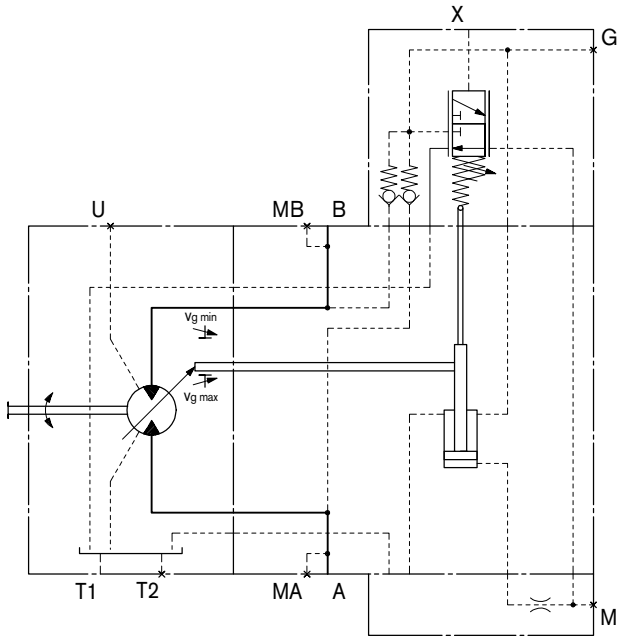


HD - Hydraulic control, pilot-pressure related

Circuit diagram HD1, HD2, HD3
Sizes 28 to 200



Sizes 250 to 1000



Note

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

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

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

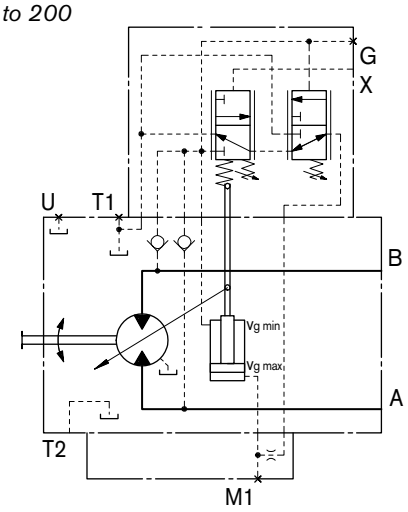
HD.D Pressure control, direct

The pressure control overlays the HD function. If the load increases, or a reduction in the swivel angle of the motor causes the system pressure to increase, the motor will start to swivel to a greater angle when the pressure reaches the setpoint value of the pressure control.

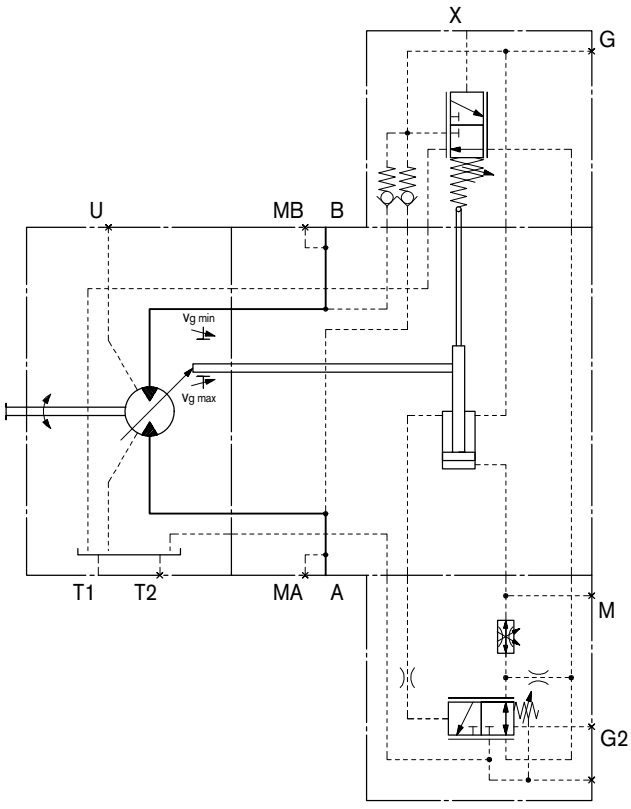
The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range on the pressure control valve:
Sizes 28 to 200 _____ 1150 – 5800 psi (80 – 400 bar)
Sizes 250 to 1000 _____ 1150 – 5100 psi (80 – 350 bar)

Circuit diagram HD.D
Sizes 28 to 200



Sizes 250 to 1000



HD - Hydraulic control, pilot-pressure related

HD.E Pressure control, direct with 2nd pressure setting

Sizes 28 to 200

Connecting an external pilot pressure to port G2 allows the pressure controller setting to be over-ridden and a 2nd pressure setting to be used.

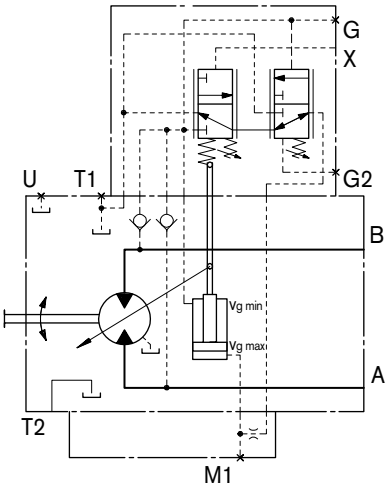
Required pilot pressure on port G2:

Sizes 28 to 200 _____ p_{St} = 290 – 725 psi (20 – 50 bar)

Please specify the 2nd pressure setting in plain text when ordering.

Circuit diagram HD.E

Sizes 28 to 200



Sizes 250 to 1000 (HD.D)

Pressure control with 2nd pressure setting provided as standard with HD.D (see page 10).

Connecting an external pilot pressure to port G2 allows the pressure controller setting to be over-ridden and a 2nd pressure setting to be used.

Required pilot pressure on port G2:

Sizes 250 to 1000 _____ $p_{St} \geq$ 1450 psi (100 bar)

Please specify the 2nd pressure setting in plain text when ordering.

HD.G Pressure control, remote

Sizes 250 to 1000

When the set pressure value is reached, the remote pressure control regulates the motor continuously up to the maximum displacement $V_{g\,max}$. A pressure-relief valve (not supplied) controls the internal pressure cut-off valve. The pressure-relief valve is separate from the motor and is connected to X3.
As long as operating pressure is below the set point of the external pressure-relief valve (1150 – 5100 psi / 80 – 350 bar), the pressure is equal on both sides of the internal pressure cut-off valve, and spring force keeps it closed. The external relief valve opens when the operating pressure exceeds the set point, and the pressure on the spring end of the pressure cut-off valve is reduced.
The pressure cut-off valve then modulates the motor displacement (i.e.-swivelling towards maximum displacement) to limit operating pressure.

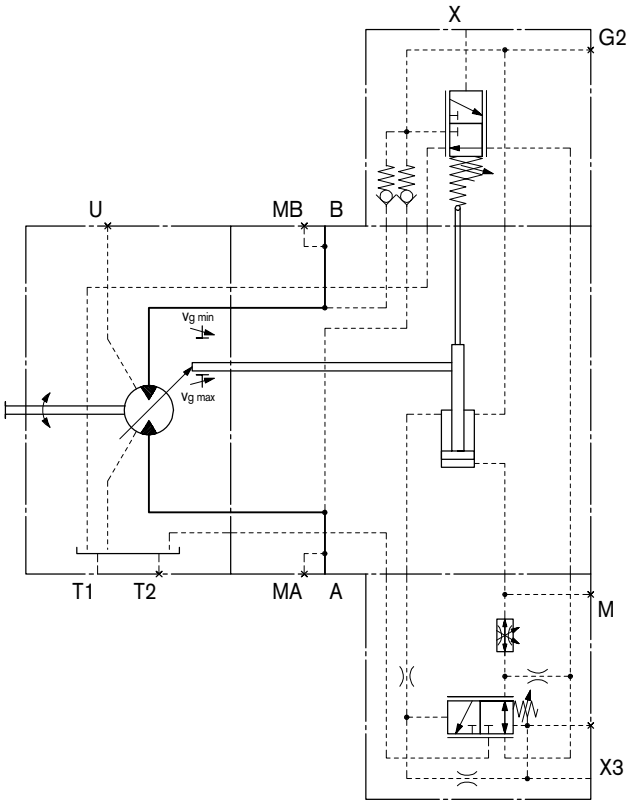
The standard differential pressure setting of the internal pressure cut-off valve is 365 psi (25 bar). We recommend the following for use as the external (i.e.-remote control) pressure-relief valve:

DBD 6 (hydraulic) according to RE 25402

The max. line length must not exceed 6 ft (2 m).

Circuit diagram HD.G

Sizes 250 to 1000



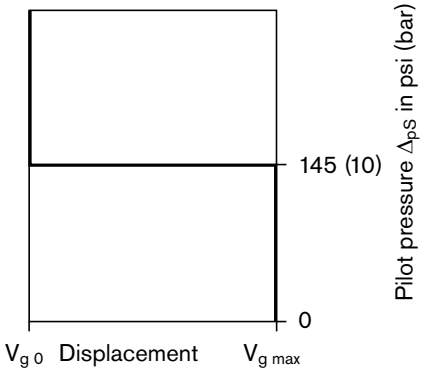
HZ - Hydraulic two-point control

Hydraulic two-point control allows the displacement to be set to $V_{g\,min}$ or $V_{g\,max}$ by switching the pilot pressure at port X on or off.

No pilot pressure ≙ position at $V_{g\,max}$
Pilot pressure switched (>145 psi (10 bar)) ≙ position at $V_{g\,min}$

Standard configuration:
– Start of control at $V_{g\,max}$ (max. torque, min. speed)
– End of control at $V_{g\,min}$ (min. torque, max. permitted speed)

Characteristic HZ



Please note:

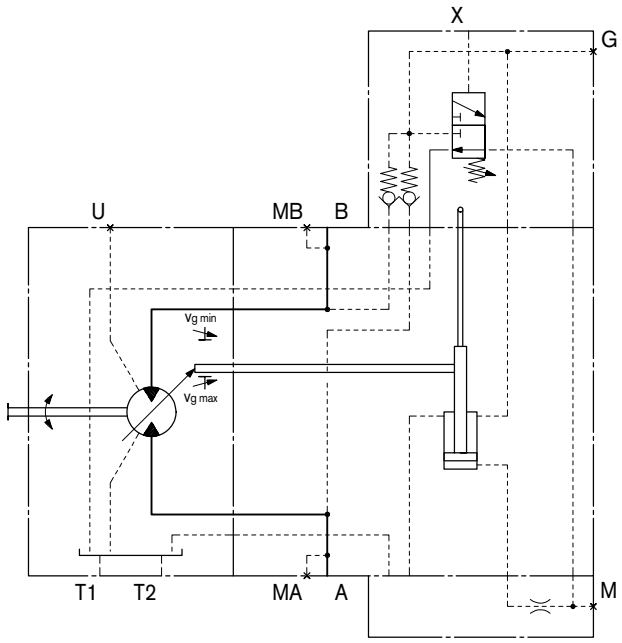
– Maximum permissible pilot pressure: 1450 psi (100 bar)

– For reliable control, an operating pressure of at least 435 psi (30 bar) is necessary in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) is to be applied at port G via an external check valve. Lower pressures may be adequate in individual cases.

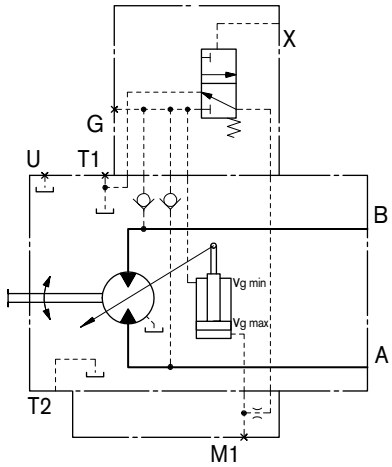
The following only applies to sizes 250 to 1000:

– Fluid escapes from port X at the rate of max. 0.08 gpm (0.3 l/min) due to internal leakage (operating pressure > pilot pressure). To prevent a build-up in pilot pressure, port X must be vented to tank.

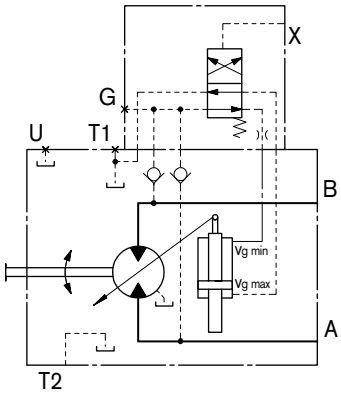
Circuit diagram HZ
Sizes 250 to 1000



Circuit diagram HZ1
Sizes 28, 140, 160, 200



Circuit diagram HZ3
Sizes 55, 80, 107



EP - Electric control with proportional solenoid

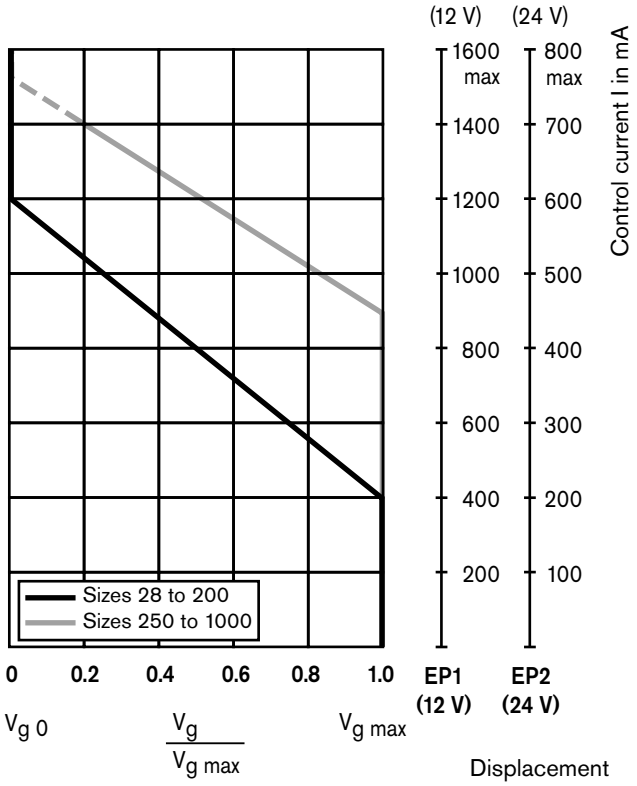
Electric control using a proportional solenoid (sizes 28 to 200) or proportional valve (sizes 250 to 1000) permits continuous control of the displacement according to an electric signal. The control is proportional to the applied electric control current. For sizes 250 to 1000, an external pressure of p_{min} = 435 psi (30 bar) is necessary for the control oil supply to port P (p_{max} = 1450 psi (100 bar)).

Standard configuration:

– Start of control at $V_{g\,max}$ (max. torque, min. speed)

– End of control at $V_{g\,min}$ (min. torque, max. permitted speed)

Characteristic EP



Please note:

– For reliable control, an operating pressure of at least 435 psi (30 bar) is necessary in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) is to be applied at port G via an external check valve. Lower pressures may be adequate in individual cases.

The following only applies to sizes 250 to 1000:

– The start of control and the EP characteristic are influenced by the case pressure. An increase in the case pressure causes an increase in the start of control (see page 6) and thus a parallel displacement of the characteristic.

Technical data, solenoid for EP1, EP2
(sizes 28 to 200)

	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at V_{gmax}	400 mA	200 mA
End of control at $V_{g\,min}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 68°F (20°C))	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection	See connector design, page 74	

The following electronic controllers and amplifiers are available for controlling the proportional solenoids (sizes 28 to 200) (information is also available on the Internet at www.boschrexroth.com/mobile-electronics):

– 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
– **VT 2000** electric amplifier, series 5X RE 29904
  (for stationary application)

Technical data, proportional valve for EP1, EP2
(sizes 250 to 1000)

	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at $V_{g\,max}$	900 mA	450 mA
End of control at $V_{g\,min}$	1400 mA	700 mA
Limiting current	2.2 A	1.0 A
Nominal resistance (at 68°F (20°C))	2.4 Ω	12 Ω
Actuated time	100 %	100 %
Type of protection	See connector design, page 74	

See also proportional pressure-reduction valve DRE 4K (RE 29 181).

Note

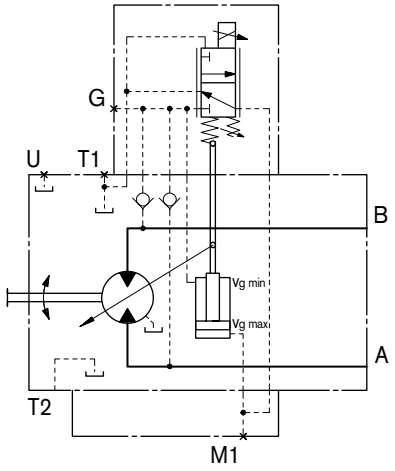
The spring return feature in the control unit is not a safety device

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

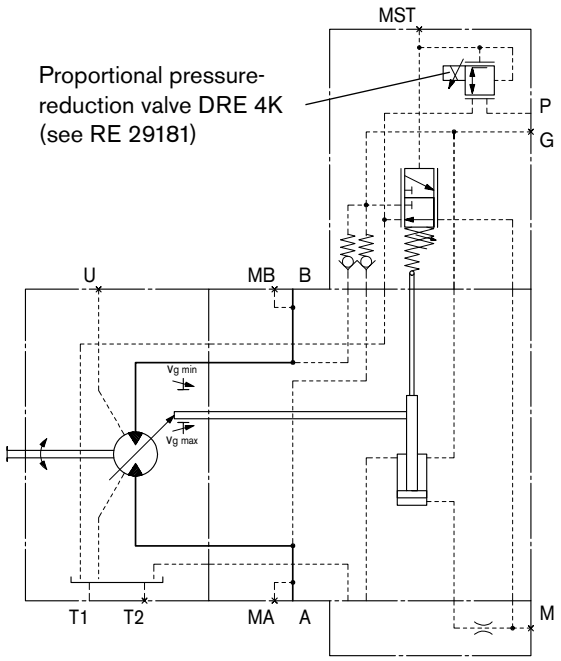
Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e. g. immediate stop).

EP - Electric control with proportional solenoid

Circuit diagram EP1, EP2
Sizes 28 to 200



Sizes 250 to 1000



EP.D Electric control with pressure control, direct

The pressure control overlays the EP function. If the load increases or a reduction in the swivel angle of the motor causes the system pressure to increase, the motor will start to swivel to a greater angle when the pressure reaches the setpoint value of the pressure control.

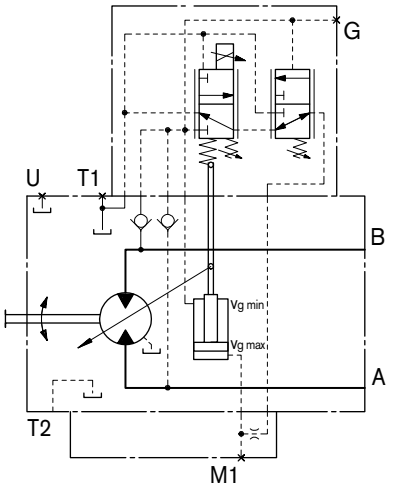
The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range on the pressure-control valve:

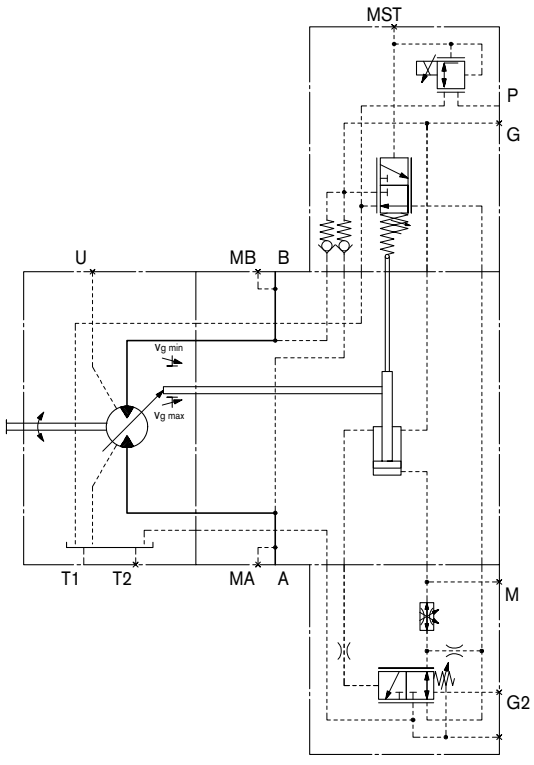
Sizes 28 to 200 _____ 1150 – 5800 psi (80 – 400 bar)

Sizes 250 to 1000 _____ 1160 – 5100 psi (80 – 350 bar)

Circuit diagram EP.D
Sizes 28 to 200



Sizes 250 to 1000



EP - Electric control with proportional solenoid

EP.E Pressure control, direct with 2nd pressure setting

Sizes 28 to 200

Connecting an external pilot pressure to port G2 allows the pressure controller setting to be overridden and a 2nd pressure setting to be used.

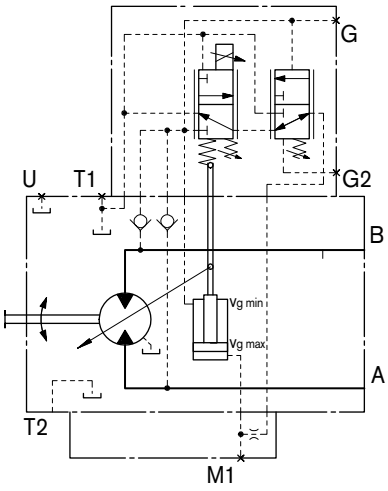
Required pilot pressure on port G2:

Sizes 28 to 200 _____ p_{St} = 290 – 725 psi (20 – 50 bar)

Please specify the 2nd pressure setting in plain text when ordering.

Circuit diagram EP.E

Sizes 28 to 200



Sizes 250 to 1000 (EP.D)

Pressure control with 2nd pressure setting provided as standard with EP.D (see circuit diagram, page 14).

Connecting an external pilot pressure to port G2 allows the pressure controller setting to be overridden and a 2nd pressure setting to be used.

Required pilot pressure on port G2:

Sizes 250 to 1000 _____ $p_{St} \geq$ 1450 psi (100 bar)

Please specify the 2nd pressure setting in plain text when ordering.

EP.G Electric control with pressure control, remote

Sizes 250 to 1000

When the set pressure value is reached, the remote pressure control regulates the motor continuously up to the maximum displacement $V_{g\,max}$. A pressure-relief valve (not supplied) controls the internal pressure cut-off valve. The pressure-relief valve is separate from the motor and is connected to X3.
As long as operating pressure is below the set point of the external pressure-relief valve (1150 – 5100 psi / 80 – 350 bar), the pressure is equal on both sides of the internal pressure cut-off valve, and spring force keeps it closed. The external relief valve opens when the operating pressure exceeds the set point, and the pressure on the spring end of the pressure cut-off valve is reduced.
The pressure cut-off valve then modulates the motor displacement (i.e.-swivelling towards maximum displacement) to limit operating pressure.

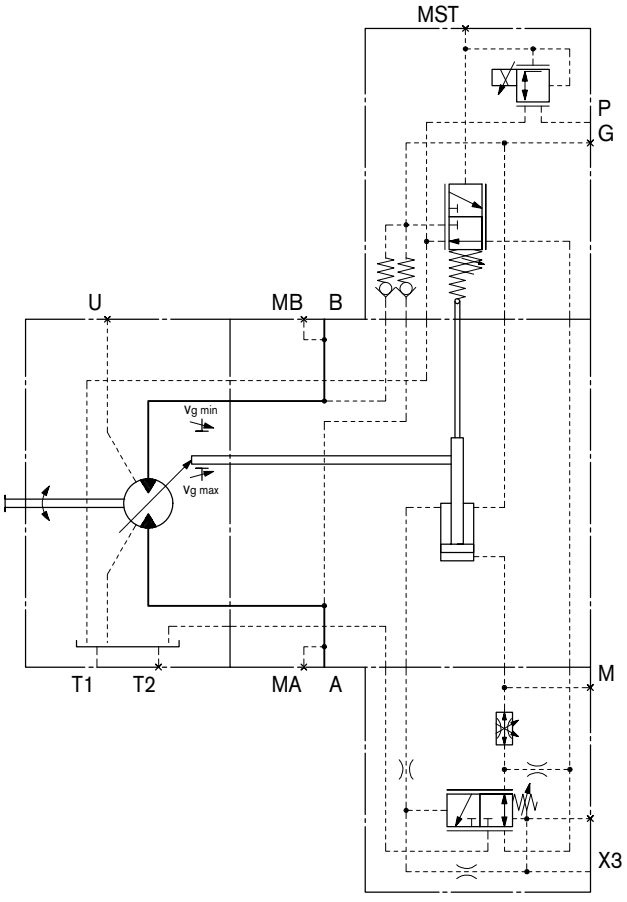
The standard differential pressure setting of the internal pressure cut-off valve is 365 psi (25 bar). We recommend the following for use as the external (i.e.-remote control) pressure-relief valve:

DBD 6 (hydraulic) according to RE 25402

The max. line length must not exceed 6 ft (2 m).

Circuit diagram EP.G

Sizes 250 to 1000



EZ - Electric two-point control, with switching solenoid

The electric control with switching solenoid (sizes 28 to 200) or switching valve (sizes 250 to 1000) permits setting the displacement to $V_{g\,min}$ or $V_{g\,max}$ by switching the electric current to the switching solenoid or switching valve on or off.

Please note:

– For reliable control, an operating pressure of at least 435 psi (30 bar) is necessary in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) is to be applied at port G via an external check valve. Lower pressures may be adequate in individual cases.

Technical data, solenoid with EZ1, EZ2 with dia. 37
(sizes 28, 140, 160, 200)

	EZ1	EZ2
Voltage	12 V (±20 %)	24 V (±20 %)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,min}$	current switched on	current switched on
Nominal resistance (at 68°F (20°C))	5.5 Ω	21.7 Ω
Nominal output	26.2 W	26.5 W
Active current, min. necessary	1.32 A	0.67 A
Actuated time	100 %	100 %
Type of protection	See connector design, page 74	

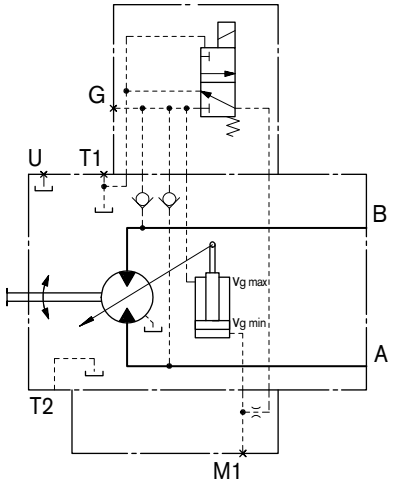
Technical data, solenoid with EZ3, EZ4 with dia. 45
(sizes 55, 80, 107)

	EZ3	EZ4
Voltage	12 V (±20 %)	24 V (±20 %)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,min}$	current switched on	current switched on
Nominal resistance (at 68°F (20°C))	4.8 Ω	19.2 Ω
Nominal output	30 W	30 W
Active current, min. necessary	1.5 A	0.75 A
Actuated time	100 %	100 %
Type of protection	See connector design, page 74	

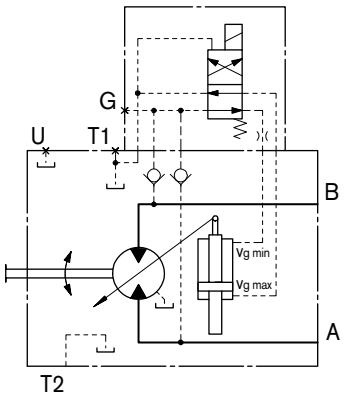
Technical data, switching valve with EZ1, EZ2
(sizes 250 to 1000)

	EZ1	EZ2
Voltage	12 V (±20 %)	24 V (±20 %)
Position $V_{g\,max}$	de-energized	de-energized
Position $V_{g\,min}$	current switched on	current switched on
Nominal resistance (at 68°F (20°C))	6 Ω	23 Ω
Nominal output	26 W	26 W
Active current, min. necessary	2 A	1.04 A
Actuated time	100 %	100 %
Type of protection	See connector design, page 74	

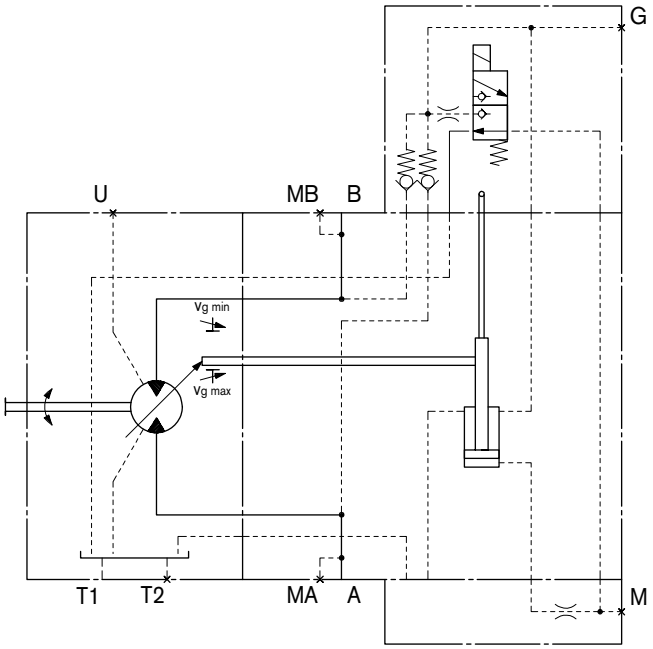
Circuit diagram EZ1, EZ2
Sizes 28, 140, 160, 200



Circuit diagram EZ3, EZ4
Sizes 55, 80, 107



Circuit diagram EZ1, EZ2
Sizes 250 to 1000



HA - Automatic control, high-pressure related

With the automatic high-pressure related control, the motor displacement is adjusted automatically depending on the operating pressure.

The control unit internally measures the operating pressure at A or B (no control line required) and, when the pressure reaches the set pressure value, the controller swivels the motor with increasing operating pressure from $V_{g\ min}$ to $V_{g\ max}$.

Standard configuration HA1, HA2:

Start of control at $V_{g\ min}$ (min. torque, max. speed)
End of control at $V_{g\ max}$ (max. torque, min. speed)

Please note:

- For safety reasons, winch drives are not permissible with start of control at $V_{g\ min}$ (standard for HA).
- For reliable control, an operating pressure of at least 435 psi (30 bar) is necessary in A (B). If a control operation is performed at an operating pressure < 435 psi (30 bar), an auxiliary pressure of at least 435 psi (30 bar) is to be applied at port G via an external check valve. Lower pressures may be adequate in individual cases.
- The start of control and the HA characteristic are influenced by the case pressure. An increase in the case pressure causes an increase in the start of control (see page 6) and thus a parallel displacement of the characteristic. Only with HA1, HA2, HA.T, HA.R, HA.U (sizes 250 to 1000) and with HA1T (sizes 28 to 200).

The following only applies to sizes 250 to 1000:

- Fluid escape from port X at the rate of 0.08 gpm (0.3 l/min) due to internal leakage (operating pressure > pilot pressure). To prevent a build-up in pilot pressure, port X must be vented to tank.
  Only with HA.T control.

HA - automatic control, high-pressure related

HA1 Approximate without pressure increase

An increase in operating pressure of $\Delta p \leq 145$ psi (10 bar) causes an increase in the displacement from 0 cm^3 to $V_{g\,max}$ (sizes 28 to 200) or from 0.2 $V_{g\,max}$ to $V_{g\,max}$ (sizes 250 to 1000).

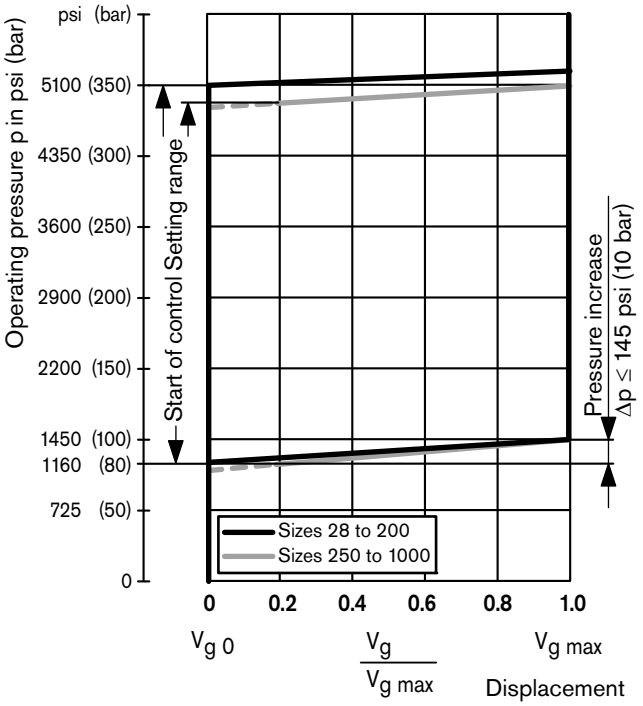
Start of control, setting range

Sizes 28 to 200 _____ 1160 – 5100 psi (80 – 350 bar)

Sizes 250 to 1000 _____ 1160 – 4930 psi (80 – 340 bar)

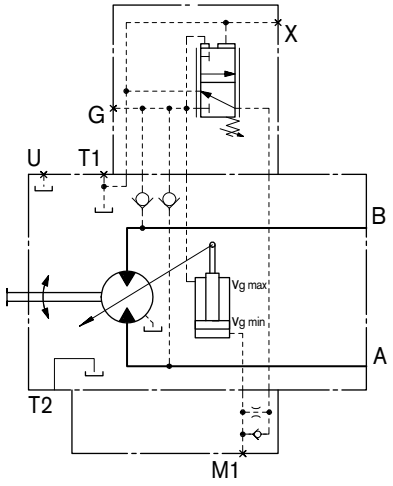
Please state the desired start of control in plain text when ordering, e.g.: start of control at 4350 psi (300 bar)

Characteristic HA

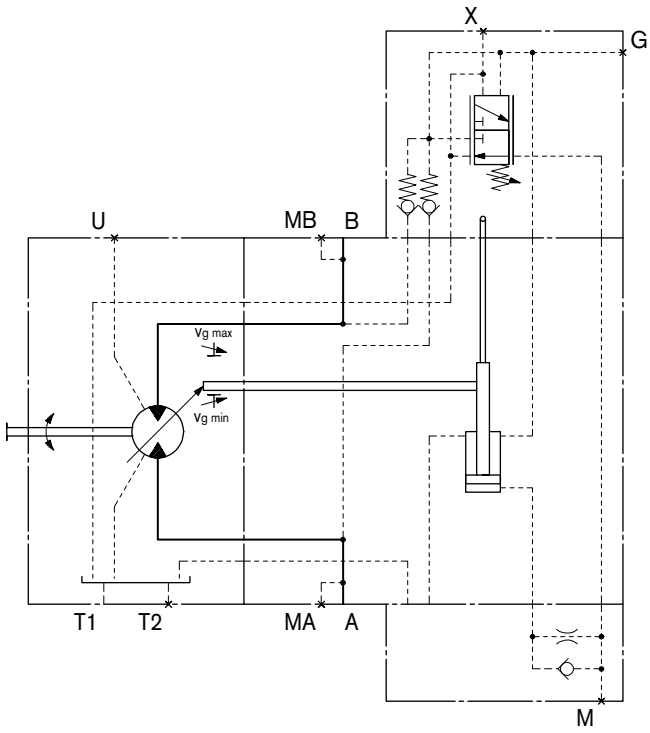


Circuit diagram HA1

Sizes 28 to 200



Sizes 250 to 1000



HA - Automatic control, high-pressure related

HA2 Pressure increase Δp = 1450 psi (100 bar)

An increase in operating pressure of Δp = 1450 psi (100 bar) causes an increase in the displacement from 0 cm^3 to $V_{g\,max}$ (sizes 28 to 200) or from 0.2 $V_{g\,max}$ to $V_{g\,max}$ (sizes 250 to 1000).

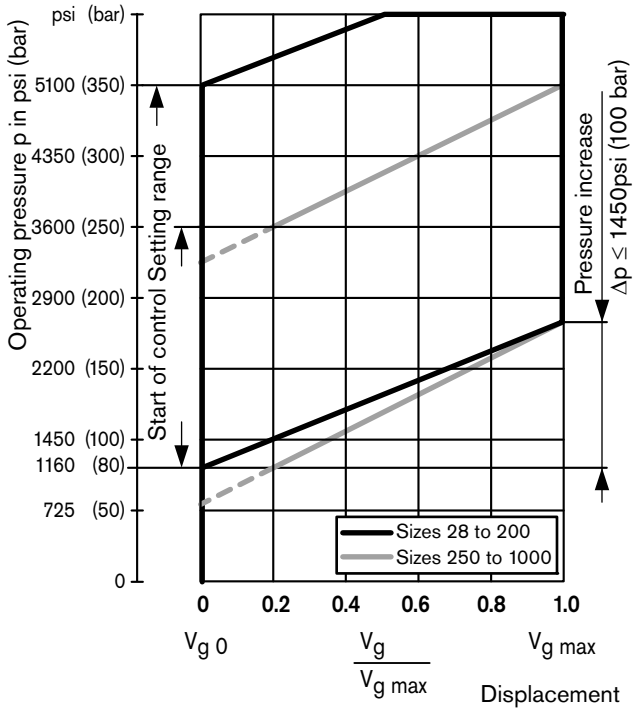
Start of control, setting range

Sizes 28 to 200 _____ 1160 – 5100 psi (80 – 350 bar)

Sizes 250 to 1000 _____ 1160 – 3600 psi (80 – 250 bar)

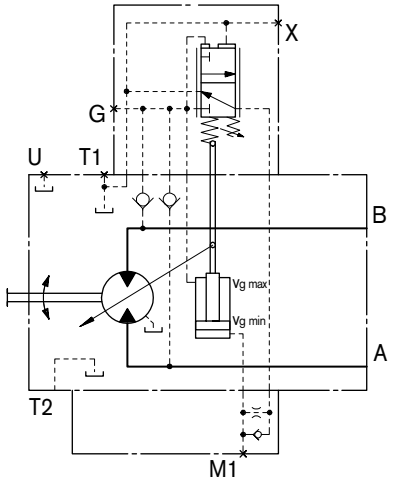
Please state the desired start of control in plain text when ordering, e.g.: start of control at 2900 psi (200 bar)

Characteristic HA2

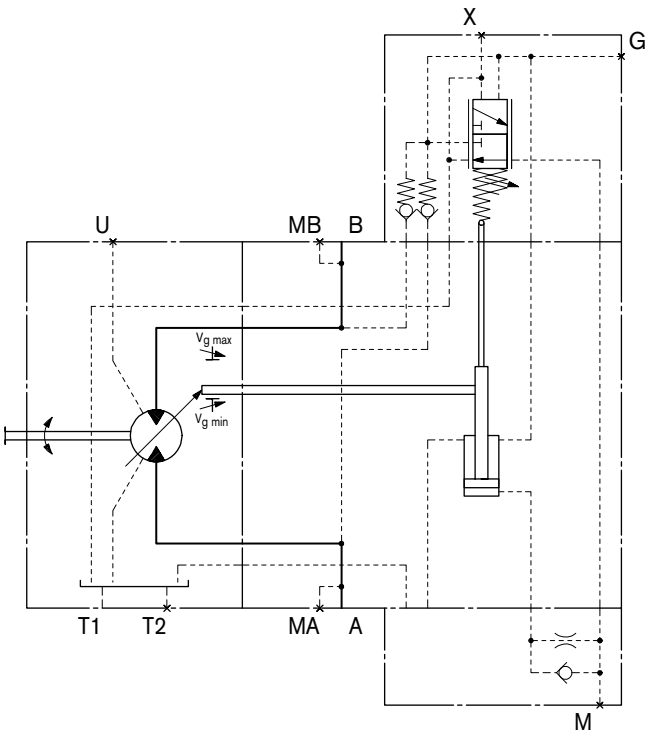


Circuit diagram HA2

Sizes 28 to 200



Sizes 250 to 1000



HA - Automatic control, high-pressure related (override)

HA.T Hydraulic override of pressure setting

With the HA.T control, the start of control can be influenced by applying a pilot pressure to port X.

For each 15 psi (1 bar) of pilot pressure, the start of control is reduced by 250 psi (17 bar) for sizes 28 to 200 or 115 psi (8 bar) for sizes 250 to 1000.

Examples (sizes 28 to 200):

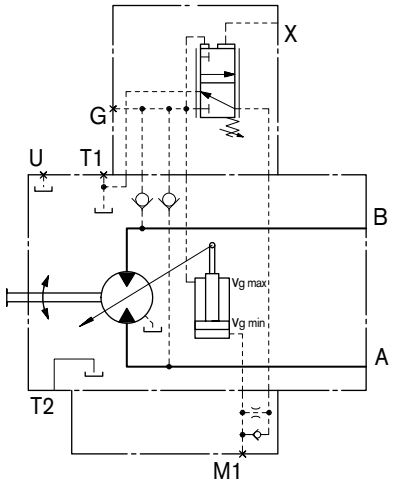
Start of control adjustment	4350 psi (300 bar)	4350 psi (300 bar)
Pilot pressure at port X	0 psi (0bar)	145 psi (10 bar)
Start of control at	4350 psi (300 bar)	1885 psi (130 bar)

Note:

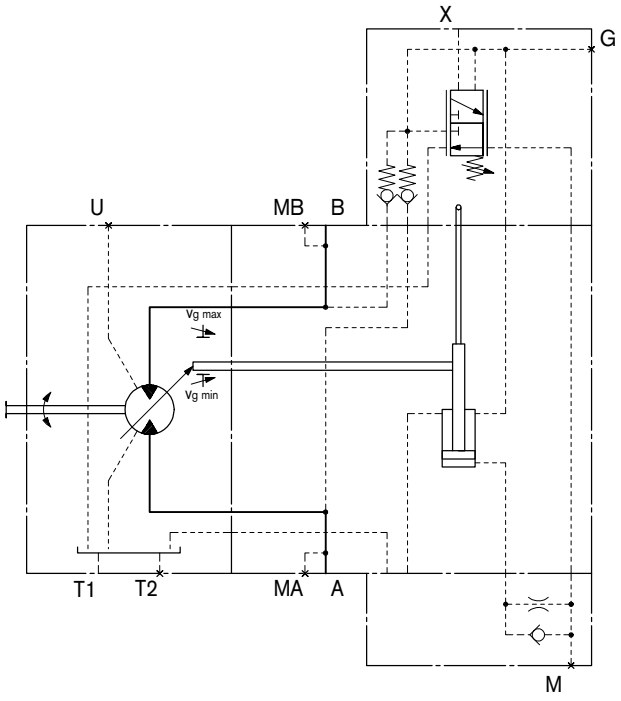
– Max. permissible pilot pressure 1450 psi (100 bar)

Circuit diagram HA1.T

Sizes 28 to 200



Sizes 250 to 1000



HA.U1, HA.U2 Electric override of pressure setting

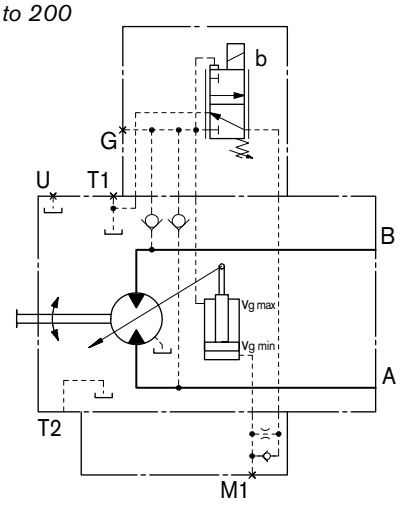
With the HA.U1 or HA.U2 control, the start of control can be overridden by an electric signal to an switching solenoid. When the over-ride solenoid is energized, the variable motor swivels to the maximum swivel angle without stopping at an intermediate position. The start of control can be set to between 1160 and 4350 psi (80 and 300 bar) (specify required setting in clear text when ordering).

Technical data, solenoid b with dia. 45 (el. override)

	U1	U2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Position $V_{g\ max}$	current switched on	current switched on
Nominal resistance (at 68°F (20°C))	4.8 Ω	19.2 Ω
Nominal output	30 W	30 W
Active current, min. necessary	1.5 A	0.75 A
Actuated time	100 %	100 %
Type of protection	See connector design, page 74	

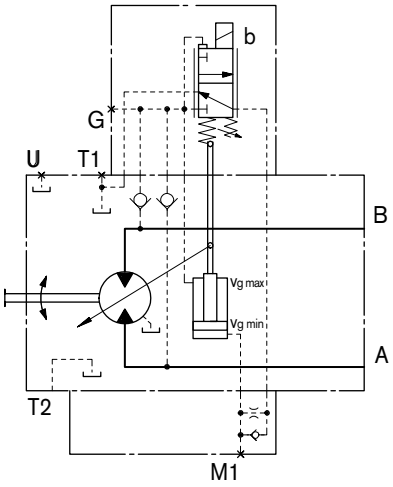
Circuit diagram HA1U1, HA1U2

Sizes 28 to 200



Circuit diagram HA2U1, HA2U2

Sizes 28 to 200



HA - Automatic control, high-pressure related (override)

HA.R1, HA.R2 Electric override of pressure setting, with elect. travel direction valve

(see page 25)

With the HA.R1 or HA.R2 control, the high-pressure related closed loop control can be overridden by an electric signal to switching solenoid b. When the over-ride solenoid is energized, the variable motor swivels to the maximum swivel angle without stopping at an intermediate position.

The travel direction valve ensures that the preselected pressure side of the hydraulic motor always controls the swivel angle, even if the high-pressure side changes (e.g. travel drive during a descent). This therefore prevents an undesirable swiveling of the variable motor to a larger displacement.

Depending on the direction of rotation (direction of travel), the travel direction valve (see page 25) can be actuated through the pressure spring or switching solenoid a.

Technical data, solenoid a with dia. 37 (travel direction valve)

		R1	R2
Voltage		12 V (±20 %)	24 V (±20 %)
No override		de-energized	de-energized
Direction of rotation	Operating pressure in	switching solenoid a	
counter-clockwise	B	actuated	actuated
clockwise	A	de-energized	de-energized
Nominal resistance (at 68°F (20°C))		5.5 Ω	21.7 Ω
Nominal output		26.2 W	26.5 W
Active current, min. necessary		1.32 A	0.67 A
Actuated time		100 %	100 %
Type of protection		See connector design, page 74	

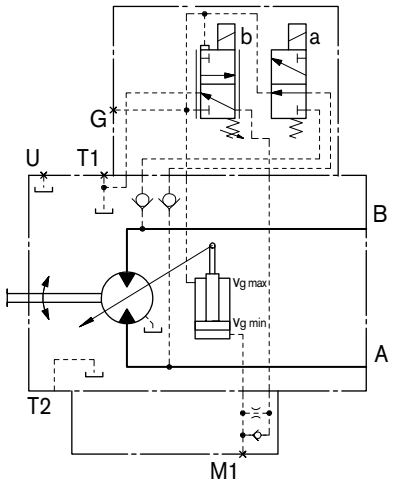
Technical data, solenoid b with dia. 45[1]) (el. override)

	R1	R2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Position $V_{g\,max}$	current switched on	current switched on
Nominal resistance (at 68°F (20°C))	4.8 Ω	19.2 Ω
Nominal output	30 W	30 W
Active current, min. necessary	1.5 A	0.75 A
Actuated time	100 %	100 %
Type of protection	See connector design, page 74	

[1]) for solenoids with dia. 45, the version "DEUTSCH - molded connector" is available on request.

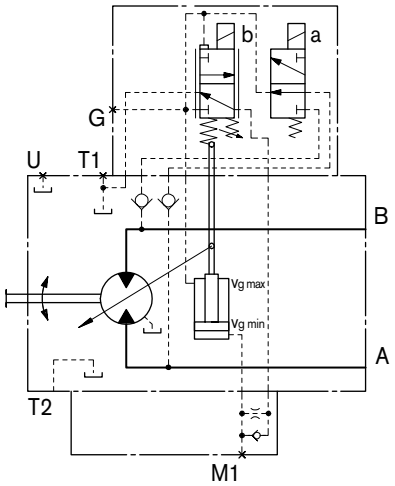
Circuit diagram HA1R1, HA1R2

Sizes 28 to 200



Circuit diagram HA2R1, HA2R2

Sizes 28 to 200



DA - Hydraulic control, speed related

The (A)A6VM variable motor with speed-related hydraulic control is best used for hydrostatic drives in combination with the AA4VG variable pump with DA control.

The pilot pressure derived from the drive speed of the AA4VG variable pump, together with the operating pressure, regulate the swivel angle of the hydraulic motor.

Increasing drive speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher speed), depending on the operating pressure.

If the operating pressure increase above the pressure setting of the controller, the variable motor swivels to a larger displacement (higher torque, lower speed).

The design of a drive with DA control must be carried out using the technical data relating to the AA4VG variable pump with DA control.

Detailed information can be obtained from our sales departments and on the Internet at www.boschrexroth.com/da-control.

Please note:

– The start of control and the DA characteristic are influenced by the case pressure. An increase in the case pressure causes a drop in the start of control (see page 6) and thus a parallel displacement of the characteristic.

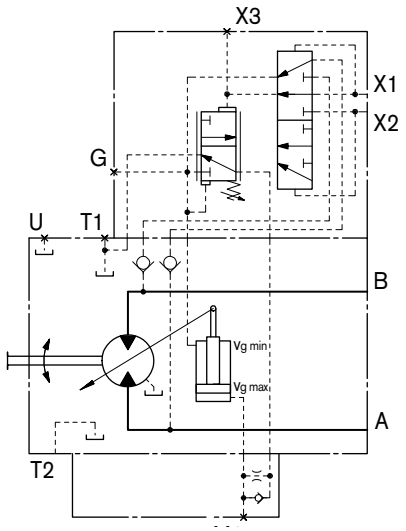
DA - Hydraulic control, speed related

DA, DA1, DA4 Hydraulic control speed related with hydr. travel direction valve

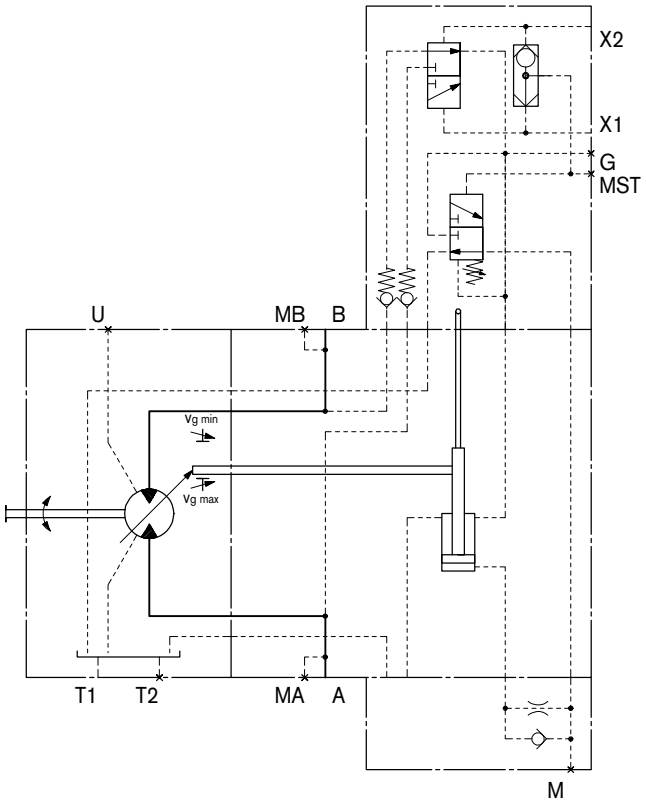
The travel direction valve is operated according to the direction of rotation (direction of travel) using the pilot pressures X_1 or X2.

Direction of rotation	Operating pressure in	Pilot pressure in
clockwise	A	X_1
counter-clockwise	B	X_2

Circuit diagram DA, DA1, DA4
Sizes 28 to 200



Circuit diagram DA
Sizes 250 to 1000



DA2, DA3, DA5, DA6 Hydraulic control speed related with electr. travel direction valve + electr. $V_{g\,max}$ control

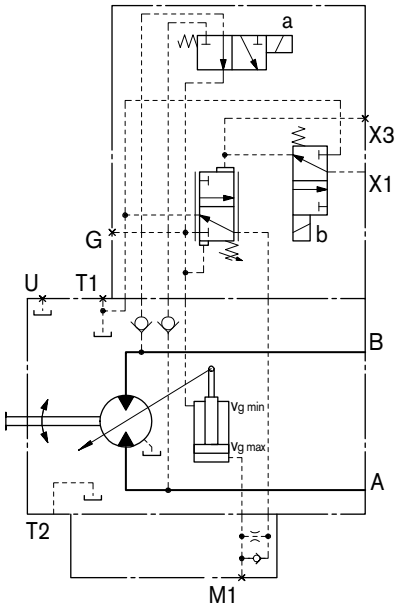
Depending on the direction of rotation (direction of travel), the travel direction valve can be actuated through the pressure spring or switching solenoid a.

By connecting an electric current to switching solenoid b, the closed loop control can be overridden and the motor adjusted to max. displacement (high torque, low speed) (electric $V_{g\,max}$ circuit).

Technical data, solenoid A/B

		DA2, DA5	DA3, DA6
Voltage		12 V (±20 %)	24 V (±20 %)
Direction of rotation	Operating pressure in	switching solenoid a	
counter-clockwise	B	de-energized	de-energized
clockwise	A	actuated	actuated
Nominal resistance (at 68°F (20°C))		5.5 Ω	21.7 Ω
Nominal output		26.2 W	26.5 W
Active current, min. necessary		1.32 A	0.67 A
Actuated time		100 %	100 %
Type of protection		See connector design, page 74	

Circuit diagram DA2, DA3, DA5, DA6
Sizes 28 to 200



Electric travel direction valve (for DA, HA.R)

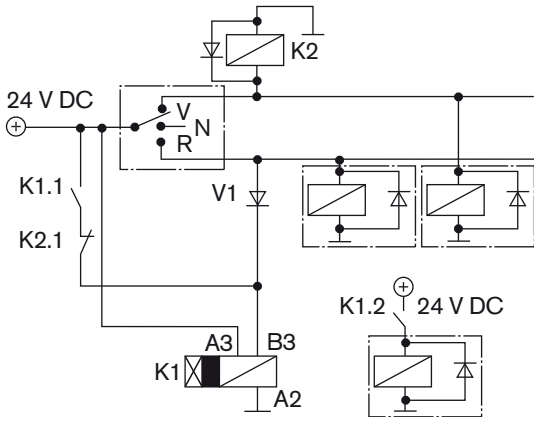
Application in travel drives in closed circuits. The travel direction valve of the motor is switched using the 4/3-directional valve on the control device of the driving pump.

When the pump (AA4VG, AA10VG) is switched to the neutral position or into reverse, the vehicle may experience impulsive braking depending on the vehicle's mass and current speed.

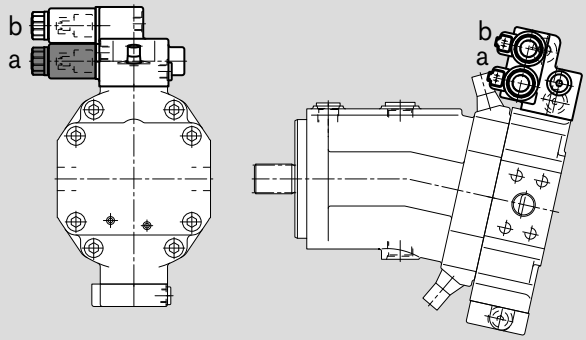
This impulsive braking is prevented through the use of the following electric circuit.

With this control, when the pump (AA4VG, AA10VG) is switched
1. to the neutral position: the previous travel direction is retained.
2. to reverse: the motor switches to the other travel direction following a time delay (approx. 0.8 s) with respect to the pump.

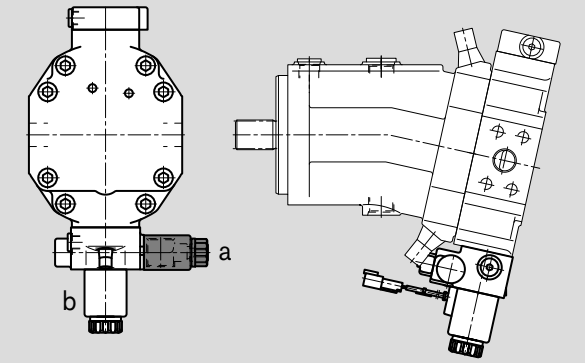
Electric travel direction valve circuit diagram



DA2, DA3, DA5, DA6 control (see page 24)



HA1R., HA2R. control (see page 22)



Switching solenoid a on travel direction valve

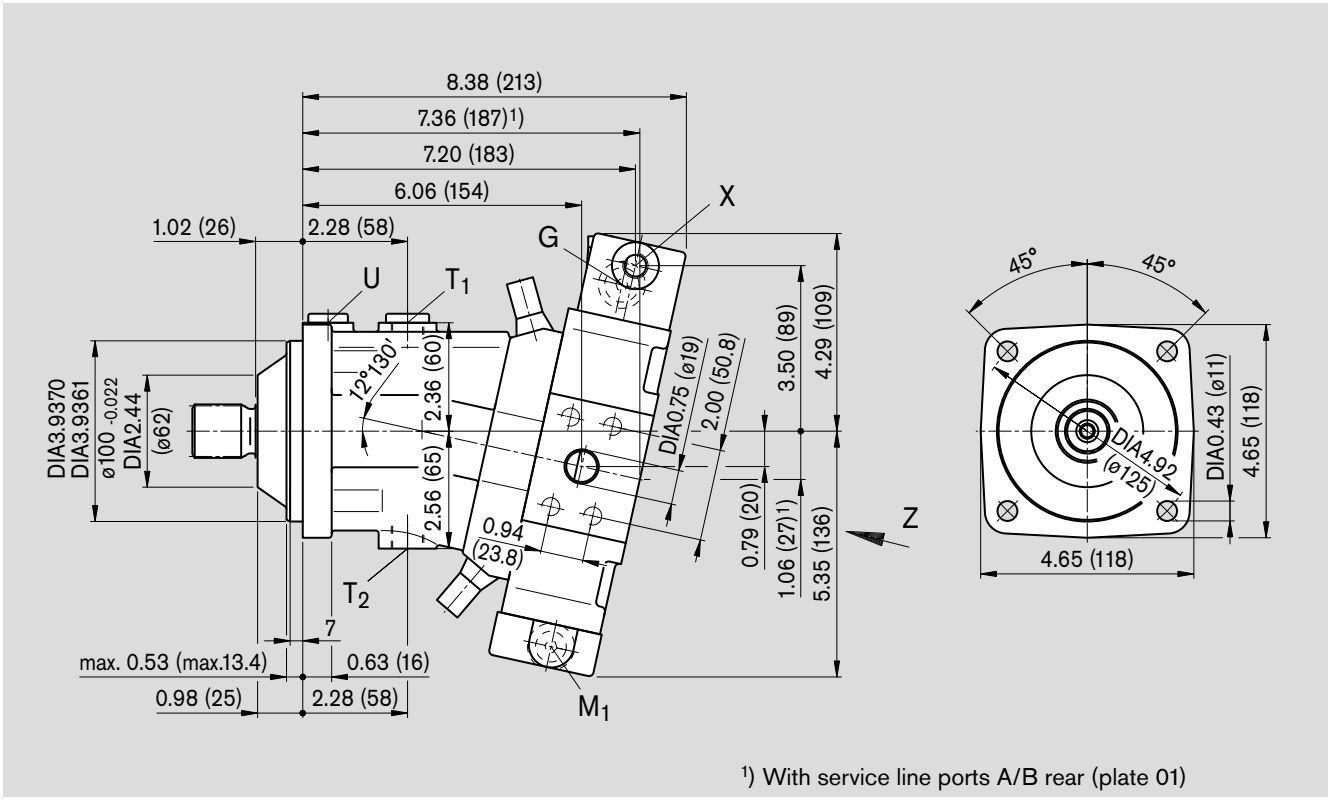
Unit dimensions, size 28 (ISO Version)

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

HD1, HD2 Hydraulic control, pilot-pressure related

HZ1 Hydraulic two-point control

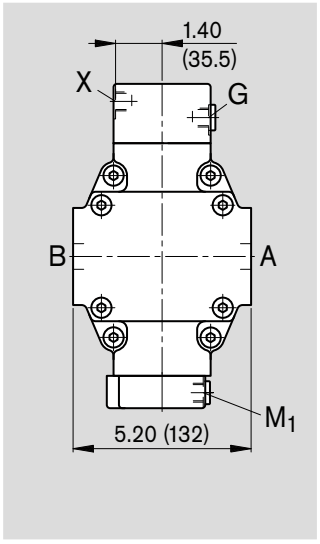
SAE flange ports A/B side, opposite **(02)**



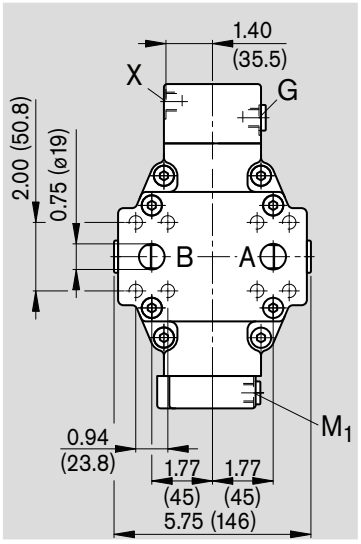
1) With service line ports A/B rear (plate 01)

View Z

SAE flange ports A/B side, opposite **(02)**



SAE flange ports A/B rear **(01)**

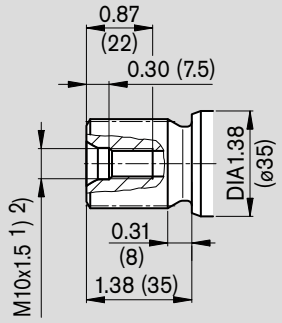


Unit dimensions, size 28 (ISO Version)

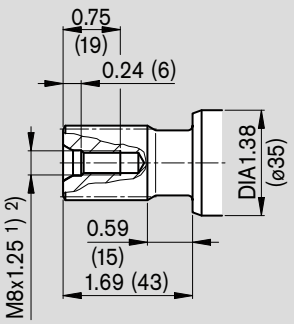
Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

Shaft ends

A Splined shaft DIN 5480
W30x2x30x14x9g



Z Splined shaft DIN 5480
W25x1.25x30x18x9g



Ports

A, B	Service line ports (high-pressure series)	SAE J518	3/4 in		
	Fixing thread A/B	DIN 13	M10x1.5;	0.67 (17) deep 2)	
T_1	Case drain port 3)	DIN 3852	M18x1.5;	0.47 (12) deep	100 lb-ft (140 Nm) 2)
T_2	Case drain port	DIN 3852	M18x1.5;	0.47 (12) deep	100 lb-ft (140 Nm) 2)
X, X_1, X_3	Pilot-pressure port	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
G	Port for synchronous control of multiple units and for remote control pressure 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
G_2	Port for 2nd pressure setting 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
U	Flow port 3)	DIN 3852	M16x1.5;	0.47 (12) deep	70 lb-ft (100 Nm) 2)
M_1	Gauge port for control pressure 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)

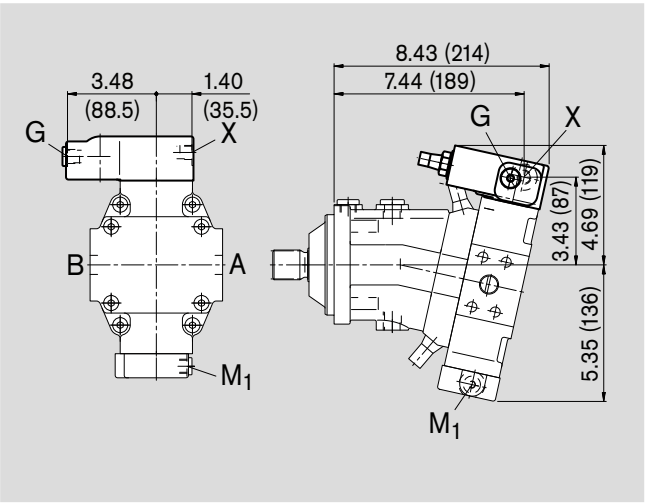
1) Center bore according to DIN 332 (thread according to DIN 13)
2) Please observe the general notes for the max. tightening torques on page 76
3) Plugged

Unit dimensions, size 28 (ISO Version)

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

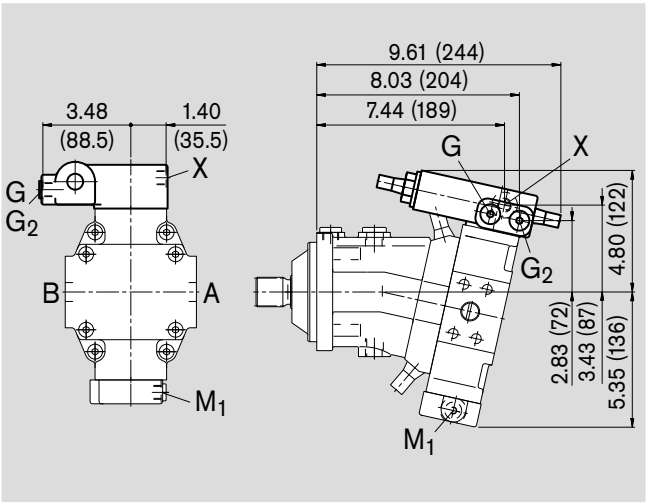
HD.D

Hydraulic control, pilot-pressure related,
with pressure control, direct



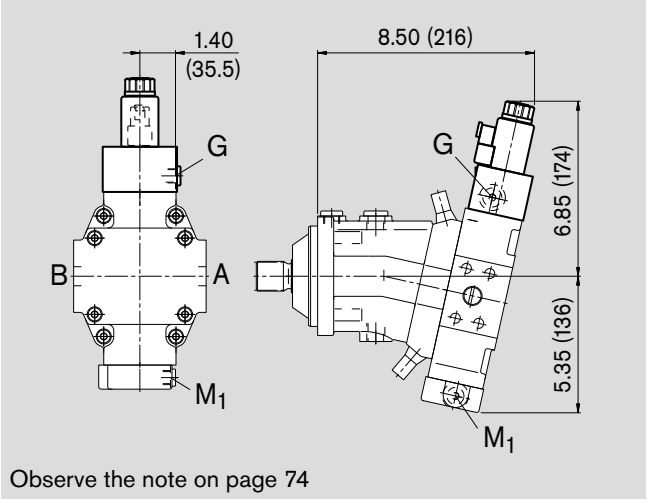
HD.E

Hydraulic control, pilot-pressure related,
with pressure control, direct and 2nd pressure setting



EP1, EP2

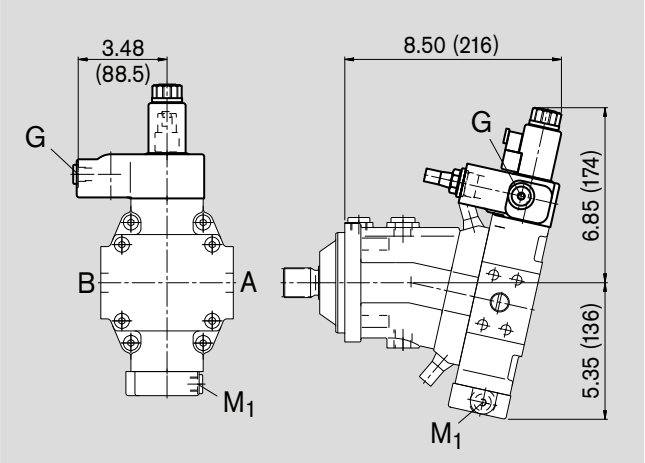
Electric control with proportional solenoid



Observe the note on page 74

EP.D

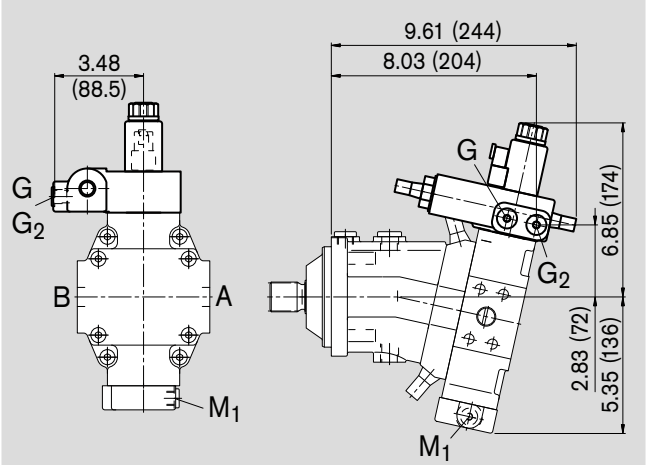
Electric control (proportional solenoid)
with pressure control, direct



Observe the note on page 74

EP.E

Electric control (proportional solenoid)
with pressure control, direct and 2nd pressure setting



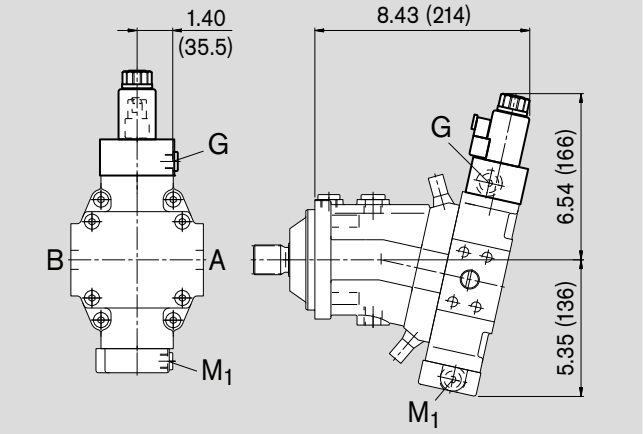
Observe the note on page 74

Unit dimensions, size 28

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

EZ1, EZ2

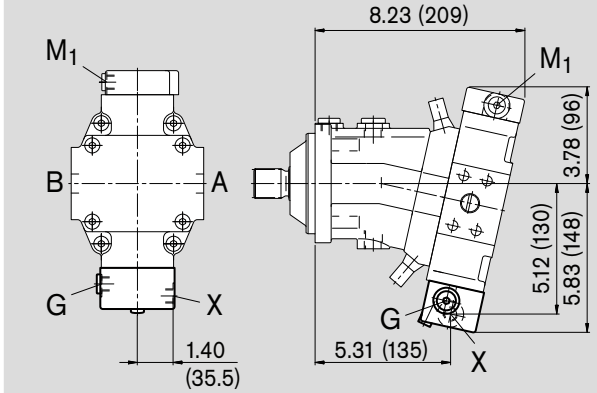
Electric two-point control with switching solenoid



Observe the note on page 74

HA1, HA2 / HA1T, HA2T

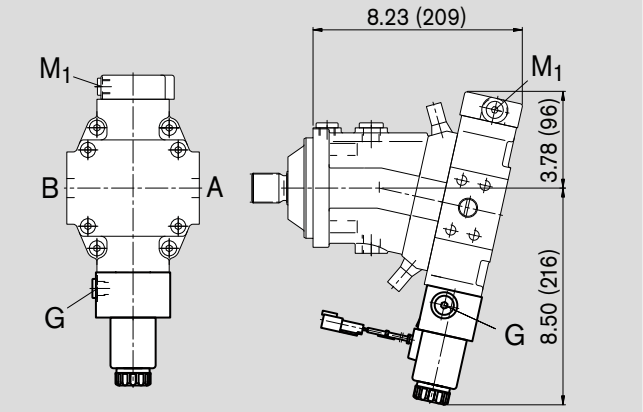
Automatic control, high-pressure related / high-pressure related and hydraulic override



HA1 and HA2, X plugged
HA1T and HA2T, X open

HA1U1, HA2U2

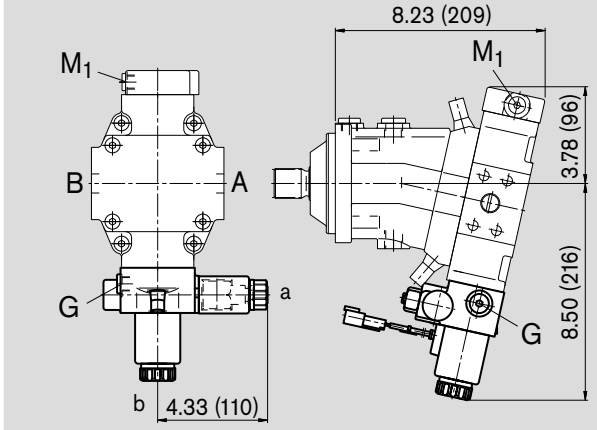
Automatic control, high-pressure related and electric override



Observe the note on page 74

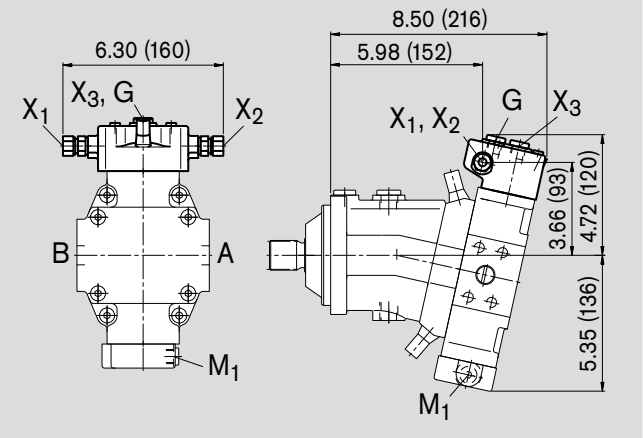
HA1R1, HA2R2

Automatic control, high-pressure related, electric override and electric travel direction valve



DA1, DA4

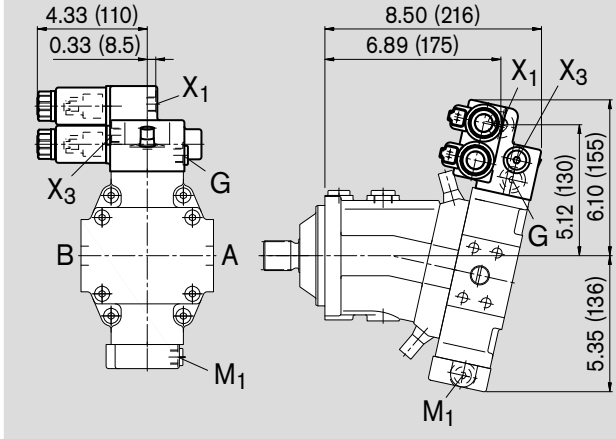
Hydraulic control, speed related and hydraulic travel direction valve



X_1, X_2 with fitting 8B-ST according to DIN 2353-CL

DA2, DA3, DA5, DA6

Hydraulic control, speed related, el. travel direction valve and el. $V_{g\ max}$ control

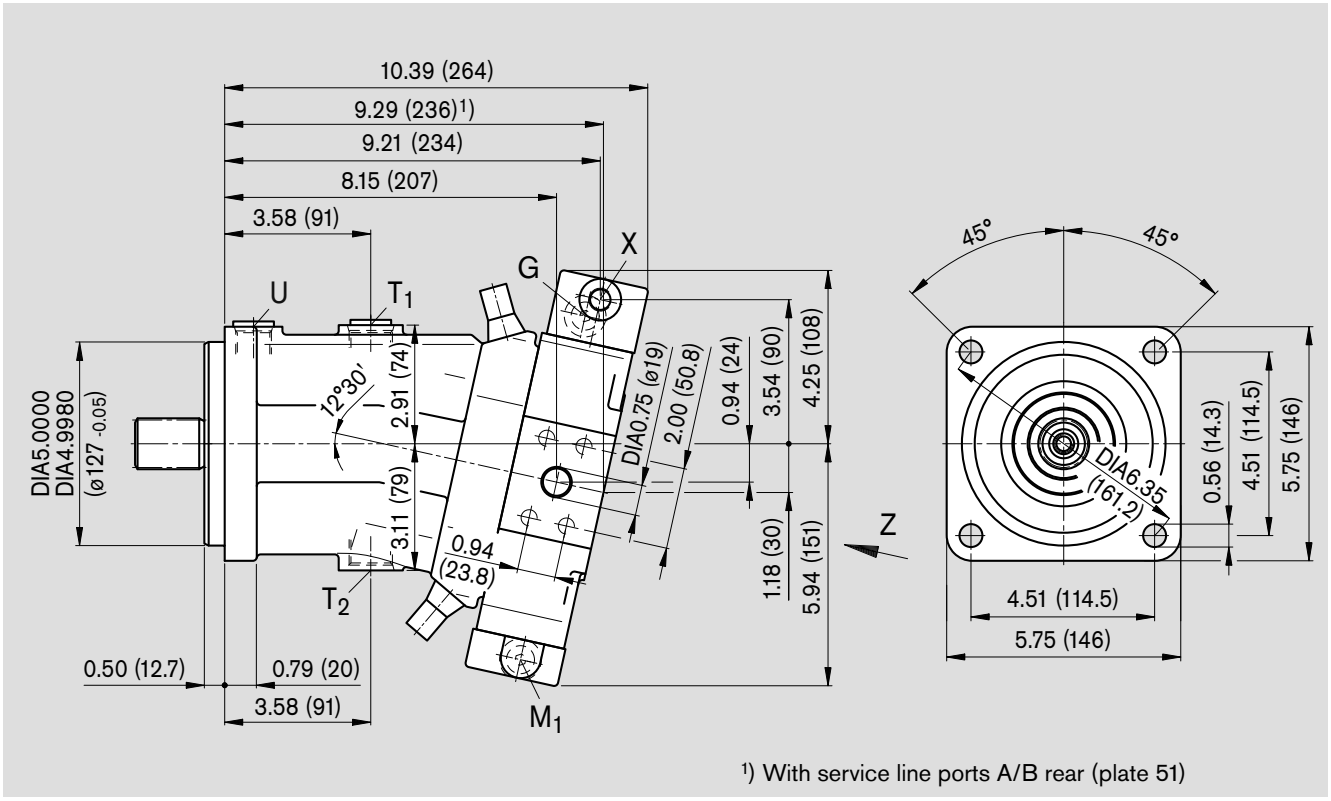


Unit dimensions, size 55 (SAE Version)

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

HD1, HD2 Hydraulic control, pilot-pressure related

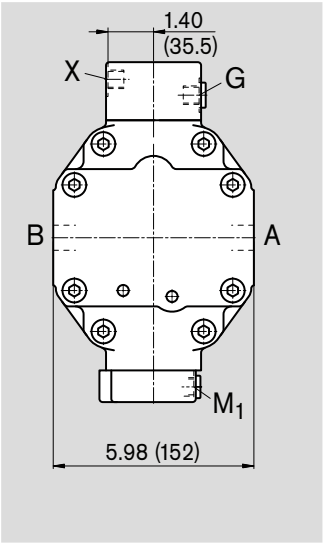
SAE flange ports A/B side, opposite **(52)**



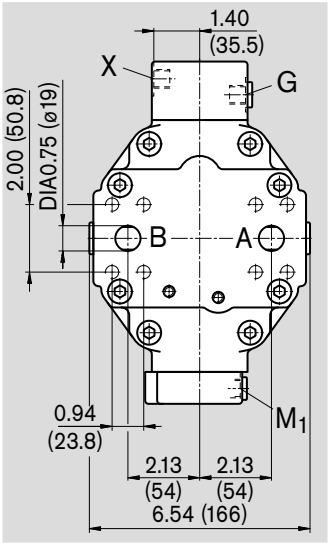
1) With service line ports A/B rear (plate 51)

View Z

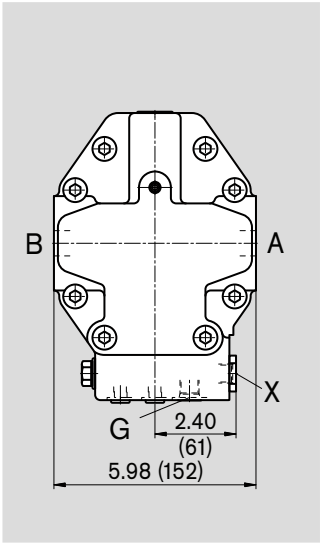
SAE flange ports A/B side, opposite **(52)**



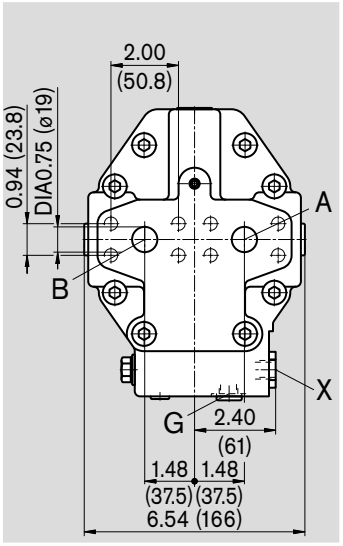
SAE flange ports A/B rear **(51)**



SAE flange ports A/B side, opposite with **HZ3, EZ3 (52)**



SAE flange ports A/B rear with **HZ3, EZ3 (51)**

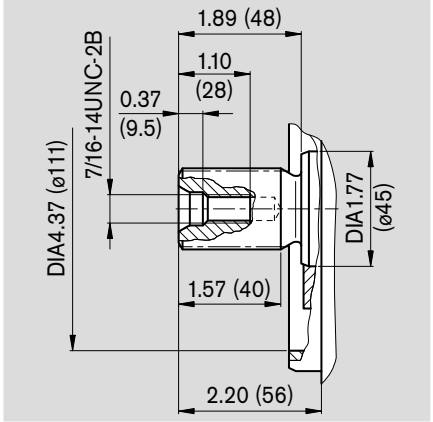


Unit dimensions, size 55 (SAE Version)

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

Shaft end

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



Ports

A, B	Service line ports (high-pressure series)	SAE J518	3/4 in		
	Fixing thread A/B	ISO 68	3/8 in -12 UNC-2B;	0.83 (21) deep [2]	
T_1	Case drain port [3]	ISO 11926	1 1/16 in -12 UN-2B;	0.79 (20) deep	265 lb-ft(360 Nm) [2]
T_2	Case drain port	ISO 11926	1 1/16 in -12 UN-2B;	0.79 (20) deep	265 lb-ft(360 Nm) [2]
X, X_1, X_3	Pilot-pressure port	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
G	Port for synchronous control of multiple units and for remote control pressure [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
G_2	Port for 2nd pressure setting [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
U	Flow port [3]	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft(240 Nm) [2]
M_1	Gauge port for control pressure [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]

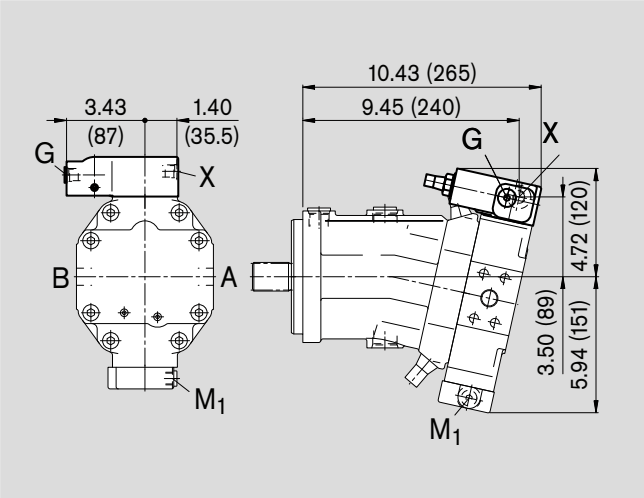
[1] ANSI B92.1a-1976, pressure angle 30°, flat root, side fit, tolerance class 5
[2] please observe the general notes for the max. tightening torques on page 76
[3] plugged

Unit dimensions, size 55 (SAE Version)

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

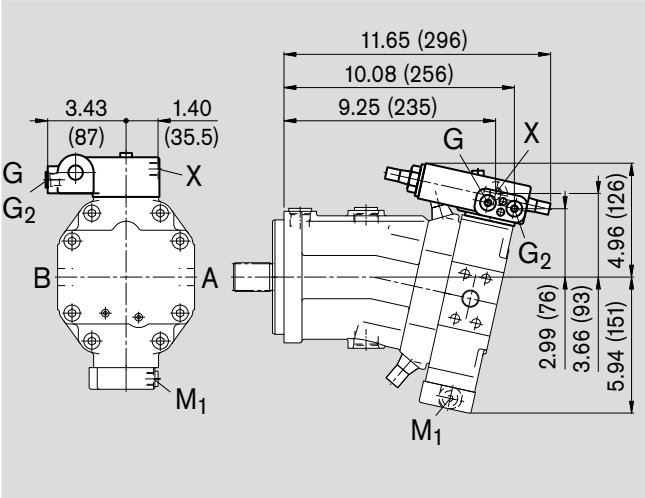
HD.D

Hydraulic control, pilot-pressure related,
with pressure control, direct



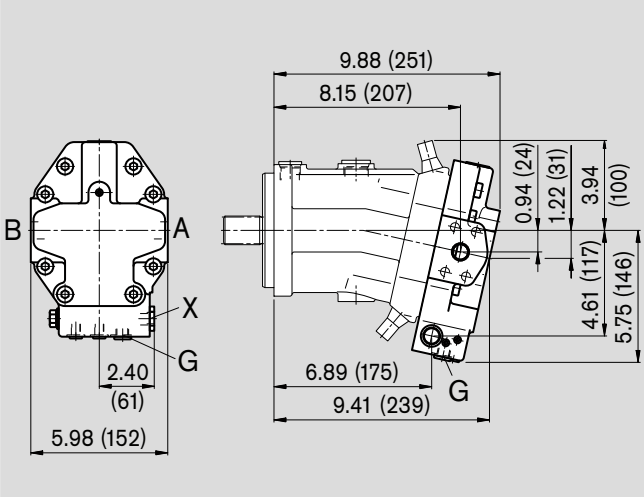
HD.E

Hydraulic control, pilot-pressure related,
with pressure control, direct and 2nd pressure setting



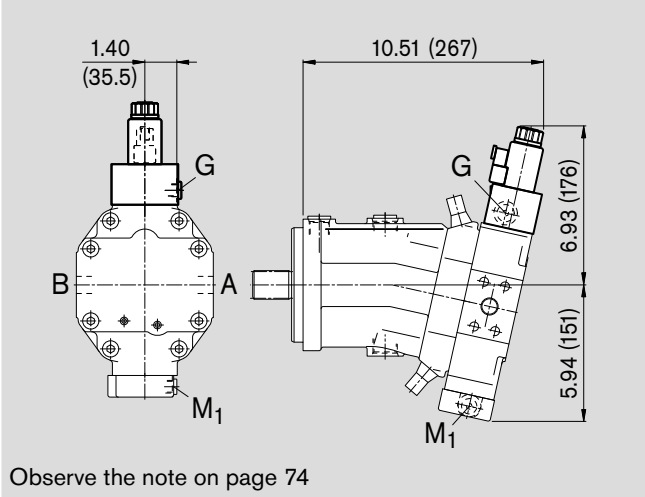
HZ3

Hydraulic two-point control



EP1, EP2

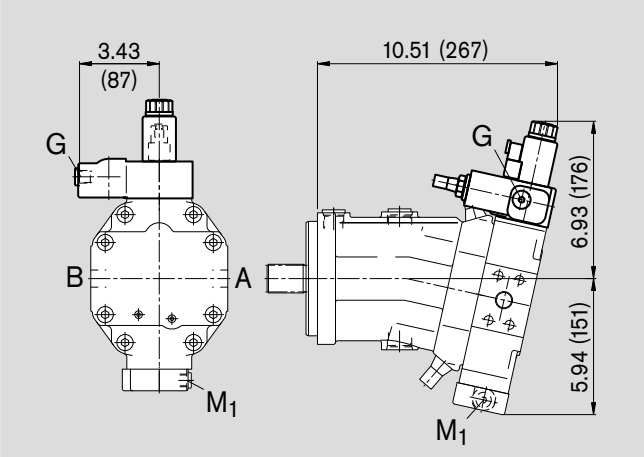
Electric control with proportional solenoid



Observe the note on page 74

EP.D

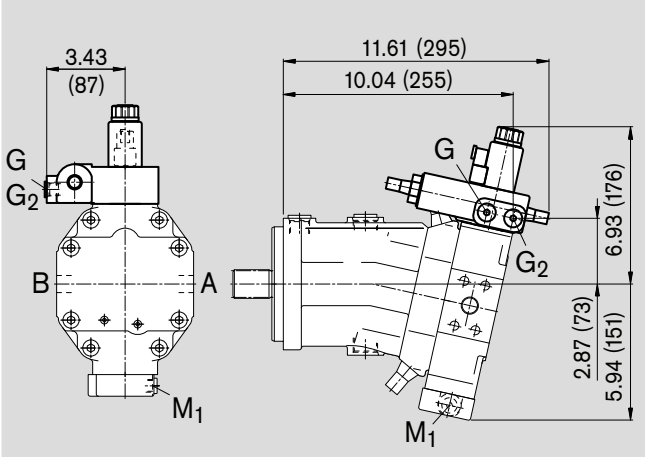
Electric control (proportional solenoid)
with pressure control, direct



Observe the note on page 74

EP.E

Electric control (proportional solenoid)
with pressure control, direct and 2nd pressure setting



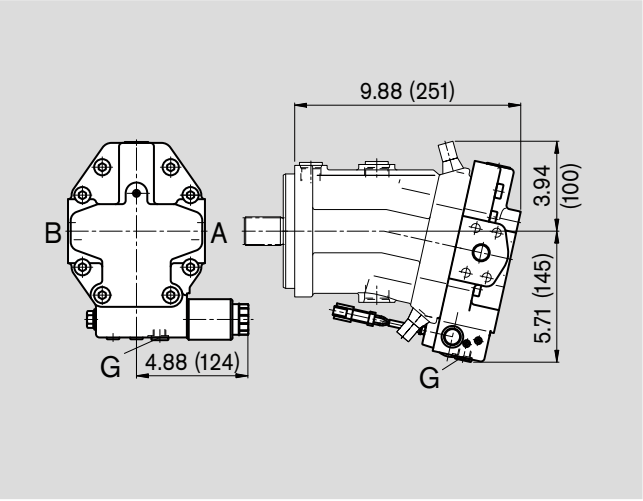
Observe the note on page 74

Unit dimensions, size 55 (SAE Version)

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

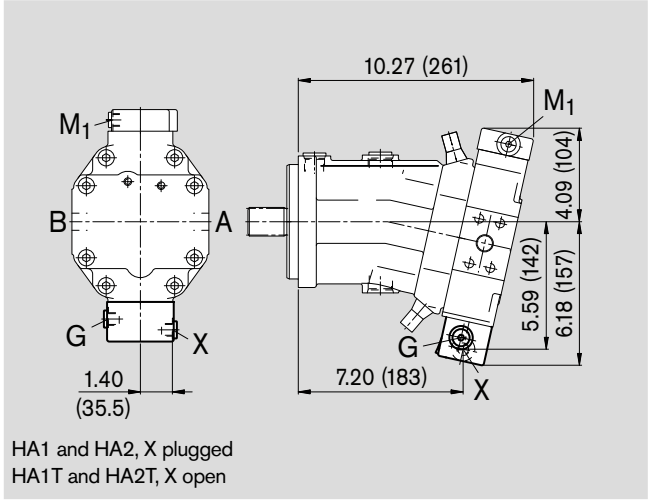
EZ3, EZ4

Electric two-point control with switching solenoid



HA1, HA2 / HA1T, HA2T

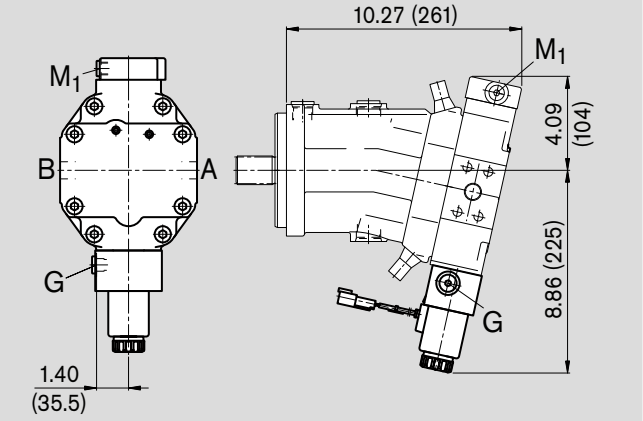
Automatic control, high-pressure related / high-pressure related and hydraulic override



HA1 and HA2, X plugged
HA1T and HA2T, X open

HA1U1, HA2U2

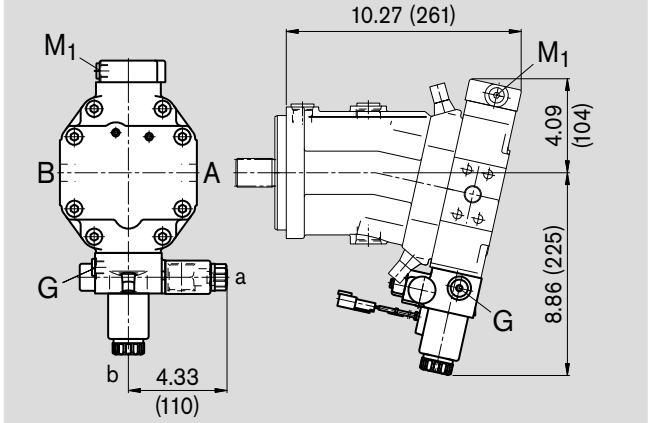
Automatic control, high-pressure related and electric override



Observe the note on page 74

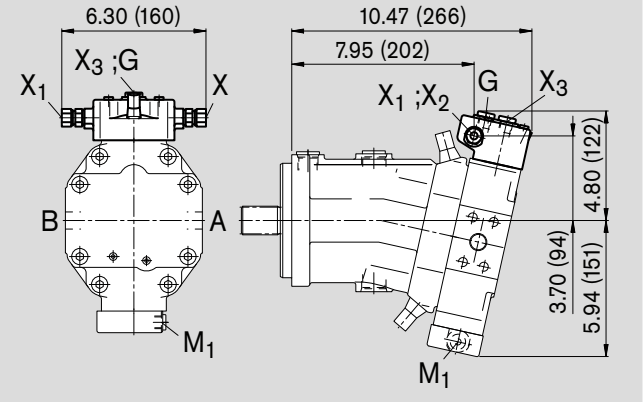
HA1R1, HA2R2

Automatic control, high-pressure related, electric override and electric travel direction valve



DA1, DA4

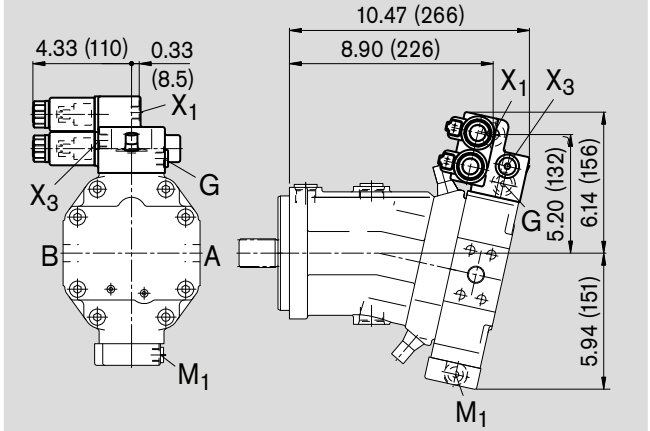
Hydraulic control, speed related and hydraulic travel direction valve



X_1, X_2 with fitting 8B-ST according to DIN 2353-CL

DA2, DA3, DA5, DA6

Hydraulic control, speed related, el. travel direction valve and el. $V_{g\,max}$ control

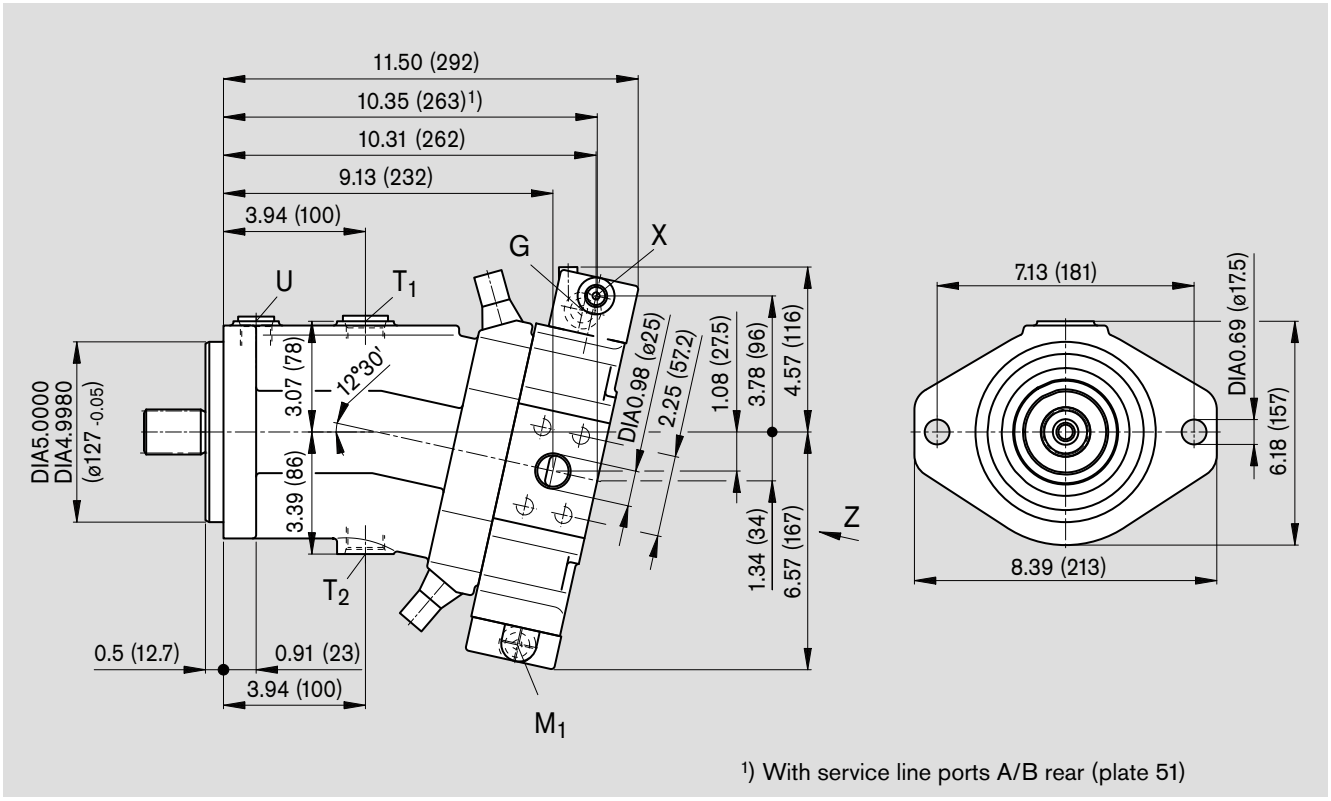


Unit Dimensions, Size 80 (SAE Version)

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

HD1, HD2 Hydraulic control, pilot pressure dependent

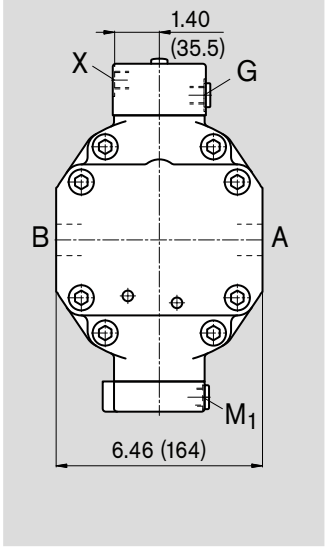
SAE flange ports A/B at side, opposite **(52)**



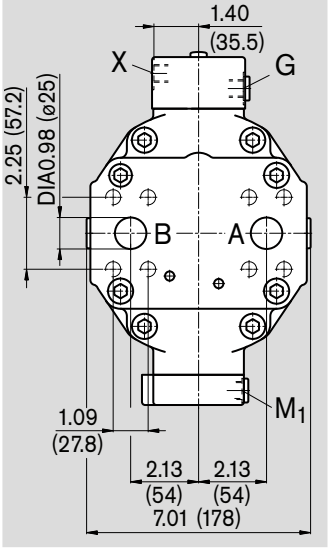
1) With service line ports A/B rear (plate 51)

Few Z

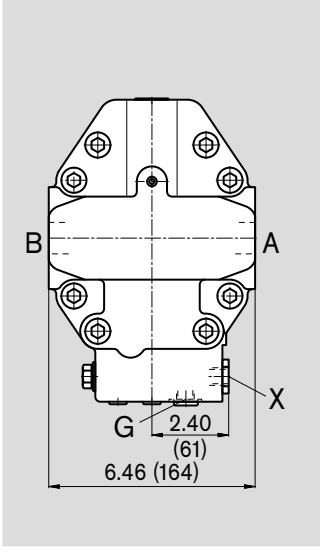
SAE flange ports A/B side, opposite **(52)**



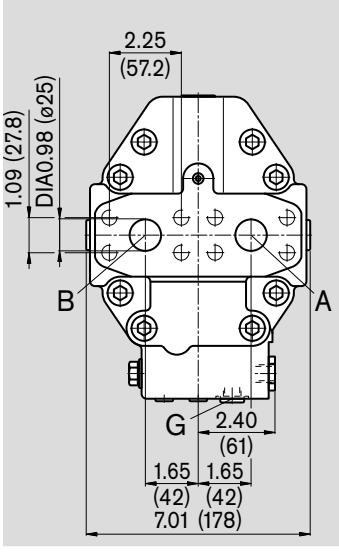
SAE flange ports A/B rear **(51)**



SAE flange ports A/B side, opposite with **HZ3, EZ3 (52)**



SAE flange ports A/B rear with **HZ3, EZ3 (51)**

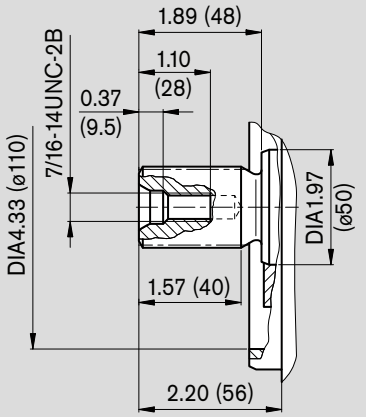


Unit dimensions, size 80 (SAE Version)

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

Shaft end

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



Ports

A, B	Service line ports (high-pressure series)	SAE J518	1 in		
	Fixing thread A/B	ISO 68	7/16 in -14 UNC-2B;	0.87 (22) deep [2]	
T_1	Case drain port [3]	ISO 11926	1 1/16 in -12 UN-2B;	0.79 (20) deep	265 lb-ft(360 Nm) [2]
T_2	Case drain port	ISO 11926	1 1/16 in -12 UN-2B;	0.79 (20) deep	265 lb-ft(360 Nm) [2]
X, X_1, X_3	Pilot-pressure port	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
G	Port for synchronous control of multiple units and for remote control pressure [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
G_2	Port for 2nd pressure setting [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
U	Flow port [3]	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft(240 Nm) [2]
M_1	Gauge port for control pressure [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]

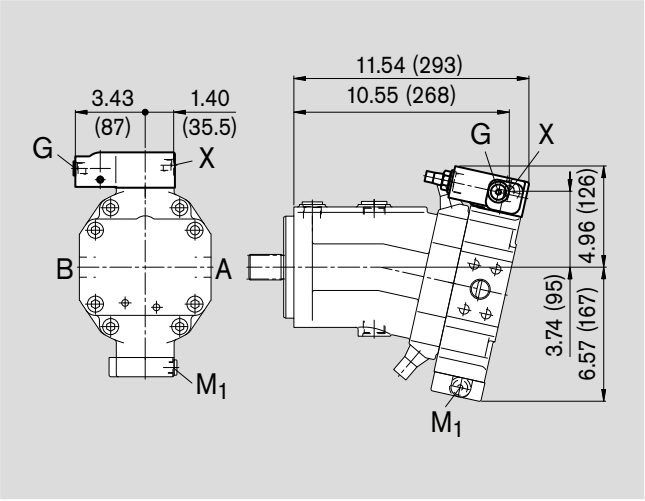
[1] ANSI B92.1a-1976, pressure angle 30°, flat root, side fit, tolerance class 5
[2] please observe the general notes for the max. tightening torques on page 76
[3] plugged

Unit dimensions, size 80 (SAE Version)

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

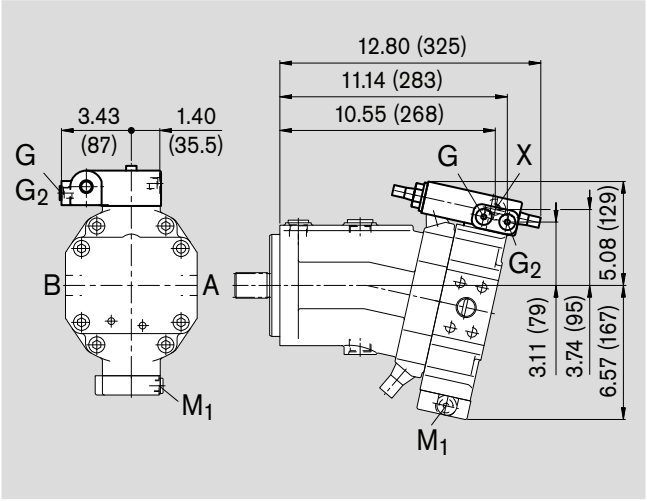
HD.D

Hydraulic control, pilot-pressure related,
with pressure control, direct



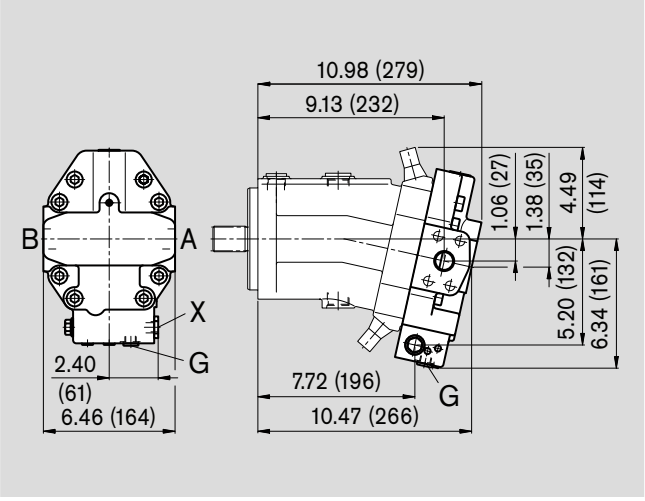
HD.E

Hydraulic control, pilot-pressure related,
with pressure control, direct and 2nd pressure setting



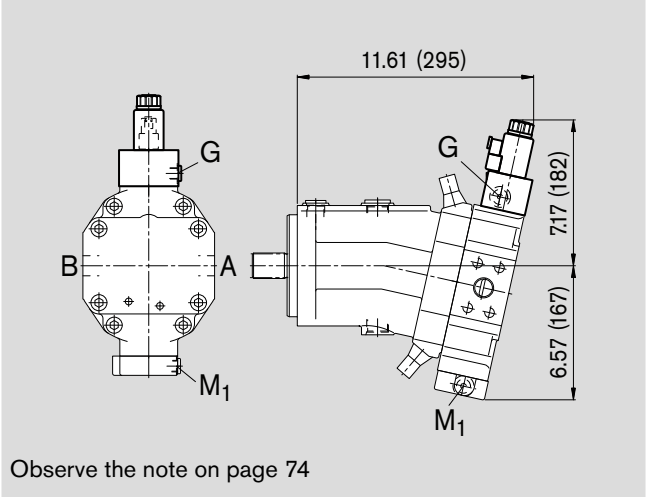
HZ3

Hydraulic two-point control



EP1, EP2

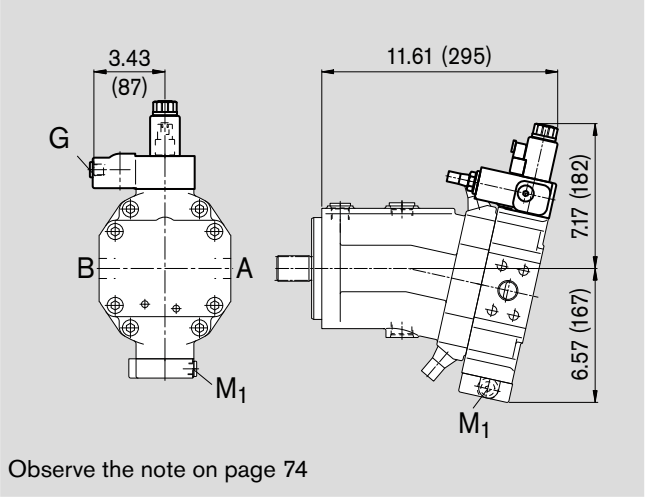
Electric control with proportional solenoid



Observe the note on page 74

EP.D

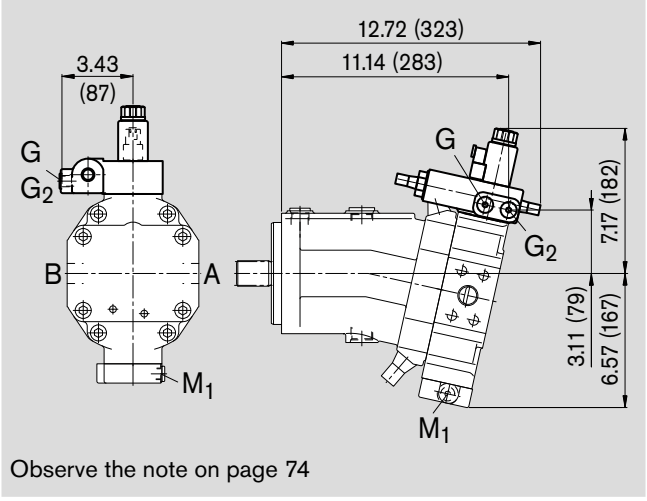
Electric control (proportional solenoid)
with pressure control, direct



Observe the note on page 74

EP.E

Electric control (proportional solenoid)
with pressure control, direct and 2nd pressure setting



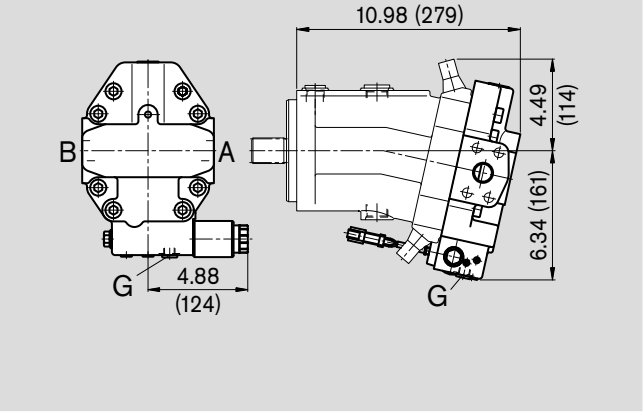
Observe the note on page 74

Unit dimensions, size 80 (SAE Version)

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

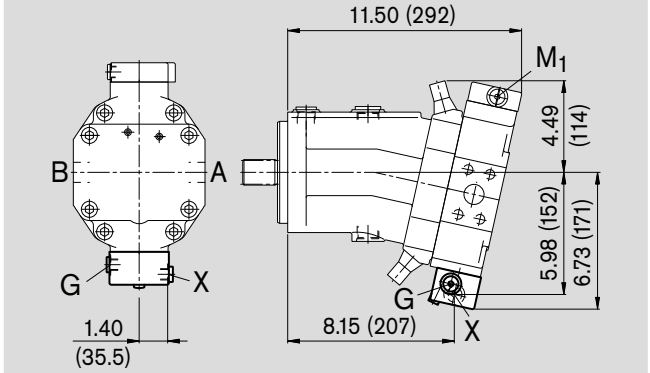
EZ3, EZ4

Electric two-point control with switching solenoid



HA1, HA2 / HA1T, HA2T

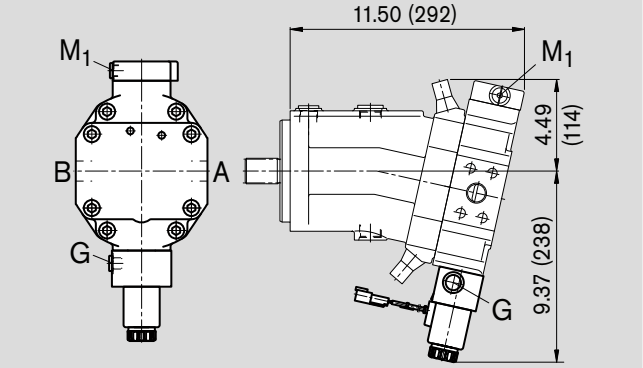
Automatic control, high-pressure related / high-pressure related and hydraulic override



HA1 and HA2, X plugged
HA1T and HA2T, X open

HA1U1, HA2U2

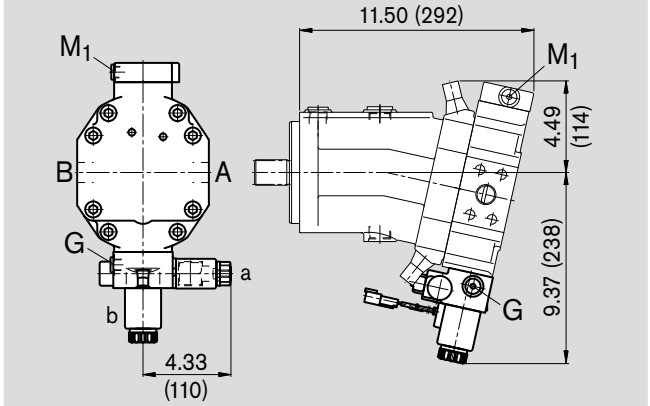
Automatic control, high-pressure related and electric override



Observe the note on page 74

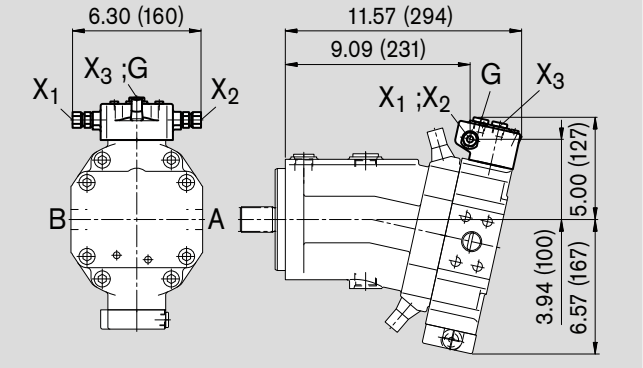
HA1R1, HA2R2

Automatic control, high-pressure related, electric override and electric travel direction valve



DA1, DA4

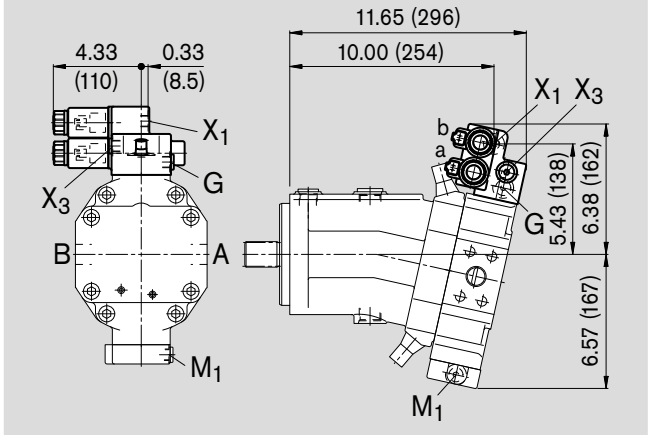
Hydraulic control, speed related and hydraulic travel direction valve



X_1, X_2 with fitting 8B-ST according to DIN 2353-CL

DA2, DA3, DA5, DA6

Hydraulic control, speed related, el. travel direction valve and el. $V_{g\ max}$ control

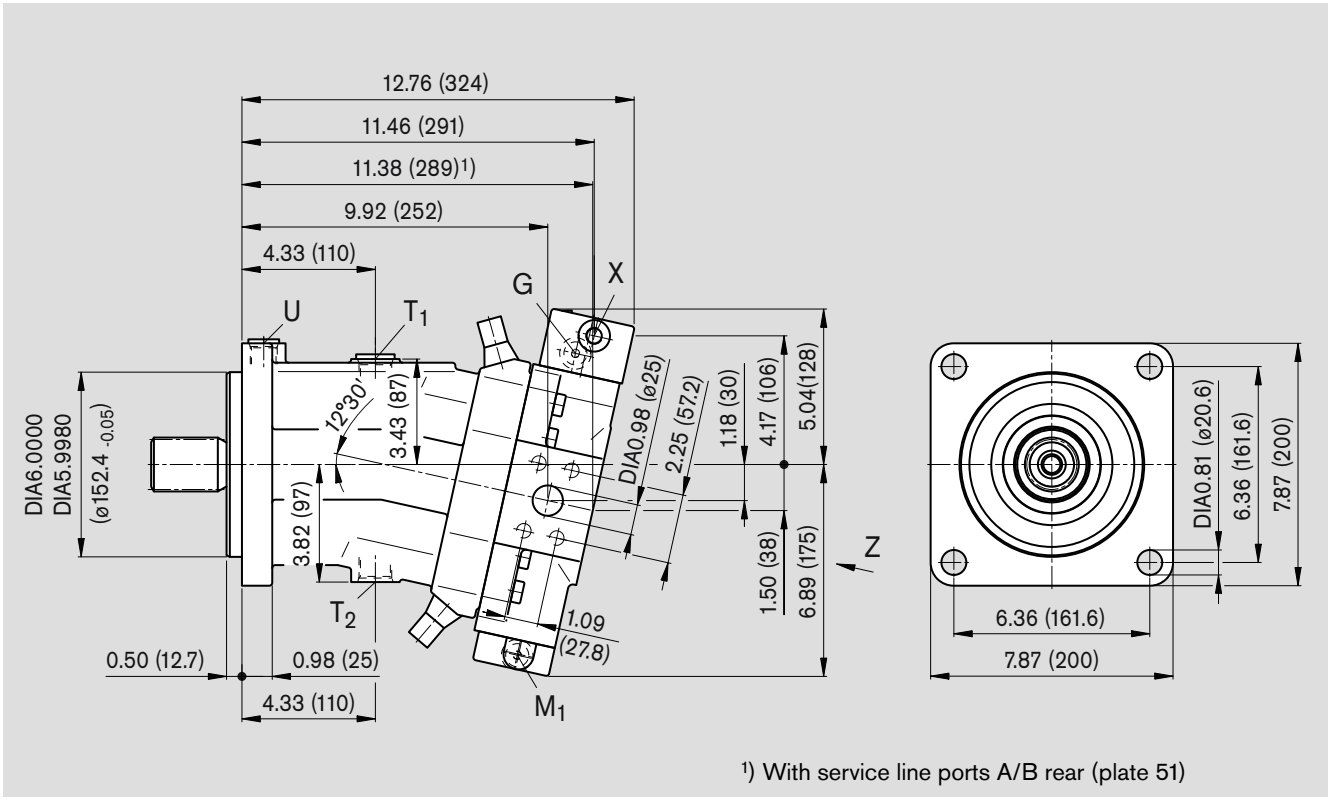


Unit dimensions, size 107 (SAE Version)

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

HD1, HD2 Hydraulic control, pilot-pressure related

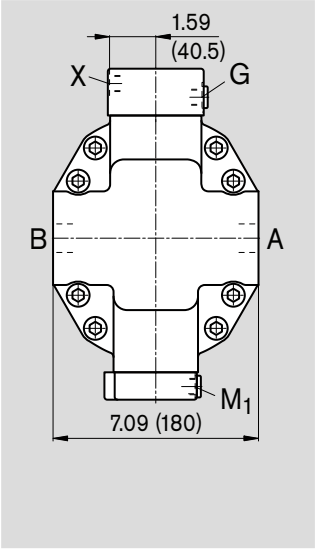
SAE flange ports A/B side, opposite **(52)**



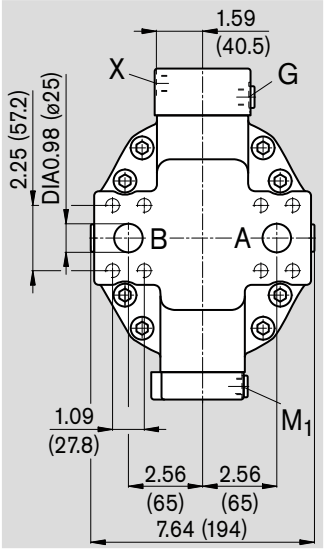
1) With service line ports A/B rear (plate 51)

View Z

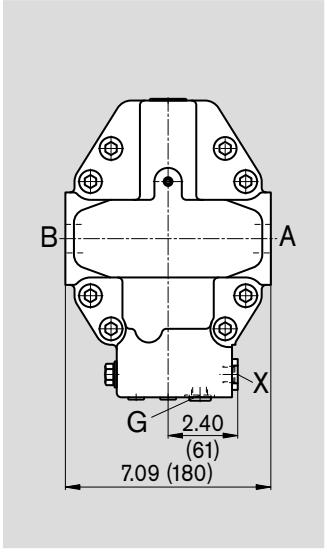
SAE flange ports **A/B side,** opposite (52)



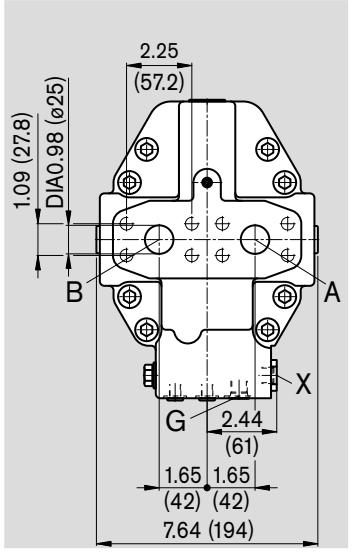
SAE flange ports **A/B, rear (51)**



SAE flange ports A/B side, opposite with **HZ3, EZ3** (52)



SAE flange ports A/B, rear with HZ3, EZ3 (51)

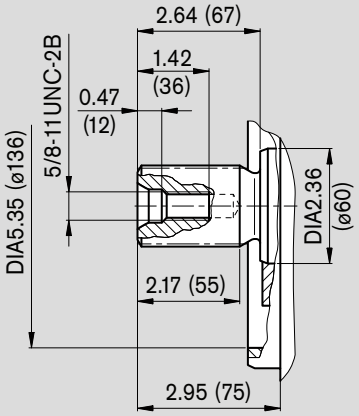


Unit dimensions, size 107 (SAE Version)

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

Shaft end

S Splined shaft 1 3/4in 13T 8/16DP [1]
(SAE J744 – 44-4 (D))



Ports

A, B	Service line ports (high-pressure series)	SAE J518	1 in		
	Fixing thread A/B	ISO 68	7/16 in -14 UNC-2B;	0.87 (22) deep [2]	
T_1	Case drain port [3]	ISO 11926	1 1/16 in -12 UN-2B;	0.79 (20) deep	265 lb-ft(360 Nm) [2]
T_2	Case drain port	ISO 11926	1 1/16 in -12 UN-2B;	0.79 (20) deep	265 lb-ft(360 Nm) [2]
X, X_1, X_3	Pilot-pressure port	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
G	Port for synchronous control of multiple units and for remote control pressure [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
G_2	Port for 2nd pressure setting [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
U	Flow port [3]	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft(240 Nm) [2]
M_1	Gauge port for control pressure [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]

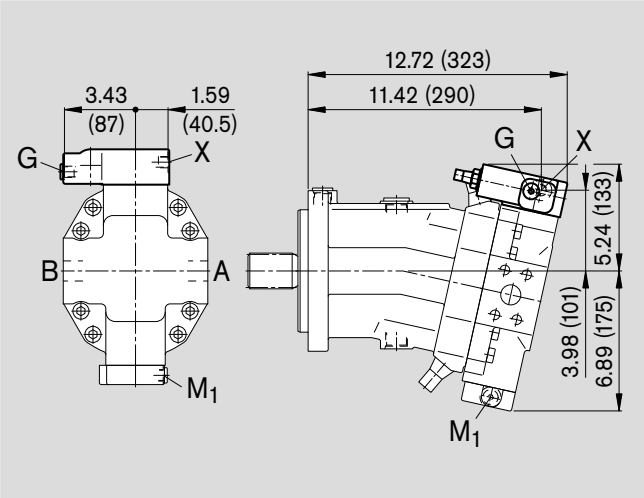
[1] ANSI B92.1a-1976, pressure angle 30°, flat root, side fit, tolerance class 5
[2] please observe the general notes for the max. tightening torques on page 76
[3] plugged

Unit Dimensions, Size 107 (SAE Version)

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

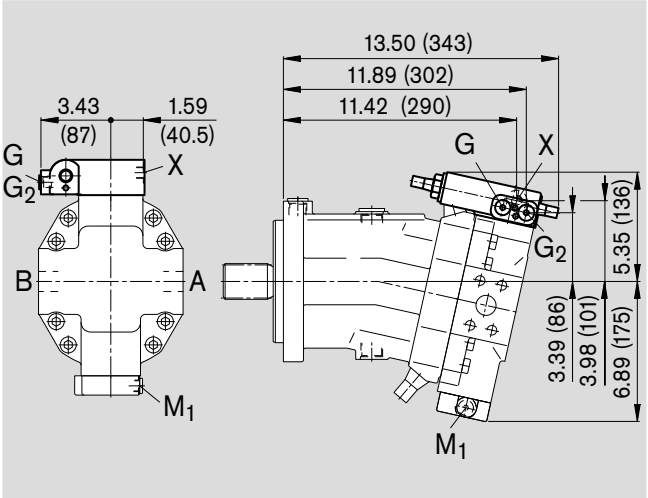
HD.D

Hydraulic control, pilot-pressure related,
with pressure control, direct



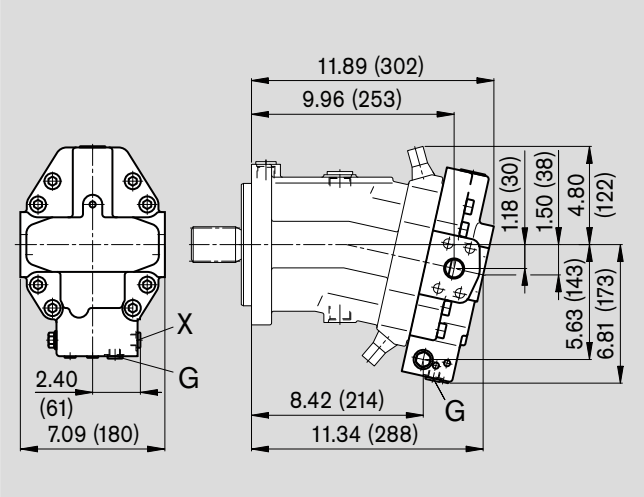
HD.E

Hydraulic control, pilot-pressure related,
with pressure control, direct and 2nd pressure setting



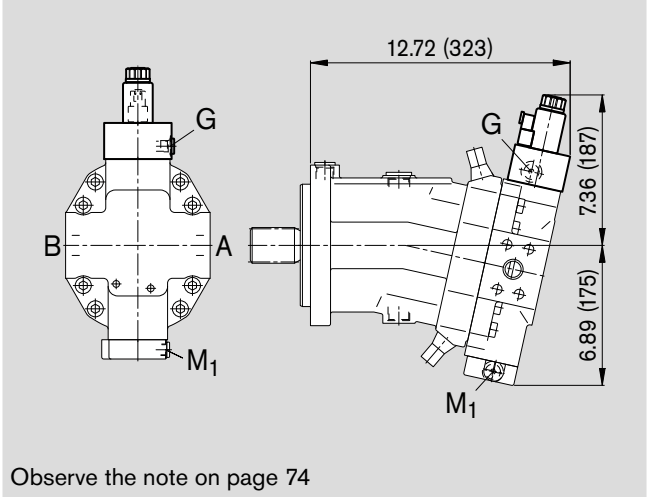
HZ3

Hydraulic two-point control



EP1, EP2

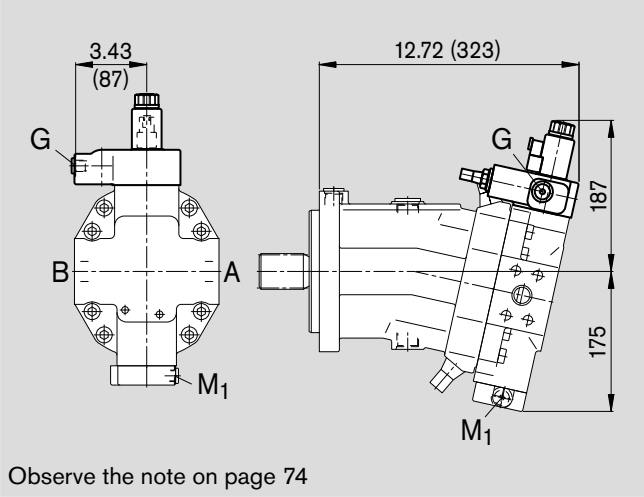
Electric control with proportional solenoid



Observe the note on page 74

EP.D

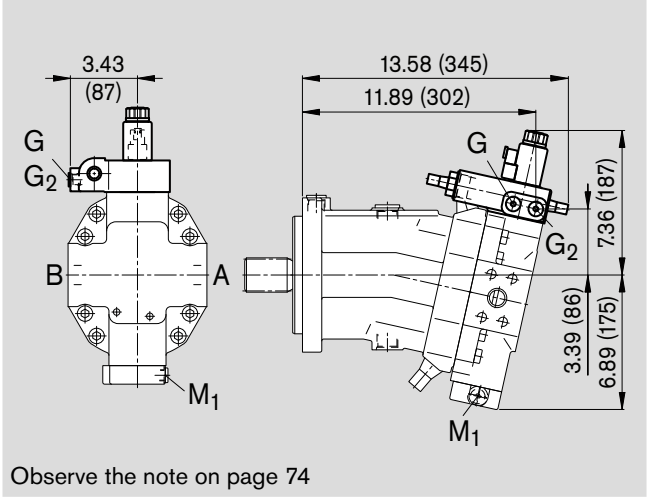
Electric control (proportional solenoid)
with pressure control, direct



Observe the note on page 74

EP.E

Electric control (proportional solenoid)
with pressure control, direct and 2nd pressure setting



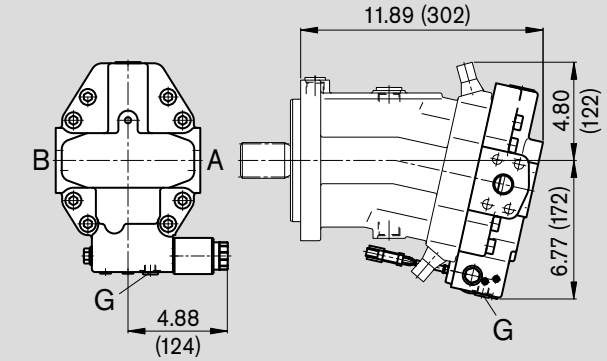
Observe the note on page 74

Unit Dimensions, Size 107 (SAE Version)

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

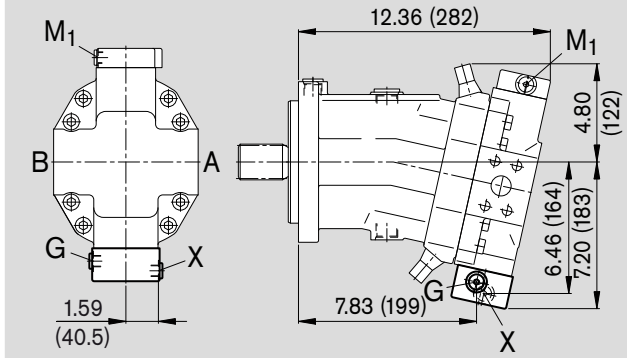
EZ3, EZ4

Electric two-point control with switching solenoid



HA1, HA2 / HA1T, HA2T

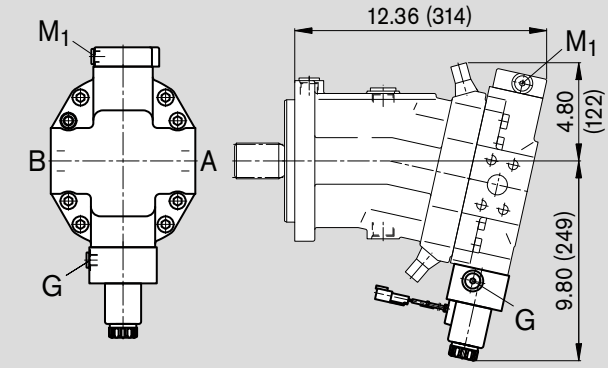
Automatic control, high-pressure related / high-pressure related and hydraulic override



HA1 and HA2, X plugged
HA1T and HA2T, X open

HA1U1, HA2U2

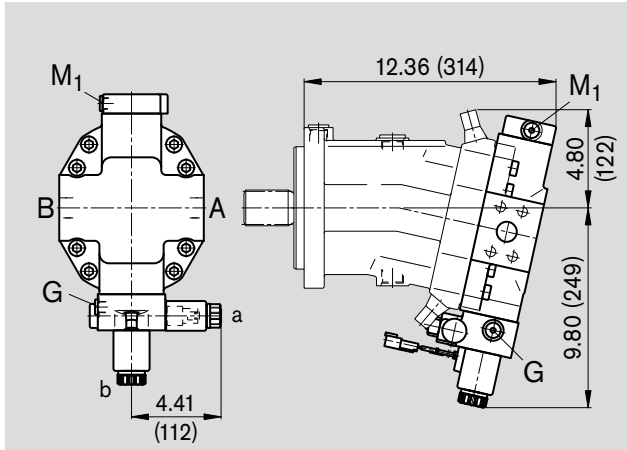
Automatic control, high-pressure related and electric override



Observe the note on page 74

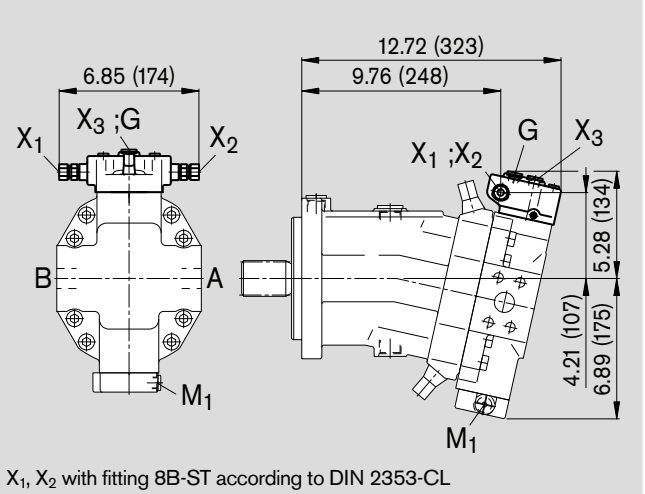
HA1R1, HA2R2

Automatic control, high-pressure related, electric override and electric travel direction valve



DA1, DA4

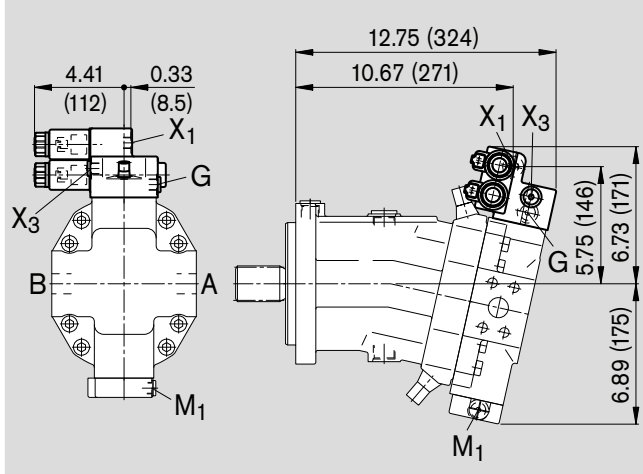
Hydraulic control, speed related and hydraulic travel direction valve



X_1, X_2 with fitting 8B-ST according to DIN 2353-CL

DA2, DA3, DA5, DA6

Hydraulic control, speed related, el. travel direction valve and el. $V_{g\ max}$ control



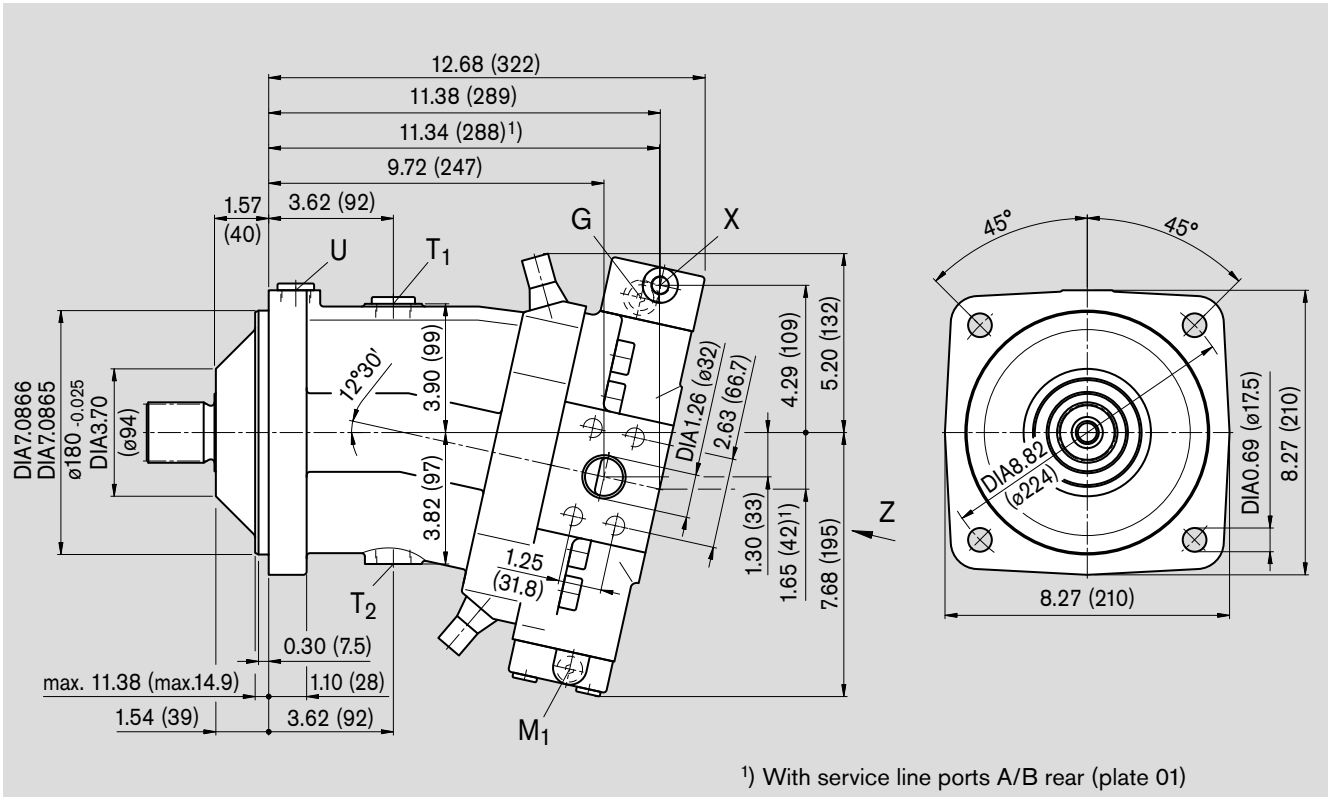
Unit dimensions, size 140 (ISO Version)

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

HD1, HD2 Hydraulic control, pilot-pressure related

HZ1 Hydraulic two-point control

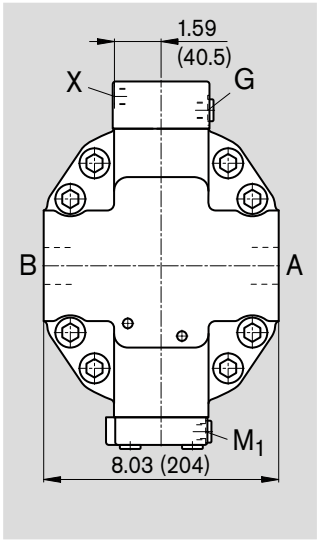
SAE flange ports A/B side, opposite **(02)**



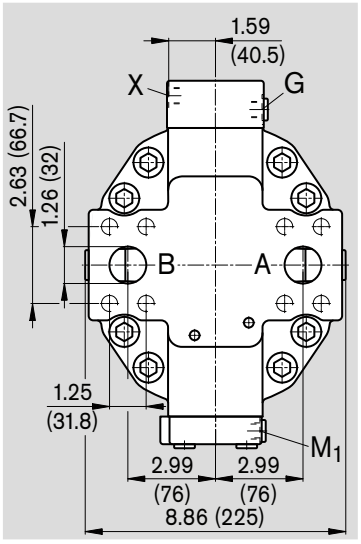
1) With service line ports A/B rear (plate 01)

View Z

SAE flange ports A/B side, opposite **(02)**



SAE flange ports A/B rear **(01)**

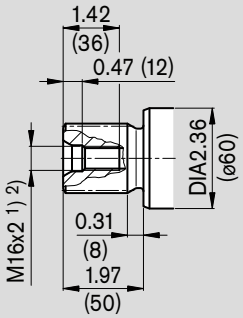


Unit dimensions, size 140 (ISO Version)

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

Shaft end

Z Splined shaft DIN 5480
W45x2x30x21x9g



Ports

A, B	Service line ports (high-pressure series)	SAE J518	1 1/4 in		
	Fixing thread A/B	DIN 13	M14x2;	0.75 (19) deep 2)	
T_1	Case drain port 3)	DIN 3852	M26x1.5;	0.63 (16) deep	170 lb-ft (230 Nm) 2)
T_2	Case drain port	DIN 3852	M26x1.5;	0.63 (16) deep	170 lb-ft (230 Nm) 2)
X, X_1, X_3	Pilot-pressure port	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
G	Port for synchronous control of multiple units and for remote control pressure 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
G_2	Port for 2nd pressure setting 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
U	Flow port 3)	DIN 3852	M22x1.5;	0.55 (14) deep	70 lb-ft (210 Nm) 2)
M_1	Gauge port for control pressure 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)

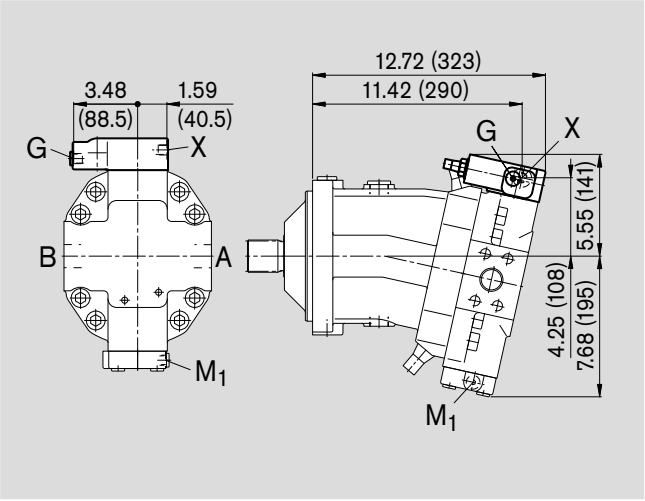
1) Center bore according to DIN 332 (thread according to DIN 13)
2) Please observe the general notes for the max. tightening torques on page 76
3) Plugged

Unit dimensions, size 140 (ISO Version)

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

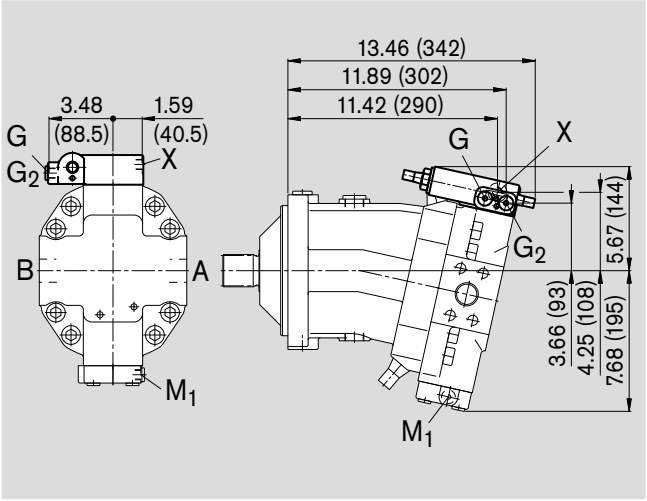
HD.D

Hydraulic control, pilot-pressure related,
with pressure control, direct



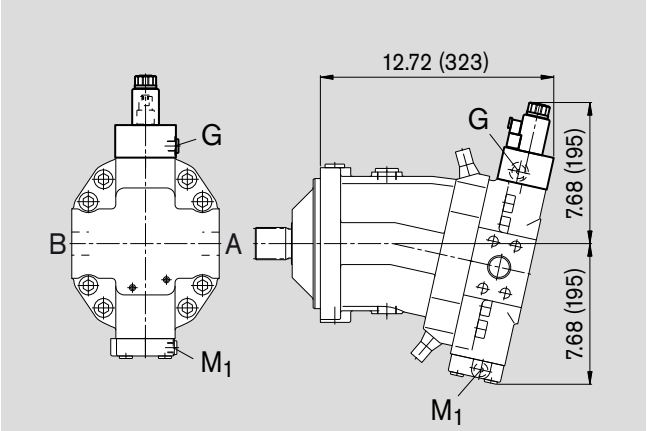
HD.E

Hydraulic control, pilot-pressure related,
with pressure control, direct and **2nd** pressure setting



EP1, EP2

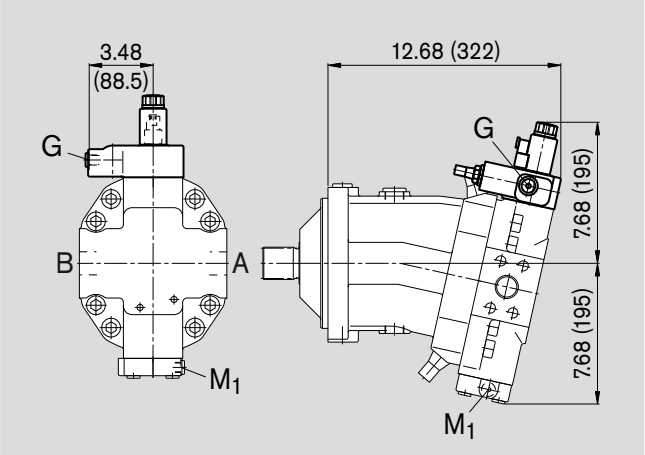
Electric control with proportional solenoid



Observe the note on page 74

EP.D

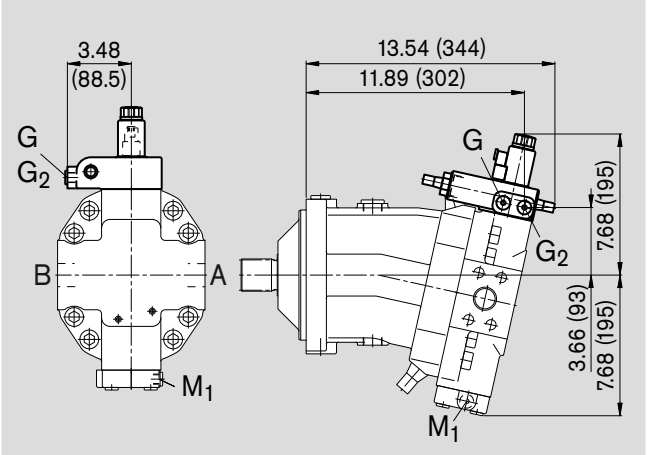
Electric control (proportional solenoid)
with pressure control, direct



Observe the note on page 74

EP.E

Electric control (proportional solenoid)
with pressure control, direct and 2nd pressure setting



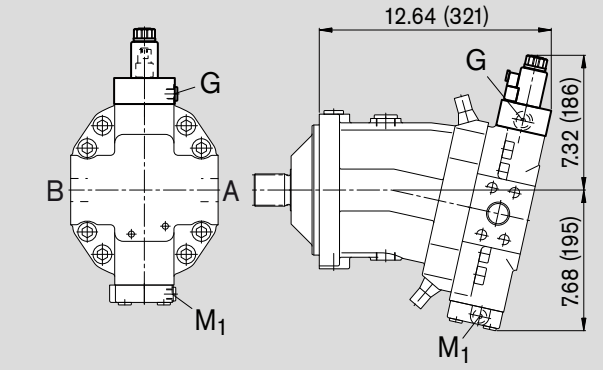
Observe the note on page 74

Unit dimensions, size 140 (ISO Version)

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

EZ1, EZ2

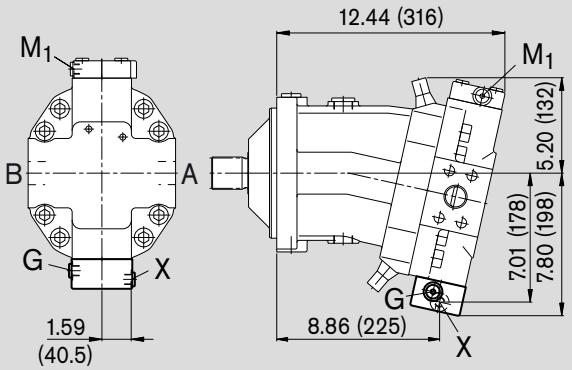
Electric two-point control with switching solenoid



Observe the note on page 74

HA1, HA2 / HA1T, HA2T

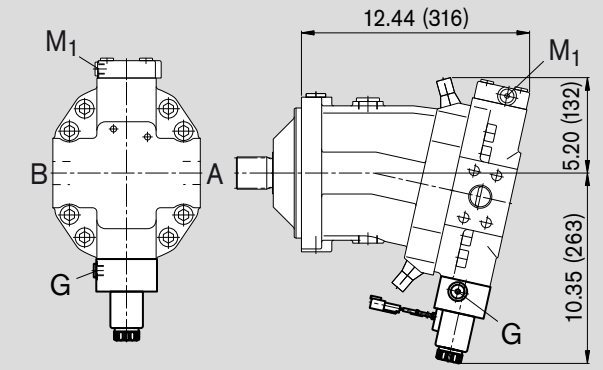
Automatic control, high-pressure related / high-pressure related and hydraulic override



HA1 and HA2, X plugged
HA1T and HA2T, X open

HA1U1, HA2U2

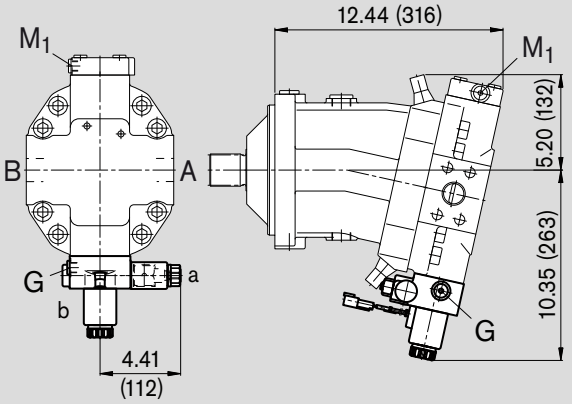
Automatic control, high-pressure related and electric override



Observe the note on page 74

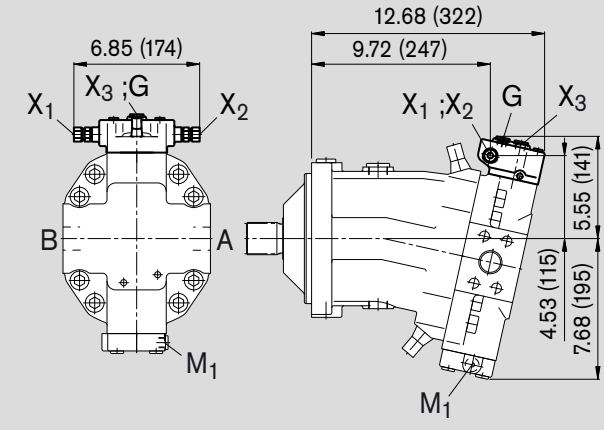
HA1R1, HA2R2

Automatic control, high-pressure related, electric override and electric travel direction valve



DA1, DA4

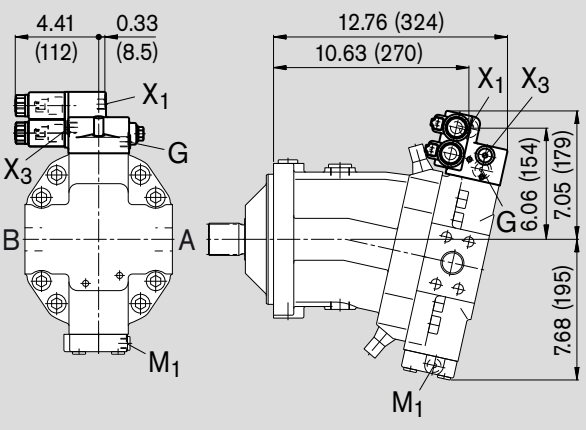
Hydraulic control, speed related and hydraulic travel direction valve



X_1, X_2 with fitting 8B-ST according to DIN 2353-CL

DA2, DA3, DA5, DA6

Hydraulic control, speed related, el. travel direction valve and el. $V_{g\,max}$ control



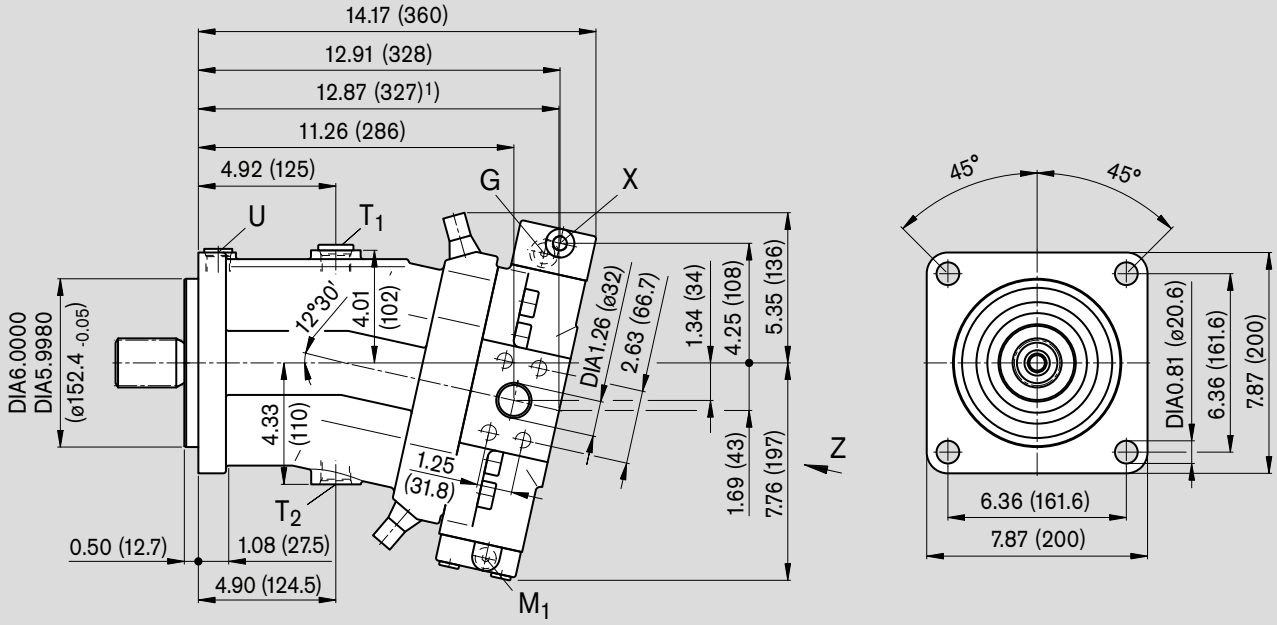
Unit dimensions, size 160 (SAE Version)

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

HD1, HD2 Hydraulic control, pilot-pressure related

HZ1 Hydraulic two-point control

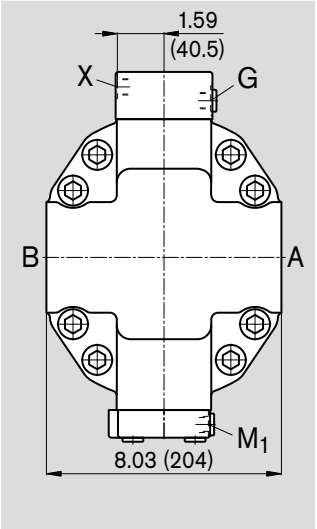
SAE flange ports A/B side, opposite **(52)**



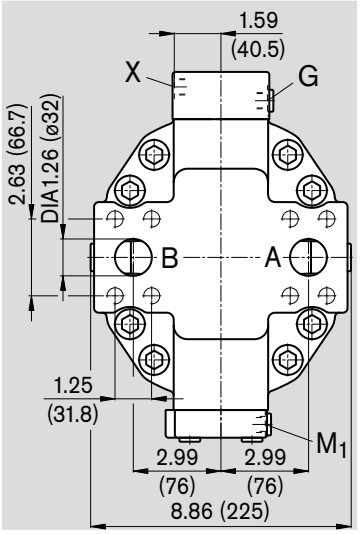
1) With service line ports A/B rear (plate 51)

View Z

SAE flange ports A/B side, opposite **(52)**



SAE flange ports A/B rear **(51)**

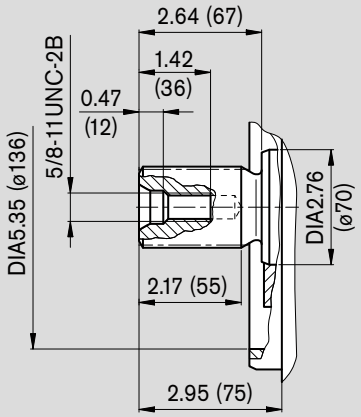


Unit dimensions, size 160 (SAE Version)

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

Shaft end

S Splined shaft 1 3/4in 13T 8/16DP [1]
(SAE J744 – 44-4 (D))



Ports

A, B	Service line ports (high-pressure series)	SAE J518	1 1/4 in		
	Fixing thread A/B	ISO 68	1/2 in -13 UNC-2B;	0.75 (19) deep [2]	
T_1	Case drain port [3]	ISO 11926	1 1/16 in -12 UN-2B;	0.79 (20) deep	265 lb-ft(360 Nm) [2]
T_2	Case drain port	ISO 11926	1 1/16 in -12 UN-2B;	0.79 (20) deep	265 lb-ft(360 Nm) [2]
X, X_1, X_3	Pilot-pressure port	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
G	Port for synchronous control of multiple units and for remote control pressure [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
G_2	Port for 2nd pressure setting [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
U	Flow port [3]	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft(240 Nm) [2]
M_1	Gauge port for control pressure [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]

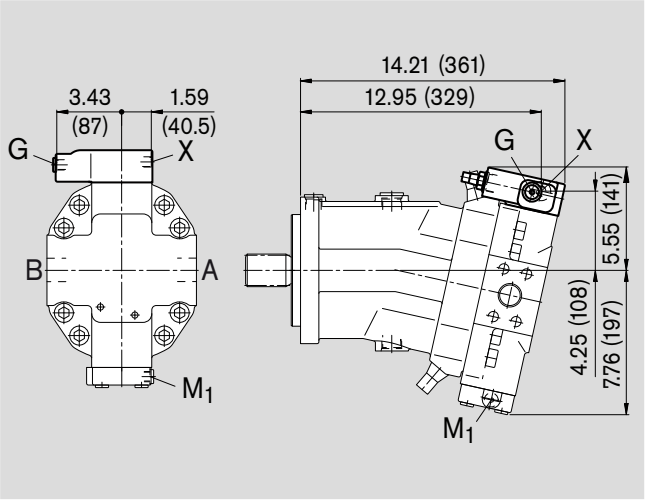
[1] ANSI B92.1a-1976, pressure angle 30°, flat root, side fit, tolerance class 5
[2] please observe the general notes for the max. tightening torques on page 76
[3] plugged

Unit dimensions, size 160 (SAE Version)

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

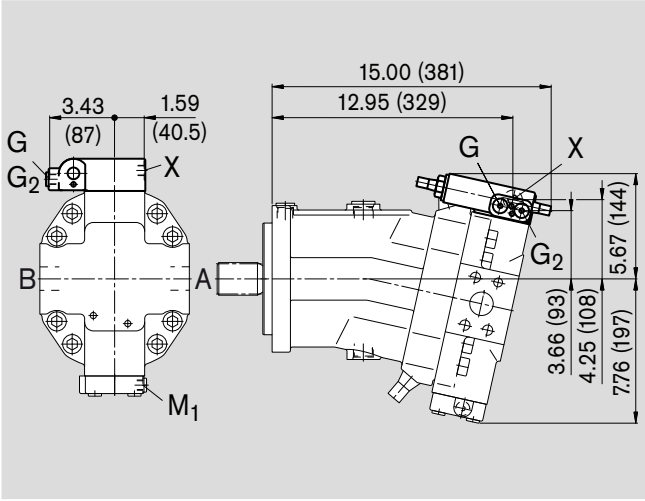
HD.D

Hydraulic control, pilot-pressure related,
with pressure control, direct



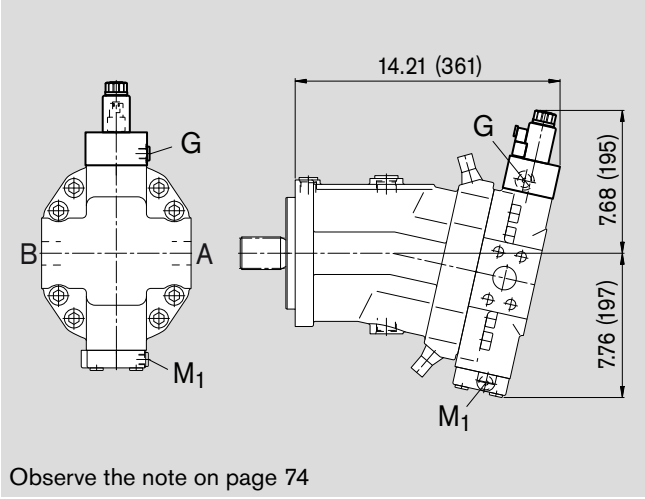
HD.E

Hydraulic control, pilot-pressure related,
with pressure control, direct and 2nd pressure setting



EP1, EP2

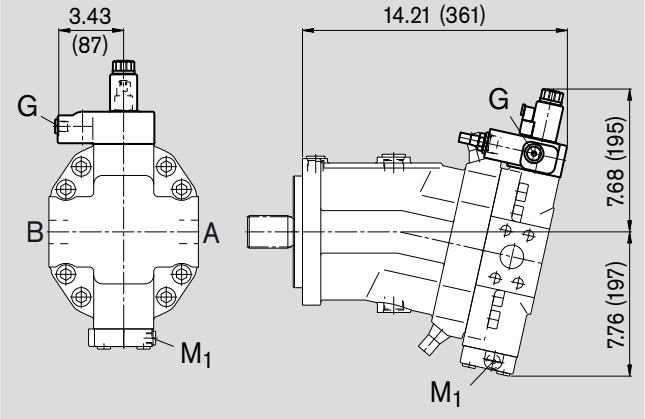
Electric control with proportional solenoid



Observe the note on page 74

EP.D

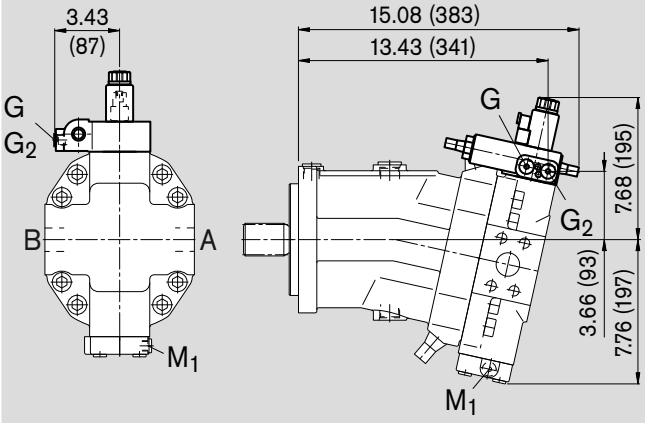
Electric control (proportional solenoid)
with pressure control, direct



Observe the note on page 74

EP.E

Electric control (proportional solenoid)
with pressure control, direct and 2nd pressure setting



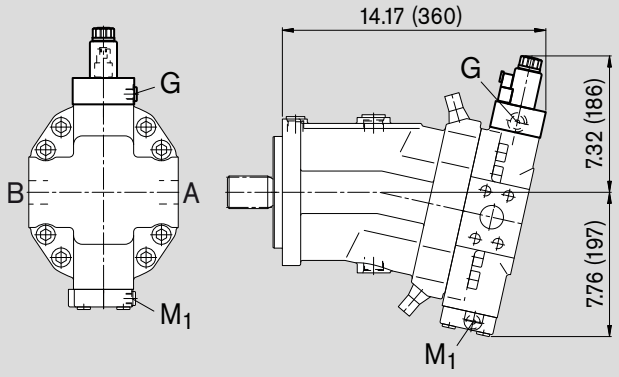
Observe the note on page 74

Unit dimensions, size 160 (SAE Version)

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

EZ1, EZ2

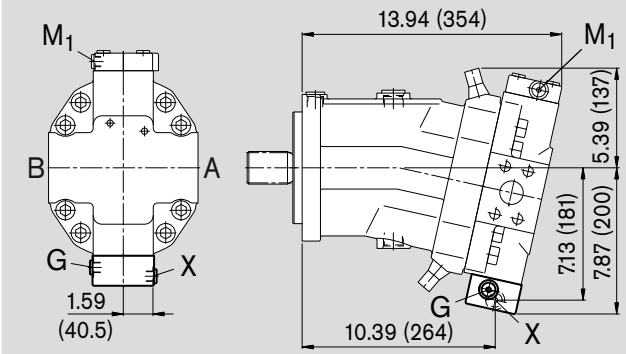
Electric two-point control with switching solenoid



Observe the note on page 74

HA1, HA2 / HA1T, HA2T

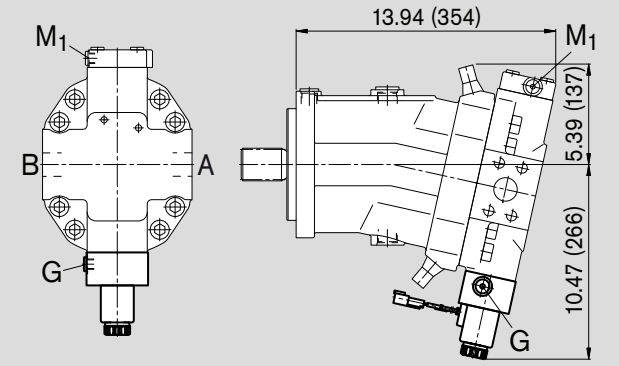
Automatic control, high-pressure related / high-pressure related and hydraulic override



HA1 and HA2, X plugged
HA1T and HA2T, X open

HA1U1, HA2U2

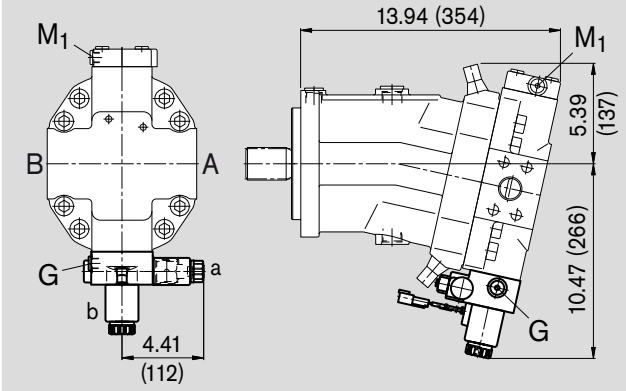
Automatic control, high-pressure related and electric override



Observe the note on page 74

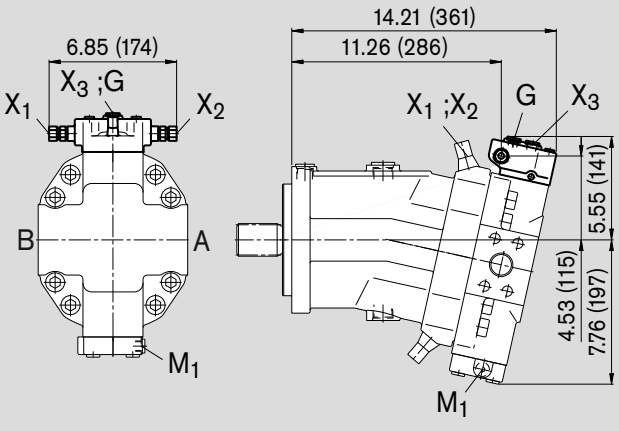
HA1R1, HA2R2

Automatic control, high-pressure related, electric override and electric travel direction valve



DA1, DA4

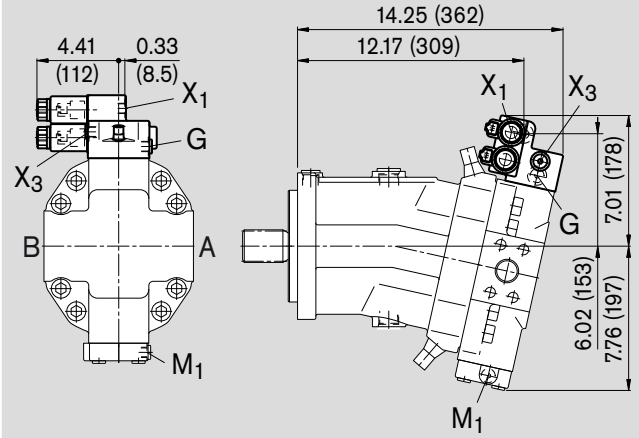
Hydraulic control, speed related and hydraulic travel direction valve



X_1, X_2 with fitting 8B-ST according to DIN 2353-CL

DA2, DA3, DA5, DA6

Hydraulic control, speed related, el. travel direction valve and el. $V_{g\,max}$ control



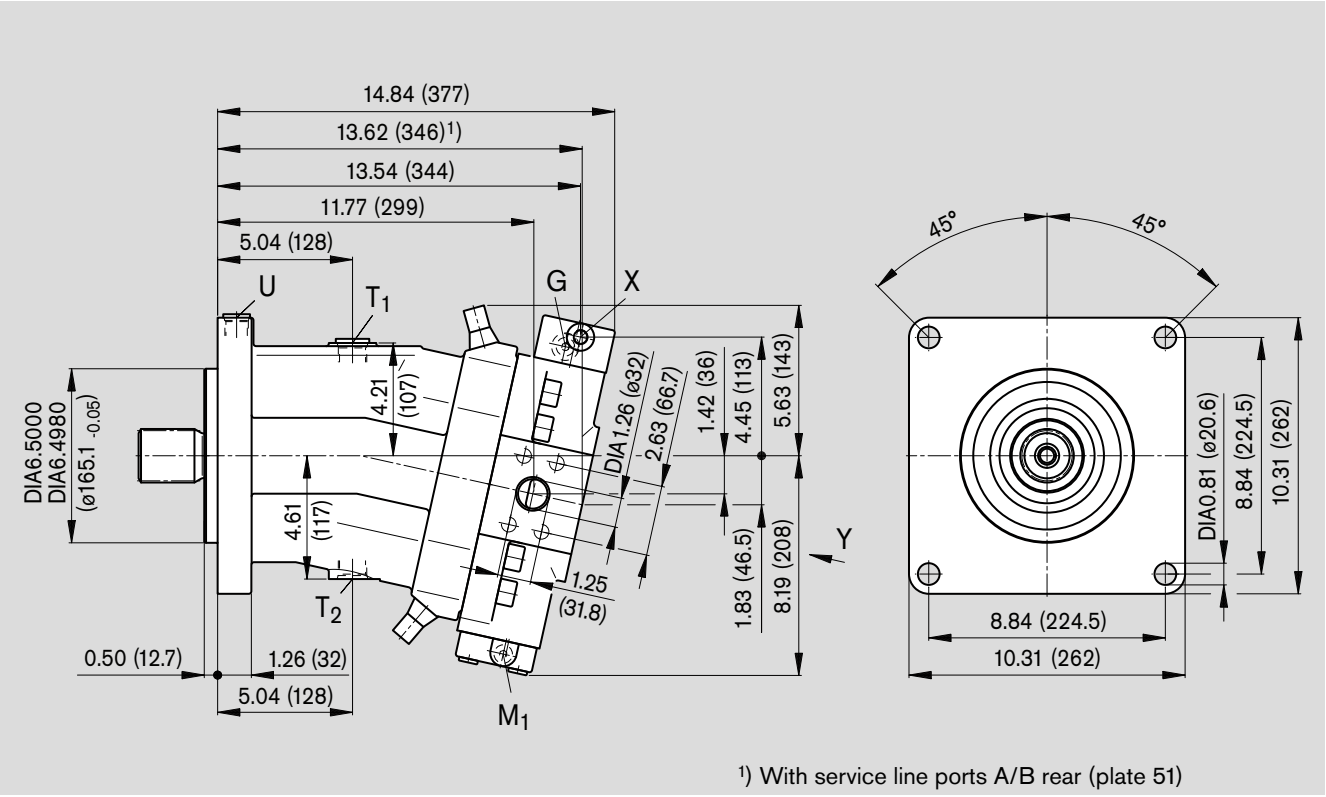
Unit dimensions, size 200 (SAE Version)

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

HD1, HD2 Hydraulic control, pilot-pressure related

HZ1 Hydraulic two-point control

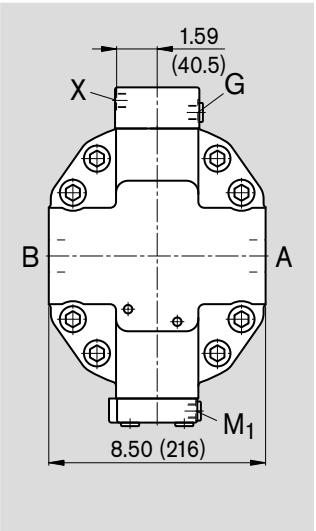
SAE flange ports A/B side, opposite **(52)**



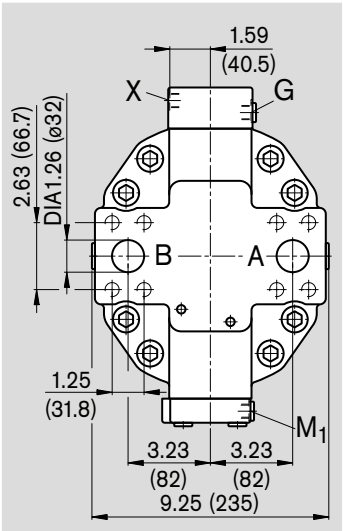
1) With service line ports A/B rear (plate 51)

View Z

SAE flange ports A/B side, opposite **(52)**



SAE flange ports A/B rear **(51)**

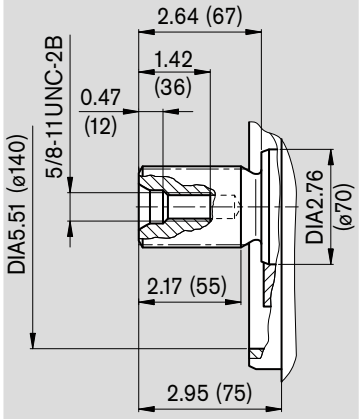


Unit dimensions, size 200 (SAE Version)

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

Shaft end

S Splined shaft 2in 15T 8/16DP [1]
Similar to SAE J744 – 50-4 (F)
Length (2.64 in) deviats from standard (3.125 in)



Ports

A, B	Service line ports (high-pressure series)	SAE J518	1 1/4 in		
	Fixing thread A/B	ISO 68	1/2 in -13 UNC-2B;	0.75 (19) deep [2]	
T_1	Case drain port [3]	ISO 11926	1 1/16 in -12 UN-2B;	0.79 (20) deep	265 lb-ft(360 Nm) [2]
T_2	Case drain port	ISO 11926	1 1/16 in -12 UN-2B;	0.79 (20) deep	265 lb-ft(360 Nm) [2]
X, X_1, X_3	Pilot-pressure port	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
G	Port for synchronous control of multiple units and for remote control pressure [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
G_2	Port for 2nd pressure setting [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]
U	Flow port [3]	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft(240 Nm) [2]
M_1	Gauge port for control pressure [3]	ISO 11926	9/16 in -18 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2]

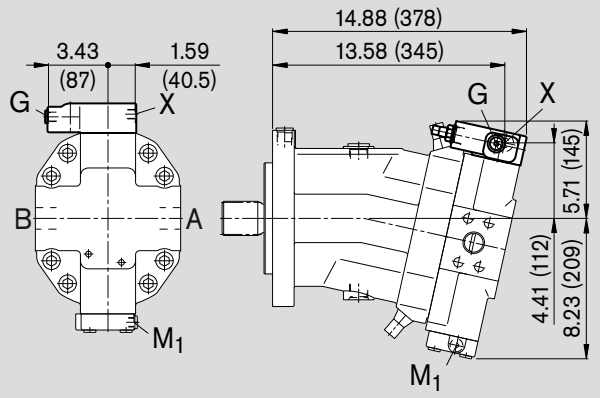
[1] ANSI B92.1a-1976, pressure angle 30°, flat root side, tolerance class 5
[2] please observe the general notes for the max. tightening torques on page 76
[3] plugged

Unit dimensions, size 200 (SAE Version)

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

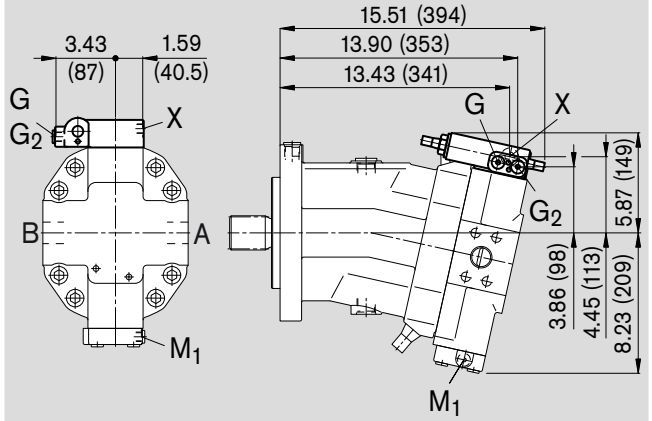
HD.D

Hydraulic control, pilot-pressure related,
with pressure control, direct



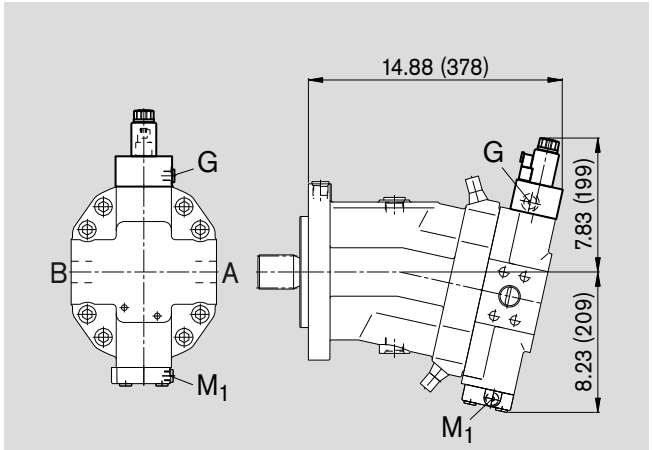
HD.E

Hydraulic control, pilot-pressure related,
with pressure control, direct and 2nd pressure setting



EP1, EP2

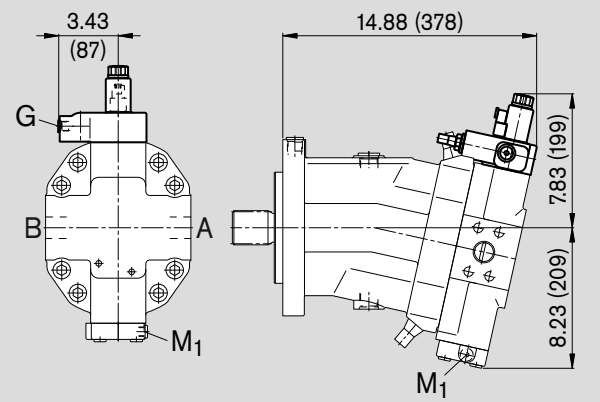
Electric control with proportional solenoid



Observe the note on page 74

EP.D

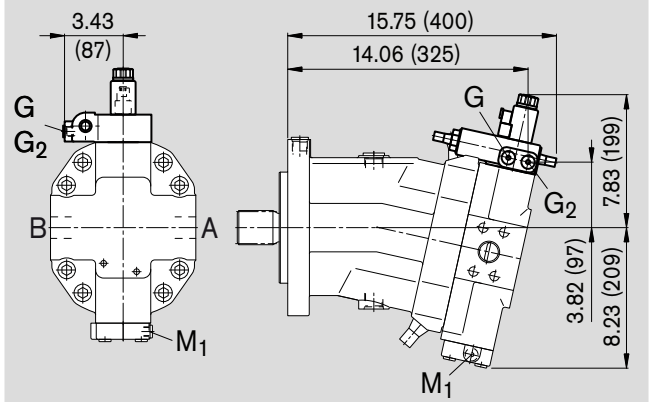
Electric control (proportional solenoid)
with pressure control, direct



Observe the note on page 74

EP.E

Electric control (proportional solenoid)
with pressure control, direct and 2nd pressure setting



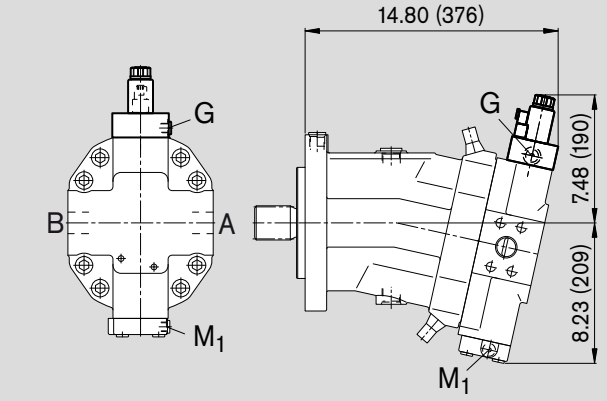
Observe the note on page 74

Unit dimensions, size 200 (SAE Version)

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

EZ1, EZ2

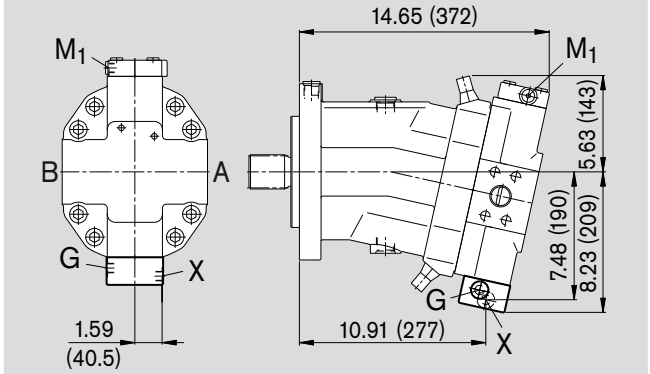
Electric two-point control witch switching solenoid



Observe the note on page 74

HA1, HA2 / HA1T, HA2T

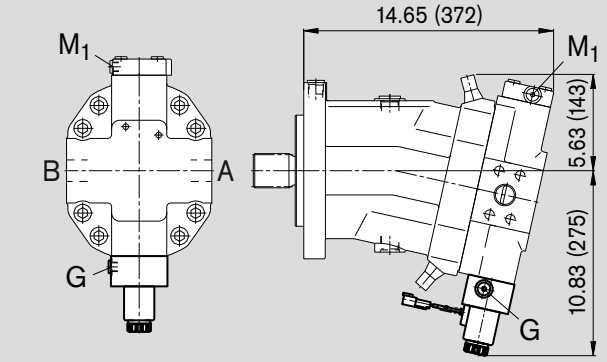
Automatic control, high-pressure related /
high-pressure related and hydraulic overrid



HA1 and HA2, X plugged
HA1T and HA2T, X open

HA1U1, HA2U2

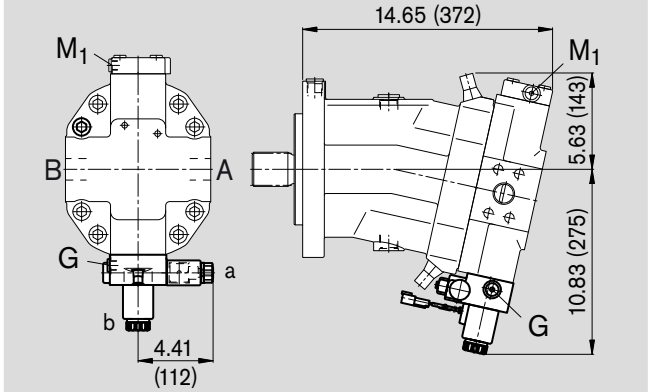
Automatic control, high-pressure related and
Electric override



Observe the note on page 74

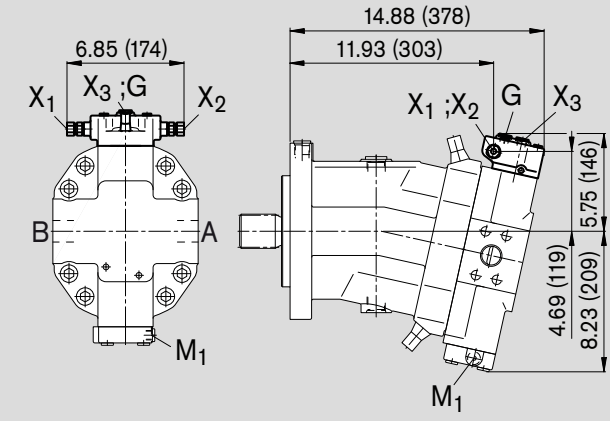
HA1R1, HA2R2

Automatic control, high-pressure related, electric override and
electric travel direction valve



DA1, DA4

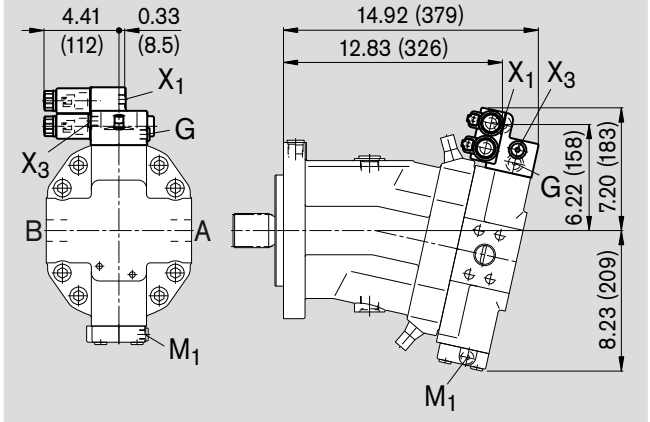
Hydraulic control, speed related and
hydraulic travel direction valve



X_1, X_2 with fitting 8B-ST according to DIN 2353-CL

DA2, DA3, DA5, DA6

Hydraulic control, speed related,
el. travel direction valve and el. $V_{g\ max}$ control



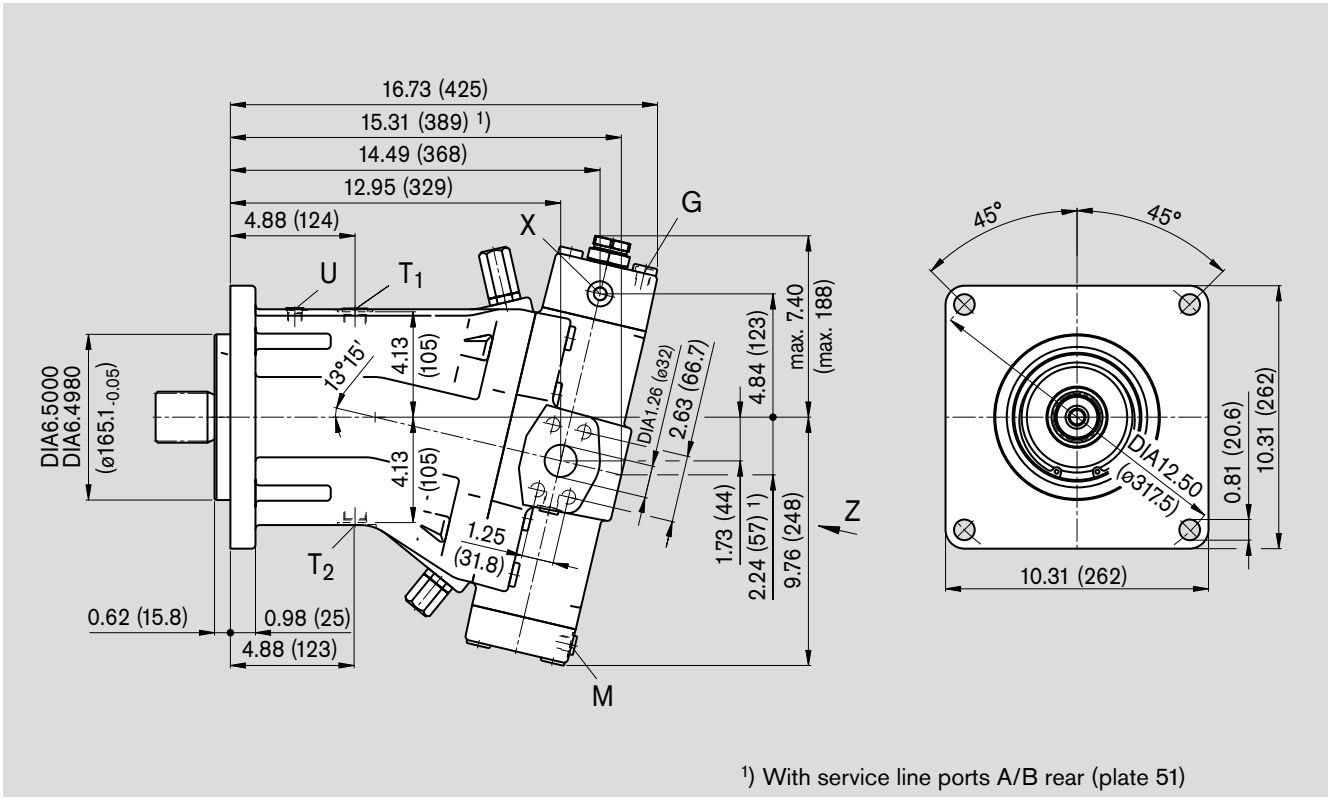
Unit dimensions, size 250 (SAE Version)

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

HD1, HD2 Hydraulic control, pilot-pressure related

HZ - Hydraulic two-point control

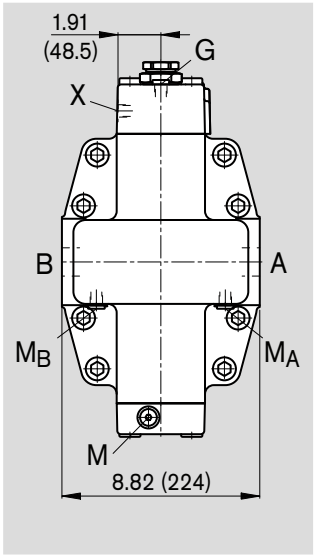
SAE flange ports A/B side, opposite **(52)**



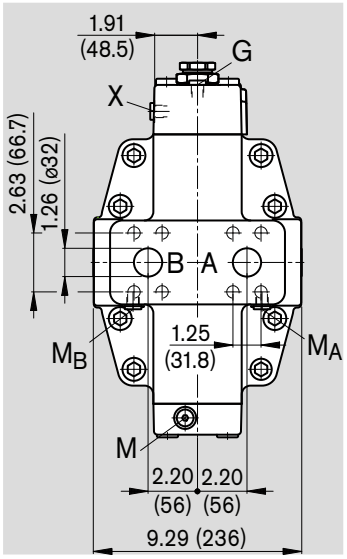
1) With service line ports A/B rear (plate 51)

View Z

SAE flange ports A/B side, opposite **(52)**



SAE flange ports A/B rear **(51)**

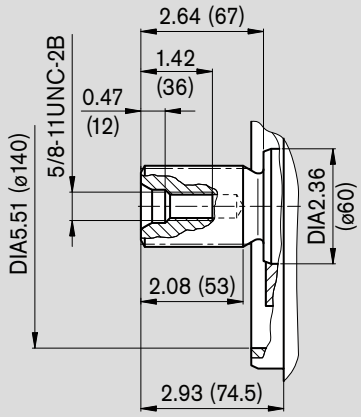


Unit dimensions, size 250 (SAE Version)

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

Shaft end

S Splined shaft 2in 15T 8/16DP [1])
Similar to SAE J744 – 50-4 (F)
Length (2.64 in) deviats from standard (3.125 in)



Ports

A, B	Service line ports (high-pressure series)	SAE J518	1 1/4 in		
	Fixing thread A/B	ISO 68	1/2 in -13 UNC-2B;	0.75 (19) deep [2])	
T_1	Case drain port	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft(240 Nm) [2])
T_2	Case drain port [3])	ISO 11926	7/8 in -14 UNF-2B;	0.67 (17) deep	180 lb-ft(240 Nm) [2])
X	Pilot-pressure port	ISO 11926	9/16 in -14 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2])
X_3	Port for remote control valve	ISO 11926	9/16 in -14 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2])
P	Port for control oil supply	ISO 11926	9/16 in -14 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2])
G	Port for synchronous control of multiple units and for remote control pressure [3])	ISO 11926	9/16 in -14 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2])
G_2	Port for 2nd pressure setting [3])	ISO 11926	9/16 in -14 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2])
U	Flow port [3])	ISO 11926	9/16 in -14 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2])
M	Gauge port for control pressure [3])	ISO 11926	9/16 in -14 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2])
M_A, M_B	Gauge port for operating pressure [3])	ISO 11926	9/16 in -14 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2])
M_{St}	Gauge port for pilot pressure [3])	ISO 11926	9/16 in -14 UNF-2B;	0.51 (13) deep	60 lb-ft (80 Nm) [2])

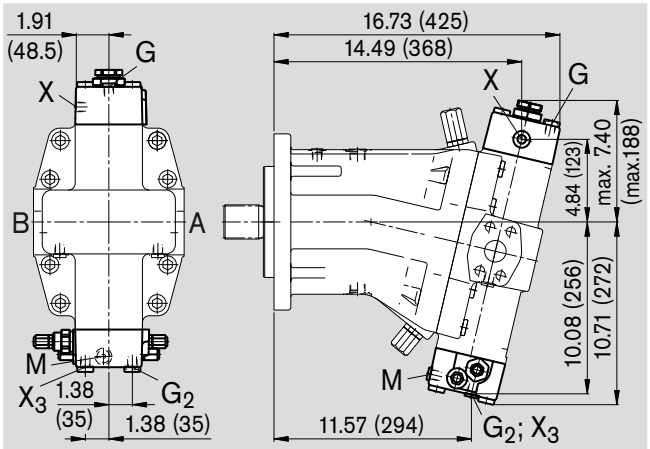
[1]) ANSI B92.1a-1976, pressure angle 30°, flat root side, tolerance class 5
[2]) please observe the general notes for the max. tightening torques on page 76
[3]) plugged

Unit dimensions, size 250

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

HD.D

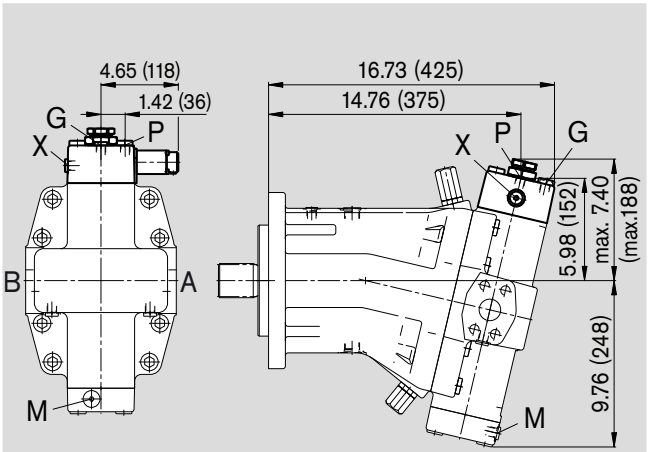
Hydraulic control pilot-pressure related,
with pressure control, direct; **HD.G** remote



HD.D with G_2, without X_3
HD.G with X_3, without G_2

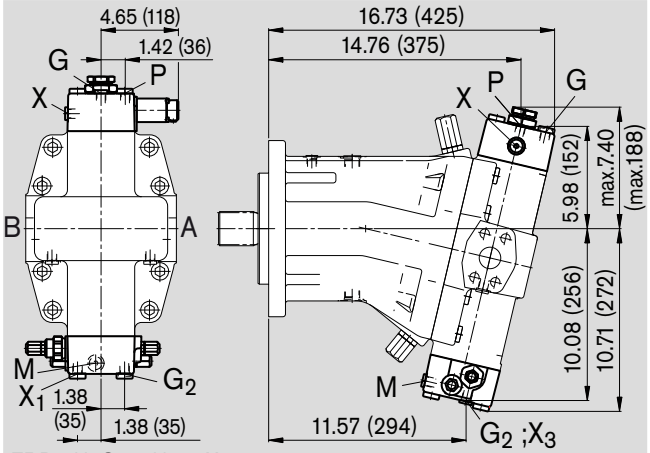
EP1, EP2

Electric control, with proportional valve



EP.D

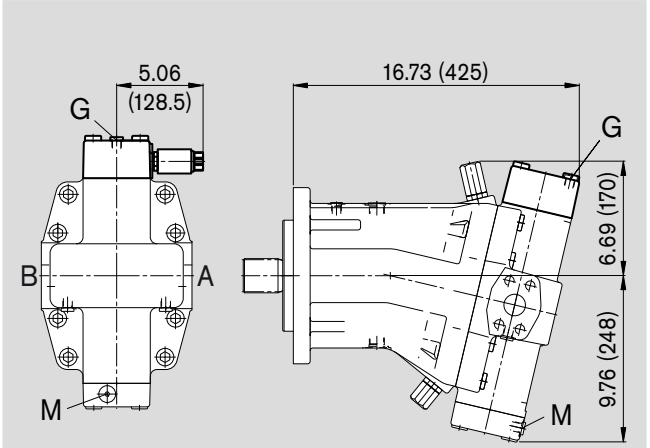
Electric control (proportional valve)
with pressure control, direct; **EP.G** remote



EP.D with G2, without X3
EP.G with X3, without G2

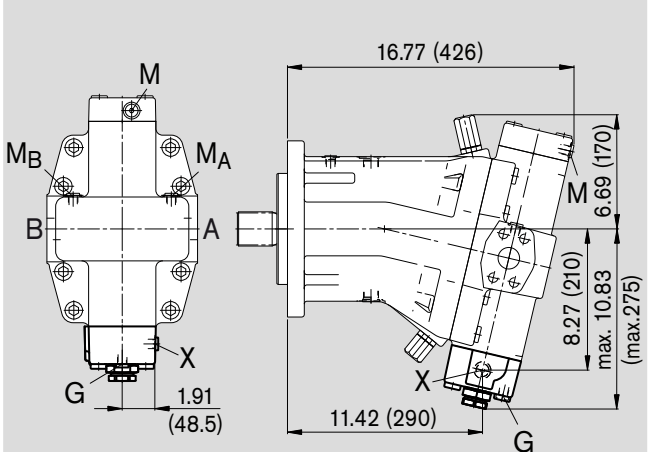
EZ1, EZ2

Electric two-point control with switching valve



HA1, HA2 / HA1T, HA2T

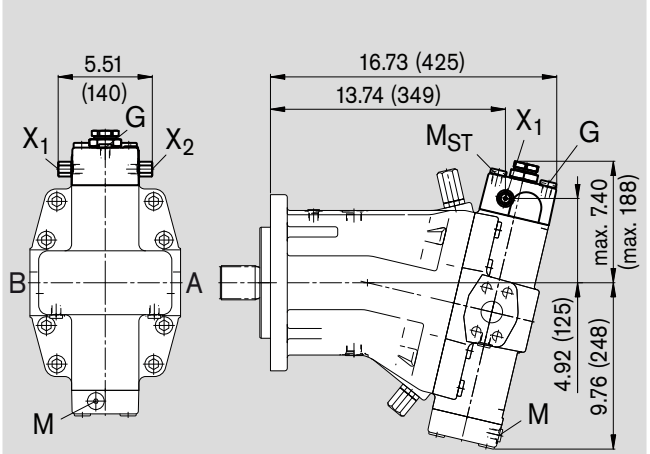
Automatic control, high-pressure related /
high-pressure related and hydraulic override



HA1 and HA2, X plugged
HA1T and HA2T, X open

DA

Hydraulic control, speed related and
with hydraulic travel direction valve



X1, X2 With B-fitting B0-GEV 8L/M14x1.5-WD

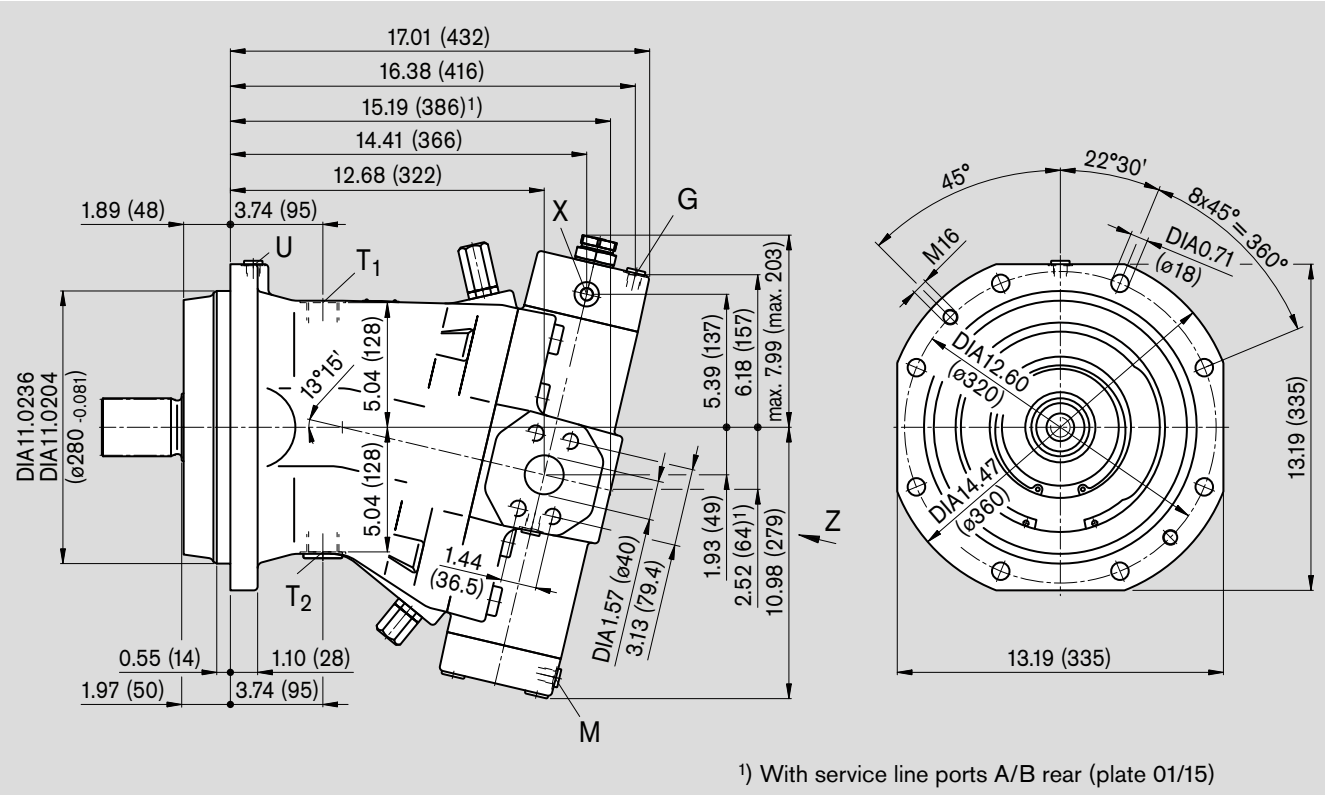
Unit dimensions, size 355 (ISO Version)

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

HD1, HD2 Hydraulic control, pilot-pressure related

HZ - Hydraulic two-point control

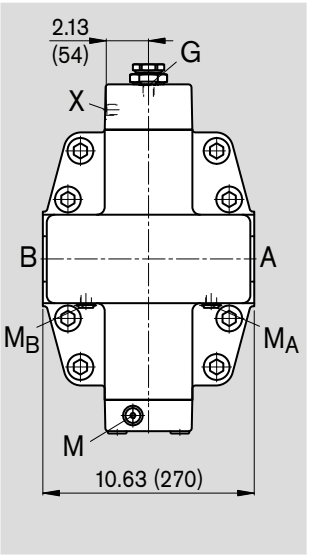
SAE flange ports A/B side, opposite **(02)**



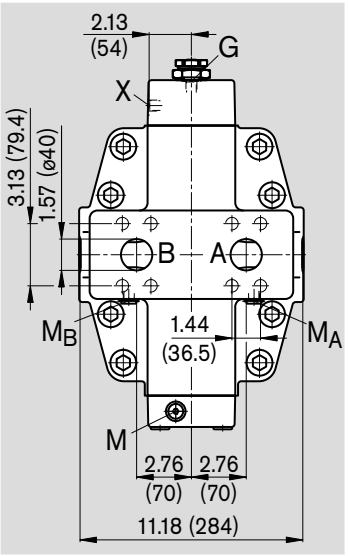
1) With service line ports A/B rear (plate 01/15)

View Z

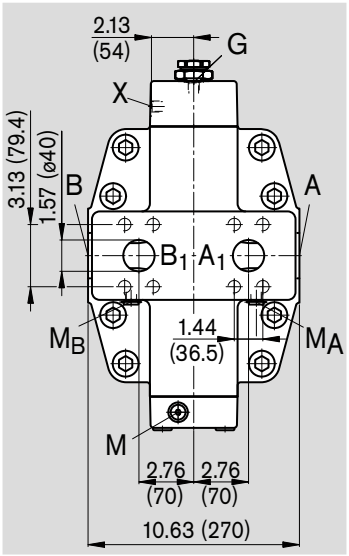
SAE flange ports A/B side, opposite **(02)**



SAE flange ports A/B rear **(01)**



SAE flange ports A/B side, opposite + A_1/B_1 rear **(15)**

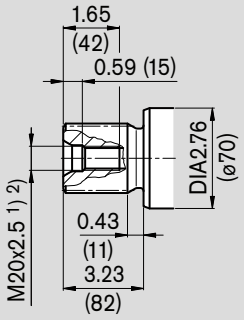


Unit dimensions, size 355 (ISO Version)

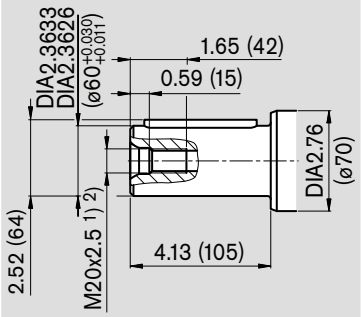
Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

Shaft ends

A Splined shaft DIN 5480
W60x2x30x28x9g



P Parallel shaft with key
DIN 6885, AS18x11x100



Ports

A, B	Service line ports (high-pressure series)	SAE J518	1 1/2 in		
A_1, B_1	Additional service line ports with plate 15	SAE J518	1 1/2 in		
	Fixing thread A/B and A1/B1	DIN 13	M16x2;	0.94 (24) deep [2]	
T_1	Case drain port [3]	DIN 3852	M33x2;	0.71 (18) deep	400 lb-ft (540 Nm) [2]
T_2	Case drain port	DIN 3852	M33x2;	0.71 (18) deep	400 lb-ft (540 Nm) [2]
X, X_1, X_2	Pilot-pressure port	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) [2]
X_3	Port for remote control valve	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) [2]
P	Port for control oil supply	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) [2]
G	Port for synchronous control of multiple units and for remote control pressure [3]	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) [2]
G_2	Port for 2nd pressure setting [3]	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) [2]
U	Flow port [3]	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) [2]
M	Gauge port for control pressure [3]	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) [2]
M_A, M_B	Gauge port for operating pressure [3]	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) [2]
M_{St}	Gauge port for pilot pressure [3]	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) [2]

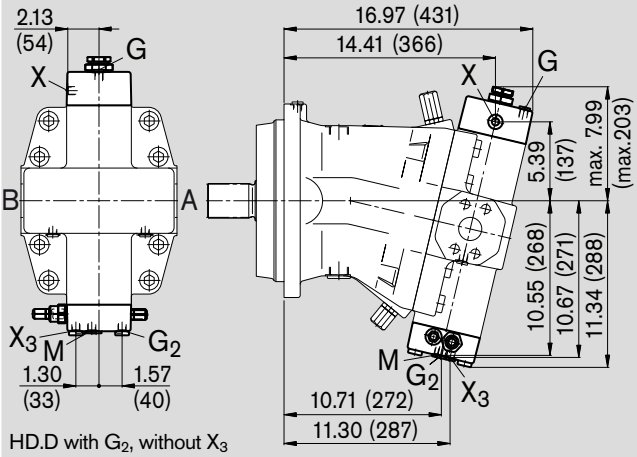
[1]) center bore according to DIN 332 (thread according to DIN 13)
[2]) please observe the general notes for the max. tightening torques on page 76
[3]) plugged

Unit dimensions, size 355 (ISO Version)

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

HD.D

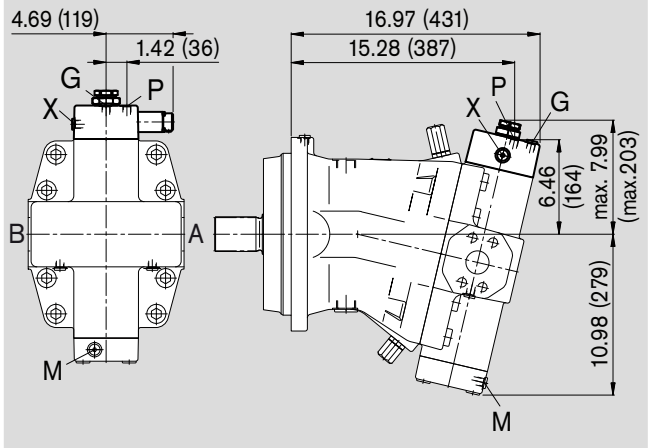
Hydraulic control pilot-pressure related,
with pressure control, direct; **HD.G** remote



HD.D with G_2, without X_3
HD.G with X_3, without G_2

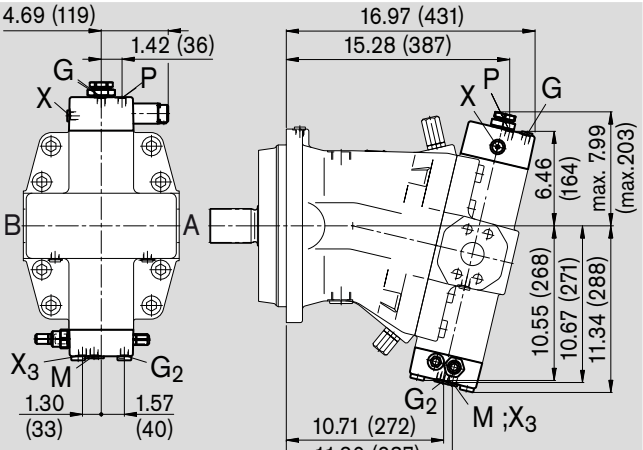
EP1, EP2

Electric control, with proportional valve



EP.D

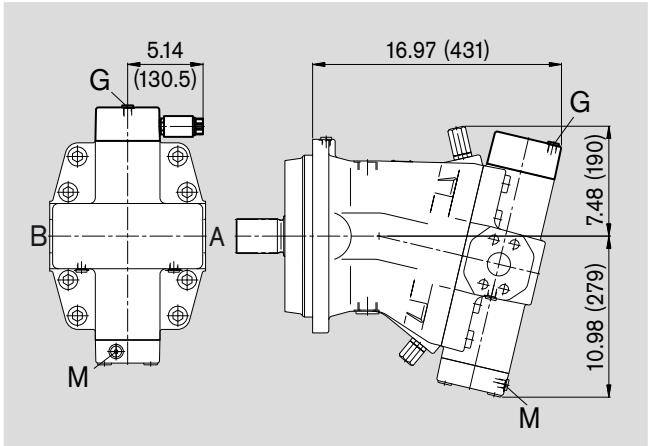
Electric control (proportional valve),
with pressure control, direct; **EP.G** remote



EP.D with G2, without X3
EP.G with X3, without G2

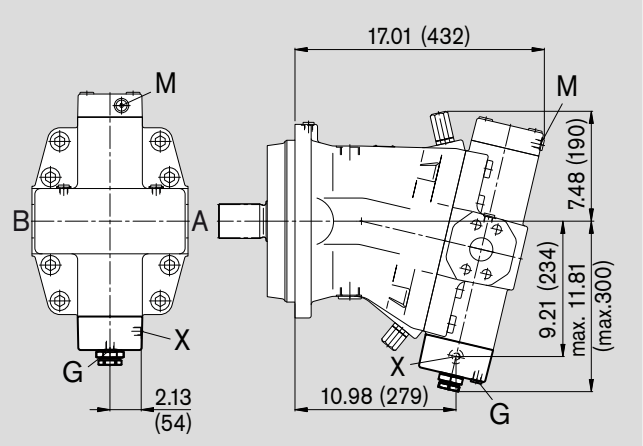
EZ1, EZ2

Electric two-point control with switching valve



HA1, HA2 / HA1T, HA2T

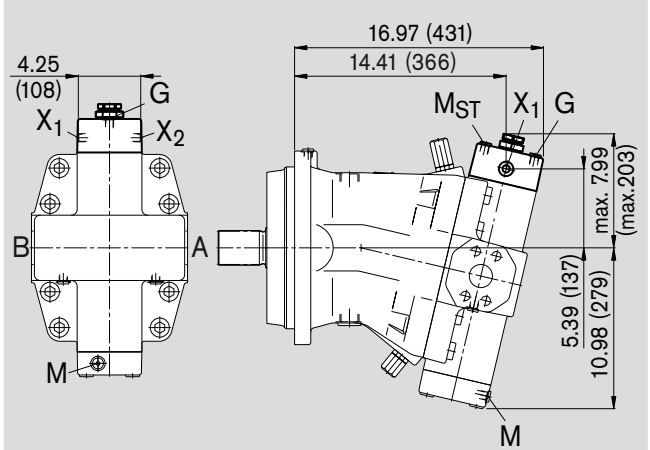
Automatic control, high-pressure related /
high-pressure related and hydraulic override



HA1 and HA2, X plugged
HA1T and HA2T, X open

DA

Hydraulic control, speed related and
with hydraulic travel direction valve



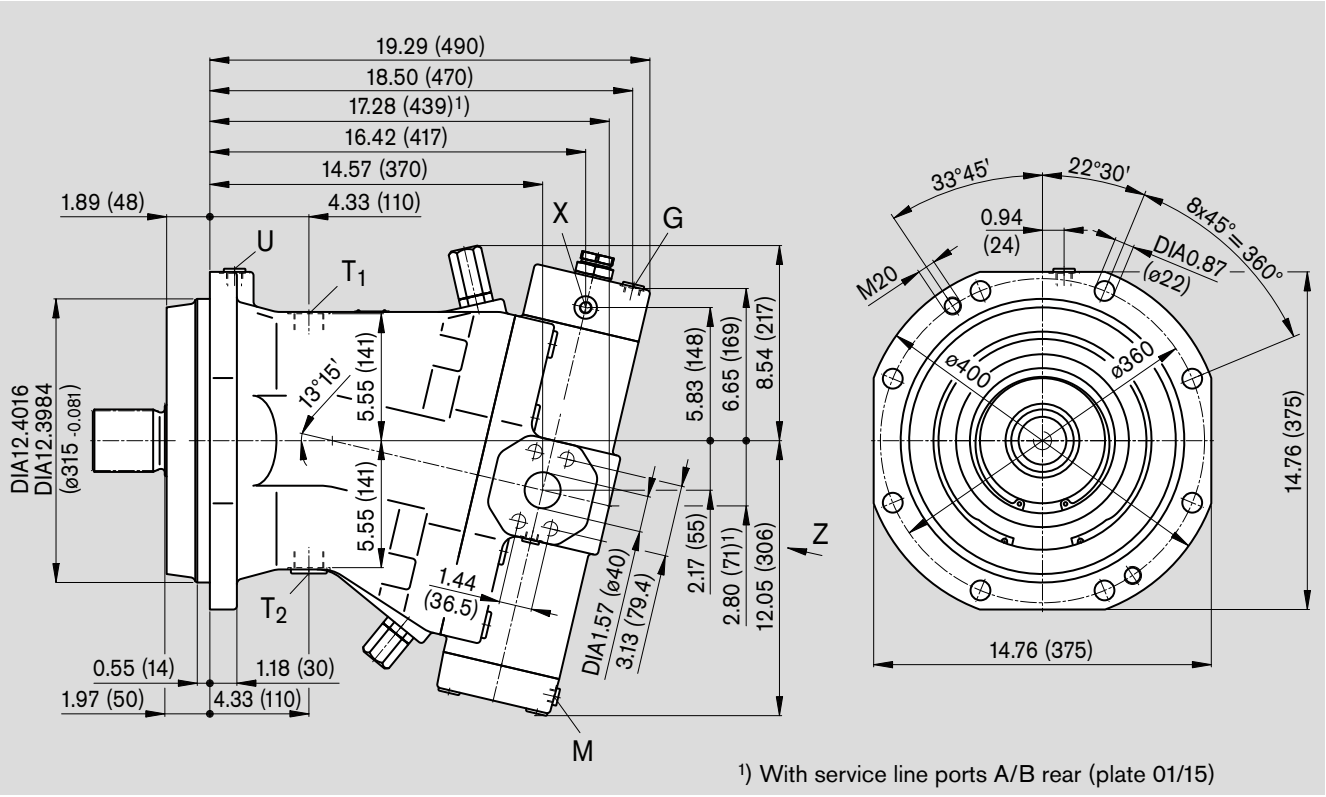
Unit dimensions, size 500 (ISO Version)

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

HD1, HD2 Hydraulic control, pilot-pressure related

HZ - Hydraulic two-point control

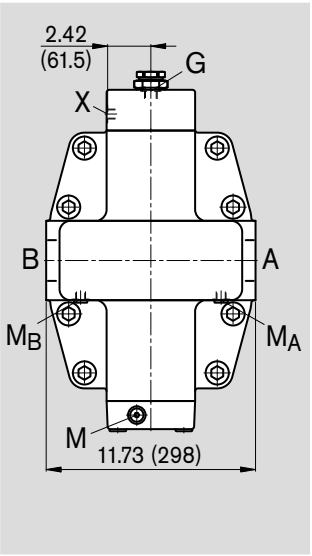
SAE flange ports A/B side, opposite **(02)**



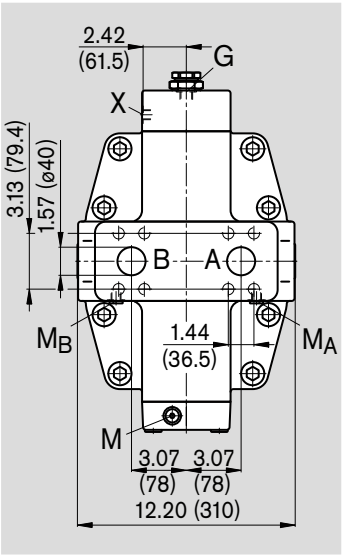
1) With service line ports A/B rear (plate 01/15)

View Z

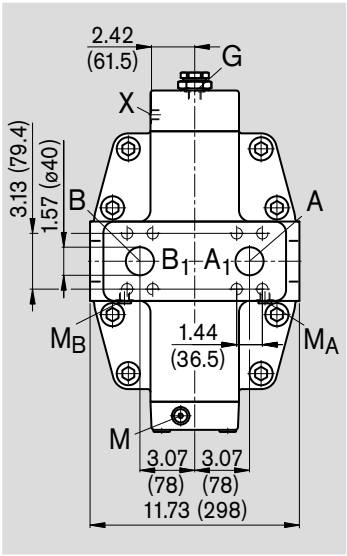
SAE flange ports A/B side, opposite **(02)**



SAE flange ports A/B rear **(01)**



SAE flange ports A/B side, opposite + A1/B1 rear **(15)**

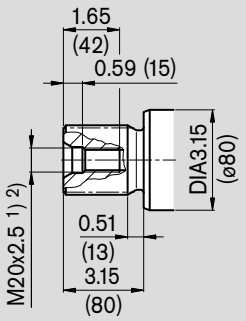


Unit dimensions, size 500 (ISO Version)

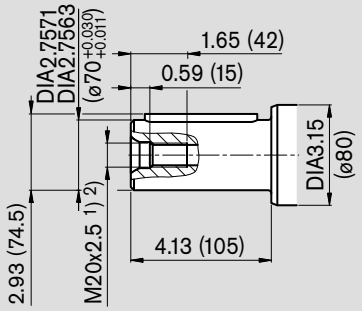
Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

Shaft ends

A Splined shaft DIN 5480
W70x3x30x22x9g



P Parallel shaft with key
DIN 6885, AS20x12x100



Ports

A, B	Service line ports (high-pressure series)	SAE J518	1 1/2 in		
A_1, B_1	Additional service line ports with plate 15	SAE J518	1 1/2 in		
	Fixing thread A/B and A_1/B_1	DIN 13	M16x2;	0.94 (24 deep) 2)	
T_1	Case drain port	DIN 3852	M33x2;	0.71 (18) deep	400 lb-ft (540 Nm) 2)
T_2	Case drain port 3)	DIN 3852	M33x2;	0.71 (18) deep	400 lb-ft (540 Nm) 2)
X, X_1, X_2	Pilot-pressure port	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
X3	Port for remote control valve	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
P	Port for control oil supply	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
G	Port for synchronous control of multiple units and for remote control pressure 3)	DIN 3852	M18x1.5;	0.47 (12) deep	100 lb-ft (140 Nm) 2)
G2	Port for 2nd pressure setting 3)	DIN 3852	M18x1.5;	0.47 (12) deep	100 lb-ft (140 Nm) 2)
U	Flow port 3)	DIN 3852	M18x1.5;	0.47 (12) deep	100 lb-ft (140 Nm) 2)
M	Gauge port for control pressure 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
M_A, M_B	Gauge port for operating pressure 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
M_{St}	Gauge port for pilot pressure 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)

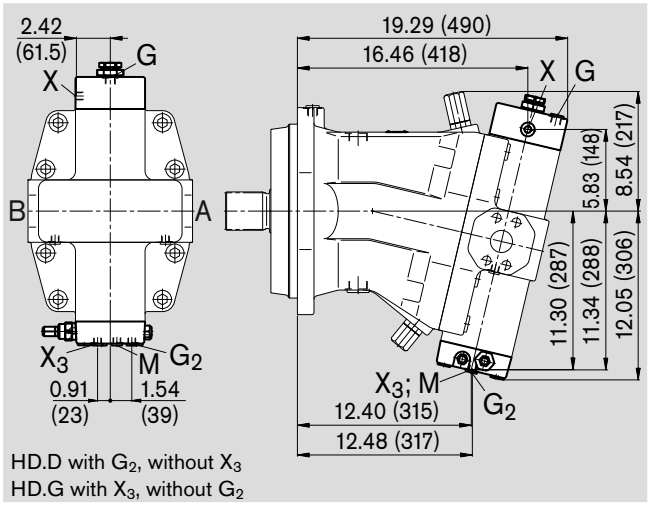
1) center bore according to DIN 332 (thread according to DIN 13)
2) please observe the general notes for the max. tightening torques on page 76
3) plugged

Unit dimensions, size 500 (ISO Version)

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

HD.D

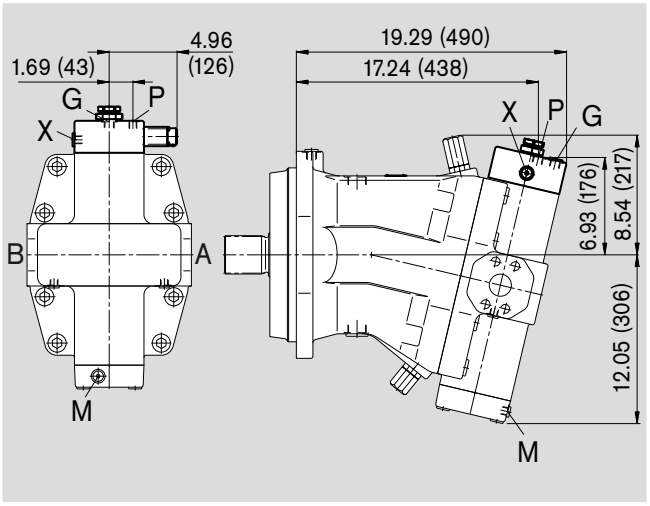
Hydraulic control pilot-pressure related,
with pressure control, direct; **HD.G** remote



HD.D with G_2, without X_3
HD.G with X_3, without G_2

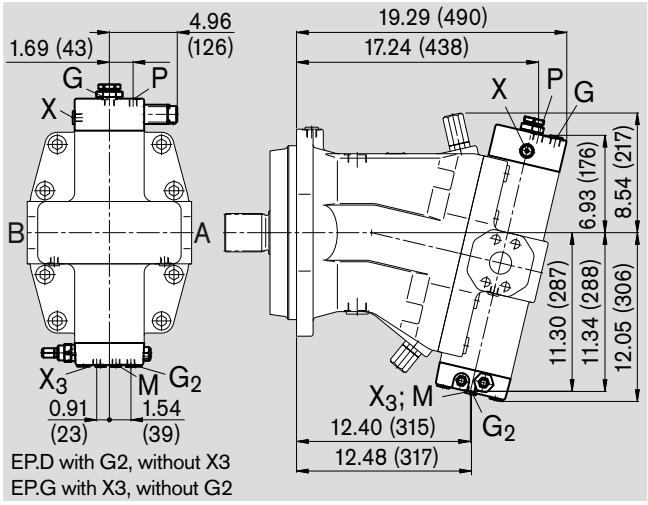
EP1, EP2

Electric control, with proportional valve



EP.D

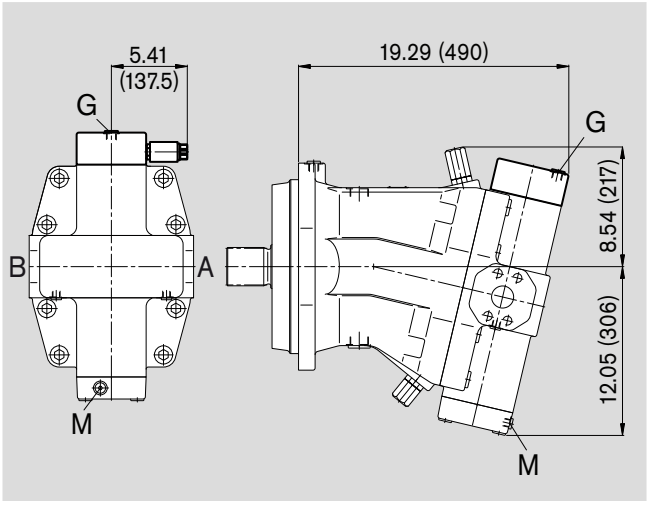
Electric control (proportional valve),
with pressure control, direct; **EP.G** remote



EP.D with G2, without X3
EP.G with X3, without G2

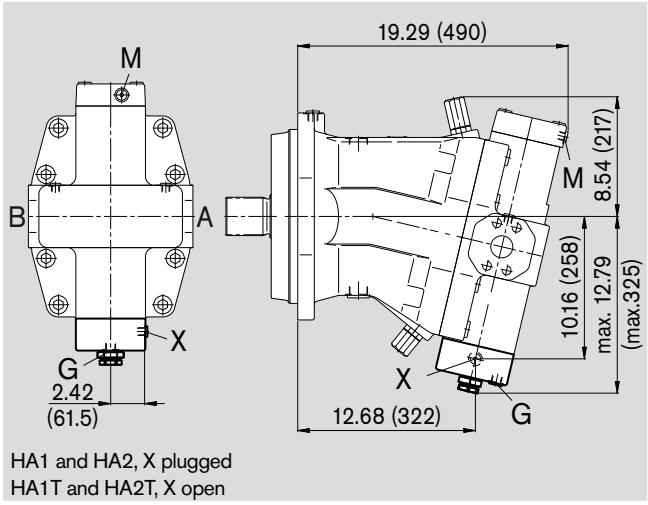
EZ1, EZ2

Electric two-point control with switching valve



HA1, HA2 / HA1T, HA2T

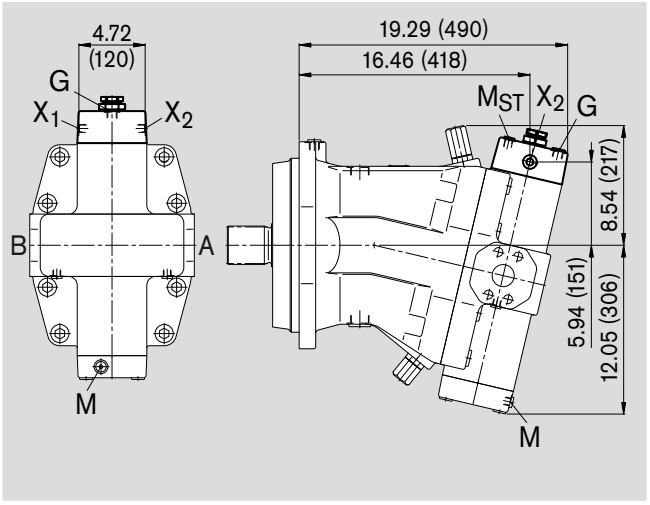
Automatic control, high-pressure related /
high-pressure related and hydraulic override



HA1 and HA2, X plugged
HA1T and HA2T, X open

DA

Hydraulic control, speed related and
with hydraulic travel direction valve



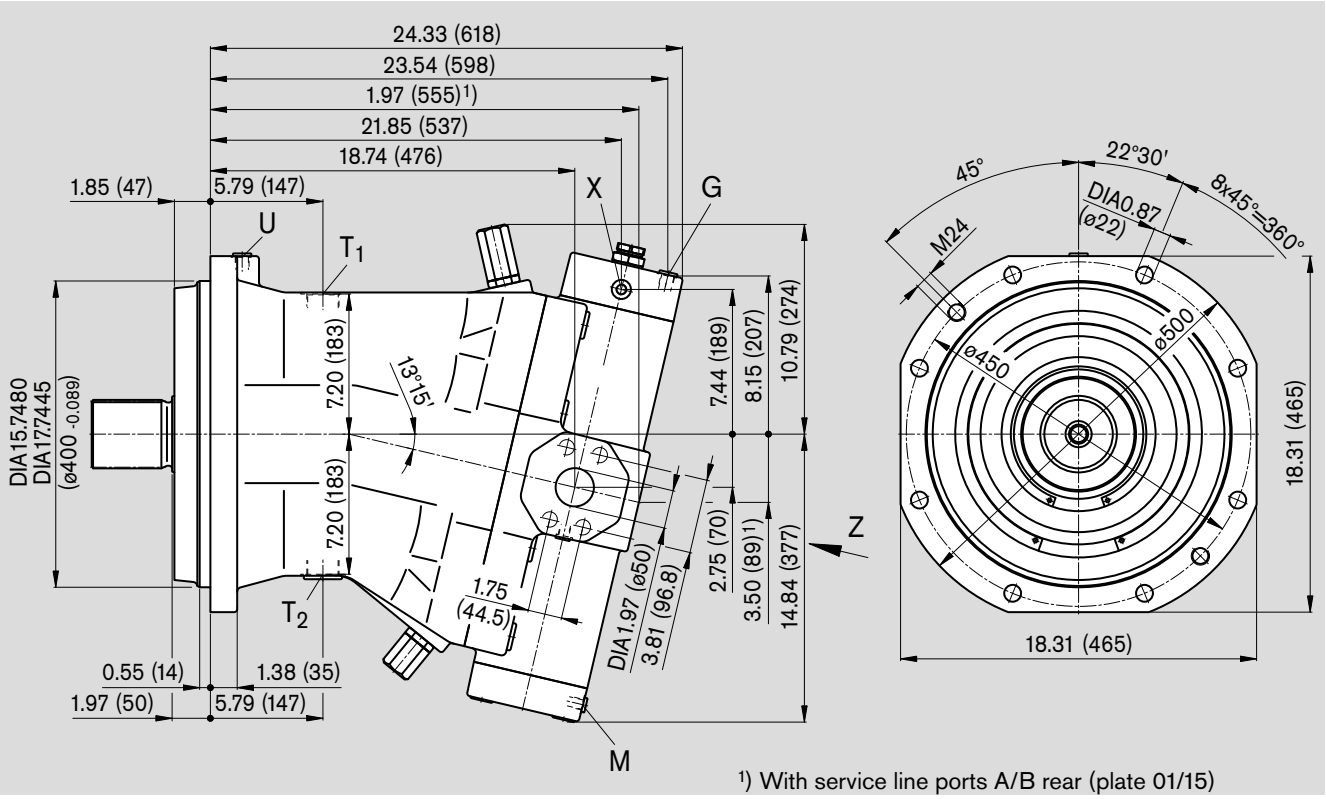
Unit dimensions, size 1000 (ISO Version)

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

HD1, HD2 Hydraulic control, pilot-pressure related

HZ Hydraulic two-point control

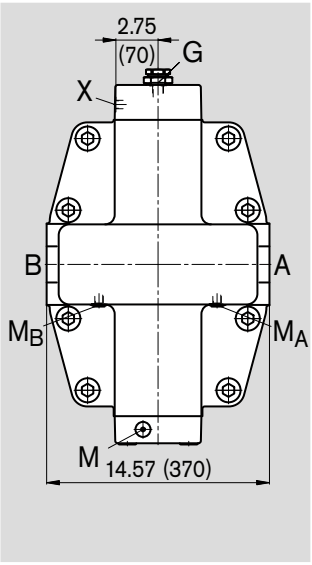
SAE flange ports A/B side, opposite **(02)**



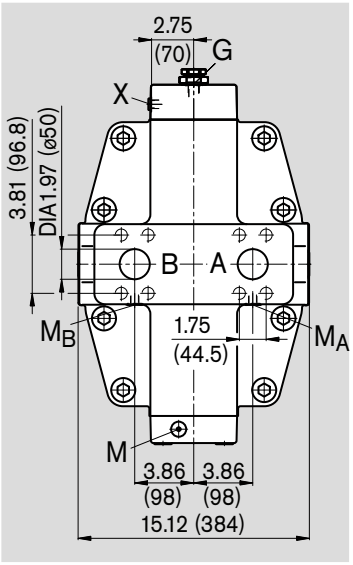
1) With service line ports A/B rear (plate 01/15)

View Z

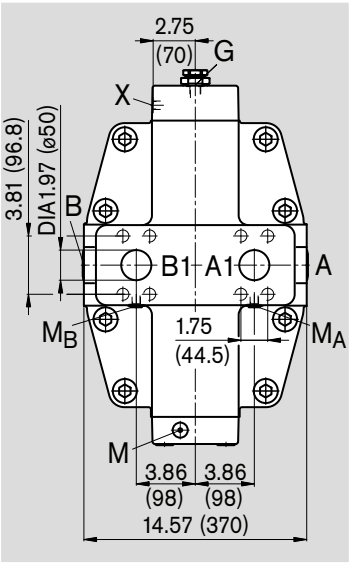
SAE flange ports A/B side, opposite **(02)**



SAE flange ports A/B rear **(01)**



SAE flange ports A/B side, opposite + A1/B1 rear **(15)**

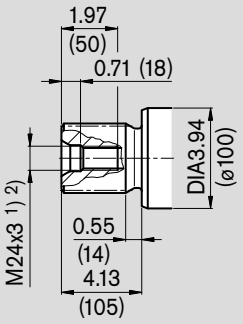


Unit dimensions, size 1000 (ISO Version)

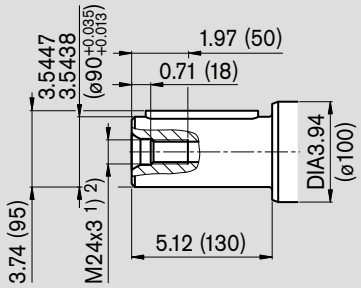
Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

Shaft ends

A Splined shaft DIN 5480
W90x3x30x28x9g



P Parallel shaft with key
DIN 6885, AS25x14x125



Ports

A, B	Service line ports (high-pressure series)	SAE J518	2 in		
A_1, B_1	Additional service line ports with plate 15	SAE J518	2 in		
	Fixing thread A/B and A1/B1	DIN 13	M20x2.5;	0.94 (24) deep 2)	
T_1	Case drain port	DIN 3852	M42x2;	0.79 (20) deep	530 lb-ft (720 Nm) 2)
T_2	Case drain port 3)	DIN 3852	M42x2;	0.79 (20) deep	530 lb-ft (720 Nm) 2)
X	Pilot-pressure port	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
X_3	Port for remote control valve	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
P	Port for control oil supply	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
G	Port for synchronous control of multiple units and for remote control pressure 3)	DIN 3852	M18x1.5;	0.47 (12) deep	100 lb-ft (140 Nm) 2)
G_2	Port for 2nd pressure setting 3)	DIN 3852	M18x1.5;	0.47 (12) deep	100 lb-ft (140 Nm) 2)
U	Flow port 3)	DIN 3852	M18x1.5;	0.47 (12) deep	100 lb-ft (140 Nm) 2)
M	Gauge port for control pressure 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
M_A, M_B	Gauge port for operating pressure 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)
M_{St}	Gauge port for pilot pressure 3)	DIN 3852	M14x1.5;	0.47 (12) deep	60 lb-ft (80 Nm) 2)

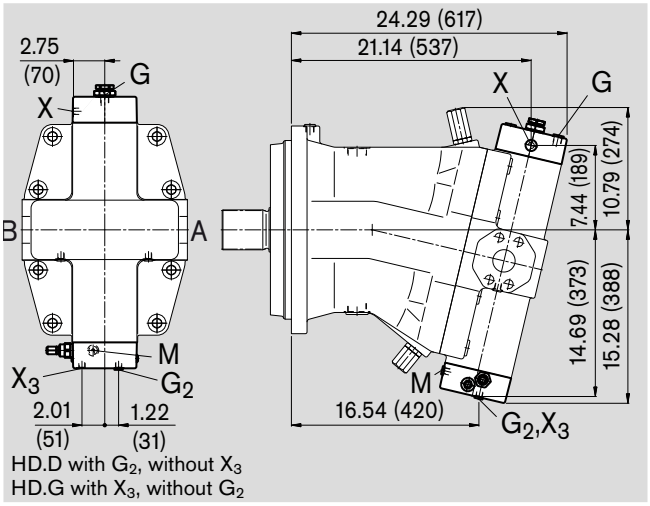
1) center bore according to DIN 332 (thread according to DIN 13)
2) please observe the general notes for the max. tightening torques on page 76
3) plugged

Unit dimensions, size 1000 (ISO Version)

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

HD.D

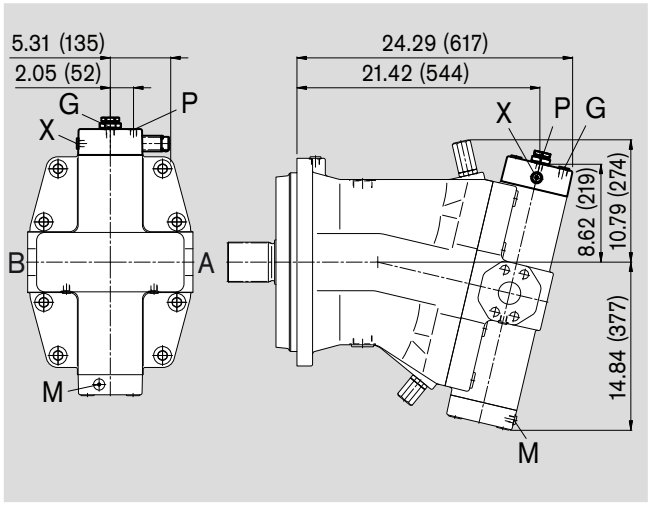
Hydraulic control pilot-pressure related,
with pressure control, direct; **HD.G** remote



HD.D with G_2, without X_3
HD.G with X_3, without G_2

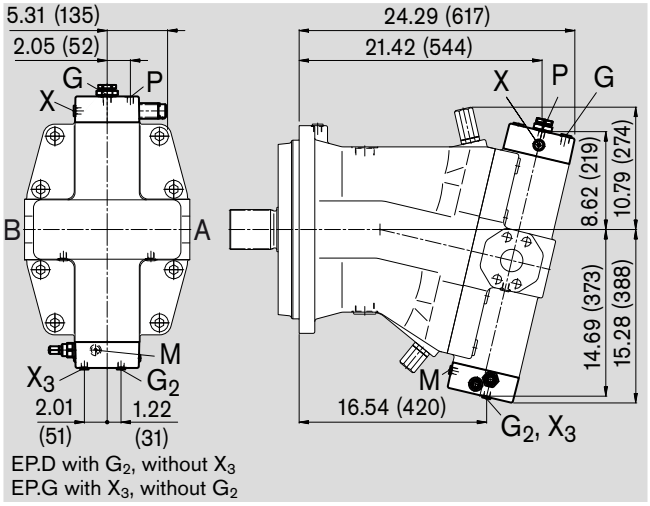
EP1, EP2

Electric control, with proportional valve



EP.D

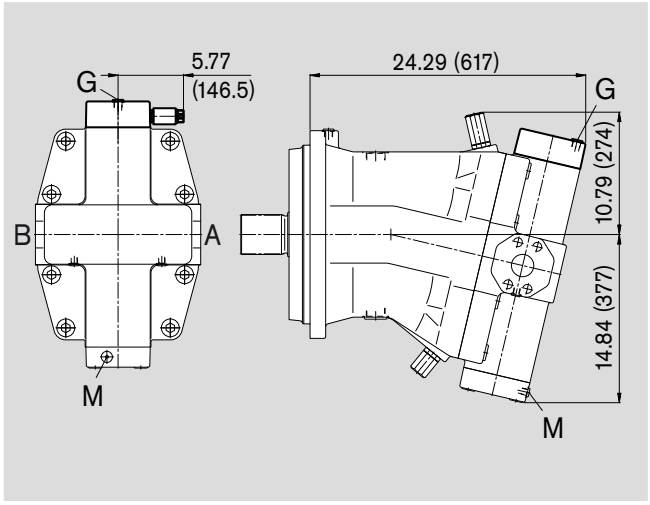
Electric control (proportional valve),
with pressure control, direct; **EP.G** remote



EP.D with G_2, without X_3
EP.G with X_3, without G_2

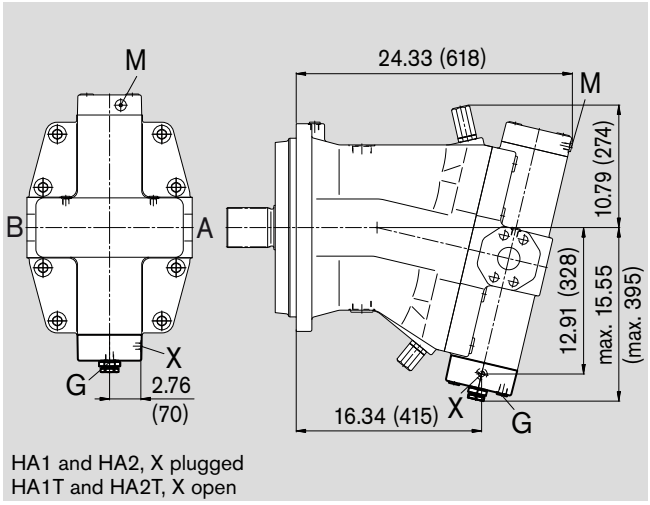
EZ1, EZ2

Electric two-point control with switching valve



HA1, HA2 / HA1T, HA2T

Automatic control, high-pressure related /
high-pressure related and hydraulic override



HA1 and HA2, X plugged
HA1T and HA2T, X open

Flush and boost pressure valve

The flush and boost pressure valve is used to remove heat from the closed circuit and to ensure that a minimum boost pressure is present (opening pressure 230 psi (16 bar), fixed; note when setting primary valve). A side effect is flushing of the case.

Warm hydraulic fluid is removed from the respective low pressure side into the motor case. This is then fed into the tank, together with the case drain fluid. The hydraulic fluid drawn out of the closed circuit in this way must be replaced by cooled hydraulic fluid that is pumped in by the boost pump.

In the open circuit, the flush and boost pressure valve is used solely to flush the case from the return line.

The valve is mounted to the variable motor or integrated into the control unit (depending on the type of control and the size).

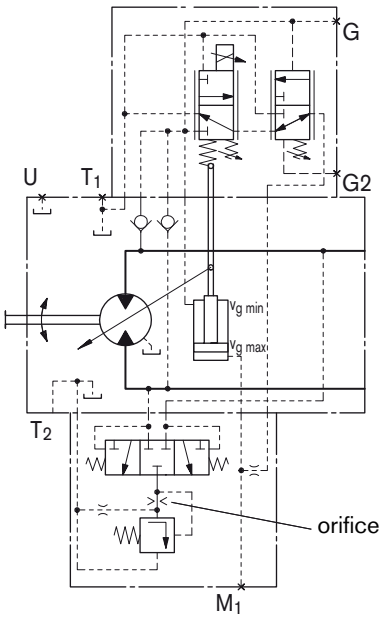
Orifices can be used to adjust the flushing volumes as required.

Standard flushing volumes (at low pressure $\Delta p_{LP} = 365$ psi (25 bar))

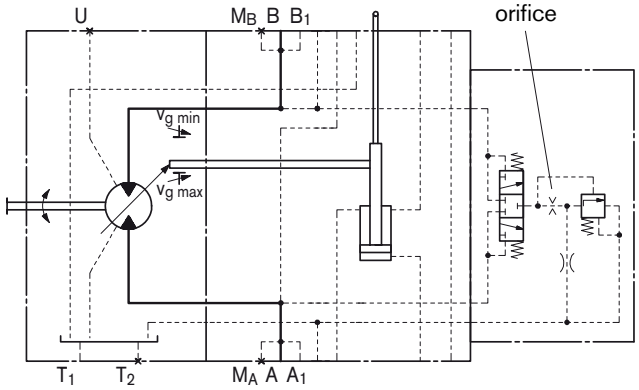
Size	Flushing volume	Mat. no. of the orifice
28, 55	0.9 gpm (3.5 l/min)	R909651766
80	1.3 gpm (5 l/min)	R909419695
107	2.1 gpm (8 l/min)	R909419696
140, 160, 200	2.6 gpm (10 l/min)	R909419697
250	2.6 gpm (10 l/min	R909419697
355, 500, 1000	4.2 gpm (16 l/min)	R910803019

For sizes 28 to 200, orifices for flushing volumes of 1.3 - 2.6 gpm (3.5 - 10 l/min) can be supplied. In the case of non-standard flushing volumes, please specify the desired flushing volume when ordering. The flushing volume without orifice is approx. 3.17 to 3.70 gpm (12 to 14 l) at low pressure $\Delta p_{LP} = 365$ psi (25 bar).

Circuit diagram
Sizes 28 to 200



Circuit diagram
Sizes 250 to 1000

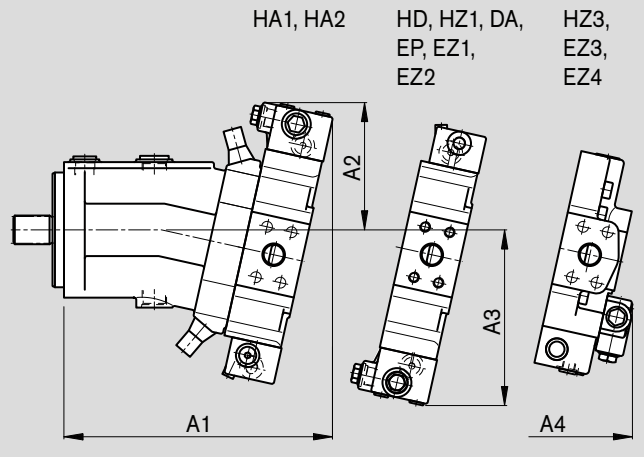


Flush and boost pressure valve

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

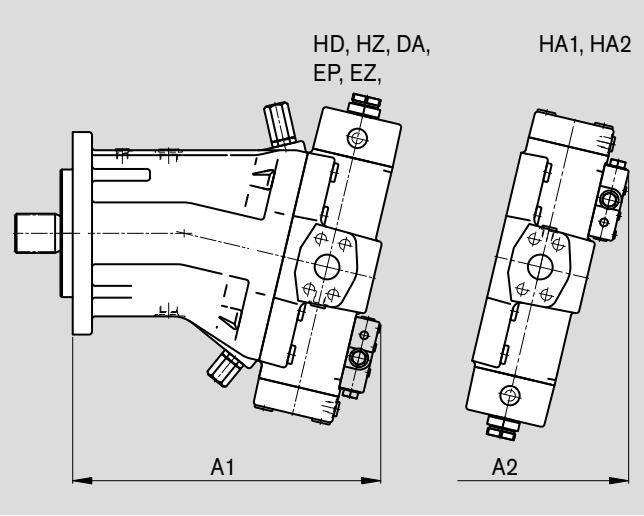
Dimensions

Sizes 28 to 200



Size		A1	A2	A3	A4
A6VM	28	8.43 (214)	4.92 (125)	6.34 (161)	–
	140	12.64 (321)	6.06 (154)	8.58 (218)	–
AA6VM	55	10.51 (267)	5.24 (133)	6.93 (176)	10.24 (260)
	80	11.69 (297)	5.59 (142)	7.60 (193)	10.94 (278)
	107	12.60 (320)	5.67 (144)	7.87 (200)	11.85 (301)
	160	14.17 (360)	6.06 (154)	8.66 (220)	–
	200	14.84 (377)	6.30 (160)	9.09 (231)	–

Sizes 250 to 1000



Size		A1	A2
AA6VM	250	15.71 (399)	17.48 (444)
A6VM	355	15.63 (397)	17.56 (446)
	500	17.32 (440)	19.84 (504)
	1000	21.73 (552)	24.76 (629)

BVD counterbalance valve (sizes 55 to 160)

Function

Driving/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given flow during braking, downhill travel or decrease in motor load.

Please note

- The BVD counterbalance valve must be specified explicitly in the order. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: AA6VM80HA1T/63W–VSC380A + BVD20F27S/41B–V03K16D0400S12
- For safety reasons, winch drives are forbidden with start of control at $V_{g\,min}$ (e.g. HA)!
- The counterbalance valve does not replace the mechanical service brake and parking brake.
- Note the detailed information about the BVD counterbalance valve in RE 95522

Driving counterbalance valve BVD...F

Example of application

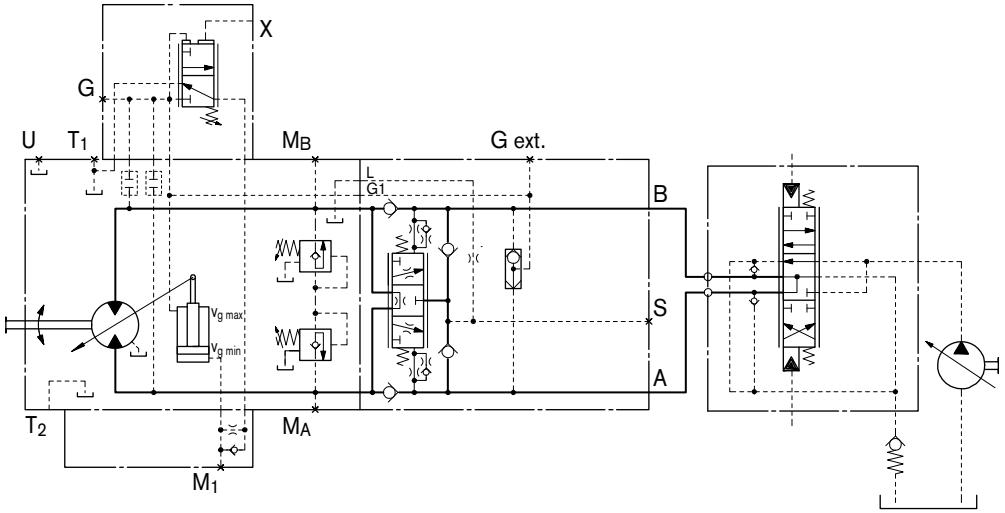
- Travel drive on wheeled excavators

Winch counterbalance valve BVD...W

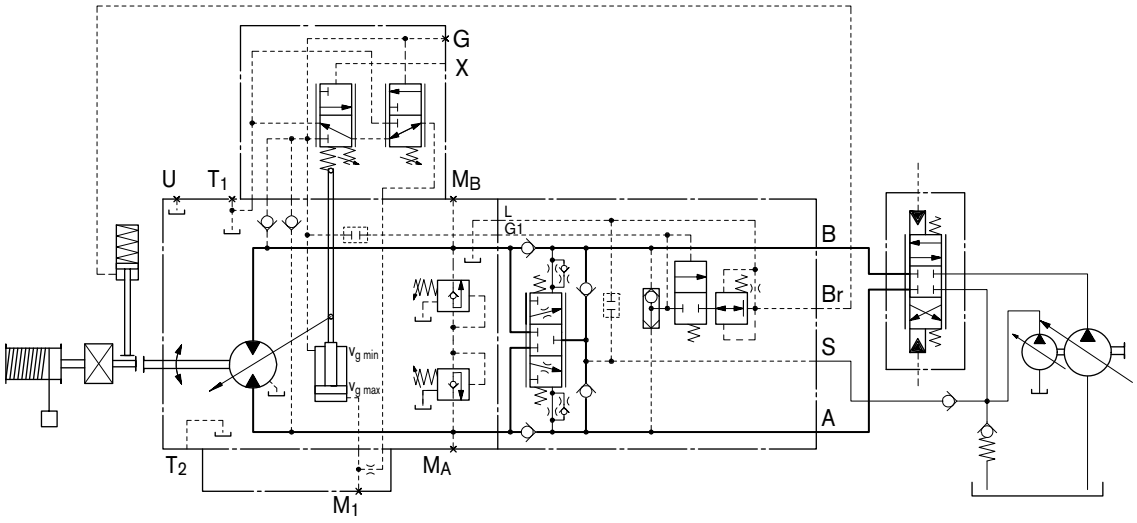
Typical applications

- Winch drives in cranes
- Track drive in excavator crawlers

Example circuit diagram for travel drive on wheeled excavators
AA6VM80HA1T/63W–VSC380A + BVD20F27S/41B–V03K16D0400S12



Example circuit diagram for winch gears in cranes
AA6VM80HD1D/63W–VSC380B + BVD20W27L/41B–V01K00D0600S00

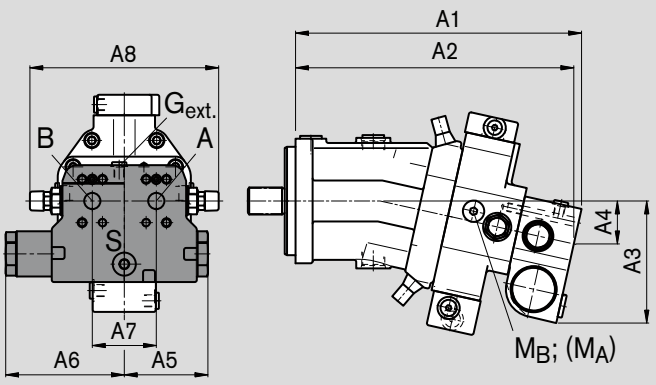


BVD counterbalance valve (sizes 55 to 160)

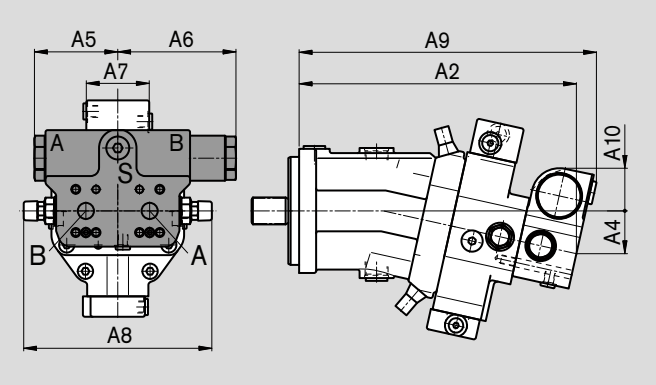
Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (mm).

Dimensions

(A)A6VM to HA



(A)A6VM to HD and EP [1]



(A)A6VM	Counter balance valve	Ports [2]					Ports on the motor
Size...Plate	Type	A, B	S	$G_{ext.}$ (version S)	$G_{ext.}$ (version L)	Br (version L)	M_A, M_B Gauge port (plugged)
55...38	BVD20...17	3/4 in	M22x1.5; 0.55 (14) deep	M12x1.5; 0.49 (12.5) deep	M14x1.5; 0.31 (8) deep	M12x1.5; 0.49 (12.5) deep	M18x1.5; 0.47 (12) deep
80...38	BVD20...27	1 in					
107...37	BVD20...28	1 in					
107...38	BVD25...38	1 1/4 in	M27x2; 0.63 (16) deep			M12x1.5; 0.47 (12) deep	
140...38	BVD25...38	1 1/4 in					
160...38	BVD25...38	1 1/4 in					
250...08	on request						

(A)A6VM	Dimensions									
Size...Plate	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
55...38	13.19	12.83	5.63	1.97	3.86	5.47	2.95	8.74	13.78	1.97
	(335)	(326)	(143)	(50)	(98)	(139)	(75)	(222)	(350)	(50)
80...38	14.33	13.98	5.83	2.17	3.86	5.47	2.95	8.74	14.92	1.81
	(364)	(355)	(148)	(55)	(98)	(139)	(75)	(222)	(379)	(46)
107...37	15.51	15.16	5.98	2.32	3.86	5.47	3.31	9.21	16.10	1.61
	(394)	(385)	(152)	(59)	(98)	(139)	(84)	(234)	(409)	(41)
107...38	16.22	15.83	6.50	2.48	4.74	6.89	3.31	9.37	16.81	2.20
	(412)	(402)	(165)	(63)	(120.5)	(175)	(84)	(238)	(427)	(56)
140...38	16.18	15.79	6.61	2.64	4.74	6.89	3.31	9.37	17.56	2.09
	(411)	(401)	(168)	(67)	(120.5)	(175)	(84)	(238)	(446)	(53)
160...38	17.68	17.28	6.68	2.68	4.74	6.89	3.31	9.37	18.27	2.01
	(449)	(439)	(170)	(68)	(120.5)	(175)	(84)	(238)	(464)	(51)
250...08	on request									

[1] In the installation version for the HD and EP controls, the molded connection designations on the brake valve do not correspond with the connection designation of the A6VM. The designation of the connections on the engine installation drawing is binding!

[2] **Ports on the counterbalance valve**

A, B Service line ports
S Boosting (plugged)
$G_{ext.}$ Brake release, high pressure, plugged
Br Brake release, reduced high pressure, open
Version S "Port for brake release with high pressure"
Version L "Port for brake release with reduced high pressure"

BVD counterbalance valve (sizes 55 to 160)

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

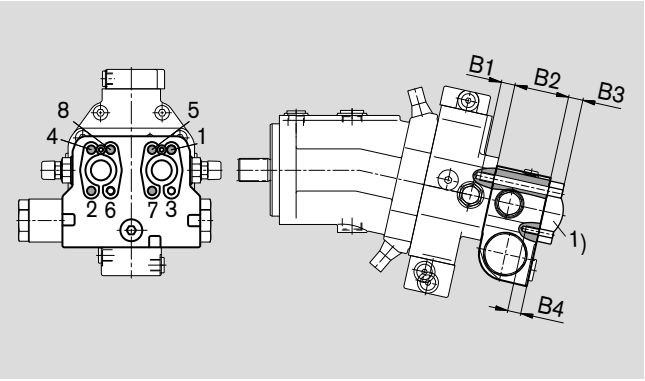
Attaching the counterbalance valve

When delivered, the counterbalance valve is attached to the motor using 2 tacking screws. Do not remove the tacking screws when connecting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be attached to the motor port plate using the provided tacking screws. In both cases, the final attachment of the counterbalance valve to the motor is by the connectio of the service lines, e.g. using SAE 4-bolt flanges. A total of 6 screws with thread lengths B1+B2+B3 and 2 screws with thread lengths B3+B4 are required.

When tightening the screws, it is imperative that the sequence 1 to 8 (as shown in the adjacent diagram) be adhered to and carried out in two phases.

In the first phase the screws should be tightened to 50% of their tightening torque before being tightened to maximum tightening torque in the second phase (see table below).

Thread	Property class	Tightening torque in lb-ft (Nm)
M10	10.9	55 (75)
M12	10.9	95 (130)
M14	10.9	150 (205)



1) Flange, e.g. SAE flange

Size...Plate	55...38	80...38 107...37	107, 140, 160...38
B1 2)	M10x1.5 0.67 (17) deep	M12x1.75 0.59 (15) deep	M14x2 0.75 (19) deep
B2	2.68 (68)	2.68 (68)	3.35 (85)
B3	Customer specific		
B4	M10x1.5 0.59 (15) deep	M12x1.75 0.63 (16) deep	M14x2 0.75 (19) deep

2) Minimum required reach 1 x DIA. thread

Swivel angle indicator (Sizes 250 to 1000)

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

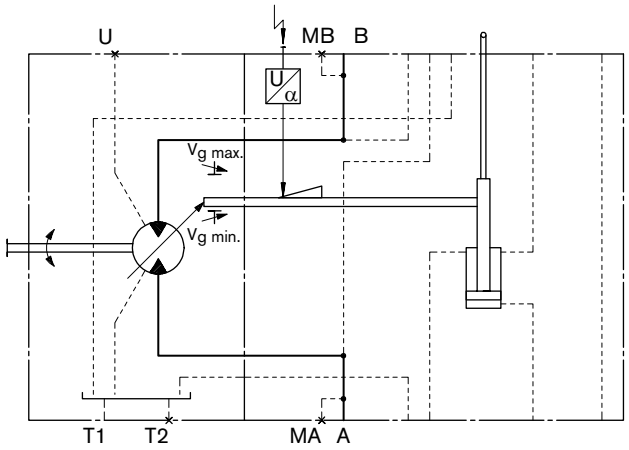
Optical swivel angle indicator (V)

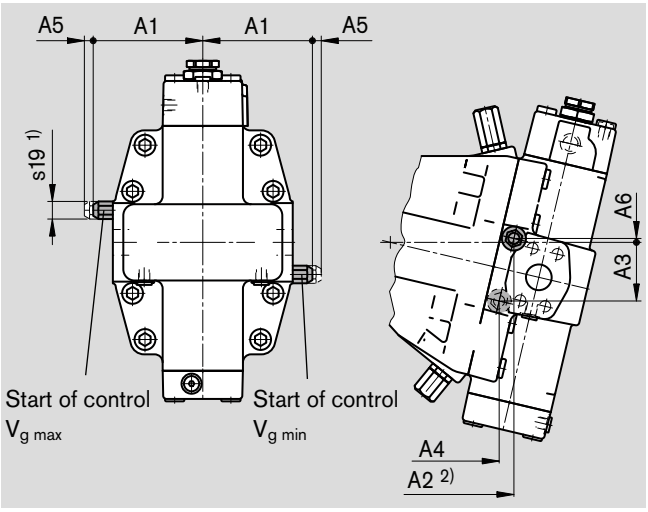
The swivel position is indicated by a pin on the side of the port plate. The length of the protruding pin is dependent on the position of the lens plate.

If the pin is flush with the port plate, the motor is positioned at the start of control. At max. swivel, the pin length is 0.31 in (8 mm) (visible after removing the cap nut).

Sizes 250 to 1000

Example: Start of control at $V_{g\ min}$





Size		A1	A2[2)]	A3	A4	A5[3)]	A6
AA6-	250	5.37	11.73	2.87	11.02	0.43	0.20
		(136.5)	(298)	(73)	(280)	(11)	(5)
A6VM	350	6.28	11.34	3.31	10.47	0.43	0.31
		(159.5)	(288)	(84)	(266)	(11)	(8)
	500	6.79	13.03	3.50	12.17	0.43	0.12
		(172.5)	(331)	(89)	(309)	(11)	(3)
	1000	8.21	16.93	4.49	15.83	0.43	0.12
		(208.5)	(430)	(114)	(402)	(11)	(3)

[1)] Width across flats
[2)] Distance to mounting flange
[3)] Clearance required for removing the cap nut

Electric swivel angle indicator (E)

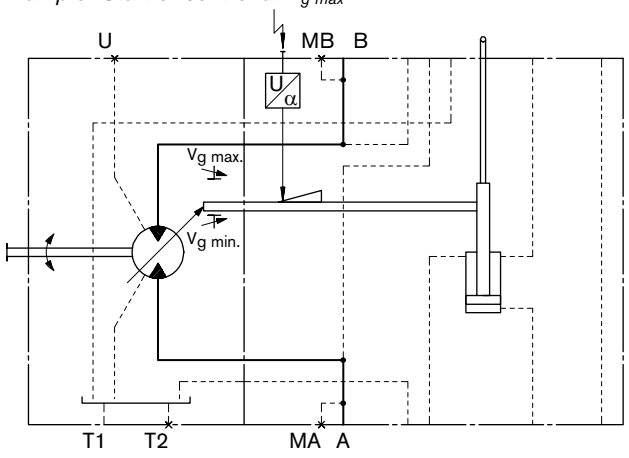
The motor position is measured by an inductive pos. transducer. It converts the stroke of the control device to an electric signal.

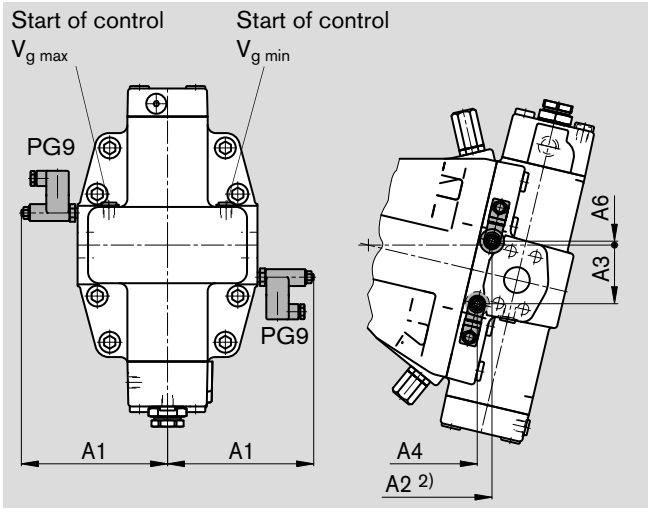
This signal can be used to pass the swivel position to an electric controller.

Inductive pos. transducer type IW9–03–01
Type of protection according to DIN/EN 60529: IP65

Sizes 250 to 1000

Example: Start of control at $V_{g\ max}$





Size		A1	A2[2)]	A3	A4	A6
AA6VM	250	7.17	11.73	2.87	11.02	0.20
		(182)	(298)	(73)	(280)	(5)
A6VM	355	8.07	11.34	3.31	10.47	0.31
		(205)	(288)	(84)	(266)	(8)
	500	8.59	13.03	3.50	12.17	0.12
		(218)	(331)	(89)	(309)	(3)
	1000	10.00	16.93	4.49	15.83	0.12
		(254)	(430)	(114)	(402)	(3)

[2)] Distance to mounting flange

Speed measurement (sizes 28 to 500)

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

The (A)A6VM...D and (A)A6VM...F ("prepared for speed measurement", i.e. without sensor) versions have teeth on the rotary group. The rotating, toothed rotary group generates a signal in proportion to the speed. The signal is picked up by a sensor and can be forwarded for evaluation.

Note

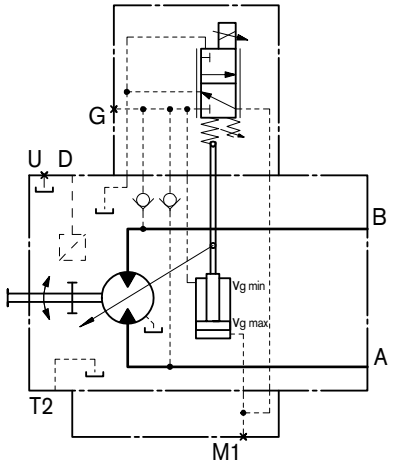
– For sizes 28 to 200 with speed measurement, only port T2 may be used to drain the case drain.

Version "D" (NG 28 to 200)
Suitable for mounting the inductive speed sensor ID (see RE 95130). The ID sensor is screwed into the upper case drain port T_1. The spacer ring (sizes 28 to 107) or threaded-reducing connector stud (sizes 140 to 200) required for the inductive speed sensor ID is included in the supply volume of the sensor (only when ordering, speed sensor with installation parts).

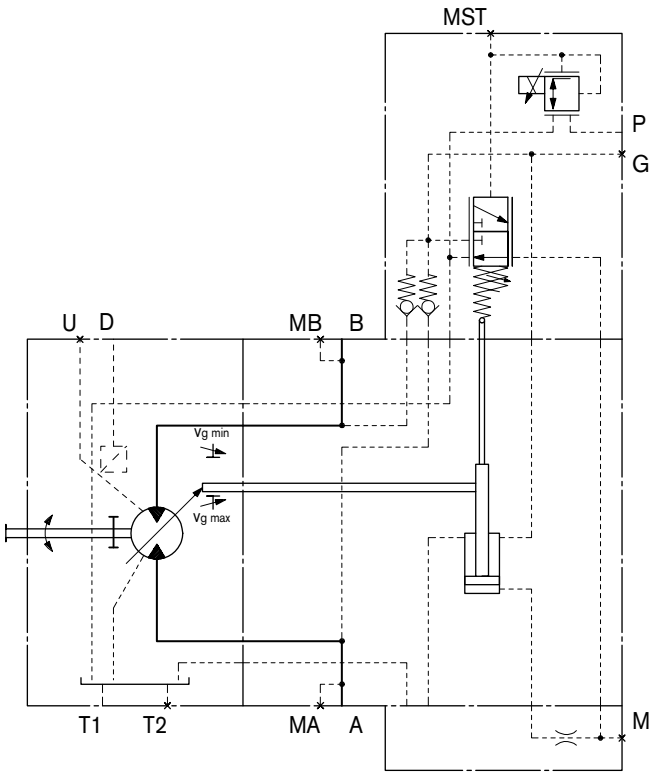
Version "F" (NG 55 to 500)
Suitable for mounting the HDD Hall-effect speed sensor (see RE 95135). With sizes 55 to 200, the HDD sensor is flanged onto the upper case drain port T1; with size 250 to 500, it is flanged onto the port provided for this purpose with two fixing screws. In the standard version, the port is plugged with a pressure-resistant flange cover.

We recommend ordering the (A)A6VM variable motor complete with mounted sensor. Please specify the ordering code for the sensor separately.

Circuit diagram
(A)A6VM 28 to 200 EP



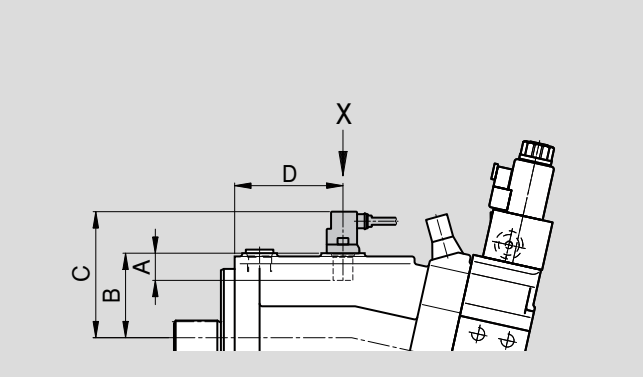
Circuit diagram
(A)A6VM 250 to 500 EP



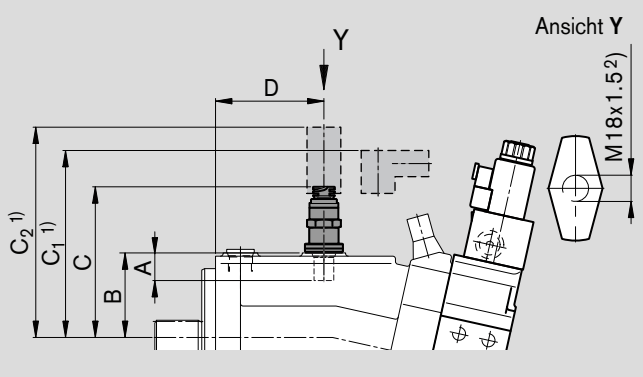
Speed measurement (sizes 28 to 500)

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

Version "F" (sizes 55 to 200): with HDD sensor

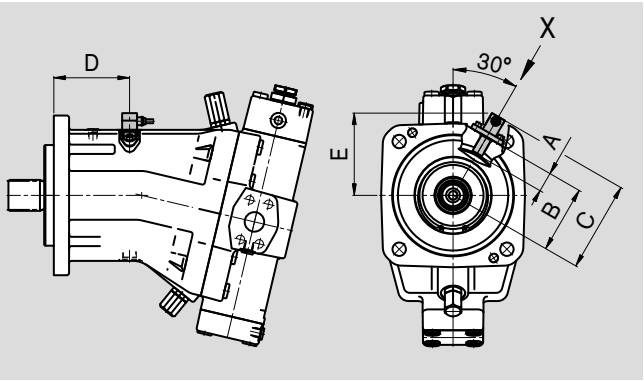


Version "D" (sizes 28 to 200): with ID sensor

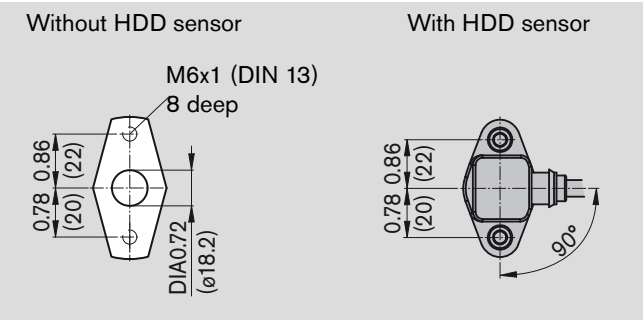


1) Clearance required for attaching/detaching the mating connector: min. 0.51 in (13 mm)
2) Tightening torque, max.: 36.9 lb-ft (50 Nm) (ID sensor)

Version "F" (size 250 to 500): with HDD.L32 sensor



View X



Size			28	55	80	107	140	160	200	250	355	500
Sensor selection				IDR 18/20 – L250			IDR 18/20 – L400					
				HDD.L16.../20						HDD.L32.../20		
Number of teeth			40	54	58	67	72	75	80	78	90	99
HDD	A	Insertion depth (tolerance ± 0.1)		0.63	0.63	0.63	0.63	0.63	0.63	1.27	1.27	1.27
				(16)	(16)	(16)	(16)	(16)	(16)	(32.5)	(32.5)	(32.5)
	B	Contact surface		2.86	3.02	3.37	3.57	3.69	3.88	4.35	4.82	5.21
				(72.6)	(76.6)	(85.6)	(90.6)	(93.6)	(98.6)	(110.5)	(122.5)	(132.5)
	C			4.37	4.53	4.88	5.08	5.20	5.39	5.87	6.34	6.73
				(111)	(115)	(124)	(129)	(132)	(137)	(149)	(161)	(171)
	D			3.58	3.94	4.33	3.62	4.90	5.04	3.23	3.66	4.45
				(91)	(100)	(110)	(92)	(124.5)	(128)	(82)	(93)	(113)
	E									5.31	5.71	6.06
										(135)	(145)	(154)
ID	A	Insertion depth (tolerance ± 0.1)	0.69	0.69	0.69	0.69	0.96	0.96	0.96			
			(17.5)	(17.5)	(17.5)	(17.5)	(24.5)	(24.5)	(24.5)			
	B	Contact surface	2.36	2.91	3.07	3.43	3.90	4.02	4.21			
			(60)	(74)	(78)	(87)	(99)	(102)	(107)			
	C	without mating connector	4.72	5.28	5.43	5.79	6.18	6.30	6.50			
			(120)	(134)	(138)	(147)	(157)	(160)	(165)			
	C1	with 90° mating connector	6.89	7.44	7.60	7.95	8.35	8.46	8.66			
			(175)	(189)	(193)	(202)	(212)	(215)	(220)			
	C2	with 180° mating connector	6.04	6.59	6.75	7.11	7.50	7.62	7.81			
			(153.5)	(167.5)	(171.5)	(180.5)	(190.5)	(193.5)	(198.5)			
	D		2.28	3.58	3.94	4.33	3.62	4.90	5.04			
			(58)	(91)	(100)	(110)	(92)	(124.5)	(128)			

Connectors for solenoids (for EP, EZ, HA.U, HA.R, DA only)

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

DEUTSCH DT04-2P-EP04, 2-pin

Molded, without bidirectional suppressor diode
(for EP, EZ1/2, DA) _____ P

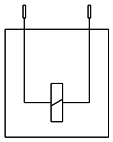
Molded, with bidirectional suppressor diode
(for switching solenoid for the EZ1/2, DA control units) ____ Q

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

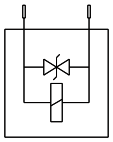
The protection circuit with a bidirectional suppressor diode is necessary for limiting overvoltages. Overvoltages are generated by disconnecting the current using switches, relay contacts or by unplugging an energized mating connector.

Switching symbol

Without bidirectional suppressor diode



With bidirectional suppressor diode

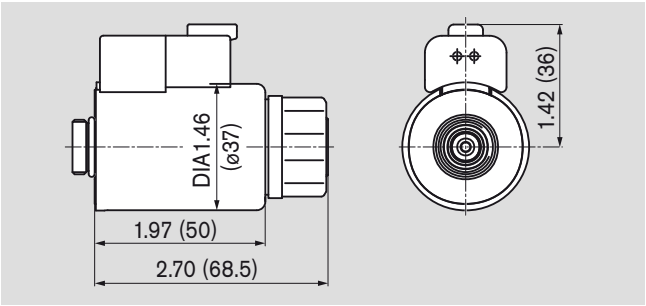


Mating connector

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

Consisting of:	DT-Designation
– 1 case	DT06-2S-EP04
– 1 wedge	W2S
– 2 sockets	0462-201-16141

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



HIRSCHMANN DIN EN 175 301-803-A/ISO 4400

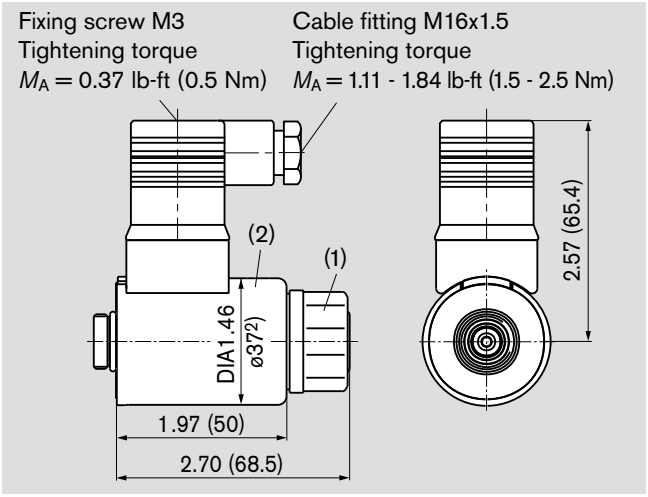
(not for new projects with sizes 28 - 200)

Without bidirectional suppressor diode
(for EP, EZ, HA.U, HA.R, DA) _____ H

Type of protection according to DIN/EN 60529: IP65

The seal ring in the cable fitting is suitable for line diameters from 0.18 in to 0.39 in (4.5 mm to 10 mm).

The HIRSCHMANN connector is included in the supply volume for the motor.



[2]) Solenoid with DIA 1.77 (ø45) for following controls: HA.U, HA.R (for elec. override), EZ3 and EZ4.

Note for cylindric solenoids:

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

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

We reserve the right to change the position of the solenoid connector from that depicted in the brochure or drawing during assembly of the solenoid.

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 system may empty via the hydraulic lines.

The case drain inside the case interior must be drained to the tank via the highest case drain port.

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

Installation position

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

Below-tank installation (standard)

Motor below the minimum fluid level of the tank.

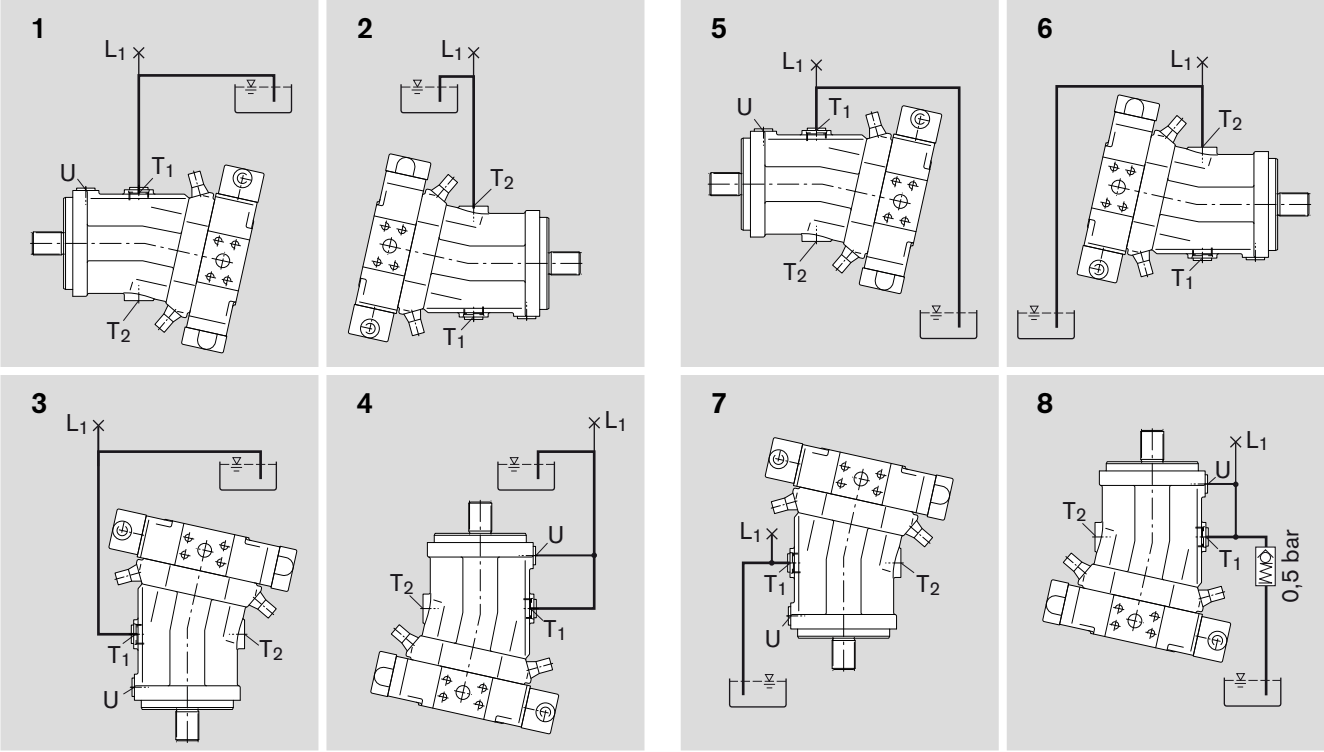
Recommended installation positions: 1 and 2.

Above-tank installation

Motor above the min. fluid level of the tank

– Note: Installation position 8 (shaft up)

  In this installation position, if the case interior is only partially drained, lubrication of the bearings will no longer be adequate. A check valve (opening pressure 7.25 psi (0.5 bar)) in the case drain line can prevent the system emptying through the case drain line.



Installation position	Air bleeding	Filling
1	–	T_1 (L_1)
2	–	T_2 (L_1)
3	–	T_1 (L_1)
4	U	T_1 (L_1)

Installation position	Air bleeding	Filling
5	–	T_1 (L_1)
6	–	T_2 (L_1)
7	–	T_1 (L_1)
8	U	T_1 (L_1)

General instructions

– The (A)A6VM motor is designed to be used in open and closed circuits.

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

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

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

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

– Tightening torques:
  - The tightening torques specified in this data sheet are maximum values and must not be exceeded (maximum values for screw thread).
    Manufacturer's instruction for the max. permissible tightening torques of the used armatures must be observed!
  - For ISO68 / DIN 13 fixing screws, we recommend checking the tightening torque individually according to VDI 2230 Edition 2003.

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

Bosch Rexroth Corporation
Hydraulics
Axial & Radial Piston Units
8 Southchase Court
Fountain Inn, SC 29644-9018, USA
Telephone (864) 967-2777
Facsimile (864) 967-8900
www.boschrexroth-us.com