Data sheet

# Axial piston pumps with variable displacement volume: LH30VO


The Liebherr LH30VO axial piston pumps were developed for open loop circuits in mobile and stationary applications.

The medium-pressure pumps have a swashplate design and a through-drive capacity of up to 130 %.

Further controls have been added, including power controls (LR), electrical volume flow controls (VE) with rising characteristic and additional jump function at signal loss (VK). They are tailored to the most common applications such as working hydraulics, ventilation, steering or power units.

Its increased performance and optimized production and assembly processes make the LH30VO an attractive, high-performance product for mobile and stationary applications that require a pressure range of up to 4,061 psi (280 bar).

**valid for:**
LH30VO 028
LH30VO 045
LH30VO 085

**Features:**
Series 20
Open loop circuit

**Control types:**
Pressure control
Volume flow control
Power control
Various combined controls

**Pressure range:**
Nominal pressure $pHD_N$ = 4,061 psi (280 bar)
Maximum pressure $pHD_{max}$ = 4,641 psi (320 bar)

**Document identification:**
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LIEBHERR

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LH30VO 028 to 085

# 1 Type code

Axial piston pump
LH30VO 028 to 085

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | | / | | 20 | V | | | | | 0 | 00 | | 000 | | | |

## 1. Manufacturer

| | |
|---|---|
| Liebherr Machines Bulle SA | L |

## 2. Division

| | |
|---|---|
| Hydraulics | H |

## 3. Nominal pressure range

| | |
|---|---|
| Nominal pressure $p_N$ = 4,061 psi (280 bar) /<br>Maximum pressure $p_{max}$ = 4,641 psi (320 bar) | 3 |

## 4. Version

| | |
|---|---|
| Single unit (pump) (multiple unit inline, see section 5.11) | 0 |

## 5. Design

| | |
|---|---|
| Variable | V |

## 6. Circuit

| | |
|---|---|
| Open loop circuit | O |

## 7. Nominal size (NS)

| | | | | |
|---|---|---|---|---|
| NS (multiple unit inline, see section 5.11) | 028 | 045 | 085 | |

## 8. Control (3- / 6- or 9-digit)

| | |
|---|---|
| **1. Control axis** | **XX-** |
| **2. Control axis (combination control)** | **XX-XX-** |
| **3. Control axis (combination control)** | **XX-XX-XX-** |

| **Mechanical-hydraulic controls** | | | | |
|---|---|---|---|---|
| Pressure cut-off | ■ | ■ | ■ | DA- |
| Hydraulic pressure control (remotely controllable) /<br>pressure cut-off (combination control) | ■ | ■ | ■ | DF-DA- |
| Load sensing control (without pressure-relief nozzle in control) /<br>pressure cut-off (combination control) | ▼ | ▼ | ▼ | LS0DA- |
| Load sensing control (with pressure-relief nozzle in control) /<br>pressure cut-off (combination control) | □ | □ | □ | LS1DA- |
| Power control | ■ | ■ | ■ | LR- |
| A dash must be added as suffix for 2-digit mechanical-hydraulic controls. This applies to each control axis. | | | | |

# 1 Type code

Axial piston pump
LH30VO 028 to 085

| | 028 | 045 | 085 | |
|---|---|---|---|---|
| **Electro-hydraulic controls** | | | | |
| Electrical pressure control | ▼ | ▼ | ▼ | DE_ |
| Load sensing control (without pressure-relief nozzle in control) / Electrical pressure control (combination control) | ■ | ■ | ■ | LS0DE_ |
| Load sensing control (with pressure-relief nozzle in control) / Electrical pressure control (combination control) | □ | □ | □ | LS1DE_ |
| The underscore placeholder for electrical pressure controls is for the desired voltage / characteristic / plug. Please enter 1-8 instead of the underscore. | | | | |
| Voltage / characteristic / plug: 24V, rising characteristic, Deutsch plug | ■ | ■ | ■ | 1 |
| Voltage / characteristic / plug: 24 V, falling characteristic, Deutsch plug | ■ | ■ | ■ | 2 |
| Voltage / characteristic / plug: 12V, rising characteristic, Deutsch plug | ■ | ■ | ■ | 3 |
| Voltage / characteristic / plug: 12V, falling characteristic, Deutsch plug | ■ | ■ | ■ | 4 |
| Voltage / characteristic / plug: 24V, rising characteristic, AMP plug | ▼ | ▼ | ▼ | 5 |
| Voltage / characteristic / plug: 24 V, falling characteristic, AMP plug | ▼ | ▼ | ▼ | 6 |
| Voltage / characteristic / plug: 12V, rising characteristic, AMP plug | ■ | ■ | ■ | 7 |
| Voltage / characteristic / plug: 12V, falling characteristic, AMP plug | ■ | ■ | ■ | 8 |

| | | | | |
|---|---|---|---|---|
| Electrical volume control | ■ | ■ | ■ | VE_ |
| Electrical volume control with jump function at signal loss | ■ | ■ | ■ | VK_ |
| Volume electrically overridden (retarder) | ■ | ■ | ■ | VO_ |
| The underscore placeholder for electrical volume flow controls is for the desired voltage / characteristic / plug. Please enter 1-7 instead of the underscore. | | | | |
| Voltage / characteristic / plug: 24V, rising characteristic, Deutsch plug | □ | □ | □ | 1 |
| Voltage / characteristic / plug: 12V, rising characteristic, Deutsch plug | □ | □ | □ | 3 |
| Voltage / characteristic / plug: 24V, rising characteristic, AMP plug | ■ | ■ | ■ | 5 |
| Voltage / characteristic / plug: 12V, rising characteristic, AMP plug | □ | □ | □ | 7 |

### Availability matrix for controls (1-3 control axes)

| | | Basic option | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DA- | DE_ | LS0DA- | LS1DA- | LS0DE_ | LS1DE_ | DF-DA- | DE_DA- | VE_ | VK_ | LR- |
| Additional option | None | ■ | ▼ | ▼ | □ | ■ | □ | ■ | ■ | ■ | ■ | ■ |
| | DA- | - | ■ | - | - | ■ | □ | - | - | ■ | ■ | ■ |
| | VE_ | ■ | ■ | ■ | □ | ■ | □ | ■ | ■ | - | - | - |
| | VK_ | ■ | ■ | ■ | □ | ■ | □ | ■ | ■ | - | - | - |
| | LR- | ■ | - | ■ | □ | ■ | □ | ■ | ■ | - | - | - |
| | VO_ | ■ | ■ | ■ | □ | ■ | □ | ■ | ■ | - | - | ■ |

# 1 Type code

Axial piston pump
LH30VO 028 to 085

| | 028 | 045 | 085 | |
|---|---|---|---|---|
| **9. Series** | | | | |
| Design | 20 | | | |
| **10. Seal material** | | | | |
| Viton | V | | | |
| **11. Direction of rotation (looking at the face of the drive shaft)** | | | | |
| Counterclockwise | ■ | ■ | ■ | L |
| Clockwise | ■ | ■ | ■ | R |
| **12. Mounting flange** | | | | |
| SAE B = 4.0 inch (101.6 mm) (SAE J744) 2-hole fastening | ▼ | ▼ | - | B2 |
| SAE C = 5.0 inch (127.0 mm) (similar to SAE J744) 2+4-hole fastening | - | - | ▼ | C6 |
| **13. Driving shaft end** | | | | |
| ANSI, 7/8”, 13 teeth, with undercut | ■ | ■ | - | A1 |
| ANSI, 7/8”, 13 teeth, without undercut | ▼ | ■ | - | A2 |
| ANSI, 1”, 15 teeth, with undercut | □ | ■ | - | A3 |
| ANSI, 1”, 15 teeth, without undercut | □ | ▼ | - | A4 |
| ANSI, 1 1/4”, 14 teeth, with undercut | - | - | ■ | A5 |
| ANSI, 1 1/4”, 14 teeth, without undercut | - | - | □ | A6 |
| ANSI, 1 1/2”, 17 teeth, with undercut | - | - | □ | A9 |
| ANSI, 1 1/2”, 17 teeth, without undercut | - | - | ▼ | A0 |
| **14. Working connection** | | | | |
| Metric fastening thread at the side ISO 6162-2 / SAE J518-2 | □ | ■ | ▼ | A1 |
| Metric fastening thread at the rear ISO 6162-2 / SAE J518-2 | □ | ■ | ■ | A3 |
| Metric fastening thread at the side ISO 6162-1 / SAE J518-1 | ▼ | ▼ | - | B1 |
| Metric fastening thread at the rear ISO 6162-1 / SAE J518-1 | ■ | ■ | - | B3 |
| **15. Add-on parts** | | | | |
| Without add-on parts | 0 | | | |
| **16. Gear pump** | | | | |
| Without gear pump | 00 | | | |

# 1 Type code

Axial piston pump
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### 17. Through-drive

| | | | 028 | 045 | 085 | |
|---|---|---|---|---|---|---|
| Without through-drive | | | ■ | ■ | ▼ | 0000 |
| Centering diameter | Shaft gearing | Fastening | | | | |
| Ø3.25 (82.55) (SAE J744-A) | ANSI B92.1a 5/8 in 9T 16/32DP | 2-hole/open hole | ■ | ■ | ■ | A11D |
| Ø3.25 (82.55) (SAE J744-A) | ANSI B92.1a 3/4 in 11T 16/32DP | 2-hole/open hole | ■ | ■ | ■ | A21D |
| Ø4.00 (101.6) (SAE J744-B) | ANSI B92.1a 7/8 in 13T 16/32DP | 2-hole/open hole | ▼ | ■ | ■ | B11D |
| Ø4.00 (101.6) (SAE J744-B) | ANSI B92.1a 1 in 15T 16/32DP | 2-hole/open hole | - | ▼ | ■ | B21D |
| Ø5.00 (127) (SAE J744-C) | ANSI B92.1a 1 1/4 in 14T 12/24DP | 2-hole/open hole | - | - | □ | C11D |
| Ø5.00 (127) (SAE J744-C) | ANSI B92.1a 1 1/2 in 17T 12/24DP | 2-hole/open hole | - | - | ▼ | C21D |
| Special / Centering diameter | No shaft coupling | 4-hole/closed hole | ▼ | ▼ | ▼ | K02G |

### 18. Valves

| | | | | | | |
|---|---|---|---|---|---|---|
| Without valve | | | 000 | | | |

### 19. Sensors

| | | | | | | |
|---|---|---|---|---|---|---|
| Without sensor | | | ▼ | ▼ | ▼ | 0 |
| Preparation for pressure measuring connection (Minimess) | | | - | □ | □ | V |

### 20. Swivel angle limit stops

| | | | | | | |
|---|---|---|---|---|---|---|
| Standard (without $Q_{min}$ + $Q_{max}$ limit stop) | | | ▼ | ▼ | ▼ | 0 |
| With $Q_{max}$ fixed limit stop (please specify in purchase order) | | | □ | □ | □ | 5 |

### 21. Special design and options

| | | | | | | |
|---|---|---|---|---|---|---|
| Primer | | | ▼ | ▼ | ▼ | G |
| Primer + paint (color as specified by customer) | | | □ | □ | □ | F |
| Conservation without primer (tank pump) | | | □ | □ | □ | K |
| Additional Leakage oil connection | | | ■ | ■ | ■ | Z |

▼ = Preferred series
■ = Available
□ = Available on request
- = Not possible

**Note**
Contact addresses for requests are listed on the reverse of this document.

## 2.1 Table of values

| Nominal size | | | | 028 | 045 | 085 |
|---|---|---|---|---|---|---|
| Displacement volume | | $V_{g\ max}$ | $inch^3$ ($cm^3$) | 1.75 (28.7) | 2.84 (46.5) | 5.25 (86.1) |
| | | $V_{g\ min}$ | $inch^3$ ($cm^3$) | 0 | 0 | 0 |
| Volume flow at $V_{g\ max}$ and $n_{max}$ | | $q_{v\ max}$ | US.liq. gal/min (l/min) | 25.02 (94.7) | 36.85 (139.5) | 54.58 (206.6) |
| Min. speed at $V_{g\ max}$ and $p_{abs}$ = 14.5 psi (1 bar) at the suction port | | $n_{min}$ | rpm | 100* | 100* | 100* |
| Max. speed at $V_{g\ max}$ and $p_{abs}$ = 14.5 psi (1 bar) at the suction port | | $n_{max}$ | rpm | 3,300 | 3,000 | 2,400 |
| Torque at $V_{g\ max}$ and Δp = 4,061 psi (280 bar) | | $M_{max}$ | lbf ft (Nm) | 94.33 (127.9) | 152.82 (207.2) | 283.00 (383.7) |
| Drive power at $qv_{max}$ and Δp = 4,061 psi (280 bar) | | $p_{max}$ | kW (hp) | 59.27 (44.2) | 87.30 (65.1) | 129.27 (96.4) |
| Engine moment of inertia | | $J_{TW}$ | $lb{\cdot}ft^2$ ($kgm^2$) | 0.047 (0.002) | 0.095 (0.004) | 0.230 (0.0097) |
| Weight without through-drive (approx.) | | m | lb (kg) | 35.27 (16) | 46.30 (21) | 85.98 (39) |
| Weight with through-drive (approx.) | | m | lb (kg) | 39.68 (18) | 52.91 (24) | 94.80 (43) |
| Torsional stiffness | Driving shaft code "A1" | lbf ft/rad (Nm/rad) | | 14,604 (19,800) | 17,406 (23,600) | - |
| | Driving shaft code "A2" | | | 15,931 (21,600) | 20,357 (27,600) | - |
| | Driving shaft code "A3" | | | □ | 23,602 (32,000) | - |
| | Driving shaft code "A4" | | | □ | 24,044 (32,600) | - |
| | Driving shaft code "A5" | | | - | - | 51,482 (69,800) |
| | Driving shaft code "A6" | | | - | - | 59,521 (80,700) |
| | Driving shaft code "A9" | | | - | - | □ |
| | Driving shaft code "A0" | | | - | - | 76,190 (103,300) |

□ = Available on request
- = Not possible

*) Depending on the specific application, special approval for a lower minimum speed at lower operating pressure is possible. Please contact Liebherr, stating your expected load cycle.

**Note**
Theoretical, rounded values which do not take into account the efficiency, tolerances, contamination of the hydraulic fluid, and deflection of the driving shaft.

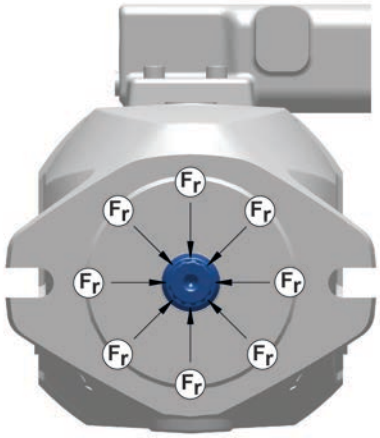
## 2.2 Maximum radial and axial force load on the driving shaft

**Note**
The radial and axial forces are calculated separately and for stated load cycles (pressure and direction of force). If you are planning a belt drive, or expect continuous axial and/or radial forces, please contact Liebherr stating the anticipated load cycle.

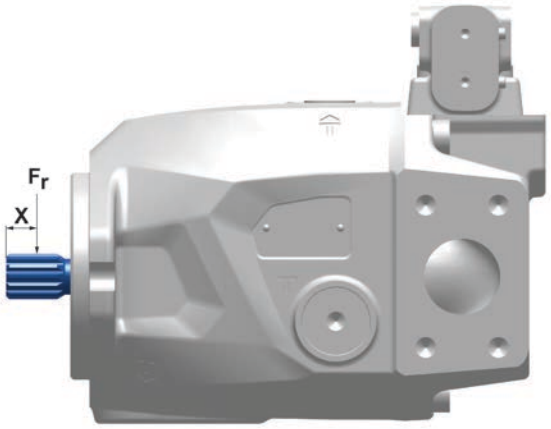
**Note**
Theoretical, rounded values which do not take into account the efficiency, tolerances, contamination of the hydraulic fluid, and deflection of the driving shaft.

**Generally applicable information for calculation**

- $Vg_{max}$
- Operating pressure pHD: 2,901 psi (200 bar)



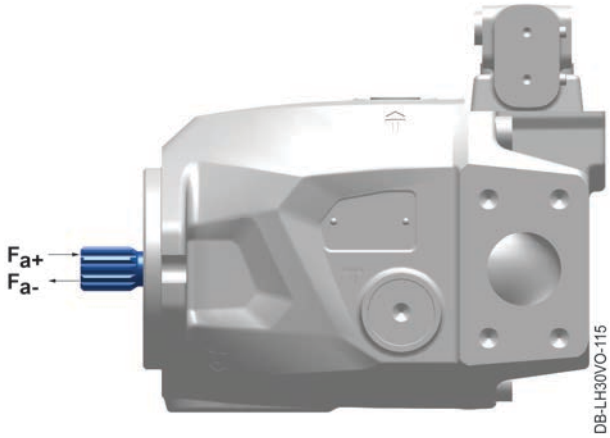
DB-LH30VO-113



DB-LH30VO-114

| Nominal size | | | 028 | 045 | 085 |
|---|---|---|---|---|---|
| X | | inch (mm) | 0.49 (12.5) | 0.59 (15) | 0.71 (18) |
| Position of radial force application | | - | All | | |
| Max. radial force $F_r$ | Reduction of LLD* by 20% | lbf (N) | 112.40 (500) | 146.12 (650) | 348.44 (1,550) |
| | Reduction of LLD* by 50% | | 314.72 (1,400) | 292.24 (1,300) | 629.44 (2,800) |

LLD*) Bearing service life




| Nominal size | | | 028 | 045 | 085 |
|---|---|---|---|---|---|
| Max. axial force $F_{a+}$ | Reduction of LLD* by 20% | lbf (N) | 22.48 (100) | 22.48 (100) | 112.40 (500) |
| | Reduction of LLD* by 50% | | 67.44 (300) | 112.40 (500) | 269.76 (1,200) |
| Max. axial force $F_{a-}$ | Reduction of LLD* by 20% | lbf (N) | 427.12 (1,900) | 348.44 (1,550) | 606.96 (2,700) |
| | Reduction of LLD* by 50% | | 517.04 (2,300) | 494.56 (2,200) | 899.20 (4,000) |

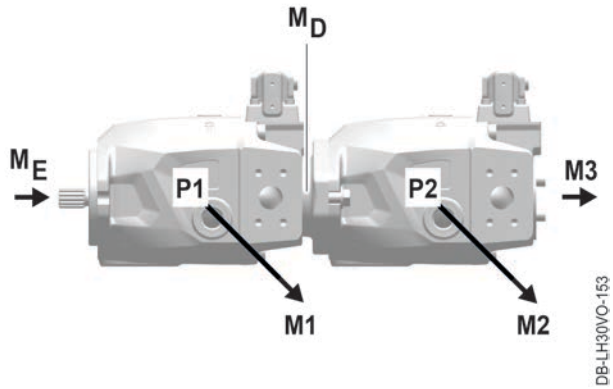
LLD*) Bearing service life

## 2.3 Maximum input and through-drive torques

**Note**
Theoretical, rounded values which do not take into account the efficiency, tolerances, contamination of the hydraulic fluid, and deflection of the driving shaft.

**Generally applicable information for calculation**

- $Vg_{max}$
- Operating pressure pHD: 4,061 psi (280 bar)



| | |
|---|---|
| M1 | Torque, axial piston pump 1 |
| M2 | Torque, axial piston pump 2 |
| M3 | Torque, axial piston pump 3 |
| P1 | Axial piston pump 1 |

| | |
|---|---|
| P2 | Axial piston pump 2 |
| $M_E$ [1] | Input torque |
| $M_D$ [2] | Through-drive torque |
| - | - |

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

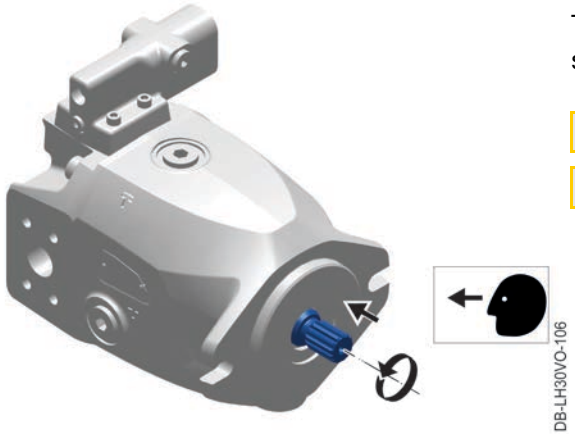
2) $M_D = M2+M3$
$M_D < M_{D\ max}$

| Nominal size | | | | | 028 | 045 | 085 |
|---|---|---|---|---|---|---|---|
| Torque* at $V_{g\ max}$ and Δp = 4,061 psi (280 bar) | | | $M_{max}$ | lbf ft (Nm) | 94 (128) | 153 (207) | 283 (384) |
| Max. torque from driving shaft input (installed without shear force) | A1 | 7/8", 13 teeth, with undercut | $M_{E\ max}$ | lbf ft (Nm) | 173 (235) | 173 (235) | - |
| | A2 | 7/8", 13 teeth, without undercut | $M_{E\ max}$ | lbf ft (Nm) | 207 (280) | 207 (280) | - |
| | A3 | 1", 15 teeth, with undercut | $M_{E\ max}$ | lbf ft (Nm) | 273 (370) | 273 (370) | - |
| | A4 | 1", 15 teeth, without undercut | $M_{E\ max}$ | lbf ft (Nm) | 330 (447) | 330 (447) | - |
| | A5 | 1 1/4", 14 teeth, with undercut | $M_{E\ max}$ | lbf ft (Nm) | - | - | 498 (675) |
| | A6 | 1 1/4", 14 teeth, without undercut | $M_{E\ max}$ | lbf ft (Nm) | - | - | 579 (785) |
| | A9 | 1 1/2", 17 teeth, with undercut | $M_{E\ max}$ | lbf ft (Nm) | - | - | 944 (1280) |
| | A0 | 1 1/2", 17 teeth, without undercut | $M_{E\ max}$ | lbf ft (Nm) | - | - | 1090 (1478) |
| Max. torque of through drive | | | $M_{D\ max}$ | Nm | 117 (158) | 221 (300) | 392 (532) |

□ = Available on request
- = Not possible

## 2.4 Direction of rotation

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | | / | | 20 | V | | | | | 0 | 00 | | 000 | | | |



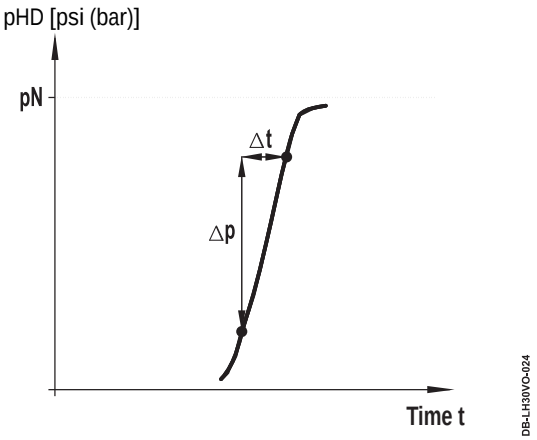

The direction of rotation is stated looking at the driving shaft as shown in the figure.

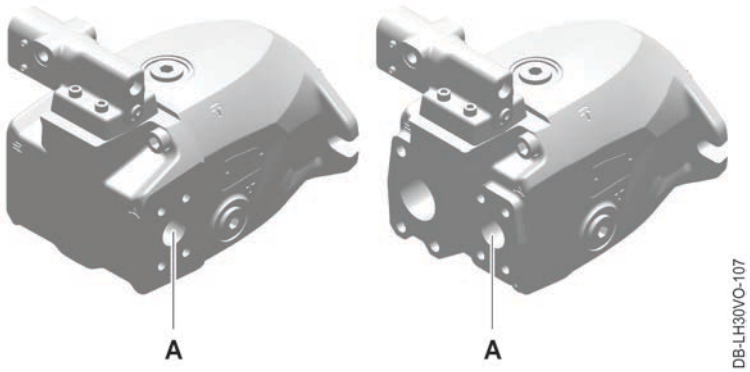
**R** right = clockwise

**L** left = counterclockwise

## 2.5 Permissible pressure range

### 2.5.1 Operating pressure



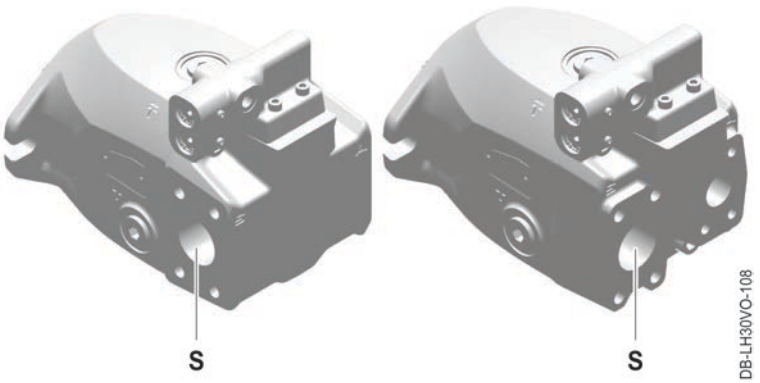

| Operating pressure at connection A | | | | | |
|---|---|---|---|---|---|
| **Nominal size** | | | **028** | **045** | **085** |
| Minimum pressure[1] | $pHD_{min}$ | psi (bar) | 232 (16) | | |
| Nominal pressure (fatigue-resistant) | $pHD_{N}$ | psi (bar) | 4,061 (280) | | |
| Maximum pressure (individual active duration) | $pHD_{max}$ | psi (bar) | 4,641 (320) | | |
| Individual active duration maximum pressure $pHD_{max}$ | t | s | < 1 | | |
| Total active duration of maximum pressure $pHD_{max}$ | t | Op.h* | 300** | | |
| Pressure change speed | RA | psi/s (bar/s) | 246,564 (17,000) | | |

*) Op.h = Operating hours

[1]) In the working circuit there must be a minimum pressure at connection A to ensure sufficient lubrication in the engine during operation at all swivel angles.

**) if not otherwise indicated

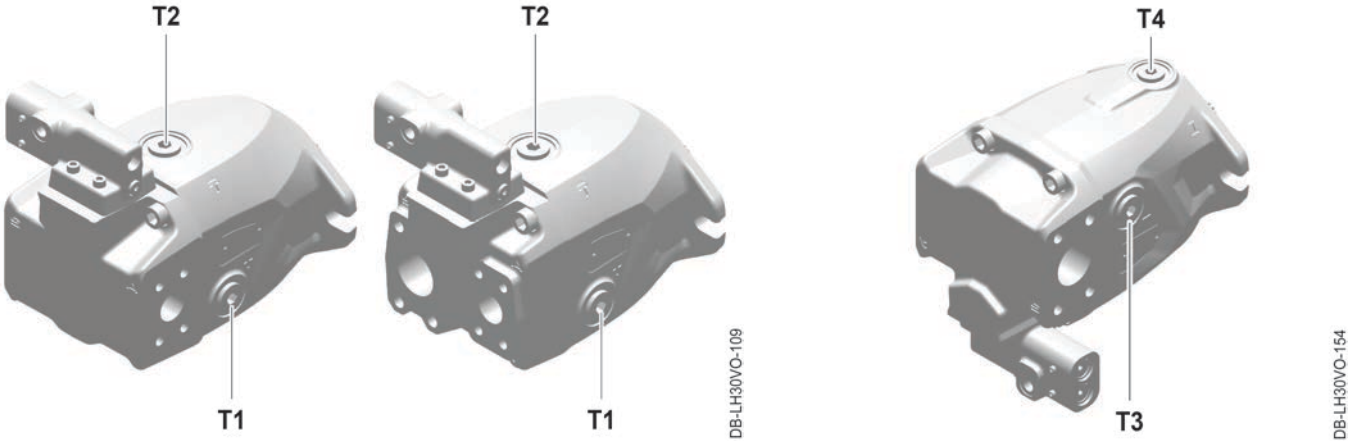
**DANGER**
**Failure of the fastening bolts at working connection A!**
Risk of fatal injury.
Use fastening bolts of strength class 10.9.



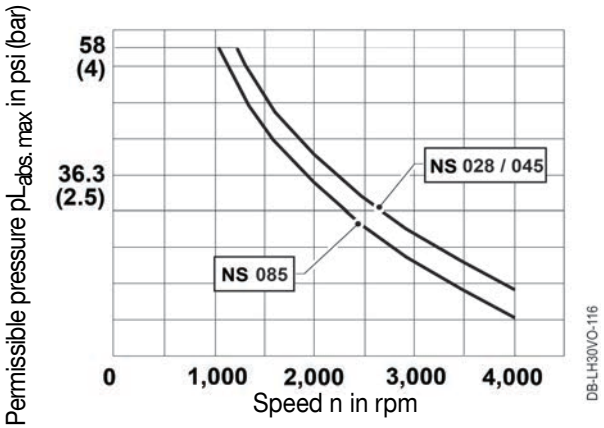

| Suction pressure at connection S | | | |
|---|---|---|---|
| **Nominal size** | | | **028 to 085** |
| Minimum pressure, absolute | $pS_{min}$ | psi (bar) | 11.60* (0.8) |
| Maximum pressure, absolute | $pS_{max}$ | psi (bar) | 29* (2) |

*) deviating values on request

### 2.5.2 Housing pressure, leakage oil pressure




*) Leakage oil connection T4 can be ordered as a special design. For further information, see: Type code




| Leakage oil pressure at connection T1 / T2 | | | |
|---|---|---|---|
| **Nominal size** | | | **028 to 085** |
| Maximum pressure, absolute | $pL_{max}$ | psi (bar) | 29* (2) |

*) The housing or leakage oil pressure pL must not exceed the suction pressure at connection S + 7.25 psi (0.5 bar) in any operating state.

$pL \leq pS_{max} + 7.25$ psi (0.5 bar)

**Note**
The pressure in the axial piston unit must always be higher than the outside pressure on the shaft sealing ring.

## 2.6 Shaft sealing ring

### 2.6.1 General information

Rotary shaft lip seals are special sealing elements that allow a specific housing pressure. To ensure that the tribological system works optimally, the operating conditions must be met.

The sealing edge temperature varies due to the following factors in the housing:
- Circumferential speed
- Hydraulic fluid temperature
- Lubricant
- Pressure build-up

The sealing edge temperature can be 68 °F to 104 °F (20 °C to 40 °C) above the leakage oil temperature of a hydraulic axial piston unit.

### 2.6.2 Temperature range

The FKM rotary shaft lip seal is approved for leakage oil temperatures from -13 °F to +239 °F (-25 °C to +115 °C). For specific applications below -13 °F (-25 °C): Please contact us.

## 2.7 Hydraulic fluids

### 2.7.1 General information

The selection of the suitable hydraulic fluid is determined by the expected operating temperature as a function of the ambient temperature, which is equivalent to the tank temperature.

**CAUTION**
Mixing different mineral oil hydraulic fluids is prohibited!

**Minimum required quality**

| Specification |
|---|
| LH-00-HYC3A |
| LH-00-HYE3A |

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

### 2.7.2 Fill quantity

| Nominal size | | 028 | 045 | 085 |
|---|---|---|---|---|
| Fill quantity | US.liq.gal (liters) | 0.15 (0.55) | 0.16 (0.6) | 0.42 (1.6) |

**Note**
Before commissioning, the hydraulic unit must be filled with oil and vented.
This must be checked during operation and after long periods of standstill and must be repeated if necessary!

### 2.7.3 Filtering

- To maintain the required cleanliness class "21/17/14 according to ISO 4406" under all circumstances, it is necessary to filter the hydraulic fluid.
- Filtering of the hydraulic fluid is achieved by the device-specific use of oil filters in the hydraulic system.
- The cleaning and maintenance intervals of the oil filters, and of the entire oil circuit, depend on use of the device; please see the device-specific operating instructions.

### 2.7.4 Limits of use

**CAUTION**
Temperatures ≤ -40 °F (-40 °C) in the system = The axial piston unit must not be operated.
Preheat the axial piston unit to at least -40 °F (-40 °C).

| Phase | Temperature [ °F (°C) ]** | Viscosity [ inch²/s (mm²/s) ]* |
|---|---|---|
| Cold-start phase | -40 to -13 °F (-40 to -25 °C) | 2.48-1.55 (1,600-1,000) |
| Warm-up phase | Warmer than -13 °F (-25 °C) | 1.55-0.775 (1,000-500) |
| Normal operation | | < 0.775 (500) |

*) depending on the hydraulic fluid used
**) relative to the tank temperature

**Note**
Optimal range of use: 0.025-0.056 inch²/s (16-36 mm²/s)
At the maximum leakage oil temperature, the viscosity must not drop below 0.012 inch²/s (8 mm²/s) (short-term, i.e., < 3 min., 0.011 inch²/s (7 mm²/s)).

- Cold-start phase:

**CAUTION**
During the cold-start phase, the following operating conditions must be met:

- Operating pressure: $pHD_{min} < pHD_{coldstart} < 435$ psi (30 bar)
- Speed $n_{coldstart} \leq 1{,}000$ rpm

Start the drive motor and operate the axial piston unit at the stated operating conditions until a temperature of at least -13 °F (-25 °C) is reached.

- Warm-up phase:

**CAUTION**
During the warm-up phase, the following operating conditions must be met:

- Operating pressure range: $pHD_{min} < pHD_{warmup} < 50\%$ of $pHD_N$
- Speed $n_{warmup} \leq 50\%$ of $n_{max}$

Start the drive motor and operate the axial piston unit with the stated operating conditions until a viscosity of approx. 0.775 $inch^2/s$ (500 $mm^2/s$) is reached.

- Normal operation:

**Note**
No restrictions of the operating data.

# 3 Actuation and control type

Axial piston pump
LH30VO 028 to 085

## 3.1 Control types

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | | / | | 20 | V | | | | | 0 | 00 | | 000 | | | |

**Note**
For each control type or function, only one nominal size is illustrated, typically based on the nominal size 045. Special applications and custom designs are not described in this section. Always use the information from the supplied installation drawing or contact Liebherr.

**The following applies to all control types:**

**DANGER**
**The spring-loaded reset in the control valve is not a safety device!**
Contamination in the hydraulic system, such as abrasion or residual dirt from equipment or system components, can cause blockages in undefined points of various control components.
Under certain circumstances, it may no longer be possible to implement the machine operator's settings.
The implementation of a safety device, e.g., for an emergency stop, is the responsibility of the device or system manufacturer.

**DANGER**
**The control valve is not an overload safety device!**
The implementation of an overload safety device, e.g., a pressure limiting valve, is the responsibility of the device or system manufacturer.
Pressure limiting valves are included in our portfolio and can be ordered separately; please add your requirements in free text.

The following modular control types can be ordered for the LH30VO model series:

### 3.1.1 Mechanical-hydraulic controls

- DA- control, see section 3.2.1
- DF-DA- control, see section 3.2.2
- LS0DA- control, see section 3.2.3

### 3.1.2 Electro-hydraulic controls

- DE1/3/5/7 control, rising characteristic, see section 3.2.4
- DE2/4/6/8 control, falling characteristic, see section 3.2.5

- LS0DE1/3/5/7 control, rising characteristic, see section 3.2.6
- LS0DE2/4/6/8 control, falling characteristic, see section 3.2.7

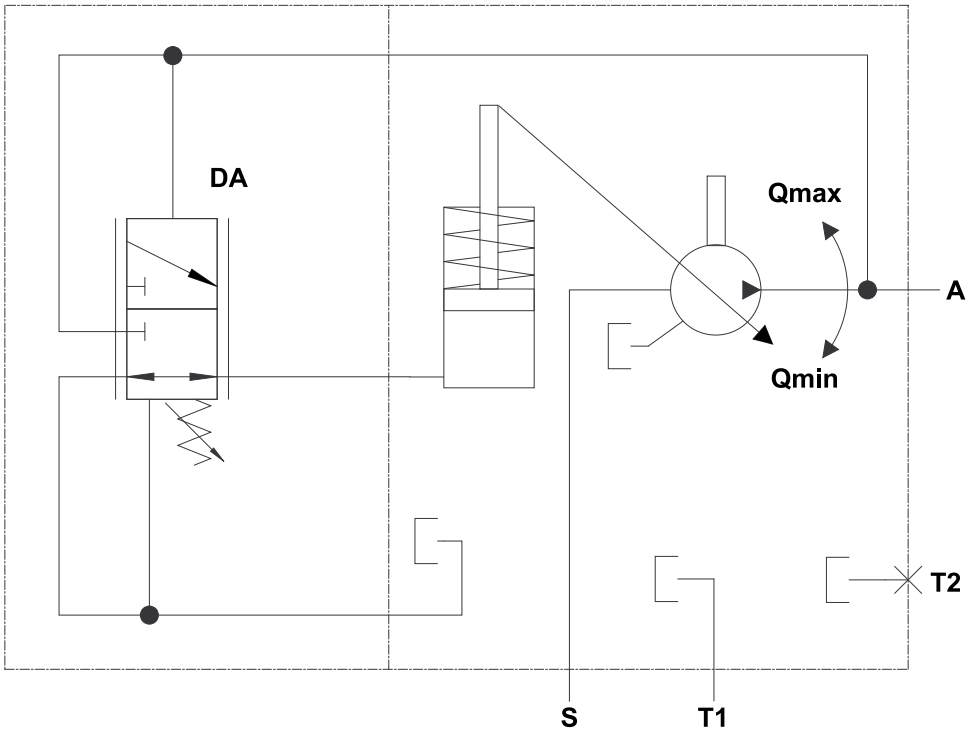
- VE1/3/5/7 control, rising characteristic, see section 3.2.8

- VO1/3/5/7 control, see section 3.2.9

**Other control types on request.**

## 3.2 Standard hydraulic diagrams

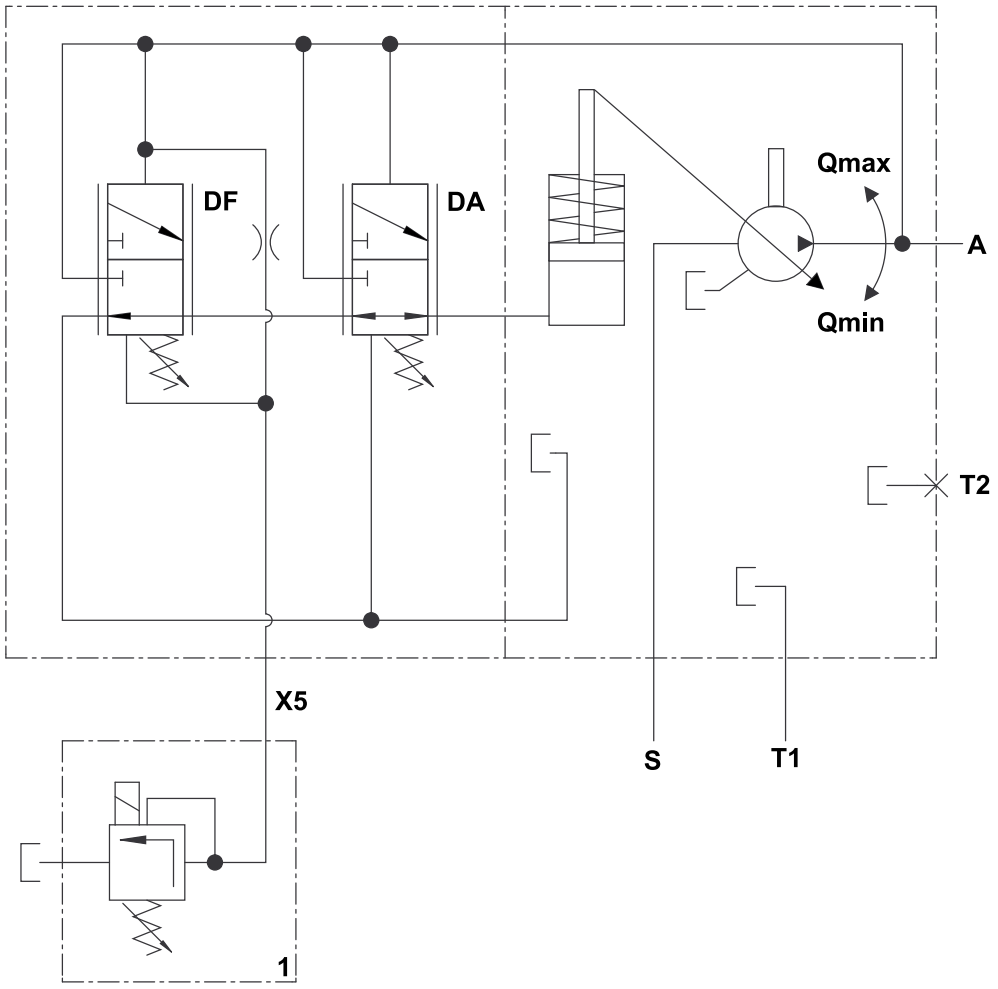
### 3.2.1 DA- - Pressure cut-off




DA- DB-LH30VO-056

| | | | |
|---|---|---|---|
| A | Working connection ISO 6162-1/-2 (SAE J518) | T1, T2 | Leakage oil connections ISO 11926 |
| S | Suction port ISO 6162-1/-2 (SAE J518) | - | - |

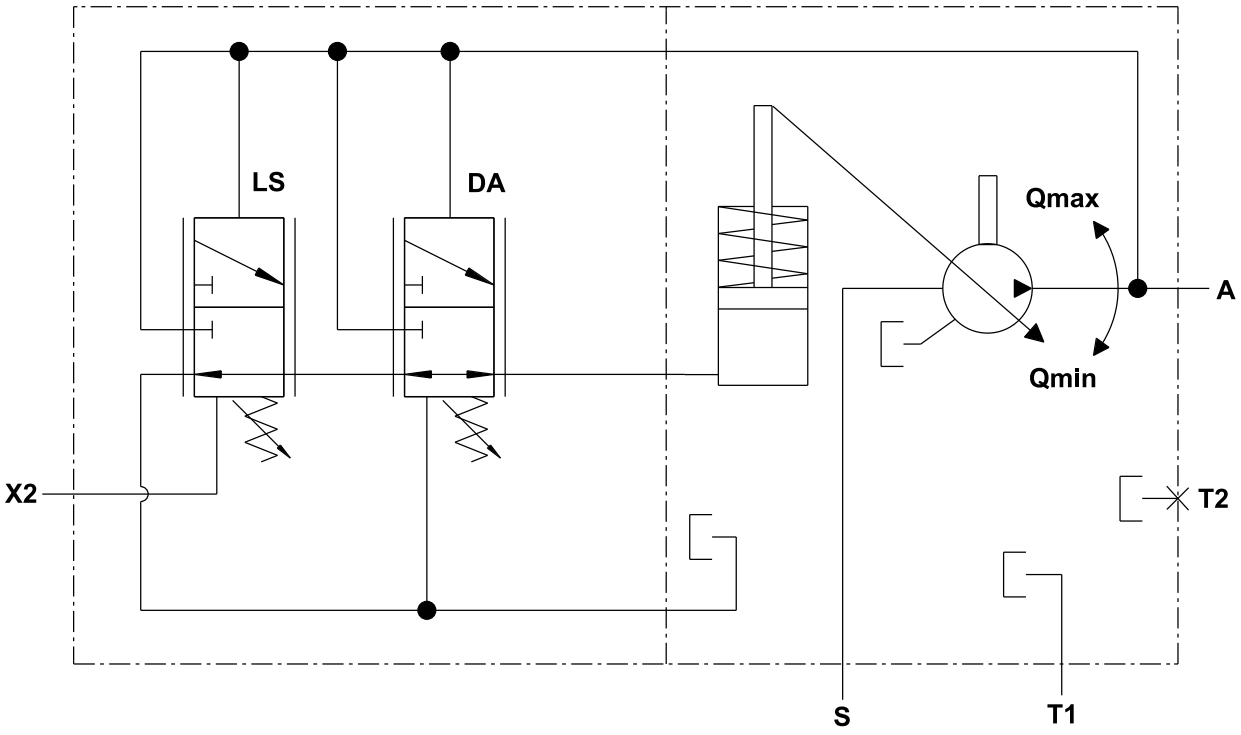
### 3.2.2 DF-DA- - Hydraulic pressure control, remotely controllable with pressure cut-off




**DF-DA-**

| | | | |
|---|---|---|---|
| A | Working connection ISO 6162-1/-2 (SAE J518) | T1, T2 | Leakage oil connections ISO 11926 |
| S | Suction port ISO 6162-1/-2 (SAE J518) | X5 | DF pressure ISO 9974-1-M12x1.5 |
| 1 | Pressure limiting valve<br>not included in scope of delivery | - | - |

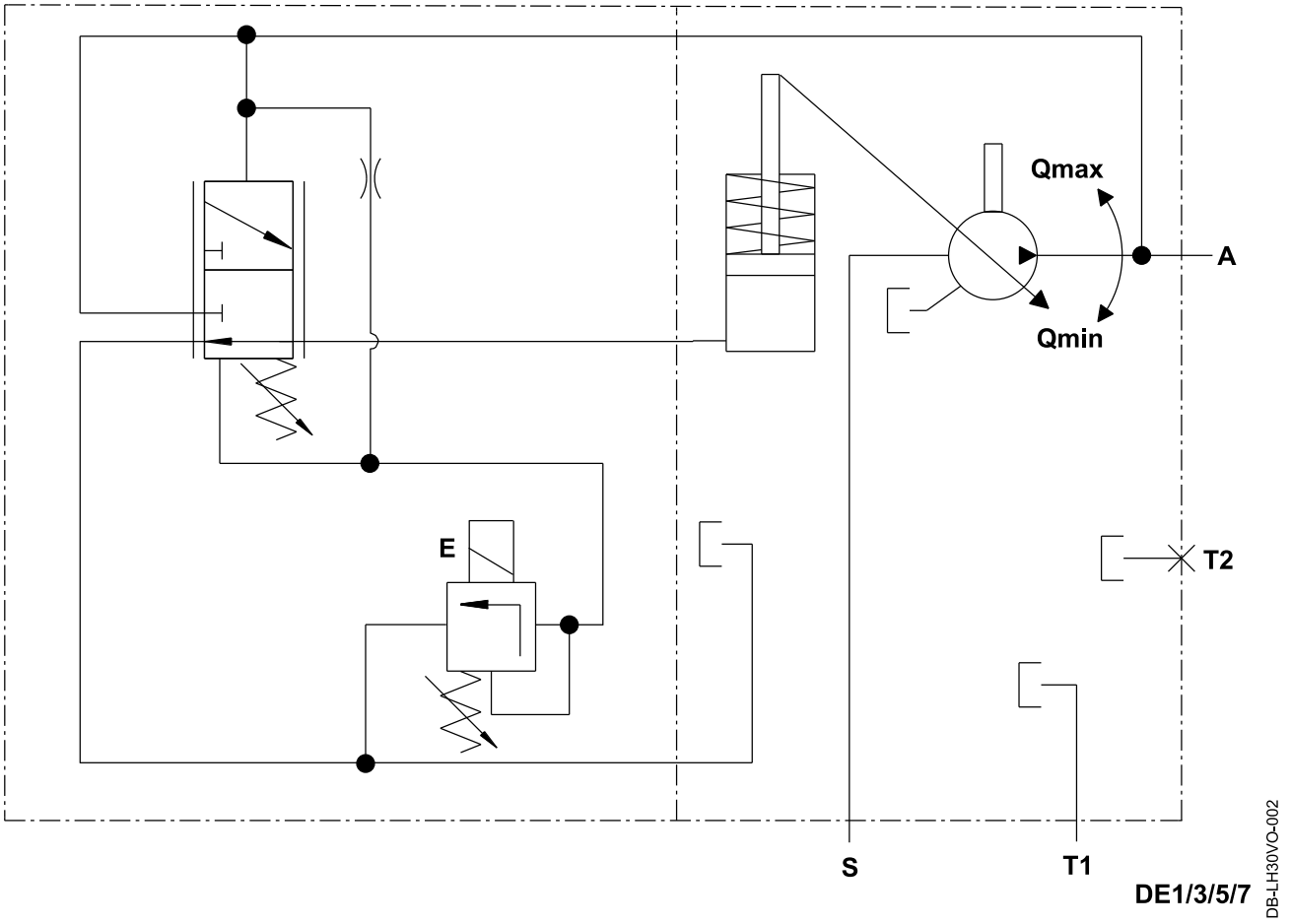
### 3.2.3 LS0DA- - Load sensing + pressure cut-off




| | | | |
|---|---|---|---|
| A | Working connection ISO 6162-1/-2 (SAE J518) | T1, T2 | Leakage oil connections ISO 11926 |
| S | Suction port ISO 6162-1/-2 (SAE J518) | X2 | LS pressure ISO 9974-1 |

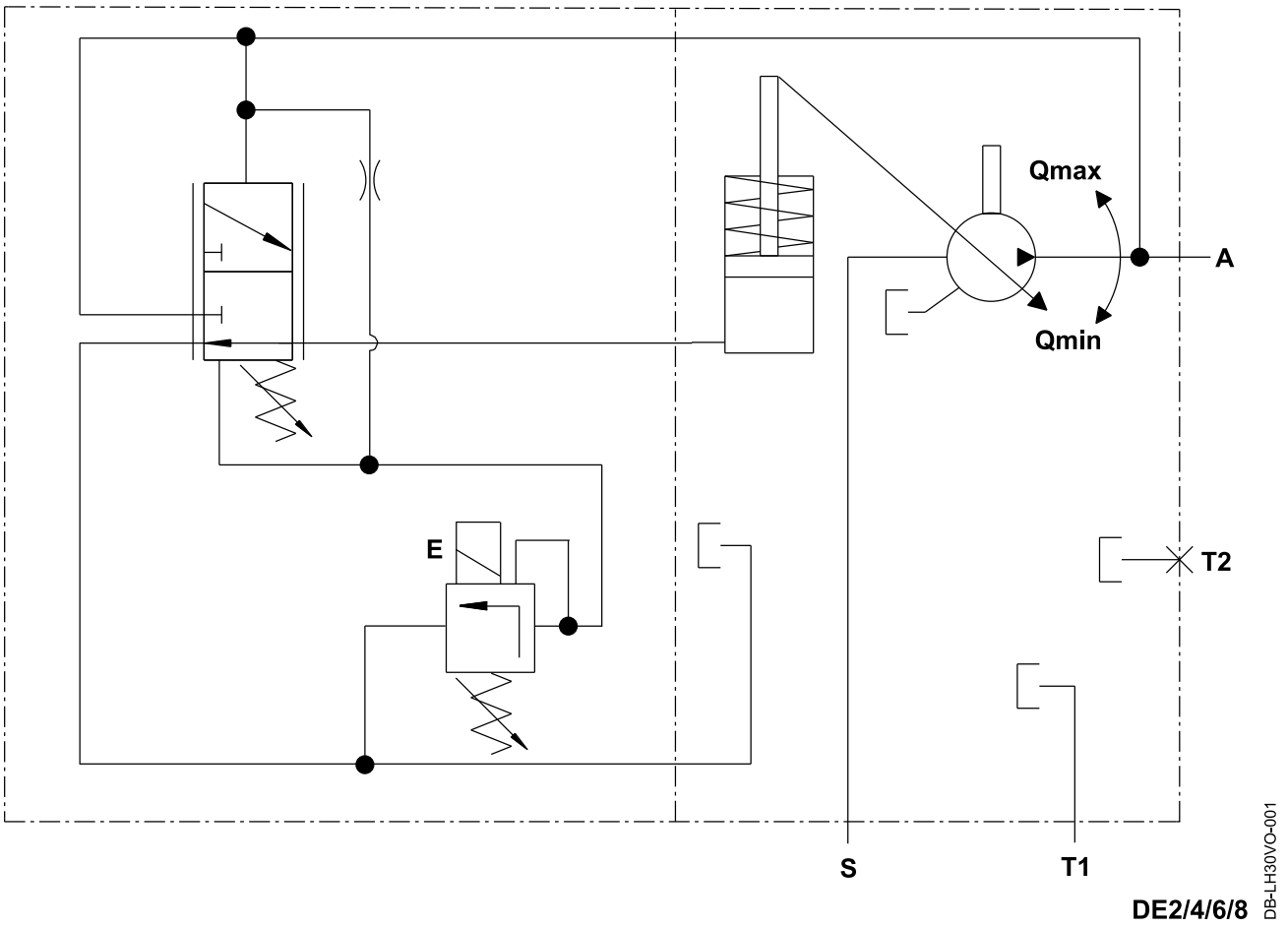
**Note**
The orifice required for the LS function to generate the pressure drop is not included in the axial piston unit's scope of delivery.

### 3.2.4 DE_ - Electrical pressure control, rising characteristic (DE1/3/5/7)



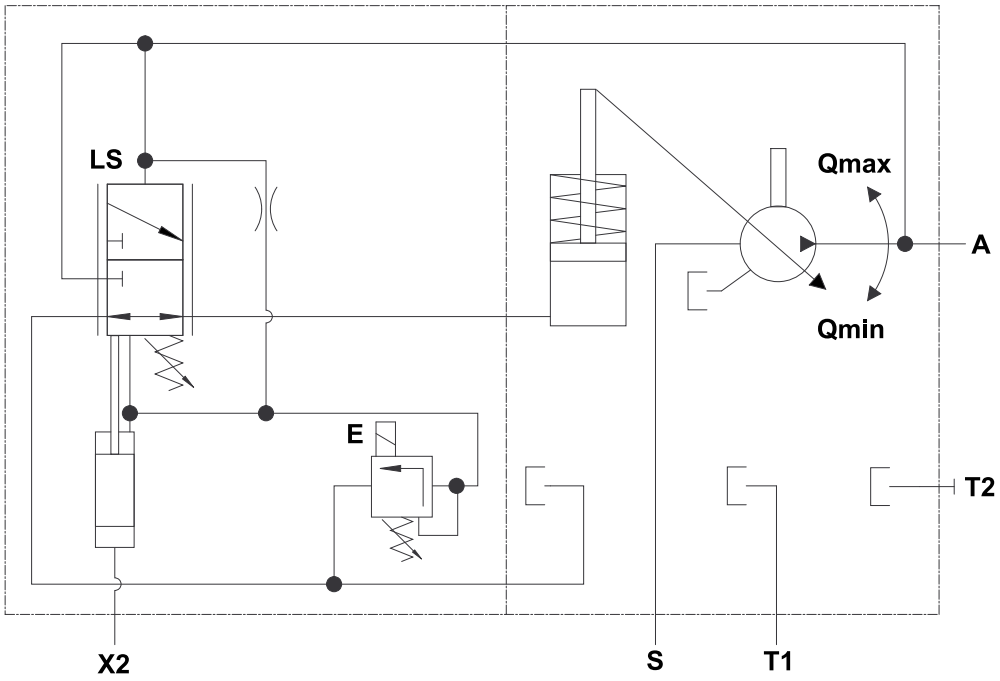

| | | | |
|---|---|---|---|
| A | Working connection ISO 6162-1/-2 (SAE J518) | T1, T2 | Leakage oil connections ISO 11926 |
| S | Suction port ISO 6162-1/-2 (SAE J518) | E | _1 / _3: Deutsch plug DT04-2P 2-pin<br>_5 / _7: AMP plug Junior Timer 2-pin |

### 3.2.5 DE_ - Electrical pressure control, falling characteristic (DE2/4/6/8)




| | | | |
|---|---|---|---|
| A | Working connection ISO 6162-1/-2 (SAE J518) | T1, T2 | Leakage oil connections ISO 11926 |
| S | Suction port ISO 6162-1/-2 (SAE J518) | E | _2 / _4: Deutsch plug DT04-2P 2-pin<br>_6 / _8: AMP plug Junior Timer 2-pin |

### 3.2.6 LS0DE_ - Load sensing + electrical pressure control, rising characteristic (LS0DE1/3/5/7)

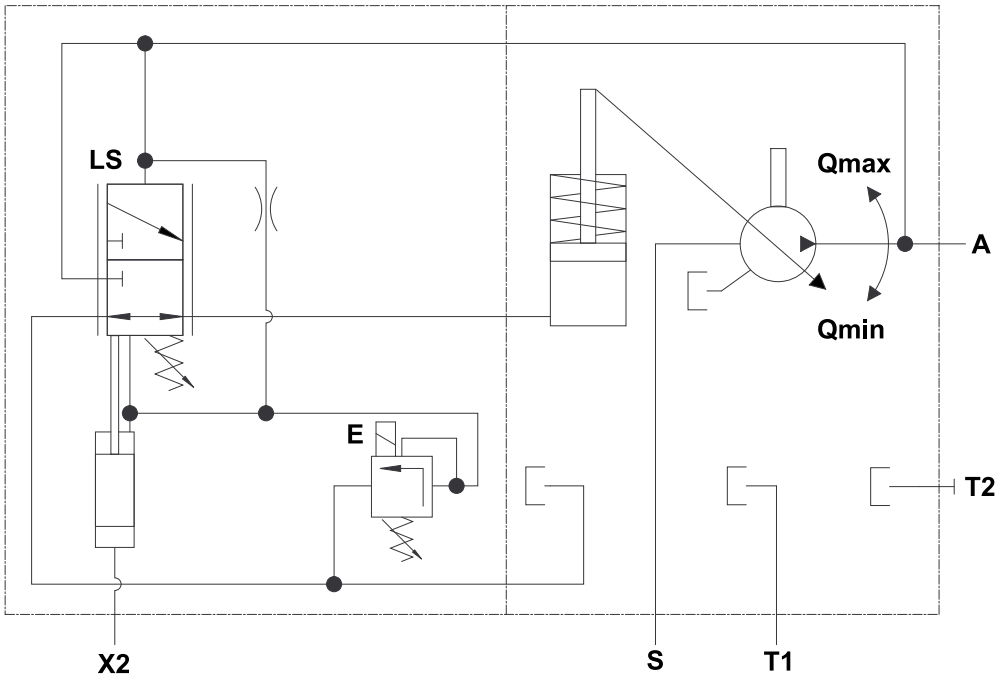



LS0DE1/3/5/7

DB-LH30VO-061

| | | | |
|---|---|---|---|
| A | Working connection ISO 6162-1/-2 (SAE J518) | T1, T2 | Leakage oil connections ISO 11926 |
| S | Suction port ISO 6162-1/-2 (SAE J518) | X2 | LS pressure ISO 9974-1 |
| E | 1 / _3: Deutsch plug DT04-2P 2-pin<br>_5 / _7: AMP plug Junior Timer 2-pin | - | - |

### 3.2.7 LS0DE_ - Load sensing + electrical pressure control, falling characteristic (LS0DE2/4/6/8)

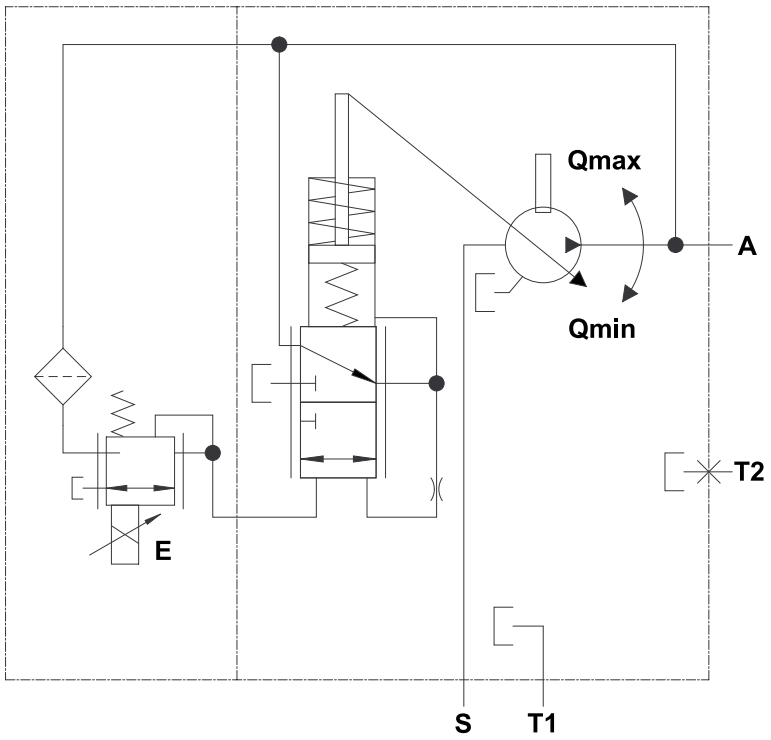



LS0DE2/4/6/8

DB-LH30VO-060

| | | | |
|---|---|---|---|
| A | Working connection ISO 6162-1/-2 (SAE J518) | T1, T2 | Leakage oil connections ISO 11926 |
| S | Suction port ISO 6162-1/-2 (SAE J518) | X2 | LS pressure ISO 9974-1 |
| E | _2 / _4: Deutsch plug DT04-2P 2-pin<br>_6 / _8: AMP plug Junior Timer 2-pin | - | - |

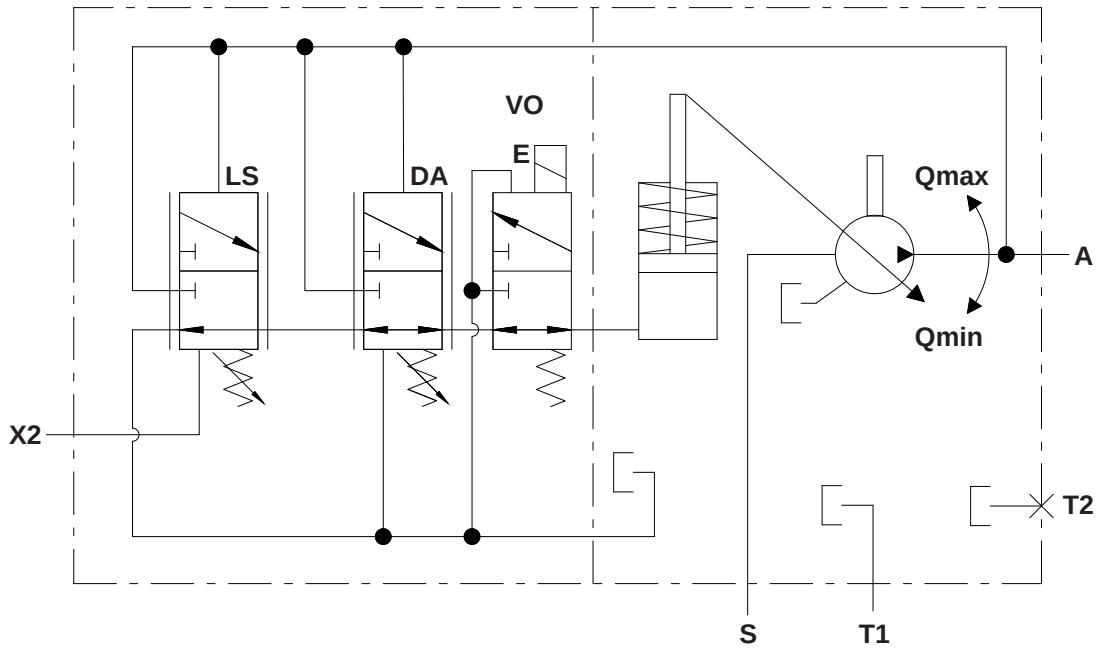
### 3.2.8 VE_ - Electrical volume control, rising characteristic (VE1/3/5/7)




VE1/3/5/7 DB-LH30VO-058

| | | | |
|---|---|---|---|
| A | Working connection ISO 6162-1/-2 (SAE J518) | T1, T2 | Leakage oil connections ISO 11926 |
| S | Suction port ISO 6162-1/-2 (SAE J518) | E | _1 / _3: Deutsch plug DT04-2P 2-pin<br>_5 / _7: AMP plug Junior Timer 2-pin |

### 3.2.9 VO_ - Retarder (VO1/3/5/7)




VO1/3/5/7

DB-LH30VO-141

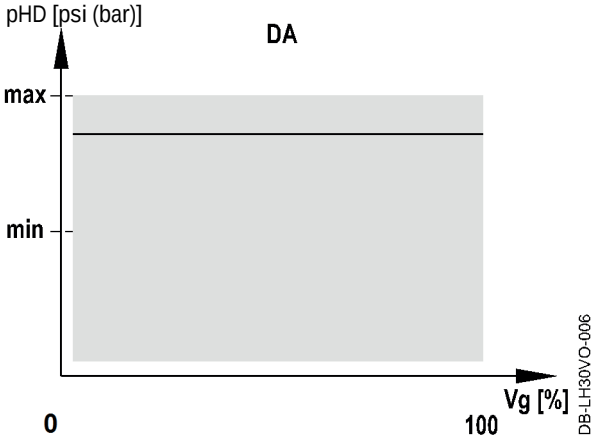
| | | | |
|---|---|---|---|
| A | Working connection ISO 6162-1/-2 (SAE J518) | X2 | LS pressure ISO 9974-1 |
| S | Suction port ISO 6162-1/-2 (SAE J518) | T1, T2 | Leakage oil connections ISO 11926 |
| E | _1 / _3: Deutsch plug DT04-2P 2-pin<br>_5 / _7: AMP plug Junior Timer 2-pin | - | - |

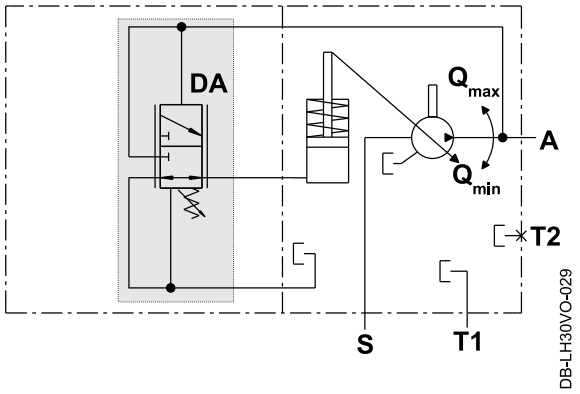
## 3.3 Control functions

- DA- function / pressure cut-off, see section 3.3.1
- DF- function / hydraulic pressure control, remotely controllable, see section 3.3.2
- LS0- function / load sensing without vent nozzle in the control, see section 3.3.3
- LR- function, power control, see section 3.3.4
- DE1/3/5/7- function / pressure control, rising characteristic, see section 3.3.5
- DE2/4/6/8- function / pressure control, falling characteristic, see section 3.3.6
- VE1/3/5/7- function, rising characteristic, see section 3.3.7
- VK1/3/5/7- function, rising characteristic, see section 3.3.8
- VO1/3/5/7- function, retarder, see section 3.3.9

### 3.3.1 DA- function

**Characteristic curve**




**Additional technical data**

| | |
|---|---|
| DA adjustment range | 2,176-4,061 psi* (150-280 bar) |

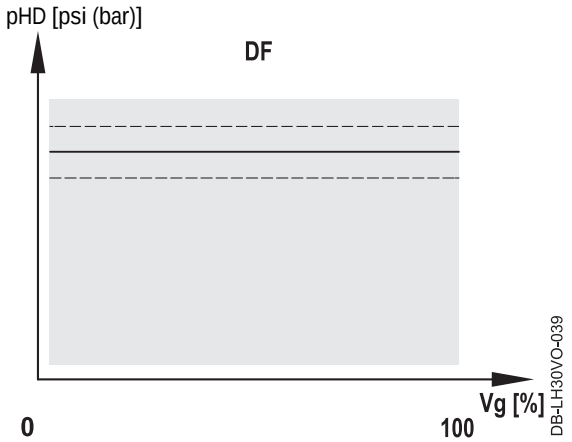
*) depending on requirement

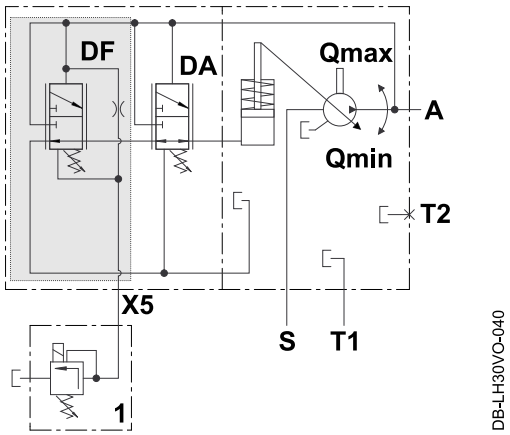
The DA pressure control limits the maximum high pressure of the axial piston unit in the control range. When a fixed, preset high pressure value pHD is reached, the axial piston unit swings in the direction of $V_{g\ min}$ and protects the hydraulic system against damage and overload. It swings in the direction of $V_{g\ min}$ until the volume flow that is generated matches the fixed, preset high pressure value pHD.

Once the system pressure drops below the fixed, preset high pressure value pHD, the axial piston unit swings up to $V_{g\ max}$.

### 3.3.2 DF- function

**Characteristic curve**




**Additional technical data**

| | |
|---|---|
| Adjustment range Δp | 203-363 psi* (14-25 bar) |

*) depending on requirement

The DF function can only be ordered in combination with the DA function for safety reasons.

The remote control can limit the system pressure via an external pressure limiting valve* (No. 1). The DF- pressure control provides a fixed, preset pressure differential Δp.

Any system pressure below the fixed DA- cut-off pressure can be set as the sum of the set pressure value of the external pressure limiting valve and the Δp of the DF- pressure control. For further information: see section 3.3.1.

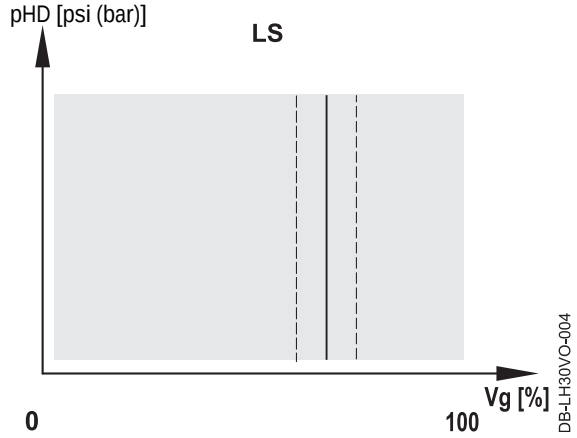
If the X5 connection to the tank is vented, the pump operates in standby mode. This is useful for ramping up the axial piston unit from idle state.

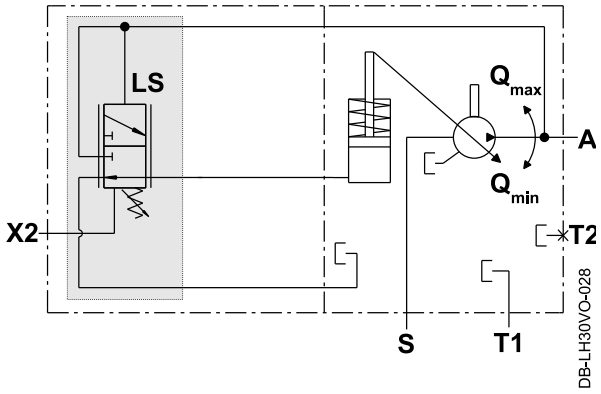
*) not included in the scope of delivery

**Note**
The DF function can only be ordered in combination with the pressure cut-off (DA-).

### 3.3.3 LS0- function

**Characteristic curve**




**Additional technical data**

| | | |
|---|---|---|
| LS pressure adjustment range | Δp | 203-363 psi* (14-25 bar) |

*) depending on requirement

Load sensing systems, such as in an LS0DA control, can be used to further improve the dynamic properties of the control system for variable displacement axial piston pumps. By adjusting the volume flow to the current requirements of one or more consumers, the LS0 function is designed as a load pressure sensing system. It reduces performance losses compared to control functions that deliver at maximum flow rate despite volume flow requirements being lower.

At an external adjustable orifice plate, the pressure difference Δp between the highest LS pressure occurring in the system (controlled by shuttle valves in case of several consumers) and the high pressure pHD is compared and kept in equilibrium by the pressure compensator (LS axis) by adapting to the demand from the consumers. The LS pressure depends on spring force and is therefore adjustable.

If there is no demand from the consumers, the axial piston unit controls in the direction of $V_{g\ min}$ until the value corresponds to the set LS pressure.

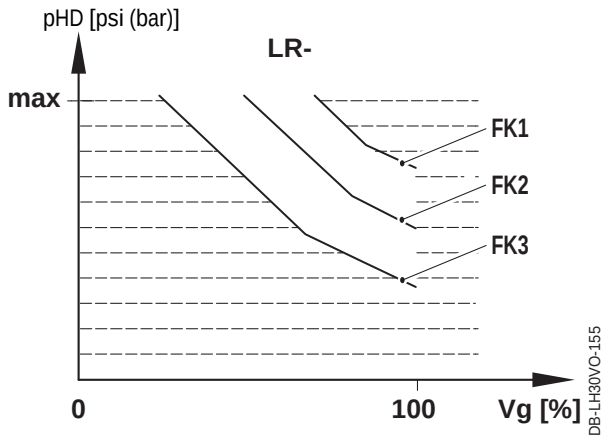
As the consumer demand increases (increasing Δp at the orifice), the axial piston unit controls in the direction of $V_{g\ max}$ until the working pressure pHD corresponds to the sum of the consumer demand-dependent LS pressure + Δp.

**Note**
The LS function can only be ordered in combination with the pressure cut-off (DA-) or the electrical pressure control DE_.

### 3.3.4 LR- function

The swivel angle is controlled as a function of the load-dependent operating pressure pHD such that the maximum torque permitted by the drive motor is not exceeded at constant speed.

#### Characteristic curve




The LR function prevents the maximum available mechanical drive power being exceeded by the axial piston unit.

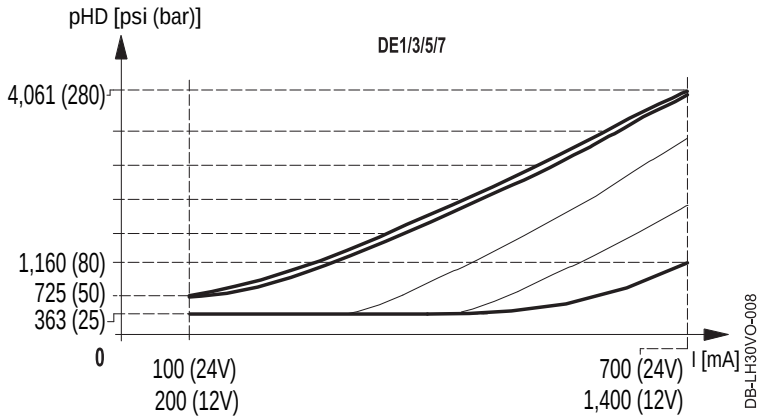
Below the spring characteristic (FK1 to FK3) the cradle spring pushes the axial piston unit to the largest swivel angle, $V_{g\ max}$. As the operating pressure pHD increases, the axial piston unit swings back in the direction of $V_{g\ min}$ when the start of control value is reached.

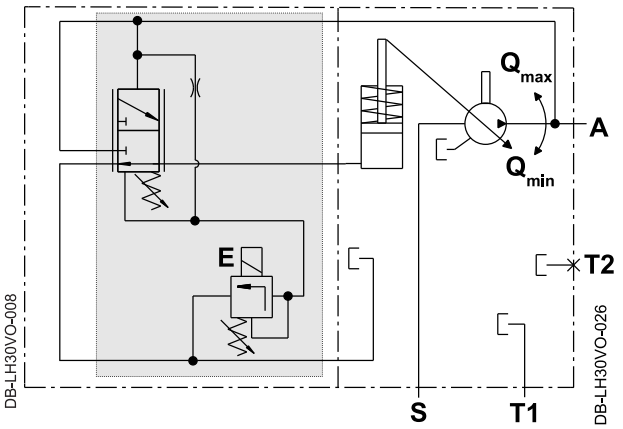
**Note**
Liebherr recommends combining the LR- function with a pressure control.

FK1, FK2 and FK3 are currently available spring characteristics which are specially designed for different applications and are preset during assembly. In order to select the right spring characteristic, the desired start of control in pHD [psi (bar)] at the maximum swivel angle must be specified in the order in free text.

### 3.3.5 DE- function, rising characteristic (DE1/3/5/7)

**Characteristic curve**




**Additional technical data**

| | | |
|---|---|---|
| Resulting start of control | max | 725 psi (50 bar) |
| | min | 363 psi (25 bar) |
| Adjustment range, end of control | max | 4,061 psi (280 bar) |
| | min | 1,160 psi (80 bar) |
| Standby pressure pStbyD* at Δp = 290 psi (20 bar) | | 363-725 psi (25-50 bar) |

**Note**
Technical data of proportional magnet, see section 3.4.

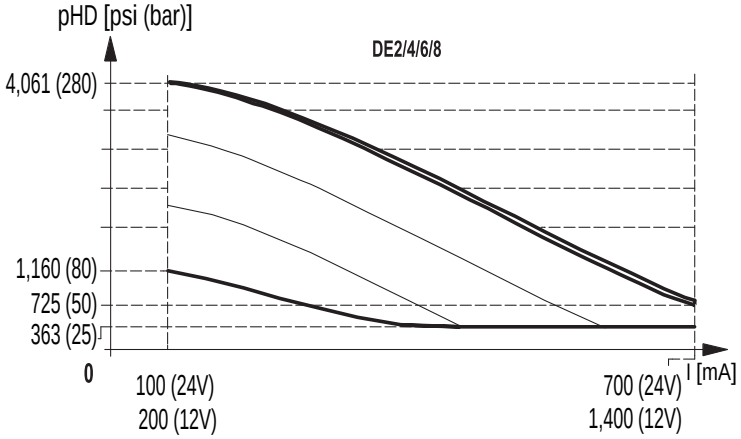
The DE- function is an electronic pressure control the pressure level of which can be continuously adjusted by a defined, variable magnetic field at the proportional magnet.

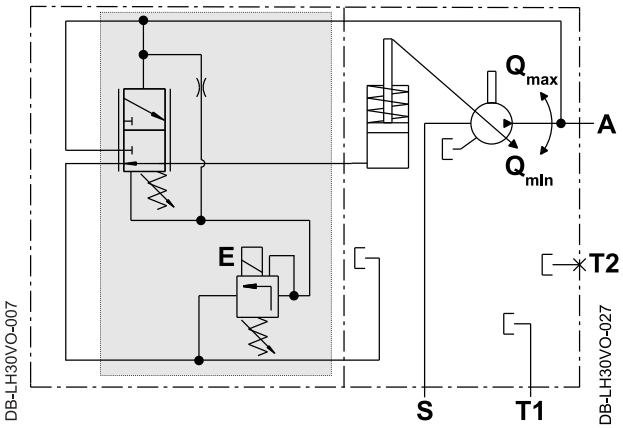
The pump is kept at $V_{g\ max}$ by a spring. The high pressure is routed to a proportional pressure limiting valve by a pressure compensator. When the opening pressure is reached, the pump's pressure control valve switches and the high pressure swings the pump in direction $V_{g\ min}$, until the pressure level in the system is again below the proportional pressure limiting valve's set value.

If the magnetic field at the proportional magnet is reduced, the axial piston unit swings in the direction of $V_{g\ min}$; if the magnetic field stops completely, the unit self-regulates to standby pressure (pStby).

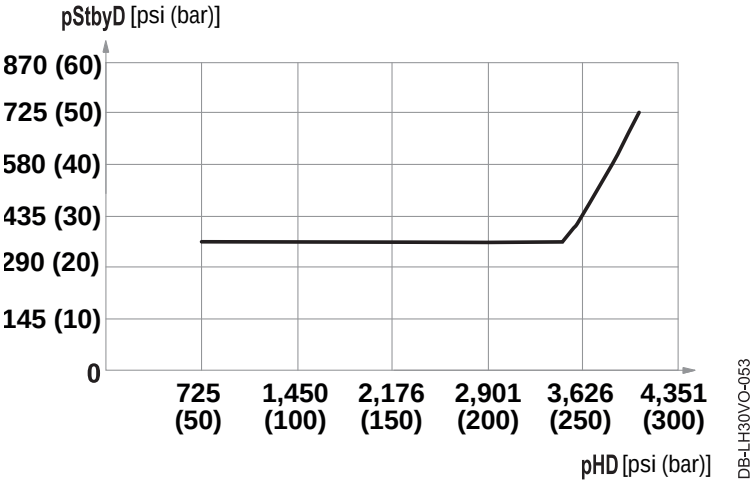
### 3.3.6 DE- function, falling characteristic (DE2/4/6/8)

**Characteristic curve**




**Dependence of standby pressure on high pressure (at $I_{max}$)**




**Additional technical data**

| | | |
|---|---|---|
| Adjustment range, start of control | max | 4,061 psi (280 bar) |
| | min | 1,160 psi (80 bar) |
| Resulting end of control | max | 725 psi (50 bar) |
| | min | 363 psi (25 bar) |
| Standby pressure pStbyD* at Δp = 290 psi (20 bar) | | 363-725 psi (25-50 bar) |

*) see diagram

**Note**
Technical data of proportional magnet, see section 3.4.

The DE- function is an electronic pressure control the pressure level of which can be continuously adjusted by a defined, variable magnetic field at the proportional magnet.

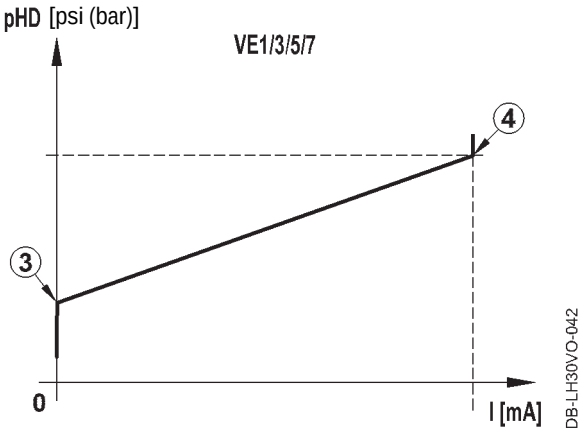
The pump is kept at $V_{g\ max}$ by a spring. The high pressure is routed to a proportional pressure limiting valve by a pressure compensator (on a pressure control valve). When the opening pressure is reached, the pump's pressure control valve switches and the high pressure swings the pump in direction $V_{g\ min}$, until the pressure level in the system is again below the proportional pressure limiting valve's set value.

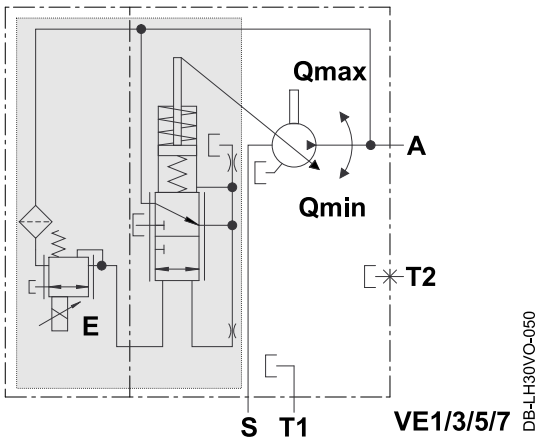
In the function, for example, for fan drives, the axial piston unit swings to $V_{g\ max}$ if there is no or only a faulty magnetic field at the proportional magnet.

If the magnetic field at the proportional magnet is increased to $I_{max}$, the axial piston unit swings in the direction of $V_{g\ min}$ and self-regulates to standby pressure (pStby).

### 3.3.7 VE- function, rising characteristic

**Characteristic curve**




**Additional technical data**

**Note**
Technical data of pressure reduction valve, see section 3.4.3.

For the VE function, the axial piston unit's displacement volume $V_g$ is continuously adjusted via a proportional magnet. As standard, the VE function is designed with a positive characteristic curve. (**VE1/3/5/7**)

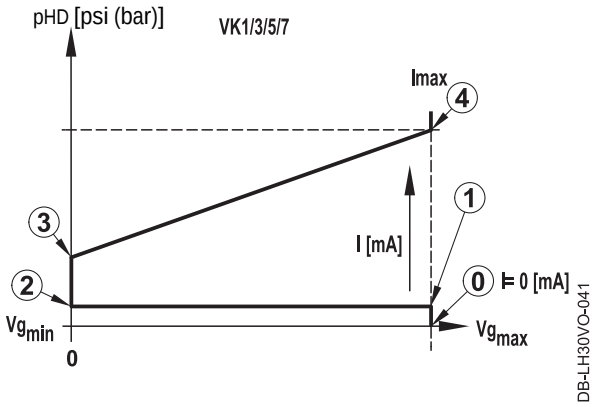
In depressurized state, the cradle spring pushes the axial piston unit to the largest swivel angle $V_{g\ max}$.
This ensures pressure build-up. This is why the LH30VO does not need external auxiliary pressure.

At a pressure > 145 psi (10 bar) and a control current I < 230 mA (start of control 1), the axial piston unit swings to $V_{g\ min}$ and can then be swung to an arbitrary angle with a rising control current I (> 230 mA, start of control 1).
$V_{g\ max}$ is reached at control current I = 440 mA (end of control 2).

The VE function can be used with a superordinate DA function; in other words, the control current-dependent VE function is only executed below the value set for pressure cut-off up to end of control 2.

### 3.3.8 VK- function, rising characteristic

**Characteristic curve**




**Additional technical data**

**Note**
Technical data of pressure reduction valve, see section 3.4.3.

Based on the VE function (Nos. 2-4) with a positive characteristic curve (VE1/3/5/7), the VK function additionally features a jump function that allows the axial piston unit to swing to $V_{g\ max}$ in the event of a missing or faulty actuation signal, for example, in the event of a cable break.

The proportional magnet must always be provided with a control current I > 160 mA (No. 2) to maintain the control function.

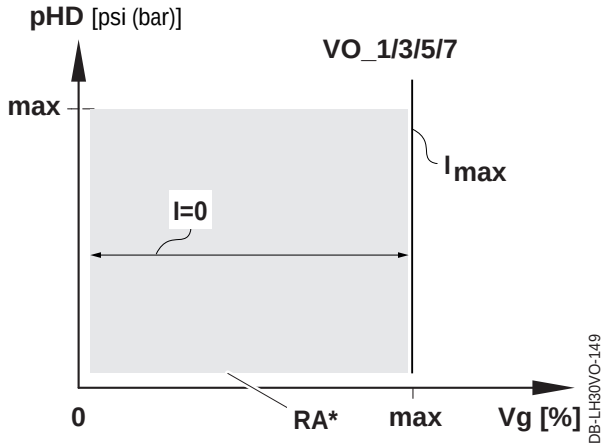
If the control current I drops below 160 mA due to an external influence (no or faulty actuation signal), the axial piston unit swings to $V_{g\ max}$.

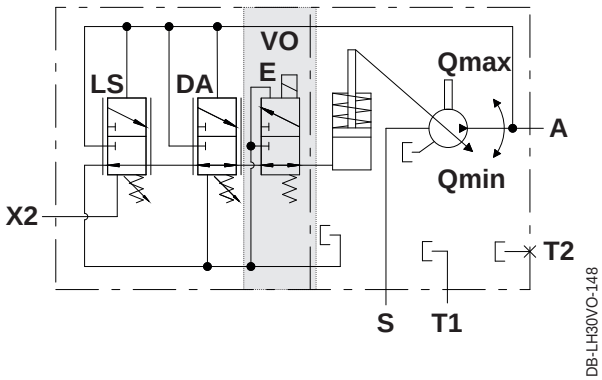
On restarting the machine, or after activating the jump function (dropping below control current I < 160 mA), the proportional magnet must be supplied with a control current $I_{max}$ = 440 mA (No. 4) once only in order to be able to swing the axial piston unit to an arbitrary angle again.

### 3.3.9 VO- function

The functions of further control axes, for example, LS0DA- are overridden by the VO_ function.

**Characteristic curve**




RA*) further control axes

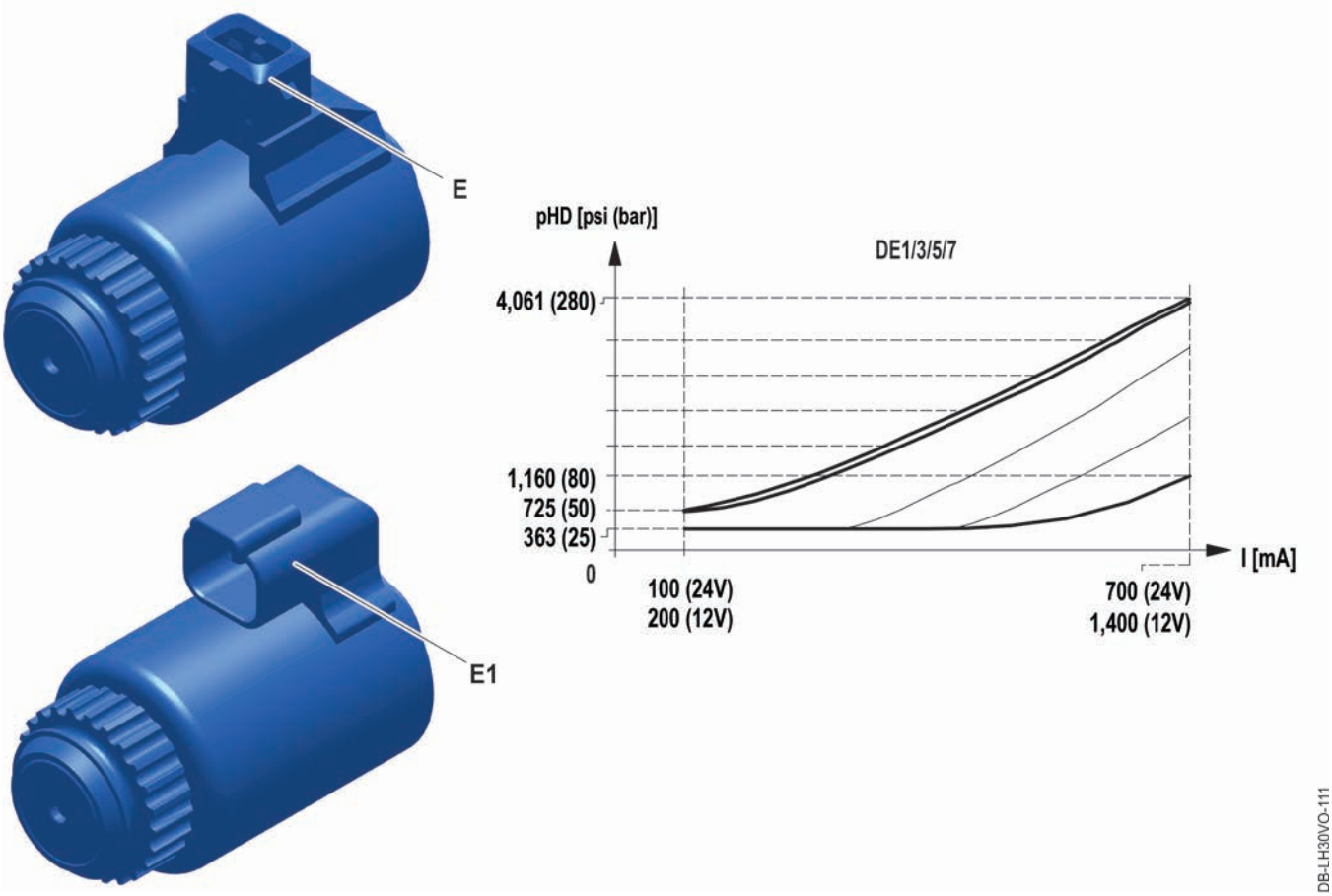
The electrically actuated retarder function adjusts the axial piston unit to Vg max; this is done by energizing the switching magnets at connection E. Other control axes, e.g., LS0DA- are thereby disabled.

If the switching magnet at connection E is not energized (I= 0 mA), the other control axes are active.

**Note**
The VO_ function is only available as a combination control with other control axes; shown here using the LS0DA- as an example.

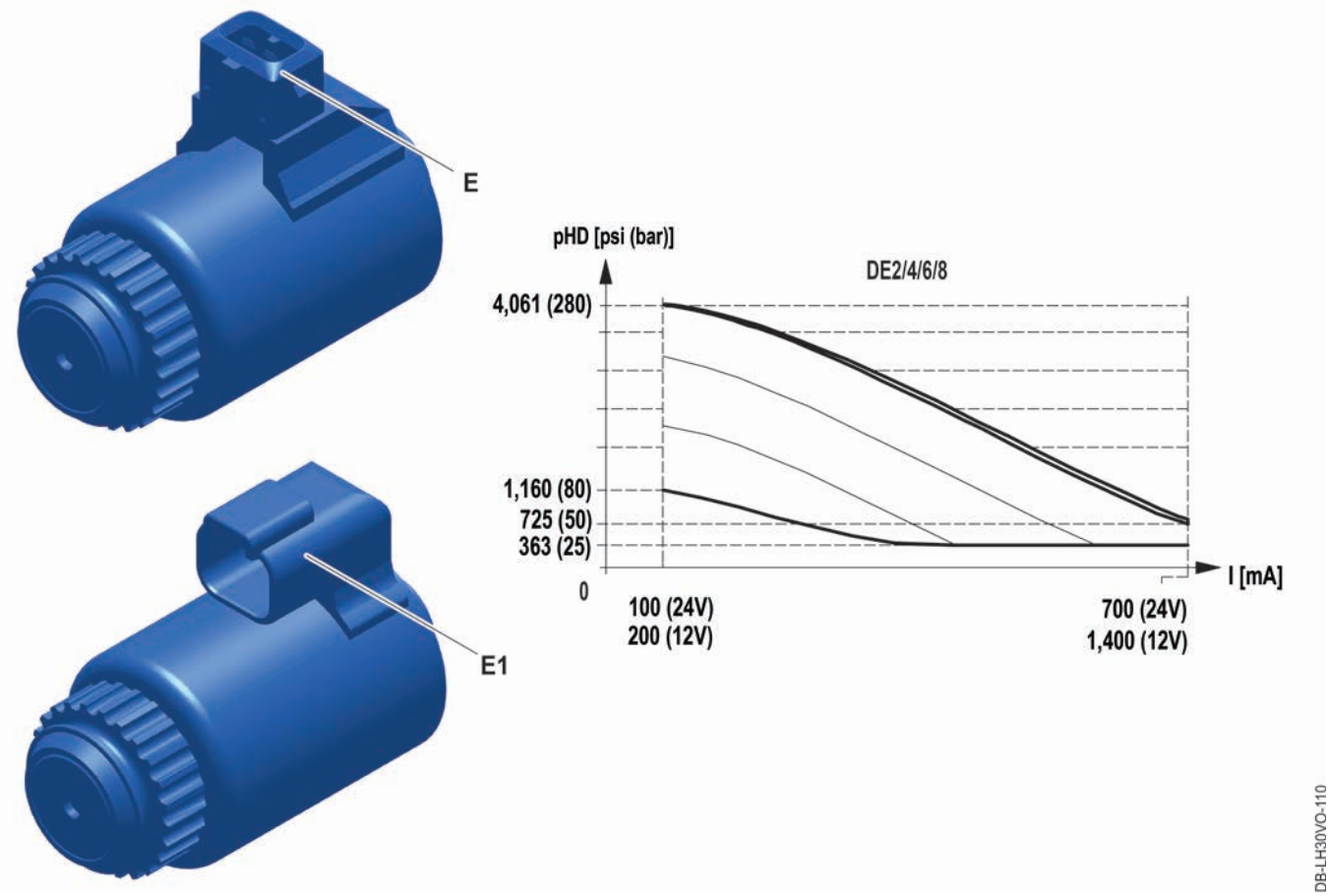
## 3.4 Electrical components

### 3.4.1 DE_1/3/5/7 (proportional magnet, rising characteristic)



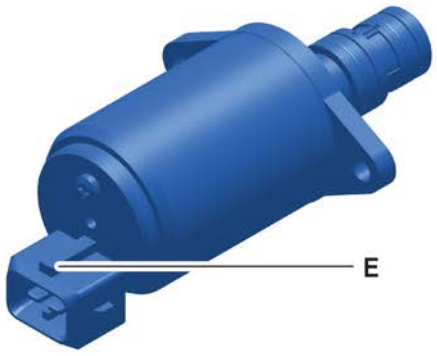

| Technical data of proportional magnet DE_ | 1/5 | 3/7 |
|---|---|---|
| Connection E | AMP Junior Timer | |
| Connection E1 | Deutsch DT04-2P | |
| Nominal voltage U | 24 V | 12 V |
| Current $I_{max.}$ | 700 mA | 1,400 mA |
| Nominal resistance R | 24.4 - 26.2 Ω | 6.0 - 6.4 Ω |
| Power P | 0.03 hp (18.7 W) | 0.02 hp (18.3 W) |
| Dither frequency | 100 - 200 Hz | |
| Minimal dither oscillation width within the control range | 240 mA | 120 mA |
| Duty cycle | 100 % | |
| Degree of protection according to DIN VDE0470 when assembled and plugged in | max. IP 65 | |
| Permissible ambient temperature | -4 °F to +176 °F (-20 °C to +80 °C) | |

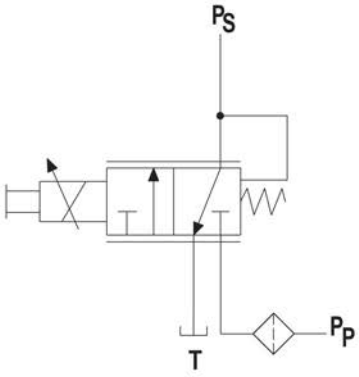
### 3.4.2 DE_2/4/6/8 (proportional magnet, falling characteristic)

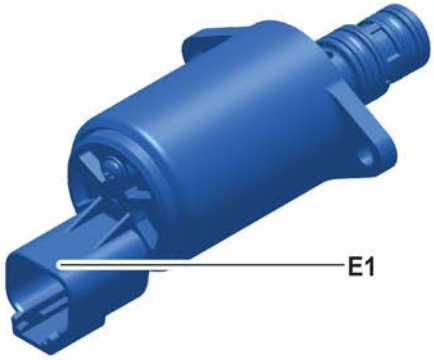


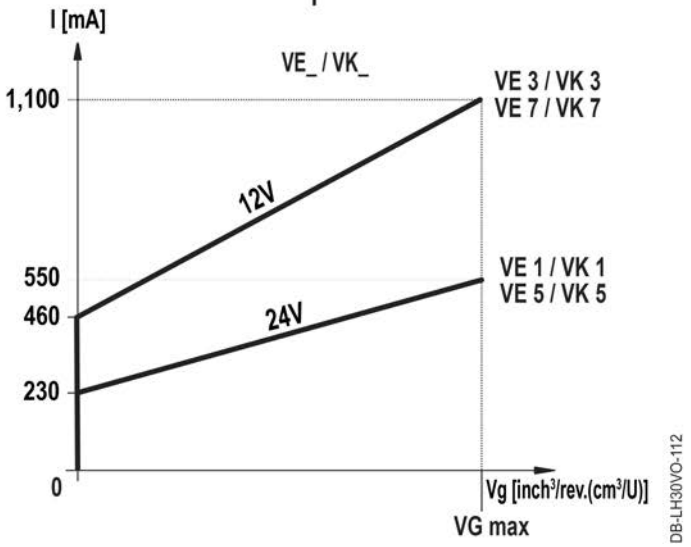

| Technical data of proportional magnet DE_ | 2/6 | 4/8 |
|---|---|---|
| Connection E | AMP Junior Timer | |
| Connection E1 | Deutsch DT04-2P | |
| Nominal voltage U | 24 V | 12 V |
| Current $I_{max.}$ | 700 mA | 1,400 mA |
| Nominal resistance R | 24.4 - 26.2 Ω | 6.0 - 6.4 Ω |
| Power P | 0.03 hp (18.7 W) | 0.02 hp (18.3 W) |
| Dither frequency | 100 - 200 Hz | |
| Minimal dither oscillation width within the control range | 240 mA | 120 mA |
| Duty cycle | 100 % | |
| Degree of protection according to DIN VDE0470 when assembled and plugged in | max. IP 65 | |
| Permissible ambient temperature | -4 °F to +176 °F (-20 °C to +80 °C) | |

### 3.4.3 VE_/ VK_1/3/5/7 (pressure reduction valve)



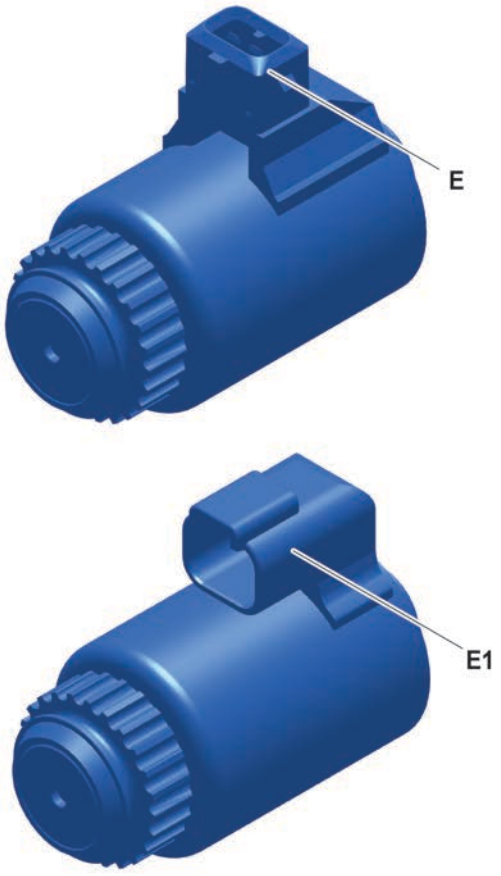




| Technical data of pressure reduction valve VE_/ VK_ | 1/5 | 3/7 |
|---|---|---|
| Connection E | AMP Junior Timer | |
| Connection E1 | Deutsch DT04-2P | |
| Nominal voltage U | 24 V | 12 V |
| Current $I_{max.}$ | 750 mA | 1,500 mA |
| Supply pressure $p_{max.}$ | 5,076 psi (350 bar) | |
| Nominal resistance R | 22.0 Ω ± 6% | 5.3 Ω ± 6% |
| Dither frequency | 100 - 200 Hz | |
| Degree of protection according to DIN VDE0470/EN when assembled and plugged in | max. IP 67 | |
| Permissible ambient temperature | -22 °F to +194 °F (-30 °C to +90 °C) | |

### 3.4.4 VO_1/3/5/7 (switching magnet)




| Technical data of switching magnet VO_ | 1/5 | 3/7 |
|---|---|---|
| Connection E | AMP Junior Timer | |
| Connection E1 | Deutsch DT04-2P | |
| Nominal voltage U | 24 V | 12 V |
| Current $I_{max.}$ | 700 mA | 1,400 mA |
| Nominal resistance R | 24.4 - 26.2 Ω | 6.0 - 6.4 Ω |
| Power P | 0.03 hp (18.7 W) | 0.02 hp (18.3 W) |
| Dither frequency | 100 - 200 Hz | |
| Minimal dither oscillation width within the control range | 240 mA | 120 mA |
| Duty cycle | 100 % | |
| Degree of protection according to DIN VDE0470 when assembled and plugged in | max. IP 65 | |
| Permissible ambient temperature | -4 °F to +176 °F (-20 °C to +80 °C) | |

## 4.1 General information on project planning

The installation variant provided in the device or system in combination with the installation position must be agreed on with Liebherr when designing the axial piston unit and must be approved by Liebherr.

Liebherr differentiates between three installation variants for axial piston units: A, B and C; and between six installation positions: 1-6.

**Note**
Liebherr recommends:
Installation variant: Under-tank installation A
Installation position: 2 driving shafts, horizontal, control at top

**CAUTION**
"Overheating" due to air pockets in the bearing area or rotary shaft lip seal in case of over-tank installation (installation variant B)!
Damage to the hydraulic product.
Ensure that the following conditions are met:
- The housing is completely filled with hydraulic fluid during commissioning and operation.
- The housing is completely vented* after commissioning and during operation.

*) For installation positions 3 and 4, complete filling and venting is not possible without an additional leakage oil connection. In this case, the axial piston unit must be connected, filled and vented in installation position 2 prior to final positioning. It can then be rotated to installation position 3 or 4.

If installation position 3 and 4 is planned: Order leakage oil connection T4 as a special design.
“Type code” on page 3
I

**Note**
For the over-tank installation B installation variant: a non-return valve must be provided in the leakage oil line. Maximum opening pressure of 7.25 psi (0.5 bar). Draining of the axial piston unit is prevented.

### 4.1.1 Leakage oil lines

**Note**
Route leakage oil line so that it is above the level of the axial piston unit.

### 4.1.2 Hydraulic fluid tank

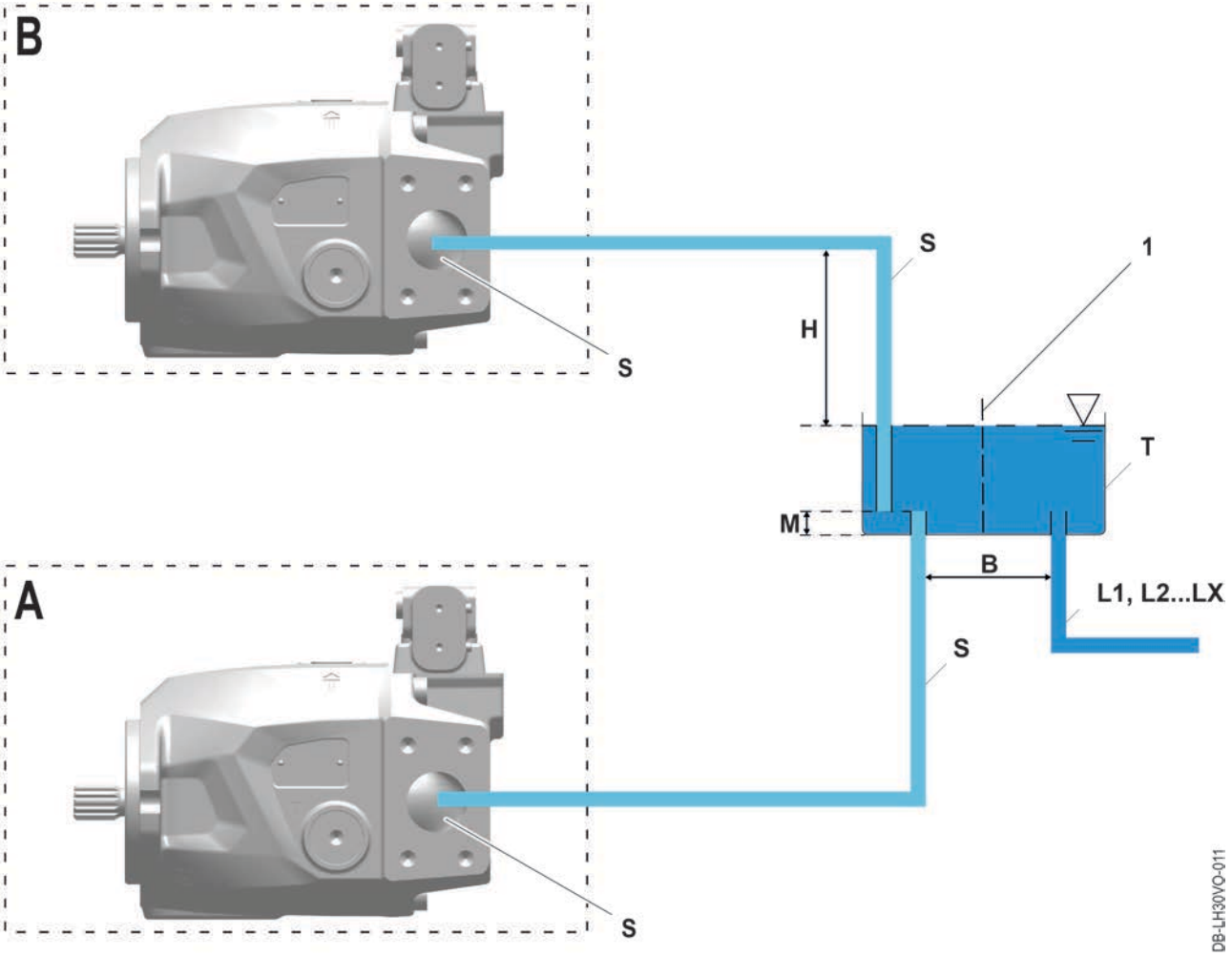
The hydraulic fluid tank must be designed so that the hydraulic fluid cools sufficiently during circulation and that contamination from operation settles at the bottom of the tank.

Prevent formation of foam: Make sure that the lines in each installation variant/installation position open into the hydraulic fluid tank at least 7.87 inch (200 mm) below the minimum fluid level.

## 4.2 Installation variants

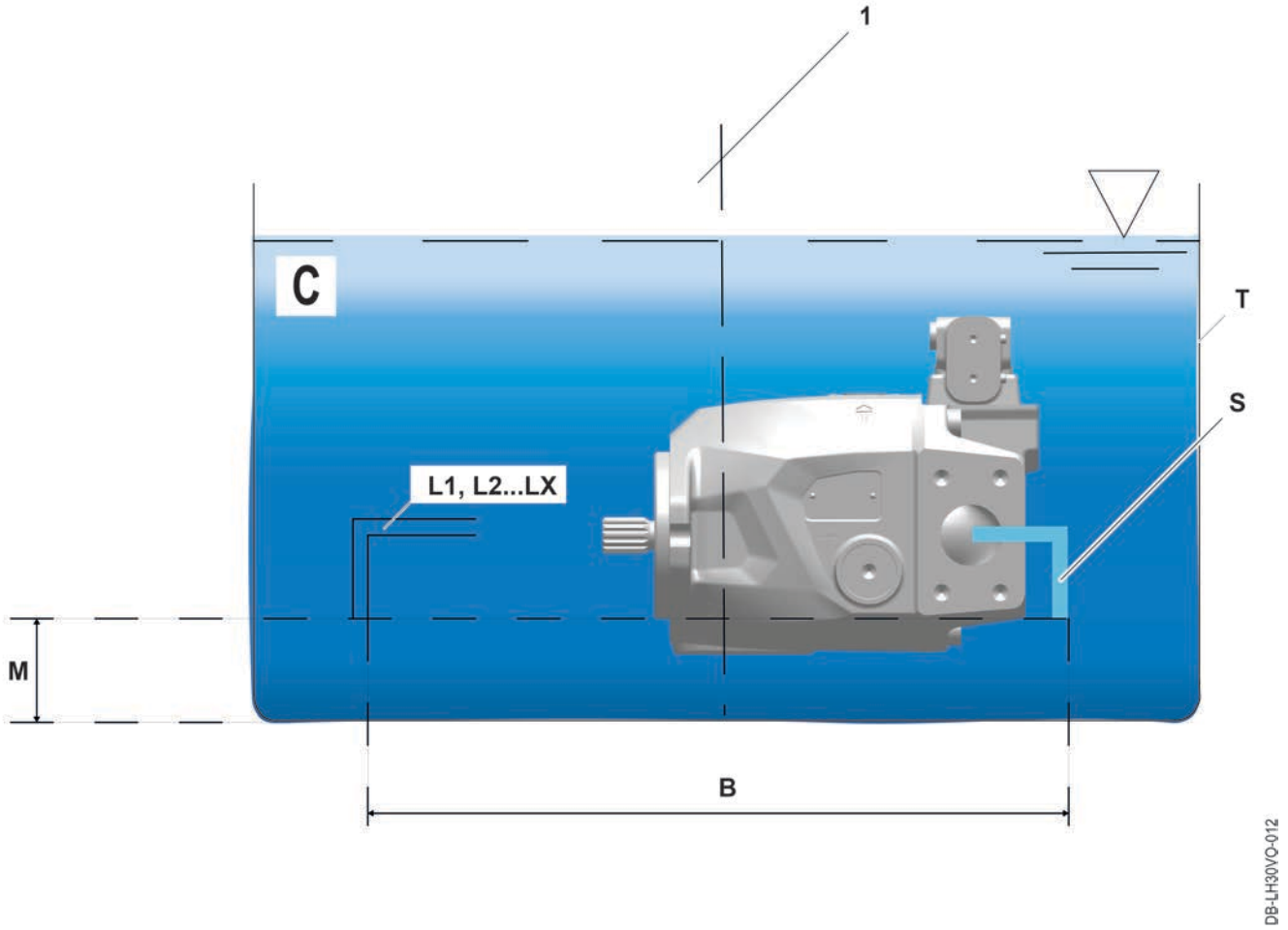
**Note**
Liebherr recommends: Under-tank installation A, which means that:
- There is hydraulic fluid at suction port S when not operated.
- The housing cannot drain to the tank.

**Under-tank installation "A":** The axial piston unit is installed **below** the tank's minimum fluid level.
**Over-tank installation "B":** The axial piston unit is installed **above** the tank's minimum fluid level.




| | | |
|---|---|---|
| 1 | Splash plate | To calm the hydraulic fluid in the tank |
| B | Clearance | Between suction port and leakage oil connection in the tank (the larger the better) |
| H | Maximum suction height (only for over-tank installation) | 29.53 inch (750 mm) |
| L | Leakage oil connections | - |
| M | Minimum distance between line end and tank bottom | 4.53 inch (115 mm) |
| S | Suction line connection | - |
| T | Tank | - |

**Tank installation "C":** The axial piston unit is installed **below** the minimum fluid level **in the tank**. This tank installation variant is not permitted for axial piston units with electric components (for example: electric proportional magnet).

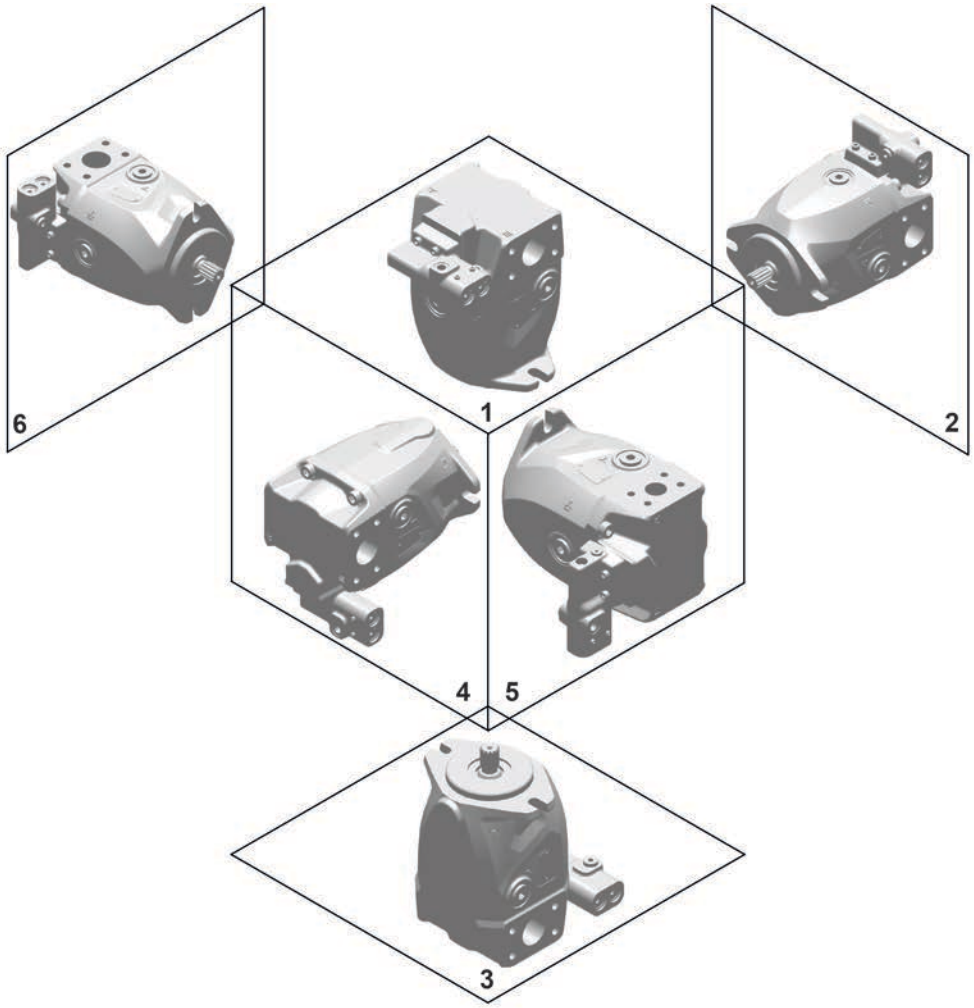



| | | |
|---|---|---|
| 1 | Splash plate | To calm the hydraulic fluid in the tank |
| B | Clearance | Between suction port and leakage oil connection in the tank (the larger the better) |
| L | Leakage oil connections | - |
| M | Minimum distance between line end and tank bottom | 4.53 inch (115 mm) |
| S | Suction line connection | - |
| T | Tank | - |

**Note**
For the tank installation C installation variant, the hydraulic product must be ordered and used as a special design without primer. “Type code” on page 3

## 4.3 Installation positions

There are six installation positions in each of the three installation variants.

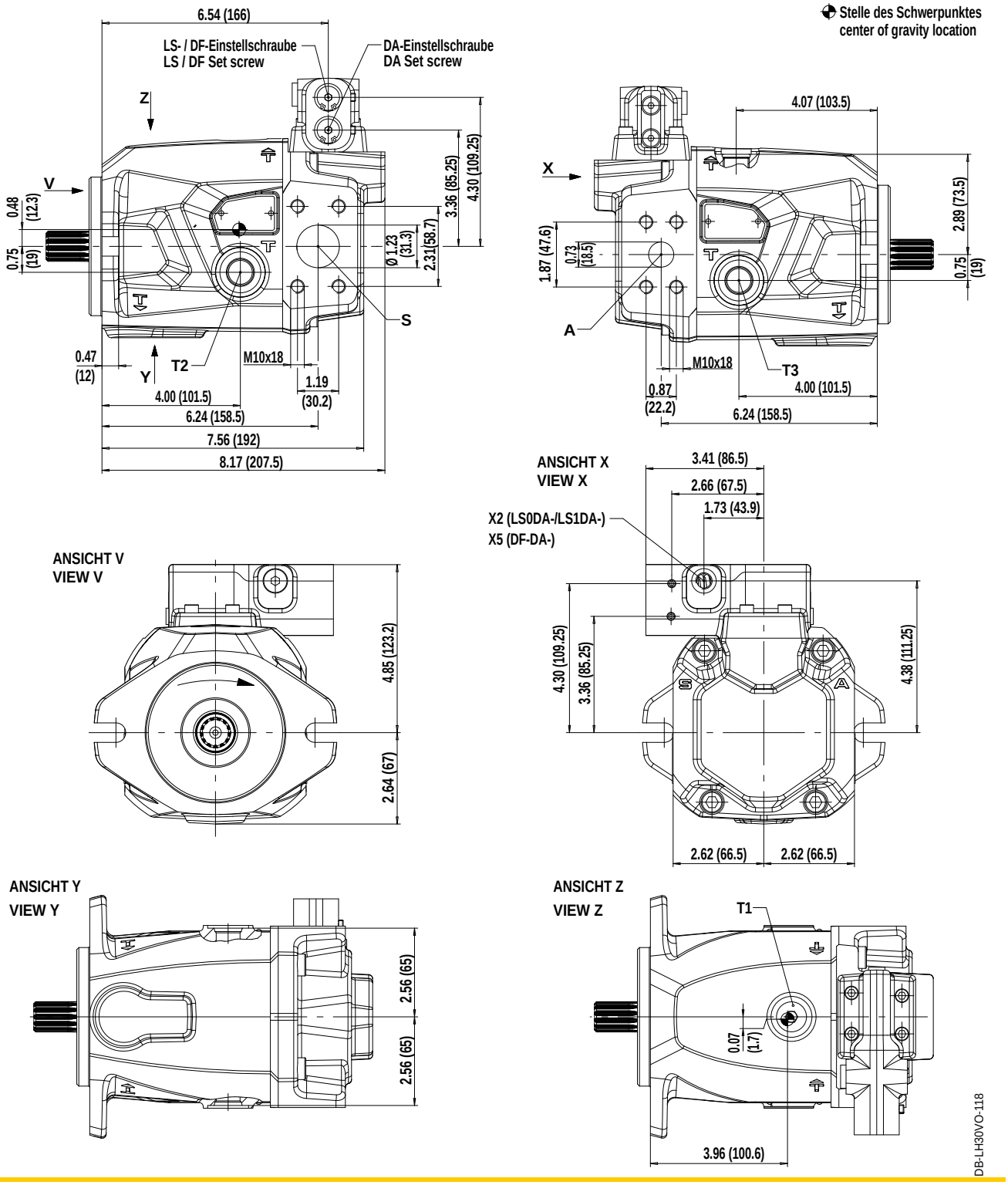



**Note**
Installation positions 3 and 4 are critical for filling and venting. For further information: see section 4.1.

## 5.1 NS 028, main dimensions

### 5.1.1 Working connection, lateral, control type LS0DA- / LS1DA- / DF-DA-

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 028 | / | LS0DA- | 20 | V | R | B2 | | B1 | 0 | 00 | 0000 | 000 | | | |



| | |
|---|---|
| A | Working connection<br>ISO 6162-1 (SAE J518-1) - 3/4“ |
| S | Suction port<br>ISO 6162-1 (SAE J518-1) - 1 1/4“ |
| T1, T2, T3 | Leakage oil connections<br>ISO 11926 - 3/4-16 UNF-2B |

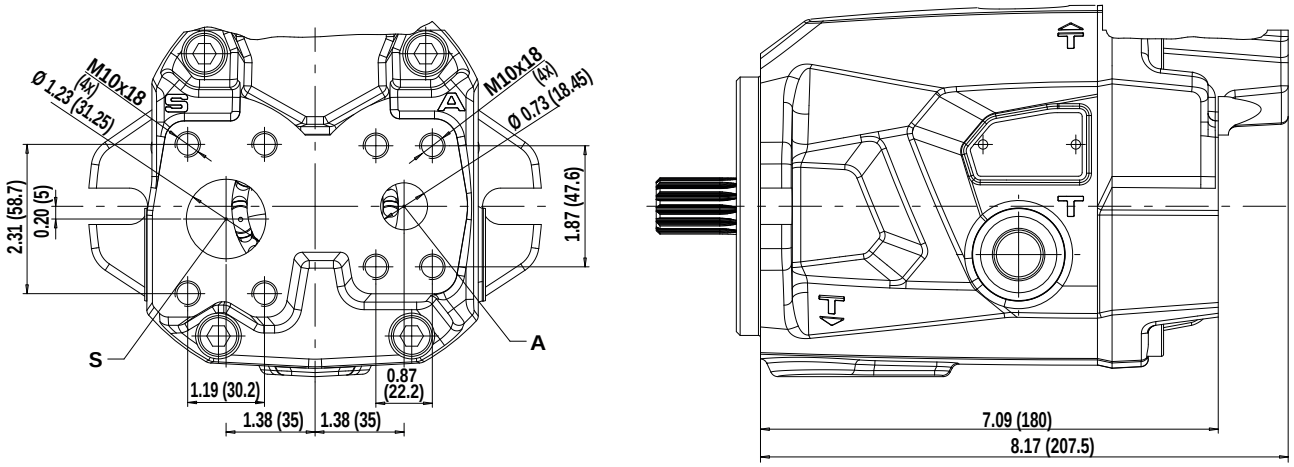
| | |
|---|---|
| X2 | LS0DA: LS pressure connection ISO 9974-1-M12x1.5<br>LS1DA: LS pressure connection ISO 9974-1-M12x1.5 |
| X5 | DF-DA-: DF control pressure connection for external pressure limiting valve, ISO 9974-1-M12x1.5 |
| - | - |

**Note**
**Direction of rotation counterclockwise:** Connecting plate and control arranged in mirror image.

### 5.1.2 NS 028, working connection, rear

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 028 | / | | 20 | V | R | B2 | | B3 | 0 | 00 | 0000 | 000 | | | |

**Note**
Dimensions not shown, see section 5.1.
**Direction of rotation counterclockwise:** Connecting plate and control arranged in mirror image.

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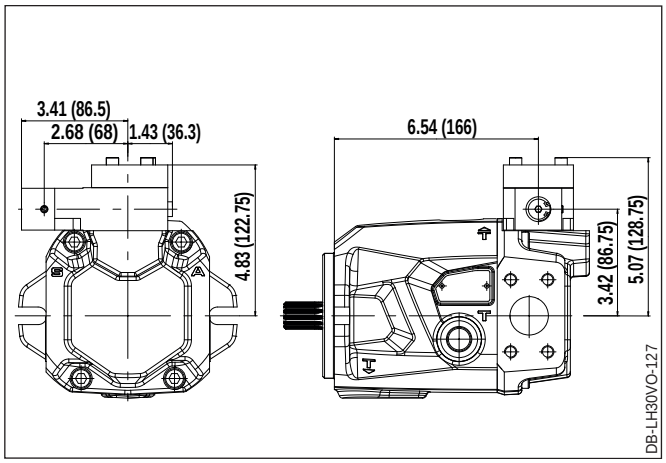
### 5.1.3 NS 028, other control types

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 028 | / | | 20 | V | R | | | | 0 | 00 | 0000 | 000 | | | |

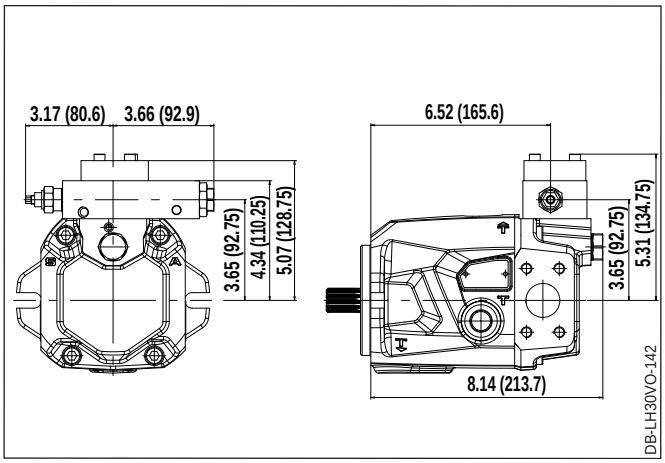
**Note**
Dimensions of control types LS0DA- / LS1DA- / DF-DA-, see section 5.1.
**Direction of rotation counterclockwise:** Connecting plate and control arranged in mirror image.

DA-



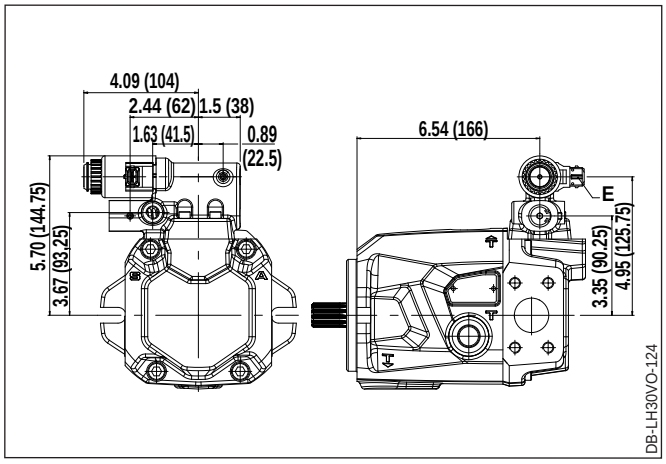

| | |
|---|---|
| - | - |
| - | - |

LR-



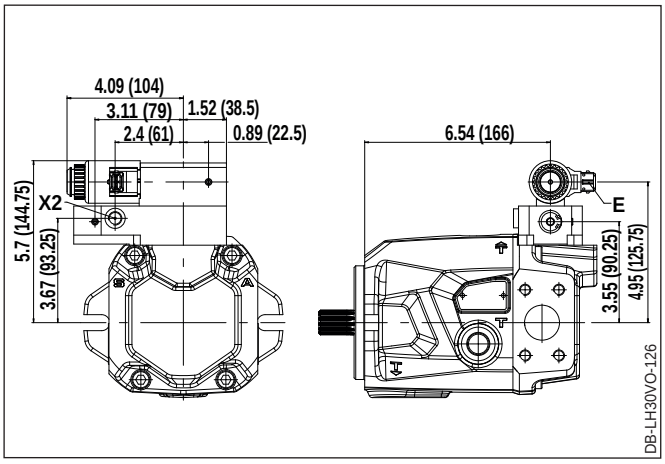

| | |
|---|---|
| - | - |
| - | - |

DE_



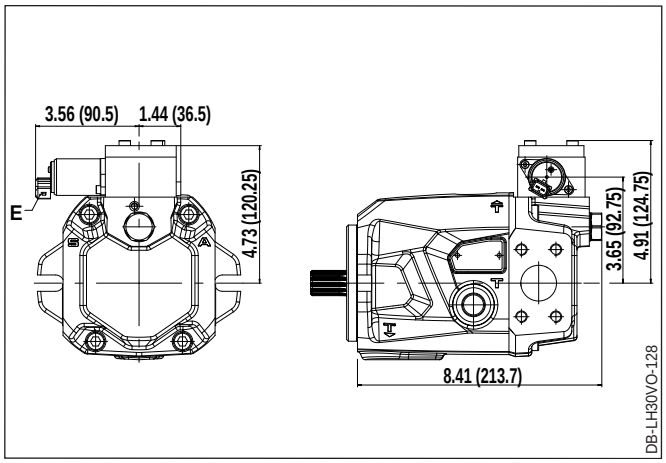

| | |
|---|---|
| E | 1/2/3/4: Deutsch plug DT04-2P 2-pin<br>5/6/7/8: AMP plug Junior Timer 2-pin |
| - | - |

LS0DE_ / LS1DE_



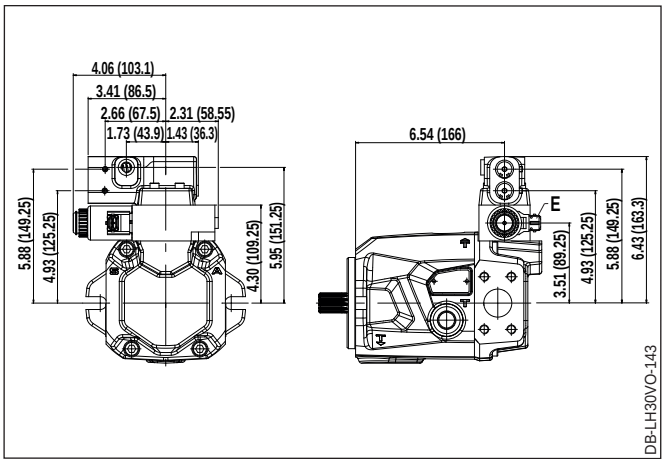

| | |
|---|---|
| E | 1/2/3/4: Deutsch plug DT04-2P 2-pin<br>5/6/7/8: AMP plug Junior Timer 2-pin |
| X2 | LS0DE_: LS pressure connection<br>ISO 9974-1-M12x1.5<br>LS1DE_: LS pressure connection<br>ISO 9974-1-M12x1.5 |

VE_ / VK_




| | |
|---|---|
| E | 1/3: Deutsch plug DT04-2P 2-pin<br>5/7: AMP plug Junior Timer 2-pin |
| - | - |

LS0DA-VO_

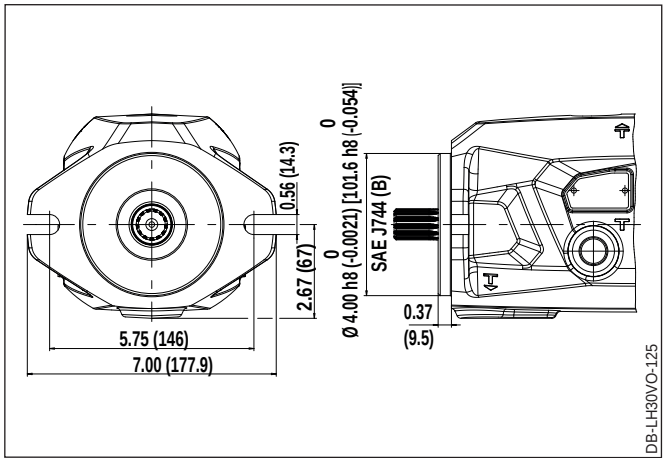



| | |
|---|---|
| E | 1/3: Deutsch plug DT04-2P 2-pin<br>5/7: AMP plug Junior Timer 2-pin |
| - | - |

## 5.2 NS 028, mounting flange

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 028 | / | | 20 | V | | B2 | | | 0 | 00 | | 000 | | | |

SAE B, (SAE J744)

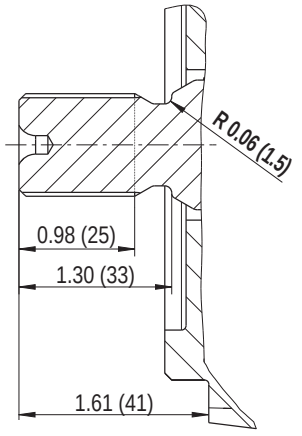



B2

## 5.3 NS 028, shaft end

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 028 | / | | 20 | V | | | | | 0 | 00 | | 000 | | | |

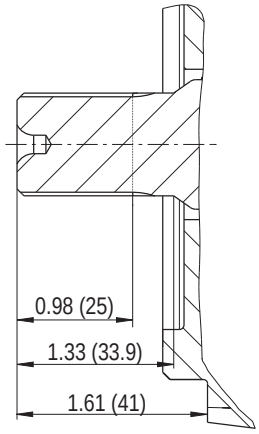
**Splined shaft ANSI B92.1a-1976 7/8'' 13T, with undercut**




DB-LH30VO-072

A1

**Splined shaft ANSI B92.1a-1976 7/8'' 13T, without undercut**



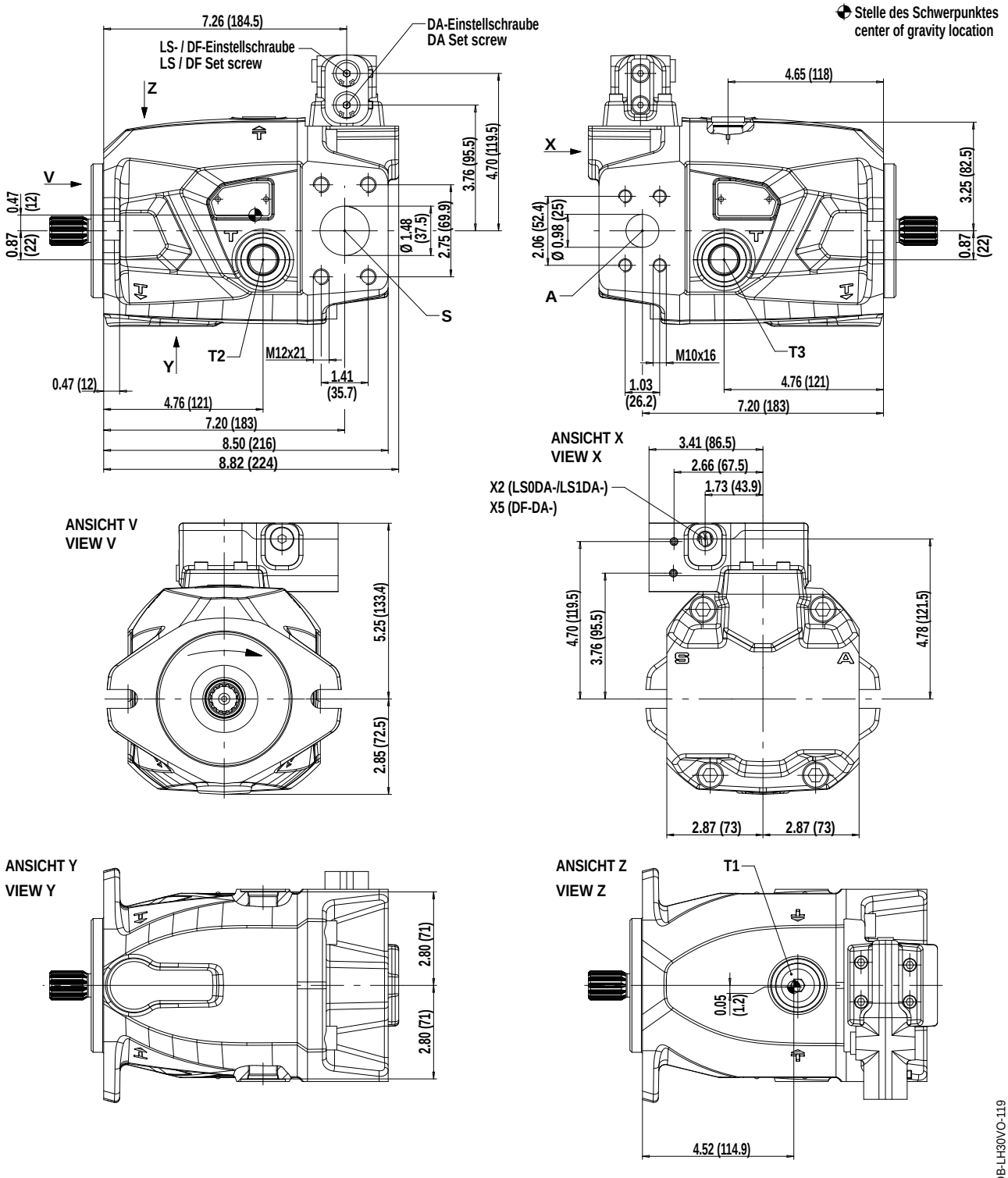

DB-LH30VO-071

A2

## 5.4 NS 045, main dimensions

### 5.4.1 Working connection, lateral, control type LS0DA- / LS1DA- / DF-DA-

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 045 | / | LS0DA- | 20 | V | R | B2 | | B1 | 0 | 00 | 0000 | 000 | | | |



| | |
|---|---|
| A | Working connection<br>ISO 6162-1/-2 (SAE J518-1/-2) - 1“ |
| S | Suction port<br>ISO 6162-1/-2 (SAE J518-1/-2) - 1 1/2“ |
| T1, T2, T3 | Leakage oil connections<br>ISO 11926 - 7/8-14 UNF-2B |

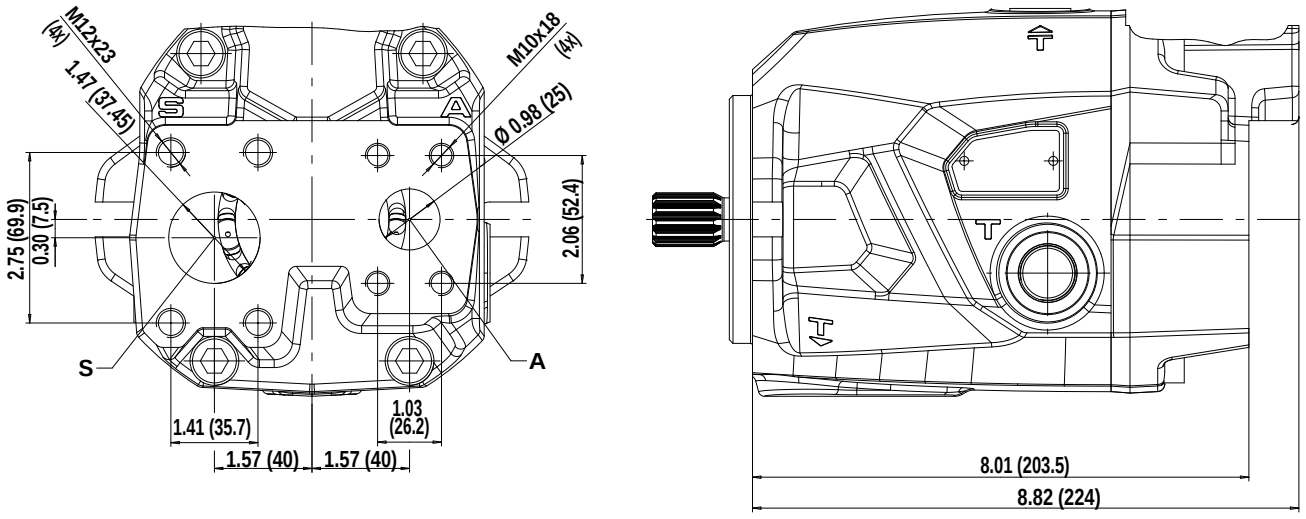
| | |
|---|---|
| X2 | LS0DA: LS pressure connection<br>ISO 9974-1-M12x1.5<br>LS1DA: LS pressure connection<br>ISO 9974-1-M12x1.5 |
| X5 | DF-DA-: DF control pressure connection for external pressure limiting valve,<br>ISO 9974-1-M12x1.5 |
| - | - |

**Note**
**Direction of rotation counterclockwise:** Connecting plate and control arranged in mirror image.

### 5.4.2 NS 045, working connection, rear

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 045 | / | | 20 | V | R | | | B3 | 0 | 00 | 0000 | 000 | | | |

**Note**
Dimensions not shown, see section 5.1.
**Direction of rotation counterclockwise:** Connecting plate and control arranged in mirror image.

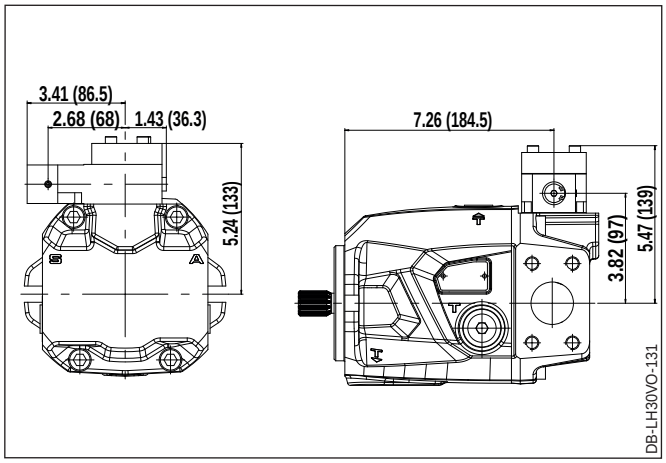


### 5.4.3 NS 045, other control types

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 045 | / | | 20 | V | R | | | B1 | 0 | 00 | 0000 | 000 | | | |

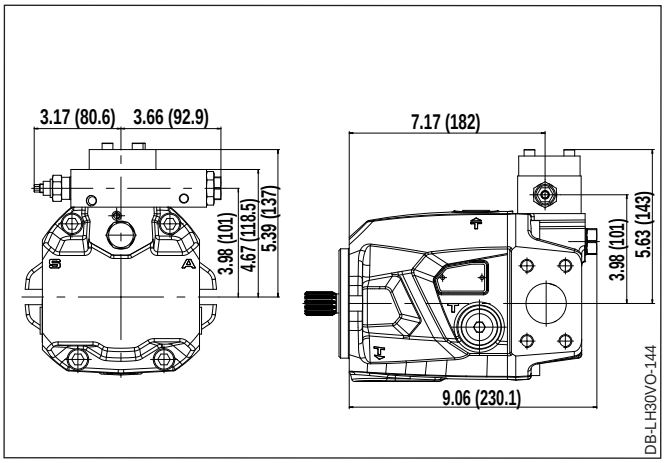
**Note**
Dimensions of control types LS0DA- / LS1DA- / DF-DA-, see section 5.1.
**Direction of rotation counterclockwise:** Connecting plate and control arranged in mirror image.

DA-



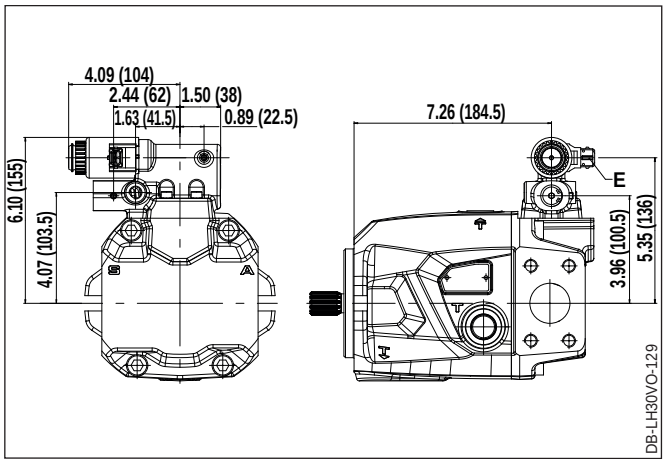

| | |
|---|---|
| - | - |
| - | - |

LR-



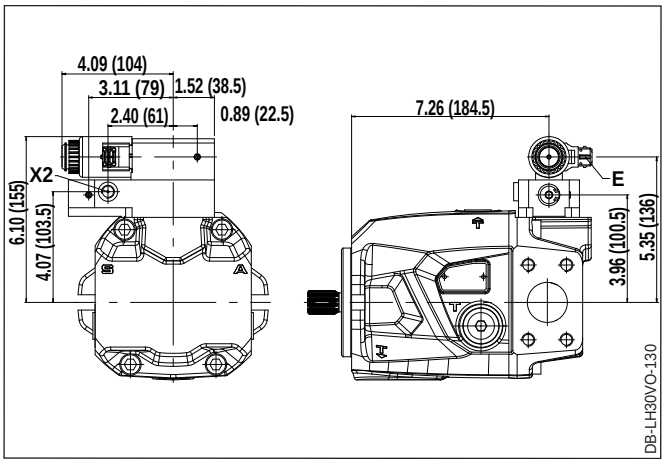

| | |
|---|---|
| - | - |
| - | - |

DE_



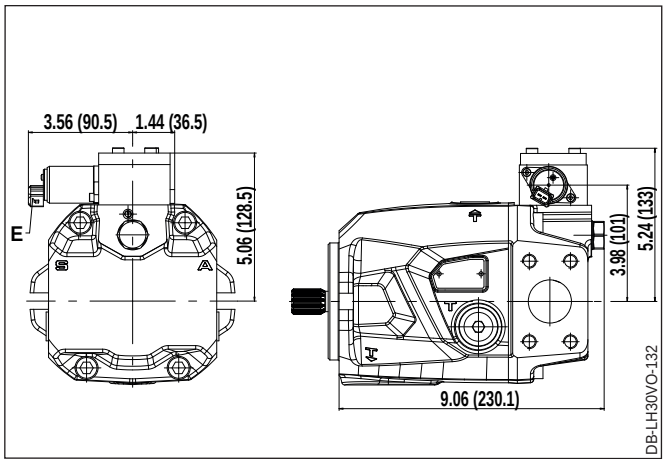

| | |
|---|---|
| E | 1/2/3/4: Deutsch plug DT04-2P 2-pin<br>5/6/7/8: AMP plug Junior Timer 2-pin |
| - | - |

LS0DE_ / LS1DE_



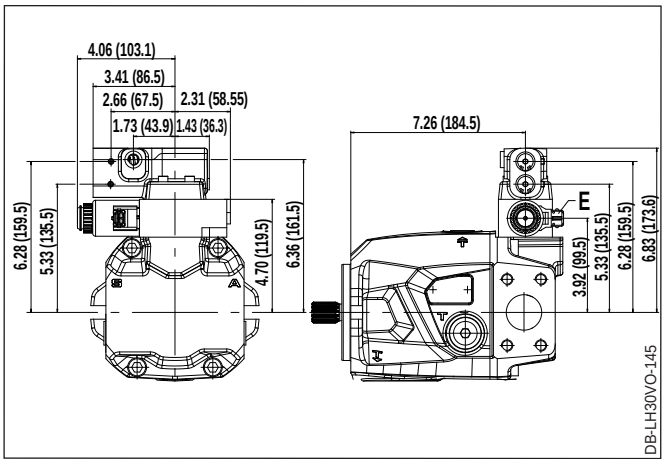

| | |
|---|---|
| E | 1/2/3/4: Deutsch plug DT04-2P 2-pin<br>5/6/7/8: AMP plug Junior Timer 2-pin |
| X2 | LS0DE_: LS pressure connection<br>ISO 9974-1-M12x1.5<br>LS1DE_: LS pressure connection<br>ISO 9974-1-M12x1.5 |

| VE_ / VK_ |
|---|




| | |
|---|---|
| E | 1/3: Deutsch plug DT04-2P 2-pin<br>5/7: AMP plug Junior Timer 2-pin |
| - | - |

| LS0DA-VO_ |
|---|

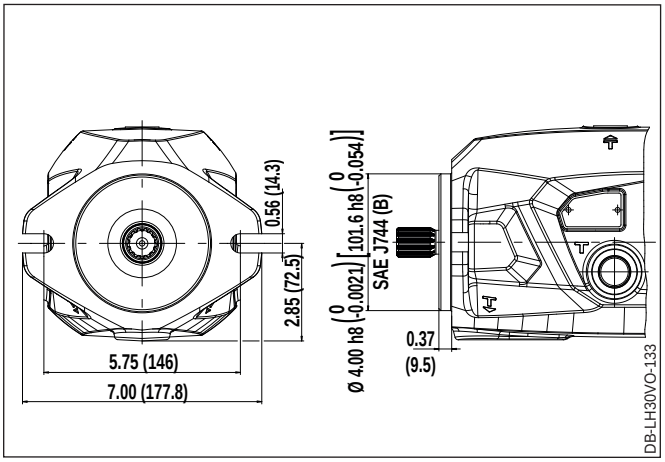



| | |
|---|---|
| E | 1/3: Deutsch plug DT04-2P 2-pin<br>5/7: AMP plug Junior Timer 2-pin |
| - | - |

## 5.5 NS 045, mounting flange

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 045 | / | | 20 | V | | B2 | | | 0 | 00 | | 000 | | | |

SAE B, (SAE J744)

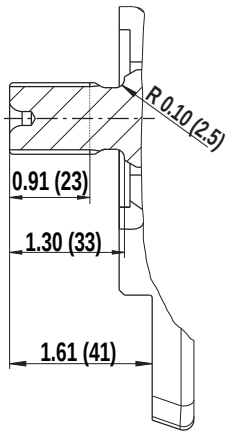



B2

## 5.6 NS 045, shaft end

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 045 | / | | 20 | V | | | | | 0 | 00 | | 000 | | | |

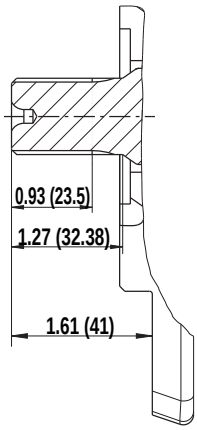
**Splined shaft ANSI B92.1a-1976 7/8'' 13T, with undercut**




DB-LH30VO-073

A1

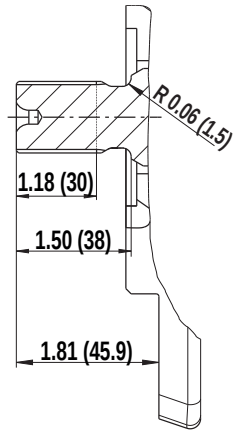
**Splined shaft ANSI B92.1a-1976 7/8'' 13T, without undercut**




DB-LH30VO-074

A2

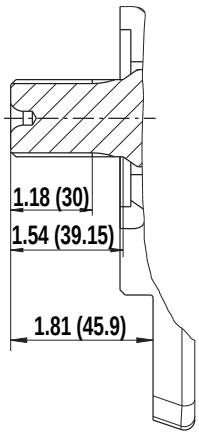
**Splined shaft ANSI B92.1a-1976 1'' 15T, with undercut**




DB-LH30VO-075

A3

**Splined shaft ANSI B92.1a-1976 1'' 15T, without undercut**



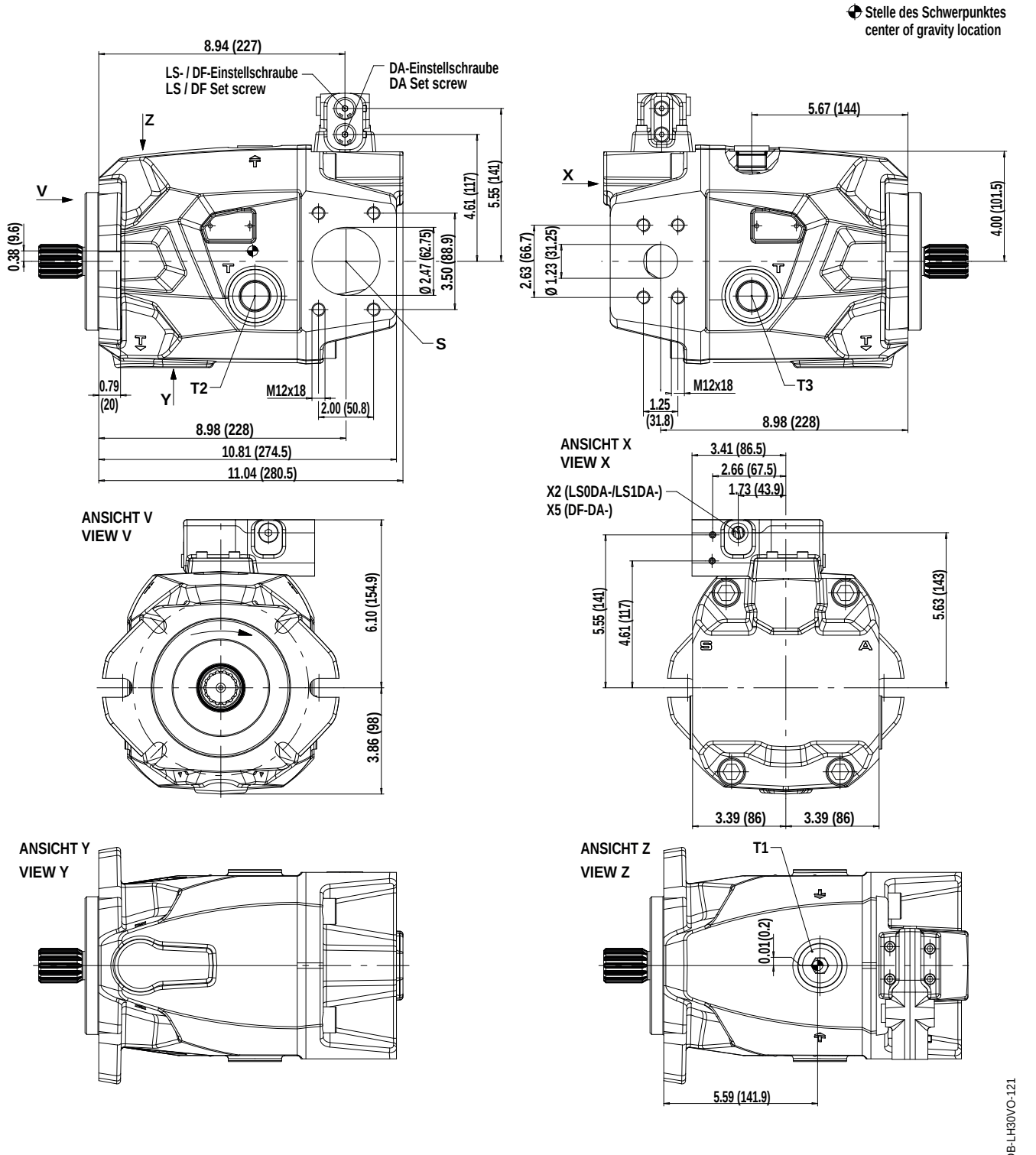

DB-LH30VO-076

A4

## 5.7 NS 085 main dimensions

### 5.7.1 Working connection, lateral, control type LS0DA- / LS1DA- / DF-DA-

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 085 | / | LS0DA- | 20 | V | R | C6 | | A1 | 0 | 00 | 0000 | 000 | | | |



| | |
|---|---|
| A | Working connection<br>ISO 6162-2 (SAE J518-2) - 1 1/4" |
| S | Suction port<br>ISO 6162-2 (SAE J518-2) - 2 1/2“ |
| T1, T2, T3 | Leakage oil connections<br>ISO 11926 - 1 1/16-12 UNF-2B |

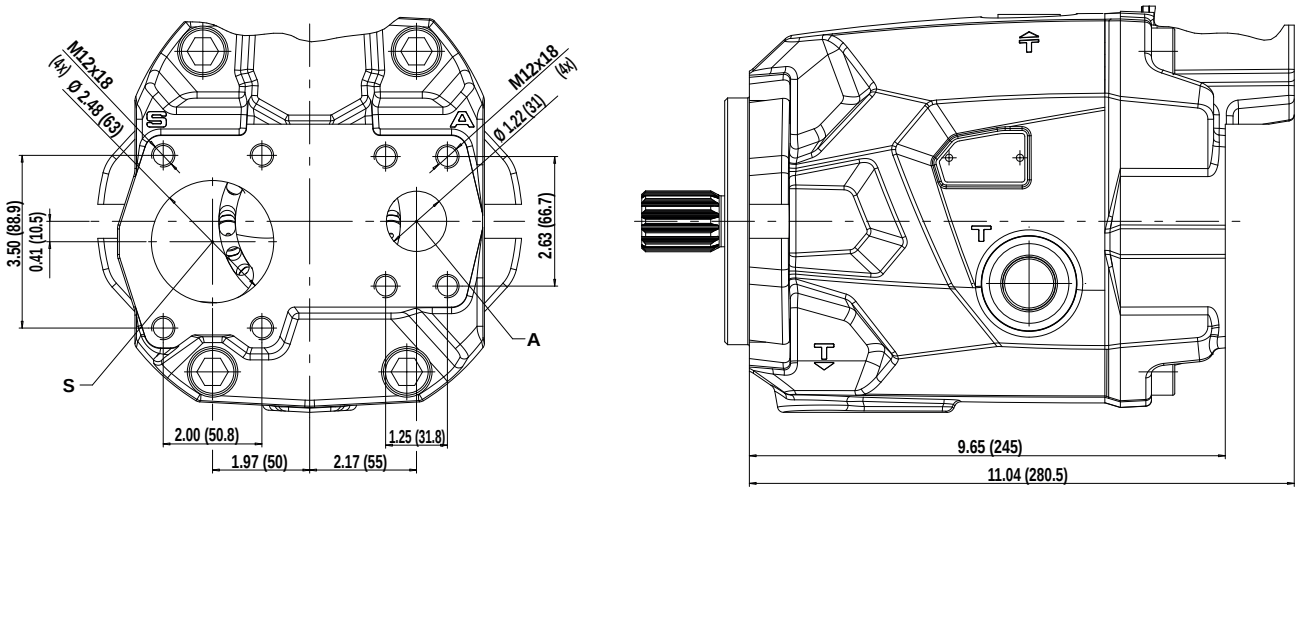
| | |
|---|---|
| X2 | LS0DA: LS pressure connection<br>ISO 9974-1-M12x1.5<br>LS1DA: LS pressure connection<br>ISO 9974-1-M12x1.5 |
| X5 | DF-DA-: DF control pressure connection<br>for external pressure limiting valve,<br>ISO 9974-1-M12x1.5 |
| - | - |

**Note**
**Direction of rotation counterclockwise:** Connecting plate and control arranged in mirror image.

### 5.7.2 NS 085, working connection, rear

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 085 | / | | 20 | V | R | C6 | | A3 | 0 | 00 | 0000 | 000 | | | |

**Note**
Dimensions not shown, see section 5.1.
**Direction of rotation counterclockwise:** Connecting plate and control arranged in mirror image.

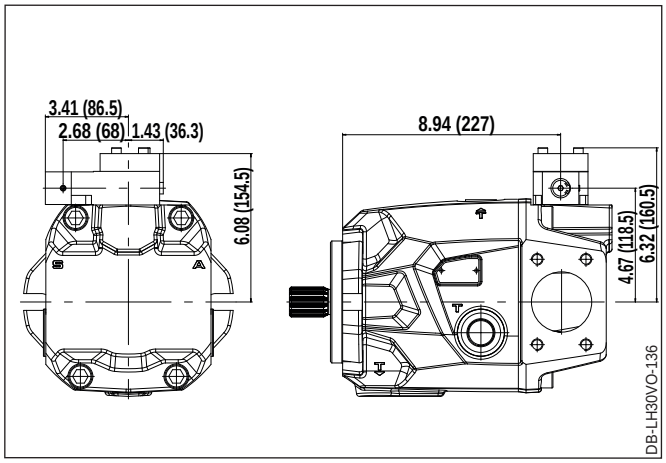


### 5.7.3 NS 085, other control types

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 085 | / | | 20 | V | R | | | A1 | 0 | 00 | 0000 | 000 | | | |

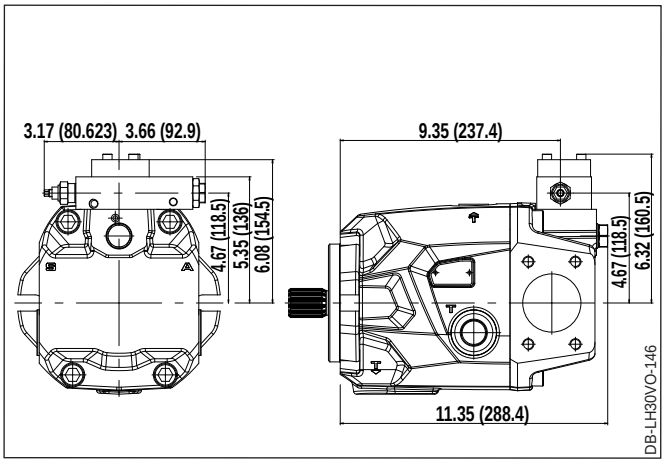
**Note**
Dimensions of control types LS0DA- / LS1DA- / DF-DA-, see section 5.1.
**Direction of rotation counterclockwise:** Connecting plate and control arranged in mirror image.

DA-



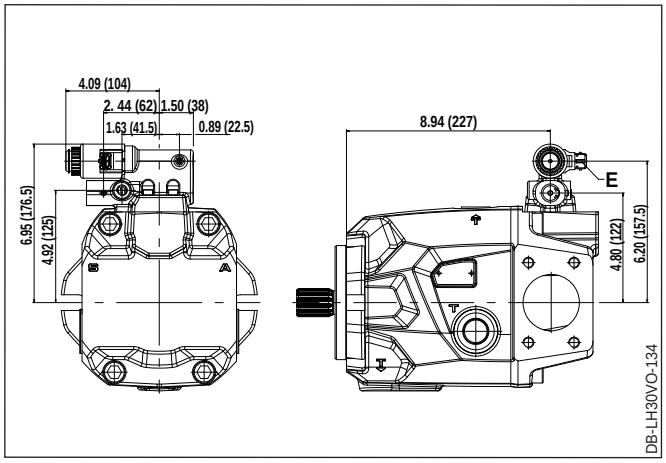

| | |
|---|---|
| - | - |
| - | - |

LR-



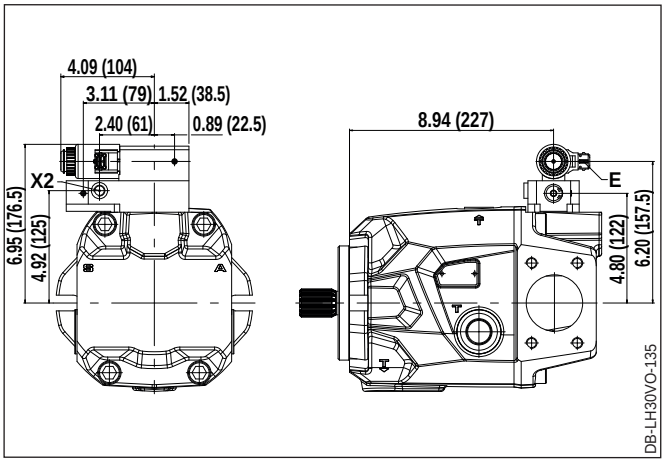

| | |
|---|---|
| - | - |
| - | - |

DE_



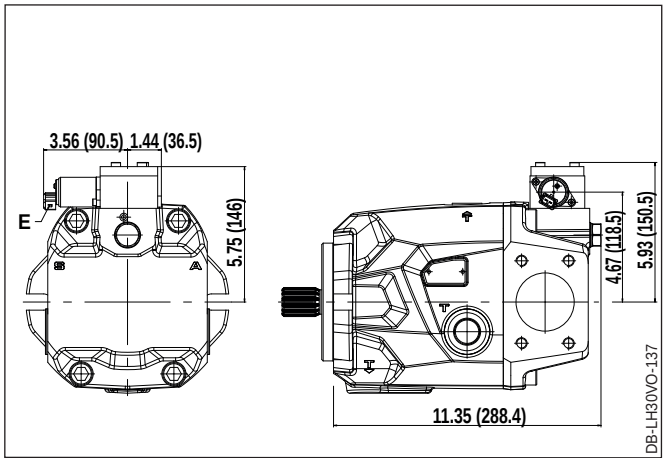
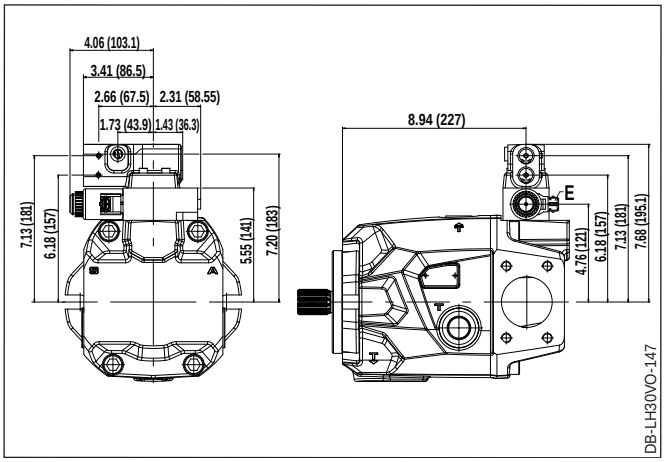

| | |
|---|---|
| E | 1/2/3/4: Deutsch plug DT04-2P 2-pin<br>5/6/7/8: AMP plug Junior Timer 2-pin |
| - | - |

LS0DE_ / LS1DE_




| | |
|---|---|
| E | 1/2/3/4: Deutsch plug DT04-2P 2-pin<br>5/6/7/8: AMP plug Junior Timer 2-pin |
| X2 | LS0DE_: LS pressure connection<br>ISO 9974-1-M12x1.5<br>LS1DE_: LS pressure connection<br>ISO 9974-1-M12x1.5 |

**Note**
**Direction of rotation clockwise:** Connecting plate and control arranged in mirror image.

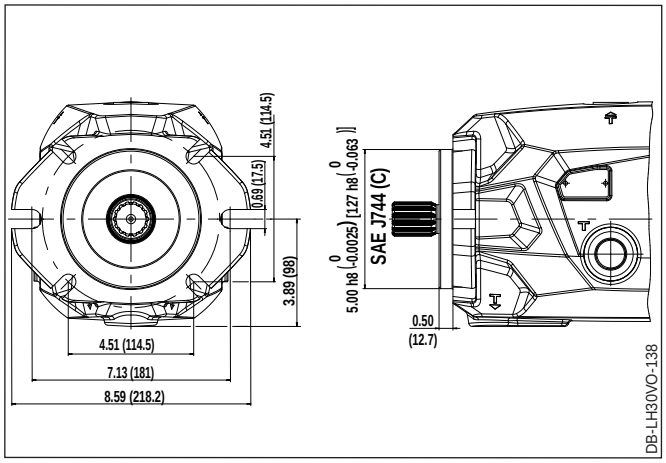
| VE_ / VK_ | LS0DA-VO_ |
|---|---|
|  |  |
| E: 1/3: Deutsch plug DT04-2P 2-pin<br>5/7: AMP plug Junior Timer 2-pin | E: 1/3: Deutsch plug DT04-2P 2-pin<br>5/7: AMP plug Junior Timer 2-pin |
| - : - | - : - |



## 5.8 NS 085, mounting flange

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 085 | / | | 20 | V | | C6 | | | 0 | 00 | | 000 | | | |

**Similar to SAE C, (SAE J744), 2+4-hole fastening**

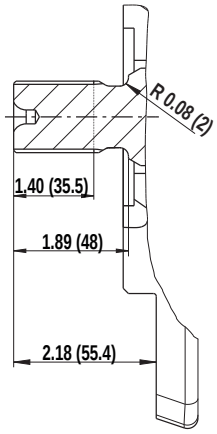



C6

## 5.9 NS 085, shaft end

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | 085 | / | | 20 | V | | | | | 0 | 00 | | 000 | | | |

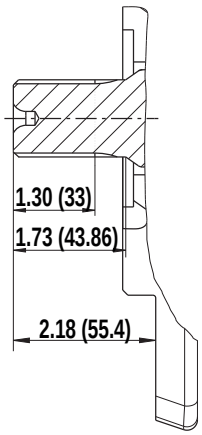
**Splined shaft ANSI B92.1a-1976 1 1/4'' 14T, with undercut**




DB-LH30VO-078

A5

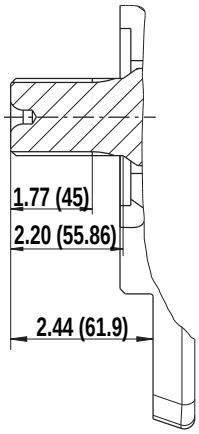
**Splined shaft ANSI B92.1a-1976 1 1/4'' 14T, without undercut**




DB-LH30VO-077

A6

**Splined shaft ANSI B92.1a-1976 1 1/2'' 17T, without undercut**




DB-LH30VO-079

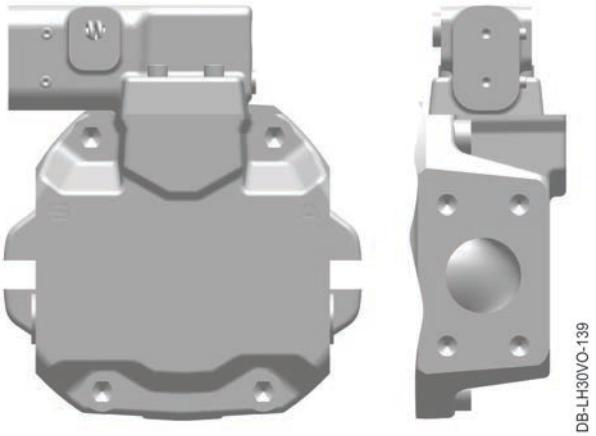
A0

## 5.10 Through-drive

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | | 8 | 9. | 10. | 11. | 12. | 13. | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L | H | 3 | 0 | V | O | | / | | 20 | V | | | | | 0 | 00 | | 000 | | | |

### 5.10.1 Axial piston unit without through-drive

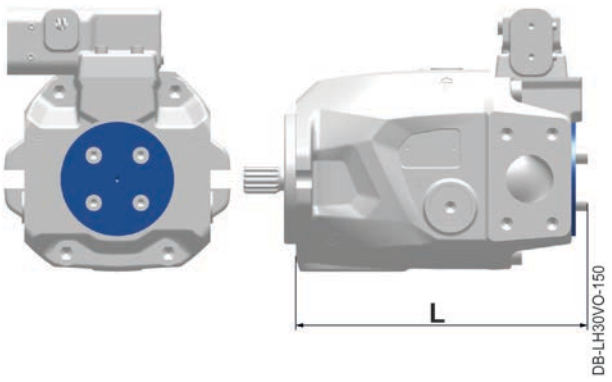
**Note**
For dimensions for axial piston unit without through-drive, see main dimensions.




**0000**

### 5.10.2 Axial piston unit with preparation for adapter mounting kit

**Note**
Preparation for adapter mounting kit, sealed with cover.
To use the through-drive, the selected adapter mounting kit including coupling ferrule (see installation drawing) must be ordered separately; the cover must be removed and the adapter mounting kit fitted.




**K02G** 4-hole

| NS | L | L* |
|---|---|---|
| 028 | 8.05 (204.5) | 8.41 (213.7) |
| 045 | 9.00 (228.5) | 9.06 (230.1) |
| 085 | 11.30 (287) | 11.35 (288.4) |

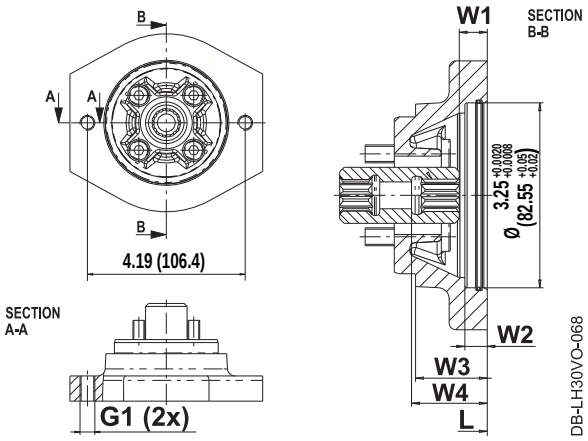
L) Up to mounting flange
L*) Total length of axial piston unit with control type VE_/ VK_ and LR- (see note).

**Note**
NS 028: Total length of axial piston unit with control type VE_/ VK_ and LR-, see section 5.1.3.
NS 045: Total length of axial piston unit with control type VE_/ VK_ and LR-, see section 5.4.3.
NS 085: Total length of axial piston unit with control type VE_/ VK_ and LR-, see section 5.7.3.

### 5.10.3 Axial piston unit with through-drive SAE A

**Note**
O-ring for sealing of axial piston unit 2 is included in the scope of delivery.
NS 028 / 045: The following applies to control type VE_/ VK_ and LR-; total length up to mounting flange L + 0.51 inch (13 mm).

**Shaft gearing: 5/8 in 9T 16/32DP**




A11D 2-hole

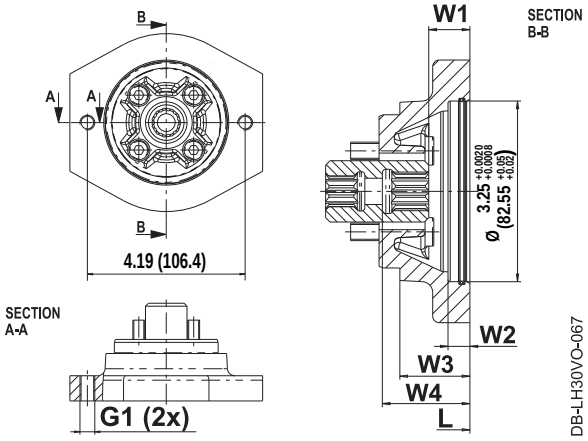
| NS | W1 | W2 | W3 | W4 | L | G1 (2-hole) |
|---|---|---|---|---|---|---|
| 028 | 0.39 (9.9) | 0.394 (10) | 1.26 (32) | 1.33 (33.8) | 8.66 (220) | M10x1.5; 17 deep |
| 045 | 0.57 (14.5) | 0.394 (10) | 1.26 (32) | 1.41 (35.8) | 9.61 (244) | M10x1.5; 17 deep |
| 085 | 0.53 (13.4) | 0.394 (10) | 0.77 (19.5) | 1.34 (34) | 11.42 (290) | M10x1.5; 19.5 deep |

L*) Up to mounting flange

### 5.10.4 Axial piston unit with through-drive SAE A-B

**Note**
O-ring for sealing of axial piston unit 2 is included in the scope of delivery.
NS 028 / 045: The following applies to control type VE_/ VK_ and LR-; total length up to mounting flange L + 0.51 inch (13 mm).

**Shaft gearing: 3/4 in 11T 16/32DP**




A21D 2-hole

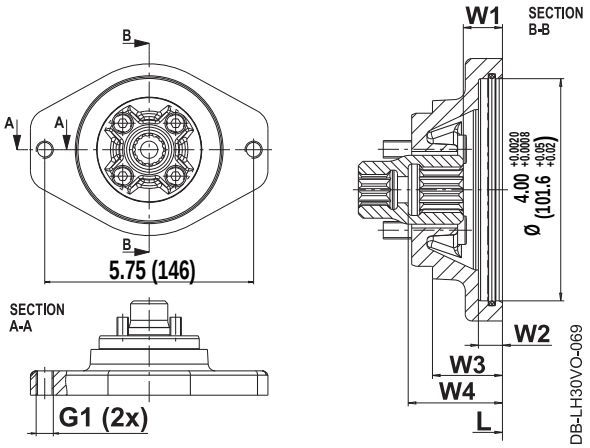
| NS | W1 | W2 | W3 | W4 | L | G1 (2-hole) |
|---|---|---|---|---|---|---|
| 028 | 0.74 (18.8) | 0.394 (10) | 1.26 (32) | 1.57 (40) | 8.66 (220) | M10x1.5; 17 deep |
| 045 | 0.82 (20.9) | 0.394 (10) | 1.26 (32) | 1.66 (42.1) | 9.61 (244) | M10x1.5; 17 deep |
| 085 | 0.93 (23.6) | 0.394 (10) | 0.77 (19.5) | 1.57 (40) | 11.42 (290) | M10x1.5; 19.5 deep |

L*) Up to mounting flange

### 5.10.5 Axial piston unit with through-drive SAE B

**Note**
O-ring for sealing of axial piston unit 2 is included in the scope of delivery.
NS 028 / 045: The following applies to control type VE_/ VK_ and LR-; total length up to mounting flange L + 0.51 inch (13 mm).

**Shaft gearing: 7/8 in 13T 16/32DP**




**B11D** 2-hole

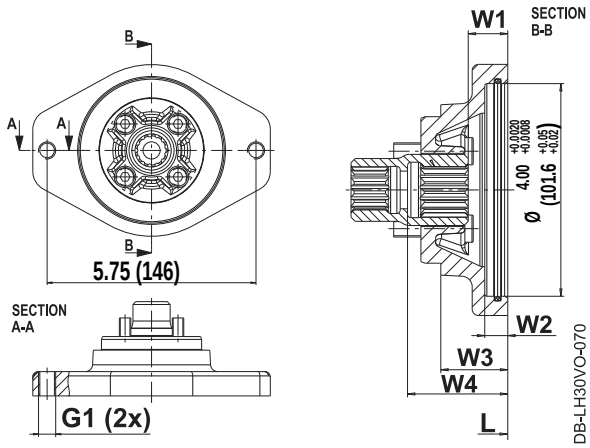
| NS | W1 | W2 | W3 | W4 | L | G1 (2-hole) |
|---|---|---|---|---|---|---|
| 028 | 0.70 (17.8) | 0.43 (11) | 1.26 (32) | 1.70 (43.1) | 8.66 (220) | M12x1.5; 17 deep |
| 045 | 0.85 (21.7) | 0.43 (11) | 1.26 (32) | 1.78 (45.1) | 9.61 (244) | M12x1.5; 17 deep |
| 085 | 0.79 (20) | 0.43 (11) | 1.04 (26.5) | 1.69 (43) | 11.69 (297) | M12x1.5; 18 deep |

L*) Up to mounting flange

### 5.10.6 Axial piston unit with through-drive SAE B-B

**Note**
O-ring for sealing of axial piston unit 2 is included in the scope of delivery.
NS 028 / 045: The following applies to control type VE_/ VK_ and LR-; total length up to mounting flange L + 0.51 inch (13 mm).

**Shaft gearing: 1 in 15T 16/32DP**




**B21D** 2-hole

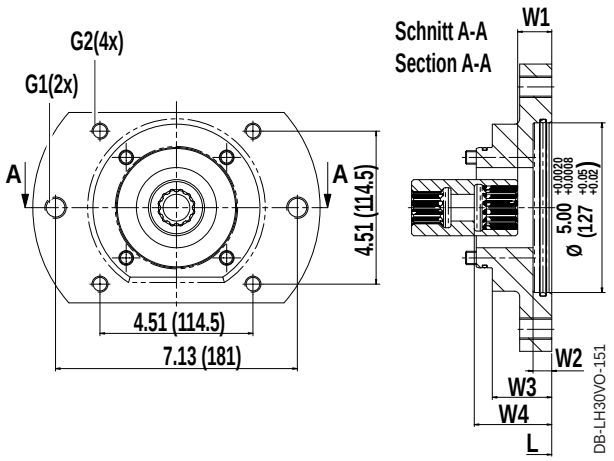
| NS | W1 | W2 | W3 | W4 | L | G1 (2-hole) |
|---|---|---|---|---|---|---|
| 028 | - | - | - | - | - | - |
| 045 | 0.82 (20.9) | 0.43 (11) | 1.26 (32) | 1.96 (49.9) | 9.61 (244) | M12x1.75; 17 deep |
| 085 | 0.87 (22.2) | 0.43 (11) | 1.04 (26.5) | 1.89 (48) | 11.69 (297) | M12x1.75; 18 deep |

L*) Up to mounting flange
- not possible

### 5.10.7 Axial piston unit with through-drive SAE C

**Note**
O-ring for sealing of axial piston unit 2 is included in the scope of delivery.

**Shaft gearing: 1 1/4 in 14T 12/24DP**



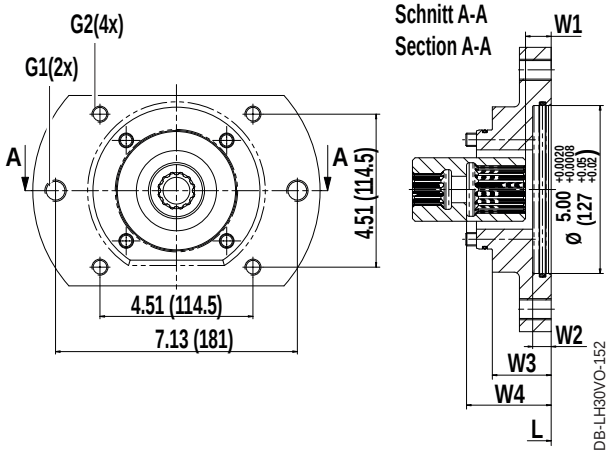

C11D 2-hole
C12D 4-hole

| NS | W1 | W2 | W3 | W4 | L | G1 (2-hole)<br>G2 (4-hole) |
|---|---|---|---|---|---|---|
| 028 | - | - | - | - | - | - |
| 045 | - | - | - | - | - | - |
| 085 | 1.00<br>(25.5) | 0.55<br>(14) | 1.75<br>(44.5) | 2.28<br>(58) | 12.40<br>(315) | G1: M16x2; 24 deep<br>G2: M12x1.75; 24 deep |

### 5.10.8 Axial piston unit with through-drive SAE C-C

**Note**
O-ring for sealing of axial piston unit 2 is included in the scope of delivery.

**Shaft gearing: 1 1/2 in 17T 12/24DP**




C21D 2-hole
C22D 4-hole

| NS | W1 | W2 | W3 | W4 | L | G1 (2-hole)<br>G2 (4-hole) |
|---|---|---|---|---|---|---|
| 028 | - | - | - | - | - | - |
| 045 | - | - | - | - | - | - |
| 085 | 0.76<br>(19.4) | 0.55<br>(14) | 1.75<br>(44.5) | 2.52<br>(64) | 12.40<br>(315) | G1: M16x2; 24 deep<br>G2: M12x1.75; 24 deep |

## 5.11 Multiple axial piston unit

**General information**
On request, multiple axial piston units consisting of 2 or more individual units can be implemented.

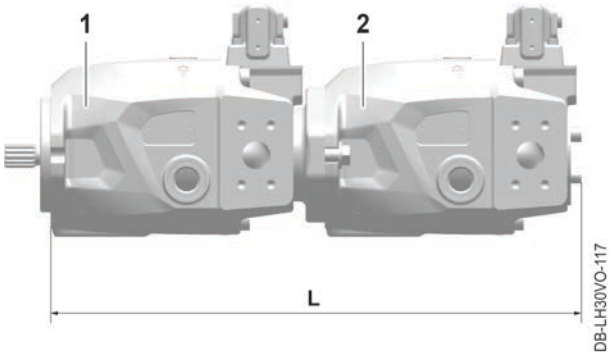
The type code must be completed separately for each individual unit. These type codes must be separated with a dash when ordering.

On the separate type plate for the multiple unit, the nominal sizes are separated by a "+". The last nominal size is followed only by the code for the direction of rotation. (Spaces before and after the letter are mandatory)

| 1. | 2. | 3. | 4. | 5. | 6. | 7. | 11. |
|---|---|---|---|---|---|---|---|
| L | H | 3 | 8 | V | O | 045+045... | |

Type code 4 on the type plate changes from 0 to 8 for the design and the multiple unit is designated as LH38VO.

Details of the individual units can be found on the type plate of each individual unit.




| | |
|---|---|
| 1 | Basic axial piston unit |
| 2 | Add-on axial piston unit |

| | |
|---|---|
| L | Total length of multi-circuit axial piston unit in inch (mm) |
| - | - |

### 5.11.1 Dimensions of the multiple unit

| Basic axial piston unit 1 | | Add-on axial piston unit 2 with type code for through-drive | | | | | |
|---|---|---|---|---|---|---|---|
| | | NS 028 | | NS 045 | | NS 085 | |
| Nominal size | Through-drive type code | K02G | K02G with VE_/ VK_ / LR- | K02G | K02G with VE_/ VK_ / LR- | K02G | K02G with VE_/ VK_ / LR- |
| NS 028 | A11D | ■ L = 16.71 (424.5) | ■ L = 17.07 (433.7) | - | - | - | - |
| | A21D | | | | | | |
| | B11D | | | | | | |
| | B21D | | | | | | |
| NS 045 | A11D | ■ L = 17.66 (448.5) | ■ L = 18.00 (457.1) | ■ L = 18.60 (472.5) | ■ L = 18.67 (474.1) | - | - |
| | A21D | | | | | | |
| | B11D | | | | | | |
| | B21D | | | | | | |
| NS 085 | A11D | ■ L = 19.47 (494.5) | ■ L = 19.83 (503.7) | ■ L = 20.41 (518.5) | ■ L = 20.48 (520.1) | ■ L = 22.72 (577) | ■ L = 22.77 (578.4) |
| | A21D | | | | | | |
| | B11D | ■ L = 19.74 (501.5) | ■ L = 20.11 (510.7) | ■ L = 20.69 (525.5) | ■ L = 20.75 (527.1) | ■ L = 22.99 (584) | ■ L = 23.05 (585.4) |
| | B21D | | | | | | |
| | C11D | ■ L = 20.45 (519.5) | ■ L = 20.81 (528.7) | ■ L = 21.40 (543.5) | ■ L = 21.46 (545.1) | ■ L = 23.70 (602) | ■ L = 23.76 (603.4) |
| | C21D | | | | | | |

■ = Available
□ = Available on request
- = Not possible
L* = Total length in inch (mm)


**Changes, conditions, copyright**

For the purposes of technical development, we reserve the right to make changes without prior notice.



The information in thieyps data sheet does not release the user from their obligation to make their own assessments and tests.

The data sheet mainly shows an example configuration (LH30VO 045), unless otherwise indicated. The product delivered to you may therefore differ from the product illustrated.

Deviations are also possible in terms of data and values in this data sheet; these are only used to pre-select the product configuration and are not binding. The values area always values for the example configuration (LH30VO 045), unless otherwise indicated. Always use the values from the installation drawing supplied to you.

The information above does not extend the warranty and liability conditions in the General Terms and Conditions of Liebherr Machines Bulle SA and Liebherr-Components AG.

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