



■ Product description:

- The HD-A10VSO/31 , variable pump in axial piston swash plate design for hydrostatic drives in an open circuit, is designed for stationary applications.
- The HD-A10VO/31, variable pump in axial piston swash plate design for hydrostatic drives in an open circuit, is designed for mobile applications.
- The flow is proportional to the drive speed and the displacement. The flow can be steplessly varied by adjusting the swash-plate angle.

■ Features:

- Excellent suction characteristics
- Permissible continuous operating pressure up to 28 MPa
- Axial and radial load capacity of drive shaft
- Short response time
- The through drive is suitable for adding gear pumps and axial piston pumps up to the same size
- Low noise and long service life
- Favorable power-to-weight ratio
- Versatile controller range

■ Applications:

- The Steel Metallurgy and Forging Machine
- Engineering Machinery and facility processing
- The Ships and Water Resources and Hydropower Hoist
- The Oil and Petrochemical Machinery
- Building and mobile machine



■ Type Code For Standard Program:

HD	-		A10VS	O	100	DR	/	31	R	-	P	P	A	12	N00
0		1	2	3	4	5		6	7		8	9	10	11	12

0. Manufacturer:

华德液压 HUADE HYDRAULIC

1. Hydraulic fluid version:

Hydraulic fluid/ Standard:	10	18	28	45	71	100	140	Code
Mineral oil.....no code	■	■	■	■	■	■	■	-
Flame retardant hydraulic fluid (HF) See details in Hydraulic Selection	-	-	■	■	■	■	■	E
High-speed version	-	-	-	□	□	□	■	H

2. Axial piston unit:

Axial piston unit / Version:	10	18	28	45	71	100	140	代码
Swash plate design, variable, up to industrial grade	■	■	■	■	■	■	■	A10VS
Size10: Nominal pressure 250 bar, Peak Pressure 315 bar. Size 18...140: Nominal pressure 280 bar, Peak Pressure 350 bar.								

3. Type of operation:

Type of operation / Version:	10	18	28	45	71	100	140	Coede
Pump, open circuit	■	■	■	■	■	■	■	O

4. Size:

Size / Version:	10	18	28	45	71*	100	140	Code
Size \cong V_{gmax} (cm ³ /r)	10	18	28	45	71	100	140	-

5. Control devices:

Control devices / Version:		10	18	28	45	71	100	140	Code
Two-point control, directly operated		-	■	■	■	■	■	■	DG
Pressure control		■	■	■	■	■	■	■	DR
pressure control...remotely operated		■	■	■	■	■	■	■	DRG
Flow control		■	■	■	■	■	■	■	DFR
Pressure and Flow control, X-T plugged		■	■	■	■	■	■	■	DFR1
Pressure, flow and power control		■	■	■	■	■	■	■	DFLR
Electro-flow control...with swash-plate position feedback		-	-	□	□	□	□	□	FE1
Flow/Pressure electronic control		-	□	□	□	□	□	□	DFE1
Electro -hydraulic pressure control	negative characteristic	12V	-	□	□	□	□	□	ED71
		24V	-	□	□	□	□	□	ED72
	positive characteristic	12V	-	□	□	□	□	□	ER71
		24V	-	□	□	□	□	□	ER72

■ Type Code For Standard Program:

6. Series:

Series / Version:	10	18	28	45	71	100	140	Code
Series 31	-	■	■	■	■	■	■	31
Series 52	■	-	-	-	-	-	-	52

7. Direction of rotation:

Direction of rotation:	Direction of rotation	Code
With view on drive shaft	Clockwise(forward dextral)	R
	Counter-clockwise (reverse left-handed)	L

8. Seals:

Seals / Version:	10	18	28	45	71	100	140	Code
NBR (Nitri-caoutchouc to DIN ISO 1629, with shaft seal FKM)	■	■	■	■	■	■	■	P
FKM (fluor-caoutchouc to DIN ISO 1629)	■	■	■	■	■	■	■	V

9. Shaft end:

Shaft end / Version:	10	18	28	45	71	100	140	Code
Keyed parallel shaft to DIN 6885	■	■	■	■	■	■	■	P
Splined shaft SAE ANSI B92.1a	not for through drive	■	■	■	■	■	■	P
	standard shaft	■	■	■	■	■	■	S
	similar to shaft S , however for higher input torque	-	■	■	■	■	-	-
reduced diameter, not for through drive	■	-	-	-	-	-	-	U

10. Mounting flange:

Mounting flange / Version:	10	18	28	45	71	100	140	Code	
ISO 3019-2 DIN	2-hole	■	■	■	■	■	■	-	A
	4-hole	-	-	-	-	-	-	■	B
ISO 3019-1 SAE	2-hole	■	-	-	-	-	-	-	C


11. Service line port:


Service line port / Version:	10	18	28	45	71	100	140	Code
Port B and S at rear of opposite sides SAE flange port , metric fixing thread	-	■	■	■	-	■	■	12
Port B and S at rear of opposite sides SAE flange port , metric fixing thread	-	-	-	-	■	-	-	42
Port B and S at rear Metric threaded ports, not for through drive	■	-	-	-	-	-	-	14


■ Type Code For Standard Program:

12. Through drive:

Through drive / Version:		10	18	28	45	71	100	140	Code
Without through drive		■	■	■	■	■	■	■	N00
With through drive for mounting an axial piston unit, gear, or radial piston pump									
Flange	Coupling for splined shaft	10	18	28	45	71	100	140	Code
Flange ISO 3019-1		ANSI B92.1a							
82-2 (A)	5/8" 9T 16/32 DP	-	■	■	■	■	■	■	K01
	3/4" 11T 16/32 DP	-	■	■	■	■	■	■	K52
101-2 (B)	7/8" 13T 16/32 DP	-	-	■	■	■	■	■	K68
	1" 15T 16/32 DP	-	-	-	■	■	■	■	K04
127-2 (C)	1-1/4" 14T 12/24 DP	-	-	-	-	■	■	■	K07
	1-1/2" 17T 12/24 DP	-	-	-	-	-	■	■	K24
152-4 (D)	1-3/4" 13T 8/16 DP	-	-	-	-	-	-	■	K17
Φ63 metric 4-hole	shaft key Φ25	-	-	■	■	■	■	■	K57
Flange ISO 3019-1		ANSI B92.1a							
ISO 80 2-hole	3/4" 11T 16/32 DP	-	■	■	■	■	■	■	KB2
ISO 100 2-hole	7/8" 13T 16/32 DP	-	-	■	■	■	■	■	KB3
	1" 15T 16/32 DP	-	-	-	■	■	■	■	KB4
ISO 125 2-hole	1-1/4" 14T 12/24 DP	-	-	-	-	■	■	■	KB5
	1-1/2" 17T 12/24 DP	-	-	-	-	-	■	■	KB6
ISO 180 2-hole	1-3/4" 13T 8/16 DP	-	-	-	-	-	-	■	KB7

 = Preferred scenario (short available time)

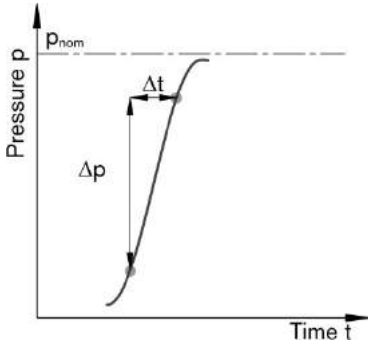
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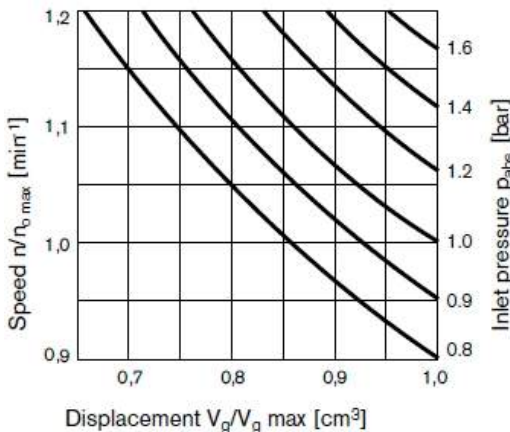
■ Technical data...Size10 Series 52 :

- Applies to mineral oil medium run
- Operating pressure range:
- Pressure at service line port (pressure port) B:
Nominal pressure P_{nom} ----- 250 bar
Peak pressure P_{max} ----- 315 bar
- Single operating period 2.5 ms, Total operating period 300 h
- Minimum pressure (high-pressure side): 10 bar absolute
- Rate of pressure change R_{Amax} : 16000 bar/s



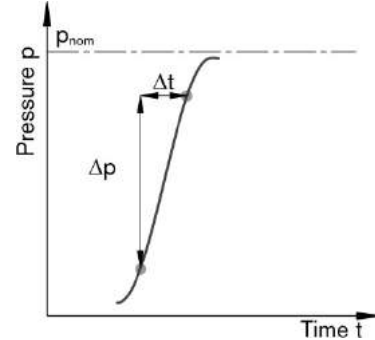
- Pressure at suction port S (inlet):
Minimum pressure $P_{S min}$ ----- 0.8 bar...absolute
Maximum pressure $P_{S max}$ ----- 5 bar ...absolute
- Case drain pressure:
- The lower the input speed and the case drain pressure, the longer the service life of the shaft end seal.
- Maximum permissible case drain pressure (at port L, L1)
Maximum 0.5 bar higher than the inlet pressure at port S, however not higher than 2 bar absolute.
 $P_{L max}$ ----- 2 bar...absolute

- Maximum permissible speed (limit speed)
- To determine the min.required inlet pressure P_{abs} at inlet port S or the reduction of displacement at higher input speeds, see the diagram below:



■ Technical data...Size18...140 Series 31

- Applies to mineral oil medium run
- Operating pressure range:
- Pressure at service line port (pressure port) B:
Nominal pressure P_{nom} ----- 280 bar
Peak pressure P_{max} ----- 350 bar
- Single operating period 2.5 ms, Total operating period 300 h
- Minimum pressure (high-pressure side): 10 bar absolute
- Rate of pressure change R_{Amax} : 16000 bar/s

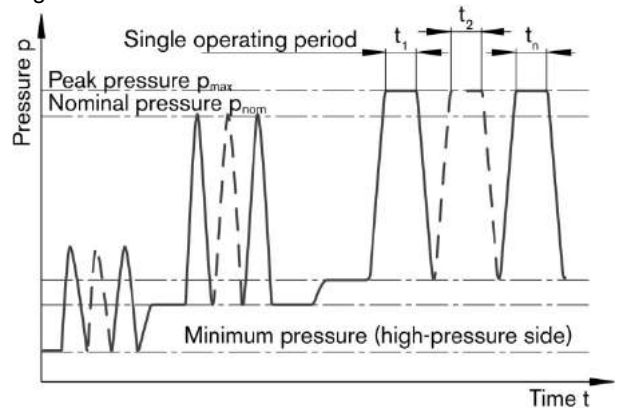


- Pressure at suction port S (inlet):
Minimum pressure $P_{S min}$ ----- 0.8 bar...absolute
Maximum pressure $P_{S max}$ ----- 10 bar
- Case drain pressure:
- The lower the input speed and the case drain pressure, the longer the service life of the shaft end seal.
- Maximum permissible case drain pressure (at port L, L1)
Maximum 0.5 bar higher than the inlet pressure at port S, however not higher than 2 bar absolute.
 $P_{L max}$ ----- 2 bar...absolute

- Definition:
- Nominal pressure P_{nom}
The nominal pressure corresponds to the maximum design pressure.

- Peak pressure P_{max}
The peak pressure corresponds the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

- Minimum pressure (high-pressure side):
Minimum pressure on the high-pressure side (B) that is required in order to prevent damage to the axial piston unit.
- Rate of pressure change R_A
Maximum permissible rate of pressure build-up and pressure reduction during a pressure change over the entire pressure range.



- Total operating period = $t_1 + t_2 + t_3 + \dots + t_n$

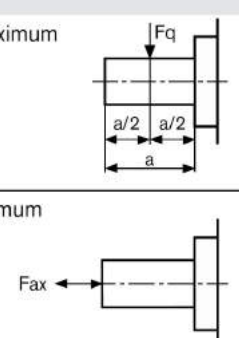
■ Technical data...Size10 Series 52:

- Standard Program, applies to mineral oil medium run
- Table of values : (theoretical values, without efficiencies and tolerances: values rounded)

Size	NG	10
Geometrical displacement per revolution	$V_{g \max}$ cm ³	10.5
Speed ³⁾		
maximum at $V_{g \max}$	n_{nom} rpm	3600
maximum at $V_g < V_{g \max}$	$n_{\text{max perm}}$ rpm	4320
Flow		
at n_{nom} and $V_{g \max}$	$q_{v \max}$ l/min	37
at $n_E = 1500$ rpm and $V_{g \max}$	$q_{vE \max}$ l/min	15
Power at $\Delta p = 250$ bar		
at n_{nom} , $V_{g \max}$	P_{\max} kW	16
at $n_E = 1500$ rpm and $V_{g \max}$	$P_{E \max}$ kW	7
Torque		
at $V_{g \max}$ and $\Delta p = 250$ bar	T_{\max} Nm	42
	T Nm	17
Rotary stiffness, drive shaft		
S	c Nm/rad	9200
R	c Nm/rad	–
U	c Nm/rad	6800
W	c Nm/rad	–
P	c Nm/rad	10700
Moment of inertia rotary group	J_{TW} kgm ²	0.0006
Angular acceleration, maximum ⁵⁾	α rad/s ²	8000
Filling capacity	V L	0.2
Weight (without through drive) approx.	m kg	8

□ Permissible radial and axial forces on the drive shaft

Size	NG	10
Radial force maximum at a/2	$F_{q \max}$ N	250
Axial force maximum	$+ F_{ax \max}$ N	400



□ Permissible input and through drive torques

Size	NG	10
Torque at $V_{g \max}$ and $\Delta p = 250$ bar ¹⁾	T_{\max} Nm	42
Input torque for drive shaft, maximum ²⁾		
S	$T_{E \max}$ Nm	126
	\emptyset in	3/4
R	$T_{E \max}$ Nm	–
	\emptyset in	–
U	$T_{E \max}$ Nm	60
	\emptyset in	5/8
W	$T_{E \max}$ Nm	–
	\emptyset in	–
P	$T_{E \max}$ Nm	90
	\emptyset mm	18
Maximum through-drive torque for drive shaft		
S	$T_{D \max}$ Nm	–
R	$T_{D \max}$ Nm	–

■ Technical data... Size 18... 140 Series 31

□ Standard Program, applies to mineral oil medium run

□ Table of values: (theoretical values, without efficiencies and tolerances: values rounded)

Size	NG		18	28	45	71	100	140	
Geometrical displacement per revolution									
	$V_{g \max}$	cm ³	18	28	45	71	100	140	
Speed ¹⁾									
	maximum at $V_{g \max}$	n_{nom} rpm	3300	3000	2600	2200	2000	1800	
	maximum at $V_g < V_{g \max}$	$n_{\text{max perm}}$ rpm	3900	3600	3100	2600	2400	2100	
Flow									
	at n_{nom} and $V_{g \max}$	$q_{v \max}$ l/min	59	84	117	156	200	252	
	at $n_E = 1500$ rpm and $V_{g \max}$	$q_{vE \max}$ l/min	27	42	68	107	150	210	
Power at $\Delta p = 280$ bar									
	at n_{nom} , $V_{g \max}$	P_{\max} kW	30	39	55	73	93	118	
	at $n_E = 1500$ rpm and $V_{g \max}$	$P_{E \max}$ kW	12.6	20	32	50	70	98	
Torque									
	at $V_{g \max}$ and	$\Delta p = 280$ bar	T_{\max} Nm	80	125	200	316	445	623
		$\Delta p = 100$ bar	T Nm	30	45	72	113	159	223
Rotary stiffness, drive shaft									
	S	c	Nm/rad	11087	22317	37500	71884	121142	169537
	R	c	Nm/rad	14850	26360	41025	76545	–	–
	P	c	Nm/rad	13158	25656	41232	80627	132335	188406
Moment of inertial rotary group			J_{TW} kgm ²	0.00093	0.0017	0.0033	0.0083	0.0167	0.0242
Angular acceleration, maximum ²⁾			α rad/s ²	6800	5500	4000	3300	2700	2700
Filling capacity			V L	0.4	0.7	1.0	1.6	2.2	3.0
Weight (without through drive) approx.			m kg	12	15	21	33	45	60

1) The values are applicable:

- ✚ for absolute pressure $P_{\text{abs}} = 1$ bar at the suction port S;
- ✚ for the optimum viscosity range of $V_{\text{opt}} = 16$ to 36 mm²/s
- ✚ for mineral-based operating materials

2) The scope of application lies between the minimum necessary and the maximum permissible drive speeds:

- ✚ Valid for external excitation;
- ✚ The limiting value is only valid for a single pump;
- ✚ The loading capacity of the connecting parts must be taken into account.
- ✚ If the drive speed continuous increasing and up to the limit speed, please conform to the curves shows.

□ Notes:

✚ Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit.

✚ We recommend checking the loading with tests or calculations /simulations and comparison with the permissible values.

□ Determination of size:

Flow	$q_v = \frac{V_g \cdot n \cdot \eta_v}{1000}$	[l/min]	V_g = Displacement per revolution in cm ³
			Δp = Differential pressure in bar
Torque	$T = \frac{V_g \cdot \Delta p}{20 \cdot p \cdot h_{mh}}$	[Nm]	n = Speed in rpm
			η_v = Volumetric efficiency
Power	$P = \frac{2\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p}{600 \cdot \eta_t}$	[kW]	η_{mh} = Mechanical-hydraulic efficiency
			η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

■ Technical data...Size18...140 Series 31:

□ High- speed version, applies to mineral oil medium run

□ Table of values: (theoretical values, without efficiencies and tolerances: values rounded)

Size	NG		45	71	100	140		
Geometrical displacement per revolution								
	$V_{g \max}$	cm ³	45	71	100	140		
Speed ¹⁾								
	maximum at $V_{g \max}$	n_{nom}	rpm	3000	2550	2300	2050	
	maximum at $V_g < V_{g \max}$	$n_{\text{max perm}}$	rpm	3300	2800	2500	2200	
Flow								
	at n_{nom} and $V_{g \max}$	$q_{v \max}$	l/min	135	178	230	287	
Power at $\Delta p = 280$ bar								
	at n_{nom} , $V_{g \max}$	P_{\max}	kW	63	83	107	134	
Torque								
	at $V_{g \max}$ and	$\Delta p = 280$ bar	T_{\max}	Nm	200	316	445	623
		$\Delta p = 100$ bar	T	Nm	72	113	159	223
Rotary stiffness, drive shaft								
	S	c	Nm/rad	37500	71884	121142	169537	
	R	c	Nm/rad	41025	76545	–	–	
	P	c	Nm/rad	41232	80627	132335	188406	
Moment of inertial rotary group								
	J_{TW}	kgm ²	0.0033	0.0083	0.0167	0.0242		
Angular acceleration, maximum ²⁾								
	α	rad/s ²	4000	3300	2700	2700		
Filling capacity								
	V	L	1.0	1.6	2.2	3.0		
Weight (without through drive) approx.								
	m	kg	21	33	45	60		

3) The values are applicable:

- ✚ for absolute pressure $P_{\text{abs}} = 1$ bar at the suction port S;
- ✚ for the optimum viscosity range of $V_{\text{opt}} = 16$ to 36 mm²/s
- ✚ for mineral-based operating materials

4) The scope of application lies between the minimum necessary and the maximum permissible drive speeds:

- ✚ Valid for external excitation;
- ✚ The limiting value is only valid for a single pump;
- ✚ The loading capacity of the connecting parts must be taken into account.
- ✚ If the drive speed continuous increasing and up to the limit speed, please conform to the curves shows.

□ Notes:

✚ Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit.

✚ We recommend checking the loading with tests or calculations /simulations and comparison with the permissible values.

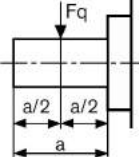
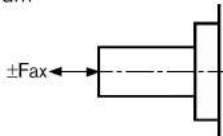
□ Recommendation:

Sizes 45, 71, 100 and 140 are optionally available in high-speed version.

External dimensions are not affected by this option.

■ Technical data:

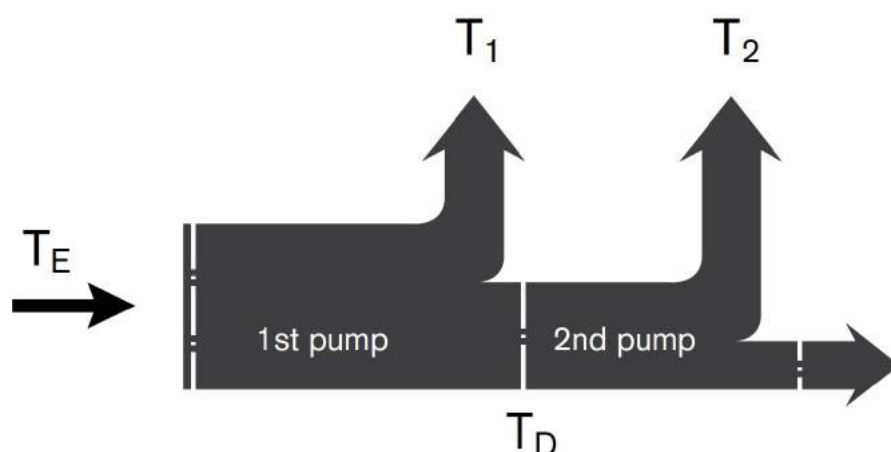
□ Permissible radial and axial loading on the drive shaft

Size	NG	18	28	45	71	100	140
Radial force maximum at $a/2$	 $F_{q \max}$ N	350	1200	1500	1900	2300	2800
Axial force maximum	 $\pm F_{ax}$ $+ F_{ax \max}$ N	700	1000	1500	2400	4000	4800

□ Permissible input and through-drive torques

Size	NG	18	28	45	71	100	140
Torque at $V_{g \max}$ and $\Delta p = 280 \text{ bar}^1$)	T_{\max} Nm	80	125	200	316	445	623
Input torque for drive shaft, maximum ²⁾							
S	$T_{E \max}$ Nm	124	198	319	626	1104	1620
	\emptyset in	3/4	7/8	1	1 1/4	1 1/2	1 3/4
R	$T_{E \max}$ Nm	160	250	400	644	–	–
	\emptyset in	3/4	7/8	1	1 1/4	–	–
P	$T_{E \max}$ Nm	88	137	200	439	857	1206
	\emptyset mm	18	22	25	32	40	45
Maximum through-drive torque for drive shaft							
S	$T_{D \max}$ Nm	108	160	319	492	778	1266
R	$T_{D \max}$ Nm	120	176	365	548	–	–
P	$T_{D \max}$ Nm	88	137	200	439	778	1206

□ Distribution of torques:



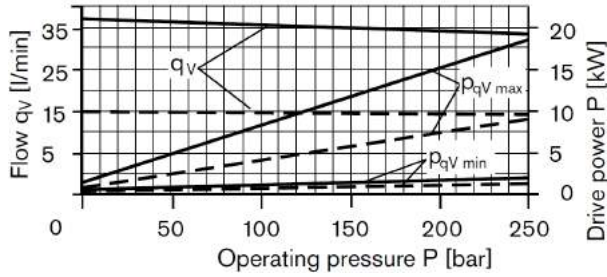
■ Drive power and flow:

□ Operating material:

Hydraulic fluid ISO VG 46 DIN 51519, $t = 50 \text{ } ^\circ \text{C}$

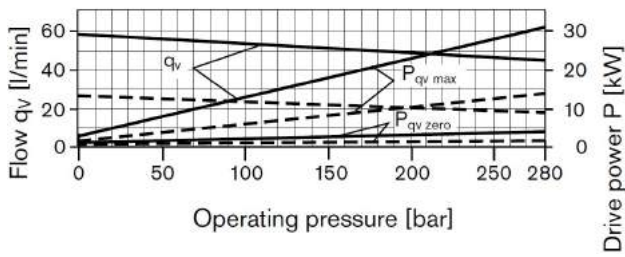
□ Size10

----- n = 1500 rpm
 _____ n = 3600 rpm



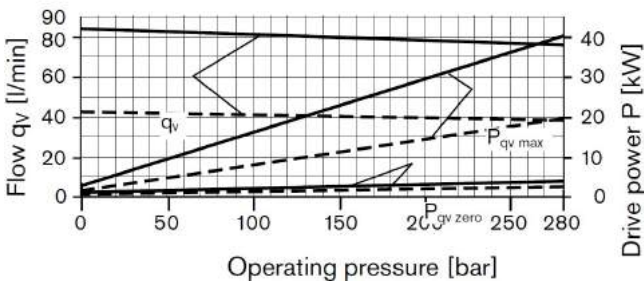
□ Size18

----- n = 1500 rpm
 _____ n = 3300 rpm



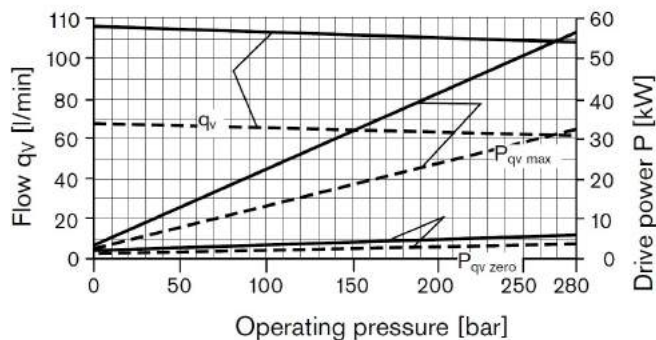
□ Size 28

----- n = 1500 rpm
 _____ n = 3000 rpm



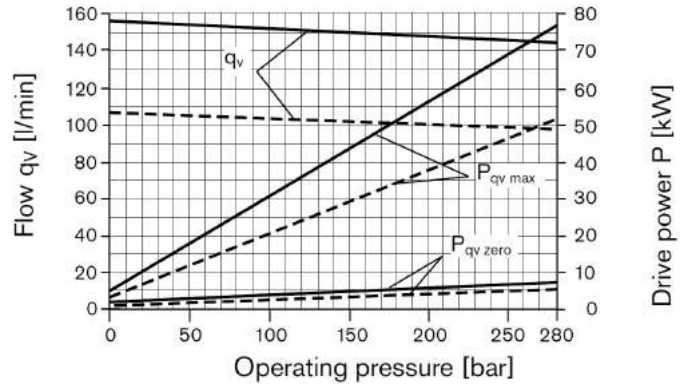
□ Size 45

----- n = 1500 rpm
 _____ n = 2600 rpm



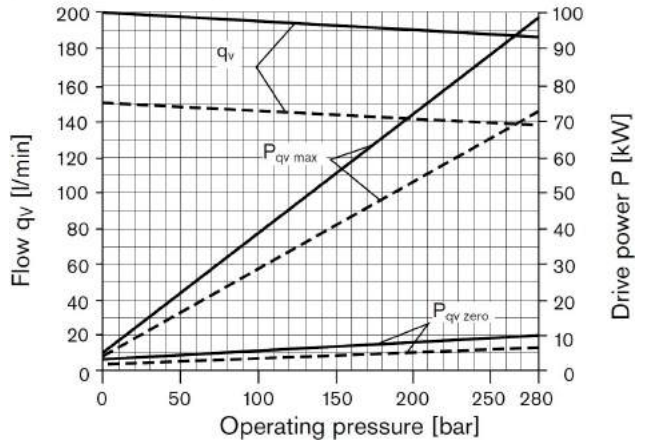
□ Size 71

----- n = 1500 rpm
 _____ n = 2200 rpm



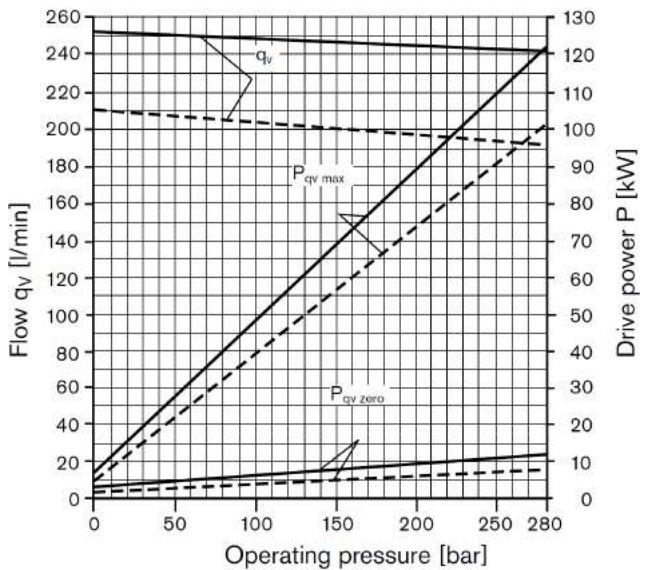
□ Size100

----- n = 1500 rpm
 _____ n = 2000 rpm



□ Size140

----- n = 1500 rpm
 _____ n = 1800 rpm



■ Characteristics curves.....Pressure control DR:

■ Noise level

Characteristics for pump

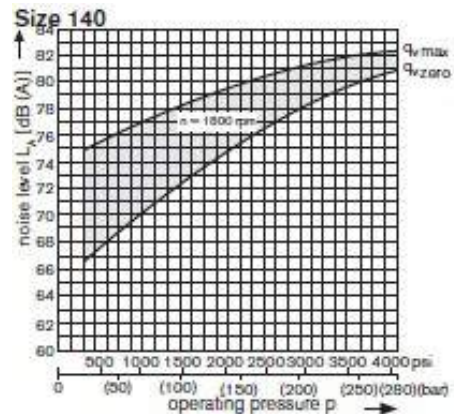
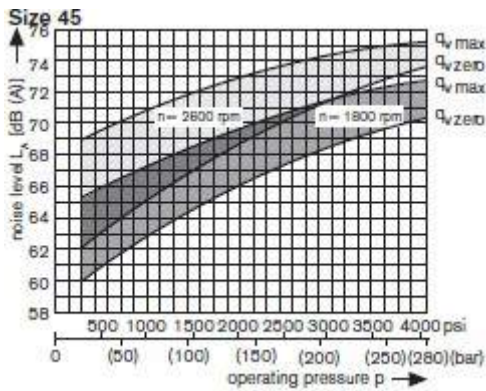
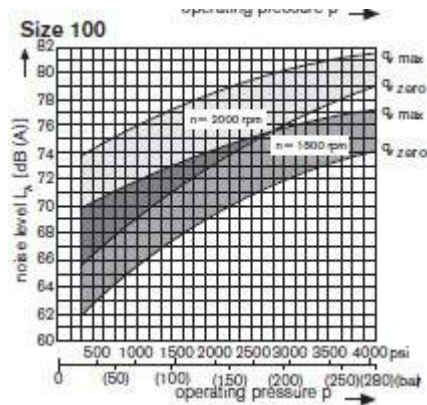
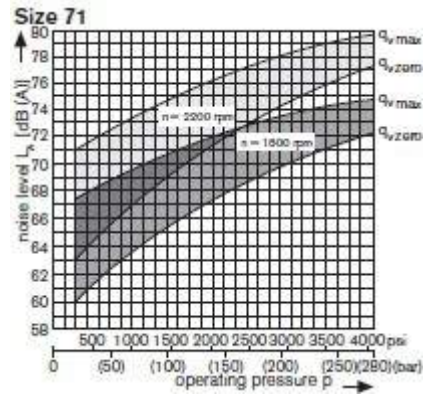
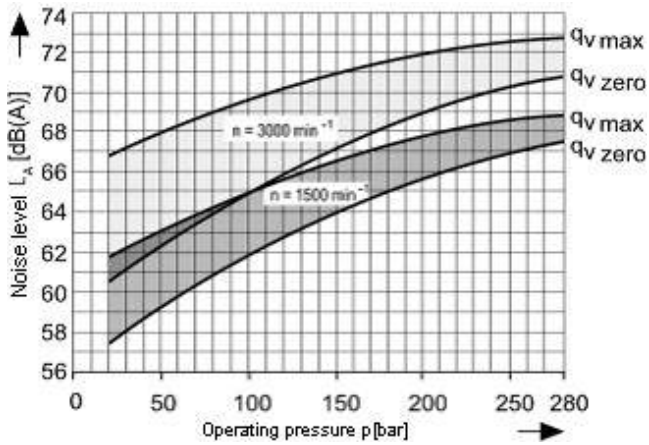
Measured in an anechoic chamber

Distance from microphone to pump = 3.3ft (1m)

Measuring error: $\pm 2\text{dB(A)}$

Fluid: Hydraulic oil to DIN45 635, $t=122^\circ\text{F}$ (50°C)

□ Size 28



■ DG - Two-point control, directly operated

- Characteristics:
- The variable pump can be set to a minimum swivel angle by
- connecting an external control pressure to port X.
- This will supply control fluid directly to the stroke piston; a
- minimum control pressure of $p_{st} \geq 50$ bar is required
- The variable pump can only be switched between V_{gmax} or V_{gmin} .

■ Controls

- The required control pressure at port X is directly dependent on the actual operating pressure p_B in port B. (See control pressure characteristic).

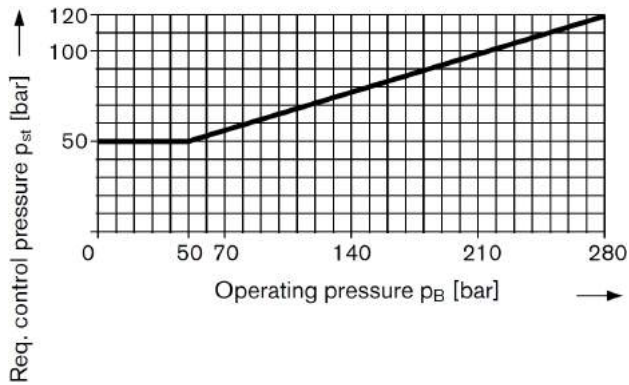
Control pressure p_{st} in $X = 0$ bar $\hat{=}$ V_{gmax}

Control pressure p_{st} in $X \geq 50$ bar $\hat{=}$ V_{gmin}

□ Controller Data:

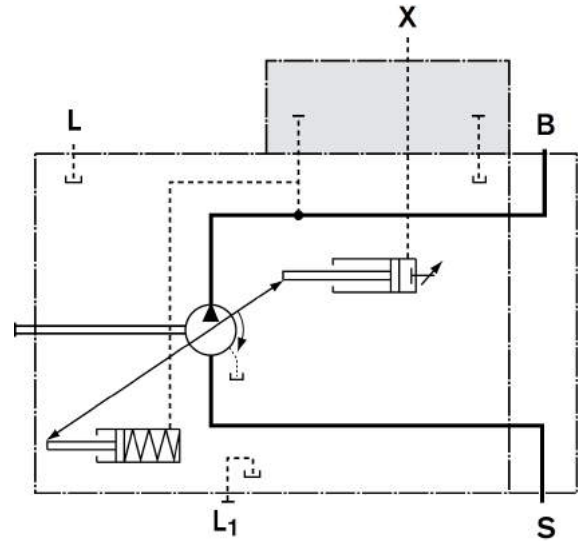
- Min operating pressure \square 50 bar
- Max operating pressure \square 120 bar

■ Control pressure characteristic:



■ Circuit diagram:

- Size18...140 Series 31:



□ Service line port

	Port for
B	Service line
S	Suction line
L, L₁	Case drain (L ₁ plugged)
X	Pilot pressure

■ DR – Pressure control:

■ Characteristics:

The pressure control limits the maximum pressure at the pump output within the pump control range. The variable pump only supplies as much hydraulic fluid as is required by the consumers.

If the operating pressure exceeds the pressure setpoint set at the integrated pressure valve, the pump will adjust towards a smaller displacement and the control deviation will be reduced. The pressure can be set steplessly at the control valve.

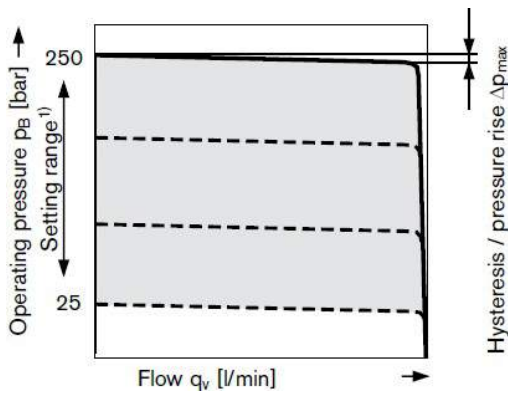
Pressure setting range:

Size10	Series 52	25...250 bar
Size18...100	Series 31	25...280 bar

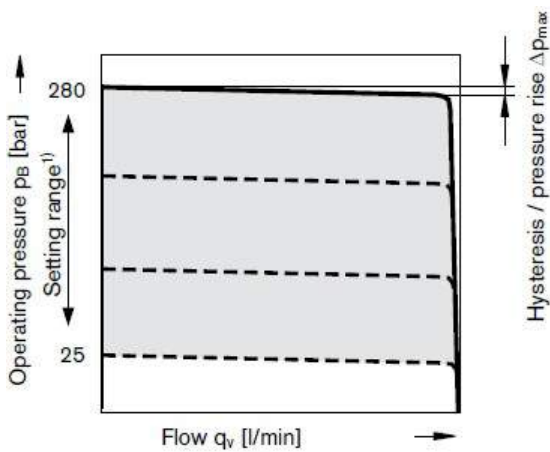
■ Static characteristic:

□ Working Conditions: $n = 1500 \text{ rpm}$ $t_{oil} = 50^\circ\text{C}$

□ Size10 Series 52



□ Size18...100 Series 31



1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and must not be exceeded. The range of possible settings at the valve is higher.

■ Controller Data:

□ Hysteresis and repeatability Δp maximum 3 bar

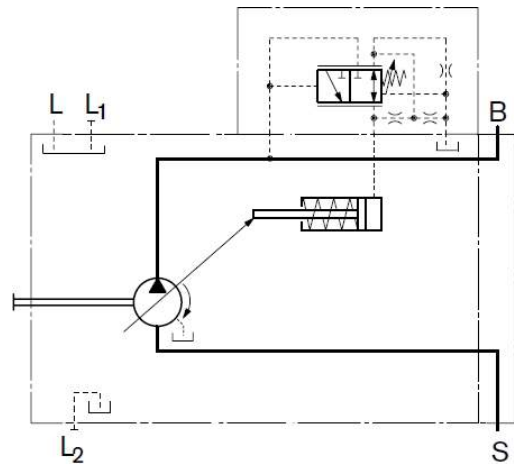
□ Pressure rise, maximum:

Size	10	18	28	45	71	100	140
Δp bar	6	4	4	6	8	10	12

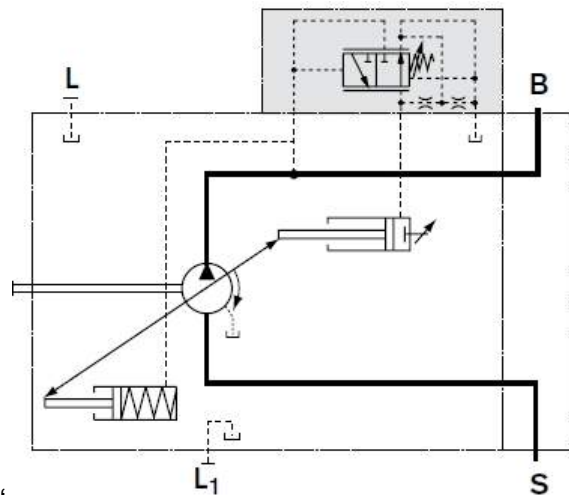
□ Control fluid consumptionmaximum approx.3 L/min

■ Circuit diagram:

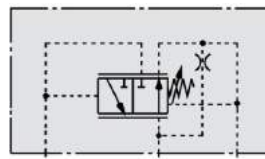
□ Size10 Series 52



□ Size18...100 Series31



□ Size 140 Series31

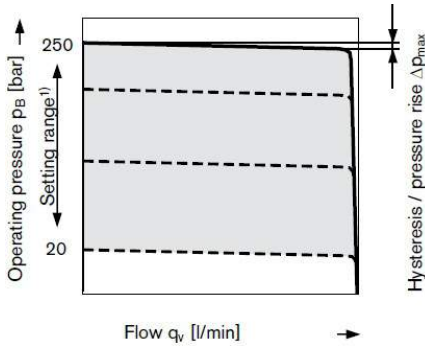


□ Service line port

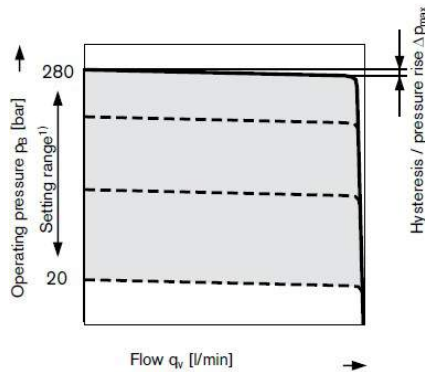
	Port for
B	Service line
S	Suction line
L, L ₁	Case drain (L ₁ plugged)

- DRG - Pressure control, remotely operated
- Characteristics:
 - The pressure control limits the maximum pressure at the pump output within the pump control range. The variable pump only supplies as much hydraulic fluid as is required by the consumers. The pressure can be set steplessly at the control valve.
 - The DRG control valve overrides the function of the DR pressure controller
 - A pressure relief valve can be externally piped to port X for remote setting of pressure below the setting of the DR control valve spool. This relief valve is not included in the delivery contents of the DRG control. As per consumers' requirements, the DRG controller can also be equipped with pressure regulating valve block or multiple pressure regulating valve block specially designed for HUADE hydraulic.
 - The max. length of piping should not exceed 2 m.
- Setting:
 - The differential pressure at the DRG control valve is set as standard to 20 bar. This results in a pilot oil flow to the relief valve of approx. 1.5 l/min at port X. If another setting is required (range from 10-22 bar) please state in clear text.

- Static characteristic:
 - Working Conditions: $n = 1500 \text{ rpm}$ $t_{oil} = 50^\circ\text{C}$
 - Size10 Series 52



- Size18...140 Series 31



1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and must not be exceeded. The range of possible settings at the valve is higher

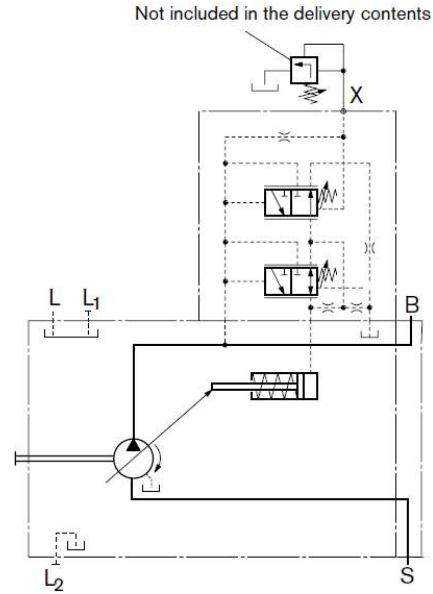
- Controller data:
 - Hysteresis and repeatability Δp maximum 3 bar
 - Pressure rise, maximum:

Size	10	18	28	45	71	100	140
Δp bar	6	4	4	6	8	10	12

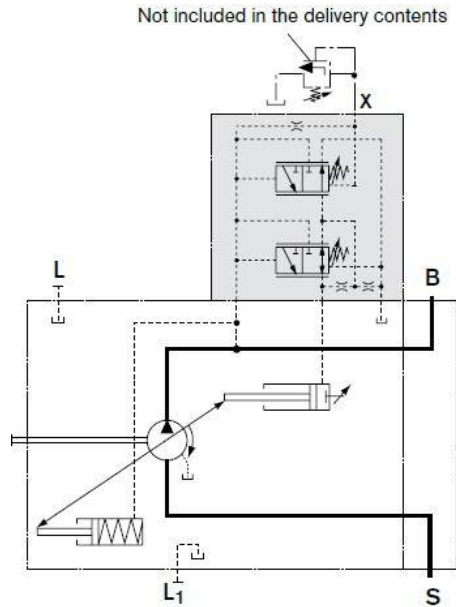
- Control fluid consumption.....maximum approx.4.5 L/min

- Circuit diagram:

- Size10 Series 52

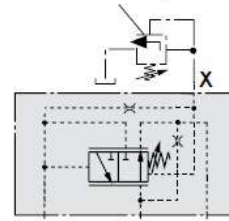


- Size18...100 Series31



- Size140

Not included in the delivery contents



- Connection lines:

- B Service line
- S Suction line
- L/L₁ Case drain (L1 plugged)
- X Pilot pressure Size10...100 with adapter
- X Pilot pressure Size140 without adapter

■ DFR/DFR1– Pressure and flow control

□ Constant flow control

■ Characteristics:

□ In addition to the pressure control function, the pump flow may be varied by means of a differential pressure over an adjustable orifice installed in the service line to the actuator. The pump flow is equal to the actual required flow by the actuator, regardless of changing pressure levels.

□ The pressure control overrides the flow control function

■ Setting:

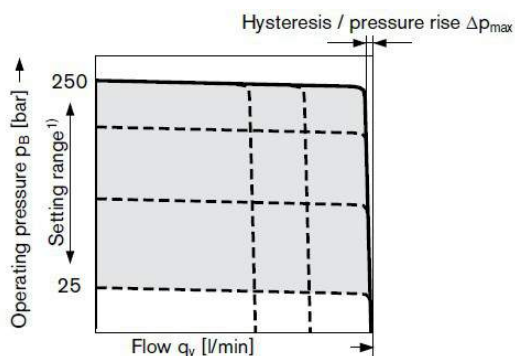
□ The DFR1 version has no connection between X and the reservoir. Unloading the LS-pilot line must be possible in the valve system.

□ Because of the flushing function sufficient unloading of the X-line must also be provided.

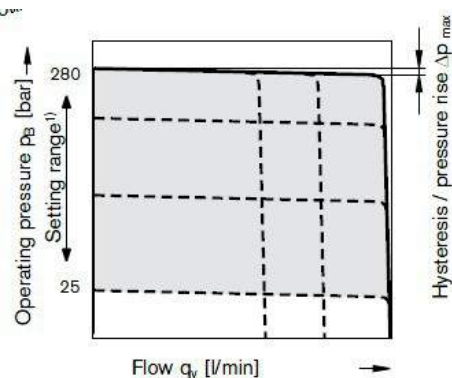
■ Static characteristic:

(n = 1500 rpm t_{oil} = 50°C)

□ Size10 Series 52



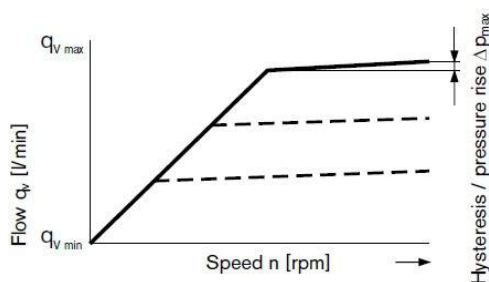
□ Size18...140 Series 31



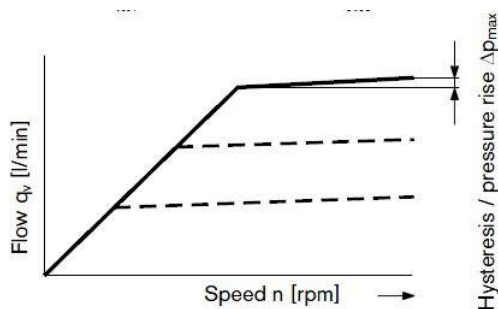
1) In order to prevent damage to the pump and the system, this setting range is the permissible setting range and must not be exceeded.

■ Static characteristic at variable speed:

□ Size10 Series 52



□ Size18...140 Series31



□ Differential pressure Δp

Standard setting: 14 to 22 bar.

If another setting is required, please state in clear text.

□ Relieving the load on port X to the reservoir results in a zero stroke ("standby") pressure which lies about 1 to 2 bar higher than the differential pressure Δp. System influences are not taken into account.

■ Controller data :

□ Hysteresis and repeatability Δp..... maximum 3 bar

□ Pressure rise, maximum:

Size	10	18	28	45	71	100	140
Δp bar	6	4	4	6	8	10	12

□ Control fluid consumption.....maximum approx.4.5 L/min

■ Maximum flow deviation:

□ Measured at drive speed n = 1500 rpm

Size	10	18	28	45	71	100	140
Δq _{max} l/min	0.5	1.0	1.0	1.8	2.8	4.0	6.0

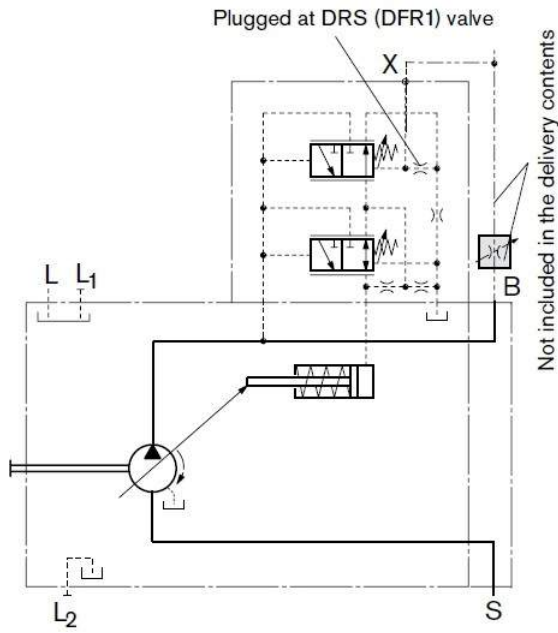
□ Control fluid consumption DFR_maximum approx. 3 to 4.5 l/min

□ Control fluid consumption DFR1_____maximum approx. 3 l/min

■ DFR/DFR1– Pressure and flow control:

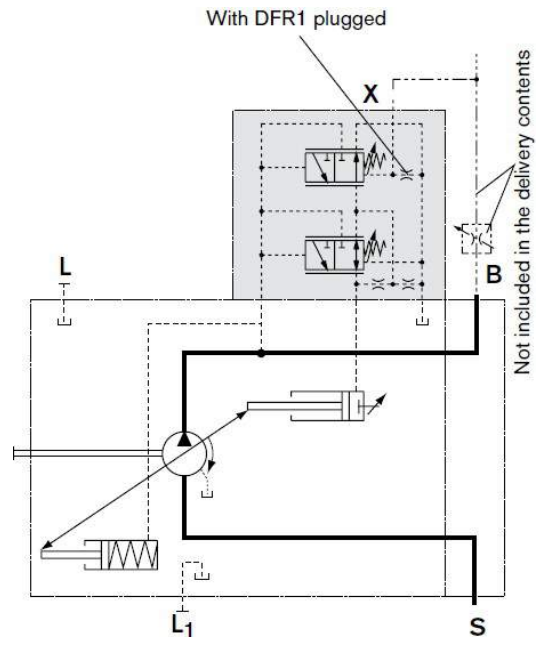
■ Circuit diagram:

□ Size 10 Series 52

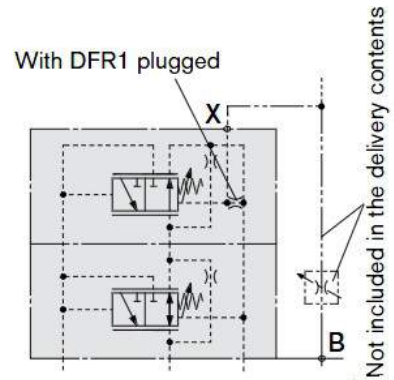


■ Circuit diagram:

□ Size 18...100 Series 31



□ Size 140 Series 31



□ Connection lines:

- B Service line
- S Suction line
- L/L₁ Case drain (L₁ plugged)
- X Pilot pressure

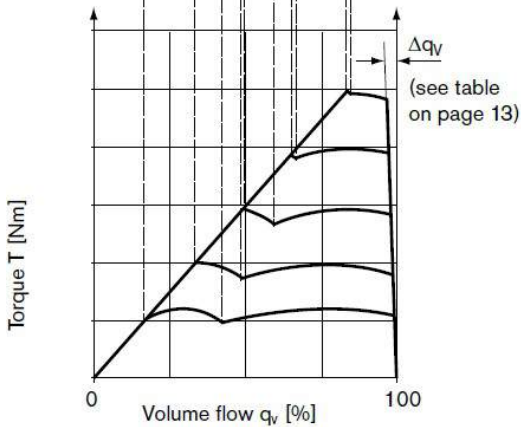
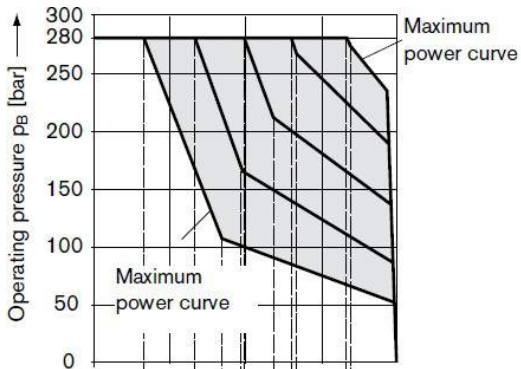
■ DFLR – Pressure, flow and power control:

- Constant power control

■ Characteristics:

- In order to achieve a constant drive torque with varying operating pressures, the swivel angle and with it the output flow from the axial piston pump is varied so that the product of flow and pressure remains constant.
- Flow control is possible below the power control curve.

■ Static curves and torque characteristic:



- The power characteristic is set in the factory; when ordering, please state in clear text, e.g. 20 kW at 1500 rpm.

■ Controller data:

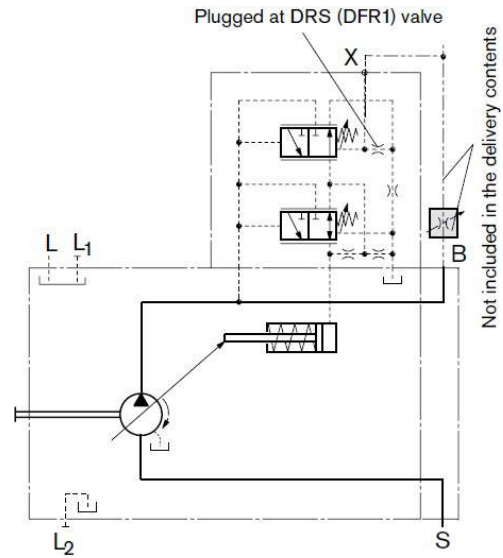
- Beginning of control..... 50 bar
- Control fluid consumption..... maximum approx. 5.5 L/min
- For pressure control DR data: See page 14.
- For flow control FR data: See page 16.

□ Connection lines:

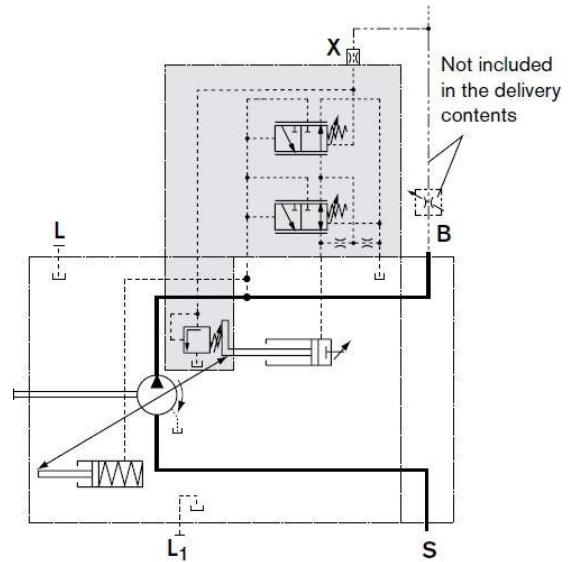
- B Service line
- S Suction line
- L/L₁ Case drain (L₁ plugged)
- X Pilot pressure

■ Circuit diagram:

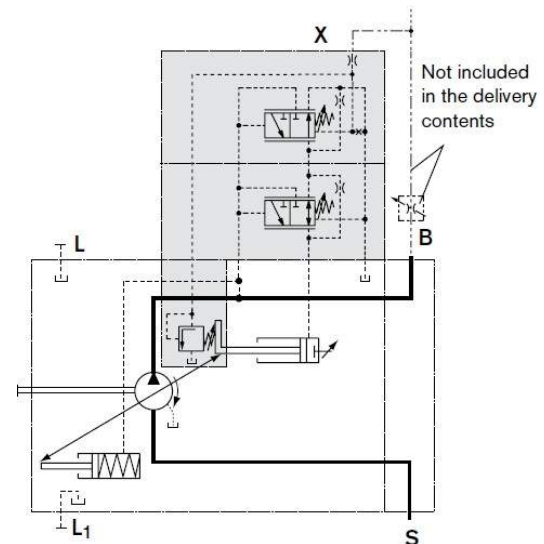
- Size10 Series52



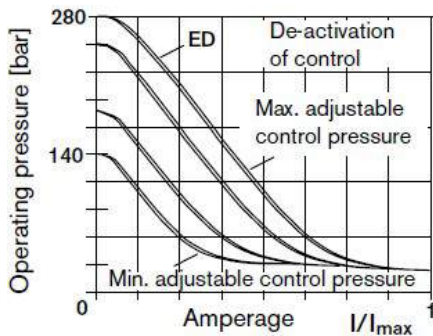
- Size18...100 Series31



- 规格 140 系列 31

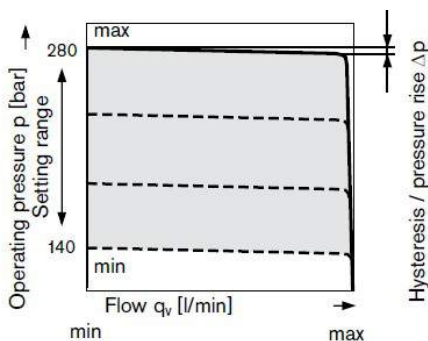


- ED – Electro-hydraulic pressure control:
 - Electro-hydraulic pressure control...negative characteristic
- Characteristics:
 - The ED valve is set to a certain pressure by a specified, variable solenoid current, If there is a change at the consumer (load pressure), the position of the control piston changes.
 - This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level. The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.
 - When the solenoid current signal drops towards a zero value, the maximum output pressure is limited to p_{max} by an adjustable hydraulic pressure cut-off.
 - The response time characteristic of the ED-control was optimized for the use as a fan drive system. When ordering, state the type of application in clear text.
- Static current-pressure characteristic ED:
 - Measured at pump in zero stroke - negative characteristic
 - Hysteresis of the static current-pressure characteristic < 3 bar



■ Static flow-pressure characteristic:

- At $n = 1500 \text{ rpm}$ $t_{oil} = 50^\circ\text{C}$

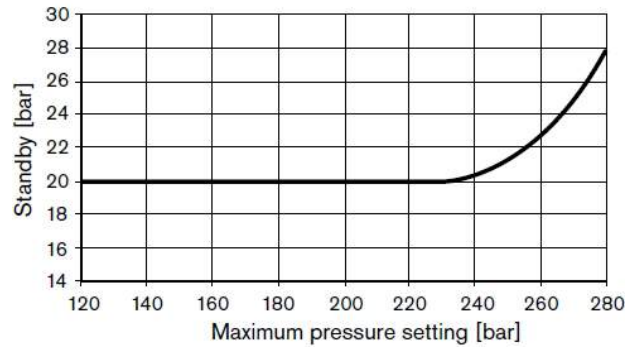


Control data

Stand-by standard setting 20 bar, other values on request.

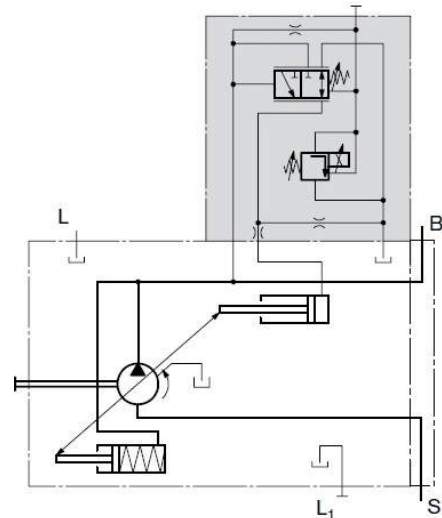
Hysteresis and pressure increase _____ $\Delta p < 4 \text{ bar}$
 Control fluid consumption _____ 3 to 4.5 l/min.

■ Influence of pressure setting on standby level:



■ Circuit diagram:

- Size 18...100 Series 31



□ Connection lines:

- B Service line
- S Suction line
- L/L₁ Case drain (L₁ plugged)

■ Technical data:

- Operating temperature range at valve -20°C to $+115^\circ\text{C}$

Technical data, solenoid	ED71	ED72
Voltage	12 V ($\pm 20\%$)	24 V ($\pm 20\%$)
Control current		
Control begin at $q_{v \text{ min}}$	100 mA	50 mA
End of control at $q_{v \text{ max}}$	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 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %
For type of protection, see plug design on page 43		
For details on the control electronics, see page 16		

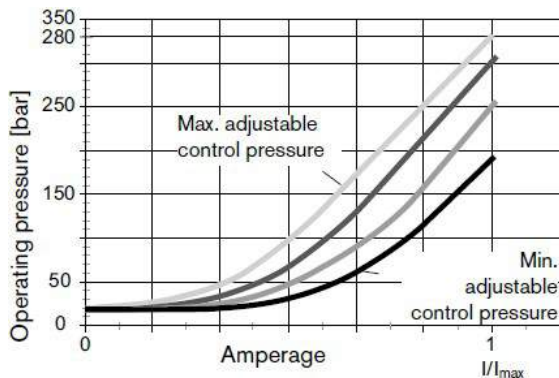
- ER – Electro-hydraulic pressure control:
- Electro-hydraulic pressure control...positive characteristic

■ Characteristics:

- The ER valve is set to a specific pressure by a specified, variable solenoid current. If there is a change at the consumer (load pressure), the position of the control piston changes.
- This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level. The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.
- If the solenoid current drops to zero, the pressure is limited to p_{min} (stand-by).

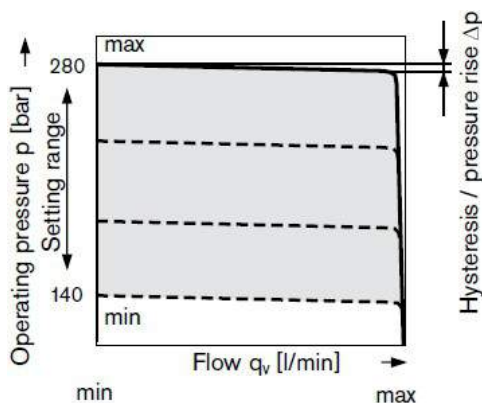
■ Static current-pressure characteristic ER:

- measured at pump in zero stroke - positive characteristic
- Hysteresis of the static current-pressure characteristic < 3 bar
- Influence of pressure setting on stand-by ± 2 bar



■ Static flow-pressure characteristic:

- At $n = 1500$ rpm $t_{oil} = 50^\circ C$

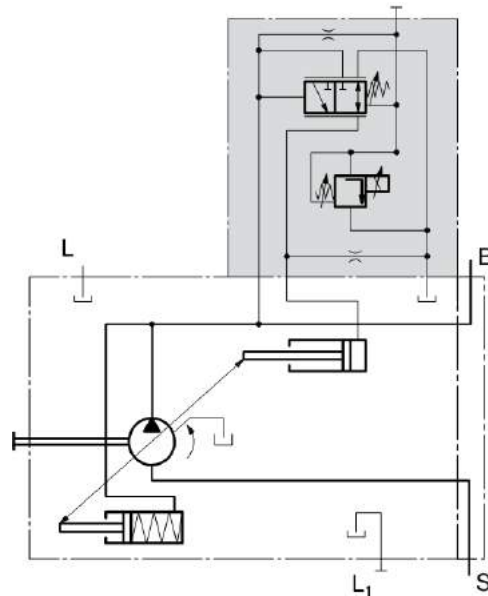


■ Control data:

- Standby standard setting 20 bar, other values on request.
- Hysteresis and pressure increase $\Delta p < 4$ bar
- Control fluid consumption 3~4.5 L/min

■ Circuit diagram:

- Size18...100 Series 31



□ Connection lines:

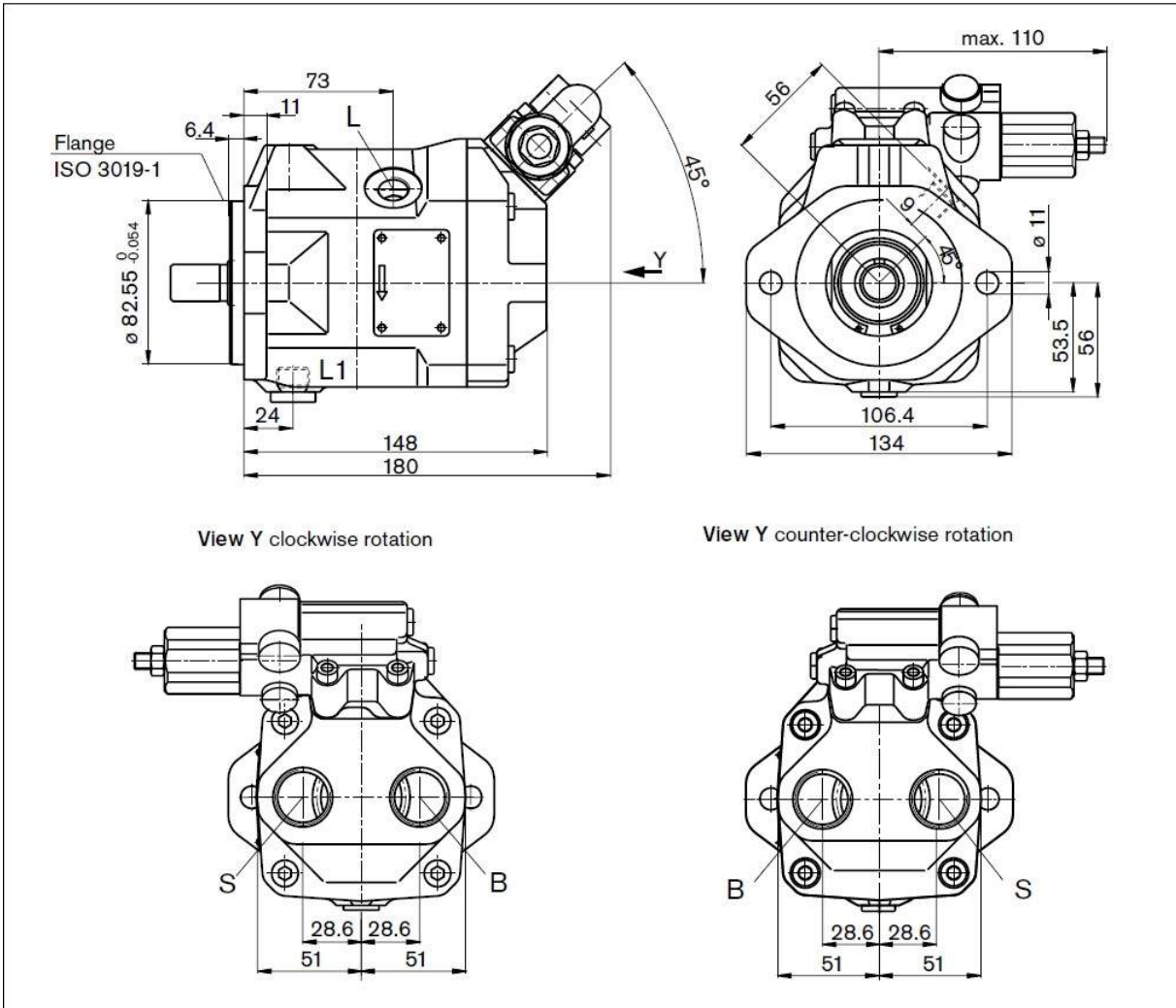
- B Service line
- S Suction line
- L/L₁ Case drain (L₁ plugged)

■ Technical data:

- operating temperature range at valve -20 °C to +115°C

Technical data, solenoid	ED71	ED72
Voltage	12 V ($\pm 20\%$)	24 V ($\pm 20\%$)
Control current		
Control begin at $q_{v\ min}$	100 mA	50 mA
End of control at $q_{v\ max}$	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 to 200 Hz	100 to 200 Hz
Actuated time	100 %	100 %
For type of protection, see plug design on page 43		

- Dimensions: Size10 Series 52
- DR - Pressure control:
- Centering flange SAE version

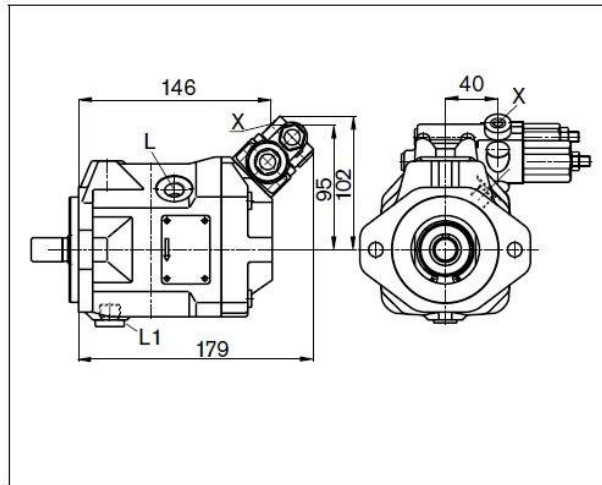
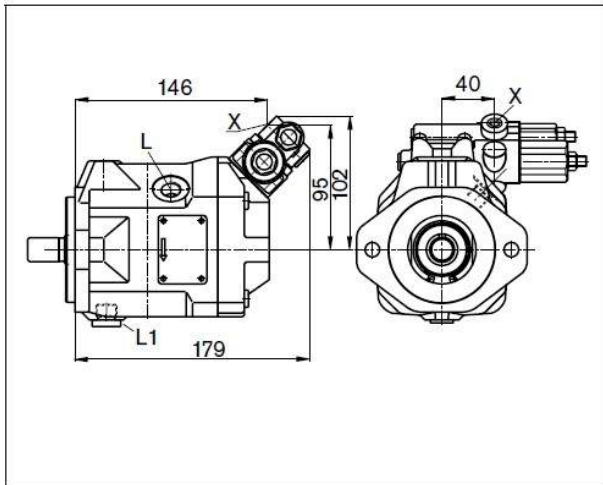


DRG

Pressure and flow control, remote controlled

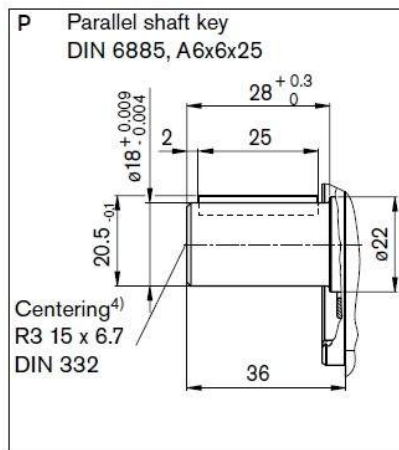
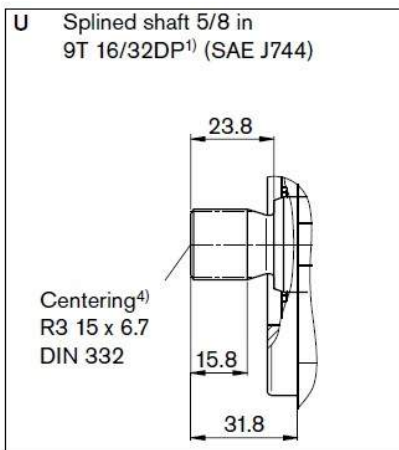
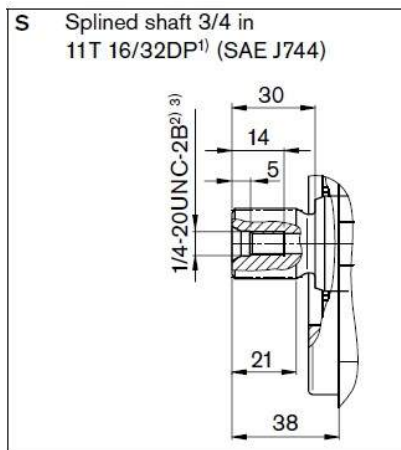
DFR / DFR1

Pressure and flow control



■ Dimensions: Size10 Series 52

□ Drive shaft:



- 1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Thread according to ASME B1.1
- 3) For the maximum tightening torques the general instructions on page 9 must be observed.
- 4) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw

□ Ports:

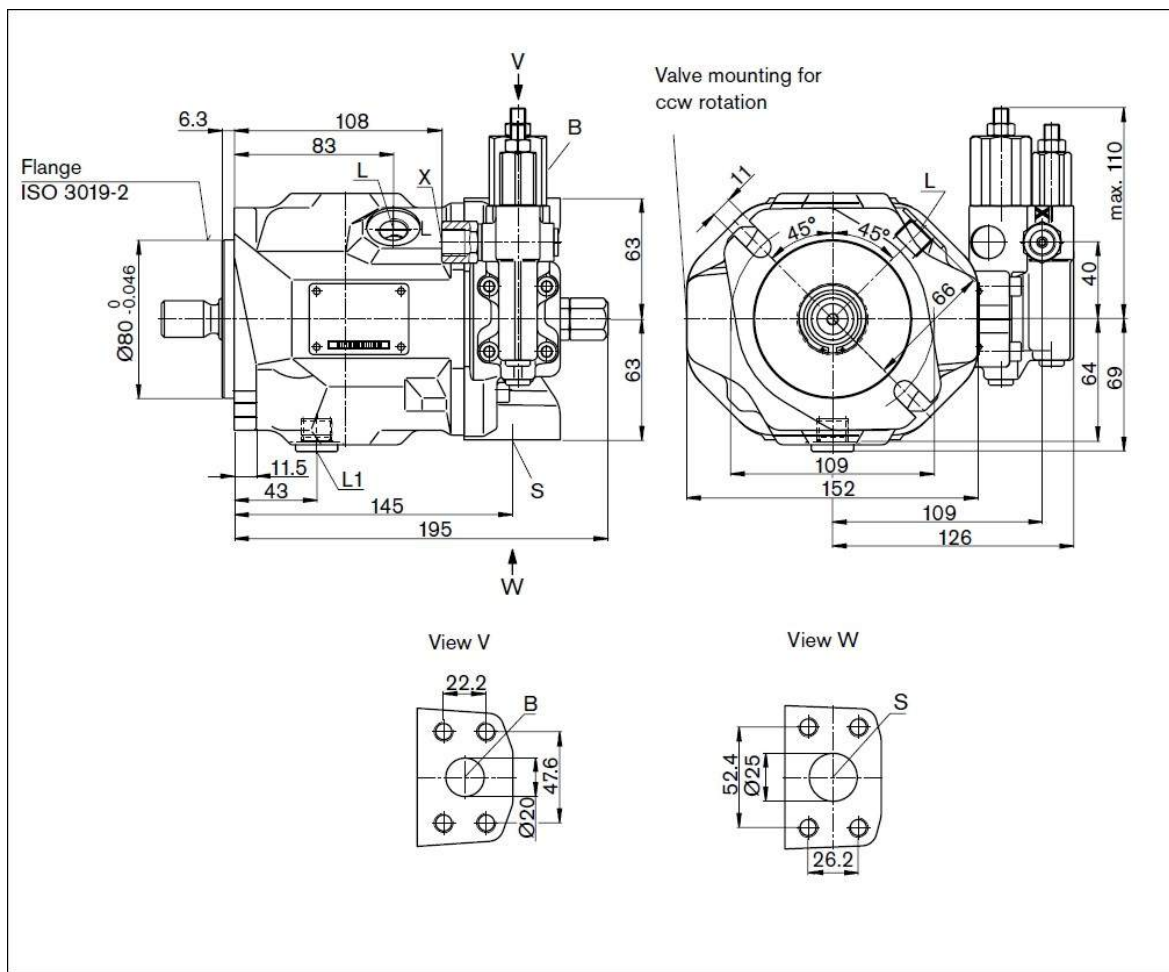
Designation	Port for	Standard	Size	Maximum pressure (bar)	State
B	Service line	DIN 3852	M27 X 2 16 deep	315	O
S	Suction line	DIN 3852	M27 X 2 16 deep	5	O
L...metric	Case drain fluid	DIN 3852	M16 X 1.5 12 deep	2	O
L ₁ ...metric	Case drain fluid	DIN 3852	M16 X 1.5 12 deep	2	X
L...SAE	Case drain fluid	ISO 11926	9/16-18 UNF-2B 16 deep	2	O
L ₁ ...SAE	Case drain fluid	ISO 11926	9/16-18 UNF-2B 16 deep	2	X
X...with adapter	Pilot pressure	DIN 3852	M14 X 1.5 11.5 deep	315	O
X...without adapter	Pilot pressure	ISO 11926	7/16-20 UNF-2B 11.5 deep	315	O

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

■ Dimensions: Size 18

□ DFR/DFR1 - Pressure and flow control, hydraulic:

□ Clockwise rotation



□ Ports:

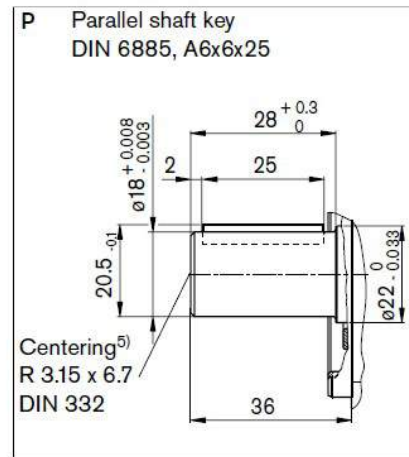
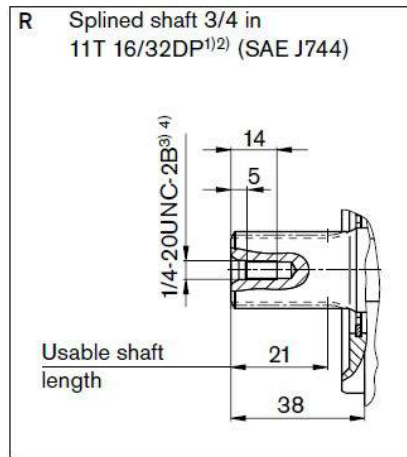
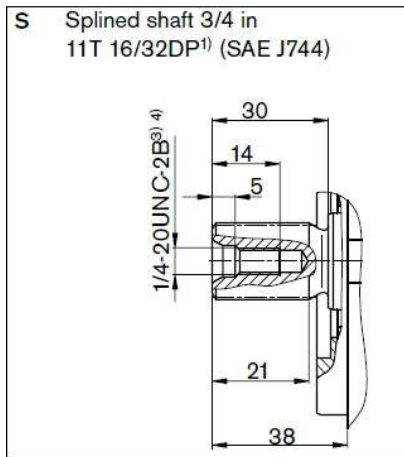
Designation	Port for	Standard	Size	Maximum pressure (bar)	State
B	Service line fastening thread	SAE J518 DIN 13	3/4" M10 X 1.5 17 deep	350	O
S	Suction line fastening thread	SAE J518 DIN 13	1" M10 X 1.5 17 deep	10	O
L	Case drain fluid	DIN 3852	M16 X 1.5 12 deep	2	O
L1	Case drain fluid	DIN 3852	M16 X 1.5 12 deep	2	X
X	Pilot pressure	DIN 3852	M14 X 1.5 12 deep	350	O
X	Pilot pressure with DG-control	ISO 228	G 1/4" 12 deep	350	O

□ O = Must be connected (plugged on delivery)

□ X = Plugged (in normal operation)

■ Dimensions: Size 18

□ Drive shaft:

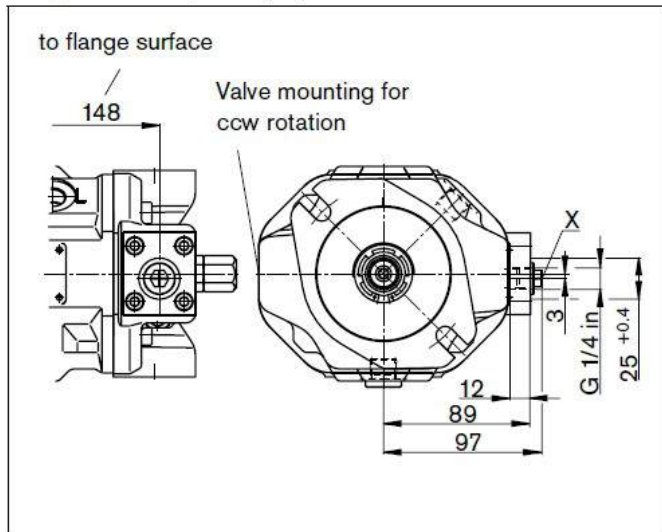


- 1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard
- 3) Thread according to ASME B1.1
- 4) For the maximum tightening torques the general instructions on [page 9 must be observed](#)
- 5) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw

■ Dimensions: Size 18

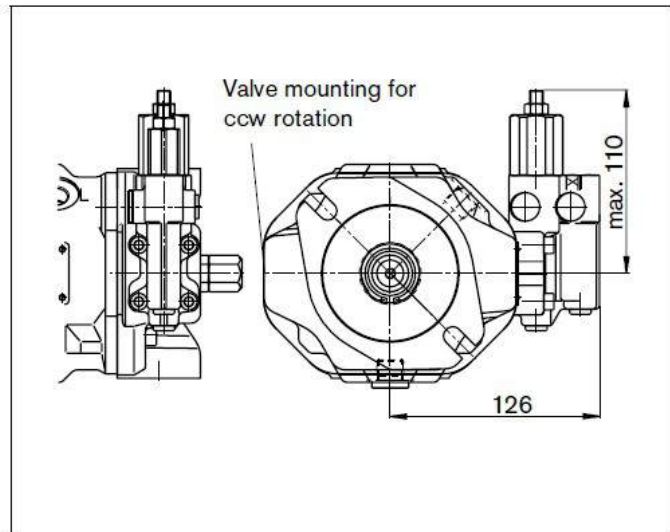
DG

Two-point control, directly operated



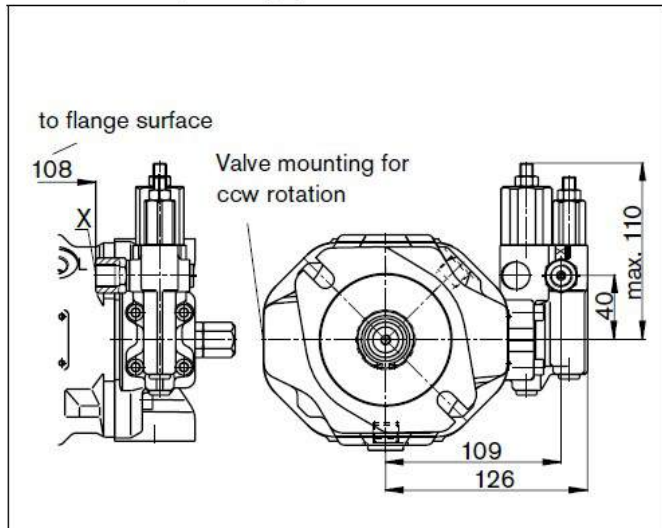
DR

Pressure control



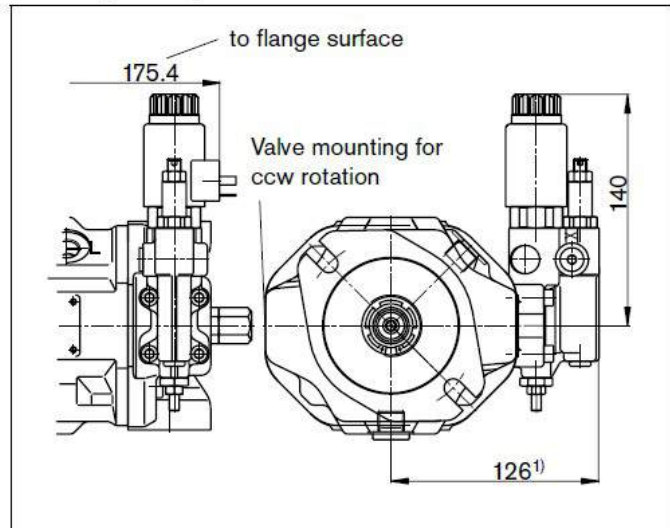
DRG

Pressure control, remotely operated



ED7., ER7.

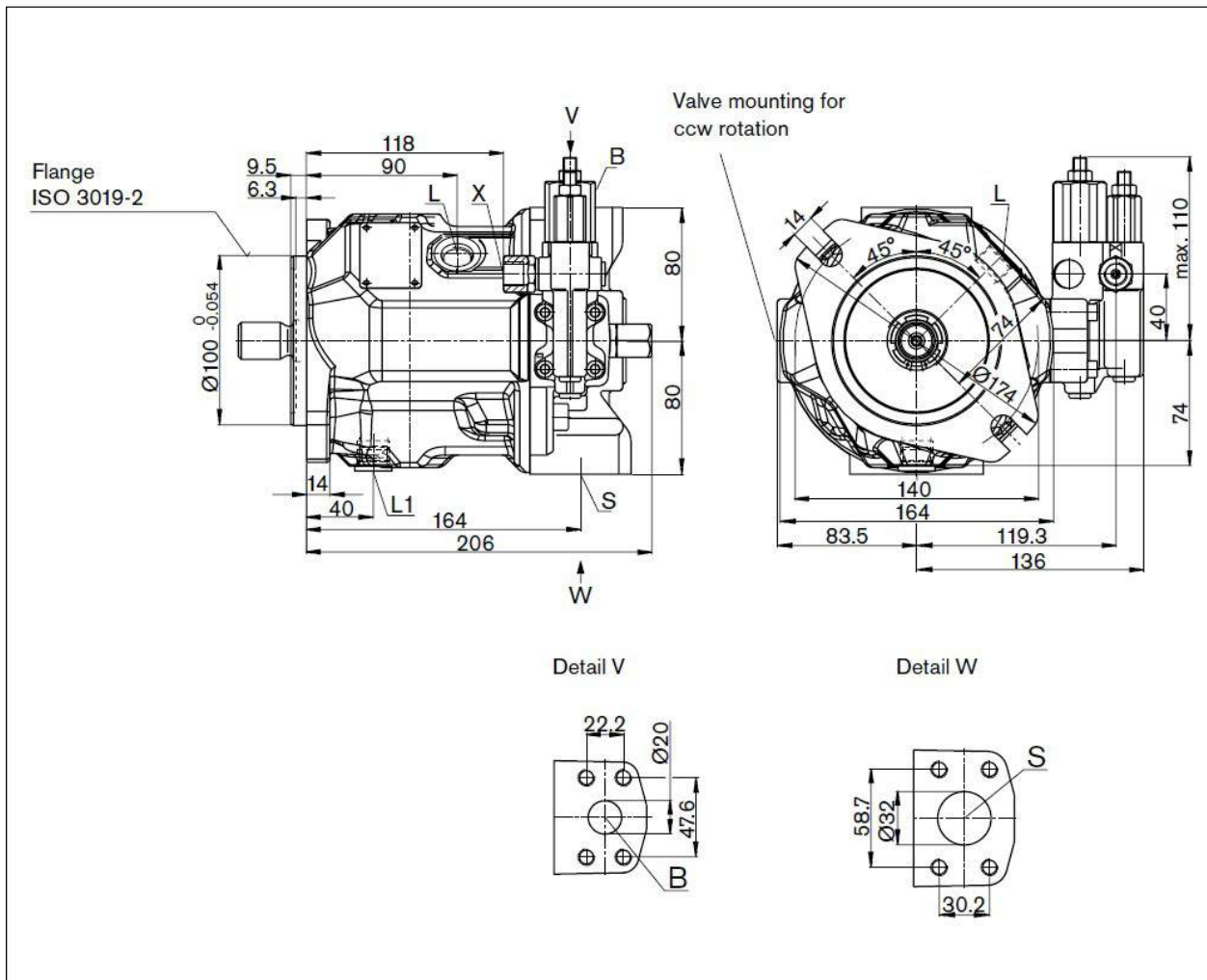
Electro-hydraulic pressure control



1) ER7.: 161 mm if using a sandwich plate pressure reducing valve.

■ Dimensions: Size 28

- DFR/DFR1 – Pressure and flow control, hydraulic:
- Clockwise rotation



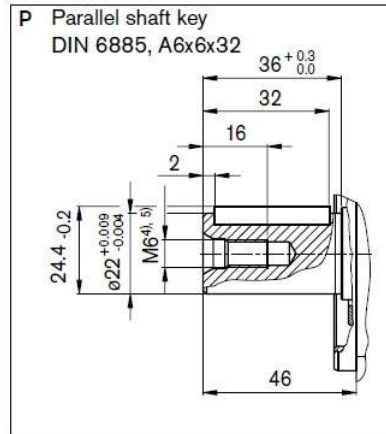
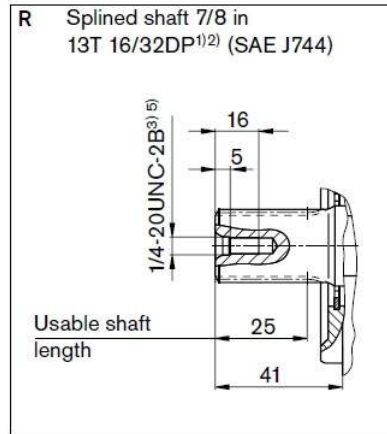
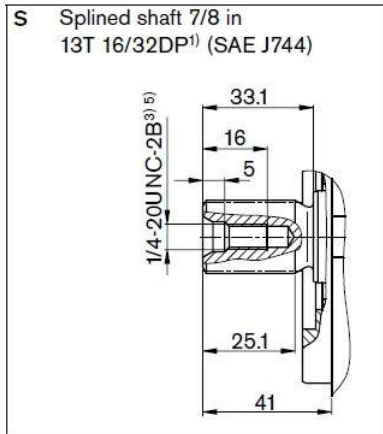
□ Ports:

Designation	Port for	Standard	Size	Maximum pressure (bar)	State
B	Service line fastening thread	SAE J518 DIN 13	3/4" M10 X 1.5 17 deep	350	O
S	Suction line fastening thread	SAE J518 DIN 13	1-1/4" M10 X 1.5 17 deep	10	O
L	Case drain fluid	DIN 3852	M18 X 1.5 12 deep	2	O
L ₁	Case drain fluid	DIN 3852	M18 X 1.5 12 deep	2	X
X	Pilot pressure	DIN 3852	M14 X 1.5 12 deep	350	O
X	Pilot pressure with DG-control	ISO 228	G 1/4" 12 deep	350	O

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

■ Dimensions: Size 28

▣ Drive shaft:

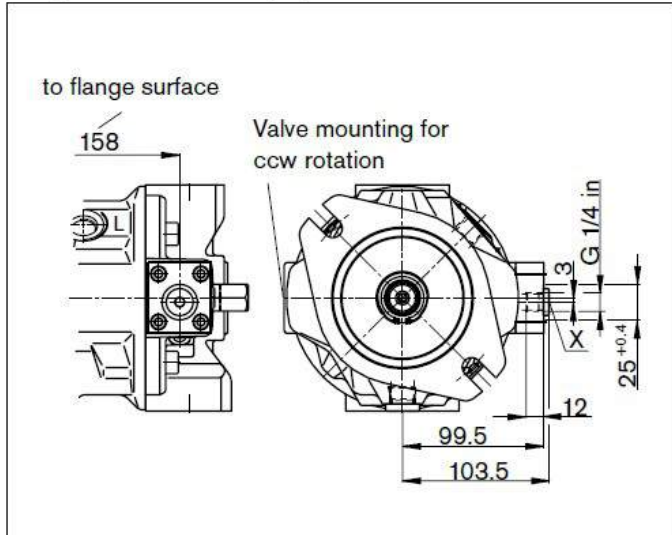


- 1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Spline according to ANSI B92.1a, run out of spline is a deviation from standard.
- 3) Thread according to ASME B1.1
- 4) Thread according to DIN 13
- 5) For the maximum tightening torques the general instructions **on page 9 must be observed.**

■ Dimensions: Size 28

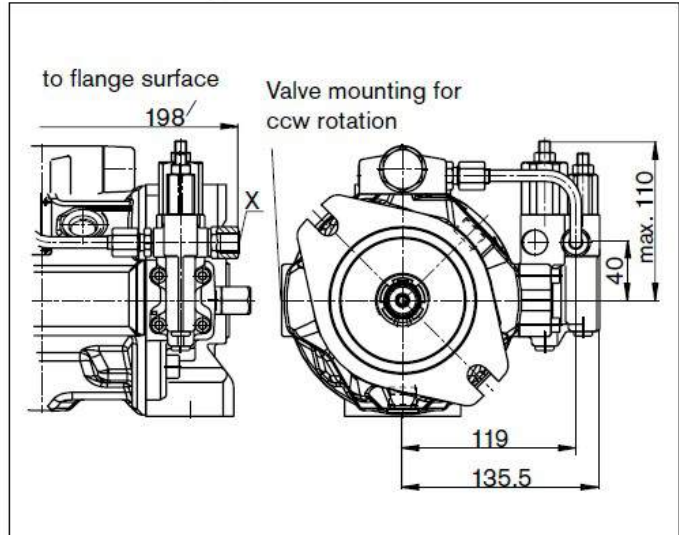
DG

Two-point control, directly operated



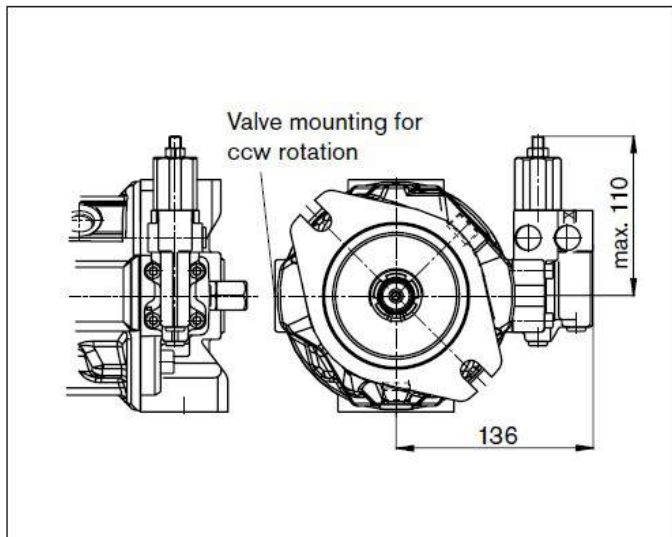
DFLR

Pressure, flow and power control



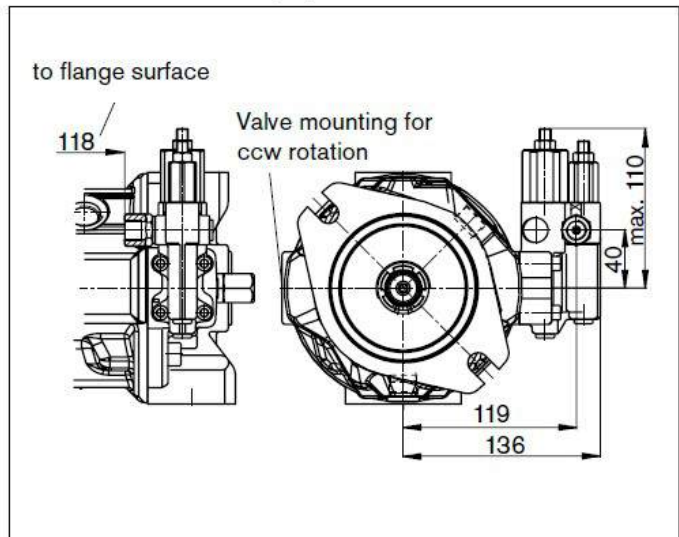
DR

Pressure control



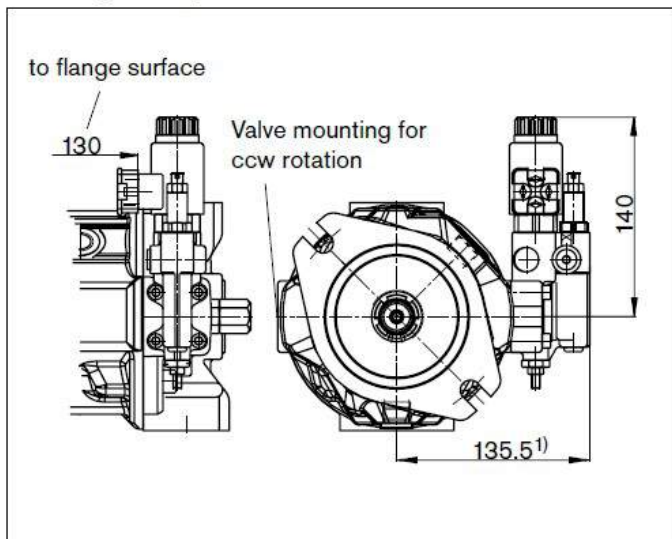
DRG

Pressure control, remotely operated



ED7. / ER7.

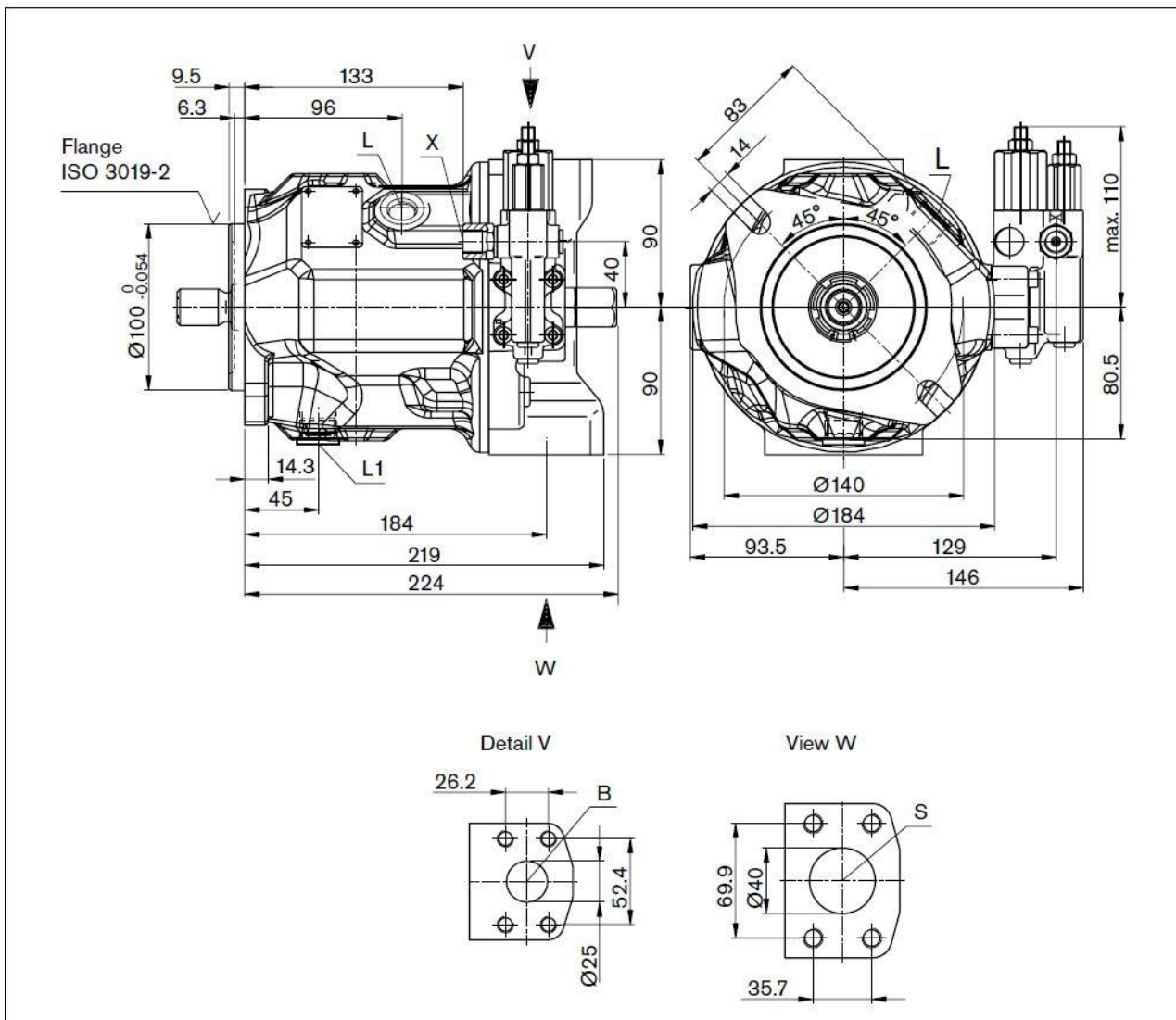
Electro-hydraulic pressure control



1) ER7.: 170.5 mm when using a sandwich plate pressure reducing valve.

■ Dimensions: Size 45

- Pressure and flow control, hydraulic:
- Clockwise rotation



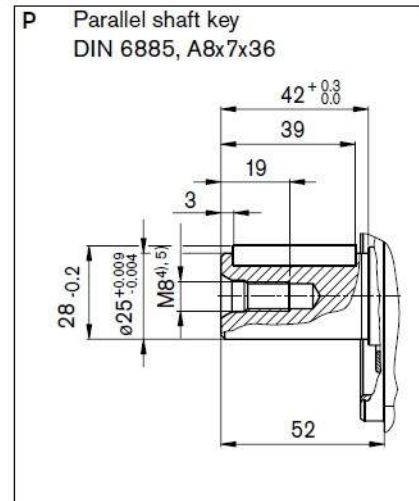
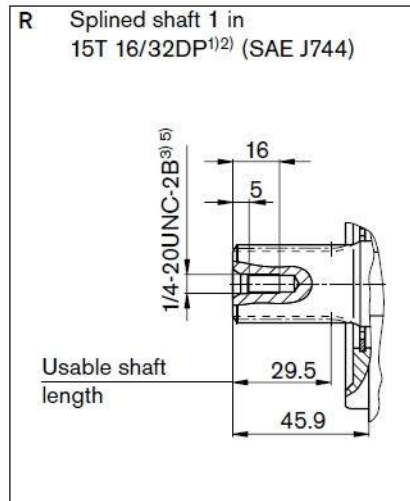
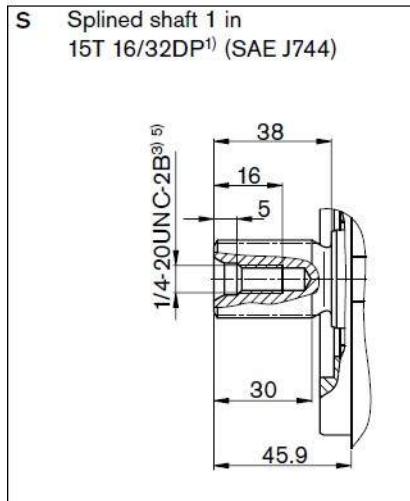
□ Ports:

Designation	Port for	Standard	Size	Maximum pressure (bar)	State
B	Service line fastening thread	SAE J518 DIN 13	1" M10 X 1.5 17 deep	350	O
S	Suction line fastening thread	SAE J518 DIN 13	1-1/2" M12 X 1.75 17 deep	10	O
L	Case drain fluid	DIN 3852	M22 X 1.5 12 deep	2	O
L ₁	Case drain fluid	DIN 3852	M22 X 1.5 12 deep	2	X
X	Pilot pressure	DIN 3852	M14 X 1.5 12 deep	350	O
X	Pilot pressure with DG-control	ISO 228	G 1/4" 12 deep	350	O

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

■ Dimensions: Size 45

□ Drive shaft:

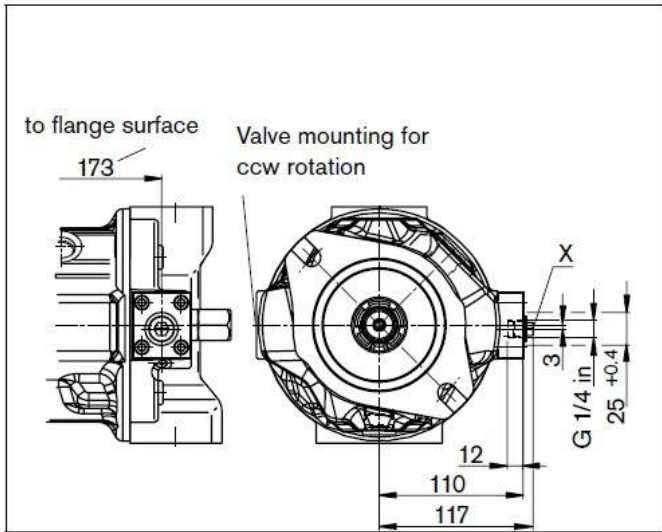


- 1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Spline according to ANSI B92.1a, run out of spline is a deviation from standard.
- 3) Thread according to ASME B1.1
- 4) Thread according to DIN 13
- 5) For the maximum tightening torques the general instructions on [page 9 must be observed.](#)

■ Dimensions: Size 45

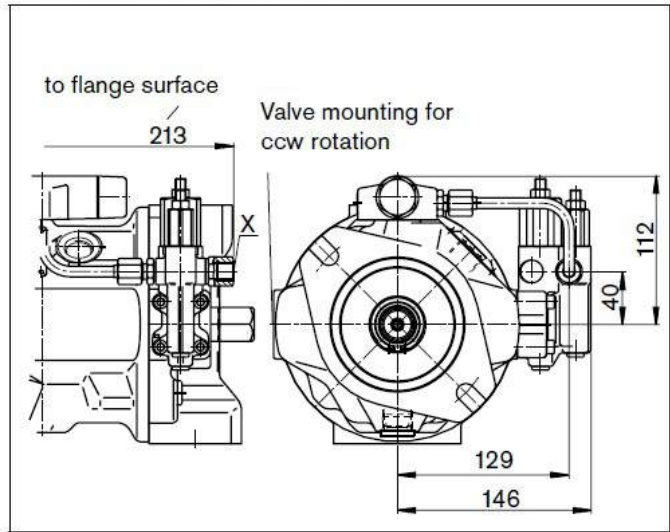
DG

Two-point control, directly operated



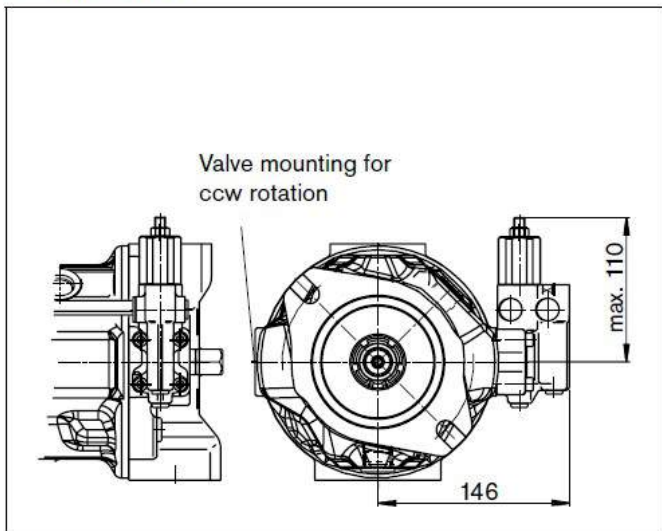
DFLR

Pressure, flow and power control



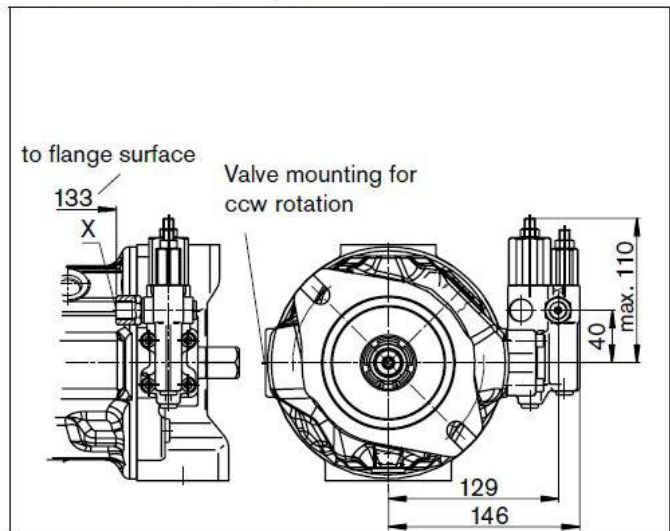
DR

Pressure control



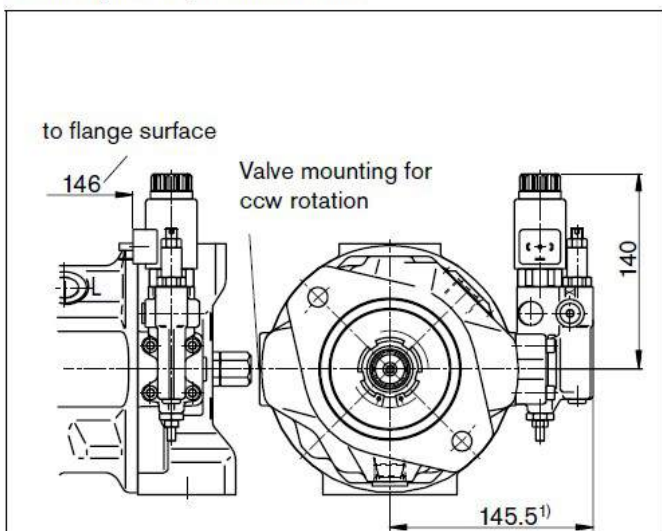
DRG

Pressure control, remotely operated



ED7. / ER7.

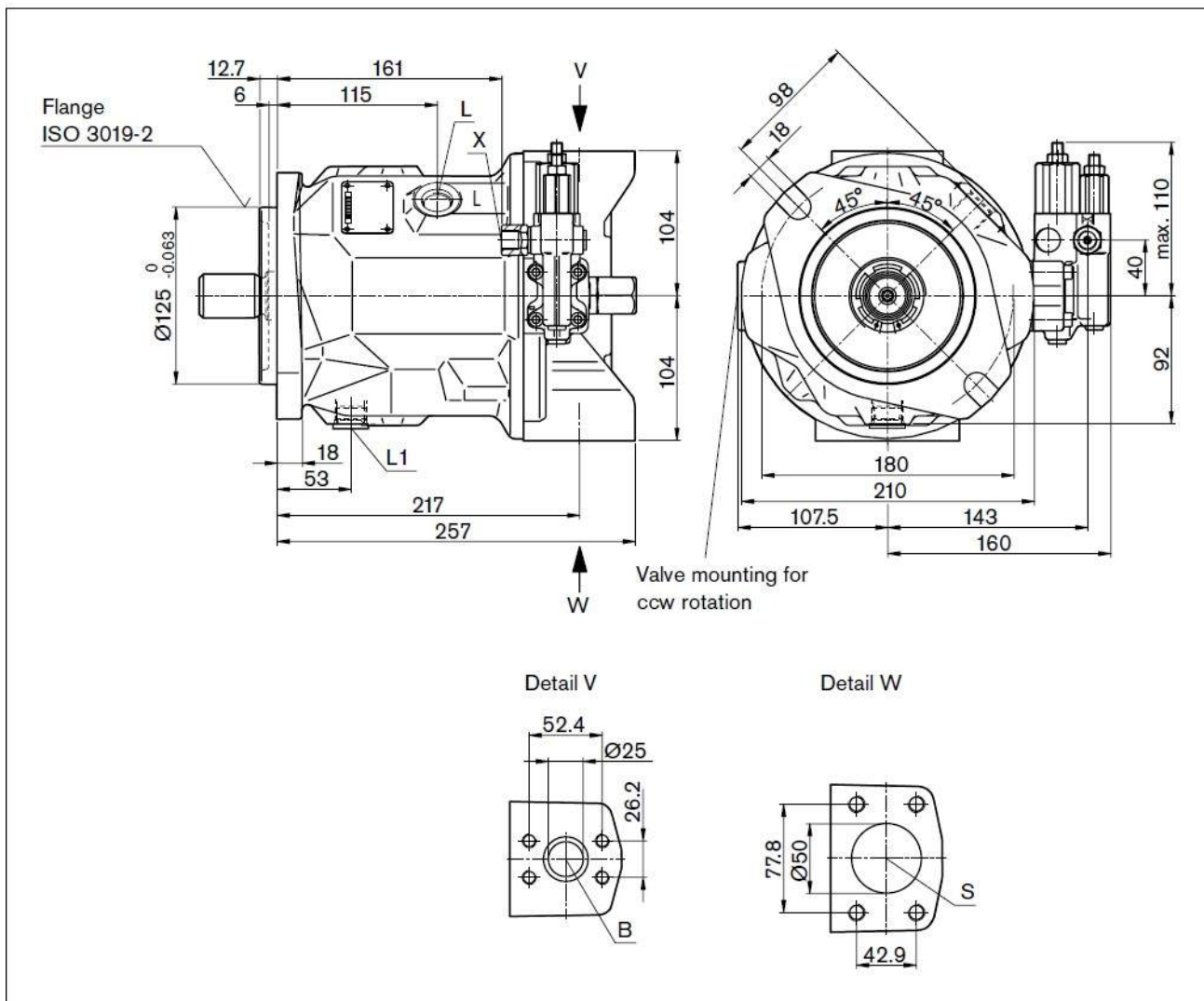
Electro-hydraulic pressure control



1) ER7.: 180.5 mm if using a sandwich plate pressure reducing valve.

■ Dimensions: Size 71

- DFR/DFR1 – Pressure and flow control, hydraulic:
- Clockwise rotation



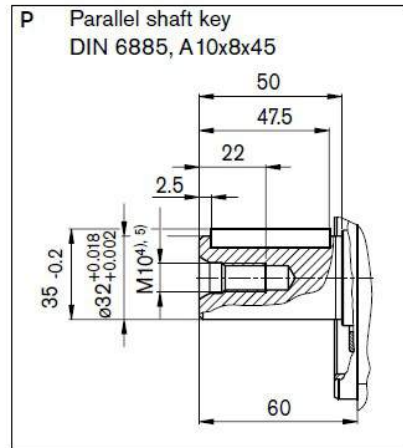
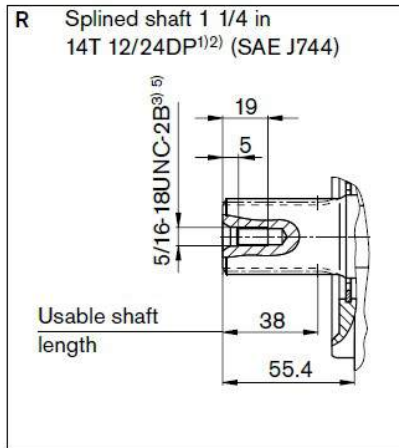
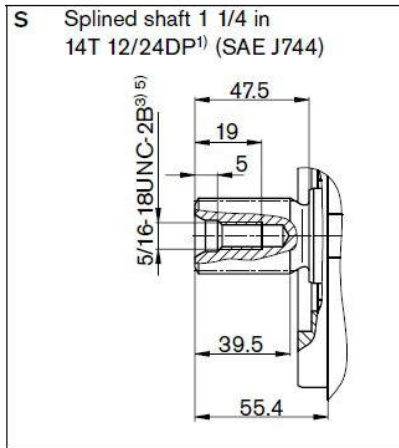
□ 油口尺寸:

Designation	Port for	Standard	Size	Maximum pressure (bar)	State
B	Service line fastening thread	SAE J518 DIN 13	1" M10 X 1.5 17 deep	350	O
S	Suction line fastening thread	SAE J518 DIN 13	2" M12 X 1.75 20 deep	10	O
L	Case drain fluid	DIN 3852	M22 X 1.5 14 deep	2	O
L ₁	Case drain fluid	DIN 3852	M22 X 1.5 14 deep	2	X
X	Pilot pressure	DIN 3852	M14 X 1.5 12 deep	350	O
X	Pilot pressure with DG-control	ISO 228	G 1/4" 12 deep	350	O

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

■ Dimensions: Size 71

□ Drive shaft:

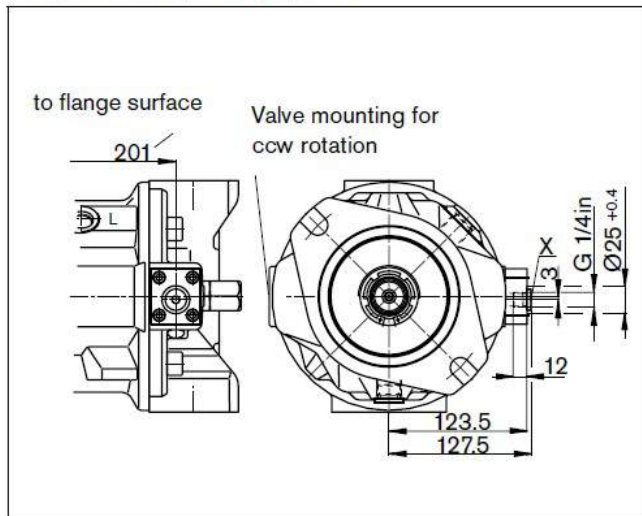


- 1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Spline according to ANSI B92.1a, run out of spline is a deviation from standard.
- 3) Thread according to ASME B1.1
- 4) Thread according to DIN 13
- 5) For the maximum tightening torques the general instructions on page 9 must be observed.

■ Dimensions: Size 71

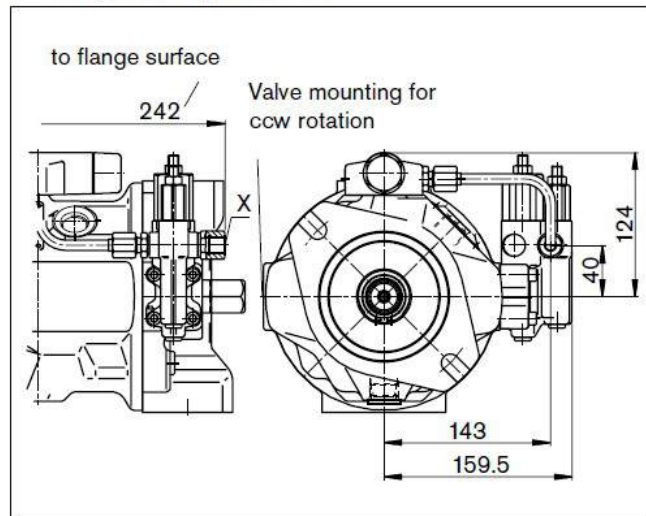
DG

Two-point control, directly operated



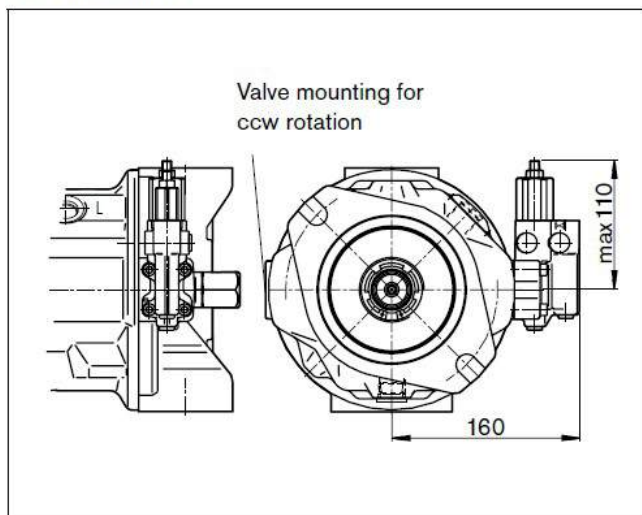
DFLR

Pressure, flow and power control



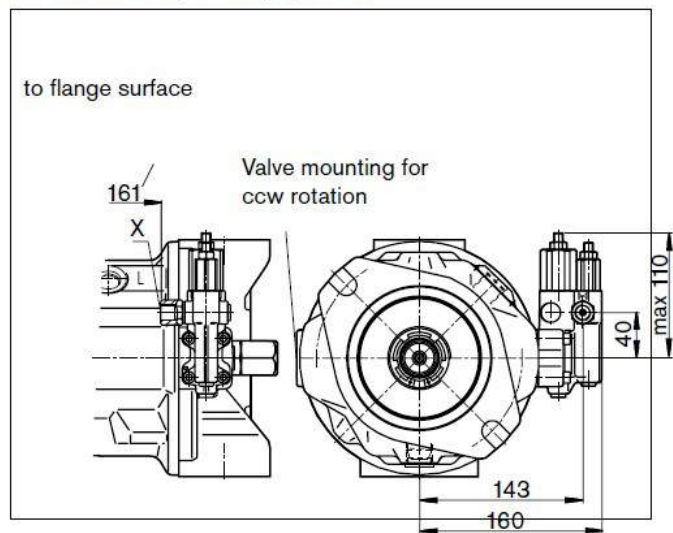
DR

Pressure control



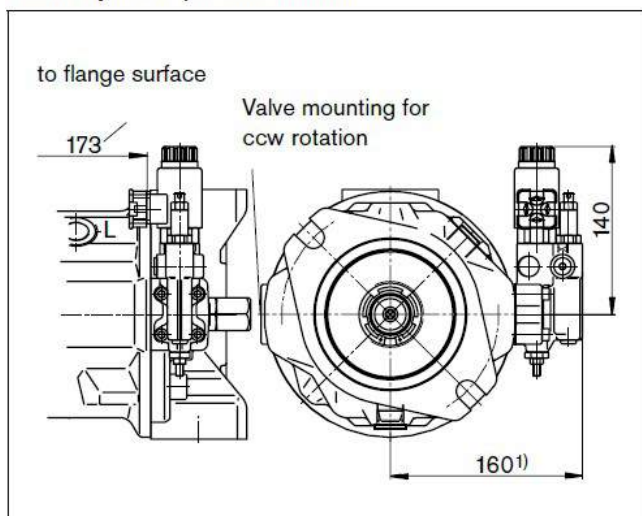
DRG

Pressure control, remotely operated



ED7. / ER7.

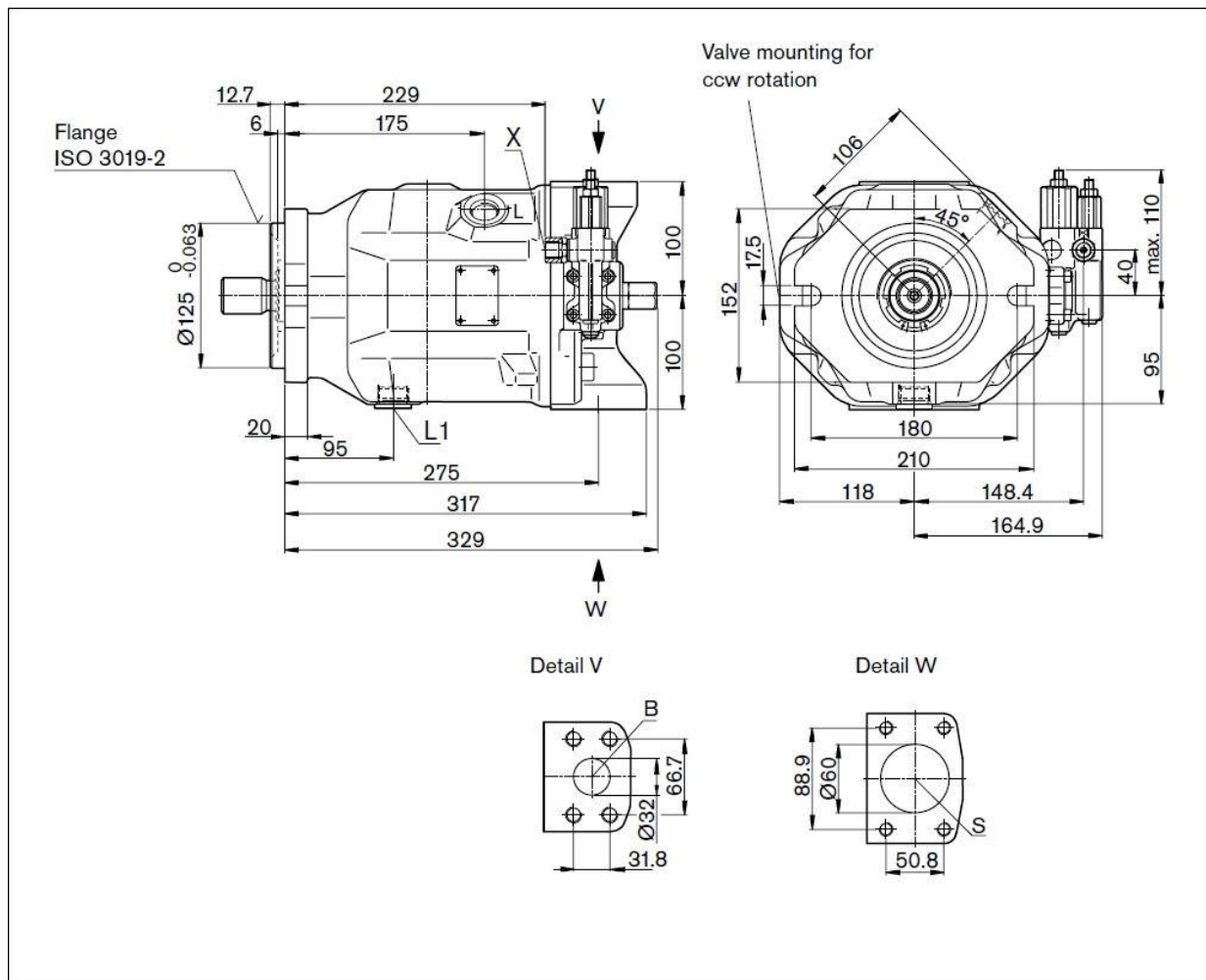
Electro-hydraulic pressure control



1) ER7.: 195 mm if using a sandwich plate pressure reducing valve.

■ Dimensions: Size 100

- DFR/DFR1- Pressure and flow control, hydraulic:
- Clockwise rotation



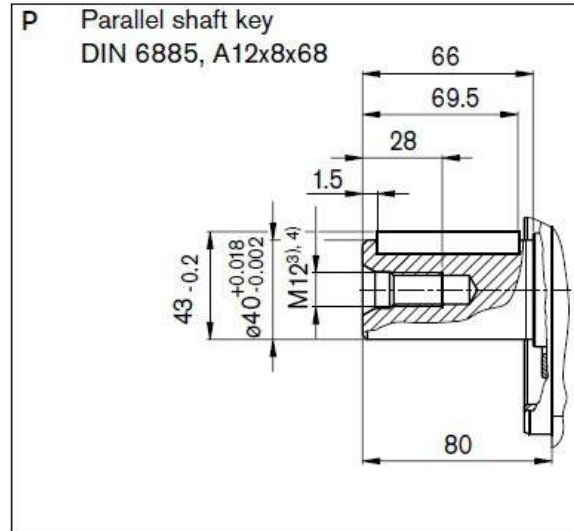
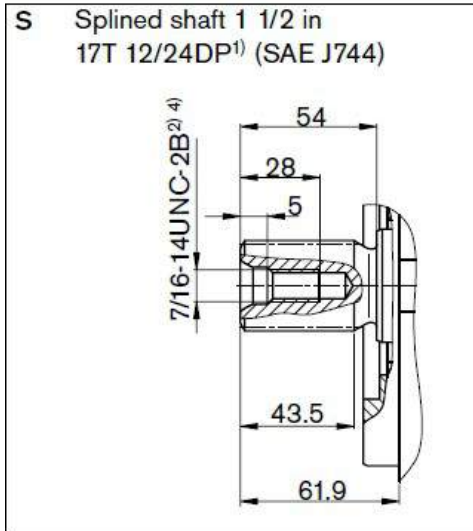
□ 油口尺寸:

Designation	Port for	Standard	Size	Maximum pressure (bar)	State
B	Service line fastening thread	SAE J518 DIN 13	1-1/4" M14 X 2 19 deep	350	O
S	Suction line fastening thread	SAE J518 DIN 13	2-1/2" M12 X 1.75 17 deep	10	O
L	Case drain fluid	DIN 3852	M27 X 2 16 deep	2	O
L ₁	Case drain fluid	DIN 3852	M27 X 2 16 deep	2	X
X	Pilot pressure	DIN 3852	M14 X 1.5 12 deep	350	O
X	Pilot pressure with DG-control	ISO 228	G 1/4" 12 deep	350	O

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

■ Dimensions: Size 100

▣ Drive shaft:



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

2) Thread according to ASME B1.1

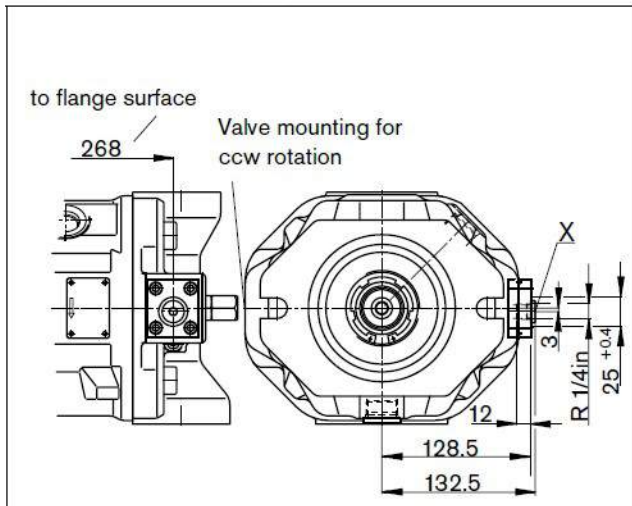
3) Thread according to DIN 13

4) For the maximum tightening torques the general instructions on page 9 must be observed.

■ Dimensions: Size 100

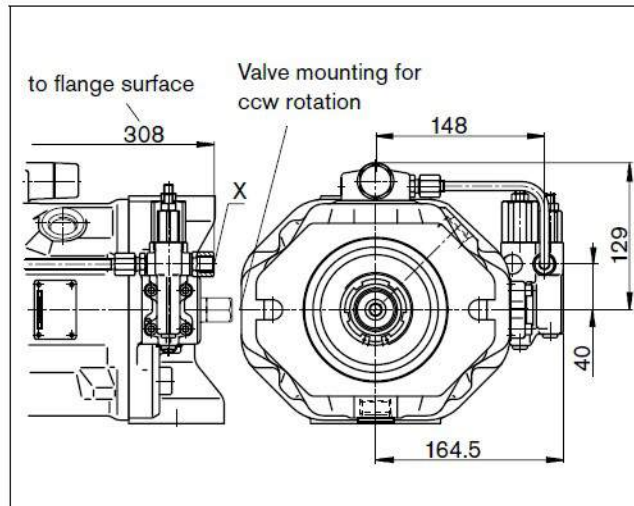
DG

Two-point control, directly operated



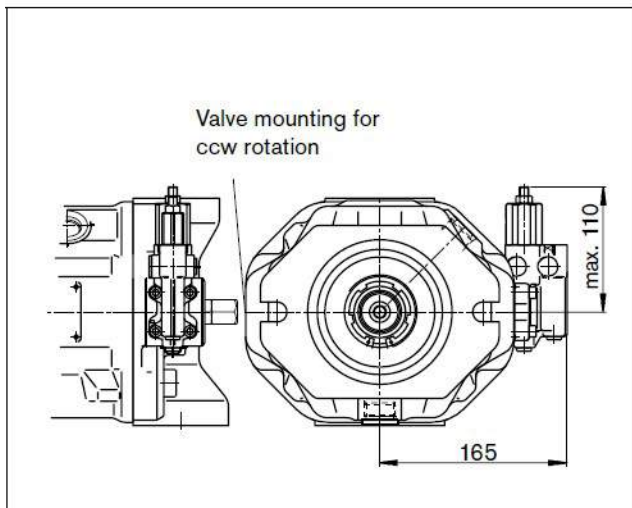
DFLR

Pressure, flow and power control



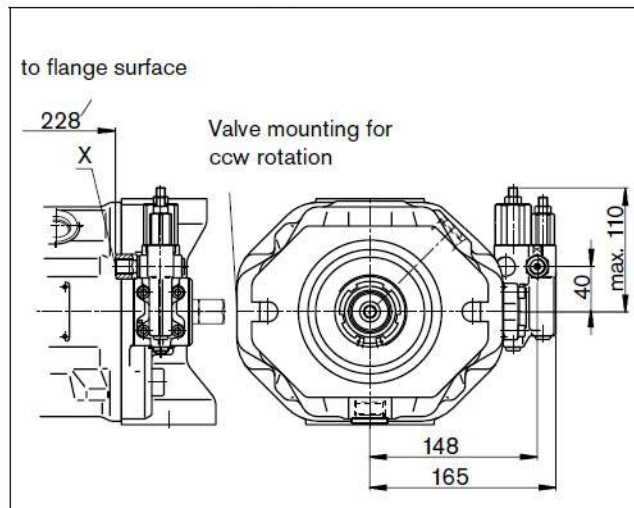
DR

Pressure control



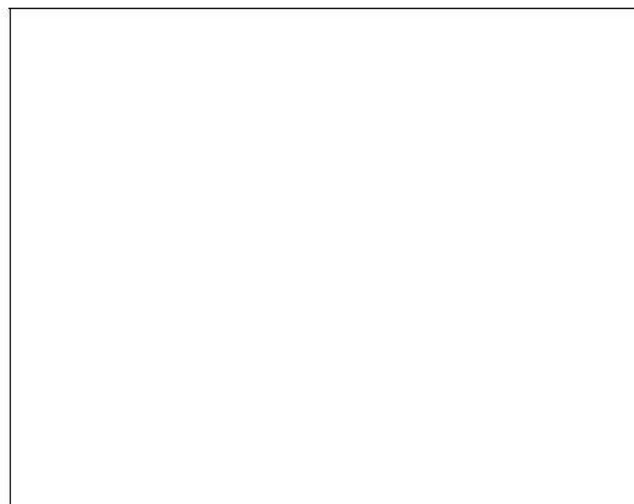
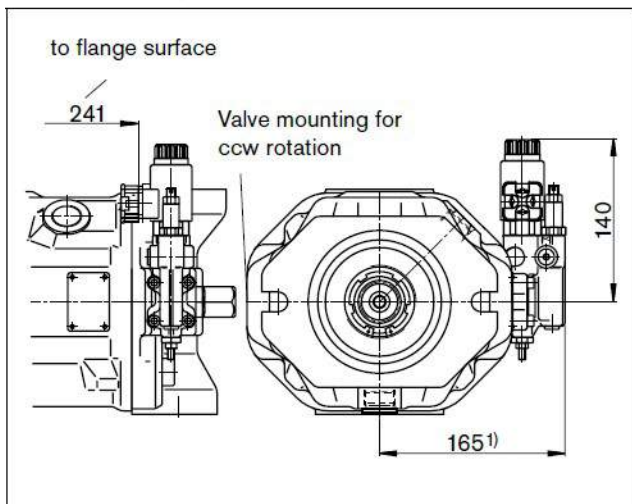
DRG

Pressure control, remotely operated



ED7. / ER7.

Electro-hydraulic pressure control

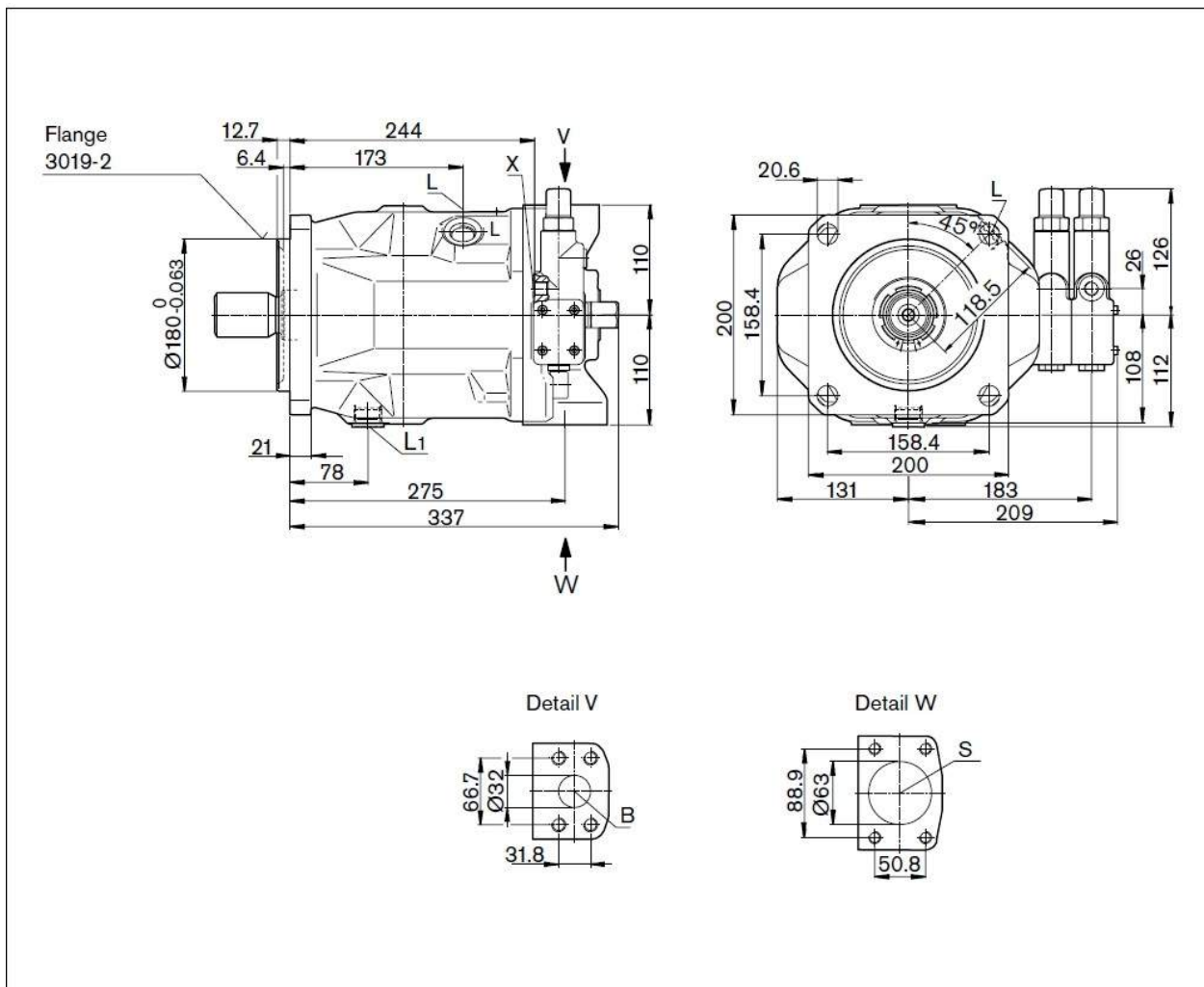


1) ER7.: 200 mm when using a sandwich plate pressure reducing valve.

■ Dimensions: Size 140

□ DFR/DFR1- Pressure and flow control, hydraulic

□ Clockwise rotation



□ Ports:

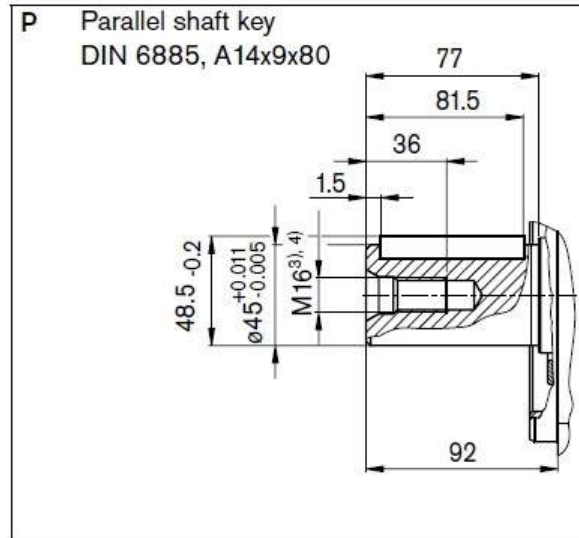
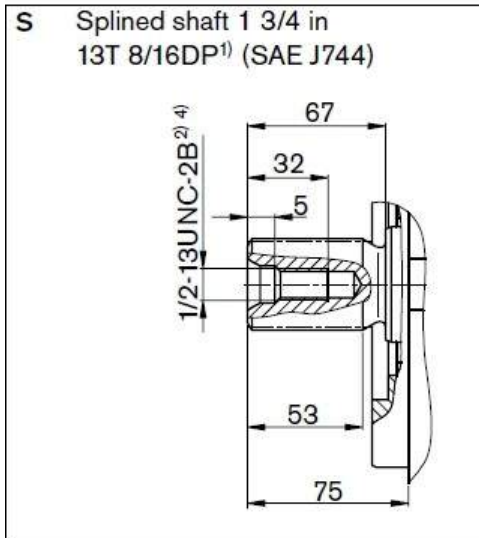
Designation	Port for	Standard	Size	Maximum pressure (bar)	State
B	Service line fastening thread	SAE J518 DIN 13	1-1/4" M14 X 2 19 deep	350	O
S	Suction line fastening thread	SAE J518 DIN 13	2-1/2" M12 X 1.75 17 deep	10	O
L	Case drain fluid	DIN 3852	M27 X 2 16 deep	2	O
L ₁	Case drain fluid	DIN 3852	M27 X 2 16 deep	2	X
X	Pilot pressure	DIN 3852	M14 X 1.5 12 deep	350	O
X	Pilot pressure with DG-control	DIN 3852	M14 X 1.5 12 deep	350	O
M _H	Gauge port, high pressure	DIN 3852	M14 X 1.5 12 deep	350	X

□ O = Must be connected (plugged on delivery)

□ X = Plugged (in normal operation)

■ Dimensions: Size 140

▣ Drive shaft:



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

2) Thread according to ASME B1.1

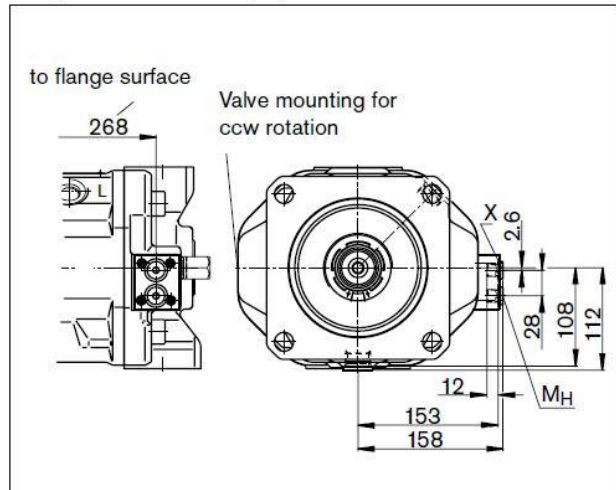
3) Thread according to DIN 13

4) For the maximum tightening torques the general instructions on page 9 must be observed.

■ Dimensions: Size 140

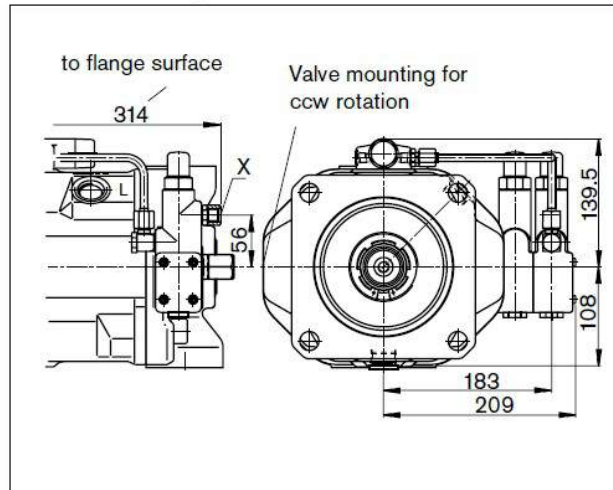
DG

Two-point control, directly operated



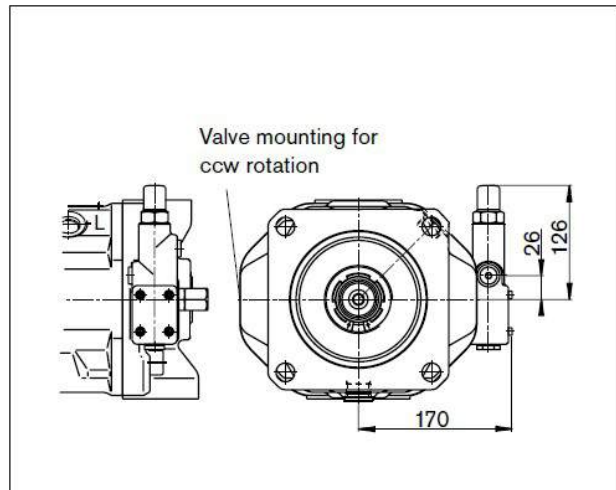
DFLR

Pressure, flow and power control



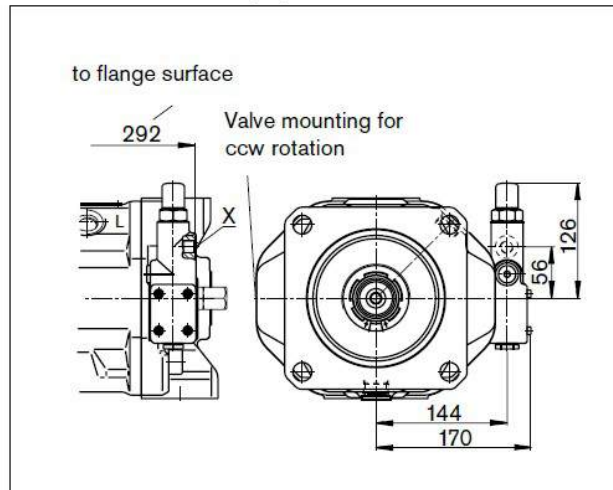
DR

Pressure control



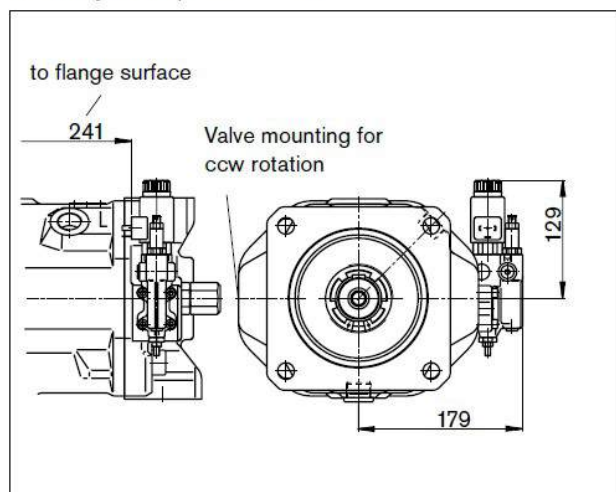
DRG

Pressure control, remotely operated



ED7. / ER7.

Electro-hydraulic pressure control



1) ER7.: 214 mm when using a sandwich plate pressure reducing valve.