

**MANNESMANN  
REXROTH****Variable Displacement Pump A10VO**Series 5, open circuits, SAE-Version  
Axialpiston, swash plate design**RE  
92703/04.96**

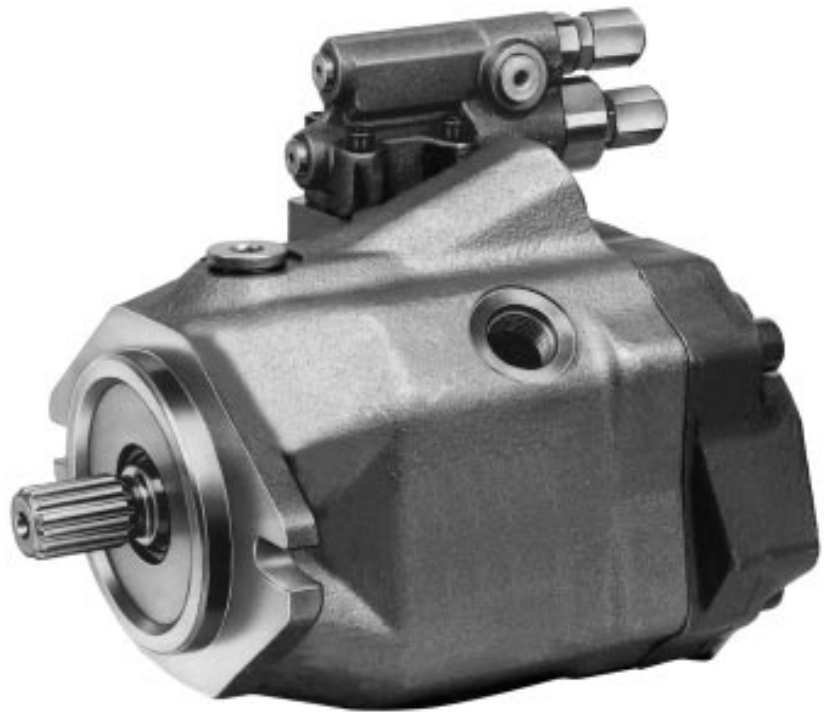
Brueninghaus Hydromatik

size 28...60

Nominal pressure 250 bar

Peak pressure 315 bar

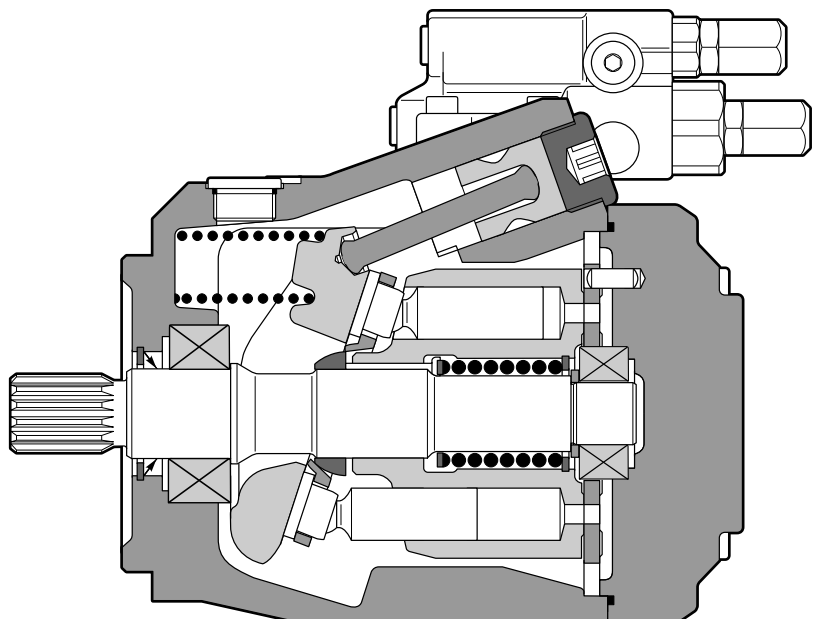
replaces 08.91



The variable displacement axial piston pump A10VO in swashplate design was designed for hydrostatic drives in open circuits.

Flow is proportional to the drive speed and the displacement. By adjusting the position of the swashplate it is possible to vary the flow steplessly.

- Strong bearings for long life
- High permissible drive speed
- High power-weight ratio
- Small dimensions
- Low noise level
- Good suction characteristics
- Permissible continuous pressure 250 bar
- Axial and radial loading of drive shaft possible
- Pressure and flow control
- Short control times
- 2 drain ports





### Hydraulic fluid

Prior to project design, please see our catalogue sheets RE 90220 (mineral oils) and RE 90221 (environmentally compatible fluids) for detailed information on the selection of hydraulic fluids and application conditions.

When operating with environmentally compatible fluids certain limitations may apply. Please consult us.

#### Operating viscosity range

For optimum efficiency and service life, we recommend that the operating viscosity (at operating temperature) be selected in the range

$$v_{opt} = \text{optimum operating viscosity } 16 \dots 36 \text{ mm}^2/\text{s}$$

referred to tank temperature (open circuit).

referred to tank temperature (open loop circuit).

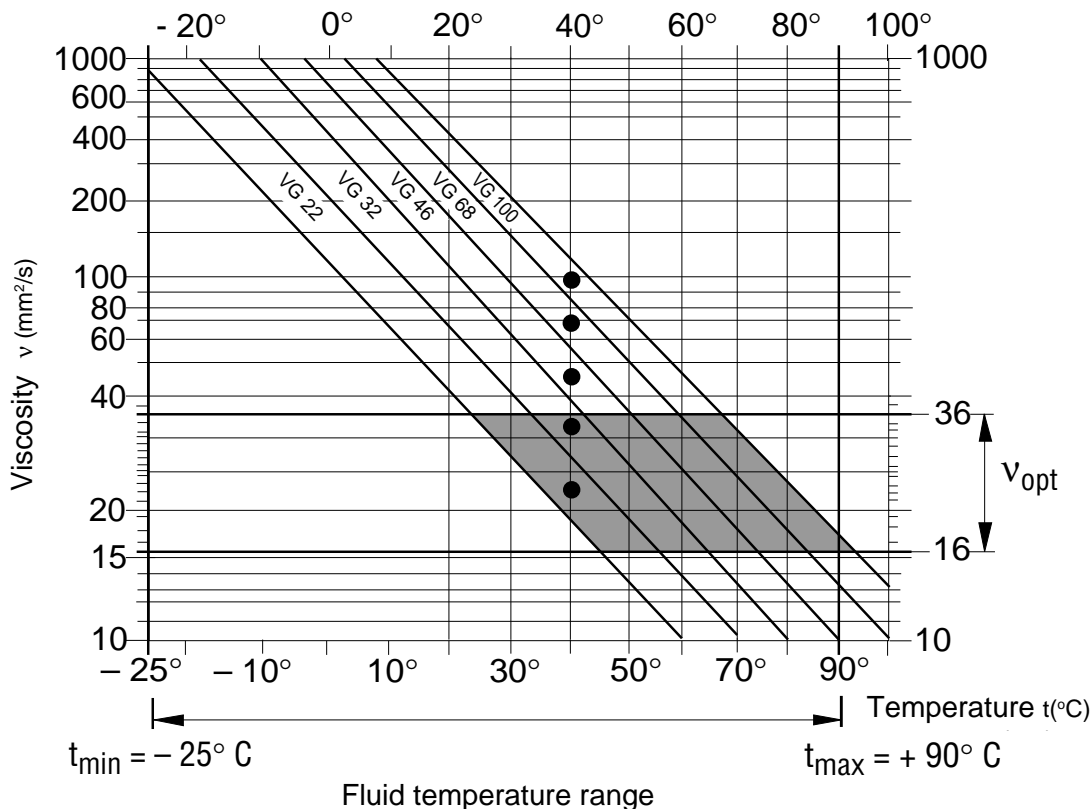
#### Limits of viscosity range

The following values are valid for extreme operating conditions:

$v_{min} = 10 \text{ mm}^2/\text{s}$   
for short periods at max. leakage oil temperature of  $90^\circ \text{C}$ .

$v_{max} = 1000 \text{ mm}^2/\text{s}$   
for short periods upon cold start.

#### Selection diagramm



#### Temperature range (see selection diagram)

$$t_{min} = -25^\circ \text{C}$$

$$t_{max} = +90^\circ \text{C}$$

#### Notes on the selection of the hydraulic fluid

For correct selection of the fluid it is assumed that the operating temperature in the tank is known (open circuits), in relation to the ambient temperature.

The hydraulic fluid should be selected so that, within the operating temperature range, the operating viscosity lies within the optimum range  $v_{opt}$  (see shaded section of selection diagram). We recommend that the higher viscosity grade is selected in each case.

Example: At an ambient temperature of  $X^\circ \text{C}$  the operating temperature in the tank will be  $60^\circ \text{C}$ . In the optimum operating viscosity range ( $v_{opt}$ ; shaded section) this corresponds to viscosity grade VG 46 or VG 68; VG 68 should be selected.

Important: The leakage oil temperature is influenced by pressure and speed and is always higher than the tank temperature. At no point in the system, however, may the temperature be higher than  $90^\circ \text{C}$ .

If it is not possible to comply with the above conditions because of extreme operating parameters or a high ambient temperature, please consult us.

#### Filtration

In order to guarantee reliable function, the operating fluid must be maintained to a cleanliness grade of minimum

9 to NAS 1638 or

6 to SAE

18/15 to ISO/DIS 4406

This may be achieved for example with filter elements, type...D 020...(see RE 50 075). This gives a filtration quotient of

$$\beta_{20} \geq 100.$$

### Technical Data

#### Operating pressure range - Inlet side

Absolute pressure at port S (inlet port)

$p_{abs \text{ min}}$  \_\_\_\_\_ 0,8 bar  
 $p_{abs \text{ max}}$  \_\_\_\_\_ 30 bar

#### Operating pressure range - Outlet side

pressure at port B

Nominal pressure  $p_N$  \_\_\_\_\_ 250 bar  
 Peak pressure  $p_{max}$  \_\_\_\_\_ 315 bar  
 (Pressure data to DIN 24312)

#### Direction of flow

S to B.

#### Case drain pressure

Maximum permissible pressure of leakage fluid (at port L,  $L_1$ ):  
 maximum 0,5 bar higher than the inlet pressure at port S, but not higher than 2 bar absolute.

Determination of inlet pressure  $p_{abs}$  at the inlet port, resp. the reduction in displacement for increasing speed.

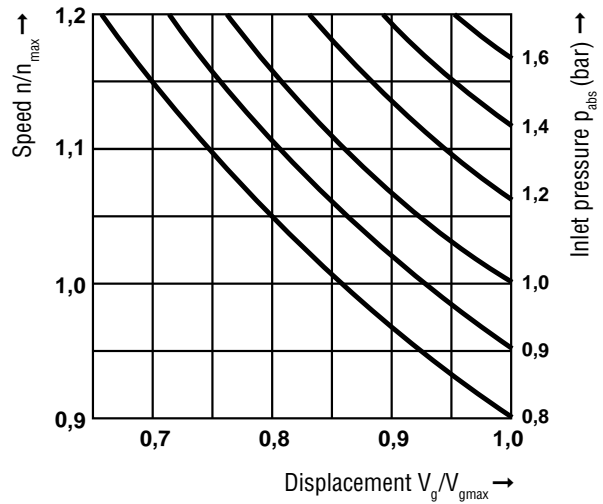


Table of values (theoretical values, without considering  $\eta_{mh}$  and  $\eta_v$ ; values rounded)

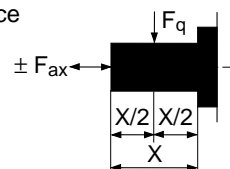
| Size                                |                        |                                       | 28     | 45                 | 60     |
|-------------------------------------|------------------------|---------------------------------------|--------|--------------------|--------|
| Displacement                        |                        | $V_{g \text{ max}}$ cm <sup>3</sup>   | 28     | 45                 | 60     |
| Max. speed <sup>1)</sup>            | at $V_{g \text{ max}}$ | $n_{o \text{ max}}$ min <sup>-1</sup> | 3000   | 2600 <sup>2)</sup> | 2700   |
| Max. flow                           | at $n_{o \text{ max}}$ | $Q_{o \text{ max}}$ L/min             | 84     | 117                | 162    |
|                                     | at $n_E = 1450$ rpm    | L/min                                 | 41     | 65                 | 87     |
| Max. power ( $\Delta p = 250$ bar)  | at $n_{o \text{ max}}$ | $P_{o \text{ max}}$ kW                | 35     | 49                 | 68     |
|                                     | at $n_E = 1450$ rpm    | kW                                    | 17     | 27                 | 36     |
| Max. torque ( $\Delta p = 250$ bar) | at $V_{g \text{ max}}$ | $M_{max}$ Nm                          | 111    | 179                | 238    |
| Moment of inertia about drive axis  |                        | J kgm <sup>2</sup>                    | 0,0017 | 0,0033             | 0,0056 |
| Fill capacity                       |                        | L                                     | 0,3    | 0,5                | 0,8    |
| Approx. weight (without oil fill)   |                        | m kg                                  | 15     | 18                 | 22     |
| Permissible loading on drive shaft: |                        |                                       |        |                    |        |
| max. perm. axial force              |                        | $F_{ax \text{ max}}$ N                | 1000   | 1500               | 2000   |
| max. perm. radial force             |                        | $F_{q \text{ max}}$ N                 | 1200   | 1500               | 1700   |

1) The values shown are valid provided there is an absolute pressure of 1 bar at suction inlet S.

By increasing the inlet pressure ( $p_{abs} > 1$  bar) or reduction of the displacement, the speed can be raised up to the maximum speed limit (see diagram).

2) Higher drive speed on request

Direction of force



#### Calculation of size

Flow  $Q = \frac{V_g \cdot n \cdot \eta_v}{1000}$  [L/min]

Drive torque  $M = \frac{1,59 \cdot V_g \cdot \Delta p}{100 \cdot \eta_{mh}}$  [Nm]

Drive power  $P = \frac{2\pi \cdot M \cdot n}{60000} = \frac{M \cdot n}{9549} = \frac{Q \cdot \Delta p}{600 \cdot \eta_t}$  [kW]

$V_g$  = geometr. displacement [cm<sup>3</sup>] per rev.

$\Delta p$  = pressure differential [bar]

$n$  = speed [rpm]

$\eta_v$  = volumetric efficiency

$\eta_{mh}$  = mech.-hydr. efficiency

$\eta_t$  = overall efficiency ( $\eta_t = \eta_v \cdot \eta_{mh}$ )

## Operating Curves for Pump with Pressure Control DR

### Noise level

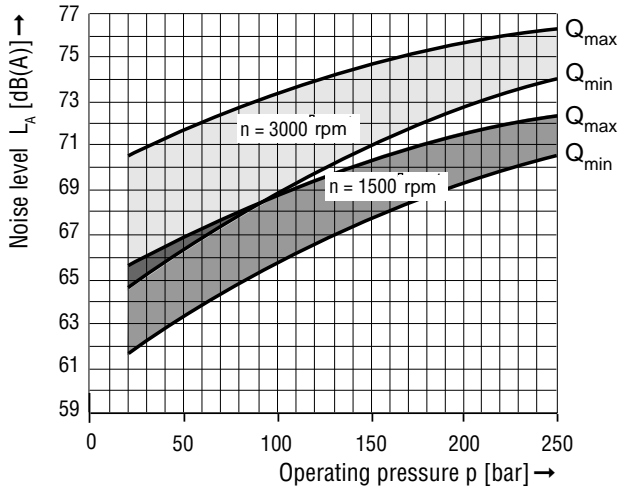
Measured in an anechoic chamber to DIN 43635

Distance from microphone to pump = 1 m

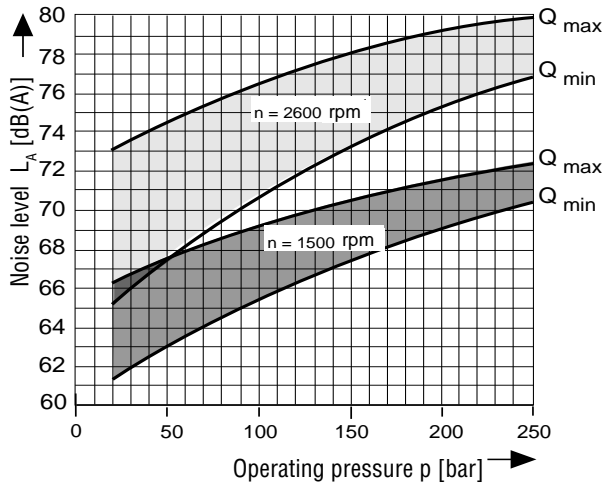
Measuring error to DIN 45635, part 1:  $\pm 2$  dB (A)

(Fluid: hydraulic oil to ISO VG 46 DIN 51519,  $t = 50^\circ\text{C}$ )

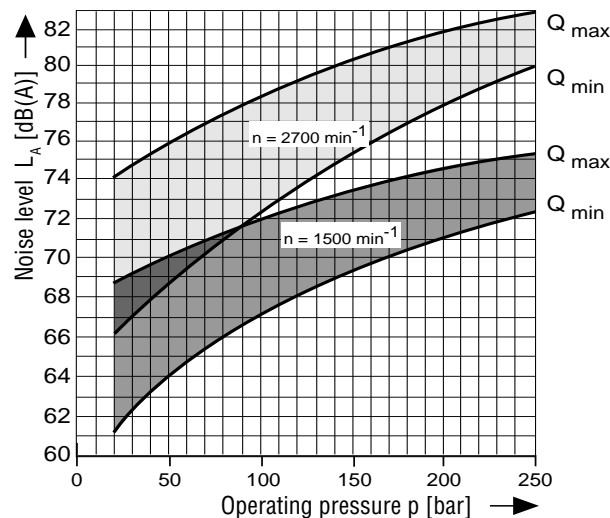
### Size 28



### Size 45



### Size 60

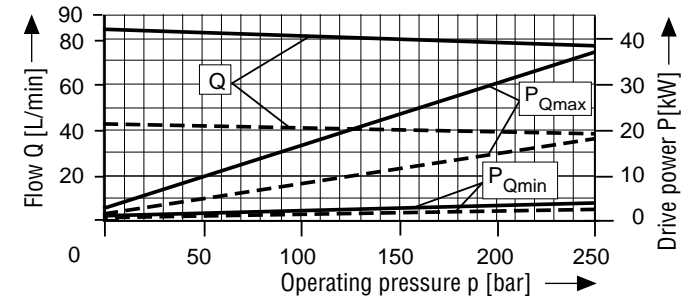


### Drive power and output flow

(fluid: mineral oil to ISO VG 46 DIN 51519,  $t = 50^\circ\text{C}$ )

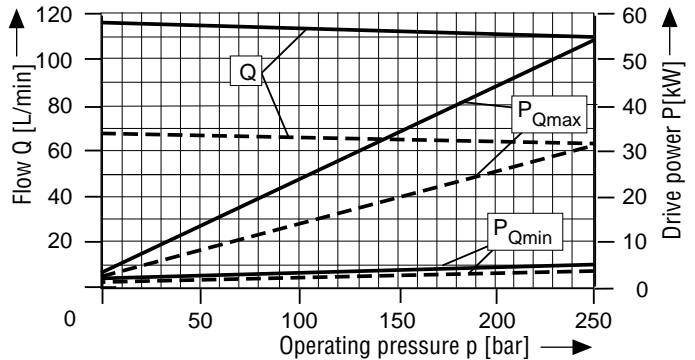
### Size 28

--- n = 1500 rpm  
— n = 3000 rpm



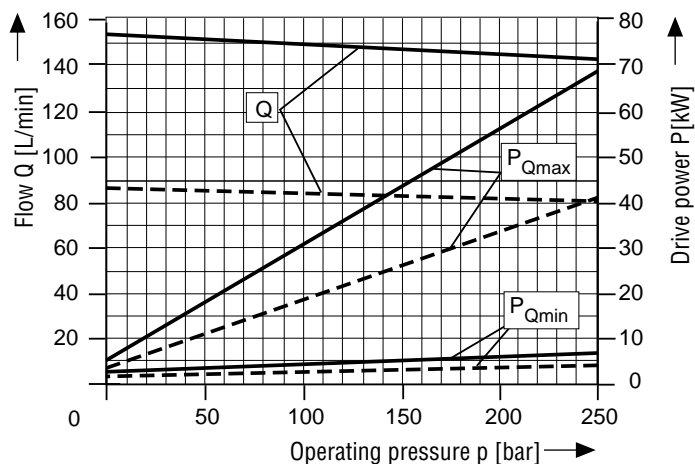
### Size 45

--- n = 1500 rpm  
— n = 2600 rpm



### Size 60

--- n = 1500 rpm  
— n = 2700 rpm



### Installation Notes

Installation position is optional. The pump housing must be filled with fluid during commissioning and remain full when operating. In order to achieve the lowest noise value, all connections (suction, pressure, case drain ports) must be linked by flexible couplings to tank.

Avoid placing a check valve in the case drain line.

This may, however, be permissible in individual cases, after consultation with us.

#### 1. Vertical installation (shaft end upwards)

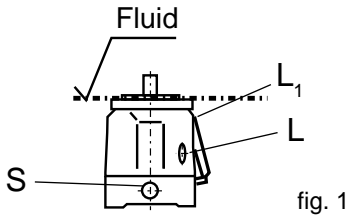
The following installation conditions must be taken into account:

##### 1.1. Arrangement in tank

Before installation fill pump housing, keeping it in a horizontal position.

a) If the minimum fluid level is equal to or above the pump mounting surface leave ports "L", "L<sub>1</sub>" and "S" open (see Fig.1).

b) If the minimum fluid level is below the pump mounting surface pipe port "L<sub>1</sub>", and possibly "S" according to Fig. 2. Close port "L" with respect to conditions in 1.2.1.



##### 1.2. Installation outside a tank

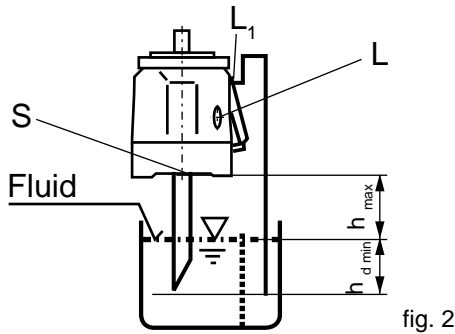
Before installing the pump, fill the pump with housing in the horizontal position. For mounting above a tank see fig. 2.

Limiting conditions:

1.2.1. Minimum pump inlet pressure  $p_{in\ min} = 0,8$  bar both static and dynamic conditions.

Note: Avoid mounting above a tank wherever possible in order to achieve a low noise level.

The permissible suction height  $h$  comes from the overall pressure loss, but may **not** be bigger than  $h_{max} = 800$  mm (immersion depth  $h_{d\ min} = 200$  mm).



Overall pressure loss  $\Delta p_{total} = \Delta p_1 + \Delta p_2 + \Delta p_3 \leq (1 - p_{in\ min}) = 0,2$  bar  
 $\Delta p_1$ : Pressure loss in pipe due to accelerating column of fluid

$$\Delta p_1 = \frac{\rho \cdot l \cdot dv}{dt} \cdot 10^{-5} \text{ (bar)}$$

$\rho$  = density (kg/m<sup>3</sup>)  
 $l$  = pipe length (m)  
 $dv/dt$  = change in rate of fluid velocity (m/s<sup>2</sup>)

$\Delta p_2$ : Pressure loss due to static head

$$\Delta p_2 = h \cdot \rho \cdot g \cdot 10^{-5} \text{ (bar)}$$

$h$  = head (m)  
 $\rho$  = density (kg/m<sup>3</sup>)  
 $g$  = gravity. = 9,81 m/s<sup>2</sup>

$\Delta p_3$ : Line losses (elbows etc.)

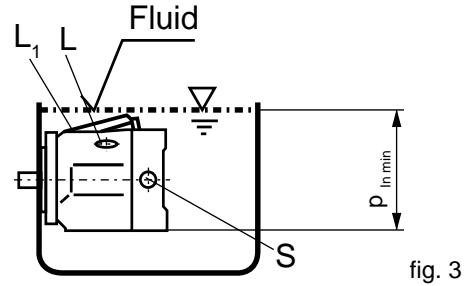
#### 2. Horizontal installation

The pump must be installed, so that "L" or "L<sub>1</sub>" is at the top.

##### 2.1. Installation within a tank

a) If the minimum fluid level is equal to or above the top of the pump, ports "L", "L<sub>1</sub>" and "S" should remain open (see fig. 3)

b) If the minimum fluid level is below the top of the pump, pipe ports "L", "L<sub>1</sub>" and possibly "S" as fig. 4. The conditions correspond to item 1.2.1.

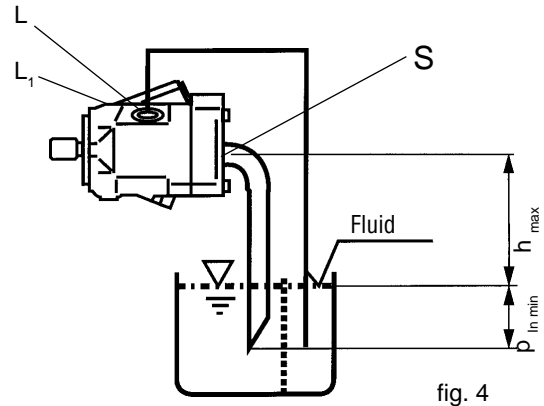


##### 2.2. Installation outside a tank

Fill the pump housing before commissioning.

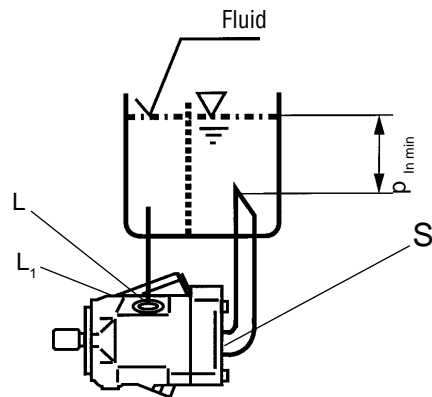
Pipe ports "S" and the higher port "L" or "L<sub>1</sub>".

a) When mounting above the tank, see fig. 4. Conditions correspond to 1.2.1.



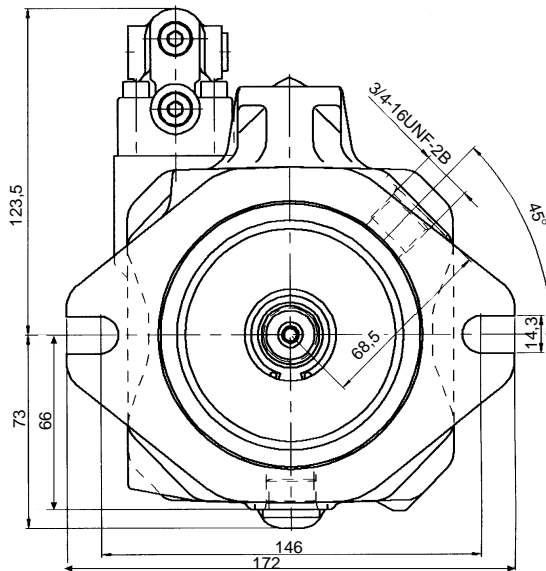
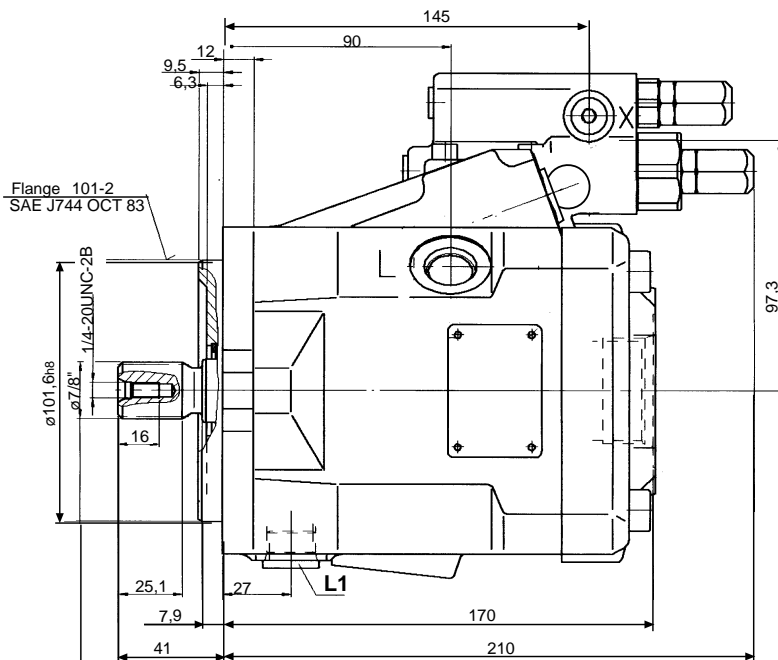
b) Mounting below the tank

Pipe ports "L" and "S" according to fig.5.



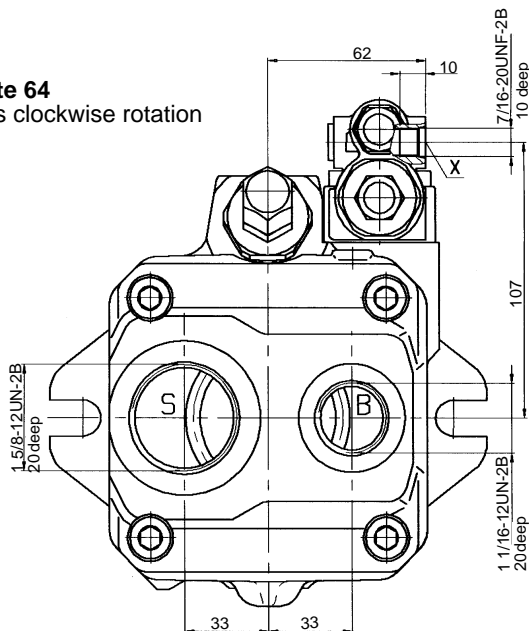
**Dimensions size 28**

Version A10VO 28 **DR**  
**DFR** **61**  
**DFR1 /52 R -X S C** **64 N00**  
**DRG**



shaft 22-4; SAE J744 OCT 83  
30° pressure angle; 13 teeth,  
16/32 DP

**View W**  
**Portplate 64**  
shown is clockwise rotation



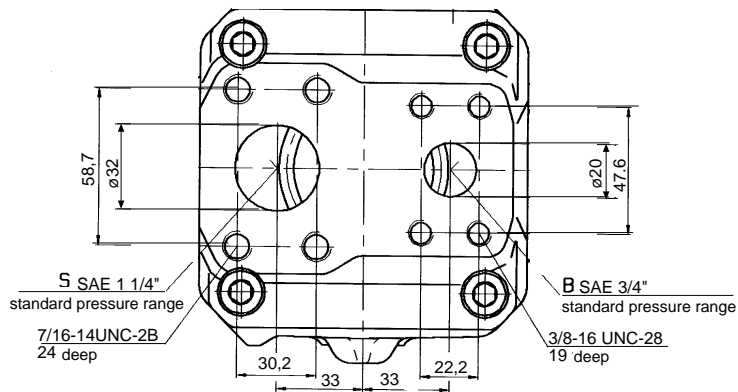
For ccw - rotation, turn port plate 180°

**Ports**

|                  |               |               |
|------------------|---------------|---------------|
| B                | Pressure port | 1 1/16-2UN-2B |
| S                | Inlet port    | 1 5/8-12UN-2B |
| L/L <sub>1</sub> | Case drain    | 3/4-16UNF-2B  |
| X                | Pilot port    | 7/16-20UNF-2B |

**in model pressure control DR pilot port X is plugged**

**View W**  
**Portplate 61**  
shown is clockwise rotation



For ccw - rotation, turn port plate 180°

**Ports**

|                  |               |                                      |
|------------------|---------------|--------------------------------------|
| B                | Pressure port | SAE 3/4" (Standard pressure range)   |
| S                | Inlet port    | SAE 1 1/4" (Standard pressure range) |
| L/L <sub>1</sub> | Case drain    | 3/4-16UNF-2B                         |
| X                | Pilot port    | 7/16-20UNF-2B                        |

**in model pressure control DR pilot port X is plugged**

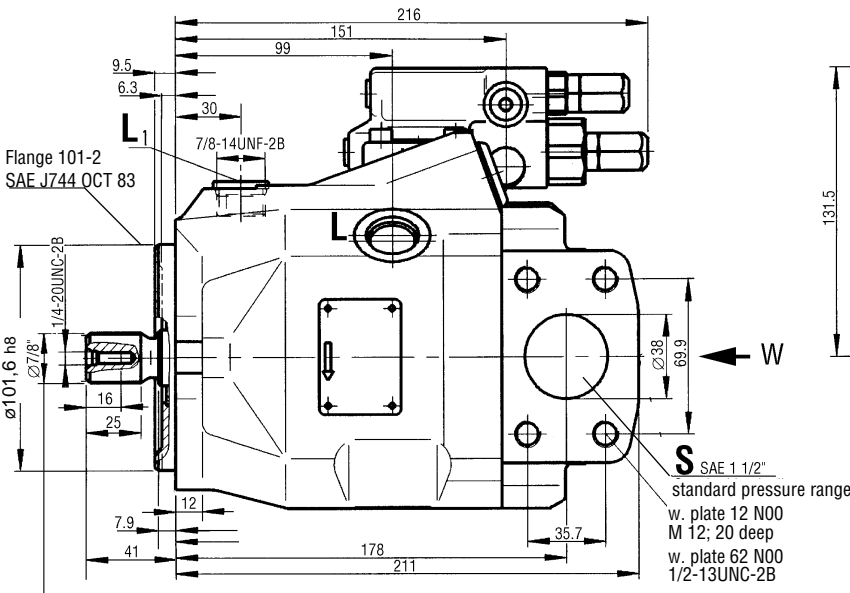




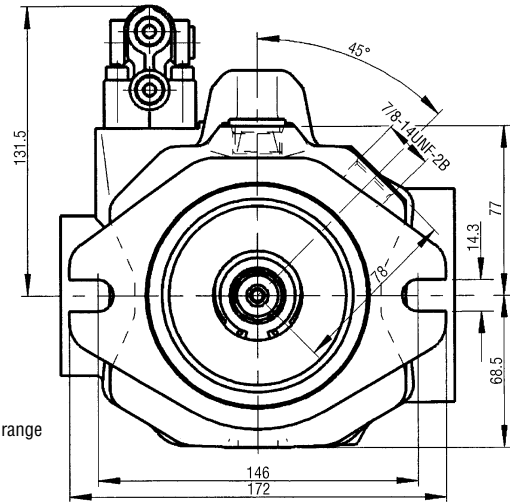


### Dimensions size 45

Version A10VO 45 **DFR /52 R- X U C 12 N00**  
**DRG 62**

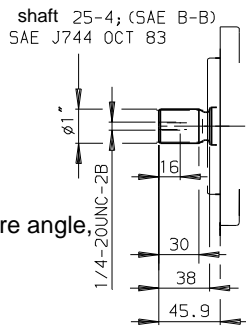


shaft 22-4; SAE J744 OCT 83  
30° pressure angle, 13 teeth;  
16/32 DP



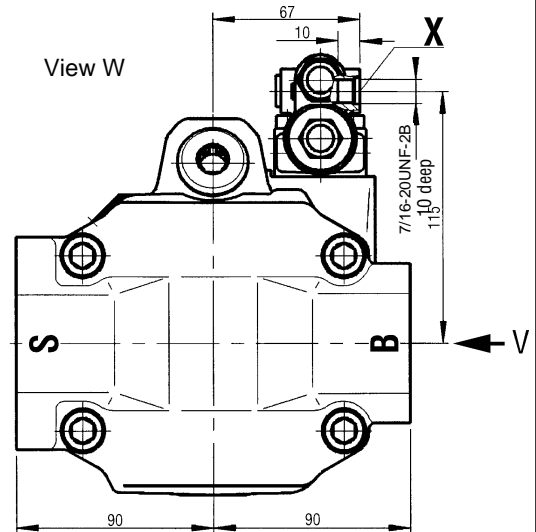
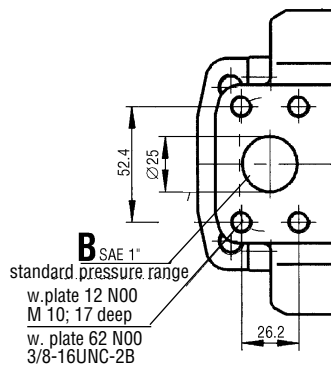
View W

#### Shaft S



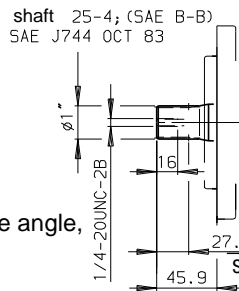
30° pressure angle,  
15 teeth,  
16/32 DP

View V



View V

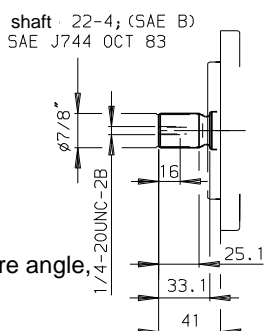
#### Shaft R



30° pressure angle,  
15 teeth,  
16/32 DP

Shown for clockwise rotation  
For ccw - rotation, turn port plate 180°

#### Shaft U



30° pressure angle,  
13 teeth,  
16/32 DP

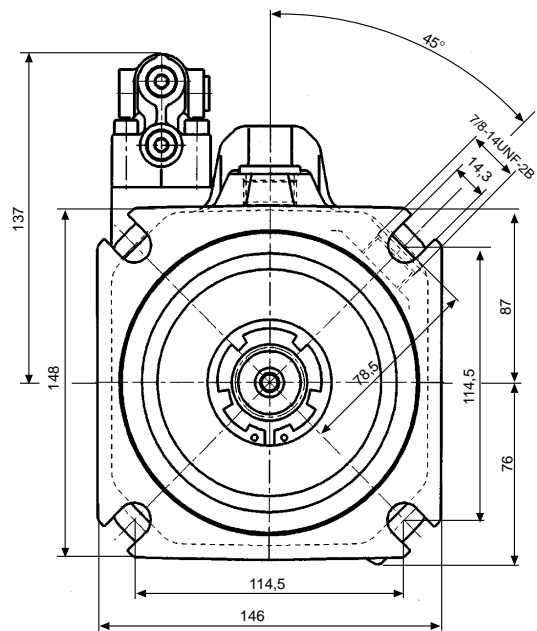
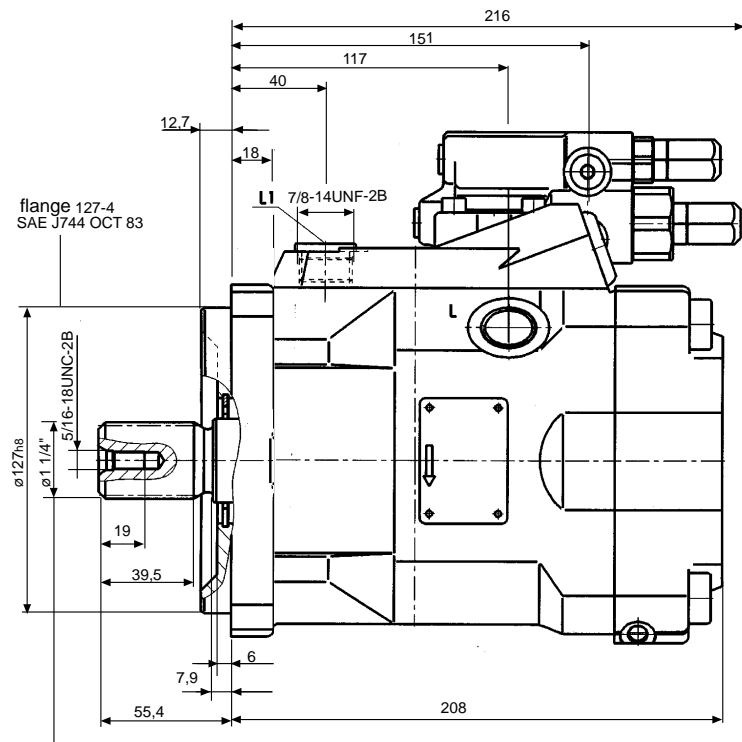
#### Ports

|                  |               |                                      |
|------------------|---------------|--------------------------------------|
| B                | Pressure port | SAE 1" (Standard pressure range)     |
| S                | Inlet port    | SAE 1 1/2" (Standard pressure range) |
| L/L <sub>1</sub> | Case drain    | 7/8-14UNF-2B                         |
| X                | Pilot drain   | 7/16-20UNF-2B                        |

**Dimensions size 60**

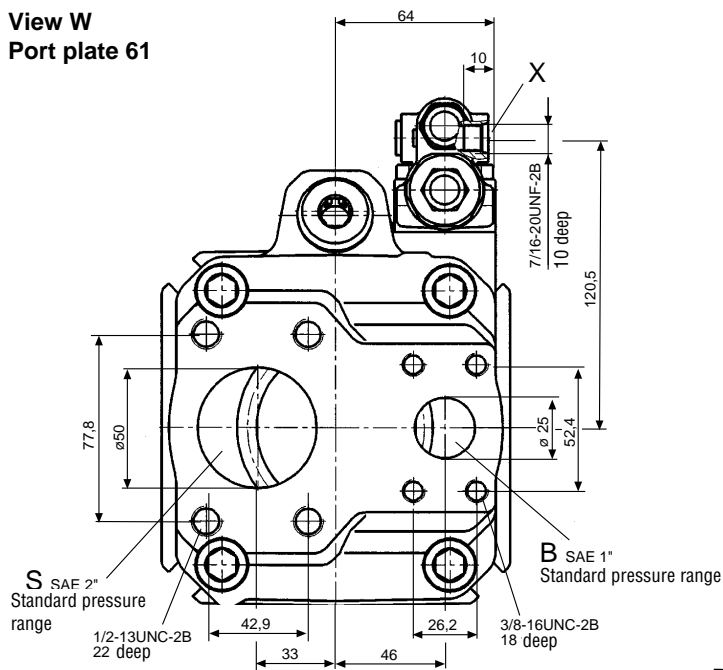
Version A10VO 60

**DR**  
**DFR /52 R- X S C 61 N00**  
**DRG**



shaft 32-4; SAE J744 OCT 83  
30° pressure angle, 14 teeth;  
12/24 DP

**View W**  
**Port plate 61**



Shown for clockwise rotation  
For ccw - rotation, turn port plate 180°

**Ports**

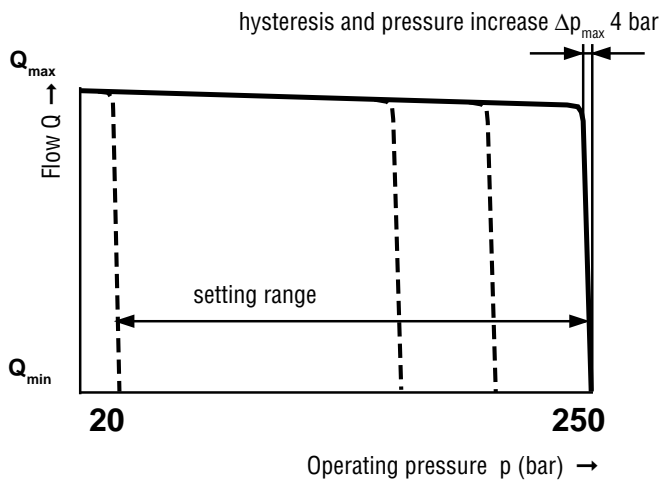
- |                  |               |                                  |
|------------------|---------------|----------------------------------|
| B                | Pressure port | SAE 1" (Standard pressure range) |
| S                | Inlet port    | SAE 2" (Standard pressure range) |
| L/L <sub>1</sub> | Case drain    | 7/8-14UNF-2B                     |
| X                | Pilot port    | 7/16-20UNF-2B                    |
- in model pressure control DR pilot port X is plugged**

## DR Pressure control

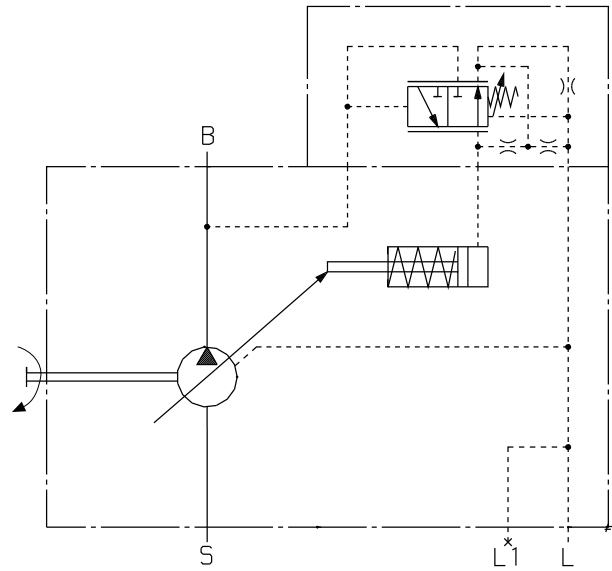
The pressure control serves to maintain a constant pressure in the hydraulic system, within the control range of the pump. The pump therefore supplies only the amount of hydraulic fluid required by the actuators. Pressure may be steplessly set at the pilot valve.

Dimensions see page 7,8 and 11.

**Static characteristic**  
(at  $n_1 = 1500 \text{ rpm}$ ;  $t_{oil} = 50^\circ \text{ C}$ )



Control oil consumption max. 3 L/min.

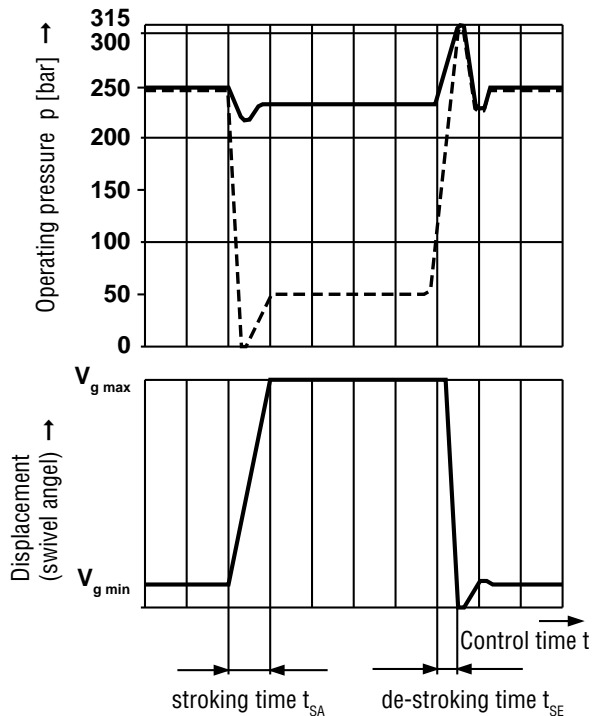


### Dynamic characteristics

The curves show average measured values under test conditions, unit in the tank.

Conditions:  $n = 1500 \text{ rpm}$   
 $t_{oil} = 50^\circ \text{ C}$   
Line relief valve set at 315 bar

Stepped loading by suddenly opening or closing the pressure line using a pressure relief valve at 1m downstream from the axial piston unit.



| Size | $t_{SA}$ (ms)<br>against 50 bar | $t_{SA}$ (ms)<br>against 220 bar | $t_{SE}$ (ms)<br>zero stroke 250 bar |
|------|---------------------------------|----------------------------------|--------------------------------------|
| 28   | 70                              | 65                               | 20                                   |
| 45   | 85                              | 75                               | 20                                   |
| 60   | 100                             | 85                               | 25                                   |

## DRG Pressure control, remote control

Function and design as for DR.

A pressure relief valve may be externally piped to port X for remote control purposes. It is not, however, included with the DRG control.

The differential pressure at the pilot valve is set as standard to 20 bar and this results in a pilot flow of 1,5 L/min. If another setting is required (in the range 10 – 22 bar), please state this in clear text.

We recommend that one of the following is used as the separate pressure relief valve:

DBDH 6 (hydraulic) to RE 25402,

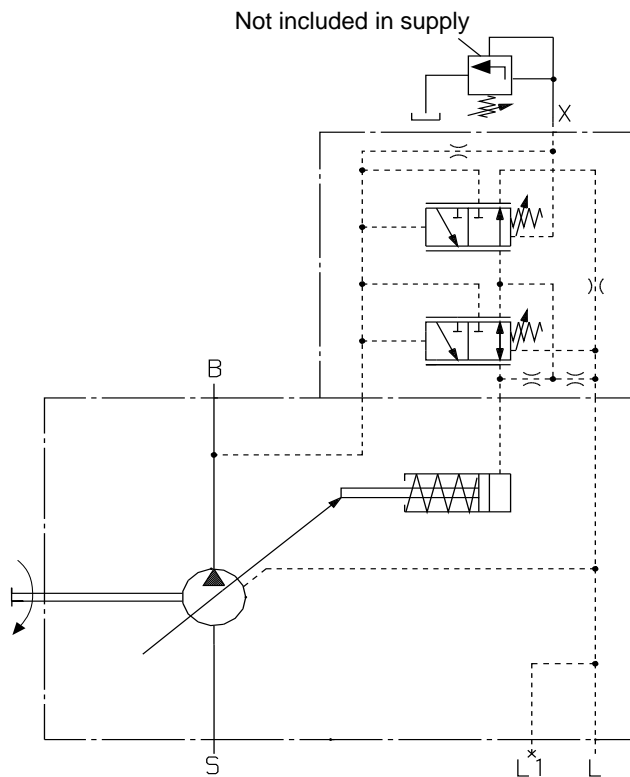
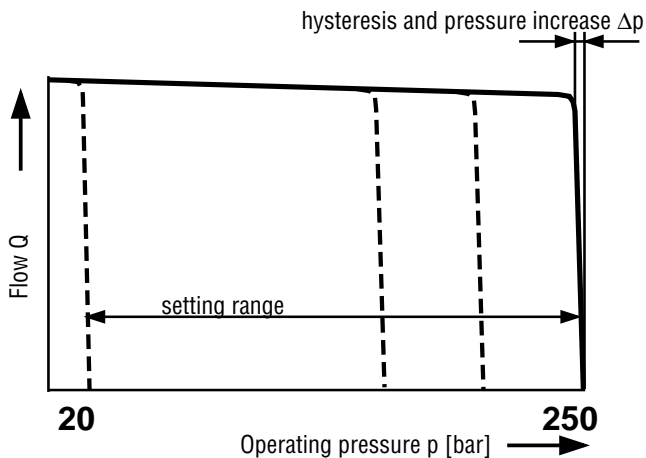
DBEC-3X (electrical) to RE 29142 or

DBETR-SO 381 with 0,8 mm dia. nozzle in P (electrical) to RE 29166.

The length of piping must not exceed 2m.

### Static characteristic

(at  $n_1 = 1500$  rpm;  $t_{oil} = 50^\circ C$ )



Dimensions see pages 7, 9, 10 and 11.

### Control data

Hysteresis and repetitive accuracy  $\Delta p$  ..... max. 3 bar

Max. pressure increase

| Size           | 28 | 45 | 60 |
|----------------|----|----|----|
| $\Delta p$ bar | 4  | 6  | 8  |

Control oil consumption ..... approx. 4,5 L/min

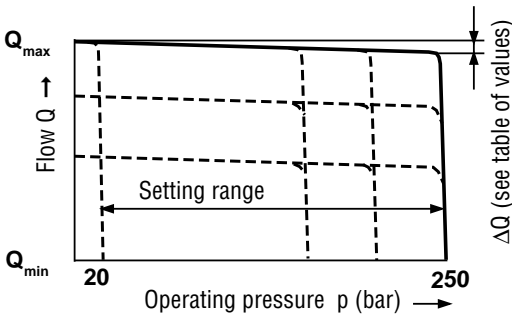
Flow loss at  $Q_{max}$  see page 5.

## DFR/DFR1 Pressure/flow control

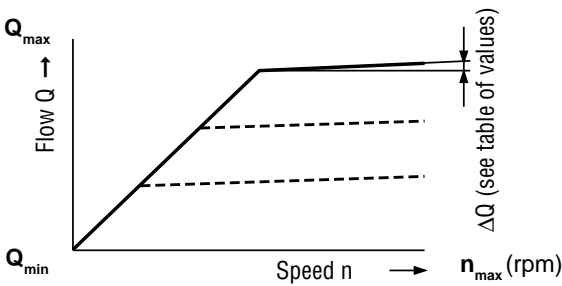
In addition to the pressure control function, the pump flow may be varied by means of a differential pressure at the actuator (e.g. an orifice, not included in supply). The pump flow is equal to the actual required flow by the actuator. The DFR1-valve has no connection between X and tank.

Dimensions see pages 7, 9, 10 and 11.

**Static characteristic** (at  $n_1 = 1500 \text{ rpm}$ ;  $t_{oil} = 50^\circ \text{ C}$ )



**Static characteristic at variable speed**

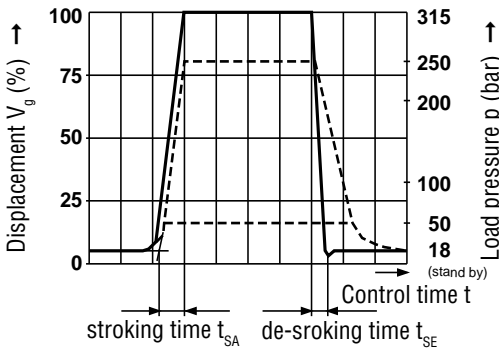


**Max. Flow deviation** (hysteresis and increase) measured at drive speed  $n = 1500 \text{ rpm}$

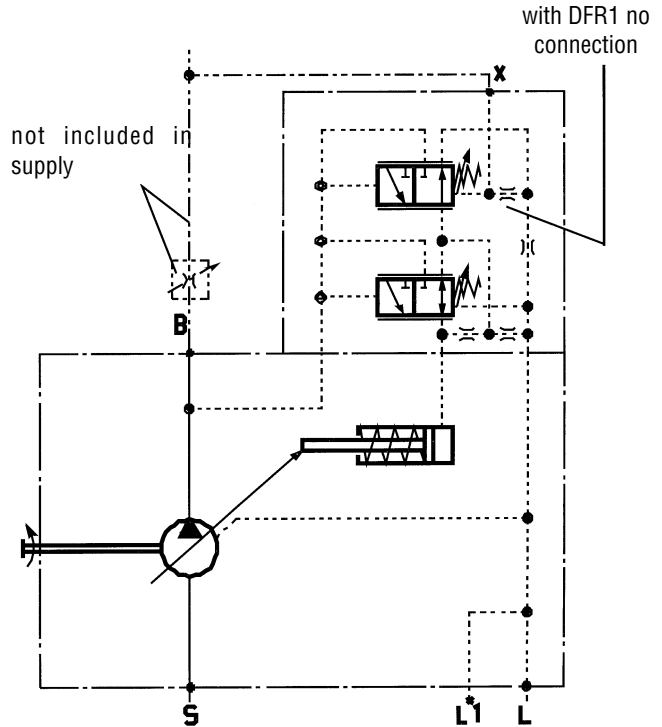
| Size                     | 28  | 45  | 60  |
|--------------------------|-----|-----|-----|
| $\Delta Q \text{ L/min}$ | 1,0 | 1,8 | 2,5 |

**Dynamic characteristic of flow control**

The curves shown are measured average values under test conditions, with the unit within the tank.



| Size | $t_{SA} \text{ (ms)}$<br>stand by–250 bar | $t_{SE} \text{ (ms)}$<br>250 bar–stand by | $t_{SE} \text{ (ms)}$<br>50 bar–stand by |
|------|---|---|--|
| 28   | upon request                              |   |  |
| 45   | 75  | 25  | 50                                       |
| 60   | upon request                              |   |  |



Control oil consumption max. 3 L/min.

**Flow control/differential pressure  $\Delta p$ :**

Adjustable between 10 and 22 bar

Standard setting: 14 bar. If a different setting is required, please state in clear text.

When port X is unloaded to tank, a zero stroke pressure of  $p = 18 \pm 2 \text{ bar}$  ("stand by") results.

**Optional valves at port B**

(not included in supply)

Mobile valve blocks SP 12 (RE 64145)

Mobile valve blocks SP 18 (RE 64148)

Mobile valve blocks MP 18 (RE 64594)

Mobile valve blocks MP 22 (RE 64598)

Proportional directional valves 4WRE (RE 29060)

Variable displacement pump A10VO, Series 5

Variable displacement pump A10VO, Series 5