HYDSTAR

ISO9001认证企业

液压泵专业生产厂家-江苏海斯特

Hydraulic Pump Manufacture-Hydstar Hydraulic

Technical Manual

2023

江苏海斯特液压科技有限公司

Jiangsu Hydstar Hydraulic Technology Co., Ltd.

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Piston Pump

Variable Displacement Pump

Piston Motor

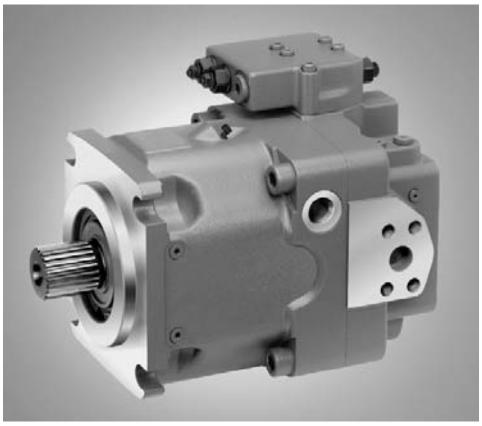
Fixed Motor

Variable Displacement Motor

Axial Piston Variable Pump
A11VO

Data sheet

Series 1
Size NG40 to 260
Nominal pressure 350 bar
Maximum pressure 400 bar
Open circuit



Contents

Features

– Variable axial piston pump of swashplate design for hydrostatic drives in open circuit hydraulic system.

– Designed primarily for use in mobile applications.

– The pump operates under self-priming conditions, with tank pressurization, or with an optional built-in charge pump (impeller).

– A comprehensive range of control options is available matching any application requirement.

– Power control option is externally adjustable, even when the pump is running.

– The through drive is suitable for adding gear pumps and axial piston pumps up to the same, i.e. 100% through drive.–

The output flow is proportional to the drive speed and infinitely variable between $q_{V\,max}$ and $q_{V\,min} = 0$.

Ordering Code / Standard Program

A11V		O			/	1			–	N							
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15	16

Axial piston unit

01	Swashplate design, variable, nominal pressure 350 bar, maximum pressure 400 bar	**A11V**

Charge pump (impeller)

		40	60	75	95	130	145	190	260	
02	without charge pump (no code)	●	●	●	●	●	●	●	●	
	with charge pump	–	–	–	–	●	●	●	●	**L**

Operation

03	Pump, open circuit	**O**

Size

04	≈ Displacement $V_{g\,max}$ in cm^3	**40**	**60**	**75**	**95**	**130**	**145**	**190**	**260**

Control unit

										40	60	75	95	130	145	190	260	
05	Power control			LR						●	●	●	●	●	●	●	●	**LR**
	with override	cross sensing	negative	LR		C				●	●	●	●	●	●	●	●	**LR .C**
		high-pressure related	negative	LR3						●	●	●	●	●	●	●	●	**LR3**
		pilot-pressure related	negative	LG1						●	●	●	●	●	●	●	●	**LG1**
			positive	LG2						●	●	●	●	●	●	●	●	**LG2**
		electric U = 12 V	negative	LE1						❍	❍	❍	●	●	●	●	●	**LE1**
		U = 24 V	negative	LE2						❍	●	●	●	●	●	●	●	**LE2**
	with pressure cut-off				D					●	●	●	●	●	●	●	●	**L . D. .**
		hydraulic, 2-stage			E					●	●	●	●	●	●	●	●	**L . E. .**
		hydraulic, remote controlled					G			●	●	●	●	●	●	●	●	**L . . G.**
	with load sensing							S		●	●	●	●	●	●	●	●	**L . . .S**
		electric, prop. override, 24 V						S2		❍	❍	❍	●	●	●	●	●	**L . . .S2**
		hydraulic, prop. override						S5		❍	❍	❍	●	●	●	●	●	**L . . .S5**
	with stroke limiter	negative characteristic	Δp = 25 bar					H1		●	●	●	●	●	●	●	●	**L . . .H1**
			Δp = 10 bar					H5		●	●	●	●	●	●	●	●	**L . . .H5**
		positive characteristic	Δp = 25 bar					H2		●	●	●	●	●	●	●	●	**L . . .H2**
			Δp = 10 bar					H6		●	●	●	●	●	●	●	●	**L . . .H6**
			U = 12 V					U1		●	●	●	●	●	●	●	●	**L . . .U1**
			U = 24 V					U2		●	●	●	●	●	●	●	●	**L . . .U2**
	Pressure control			DR						●	●	●	●	●	●	●	●	**DR**
		with load sensing		DRS						●	●	●	●	●	●	●	●	**DRS**
		remote controlled		DRG						●	●	●	●	●	●	●	●	**DRG**
		for parallel operation		DRL						●	●	●	●	●	●	●	●	**DRL**
	Hydraulic control,		Δp = 10 bar	HD1						●	●	●	●	●	●	●	●	**HD1**
	pilot-pressure related	(positive characteristic)	Δp = 25 bar	HD2						●	●	●	●	●	●	●	●	**HD2**
		with pressure cut-off			D					●	●	●	●	●	●	●	●	**HD.D**
		with pressure cut-off, remote controlled			G					❍	●	❍	❍	❍	❍	●	●	**HD. G**
	Electric control		U = 12 V	EP1						●	●	●	●	●	●	●	●	**EP1**
	with proportional solenoid	(positive characteristic)	U = 24 V	EP2						●	●	●	●	●	●	●	●	**EP2**
		with pressure cut-off			D					●	●	●	●	●	●	●	●	**EP. D**
		with pressure cut-off, remote control			G					●	●	●	●	●	●	●	●	**EP. G**

In case of controls with several additional functions, observe the order of the columns, only one option per column is possible (e.g. LRDCH2). The following combinations are not available for the power control: LRDS2, LRDS5, L...GS, L...GS2, L...GS5, L...EC and the combination L...DG in conjunction with the stroke limiters H1, H2, H5, H6, U1 and U2.

Ordering Code / Standard Program

A11V		O			/	1			–	N							
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15	16

Series

06		**1**

Index

07		Size 40 ... 130	**0**
		Size 145 ... 260	**1**

Direction of rotation

08	Viewed from shaft end	clockwise	**R**
		counter-clockwise	**L**

Seals

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

Shaft end (see page 8 for permissible input and through drive torques)

			40	60	75	95	130	145	190	260	
10	Splined shaft DIN 5480 for single and combination pump		●	●	●	●	●	●	●	●	**Z**
	Parallel keyed shaft DIN 6885		●	●	●	●	●	●	●	●	**P**
	Splined shaft ANSI B92.1a–1976	for single pump	●	●	●	●	●	●	●	●	**S**
		for combination pump	●	●	●	–[1]	–[1]	–[1]	●	●	**T**

Mounting flange

		40	60	75	95	130	145	190	260	
11	SAE J744 – 2-hole	●	●	–	–	–	–	–	–	**C**
	SAE J744 – 4-hole	–	–	●	●	●	●	●	●	**D**
	SAE J617 [2] (SAE 3)	–	–	–	●	●	●	●	–	**G**

Service line ports

		40	60	75	95	130	145	190	260	
12	Pressure and suction port SAE, at side, opposite side (with metric fastening threads)	●	●	●	●	●	●	●	●	**12**

Through drive (see page 58 for attachments)

	Flange SAE J744 [3]		Coupler for splined shaft			40	60	75	95	130	145	190	260	
13	–		–			●	●	●	●	●	●	●	●	**N00**
	82-2	(A)	5/8in	9T 16/32DP	(A)	●	●	●	●	●	●	●	●	**K01**
			3/4in	11T 16/32DP	(A-B)	❍	●	❍	●	●	●	❍	❍	**K52**
	101-2	(B)	7/8in	13T 16/32DP	(B)	●	●	●	●	●	●	●	●	**K02**
			1 in	15T 16/32DP	(B-B)	●	●	●	●	●	●	●	●	**K04**
			W35	2x30x16x9g		●	●	●	●	●	●	●	●	**K79**
	127-2	(C) [4]	1 1/4in	14T 12/24DP	(C)	–	●	●	●	●	●	●	●	**K07**
			1 1/2in	17T 12/24DP	(C-C)	–	–	–	●	●	●	●	●	**K24**
			W30	2x30x14x9g		–	●	●	●	●	●	●	●	**K80**
			W35	2x30x16x9g		–	●	●	●	●	●	●	●	**K61**
	152-4	(D)	1 1/4in	14T 12/24DP	(C)	–	–	●	●	●	●	●	●	**K86**
			1 3/4in	13T 8/16DP	(D)	–	–	–	–	●	●	●	●	**K17**
			W40	2x30x18x9g		–	–	●	●	●	●	●	●	**K81**
			W45	2x30x21x9g		–	–	–	●	●	●	●	●	**K82**
			W50	2x30x24x9g		–	–	–	–	●	●	●	●	**K83**
	165-4	(E)	1 3/4in	13T 8/16DP	(D)	–	–	–	–	–	–	●	●	**K72**
			W50	2x30x24x9g		–	–	–	–	–	–	●	●	**K84**
			W60	2x30x28x9g		–	–	–	–	–	–	–	●	**K67**

Ordering Code / Standard Program

A11V		O			/	1			–	N							
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15	16

Swivel angle indicator (page 59)

		40	60	75	95	130	145	190	260	
14	without swivel angle indicator (no symbol)	●	●	●	●	●	●	●	●	
	with optical swivel angle indicator	●	–	●	●	●	●	●	●	**V**
	with electric swivel angle sensor	●	–	●	●	●	●	●	●	**R**

Connector for solenoids (page 60)

		40	60	75	95	130	145	190	260	
15	DEUTSCH connector molded, 2-pin – without suppressor diode	●	●	●	●	●	●	●	●	**P**

Standard / special version

16	Standard version	without symbol	
		combined with attachment part or attachment pump	**-K**
	Special version		**-S**
		combined with attachment part or attachment pump	**-SK**

1) **S**-shaft suitable for combination pump!
2) To fit the flywheel case of the combustion engine
3) 2 ≙ 2-hole; 4 ≙ 4-hole
4) Size 190 and 260 with 2 + 4-hole flange

● = available ❍ = on request – = 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 operating conditions.

The variable pump A11VO is not suitable for operating with HFA, HFB and HFC. If 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 16 to 36 mm^2/s

depending on the tank temperature (open circuit).

Limits of viscosity range

The limiting values for viscosity are as follows:

ν_{min} = 5 mm^2/s
Short-term (t < 3 min)
At max. perm. temperature of t_{max} = +115°C.

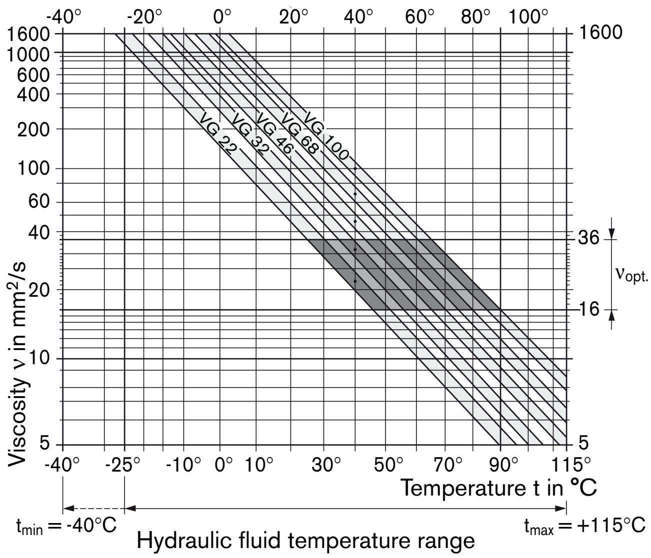
ν_{max} = 1600 mm^2/s
Short-term (t < 3 min)
At cold start (p ≤ 30 bar, n ≤ 1000 rpm, t_{min} = -40°C).
Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Note that the maximum hydraulic fluid temperature of 115°C 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 5 K higher than the average case drain temperature.

Special measures are necessary in the temperature range from -40°C and -25°C (cold start phase), 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 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 ($\nu_{opt.}$) – see 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 60°C is set. In the optimum operating viscosity range (ν_{opt}; shaded area) this corresponds to the viscosity classes VG 46 and 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 tank temperature. At no point in the system may the temperature be higher than 115°C.

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

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 claenliness level of at least

20/18/15 according to ISO 4406.

At very high hydraulic fluid temperatures (90°C to max. 115°C, not permitted for sizes 250 to 1000) at least cleanliness level

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

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

Technical Data

Operating pressure range

Inlet

Absolute pressure at port S (suction port)
Version *without* charge pump

$p_{abs\ min}$ ____ 0.8 bar
$p_{abs\ max}$ ____ 30 bar

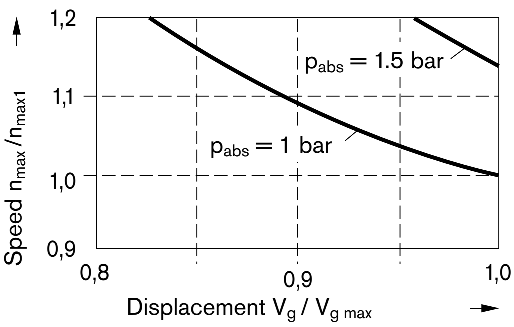
If the pressure is > 5 bar, please ask.

Version *with* charge pump

$p_{abs\ min}$ ____ 0.6 bar
$p_{abs\ max}$ ____ 2 bar

Maximum permissible speed (speed limit)

Permissible speed by increasing the inlet pressure p_{abs} at the suction port S or at $V_g \leq V_{g\ max}$



Outlet

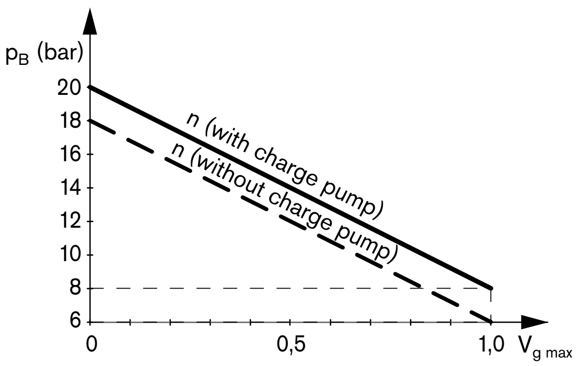
Pressure at port A or B

Nominal pressure p_N ____ 350 bar
Maximum pressure p_{max} ____ 400 bar

Nominal pressure:	Max. design pressure at which fatigue strength is ensured.
Maximum pressure:	Max. operating pressure which is permissible for short-term (t < 1s).

Minimum operating pressure

A minimum operating pressure $p_{B\ min}$ is required in the pump service line depending on the speed, the swivel angle and the displacement (see diagram).



Case drain pressure

The case drain pressure at the ports T_1 and T_2 may be a maximum of 1.2 bar higher than the inlet pressure at the port S but not higher than

$p_{L\ abs.\ max}$ ____ 2 bar.

An unrestricted, full size case drain line directly to tank is required.

Temperature range of the shaft seal ring

The FKM shaft seal ring is permissible for case drain temperatures of -25°C to +115°C.

Note:
For applications below -25°C, an NBR shaft seal ring is necessary (permissible temperature range: -40°C to +90°C).
State NBR shaft seal ring in clear text in the order.

Flushing the case

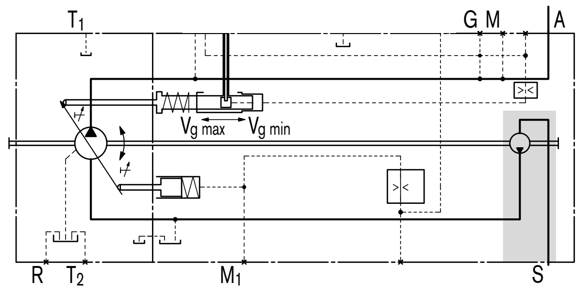
If a variable pump with control unit **EP, HD, DR** or stroke limiter (**H., U.,**) is operated over a long period (t > 10 min) with flow zero or operating pressure < 15 bar, flushing of the case via ports "T_1", "T_2" or "R" is necessary.

Size	40	60	75	95	130	145	190	260
$q_{V\ flush}$(l/min)	2	3	3	4	4	4	5	6

Flushing the case is unnecessary in versions with charge pump (A11VLO), since a part of the charge flow is directed to the case.

Charge pump (impeller)

The charge pump is a circulating pump with which the A11VLO (size 130...260) is filled and therefore can be operated at higher speeds. This also simplifies cold starting at low temperatures and high viscosity of the hydraulic fluid. Tank charging is therefore unnecessary in most cases. A tank pressure of a max. 2 bar is permissible with charge pump.



Technical Data

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

Size	A11VO		40	60	75	95	130	145	190	260
Displacement	$V_{g\,max}$	cm^3	42	58.5	74	93.5	130	145	193	260
	$V_{g\,min}$	cm^3	0	0	0	0	0	0	0	0
Speed										
maximum at $V_{g\,max}$ [1]	n_{max}	rpm	3000	2700	2550	2350	2100	2200	2100	1800
maximum at $V_g \leq V_{g\,max}$ [3]	n_{max1}	rpm	3500	3250	3000	2780	2500	2500	2100	2300
Flow at n_{max} and $V_{g\,max}$	$q_{v\,max}$	l/min	126	158	189	220	273	319	405	468
Power at $q_{v\,max}$ and $\Delta p = 350$ bar	P_{max}	kW	74	92	110	128	159	186	236	273
Torque at $V_{g\,max}$ and $\Delta p = 350$ bar	T_{max}	Nm	234	326	412	521	724	808	1075	1448
Rotary stiffness	Z shaft	Nm/rad	88894	102440	145836	199601	302495	302495	346190	686465
	P shaft	Nm/rad	87467	107888	143104	196435	312403	312403	383292	653835
	S shaft	Nm/rad	58347	86308	101921	173704	236861	236861	259773	352009
	T shaft	Nm/rad	74476	102440	125603	–	–	–	301928	567115
Moment of inertia for rotary group	J_{TW}	kgm^2	0.0048	0.0082	0.0115	0.0173	0.0318	0.0341	0.055	0.0878
Angular acceleration, max. [4]	α	rad/s^2	22000	17500	15000	13000	10500	9000	6800	4800
Filling capacity	V	l	1.1	1.35	1.85	2.1	2.9	2.9	3.8	4.6
Mass (approx.)	m	kg	32	40	45	53	66	76	95	125

Size	A11VLO (with charge pump)		130	145	190	260
Displacement	$V_{g\,max}$	cm^3	130	145	193	260
	$V_{g\,min}$	cm^3	0	0	0	0
Speed						
maximum at $V_{g\,max}$ [2]	n_{max}	rpm	2500	2500	2500	2300
maximum at $V_g \leq V_{g\,max}$ [3]	n_{max1}	rpm	2500	2500	2500	2300
Flow at n_{max} and $V_{g\,max}$	$q_{v\,max}$	l/min	325	363	483	598
Power at $q_{v\,max}$ and $\Delta p = 350$ bar	P_{max}	kW	190	211	281	349
Torque at $V_{g\,max}$ and $\Delta p = 350$ bar	T_{max}	Nm	724	808	1075	1448
Rotary stiffness	Z shaft	Nm/rad	302495	302495	346190	686465
	P shaft	Nm/rad	312403	312403	383292	653835
	S shaft	Nm/rad	236861	236861	259773	352009
	T shaft	Nm/rad	–	–	301928	567115
Moment of inertia for rotary group	J_{TR}	kgm^2	0.0337	0.036	0.0577	0.0895
Angular acceleration, max. [4]	α	rad/s^2	10500	9000	6800	4800
Filling capacity	V	l	2.9	2.9	3.8	4.6
Mass (approx.)	m	kg	72	73	104	138

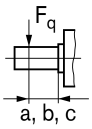
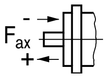
1) The values apply at absolute pressure (p_{abs}) 1 bar at the suction port S and mineral hydraulic fluid.
2) The values apply at absolute pressure (p_{abs}) of at least 0.8 bar at the suction port S and mineral hydraulic fluid.
3) The values apply at $V_g \leq V_{g\,max}$ or in case of an increase in the inlet pressure p_{abs} at the suction port S (see diagram page 6)
4) – The area of validity is situated between 0 and the maximum permissible speed.
It applies for external stimuli (e.g. engine 2-8 times rotary frequency, cardan shaft twice the rotary frequency).
– The limit value applies for a single pump only.
– The loading on the connection parts has to be considered.

Caution:
Exceeding the permissible limit values could cause a loss of function, reduced service life or the destruction of the axial piston unit. The permissible values can be determined by calculation.

Technical Data

Permissible radial and axial loading on drive shaft

The values stated are maximum data and not permissible for continuous operation

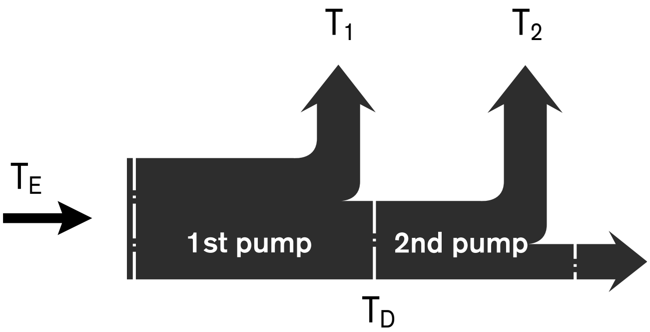
Size			Size	40	60	75	95	130	145	190	260
Radial force, max. at distance a, b, c (from shaft collar)		$F_{q\,max}$	N	3600	5000	6300	8000	11000	11000	16925	22000
		a	mm	17.5	17.5	20	20	22.5	22.5	26	29
		$F_{q\,max}$	N	2891	4046	4950	6334	8594	8594	13225	16809
		B	mm	30	30	35	35	40	40	46	50
		$F_{q\,max}$	N	2416	3398	4077	5242	7051	7051	10850	13600
		c	mm	42.5	42.5	50	50	57.5	57.5	66	71
Axial force, max.		$\pm F_{ax\,max}$	N	1500	2200	2750	3500	4800	4800	6000	4150

Permissible input and through drive torques

Size		Size	40	60	75	95	130	145	190	260
Torque (at $V_{g\,max}$ and $\Delta p = 350$ bar [1])	T_{max}	Nm	234	326	412	521	724	808	1075	1448
Input torque, max. [2]										
at shaft end P	$T_{E\,perm.}$	Nm	468	648	824	1044	1448	1448	2226	2787
Shaft key DIN 6885			ø32	ø35	ø40	ø45	ø50	ø50	ø55	ø60
at Z shaft end	$T_{E\,perm.}$	Nm	912	912	1460	2190	3140	3140	3140	5780
DIN 5480			W35	W35	W40	W45	W50	W50	W50	W60
at S shaft end	$T_{E\,perm.}$	Nm	314	602	602	1640	1640	1640	1640	1640
ANSI B92.1a-1976 (SAE J744)			1 in	1 1/4 in	1 1/4 in	1 3/4 in	1 3/4 in	1 3/4 in	1 3/4 in	1 3/4 in
at T shaft end	$T_{E\,perm.}$	Nm	602	970	970	–	–	–	2670	4070
ANSI B92.1a-1976 (SAE J744)			1 1/4 in	1 3/8 in	1 3/8 in	–	–	–	2 in	2 1/4 in
Through drive torque, max. [3]	$T_{D\,perm.}$	Nm	314	521	660	822	1110	1110	1760	2065

1) Efficiency not considered
2) For drive shafts with no radial force
3) Observe max. input torque for shaft **S**!

Torque distribution



Determining the nominal value

Flow $$q_v = \frac{V_g \cdot n \cdot \eta_v}{1000}$$ l/min

Torque $$T = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}}$$ Nm

Power $$P = \frac{2\pi \cdot T \cdot n}{60{,}000} = \frac{q_v \cdot \Delta p}{600 \cdot \eta_t}$$ kW

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Overall efficiency ($n_t = n_v \cdot n_{mh}$)

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LR – Power Control

The power control regulates the displacement of the pump depending on the operating pressure so that a given drive power is not exceeded at constant drive speed.

$p_B \cdot V_g = \text{constant}$	p_B = operating pressure V_g = displacement

The precise control with a hyperbolic control characteristic, provides an optimum utilization of available power.

The operating pressure acts on a rocker via a measuring piston. An externally adjustable spring force counteracts this, it determines the power setting.

If the operating pressure exceeds the set spring force, the control valve is actuated by the rocker, the pump swivels back (direction $V_{g\ min}$). The lever length at the rocker is shortened and the operating pressure can increase at the same rate as the displacement decreases without the drive powers being exceeded ($p_B \cdot V_g$ = constant).

The hydraulic output power (characteristic LR) is influenced by the efficiency of the pump.

State in clear text in the order:

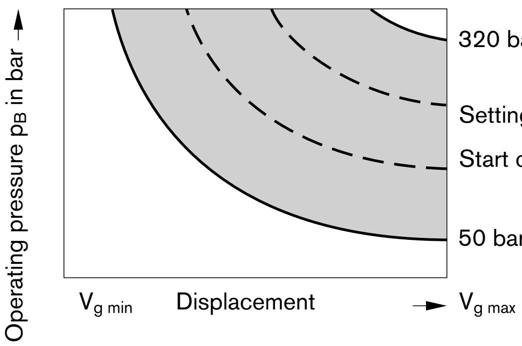
– drive power P in kW

– drive speed n in rpm

– max. flow $q_{V\ max}$ in l/min

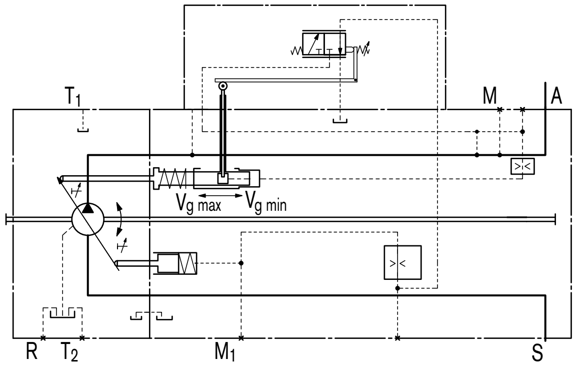
After clarifying the details a power diagram can be created by our computer.

Characteristic LR

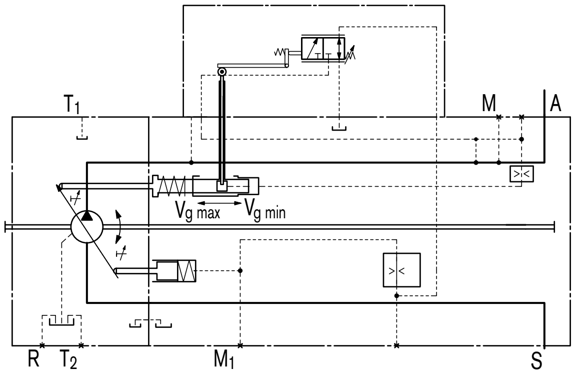


Circuit diagram LR

Size 40 ... 145



Size 190 ... 260



LR – Power Control

LRC Override with cross sensing

Cross sensing control is a summation power control system, whereby the total power, of both the A11VO and of a same size A11VO power controlled pump mounted onto the through drive, are kept constant.

If a pump is operating at pressures below the start of the control curve setting, then the surplus power not required, in a critical case up to 100%, becomes available to the other pump. Total power is thus divided between two systems as demand requires.

Any power being limited by means of pressure cut-off or other override functions is not taken into account.

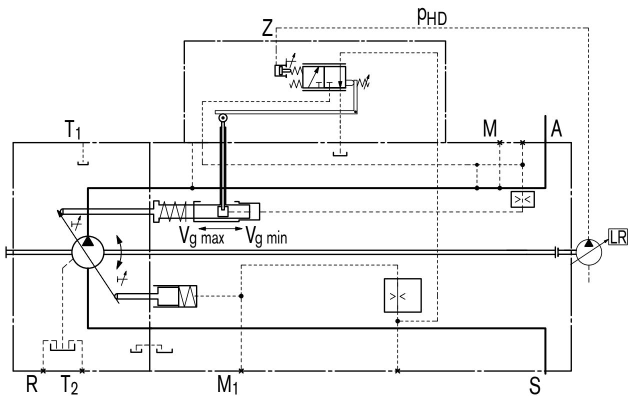
Half side cross sensing function

When using the LRC control on the 1st pump (A11VO) and a power-controlled pump without cross sensing attached to the through drive, the power required for the 2nd pump is deducted from the setting of the 1st pump. The 2nd pump has priority in the total power setting.

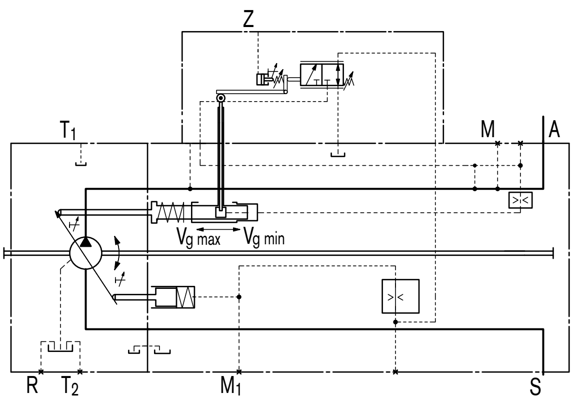
The size and start of control of the power control of the 2nd pump must be specified for rating the control of the 1st pump.

Circuit diagram LRC

Size 40 ... 145



Size 190 ... 260



LR3 High-pressure related override

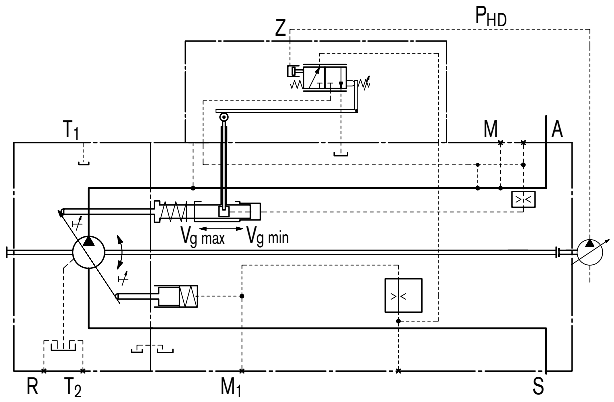
The high-pressure related power override is a total power control in which the power control setting is piloted by the load pressure of an attached fixed pump (port Z).

As a result the A11VO can be set to 100% of the total drive power. The power setting of the A11VO is reduced proportional to the load-dependent rise in operating pressure of the fixed pump. The fixed pump has priority in the total power setting.

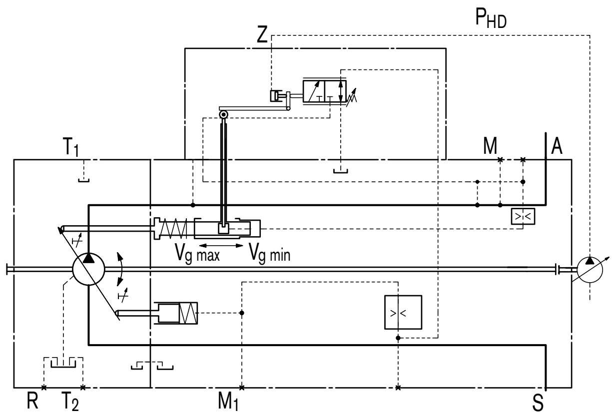
The measuring area of the power reduction pilot piston is designed as a function of the size of the fixed pump.

Circuit diagram LR3

Size 40 ... 145



Size 190 ... 260



LR – Power Control

LG1/2 Pilot-pressure related override

This power control works by overriding the control setting with an external pilot pressure signal. This pilot pressure acts on the adjustment spring of the power regulator via port Z.

The mechanically adjusted basic setting can be hydraulically adjusted by means of different pilot pressure settings, enabling different power mode settings.

If the pilot pressure signal is then adjusted by means of an external power limiting control, the total hydraulic power consumption of all users can be adapted to the available drive power from the engine.

The pilot pressure used for power control is generated by an external control element that is not a component part of the A11VO (e.g. see also data sheet RE 95310, Electronic Load Limiting Control, LLC).

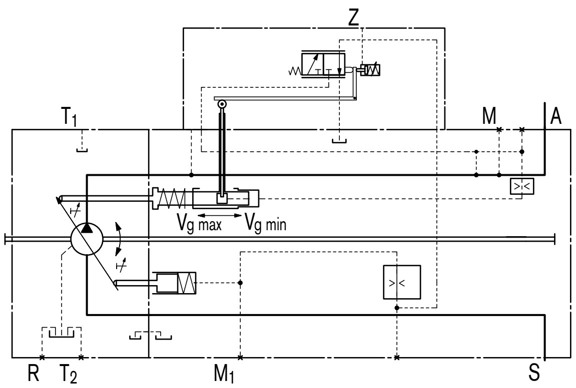
LG1 Negative power override

Power control with negative override, LG1: the force resulting from the pilot pressure is acting against the mechanical adjustment spring of the power control.

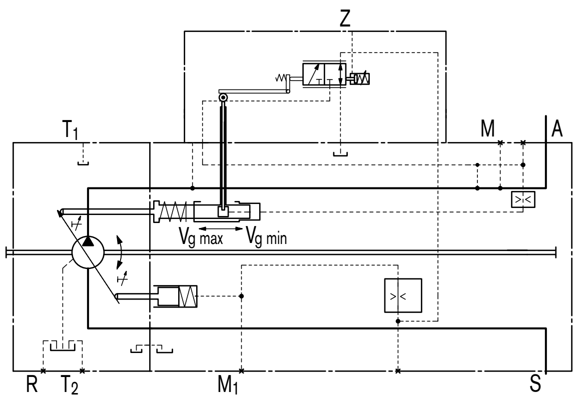
Increasing the pilot pressure reduces the power setting.

Circuit diagram LG1

Size 40 ... 145



Size 190 ... 260



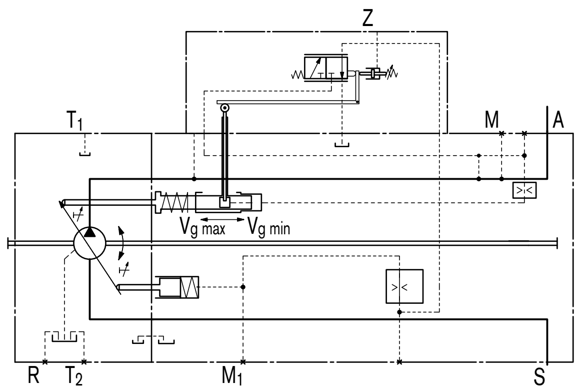
LG2 Positive power override

Power control with positive override, LG2: the force resulting from the pilot pressure is additive the mechanical adjustment spring of the power control.

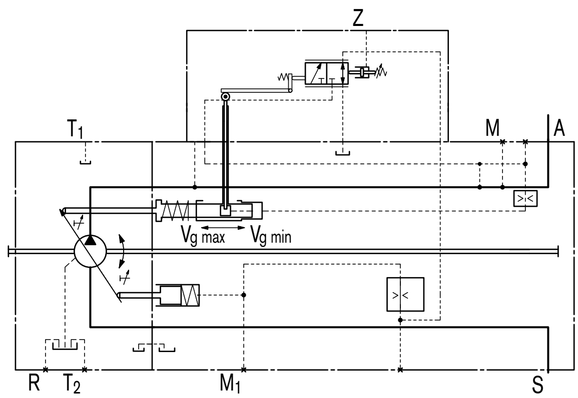
An increase in pilot pressure increases the power output.

Circuit diagram LG2

Size 40 ... 145



Size 190 ... 260



LR – Power Control

LE1/2 Electric override (negative)

Contrary to hydraulic power control override, the basic power setting is reduced by an electric pilot current applied to a proportional solenoid. The resulting force is acting against the mechanical power control adjustment spring.

The mechanically adjusted basic power setting can be varied by means of different control current settings.

Increase in current = decrease in power

If the pilot current signal is adjusted by a load limiting control the power consumption of all actuators will be reduced to match the available power from the diesel engine.

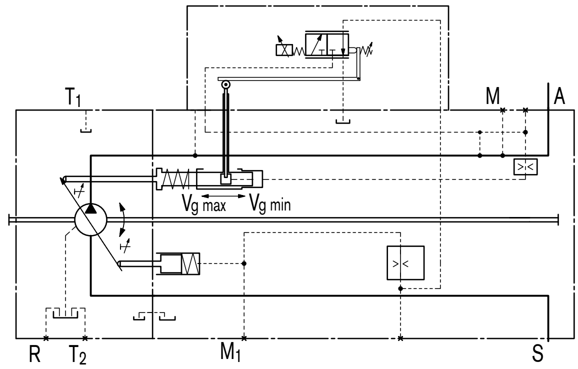
A 12V (LE1) or 24V (LE2) supply is required for the control of the proportion solenoid.

Technical data - Solenoids

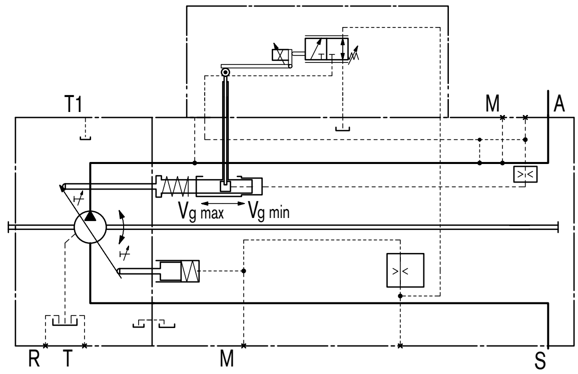
	LE1	LE2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control	400 mA	200 mA
End of control	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20°C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection	see connector version, page 60	

Circuit diagram LE1/2

Size 40 ... 145

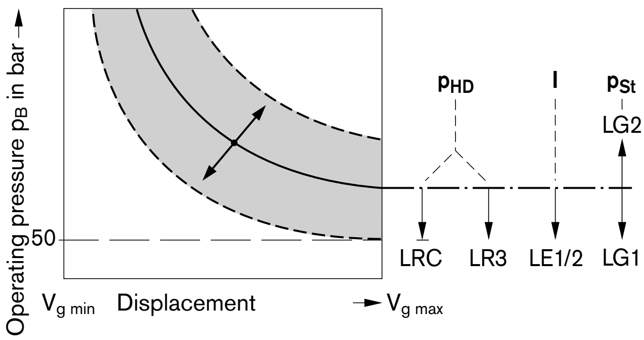


Size 190 ... 260



Overview of power overrides

Effect of power overrides at rising pressure or current



LR – Power Control

LRD Power control with pressure cut-off

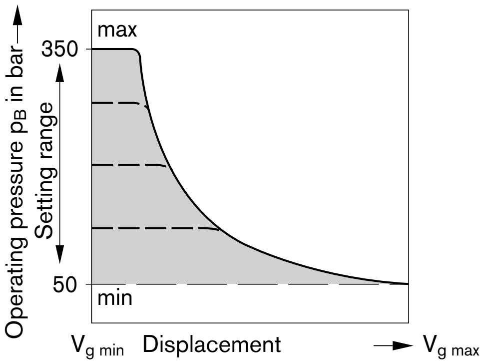
The pressure cut-off corresponds to a pressure control which adjusts the pump displacement back to $V_{g\,min}$, when the pressure setting is reached.

This function overrides the power control, i.e. below the preset pressure value, the power function is effective.

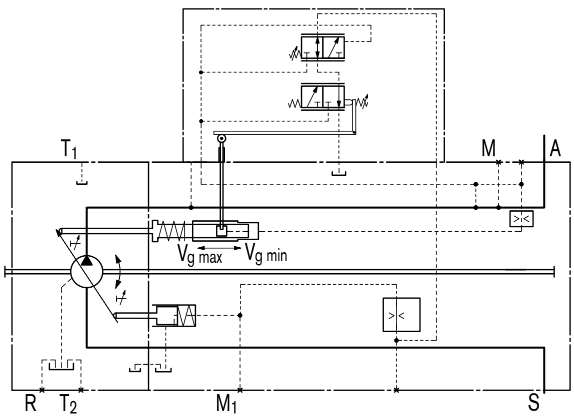
The pressure cut-off function is integrated into the pump control module and is preset to a specified value at the factory.

Setting range from 50 to 350 bar

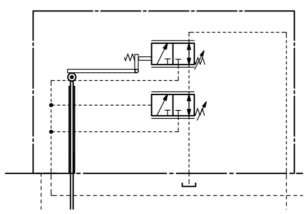
Characteristic LRD



Circuit diagram LRD
Size 40...145



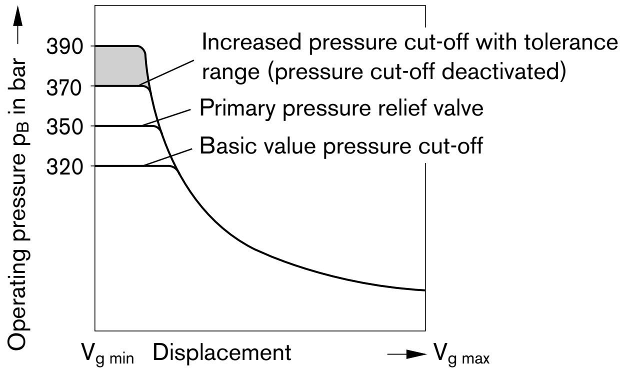
Size 190...260



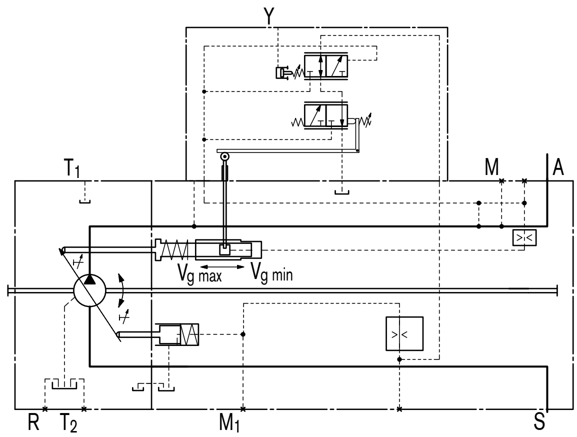
LRE Power control with pressure cut-off, 2-stage

By connecting an external pilot pressure to port Y, the basic value of the pressure cut-off can be increased by 50 $^{+20}$ bar and a 2nd pressure setting implemented.
This value is usually above the primary pressure relief valve setting and therefore disables the pressure cut-off function.
The pressure signal at port Y must be between 20 and 50 bar.

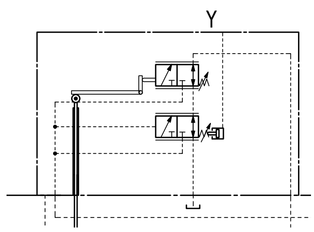
Characteristic LRE



Circuit diagram LRE
Size 40...145



Size 190...260



LRG Power control with pressure cut-off, hydraulically remote controlled

See page 21 for description and characteristic (pressure control remote controlled, DRG)

LR – Power Control

LRDS Power control with pressure cut-off and load sensing

The load sensing control is a flow control option that operates as a function of the load pressure to regulate the pump displacement to match the actuator flow requirement.

The flow depends here on the cross section of the external sensing orifice (1) fitted between the pump outlet and the actuator. The flow is independent of the load pressure below the power curve and the pressure cut-off setting and within the control range of the pump.

The sensing orifice is usually a separately arranged load sensing directional valve (control block). The position of the directional valve piston determines the opening cross section of the sensing orifice and thus the flow of the pump.

The load sensing control compares pressure before and after the sensing orifice and maintains the pressure drop across the orifice (differential pressure Δp) and with it the pump flow constant.

If the differential pressure Δp increases at the sensing orifice, the pump is swivelled back (towards $V_{g\,min}$), and, if the differential pressure Δp decreases, the pump is swivelled out (towards $V_{g\,max}$) until the pressure drop across the sensing orifice in the valve is restored.

$\Delta p_{orifice} = p_{pump} - p_{actuator}$

The setting range for Δp is between 14 bar and 25 bar.

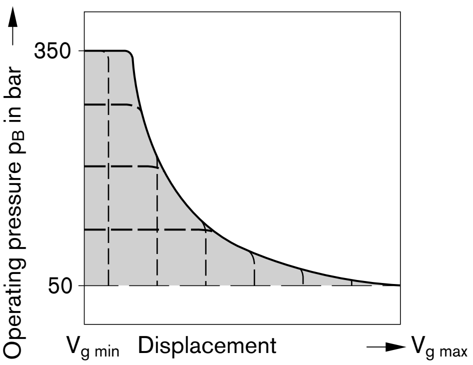
The standard differential pressure setting is 18 bar. (Please state in clear text when ordering).

The stand-by pressure in zero stroke operation (sensing orifice plugged) is slightly above the Δp setting.

In a standard LS system the pressure cut-off is integrated in the pump control. In a LUDV (flow sharing) system the pressure cut-off is integrated in the LUDV control block.

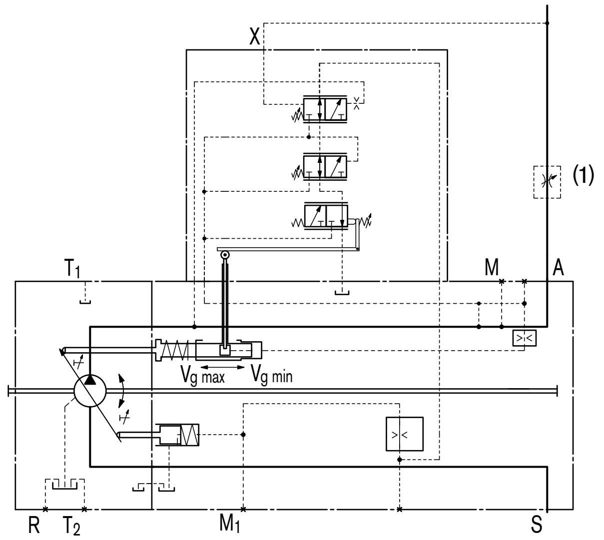
(1) The sensing orifice (control block) is not included in the pump supply.

Characteristic LRDS

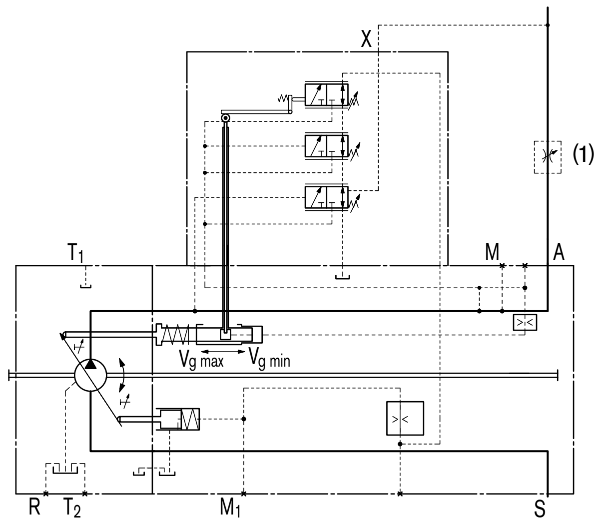


Circuit diagram LRDS

Size 40 ... 145



Size 190 ... 260



LR – Power Control

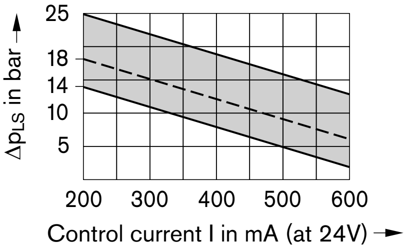
LRS2 Power control with load sensing, electric override

This control option adds a proportional solenoid to override to the mechanically set load sensing pressure. The pressure differential change is proportional to the solenoid current.

Increasing current = smaller Δp-setting

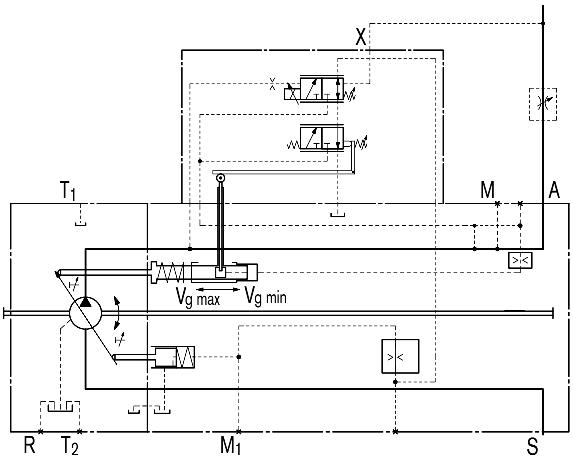
See following characteristic for details (example). Please consult us during the project planning phase.
For solenoid specification, see page 12 (LE2)

Characteristic LRS2

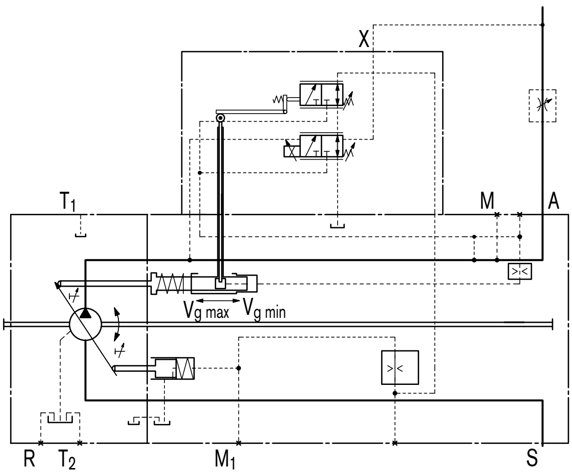


Circuit diagram LRS2

Size 40 ... 145



Size 190 ... 260



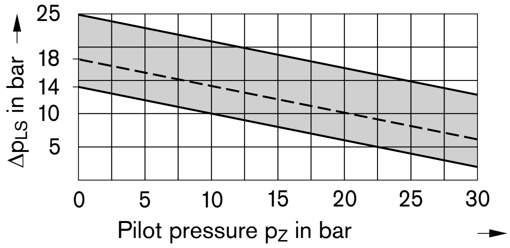
LRS5 Power control with load sensing, hydraulic override

This control option adds an external proportional pilot pressure signal (to port Z) to override the mechanically set load sensing pressure.

Increasing pilot pressure = smaller Δp-setting

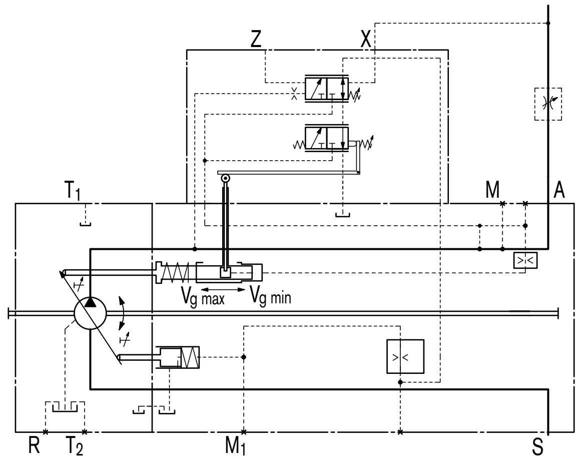
See following characteristic for details (example). Please consult us during the project planning phase.

Characteristic LRS5

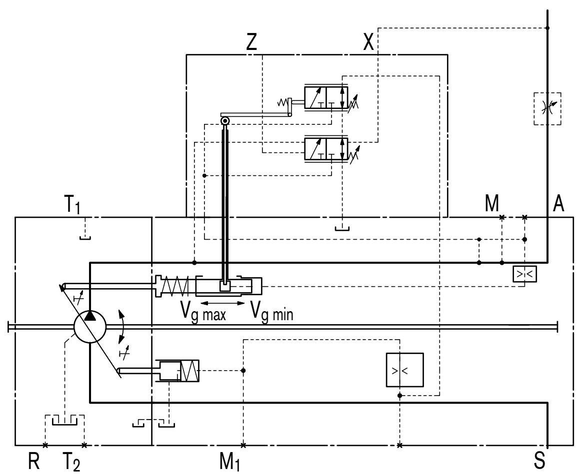


Circuit diagram LRS5

Size 40 ... 145



Size 190 ... 260



LR – Power Control

LR... Power control with stroke limiter

The stroke limiter can be used to vary or limit the displacement of the pump continuously over the whole control range. The displacement is set in LRH with the pilot pressure p_{St} (max. 40 bar) applied to port Y or in LRU by the control current applied to the proportional solenoid. A DC current of 12V (U1) or 24V (U2) is required to control the proportional solenoid.

The power control overrides the stoke limiter control, i.e. below the hyperbolic power characteristic, the displacement is controlled by the control current or pilot pressure. When exceeding the power characteristic with a set flow or load pressure, the power control overrides and reduces the displacement following the hyperbolic characteristic.

To permit operation of the pump displacement control from its starting position $V_{g\ max}$ to $V_{g\ min}$, a minimum control pressure of 30 bar is required for the electric stroke limiter LRU1/2 and the hydraulic stroke limiter LRH2/6.

The required control pressure is taken either from the load pressure, or from the externally applied control pressure at the G port.

To ensure functioning of the stroke limiter even at low operating pressure, port G must be supplied with external control pressure of approx. 30 bar.

Note:
If no external control pressure is connected at G, the shuttle valve must be removed.

Note

The spring return feature in the controller is not a safety device

The spool valve inside the controller 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).

LR – Power Control

LRH1/5 Hydraulic stroke limiter (negative characteristic)

Control from $V_{g\,max}$ to $V_{g\,min}$

With increasing pilot pressure the pump swivels to a smaller displacement.

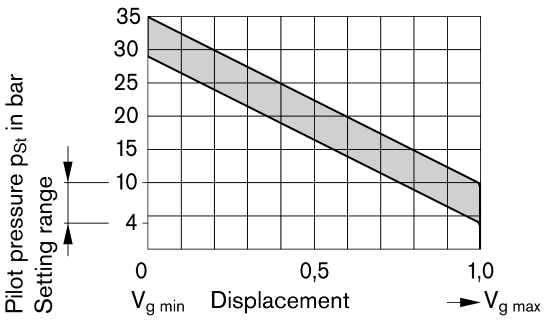
Start of control (at $V_{g\,max}$), can be set _______ from 4 – 10 bar

State start of control in clear text in the order.

Starting position without control signal (pilot pressure): $V_{g\,max}$

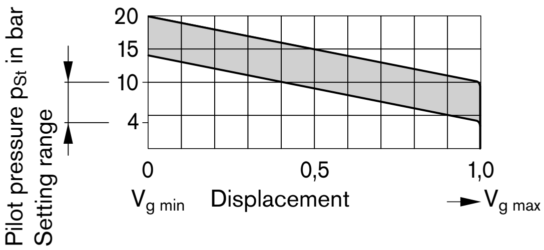
Characteristic H1

Increase in pilot pressure ($V_{g\,max}$ – $V_{g\,min}$) ________ Δp = 25 bar



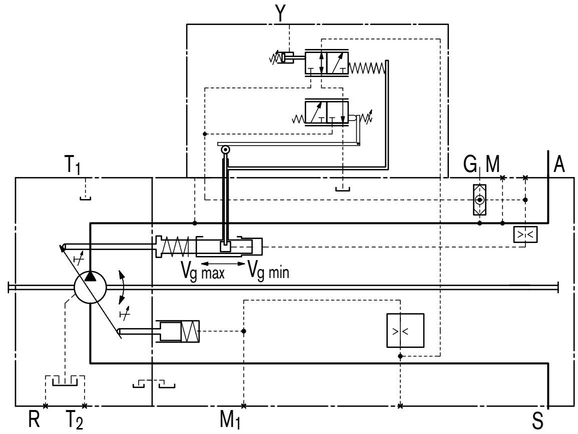
Characteristic H5

Increase in pilot pressure ($V_{g\,max}$ – $V_{g\,min}$) ________ Δp = 10 bar

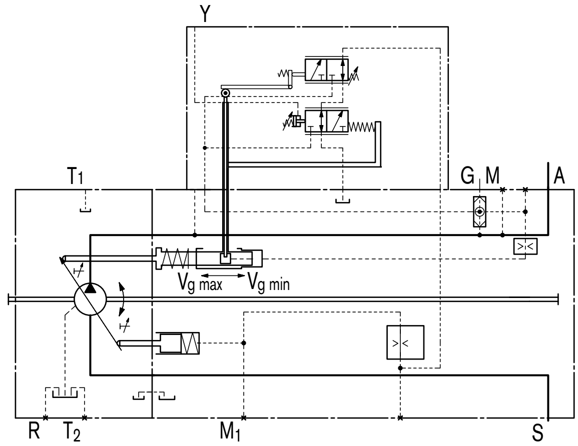


Circuit diagram LRH1/5

Size 40 ... 145



Size 190 ... 260



LR – Power Control

LRH2/6 Hydraulic stroke limiter (positive characteristic)

Control from $V_{g\,min}$ to $V_{g\,max}$

With increasing pilot pressure the pump swivels to a higher displacement.

Start of control (at $V_{g\,min}$), can be set ________ from 4–10 bar

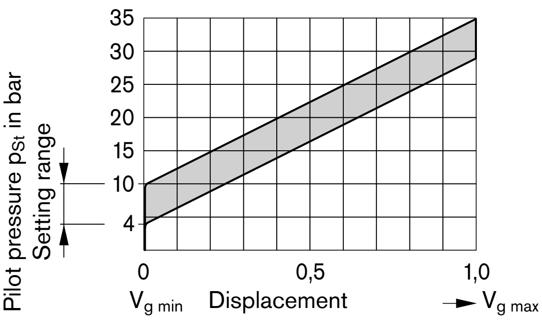
State start of control in clear text in the order.

Starting position without control signal (pilot pressure):

- at operating pressure and external control pressure < 30 bar: $V_{g\,max}$
- at operating pressure or external control pressure > 30 bar: $V_{g\,min}$

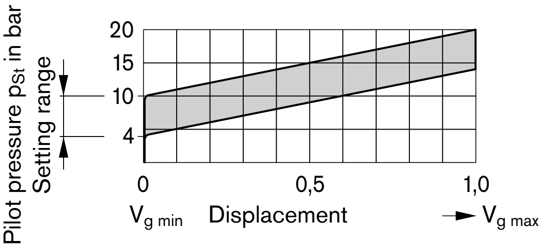
Characteristic H2

Increase in pilot pressure ($V_{g\,min}$ – $V_{g\,max}$) _______ $\Delta p = 25$ bar



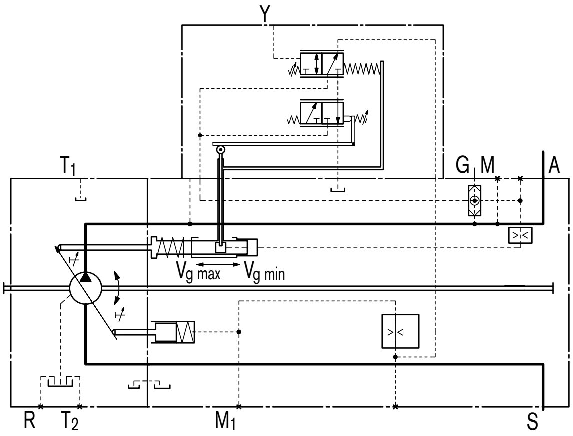
Characteristic H6

Increase in pilot pressure ($V_{g\,min}$ – $V_{g\,max}$) _______ $\Delta p = 10$ bar

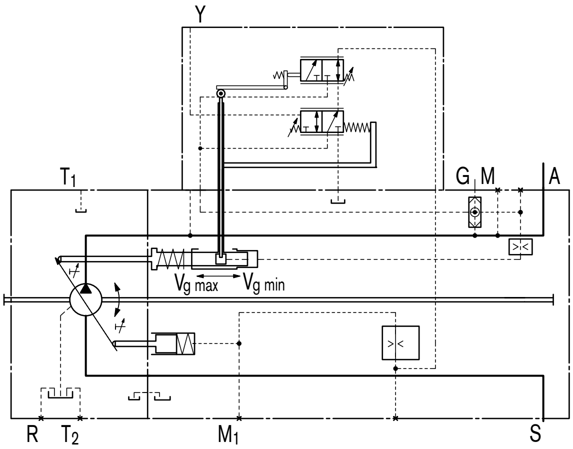


Circuit diagram LRH2/6

Size 40 ... 145



Size 190 ... 260



LR – Power Control

LRU1/2 Electric stroke limiter (positive characteristic)

Control from $V_{g\,min}$ to $V_{g\,max}$

With increasing control current the pump swivels to a higher displacement.

Technical data - solenoids

	LRU1	LRU2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at $V_{g\,max}$	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 20°C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection	see connector version, page 60	

Starting position without control signal (control current):

– at operating pressure and external control pressure < 30 bar: $V_{g\,max}$

– at operating pressure or external control pressure > 30 bar: $V_{g\,min}$

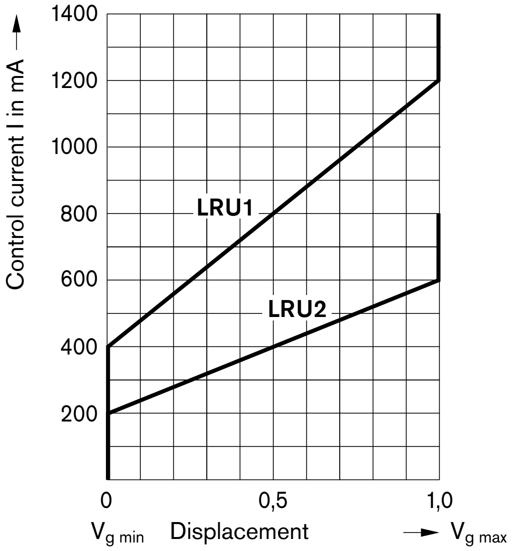
The following electronic controllers and amplifiers are available for actuating the proportional solenoids

– BODAS controller RC

Series 20 ____ RE 95200
Series 21 ____ RE 95201
Series 22 ____ RE 95202
Series 30 ____ RE 95203
and application software

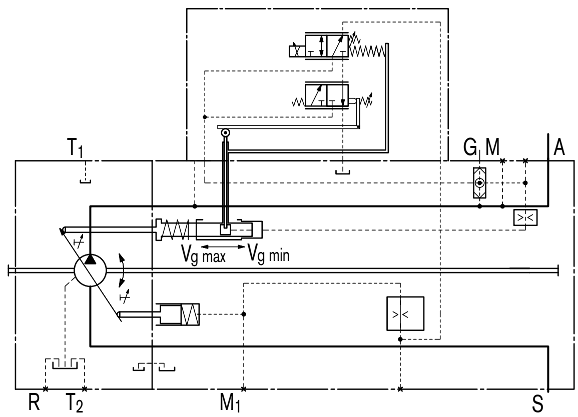
– Analog amplifier RA ____ RE 95230

Characteristic LRU1/2

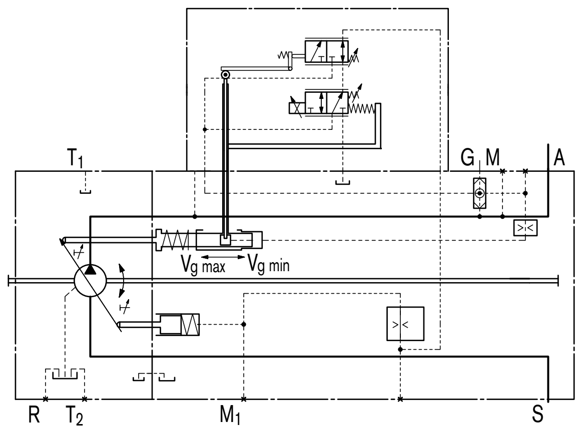


Circuit diagram LRU1/2

Size 40 ... 145



Size 190 ... 260



DR – Pressure Control

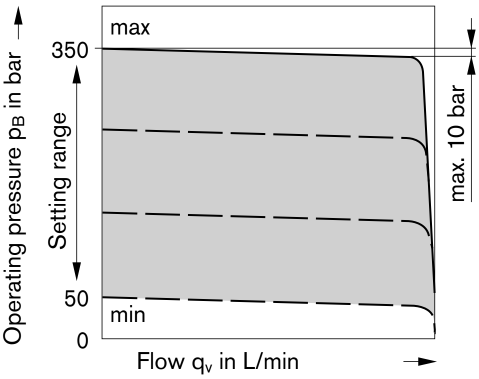
DR Pressure control

The pressure control keeps the pressure in a hydraulic system constant within its control range even under varying flow conditions. The variable pump only moves as much hydraulic fluid as is required by the actuators. If the operating pressure exceeds the setpoint set at the integral pressure control valve, the pump displacement is automatically swivelled back until the pressure deviation is corrected.

Starting position in depressurized state: $V_{g\,max}$

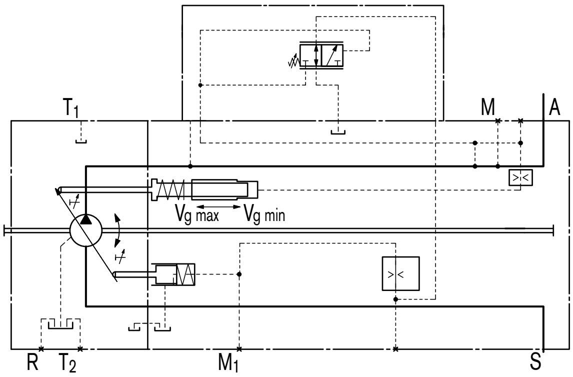
Setting range from 50 to 350 bar.

Characteristic: DR

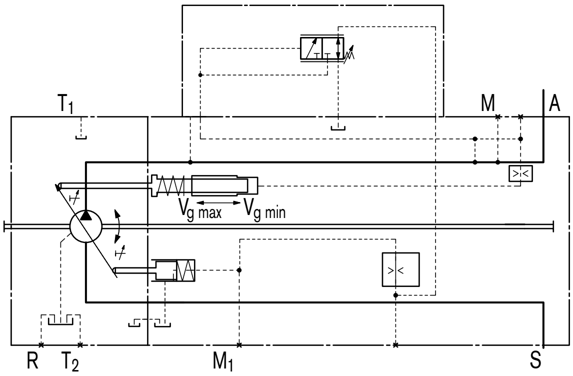


Circuit diagram DR

Size 40 ... 145



Size 190 ... 260



DR – Pressure Control

DRS Pressure control with load sensing

The load sensing control is a flow control option that operates as a function of the load pressure to regulate the pump displacement to match the actuator flow requirement.

The flow depends here on the cross section of the external sensing orifice (1) fitted between the pump outlet and the actuator. The flow is independent of the load pressure below the pressure cut-off setting and within the control range of the pump.

The sensing orifice is usually a separately arranged load sensing directional valve (control block). The position of the directional valve piston determines the opening cross section of the sensing orifice and thus the flow of the pump.

The load sensing control compares pressure before and after the sensing orifice and maintains the pressure drop across the orifice (differential pressure Δp) and with it the pump flow constant.

If the differential pressure Δp increases at the sensing orifice, the pump is swivelled back (towards $V_{g\,min}$), and, if the differential pressure Δp decreases, the pump is swivelled out (towards $V_{g\,max}$) until the pressure drop across the sensing orifice in the valve is restored.

$\Delta p_{orifice} = p_{pump} - p_{actuator}$

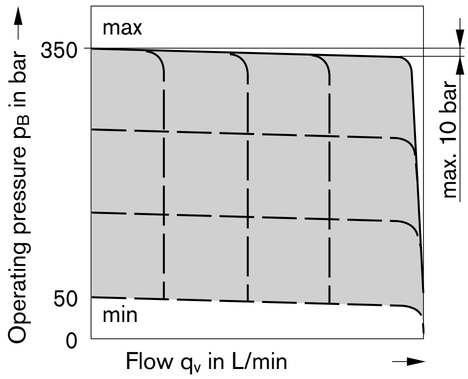
The setting range for Δp is between 14 bar and 25 bar.

The standard differential pressure setting is 18 bar. (Please state in clear text when ordering).

The stand-by pressure in zero stroke operation (sensing orifice plugged) is slightly above the Δp setting.

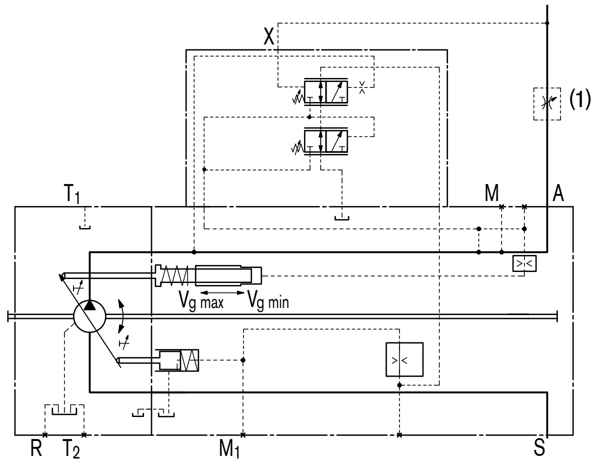
(1) The sensing orifice (control block) is not included in the pump supply.

Characteristic: DRS

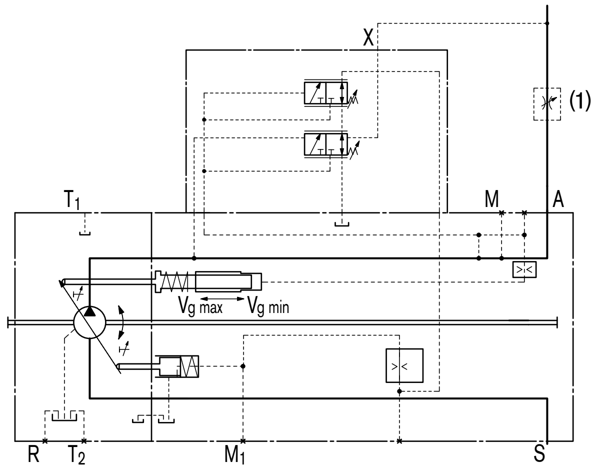


Circuit diagram DRS

Size 40 ... 145



Size 190 ... 260



DR – Pressure Control

DRG Pressure control, remote controlled

The remote control pressure cut-off regulator permits the adjustment of the pressure setting by a remotely installed pressure relief valve (1). Pilot flow for this valve is provide by a fixed orifice in the control module.

Setting range from 50 to 350 bar.

In addition the pump can be unloaded into a standby pressure condition by an externally installed 2/2-way directional valve (2).

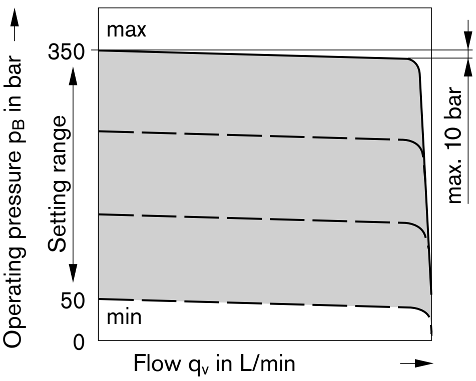
Both functions can be used individually or in combination (see circuit diagram).

The external valves are not included in the pump supply.

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

DBDH 6 (manual control), see RE 25402

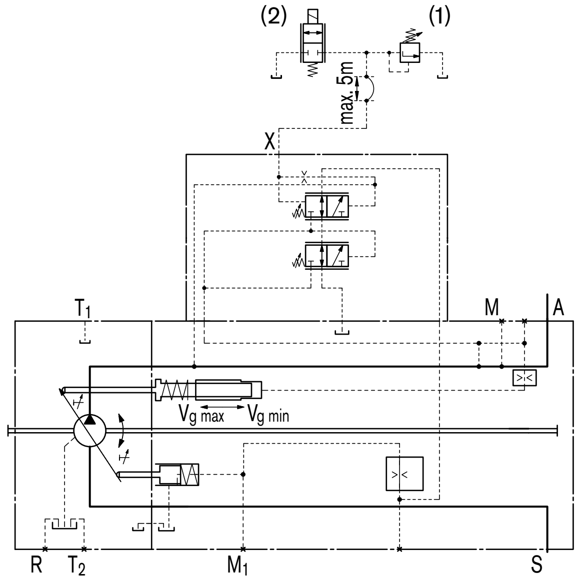
Characteristic: DRG



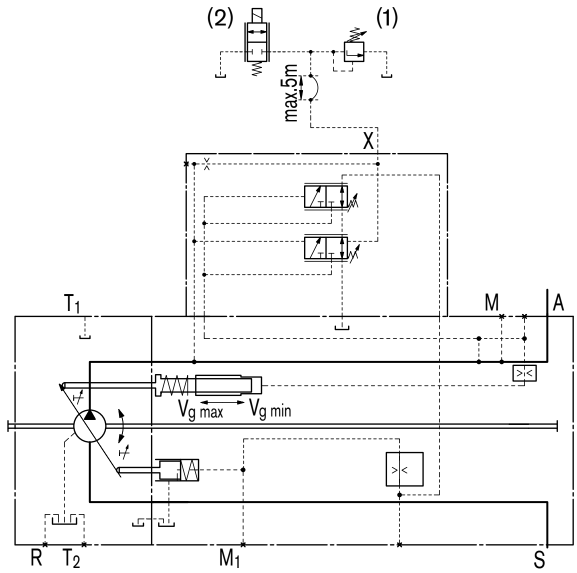
Note: The remote controlled pressure cut-off is also possible in combination with LR, HD and EP.

Circuit diagram DRG

Size 40 ... 145



Size 190 ... 260



DR – Pressure Control

DRL Pressure control for parallel operation

The pressure control DRL is suitable for pressure control of several axial piston pumps A11VO in parallel operation pumping into a common pressure header.

The parallel pressure control has a pressure rise characteristic of approx. 15 bar from $q_{v\,max}$ to $q_{v\,min}$. The pump regulates therefore to a pressure dependent swive angle. This results in stable control behavior, without the need of "staging" the individual pump compensators.

With the externally installed pressure relief valve (1) the nominal pressure setting of all pumps connected to the system is adjusted to the same value.

Setting range from 50 to 350 bar.

Each pump can be individually unloaded from the system by a separately installed 3/2-way directional valve (2).

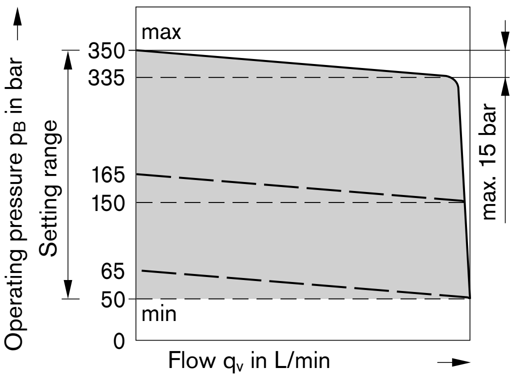
The check valves (3) in the service line (port A) or control line (port X) must be provided generally.

The external valves are not included in the pump supply.

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

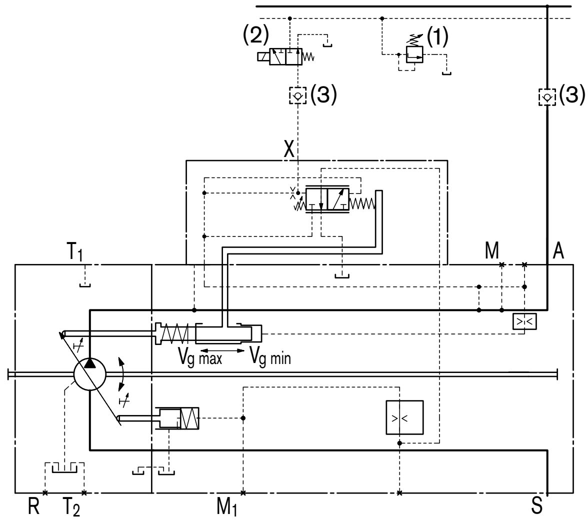
DBDH 6 (manual control), see RE 25402

Characteristic DRL

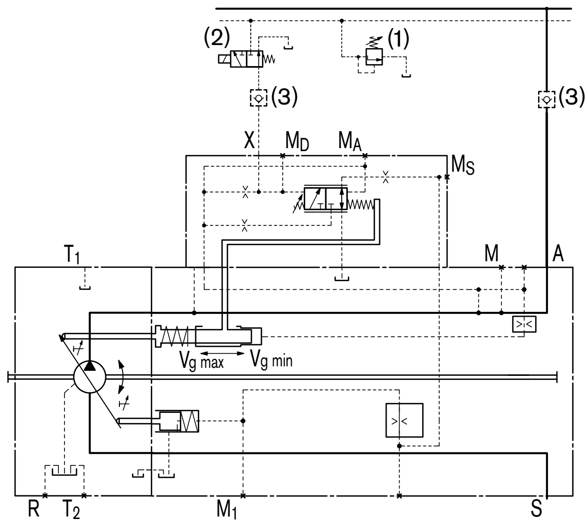


Circuit diagram DRL

Size 40 ... 145



Size 190 ... 260



HD – Hydraulic Control, Pilot-Pressure Related

With the pilot-pressure related control the pump displacement is adjusted in proportion to the pilot pressure applied to port Y. Maximum permissible pilot pressure $p_{St\,max} = 40$ bar

Control from $V_{g\,min}$ to $V_{g\,max}$.

With increasing pilot pressure the pump swivels to a higher displacement.

Start of control (at $V_{g\,min}$), can be set ________ from 4–10 bar

State start of control in clear text in the order.

Starting position without control signal (pilot pressure):

- at operating pressure and external control pressure < 30 bar: $V_{g\,max}$
- at operating pressure or external control pressure > 30 bar: $V_{g\,min}$

A control pressure of 30 bar is required to swivel the pump from its starting position $V_{g\,max}$ to $V_{g\,min}$.

The required control pressure is taken either from the load pressure, or from the externally applied control pressure at the G port.

To ensure the control even at low operating pressure < 30 bar the port G must be supplied with an external control pressure of approx. 30 bar.

Note:
If no external control pressure is connected at G, the shuttle valve must be removed.

Note

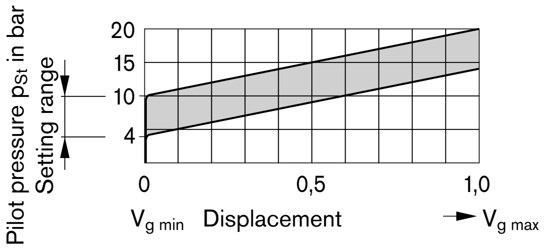
The spring return feature in the controller is not a safety device

The spool valve inside the controller 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).

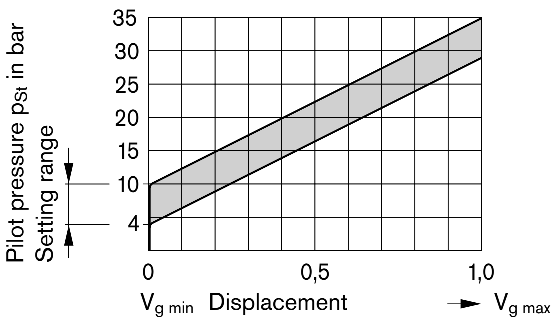
Characteristic HD1

Increase in pilot pressure $V_{g\,min}$ to $V_{g\,max}$ ________ $\Delta p = 10$ bar



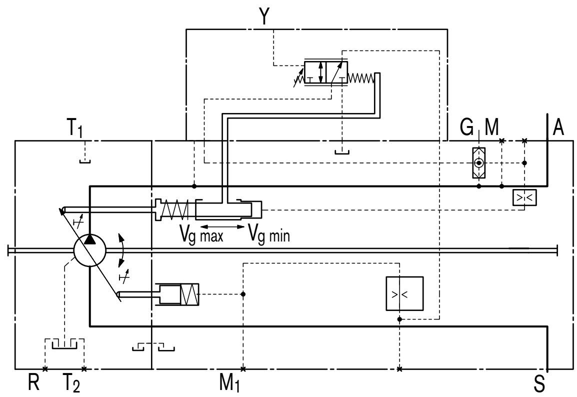
Characteristic HD2

Increase in pilot pressure $V_{g\,min}$ to $V_{g\,max}$ ________ $\Delta p = 25$ bar



Circuit diagram HD

Size 40 ... 260



HD – Hydraulic Control, Pilot-Pressure Related

HD.D Hydraulic control with pressure cut-off

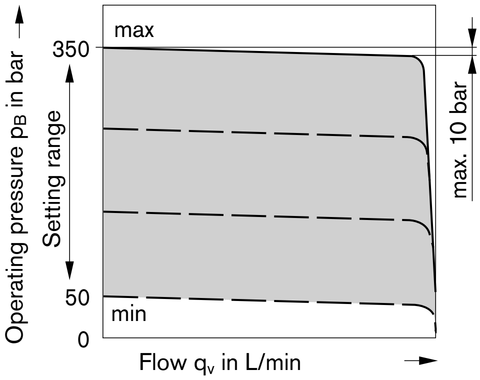
The pressure cut-off corresponds to a pressure control which adjusts the pump displacement back to $V_{g\,min}$ when the pressure setting is reached.

This function overrides the HD control, i.e. the pilot-pressure related displacement control is functional below the pressure setting.

The pressure cut-off function is integrated into the pump control module and is preset to a specified value at the factory.

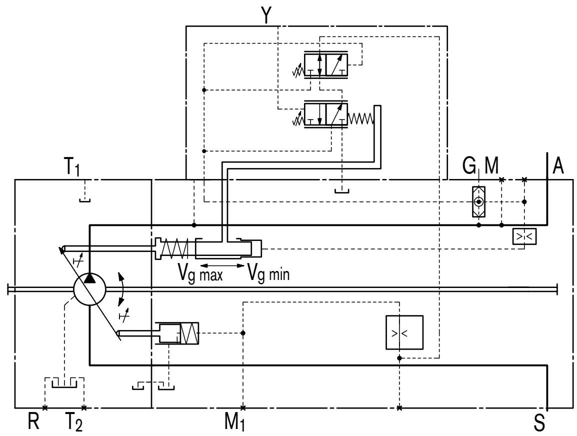
Setting range from 50 to 350 bar.

Pressure cut-off characteristic D

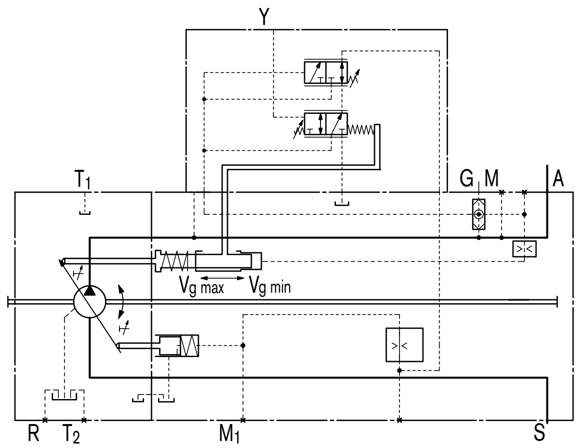


Circuit diagram HD.D

Size 40 ... 145



Size 190 ... 260



EP – Electric Control with Proportional Solenoid

With the electric control with proportional solenoid, the pump displacement is adjusted proportionally to the solenoid current, resulting in a magnetic control force, acting directly onto the control spool that pilots the pump control piston.

Control from $V_{g\ min}$ to $V_{g\ max}$

With increasing control current the pump swivels to a higher displacement.

Starting position wthout control signal (control current):

– at operating pressure and external control pressure < 30 bar: $V_{g\ max}$

– at operating pressure or external control pressure > 30 bar: $V_{g\ min}$

A control pressure of 30 bar is required to swivel the pump from its starting position $V_{g\ max}$ to $V_{g\ min}$.

The required control pressure is taken either from the load pressure, or from the externally applied control pressure at port G.
To ensure the control even at low operating pressure < 30 bar the port G must be supplied with an external control pressure of approx. 30 bar.

Note:
If no external control pressure is connected at G, the shuttle valve must be removed.

Note:
Install pump with EP control in the oil tank only when using mineral hydraulic oils and an oil temperature in the tank of max. 80°C.

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

– BODAS controller RC

Series 20 ______ RD 95200
Series 21 ______ RD 95201
Series 22 ______ RD 95202
Series 30 ______ RD 95203
and application software

– Analog amplifier RA ______ RE 95230

Technical data, solenoid at EP1, EP2

	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at $V_{g\ min}$	400 mA	200 mA
End of control at $V_{g\ max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20°C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection	see connector version, page 60	

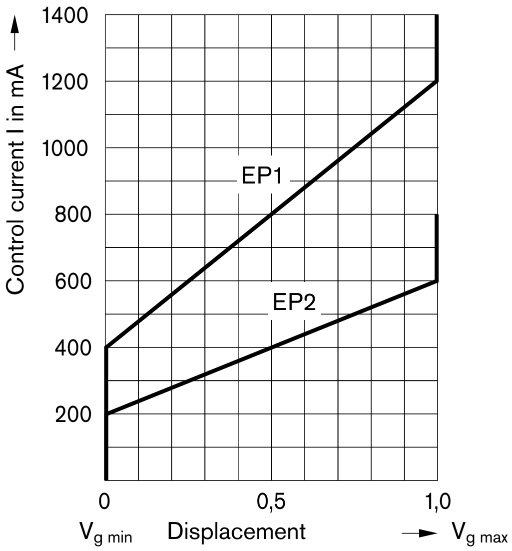
Note

The spring return feature in the controller is not a safety device

The spool valve inside the controller 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.

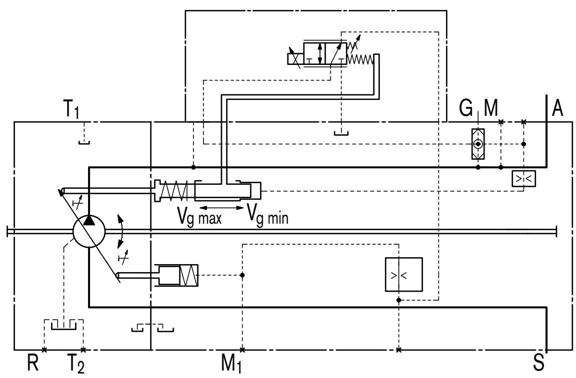
Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).

Characteristic EP1/2



Circuit diagram EP1/2

Size 40 ... 260



EP – Electric Control with Proportional Solenoid

EP.D Electric control with pressure cut-off

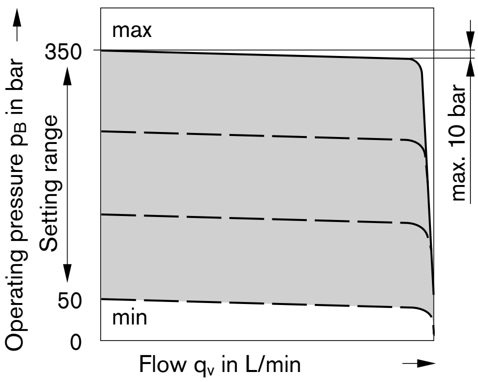
The pressure cut-off corresponds to a pressure control which adjusts the pump displacement back to $V_{g\ min}$ when the pressure setting is reached.

This function overrides the EP control, i.e. the control current related displacement control is functional below the pressure setting.

The valve for the pressure cut-off is integrated in the control case and is set to a fixed specified pressure value at the factory.

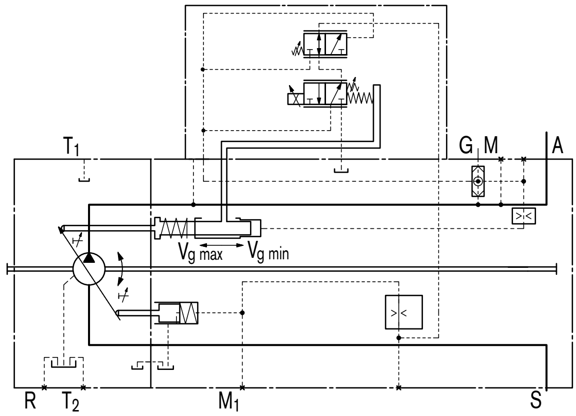
Setting range from 50 to 350 bar

Pressure cut-off characteristic D

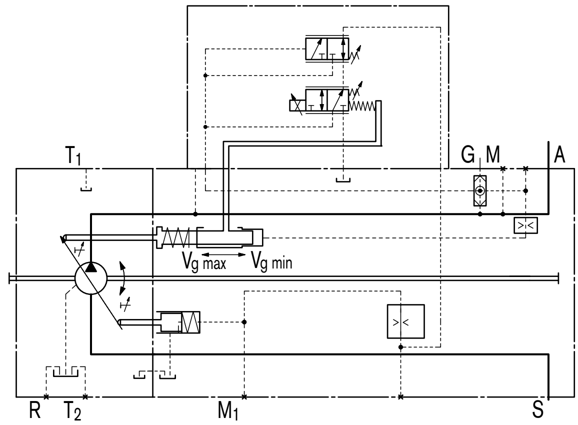


Circuit diagram EP.D

Size 40 ... 145



Size 190 ... 260

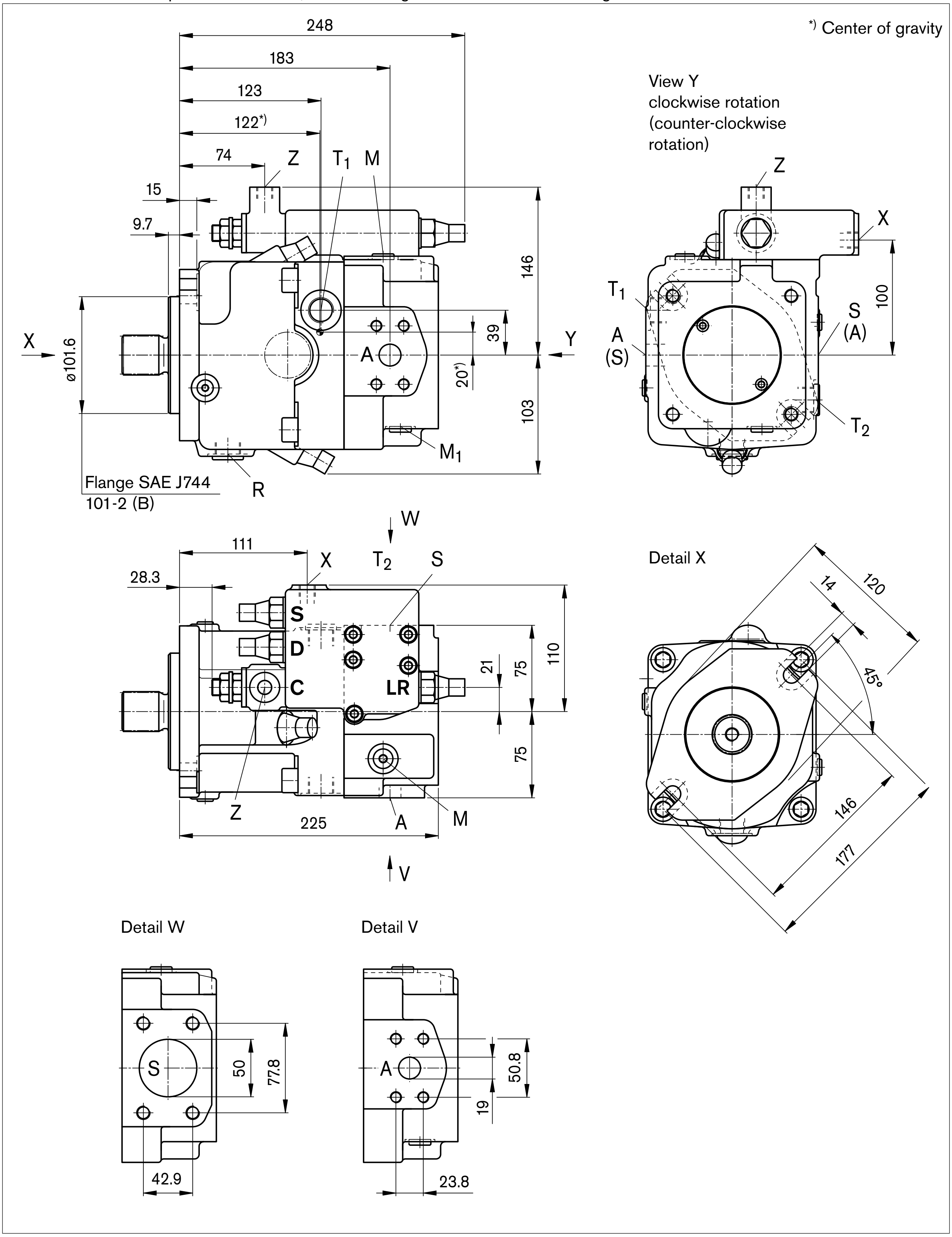


Dimensions, Size 40

Before finalizing your design, please request a certified drawing. Dimensions in mm.

LRDCS

Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

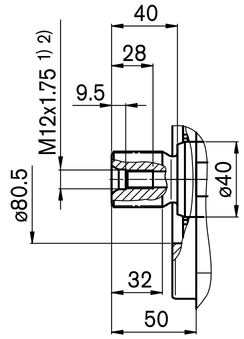


Dimensions, Size 40

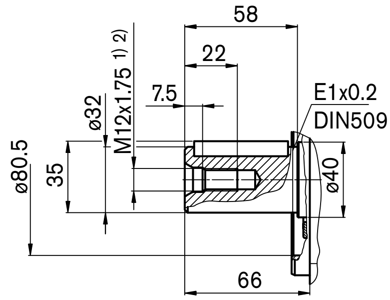
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

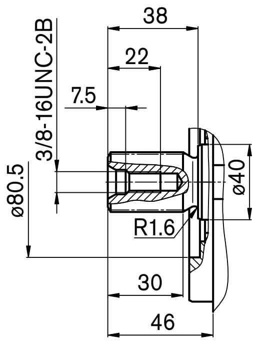
Z Splined shaft DIN 5480
W35x2x30x16x9g



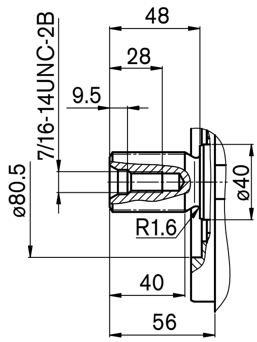
P Parallel keyed shaft DIN 6885,
AS10x8x56



S Splined shaft SAE J744
1 in 15T 16/32 [3]



T Splined shaft SAE J744
1 1/4 in 14T 12/24DP [3]



Ports

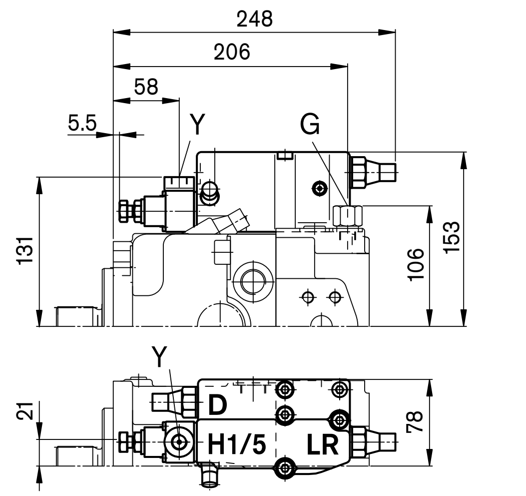
Designation	Function	Standard	Size[2]		Max. pressure (bar) [4]	State
A	Service line port Fixing thread	SAE J518 DIN 13	3/4 in M10x1.5;	 16 deep	400	O
S	Suction port Fixing thread	SAE J518 DIN 13	2 in M12x1.75;	 17 deep	30	O
T_1, T_2	Tank port	DIN 3852	M22x1.5;	14 deep	10	[5]
R	Air bleed	DIN 3852	M22x1.5;	14 deep	10	X
M_1	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For max. tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T1 or T2 must be connected (see also page 61)
O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

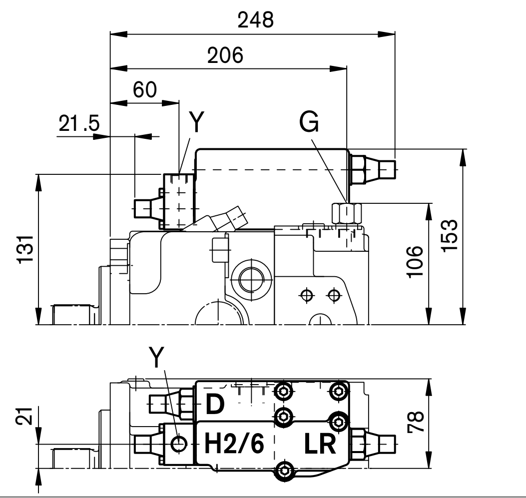
Dimensions, Size 40

Before finalizing your design, please request a certified drawing. Dimensions in mm.

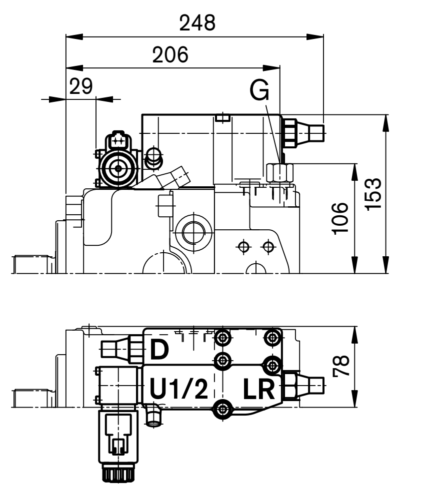
LRDH1/LRDH5
Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



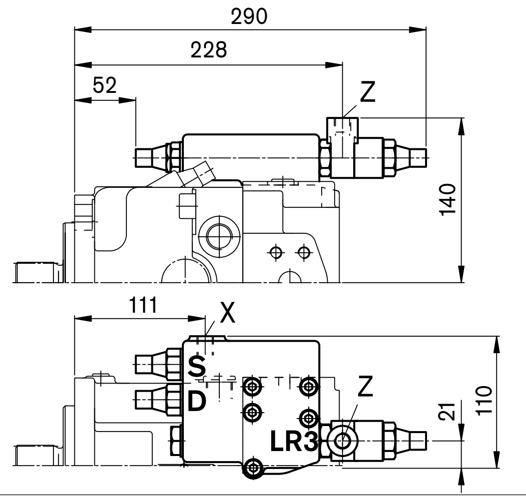
LRDH2/LRDH6
Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



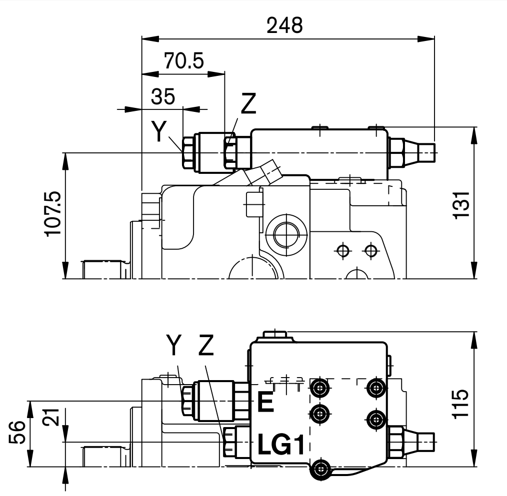
LRDU1/LRDU2
Power control with pressure cut-off and electric stroke limiter (positive characteristic)



LR3DS
Power control with high-pressure related override, pressure cut-off and load sensing control



LG1E
Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off



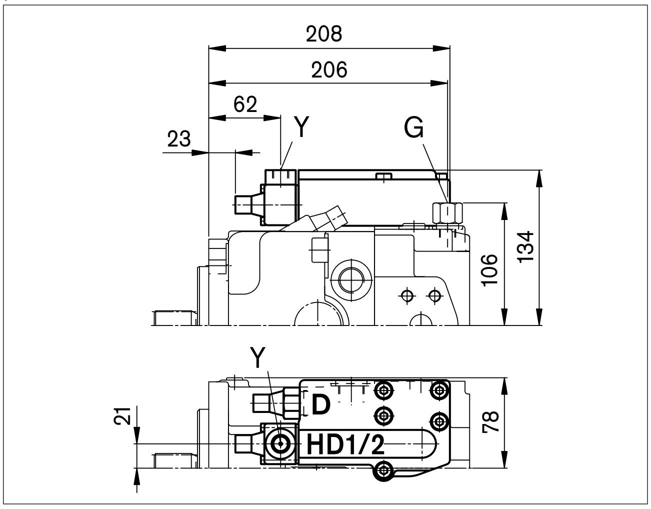
LG2E
Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off

Dimensions, Size 40

Before finalizing your design, please request a certified drawing. Dimensions in mm.

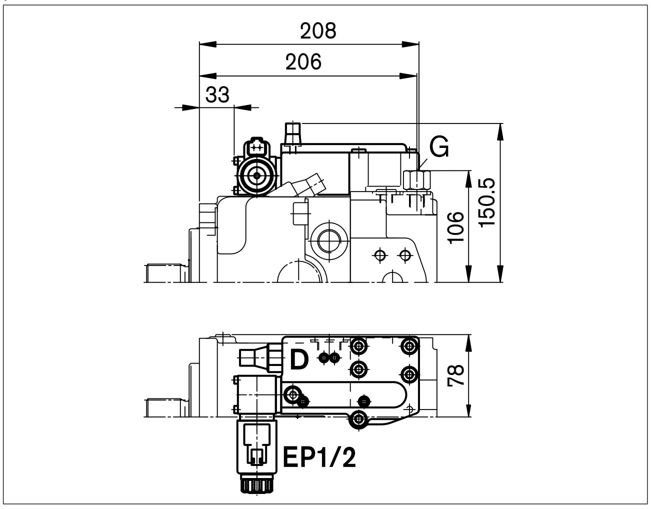
HD1D/HD2D

Hydraulic control, pilot-pressure related with pressure cut-off



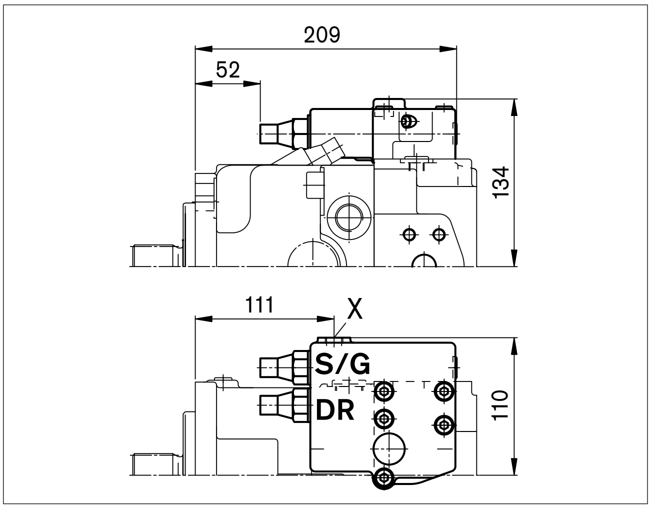
EP1D/EP2D

Electric control with proportional solenoid and pressure cut-off



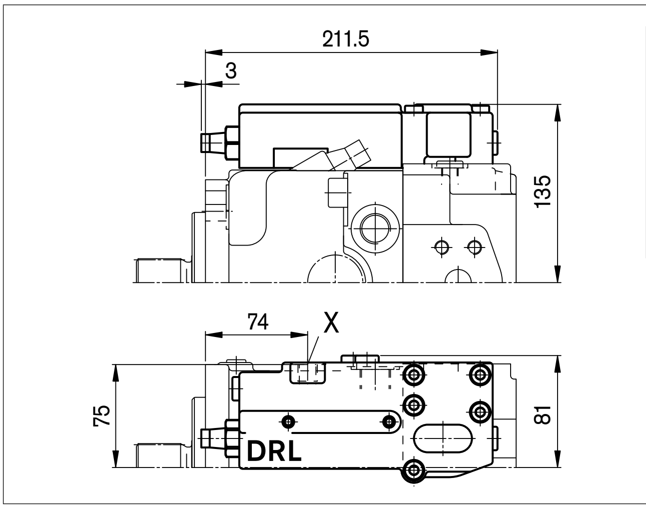
DRS/DRG

Pressure control with load sensing control
Pressure control remote controlled



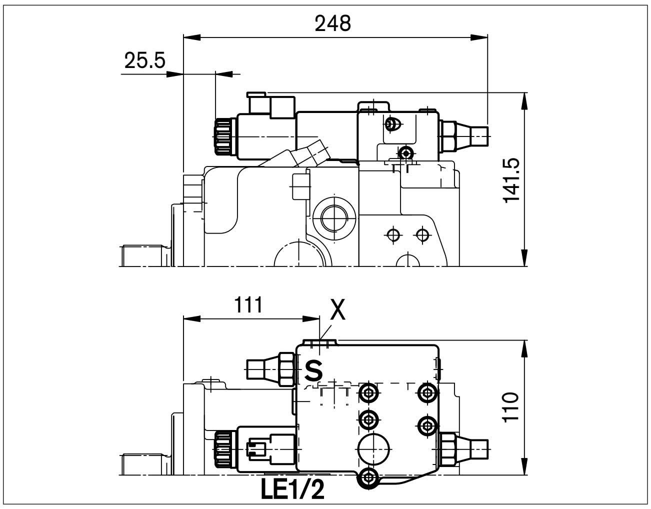
DRL

Pressure control for parallel operation



LE1S/LE2S

Power control with electric override (negative) and load sensing control



LE2S2/LE1S5/LE2S5

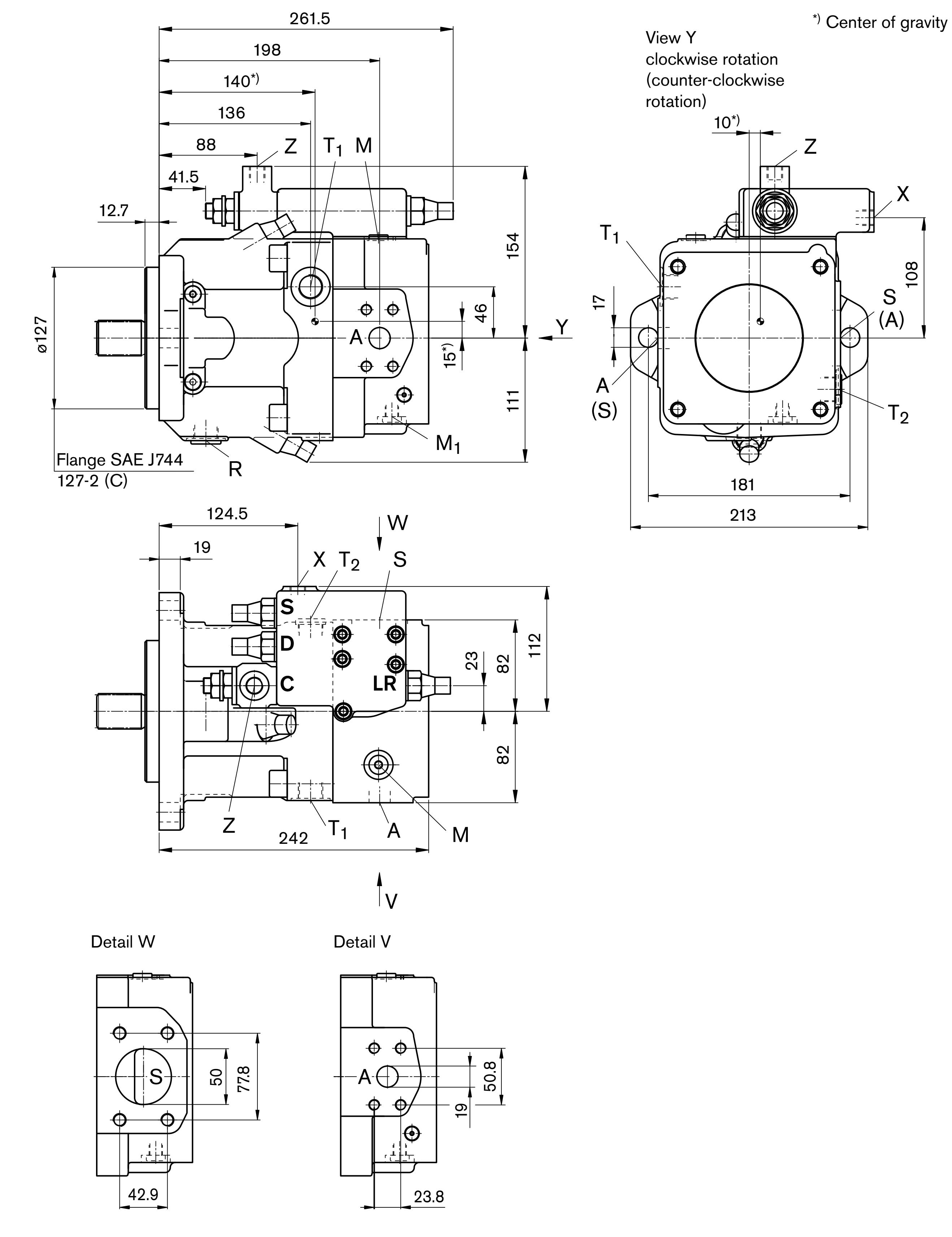
Power control with electric override (negative) and load sensing control, override

Dimensions, Size 60

Before finalizing your design, please request a certified drawing. Dimensions in mm.

LRDCS

Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

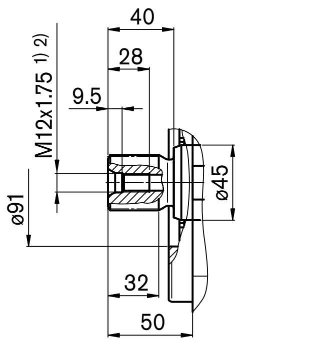


Dimensions, Size 60

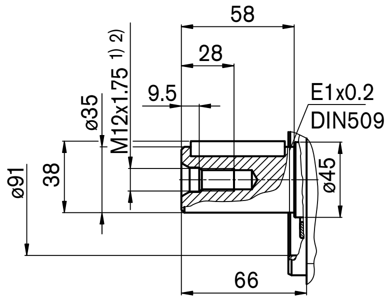
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

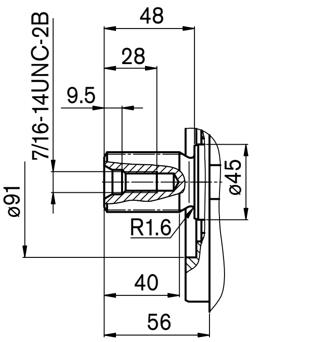
Z Splined shaft DIN 5480
W35x2x30x16x9g



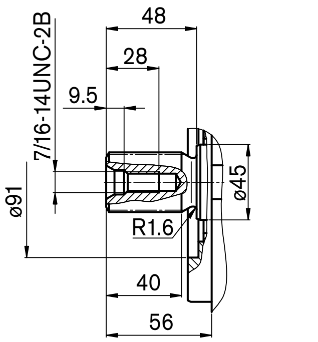
P Parallel keyed shaft DIN 6885,
AS10x8x56



S Splined shaft SAE J744
1 1/4 in 14T 12/24DP [3]



T Splined shaft SAE J744
1 3/8 in 21T 16/32DP [3]



Ports

Designation	Function	Standard	Size[2]		Max. pressure (bar) [4]	State
A	Service line port Fixing thread	SAE J518 DIN 13	3/4 in M10x1.5;	 17 deep	400	O
S	Suction port Fixing thread	SAE J518 DIN 13	2 in M12x1.75;	 20 deep	30	O
T_1, T_2	Tank port	DIN 3852	M22x1.5;	14 deep	10	[5]
R	Air bleed	DIN 3852	M22x1.5;	14 deep	10	X
M_1	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

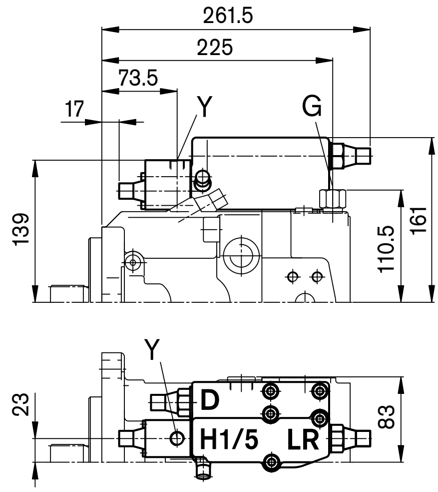
1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For max. tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T1 or T2 must be connected (see also page 61)
O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

Dimensions, Size 60

Before finalizing your design, please request a certified drawing. Dimensions in mm.

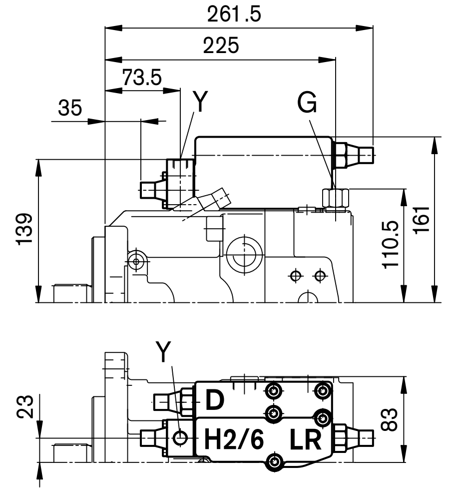
LRDH1/LRDH5

Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



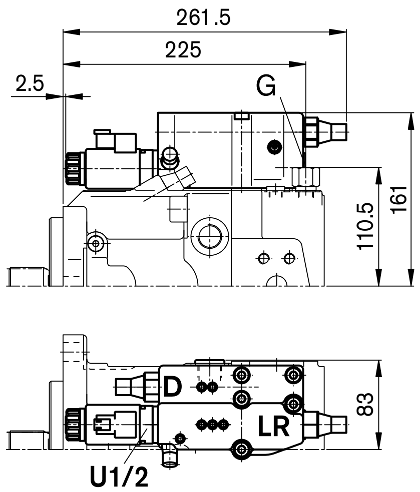
LRDH2/LRDH6

Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



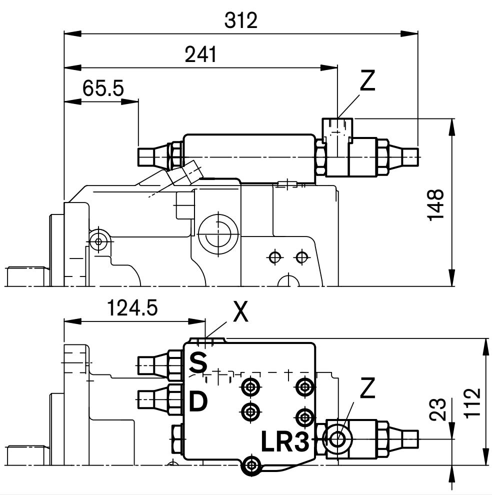
LRDU1/LRDU2

Power control with pressure cut-off and electric stroke limiter (positive characteristic)



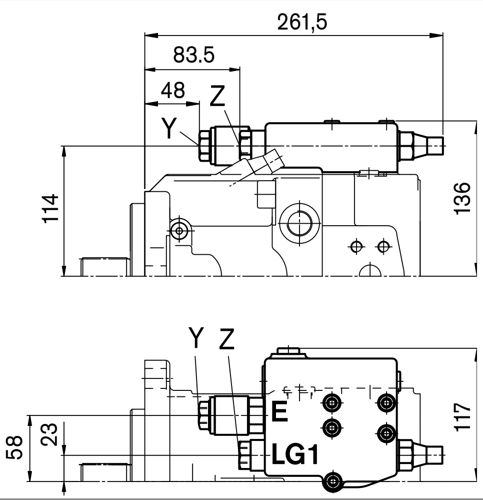
LR3DS

Power control with high-pressure related override, pressure cut-off and load sensing control



LG1E

Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off



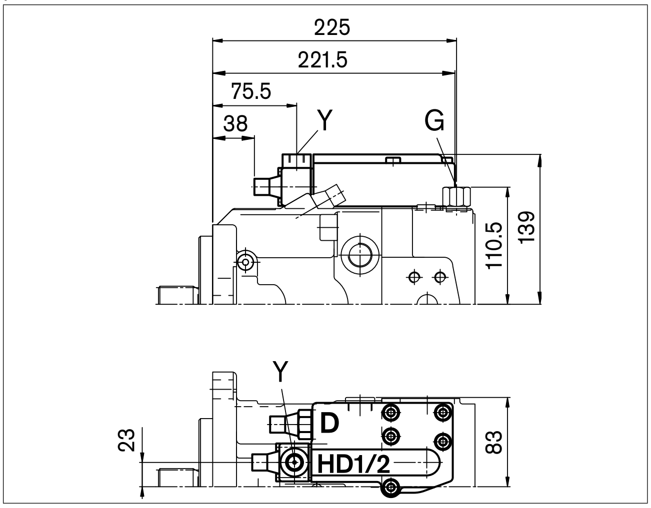
LG2E

Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off

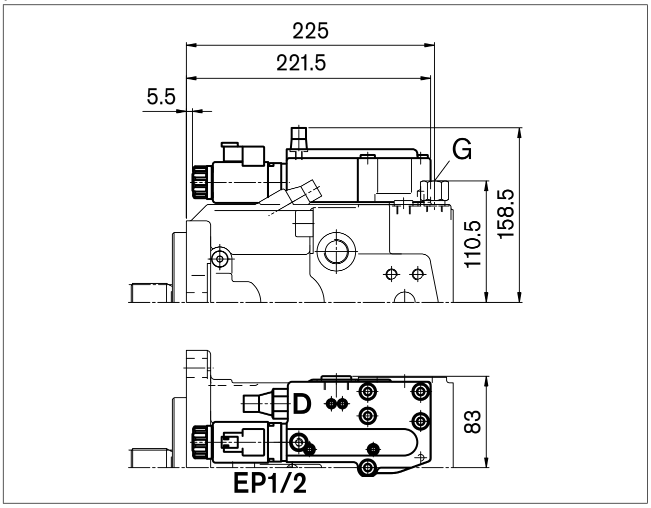
Dimensions, Size 60

Before finalizing your design, please request a certified drawing. Dimensions in mm.

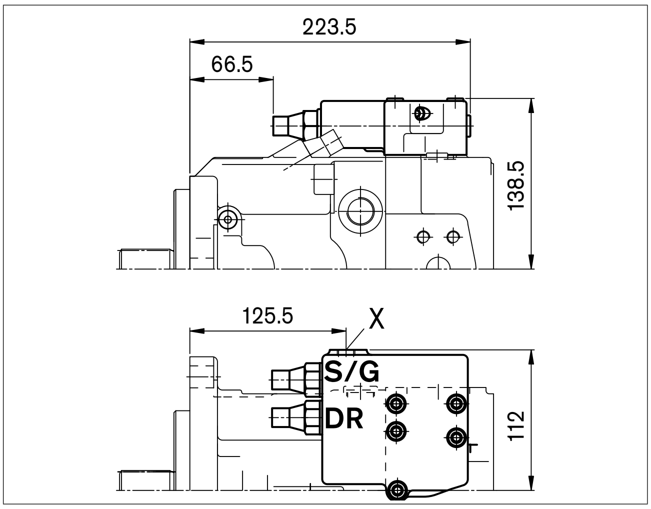
HD1D/HD2D
Hydraulic control, pilot-pressure related with pressure cut-off



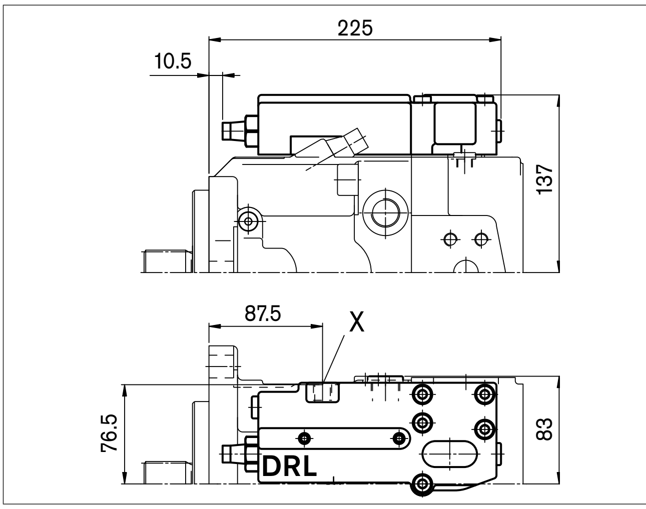
EP1D/EP2D
Electric control with proportional solenoid and pressure cut-off



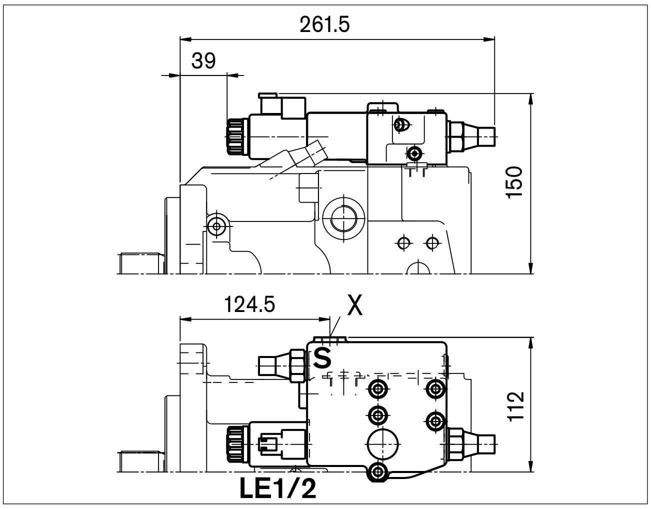
DRS/DRG
Pressure control with load sensing control
Pressure control remote controlled



DRL
Pressure control for parallel operation



LE1S/LE2S
Power control with electric override (negative) and load sensing control



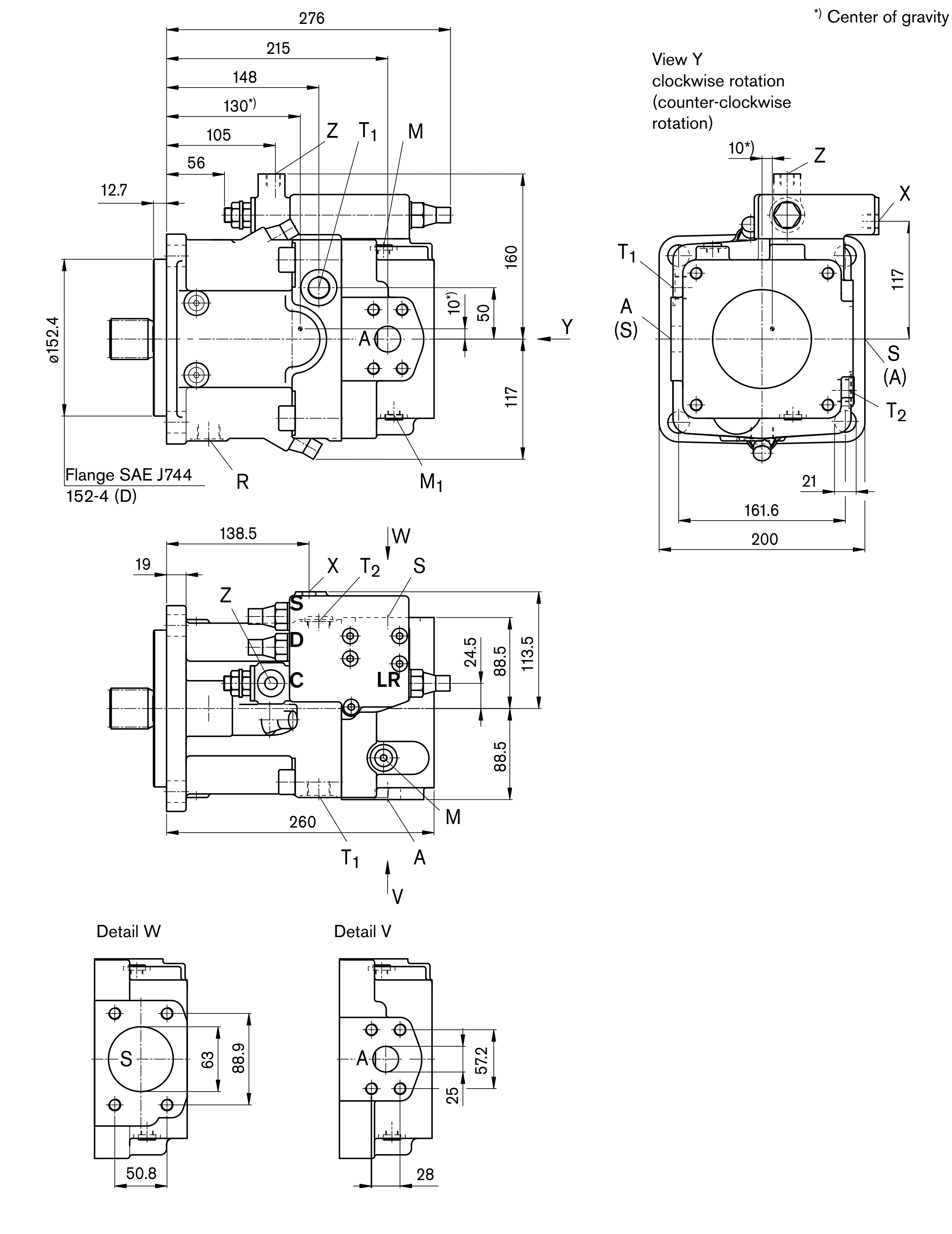
LE2S2/LE1S5/LE2S5
Power control with electric override (negative) and load sensing control, override

Dimensions, Size 75

Before finalizing your design, please request a certified drawing. Dimensions in mm.

LRDCS

Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

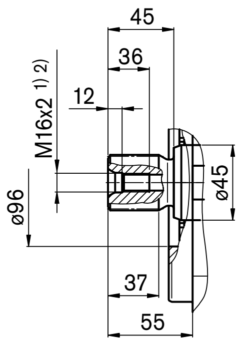


Dimensions, Size 75

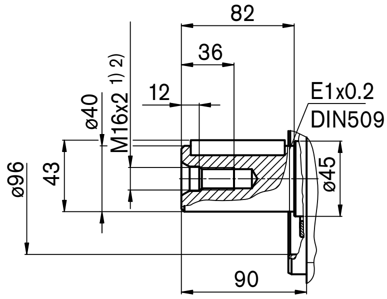
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

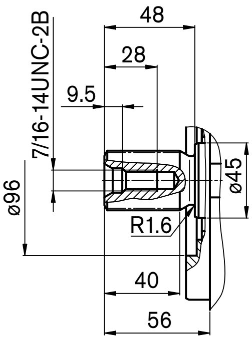
Z Splined shaft DIN 5480
W40x2x30x18x9g



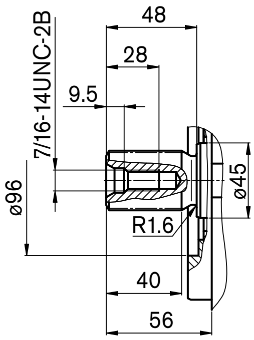
P Parallel keyed shaft DIN 6885
AS12x8x80



S Splined shaft SAE J744
1 1/4 in 14T 12/24DP [3]



T Splined shaft SAE J744
1 3/8 in 21T 16/32DP [3]



Ports

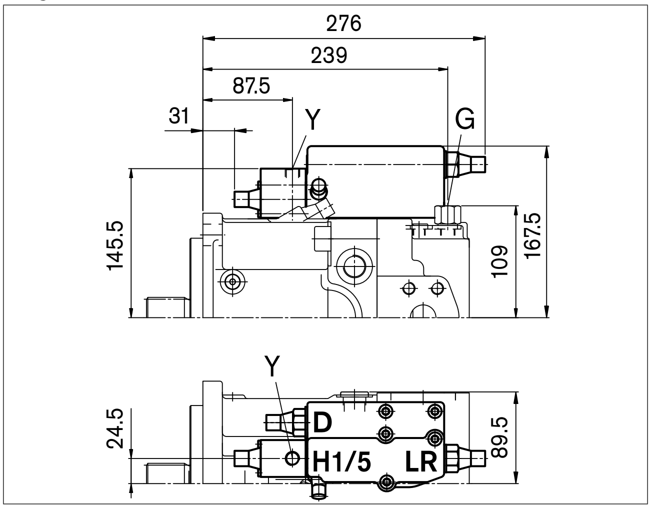
Designation	Function	Standard	Size[2]		Max. pressure (bar) [4]	State
A	Service line port Fixing thread	SAE J518 DIN 13	1 in M12x1.75;	 17 deep	400	O
S	Suction port Fixing thread	SAE J518 DIN 13	2 1/2in M12x1.75;	 17 deep	30	O
T_1, T_2	Tank port	DIN 3852	M22x1.5;	14 deep	10	[5]
R	Air bleed	DIN 3852	M22x1.5;	14 deep	10	X
M_1	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

[1] Center bore according to DIN 332 (thread acc. to DIN 13)
[2] For max. tightening torque, please refer to general notes on page 64
[3] ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
[4] Depending on adjustment data and operating pressure
[5] Depending on installation position, T1 or T2 must be connected (see also page 61)
O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

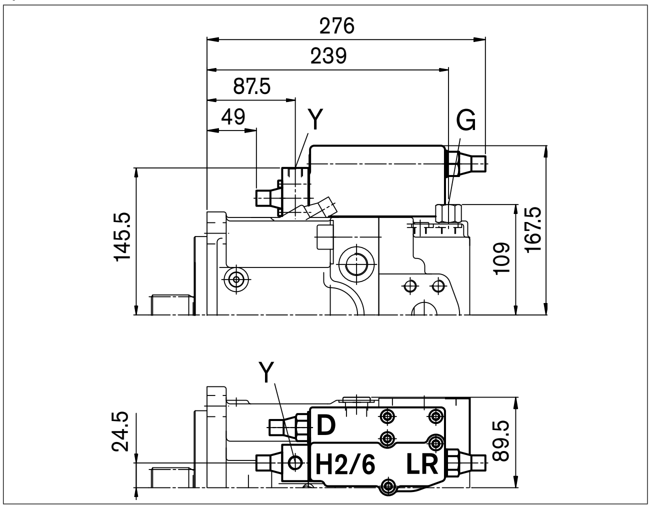
Dimensions, Size 75

Before finalizing your design, please request a certified drawing. Dimensions in mm.

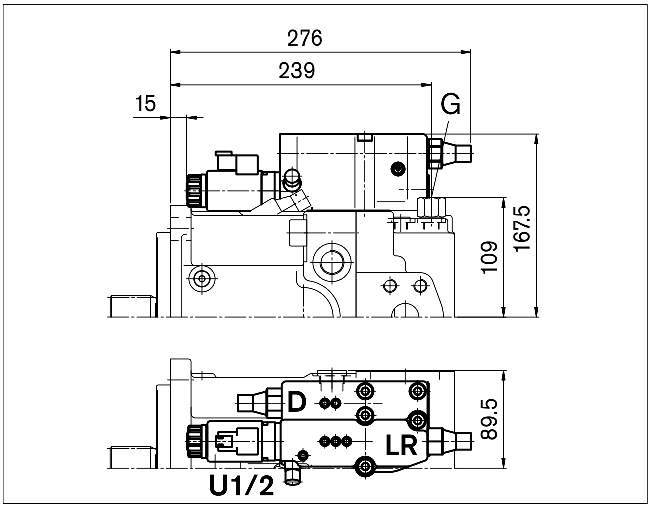
LRDH1/LRDH5
Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



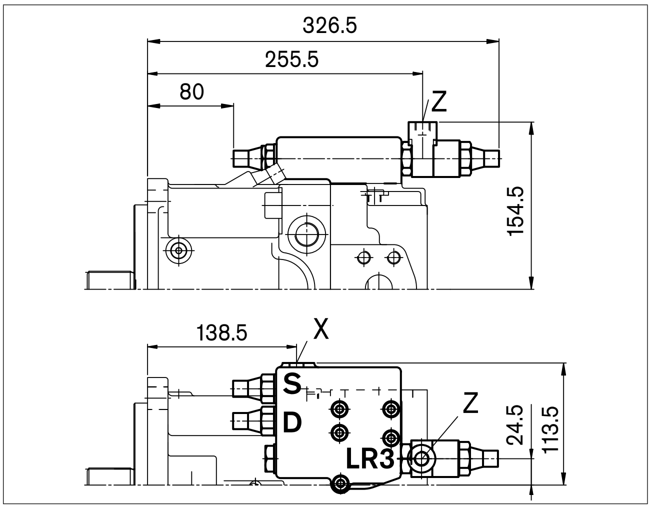
LRDH2/LRDH6
Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



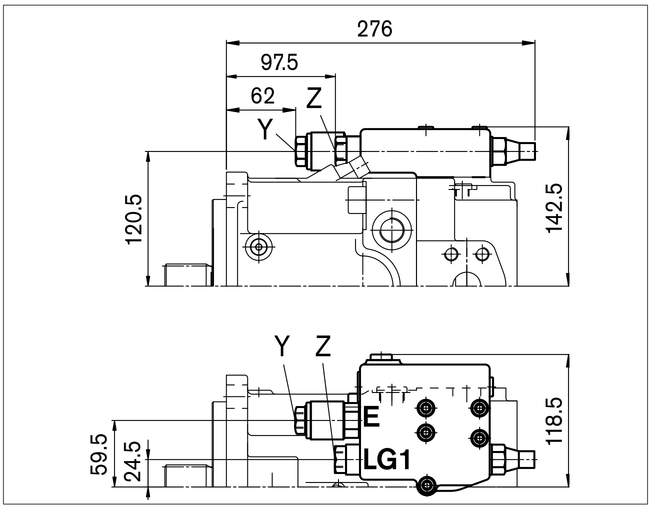
LRDU1/LRDU2
Power control with pressure cut-off and electric stroke limiter (positive characteristic)



LR3DS
Power control with high-pressure related override, pressure cut-off and load sensing control



LG1E
Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off

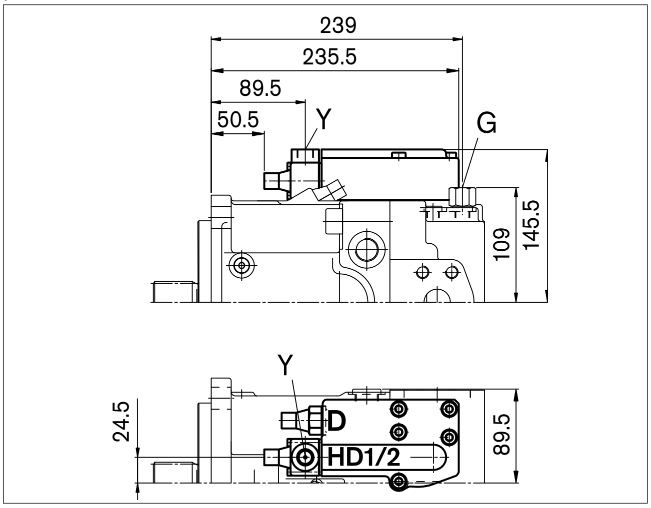


LG2E
Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off

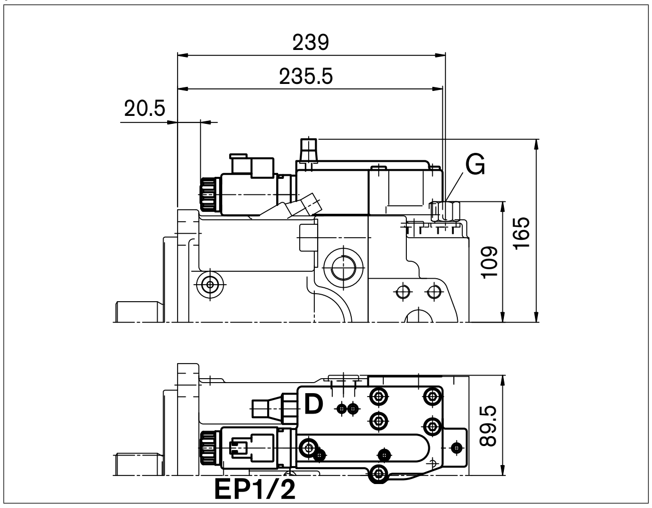
Dimensions, Size 75

Before finalizing your design, please request a certified drawing. Dimensions in mm.

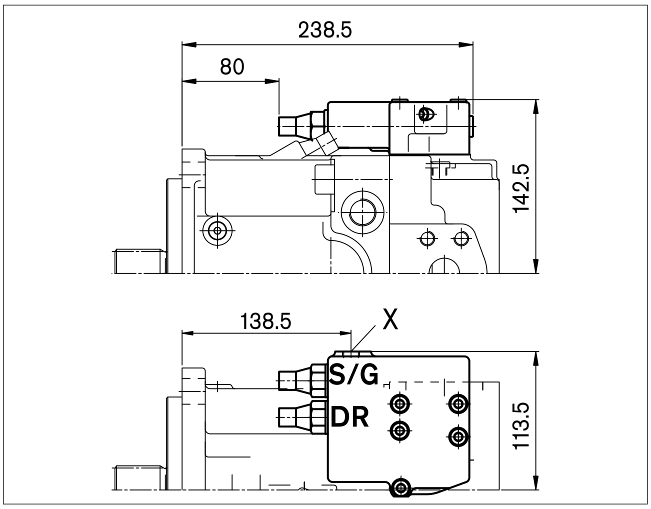
HD1D/HD2D
Hydraulic control, pilot-pressure related with pressure cut-off



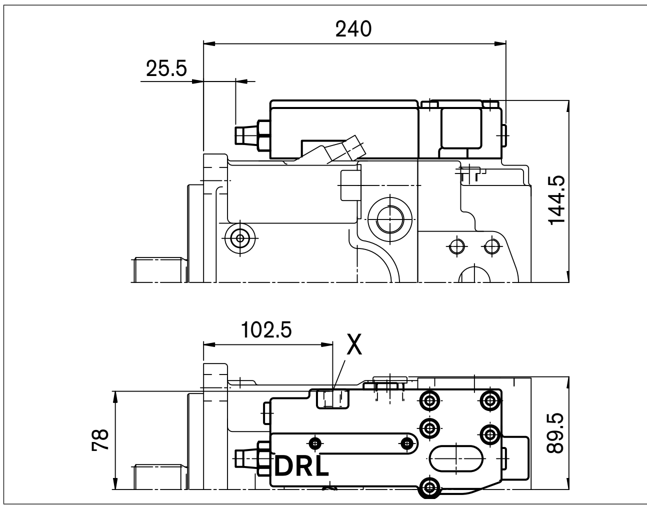
EP1D/EP2D
Electric control with proportional solenoid and pressure cut-off



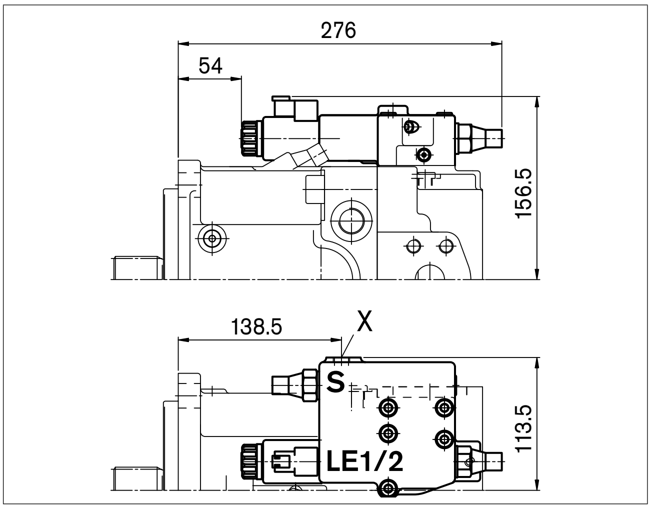
DRS/DRG
Pressure control with load sensing control
Pressure control remote controlled



DRL
Pressure control for parallel operation



LE1S/LE2S
Power control with electric override (negative) and load sensing control



LE2S2/LE1S5/LE2S5
Power control with electric override (negative) and load sensing control, override

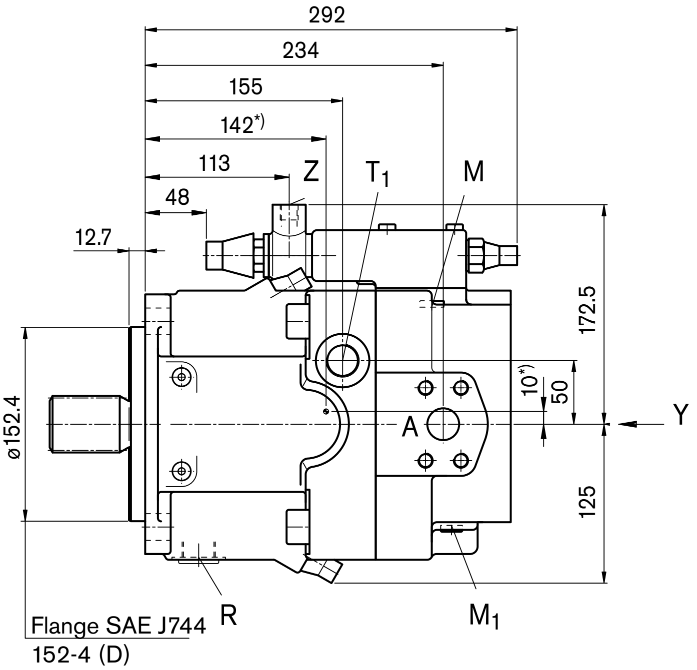
Dimensions, Size 95

Before finalizing your design, please request a certified drawing. Dimensions in mm.

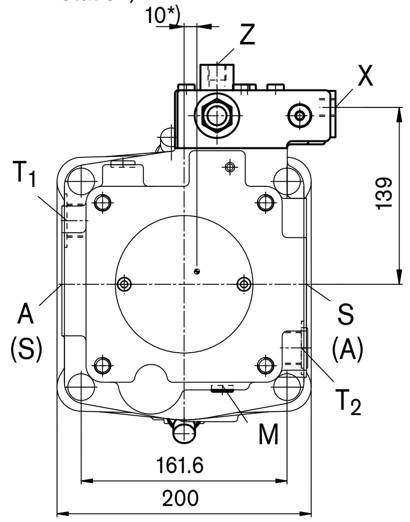
LRDCS

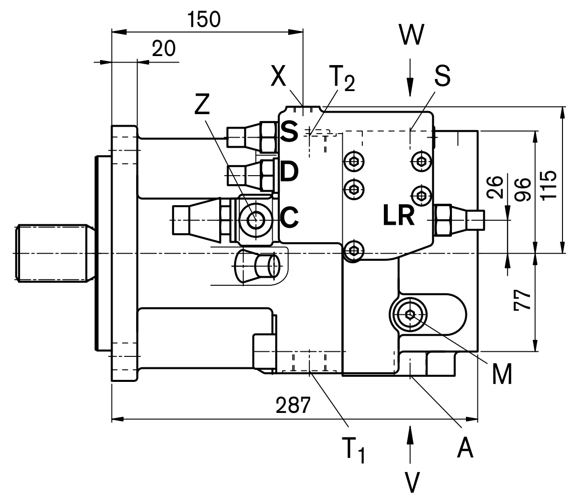
Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

*) Center of gravity

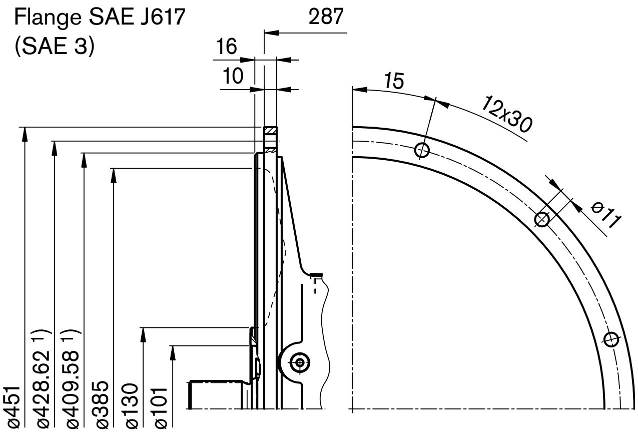


View Y
clockwise rotation
(counter-clockwise
rotation)

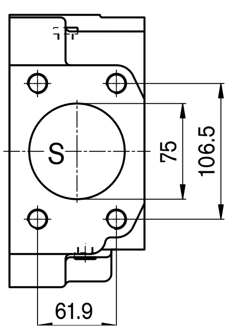




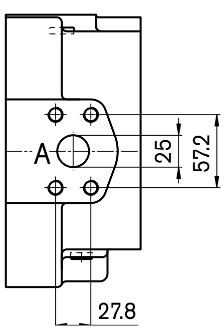
Flange SAE J617
(SAE 3)



Detail W



Detail V



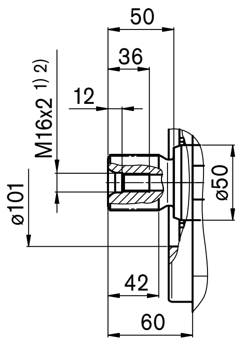
1) Dimensions according to SAE J617-No. 3, for connection to the flywheel case of the combustion engine

Dimensions, Size 95

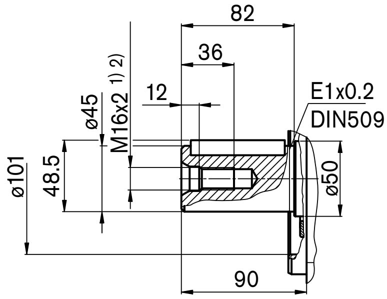
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

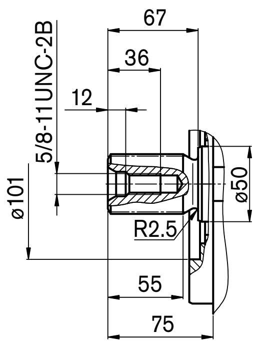
Z Splined shaft DIN 5480
W45x2x30x21x9g



P Parallel keyed shaft DIN 6885 –
AS14x9x80



S Splined shaft SAE J744
1 3/4 in 13T 8/16DP [3)]



Ports

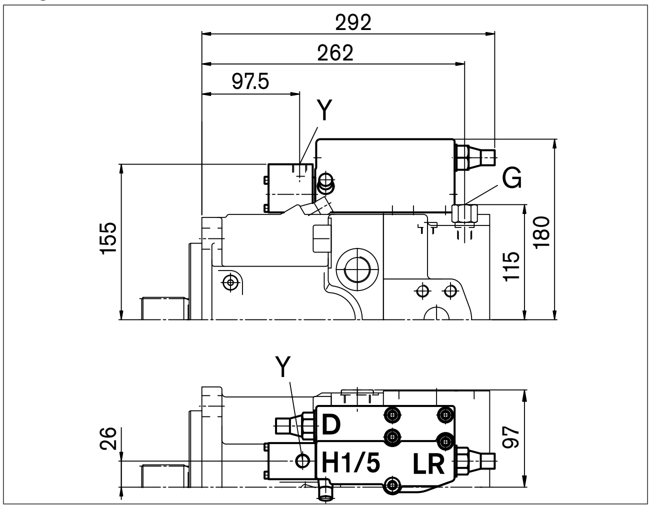
Designation	Function	Standard	Size[2)]		Max. pressure (bar) [4)]	State
A	Service line port Fixing thread	SAE J518 DIN 13	1 in M12x1.75;	 17 deep	400	O
S	Suction port Fixing thread	SAE J518 DIN 13	3 in M16x2;	 24 deep	30	O
T_1, T_2	Tank port	DIN 3852	M26x1.5;	16 deep	10	[5)]
R	Air bleed	DIN 3852	M26x1.5;	16 deep	10	X
M_1	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For max. tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T1 or T2 must be connected (see also page 61)
O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

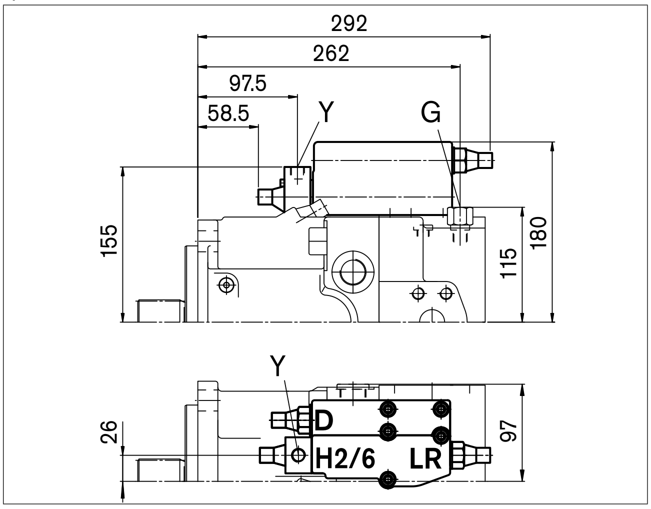
Dimensions, Size 95

Before finalizing your design, please request a certified drawing. Dimensions in mm.

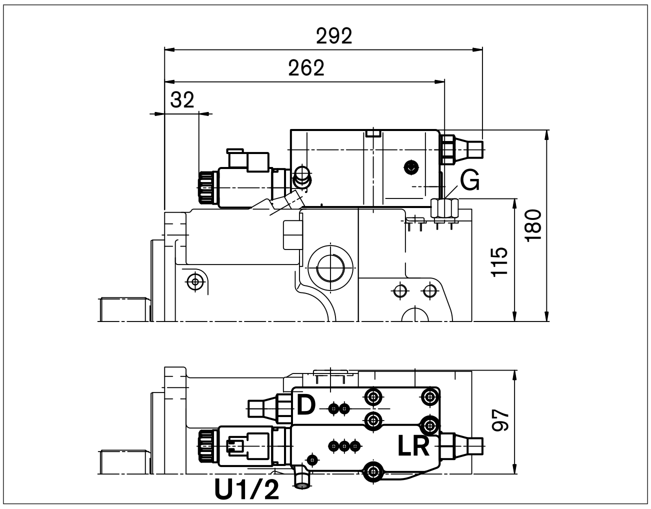
LRDH1/LRDH5
Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



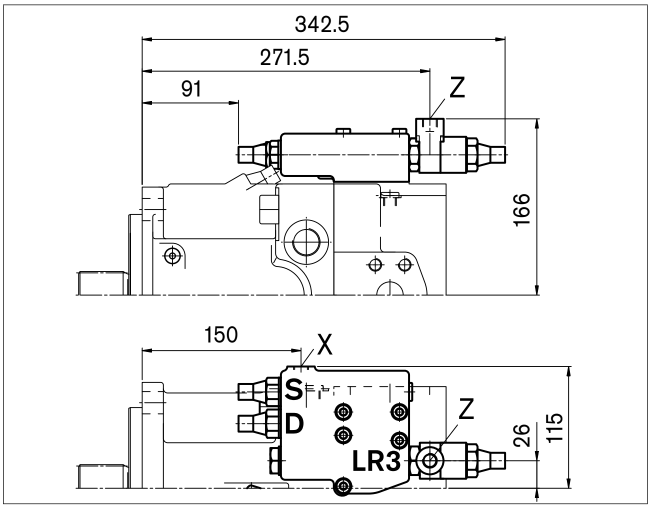
LRDH2/LRDH6
Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



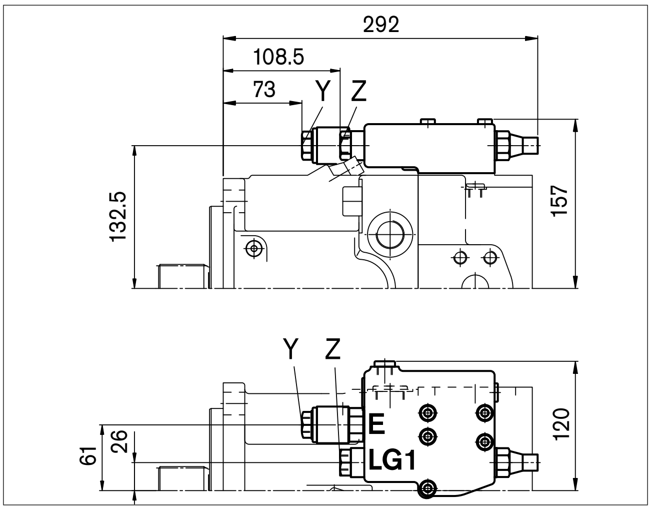
LRDU1/LRDU2
Power control with pressure cut-off and electric stroke limiter (positive characteristic)



LR3DS
Power control with high-pressure related override, pressure cut-off and load sensing control



LG1E
Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off



LG2E
Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off

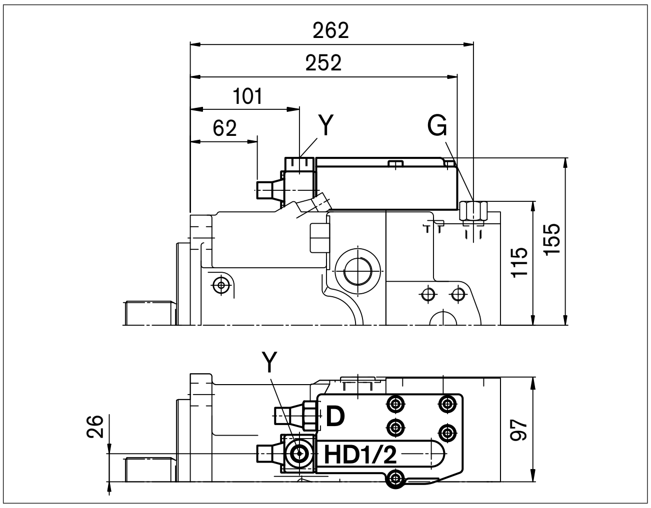
42/64

Dimensions, Size 95

Before finalizing your design, please request a certified drawing. Dimensions in mm.

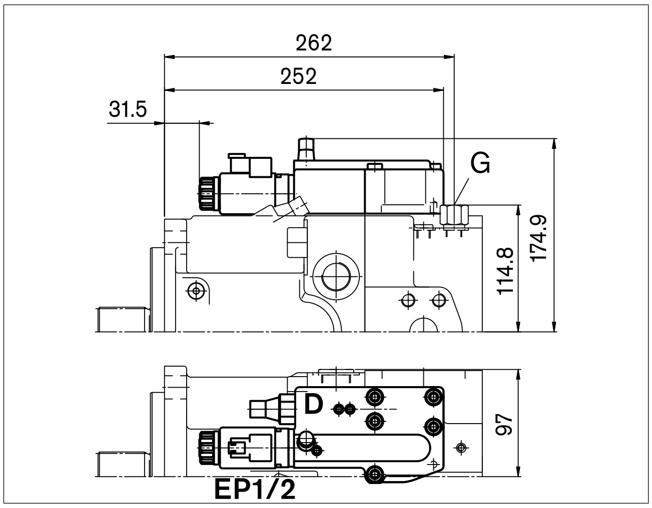
HD1D/HD2D

Hydraulic control, pilot-pressure related with pressure cut-off



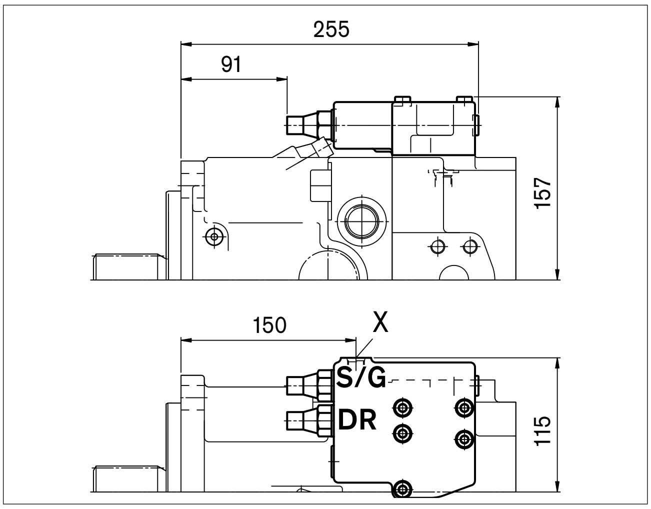
EP1D/EP2D

Electric control with proportional solenoid and pressure cut-off



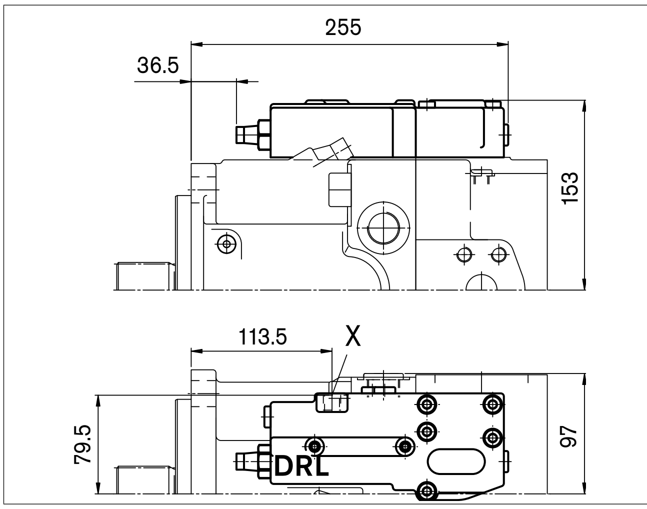
DRS/DRG

Pressure control with load sensing control
Pressure control remote controlled



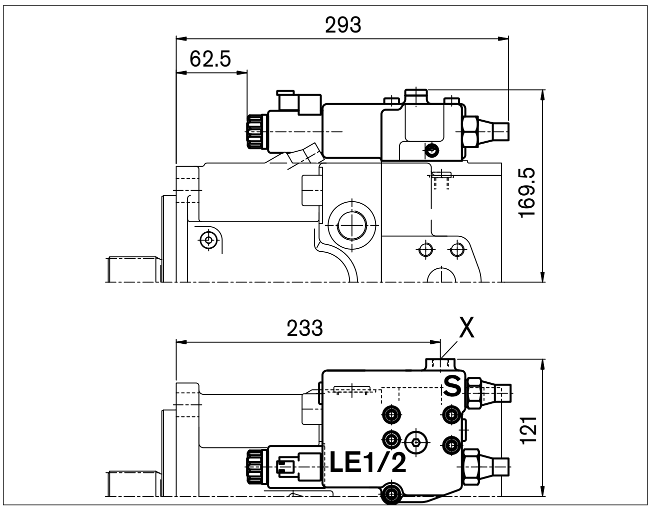
DRL

Pressure control for parallel operation



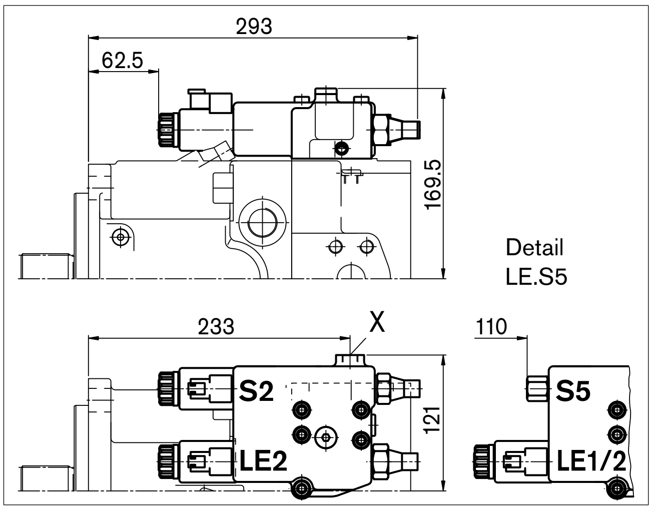
LE1S/LE2S

Power control with electric override (negative) and load sensing control



LE2S2/LE1S5/LE2S5

Power control with electric override (negative) and load sensing control, override

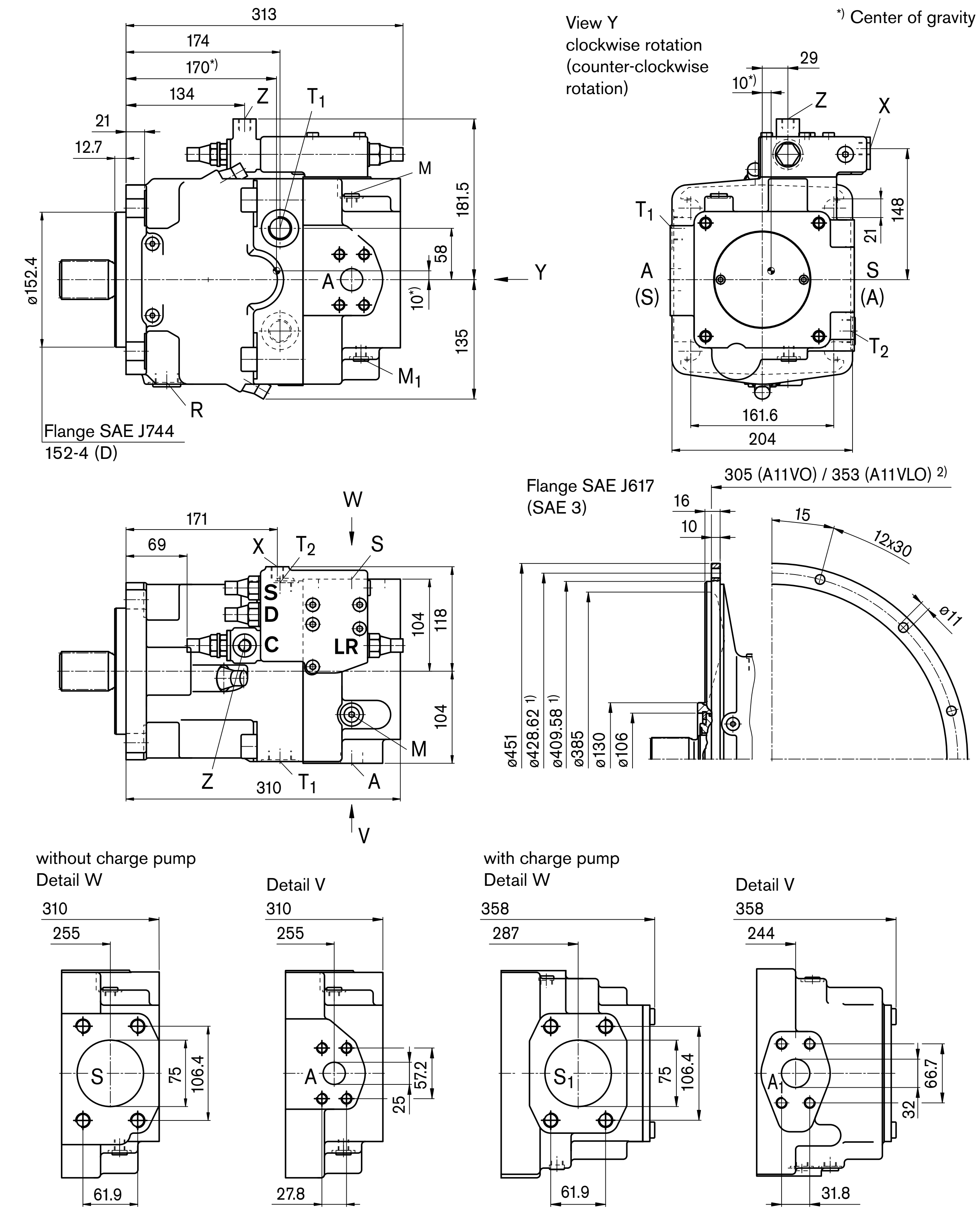


Dimensions, Size 130/145

Before finalizing your design, please request a certified drawing. Dimensions in mm.

LRDCS

Power control LR with pressure cut-off D, cross sensing control C and load sensing control S



1) Dimensions according to SAE J617-No. 3, for connection to the flywheel case of the combustion engine

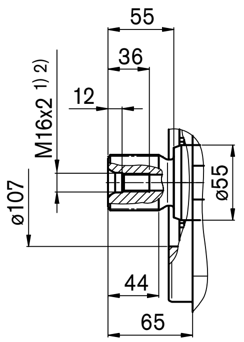
2) The case or length dimension with flange SAE 3 is 5 mm shorter than the standard case.

Dimensions, Size 130/145

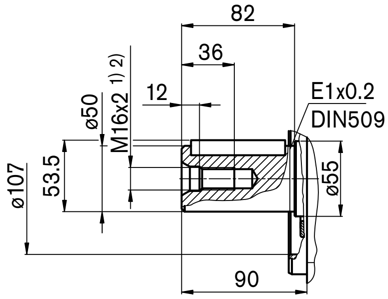
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

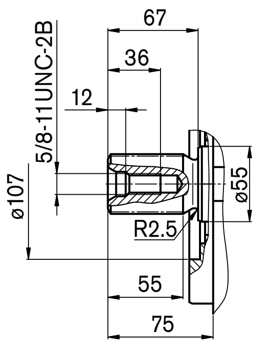
Z Splined shaft DIN 5480
W50x2x30x24x9g



P Parallel keyed shaft DIN 6885,
AS14x9x80



S Splined shaft SAE J744
1 3/4 in 13T 8/16DP [3]



Ports

Designation	Function	Standard	Size[2]		Max. pressure (bar) [4]	State
A	Service line port Fixing thread	SAE J518 DIN 13	1 in M12x1.75;	 17 deep	400	O
A_1	Service line port Fixing thread	SAE J518 DIN 13	1 1/4 in M14x2;	 19 deep	400	O
S, S_1	Suction port Fixing thread	SAE J518 DIN 13	3 in M16x2;	 24 deep	30 2[6]	O
T_1, T_2	Tank port	DIN 3852	M26x1.5;	16 deep	10	[5]
R	Air bleed	DIN 3852	M26x1.5;	16 deep	10	X
M_1	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

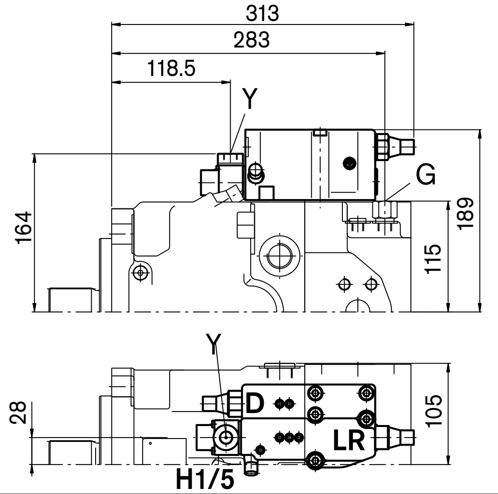
1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For max. tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T1 or T2 must be connected (see also page 61)
6) with charge pump
O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

Dimensions, Size 130/145

Before finalizing your design, please request a certified drawing. Dimensions in mm.

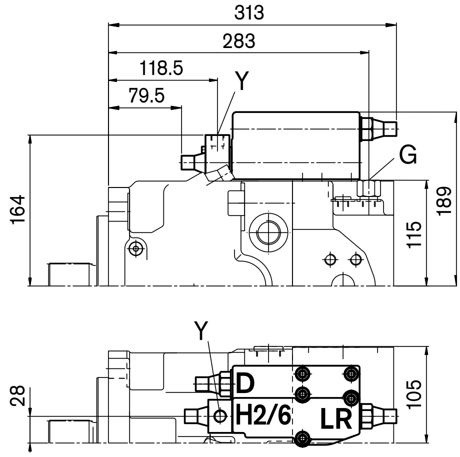
LRDH1/LRDH5

Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



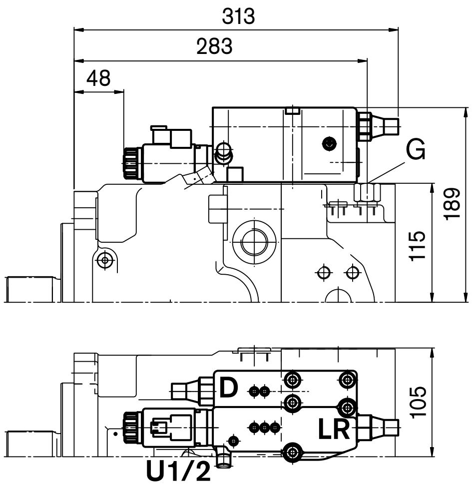
LRDH2/LRDH6

Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



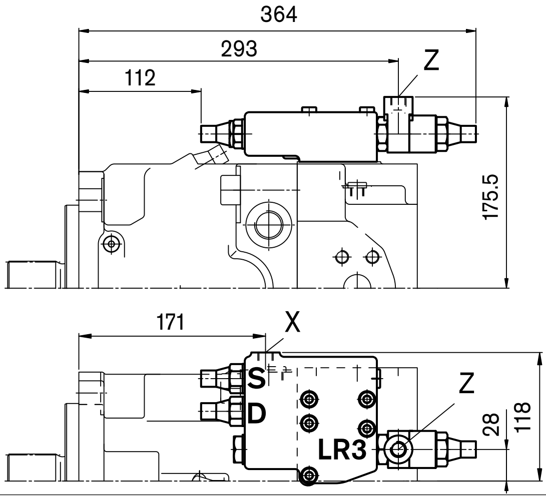
LRDU1/LRDU2

Power control with pressure cut-off and electric stroke limiter (positive characteristic)



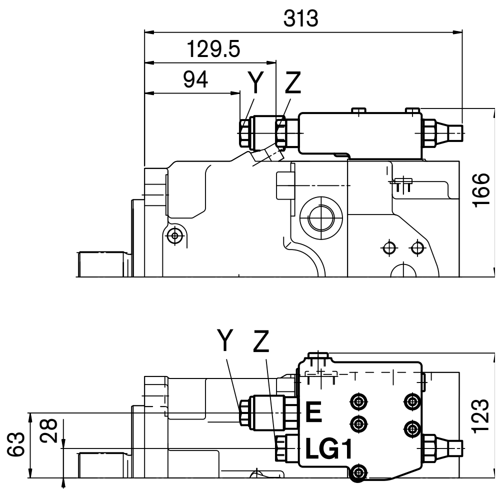
LR3DS

Power control with high-pressure related override, pressure cut-off and load sensing control



LG1E

Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off



LG2E

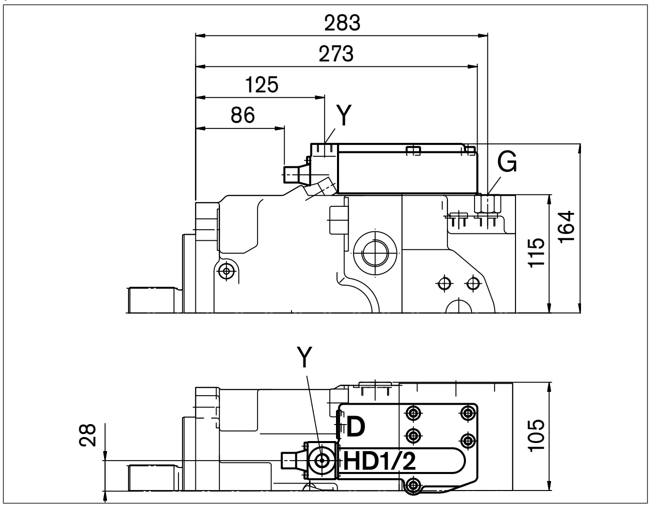
Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off

Dimensions, Size 130/145

Before finalizing your design, please request a certified drawing. Dimensions in mm.

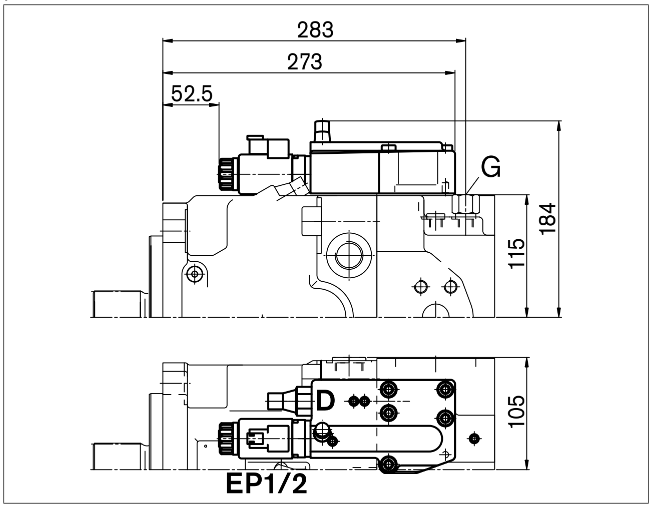
HD1D/HD2D

Hydraulic control, pilot-pressure related with pressure cut-off



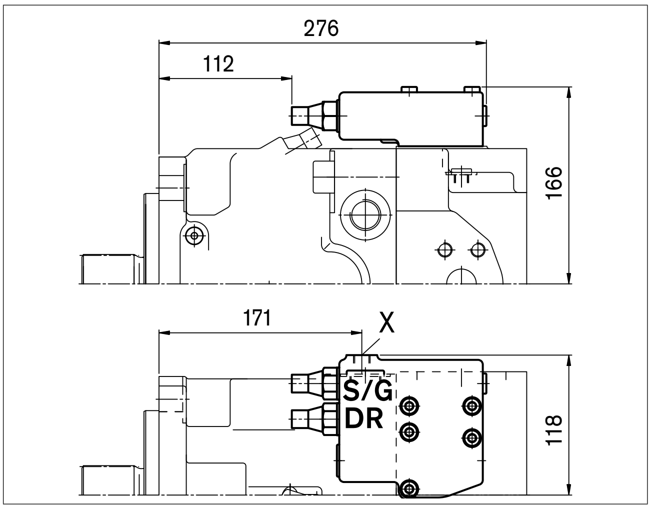
EP1D/EP2D

Electric control with proportional solenoid and pressure cut-off



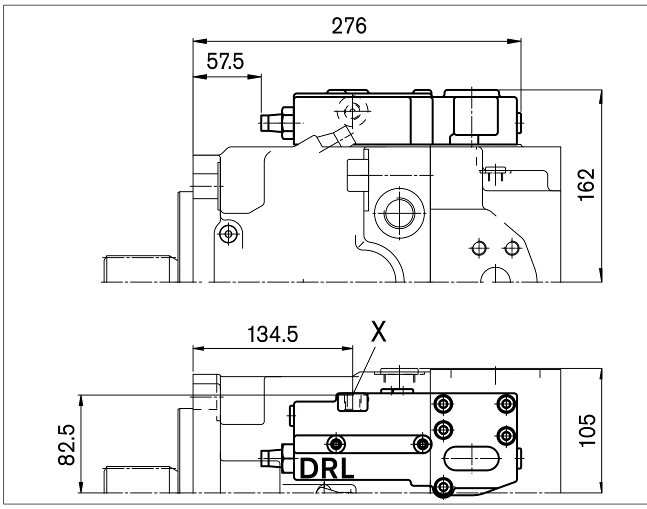
DRS/DRG

Pressure control with load sensing control
Pressure control remote controlled



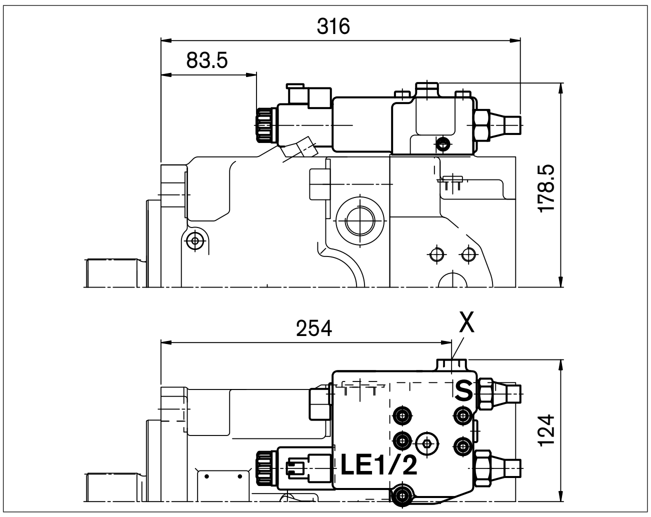
DRL

Pressure control for parallel operation



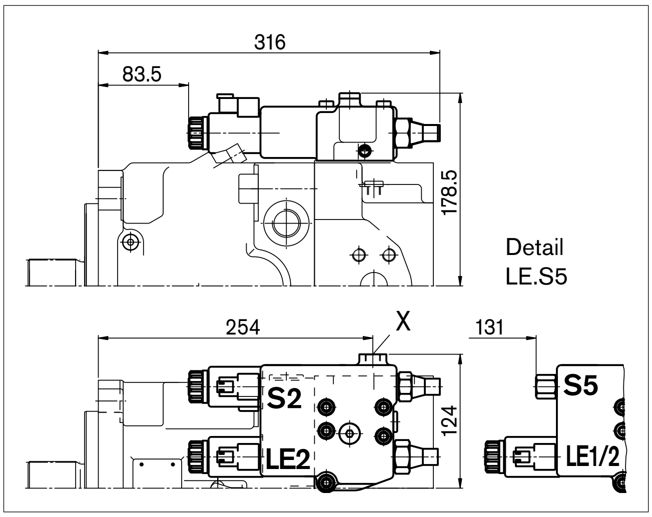
LE1S/LE2S

Power control with electric override (negative) and load sensing control



LE2S2/LE1S5/LE2S5

Power control with electric override (negative) and load sensing control, override

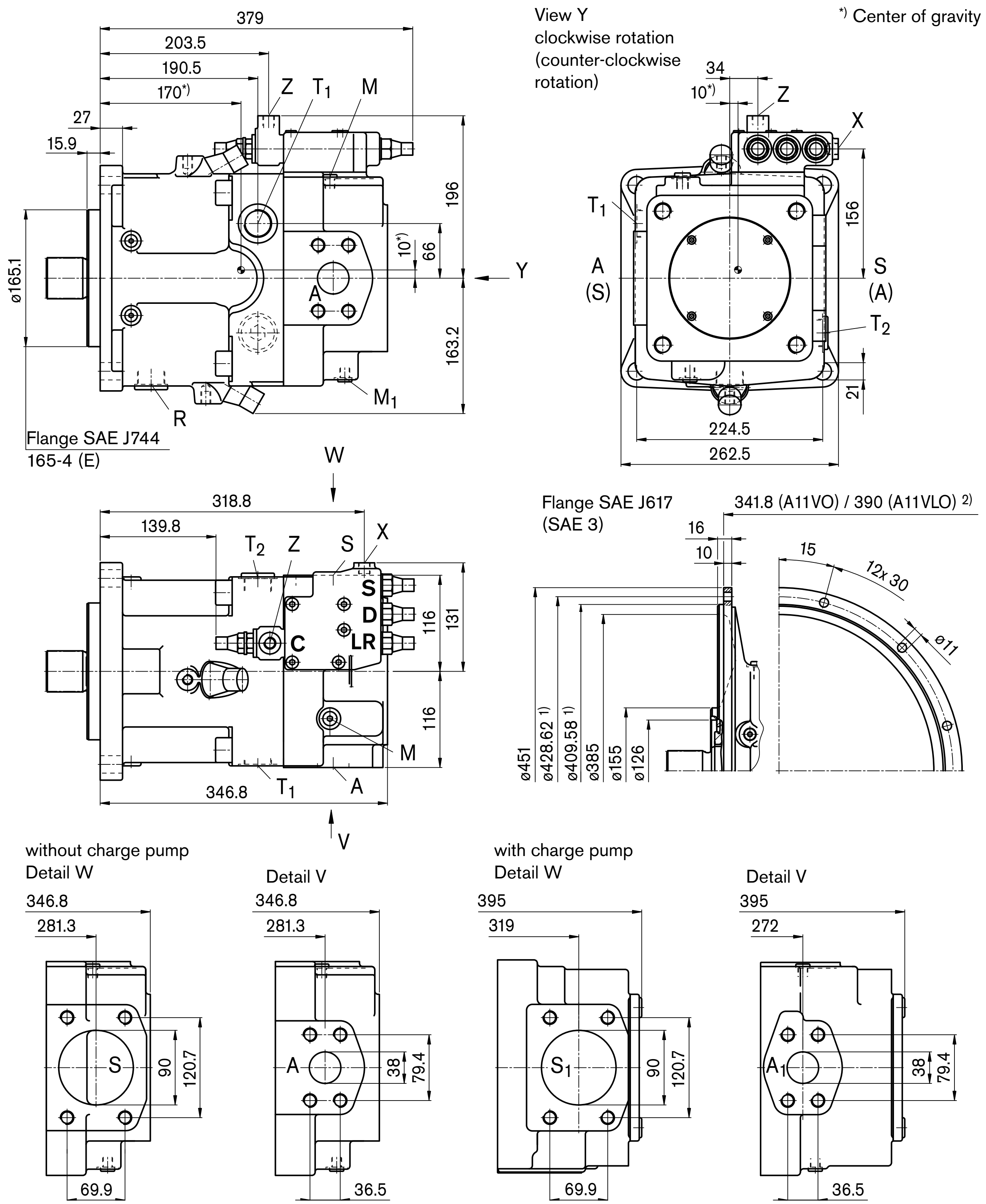


Dimensions, Size 190

Before finalizing your design, please request a certified drawing. Dimensions in mm.

LRDCS

Power control LR with pressure cut-off D, cross sensing control C and load sensing control S



[1] Dimensions according to SAE J617-No. 3, for connection to the flywheel case of the combustion engine

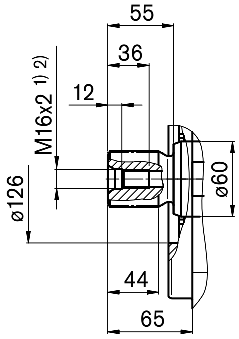
[2] The case or length dimension with flange SAE 3 is 5 mm shorter than the standard case.

Dimensions, Size 190

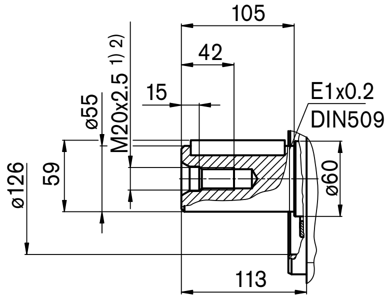
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

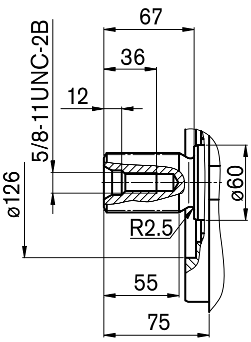
Z Splined shaft DIN 5480
W50x2x30x24x9g



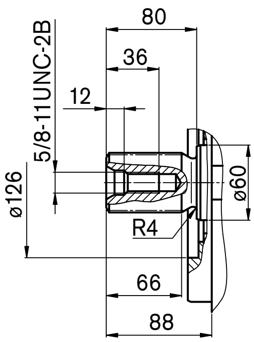
P Parallel keyed shaft DIN 6885,
AS16x10x100



S Splined shaft SAE J744
1 3/4 in 13T 8/16DP [3]



T Splined shaft SAE J744
2 in 15T 8/16DP [3]



Ports

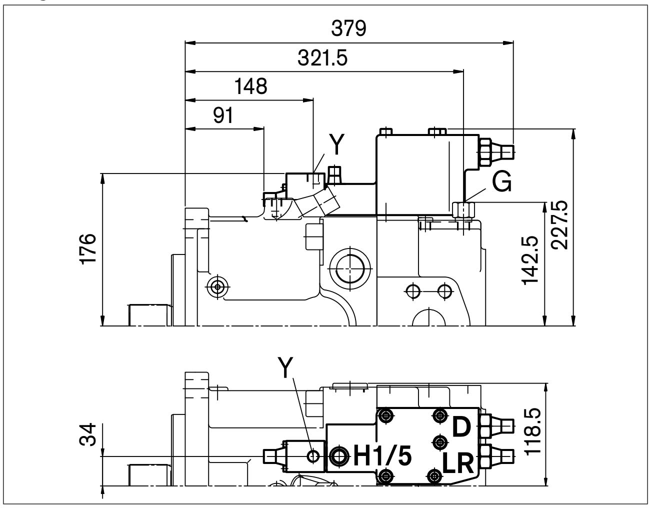
Designation	Function	Standard	Size[2]		Max. pressure (bar) [4]	State
A, A_1	Service line port Fixing thread	SAE J518 DIN 13	1 1/2 in M16x2;	 21 deep	400	O
S, S_1	Suction port Fixing thread	SAE J518 DIN 13	3 1/2 in M16x2;	 24 deep	30 2[6]	O
T_1, T_2	Tank port	DIN 3852	M33x2;	18 deep	10	[5]
R	Air bleed	DIN 3852	M33x2;	18 deep	10	X
M_1	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

[1] Center bore according to DIN 332 (thread acc. to DIN 13)
[2] For max. tightening torque, please refer to general notes on page 64
[3] ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
[4] Depending on adjustment data and operating pressure
[5] Depending on installation position, T1 or T2 must be connected (see also page 61)
[6] with charge pump
O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

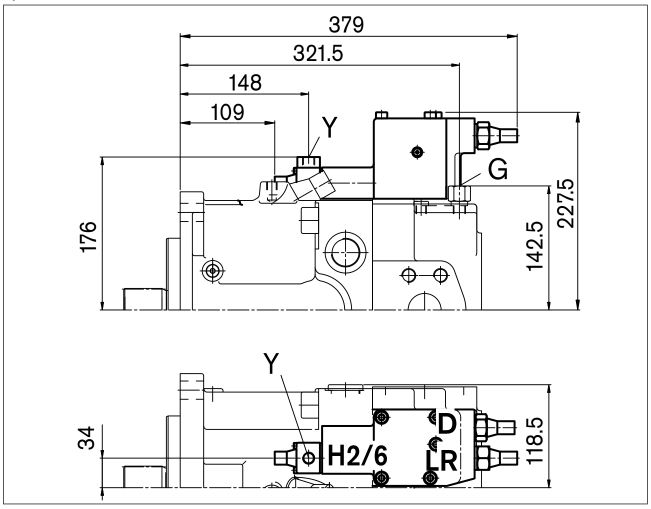
Dimensions, Size 190

Before finalizing your design, please request a certified drawing. Dimensions in mm.

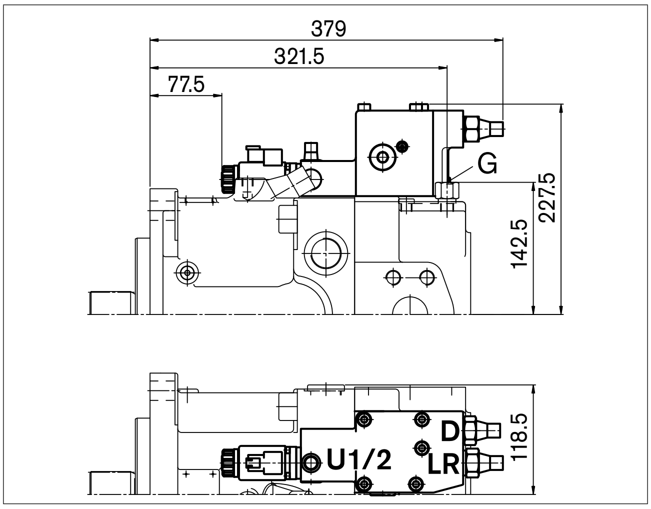
LRDH1/LRDH5
Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



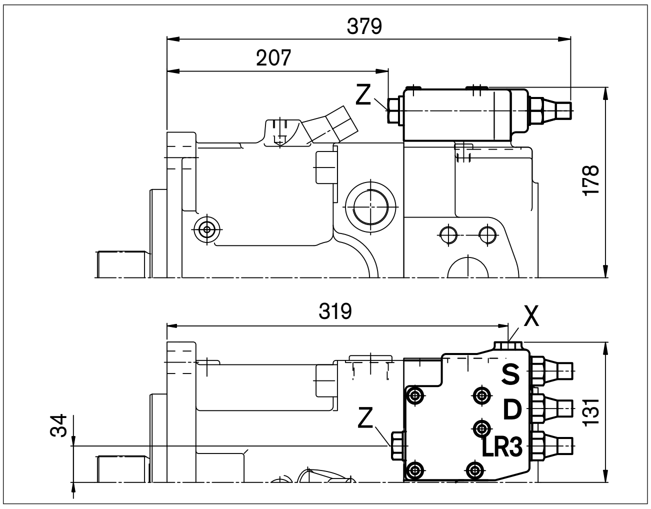
LRDH2/LRDH6
Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



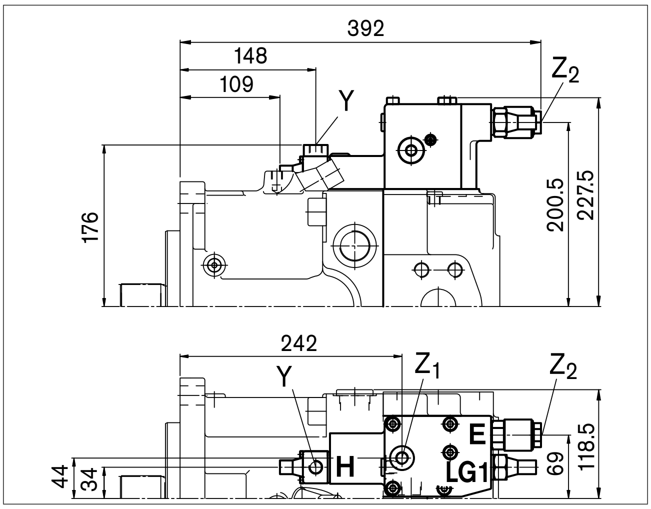
LRDU1/LRDU2
Power control with pressure cut-off and electric stroke limiter (positive characteristic)



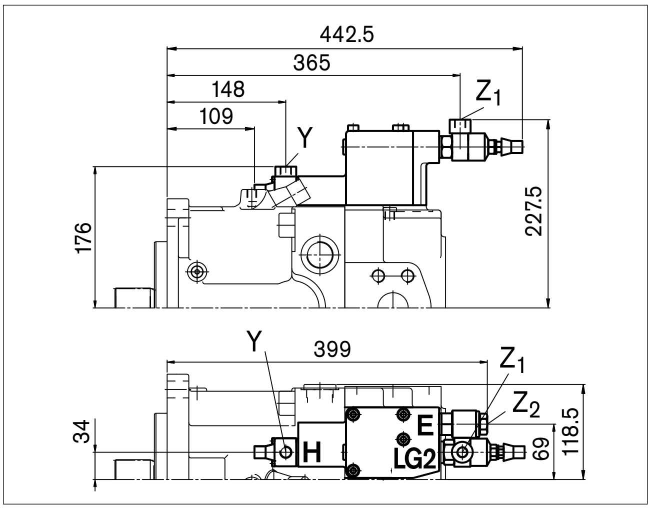
LR3DS
Power control with high-pressure related override, pressure cut-off and load sensing control



LG1EH
Power control with pilot-pressure related override (neg.), 2-stage pressure cut-off and hydr. stroke limiter



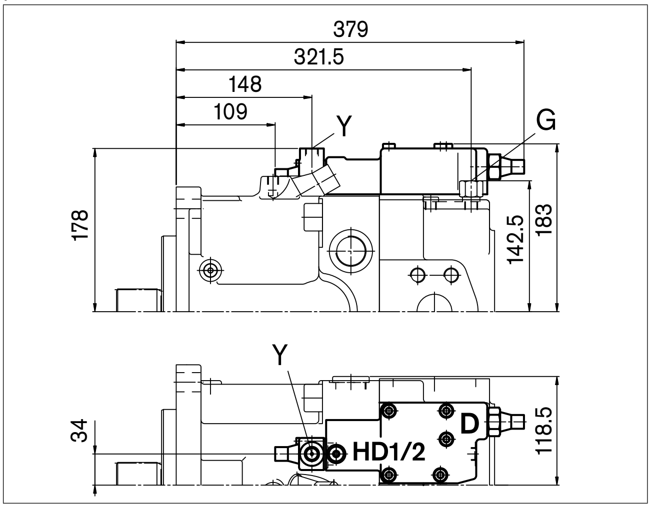
LG2EH
Power control with pilot-pressure related override (pos.), 2-stage pressure cut-off and hydr. stroke limiter



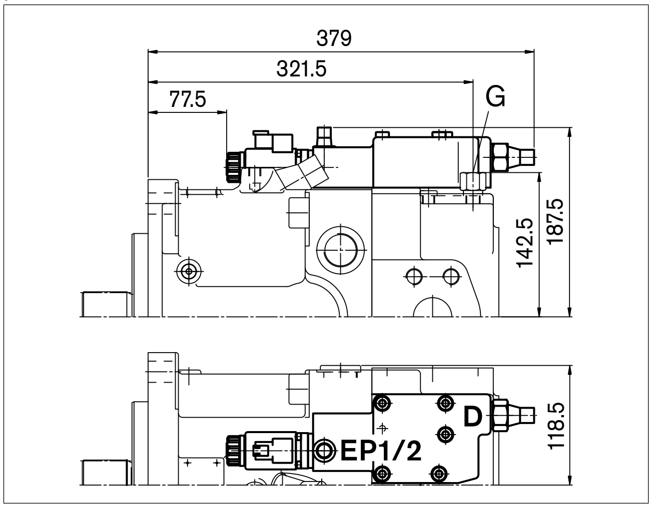
Dimensions, Size 190

Before finalizing your design, please request a certified drawing. Dimensions in mm.

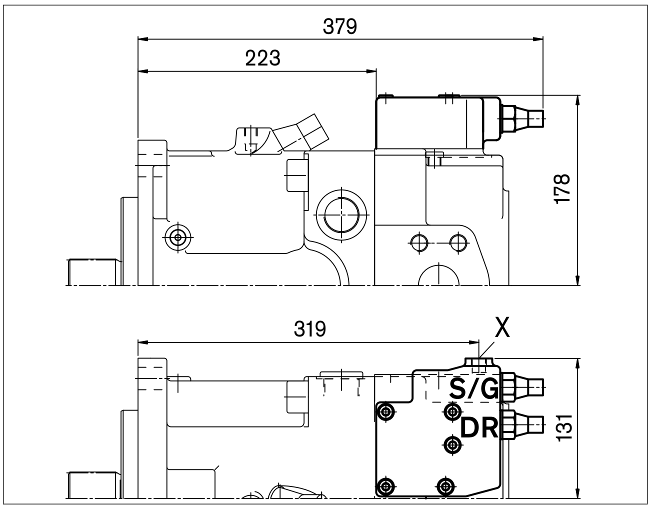
HD1D/HD2D
Hydraulic control, pilot-pressure related with pressure cut-off



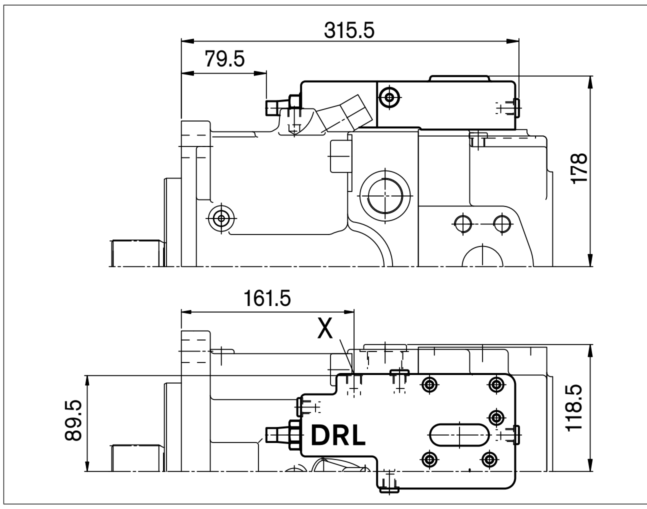
EP1D/EP2D
Electric control with proportional solenoid and pressure cut-off



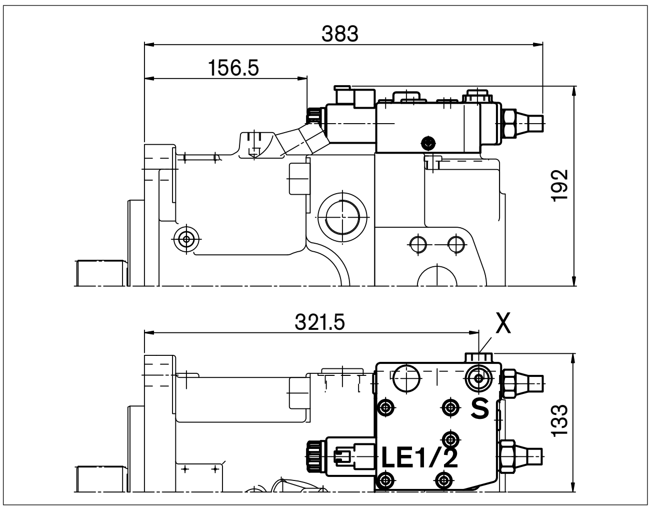
DRS/DRG
Pressure control with load sensing control
Pressure control remote controlled



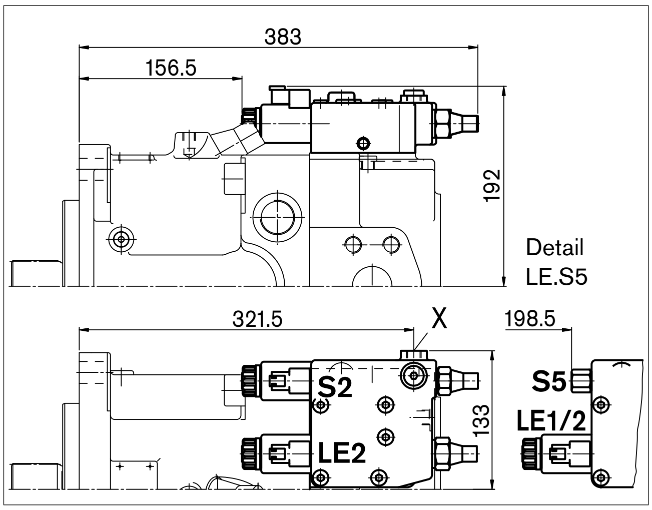
DRL
Pressure control for parallel operation



LE1S/LE2S
Power control with electric override (negative) and load sensing control



LE2S2/LE1S5/LE2S5
Power control with electric override (negative) and load sensing control, override

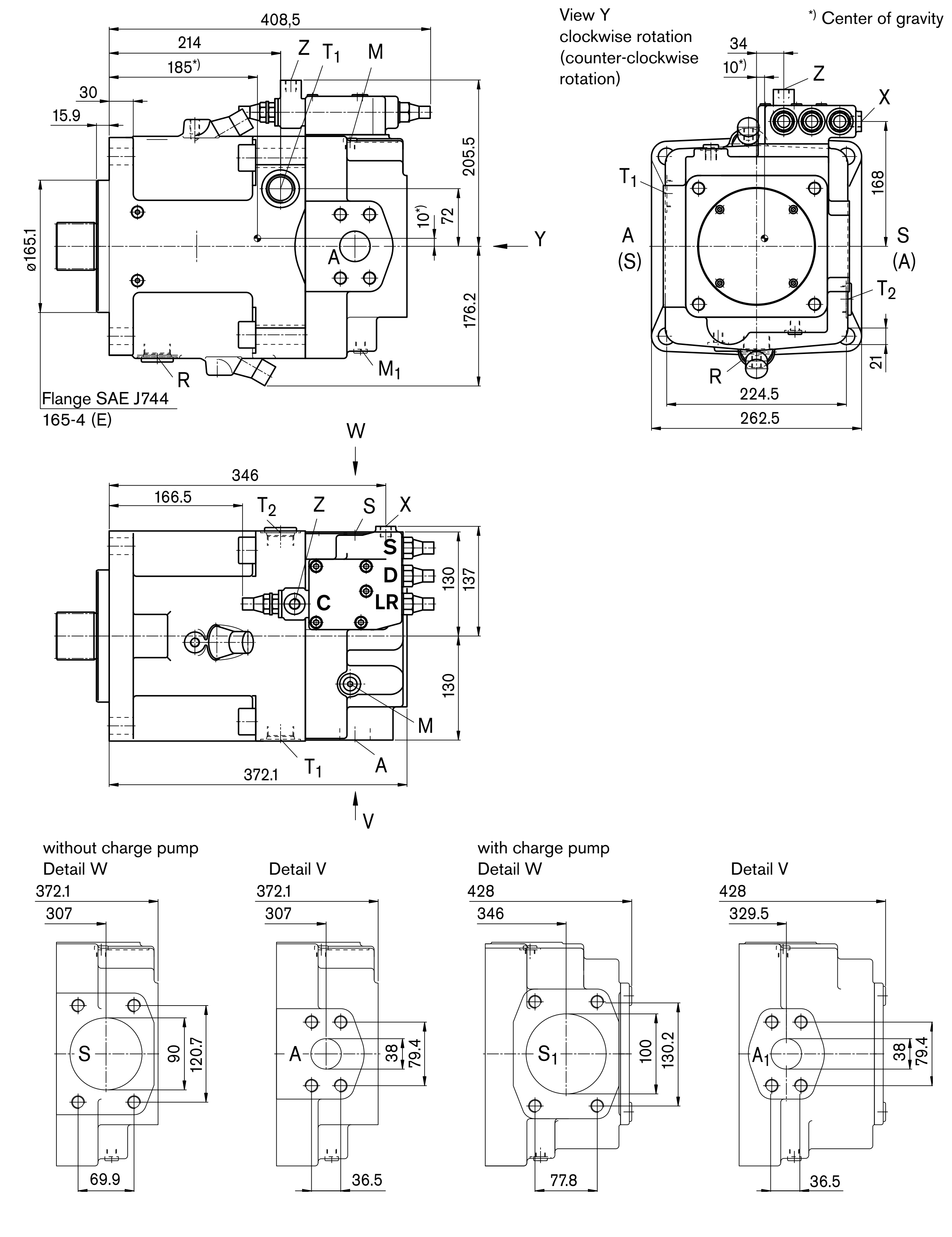


Dimensions, Size 260

Before finalizing your design, please request a certified drawing. Dimensions in mm.

LRDCS

Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

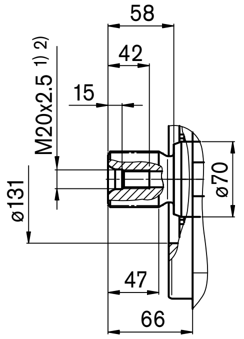


Dimensions, Size 260

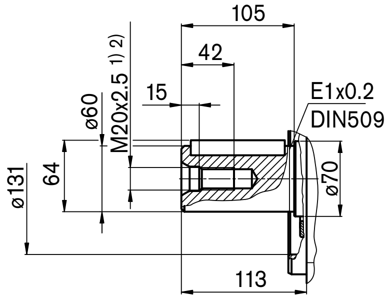
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

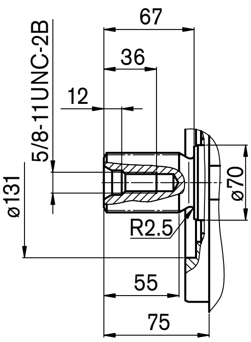
Z Splined shaft DIN 5480
W60x2x30x28x9g



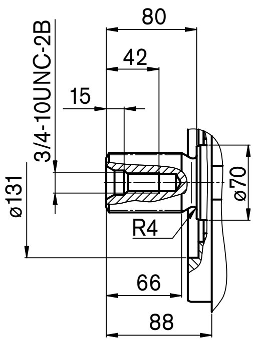
P Parallel keyed shaft DIN 6885,
AS18x11x100



S Splined shaft SAE J744
1 3/4 in 13T 8/16DP [3]



T Splined shaft SAE J744
2 1/4 in 17T 8/16DP [3]



Ports

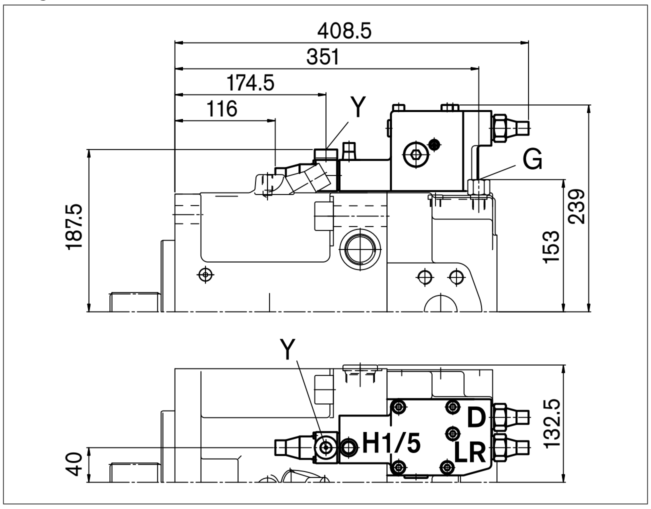
Designation	Function	Standard	Size[2]		Max. pressure (bar) [4]	State
A, A_1	Service line port Fixing thread	SAE J518 DIN 13	1 1/2 in M16x2;	 21 deep	400	O
S	Suction port Fixing thread	SAE J518 DIN 13	3 1/2 in M16x2;	 24 deep	30	O
S_1	Suction port Fixing thread	SAE J518 DIN 13	4 in M16x2;	 21 deep	2[6]	O
T_1, T_2	Tank port	DIN 3852	M33x2;	16 deep	10	[5]
R	Air bleed	DIN 3852	M33x2;	16 deep	10	X
M_1	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For max. tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T1 or T2 must be connected (see also page 61)
6) with charge pump
O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

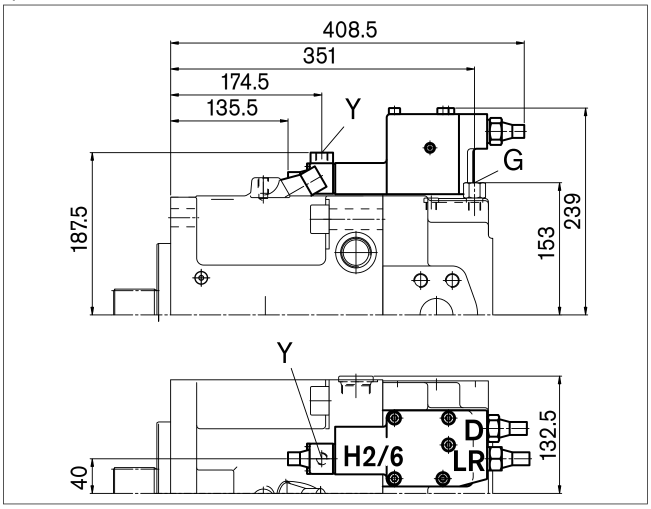
Dimensions, Size 260

Before finalizing your design, please request a certified drawing. Dimensions in mm.

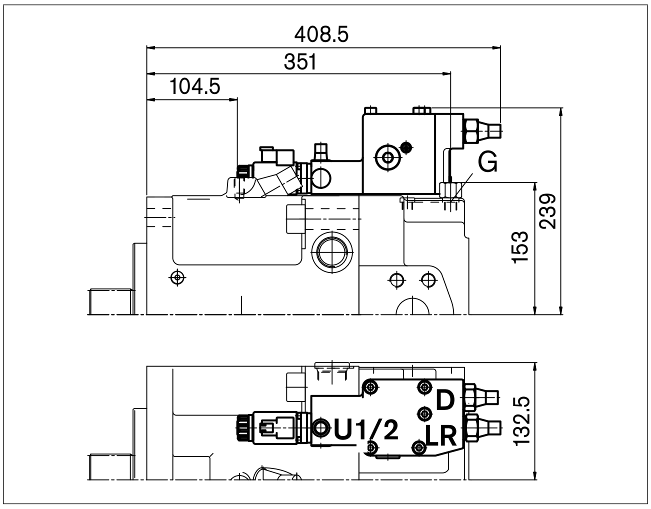
LRDH1/LRDH5
Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



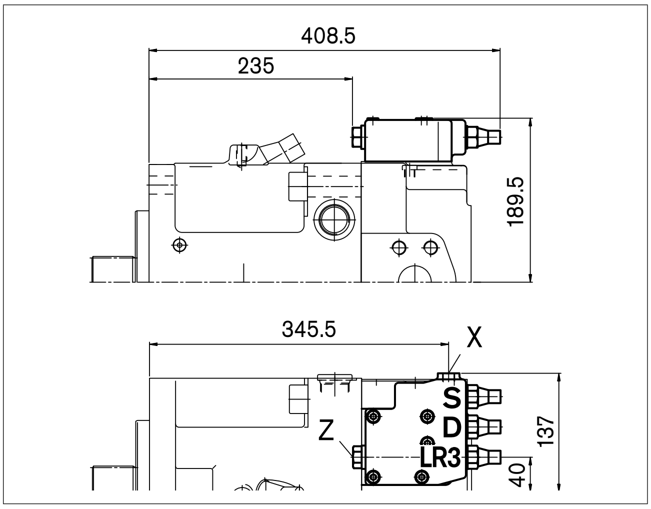
LRDH2/LRDH6
Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



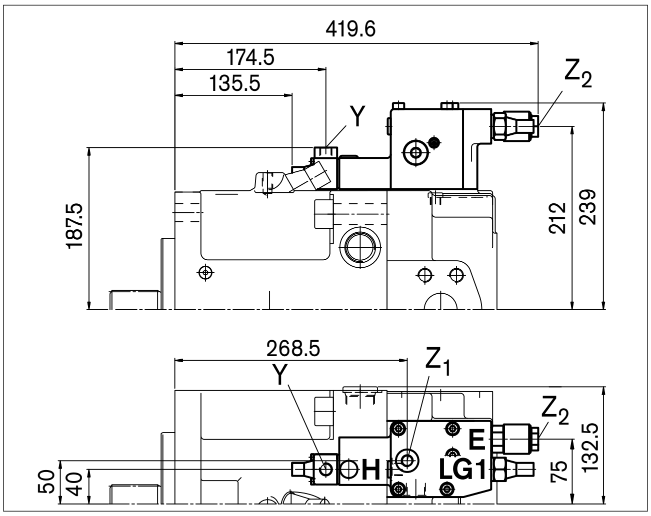
LRDU1/LRDU2
Power control with pressure cut-off and electric stroke limiter (positive characteristic)



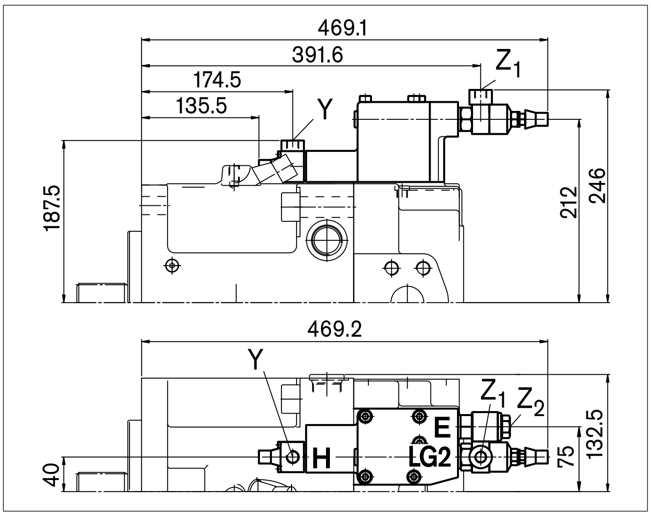
LR3DS
Power control with high-pressure related override, pressure cut-off and load sensing control



LG1EH
Power control with pilot-pressure related override (neg.), 2-stage pressure cut-off and hydr. stroke limiter



LG2EH
Power control with pilot-pressure related override (pos.), 2-stage pressure cut-off and hydr. stroke limiter

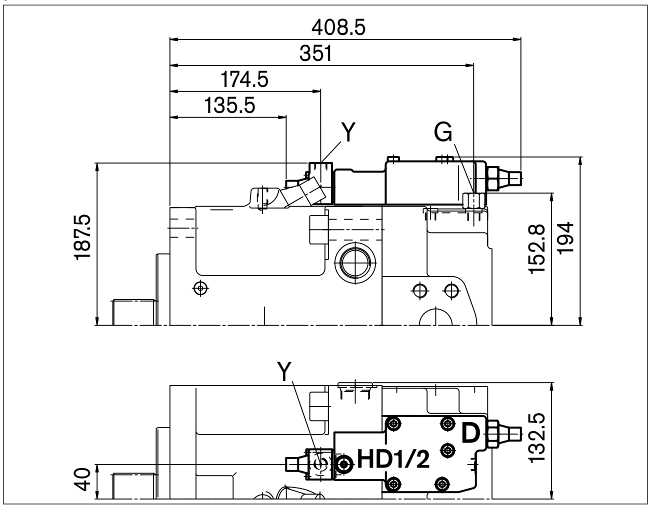


Dimensions, Size 260

Before finalizing your design, please request a certified drawing. Dimensions in mm.

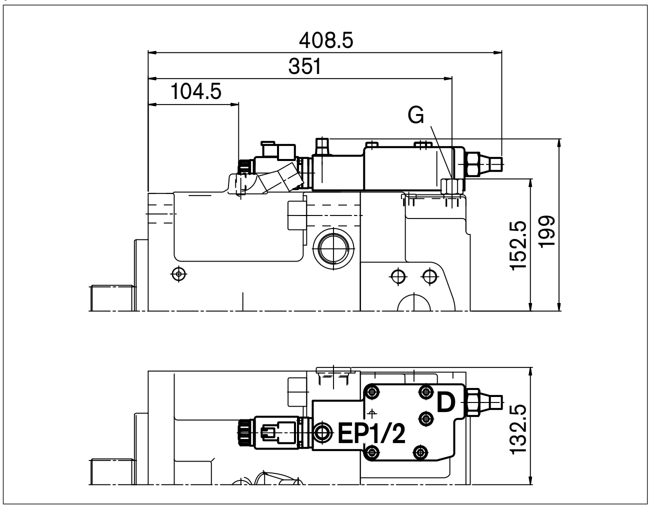
HD1D/HD2D

Hydraulic control, pilot-pressure related with pressure cut-off



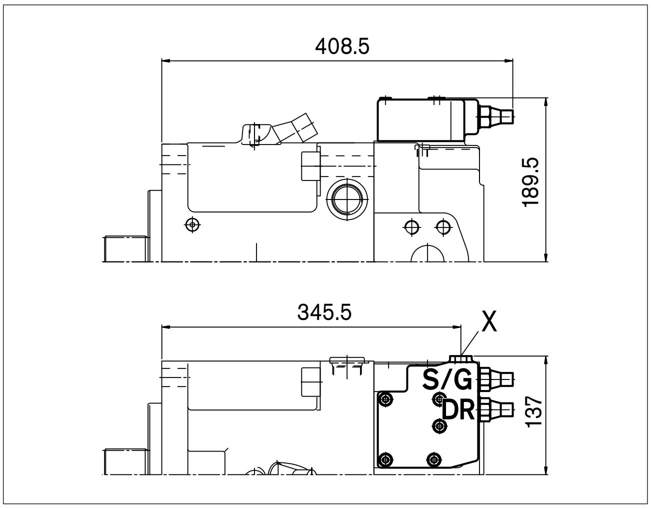
EP1D/EP2D

Electric control with proportional solenoid and pressure cut-off



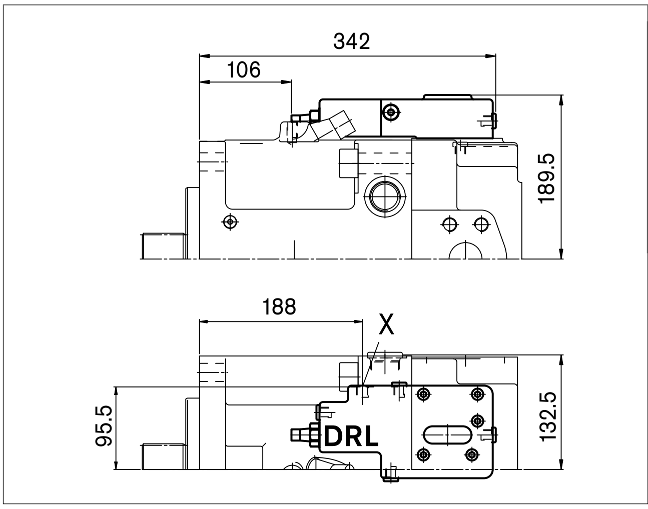
DRS/DRG

Pressure control with load sensing control
Pressure control remote controlled



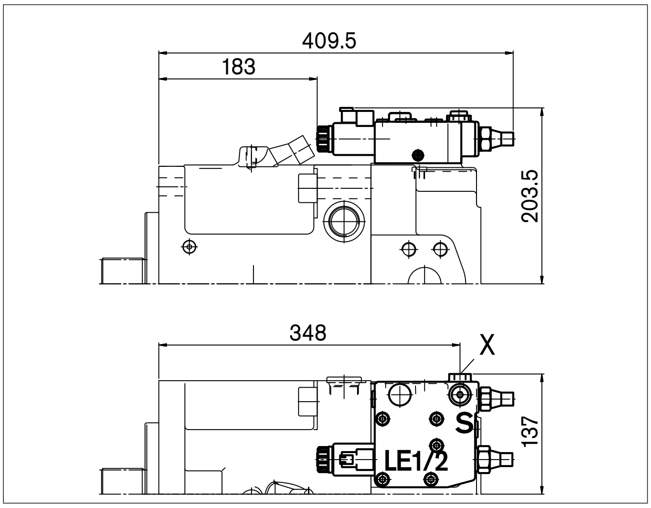
DRL

Pressure control for parallel operation



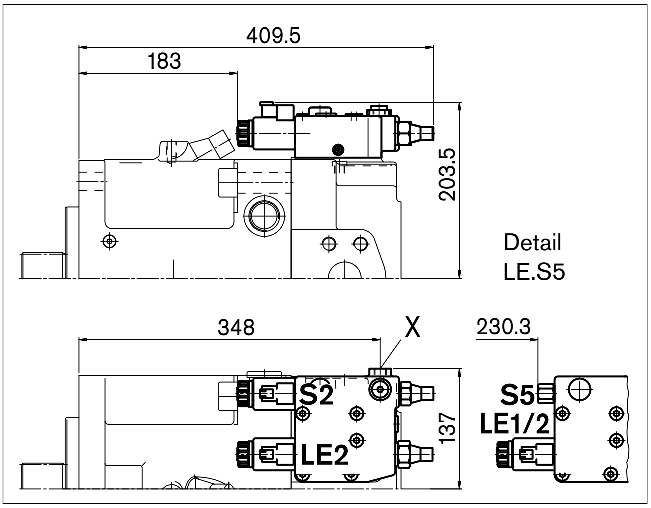
LE1S/LE2S

Power control with electric override (negative) and load sensing control



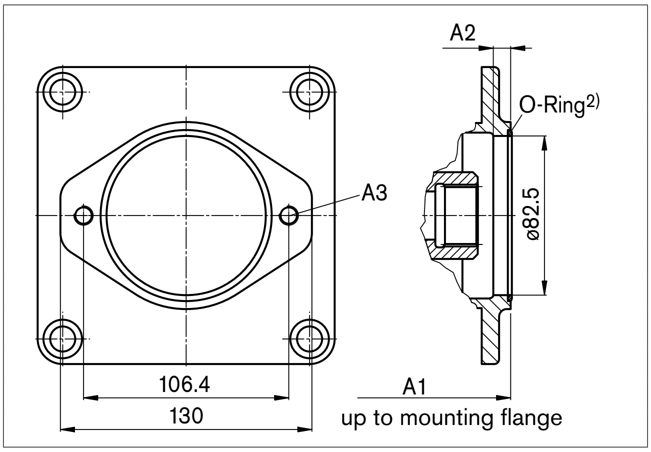
LE2S2/LE1S5/LE2S5

Power control with electric override (negative) and load sensing control, override



Through Drive Dimensions

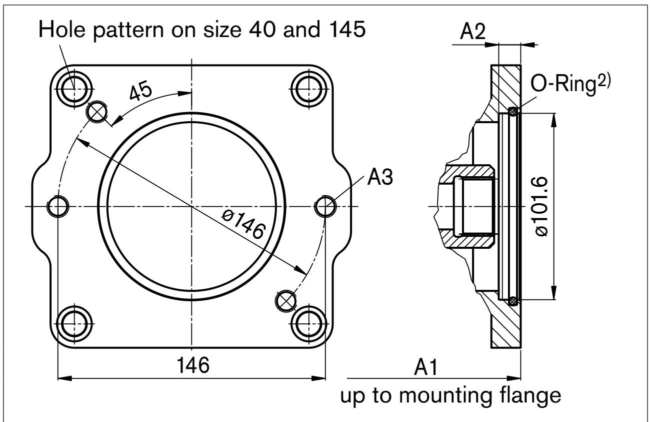
Flange SAE J744 – 82-2 (A) **Coupler** for splined shaft acc. to ANSI B92.1a-1976 5/8 in 9T 16/32 DP[1] (SAE J744 – 16-4 (A) **K01**
3/4 in 11T 16/32 DP[1] (SAE J744 – 19-4 (A-B)) **K52**



	A1		A2	A3[3]
Size	**K01**	**K52**		
40	240	240	8	M10x1.5; 15 deep
60	257	257	–	M10x1.5; 15 deep
75	275	275	–	M10x1.5; 15 deep
95	306	306	–	M10x1.5; 12.5 deep
130/145	329	329	–	M10x1.5; 12.5 deep
130/145*	363	363	–	M10x1.5; 12.5 deep
190	359.8	359.8	–	M10x1.5; 13 deep
190*	394	394	–	M10x1.5; 13 deep
260	385	385	–	M10x1.5; 13 deep
260*	427.3	427.3	–	M10x1.5; 13 deep

*) Version with charge pump

Flange SAE J744 – 101-2 (B) **Coupler** for splined shaft acc. to ANSI B92.1a-1976 7/8 in 13T 16/32 DP[1] (SAE J744 – 22-4 (B)) **K02**
1 in 15T 16/32 DP[1] (SAE J744 – 25-4 (B-B)) **K04**
Coupler for splined shaft acc. to DIN 5480 W35x2x30x16x9g **K79**

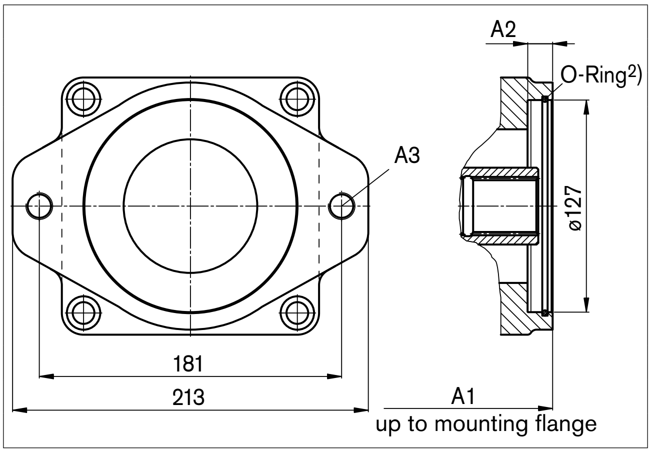


In size 190 and 260 the hole template is turned 45° counter-clockwise.

	A1			A2	A3[3]
Size	**K02**	**K04**	**K79**		
40	244	244		10	M12x1.75; 19 deep
60	261	261	261	10	M12x1.75; 19 deep
75	279	279		10	M12x1.75; 19 deep
95	303	303	303	10	M12x1.75; 16 deep
130/145	326	326	326	10	M12x1.75; 16 deep
130/145*	360	360	360	10	M12x1.75; 16 deep
190	371.8	369.8	361.8	–	M12x1.75; 15 deep
190*	404	404	394	–	M12x1.75; 15 deep
260	395	395	395	–	M12x1.75; 15 deep
260*	437.5	437.5	437.5	–	M12x1.75; 15 deep

*) Version with charge pump

Flange SAE J744 – 127-2 (C) **Coupler** for splined shaft acc. to ANSI B92.1a-1976 1 1/4 in 14T 12/24 DP[1] (SAE J744 – 32-4 (C)) **K07**
1 1/2 in 17T 12/24 DP[1] (SAE J744 – 38-4 (C-C)) **K24**
Coupler for splined shaft acc. to DIN 5480 W30x2x30x14x9g **K80**
W35x2x30x16x9g **K61**



	A1				A2	A3[3]
Size	**K07**	**K24**	**K80**	**K61**		
60	272	–	265	265	13	M16x2; 20 deep
75	290	–	283	283	13	M16x2; 20 deep
95	318	318	318	318	13	M16x2; 16 deep
130/145	330	330	330	330	13	M16x2; 20 deep
130/145*	364	364	364	364	13	M16x2; 20 deep

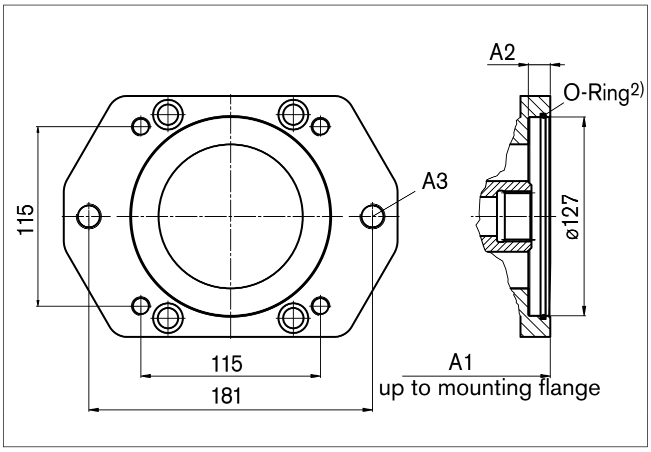
*) Version with charge pump

Note:
The mounting flange may be turned through 90°. Standard position as illustrated. Please state in clear text if required.

1) 30° pressure angle, flat root, side fit, tolerance class 5
2) O-ring included in the delivery contents
3) DIN 13, for max. tightening torque, please refer to general notes on page 64

Through Drive Dimensions

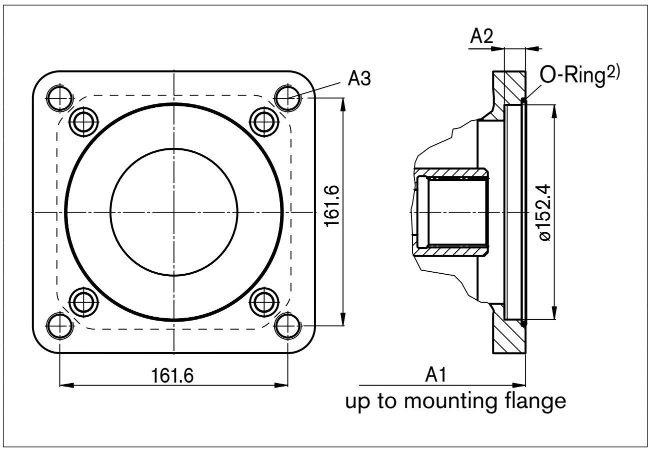
Flange SAE J744–127-2+4 (A) **Coupler** for splined shaft acc. to ANSI B92.1a-19761 1/4 in 14T 12/24 DP[1)] (SAE J744 – 32-4 (C) **K07**
1 1/2 in 17T 12/24 DP[1)] (SAE J744 – 38-4 (C-C)) **K24**
Coupler for splined shaft acc. to DIN 5480 W30x2x30x14x9g **K80**
W35x2x30x16x9g **K61**



	A1				A2	A3[3)]
Size	K07	K24	K80	K61		
190	367.8	367.8	367.8	367.8	13	M16x2; 19 deep
190*	400	400	400	400	13	M16x2; 19 deep
260	391.5	391.5	391.5	391.5	13	M16x2; 19 deep
260*	433.5	433.5	433.5	433.5	13	M16x2; 19 deep

*) Version with charge pump

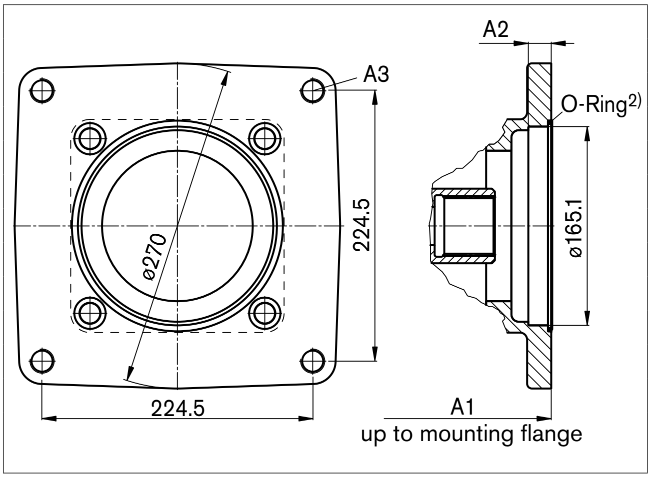
Flange SAE J744 – 152-4 (D) **Coupler** for splined shaft acc. to ANSI B92.1a-1976 1 1/4 in 14T 12/24 DP[1)] (SAE J744 – 32-4 (C)) **K86**
1 3/4 in 13T 8/16 DP[1)] (SAE J744 – 44-4 (D)) **K17**
Coupler for splined shaft acc. to DIN 5480 W40x2x30x18x9g **K81**
W45x2x30x21x9g **K82**
W50x2x30x24x9g **K83**



	A1					A2	A3[3)]
Size	K86	K17	K81	K82	K83		
75	290	–	290	–	–	13	M20x2.5; 28 deep
95	317	327	317	317	–	30	M20x2.5; 25 deep
130/145	340	350	340	340	340	30	M20x2.5; 25 deep
130/145*	374	384	374	374	374	30	M20x2.5; 25 deep
190	392	392	392	392	392	13	M20x2.5; 22 deep
190*	424	424	424	424	424	13	M20x2.5; 22 deep
260	417	417	417	417	417	13	M20x2.5; 22 deep
260*	459	459	459	459	459	13	M20x2.5; 22 deep

*) Version with charge pump

Flange SAE J744 – 101-2 (E) **Coupler** for splined shaft acc. to ANSI B92.1a-1976 1 3/4 in 13T 16/32 DP[1)] (SAE J744 – 32-4 (C)) **K72**
Coupler for splined shaft acc. to DIN 5480 W50x2x30x24x9g) **K84**
W60x2x30x28x9g **K67**



	A1			A2	A3[3)]
Size	K72	K84	K67		
190	376.8	376.8	–	19	M20x2.5; 20 deep
190*	409	409	–	19	M20x2.5; 20 deep
260	417	400	400	19	M20x2.5; 20 deep
260*	459	442.5	442.5	19	M20x2.5; 20 deep

*) Version with charge pump

Note:
The mounting flange may be turned through 90°. Standard position as illustrated. Please state in clear text if required.

1) 30° pressure angle, flat root, side fit, tolerance class 5
2) O-ring included in the delivery contents
3) DIN 13, for max. tightening torque, please refer to general notes on page 64

Overview of Attachments for A11V(L)O

Through drive Flange	A11VO Coupler for splined shaft	Code	Attachment – 2nd pump A11VO Size (shaft)	A10V(S)O/31 Size (shaft)	A10V(S) O/53 Size (shaft)	A4FO Size (shaft)	A4VG Size (shaft)	A10VG Size (shaft)	External gear pump	Through drive available for size
82-2 (A)	5/8 in	K01	–	18 (U)	10 (U)	–	–	–	Frame size F Size 4-22 1)	40...260
	3/4 in	K52	–	18 (S)	10 (S)	–	–	–	–	40...260
101-2 (B)	7/8 in	K02	–	28 (S, R) 45 (U)	28 (S, R) 45 (U, W)	16, 22, 28 (S)	–	18 (S)	Frame size N Size 20-32 1) Frame size G Size 38-45 1)	40...260
	1 in	K04	40 (S)	45 (S, R)	45 (S, R) 60 (U, W)	–	28 (S)	28, 45 (S)	–	40...260
	W35	K79	40 (Z)	–	–	–	–	–	–	40...260
127-2 (C)	1 1/4 in	K07	60 (S)	71 (S, R) 100 (U)	60 (S) 2) 85 (U)	–	40, 56, 71 (S)	63 (S)	–	60...260
	1 1/2 in	K24	–	100 (S)	85 (S)	–	–	–	–	95...260
	W30	K80	–	–	–	–	40, 56 (Z)	–	–	60...260
	W35	K61	60 (Z)	–	–	–	40, 56 (A) 71 (Z)	–	–	60...260
152-4 (D)	1 1/4 in	K86	75 (S)	–	–	–	–	–	–	75...260
	1 3/4 in	K17	95, 130, 145 (S)	140 (S)	–	–	90, 125 (S)	–	–	130...260
	W40	K81	75 (Z)	–	–	–	125 (Z)	–	–	75...260
	W45	K82	95 (Z)	–	–	–	90, 125 (A)	–	–	95...260
	W50	K83	130, 145 (Z)	–	–	–	–	–	–	130...260
165-4 (E)	1 3/4 in	K72	190, 260 (S)	–	–	–	180, 250 (S)	–	–	190...260
	W50	K84	190 (Z)	–	–	–	180 (Z)	–	–	190...260
	W60	K67	260 (Z)	–	–	–	–	–	–	260

1) We recommends special versions of the gear pumps. Please ask.
2) Only A10VO with 4-hole mounting flange can be mounted to A11V(L)O 190 and 260.

Combination Pumps A11VO + A11VO

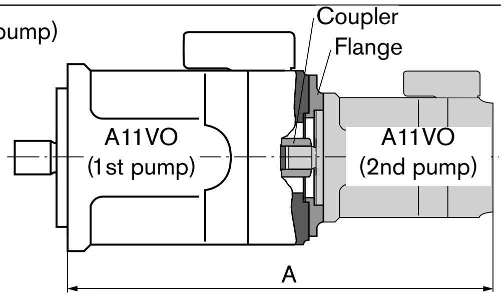
Total length A 1)

A11VO 1st pump	2nd pump Size 40	Size 60	Size 75	Size 95	Size 130/145	Size 130/145 2)	Size 190	Size 190 2)	Size 260	Size 260 2)
Size 40	–	–	–	–	–	–	–	–	–	–
Size 60	490	507	–	–	–	–	–	–	–	–
Size 75	–	525	550	–	–	–	–	–	–	–
Size 95	528	560	577	604	–	–	–	–	–	–
Size 130/145	551	572	600	627	650	698	–	–	–	–
Size 130/145 2)	585	606	634	661	684	732	–	–	–	–
Size 190	586.8	609.8	652	679	702	750	723.6	772.3	–	–
Size 190 2)	619	642	684	711	734	782	755.8	804.5	–	–
Size 260	620	633.5	677	704	727	775	746.8	795.5	772	828
Size 260 2)	662.5	675.5	719	746	769	817	789.3	838	814.5	870.5

1) When using the Z shaft (splined shaft DIN 5480) for the attached pump (2nd pump)
2) Version with charge pump

When ordering combination pumps, the type designations of the 1st and 2nd pumps must be connected by a "+".
Ordering code 1st pump + Ordering code 2nd pump

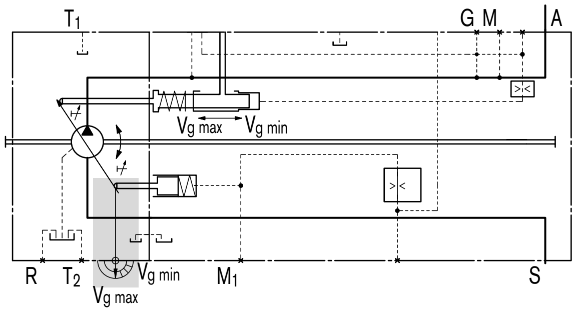
Ordering example:
A11VO130LRDS/10R-NZD12K61 + A11VO60LRDS/10R-NZC12N00

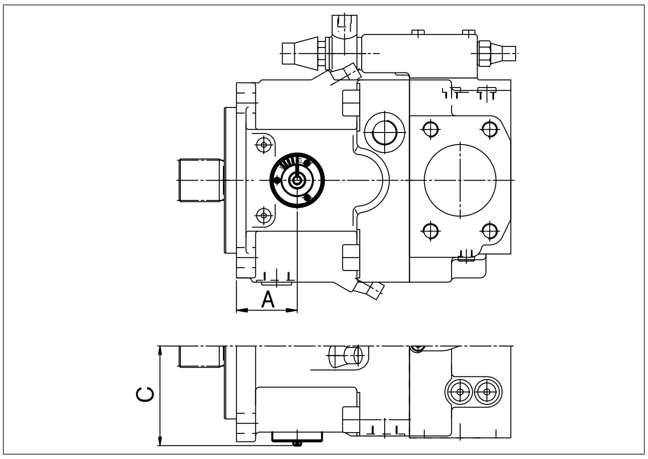


Swivel Angle Indicator

Optical swivel angle indicator, V

With the optical swivel angle indicator, a mechanical pointer on the side of the pump case displays the position of the swivel angle of the pump.



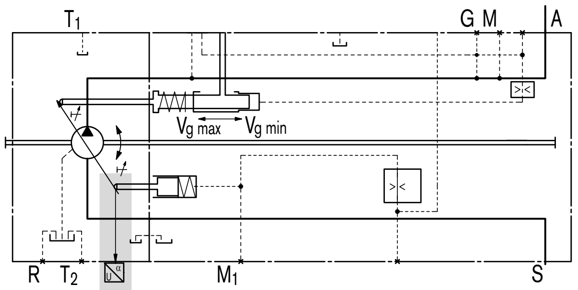


Size	A	C
40	50.5	84.0
60	not available	
75	60.7	97.0
95	63,5	104.0
130	70.9	112.0
190	87.6	123.5
260	87.6	137.0

Electric swivel angle sensor, R

With the electric swivel angle indicator the swivel position of the pump is measured by an electric swivel angle sensor. It has a robust, sealed case and integrated electronics designed for automotive applications.

As an output the Hall effect swivel angle sensor supplies a voltage signal proportional to the swivel angle (see technical parameters).



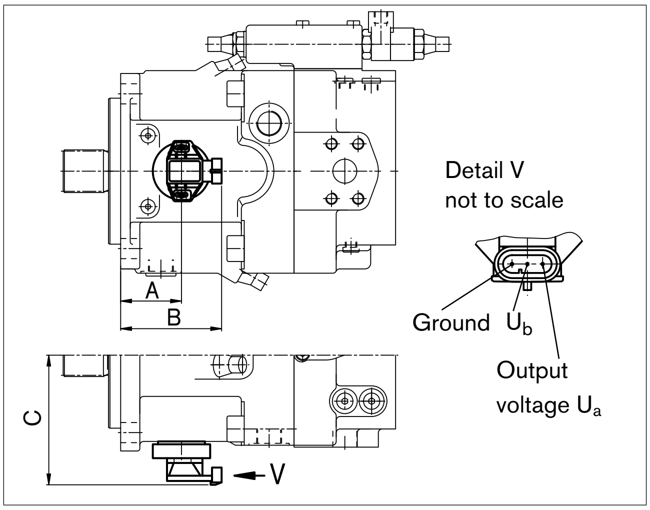
Parameters		
Supply voltage U_b	10...30 V DC	
Output voltage U_a	2.5 V ($V_{g\ min}$)	4.5 V ($V_{g\ max}$)
Reverse-connect protection	Short-circuit-proof	
EMC stability	Details on request	
Operating temperature range	-40°C...+125°C	
Vibration resistance Sinusoidal vibration EN 60068-2-6	10 *g* / 5...2000 Hz	
Shock resistance: Continuous shock IEC 68-2-29	*25 g*	
Resistance to salt spray DIN 50021-SS	96 h	
Type of protection DIN/EN 60529	IP67 and IP69K	
Case material	synthetic material	

Mating connector

AMP Superseal 1.5; 3-pin,

Consisting of:	AMP no.
– 1 female connector case, 3-pin	282087-1
– 3 single wire seals, yellow	281934-2
– 3 female connector contacts 1.8–3.3 mm	283025-1

The mating connector is not included in the delivery contents.



Size	A	B	C
40	50.5	88.5	118.3
60	not available		
75	60.7	98.7	131.3
95	63.5	101.5	138.3
130	70.9	108.9	146.3
190	87.6	125.6	157.8
260	87.6	125.6	171.3

Connector for Solenoids

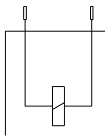
DEUTSCH DT04-2P-EP04, 2-pin

molded, without bidirectional suppressor diode
(standard) ______________________________ **P**

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

Circuit diagram symbol

without bidirectional
suppressor diode

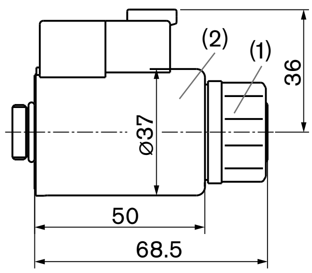


Mating connector

DEUTSCH DT06-2S-EP04

Consisting of:	DT designation
– 1 case	DT06-2S-EP04
– 1 wedge	W2S
– 2 female connectors	0462-201-16141

The mating connector is not included in the delivery contents.



Note for round solenoids:

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

Proceed as follows:

- 1. Loosen fixing nut (1)
- 2. Turn the solenoid body (2) to the desired position.
- 3. Tighten the fixing nut
  Tightening torque of fixing nut: 5^{+1} Nm
  (width across the flats WAF 26, 12kt DIN 3124)

Installation Notes

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 in the case interior must be directed to the tank via the highest tank port (T_1, T_2). The minimum suction pressure at port S must not fall below 0.8 bar absolute (without charge pump) or 0.6 bar (with charge pump).

In all operational conditions, the suction line and 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)

Pump below the minimum fluid level of the tank.

Recommended installation positions: 1 and 2.

Above-tank installation

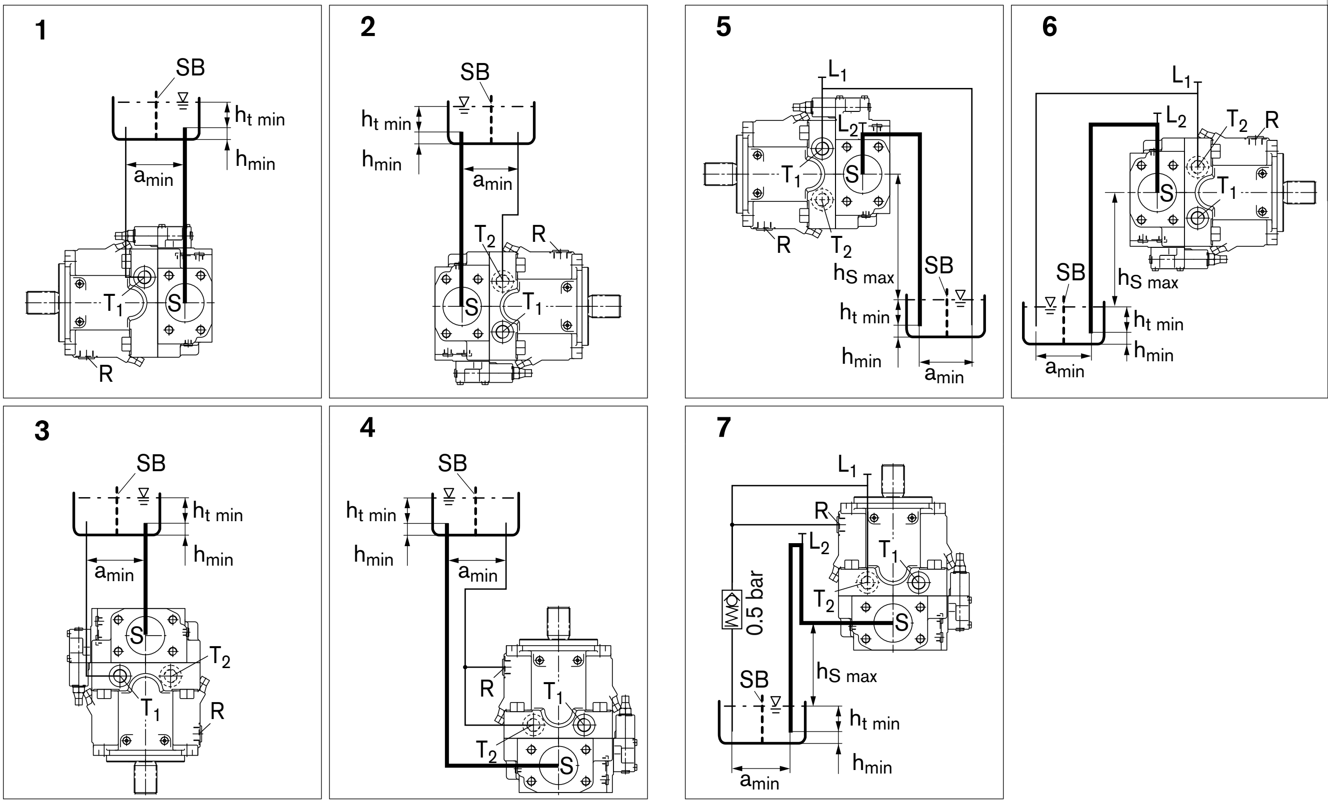
Pump above the minimum fluid level of the tank.

Observe the maximum permissible suction height $h_{s\,max}$ = 800 mm.

The version A11VLO (with charge pump) is not designed for installation above the tank.

Recommendation for installation position 7 (shaft up): A check valve in the case drain line (opening pressure 0.5 bar) can prevent the case interior from draining.

For control options with pressure control, displacement limiters, HD and EP control, the minimum displacement setting must be $V_g \geq 5\%\ V_{g\,max}$.



$h_{s\,max}$ = 800 mm, $h_{t\,min}$ = 200 mm, h_{min} = 100 mm, SB = Silencer plate (baffle plate)

When designing the tank, ensure adequate space a_{min} between the suction line and the case drain line to prevent the heated, returned fluid from being directly drawn back out.

Installation position	Air bleeding	Filling
1	T_1	S + T_1
2	R	S + T_2
3	T_1/T_2	S + T_1/T_2
4	R	S + T_1/T_2

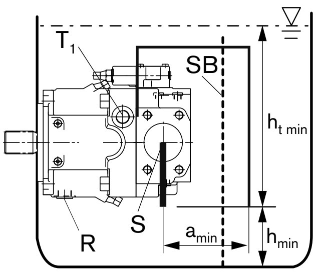
Installation position	Air bleeding	Filling
5	L_1 + L_2	L_2 (S) + L_1 (T_1)
6	R + L_2	L_2 (S) + L_1 (T_2)
7	L_1 + L_2	L_2 (S) + L_1 (T_1/T_2)

Installation Notes

Tank installation

Pump below the minimum fluid level in the tank.

8



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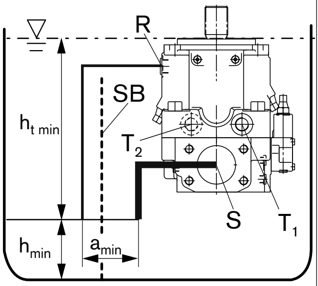

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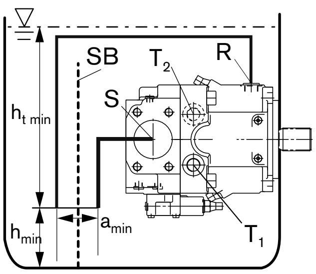

$h_{s\ max}$ = 800 mm, $h_{t\ min}$ = 200 mm, h_{min} = 100 mm,
SB = Silencer plate (baffle plate)

When designing the tank, ensure adequate space a_{min} between the suction line and the case drain line to prevent the heated, returned fluid from being directly drawn back out.

Installation position	Air bleeding	Filling
8	T_1	automatically via all open T_1, T_2, R and S ports, though position below the hyraulic fluid level
9	R	
10	R	

Notice

General Notes

– The A11VO pump is designed to be used in open circuits.

– Project planning, assembly and commissioning of the axial piston unit require the involvement of qualified personnel.

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

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

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

– Pressure ports:
The ports and fixing threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.

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

– The following tightening torques apply:

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

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

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

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

– The product is not approved as a component for the safety concept of a general machine according to DIN EN ISO 13849.

Thread size		Max. permissible tightening torque of the screw thread M_{Gmax}	Required tightening torque for locking screws M_V	WAF Hexagon socket
M12x1.5	DIN 3852	50 Nm	25 Nm	6 mm
M14x1.5	DIN 3852	80 Nm	35 Nm	6 mm
M22x1.5	DIN 3852	210 Nm	80 Nm	10 mm
M26x1.5	DIN 3852	230 Nm	120 Nm	12 mm
M33x2	DIN 3852	540 Nm	310 Nm	17 mm