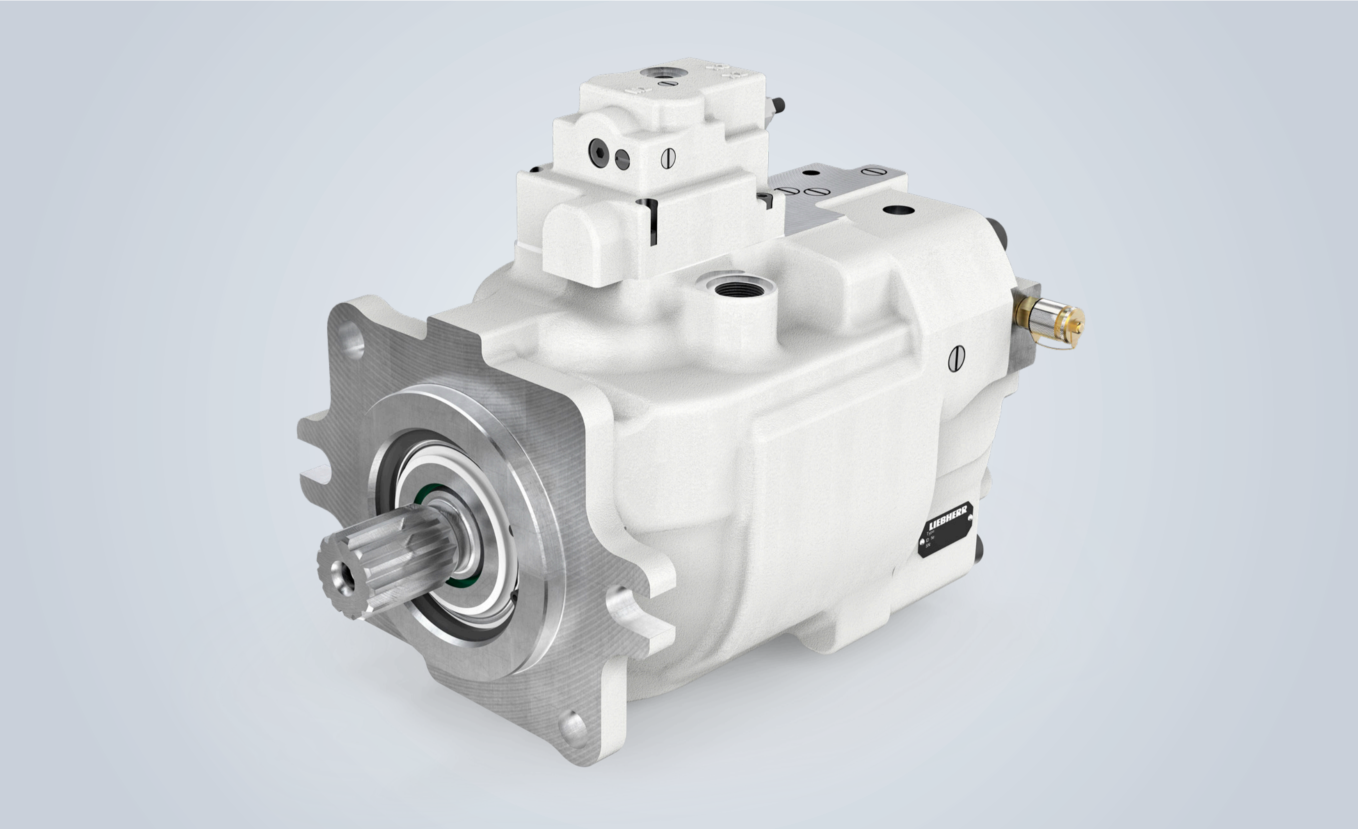
Data sheet

Axial piston pump DPVO



The Liebherr axial piston pumps in the DPVO series are designed as swashplates for open circuits.

These variable displacement pumps are available in nominal sizes ranging from 108 to 215. The nominal pressure of the units is 5,802 psi (400 bar) and the maximum pressure is 6,527 psi (450 bar) absolute.

These pumps for open circuits with inverted piston design were specially developed for high pressure applications.

They stand out with a 22° swivel angle and high pressure capacity, as well as 100 percent through-drive capability. They can be combined with all common controls.

In nominal sizes 165 and 215, the variable displacement pump is also available with impeller. This achieves a higher self-suction speed and a higher displacement.

Valid for:
DPVO 108
DPVO 140
DPVO 165 / DPVO 165i
DPVO 215 / DPVO 215i

Features:
D series
Open circuit

Control types:
Various control types can be selected

Pressure range:
Nominal pressure p_N = 5,802 psi (400 bar)
Maximum pressure p_{max} = 6,527 psi (450 bar)

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Version: 1.4

LIEBHERR

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1 Type code

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

1. Pump type

D series / pump / variable displacement	DPV

2. Type of circuit

Open	0

3. Nominal size (NS)

	108	140	165	215	

4. Residual displacement $V_{g\ min}$

0 - 15% of $V_{g\ max}$ / enter value in cm^3/rev	■	

5. Activation / control type

	108	140	165	215	
Pressure cut-off	■	□	■	□	DA
Electro-proportional (positive characteristic) / pressure cut-off	■	■	■	■	EL1 - DA
Electro-proportional (negative characteristic) / pressure cut-off	□	■	□	□	EL2 - DA
Electro-proportional (positive characteristic) / pressure cut-off with override	■	□	■	■	EL1 - DA1
Electro-proportional (positive characteristic) / load sensing	□	■	■	■	EL1 - LS
Electro-proportional (negative characteristic) / load sensing	■	□	□	■	EL2 - LS
Electro-proportional (positive characteristic) / load sensing with Δp lowering	□	□	□	□	EL1 - LS1
Load sensing / pressure cut-off	■	■	■	■	LS - DA
Load sensing / pressure cut-off with override	□	□	□	□	LS - DA1
Load sensing with Δp lowering / pressure cut-off with override	□	□	□	□	LS1 - DA1
Fan drive	■	□	■	□	LU
Power control	□	□	□	□	LR
Power control, override option	□	□	□	□	LR1
Power control / load sensing	■	■	■	■	LR - LS
Power control, override option (positive characteristic) / load sensing	■	■	■	■	LR1 - LS
Power control, override option (negative characteristic) / load sensing	□	□	□	■	LR2 - LS
Power control / load sensing with Δp lowering	□	□	□	□	LR - LS1
Power control, override option / load sensing with Δp lowering	■	□	■	□	LR1 - LS1
Power control, override option / steering pressure-proportional (negative characteristic) / pressure cut-off	□	□	□	■	LR1 - SD2 - DA
Power control / steering pressure-proportional (negative characteristic) / pressure cut-off	□	□	□	□	LR - SD2 - DA
Power control / steering pressure-proportional (negative characteristic) / pressure cut-off with override	□	■	□	□	LR - SD2 - DA1
Power control, override option / steering pressure-proportional (negative characteristic) / pressure cut-off with override	□	□	□	■	LR1 - SD2- DA1
Steering pressure-proportional (positive characteristic)	□	□	□	□	SD1
Total performance regulation / steering pressure-proportional (positive characteristic)	□	□	□	□	SL - SD1
Total performance regulation with override / steering pressure-proportional (positive characteristic)	□	□	□	■	SL1 - SD1

1 Type code

	108	140	165	215	

6. Design

	1				

7. Direction of rotation (viewed towards the drive shaft)

	108	140	165	215	
Right, without impeller	■	■	■	■	R
Left, without impeller	□	□	■	■	L
Right, with impeller	□	□	□	■	R
Left, with impeller	□	□	■	■	L

8. Mounting flange

		108	140	165	215	
Diesel engine flange SAE J617a	SAE 1	□	□	□	□	11
	SAE 2	■	■	■	■	12
	SAE 3	□	□	□	□	13
	SAE 4	■	■	■	-	14
Mounting flange SAE J744	SAE D	■	■	■	-	24
	SAE E	-	-	-	■	25

9. Shaft end

		108	140	165	215	
Splined shaft	DIN 5480	■	■	■	■	1
	ANSI B92.1a	□	■	■	■	2

10. Connections

ISO 6162-2 / SAE J518-2, high-pressure connection 6000 psi	A				

11. Add-on parts

	108	140	165	215	
Without add-on parts	■	■	■	■	0
With impeller	□	■	■	■	I

12. Gear pump

	108	140	165	215	
Without gear pump	■	■	■	■	00
With gear pump, V_g = 24 cm^3, enter value in cm^3/rev	■	□	■	□	24

13. Through-drive

Standard centring diameter		Hub for shaft spline	Fastening thread position according to SAE J744	108	140	165	215	
Without through-drive				□	□	□	□	0000
Ø101.6	SAE B	ANSI B92.1a 7/8 in 13T 16/32DP	Type K Basic (2-hole)	■	■	■	■	B11D
			Type S Basic (4-hole)	■	■	■	■	B12D
	SAE BB	ANSI B92.1a 1 in 15T 16/32DP	Type K Basic (2-hole)	■	■	■	■	B21D
			Type S Basic (4-hole)	■	■	■	■	B22D
Ø127	SAE C	ANSI B92.1a 1 1/4 in 14T 12/24DP	Type K Basic (2-hole)	□	□	■	■	C11D
			Type S Basic (4-hole)	□	□	■	■	C12D
	SAE CC	ANSI B92.1a 1 1/2 in 17T 12/24DP	Type K Basic (2-hole)	□	□	■	■	C21D
			Type S Basic (4-hole)	□	□	■	■	C22D

■ = Available / □= On request / -= Not available

1 Type code

				108	140	165	215	
Ø152.4	SAE D	ANSI B92.1a 1 3/4 in 13T 8/16DP	Type K Basic (2-hole)	□	□	□	■	D11D
			Type S Basic (4-hole)	□	□	□	■	D12D
			2- & 4-hole mixed	□	□	□	□	D13D
		DIN 5480 W40x2x18x9g	Type K Basic (2-hole)	□	□	□	□	D31D
			Type S Basic (4-hole)	□	□	□	□	D32D
			2- & 4-hole mixed	□	□	□	□	D33D*
		DIN 5480 W45x2x21x9g	Type K Basic (2-hole)	□	□	□	□	D41D
			Type S Basic (4-hole)	□	□	□	□	D42D
			2- & 4-hole mixed	□	□	□	□	D43D*
Ø165.1	SAE E	ANSI B92.1a 1 3/4 in 13T 8/16DP	Type K Basic (2-hole)	□	□	□	□	E11D
			Type S Basic (4-hole)	□	□	□	□	E12D
		DIN 5480 W50x2x24x9g	Type K Basic (2-hole)	□	□	□	□	E31D
			Type S Basic (4-hole)	□	□	□	□	E32D*

Note
*) D33D, D43D or E32D are to be written in type code of hydraulic pump 1 (when used as a multi-circuit pump in tandem design) with DIN 5480 shaft input of hydraulic pump 2.

14. Valve

Without valve	**0**

15. Sensors

Without sensor	■	■	■	■	0
With angle sensor	□	□	□	■	W

■ = Available
□ = On request
- = Not available

Note
Contact addresses for queries are provided on the back of this document.

2 Technical data

2.1 Table of values

Nominal size				108	140	165		215	
						without impeller	with impeller	without impeller	with impeller
Displacement volume		$V_{g\ max}$	cm^3	107.7	140.2	167.8	167.8	216.6	216.6
		$V_{g\ min}$	cm^3	0 - 15% of $V_{g\ max}$ > 15% of $V_{g\ max}$ on request					
Standard version** Max. speed at $V_{g\ max*}$		n_{max}	rpm	2100	2100	2100	2300	2000	2600
Volume flow at n_{max} and $V_{g\ max*}$		qv_{max}	l/min	226	294	352	386	433	563
Drive power at qv_{max} and Δp = 400 bar		p_{max}	kW	151	196	235	257	289	375
Drive torque at $V_{g\ max}$ and Δp = 400 bar		M_{max}	Nm	685	892	1067	1067	1378	1378
Torsional rigidity	Shaft DIN 5480	Nm/rad		157000	228800	247700	247700	320900	320300
	ANSI B92.1a-1976 1 3/4 IN 13T 8/16 DP	Nm/rad		-	195600	230400	-	226200	225100
Driving gear moment of inertia		J_{TW}	kgm^2	0.015	0.024	0.031	0.031	0.048	0.047
Weight (approx.)		m	kg	56	65	74	92	125	125

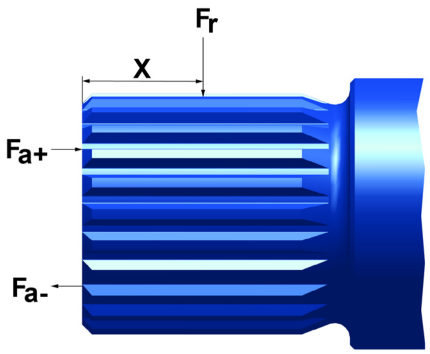
Note
The stated values (maximum values) are theoretical values, rounded, and without efficiencies or tolerances.

*) These values apply at an absolute pressure of 1 bar at the suction channel.
Higher suction pressure limits possible by increasing the suction pressure p_{abs} at the suction channel.

**) For nominal sizes 108 and 140, a high speed version, max. speed at $V_{g\ max*}$ = 2300 rpm, is available. Please specify explicitly when ordering. Values upon request.

2 Technical data

2.1.1 Maximum radial and axial load of the driving shaft



DB-V-001

Nominal size			108	140	165	215
Max. radial force	$F_{r\ max}$	N	Values upon request			
Max. axial force	$F_{a\pm\ max}$	N	1000	2000	3000	3000

Note
The radial and axial loads depend on the load cycle, e.g. pressure, rpm and direction of force.
If planning a belt drive or continuous axial and/or radial forces are expected, please contact Liebherr.

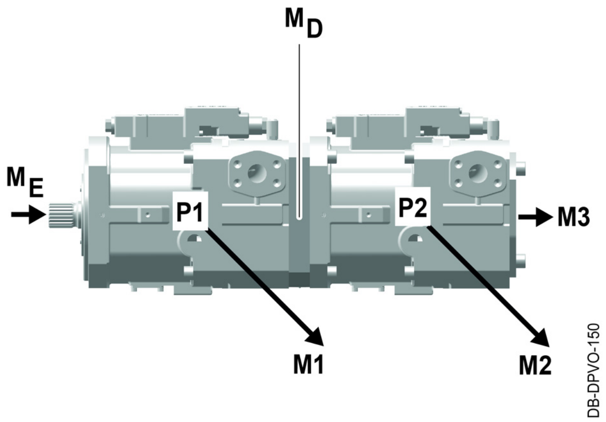
2.1.2 Maximum input and through drive torques

Note
Theoretical rounded values, not taking into account efficiency, tolerances, contamination of the hydraulic fluid or deflection of the driving shaft.

Nominal size			108	140	165		215	
					without impeller	with impeller	without impeller	with impeller
Max. torque of drive shaft input (installed without lateral force) at shaft end DIN 5480	$M_{E\ max}$	Nm	1265	1830	1950	1950	2940	2940
Max. torque of drive shaft input (installed without lateral force) at shaft end ANSI B92.1a	$M_{E\ max}$	Nm	-	1700	1700	1700	1700	1700
Max. torque of through drive	$M_{D\ max}$	Nm	1265	1830*	1950*	1100	1810*	2200*

*) $M_{E\ max}$ at shaft end ANSI B92.1a must be taken into account

2 Technical data



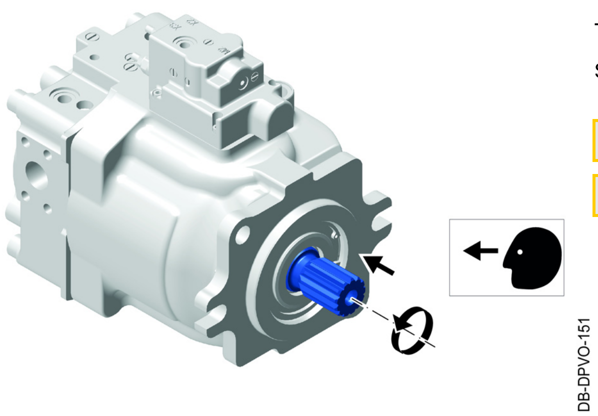
M1	Torque of axial piston pump 1		P2	Axial piston pump 2
M2	Torque of axial piston pump 2		M_E[1]	Input torque
M3	Torque of axial piston pump 3		M_D[2]	Through drive torque
P1	Axial piston pump 1		-	-

1) $M_E = M1+M2+M3$
$M_E < M_{E\ max}$

2) $M_D = M2+M3$
$M_D < M_{D\ max}$

2.2 Direction of rotation

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.



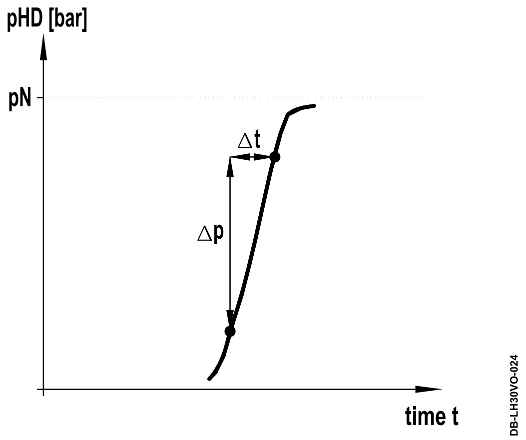
The direction of rotation is stated with view of the driving shaft, as shown in the figure.

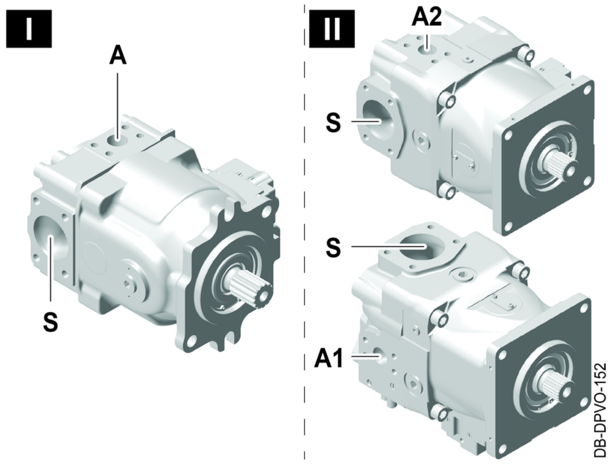
R	right	=	clockwise
L	left	=	anti-clockwise

2 Technical data

2.3 Permitted pressure range

2.3.1 Operating pressure





Note
Variant I: Nominal size 108 / 140 / 165 Standard with one high-pressure connection A.
Variant II: Nominal size 215 standard with two opposite high-pressure connections A1 / A2.

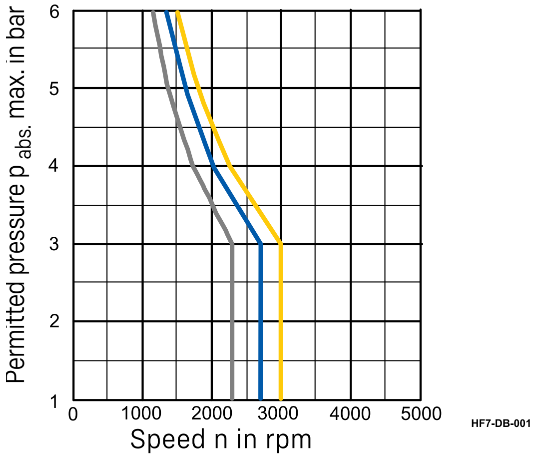
Operating pressure at connection A / A1 / A2				
Nominal size				**108 to 215**
Minimum pressure**	$V_{g\ min}$	pHD_{min}	bar	6
	$V_{g\ max}$			18
Nominal pressure (fatigue resistant)		pHD_N	bar	400
Maximum pressure (single operating period)		pHD_{max}	bar	450
Single operating period at maximum pressure pHD_{max}		t	s	< 1
Total operating period at maximum pressure pHD_{max}		t	OH*	300
Rate of pressure change		RA	bar/s	17000
Suction pressure at port S				
Minimum absolute pressure		pS_{min}	bar	0.8[1]
Maximum absolute pressure		pS_{max}	bar	2[1]

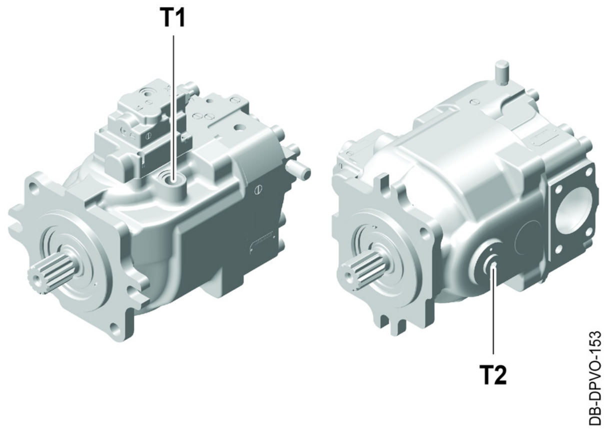
*) OH = operating hours
**) There must be minimum pressure in the working circuit at connection A to ensure adequate lubrication of the driving gear in all swivel angles during operation.
[1]) Other values upon request

DANGER
Failure of the fastening screws at working connection A / A1 / A2
Danger to life. Use fastening screws of strength category 10.9.

2 Technical data

2.3.2 Housing, leakage oil pressure





Characteristic curve	Nominal size	Shaft diameter (mm)
yellow	108	45
blue	140 / 165	50
grey	215	60

Leakage oil pressure at connection T1 / T2			
Nominal size			**108 to 215**
Permanent absolute leakage oil pressure	p_L	bar	3
Maximum absolute pressure	pL_{max}	bar	6*

*) Short pressure peaks of max. 10 bar abs. are permitted (t < 0.1 s).

Note
The pressure in the axial piston unit must always be higher than the external pressure on the shaft lip seal.

2 Technical data

2.4 Hydraulic fluids

2.4.1 General information

Selection of the appropriate hydraulic fluid is significantly influenced by the anticipated operating temperature relative to the ambient temperature, which is equivalent to the tank temperature.

ATTENTION
You must not mix different mineral oil hydraulic fluids!

Minimum required quality

Specification
LH-00-HYC3A
LH-00-HYE3A

Note
For additional information, see: www.liebherr.com (brochure: Lubricants and operating fluids)
Alternatively: contact lubricants@liebherr.com.

2.4.2 Fill quantity

Nominal size	Fill quantity
108 to 215	Values upon request

Note
Before commissioning, the axial piston unit must be filled with oil and vented.
This process must be checked and repeated if necessary during operation and after long downtimes!

2.4.3 Filtering

- Filtering of the hydraulic fluid is necessary to maintain the specified purity class "21/17/14 according to ISO 4406" under all circumstances.
- The hydraulic fluid is filtered by the device-specific use of oil filters in the hydraulic system.
- Cleaning and maintenance intervals for the oil filters and the entire oil circuit depend on use of the unit: see the device-specific operating instructions.

2 Technical data

2.5 Temperature

Note
The optimum operating range of the hydraulic fluid of 16-36 mm^2/s for Liebherr Hydraulic HVI (ISO VG 46) is from 32° to 62 °C.

If the axial piston unit is operated in the optimum operating range of the hydraulic fluid within the permitted operating conditions and operating limits, it is low-wear and is protected against temperature-dependent ageing. From a viscosity < 11 mm^2/s (for Liebherr Hydraulic HVI (ISO VG 46) = 80 °C), a halving of the service life of the hydraulic fluid must be assumed for every 10 °K increase in temperature.

If the optimum range cannot be met, a hydraulic fluid with a more suitable viscosity range must be selected or the hydraulic system must be preheated or cooled.

To prevent temperature shocks, the temperature difference between the hydraulic fluid and the axial piston unit must be kept to less than 25 °C. This can be achieved by, among other things, a continuous flow through all axial piston units in the hydraulic system.

2.5.1 Operating limits

Maximum values:

Maximum leakage oil temperature: 115 °C.

ATTENTION
The temperature should be assumed to be highest in the drive shaft bearing area (rotary shaft lip seal and bearing). Experience has shown this temperature to be 10-15 °K higher than the leakage oil temperature.

Low temperatures: (For additional information see: 2.5.2 Low temperatures, page 12)

Note
The operating limits of Liebherr hydraulic fluids are provided in the viscosity chart included below to allow users to make an informed choice.
(For additional information see: 2.5.6 Viscosity chart, page 17)

2.5.2 Low temperatures

ATTENTION
When temperatures drop below freezing point, the sealing lip of the rotary shaft lip seal may freeze if it becomes wet or frosted. This can cause the sealing lip to tear off when the axial piston unit is started. The risk must be prevented by preheating/thawing the rotary shaft lip seal/the shaft.

Note
At temperatures at which there is already a risk of hardening from freezing, the frictional heat may be sufficient to keep the seal elastic or to bring it to a functional state quickly enough after the start of movement.

2 Technical data

Overview

Temperature [°C]	Phase	Viscosity [mm^2/s]	Note
< -50 °C	Idle state	-*	No storage or operation permitted
< -40 °C	Idle state	-**	No operation permitted, preheat to at least -40 °C, select appropriate hydraulic fluid

***) Idle state < -50 °C**

ATTENTION
Temperatures < -50 °C on the system = no operation of the axial piston unit permitted.
Risk of damaging the sealing elements of the axial piston unit.
Avoid temperatures < -50 °C.

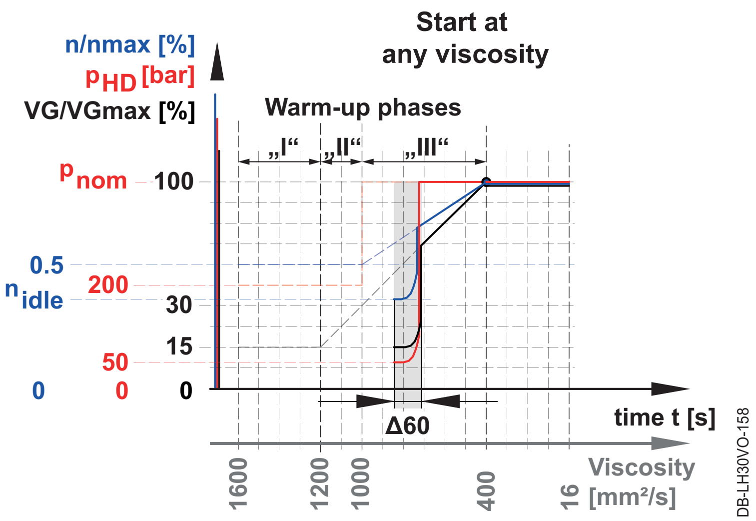
****) Idle state < -40 °C**

ATTENTION
Temperatures < -40 °C on the system = no operation of the axial piston unit permitted.
Functioning of the sealing elements in the axial piston unit is not guaranteed at temperatures < -40°C.
Preheat the axial piston unit and tank to at least -40 °C and use Liebherr Hydraulic Plus Arctic/ Liebherr Hydraulic FFE 30 hydraulic fluid with a viscosity < 1600 mm^2/s.
(For additional information see: 2.5.6 Viscosity chart, page 17)

Regardless of the viscosity < 1600 mm^2/s, the axial piston unit must be operated for at least 60 s under the following conditions before entering the cold start including the warm-up phases or on warm start:

- Operating pressure range: $p_{HD\ min} \leq p_{HD} \leq 50$ bar
- Speed: $n_{min} \leq n \leq 1000$ rpm, or idle speed of the drive motor*
- Displacement volume: $V_{g\ min} \leq V_g \leq 15\%$ of $V_{g\ max}$
- Do not move any of the equipment.

*) When using a drive with higher speeds than required in the conditions (e.g. an electric motor), please consult Liebherr, stating the potential speed(s).



After the 60 s have elapsed, determine the viscosity using the available temperature values and the viscosity chart, select the appropriate warm-up phase and operate the axial piston unit in the defined period and appropriate conditions (see Warm-up phases).

Overview

Temperature [°C]	Phase	Viscosity [mm²/s]	Note
> -40 °C	Cold start	1600-400	The current viscosity of the hydraulic fluid before start-up determines the type of start. In the range of 1600-400 [mm^2/s], it is a cold start. Entry into the warm-up phase must be selected according to the viscosity and the further warm-up phases must be run through according to the time specifications and operating conditions.
For additional information see: 2.5.6 Viscosity chart, page 17	Warm-up phase "I"	1600-1200	Observe conditions and measures (see Warm-up phase "I")
	Warm-up phase "II"	1200-1000	Observe conditions and measures (see Warm-up phase "II")
	Warm-up phase "III"	1000-400	Observe conditions and measures (see Warm-up phase "III")
	Normal operation	400-16*	Axial piston unit, fully loadable (see Normal operation)
	Optimum operating range	36-16	Axial piston unit, fully loadable (see Normal operation)

*) At maximum leakage oil temperature, the viscosity must not fall below 8 mm^2/s (for a short period, i.e. < 3 minutes, it can be 7 mm^2/s).

2.5.3 Cold start with subsequent warm-up phases

ATTENTION

Before cold start, the viscosity* must be determined on the basis of the oil temperature (e.g. tank temperature) in order to avoid damage to the axial piston units from excessive viscosity* of the hydraulic fluid. At a viscosity* > 1600 mm^2/s, the hydraulic system must be preheated.

Using the determined viscosity*, the type and duration of the warm-up must be followed, using the cold start chart**.

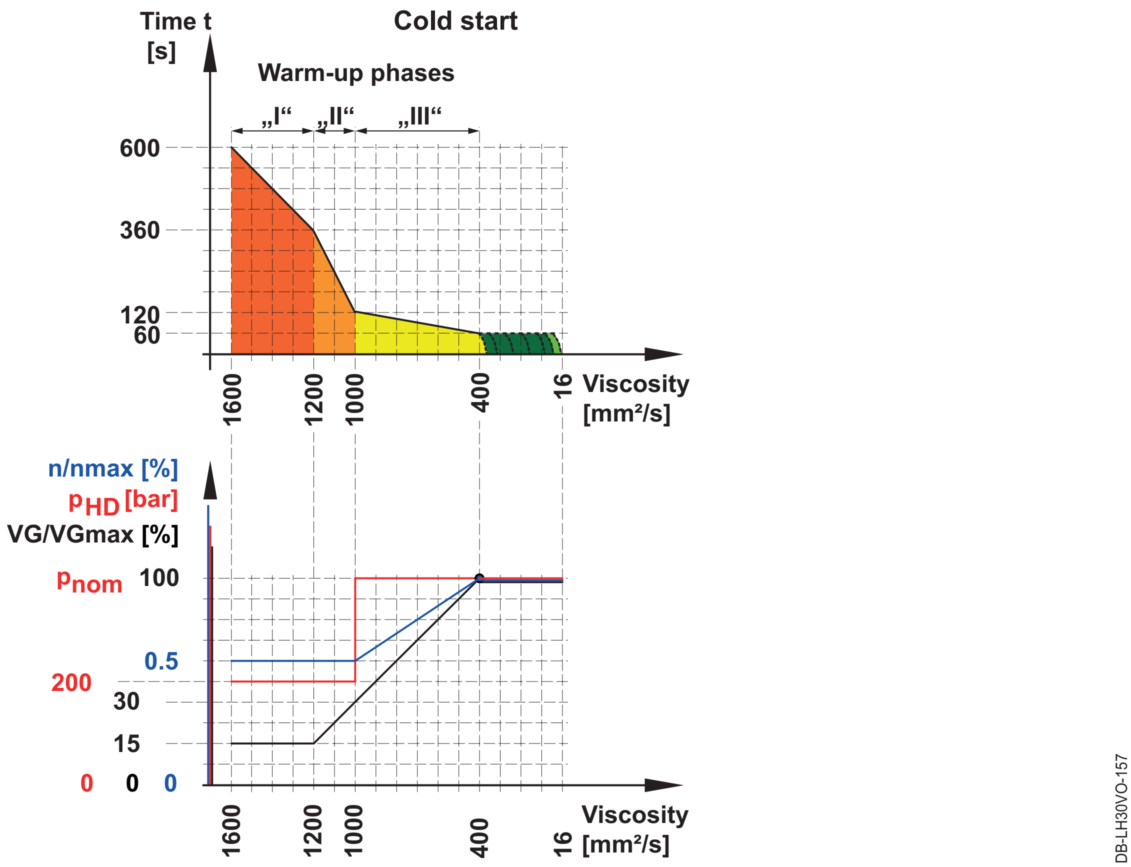
*) For additional information see: 2.5.6 Viscosity chart, page 17

The following conditions apply:

- Viscosity: 1600-1200 mm^2/s = operate the axial piston unit for 600-360 s with measures listed for Warm-up phase "I".
- Viscosity: 1200-1000 mm^2/s = operate the axial piston unit for 360-120 s with measures listed for Warm-up phase "II".
- Viscosity: 1000-400 mm^2/s = operate the axial piston unit for 120-60 s with measures listed for Warm-up phase "III".
- Viscosity: 400-16 mm^2/s = operate the axial piston unit for 60 s with measures listed for "Warm start". This means that even at ≤ 400 mm^2/s, the measures must be applied for at least 60 s.

2 Technical data

****) Cold start chart**



2.5.4 Warm-up phases

Note
Depending on the current viscosity, continue with the corresponding warm-up phase after the cold start. In the subsequent warm-up phases, the operating parameters may be increased to allow the hydraulic system to warm up rapidly.

Warm-up phase " I "

Condition:

- Viscosity: 1600-1200 mm^2/s = operate the axial piston unit with measures listed below until a viscosity of 1200 mm^2/s is reached.

Measures:

- Operating pressure range: $p_{HD\ min} \leq p_{HD\ Warm\text{-}up\ "I"} \leq 200$ bar
- Speed: $n_{min} \leq n_{Warm\text{-}up\ "I"} \leq 50\%$ of n_{max}
- Displacement volume: $V_{g\ min} \leq V_{g\ Warm\text{-}up\ "I"} \leq 15\%$ of $V_{g\ max}$

Warm-up phase " Ⅱ "

Condition:
- Viscosity: 1200-1000 mm^2/s = operate the axial piston unit with measures listed below until a viscosity of 1000 mm^2/s is reached.

Measures:
- Operating pressure range: $p_{HD\ min} \leq p_{HD\ Warm\text{-}up\ "II"} \leq$ 200 bar
- Speed: $n_{min} \leq n_{Warm\text{-}up\ "II"} \leq$ 50% of n_{max}
- Displacement volume: $V_{g\ min} \leq V_{g\ Warm\text{-}up\ "II"} \leq$ 15-30% of $V_{g\ max}$

Warm-up phase "Ⅲ"

Condition:
- Viscosity: 1000-400 mm^2/s = operate the axial piston unit with measures listed below until a viscosity of 400 mm^2/s is reached.

Measures:
- Operating pressure range: $p_{HD\ min} \leq p_{HD\ Warm\text{-}up\ "III"} \leq p_{HD\ max}$
- Speed: $n_{min} \leq n_{Warm\text{-}up\ "III"} \leq$ 50% of n_{max}
- Displacement volume: $V_{g\ min} \leq V_{g\ Warm\text{-}up\ "III"} \leq$ 30-100% of $V_{g\ max}$

Warm start

Condition:
- Viscosity: 400-16 mm^2/s = operate the axial piston unit for at least 60 s, even at viscosity < 400 mm^2/s, with measures listed below.

Measures:
- Operating pressure range: $p_{HD\ min} \leq p_{HD} \leq$ 50 bar
- Speed: $n_{min} \leq n \leq$ 1000 rpm, or idle speed of the drive motor
- Displacement volume: $V_{g\ min} \leq V_g \leq$ 15% of $V_{g\ max}$

2.5.5 Normal operation

Note

Optimum operating range: 16-36 mm^2/s

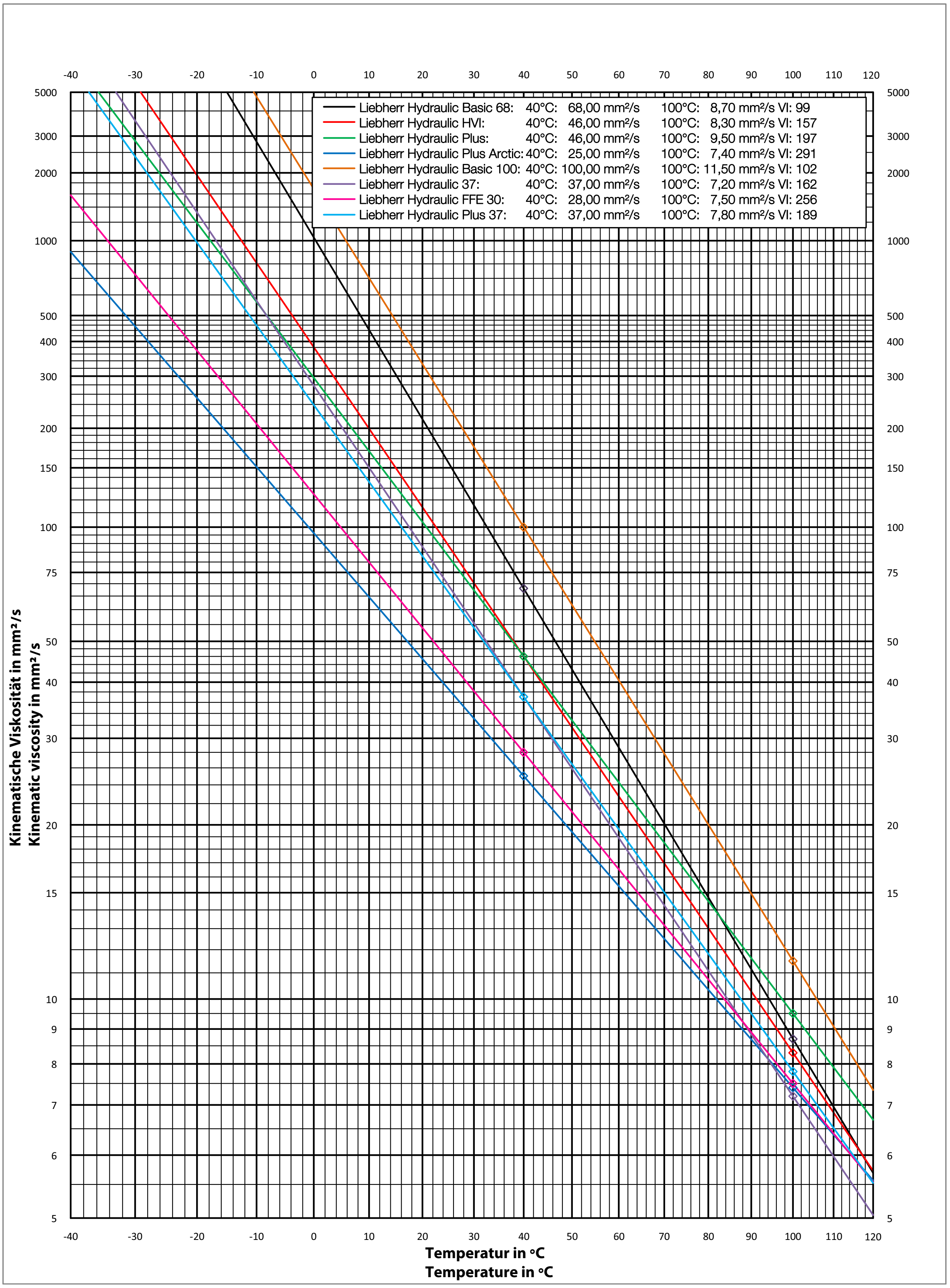
The viscosity must not fall below 8 mm^2/s (for a short period, thud < 3 minutes, 7 mm^2/s) at maximum leakage oil temperature.

Note

In the viscosity range of 400-8 mm^2/s, the axial piston unit can be put under full load.

- Operating pressure range: $p_{HD\ min} \leq p_{HD} \leq p_{HDmax}$
- Speed: $n_{min} \leq n \leq n_{max}$
- Displacement volume: $V_{G\ min} \leq V_G \leq V_{g\ max}$

2.5.6 Viscosity chart



2 Technical data

2.6 Shaft lip seal

2.6.1 General information

The rotary shaft lip seals (RWDR) are special sealing elements which permit a specific housing pressure. In order to ensure that the tribological system functions optimally, the operating conditions must be adhered to.

Sealing edge temperature varies due to the following factors in the housing:
- Circumferential speed
- Hydraulic fluid temperature
- Lubricating medium
- Pressure build-up

The sealing edge temperature could be 20 °C to 40 °C above the leakage oil temperature of a hydraulic axial piston unit.

2.7 Housing flushing

Under various operating conditions, e.g. a very low flow rate over a longer period of time, may cause a critical temperature rise in the housing.
Limit values: (For additional information see: 2.5 Temperature, page 12).

If this is the case, the housing must be flushed, so the “hot” hydraulic oil is directed to an external cooler where it cools down and from where it is fed back into the hydraulic system.

The flushing volume Q_V in l/min is to be individually set for each nominal size in connection with the application and is the responsibility of the device or system manufacturer.

2.8 Add-on parts

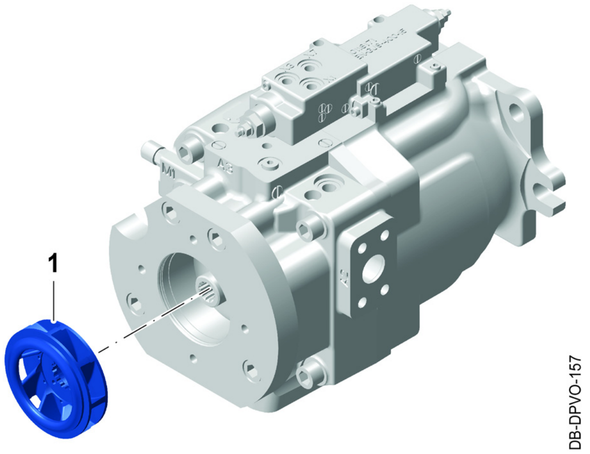
DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

2.8.1 Charge pump (impeller)

Charge pumps for variable displacement single pumps are currently available only for nominal sizes 165 and 215. They are designed as radial and centrifugal pumps with axial impeller.
Charge pumps for other nominal sizes on request.

0	Without charge pump (impeller)
I	With charge pump (impeller)

2 Technical data



Principle of charge pump

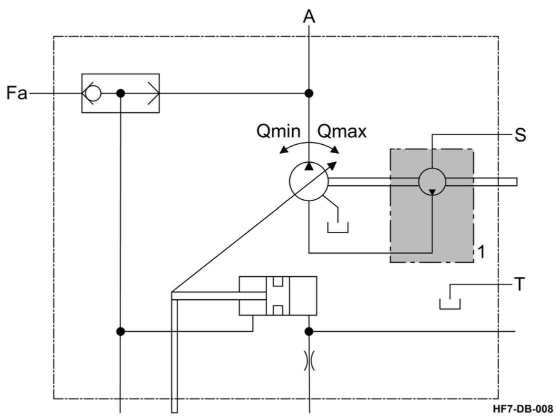
The hydraulic fluid fed in through the suction pipe connection on the connecting plate is set into rotation by the attached propeller wheel when the driving shaft is spinning, is accelerated by centrifugal force and pushed to the outside.

The hydraulic oil exits the impeller radially, i.e. perpendicular to the drive shaft, at high velocity and higher delivery pressure, and is fed in a channel to the suction kidney of the control plate.
Thus more delivery flow and higher delivery pressure are applied simultaneously to the suction kidney of the control plate, resulting in the axial piston unit to be "charged" with power.

The charge pump increases the suction pressure of the drive, which facilitates suctioning hydraulic fluid with high viscosity and benefits cold starts with minimal wear.

Note
To increase the suction pressure of the drive, a tank charging method was used in the past, where an overpressure was produced in the tank by exhaust gas from the combustion engine. This approach can be replaced by using the charge pump.

2.8.2 Hydraulic diagram with charge pump



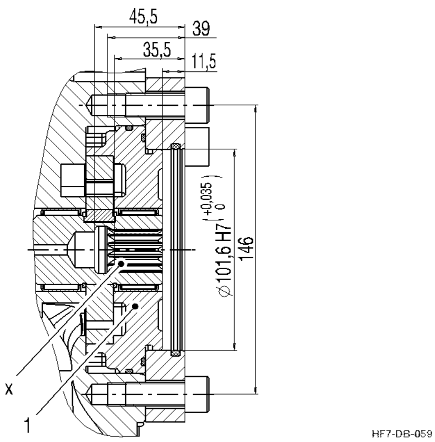
1 Charge pump

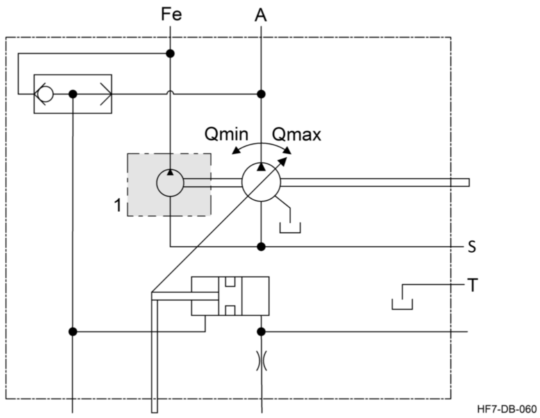
2 Technical data

2.9 Gear pump

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

00	Without gear pump
24	With gear pump





Note
A gear pump can be implemented only in combination with through-drive = B11D or 0000.
A joint gear pump on hydraulic pump 2 is recommended for multi-circuit pumps in tandem design, (For additional information see: 5.19 Multiple unit in tandem design, page 92).

1 Gear pump
X ANSI B92.1a-1976 7/8 spline shaft size 30° engagement angle 13 teeth 16/32 pitch cl.7

3 Activation and control type

3.1 Control types

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

Note
For each control type or function, only one nominal size is illustrated, typically nominal size 215. Special applications and designs are not included in this chapter. Always use the information from the installation drawing provided or contact Liebherr.

The following applies to all control types:

DANGER
The spring-guided reset in the regulating valve is not a safety device!
Contaminants in the hydraulic system such as chips or residual dirt from parts of the device or system can cause blockages at undefined points of various control components.
Under some circumstances, the machine operator's specifications can no longer be implemented.
It is the device or system manufacturer's responsibility to install a safety device e.g. an emergency stop.

DANGER
The regulating valve is not a safety device against overload!
It is the device or system manufacturer's responsibility to install protection against overload, e.g. a pressure limiting valve. Pressure limiting valves are available in the portfolio and can be ordered separately.

The following modular control types can be ordered for the DPVO series:

3.1.1 Mechanical-hydraulic control

- DA- control, see chapter 3.2.16
- LS-DA- control, see chapter 3.2.16
- LR- control, see chapter 3.2.6
- LR1- control, see chapter 3.2.7
- LR-LS- control, see chapter 3.2.8
- LR1-LS- control, see chapter 3.2.9
- LR-LS1- control, see chapter 3.2.10
- LR1-LS1- control, see chapter 3.2.11
- LR-SD2-DA- control, see chapter 3.2.12
- LR1-SD2-DA- control, see chapter 3.2.13
- LR-SD2-DA1- control, see chapter 3.2.14
- LR1-SD2-DA1- control, see chapter 3.2.15
- SL-SD1- control (for multi-circuit pumps), see chapter 3.2.17
- SL1-SD1- control (for multi-circuit pumps), see chapter 3.2.18

3.1.2 Electric-hydraulic control

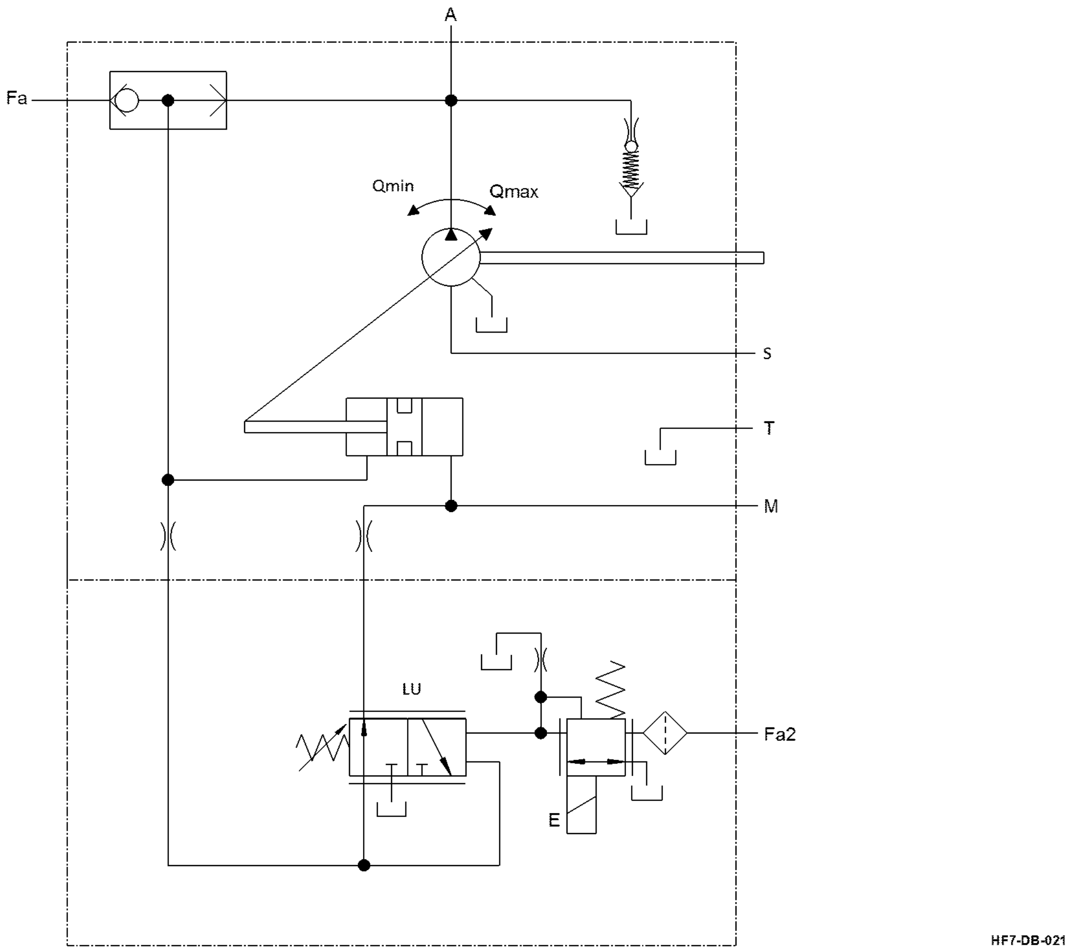
- LU- control, see chapter 3.2.1
- EL1-DA- control, see chapter 3.2.3
- EL1-DA1- control, see chapter 3.2.4
- EL1-LS- control, see chapter 3.2.5

Further control types on request.

3 Activation and control type

3.2 Standard hydraulic diagrams

3.2.1 LU- control



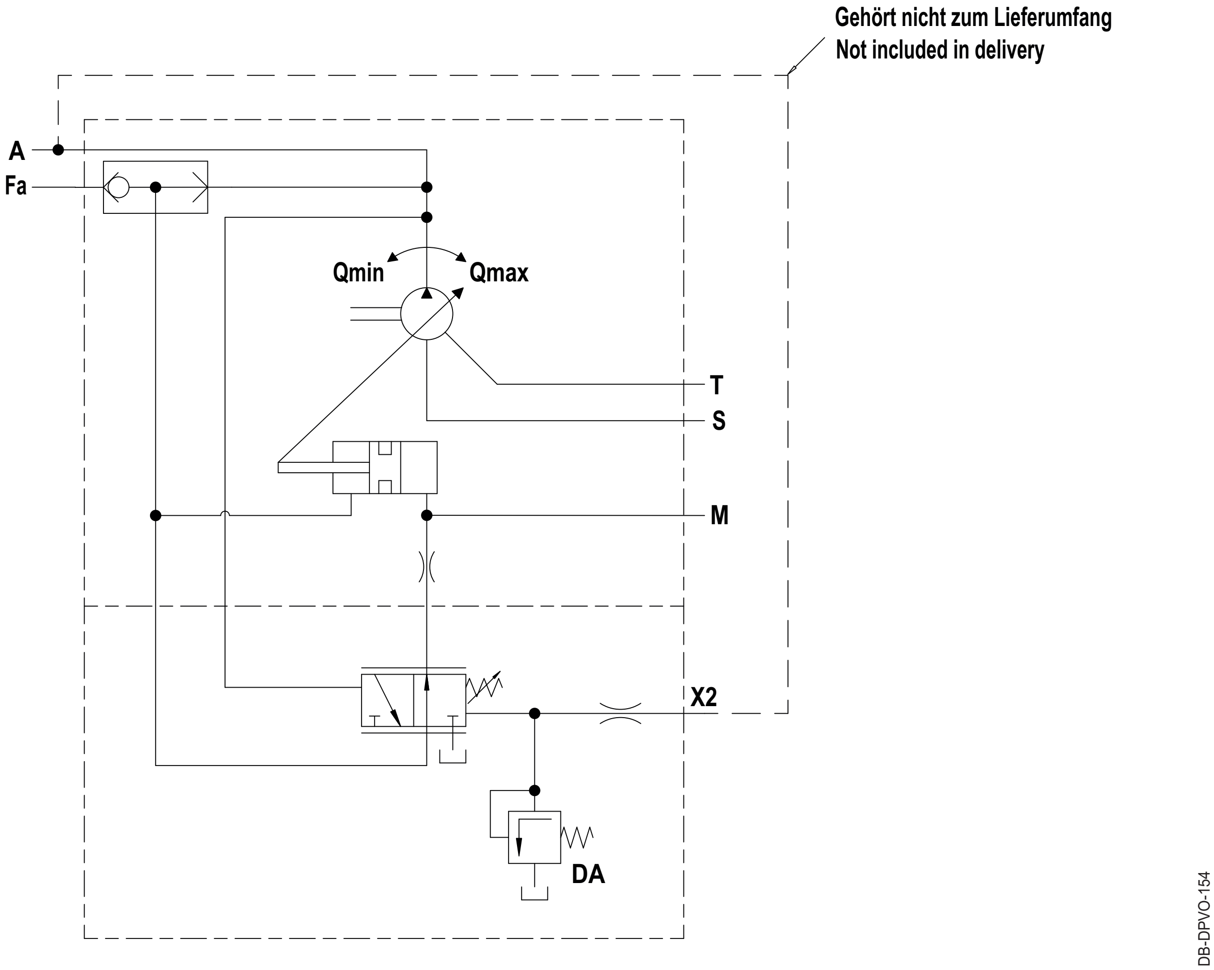
A	Working connection SAE J 518
Fa	Auxiliary pressure connection ISO 9974-1
Fa2	Auxiliary pressure connection ISO 9974-1

M	Regulated high pressure pReg
S	Suction line SAE
T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)

Key features
Electronic control with pulse-width modulated control current (PWM signal 100-160 Hz, U= 24 V, I_{max}= 750 mA), see chapter 3.3.8 The setting range is between 150 and 700 mA.

3 Activation and control type

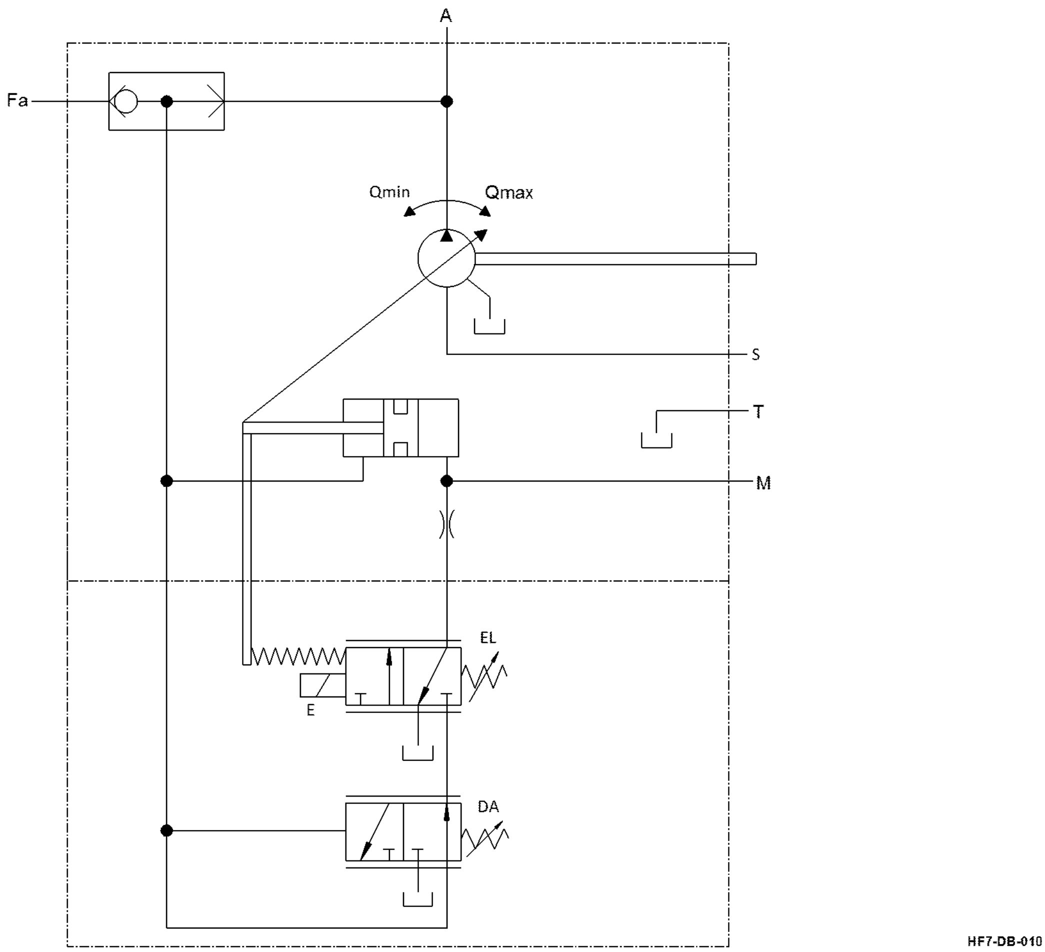
3.2.2 DA- control



A	Working connection SAE J 518		S	Suction line SAE J 518
Fa	Auxiliary pressure connection ISO 9974-1		T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
M	Regulated high pressure pReg		X2	External high pressure ISO 9974-1

3 Activation and control type

3.2.3 EL1-DA- control



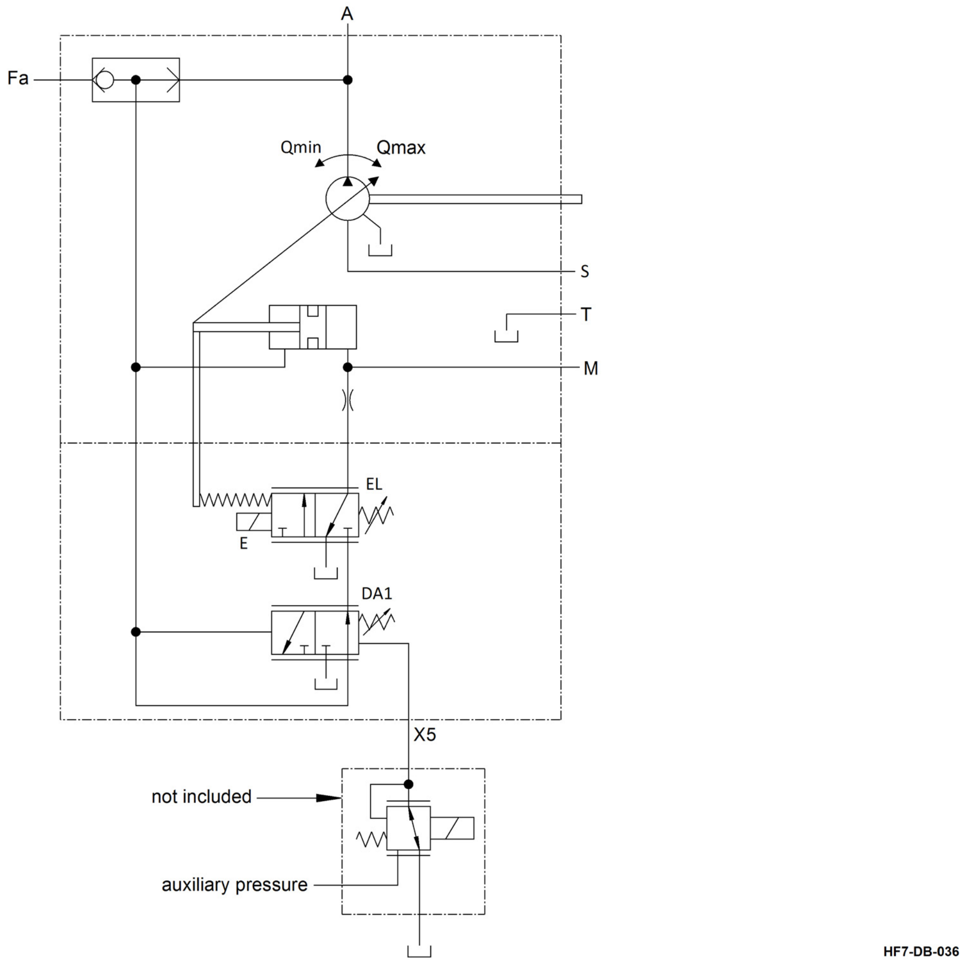
A	Working connection SAE J 518
Fa	Auxiliary pressure connection ISO 9974-1
M	Regulated high pressure pReg

S	Suction line SAE
T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
-	-

Key features
Electronic control with pulse-width modulated control current (PWM signal 100-160 Hz, U= 24 V), see chapter 3.3.3. The setting range is between 200 and 650 mA.

3 Activation and control type

3.2.4 EL1-DA1- control



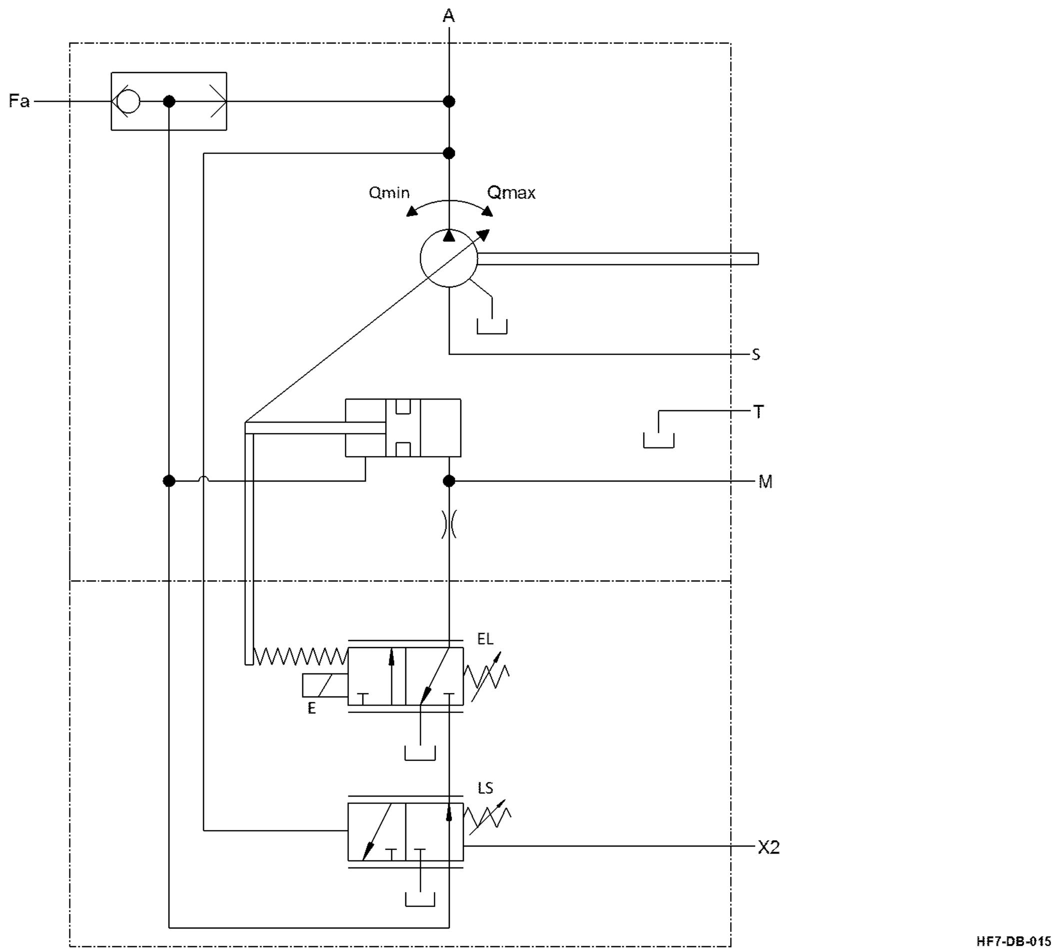
A	Working connection SAE J 518
Fa	Auxiliary pressure connection ISO 9974-1
M	Regulated high pressure pReg

S	Suction line SAE
T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
X5	DA1 override signal ISO 9974-1

Key features
An externally supplied DA1 override signal (0-13.5 bar) is applied to port X5.

3 Activation and control type

3.2.5 EL1-LS- control



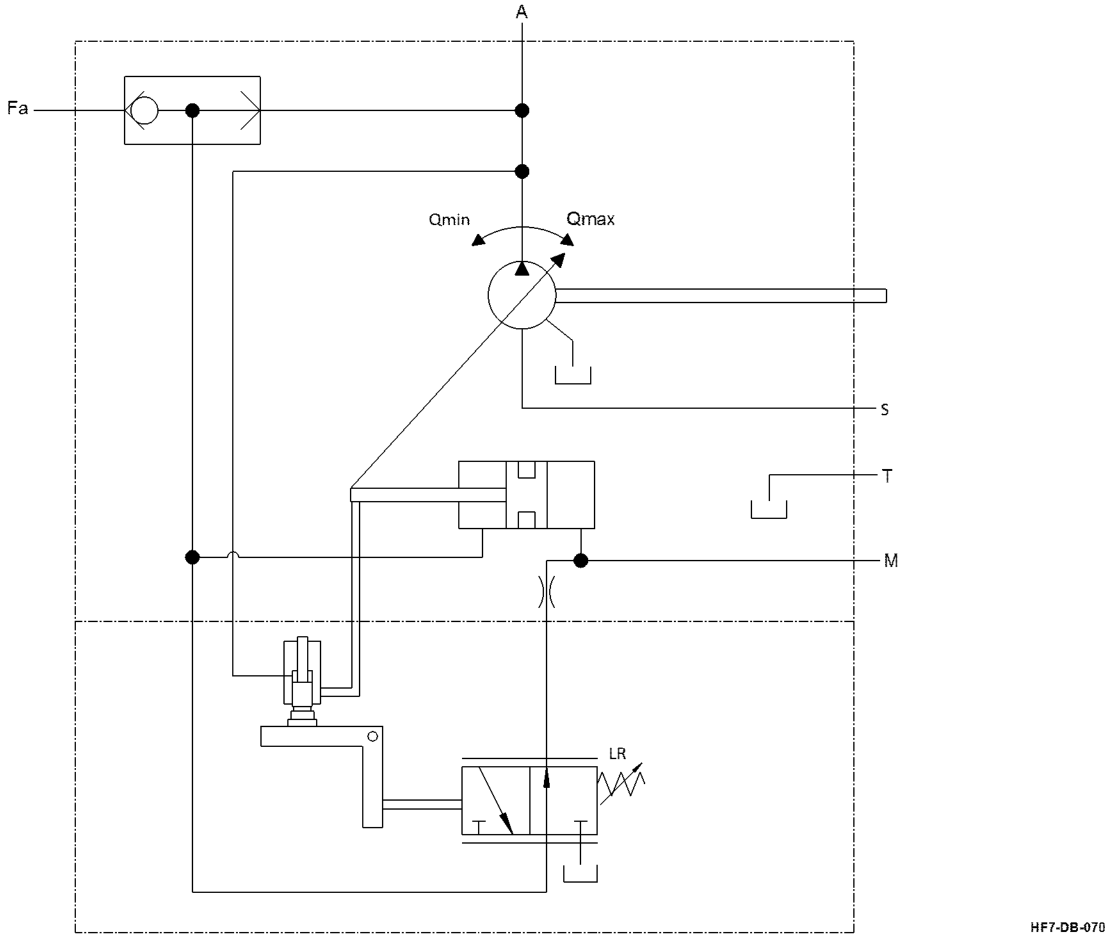
A	Working connection SAE J 518
Fa	Auxiliary pressure connection ISO 9974-1
M	Regulated high pressure pReg

S	Suction line SAE
T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
X2	LS pressure ISO 9974-1

Key features
An externally supplied LS pressure is applied to port X2.

3 Activation and control type

3.2.6 LR- control

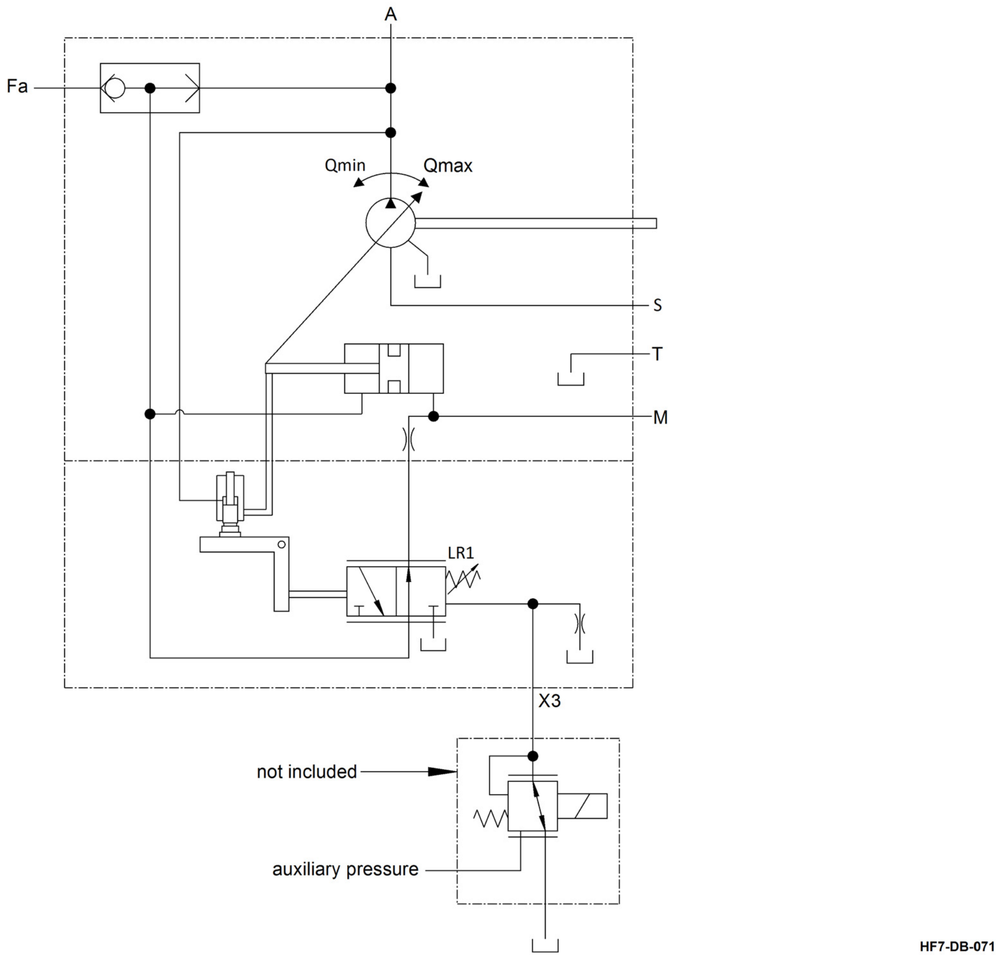


A	Working connection SAE J 518	S	Suction line SAE
Fa	Auxiliary pressure connection ISO 9974-1	T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
M	Regulated high pressure pReg	-	-

Key features
Standard fixed LR setting.

3 Activation and control type

3.2.7 LR1- control

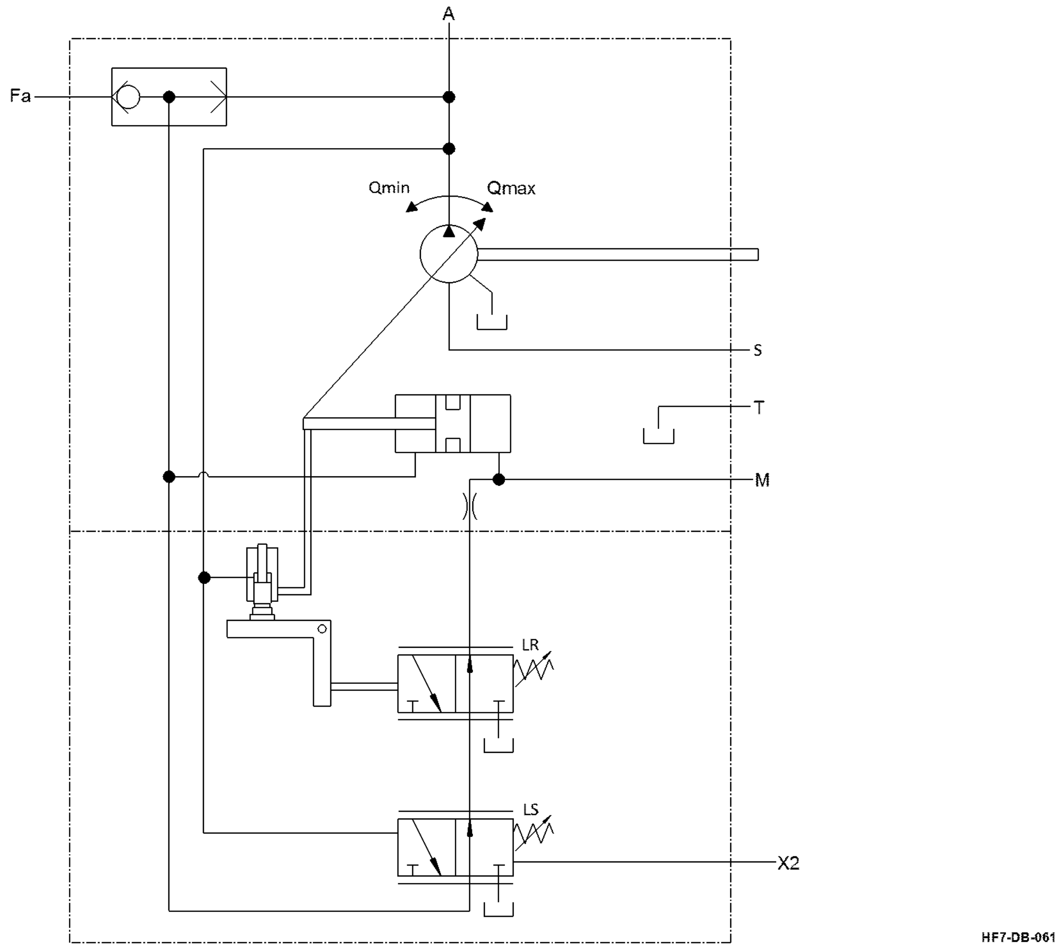


A	Working connection SAE J 518		S	Suction line SAE
Fa	Auxiliary pressure connection ISO 9974-1		T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
M	Regulated high pressure pReg		X3	LR oversteering pressure connection ISO 9974-1

Key features
An externally supplied LR oversteering pressure is applied to port X3.

3 Activation and control type

3.2.8 LR-LS- control

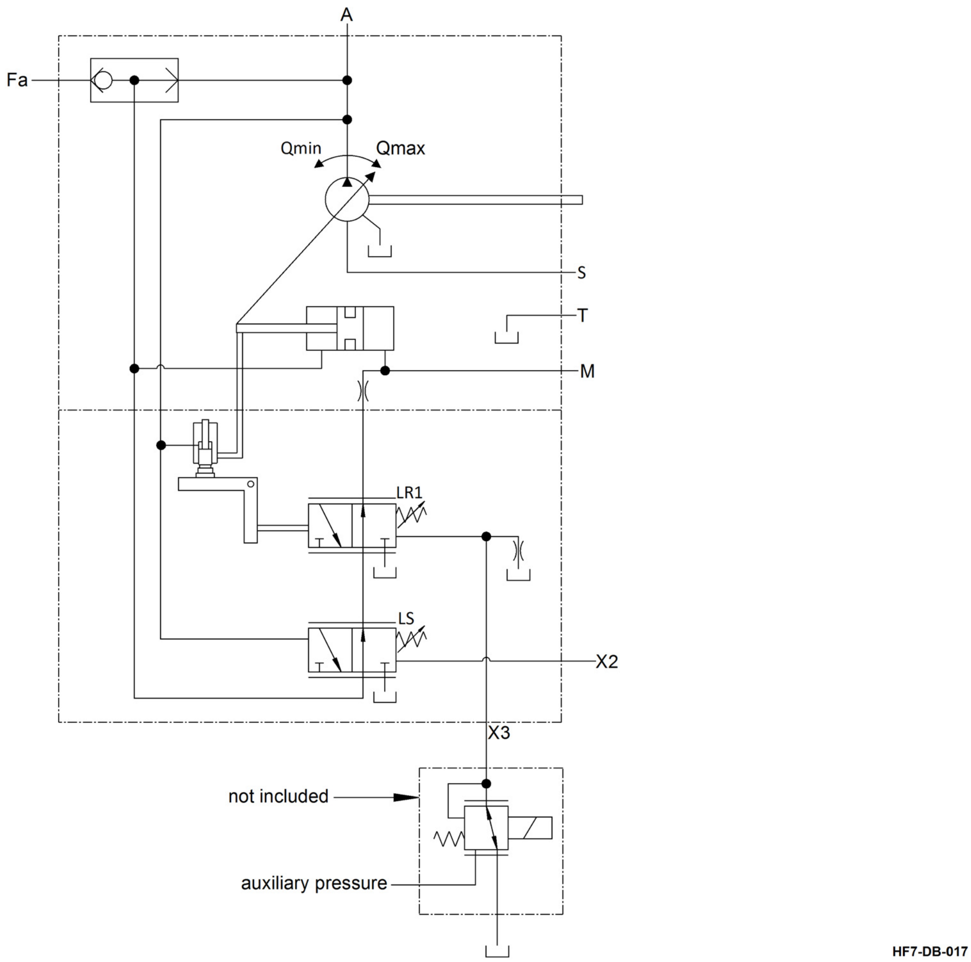


A	Working connection SAE J 518	S	Suction line SAE
Fa	Auxiliary pressure connection ISO 9974-1	T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
M	Regulated high pressure pReg	X2	LS pressure ISO 9974-1

Key features
An externally supplied LS pressure is applied to port X2.

3 Activation and control type

3.2.9 LR1-LS- control



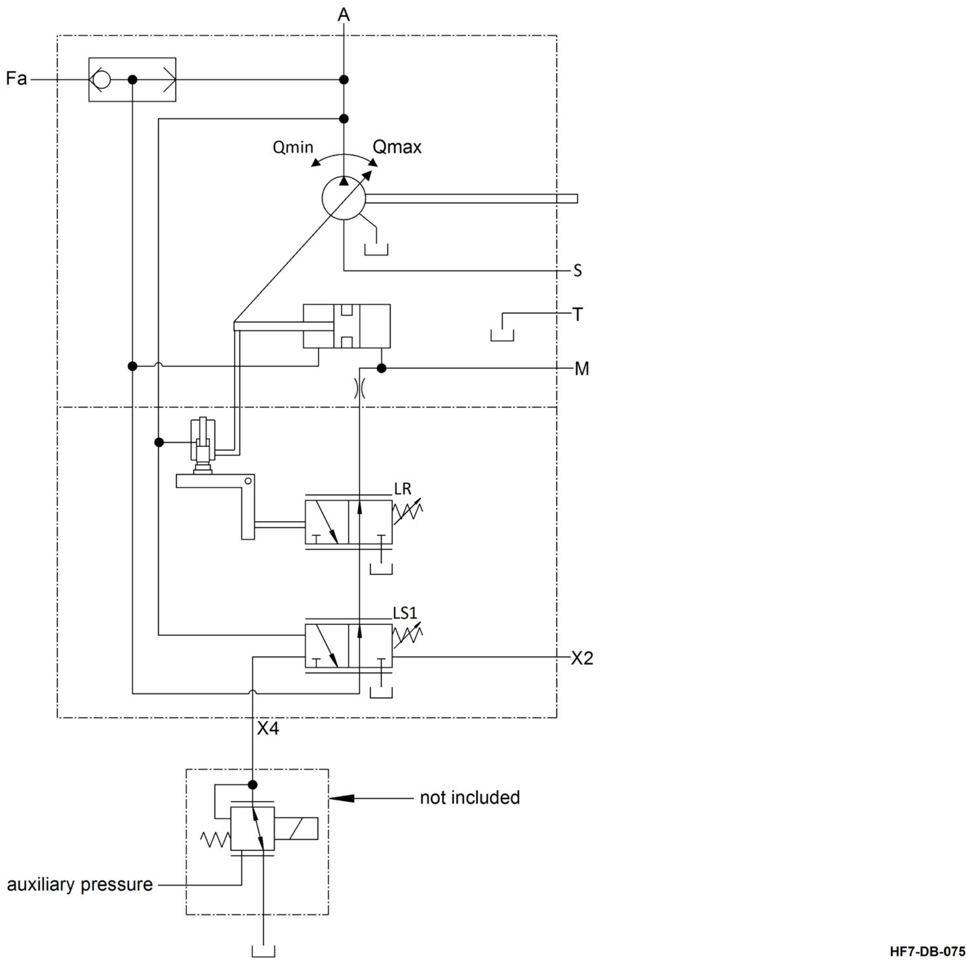
A	Working connection SAE J 518
Fa	Auxiliary pressure connection ISO 9974-1
M	Regulated high pressure pReg
S	Suction line SAE

T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
X2	LS- pressure ISO 9974-1
X3	LR oversteering pressure connection ISO 9974-1
-	-

Key features
An externally supplied LS pressure is applied to port X2.
An externally supplied LR oversteering pressure is applied to port X3.

3 Activation and control type

3.2.10 LR-LS1- control



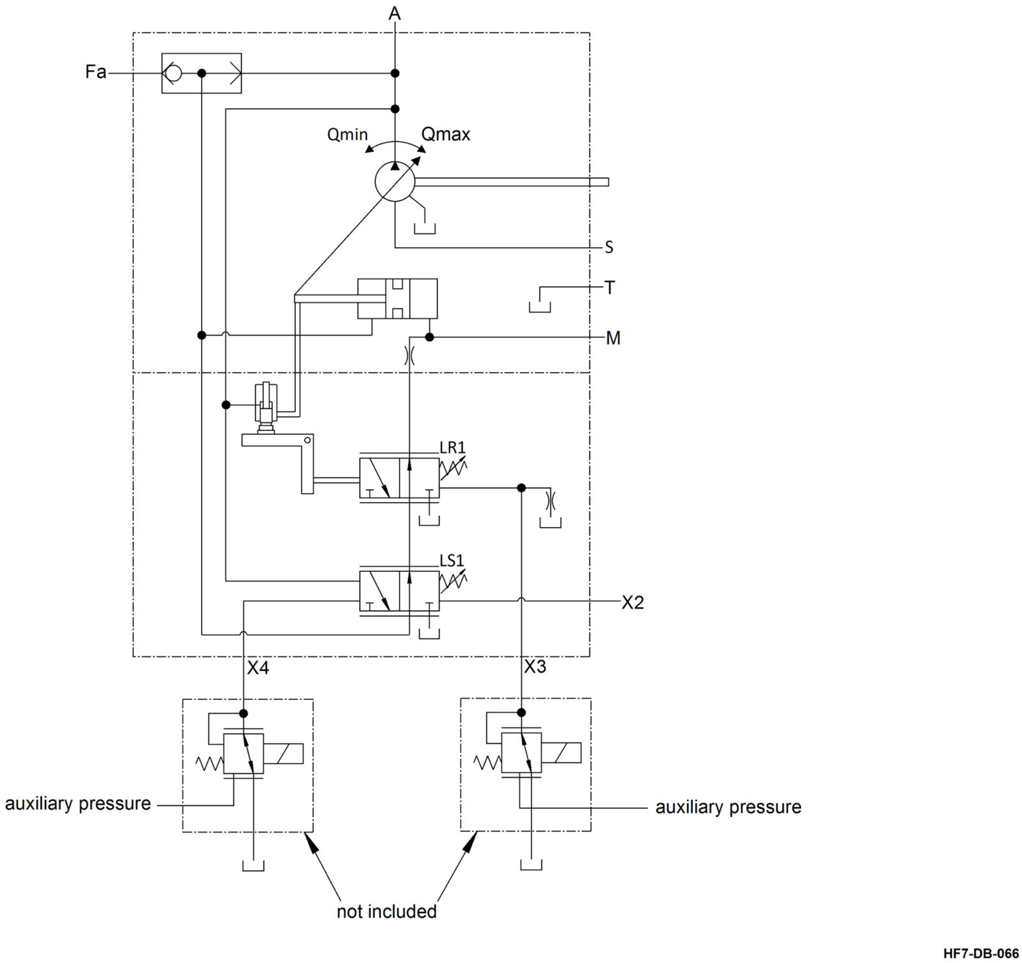
A	Working connection SAE J 518		T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
Fa	Auxiliary pressure connection ISO 9974-1		X2	LS pressure ISO 9974-1
M	Regulated high pressure pReg		X4	Δp lowering pressure pX4
S	Suction line SAE 3”		-	-

Key features
An externally supplied regulating pressure pX4 is applied to port X4.
An externally supplied LS pressure is applied to port X2.

Note
The Δp lowering is currently only available as an option for the LR - LS control.

3 Activation and control type

3.2.11 LR1-LS1- control



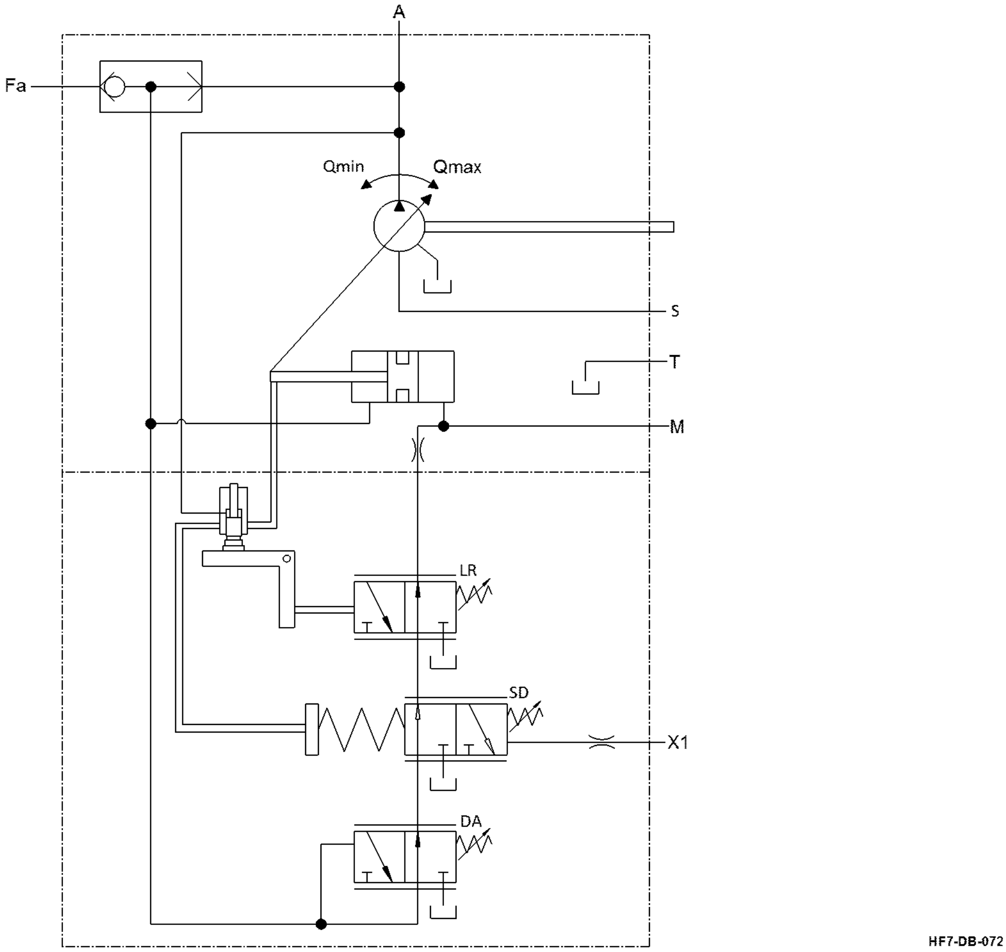
A	Working connection SAE J 518	T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
Fa	Auxiliary pressure connection ISO 9974-1	X2	LS pressure ISO 9974-1
M	Regulated high pressure pReg	X3	LR oversteering pressure connection ISO 9974-1
S	Suction line SAE 3”	X4	Δp lowering pressure pX4

Key features
An externally supplied LS pressure is applied to port X2.
An externally supplied LR oversteering pressure is applied to port X3.
An externally supplied regulating pressure pX4 is applied to port X4.

Note
The Δp lowering is currently only available as an option for the LR - LS control.

3 Activation and control type

3.2.12 LR-SD2-DA- control

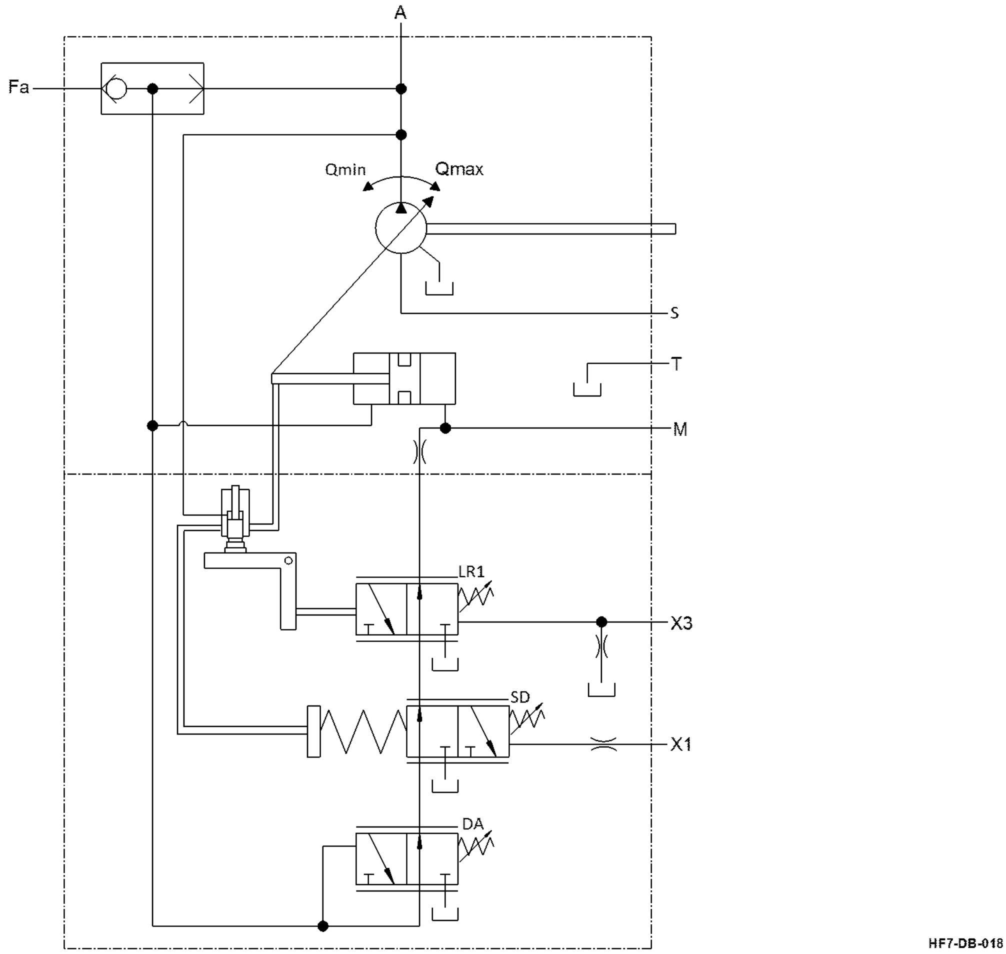


A	Working connection SAE J 518	S	Suction line SAE
Fa	Auxiliary pressure connection ISO 9974-1	T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
M	Regulated high pressure pReg	X1	SD steering pressure

Key features
An externally supplied SD steering pressure is applied to port X1. The setting range is between 5 and 30 bar max., other values on request.

3 Activation and control type

3.2.13 LR1-SD2-DA- control



A	Working connection SAE J 518
Fa	Auxiliary pressure connection ISO 9974-1
M	Regulated high pressure pReg
S	Suction line SAE

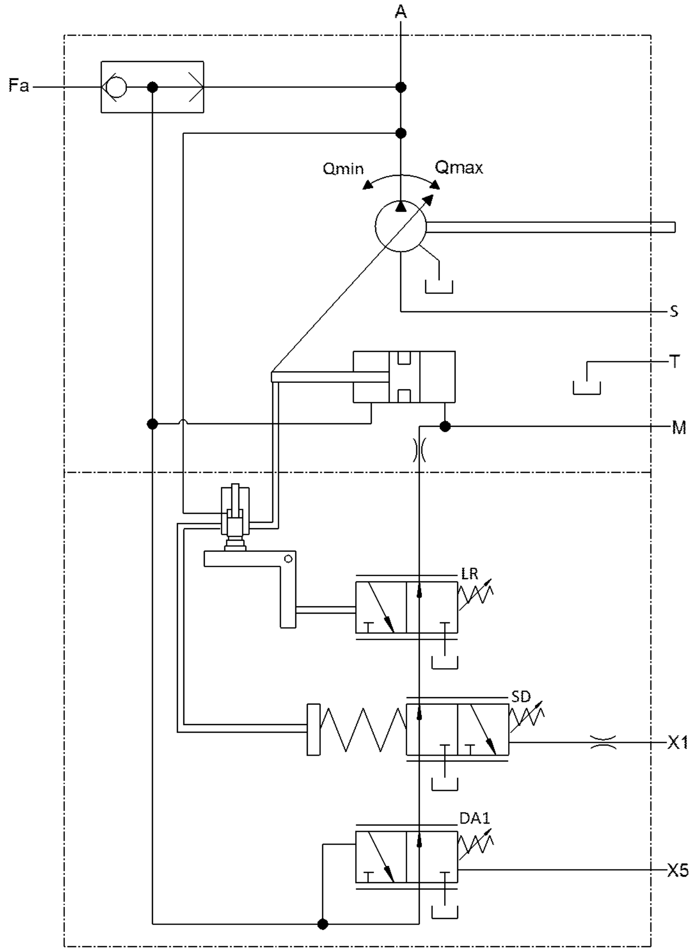
T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
X1	SD steering pressure
X3	LR oversteering pressure connection
-	-

Key features
An externally supplied SD steering pressure is applied to port X1.
The setting range is between 5 and 30 bar max., other values on request.

An externally supplied LR oversteering pressure is applied to port X3.

3 Activation and control type

3.2.14 LR-SD2-DA1- control

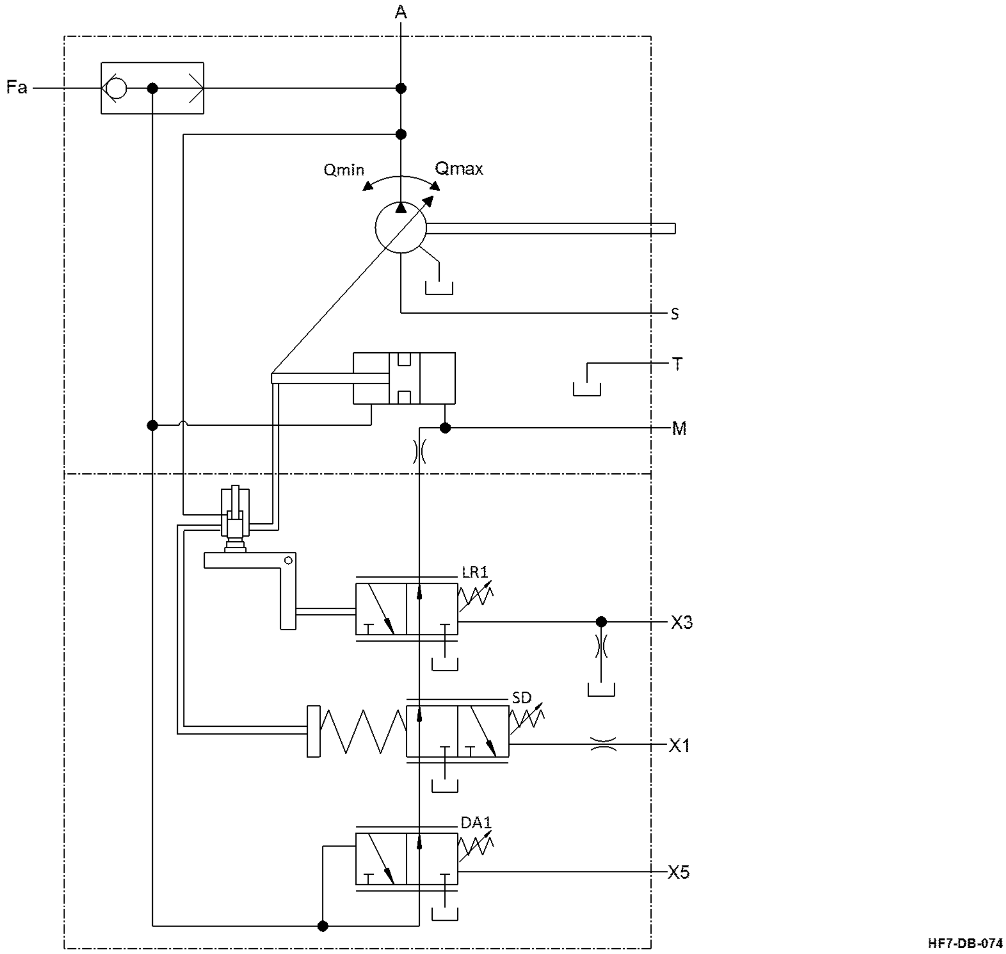


A	Working connection SAE J 518		T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
Fa	Auxiliary pressure connection ISO 9974-1		X1	SD steering pressure
M	Regulated high pressure pReg		X5	DA1 override signal ISO 9974-1
S	Suction line SAE		-	-

Key features
An externally supplied SD steering pressure is applied to port X1. The setting range is between 5 and 30 bar max., other values on request.

An externally supplied DA1 override signal (0-13.5 bar) is applied to port X5.

3.2.15 LR1-SD2-DA1- control



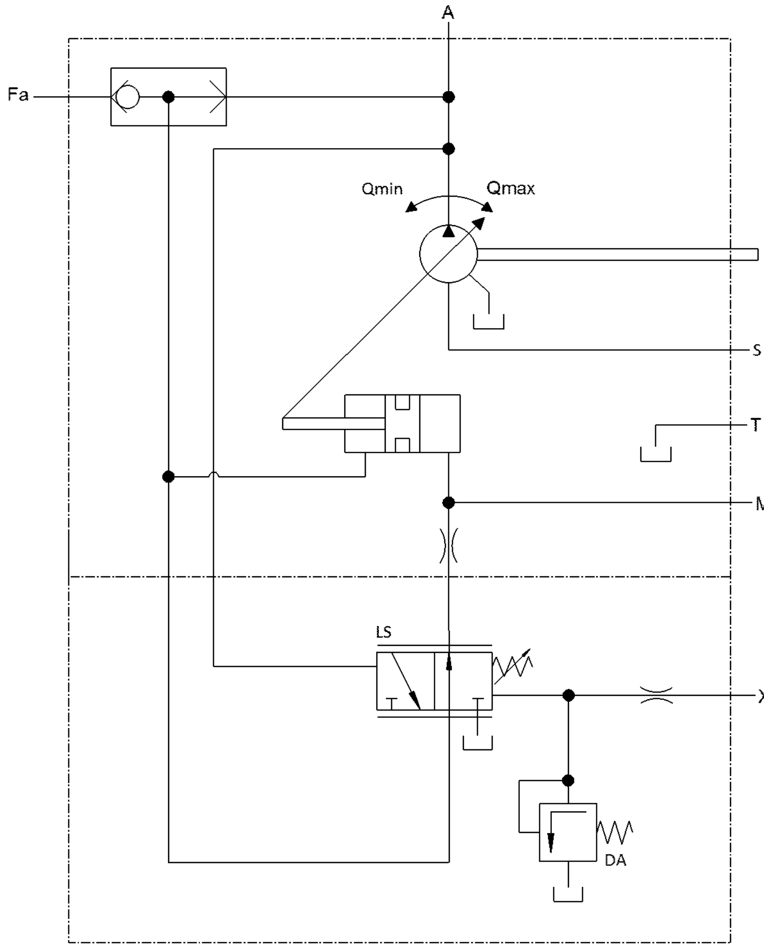
A	Working connection SAE J 518		T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
Fa	Auxiliary pressure connection ISO 9974-1		X1	SD steering pressure
M	Regulated high pressure pReg		X3	LR oversteering pressure connection
S	Suction line SAE		X5	DA1 override signal ISO 9974-1

Key features
An externally supplied SD steering pressure is applied to port X1. The setting range is between 5 and 30 bar max., other values on request.

An externally supplied LR oversteering pressure is applied to port X3.
An externally supplied DA1 override signal (0-13.5 bar) is applied to port X5.

3 Activation and control type

3.2.16 LS-DA- control

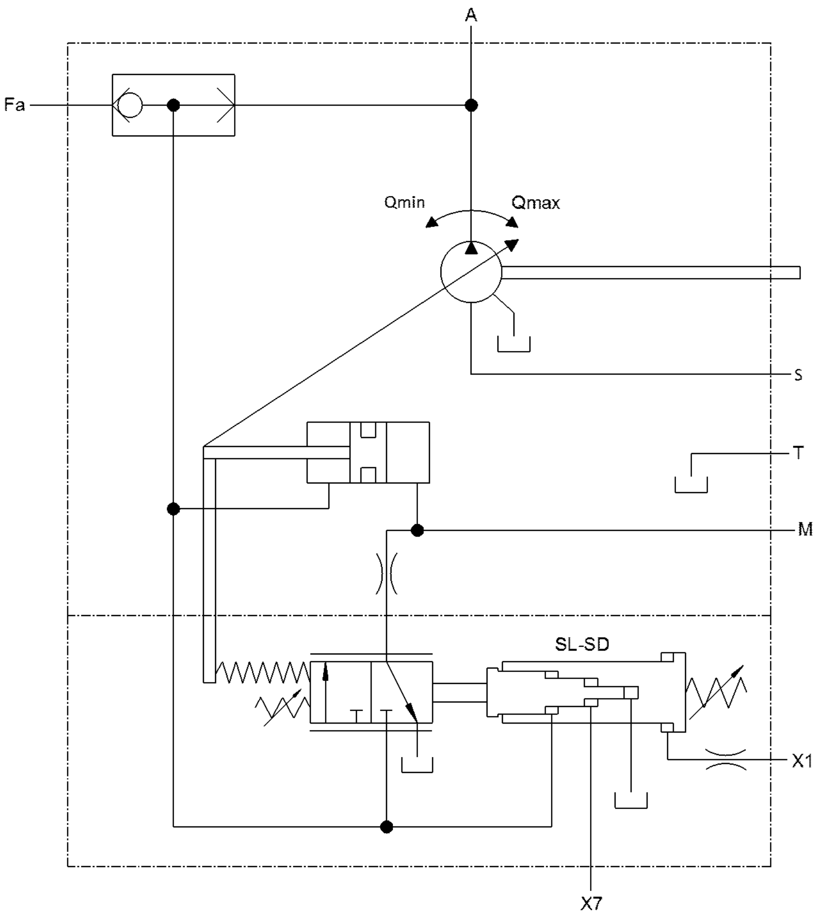


HF7-DB-025

A	Working connection SAE J 518	S	Suction line SAE
Fa	Auxiliary pressure connection ISO 9974-1	T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
M	Regulated high pressure pReg	X2	LS- pressure ISO 9974-1

Key features
An externally supplied LS pressure is applied to port X2.

3.2.17 SL-SD1- control



HF7-DB-068

A	Working connection SAE J 518
Fa	Auxiliary pressure connection ISO 9974-1
M	Regulated high pressure pReg
S	Suction line SAE

T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
X1	SD steering pressure
X7	pHD signal (other driving gear) ISO 9974-1
-	-

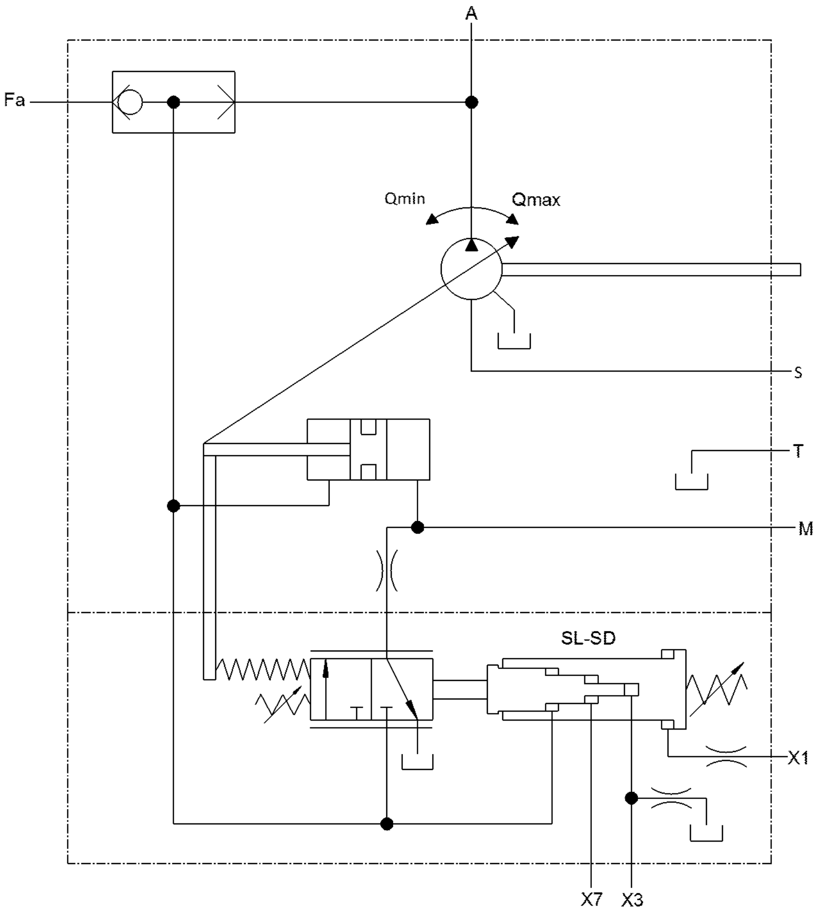
Key features
For two single pumps on pump distribution gear (PVG) or a multi-circuit pump, e.g. in tandem design.

An externally supplied SD steering pressure is applied to port X1.
The setting range is between 5 and 30 bar max., other values on request.

A pHD signal supplied by the other driving gear is applied to port X7.

3 Activation and control type

3.2.18 SL1-SD1- control



A	Working connection SAE J 518		T	Leakage oil ISO 9974-1 (e.g., for oil refuelling or draining)
Fa	Auxiliary pressure connection ISO 9974-1		X1	SD steering pressure
M	Regulated high pressure pReg		X3	SL steering pressure ISO 9974-1
S	Suction line SAE		X7	pHD signal (other driving gear) ISO 9974-1

Key features
For two single pumps on pump distribution gear (PVG) or a multi-circuit pump, e.g. in tandem design.

An externally supplied SD steering pressure is applied to port X1.
The setting range is between 5 and 30 bar max., other values on request.

An externally supplied SL steering pressure is applied to port X3.
A pHD signal supplied by the other driving gear is applied to port X7.

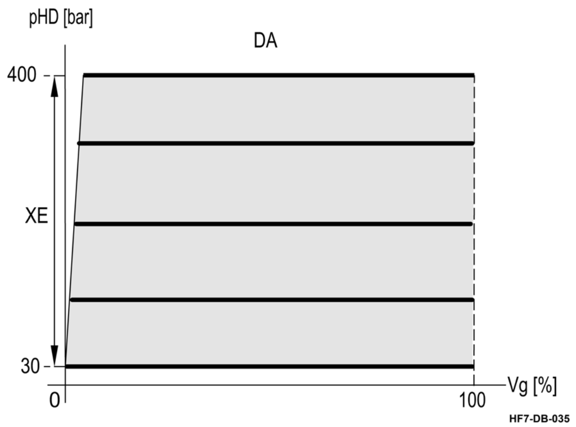
3 Activation and control type

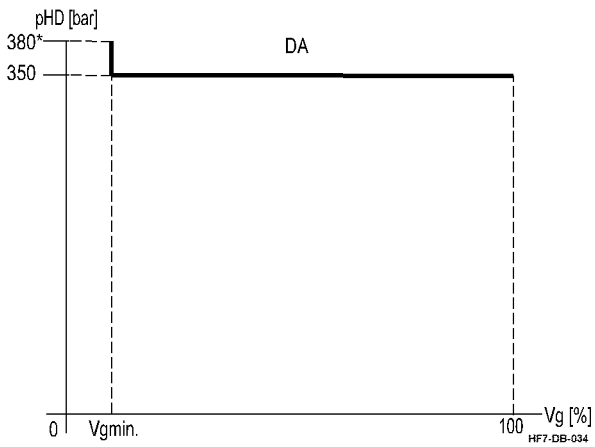
3.3 Control functions

- DA- function / pressure cut-off, see chapter 3.3.1
- DA1- function / pressure cut-off with override, see chapter 3.3.2
- EL- function / electro-proportional regulation (EL1+EL2), see chapter 3.3.3
- LR- function / hyperbolic performance regulation, see chapter 3.3.4
- LR1- function / hyperbolic performance regulation with override, see chapter 3.3.5
- LS- function / load sensing, see chapter 3.3.6
- LS1- function / load-sensing with Δp lowering, see chapter 3.3.7
- LU- function / pressure control, see chapter 3.3.8
- SD- function / steering-pressure-proportional hydraulic regulation, see chapter 3.3.9
- SL- function / total performance regulation, see chapter 3.3.10
- SL1- function / total performance regulation with override, see chapter 3.3.11

3.3.1 DA- function

Characteristic





DA pressure control minimizes or limits (cut-off) the volume flow of the axial piston unit, when a fixed high pressure value pHD is reached. Swivelling in the direction of $V_{g\ min}$ protects the hydraulic system from damage and overload.

Swivelling continues in direction $V_{g\ min}$ only until the volume flow of the axial piston unit exactly matches the consumer need at this pressure stage.

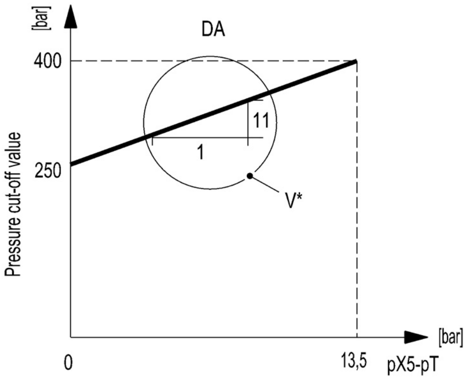
With its function, the pressure control ensures that the pressure is kept constant even when the volume flow in the system changes. This compensates all internal and external leakage oil losses.

XE setting range approx. 30 - 400 bar.

Options
- Additional internal design measures for vibration damping on request.
- Pressure cut-off with override function: see chapter 3.3.2
- DA control with V_{gmin} setting can be supplied. Value of the high pressure pHD* at the consumer corresponds to the value pHD $_{max.}$ of the pressure limiting valve at $V_{g\ min}$.

3.3.2 DA1- function

Characteristic



HF7-DB-037

The DA1 function on the DA axle in the pressure control has the task of overriding the set DA cut-off pressure of pressure stage 1 (e.g. 250 bar) via an externally supplied steering pressure pX5-pT at port X5 and thereby increasing the high pressure to the set DA cut-off pressure of pressure stage 2 (e.g. 400 bar).

The override function DA1 thus represents a two-stage pressure cut-off with 2 pressure stages.

- Pressure stage 1, e.g.: 250 bar, or
- Pressure stage 2, e.g.: 400 bar

It is therefore suitable for systems or devices that need a controlled way to increase performance or are subject to a multiple use. Examples are working hydraulics in wheeled excavators and their driving hydraulic system.

The effective steering pressure at port X5 is the difference between the total steering pressure applied and the housing pressure.

V*) With a gain factor of 11, the DA cut-off pressure increases by approx. 11 bar if, for example, an effective, external steering pressure of 1 bar is applied to port X5. The gain factor may vary and must therefore be agreed with Liebherr in the hydraulic pump configuration.

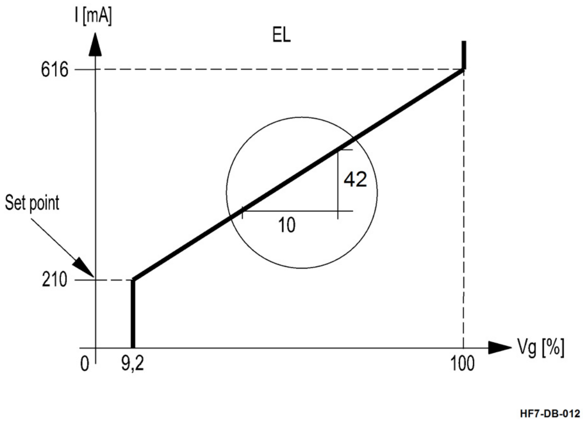
3 Activation and control type

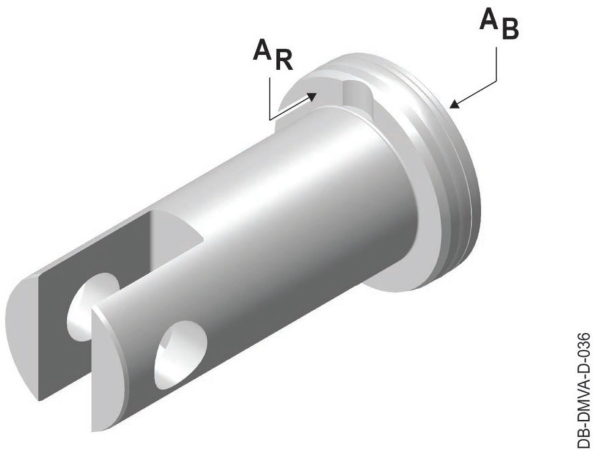
3.3.3 EL- function

For the EL function, the displacement volume V_g of the axial piston unit is adjusted proportionally and continuously via an electromagnet. The EL function is subordinate to the DA function, i.e. the control-current-dependent EL function is only executed below the set value for the pressure cut-off.

The EL function is designed with a positive characteristic as standard.

Positive characteristic (EL1)





By adjusting the drive from $V_{g\ min}$ towards $V_{g\ max}$, the axial piston unit swivels to a larger displacement volume V_g with increasing steering current = I.

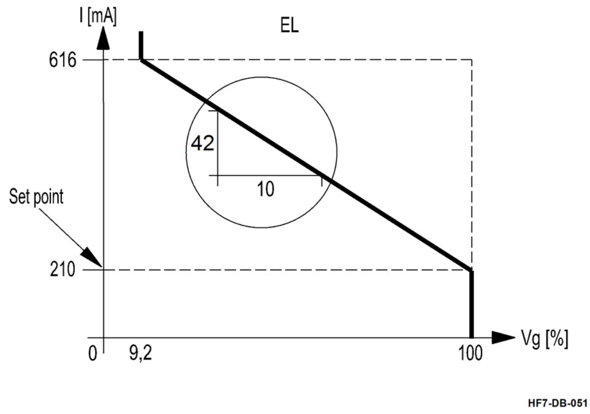
The high pressure pHD is applied to the adjusting piston ring area A_R, and the regulated high pressure pReg is applied to the adjusting piston bottom area A_B. If pReg x A_B is larger than pHD x A_R, the adjusting piston moves and swivels the axial piston unit towards $V_{g\ max}$.

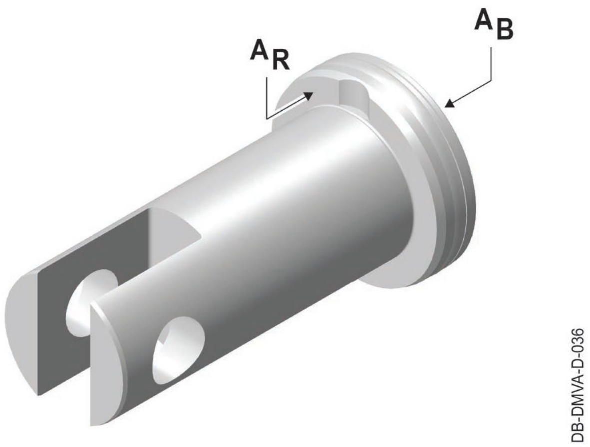
The hydraulic fluid required for this purpose is taken from high pressure pHD. At low high pressure of pHD < 30 bar, the Fa port must be supplied with auxiliary pressure of approx. 30 bar to ensure that regulation is possible.

If the activating signal is missing or defective, the axial piston unit swivels to $V_{g\ min}$.

3 Activation and control type

Negative characteristic (EL2)





If the EL function is designed with a negative characteristic, the axial piston unit swivels towards a larger displacement volume V_g as the control current I decreases. The high pressure pHD is applied to the adjusting piston ring area A_R, and the regulated high pressure pReg is applied to the adjusting piston bottom area A_B.

If pReg x A_B is larger than pHD x A_R, the adjusting piston moves and swivels the axial piston unit towards $V_{g\ max}$. The hydraulic fluid required for this purpose is taken from high pressure pHD.

At low high pressure of pHD < 30 bar, the Fa port must be supplied with auxiliary pressure of approx. 30 bar to ensure that regulation is possible.

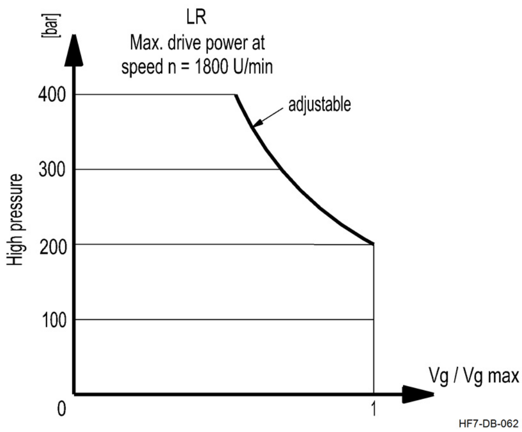
If the activating signal is missing or defective, the axial piston unit swivels to $V_{g\ max}$.

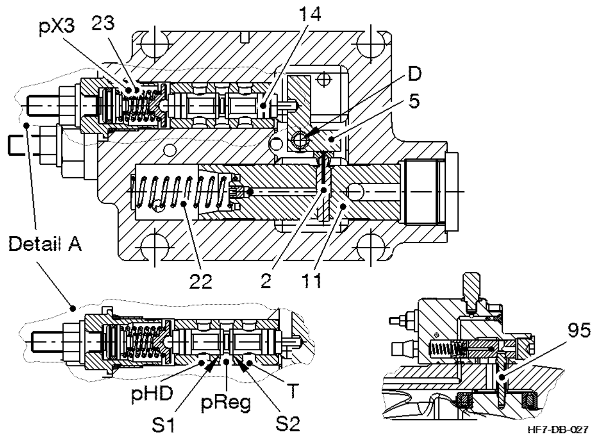
Thus the EL function with negative characteristic is suitable, for example, as a safety feature for fan drives.
See chapter 3.2.1

3 Activation and control type

3.3.4 LR- function

Characteristic





The LR function adjusts the flow rate V_g (volume flow) of the axial piston unit, depending on the pump high pressure pHD (the capacity reduction), to the performance characteristic of the drive motor while limiting the flow at a constant speed n.

Optimal performance utilisation is achieved, if the regulation runs along the hyperbolic characteristic.
When regulation of the axial piston unit starts, the working pressure pHD in the system rises to the pressure at regulation start.
This increases the force at the measuring piston 2 to lever 5. The spool 14 is moved against the pressure spring 23 and opens the connection of the adjusting chamber pReg to the tank T via a steering cam S2.

The axial piston unit thus swivels back towards $V_{g\ min}$. By swivelling back the axial piston unit, the connecting pin 95 in the swivel yoke bearing bolt pushes the return piston 11 axially against the pressure spring 22. This also shifts the force line of the measuring piston 2 on the lever 5 in the direction of pivot point D.

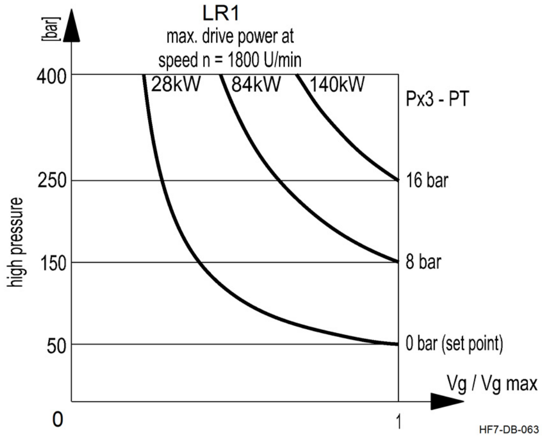
The force of the lever 5 on the spool 14 becomes smaller, so that the pressure spring 23 pushes the spool 14 back into the neutral position. The connection of the adjusting chamber pReg to the tank T is interrupted. The axial piston unit stops at a constant flow rate that corresponds to a constant performance decrease at the existing high pressure pHD.

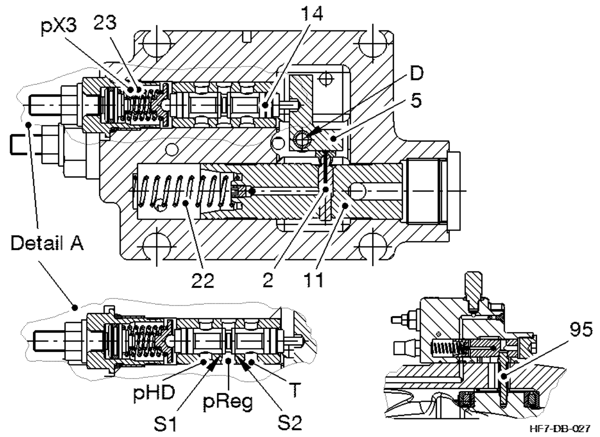
Options
Combination with other control types
Override LR1

3 Activation and control type

3.3.5 LR1- function

Characteristic





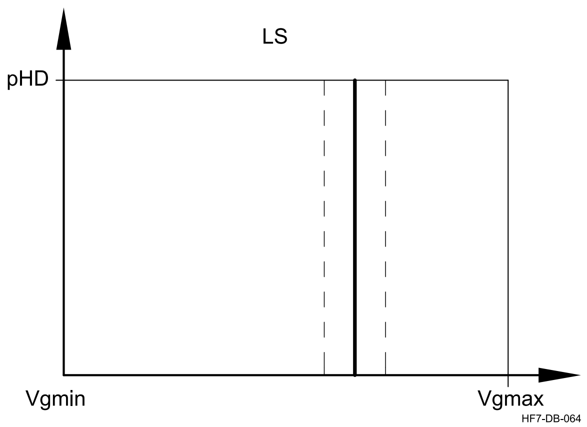
Override: The external control pressure pX3 is directed to the LR control axis via port X3 and acts against a measuring piston in addition to the spring force of the LR control. To maintain the force balance, the axial piston unit swivels towards $V_{g\ max}$ to a higher performance level.

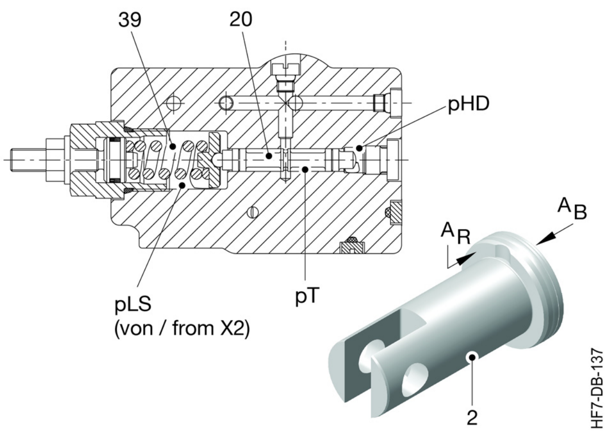
The load limiting regulation is independent of the drive motor speed.

With increasing regulating pressure pX3, the pressure for starting the regulation of the axial piston unit increases proportionally.
To stabilise the control loop, oil is discharged continuously through a nozzle from the LR steering pressure into the pump housing.

3.3.6 LS- function

Characteristic





The dynamic characteristics of the control system of variable hydraulic pumps can be further improved by load sensing (LS) systems, such as an EL/LS control. The LS function is designed as a so-called load pressure reporting system that adjusts the pressure and volume flow to the current requirements of one or more consumers.

An external steering pressure pump provides the auxiliary pressure (30 bar) via the inputs FA. Through a shuttle valve, either the high pressure pHD or the 30 bar auxiliary pressure, depending on the pressure level, is provided for regulating the pump.

3 Activation and control type

The volume flow of the axial piston unit depends on the cross section of an external measuring orifice. A larger cross-section results in regulating the pump towards $V_{g\ max}$. With a constant cross-section of the measuring orifice, the volume flow is independent of the required high pressure of the consumer (pLS).
The highest high pressure pLS occurring in the system in the lines to the actuators at port X2 is fed back to the LS control of the axial piston unit and compared against the high pressure pHD. The control ensures a constant ΔpLS value (pHD minus pLS), as it has been set previously.

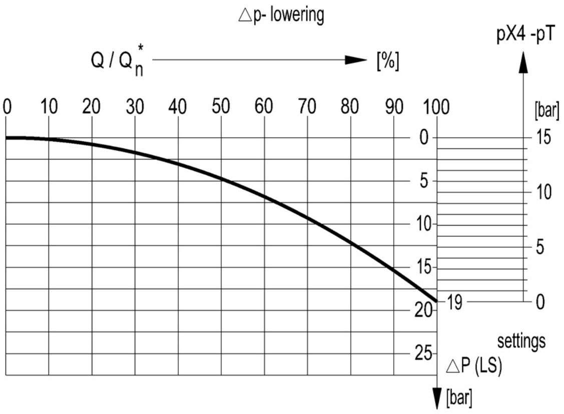
During control (one consumer actuated), the spool 20 of the LS control is pressurised on one side by the high pressure pHD and on the opposite side by the consumer-side pressure (LS pressure via port X2) and the pressure spring 39 (Δp setting). The pressure ratio at the adjusting piston 2 determines its position and thus the pressurisation of the adjusting piston on the piston bottom.

The adjusting pressure pReg applied to the adjusting piston bottom area A_B acts against the high pressure pHD applied to the adjusting piston ring area A_R. The axial piston unit is regulated between Q_{min} and Q_{max} as required.

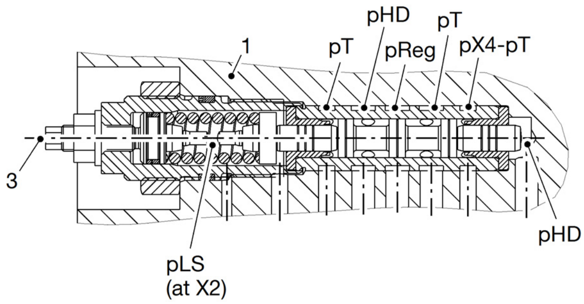
Options
Combination with other control types
Δp lowering (LS1 control)

3.3.7 LS1- function

Characteristic



HF7-DB-067



HF7-DB-138

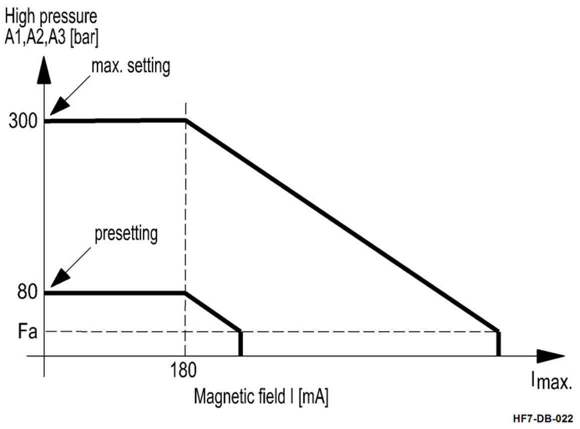
An active Δp lowering aims at reducing the flow rate. As a result, the hydraulic system is temporarily less sensitive to the operation of the pilot control unit.

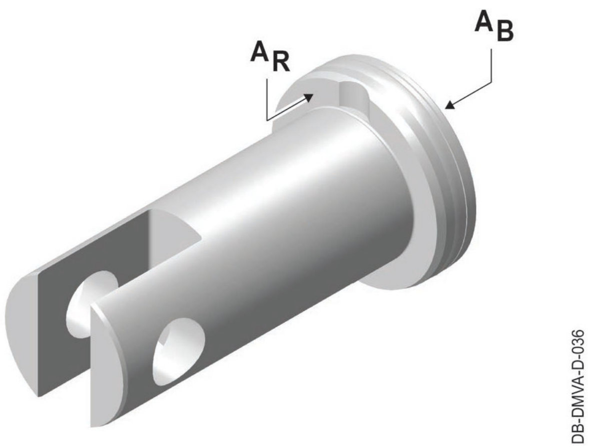
The external control pressure pX4-pT is directed to control 1 via port X4 and acts against the spring force of LS axle 3. The set pressure difference Δp-LS thus decreases and the axial piston unit is able to maintain this reduced Δp-LS at a lower flow rate (corresponds to a smaller swivel angle). With increasing external regulating pressure pX4-pT at port X4, the flow rate is further reduced.

3 Activation and control type

3.3.8 LU- function

Characteristic





The LU function generates a constant pressure source whose pressure level pReg can be set infinitely variably by a specified, variable magnet current. The LU function is designed as a so-called load pressure reporting system that adjusts the pressure and volume flow to the current requirements of a consumer.

The axial piston unit swivels with decreasing steering current I towards a larger displacement volume V_g. The high pressure pHD is applied to the adjusting piston ring area A_R, and the regulated high pressure pReg is applied to the adjusting piston bottom area A_B.

If pReg x A_B is larger than pHD x A_R, the adjusting piston moves and swivels the axial piston unit towards $V_{g\ max}$. The hydraulic fluid required for this purpose is taken from high pressure pHD. At low high pressure, i.e. pHD < 30 bar, the Fa port must be supplied with auxiliary pressure of approx. 30 bar to ensure that regulation is possible.

If the activating signal is missing or defective, the axial piston unit swivels to $V_{g\ max}$.

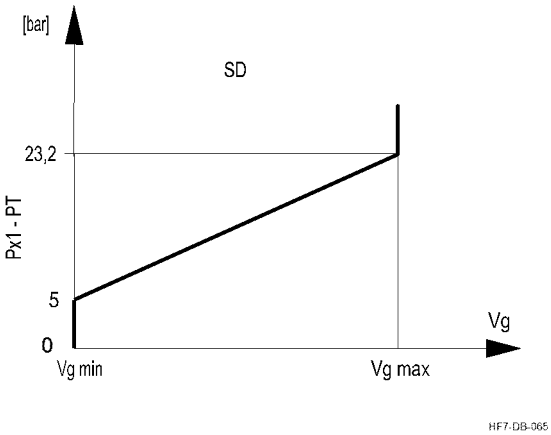
To protect the hydraulic product, the pressure control limits the high pressure pHD to a fixed set value, e.g. in the event of a power failure.

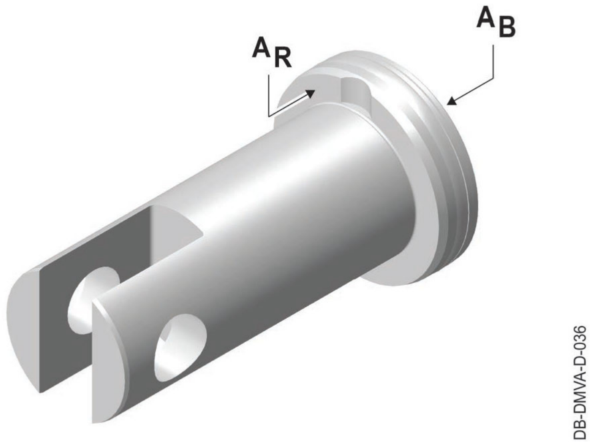
3 Activation and control type

3.3.9 SD- function

SD regulation is suitable for applications that require proportional regulation of the volume flow.

Positive characteristic (SD1)

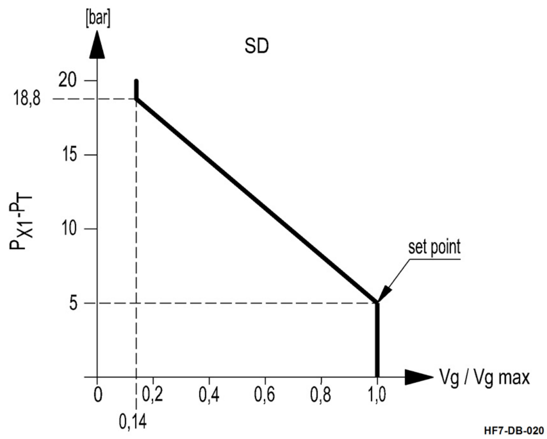


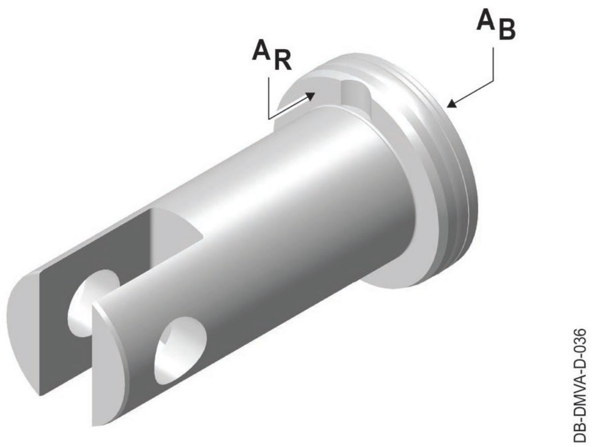


By adjusting the drive from $V_{g\ min}$ towards $V_{g\ max}$, the axial piston unit swivels to a larger displacement volume V_g with increasing SD steering pressure. The high pressure pHD is applied to the adjusting piston ring area A_R, and the regulated high pressure pReg is applied to the adjusting piston bottom area A_B.

If pReg x A_B is larger than pHD x A_R, the adjusting piston moves and swivels the axial piston unit towards $V_{g\ max}$. The hydraulic fluid required for this purpose is taken from high pressure pHD. At a low high pressure of pHD < 30 bar, the Fa port must be supplied with auxiliary pressure of approx. 30 bar to ensure that regulation is possible. If the activating signal is missing or defective, the axial piston unit swivels to $V_{g\ min}$.

Negative characteristic (SD2)





If the SD function is designed with a negative characteristic, the axial piston unit swivels towards a larger displacement volume V_g as the SD steering pressure decreases. The high pressure pHD is applied to the adjusting piston ring area A_R, and the regulated high pressure pReg is applied to the adjusting piston bottom area A_B.

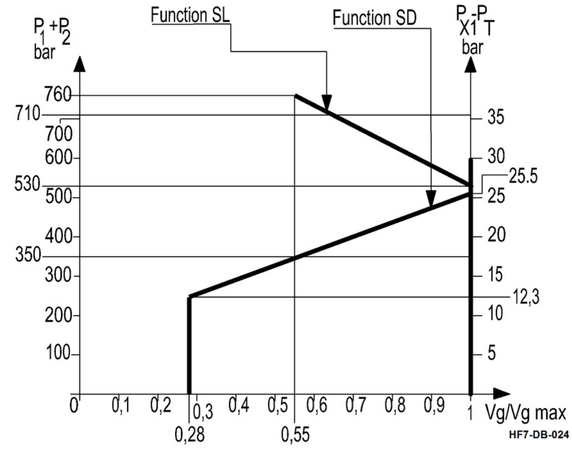
If pReg x A_B is larger than pHD x A_R, the adjusting piston moves and swivels the axial piston unit towards $V_{g\ max}$. The hydraulic fluid required for this purpose is taken from high pressure pHD.

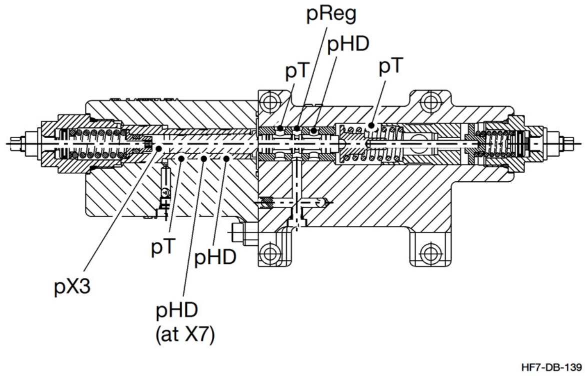
At a low high pressure of pHD < 30 bar, the Fa port must be supplied with auxiliary pressure of approx. 30 bar to ensure that regulation is possible. If the activating signal is missing or defective, the axial piston unit swivels to $V_{g\ max}$.

3 Activation and control type

3.3.10 SL- function

Characteristic





The SL function represents a performance regulation to regulate the flow rate of two identical, adjustable axial piston units that are driven by a common power source and deliver into two different circuits with different pressures.

Each of the axial piston units has its own control; these are hydraulically coupled (port X7) and have total performance regulation. If the pumps are in SL regulation, their speed, their swivel angle and thus the flow rate are identical.

Each total pressure is associated with a certain swivel angle. Though, in regulating, the volume flows of both axial piston units are reduced by the same amount, the pressures can increase up to the performance limits.

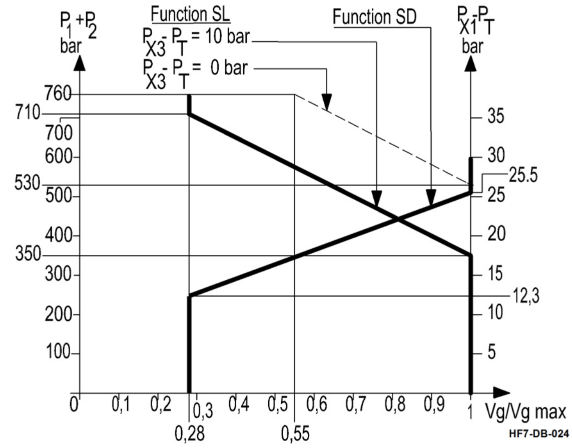
The sum of the two hydraulic performances should not exceed the installed drive power.

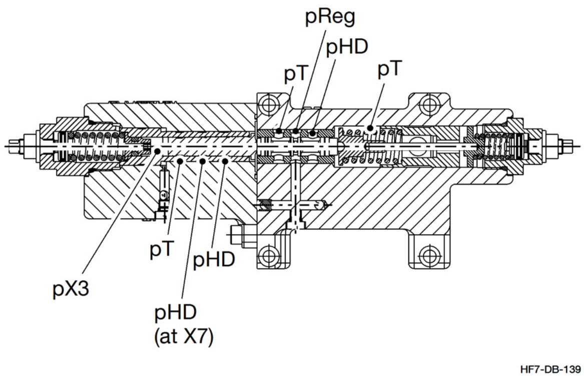
The SD function for SL-SD regulation is available only with a positive characteristic. It limits the maximum flow rate for each axial piston unit individually.

Options
Override (SL1 function)

3.3.11 SL1- function

Characteristic





Override: The external control pressure pX3 is directed to the SL control axis via port X3 and acts against a measuring piston in addition to the spring force. To maintain the force balance, the axial piston unit swivels towards $V_{g\ min}$ to a lower performance level.

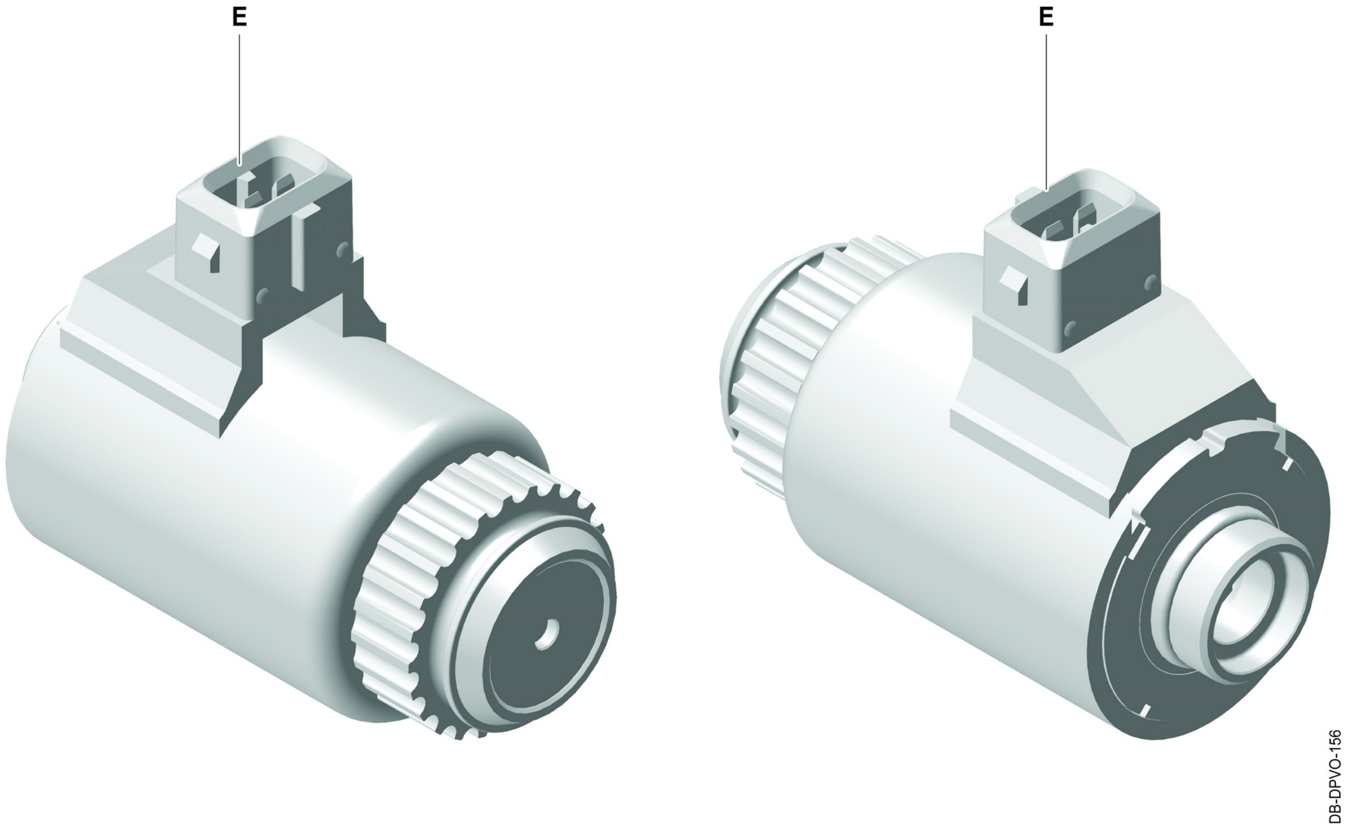
With increasing regulating pressure pX3, the pressure for starting the regulation of the axial piston unit decreases proportionally.

To stabilise the control loop, oil is discharged continuously through a nozzle from the regulating pressure pX3 into the pump housing.

3 Activation and control type

3.4 Electrical components

3.4.1 Proportional magnet (variant A)

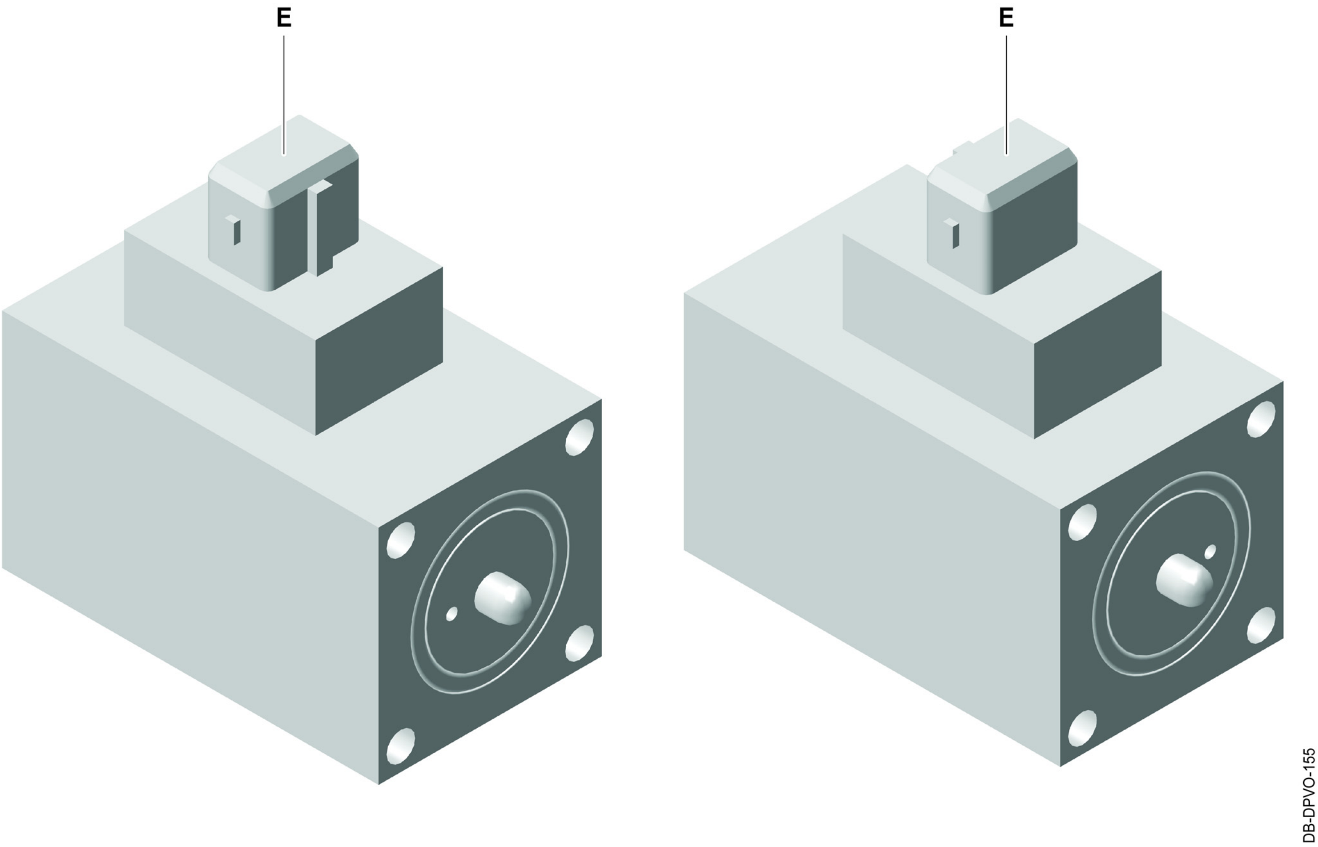


General information

Technical data of proportional magnet	
Rated voltage U	24 V
Current $I_{max.}$	700 mA
PWM frequency	100 -160Hz
Protection class according to DIN VDE0470 when assembled and connected	max. IP 65
AMP JUNIOR TIMER plug-in terminal, 2-pin	-

3 Activation and control type

3.4.2 Proportional magnet (variant B)

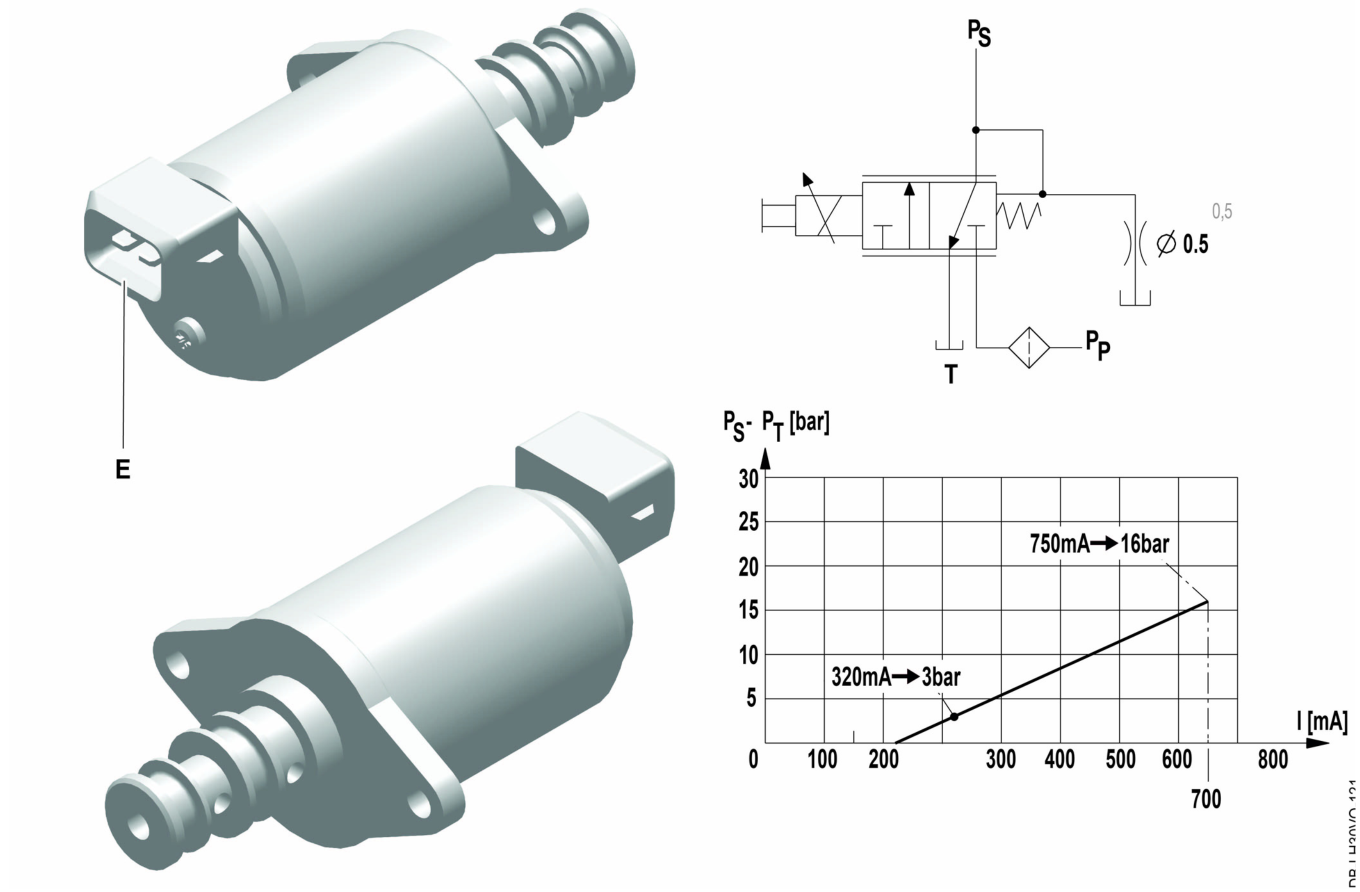


General information

Technical data of proportional magnet	
Rated voltage U	24 V
Current $I_{max.}$	700 mA
PWM frequency	100 -160Hz
Protection class according to DIN VDE0470 when assembled and connected	max. IP 67
Nominal pressure, static	350 bar
AMP JUNIOR TIMER plug-in terminal, 2-pin	-

3 Activation and control type

3.4.3 Pressure control valve (DRE)



T	Tank	PS	Output DRE
PP	Input DRE	E	Connection AMP Junior Timer

General information

Technical data of pressure control valve	
Rated voltage U	24 V
Current $I_{max.}$	750 mA
Supply pressure $p_{max.}$	50 bar
Magnet characteristic curve: flat around the regulating position	-
AMP JUNIOR TIMER plug-in terminal, 2-pin	-

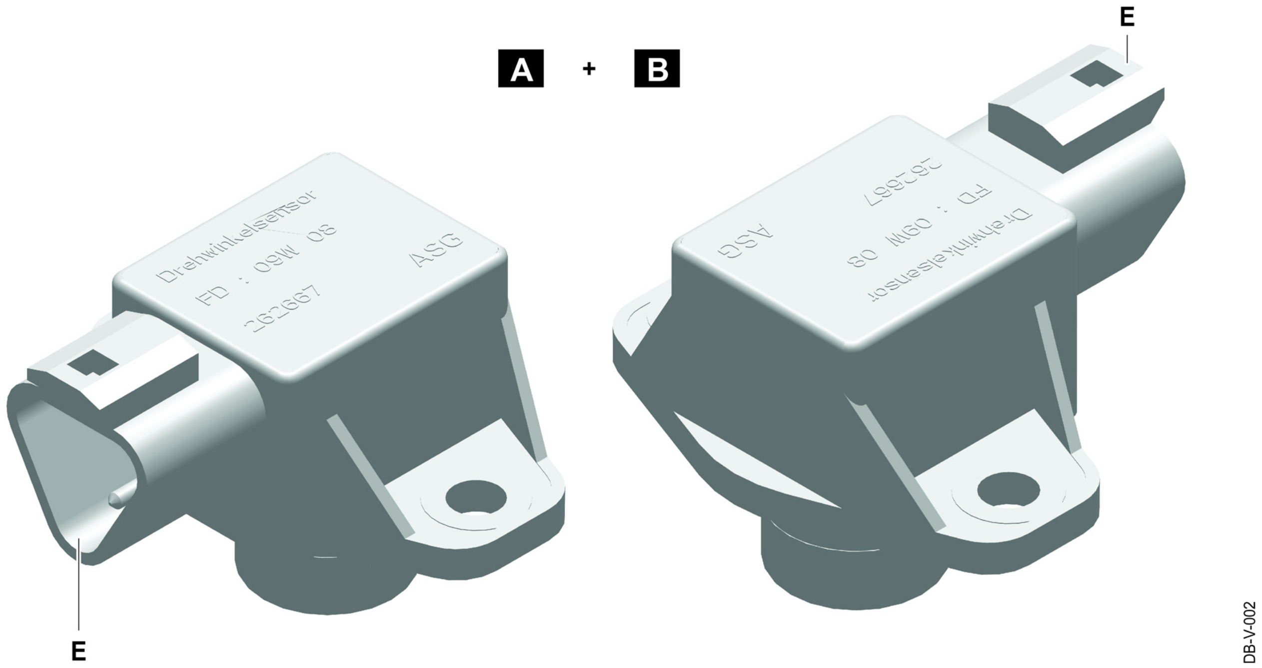
3 Activation and control type

3.4.4 Sensors

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

Rotation angle sensor

0	Without sensor
W	With rotation angle sensor



Technical data			
Variant A		**Variant B**	
Rated voltage U	5 V	Rated voltage U	8-30 V
Measuring range	-27° to +27°	Measuring range	-27° to +27°
Output signal -27° 0° +27°	0.5 VDC 2.5 VDC 4.5 VDC	Output signal -27° 0° +27°	4 mA 12 mA 20 mA
Working temperature	-40 °C to +125 °C	Working temperature	-40 °C to +85 °C
Deutsch DT04-3P electrical plug-in terminal			

Note
The angle sensor cannot be retrofitted and must be included when planning the DPVO project.
Dimensions for variant A and B are identical; specify desired variant when ordering.

4 Installation conditions

4.1 General information about project planning

The installation variant for the device or system must be coordinated with Liebherr, as well as the installation position, at the conceptual design stage of the axial piston unit and must be approved by Liebherr.

ATTENTION
Damage of the hydraulic product.
Lack of lubrication on the hydraulic product!
Make sure that the following requirements are observed:
- Comply with the approved installation positions for the hydraulic product.
- For other installation positions, contact Liebherr customer service.
- Housing is completely filled with hydraulic fluid during commissioning and operation.
- Housing is vented after commissioning and during operation.

Liebherr distinguishes between three installation variants for axial piston units:

A: Under-the-tank installation (axial piston unit is installed **under** the minimum liquid level of the tank)
B: Over-the-tank installation (axial piston unit is installed **above** the minimum liquid level of the tank)
C: Tank installation (axial piston unit is installed **in** the tank)

Liebherr distinguishes between two installation positions for axial piston units:

1/3/5/7/9/11: Driving shaft horizontal
2/4/6/8/10/12: Driving shaft vertical

Note
Liebherr recommends:
Installation variant: Under-the-tank installation A
Installation location: 1/3/5/7/9/11 Driving shaft horizontal with "control at top"

*) For installation positions 2/4/6/8 with driving shaft vertical and 1/3/5/7 with driving shaft horizontal with "control at bottom", complete filling and venting is critical. The axial piston unit must then be connected, filled and vented before final positioning in installation position 1/3/5/7/9 "control at top".
It can then be rotated to the final installation position 2/4/6/8 driving shaft vertical or 1/3/5/7 driving shaft horizontal with "control at bottom".

On some axial piston units, an additional T4 leakage oil connection is provided for the installation positions 2/4/6/8 driving shaft vertical and 1/3/5/7 driving shaft horizontal with control at bottom: Order leakage oil connection T4 as special design. (For additional information see: 1 Type code, page 3)

4.1.1 Suction line

Given the laws of physics and under simple assumptions about the hydraulic fluid, temperature and ambient pressures, the maximum suction head is 750 mm. This applies in particular to installation variant B: over-the-tank installation.

At low temperatures with high viscosities, it is essential to observe the minimum suction pressure for axial piston units. (For additional information see: 2.3.2 Housing, leakage oil pressure, page 10)

The suction line must open into the tank at a minimum distance of 115 mm from the tank bottom to prevent particles of dirt in the tank from being sucked in.

The suction line must open into the tank at a maximum distance from the leakage oil line to prevent hot leakage oil from being sucked in directly.

4 Installation conditions

4.1.2 Leakage oil lines

To prevent draining of the axial piston unit during long downtimes, the leakage oil line must be routed in a bend so that it runs at the minimum dimension Ü1 = 30 mm above the highest possible level of the axial piston unit. This applies in particular to installation variant B: over-the-tank installation.

Connect the leakage oil line to the top leakage oil connection T1, T2, T3....Tx depending on the installation position.

The leakage oil line must open into the tank at a minimum distance of 115 mm from the tank bottom to prevent stirring up dirt particles in the tank.

The leakage oil line must open into the tank at a minimum distance of 250 mm below the minimum liquid level to prevent foaming in the tank.

The leakage oil line must open into the tank at a maximum distance from the suction line to prevent hot leakage oil from being sucked in directly.

At low temperatures with high viscosities, it is essential to observe the maximum housing pressure for axial piston units with multiple driving gears and with a shared leakage oil line. (For additional information see: 2.3.2 Housing, leakage oil pressure, page 10) If the maximum housing pressure is outside the tolerance limit, a separate leakage oil line must be connected for each driving gear.

4.1.3 Hydraulic fluid tank

Design the hydraulic fluid tank so that the hydraulic oil cools off sufficiently during circulation and impurities that develop during operation settle to the bottom of the tank.

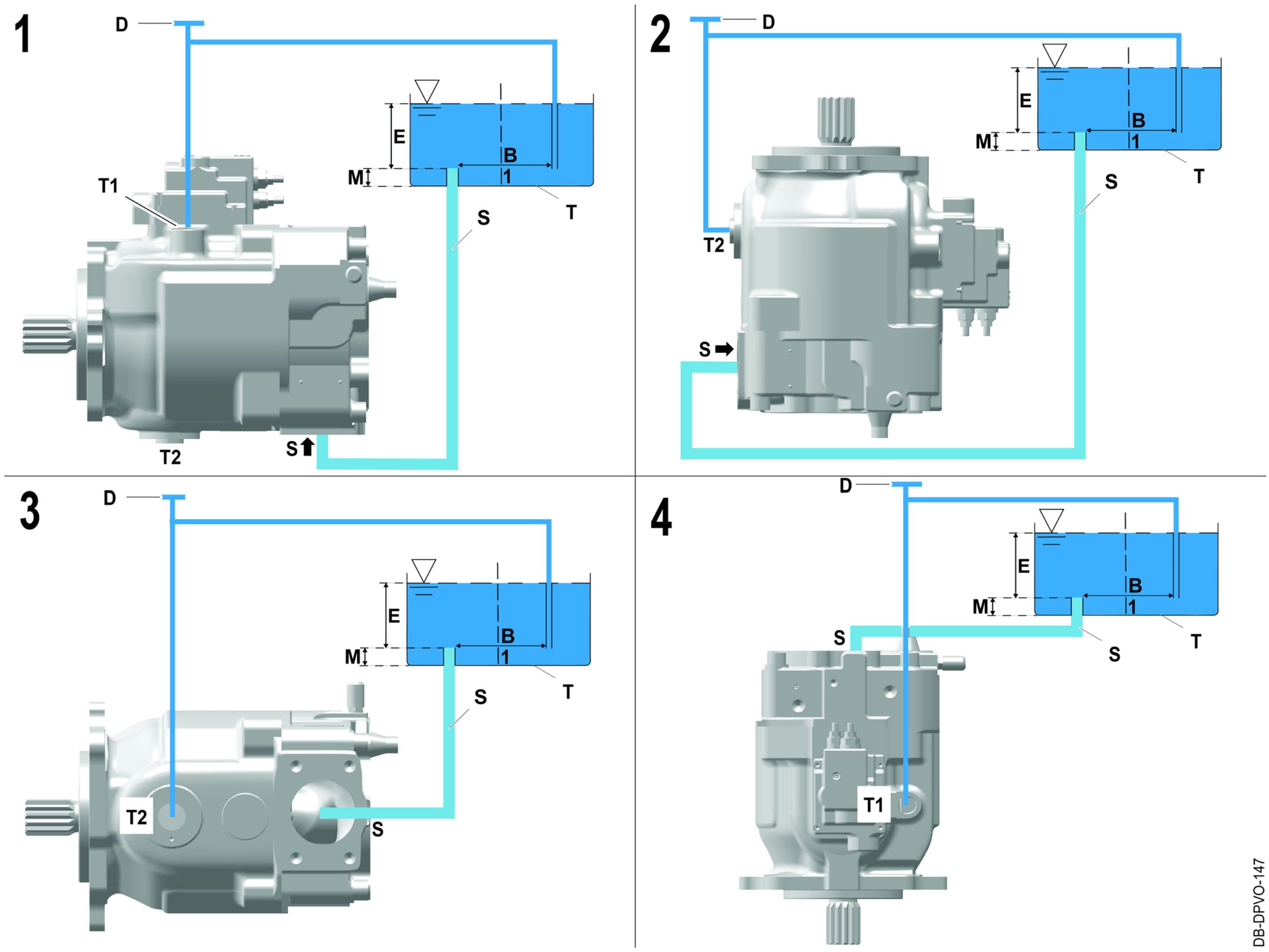
Make sure that the lines are connected according to recommendations and that they open into the hydraulic fluid tank. (For additional information see: 4.1.1 Suction line, page 55 and For additional information see: 4.1.2 Leakage oil lines, page 56)

4 Installation conditions

4.2 Installation variants

4.2.1 Under-the-tank installation variant

Note
Liebherr recommends: Under-the-tank installation A, so that:
- There is hydraulic fluid at suction port S when not operated.
- The housing cannot empty to the tank.



1	Baffle (to calm the hydraulic fluid in the tank)	M	Minimum line end distance from tank bottom = 115 mm
B	Distance between suction port and leakage oil connection in the tank (the larger the better)	S	Suction line connection
D	Fill and vent connection (external, not included in scope of delivery)	T	Tank
E	Minimum immersion depth = 250 mm	T_	Leakage oil connections T1 / T2 / T3 / T4 (T4 = optional)

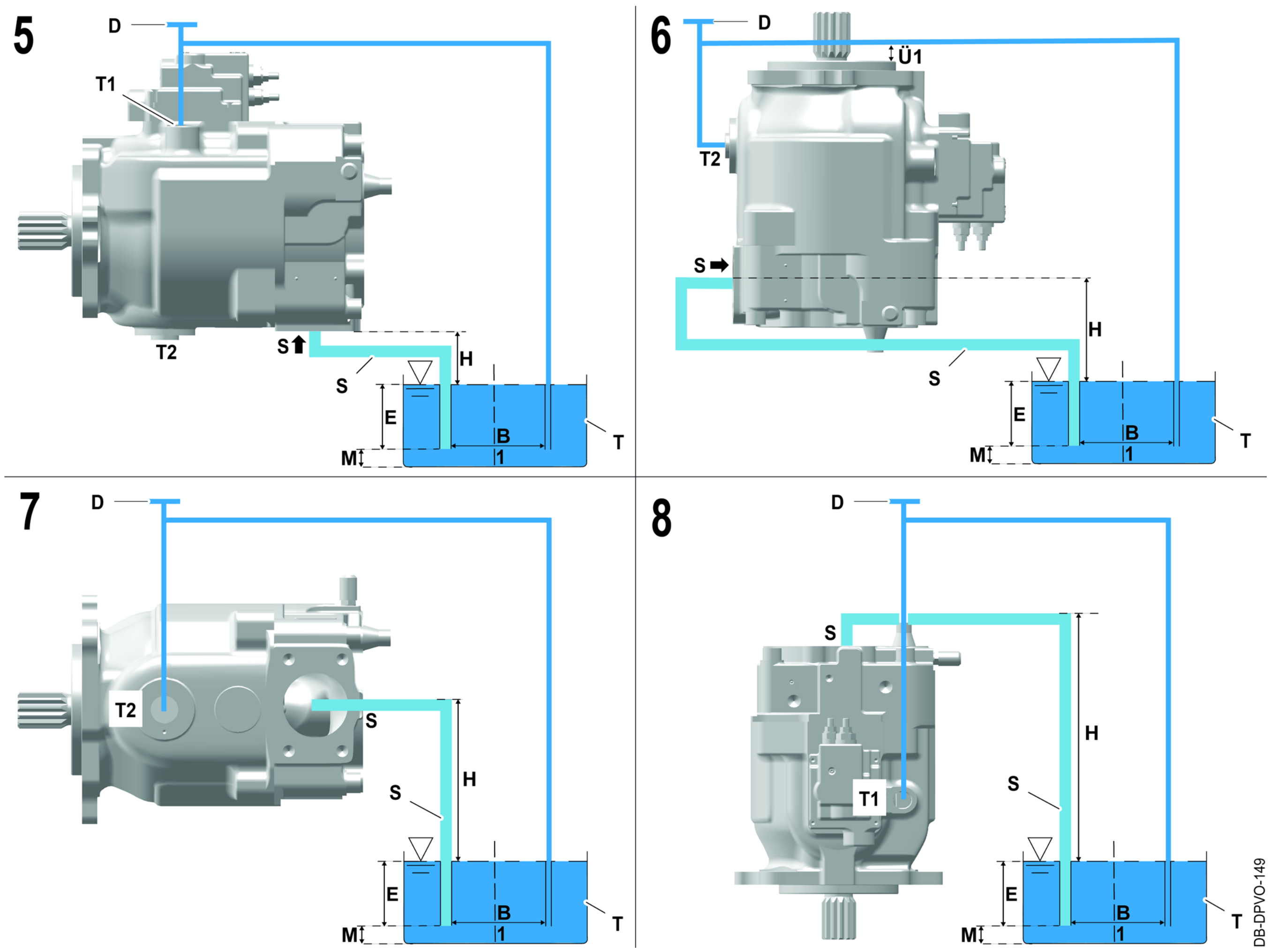
4 Installation conditions

4.2.2 Over-the-tank installation variant

ATTENTION
Damage of the hydraulic product.
The air cushion in the bearing area or on the rotary shaft lip seal “runs hot” in over-the-tank installation position (installation variant B)! Make sure that the following requirements are observed:

- Housing is completely filled with hydraulic fluid during commissioning and operation.
- Housing is vented after commissioning and during operation.

Note
To prevent draining of the axial piston unit during long shutdowns, the leakage oil line must be routed in a bend so that it runs at the minimum dimension Ü1 = 30 mm above the highest possible level of the axial piston unit.



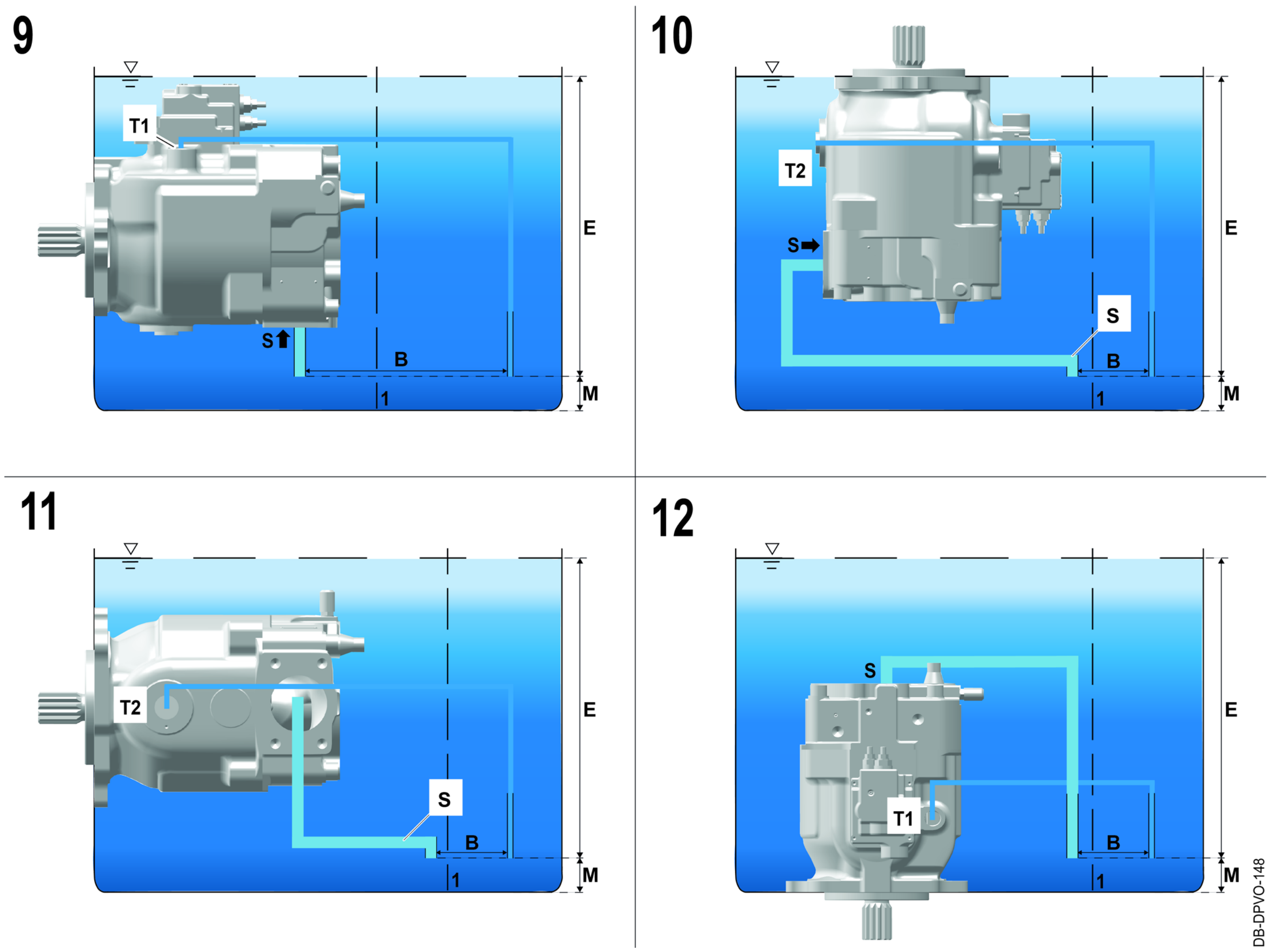
1	Baffle (to calm the hydraulic fluid in the tank)	M	Minimum line end distance from tank bottom = 115 mm
B	Distance between suction port and leakage oil connection in the tank (the larger the better)	S	Suction line connection

4 Installation conditions

D	Fill and vent connection (external, not included in scope of delivery)	T	Tank
E	Minimum immersion depth = 250 mm	T_	Leakage oil connections T1 / T2 / T3 / T4 (T4 = optional)
H	Maximum suction head = 750 mm	Ü1	Minimum leakage oil line height = 30 mm

4.2.3 Tank installation variant

Note
For tank installation variant C, the hydraulic product must be ordered and used as a special design without primer. (For additional information see: 1 Type code, page 3) This tank installation variant is not permitted for axial piston units with electrical components (for example: electro-proportional magnet)



1	Baffle	To calm the hydraulic fluid in the tank
B	Distance	Between suction port and leakage oil connection in the tank (the larger the better)

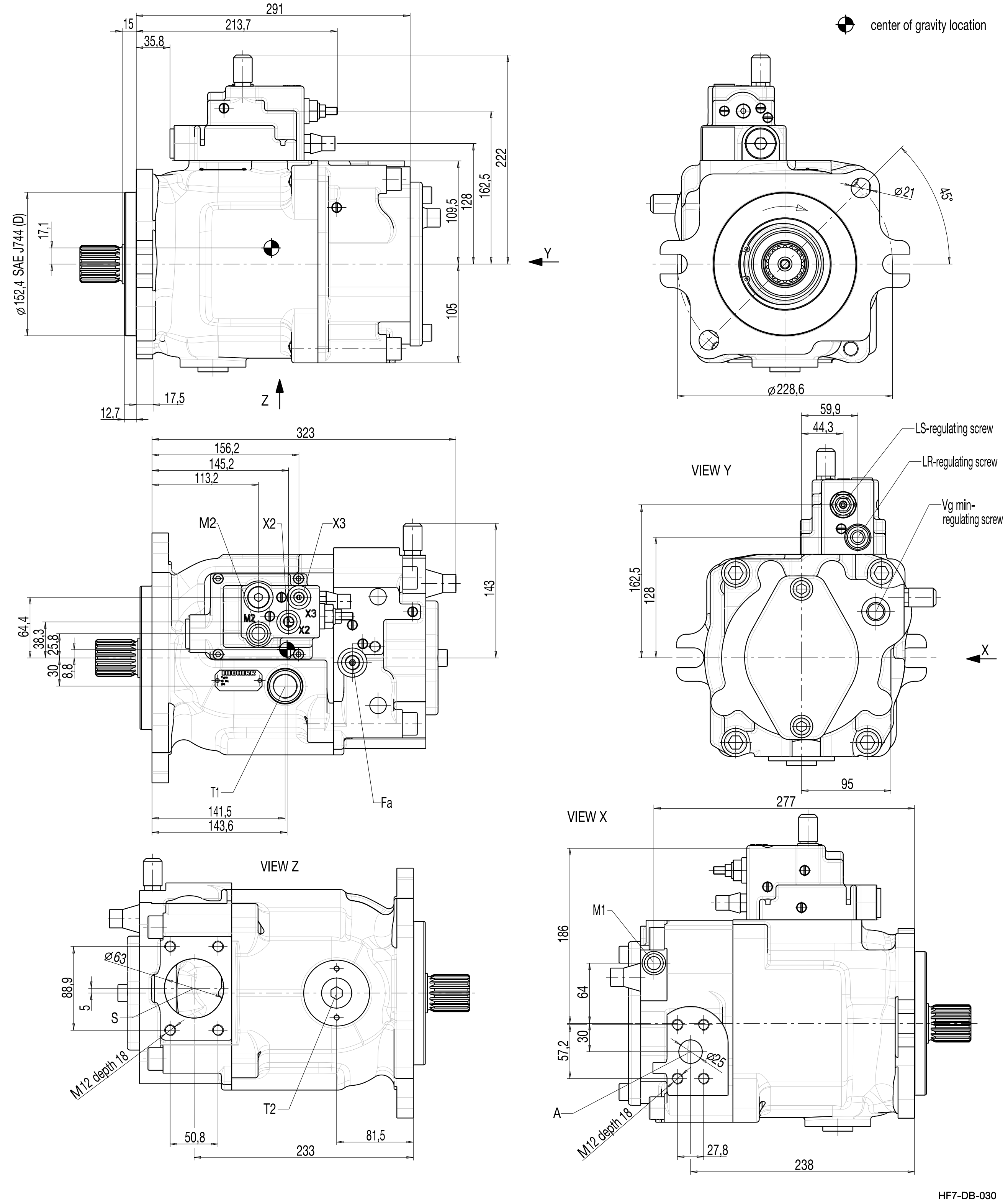
4 Installation conditions

L	Leakage oil connections	-
M	Minimum distance of the ends of the lines to the bottom of the tank	115 mm
S	Suction line connection	-
T	Tank	-

5 Dimensions

5.1 Nominal size 108, clockwise rotation

5.1.1 Nominal size 108, LR-LS- and LR1-LS control type



A	Working connection SAE J 518 - 1", 6000 psi	T1, T2	Leakage oil connection M26x1.5

5 Dimensions

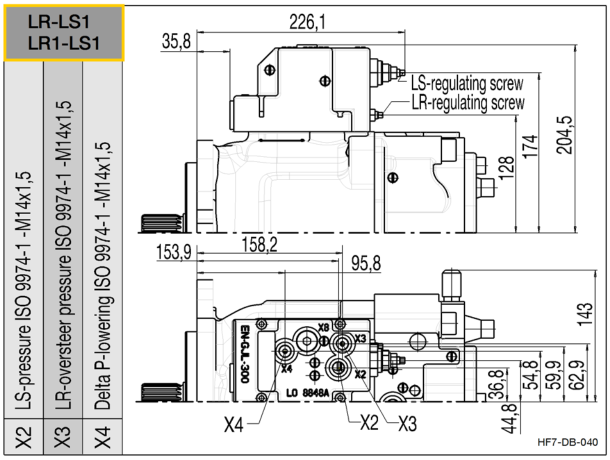
S	Suction port SAE J 518 - 2 1/2", 500 psi
M1	Regulated high pressure measuring port Minimess M16
M2	High-pressure measuring port Minimess M16

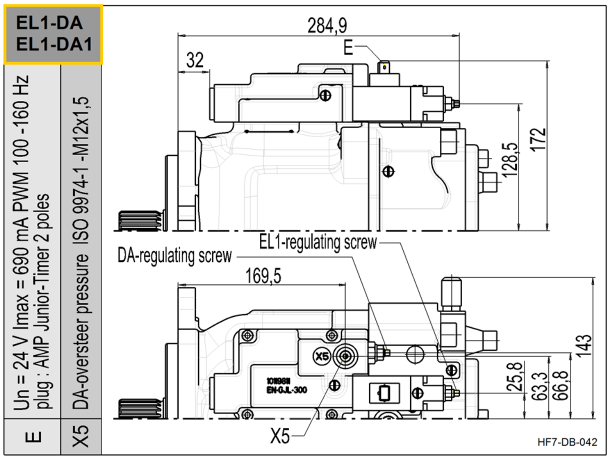
Fa	Filter output M16x1.5 (30 bar)
X2	LS pressure connection ISO 9974-1 - M12x1.5
X3	LR oversteer pressure ISO 9974-1 - M12x1.5

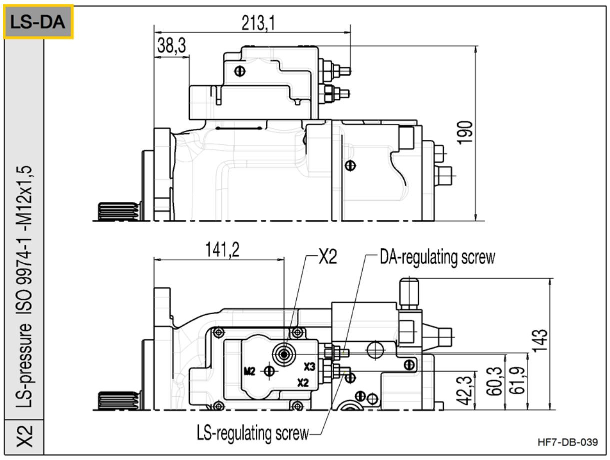
5.1.2 Nominal size 108, other control types

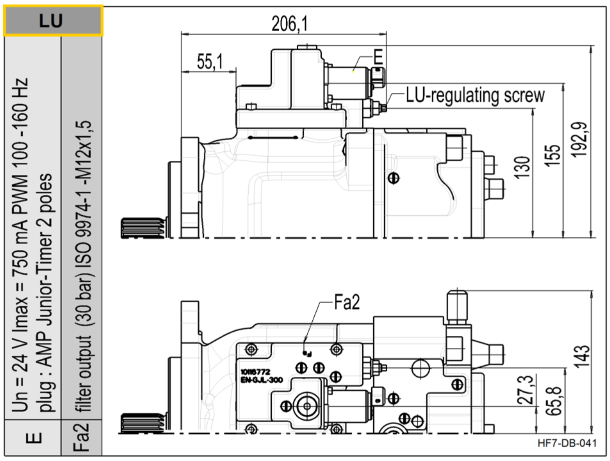
DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

Note
Dimensions of control types LR - LS and LR1 - LS, see chapter 5.1.

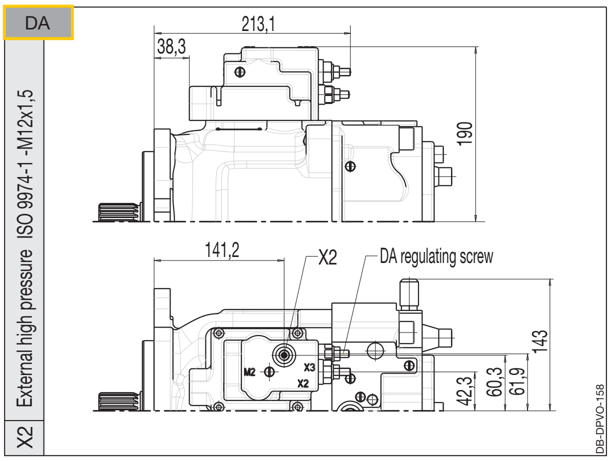








5 Dimensions

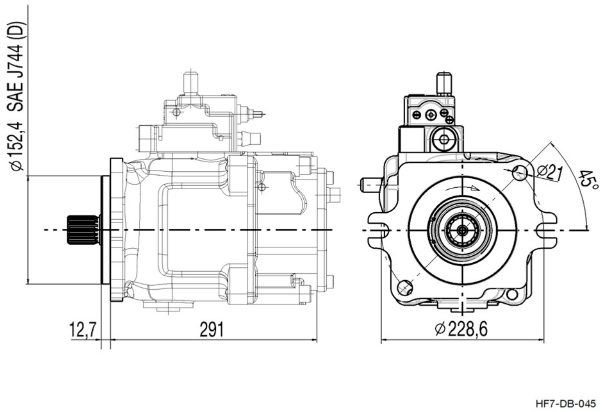


Note
X3 can be connected only to LR1
X4 can be connected only to LS1
X5 can be connected only to DA1

5.2 Nominal size 108, mounting flange

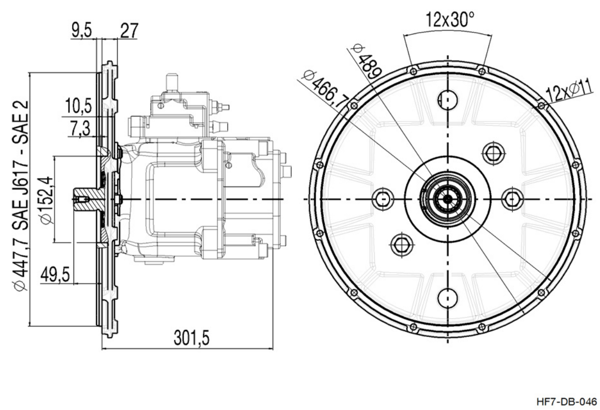
DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

SAE D (SAE J744)



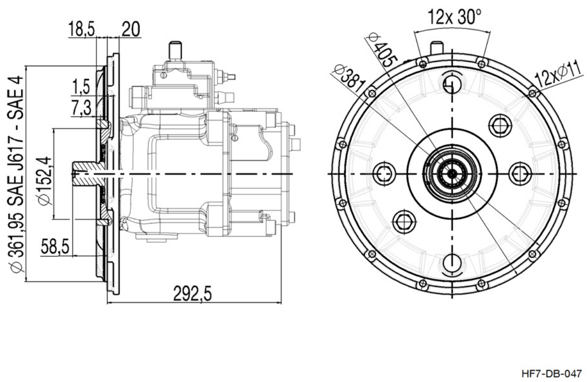
24

Diesel engine flange SAE 2 / SAE 4 (SAE J617)



12

5 Dimensions

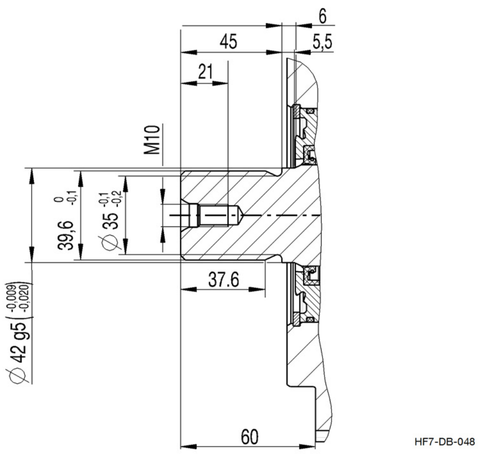


14

5.3 Nominal size 108, shaft end

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

DIN 5480 splined shaft W40x2x18x9g

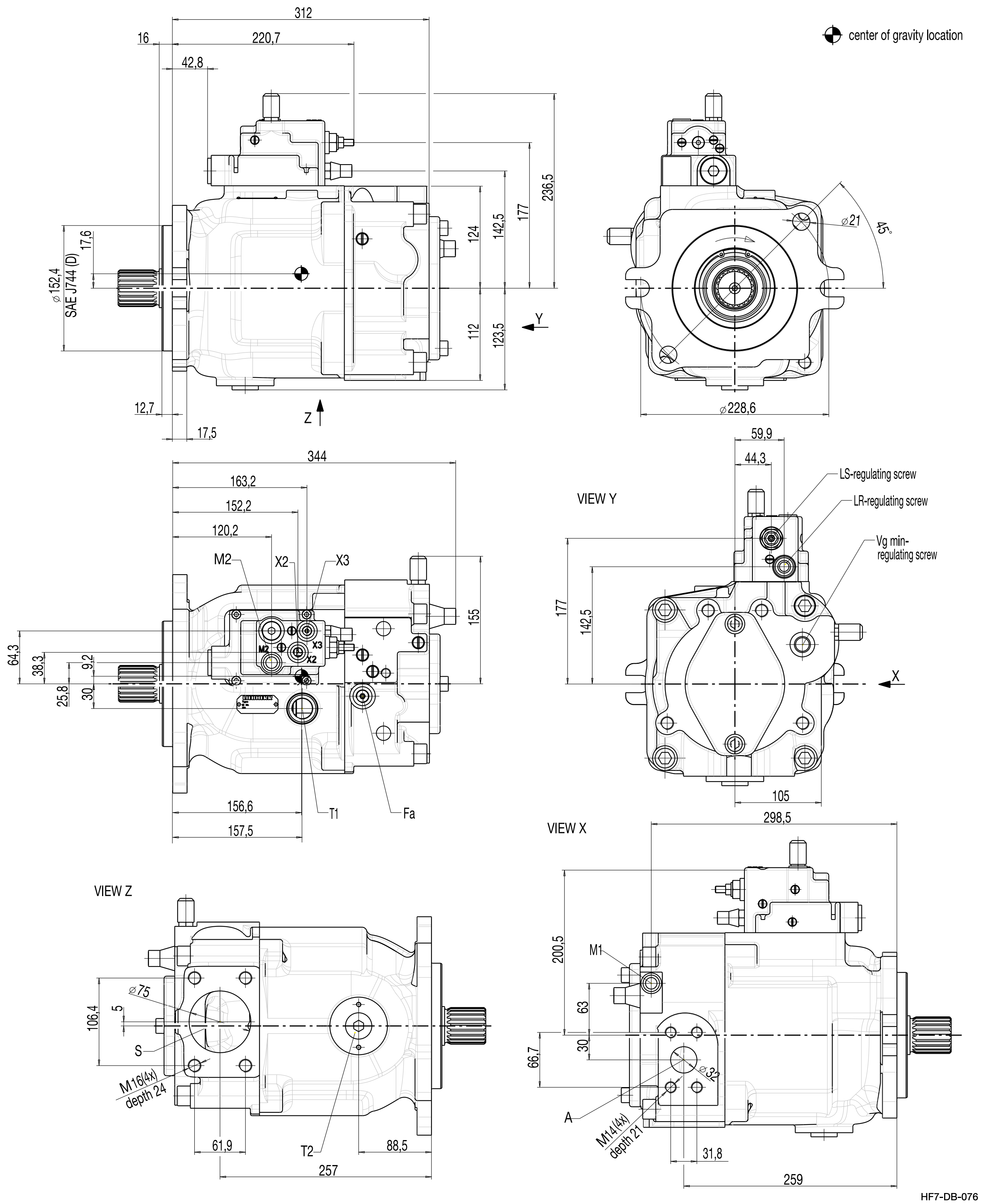


1

5 Dimensions

5.4 Nominal size 140, clockwise rotation

5.4.1 Nominal size 140, LR-LS- and LR1-LS control type



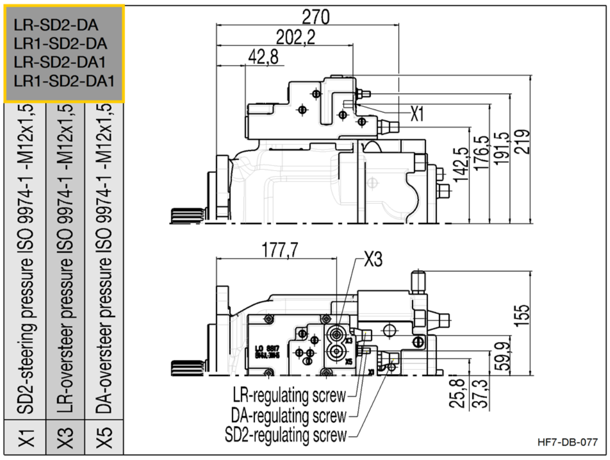
5 Dimensions

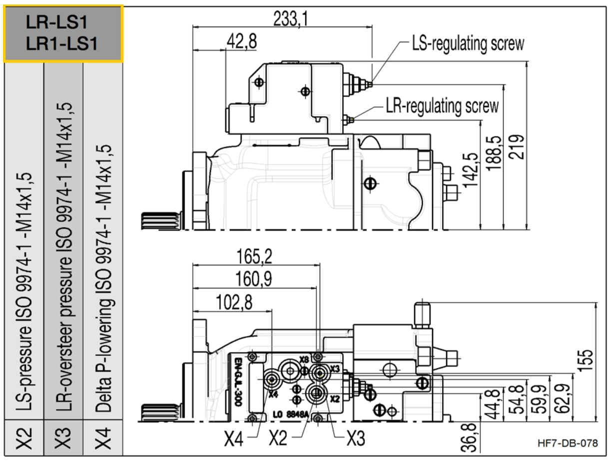
A	Working connection SAE J 518 - 1 1/4", 6000 psi	T1, T2	Leakage oil connection M26x1.5
S	Suction port SAE J 518 - 3", 500 psi	Fa	Filter output M16x1.5 (30 bar)
M1	Regulated high pressure measuring port Minimess M16	X2	LS pressure connection ISO 9974-1 - M12x1.5
M2	High-pressure measuring port Minimess M16	X3	LR oversteer pressure ISO 9974-1 - M12x1.5

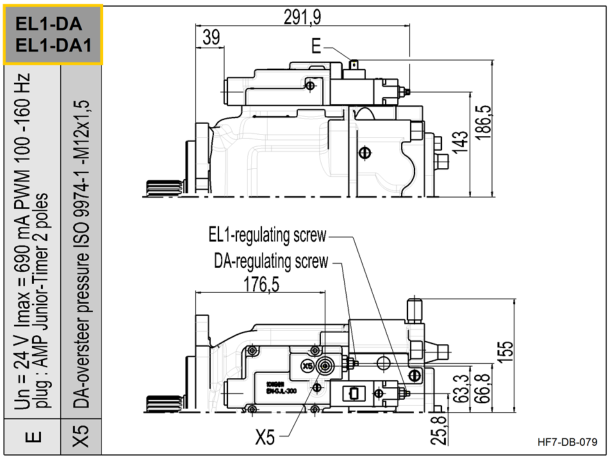
5.4.2 Nominal size 140, other control types

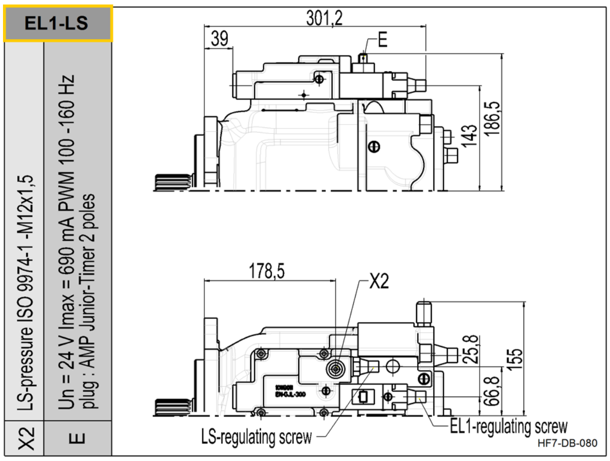
DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

Note
Dimensions of control types LR - LS and LR1 - LS, see chapter 5.4.

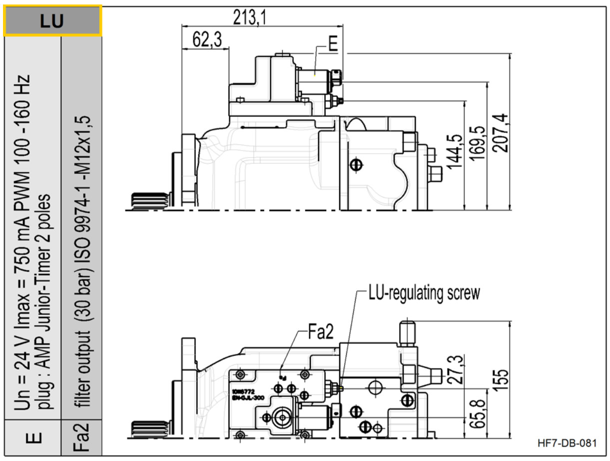


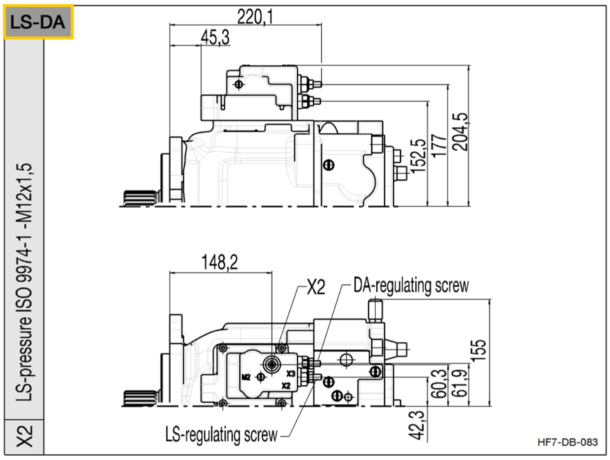






5 Dimensions



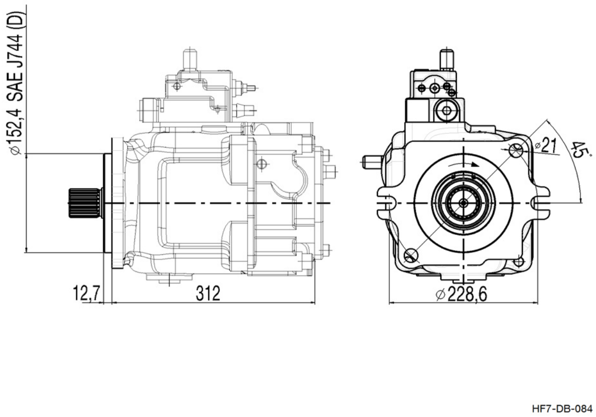


Note
X3 can be connected only to LR1
X4 can be connected only to LS1
X5 can be connected only to DA1

5.5 Nominal size 140, mounting flange

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

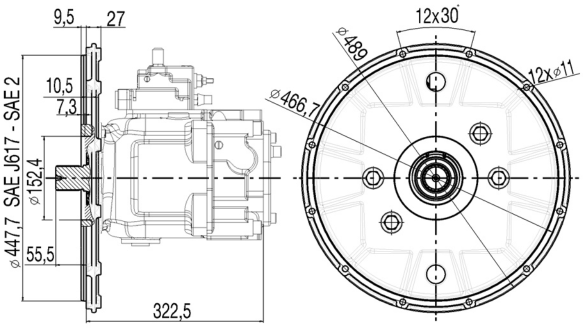
SAE D (SAE J744)



24

5 Dimensions

Diesel engine flange SAE 2 / SAE 4 (SAE J617)



12

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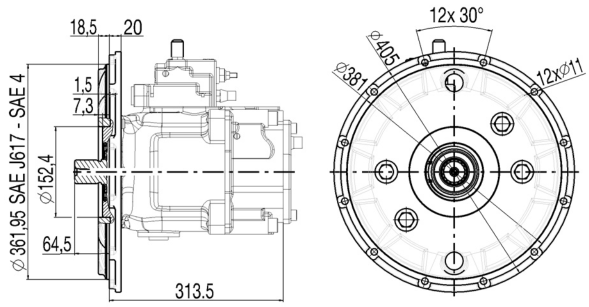

14

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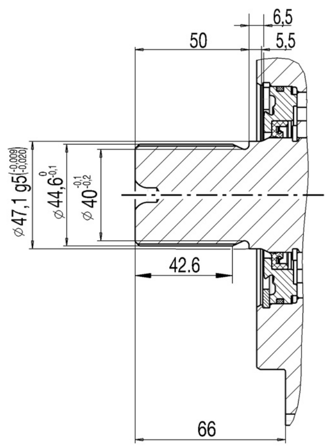
5.6 Nominal size 140, shaft end

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

DIN 5480 splined shaft W45x2x21x9g



1

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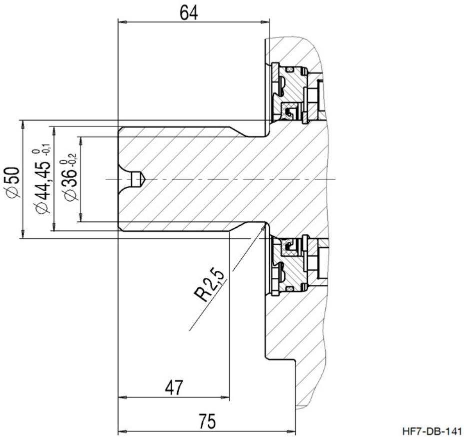
5 Dimensions

ANSI B92.1a splined shaft 1 3/4 in 13T 8/16 DP

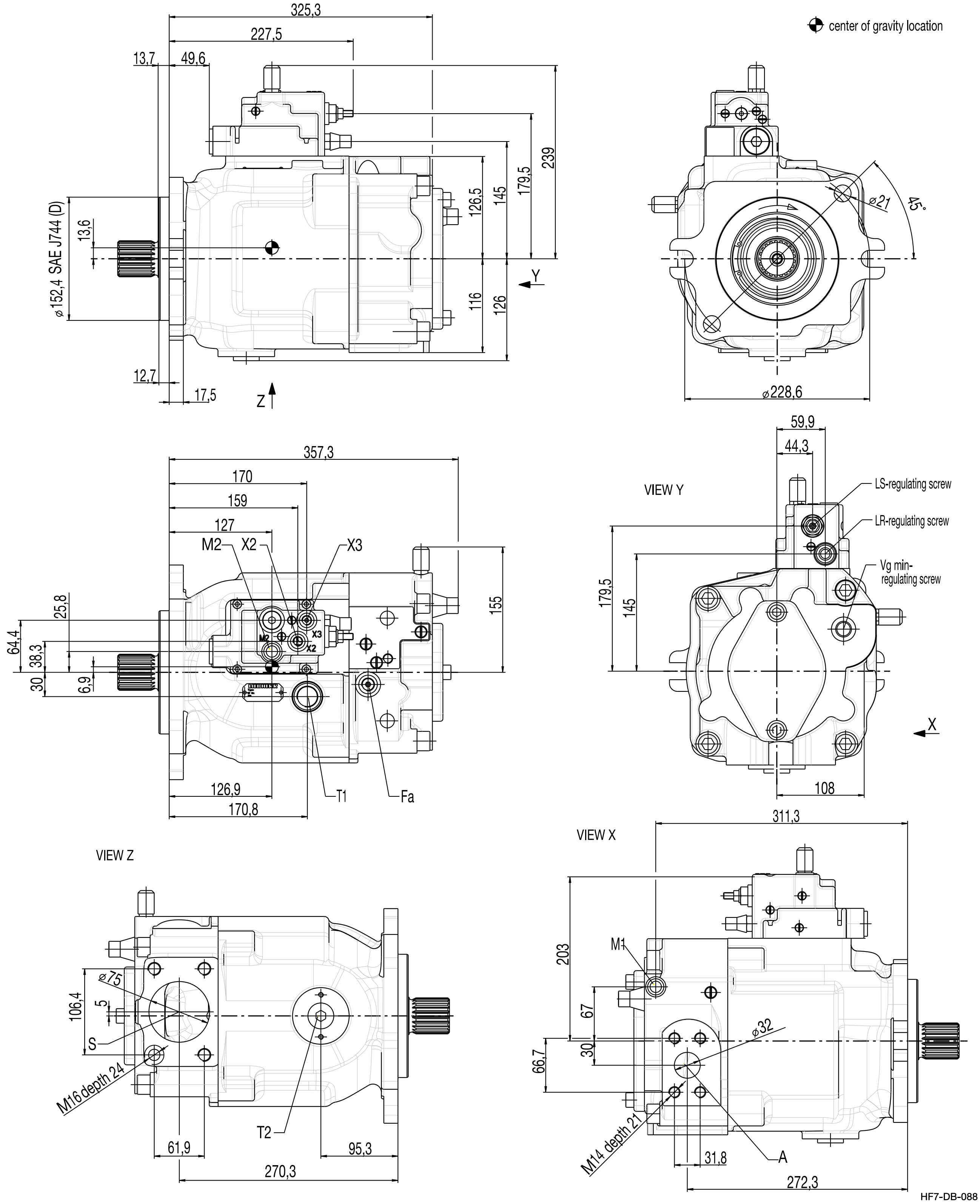


2

5 Dimensions

5.7 Nominal size 165, clockwise rotation

5.7.1 Nominal size 165, LR-LS- and LR1-LS control type



5 Dimensions

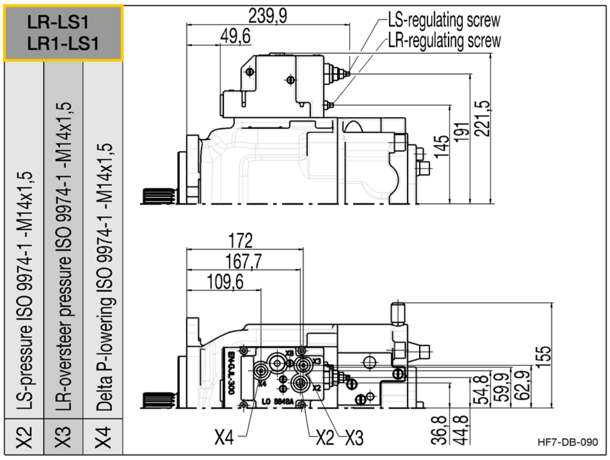
A	Working connection SAE J 518 - 1 1/4", 6000 psi
S	Suction port SAE J 518 - 3", 500 psi
M1	Regulated high pressure measuring port Minimess M16
M2	High-pressure measuring port Minimess M16

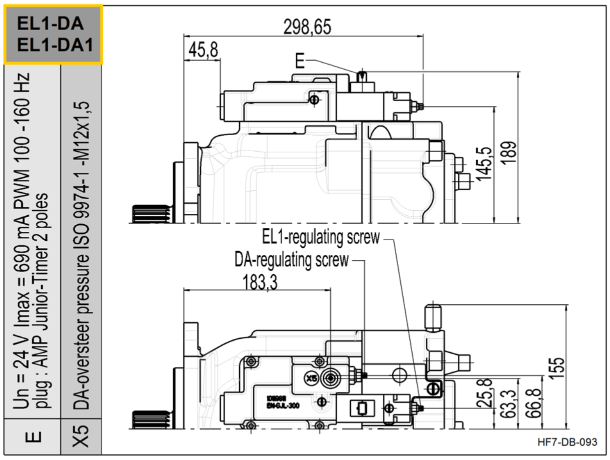
T1, T2	Leakage oil connection M26x1.5
Fa	Filter output M16x1.5 (30 bar)
X2	LS pressure connection ISO 9974-1 - M12x1.5
X3	LR oversteer pressure ISO 9974-1 - M12x1.5

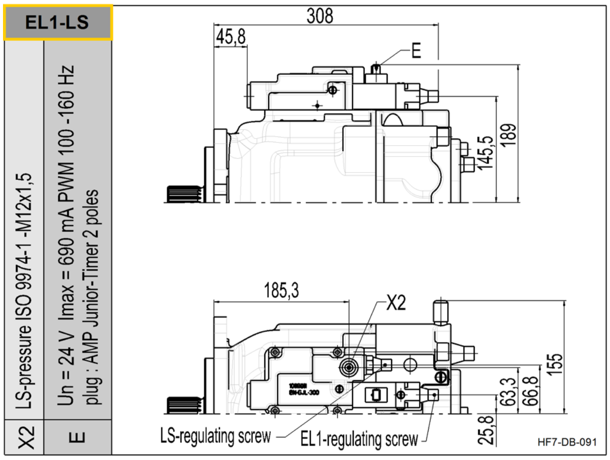
5.7.2 Nominal size 165, other control types

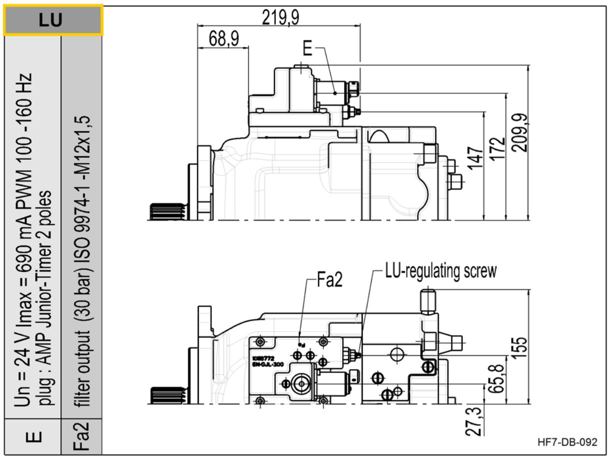
DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

Note
Dimensions of control types LR - LS and LR1 - LS, see chapter 5.7.

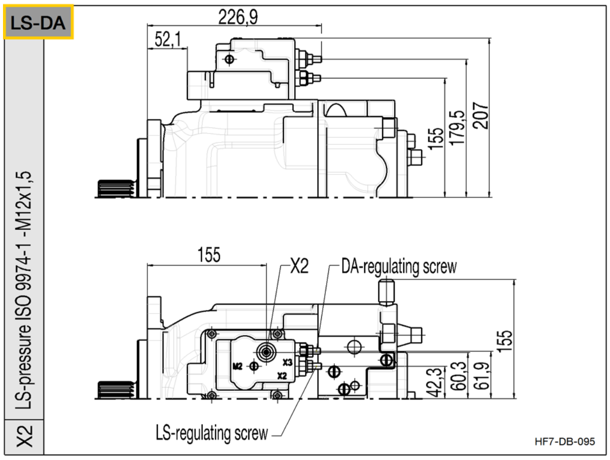


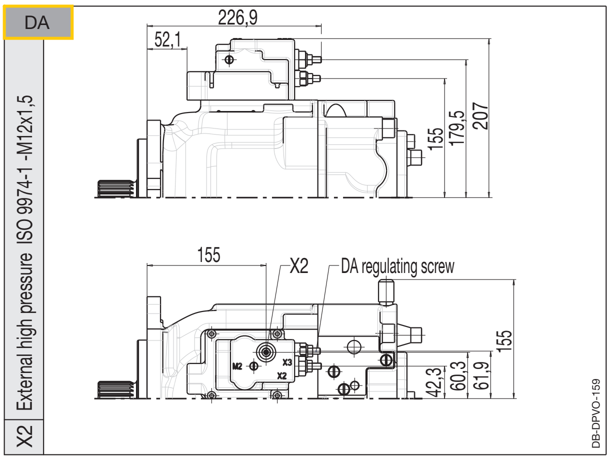






5 Dimensions



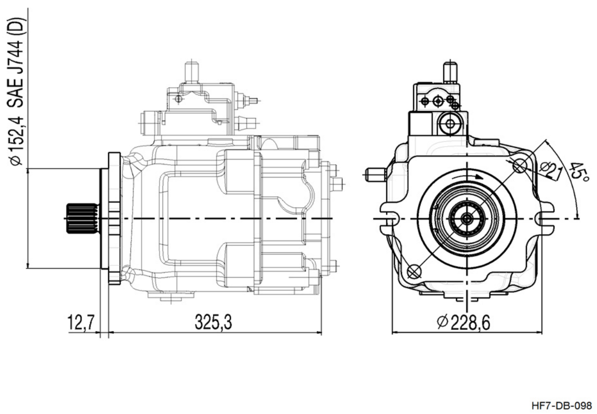


Note
X3 can be connected only to LR1
X4 can be connected only to LS1
X5 can be connected only to DA1

5.8 Nominal size 165, mounting flange clockwise rotation

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

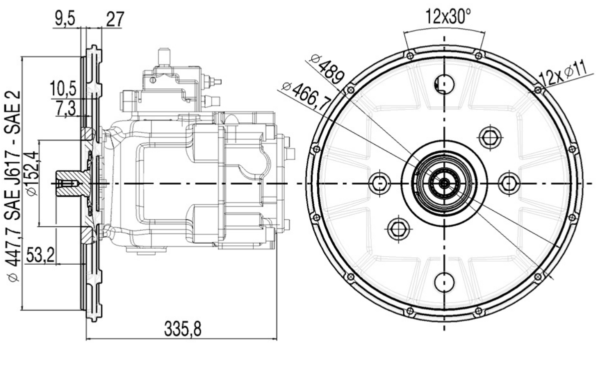
SAE D (SAE J744)



24

5 Dimensions

Diesel engine flange SAE 2 / SAE 4 (SAE J617)



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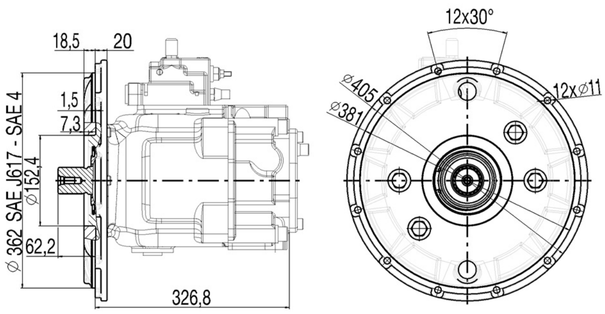
12



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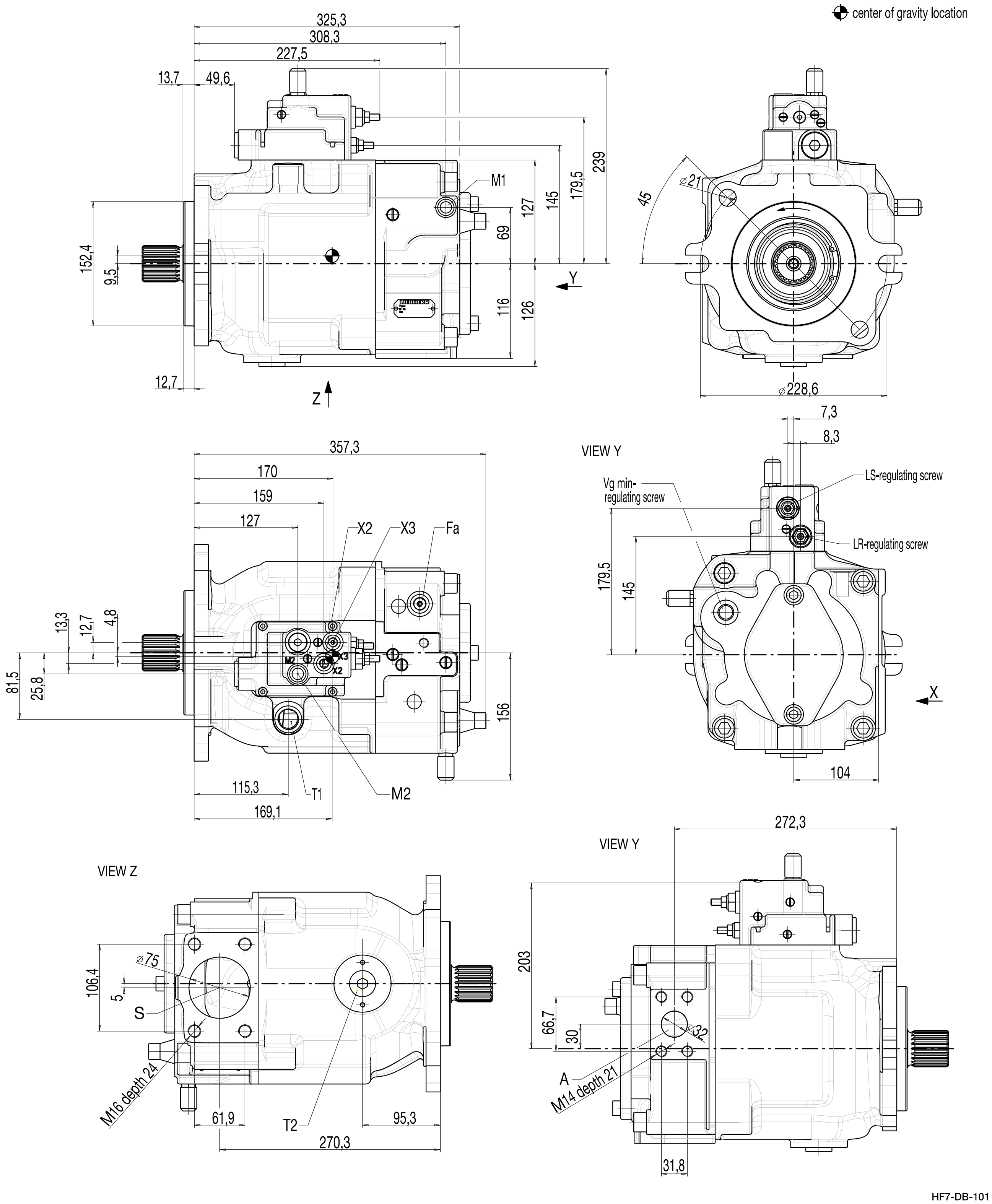
14

5 Dimensions

5.9 Nominal size 165, anti-clockwise rotation

5.9.1 Nominal size 165, LR-LS- and LR1-LS control



5 Dimensions

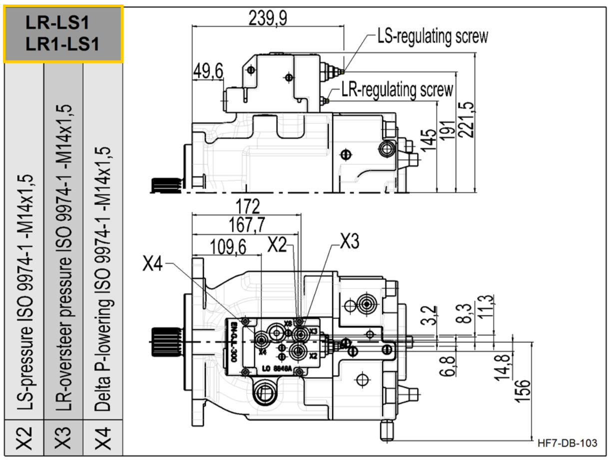
A	Working connection SAE J 518 - 1 1/4", 6000 psi
S	Suction port SAE J 518 - 3", 500 psi
M1	Regulated high pressure measuring port Minimess M16
M2	High-pressure measuring port Minimess M16

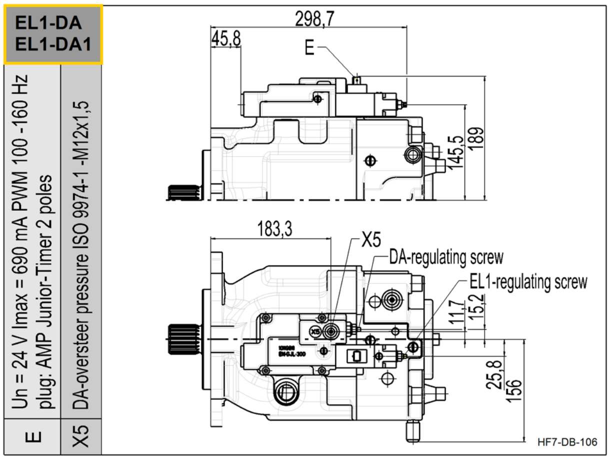
T1, T2	Leakage oil connection M26x1.5
Fa	Filter output M16x1.5 (30 bar)
X2	LS pressure connection ISO 9974-1 - M12x1.5
X3	LR oversteer pressure ISO 9974-1 - M12x1.5

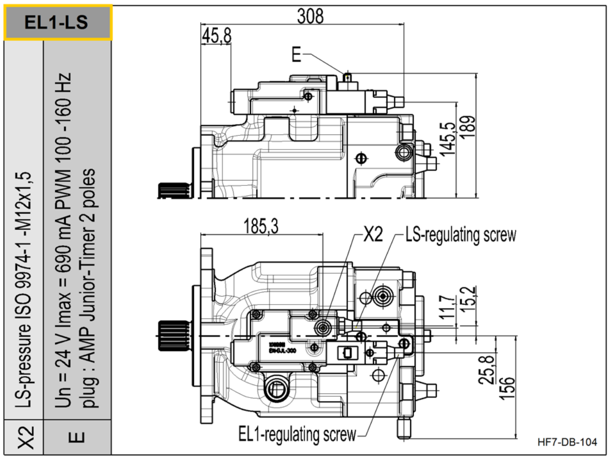
5.9.2 Nominal size 165, other control types

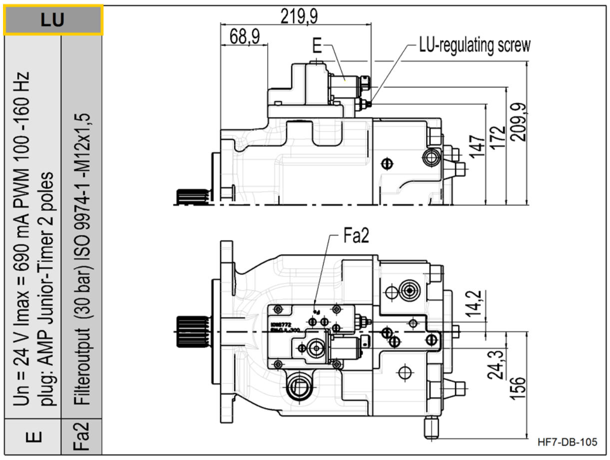
DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

Note
Dimensions of control types LR - LS and LR1 - LS, see chapter 5.9.

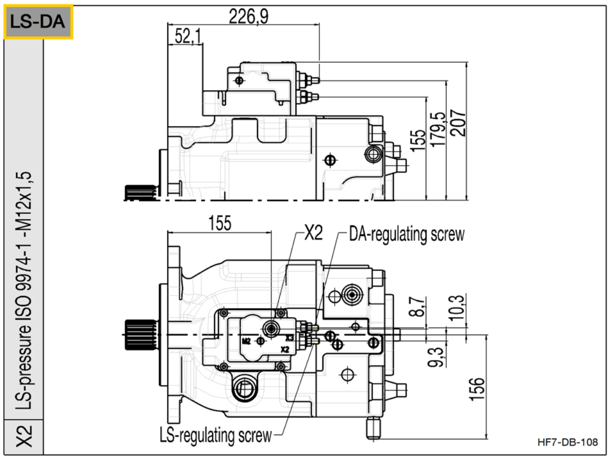








5 Dimensions



Note

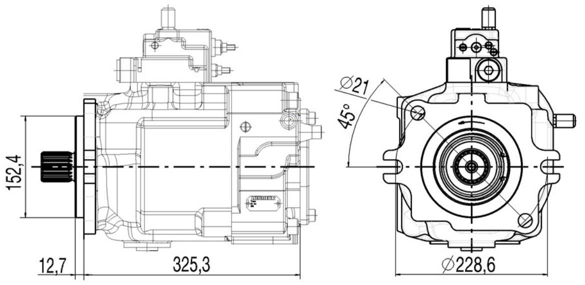
X3 can be connected only to LR1
X4 can be connected only to LS1
X5 can be connected only to DA1

5 Dimensions

5.10 Nominal size 165, mounting flange anti-clockwise rotation

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

SAE D (SAE J744)



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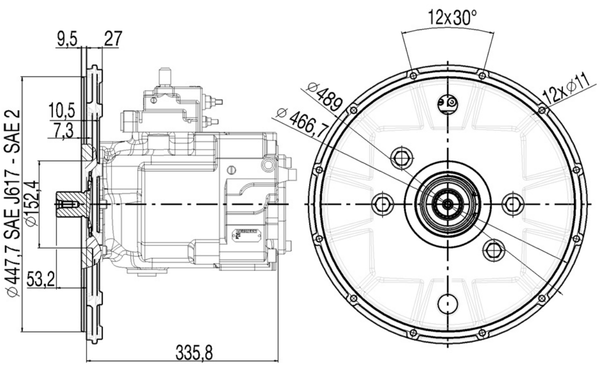
24

Diesel engine flange SAE 2 / SAE 4 (SAE J617)



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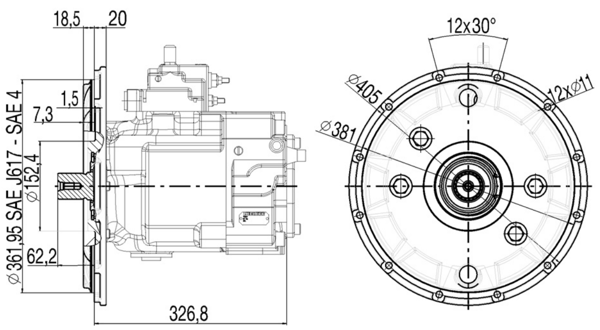
12



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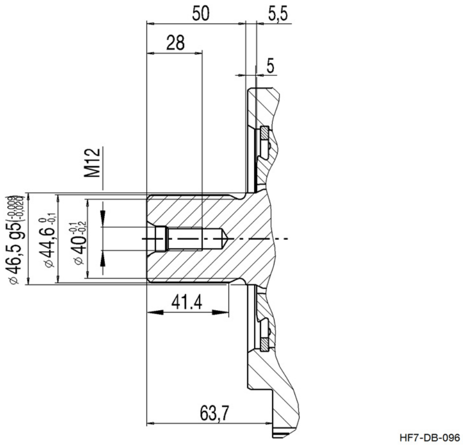
14

5 Dimensions

5.11 Nominal size 165, shaft end

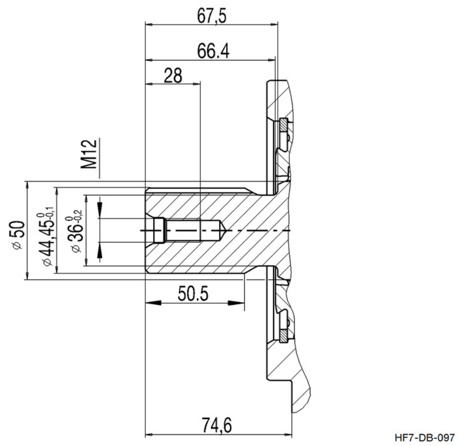
DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

DIN 5480 splined shaft W45x2x21x9g



1

ANSI B92.1a splined shaft 1 3/4 in 13T 8/16 DP

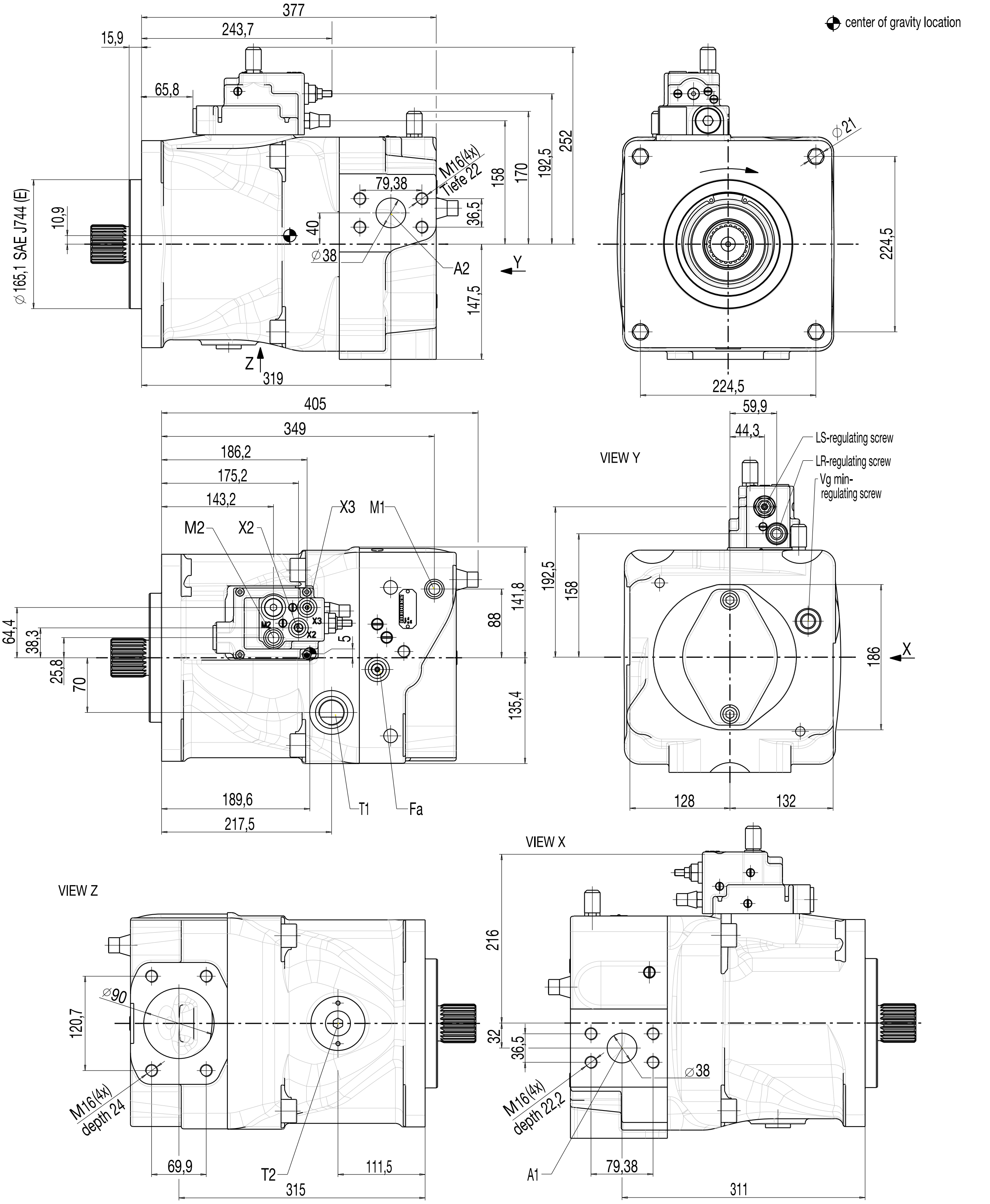


2

5 Dimensions

5.12 Nominal size 215, clockwise rotation

5.12.1 Nominal size 215, LR-LS- and LR1-LS control type



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5 Dimensions

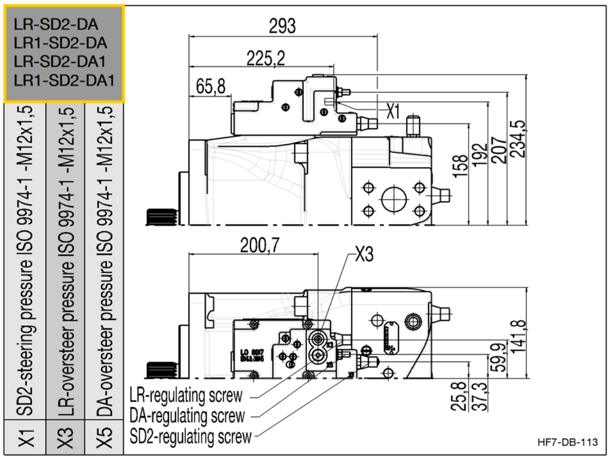
A	Working connection SAE J 518 - 1 1/2", 6000 psi
S	Suction port SAE J 518 - 3 1/2", 500 psi
M1	Regulated high pressure measuring port Minimess M16
M2	High-pressure measuring port Minimess M16

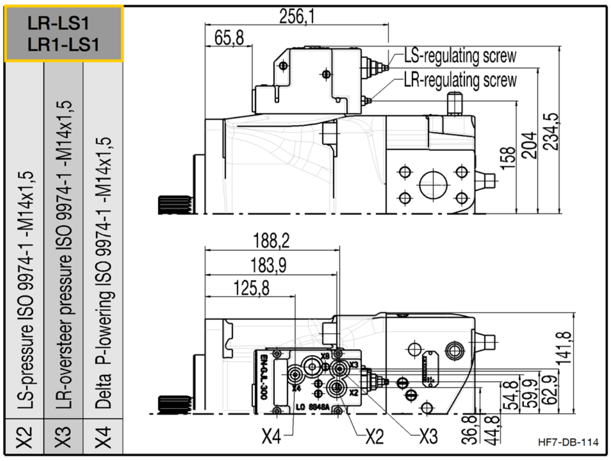
T1, T2	Leakage oil connection M33x2 / M26x1.5
Fa	Filter output M16x1.5 (30 bar)
X2	LS pressure connection ISO 9974-1 - M12x1.5
X3	LR oversteer pressure ISO 9974-1 - M12x1.5

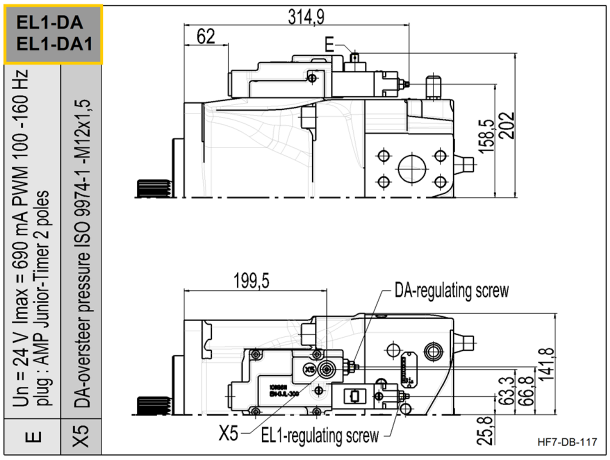
5.12.2 Nominal size 215, other control types

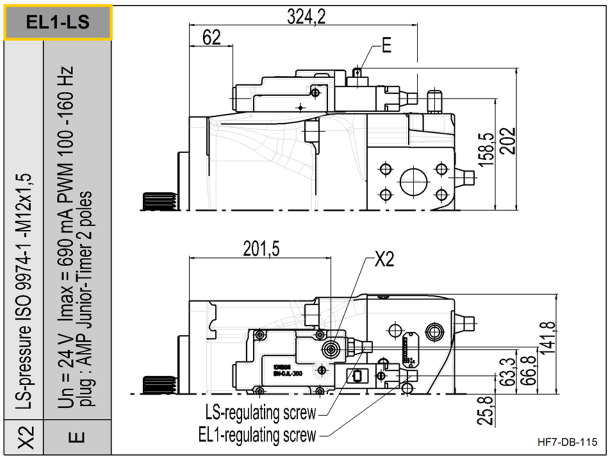
DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

Note
Dimensions of control types LR - LS and LR1 - LS, see chapter 5.12.

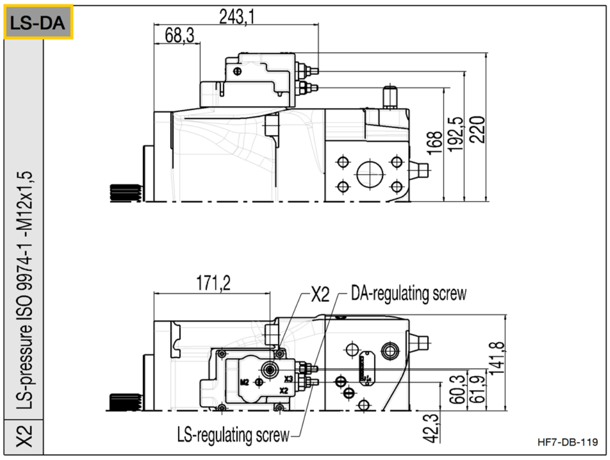


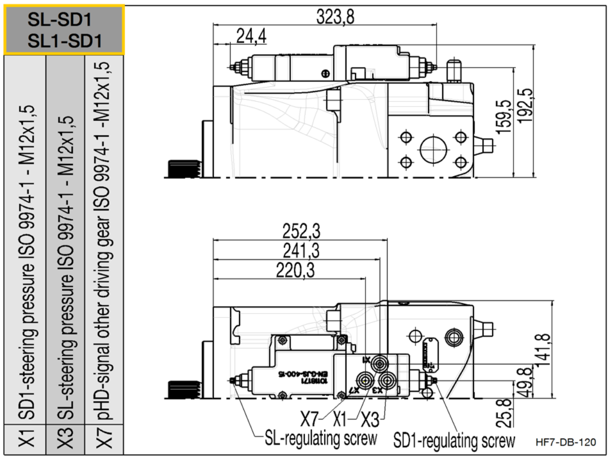






5 Dimensions





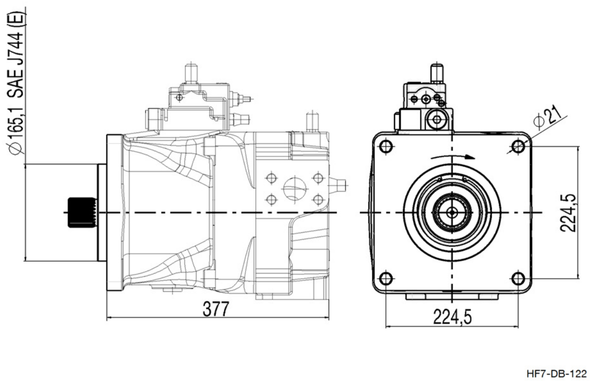
Note

X3 can be connected only to LR1
X4 can be connected only to LS1
X5 can be connected only to DA1

5.13 Nominal size 215, mounting flange

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

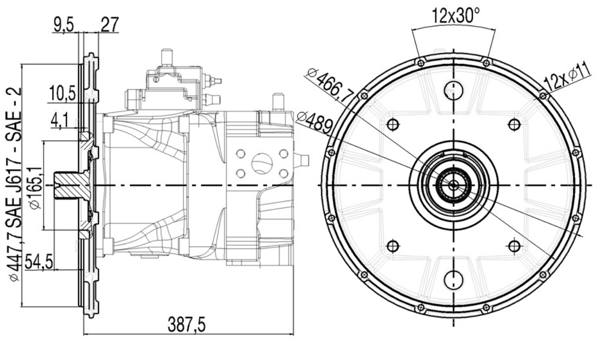
SAE E (SAE J744)



25

5 Dimensions

Diesel engine flange SAE 2 (SAE J617)



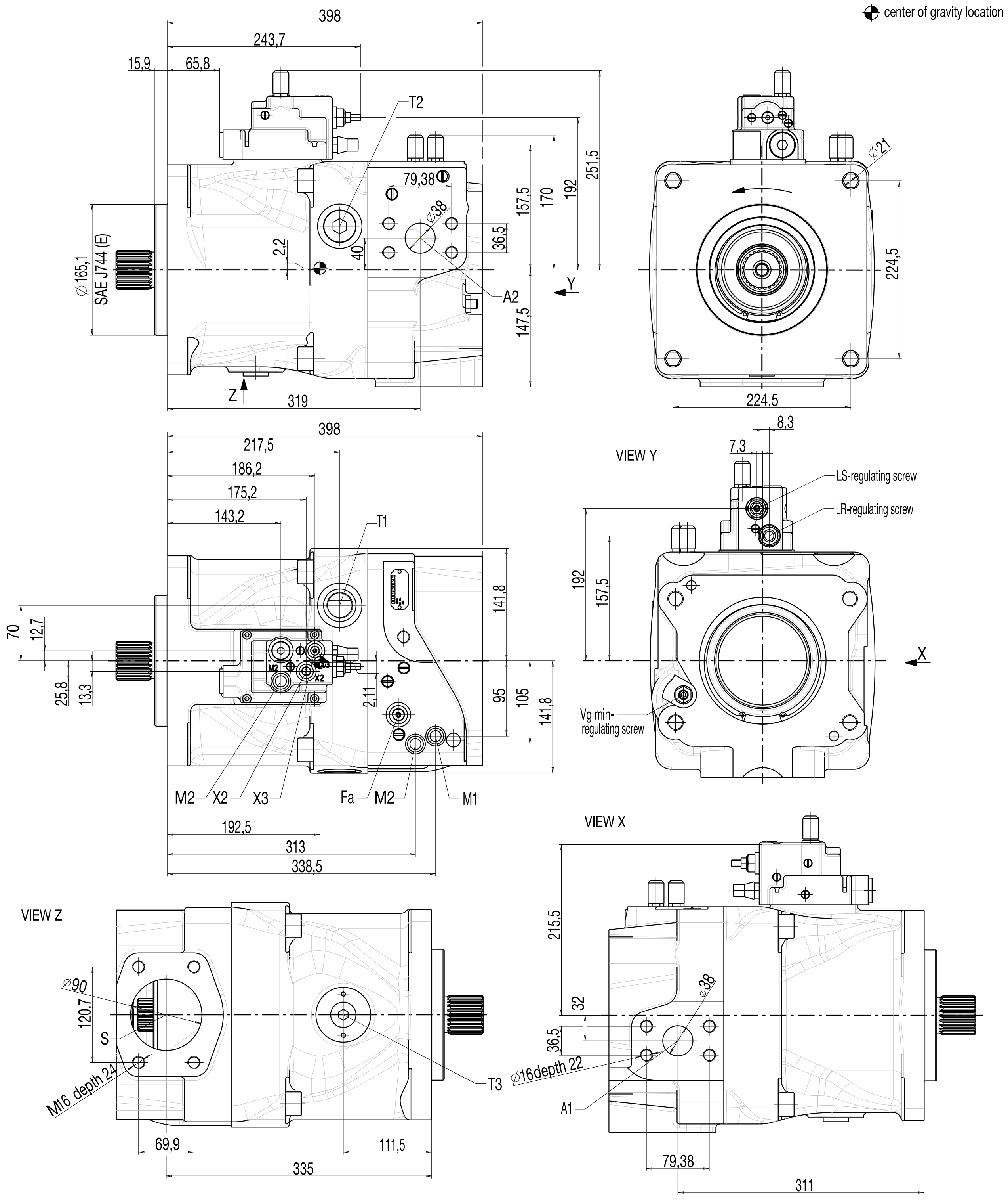
HF7-DB-123

12

5 Dimensions

5.14 Nominal size 215i, anti-clockwise rotation

5.14.1 Nominal size 215i, LR-LS- and LR1-LS control type



HF7-DB-124

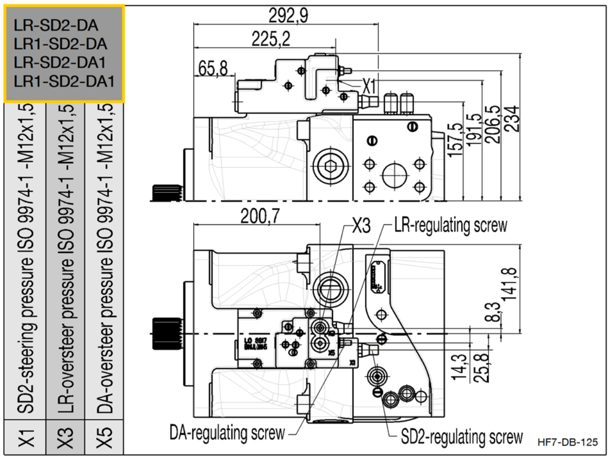
5 Dimensions

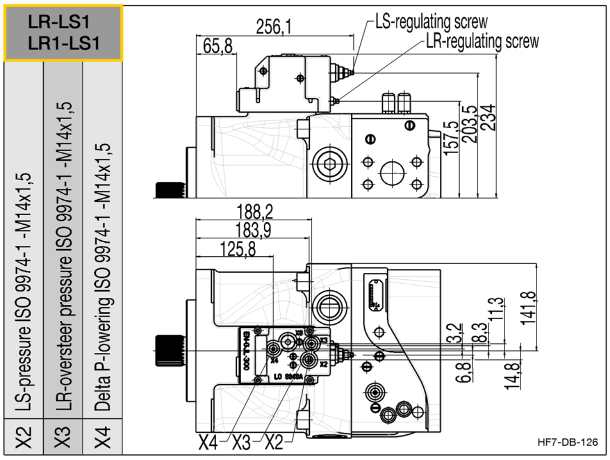
A	Working connection SAE J 518 - 1 1/2", 6000 psi	T1, T2	Leakage oil connection M33x2
S	Suction port SAE J 518 - 3 1/2", 500 psi	Fa	Filter output M16x1.5 (30 bar)
M1	Regulated high pressure measuring port Minimess M16	X2	LS pressure connection ISO 9974-1 - M12x1.5
M2	High-pressure measuring port Minimess M16	X3	LR oversteer pressure ISO 9974-1 - M12x1.5

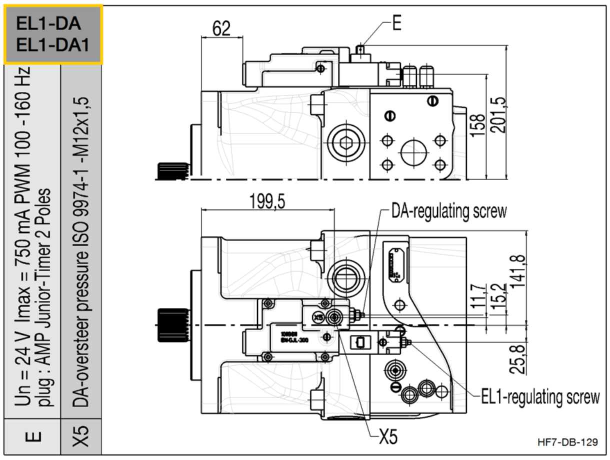
5.14.2 Nominal size 215i, other control types

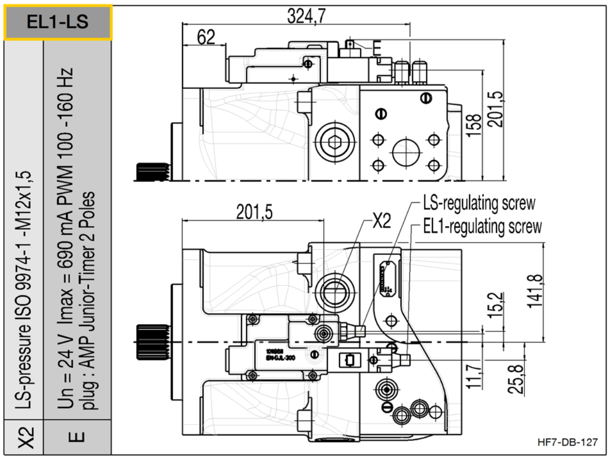
DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

Note
Dimensions of control types LR - LS and LR1 - LS, see chapter 5.14.

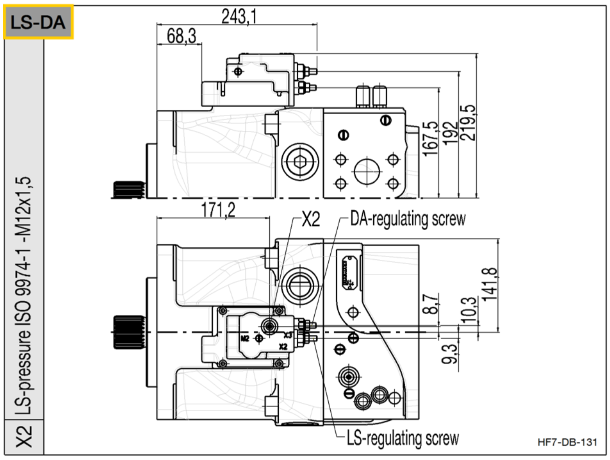


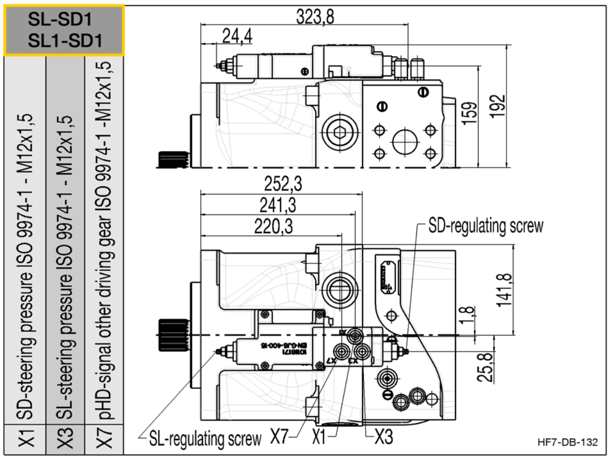






5 Dimensions



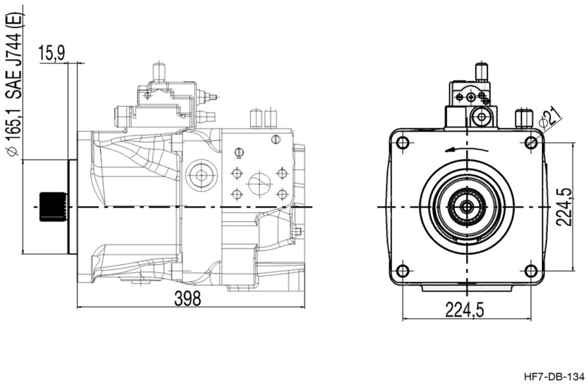


Note
X3 can be connected only to LR1
X4 can be connected only to LS1
X5 can be connected only to DA1

5.15 Nominal size 215i, mounting flange

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

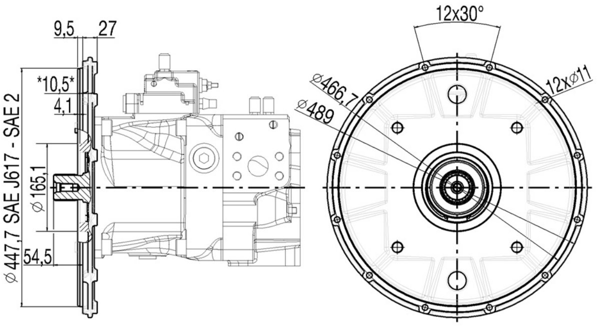
SAE E (SAE J744)



25

5 Dimensions

Diesel engine flange SAE 2 (SAE J617)



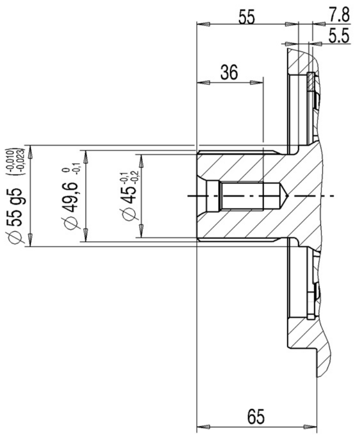
12

HF7-DB-135

5.16 Nominal sizes 215 and 215i, shaft end

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

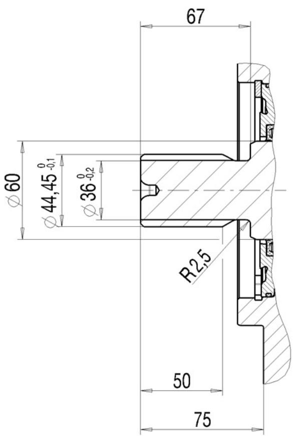
DIN 5480 splined shaft W50x2x24x9g



1

HF7-DB-133

ANSI B92.1a splined shaft 1 3/4 in 13T 8/16 DP

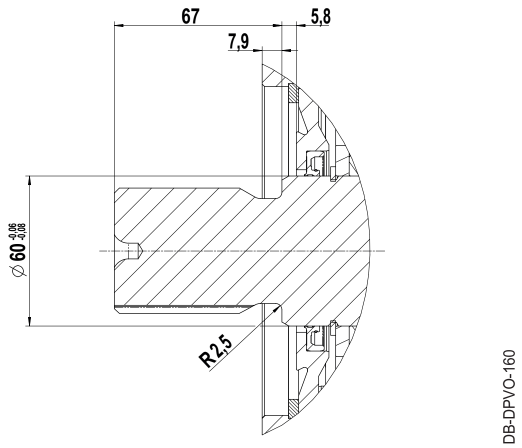


2

HF7-DB-143

5 Dimensions

ANSI B92.1a splined shaft 2 in 15T 8/16 DP

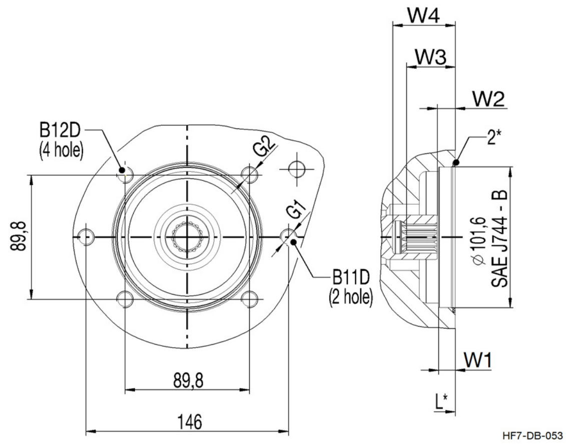


2

5.17 Through-drive ANSI B92.1a

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

5.17.1 SAE B / ANSI B92.1a-1976 7/8" 13T 16/32 DP

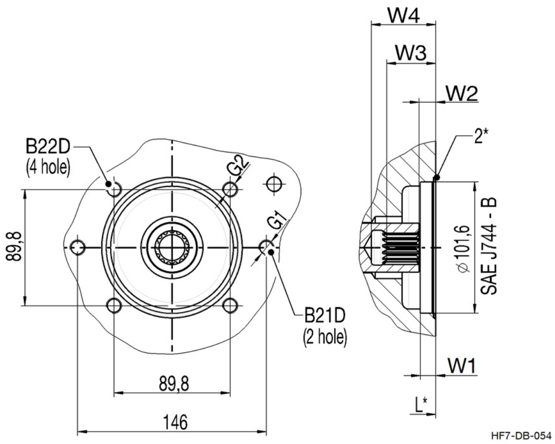


B11D 2-hole
B12D 4-hole

NS	W1	W2	W3	W4	L	G1 (2-hole)	G2 (4-hole)
108	12	13	35.1	45.1	291	M12x1.75; 18 deep	M12x1.75; 18 deep
140	12	15	33	43	312	M12x1.75; 18 deep	M12x1.75; 18 deep
165	12	16	34	44	325.3	M12x1.75; 19 deep	M12x1.75; 19 deep
215	12	12.5	33.5	44.5	355	M12x1.75; 18 deep	M12x1.75; 18 deep
215i	11	12	43.2	58	429	M12x1.75; 20 deep	M12x1.75; 20 deep

L*) up to mounting flange
2*) O-ring (included in the scope of delivery)
Option: Vertical threaded holes

5.17.2 SAE BB / ANSI B92.1a-1976 1" 15T 16/32 DP

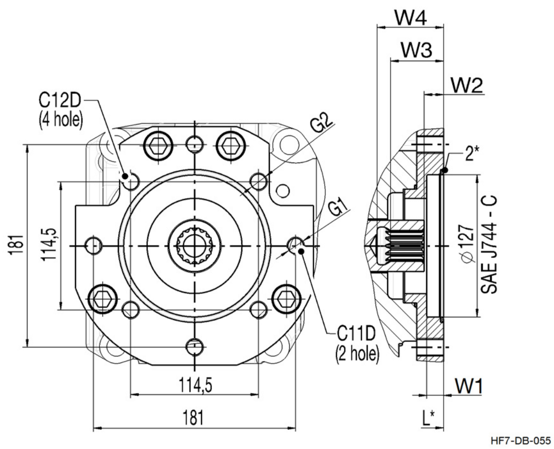


B21D	2-hole
B22D	4-hole

NS	W1	W2	W3	W4	L	G1 (2-hole)	G2 (4-hole)
108	12	13	38	50	291	M12x1.75; 18 deep	M12x1.75; 18 deep
140	12	13	37.9	49.9	312	M12x1.75; 18 deep	M12x1.75; 18 deep
165	12	14	38.9	50.9	325.3	M12x1.75; 19 deep	M12x1.75; 19 deep
215	12	12.5	37.5	49.5	355	M12x1.75; 18 deep	M12x1.75; 18 deep
215i	11	12	44.5	58	429	M12x1.75; 20 deep	M12x1.75; 20 deep

L*) up to mounting flange
2*) O-ring (included in the scope of delivery)
Option: Vertical threaded holes

5.17.3 SAE C / ANSI B92.1a-1976 1 1/4" 14T 12/24 DP



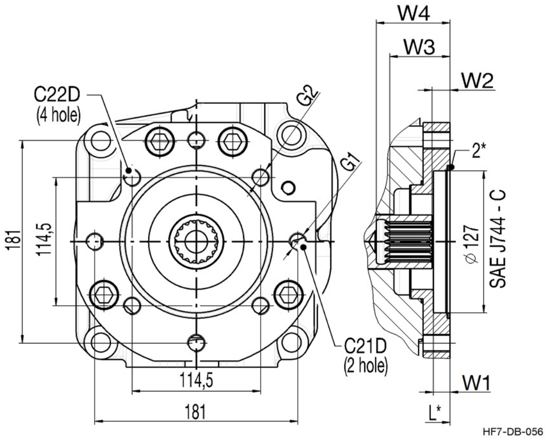
C11D	2-hole
C12D	4-hole

NS	W1	W2	W3	W4	L	G1 (2-hole)	G2 (4-hole)
108	A	A	A	A	A	A	A
140	A	A	A	A	A	A	A
165	15	17	48.4	60.4	349.3	M16x2; 24 deep	M12x1.75; 24 deep
215	18	18	47.5	59.5	401	M16x2; 28 deep	M12x1.75; 28 deep
215i	18	16	58	58	429	M16x2; 24 deep	M12x1.75; 24 deep

L*) up to mounting flange
2*) O-ring (included in the scope of delivery)
Option: Vertical threaded holes

5 Dimensions

5.17.4 SAE CC / ANSI B92.1a-1976 1 1/2" 17T 12/24 DP

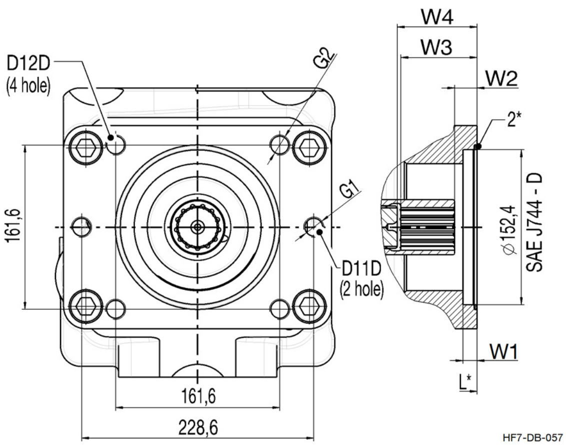


C21D 2-hole
C22D 4-hole

NS	W1	W2	W3	W4	L	G1 (2-hole)	G2 (4-hole)
108	A	A	A	A	A	A	A
140	A	A	A	A	A	A	A
165	15	17	54.8	66.8	349.3	M16x2; 24 deep	M12x1.75; 24 deep
215	18	18	53.5	65.5	401	M16x2; 28 deep	M12x1.75; 28 deep
215i	18	18	66	66	437	M16x2; 24 deep	M12x1.75; 24 deep

L*) up to mounting flange
2*) O-ring (included in the scope of delivery)
Option: Vertical threaded holes

5.17.5 SAE D / ANSI B92.1a-1976 1 3/4" 13T 8/16 DP



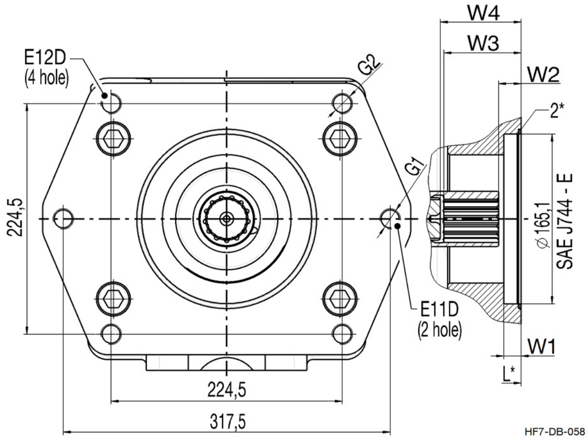
D11D 2-hole
D12D 4-hole

NS	W1	W2	W3	W4	L	G1 (2-hole)	G2 (4-hole)
108	A	A	A	A	A	A	A
140	A	A	A	A	A	A	A
165	A	A	A	A	A	A	A
215	14	22	66.5	78.5	414	M20x2.5; 41 deep	M20x2.5; 41 deep
215i	14	22	75	78.5	449.5	M20x2.5; 25 deep	M20x2.5; 25 deep

L*) up to mounting flange
2*) O-ring (included in the scope of delivery)

5 Dimensions

5.17.6 SAE E / ANSI B92.1a-1976 1 3/4" 13T 8/16 DP



E11D 2-hole
E12D 4-hole

NS	W1	W2	W3	W4	L	G1 (2-hole)	G2 (4-hole)
215	A	A	A	A	A	A	A
215i	A	A	A	A	A	A	A

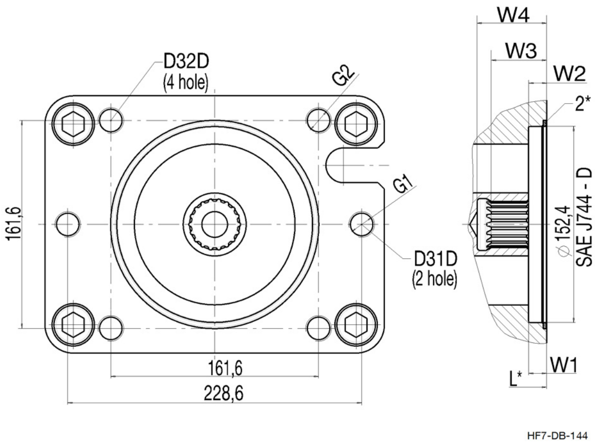
L*) up to mounting flange
2*) O-ring (included in the scope of delivery)

A = available on request

5.18 Through-drive DIN 5480

DPV	0		/			1				A				0	
1.	2.	3		4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.

5.18.1 SAE D / W40x2x18x9g / DIN 5480



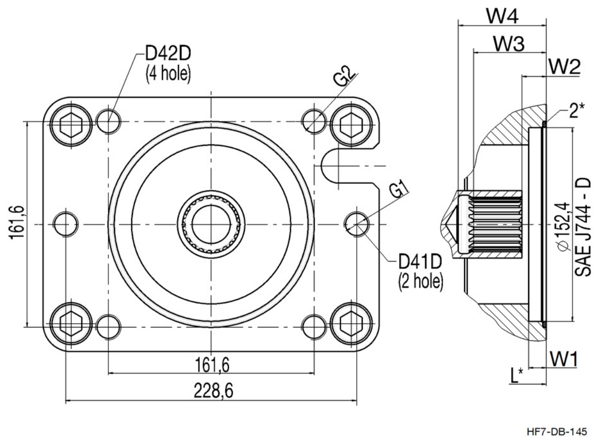
D31D 2-hole
D32D 4-hole
D33D 2- and 4-hole

NS	W1	W2	W3	W4	L	G1 (2-hole)	G2 (4-hole)
108	A	A	A	A	A	A	A
140	A	A	A	A	A	A	A
165	A	A	A	A	A	A	A
215	14	23.5	52.5	63.5	414	M20x2.5; 41 deep	M20x2.5; 41 deep
215i	14	19	60.2	71.2	442.2	M20x2.5; 44.2 deep	M20x2.5; 44.2 deep

L*) up to mounting flange
2*) O-ring (included in the scope of delivery)

5 Dimensions

5.18.2 SAE D / W45x2x21x9g / DIN 5480

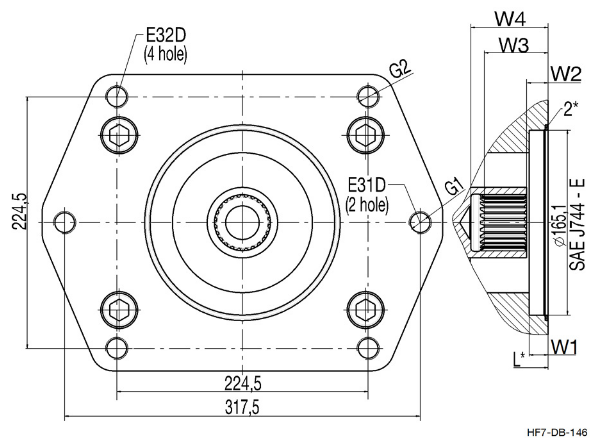


D41D	2-hole
D42D	4-hole
D43D	2- and 4-hole

NS	W1	W2	W3	W4	L	G1 (2-hole)	G2 (4-hole)
140	A	A	A	A	A	A	A
165	A	A	A	A	A	A	A
215	14	19.2	57.2	69.2	414	M20x2.5; 41 deep	M20x2.5; 41 deep
215i	14	17.7	60.2	71.2	442.2	M20x2.5; 44.2 deep	M20x2.5; 44.2 deep

L*) up to mounting flange
2*) O-ring (included in the scope of delivery)

5.18.3 SAE E / W50x2x24x9g / DIN 5480



E31D	2-hole
E32D	4-hole

NS	W1	W2	W3	W4	L	G1 (2-hole)	G2 (4-hole)
215	A	A	A	A	A	A	A
215i	A	A	A	A	A	A	A

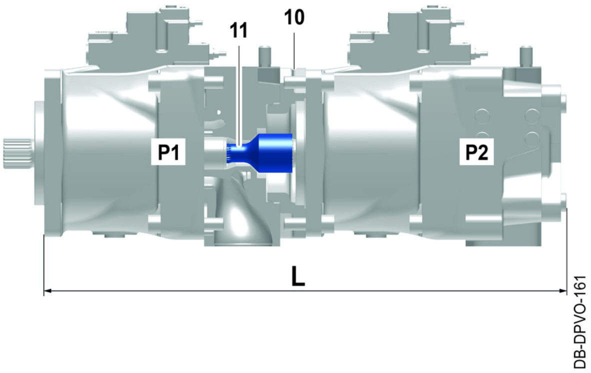
L*) up to mounting flange
2*) O-ring (included in the scope of delivery)

5 Dimensions

5.19 Multiple unit in tandem design

General information
Multi inline axial piston units of two or more single units can be supplied on request. In this case, the base axial piston pump P1 must be connected with another axial piston pump P2 through an adapter plate 10 and a coupling ferrule 11.

The type code must be filled out separately for each single unit. An abbreviated type designation on an additional type plate is used to identify the multi-unit.



P1	Base pump
P2	Mounting pump
L	Multi-unit overall length in mm

10	Adapter
11	Coupling ferrule
-	-

Note
Multi-units consisting of three single pumps can be realised on request.
Total length L valid for tandem combinations with drive shaft pump 2 = DIN 5480.

5.19.1 Dimensions of the multi-unit in tandem design

NS P1	NS P2			
	108	140	165	215
108	☐ (L = 621)	-	-	-
140	☐ (L = 642)	☐ (L = 663)	-	-
165	☐ (L = 640.3)	☐ (L = 661.3)	■ (L = 674.6)	-
215	☐ (L = 705)	☐ (L = 726)	☐ (L = 739.3)	☐ (L = 787)

■ = Available
☐ = On request
- = Not possible
L = Total length in mm

Do you have any questions? Get in touch with your contact for further information.

Liebherr Machines Bulle SA Rue Hans-Liebherr 7 1630 Bulle/FR, Switzerland
Phone +41 26 013 31 11 , Fax +41 26 013 34 85 info.lmb@liebherr.com www.liebherr.com