

# Axial piston variable pump

## A10VSO Series 31

**RE 92711**

Edition: 10.2016

Replaces: 01.2012



- ▶ All-purpose medium pressure pump
- ▶ Sizes 18 to 140
- ▶ Nominal pressure 280 bar
- ▶ Maximum pressure 350 bar
- ▶ Open circuit

### Features

- ▶ Variable pump with axial piston rotary group in swash-plate design for hydrostatic drives in open circuit.
- ▶ The flow is proportional to the drive speed and displacement.
- ▶ The flow can be infinitely varied by adjusting the swash-plate angle.
- ▶ 2 drain ports
- ▶ Excellent suction performance
- ▶ Low noise level
- ▶ Long service life
- ▶ Favorable power/weight ratio
- ▶ Versatile controller range
- ▶ Short control time
- ▶ The through drive is suitable for adding gear pumps and axial piston pumps up to the same size, i.e., 100% through drive.
- ▶ Suitable for operation with mineral oil and HF hydraulic fluids

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## Type code

| 01 | 02           | 03       | 04 | 05 | 06       | 07        | 08 | 09       | 10       | 11 | 12 | 13 |
|----|--------------|----------|----|----|----------|-----------|----|----------|----------|----|----|----|
|    | <b>A10VS</b> | <b>O</b> |    |    | <b>/</b> | <b>31</b> |    | <b>-</b> | <b>V</b> |    |    |    |

| Version |   | 18 | 28 | 45 | 71 | 88 | 100 | 140 |          |
|---------|---|----|----|----|----|----|-----|-----|----------|
| 01      | Standard version (without code)   | •  | •  | •  | •  | •  | •   | •   |          |
|         | HFA, HFB, HFC hydraulic fluid (except for Skydrol)                        | •  | •  | •  | •  | •  | •   | •   | <b>E</b> |
|         | High-speed version (external dimensions are not affected by this option). | -  | -  | •  | •  | -  | •   | •   | <b>H</b> |

### Axial piston unit

|    |   |   |   |   |   |   |   |   |              |
|----|---|---|---|---|---|---|---|---|--------------|
| 02 | Swashplate design, variable, nominal pressure 280 bar, maximum pressure 350 bar | • | • | • | • | • | • | • | <b>A10VS</b> |
|----|---|---|---|---|---|---|---|---|--------------|

### Operating mode

|    |                    |  |  |  |  |  |  |  |          |
|----|--------------------|--|--|--|--|--|--|--|----------|
| 03 | Pump, open circuit |  |  |  |  |  |  |  | <b>O</b> |
|----|--------------------|--|--|--|--|--|--|--|----------|

### Size (NG)

|    |  |           |           |           |           |           |            |            |
|----|--|-----------|-----------|-----------|-----------|-----------|------------|------------|
| 04 | Geometric displacement, (see table of values on pages 6 and 7) | <b>18</b> | <b>28</b> | <b>45</b> | <b>71</b> | <b>88</b> | <b>100</b> | <b>140</b> |
|----|--|-----------|-----------|-----------|-----------|-----------|------------|------------|

### Control device

|    |                                     |                                    |                   |                   |   |   |   |   |             |
|----|-------------------------------------|------------------------------------|-------------------|-------------------|---|---|---|---|-------------|
| 05 | Two-point control, direct operated  |                                    | •                 | •                 | • | • | • | • | <b>DG</b>   |
|    | Pressure controller                 | hydraulic                          | •                 | •                 | • | • | • | • | <b>DR</b>   |
|    |                                     | with flow controller               | hydraulic         | X-T open          | • | • | • | • | <b>DFR</b>  |
|    | with pressure cut-off               | X-T plugged with flushing function |                   | •                 | • | • | • | • | <b>DFR1</b> |
|    |                                     | hydraulic                          | remote controlled | •                 | • | • | • | • | <b>DRG</b>  |
|    |                                     | electrical                         | negative control  | $U = 12\text{ V}$ | • | • | • | • | <b>ED71</b> |
|    |                                     | $U = 24\text{ V}$                  |                   | •                 | • | • | • | • | <b>ED72</b> |
|    |                                     | electrical                         | positive control  | $U = 12\text{ V}$ | • | • | • | • | <b>ER71</b> |
|    |                                     | $U = 24\text{ V}$                  |                   | •                 | • | • | • | • | <b>ER72</b> |
|    | Pressure, flow and power controller |                                    | -                 | •                 | • | • | • | • | <b>DFLR</b> |

### Series

|    |                   |  |  |  |  |  |  |  |           |
|----|-------------------|--|--|--|--|--|--|--|-----------|
| 06 | Series 3, index 1 |  |  |  |  |  |  |  | <b>31</b> |
|----|-------------------|--|--|--|--|--|--|--|-----------|

### Direction of rotation

|    |                       |                   |  |  |  |  |  |  |          |
|----|-----------------------|-------------------|--|--|--|--|--|--|----------|
| 07 | Viewed on drive shaft | clockwise         |  |  |  |  |  |  | <b>R</b> |
|    |                       | counter-clockwise |  |  |  |  |  |  | <b>L</b> |

### Sealing material

|    |  |  |  |  |  |  |  |  |          |
|----|--|--|--|--|--|--|--|--|----------|
| 08 | FKM (fluoroelastomer)  |  |  |  |  |  |  |  | <b>V</b> |
|    | NBR (nitrile rubber) only if using HFA, HFB and HFC hydraulic fluids (position 01; order code "E") |  |  |  |  |  |  |  | <b>P</b> |

### Drive shaft

|    |                      |   |  |   |   |   |   |   |          |
|----|----------------------|---|--|---|---|---|---|---|----------|
| 09 | Splined shaft        | standard shaft                                | •  | • | • | • | • | • | <b>S</b> |
|    |                      | ANSI B92.1a                                   | similar to shaft "S" however for higher input torque | • | • | • | • | - | <b>R</b> |
|    | Parallel keyed shaft | permissible through-drive torque (see page 9) | •  | • | • | • | • | • | <b>P</b> |

### Mounting flange

|    |            | 18     | 28 | 45 | 71 | 88 | 100 | 140 |          |
|----|------------|--------|----|----|----|----|-----|-----|----------|
| 10 | ISO 3019-2 | 2-hole |    | •  | •  | •  | •   | •   | <b>A</b> |
|    |            | 4-hole |    | -  | -  | -  | -   | •   | <b>B</b> |

### Working port

|    |  |                   |   |   |   |   |   |   |           |
|----|--|-------------------|---|---|---|---|---|---|-----------|
| 11 | SAE flange port fastening thread, metric | at side, opposite | • | • | • | - | - | • | <b>12</b> |
|    |  |                   | - | - | - | • | • | - | <b>42</b> |

|    |              |          |    |    |          |           |    |          |          |    |    |    |
|----|--------------|----------|----|----|----------|-----------|----|----------|----------|----|----|----|
| 01 | 02           | 03       | 04 | 05 | 06       | 07        | 08 | 09       | 10       | 11 | 12 | 13 |
|    | <b>A10VS</b> | <b>O</b> |    |    | <b>/</b> | <b>31</b> |    | <b>-</b> | <b>V</b> |    |    |    |

**Through drive** (for mounting options, see page 42)

|    |                       |                      |                                     |  |    |    |    |    |    |     |     |     |
|----|-----------------------|----------------------|-------------------------------------|--|----|----|----|----|----|-----|-----|-----|
| 12 | Flange ISO 3019-1     |                      | Hub for splined shaft <sup>1)</sup> |  |    |    |    |    |    |     |     |     |
|    | Diameter              |                      | Diameter                            |  | 18 | 28 | 45 | 71 | 88 | 100 | 140 |     |
|    | without through drive |                      |                                     |  | •  | •  | •  | •  | •  | •   | •   | N00 |
|    | 82-2 (A)              | 5/8 in 9T 16/32DP    |                                     |  | •  | •  | •  | •  | •  | •   | •   | K01 |
|    |                       | 3/4 in 11T 16/32DP   |                                     |  | •  | •  | •  | •  | •  | •   | •   | K52 |
|    | 101-2 (B)             | 7/8 in 13T 16/32DP   |                                     |  | -  | •  | •  | •  | •  | •   | •   | K68 |
|    |                       | 1 in 15T 16/32DP     |                                     |  | -  | -  | •  | •  | •  | •   | •   | K04 |
|    | 127-2 (C)             | 1 1/4 in 14T 12/24DP |                                     |  | -  | -  | -  | •  | •  | •   | •   | K07 |
|    |                       | 1 1/2 in 17T 12/24DP |                                     |  | -  | -  | -  | -  | -  | •   | •   | K24 |
|    | 152-4 (D)             | 1 3/4 in 13T 8/16DP  |                                     |  | -  | -  | -  | -  | -  | -   | •   | K17 |
|    | Ø63, metric 4-hole    |                      | Shaft key Ø 25                      |  | -  | •  | •  | •  | •  | •   | •   | K57 |
|    | Flange ISO 3019-2     |                      |                                     |  |    |    |    |    |    |     |     |     |
|    | Diameter              |                      |                                     |  |    |    |    |    |    |     |     |     |
|    | 80, 2-hole            | 3/4 in               | 11T 16/32DP                         |  | •  | •  | •  | •  | •  | •   | •   | KB2 |
|    | 100, 2-hole           | 7/8 in               | 13T 16/32DP                         |  | -  | •  | •  | •  | •  | •   | •   | KB3 |
|    |                       | 1 in                 | 15T 16/32DP                         |  | -  | -  | •  | •  | •  | •   | •   | KB4 |
|    | 125, 2-hole           | 1 1/4 in             | 14T 12/24DP                         |  | -  | -  | -  | •  | •  | •   | •   | KB5 |
|    |                       | 1 1/2 in             | 17T 12/24DP                         |  | -  | -  | -  | -  | -  | •   | •   | KB6 |
|    | 180, 4-hole           | 1 3/4 in             | 13T 8/16DP                          |  | -  | -  | -  | -  | -  | -   | •   | KB7 |

**Connectors for solenoids<sup>2)</sup>**

|    |   |  |  |  |   |   |   |   |   |   |   |   |
|----|---|--|--|--|---|---|---|---|---|---|---|---|
| 13 | Without connector (without solenoid, with hydraulic control only, without code) |  |  |  | • | • | • | • | • | • | • |   |
|    | HIRSCHMANN connector – without suppressor diode                                 |  |  |  | • | • | • | • | • | • | • | H |

• = Available    ○ = On request    - = Not available

**Notice**

- Note the project planning notes on page 48.
- In addition to the type code, please specify the relevant technical data when placing your order.

1) Hub for splined shaft according to ANSI B92.1a  
2) Connectors for other electric components can deviate.

## Hydraulic fluids

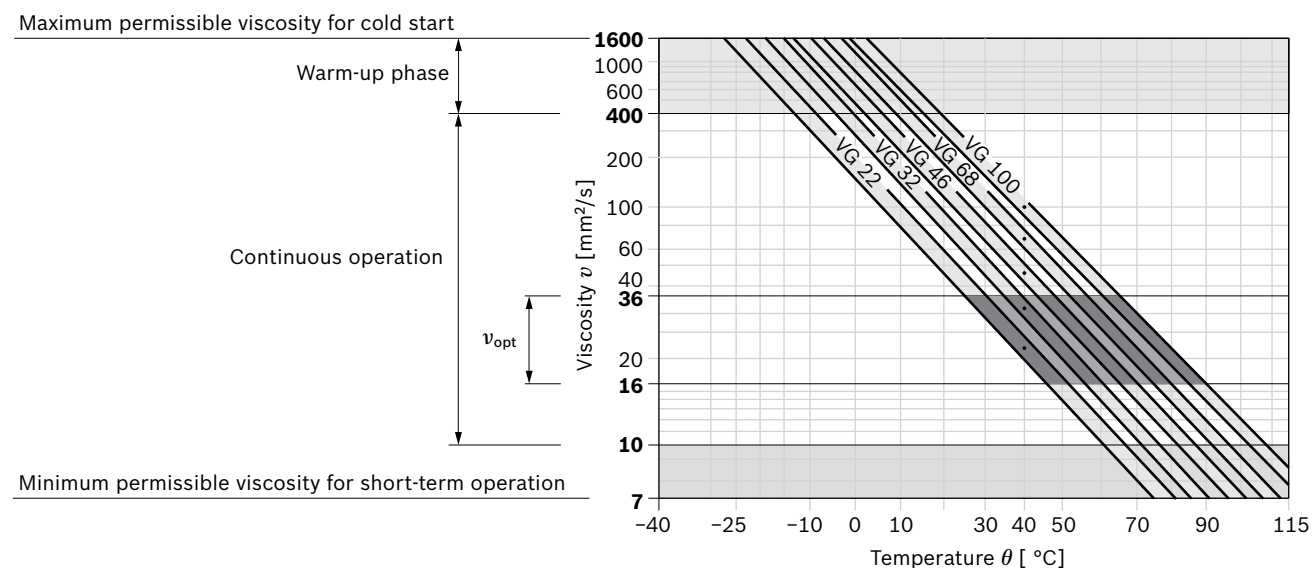
The A10VSO variable pump is designed for operation with HLP mineral oil according to DIN 51524. Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start project planning:

- ▶ 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- ▶ 90221: Environmentally acceptable hydraulic fluids
- ▶ 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU) (for permissible technical data, see data sheet 90255)
- ▶ 90223: Fire-resistant, water-containing hydraulic fluids (HFAE, HFAS, HFB, HFC)
- ▶ 90225: Restricted technical data only for operation
- ▶ with fire-resistant, water-free and water-containing hydraulic fluids (HFDR, HFDU, HFB, HFC)- technical data

### Viscosity and temperature of hydraulic fluids

|                      | Viscosity  | Shaft seal        | Temperature <sup>3)</sup>                            | Comment  |
|----------------------|--|-------------------|--|--|
| Cold start           | $v_{\max} \leq 1600 \text{ mm}^2/\text{s}$           | NBR <sup>2)</sup> | $\theta_{\text{St}} \geq -40 \text{ }^\circ\text{C}$ | $t \leq 3 \text{ min}$ , without load ( $p \leq 50 \text{ bar}$ ), $n \leq 1000 \text{ min}^{-1}$<br>Permissible temperature difference between axial piston unit and hydraulic fluid in the system maximum 25 K |
|                      |  | FKM               | $\theta_{\text{St}} \geq -25 \text{ }^\circ\text{C}$ |  |
| Warm-up phase        | $v = 1600 \dots 400 \text{ mm}^2/\text{s}$           |                   |  | $t \leq 15 \text{ min}$ , $p \leq 0.7 \times p_{\text{nom}}$ and $n \leq 0.5 \times n_{\text{nom}}$  |
| Continuous operation | $v = 400 \dots 10 \text{ mm}^2/\text{s}^{1)}$        | NBR <sup>2)</sup> | $\theta = +85 \text{ }^\circ\text{C}$                | measured at port <b>L</b> , <b>L<sub>1</sub></b>   |
|                      |  | FKM               | $\theta = +110 \text{ }^\circ\text{C}$               |  |
|                      | $v_{\text{opt}} = 36 \dots 16 \text{ mm}^2/\text{s}$ |                   |  | Range of optimum operating viscosity and efficiency  |
| Short-term operation | $v_{\min} = 10 \dots 7 \text{ mm}^2/\text{s}$        | NBR <sup>2)</sup> | $\theta = +85 \text{ }^\circ\text{C}$                | $t \leq 3 \text{ min}$ , $p \leq 0.3 \times p_{\text{nom}}$ , measured at port <b>L</b> , <b>L<sub>1</sub></b>   |
|                      |  | FKM               | $\theta = +110 \text{ }^\circ\text{C}$               |  |

### ▼ Selection diagram



1) Corresponds e.g. for VG 46 to a temperature range of +4 °C to +85 °C (see selection diagram)

2) Version EA10VSO...-P (if operating with HFA, HFB and HFC hydraulic fluids)

### Notes on selection of hydraulic fluid

The hydraulic fluid should be selected so that the operating viscosity in the operating temperature range is within the optimum range ( $v_{\text{opt}}$  see selection diagram).

### Notice

- ▶ The axial piston unit is suitable for operation with water-containing HF hydraulic fluid. See version “E”

3) If the temperature at extreme operating parameters cannot be adhered to, please contact us.

### **Filtration of the hydraulic fluid**

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit. A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

At very high hydraulic fluid temperatures (maximum 110 °C, measured at port **L, L<sub>1</sub>**), at least a cleanliness level of 19/17/14 according to ISO 4406 is necessary.

Please contact us if the above classes cannot be observed.

Working pressure range

| Pressure at working port B                           |                              |  | Definition |
|--|------------------------------|--|------------|
| Nominal pressure $p_{nom}$                           | 280 bar                      | The nominal pressure corresponds to the maximum design pressure.<br><br>The maximum pressure corresponds to the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period. |            |
| Maximum pressure $p_{max}$                           | 350 bar                      |  |            |
| Single operating period                              | 2 ms                         |  |            |
| Total operating period                               | 300 h                        |  |            |
| Minimum pressure $p_{B abs}$<br>(high-pressure side) | 10 bar <sup>1)</sup>         | Minimum pressure on the high-pressure side ( <b>B</b> ) which is required in order to prevent damage to the axial piston unit.   |            |
| Rate of pressure change $R_{A max}$                  | 16000 bar/s                  | Maximum permissible speed of pressure build-up and reduction during a pressure change across the entire pressure range.  |            |
| Pressure at suction port S (inlet)                   |                              |  |            |
| Minimum pressure     Standard<br>$p_{S min}$         | 0.8 bar absolute             | Minimum pressure at suction port <b>S</b> (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the rotational speed and displacement of the axial piston unit.  |            |
| Maximum pressure $p_{S max}$                         | 10 bar                       |  |            |
| Case pressure at port L, L <sub>1</sub>              |                              |  |            |
| Maximum pressure $p_{L max}$                         | 2 bar <sup>1)</sup> absolute | Maximum 0.5 bar higher than inlet pressure at port <b>S</b> , but not higher than $p_{L max}$ .<br>A case drain line to the reservoir is required.   |            |

▼ Rate of pressure change  $R_{A max}$



Notice

Working pressure range valid when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.

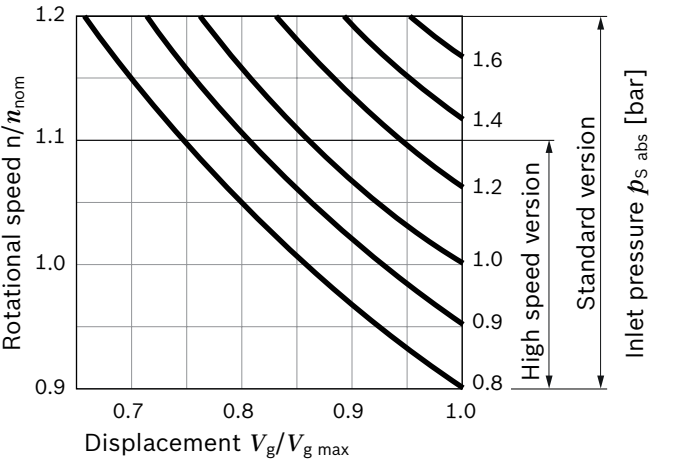
Minimum permissible inlet pressure at suction port S with speed increase

In order to avoid damage to the pump (cavitation), a minimum inlet pressure must be guaranteed at suction port S. The minimum inlet pressure level depends on the rotational speed and the displacement of the variable pump.

▼ Pressure definition



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



During continuous operation in overspeed over  $n_{nom}$ , a reduction in operational service life is to be expected due to cavitation erosion.

1) Other values on request

## Technical data, standard unit

| Size  |                                      | NG               |                  | 18      | 28     | 45     | 71     | 88     | 100    | 140    |
|---|--------------------------------------|------------------|------------------|---------|--------|--------|--------|--------|--------|--------|
| Displacement, geometric, per revolution       |                                      | $V_{g \max}$     | cm <sup>3</sup>  | 18      | 28     | 45     | 71     | 88     | 100    | 140    |
| Rotational speed maximum <sup>1)</sup>        | at $V_{g \max}$                      | $n_{\text{nom}}$ | rpm              | 3300    | 3000   | 2600   | 2200   | 2100   | 2000   | 1800   |
|   | at $V_g < V_{g \max}$ <sup>2)</sup>  | $n_{\text{max}}$ | rpm              | 3900    | 3600   | 3100   | 2600   | 2500   | 2400   | 2100   |
| Flow  | at $n_{\text{nom}}$ and $V_{g \max}$ | $q_{v \max}$     | l/min            | 59      | 84     | 117    | 156    | 185    | 200    | 252    |
|   | at $n_E = 1500$ rpm and $V_{g \max}$ | $q_{vE \max}$    | l/min            | 27      | 42     | 68     | 107    | 132    | 150    | 210    |
| Power at $\Delta p = 280$ bar                 | at $n_{\text{nom}}$ , $V_{g \max}$   | $P_{\max}$       | kW               | 28      | 39     | 55     | 73     | 86     | 93     | 118    |
|   | at $n_E = 1500$ rpm and $V_{g \max}$ | $P_{E \max}$     | kW               | 12.6    | 20     | 32     | 50     | 62     | 70     | 98     |
| Torque at $V_{g \max}$ and                    | $\Delta p = 280$ bar                 | $T_{\max}$       | Nm               | 80      | 125    | 200    | 316    | 392    | 445    | 623    |
|   | $\Delta p = 100$ bar                 | $T$              | Nm               | 30      | 45     | 72     | 113    | 140    | 159    | 223    |
| Rotary stiffness of drive shaft               | S                                    | $c$              | Nm/rad           | 11087   | 22317  | 37500  | 71884  | 71884  | 121142 | 169437 |
|   | R                                    | $c$              | Nm/rad           | 14850   | 26360  | 41025  | 76545  | 76545  | –      | –      |
|   | P                                    | $c$              | Nm/rad           | 13158   | 25656  | 41232  | 80627  | 80627  | 132335 | 188406 |
| Moment of inertia for rotary group            |                                      | $J_{TW}$         | kgm <sup>2</sup> | 0.00093 | 0.0017 | 0.0033 | 0.0083 | 0.0083 | 0.0167 | 0.0242 |
| Case volume                                   |                                      | $V$              | l                | 0.4     | 0.7    | 1.0    | 1.6    | 1.6    | 2.2    | 3.0    |
| Weight <b>without</b> through drive (approx.) |                                      | $m$              | kg               | 12.9    | 18     | 23.5   | 35.2   | 35.2   | 49.5   | 65.4   |
| Weight <b>with</b> through drive (approx.)    |                                      |                  |                  | 14      | 19.3   | 25.1   | 38     | 38     | 55.4   | 74.4   |

### Determining the characteristics

|      |   |         |
|------|---|---------|
| Flow | $q_v = \frac{V_g \times n \times \eta_v}{1000}$ | [l/min] |
|------|---|---------|

|        |  |      |
|--------|--|------|
| Torque | $T = \frac{V_g \times \Delta p}{20 \times \pi \times \eta_{mh}}$ | [Nm] |
|--------|--|------|

|       |   |      |
|-------|---|------|
| Power | $P = \frac{2 \pi \times T \times n}{60000} = \frac{q_v \times \Delta p}{600 \times \eta_t}$ | [kW] |
|-------|---|------|

### Key

$V_g$  Displacement per revolution [cm<sup>3</sup>]

$\Delta p$  Differential pressure [bar]

$n$  Rotational speed [rpm]

$\eta_v$  Volumetric efficiency

$\eta_{hm}$  Hydraulic-mechanical efficiency

$\eta_t$  Total efficiency ( $\eta_t = \eta_v \times \eta_{hm}$ )

### Notice

- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommends checking the load by means of test or calculation / simulation and comparison with the permissible values.

1) The values are applicable:

- For the optimum viscosity range from  $v_{opt} = 36$  to  $16$  mm<sup>2</sup>/s
- For hydraulic fluid based on mineral oils
- For absolute pressure  $p_{abs} = 1$  bar at suction port **S**

2) For a speed increase up to  $n_{\text{max perm}}$ , please observe the diagram on page 6.

## Technical data, high-speed version (external dimensions are the same as the standard version)

| Size  |   | NG               |                  | 45     | 71     | 100    | 140    |
|---|---|------------------|------------------|--------|--------|--------|--------|
| Displacement, geometric, per revolution       |   | $V_{g \max}$     | cm <sup>3</sup>  | 45     | 71     | 100    | 140    |
| Rotational speed maximum <sup>1)</sup>        | at $V_{g \max}$   | $n_{\text{nom}}$ | rpm              | 3000   | 2550   | 2300   | 2050   |
|   | at $V_g < V_{g \max}$ <sup>2)</sup>                         | $n_{\text{max}}$ | rpm              | 3300   | 2800   | 2500   | 2200   |
|   |   | perm             |                  |        |        |        |        |
| Flow  | at $n_{\text{nom}}$ and $V_{g \max}$                        | $q_{v \max}$     | l/min            | 135    | 178    | 230    | 287    |
| Power   | at $n_{\text{nom}}$ , $V_{g \max}$ and $\Delta p = 280$ bar | $P_{\text{max}}$ | kW               | 63     | 83     | 107    | 134    |
| Torque  | $\Delta p = 280$ bar  | $T_{\text{max}}$ | Nm               | 200    | 316    | 445    | 623    |
|   | at $V_{g \max}$ and $\Delta p = 100$ bar                    | $T$              | Nm               | 72     | 113    | 159    | 223    |
| Rotary stiffness drive shaft                  | S   | $c$              | Nm/rad           | 37500  | 71884  | 121142 | 169537 |
|   | R   | $c$              | Nm/rad           | 41025  | 76545  | –      | –      |
|   | P   | $c$              | Nm/rad           | 41232  | 80627  | 132335 | 188406 |
| Moment of inertia for rotary group            |   | $J_{\text{TW}}$  | kgm <sup>2</sup> | 0.0033 | 0.0083 | 0.0167 | 0.0242 |
| Case volume                                   |   | $V$              | l                | 1.0    | 1.6    | 2.2    | 3.0    |
| Weight <b>without</b> through drive (approx.) |   | $m$              | kg               | 23.5   | 35.2   | 49.5   | 65.4   |
| Weight <b>with</b> through drive (approx.)    |   |                  |                  | 25.1   | 38     | 55.4   | 74.4   |

### Notice

- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommends checking the load by means of test or calculation / simulation and comparison with the permissible values.

## Technical data, HF hydraulic fluids, maximum rotational speed

| Hydraulic fluid <sup>3)</sup> E-version | Size   | NG                   | 18   | 28   | 45   | 71   | 88   | 100  | 140  |
|---|--|----------------------|------|------|------|------|------|------|------|
| HFA                                     | at nominal pressure $p_N$ 140 bar            | $n_{\text{nom}}$ rpm | 2450 | 2250 | 1950 | 1650 | 1550 | 1500 | 1350 |
|   | at maximum pressure $p_{\text{max}}$ 160 bar |                      |      |      |      |      |      |      |      |
| HFB                                     | at nominal pressure $p_N$ 140 bar            | $n_{\text{nom}}$ rpm | 2650 | 2400 | 2100 | 1760 | 1650 | 1600 | 1450 |
|   | at maximum pressure $p_{\text{max}}$ 160 bar |                      |      |      |      |      |      |      |      |
| HFC                                     | at nominal pressure $p_N$ 175 bar            | $n_{\text{nom}}$ rpm | 2650 | 2400 | 2100 | 1760 | 1650 | 1600 | 1450 |
|   | at maximum pressure $p_{\text{max}}$ 210 bar |                      |      |      |      |      |      |      |      |
| Technical data, HFD hydraulic fluids    |  |                      |      |      |      |      |      |      |      |
| HFDR, HFDU polyalkylene glycol          | at nominal pressure $p_N$ 280 bar            | $n_{\text{nom}}$ rpm | 2650 | 2400 | 2100 | 1760 | 1650 | 1600 | 1450 |
| HFDU polyol ester                       | at nominal pressure $p_N$ 280 bar            |                      |      |      |      |      |      |      |      |

- 1) The values are applicable:
- At absolute pressure  $p_{\text{abs}} = 1$  bar at suction port **S**
  - For the optimal viscosity range of  $\nu_{\text{opt}} = 36$  to  $16$  mm<sup>2</sup>/s
  - For hydraulic fluid based on mineral oils
- 2) For a speed increase up to  $n_{\text{max perm}}$ , please observe the diagram on page 6.

- 3) For further information on HF hydraulic fluids, please see data sheets 90223 and 90225



### Permissible radial and axial forces of the drive shafts

| Size                        |   | NG                |   | 18  | 28   | 45   | 71   | 88   | 100  | 140  |
|-----------------------------|---|-------------------|---|-----|------|------|------|------|------|------|
| Maximum radial force at a/2 |  | $F_{q \max}$      | N | 350 | 1200 | 1500 | 1900 | 1900 | 2300 | 2800 |
| Maximum axial force         |  | $\pm F_{ax \max}$ | N | 700 | 1000 | 1500 | 2400 | 2400 | 4000 | 4800 |

#### Notice

- The values given are maximum values and do not apply to continuous operation. Drives with radial loading (pinion, V-belt drives) are not permissible!

### Permissible input and through-drive torques

| Size   |               |    | 18    | 28    | 45  | 71    | 88    | 100   | 140   |
|--|---------------|----|-------|-------|-----|-------|-------|-------|-------|
| Torque at $V_{g \max}$ and $\Delta p = 280 \text{ bar}^{1)}$ | $T_{\max}$    | Nm | 80    | 125   | 200 | 316   | 392   | 445   | 623   |
| Maximum input torque at drive shaft <sup>2)</sup>            |               |    |       |       |     |       |       |       |       |
| S  | $T_{E \max}$  | Nm | 124   | 198   | 319 | 626   | 626   | 1104  | 1620  |
|  | $\varnothing$ | in | 3 / 4 | 7 / 8 | 1   | 1 1/4 | 1 1/4 | 1 1/2 | 1 3/4 |
| R  | $T_{E \max}$  | Nm | 160   | 250   | 400 | 644   | 644   | –     | –     |
|  | $\varnothing$ | in | 3 / 4 | 7 / 8 | 1   | 1 1/4 | 1 1/4 | –     | –     |
| P  | $T_{E \max}$  | Nm | 88    | 137   | 200 | 439   | 439   | 857   | 1206  |
|  | $\varnothing$ | in | 18    | 22    | 25  | 32    | 32    | 40    | 45    |
| Maximum through-drive torque                                 |               |    |       |       |     |       |       |       |       |
| S  | $T_{D \max}$  | Nm | 108   | 160   | 319 | 492   | 492   | 778   | 1266  |
| R  | $T_{D \max}$  | Nm | 120   | 176   | 365 | 548   | 548   | –     | –     |
| P  | $T_{D \max}$  | Nm | 88    | 137   | 200 | 439   | 439   | 778   | 1206  |

#### ▼ Distribution of torques



|                      |                         |
|----------------------|-------------------------|
| Torque at 1st pump   | $T_1$                   |
| Torque at 2nd pump   | $T_2$                   |
| Torque at 3rd pump   | $T_3$                   |
| Input torque         | $T_E = T_1 + T_2 + T_3$ |
|                      | $T_E < T_{E \max}$      |
| Through-drive torque | $T_D = T_2 + T_3$       |
|                      | $T_D < T_{D \max}$      |

- 1) Efficiency not considered
- 2) For drive shafts with no radial force

## DG – Two-point control, direct operated

The variable pump can be set to a minimum swivel angle by connecting an external switching pressure to port **X**.

This will supply control fluid directly to the stroking piston; a minimum control pressure of  $p_{st} \geq 50$  bar is required.

The variable pump can only be switched between  $V_{g \max}$  or  $V_{g \min}$ .

Please note that the required control pressure at port **X** is directly dependent on the actual working pressure  $p_B$  in port **B**. (See control pressure characteristic curve).

The maximum permissible switching pressure is 280 bar.

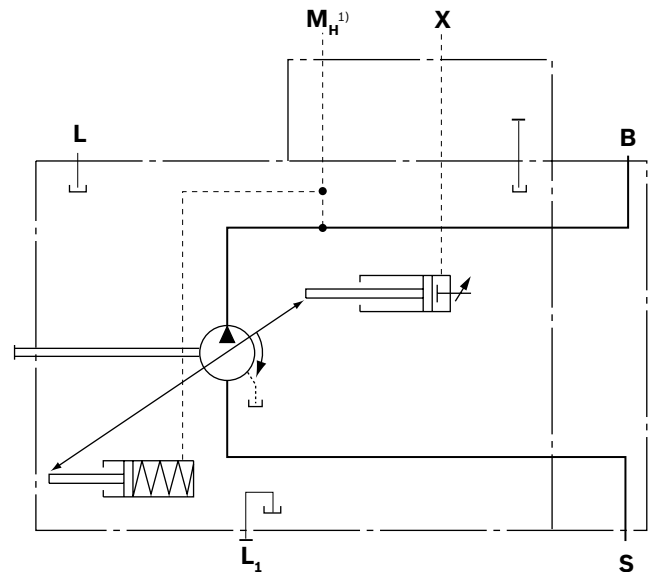
Switching pressure  $p_{st}$  in **X** = 0 bar  $\triangleq V_{g \max}$

Switching pressure  $p_{st}$  in **X**  $\geq 50$  bar  $\triangleq V_{g \min}$

### ▼ Switching pressure characteristic curve



### ▼ Circuit diagram



1) Only size 140

## DR – Pressure controller

The pressure controller limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the working pressure exceeds the pressure command value at the pressure valve, the pump will regulate to a smaller displacement to reduce the control differential.

- ▶ Initial position in depressurized state:  $V_{g \max}$ .
- ▶ Setting range<sup>1)</sup> for infinitely variable 20 to 280 bar pressure control. Standard is 280 bar.

### ▼ Characteristic curve



Characteristic curve valid at  $n_1 = 1500 \text{ rpm}$  and  $\theta_{\text{fluid}} = 50 \text{ °C}$ .

### ▼ Circuit diagram, sizes 18 to 100



### ▼ Circuit diagram, size 140



### Controller data

| NG                           |                  | 18                | 28 | 45 | 71 | 88 | 100 | 140 |
|------------------------------|------------------|-------------------|----|----|----|----|-----|-----|
| Pressure increase            | $\Delta p$ [bar] | 4                 | 4  | 6  | 8  | 9  | 10  | 12  |
| Hysteresis and repeatability | $\Delta p$ [bar] | maximum 3         |    |    |    |    |     |     |
| Pilot fluid consumption      | [l/min]          | maximum approx. 3 |    |    |    |    |     |     |

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

**DRG – Pressure controller, remote controlled**

For the remote controlled pressure controller, the LS pressure limitation is performed using a separately arranged pressure relief valve. Therefore any pressure control value under the pressure set on the pressure controller can be regulated. Pressure controller DR see page 11.

A pressure relief valve is externally piped up to port **X** for remote control. This relief valve is not included in the scope of delivery of the DRG control.

When there is differential pressure of 20 bar  $\Delta p$  (standard setting), the quantity of control fluid at the port is **X** approx. 1.5 l/min. If a different setting (range 10 to 22 bar) is required, please state in plain text.

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

- ▶ a direct operated, hydraulic or electric proportional one, suitable for the control fluid mentioned above.

The max. length of piping should not exceed 2 m.

- ▶ Basic position in depressurized state:  $V_{g\ max}$ .
- ▶ Setting range<sup>1)</sup> for pressure control 20 to 280 bar **(3)**. Standard is 280 bar.
- ▶ Setting range for differential pressure 10 - 22 bar**(2)**. Standard is 20 bar.

Unloading port **X** to the reservoir results in a zero stroke (standby) pressure which is approx. 1 to 2 bar higher than the defined differential pressure  $\Delta p$ , however system influences are not taken into account.

**▼ Characteristic curve DRG**



Characteristic curve valid for  $n_1 = 1500\text{ rpm}$  and  $t_{fluid} = 50\text{ }^{\circ}\text{C}$ .

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

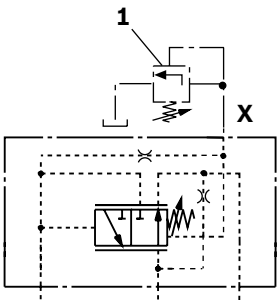
2) Zero stroke pressure from pressure setting  $\Delta p$  on controller **(2)**

**▼ Circuit diagram DRG nominal size 18 to 100**



- 1 The separate pressure relief valve and the line are not included in the scope of delivery.
- 2 Remote controlled pressure cut-off **(G)**.
- 3 Pressure controller **(DR)**

**▼ Circuit diagram, size 140**



**Controller data DRG**

| NG                           | 18                          | 28 | 45 | 71 | 88 | 100 | 140 |
|------------------------------|-----------------------------|----|----|----|----|-----|-----|
| Hysteresis and repeatability | $\Delta p$ [bar] maximum 4  |    |    |    |    |     |     |
| Pilot fluid consumption      | [l/min] maximum approx. 4.5 |    |    |    |    |     |     |

## DFR/DFR1 – Pressure flow controller

In addition to the pressure controller function (see page 11), a variable orifice (e.g. directional valve) is used to adjust the differential pressure upstream and downstream of the orifice. This is used to control the pump flow. The pump flow is equal to the actual hydraulic fluid quantity required by the consumer. With all controller combinations, the  $V_g$  reduction has priority.

- ▶ Basic position in depressurized state:  $V_{g \max}$ .
- ▶ Setting range<sup>1)</sup> to 280 bar.
- ▶ For pressure controller data see page 11

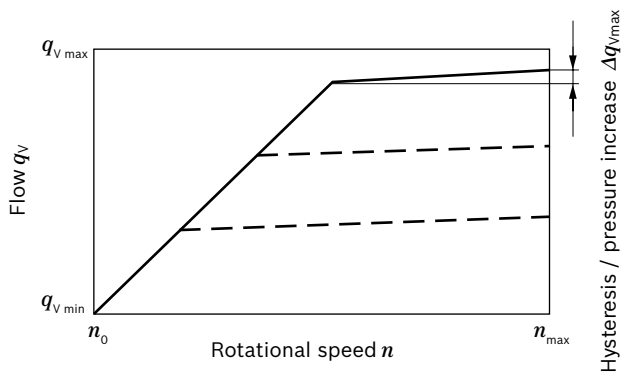
### Notice

- ▶ The DFR1 version has no unloading between **X** and the reservoir. Unloading the LS-pilot line must be possible in the valve system. Because of the flushing function of the flow controller in the DRS control valve, sufficient unloading of the **X**-line must also be provided.

### ▼ Characteristic curve



### ▼ Characteristic curve at variable rotational speed



Characteristic curve valid at  $n_1 = 1500$  rpm and  $\theta_{\text{fluid}} = 50$  °C.

### ▼ Circuit diagram DFR size 18 to 100



### ▼ Circuit diagram, size 140



- 1 The metering orifice (control block) and the line is not included in the scope of delivery.
- 2 Pressure and flow controller (FR).
- 3 Pressure controller (DR)

For further information see page 14

- 1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.
- 2) Zero stroke pressure from pressure setting  $\Delta p$  on controller (2)

#### Differential pressure $\Delta p$ :

- Standard setting: 14 bar  
If another setting is required, please state in plain text.
- Setting range: 14 bar to 22 bar

Relieving the load on port **X** to the reservoir results in a zero stroke (“standby”) pressure which lies about 1 to 2 bar higher than the defined differential pressure  $\Delta p$ , however, system influences are not taken into account.

#### Controller data

DR pressure controller data see page 11.

Maximum flow deviation measured at drive speed  
 $n = 1500$  rpm.

| <b>NG</b>                     |                              | <b>18</b>  | <b>28</b> | <b>45</b> | <b>71</b> | <b>88</b> | <b>100</b> | <b>140</b> |
|-------------------------------|------------------------------|--|-----------|-----------|-----------|-----------|------------|------------|
| Flow deviation                | $\Delta q_{Vmax}$<br>[l/min] | 0.9  | 1.0       | 1.8       | 2.8       | 3.4       | 4.0        | 6.0        |
| Hysteresis and repeat-ability | $\Delta p$ [bar]             | maximum 4  |           |           |           |           |            |            |
| Pilot fluid consumption       | [l/min]                      | maximum approx. 3 to 4.5 (DFR)<br>maximum approx. 3 (DFR1) |           |           |           |           |            |            |

## DFLR – Pressure, flow and power control

Pressure controller equipped like DR, see page 11.  
Equipment of the flow controller like DFR1, see page 13  
In order to achieve a constant drive torque with varying working pressures, the swivel angle and with it the output flow from the axial piston pump is varied so that the product of flow and pressure remains constant.  
Flow control is possible below the power control curve.

### ▼ Characteristic curve and torque characteristic



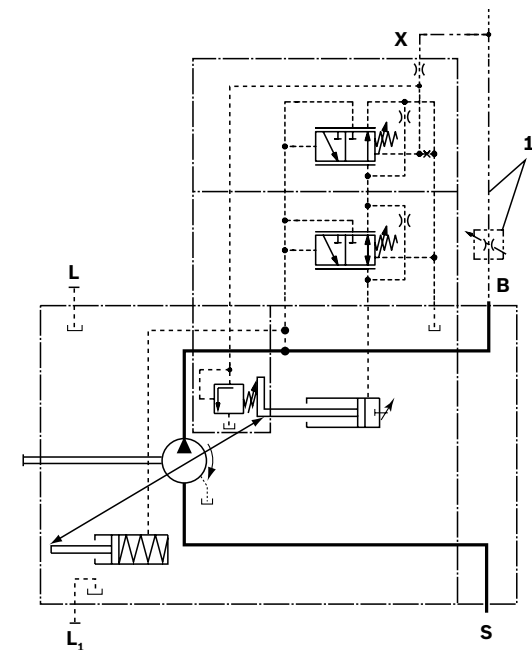
Please contact us regarding beginning of control at < 50 bar

When ordering please state the power characteristics to be set at the factory in plain text, e.g. 20 kW at 1500 rpm.

### ▼ Circuit diagram, sizes 28 to 100



### ▼ Circuit diagram, size 140



**1** The metering orifice (control block) and the line is not included in the scope of delivery.

### Controller data

For technical data of pressure controller DR see page 11.

For technical data of flow controller FR see page 14.

Control fluid consumption approx. 5.5 l/min max.

## ED – Electrohydraulic pressure control

The ED valve is set to a certain pressure by a specified variable solenoid current.

With changes on the consumer (load pressure), this causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

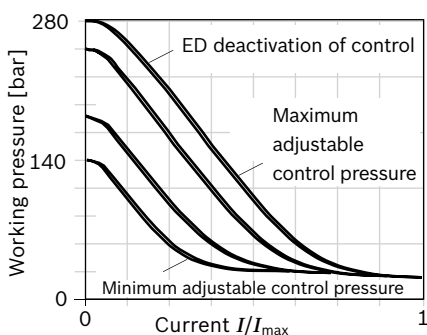
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.

As the solenoid current signal drops towards zero, the pressure will be limited to  $p_{\max}$  by an adjustable hydraulic pressure cut-off (secure fail safe function in case of power failure, e.g. for fan speed control). The swivel time characteristic of the ED control was optimized for the use as a fan drive system.

When ordering, specify the type of application in plain text.

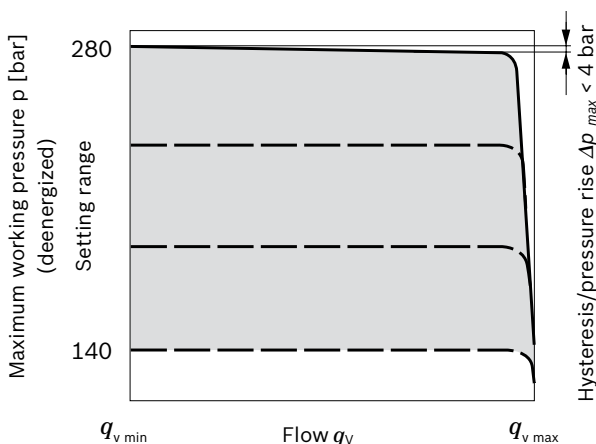
### ▼ Static current-pressure characteristic curve ED

(negative characteristic curve measured with pump in zero stroke)



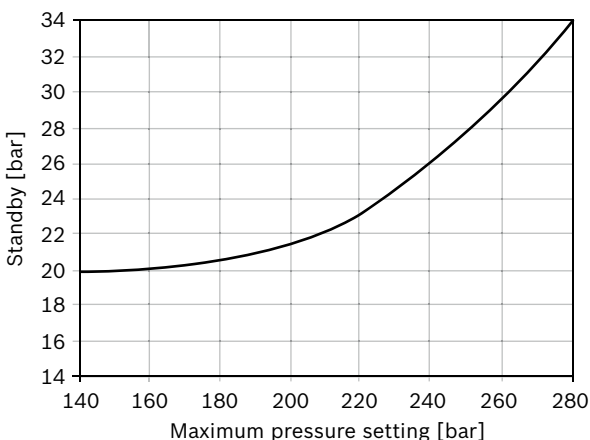
► Hysteresis static current-pressure characteristic curve < 3 bar.

### ▼ Flow-pressure characteristic curve

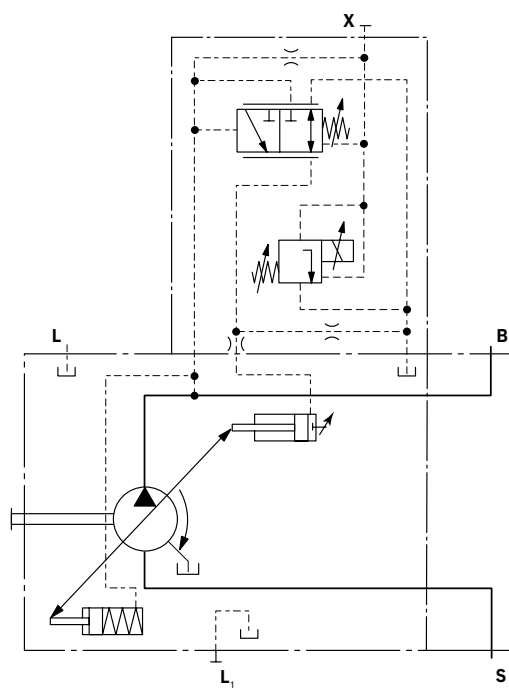


Characteristic curves valid at  $n_1 = 1500 \text{ rpm}$  and  $t_{\text{fluid}} = 50^\circ \text{C}$ .  
Control fluid consumption: 3 to 4.5 l/min.  
For standby standard setting, see diagram on right, other values on request.

### ▼ Influence of the pressure setting on standby (maximally energized)



### ▼ Circuit diagram ED71/ED72



| Technical data, solenoid   | ED71                | ED72                |
|--|---------------------|---------------------|
| Voltage  | 12 V ( $\pm 20\%$ ) | 24 V ( $\pm 20\%$ ) |
| Control current  |                     |                     |
| Start of control at $p_{\max}$   | 0 mA                | 0 mA                |
| Start of control at $p_{\min}$   | 1200 mA             | 600 mA              |
| Current limit  | 1.54 A              | 0.77 A              |
| Nominal resistance (at $20^\circ \text{C}$ )                                       | 5.5 $\Omega$        | 22.7 $\Omega$       |
| Dither frequency   | 100 to 200 Hz       | 100 to 200 Hz       |
| Duty cycle   | 100%                | 100%                |
| Electronic controls and type of protection, see page 44                            |                     |                     |
| Operating temperature range at valve $-20^\circ \text{C}$ to $+115^\circ \text{C}$ |                     |                     |



## ER – Electrohydraulic pressure control

The ER valve is set to a certain pressure by a specified variable solenoid current.

When changing the consumer (load pressure), this causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

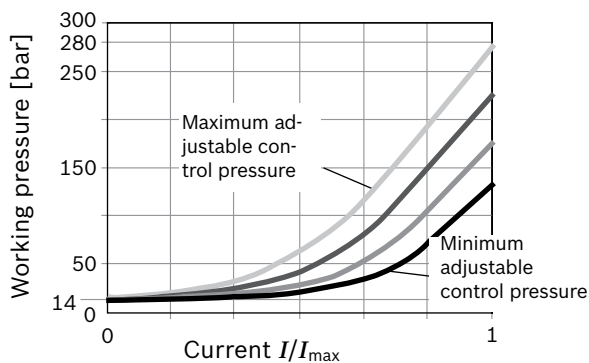
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.

If the solenoid current goes to zero, the pressure is limited to  $p_{\min}$  (standby) by the adjustable, hydraulic pressure cut-off.

Observe project planning note.

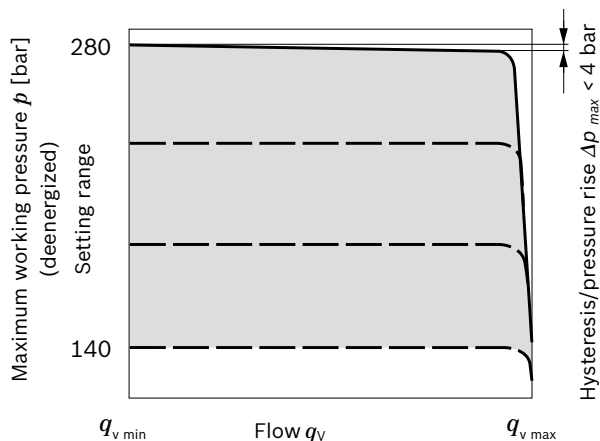
### ▼ Current-pressure characteristic curve

(positive characteristic curve measured with pump in zero stroke)



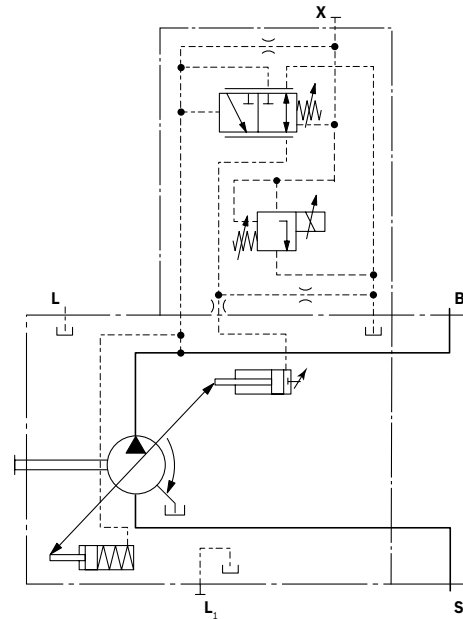
► Hysteresis static < 3 bar.

### ▼ Flow-pressure characteristic curve



- Characteristic curve valid at  $n_1 = 1500$  rpm and  $\theta_{\text{fluid}} = 50^\circ\text{C}$ .
- Control fluid consumption: 3 to 4.5 l/min.
- Standby standard setting 14 bar. Other values on request.
- Influence of pressure setting on stand by  $\pm 2$  bar

### ▼ Circuit diagram



| Technical data, solenoid   | ER71                | ER72                |
|--|---------------------|---------------------|
| Voltage  | 12 V ( $\pm 20\%$ ) | 24 V ( $\pm 20\%$ ) |
| Control current  |                     |                     |
| Start of control at $p_{\min}$   | 100 mA              | 50 mA               |
| End of control at $p_{\max}$   | 1200 mA             | 600 mA              |
| Current limit  | 1.54 A              | 0.77 A              |
| Nominal resistance (at $20^\circ\text{C}$ )                                      | 5.5 $\Omega$        | 22.7 $\Omega$       |
| Dither frequency   | 100 to 200 Hz       | 100 to 200 Hz       |
| Duty cycle   | 100%                | 100%                |
| Electronic controls and type of protection, see page 44                          |                     |                     |
| Operating temperature range at valve $-20^\circ\text{C}$ to $+115^\circ\text{C}$ |                     |                     |

### Project planning note!

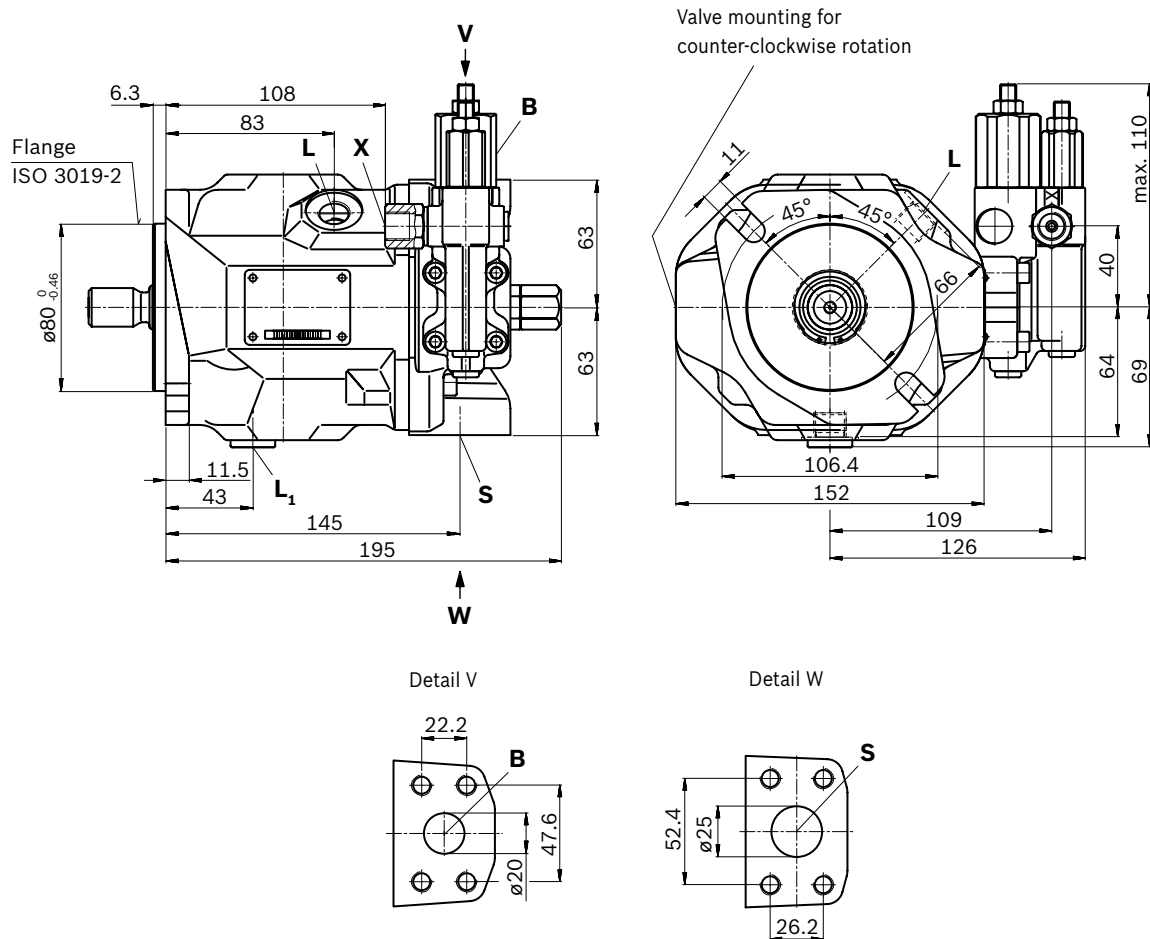
Excessive current levels ( $I > 1200$  mA at 12 V or  $I > 600$  mA at 24 V) to the ER solenoid can result in undesired pressure increases which can lead to pump or system damage. Therefore:

- Use  $I_{\max}$  current limiter solenoids.
- An intermediate plate pressure controller can be used to protect the pump in the event of overflow.

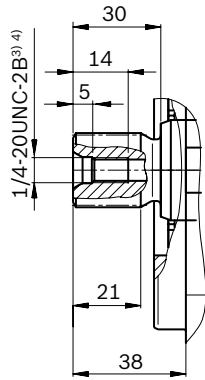
An accessory kit with intermediate plate pressure controller can be ordered from Bosch Rexroth under part number R902490825.

## Dimensions, size 18

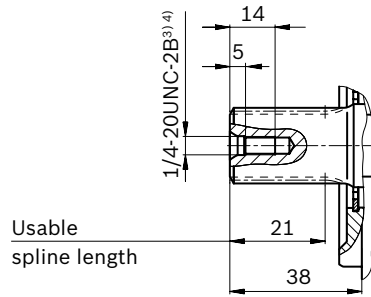
### DFR/DFR1 – Pressure flow controller, hydraulic, clockwise rotation



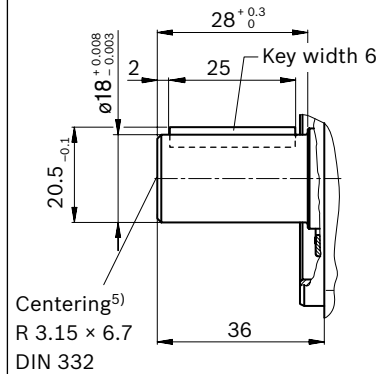
## ▼ Splined shaft 3/4 in (SAE J744)

**S** – 11T 16/32DP<sup>1)</sup>

## ▼ Splined shaft 3/4 in (SAE J744)

**R** – 11T 16/32DP<sup>1)2)</sup>

## ▼ Parallel keyed shaft, DIN 6885

**P** – A6 × 6 × 25

| Ports                |   | Standard                         | Size <sup>4)</sup>           | $p_{\max \text{ abs}}$ [bar] <sup>6)</sup> | State <sup>10)</sup> |
|----------------------|---|----------------------------------|------------------------------|--|----------------------|
| <b>B</b>             | Working port (standard pressure series)<br>Fastening thread | SAE J518 <sup>7)</sup><br>DIN 13 | 3/4 in<br>M10 × 1.5; 17 deep | 350  | O                    |
| <b>S</b>             | Suction port (standard pressure series)<br>Fastening thread | SAE J518 <sup>7)</sup><br>DIN 13 | 1 in<br>M10 × 1.5; 17 deep   | 10   | O                    |
| <b>L</b>             | Drain port  | DIN 3852 <sup>8)</sup>           | M16 × 1.5; 12 deep           | 2  | O <sup>9)</sup>      |
| <b>L<sub>1</sub></b> | Drain port  | DIN 3852 <sup>8)</sup>           | M16 × 1.5; 12 deep           | 2  | X <sup>9)</sup>      |
| <b>X</b>             | Pilot pressure port   | DIN 3852                         | M14 × 1.5; 12 deep           | 350  | O                    |
| <b>X</b>             | Pilot pressure port with DG-control                         | DIN ISO 228                      | G1/4 in; 12 deep             | 350  | O                    |

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

2) Splines according to ANSI B92.1a, spline runout is a deviation from standard.

3) Thread according to ASME B1.1

4) For notes on tightening torques, see the instruction manual

5) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw

6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

7) Metric fastening thread is a deviation from standard.

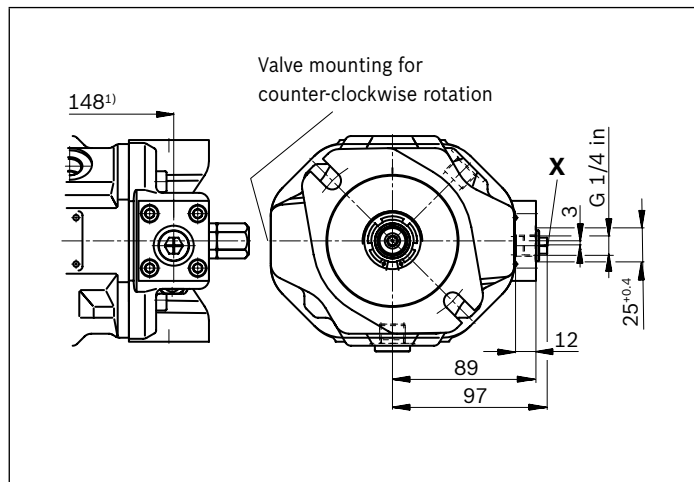
8) The countersink can be deeper than as specified in the standard.

9) Depending on the installation position, L or L<sub>1</sub> must be connected (also see installation instructions starting on page 45).

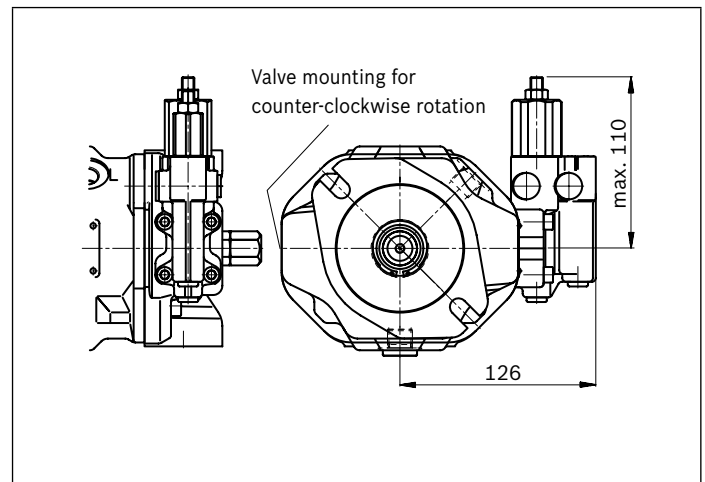
10) O = Must be connected (plugged when delivered)

X = Plugged (in normal operation)

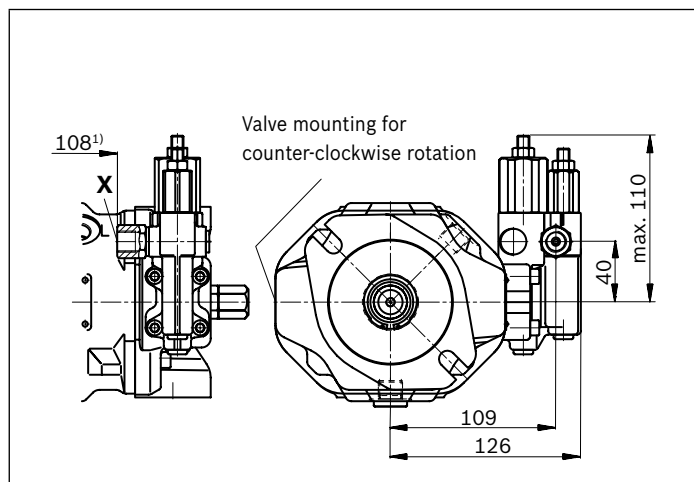
▼ **DG – Two-point control, direct operated**



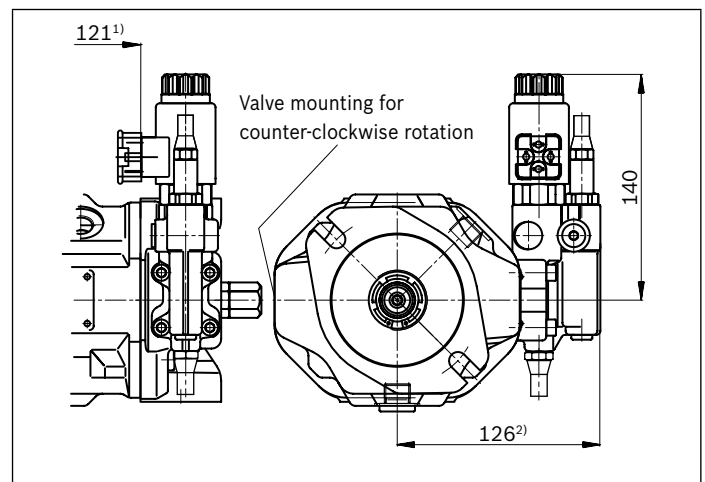
▼ **DR – Pressure controller**



▼ **DRG – Pressure controller, remote controlled**

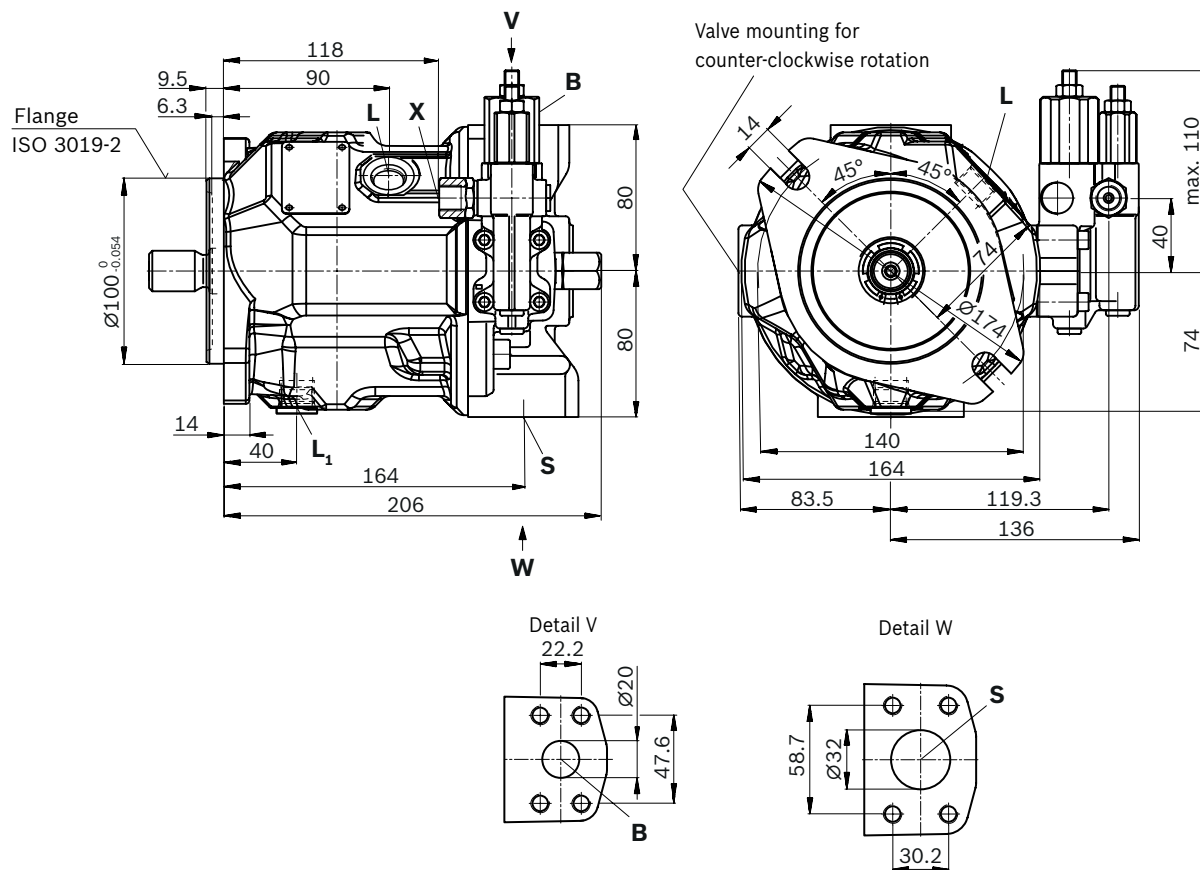


▼ **ED7., ER7. – Electrohydraulic pressure control**



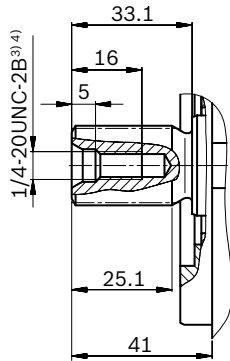
1) To flange surface

2) ER7.: 161 mm if using an intermediate plate pressure controller

**Dimensions, size 28****DFR/DFR1 – Pressure flow controller, hydraulic, clockwise rotation**

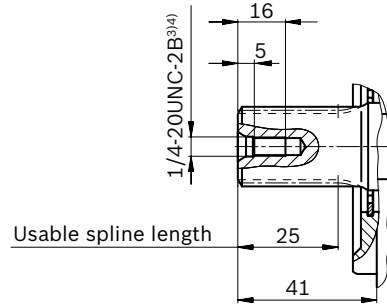
▼ Splined shaft 7/8 in (SAE J744)

**S** – 13T 16/32DP<sup>1)</sup>



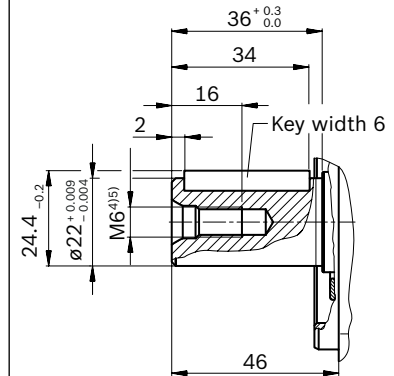
▼ Splined shaft 7/8 in (SAE J744)

**R** – 13T 16/32DP<sup>1)2)</sup>



▼ Parallel keyed shaft, DIN 6885

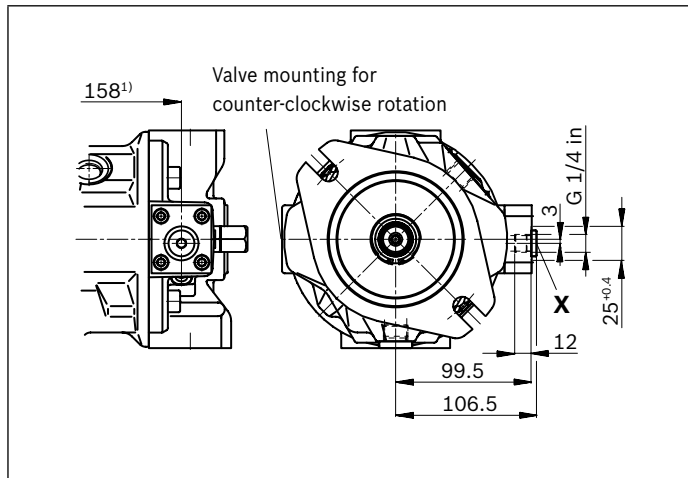
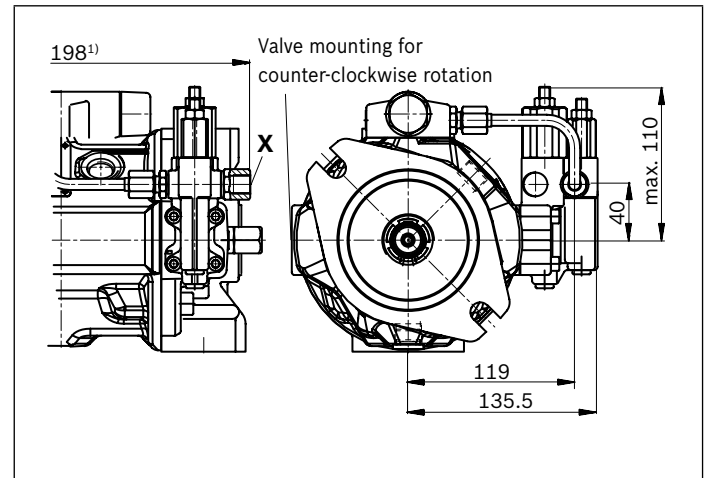
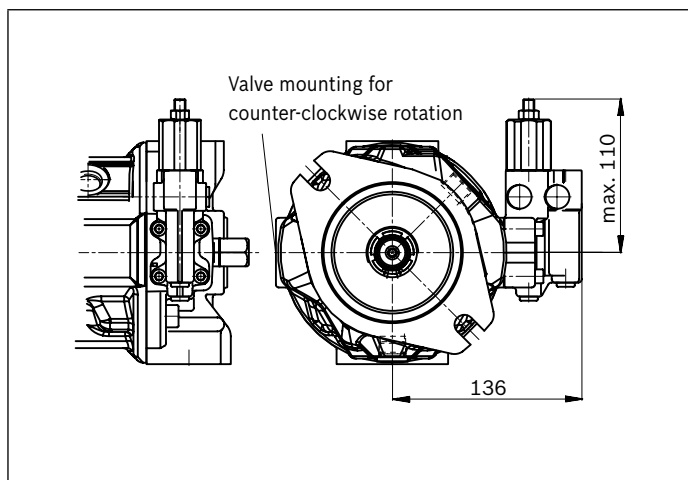
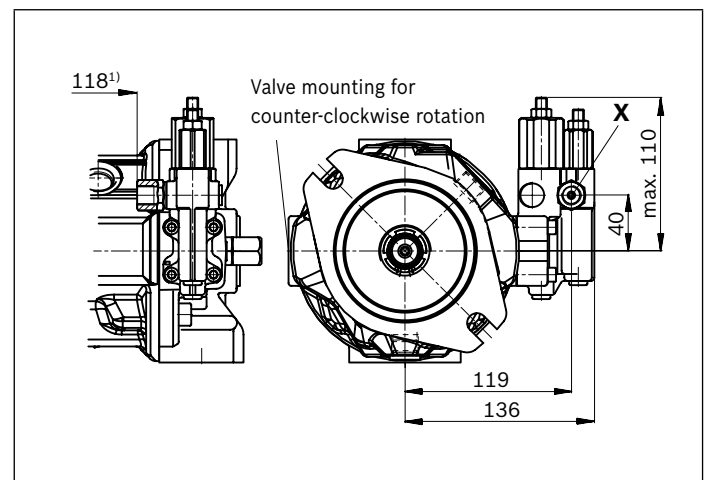
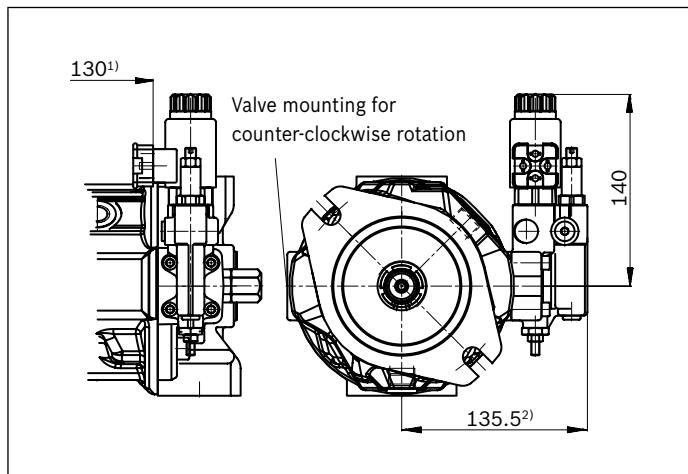
**P** – A6 × 6 × 32



| Ports                |   | Standard                         | Size <sup>4)</sup>             | $p_{\max \text{ abs}}$ [bar] <sup>6)</sup> | State <sup>10)</sup> |
|----------------------|---|----------------------------------|--------------------------------|--|----------------------|
| <b>B</b>             | Working port (standard pressure series)<br>Fastening thread | SAE J518 <sup>7)</sup><br>DIN 13 | 3/4 in<br>M10 × 1.5; 17 deep   | 350  | O                    |
| <b>S</b>             | Suction port (standard pressure series)<br>Fastening thread | SAE J518 <sup>7)</sup><br>DIN 13 | 1 1/4 in<br>M10 × 1.5; 17 deep | 10   | O                    |
| <b>L</b>             | Drain port  | DIN 3852 <sup>8)</sup>           | M18 × 1.5; 12 deep             | 2  | O <sup>9)</sup>      |
| <b>L<sub>1</sub></b> | Drain port  | DIN 3852 <sup>8)</sup>           | M18 × 1.5; 12 deep             | 2  | X <sup>9)</sup>      |
| <b>X</b>             | Pilot pressure port   | DIN 3852                         | M14 × 1.5; 12 deep             | 350  | O                    |
| <b>X</b>             | Pilot pressure port with DG-control                         | DIN ISO 228                      | G1/4 in; 12 deep               | 350  | O                    |

- 1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Splines according to ANSI B92.1a, spline runout is a deviation from standard.
- 3) Thread according to ASME B1.1
- 4) For notes on tightening torques, see the instruction manual
- 5) Thread according to DIN 13, center bore according to DIN 332-2
- 6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

- 7) Metric fastening thread is a deviation from standard.
- 8) The countersink can be deeper than as specified in the standard.
- 9) Depending on the installation position, L or L<sub>1</sub> must be connected (also see installation instructions starting on page 45).
- 10) O = Must be connected (plugged when delivered)  
X = Plugged (in normal operation)

▼ **DG – Two-point control, direct operated**▼ **DFLR – Pressure, flow and power controller**▼ **DR – Pressure controller**▼ **DRG – Pressure controller, remote controlled**▼ **ED7., ER7. – Electrohydraulic pressure control**

1) To flange surface

2) ER7.: 170.5 mm if using an intermediate plate pressure controller

## Dimensions, size 45

### DFR/DFR1 – Pressure flow controller, hydraulic, clockwise rotation

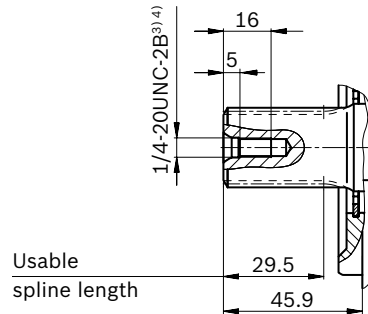




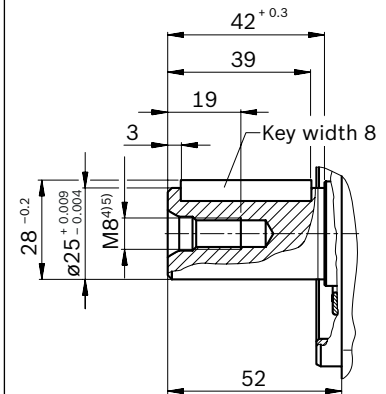
## ▼ Splined shaft 1 in (SAE J744)

**S** – 15T 16/32DP<sup>1)</sup>

## ▼ Splined shaft 1 in (SAE J744)

**R** – 15T 16/32DP<sup>1)2)</sup>

## ▼ Parallel keyed shaft, DIN 6885

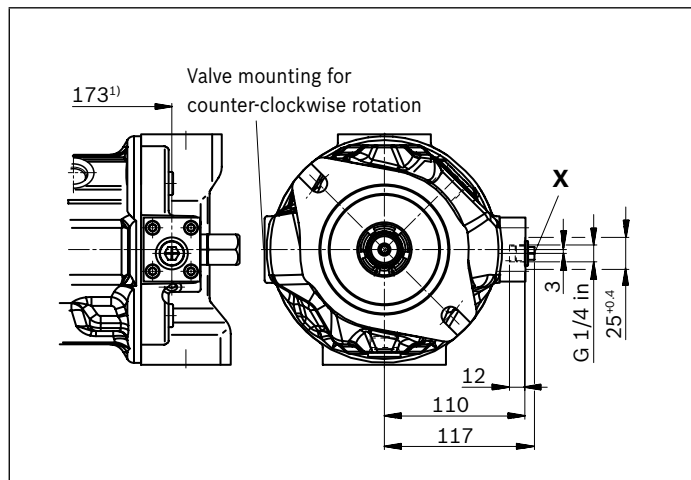
**P** – A8 × 7 × 36

| Ports                |   | Standard                         | Size <sup>4)</sup>              | $p_{\max \text{ abs}}$ [bar] <sup>6)</sup> | State <sup>10)</sup> |
|----------------------|---|----------------------------------|---------------------------------|--|----------------------|
| <b>B</b>             | Working port (standard pressure series)<br>Fastening thread | SAE J518 <sup>7)</sup><br>DIN 13 | 1 in<br>M10 × 1.5; 17 deep      | 350  | O                    |
| <b>S</b>             | Suction port (standard pressure series)<br>Fastening thread | SAE J518 <sup>7)</sup><br>DIN 13 | 1 1/2 in<br>M12 × 1.75; 20 deep | 10   | O                    |
| <b>L</b>             | Drain port  | DIN 3852 <sup>8)</sup>           | M22 × 1.5; 14 deep              | 2  | O <sup>9)</sup>      |
| <b>L<sub>1</sub></b> | Drain port  | DIN 3852 <sup>8)</sup>           | M22 × 1.5; 14 deep              | 2  | X <sup>9)</sup>      |
| <b>X</b>             | Pilot pressure port   | DIN 3852                         | M14 × 1.5; 12 deep              | 350  | O                    |
| <b>X</b>             | Pilot pressure port with DG-control                         | DIN ISO 228                      | G1/4 in; 12 deep                | 350  | O                    |

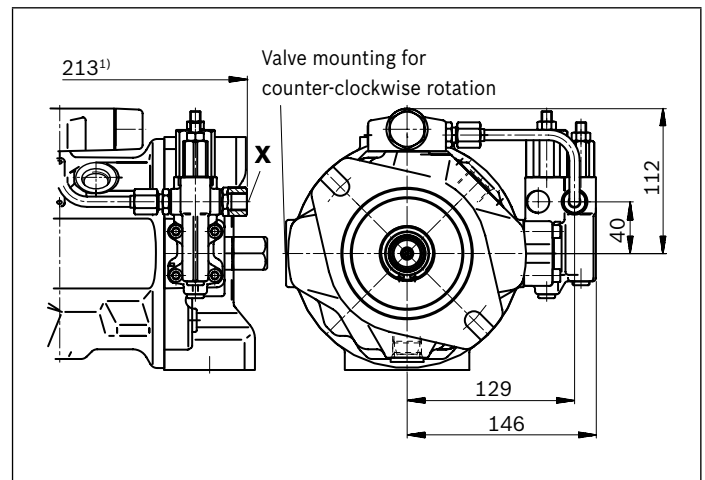
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
2) Splines according to ANSI B92.1a, spline runout is a deviation from standard.  
3) Thread according to ASME B1.1  
4) For notes on tightening torques, see the instruction manual  
5) Thread according to DIN 13, center bore according to DIN 332-2  
6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

7) Metric fastening thread is a deviation from standard.  
8) The countersink can be deeper than as specified in the standard.  
9) Depending on the installation position, L or L<sub>1</sub> must be connected (also see installation instructions starting on page 45).  
10) O = Must be connected (plugged when delivered)  
X = Plugged (in normal operation)

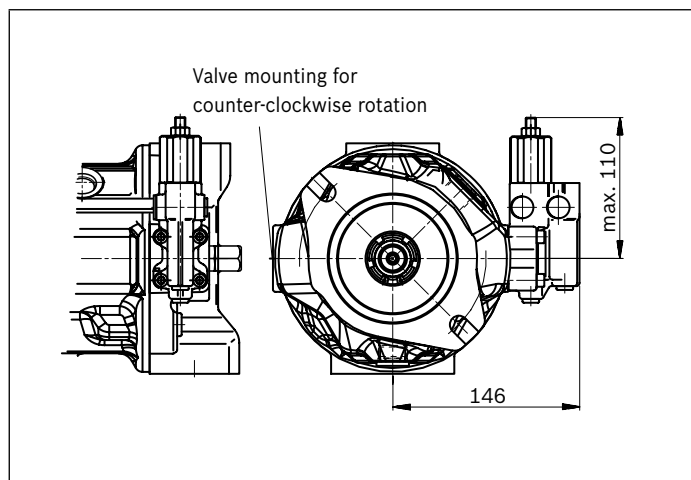
▼ **DG – Two-point control, direct operated**



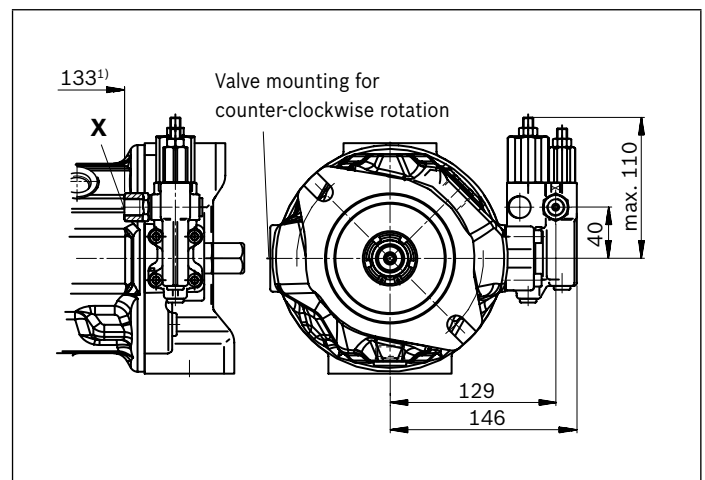
▼ **DFLR – Pressure, flow and power controller**



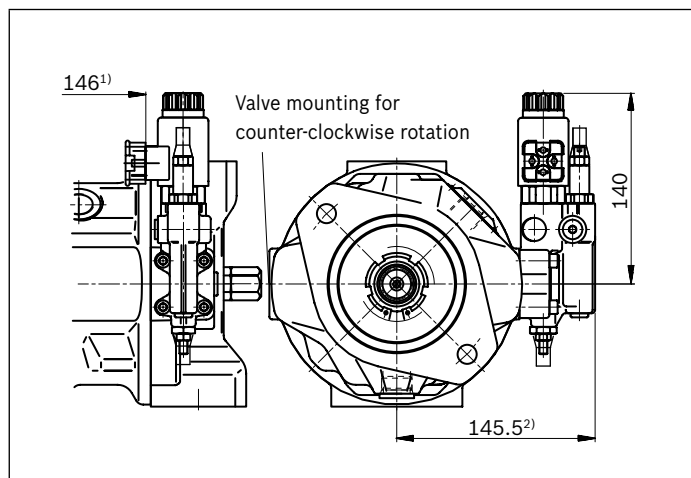
▼ **DR – Pressure controller**



▼ **DRG – Pressure controller, remote controlled**

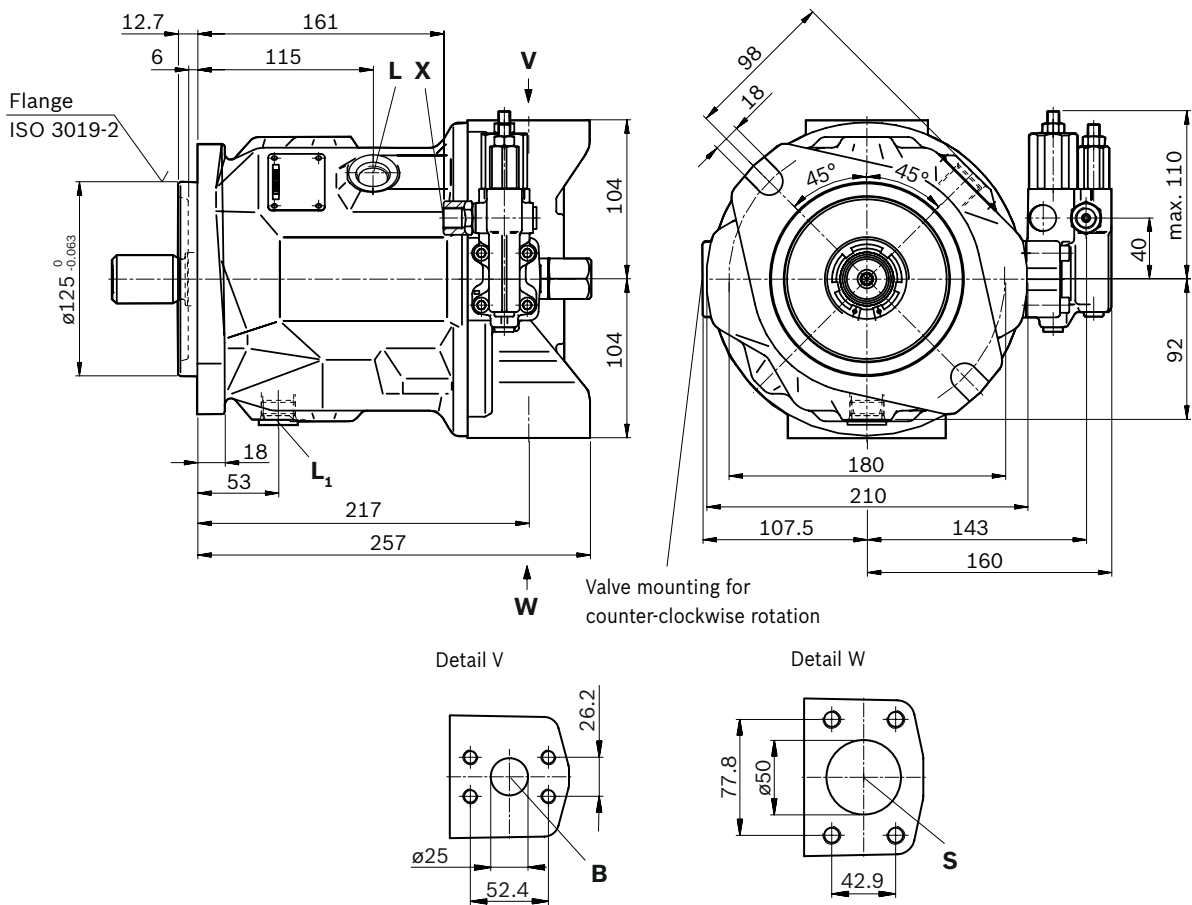


▼ **ED7., ER7. – Electrohydraulic pressure control**

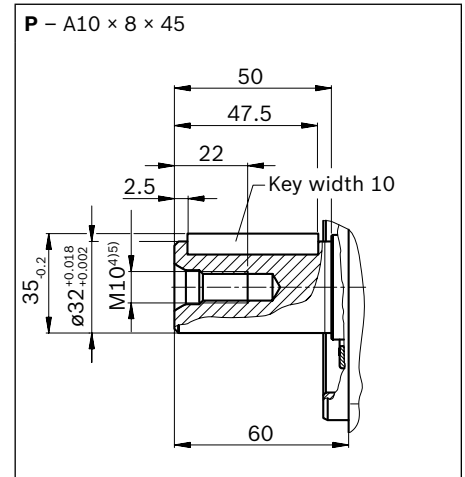


1) To flange surface

2) ER7.: 180.5 mm if using an intermediate plate pressure controller

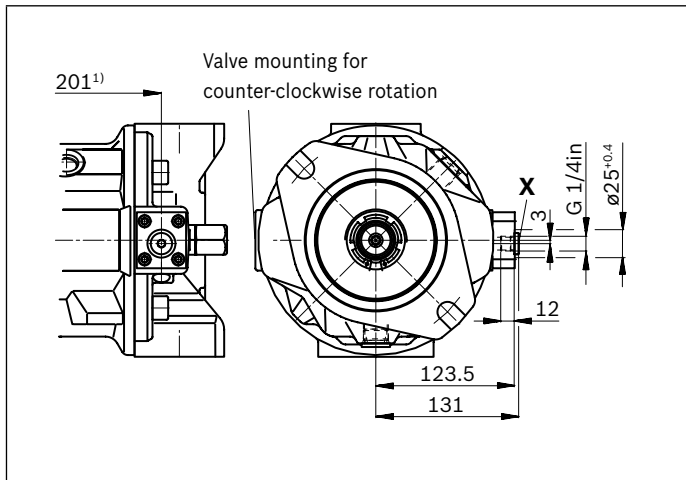
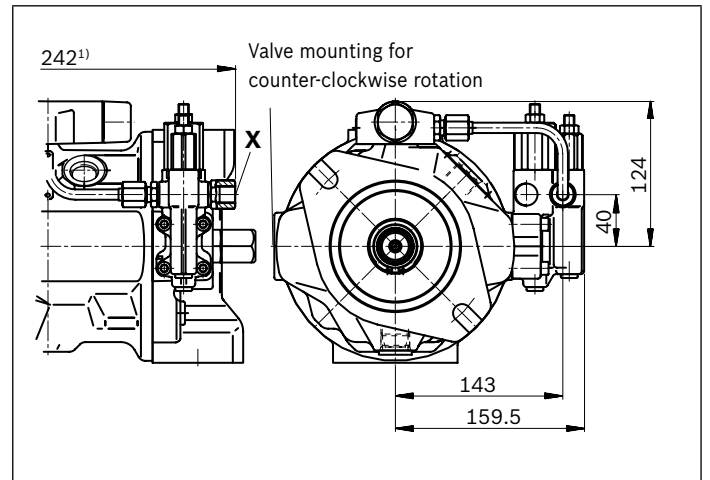
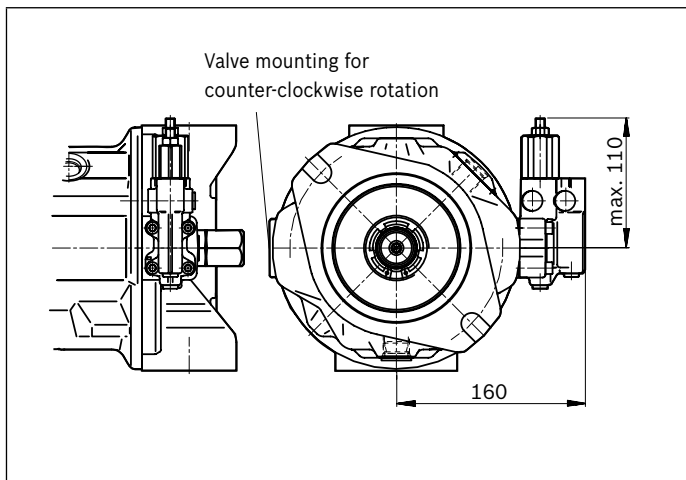
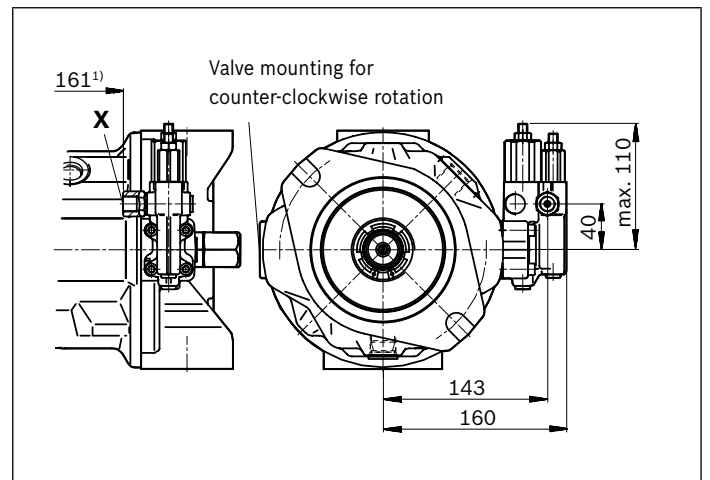
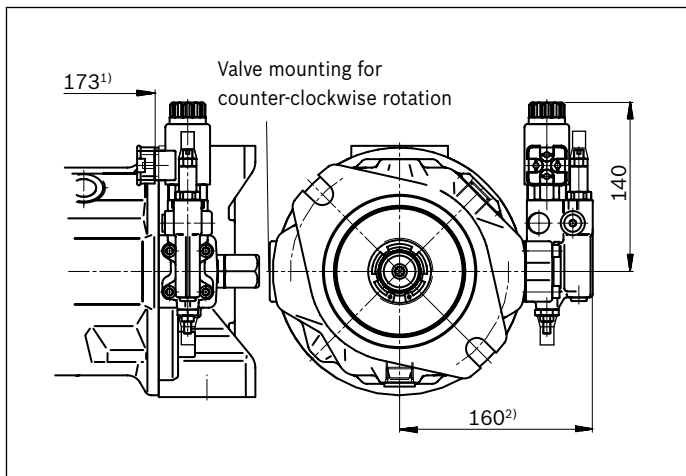
**Dimensions sizes 71 and 88****DFR/DFR1 – Pressure flow controller, hydraulic, clockwise rotation**

▼ **Parallel keyed shaft, DIN 6885**



| Ports                |   | Standard               | Size <sup>4)</sup>  | $p_{\max \text{ abs}}$ [bar] <sup>6)</sup> | State <sup>10)</sup> |
|----------------------|---|------------------------|---------------------|--|----------------------|
| <b>B</b>             | Working port (standard pressure series) | SAE J518 <sup>7)</sup> | 1 in                | 350  | O                    |
|                      | Fastening thread                        | DIN 13                 | M10 × 1.5; 17 deep  |  |                      |
| <b>S</b>             | Suction port (standard pressure series) | SAE J518 <sup>7)</sup> | 2 in                | 10   | O                    |
|                      | Fastening thread                        | DIN 13                 | M12 × 1.75; 20 deep |  |                      |
| <b>L</b>             | Drain port                              | DIN 3852 <sup>8)</sup> | M22 × 1.5; 14 deep  | 2  | O <sup>9)</sup>      |
| <b>L<sub>1</sub></b> | Drain port                              | DIN 3852 <sup>8)</sup> | M22 × 1.5; 14 deep  | 2  | X <sup>9)</sup>      |
| <b>X</b>             | Pilot pressure port                     | DIN 3852               | M14 × 1.5; 12 deep  | 350  | O                    |
| <b>X</b>             | Pilot pressure port with DG-control     | DIN ISO 228            | G1/4 in; 12 deep    | 350  | O                    |

- 7) Metric fastening thread is a deviation from standard.
- 8) The countersink can be deeper than as specified in the standard.
- 9) Depending on the installation position, L or L<sub>1</sub> must be connected (also see installation instructions starting on page 45).
- 10) O = Must be connected (plugged when delivered)  
X = Plugged (in normal operation)

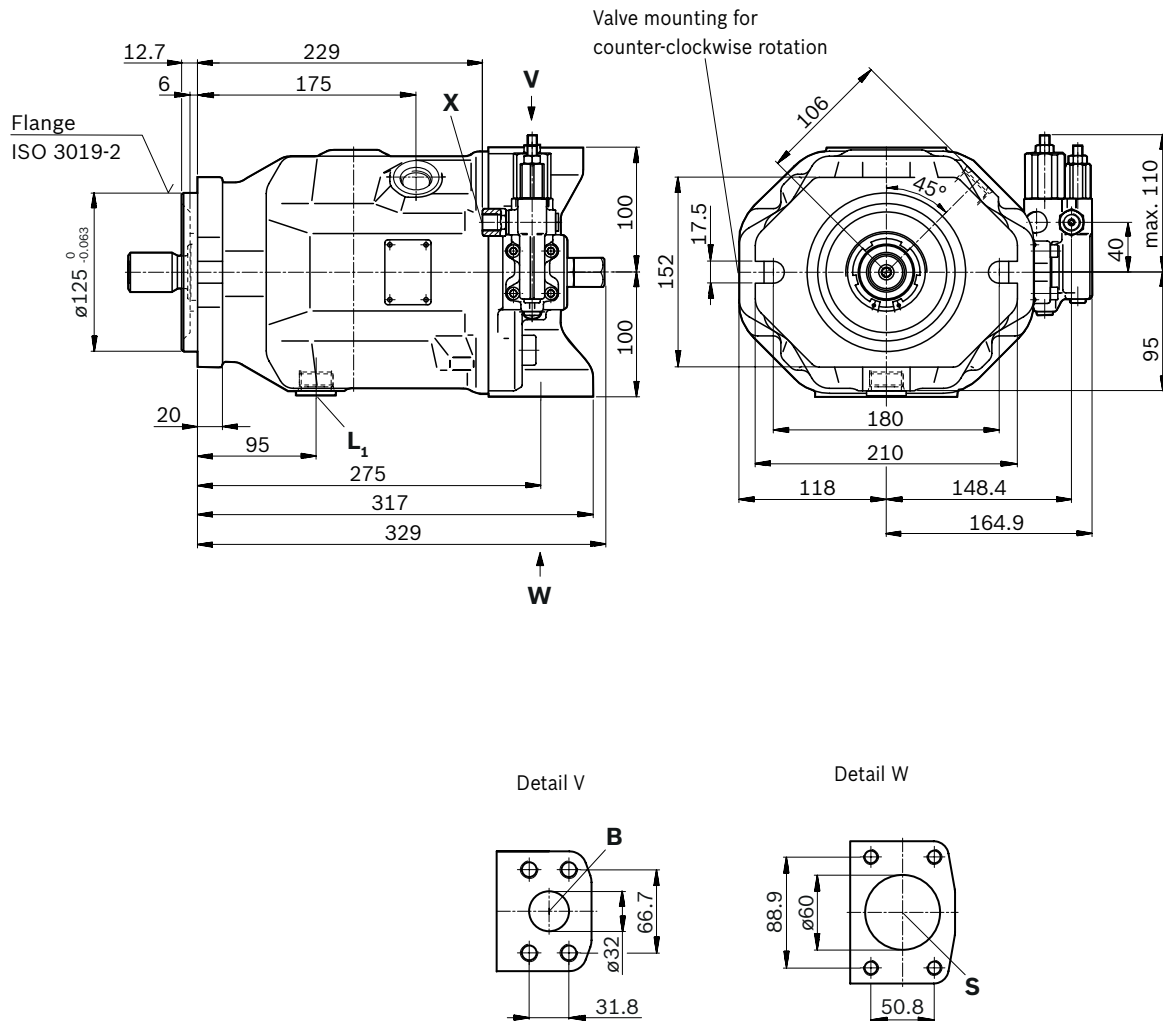
▼ **DG – Two-point control, direct operated**

▼ **DFLR – Pressure, flow and power controller**

▼ **DR – Pressure controller**

▼ **DRG – Pressure controller, remote controlled**

▼ **ED7., ER7. – Electrohydraulic pressure control**


1) To flange surface

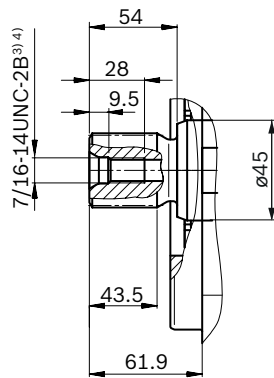
2) ER7.: 195 mm if using an intermediate plate pressure controller

## Dimensions, size 100

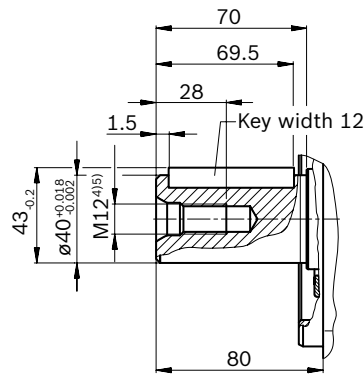
### DFR/DFR1 – Pressure flow controller, hydraulic, clockwise rotation



## ▼ Splined shaft 1 1/2 in (SAE J744)

**S** – 17T 12/24DP<sup>1)</sup>

## ▼ Parallel keyed shaft, DIN 6885

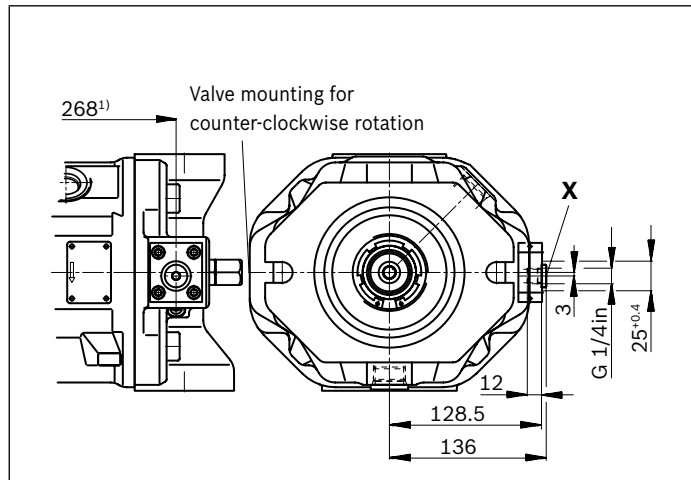
**P** – A12 × 8 × 68

| Ports                |   | Standard                         | Size <sup>4)</sup>              | $p_{\max \text{ abs}}$ [bar] <sup>6)</sup> | State <sup>10)</sup> |
|----------------------|---|----------------------------------|---------------------------------|--|----------------------|
| <b>B</b>             | Working port (high-pressure series)<br>Fastening thread     | SAE J518 <sup>7)</sup><br>DIN 13 | 1 1/4 in<br>M14 × 2; 19 deep    | 350  | O                    |
| <b>S</b>             | Suction port (standard pressure series)<br>Fastening thread | SAE J518 <sup>7)</sup><br>DIN 13 | 2 1/2 in<br>M12 × 1.75; 17 deep | 10   | O                    |
| <b>L</b>             | Drain port  | DIN 3852 <sup>8)</sup>           | M27 × 2; 16 deep                | 2  | O <sup>9)</sup>      |
| <b>L<sub>1</sub></b> | Drain port  | DIN 3852 <sup>8)</sup>           | M27 × 2; 16 deep                | 2  | X <sup>9)</sup>      |
| <b>X</b>             | Pilot pressure port   | DIN 3852                         | M14 × 1.5; 12 deep              | 350  | O                    |
| <b>X</b>             | Pilot pressure port with DG-control                         | DIN ISO 228                      | G1/4 in; 12 deep                | 350  | O                    |

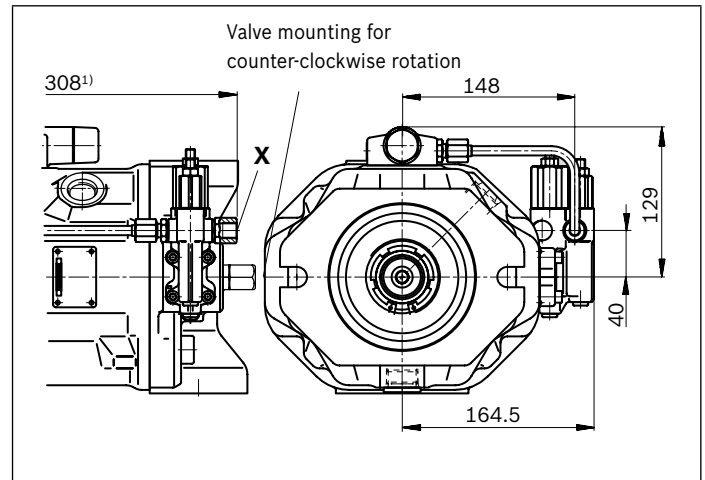
- 1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Splines according to ANSI B92.1a, spline runout is a deviation from standard.
- 3) Thread according to ASME B1.1
- 4) For notes on tightening torques, see the instruction manual
- 5) Thread according to DIN 13, center bore according to DIN 332-2
- 6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

- 7) Metric fastening thread is a deviation from standard.
- 8) The countersink can be deeper than as specified in the standard.
- 9) Depending on the installation position, L or L<sub>1</sub> must be connected (also see installation instructions starting on page 45).
- 10) O = Must be connected (plugged when delivered)  
X = Plugged (in normal operation)

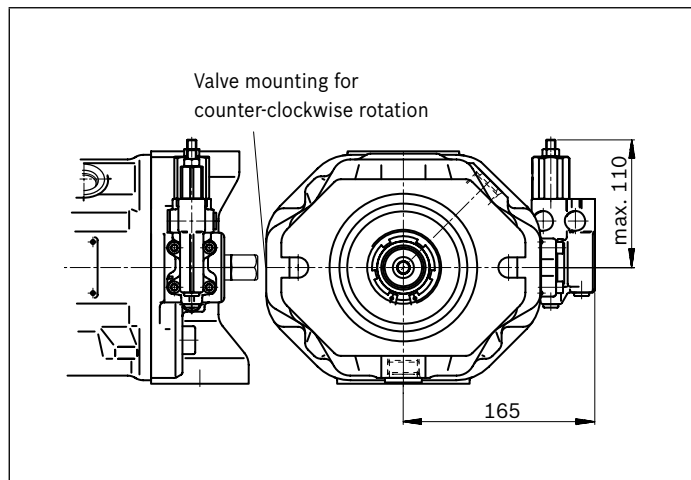
▼ **DG – Two-point control, direct operated**



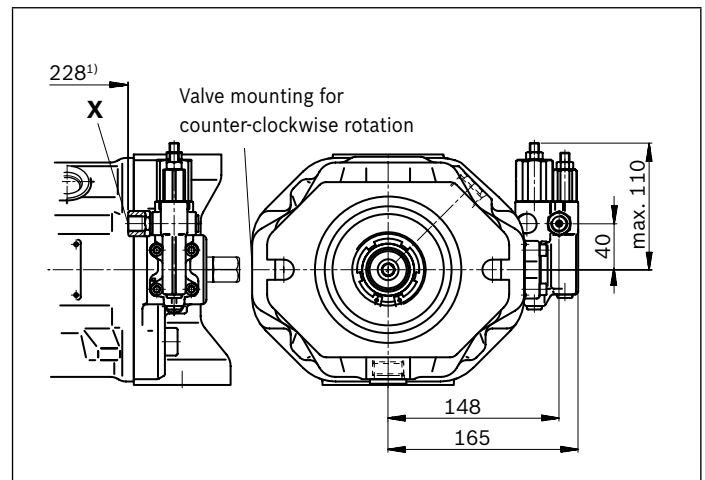
▼ **DFLR – Pressure, flow and power controller**



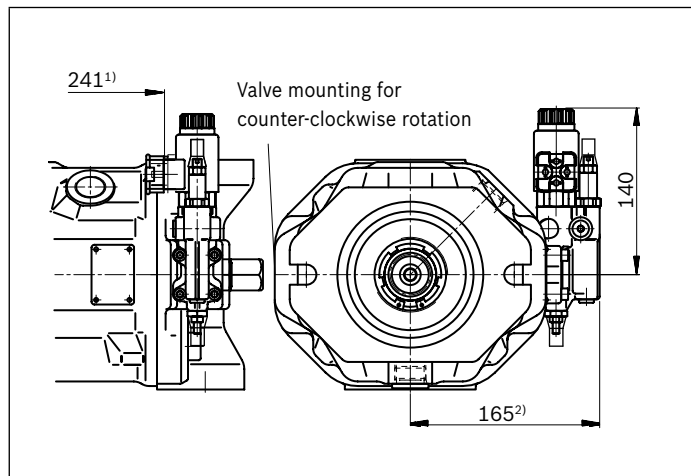
▼ **DR – Pressure controller**



▼ **DRG – Pressure controller, remote controlled**



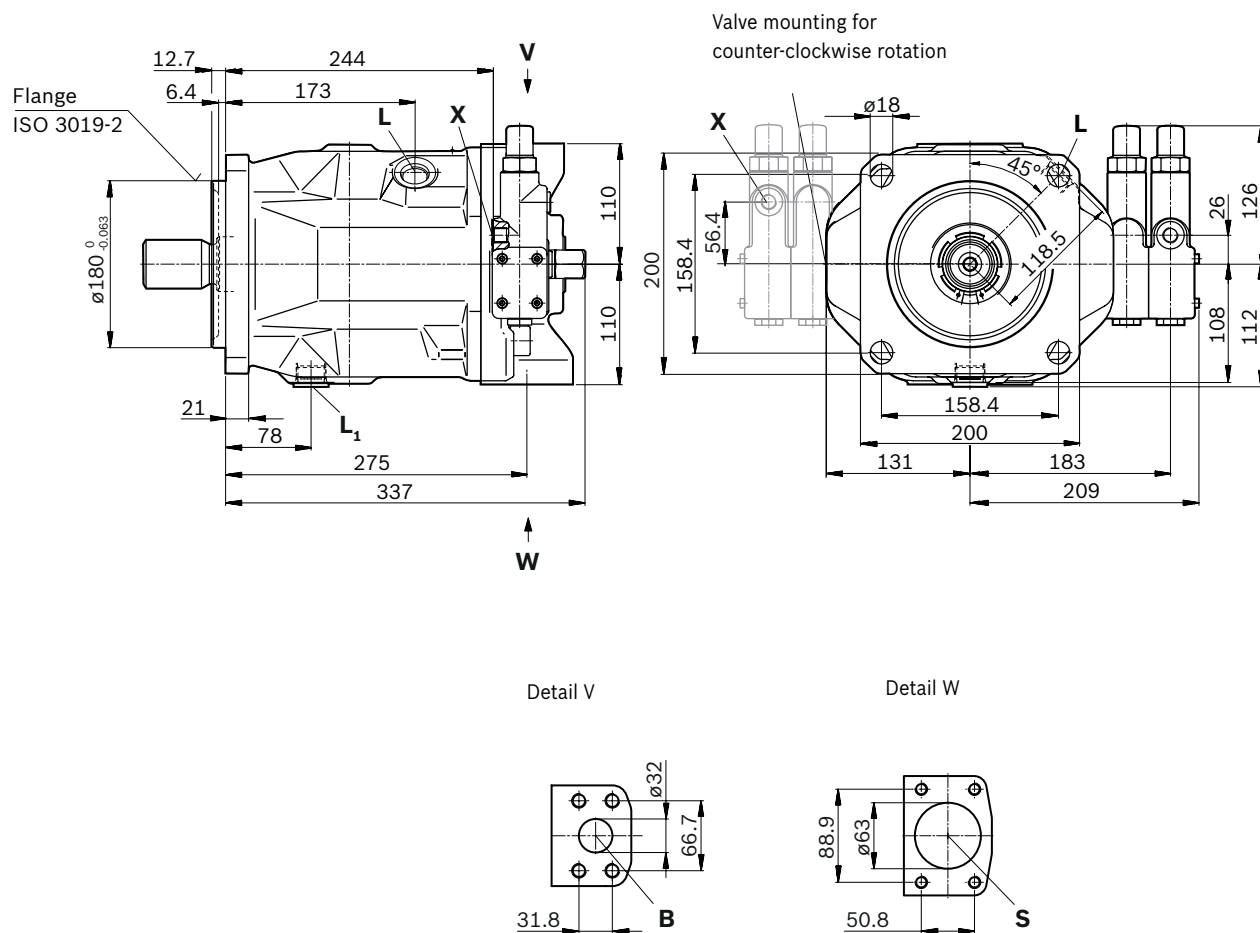
▼ **ED7., ER7. – Electrohydraulic pressure control**



1) To flange surface

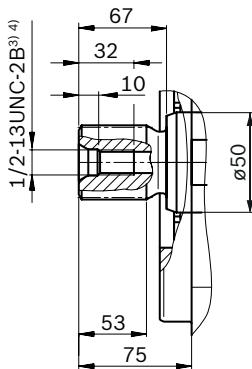
2) ER7.: 200 mm if using an intermediate plate pressure controller



**Dimensions, size 140****DFR/DFR1 – Pressure flow controller, hydraulic, clockwise rotation, mounting flange D**

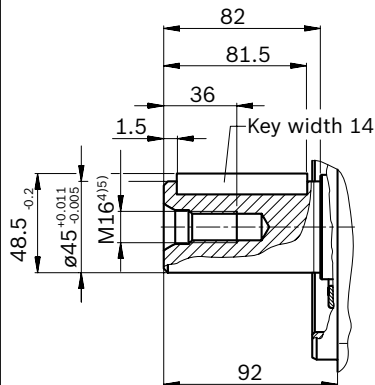
▼ **Splined shaft 1 3/4 in (SAE J744)**

**S** – 13T 8/16DP<sup>1)</sup>



▼ **Parallel keyed shaft, DIN 6885**

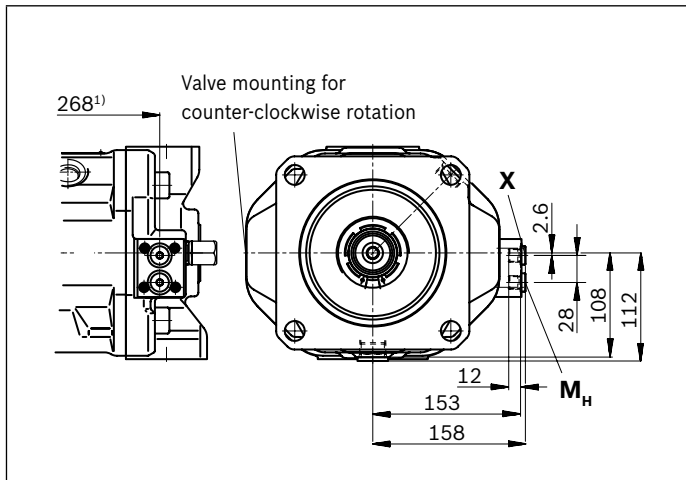
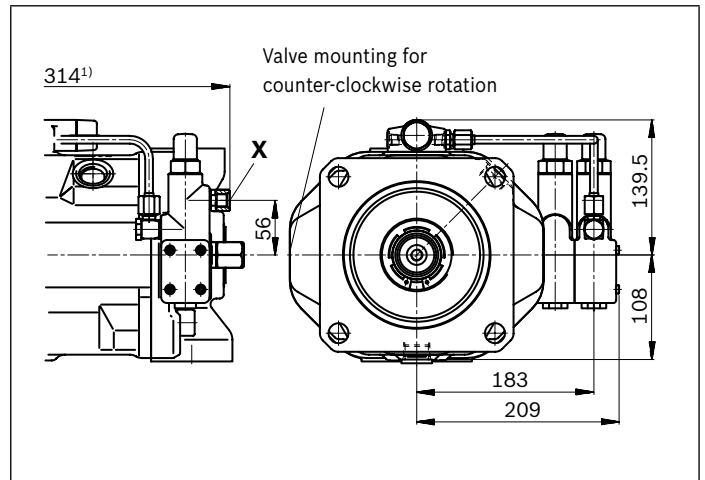
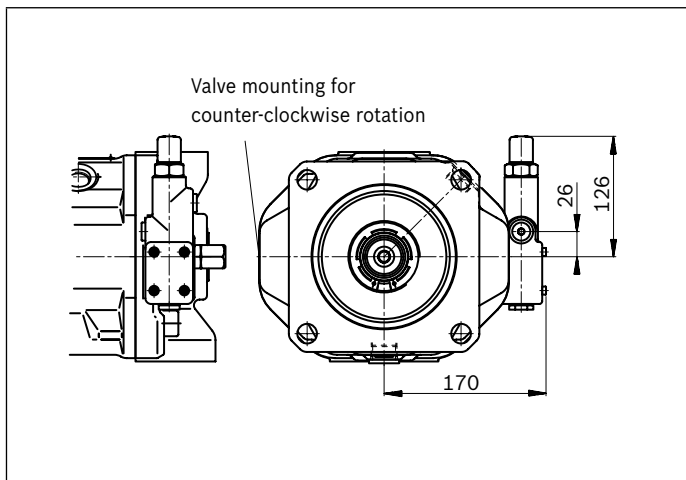
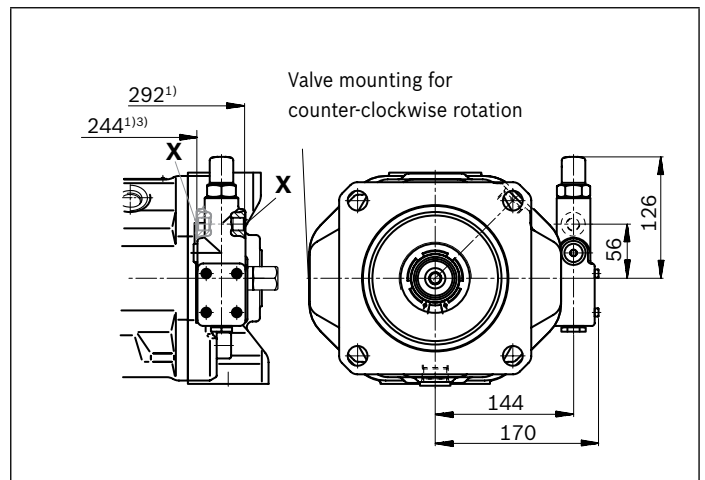
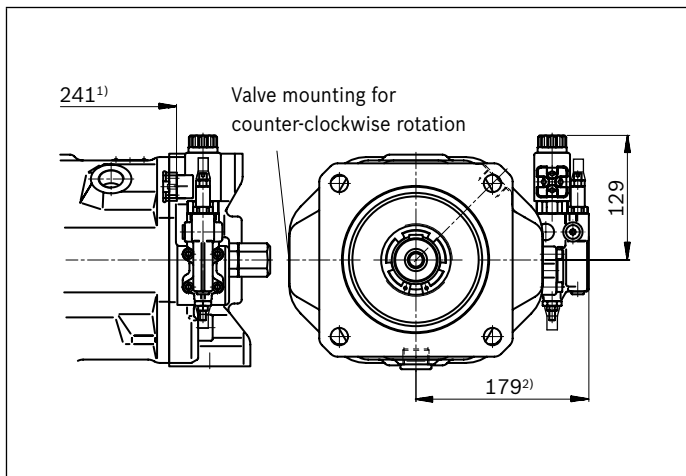
**P** – A14 × 9 × 80



| Ports                |   | Standard                         | Size <sup>4)</sup>              | $p_{\max \text{ abs}}$ [bar] <sup>6)</sup> | State <sup>10)</sup> |
|----------------------|---|----------------------------------|---------------------------------|--|----------------------|
| <b>B</b>             | Working port (high-pressure series)<br>Fastening thread     | SAE J518 <sup>7)</sup><br>DIN 13 | 1 1/4 in<br>M14 × 2; 19 deep    | 350  | O                    |
| <b>S</b>             | Suction port (standard pressure series)<br>Fastening thread | SAE J518 <sup>7)</sup><br>DIN 13 | 2 1/2 in<br>M12 × 1.75; 17 deep | 10   | O                    |
| <b>L</b>             | Drain port  | DIN 3852 <sup>8)</sup>           | M27 × 2; 16 deep                | 2  | O <sup>9)</sup>      |
| <b>L<sub>1</sub></b> | Drain port  | DIN 3852 <sup>8)</sup>           | M27 × 2; 16 deep                | 2  | X <sup>9)</sup>      |
| <b>X</b>             | Pilot pressure port   | DIN 3852                         | M14 × 1.5; 12 deep              | 350  | O                    |
| <b>X</b>             | Pilot pressure port with DG-control                         | DIN 3852                         | M14 × 1.5; 12 deep              | 350  | O                    |
| <b>M<sub>H</sub></b> | High pressure measurement (only with control DG)            | DIN 3852                         | M14 × 1.5; 12 deep              | 350  | X                    |

- 1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Splines according to ANSI B92.1a, spline runout is a deviation from standard.
- 3) Thread according to ASME B1.1
- 4) For notes on tightening torques, see the instruction manual
- 5) Thread according to DIN 13, center bore according to DIN 332-2
- 6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

- 7) Metric fastening thread is a deviation from standard.
- 8) The countersink can be deeper than as specified in the standard.
- 9) Depending on the installation position, L or L<sub>1</sub> must be connected (also see installation instructions starting on page 45).
- 10) O = Must be connected (plugged when delivered)  
X = Plugged (in normal operation)

▼ **DG – Two-point control, direct operated**

▼ **DFLR – Pressure, flow and power controller**

▼ **DR – Pressure controller**

▼ **DRG – Pressure controller, remote controlled**

▼ **ED7., ER7. – Electrohydraulic pressure control**

<sup>1)</sup> To flange surface

<sup>2)</sup> ER7.: 214 mm if using an intermediate plate pressure controller

<sup>3)</sup> For counter-clockwise rotation

## Dimensions, through drive

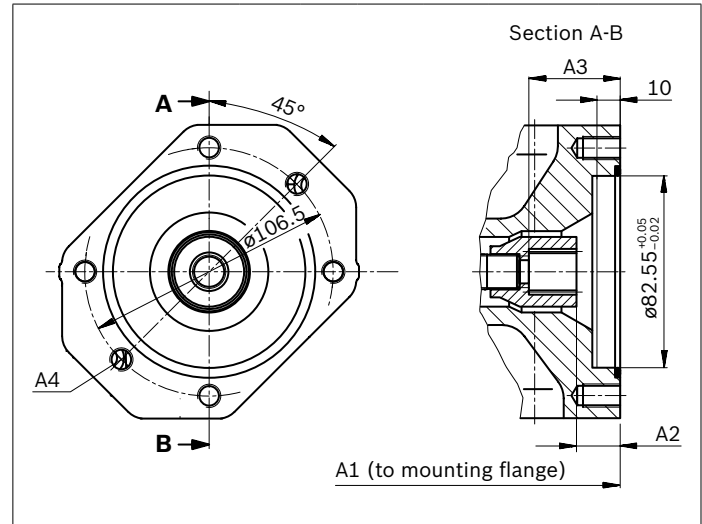
| Flange ISO 3019-1 (SAE) |                       | Hub for splined shaft <sup>1)</sup> |             | Availability over sizes |    |    |    |    |     |     | Code |
|-------------------------|-----------------------|-------------------------------------|-------------|-------------------------|----|----|----|----|-----|-----|------|
| Diameter                | Symbol                | Diameter                            |             | 18                      | 28 | 45 | 71 | 88 | 100 | 140 |      |
| 82-2 (A)                | 8, 8 <sup>p</sup> , ∞ | 5/8 in                              | 9T 16/32DP  | ●                       | ●  | ●  | ●  | ●  | ●   | ●   | K01  |
|                         |                       | 3/4 in                              | 11T 16/32DP | ●                       | ●  | ●  | ●  | ●  | ●   | ●   | K52  |

• = Available    - = Not available

### ▼ 82-2



### ▼ 82-2



| K01                 | NG  | A1  | A2   | A3   | A4 <sup>2)</sup>   |
|---------------------|-----|-----|------|------|--------------------|
| (SAE J744 16-4 (A)) |     |     |      |      |                    |
|                     | 18  | 182 | 10   | 43.3 | M10×1.5; 14.5 deep |
|                     | 28  | 204 | 10   | 33.7 | M10×1.5; 16 deep   |
|                     | 45  | 229 | 10.7 | 53.4 | M10×1.5; 16 deep   |
|                     | 71  | 267 | 11.8 | 61.3 | M10×1.5; 20 deep   |
|                     | 88  | 267 | 11.8 | 61.3 | M10×1.5; 20 deep   |
|                     | 100 | 338 | 10.5 | 65   | M10×1.5; 16 deep   |
|                     | 140 | 350 | 10.8 | 77.3 | M10×1.5; 16 deep   |

| K52                   | NG  | A1  | A2   | A3   | A4 <sup>2)</sup>   |
|-----------------------|-----|-----|------|------|--------------------|
| (SAE J744 19-4 (A-B)) |     |     |      |      |                    |
|                       | 18  | 182 | 18.8 | 38.7 | M10×1.5; 14.5 deep |
|                       | 28  | 204 | 18.8 | 38.7 | M10×1.5; 16 deep   |
|                       | 45  | 229 | 18.9 | 38.7 | M10×1.5; 16 deep   |
|                       | 71  | 267 | 21.3 | 41.4 | M10×1.5; 20 deep   |
|                       | 88  | 267 | 21.3 | 41.4 | M10×1.5; 20 deep   |
|                       | 100 | 338 | 19   | 38.9 | M10×1.5; 16 deep   |
|                       | 140 | 350 | 18.9 | 38.6 | M10×1.5; 16 deep   |

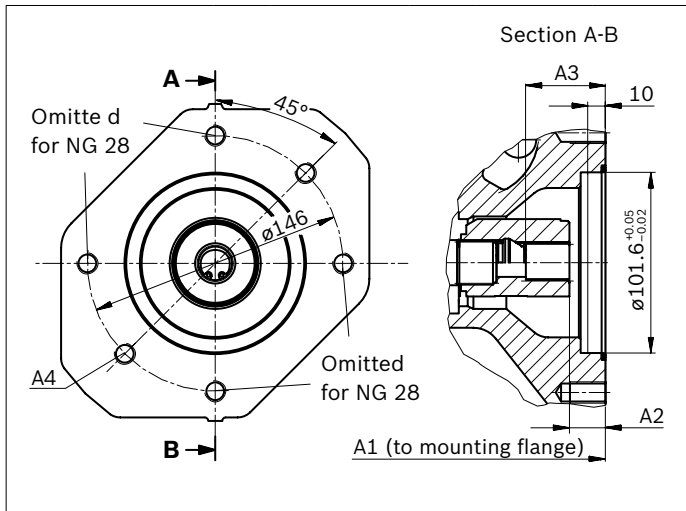
<sup>1)</sup> According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

<sup>2)</sup> Thread according to DIN 13, see instruction manual for maximum tightening torques.

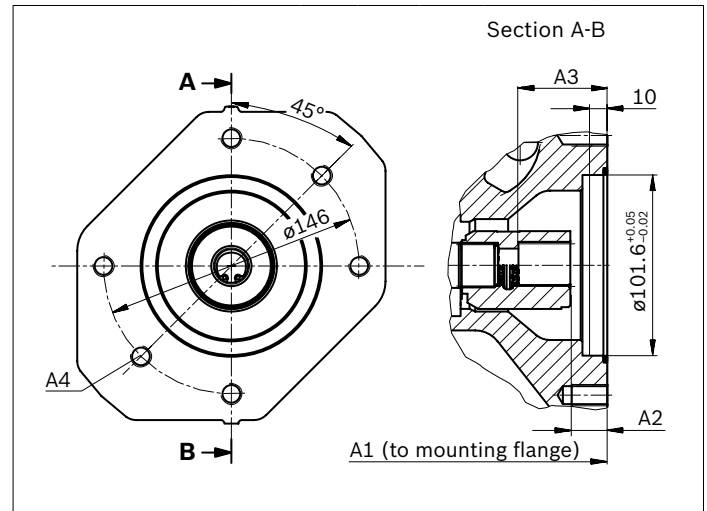
| Flange ISO 3019-1 (SAE) |         | Hub for splined shaft <sup>1)</sup> |             | Availability over sizes |    |    |    |    |     |     | Code |
|-------------------------|---------|-------------------------------------|-------------|-------------------------|----|----|----|----|-----|-----|------|
| Diameter                | Symbol  | Diameter                            |             | 18                      | 28 | 45 | 71 | 88 | 100 | 140 |      |
| 101-2 (A)               | ⌀, ⌀, ∞ | 7/8 in                              | 13T 16/32DP | –                       | •  | •  | •  | •  | •   | •   | K68  |
|                         |         | 1 in                                | 15T 16/32DP | –                       | –  | •  | •  | •  | •   | •   | K04  |

• = Available    – = Not available

## ▼ 101-2



## ▼ 101-2



| K68                 | NG  | A1  | A2   | A3   | A4 <sup>2)</sup>       |
|---------------------|-----|-----|------|------|------------------------|
| (SAE J744 22-4 (B)) |     |     |      |      |                        |
|                     | 28  | 204 | 17.8 | 41.7 | M12×1.75 <sup>3)</sup> |
|                     | 45  | 229 | 17.9 | 41.7 | M12×1.75; 18 deep      |
|                     | 71  | 267 | 20.3 | 44.7 | M12×1.75; 20 deep      |
|                     | 88  | 267 | 20.3 | 44.7 | M12×1.75; 20 deep      |
|                     | 100 | 338 | 18   | 41.9 | M12×1.75; 20 deep      |
|                     | 140 | 350 | 17.8 | 41.6 | M12×1.75; 20 deep      |

| K04                   | NG  | A1  | A2   | A3   | A4 <sup>2)</sup>  |
|-----------------------|-----|-----|------|------|-------------------|
| (SAE J744 25-4 (B-B)) |     |     |      |      |                   |
|                       | 45  | 229 | 18.4 | 46.7 | M12×1.75; 18 deep |
|                       | 71  | 267 | 20.8 | 49.1 | M12×1.75; 20 deep |
|                       | 88  | 267 | 20.8 | 49.1 | M12×1.75; 20 deep |
|                       | 100 | 338 | 18.2 | 46.6 | M12×1.75; 20 deep |
|                       | 140 | 350 | 18.3 | 45.9 | M12×1.75; 20 deep |

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

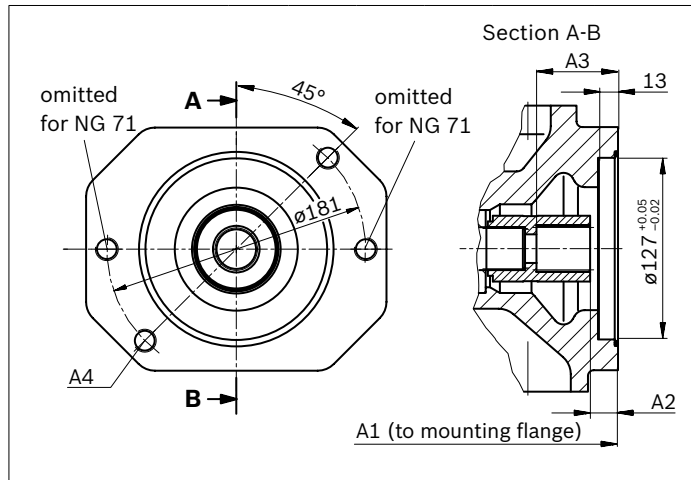
2) Thread according to DIN 13, see instruction manual for maximum tightening torques.

3) Continuous

| Flange ISO 3019-1 (SAE) |                | Hub for splined shaft <sup>1)</sup> |             | Availability over sizes |    |    |    |    |     |     | Code |
|-------------------------|----------------|-------------------------------------|-------------|-------------------------|----|----|----|----|-----|-----|------|
| Diameter                | Symbol         | Diameter                            |             | 18                      | 28 | 45 | 71 | 88 | 100 | 140 |      |
| 127-2 (C)               | $\phi, \infty$ | 1 1/4 in                            | 14T 12/24DP | -                       | -  | -  | •  | •  | •   | •   | K07  |
|                         |                | 1 1/2 in                            | 17T 12/24DP | -                       | -  | -  | -  | -  | •   | •   | K24  |

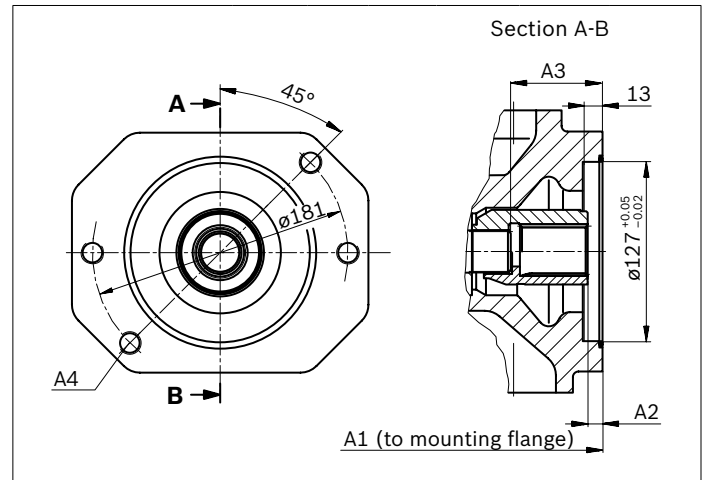
• = Available    - = Not available

▼ 127-2



| K07                 | NG  | A1  | A2   | A3   | A4 <sup>2)</sup>    |
|---------------------|-----|-----|------|------|---------------------|
| (SAE J744 32-4 (C)) |     |     |      |      |                     |
|                     | 71  | 267 | 21.8 | 58.6 | M16×2 <sup>3)</sup> |
|                     | 88  | 267 | 21.8 | 58.6 | M16×2 <sup>3)</sup> |
|                     | 100 | 338 | 19.5 | 56.4 | M16×2 <sup>3)</sup> |
|                     | 140 | 350 | 19.3 | 56.1 | M16×2; 24 deep      |



▼ 127-2



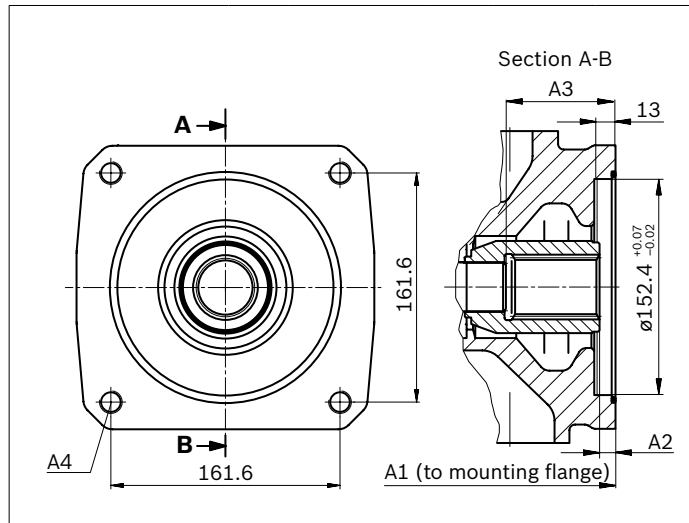
| K24                   | NG  | A1  | A2   | A3   | A4 <sup>2)</sup>    |
|-----------------------|-----|-----|------|------|---------------------|
| (SAE J744 38-4 (C-C)) |     |     |      |      |                     |
|                       | 100 | 338 | 10.5 | 65   | M16×2 <sup>3)</sup> |
|                       | 140 | 350 | 7.9  | 73.3 | M16×2; 32 deep      |

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
2) Thread according to DIN 13, see instruction manual for maximum tightening torques.

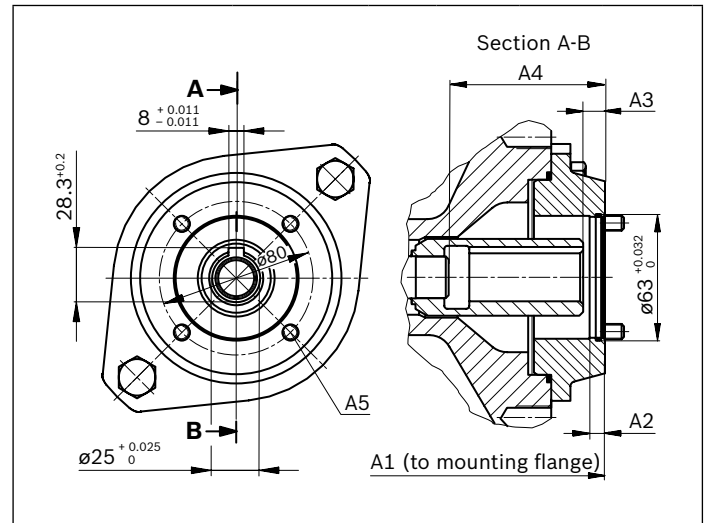
3) Continuous

| Flange ISO 3019-1 (SAE) |   | Hub for splined shaft <sup>1)</sup> | Availability over sizes |    |    |    |    |     |     | Code |
|-------------------------|---|-------------------------------------|-------------------------|----|----|----|----|-----|-----|------|
| Diameter                | Symbol  | Diameter                            | 18                      | 28 | 45 | 71 | 88 | 100 | 140 |      |
| 152-4 (A)               |  | 1 3/4 in 13T 8/16DP                 | –                       | –  | –  | –  | –  | –   | ●   | K17  |
| 63-4                    |  | Metric keyed shaft Ø25              | –                       | ●  | ●  | ●  | ●  | ●   | ●   | K57  |

• = Available    - = Not available

▼ **152-4**

| <b>K17</b>          | <b>NG</b> | <b>A1</b> | <b>A2</b> | <b>A3</b> | <b>A4<sup>2)</sup></b> |
|---------------------|-----------|-----------|-----------|-----------|------------------------|
| (SAE J744 44-4 (D)) |           |           |           |           |                        |
|                     | 140       | 350       | 11        | 77.3      | M16×2; <sup>3)</sup>   |

▼ **63-4 metric<sup>4)</sup>**

| <b>K57</b>      | <b>NG</b> | <b>A1</b> | <b>A2</b> | <b>A3</b> | <b>A4</b> | <b>A5<sup>5)</sup></b> |
|-----------------|-----------|-----------|-----------|-----------|-----------|------------------------|
| (4-hole flange) |           |           |           |           |           |                        |
|                 | 28        | 232       | 8         | 10.6      | 58.4      | M8                     |
|                 | 45        | 257       | 8         | 11        | 81        | M8                     |
|                 | 71        | 283       | 8         | 12.5      | 77        | M10                    |
|                 | 88        | 283       | 8         | 12.5      | 77        | M10                    |
|                 | 100       | 354       | 8         | 10.5      | 81        | M10                    |
|                 | 140       | 366       | 8         | 11        | 93        | M8                     |

- 1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5  
2) Thread according to DIN 13, see instruction manual for maximum tightening torques.  
3) Continuous

- 4) For mounting an R4 radial piston pump (see data sheet 11263)  
5) Screws for mounting the radial piston motor are included in the scope of delivery

| Flange ISO 3019-2 |        | Hub for splined shaft <sup>1)</sup> |  | Availability over sizes |    |    |    |    |     |     | Code |
|-------------------|--------|-------------------------------------|--|-------------------------|----|----|----|----|-----|-----|------|
| Diameter          | Symbol | Diameter                            |  | 18                      | 28 | 45 | 71 | 88 | 100 | 140 |      |
| 80, 2-hole        |        | 3/4 in 11T 16/32DP                  |  | •                       | •  | •  | •  | •  | •   | •   | KB2  |
| 100, 2-hole       |        | 7/8 in 13T 16/32DP                  |  | –                       | •  | •  | •  | •  | •   | •   | KB3  |
|                   |        | 1 in 15T 16/32DP                    |  | –                       | –  | •  | •  | •  | •   | •   | KB4  |

• = Available    – = Not available

▼ 80, 2-hole



| KB2                   | NG  | A1  | A2   | A3   | A4 <sup>2)</sup>   |
|-----------------------|-----|-----|------|------|--------------------|
| (SAE J744 19-4 (A-B)) |     |     |      |      |                    |
|                       | 18  | 182 | 18.8 | 38.7 | M10×1.5; 14.5 deep |
|                       | 28  | 204 | 18.8 | 38.7 | M10×1.5; 16 deep   |
|                       | 45  | 229 | 18.9 | 38.7 | M10×1.5; 16 deep   |
|                       | 71  | 267 | 21.3 | 41.4 | M10×1.5; 20 deep   |
|                       | 88  | 267 | 21.3 | 41.4 | M10×1.5; 20 deep   |
|                       | 100 | 338 | 19   | 38.9 | M10×1.5; 20 deep   |
|                       | 140 | 350 | 18.9 | 38.6 | M10×1.5; 20 deep   |

▼ 100, 2-hole



| KB3                 | NG  | A1  | A2   | A3   | A4 <sup>2)</sup>      |
|---------------------|-----|-----|------|------|-----------------------|
| (SAE J744 22-4 (B)) |     |     |      |      |                       |
|                     | 28  | 204 | 17.8 | 41.7 | M12×1.5 <sup>3)</sup> |
|                     | 45  | 229 | 17.9 | 41.7 | M12×1.5 <sup>3)</sup> |
|                     | 71  | 267 | 20.3 | 44.1 | M12×1.5; 20 deep      |
|                     | 88  | 267 | 20.3 | 44.1 | M12×1.5; 20 deep      |
|                     | 100 | 338 | 18   | 41.9 | M12×1.5; 20 deep      |
|                     | 140 | 350 | 17.8 | 41.6 | M12×1.5; 20 deep      |

▼ 100, 2-hole



| KB4                   | NG  | A1  | A2   | A3   | A4 <sup>2)</sup>       |
|-----------------------|-----|-----|------|------|------------------------|
| (SAE J744 25-4 (B-B)) |     |     |      |      |                        |
|                       | 45  | 229 | 18.4 | 46.7 | M12×1.75 <sup>3)</sup> |
|                       | 71  | 267 | 20.8 | 49.1 | M12×1.75; 20 deep      |
|                       | 88  | 267 | 20.8 | 49.1 | M12×1.75; 20 deep      |
|                       | 100 | 338 | 18.2 | 46.6 | M12×1.75; 20 deep      |
|                       | 140 | 350 | 18.3 | 45.9 | M12×1.75; 20 deep      |

- 1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Thread according to DIN 13, see instruction manual for maximum tightening torques.
- 3) Continuous





## Overview of mounting options

### SAE – mounting flange

| Through drive        |                          | Mounting options – 2nd pump |  |  |                          |                                     |
|----------------------|--------------------------|-----------------------------|--|--|--------------------------|-------------------------------------|
| Flange<br>ISO 3019-1 | Hub for<br>splined shaft | Code                        | A10VSO/31<br>NG (shaft)                            | A10V(S)O/5x<br>NG (shaft)                    | Gear pump<br>Design (NG) | Through drive available<br>for size |
| 82-2 (A)             | 5/8 in                   | K01                         | 18 (U)   | 10 (U)<br>18 (U)                             | AZPF                     | 18 to 140                           |
|                      | 3/4 in                   | K52                         | 18 (S, R)  | 10 (S)<br>18 (S, R)                          | –                        | 18 to 140                           |
| 101-2 (B)            | 7/8 in                   | K68                         | 28 (S, R)<br>45 (U, W) <sup>1)</sup>               | 28 (S, R)<br>45 (U, W) <sup>1)</sup>         | AZPN/G                   | 28 to 140                           |
|                      | 1 in                     | K04                         | 45 (S, R)<br>–                                     | 45 (S, R)<br>60, 63, 72 (U, W) <sup>2)</sup> | PGH4                     | 45 to 140                           |
| 127-2 (C)            | 1 1/4 in                 | K07                         | 71 (S, R)<br>88 (S, R)<br>100 (U, W) <sup>3)</sup> | 85 (U, W) <sup>3)</sup><br>100 (U, W)        | –                        | 71 to 140                           |
|                      | 1 1/2 in                 | K24                         | 100 (S)  | 85 (S)<br>100 (S)                            | PGH5                     | 100 to 140                          |
| 152-4 (4-hole D)     | 1 3/4 in                 | K17                         | 140 (S)  | –  | –                        | 140                                 |

### ISO – mounting flange

| Through drive        |                          | Mounting options – 2nd pump |                         |                           |                                     |                                     |
|----------------------|--------------------------|-----------------------------|-------------------------|---------------------------|-------------------------------------|-------------------------------------|
| Flange<br>ISO 3019-2 | Hub for<br>splined shaft | Code                        | A10VSO/31<br>NG (shaft) | A10V(S)O/5x<br>NG (shaft) | External gear pump design<br>(size) | Through drive available<br>for size |
| 80, 2-hole           | 3/4 in                   | KB2                         | 18 (S, R)               | 10 (S)                    | –                                   | 18 to 140                           |
| 100, 2-hole          | 7/8 in                   | KB3                         | 28 (S, R)               | –                         | –                                   | 28 to 140                           |
|                      | 1 in                     | KB4                         | 45 (S, R)               | –                         | –                                   | 45 to 140                           |
| 125, 2-hole          | 1 1/4 in                 | KB5                         | 71 (S, R)<br>88 (S, R)  | –                         | –                                   | 71 to 140                           |
|                      | 1 1/2 in                 | KB6                         | 100 (S)                 | –                         | –                                   | 100 to 140                          |
| 180, 4-hole          | 1 3/4 in                 | KB7                         | 140 (S)                 | –                         | –                                   | 140                                 |

### ISO – mounting flange for keyed shaft

| Through drive        |                        | Mounting options – 2nd pump |  |  |                    |                                     |
|----------------------|------------------------|-----------------------------|--|--|--------------------|-------------------------------------|
| Flange<br>ISO 3019-2 | Hub for<br>keyed shaft | Code                        |  |  | Radial piston pump | Through drive available<br>for size |
| 63-4 metric          | 3/4 in                 | K57                         |  |  | R4                 | 28 to 140                           |

1) Not for main pump NG28 with K68

2) Not for main pump NG45 with K04

3) Not for main pump NG71 and NG88 with K07

## Combination pumps A10VSO + A10VSO

By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of the 1st and 2nd pumps must be linked by a “+”.

### Order example:

**A10VSO100DFR1/31R-VSA12K04+**

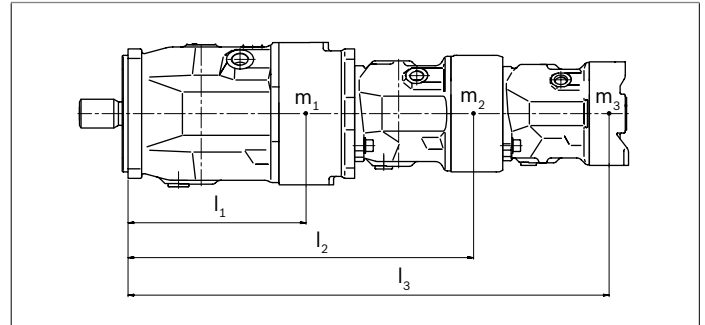
**A10VSO45DFR/31R-VSA12N00**

If no further pumps are to be mounted at the factory, the simple type designation is sufficient.

It is permissible to use a combination of two single pumps of the same nominal size (tandem pump) considering a dynamic mass acceleration of maximum 10 g (= 98.1 m/s<sup>2</sup>) without additional support brackets.

Each through drive is plugged with a **non-pressure-resistant** cover. Before commissioning the units, they must therefore be equipped with a pressure-resistant cover. Through drives can also be ordered with pressure-resistant covers. Please specify in plain text.

For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible mass torque (please contact us).



|   |                                 |      |
|---|---------------------------------|------|
| $m_1, m_2, m_3$   | Weight of pump                  | [kg] |
| $l_1, l_2, l_3$   | Distance from center of gravity | [mm] |
| $T_m = (m_1 \times l_1 + m_2 \times l_2 + m_3 \times l_3) \times \frac{1}{102}$ |                                 | [Nm] |

### Permissible mass moment of inertia

| Size   |       |    | 18   | 28   | 45   | 71   | 88   | 100  | 140                                   |
|--|-------|----|------|------|------|------|------|------|---------------------------------------|
| static   | $T_m$ | Nm | 500  | 880  | 1370 | 2160 | 2160 | 3000 | 4500 <sup>1)</sup> 3000 <sup>2)</sup> |
| dynamic at 10 g (98.1 m/s <sup>2</sup> )                       | $T_m$ | Nm | 50   | 88   | 137  | 216  | 216  | 300  | 450 <sup>1)</sup> 300 <sup>2)</sup>   |
| Weight without through drive (N00)                             | $m$   | kg | 12.9 | 18   | 23.5 | 35.2 | 35.2 | 49.5 | 65.4                                  |
| Weight with through drive (K..)                                |       |    | 13.8 | 19.3 | 25.1 | 38   | 38   | 55.4 | 74.4                                  |
| Distance, center of gravity <b>without</b> through drive (N00) | $l_l$ | mm | 92   | 100  | 113  | 127  | 127  | 161  | 159                                   |
| Distance, center of gravity <b>with</b> through drive (K..)    | $l_l$ | mm | 98   | 107  | 120  | 137  | 137  | 178  | 180                                   |

1) 4-hole flange (D)

2) 2-hole flange (C)

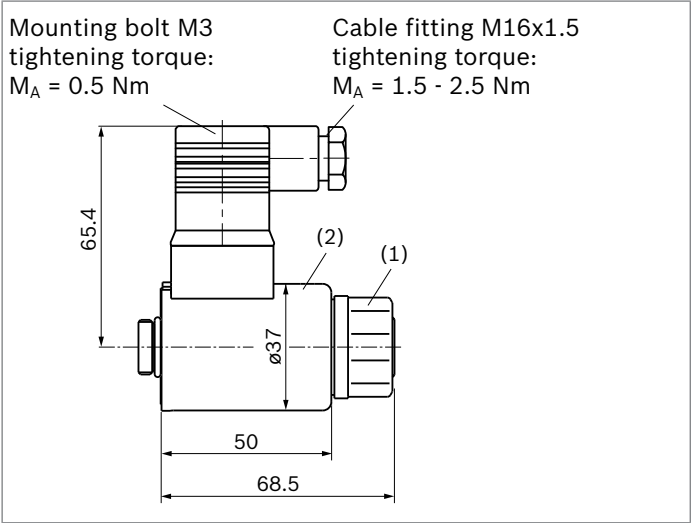
Connector for solenoids

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

without bidirectional suppressor diode **H**

There is the following type of protection with the installed mating connector:

- IP65 (DIN/EN 60529)



The seal ring in the cable fitting is suitable for lines of diameter 4.5 mm to 10 mm.

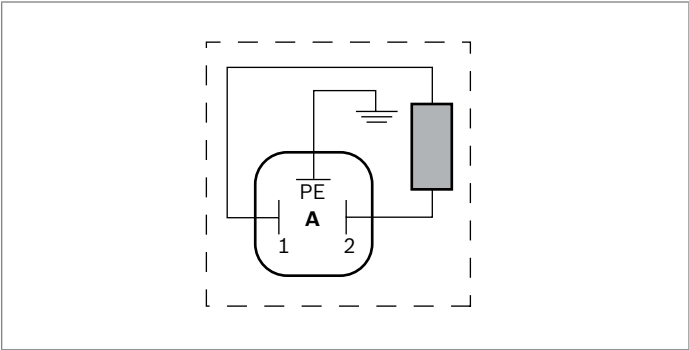
The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request.

Electronic controls

| Control   | Electronics   | Further information |       |
|---|---|---------------------|-------|
| Electric amplifier                                | VT 2000 <sup>1)</sup>                                 | analog              | 29904 |
| Electrical amplifier modules                      | VT 11029<br>VT 11030 <sup>1)</sup>                    | analog              | 29741 |
| Valve amplifiers for proportional pressure valves | VT-VSPA1-1 <sup>1)</sup><br>VT-VSPA1K-1 <sup>1)</sup> | analog              | 30111 |

Bosch Rexroth material number: R902602623

**Device plug on the solenoid according to DIN 43650**



**Notice**

- If necessary, you can change the position of the connector by turning the solenoid.
- The procedure is defined in the instruction manual.

<sup>1)</sup> Only 24 V nominal voltage

## Installation instructions

### General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.

Particularly with the “drive shaft up/down” installation position, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running. The leakage in the housing area must be discharged to the reservoir via the highest available tank port (**L**, **L<sub>1</sub>**).

For combination pumps, the leakage must be drained off at each pump.

If a shared drain line is used for several units, make sure that the respective case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operational conditions, particularly at cold start. If this is not possible, separate drain lines must be installed if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction lines and the drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height  $h_s$  results from the total pressure loss. However, it must not be higher than  $h_{s \max} = 800 \text{ mm}$ . The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute during operation and during cold start.

When designing the reservoir, ensure adequate distance between the suction line and the drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Key, see page 47.

### Installation position

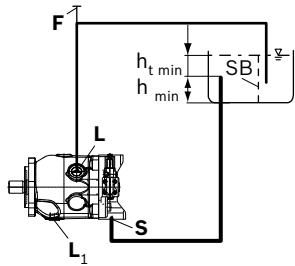
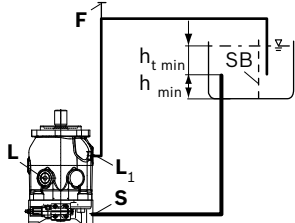
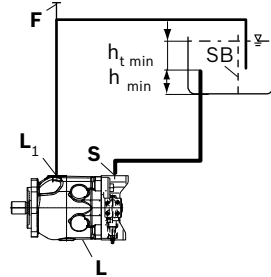
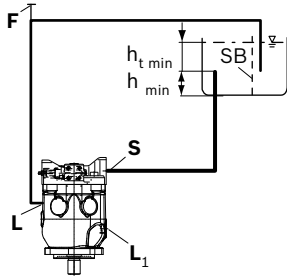
See the following examples **1** to **12**.

Further installation positions are available upon request.

Recommended installation position: **1** and **3**

### Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir and below the minimum fluid level of the reservoir.

| Installation position  | Air bleed            | Filling              |
|--|----------------------|----------------------|
| <b>1</b>   | <b>L</b>             | <b>L<sub>1</sub></b> |
|    |                      |                      |
| <b>2<sup>1)</sup></b>  | <b>L<sub>1</sub></b> | <b>L</b>             |
|  |                      |                      |
| <b>3</b>   | <b>L<sub>1</sub></b> | <b>L</b>             |
|  |                      |                      |
| <b>4<sup>1)</sup></b>  | <b>L</b>             | <b>L<sub>1</sub></b> |
|  |                      |                      |

<sup>1)</sup> Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

**Above-reservoir installation**

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. To prevent the axial piston unit from draining in position 6, the height difference  $h_{ES\ min}$  must be at least 25 mm. Observe the maximum permissible suction height  $h_{S\ max} = 800\ mm$ . A check valve in the drain line is only permissible in individual cases. Consult us for approval..

| Installation position | Air bleed            | Filling              |
|-----------------------|----------------------|----------------------|
| <b>5</b>              | <b>L</b>             | <b>L</b>             |
| <b>6<sup>1)</sup></b> | <b>L<sub>1</sub></b> | <b>L<sub>1</sub></b> |
| <b>7</b>              | <b>L<sub>1</sub></b> | <b>L<sub>1</sub></b> |
| <b>8<sup>1)</sup></b> | <b>L</b>             | <b>L</b>             |

Key, see page 47.

**Inside-reservoir installation**

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid. If the minimum fluid level is equal to or below the upper edge of the pump, see chapter “Above-reservoir installation”. Axial piston units with electrical components (e.g., electric control, sensors) may not be installed in a reservoir below the fluid level.

| Installation position  | Air bleed   | Filling  |
|------------------------|---|--|
| <b>9</b>               | Via the highest available port <b>L</b>             | Automatically via the open port <b>L</b> or <b>L<sub>1</sub></b> due to the position under the hydraulic fluid level |
| <b>10<sup>1)</sup></b> | Via the highest available port <b>L<sub>1</sub></b> | Automatically via the open port <b>L</b> , <b>L<sub>1</sub></b> due to the position under the hydraulic fluid level  |
| <b>11</b>              | Via the highest available port <b>L<sub>1</sub></b> | Automatically via the open port <b>L</b> or <b>L<sub>1</sub></b> due to the position under the hydraulic fluid level |
| <b>12<sup>1)</sup></b> | Via the highest available port <b>L</b>             | Automatically via the open port <b>L</b> or <b>L<sub>1</sub></b> due to the position under the hydraulic fluid level |

1) Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

| Key                     |  |
|-------------------------|--|
| <b>F</b>                | Filling / air bleeding   |
| <b>S</b>                | Suction port   |
| <b>L; L<sub>1</sub></b> | Drain port   |
| SB                      | Baffle (baffle plate)  |
| $h_{t \min}$            | Minimum required immersion depth (200 mm)  |
| $h_{\min}$              | Minimum required distance to the reservoir bottom (100 mm)                               |
| $h_{ES \min}$           | Minimum necessary height required to protect the axial piston unit from draining (25 mm) |
| $h_{S \max}$            | Maximum permissible suction height (800 mm)  |

#### Notice

Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

## Project planning notes

- ▶ The A10VSO axial piston variable pump is designed to be used in open circuit.
- ▶ The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified skilled personnel.
- ▶ Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, this can be requested from Bosch Rexroth.
- ▶ Before finalizing your design, please request a binding installation drawing.
- ▶ The specified data and notes contained herein must be observed.
- ▶ Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- ▶ Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or in the instruction manual.
- ▶ Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. MTTF<sub>d</sub>) for functional safety.
- ▶ Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference. Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.

- ▶ Pressure controllers are not protection against overpressure. A pressure relief valve is to be provided for the hydraulic system.
- ▶ Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended to accommodate hydraulic lines.

## Safety instructions

- ▶ During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take the appropriate safety measures (e.g. by wearing protective clothing).
- ▶ Moving parts in control equipment (e.g. valve spools) can, under certain circumstances, get stuck in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filtration) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to bring the driven consumer into a safe position (e.g. safe stop) and ensure any measures are properly implemented.

**Bosch Rexroth AG**  
Mobile Applications  
An den Kelterwiesen 14  
72160 Horb a.N., Germany  
Tel. +49 7451 92-0  
info.ma@boschrexroth.de  
www.boschrexroth.com

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