



**YEOSHE**

# Hydraulic Piston Pump PA10VO Series



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**Efficient Performance**  
**Innovative Technology**  
**Reliable Quality and Service**

**YEOSHE HYDRAULICS CO.,LTD.**

### Type code for standard program

| PA10V | O  |    |    | / | 5  |    |    | - | V  |    |    |    |    |
|-------|----|----|----|---|----|----|----|---|----|----|----|----|----|
| 01    | 02 | 03 | 04 |   | 05 | 06 | 07 |   | 08 | 09 | 10 | 11 | 12 |

#### Axial piston unit

18 28 45 60<sup>1)</sup> 63 85 100

|    |                                                                          |  |  |  |  |  |  |  |  |  |  |  |       |
|----|--------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|-------|
| 01 | nominal pressure 3600 psi (250 bar), maximum pressure 4600 psi (315 bar) |  |  |  |  |  |  |  |  |  |  |  | PA10V |
|----|--------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|-------|

#### Operation mode

|    |                    |  |  |  |  |  |  |  |  |  |  |  |   |
|----|--------------------|--|--|--|--|--|--|--|--|--|--|--|---|
| 02 | Pump, open circuit |  |  |  |  |  |  |  |  |  |  |  | O |
|----|--------------------|--|--|--|--|--|--|--|--|--|--|--|---|

#### Size (NG)

|    |                                             |  |  |  |  |  |  |  |  |  |  |  |  |
|----|---------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|
| 03 | Geometric displacement, see table of values |  |  |  |  |  |  |  |  |  |  |  |  |
|----|---------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|

#### Control device

04

|                                                    |                                                                               |                                   |          |
|----------------------------------------------------|-------------------------------------------------------------------------------|-----------------------------------|----------|
| Pressure control                                   |                                                                               |                                   |          |
| with flow control, hydraulic                       |                                                                               |                                   |          |
| X-T open                                           |                                                                               |                                   |          |
| X-T plugged                                        |                                                                               |                                   |          |
| Electrically overridable (negative characteristic) |                                                                               |                                   |          |
| with pressure cut-off, remotely operated           |                                                                               |                                   |          |
| hydraulic                                          |                                                                               |                                   |          |
| electrical                                         | negative characteristic                                                       | U = 12 V                          |          |
|                                                    |                                                                               | U = 24 V                          |          |
|                                                    | positive characteristic                                                       | U = 12 V                          |          |
|                                                    |                                                                               | U = 24 V                          |          |
| Power control with pressure cut-off                |                                                                               |                                   |          |
|                                                    | Start of control                                                              | 145 to 510 psi (10 to 35 bar)     |          |
|                                                    |                                                                               | 520 to 1015 psi (36 to 70 bar)    |          |
|                                                    |                                                                               | 1030 to 1520 psi (71 to 105 bar)  |          |
|                                                    |                                                                               | 1535 to 2030 psi (106 to 140 bar) |          |
|                                                    |                                                                               | 2045 to 3335 psi (141 to 230 bar) |          |
|                                                    | remotely operated                                                             | Start of control                  | see LA.D |
|                                                    | Flow control, X-T plugged                                                     | Start of control                  | see LA.D |
|                                                    | Flow control, electrically overridable (negative characteristic), X-T plugged | Start of control                  | see LA.D |

|   |   |   |   |   |                 |   |                    |
|---|---|---|---|---|-----------------|---|--------------------|
| ● | ● | ● | ● | ● | ●               | ● | DR                 |
| — | ● | ● | ● | — | ● <sup>3)</sup> | — | DFR                |
| ● | — | — | — | ● | ● <sup>2)</sup> | ● | DRF                |
| — | ● | ● | ● | — | ● <sup>3)</sup> | — | DFR1               |
| ● | — | — | — | ● | ● <sup>2)</sup> | ● | DRS                |
| ○ | ○ | ○ | — | ● | ●               | ○ | EFD. <sup>4)</sup> |
| ● | ● | ● | ● | ● | ●               | ● | DRG                |
| ● | ● | ● | ● | ● | ●               | ● | ED71               |
| ● | ● | ● | ● | ● | ●               | ● | ED72               |
| ● | ● | ● | ● | ● | ●               | ● | ER71 <sup>5)</sup> |
| ● | ● | ● | ● | ● | ●               | ● | ER72 <sup>5)</sup> |
| ● | ● | ● | — | ● | ●               | ● | LA5D               |
| ● | ● | ● | — | ● | ●               | ● | LA6D               |
| ● | ● | ● | — | ● | ●               | ● | LA7D               |
| ● | ● | ● | — | ● | ●               | ● | LA8D               |
| ● | ● | ● | — | ● | ●               | ● | LA9D               |
| ● | ● | ● | — | ● | ●               | ● | LA.DG              |
| ● | ● | ● | — | ● | ●               | ● | LA.DS              |
| ● | ● | ● | — | ● | ●               | ● | LA.S               |

<sup>1)</sup> Series 52 units are delivered as standard with 3.66 in<sup>3</sup> (60 cm<sup>3</sup>). Higher values on request.

<sup>2)</sup> Series 53 only with D flange

<sup>3)</sup> Series 52 only with C flange

<sup>4)</sup> The following must be taken into account during project planning:

Excessive current levels (I > 1200 mA with 12 V or I > 600 mA with 24 V) to the ER solenoid can result in undesired increase of pressure which can lead to pump or system damage:

- Use I<sub>max</sub> 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 Yeoshe

● = available

○ = on request

- = not available



## Type code for standard program

| PA10V | O  |    | /  | 5  |    | -  | V  |    |    |    |    |  |  |
|-------|----|----|----|----|----|----|----|----|----|----|----|--|--|
| 01    | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 |  |  |

04

|                                                                                    |          |
|------------------------------------------------------------------------------------|----------|
| Electro-proportional control (positive characteristic) with                        |          |
| pressure control                                                                   | U = 12 V |
|                                                                                    | U = 24 V |
| Pressure and flow control,<br>X-T open (load sensing)                              | U = 12 V |
|                                                                                    | U = 24 V |
| Pressure and flow control,<br>X-T plugged (load sensing)                           | U = 12 V |
|                                                                                    | U = 24 V |
| Electrohydraulic pressure control                                                  | U = 12 V |
|                                                                                    | U = 24 V |
| Pressure and flow control with control-<br>ler cut-off, X-T open (load sensing)    | U = 12 V |
|                                                                                    | U = 24 V |
| Pressure and flow control with control-<br>ler cut-off, X-T plugged (load sensing) | U = 12 V |
|                                                                                    | U = 24 V |
| Electrohydraulic pressure control with<br>controller cut-off                       | U = 12 V |
|                                                                                    | U = 24 V |

|   | 18 | 28 | 45 | 60 <sup>1)</sup> | 63 | 85 | 100 |       |
|---|----|----|----|------------------|----|----|-----|-------|
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EP1D  |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EP2D  |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EP1DF |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EP2DF |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EP1DS |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EP2DS |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EP1ED |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EP2ED |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EK1DF |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EK2DF |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EK1DS |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EK2DS |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EK1ED |
| ● | ●  | ●  | ●  | —                | ●  | ●  | ○   | EK2ED |

### Series

|    |                   |   |   |   |   |   |   |   |                    |
|----|-------------------|---|---|---|---|---|---|---|--------------------|
| 05 | Series 5, index 2 | - | ● | ● | ● | - | ● | - | 52 <sup>2)</sup>   |
|    | Series 5, index 3 | ● | ● | ● | - | ● | ● | ● | 53 <sup>3)4)</sup> |

### Direction of rotation

|    |                          |                   |   |
|----|--------------------------|-------------------|---|
| 06 | With view on drive shaft | clockwise         | R |
|    |                          | counter clockwise | L |

### Seals

|    |                        |   |
|----|------------------------|---|
| 07 | FKM (fluor-caoutchouc) | V |
|----|------------------------|---|

### Drive shaft

|    |                                                    | 18                                                   | 28 | 45 | 60 <sup>1)</sup> | 63 | 85 | 100 |                 |
|----|----------------------------------------------------|------------------------------------------------------|----|----|------------------|----|----|-----|-----------------|
| 08 | Splined shaft<br>ANSI B92.1a                       | standard shaft                                       | ●  | ●  | ●                | ●  | ●  | ●   | S               |
|    |                                                    | similar to shaft „S“ however for higher input torque | ●  | ●  | ●                | ●  | -  | -   | R               |
|    |                                                    | reduced diameter, not for through drive              | ●  | -  | ●                | ●  | ●  | ●   | U               |
|    |                                                    | similar to shaft "U", however for higher torque      | -  | -  | ●                | ●  | ●  | ●   | W               |
|    | Parallel shaft SAE with key, not for through drive |                                                      | -  | ●  | ●                | -  | -  | -   | K <sup>7)</sup> |
|    |                                                    | Tapered with Woodruff key                            | -  | ●  | ●                | ●  | -  | -   | C <sup>7)</sup> |

- 1) Series 52 units are delivered as standard with 3.66 in<sup>3</sup> (60 cm<sup>3</sup>). Higher values on request.  
2) Control DR, DFR, DFR1, DRG, ED and ER: delivery with size 10, 28, 45, 60 and 85<sup>6)</sup> only in series 52  
3) Control DR, DRF, DRS, DRG, ED and ER: delivery with size 18, 63, 85<sup>5)</sup> and 100 only in series 53  
4) Control EF, LA., EP. and EK. Delivery with size 18 to 100 only in series 53  
5) Control DRF and DRS: delivery with size 85 only with D flange in series 53  
6) Control DFR, DFR1: delivery with size 85 only with C flange in series 52

● = available      ○ = on request      - = not available



### Type code for standard program

| PA10V | O  |    |    | / | 5  |    |    | - | V  |    |    |    |    |
|-------|----|----|----|---|----|----|----|---|----|----|----|----|----|
| 01    | 02 | 03 | 04 |   | 05 | 06 | 07 |   | 08 | 09 | 10 | 11 | 12 |

#### Mounting flange

|  |                  |        |
|--|------------------|--------|
|  | ISO 3019-1 (SAE) | 2-bolt |
|  |                  | 4-bolt |

18 28 45 60<sup>1)</sup> 63 85 100

|   |   |   |   |   |                 |   |   |
|---|---|---|---|---|-----------------|---|---|
| ● | ● | ● | ● | ● | ●               | ● | C |
| - | - | - | ● | ● | ● <sup>2)</sup> | ● | D |

#### Service line port

|    |                                                                            |  |
|----|----------------------------------------------------------------------------|--|
| 10 | SAE flange port at rear, UNC fixing thread<br>(not for through drive)      |  |
|    | SAE flange port on opposite side, UNF fixing thread<br>(for through drive) |  |
|    | UNF threaded ports, rear (not for through drive)                           |  |

18 28 45 60<sup>1)</sup> 63 85 100

|   |   |   |   |   |   |   |    |
|---|---|---|---|---|---|---|----|
| ● | ● | ● | ● | ● | ● | ● | 61 |
| ● | ● | ● | ● | ● | ● | ● | 62 |
| - | - | - | - | - | - | - | 64 |

#### Through drive

|    |                                                        |                                          |
|----|--------------------------------------------------------|------------------------------------------|
| 11 | Without through drive, standard for versions 61 and 64 |                                          |
|    | SAE J744 flange                                        | coupling for splined shaft <sup>3)</sup> |
|    | Diameter                                               | diameter                                 |
|    | 82-2 (A)                                               | 5/8 in 9T 16/32DP                        |
|    |                                                        | 3/4 in 11T 16/32DP                       |
|    | 101-2 (B)                                              | 7/8 in 13T 16/32DP                       |
|    |                                                        | 1 in 15T 16/32DP                         |
|    | 127-4 (C)                                              | 1 1/4 in 14T 12/24DP                     |
|    |                                                        | 1 1/2 in 17T 12/24DP                     |
|    | 127-2 (C)                                              | 1 1/4 in 14T 12/24DP                     |
|    |                                                        | 1 1/2 in 17T 12/24DP                     |

18 28 45 60<sup>1)</sup> 63 85 100

|   |   |   |   |   |   |   |     |
|---|---|---|---|---|---|---|-----|
| ● | ● | ● | ● | ● | ● | ● | N00 |
|---|---|---|---|---|---|---|-----|

|   |   |   |   |   |   |   |     |
|---|---|---|---|---|---|---|-----|
| ● | ● | ● | ● | ● | ● | ● | K01 |
| ● | ● | ● | ● | ● | ● | ● | K52 |
| - | ● | ● | ● | ● | ● | ● | K68 |
| - | - | ● | ● | ● | ● | ● | K04 |
| - | - | - | ● | ● | ● | ● | K15 |
| - | - | - | - | - | ● | ● | K16 |
| - | - | - | - | - | ● | ● | K07 |
| - | - | - | - | - | ● | ● | K24 |

#### Connector for solenoids

|    |                                                            |
|----|------------------------------------------------------------|
| 12 | DEUTSCH molded connector, 2-pin – without suppressor diode |
|----|------------------------------------------------------------|

18 28 45 60<sup>1)</sup> 63 85 100

|   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|
| ● | ● | ● | ● | ● | ● | ● | P |
|---|---|---|---|---|---|---|---|

<sup>1)</sup> Series 52 units are delivered as standard with 3.66 in<sup>3</sup> (60 cm<sup>3</sup>). Higher values on request.

<sup>2)</sup> Only available in series 53. For controller designation and series assignment, please refer to positions 04, 05, including footnotes.





## Technical data

### Hydraulic fluid

When using environmentally acceptable hydraulic fluids, the limitations regarding technical data and seals must be observed. Please contact us. When ordering, indicate the hydraulic fluid that is to be used.

### Operating viscosity range

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

$$v_{\text{opt}} = \text{opt. operating viscosity 80 to 170 SUS} \\ (16 \text{ to } 36 \text{ mm}^2/\text{s})$$

referred to reservoir temperature (open circuit).

### Limits of viscosity range

For critical operating conditions the following values apply:

$$v_{\text{min}} = 60 \text{ SUS (10 mm}^2/\text{s)} \\ \text{for short periods (t} \leq 1 \text{ min)} \\ \text{at max. perm. case drain temperature of} \\ 239^\circ\text{F (115}^\circ\text{C)}.$$

Please note that the max. case drain temperature of  $115^\circ\text{C}$  is also not exceeded in certain areas (for instance bearing area). The fluid temperature in the bearing area is approx.  $7^\circ\text{F}$  ( $5^\circ\text{K}$ ) higher than the average case drain temperature.

$$v_{\text{max}} = 7500 \text{ SUS (1600 mm}^2/\text{s)} \\ \text{for short periods (t} \leq 1 \text{ min)} \\ \text{on cold start} \\ (p \leq 435 \text{ psi (30 bar), n} \leq 1000 \text{ rpm,} \\ t_{\text{min}} -13^\circ\text{F (-25}^\circ\text{C)})$$

Depending on the installation situation, special measures are necessary at temperatures between  $-40^\circ\text{F}$  ( $-40^\circ\text{C}$ ) and  $-13^\circ\text{F}$  ( $-25^\circ\text{C}$ ). Please contact us.

### Notes on the selection of the hydraulic fluid

In order to select the correct hydraulic fluid, it is necessary to know the operating temperature in relation to the ambient temperature. In an open circuit this is the reservoir temperature.

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

Example: at an ambient temperature of  $X^\circ\text{F}$  ( $^\circ\text{C}$ ) the operating temperature in the reservoir is  $140^\circ\text{F}$  ( $60^\circ\text{C}$ ). In the optimum operating viscosity range ( $v_{\text{opt}}$ ; shaded area) this corresponds to viscosity grades VG 46 resp. VG 68; VG 68 should be selected.

### Important

The case drain temperature is influenced by pressure and input speed and is always higher than the reservoir temperature. However, at no point in the component may the temperature exceed  $239^\circ\text{F}$  ( $115^\circ\text{C}$ ). The temperature difference specified on the left is to be taken into account when determining the viscosity in the bearing.

Please contact us if the above conditions cannot be met due to extreme operating parameters.

### Filtration of the fluid

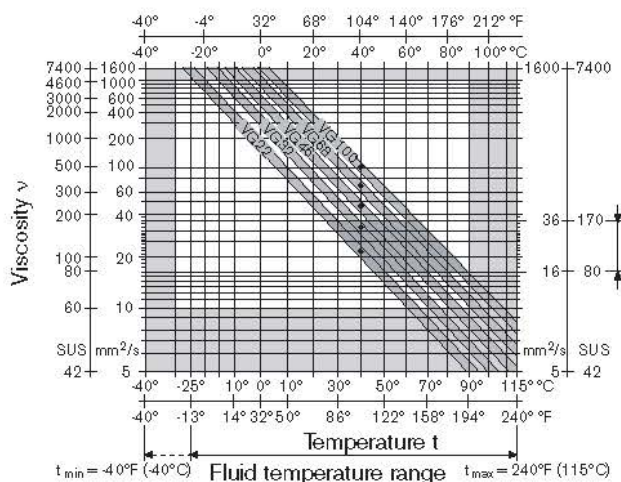
The finer the filtration the better the fluid cleanliness class and the longer the service life of the axial piston unit.

In order to guarantee the functional reliability of the axial piston unit it is necessary to carry out a gravimetric evaluation of the fluid to determine the particle contamination and the cleanliness class according to ISO 4406. A cleanliness class of at least 20/18/15 must be achieved.

At very high hydraulic fluid temperatures ( $195^\circ\text{F}$  ( $90^\circ\text{C}$ ) to maximum  $239^\circ\text{F}$  ( $115^\circ\text{C}$ )), a cleanliness class of at least 19/17/14 according to ISO 4406 is necessary.

Please contact us if the above classes cannot be observed.

### Selection diagram



### Technical data

#### Operating pressure range

##### Pressure at service line port B

Nominal pressure  $p_{nom}$  \_\_\_\_\_ 3600 psi (250 bar) absolute

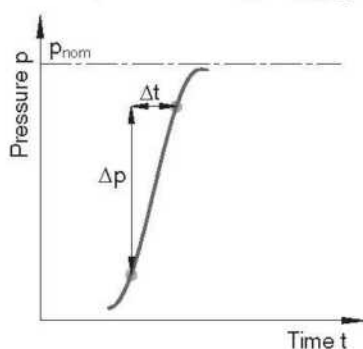
Maximum pressure  $p_{max}$  \_\_\_\_\_ 4600 psi (315 bar) absolute

Single operating period \_\_\_\_\_ 2.5 ms

Total operating period \_\_\_\_\_ 300 h

Minimum pressure (high-pressure side) \_\_\_\_\_ 145 psi (10 bar)

Rate of pressure change  $R_{A,max}$  \_\_\_\_\_ 235000 psi/s (16000 bar/s)



##### Pressure at suction port S (inlet)

Minimum pressure  $p_{S,min}$  \_\_\_\_\_ 10 psi (0.8 bar) absolute

Maximum pressure  $p_{S,max}$  \_\_\_\_\_ 75 psi (5 bar) absolute

##### Case drain pressure

Maximum permissible case drain pressure

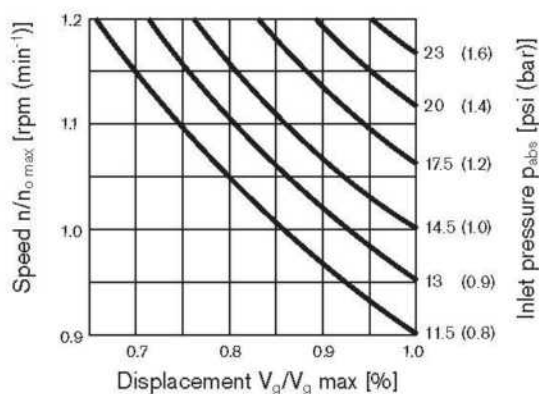
(at port L, L<sub>1</sub>):

Maximum 7.5 psi (0.5 bar) higher than the inlet pressure at port S, however not higher than 30 psi (2 bar) absolute.

$p_{L,max,abs}$  \_\_\_\_\_ 30 psi (2 bar)

##### Maximum permissible speed (limit speed)

Permissible speed by increasing inlet pressure  $p_{abs}$  at suction opening S or at  $V_g \leq V_{g,max}$ .



#### Definition

##### Nominal pressure $p_{nom}$

The nominal pressure corresponds to the maximum design pressure.

##### Maximum pressure $p_{max}$

The maximum pressure corresponds to the operating pressure within the single operating period. The total of the single operating periods must not exceed the total operating period.

##### Minimum pressure (high-pressure side)

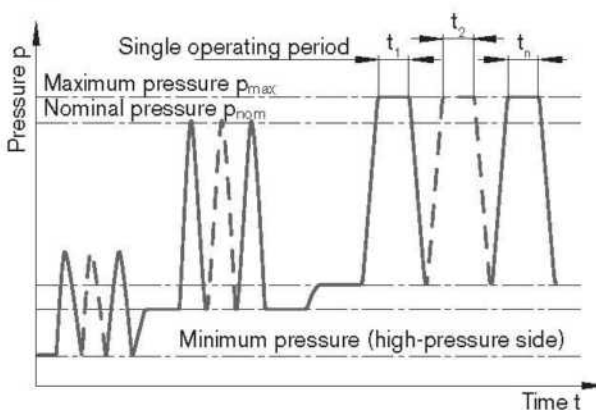
Minimum pressure on the high-pressure side (B) that is required in order to prevent damage to the axial piston unit.

##### Minimum pressure (inlet) open circuit

Minimum pressure at suction port S (inlet) that is required to prevent damage to the axial piston unit. The minimum pressure depends on the speed and displacement of the axial piston unit.

##### Rate of pressure change $R_A$

Maximum permissible pressure build-up and pressure reduction speed with a pressure change over the entire pressure range.



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



### Technical data

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

| Size                                                       | NG                    |                     | 10        | 18                   | 28       | 45                 | 60 <sup>1)</sup> | 63 <sup>2)</sup> | 85        | 100       |          |         |
|------------------------------------------------------------|-----------------------|---------------------|-----------|----------------------|----------|--------------------|------------------|------------------|-----------|-----------|----------|---------|
| Geometrical displacement per revolution                    | $V_{g \max}$          | $\text{in}^3$       | 0.64      | 1.10                 | 1.75     | 2.75               | 3.66             | 3.84             | 5.18      | 6.10      |          |         |
|                                                            |                       | $(\text{cm}^3)$     | (10.5)    | (18)                 | (28)     | (45)               | (60)             | (63)             | (85)      | (100)     |          |         |
| Speed <sup>3)</sup>                                        |                       |                     |           |                      |          |                    |                  |                  |           |           |          |         |
| maximum at $V_{g \max}$                                    | $n_{\text{nom}}$      | rpm                 | 3600      | 3300                 | 3000     | 2600 <sup>4)</sup> | 2600             | 2600             | 2500      | 2300      |          |         |
| maximum at $V_g < V_{g \max}$                              | $n_{\text{max perm}}$ | rpm                 | 4320      | 3960                 | 3600     | 3120               | 3140             | 3140             | 3000      | 2500      |          |         |
| Flow at $n_{\text{nom}}$ and $V_{g \max}$                  | $q_{v \max}$          | gpm                 | 9.7       | 15.6                 | 22       | 31                 | 41               | 43               | 55        | 60        |          |         |
|                                                            |                       | (l/min)             | (37)      | (59)                 | (84)     | (117)              | (156)            | (163)            | (212)     | (230)     |          |         |
| at $n_E = 1500$ rpm and $V_{g \max}$                       | $q_{vE \max}$         | gpm                 | 4         | 7.1                  | 1.1      | 18                 | 24               | 25.1             | 34        | 39        |          |         |
|                                                            |                       | (l/min)             | (15)      | (27)                 | (42)     | (68)               | (90)             | (95)             | (128)     | (150)     |          |         |
| Power at $\Delta p = 3600$ psi (250 bar)                   |                       |                     |           |                      |          |                    |                  |                  |           |           |          |         |
| at $n_{\text{nom}}$ , $V_{g \max}$                         | $P_{\max}$            | HP (kW)             | 22 (16)   | 34 (25)              | 47 (35)  | 65 (49)            | 88 (65)          | 90 (68)          | 119 (89)  | 130 (96)  |          |         |
| at $n_E = 1500$ rpm and $V_{g \max}$                       | $P_{E \max}$          | HP                  | 9.4       | 15                   | 24       | 38                 | 50               | 52               | 71        | 84        |          |         |
|                                                            |                       | (kW)                | (7)       | (11)                 | (18)     | (28)               | (37)             | (39)             | (53)      | (62)      |          |         |
| Torque at $V_{g \max}$ and $\Delta p = 3600$ psi (250 bar) | $T_{\max}$            | lb-ft               | 31        | 52                   | 82       | 132                | 175              | 184              | 247       | 293       |          |         |
|                                                            |                       | (Nm)                | (42)      | (71)                 | (111)    | (179)              | (238)            | (250)            | (338)     | (398)     |          |         |
|                                                            |                       |                     |           |                      |          |                    |                  |                  |           |           |          |         |
|                                                            | $T$                   | lb-ft               | 13        | 21                   | 33       | 53                 | 70               | 74               | 102       | 117       |          |         |
|                                                            |                       | (Nm)                | (17)      | (29)                 | (45)     | (72)               | (95)             | (100)            | (135)     | (159)     |          |         |
|                                                            |                       |                     |           |                      |          |                    |                  |                  |           |           |          |         |
| Rotary stiffness, drive shaft                              | S                     | $^{\circ}$          | lb-ft/rad | 6760                 | 8082     | 16400              | 37500            | 48100            | 48100     | 105100    | 105100   |         |
|                                                            |                       |                     | (Nm/rad)  | (9200)               | (11000)  | (22300)            | (37500)          | (65500)          | (65500)   | (143000)  | (143000) |         |
|                                                            | R                     | $^{\circ}$          | lb-ft/rad | –                    | 10870    | 19400              | 30240            | 51200            | 51200     | –         | –        |         |
|                                                            |                       |                     | (Nm/rad)  | –                    | (14800)  | (26300)            | (41000)          | (69400)          | (69400)   | –         | –        |         |
|                                                            | U                     | $^{\circ}$          | lb-ft/rad | 5020                 | 5870     | –                  | 22130            | 36290            | 36390     | 75900     | 75900    |         |
|                                                            |                       |                     | (Nm/rad)  | (6800)               | (8000)   | –                  | (30000)          | (49200)          | (49200)   | (102900)  | (102900) |         |
| W                                                          | $^{\circ}$            | lb-ft/rad           | –         | –                    | –        | 25370              | 39830            | 39830            | 86960     | 86960     |          |         |
|                                                            |                       | (Nm/rad)            | –         | –                    | –        | (34400)            | (54000)          | (54000)          | (117900)  | (117900)  |          |         |
| K/C                                                        | $^{\circ}$            | lb-ft/rad           | 7965      | –                    | 19770    | 32380              | 54506            | –                | –         | –         |          |         |
|                                                            |                       | (Nm/rad)            | (10800)   | –                    | (26800)  | (43900)            | (73900)          | –                | –         | –         |          |         |
| Moment of inertia rotary group                             | $J_{TW}$              | lbs-ft <sup>2</sup> | 0.0142    | 0.2207               | 0.0403   | 0.0783             | 0.1329           | 0.1329           | 0.2848    | 0.2848    |          |         |
|                                                            |                       | (kgm <sup>2</sup> ) | (0.0006)  | (0.00093)            | (0.0017) | (0.0033)           | (0.0056)         | (0.0056)         | (0.012)   | (0.012)   |          |         |
| Angular accel., max. <sup>5)</sup>                         |                       |                     | $\alpha$  | rad/s <sup>2</sup> ) | 8000     | 6800               | 5500             | 4000             | 3300      | 3300      | 2700     | 2700    |
| Filling capacity                                           |                       |                     | $V$       | gal                  | 0.05     | 0.06               | 0.08             | 0.13             | 0.21      | 0.21      | 0.26     | 0.26    |
|                                                            |                       |                     |           | (L)                  | (0.2)    | (0.25)             | (0.3)            | (0.5)            | (0.8)     | (0.8)     | (1)      | (1)     |
| Weight (without through drive) approx.                     |                       |                     | $m$       | lbs (kg)             | 17 (8)   | 25 (11.5)          | 31 (14)          | 40 (18)          | 48.5 (22) | 48.5 (22) | 75 (34)  | 75 (34) |

1) The values are applicable:

- for absolute pressure  $p_{abs} = 15$  psi (1 bar) at the suction port S
- for the optimum viscosity range of  $\nu_{opt} = 80$  to 170 SUS (16 to 36 mm<sup>2</sup>/s)
- for mineral-based operating materials with a specific mass of 0.88 kg/l.

2) Please contact us regarding higher speeds

3) The scope of application lies between the minimum necessary and the maximum permissible drive speeds.

Valid for external excitation (e.g. diesel engine 2- to 8-fold rotary frequency, cardan shaft 2-fold rotary frequency). The limiting value is only valid for a single pump. The loading capacity of the connecting parts must be taken into account.





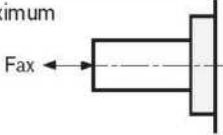
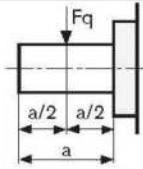
# Technical data

**Determination of size**

|        |                                                                                                         |               |                                                                               |
|--------|---------------------------------------------------------------------------------------------------------|---------------|-------------------------------------------------------------------------------|
| Flow   | $q_v = \frac{V_g \cdot n \cdot \eta_v}{231 (1000)}$                                                     | [gpm (l/min)] | $V_g$ = Geometric displ. per revolution in in <sup>3</sup> (cm <sup>3</sup> ) |
| Torque | $T = \frac{V_g \cdot \Delta p}{24 (20) \cdot \pi \cdot \eta_{mh}}$                                      | [lb-ft (Nm)]  | $\Delta p$ = Differential pressure in psi (bar)                               |
| Power  | $P = \frac{2\pi \cdot T \cdot n}{33.000 (60000)} = \frac{q_v \cdot \Delta p}{1.714 (600) \cdot \eta_t}$ | [HP (kW)]     | $n$ = Speed in rpm                                                            |
|        |                                                                                                         |               | $\eta_v$ = Volumetric efficiency                                              |
|        |                                                                                                         |               | $\eta_{mh}$ = Mechanical-hydraulic efficiency                                 |
|        |                                                                                                         |               | $\eta_t$ = Total efficiency ( $\eta_t = \eta_v \cdot \eta_{mh}$ )             |

## Technical data

### Permissible radial and axial forces on the drive shaft

| Size                        | NG                                                                                | 10          | 18           | 28            | 45            | 60/63         | 85            | 100           |
|-----------------------------|-----------------------------------------------------------------------------------|-------------|--------------|---------------|---------------|---------------|---------------|---------------|
| Radial force maximum at a/2 |  | 56<br>(250) | 78<br>(350)  | 270<br>(1200) | 337<br>(1500) | 382<br>(1700) | 450<br>(2000) | 450<br>(2000) |
| Axial force maximum         |  | 90<br>(400) | 157<br>(700) | 225<br>(1000) | 337<br>(1500) | 450<br>(2000) | 675<br>(3000) | 675<br>(3000) |

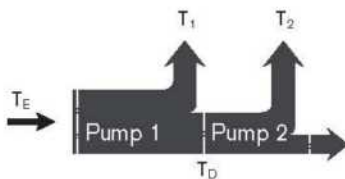
### Permissible input and through-drive torques

| Size                                                                 | NG                      | 10            | 18        | 28              | 45           | 60/63                   | 85        | 100       |
|----------------------------------------------------------------------|-------------------------|---------------|-----------|-----------------|--------------|-------------------------|-----------|-----------|
| Torque at $V_{g \max}$ and $\Delta p = 3600 \text{ psi (250 bar)}^1$ | $T_{\max}$ lb-ft (Nm)   | 31 (42)       | 52 (71)   | 82 (111)        | 132 (179)    | 184 (250)               | 293 (338) | 293 (398) |
| Input torque for drive shaft, maximum <sup>2)</sup>                  |                         |               |           |                 |              |                         |           |           |
| S                                                                    | $T_{E \max}$ lb-ft (Nm) | 93 (126)      | 91 (124)  | 198             | 319          | 630                     | 1157      | 1157      |
|                                                                      | DIA in                  | 3/4           | 3/4       | 7/8             | 1            | 1 1/4                   | 1 1/2     | 1 1/2     |
| R                                                                    | $T_{E \max}$ lb-ft (Nm) | –             | 110 (150) | 166 (225)       | 295 (400)    | 479 (650)               | –         | –         |
|                                                                      | DIA in                  | –             | 3/4       | 7/8             | 1            | 1 1/4                   | –         | –         |
| U                                                                    | $T_{E \max}$ lb-ft (Nm) | 44 (60)       | 43 (59)   | –               | 139 (188)    | 226 (306)               | 463 (628) | 463 (628) |
|                                                                      | DIA in                  | 5/8           | 5/8       | –               | 7/8          | 1                       | 1 1/4     | 1 1/4     |
| W                                                                    | $T_{E \max}$ lb-ft (Nm) | –             | –         | –               | 162 (220)    | 292 (396)               | 447 (650) | 447 (650) |
|                                                                      | DIA in                  | –             | –         | –               | 7/8          | 1                       | 1 1/4     | 1 1/4     |
| K                                                                    | $T_{E \max}$ lb-ft (Nm) | 78 (106)      | –         | 107 (145)       | 156 (212)    | 325 (441)               | –         | –         |
|                                                                      | DIA in (mm)             | 0.750 (19.05) | –         | 0.8750 (22.225) | 1.000 (25.4) | 1.2500 (31.75)          | –         | –         |
| C <sup>3)</sup>                                                      | $T_{E \max}$ lb-ft (Nm) | –             | –         | 107 (145)       | 156 (212)    | 325 (441) <sup>4)</sup> | –         | –         |
| Maximum through-drive torque for drive shaft                         |                         |               |           |                 |              |                         |           |           |
| S                                                                    | $T_{D \max}$ lb-ft (Nm) | –             | 80 (108)  | 118 (160)       | 235 (319)    | 357 (484)               | 515 (698) | 515 (698) |
| R                                                                    | $T_{D \max}$ lb-ft (Nm) | –             | 89 (120)  | 130 (176)       | 270 (365)    | 357 (484)               | –         | –         |

1) Without considering efficiency

2) For drive shafts free of radial load

### Distribution of torques



## Technical data

### Drive power and flow

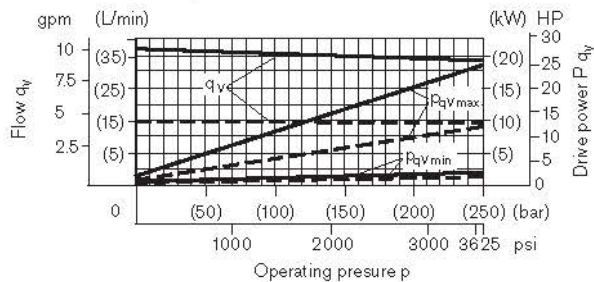
Operating material:

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

#### Size 10

---  $n = 1500\text{ rpm}$

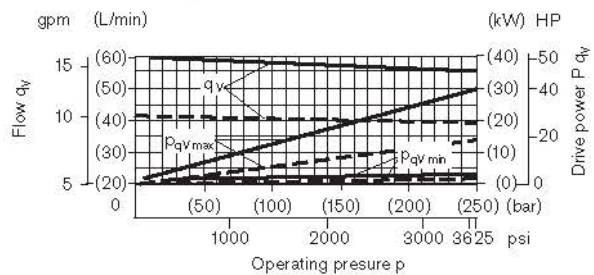
—  $n = 3600\text{ rpm}$



#### Size 18

---  $n = 1500\text{ rpm}$

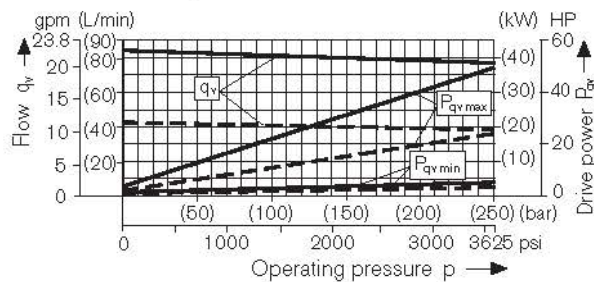
—  $n = 3300\text{ rpm}$



#### Size 28

---  $n = 1500\text{ rpm}$

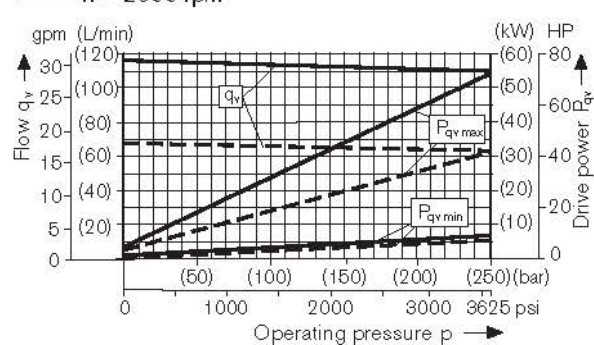
—  $n = 3000\text{ rpm}$



#### Size 45

---  $n = 1500\text{ rpm}$

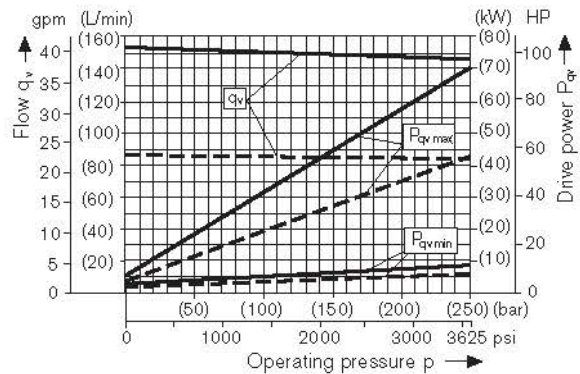
—  $n = 2600\text{ rpm}$



#### Size 60/63

---  $n = 1500\text{ rpm}$

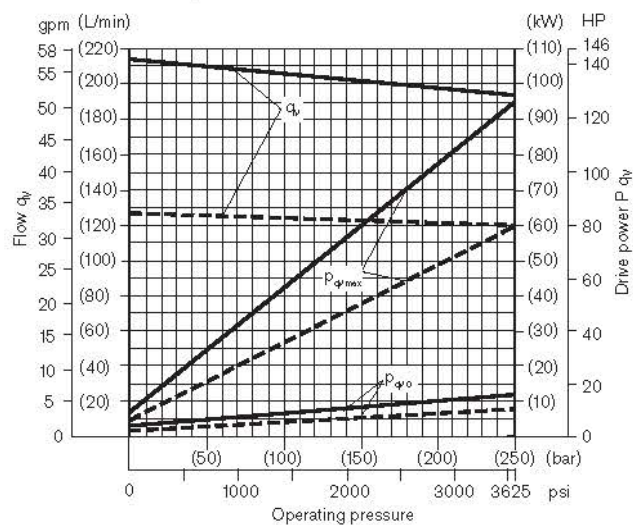
—  $n = 2600\text{ rpm}$



#### Size 85

---  $n = 1500\text{ rpm}$

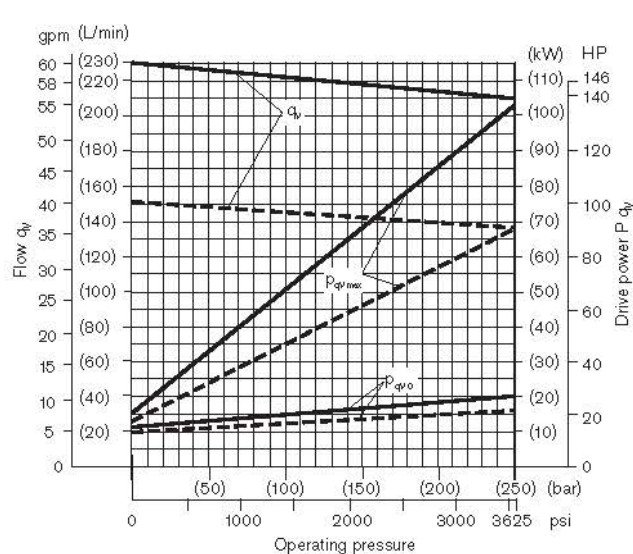
—  $n = 2500\text{ rpm}$



#### Size 100

---  $n = 1500\text{ rpm}$

—  $n = 2300\text{ rpm}$



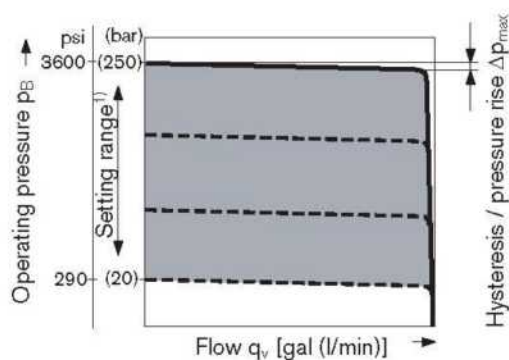


## DR – Pressure control

The pressure control limits the maximum pressure at the pump output within the pump control range. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the operating pressure exceeds the target pressure set at the pressure valve, the pump will regulate towards a smaller displacement. The pressure can be set steplessly at the control valve.

### Static characteristic

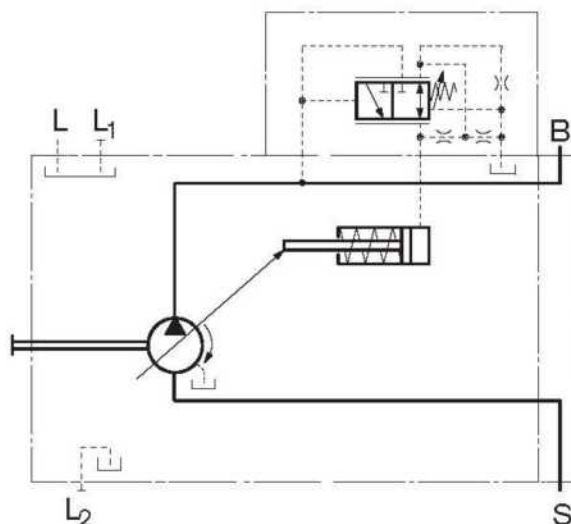
(at  $n_1 = 1500 \text{ rpm}$ ;  $t_{\text{fluid}} = 120^\circ\text{F}$  ( $50^\circ\text{C}$ ))



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

The range of possible settings at the valve are greater.

### Circuit diagram



|                     | Port for                                    |
|---------------------|---------------------------------------------|
| B                   | Service line                                |
| S                   | Suction line                                |
| L, L <sub>1,2</sub> | Case drain fluid (L <sub>1,2</sub> plugged) |

### Controller data

Hysteresis and repeatability  $\Delta p$  \_\_\_\_\_ maximum 45 psi (3 bar)

### Pressure rise, maximum

| NG             | 10  | 18  | 28  | 45  | 60/63 | 85   | 100  |
|----------------|-----|-----|-----|-----|-------|------|------|
| $\Delta p$ psi | 90  | 90  | 90  | 90  | 115   | 175  | 200  |
| (bar)          | (6) | (6) | (6) | (6) | (8)   | (12) | (14) |

Control fluid consumption \_\_\_\_\_ max. approx. 0.8 gpm (3 l/min)

## DRG – Pressure control remotely operated

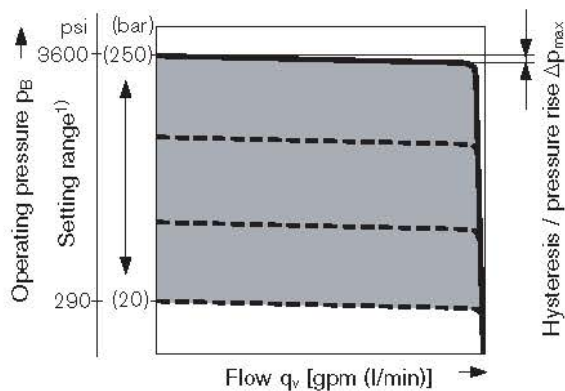
The DRG control valve overrides the function of the DR pressure controller

A pressure relief valve can be externally piped to port X for remote setting of pressure below the setting of the DR control valve spool. This relief valve is not included in the delivery contents of the pump.

The differential pressure at the control valve is set as standard to 290 psi (20 bar). The control fluid volume at port X is approx. 0.4 gpm (1.5 l/min). If another setting is required (range from 145 to 320 psi (10 to 22 bar)) please state this in clear text.

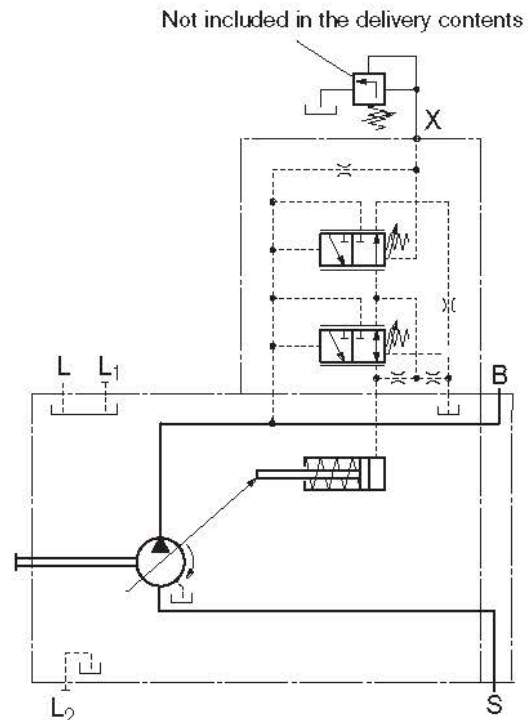
### Static characteristic

(at  $n_1 = 1500 \text{ rpm}$ ;  $t_{\text{fluid}} = 120^\circ\text{F}$  ( $50^\circ\text{C}$ ))



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

### Circuit diagram



|                     | Port for                                    |
|---------------------|---------------------------------------------|
| B                   | Service line                                |
| S                   | Suction line                                |
| L, L <sub>1,2</sub> | Case drain fluid (L <sub>1,2</sub> plugged) |
| X                   | Pilot pressure                              |

### Controller data

Hysteresis and repeatability  $\Delta p$  \_\_\_\_\_ maximum 45 psi (3 bar)

### Pressure rise, maximum

| NG             | 10  | 18  | 28  | 45  | 60/63 | 85   | 100  |
|----------------|-----|-----|-----|-----|-------|------|------|
| $\Delta p$ psi | 90  | 90  | 90  | 90  | 115   | 175  | 200  |
| (bar)          | (6) | (6) | (6) | (6) | (8)   | (12) | (14) |

Control fluid consumption \_\_\_\_\_ max. approx. 1.2 gpm (4.5 l/min)

## DRF (DFR) DRS (DFR1) – Pressure and flow control

In addition to the pressure control function, 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 required flow by the consumer, regardless of changing pressure levels.

The pressure control overrides the flow control function.

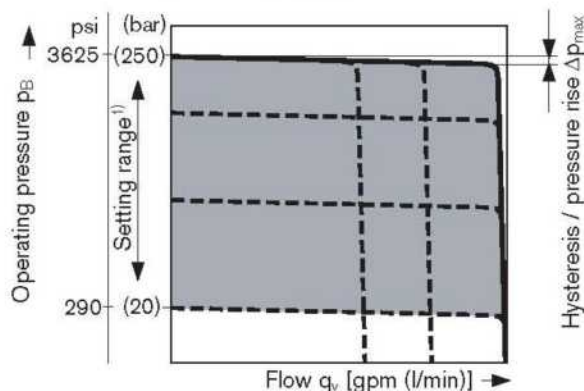
### Note

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

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

### Static characteristic

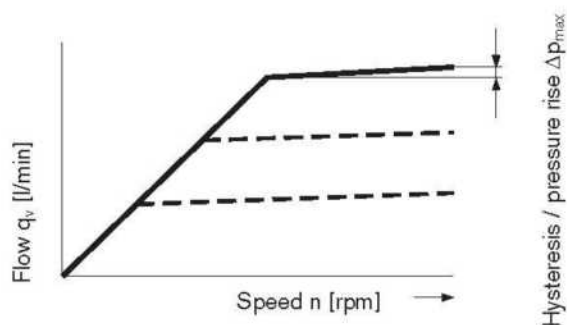
Flow control at  $n_1 = 1500 \text{ rpm}$ ;  $t_{\text{fluid}} = 120^\circ \text{F}$  ( $50^\circ \text{C}$ )



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

The range of possible settings at the valve is higher.

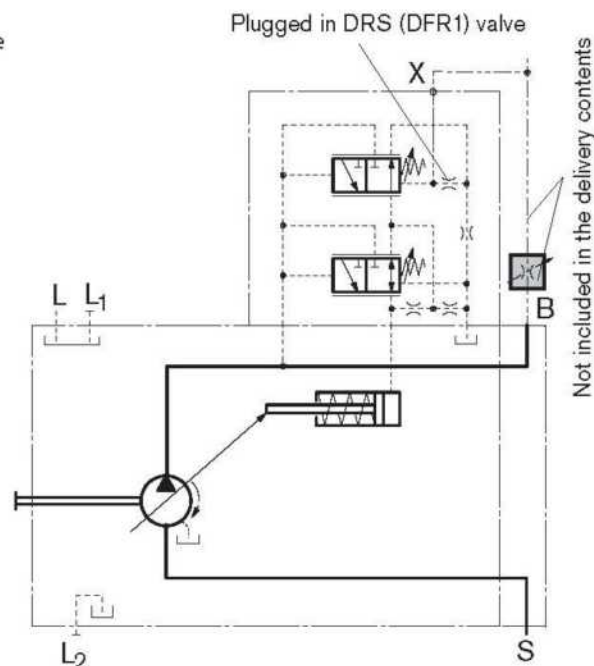
### Static characteristic at variable speed



### Possible connections at port B

(not included in the delivery, order separately)

### Circuit diagram



|         | Port for                        |
|---------|---------------------------------|
| B       | Service line                    |
| S       | Suction line                    |
| L, L1,2 | Case drain fluid (L1,2 plugged) |
| X       | Pilot pressure                  |

### Differential pressure $\Delta p$

Standard setting: 200 to 320 psi (14 to 22 bar).

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

Relieving the load on port X to the reservoir results in a zero stroke ("standby") pressure which lies about 15 to 30 psi (1 to 2 bar) higher than the differential pressure  $\Delta p$ . No account is taken of system influences.

### Controller data

Data pressure control DR.

Maximum flow deviation measured with drive speed  $n = 1500 \text{ rpm}$ .

| NG                             | 10    | 18    | 28    | 45    | 60/<br>63 | 85    | 100   |
|--------------------------------|-------|-------|-------|-------|-----------|-------|-------|
| $\Delta q_{v, \text{max}}$ gpm | 0.13  | 0.24  | 0.26  | 0.48  | 0.66      | 0.83  | 0.83  |
| (l/min)                        | (0.5) | (0.9) | (1.0) | (1.8) | (2.5)     | (3.1) | (3.1) |

### Control fluid consumption

DRF (DFR) maximum approx. 0.8 to 1.2 gpm (3 to 4.5 l/min)

DRS (DFR1) maximum approx. 0.8 gpm (3 l/min)



## LA... – Pressure, flow and power control

Pressure control equipped as DR(G)  
Flow control equipped as DRF, DRS

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

Flow control is possible below the power control curve.

When ordering please state the power characteristics to be set ex works in clear text, e.g. 27 HP (20 kW) at 1500 rpm.

### Controller data

For pressure controller DR data  
For flow control FR data.

### Controller data

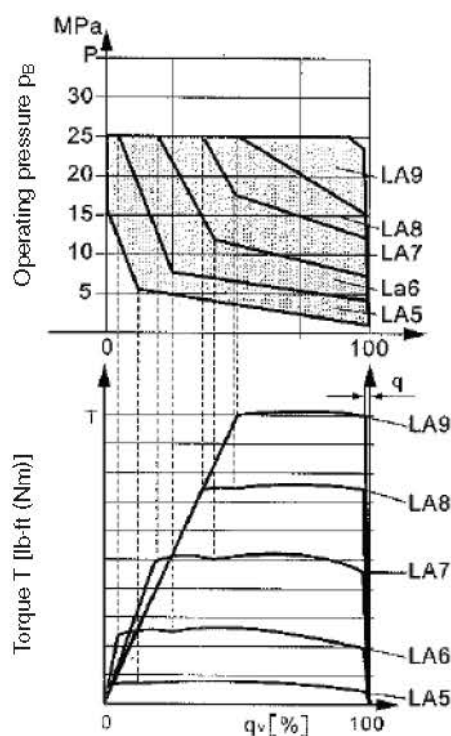
Maximum control fluid consumption.

| Start of control<br>[psi ((bar))] | Torque T [lb-ft (Nm)] for size |                             |                            |                            |                            |                                | Order code |
|-----------------------------------|--------------------------------|-----------------------------|----------------------------|----------------------------|----------------------------|--------------------------------|------------|
|                                   | 18                             | 28                          | 45                         | 63                         | 85                         | 100                            |            |
| 145 to 510<br>(10 to 35)          | 2.80 - 8.92<br>(3.8 - 12.1)    | 4.4 - 14<br>(6 - 19)        | 7.4 - 22.1<br>(10 - 30)    | 11 - 32<br>(15 - 43)       | 15 - 42<br>(20 - 57)       | 18 - 49.5<br>(24 - 68)         | LA5        |
| 520 to 1015<br>(36 to 70)         | 8.92 - 17.2<br>(12.2 - 23.3)   | 14 - 26.5<br>(19.1 - 36)    | 22.2 - 43.5<br>(30.1 - 59) | 32 - 61<br>(43.1 - 83)     | 42 - 83<br>(57.1 - 112)    | 49.5 - 97.1<br>(68.1 - 132)    | LA6        |
| 1030 to 1520<br>(71 to 105)       | 17.2 - 24.9<br>(23.4 - 33.7)   | 26.6 - 38.4<br>(36.1 - 52)  | 43.6 - 62<br>(59.1 - 84)   | 61 - 88<br>(83.1 - 119)    | 83 - 118<br>(112.1 - 160)  | 97.1 - 139.4<br>(132.1 - 189)  | LA7        |
| 1535 to 2030<br>(106 to 140)      | 24.9 - 33.2<br>(33.8 - 45)     | 38.4 - 51.6<br>(52.1 - 70)  | 62 - 83<br>(84.1 - 112)    | 88 - 116<br>(119.1 - 157)  | 118 - 156<br>(160.1 - 212) | 139.4 - 183.6<br>(189.1 - 249) | LA8        |
| 2045 to 3335<br>(141 to 230)      | 33.2 - 55.2<br>(45.1 - 74.8)   | 51.7 - 86.3<br>(70.1 - 117) | 83 - 139<br>(112.1 - 189)  | 116 - 195<br>(157.1 - 264) | 156 - 263<br>(212.1 - 357) | 183.3 - 309<br>(249.1 - 419)   | LA9        |

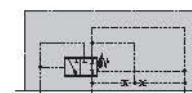
Conversion of the torque values in power [kW]:

$$P = \frac{T}{3.5 (6.4)} \text{ [HP (kW)] (at 1500 rpm)} \quad \text{or} \quad P = \frac{2\pi \cdot T \cdot n}{33.000 (60000)} \text{ [HP (kW)]}$$

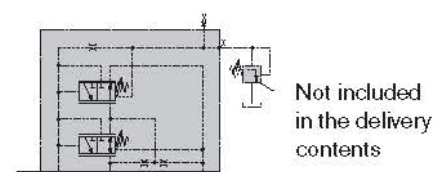
### Static curves and torque characteristic



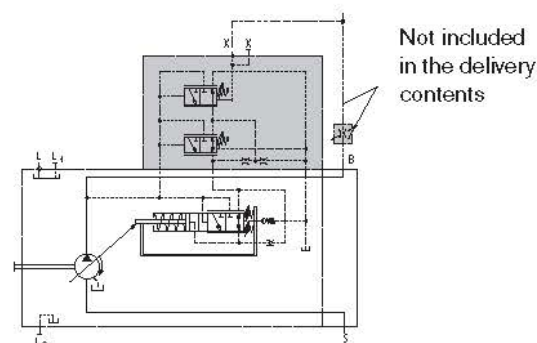
### Circuit diagram (LAXD) with pressure cut-off



### Circuit diagram (LAXDG) with pressure cut-off, remotely operated



### Circuit diagram (LAXDS) with pressure and flow control



## EP – Electro-proportional control

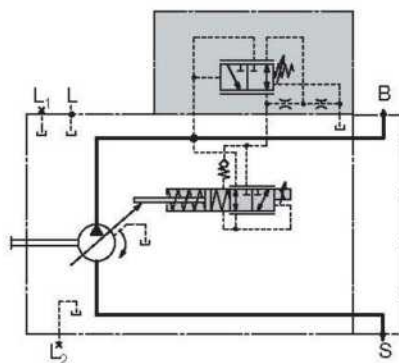
Electro-proportional control makes a stepless and reproducible setting of the pump displacement possible directly via the swashplate. The control force of the control piston is applied by a proportional solenoid. The control is proportional to the current (for start of control, see table right).

In a depressurized state, the pump is swiveled to its initial position ( $V_{g \max}$ ) by an adjusting spring. If the operating pressure exceeds 200 psi (14 bar), the pump will swivel from  $V_{g \max}$  to  $V_{g \min}$  without control by the solenoid (control current < start of control). A PWM signal is used to control the solenoid.

**EP.D:** The pressure control regulates the pump displacement back to  $V_{g \min}$  after the set target pressure has been reached.

A minimum operating pressure of 200 psi (14 bar) is needed for control. The necessary control fluid is taken from the high pressure.

### Circuit diagram EP.D



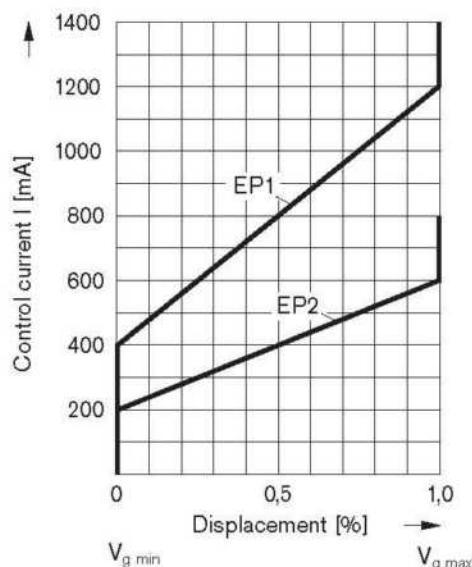
|                           | Port for                                    |
|---------------------------|---------------------------------------------|
| <b>B</b>                  | Service line                                |
| <b>S</b>                  | Suction line                                |
| <b>L, L<sub>1,2</sub></b> | Case drain fluid (L <sub>1,2</sub> plugged) |
| <b>X</b>                  | Control pressure                            |

| Technical data, solenoid                                           | EP1           | EP2           |
|--------------------------------------------------------------------|---------------|---------------|
| Voltage                                                            | 12 V (±20 %)  | 24 V (±20 %)  |
| Control current                                                    |               |               |
| Start of control at $V_{g \min}$                                   | 400 mA        | 200 mA        |
| End of control at $V_{g \max}$                                     | 1200 mA       | 600 mA        |
| Limiting current                                                   | 1.54 A        | 0.77 A        |
| Nominal resistance (at 68 °F (20 °C))                              | 5.5 Ω         | 22.7 Ω        |
| Dither frequency                                                   | 100 to 200 Hz | 100 to 200 Hz |
| Actuated time                                                      | 100 %         | 100 %         |
| For protection rating, please refer to "Socket version" on page 55 |               |               |

Operating temperature range at valve -4 °F to 239 °F (-20 °C to +115 °C)

### Characteristic EP1/2

Hysteresis < 5 %



### Note

#### The spring return at the controller is not a safety device

Dirt contamination (contaminated hydraulic fluid, wear or residual dirt from system components) could cause the controller to stick in an undefined position. The volume flow of the axial piston unit will then no longer follow the commands of the operator.

Check whether remedial measures for your application are needed on your machine in order to put the driven consumer in a safe state (e.g. immediate stop).

## EK – Electro-proportional control with controller cut-off

The variant EK... is based completely on the variant EP...

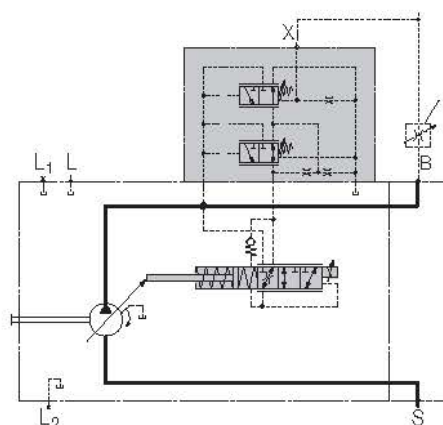
In addition to the electro-proportional control function, a controller cut-off is integrated in the electric characteristic. The pump then swivels to  $V_{g \max}$  if the control signal is lost (e.g. cable break) and then works with the DRF settings (see page 14). The controller cut-off is only intended for short-term use and not for permanent use if the control signal is lost. If the control signal is lost, the pump swivel times will be reduced by the EK valve.

A PWM signal is used to control the solenoid.

A minimum operating pressure of 200 psi (14 bar) is needed for control. The necessary control fluid is taken from the high pressure.

The  $V_{g \max}$  position is maintained by the force of the adjusting spring. To overcome the force of this spring, the solenoid must be subjected to excessive current ( $I_{res}$ ).

Circuit diagram EK.DF



|                     | Port for                                    |
|---------------------|---------------------------------------------|
| B                   | Service line                                |
| S                   | Suction line                                |
| L, L <sub>1,2</sub> | Case drain fluid (L <sub>1,2</sub> plugged) |
| X                   | Control pressure                            |

### Note

The spring return at the controller is not a safety device

Dirt contamination (contaminated hydraulic fluid, wear or residual dirt from system components) could cause the controller to stick in an undefined position. The volume flow of the axial piston unit will then no longer follow the commands of the operator.

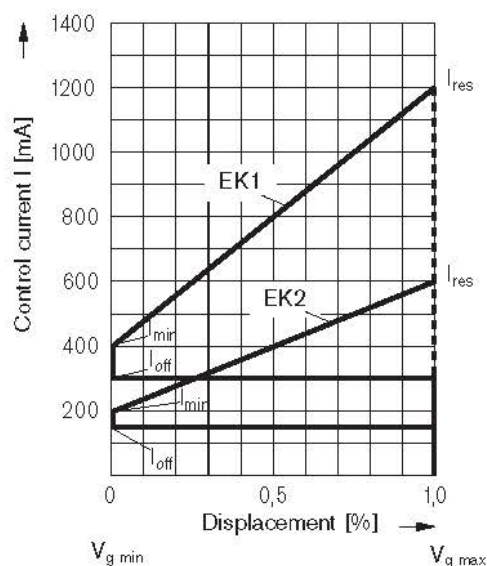
Check whether remedial measures for your application are needed on your machine in order to put the driven consumer in a safe state (e.g. immediate stop).

| Technical data, solenoid                                           | EK1           | EK2           |
|--------------------------------------------------------------------|---------------|---------------|
| Voltage                                                            | 12 V (±20 %)  | 24 V (±20 %)  |
| Control current                                                    |               |               |
| Start of control at $V_{g \min}$                                   | 400 mA        | 200 mA        |
| End of control at $V_{g \max}$                                     | 1200 mA       | 600 mA        |
| Limiting current                                                   | 1.54 A        | 0.77 A        |
| Nominal resistance (at 68 °F (20 °C))                              | 5.5 Ω         | 22.7 Ω        |
| Dither frequency                                                   | 100 to 200 Hz | 100 to 200 Hz |
| Actuated time                                                      | 100 %         | 100 %         |
| For protection rating, please refer to "Socket version" on page 55 |               |               |

Operating temperature range at valve -4 °F to 239 °F (-20 °C to +115 °C)

### Characteristic EK

Hysteresis < 5 %



|                 | EK1.   | EK2.  |
|-----------------|--------|-------|
| $I_{\min}$ [mA] | 400    | 200   |
| $I_{\max}$ [mA] | 1200   | 600   |
| $I_{off}$ [mA]  | < 300  | < 150 |
| $I_{res}$ [mA]  | > 1200 | > 600 |

For changes in current, ramp times of > 200 ms must be observed.



## EP(K).DF / EP(K).DS – EP(K) with pressure and flow control

A hydraulic pressure flow control is superimposed on the electro-proportional control.

The pressure control regulates the pump displacement back to  $V_{g\ min}$  after the set target pressure has been reached.

This function is super-imposed on the EP or EK control, i.e. the control-current dependent function is executed below the target pressure.

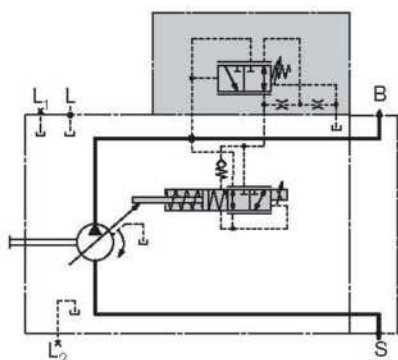
Setting range from 290 to 3600 psi (20 to 250 bar). For the pressure flow control

Pressure control has priority over electro-proportional control and flow control.

With flow control, the pump flow can be influenced in addition to pressure control. The pump flow is thus equal to the actual amount of hydraulic fluid required by the consumer. This is achieved using the differential pressure at the consumer (e.g. orifice).

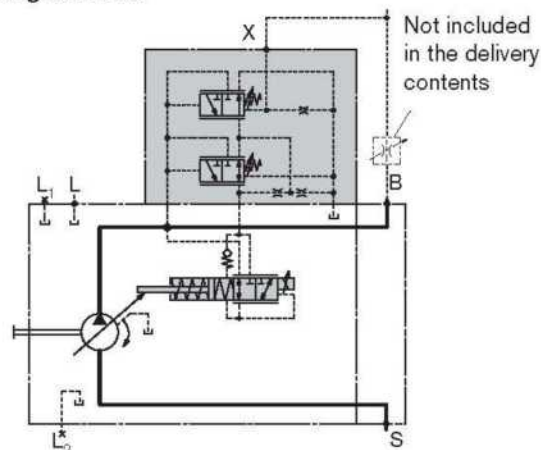
The EP.DS or EK.DS version has no connection between X and the reservoir (load sensing)

Circuit diagram EP.D



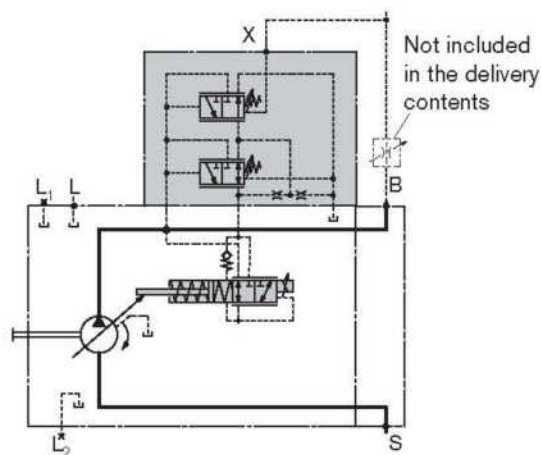
|                     | Port for                                    |
|---------------------|---------------------------------------------|
| B                   | Service line                                |
| S                   | Suction line                                |
| L, L <sub>1,2</sub> | Case drain fluid (L <sub>1,2</sub> plugged) |

Circuit diagram EP.DF



|                     | Port for                                    |
|---------------------|---------------------------------------------|
| B                   | Service line                                |
| S                   | Suction line                                |
| L, L <sub>1,2</sub> | Case drain fluid (L <sub>1,2</sub> plugged) |
| X                   | Control pressure                            |

Circuit diagram EP.DS



|                     | Port for                                    |
|---------------------|---------------------------------------------|
| B                   | Service line                                |
| S                   | Suction line                                |
| L, L <sub>1,2</sub> | Case drain fluid (L <sub>1,2</sub> plugged) |
| X                   | Control pressure                            |

## EP(K).ED – EP(K) with electro-hydraulic pressure control

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

When a change is made at the consumer (load pressure), the position of the control piston will shift.

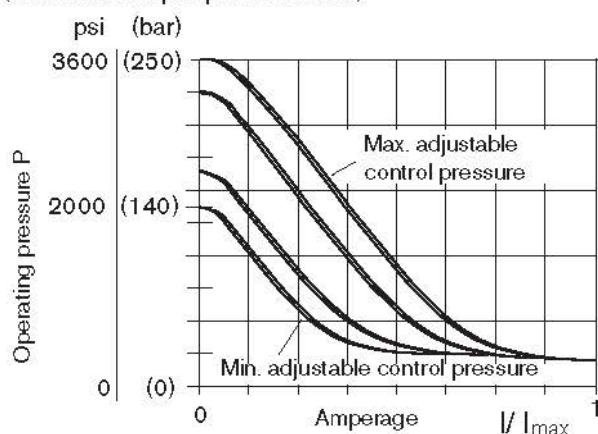
This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

The pump thus only delivers as much hydraulic fluid as the consumers can take. The pressure can be set steplessly by 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 (negative characteristic, e.g. for fan drives). A PWM signal is used to control the solenoid.

### Static current-pressure characteristic ED (negative characteristic)

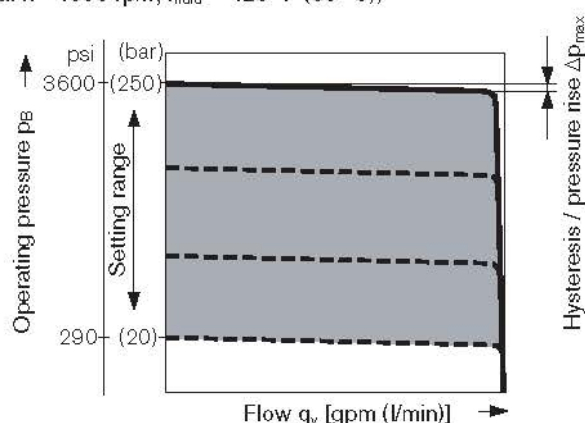
(measured with pump in zero stroke)



Hysteresis static current-pressure characteristic  
< 45 psi (3 bar).

### Static flow-pressure characteristic

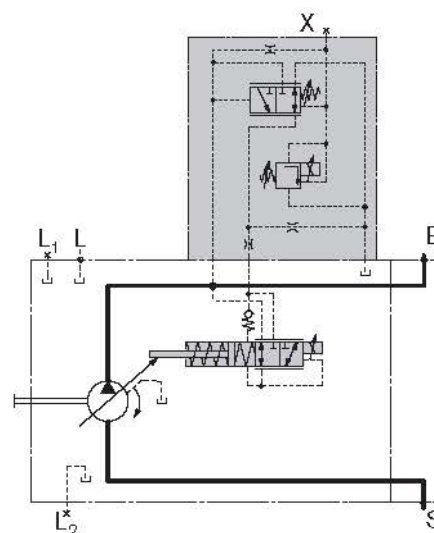
(at  $n = 1500 \text{ rpm}$ ;  $t_{fluid} = 120 \text{ °F}$  (50 °C))



### Controller data

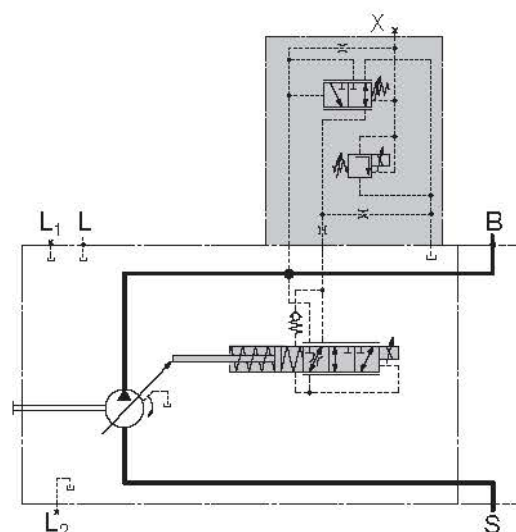
Standby standard setting: 290 psi (20 bar). Other values on request. Hysteresis / pressure rise  $\Delta p$  60 psi (4 bar)

### Circuit diagram EP.ED



|                     | Port for                                    |
|---------------------|---------------------------------------------|
| B                   | Service line                                |
| S                   | Suction line                                |
| L, L <sub>1,2</sub> | Case drain fluid (L <sub>1,2</sub> plugged) |
| X                   | Control pressure                            |

### Circuit diagram EK.ED



|                     | Port for                                    |
|---------------------|---------------------------------------------|
| B                   | Service line                                |
| S                   | Suction line                                |
| L, L <sub>1,2</sub> | Case drain fluid (L <sub>1,2</sub> plugged) |
| X                   | Control pressure                            |

## ED – Electro-hydraulic pressure control

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

When a change is made at the consumer (load pressure), the position of the control piston will shift.

This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

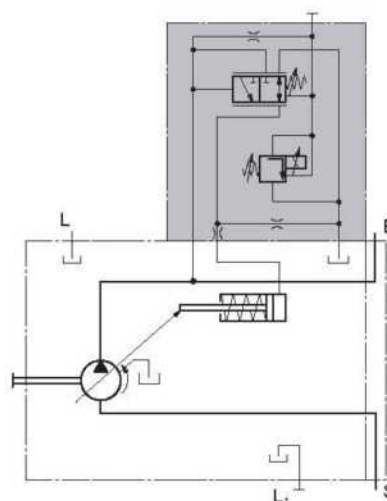
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.

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 a loss of power, e.g. for fan drives).

The response time characteristic of the ED-control was optimized for the use as a fan drive system.

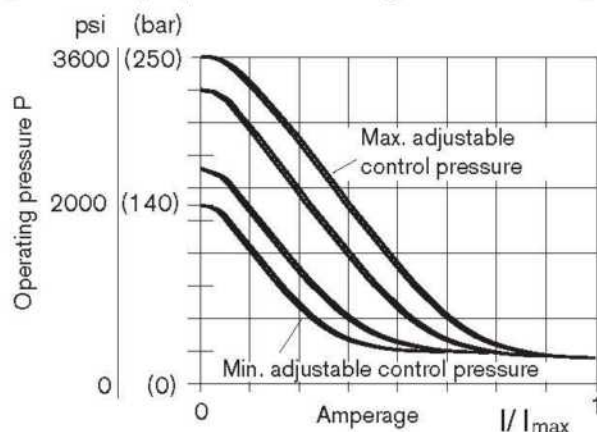
When ordering, state the type of application in clear text.

Circuit diagram ED..



### Static current-pressure characteristic ED

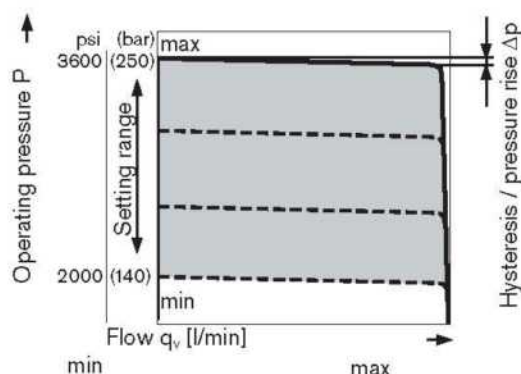
(measured at pump in zero stroke – negative characteristic)



Hysteresis static current-press. characteristic < 45 psi (3 bar)

### Static flow-pressure characteristic

(at  $n = 1500$  rpm;  $t_{fluid} = 120$  °F (50 °C))



### Controller data

Standby standard setting 290 psi (20 bar), other values on request.

Hysteresis and pressure rise \_\_\_\_\_  $\Delta p < 60$  psi (4 bar).

Control flow consumption \_\_\_\_\_ 0.8 to 1.2 gpm (3 to 4.5 l/min).

|                   | Port for                            |
|-------------------|-------------------------------------|
| B                 | Service line                        |
| S                 | Suction line                        |
| L, L <sub>1</sub> | Case drain (L <sub>1</sub> plugged) |

| Technical data, solenoid              | ED71          | ED72          |
|---------------------------------------|---------------|---------------|
| Voltage                               | 12 V (±20 %)  | 24 V (±20 %)  |
| Control current                       |               |               |
| Control begin at $q_{v \min}$         | 100 mA        | 50 mA         |
| End of control at $q_{v \max}$        | 1200 mA       | 600 mA        |
| Limiting current                      | 1.54 A        | 0.77 A        |
| Nominal resistance (at 68 °F (20 °C)) | 5.5 Ω         | 22.7 Ω        |
| Dither frequency                      | 100 to 200 Hz | 100 to 200 Hz |
| Actuated time                         | 100 %         | 100 %         |

Operating temperature range at valve -4 °F to 239 °F (-20 °C to +115 °C)



## ER – Electro-hydraulic pressure control

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

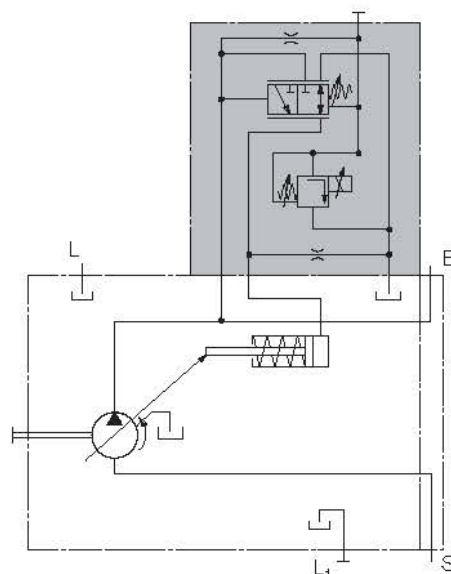
When a change is made at the consumer (load pressure), the position of the control piston will shift.

This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

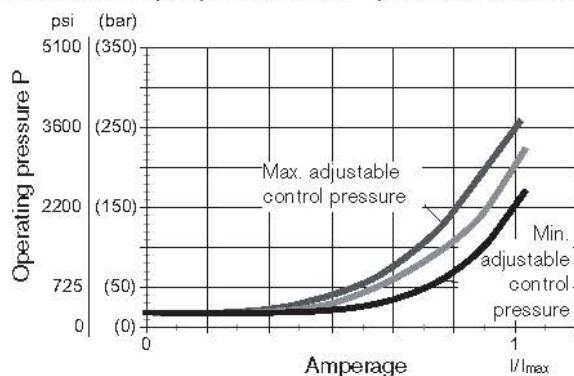
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.

As the solenoid current signal drops towards zero, the pressure will be limited to  $p_{\min}$  (stand by).

Circuit diagram ER..



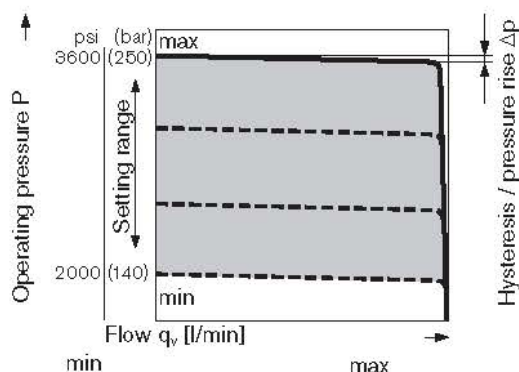
**Static current-pressure characteristic ER**  
(measured with pump in zero stroke – positive characteristic)



Hysteresis static current-pressure characteristic < 45 psi (3 bar)

Influence of pressure setting on stand by  $\pm 30$  psi (2 bar)

**Static flow-pressure characteristic**  
(at  $n = 1500$  rpm;  $t_{\text{fluid}} = 120$  °F (50°C))



### Controller data

Standby standard setting 200 psi (14 bar), other values on request.

Hysteresis and pressure rise  $\Delta p < 60$  psi (4 bar).

Control flow consumption 0.8 to 1.2 gpm (3 to 4.5 l/min).

|       | Port for                |
|-------|-------------------------|
| B     | Service line            |
| S     | Suction line            |
| L, L1 | Case drain (L1 plugged) |

| Technical data, solenoid              | ED71               | ED72               |
|---------------------------------------|--------------------|--------------------|
| Voltage                               | 12 V ( $\pm 20$ %) | 24 V ( $\pm 20$ %) |
| Control current                       |                    |                    |
| Control begin at $q_{v \min}$         | 100 mA             | 50 mA              |
| End of control at $q_{v \max}$        | 1200 mA            | 600 mA             |
| Limiting current                      | 1.54 A             | 0.77 A             |
| Nominal resistance (at 68 °F (20 °C)) | 5.5 $\Omega$       | 22.7 $\Omega$      |
| Dither frequency                      | 100 to 200 Hz      | 100 to 200 Hz      |
| Actuated time                         | 100 %              | 100 %              |

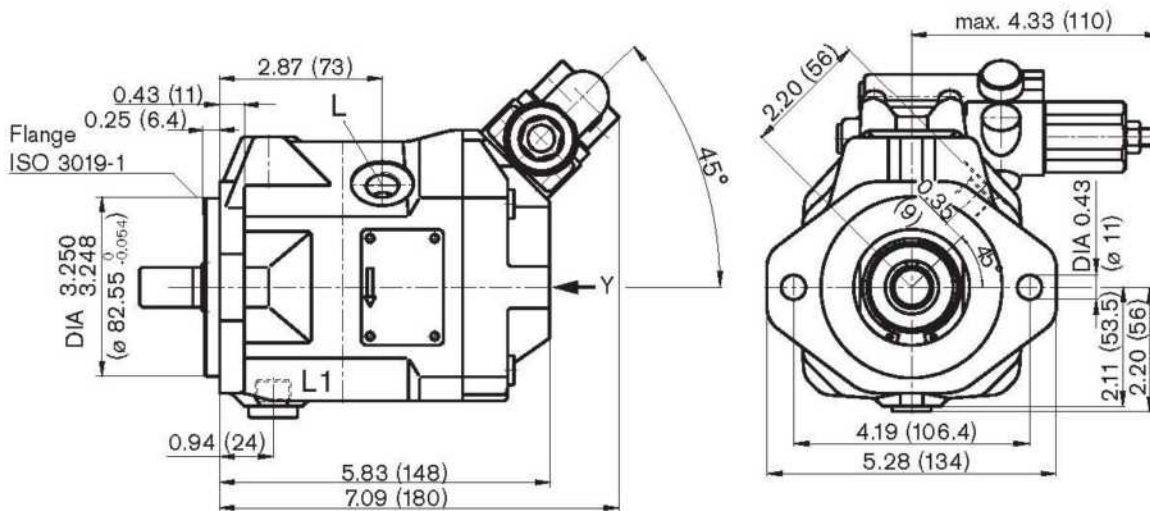
Operating temperature range at valve -4 °F to 239 °F  
(-20 °C to +115 °C)

### Dimensions, size 10

#### DR – Hydraulic pressure controller

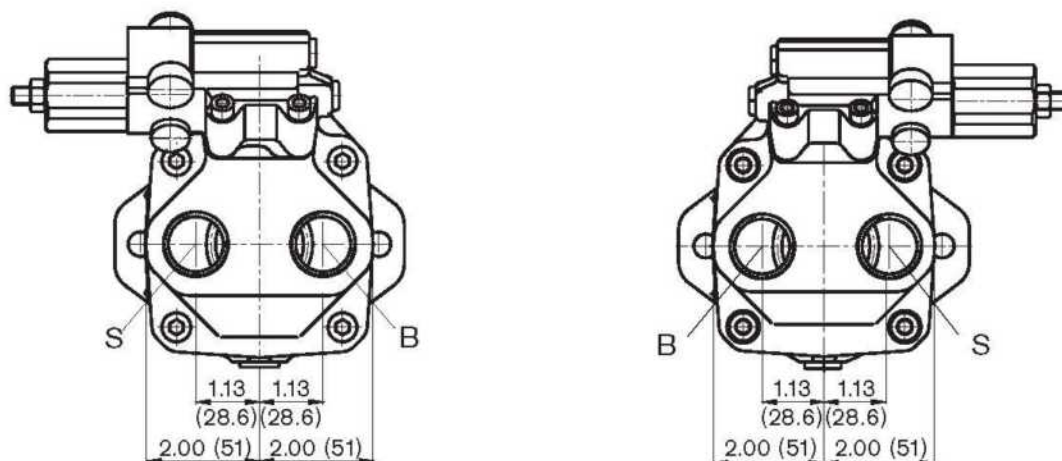
Centering flange SAE version; series 52

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).



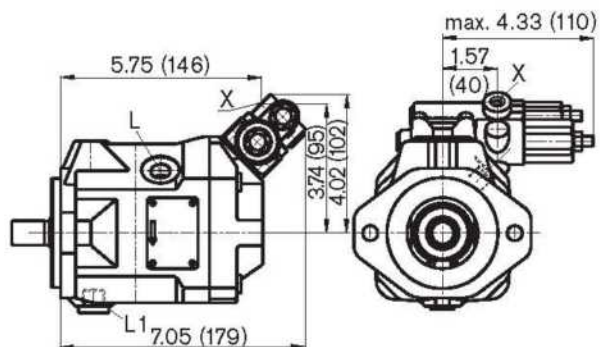
View Y clockwise rotation

View Y counter-clockwise rotation



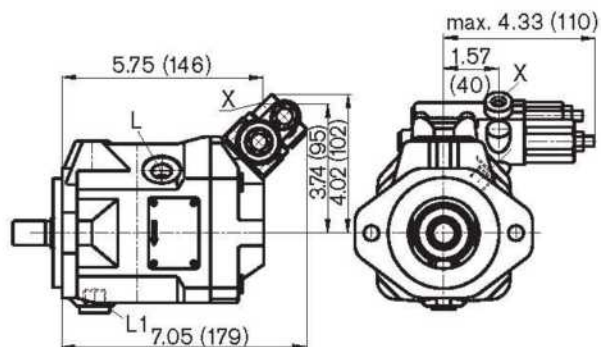
#### DRG

Pressure and flow control, remote controlled



#### DFR / DFR1

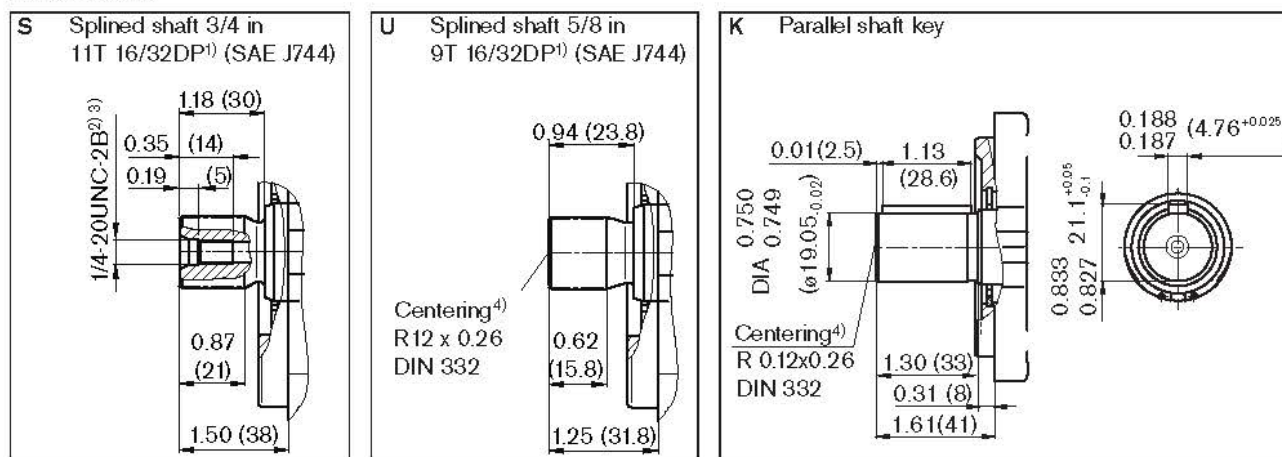
Pressure and flow control



## Dimensions, size 10

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

### Drive shaft



### Ports

| Designation    | Port for         | Standard                | Size <sup>3)</sup>              | Maximum pressure [psi (bar)] <sup>5)</sup> | State           |
|----------------|------------------|-------------------------|---------------------------------|--------------------------------------------|-----------------|
| B              | Service line     | ISO 11926               | 1 1/16-12UNF-2B; 0.79 (20) deep | 4600 (315)                                 | O               |
| S              | Suction line     | ISO 11926               | 1 1/16-12UNF-2B; 0.79 (20) deep | 75 (5)                                     | O               |
| L              | Case drain fluid | ISO 11926 <sup>6)</sup> | 9/16-18UNF-2B; 0.47 (12) deep   | 30 (2)                                     | O <sup>7)</sup> |
| L <sub>1</sub> | Case drain fluid | ISO 11926 <sup>6)</sup> | 9/16-18UNF-2B; 0.47 (12) deep   | 30 (2)                                     | X <sup>7)</sup> |
| X              | Pilot pressure   | ISO 11926 <sup>5)</sup> | 7/16-20UNF-2B; 0.45 (11.5) deep | 4600 (315)                                 | O               |

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

2) Thread according to ASME B1.1

3) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

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

5) Depending on the application, momentary pressure spikes can occur. Consider this when selecting measuring equipment and fittings.

6) The spot face can be deeper than as specified in the standard.

7) Depending on the installation position, L or L<sub>1</sub> must be connected

O = Must be connected (plugged on delivery)

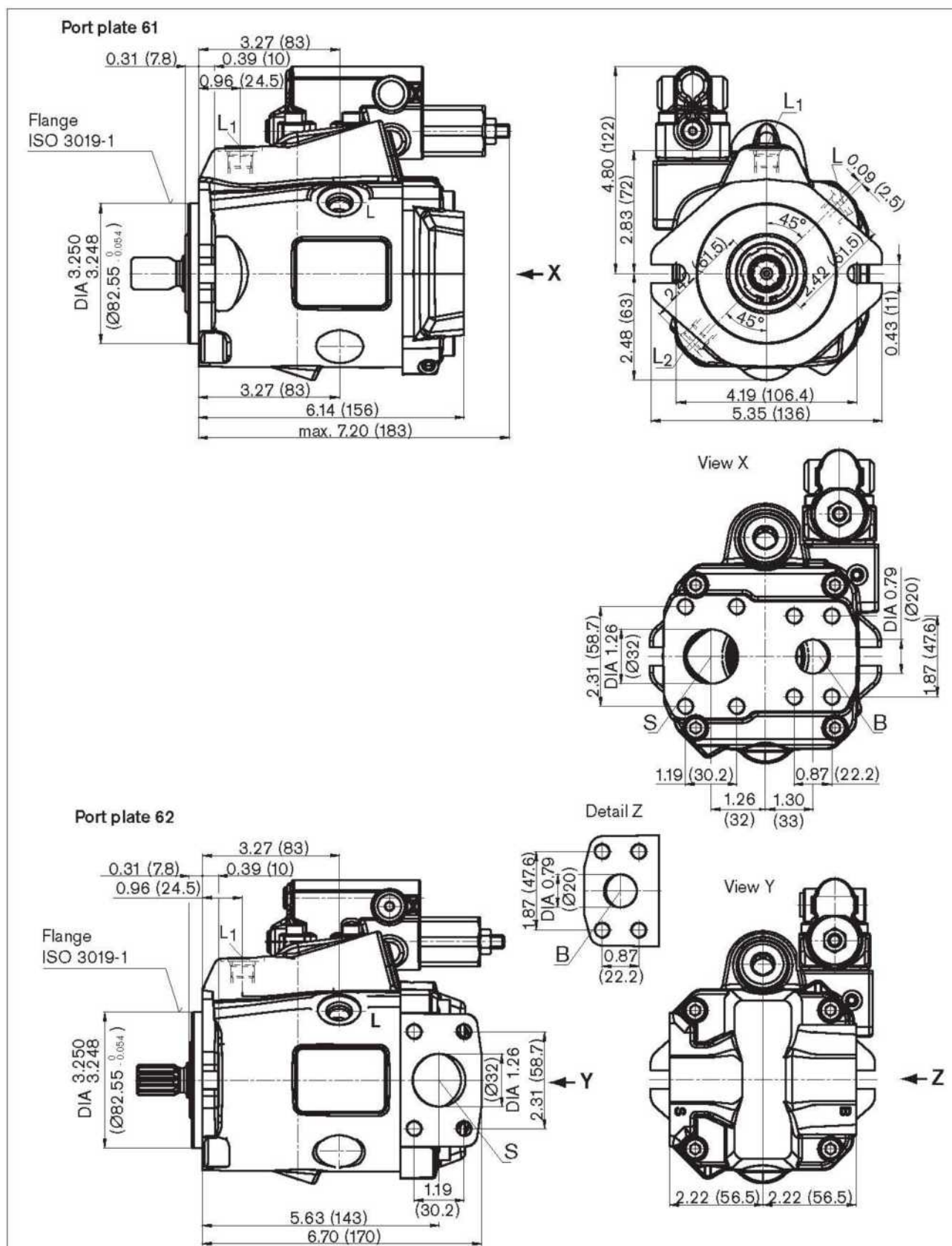
X = Plugged (in normal operation)



### Dimensions, size 18<sup>1)</sup>

**DR – Hydraulic pressure controller**  
Clockwise rotation, series 53

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

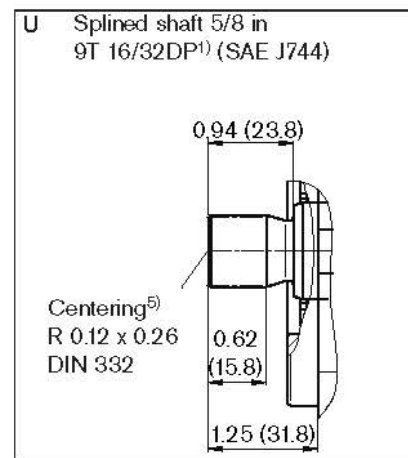
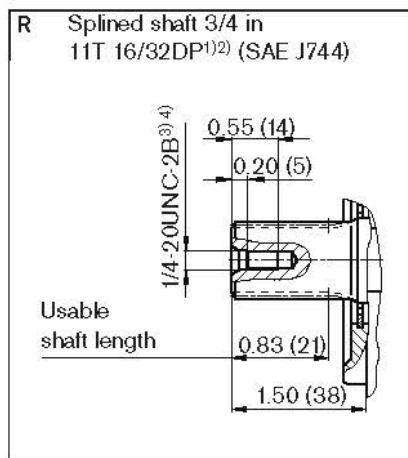
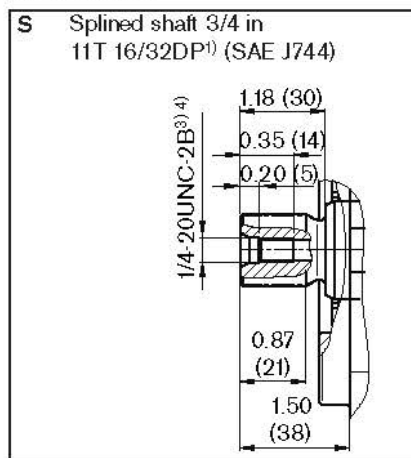


<sup>1)</sup> Dimensions of service line ports turned through 180° for counter-clockwise rotation  
For details of connection options and drive shafts

## Dimensions, size 18

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

### Drive shaft



### Ports

| Designation                     | Port for                    | Standard                | Size <sup>4)</sup>                        | Maximum pressure [psi (bar)] <sup>6)</sup> | State           |
|---------------------------------|-----------------------------|-------------------------|-------------------------------------------|--------------------------------------------|-----------------|
| B                               | Service line, fixing thread | SAE J518<br>ASME B1.1   | 3/4 in<br>3/8-16UNC-2B; 0.75 (19) deep    | 4600 (315)                                 | O               |
| S                               | Suction line, fixing thread | SAE J518<br>ASME B1.1   | 1 1/4 in<br>7/16-14UNC-2B; 0.79 (20) deep | 75 (5)                                     | O               |
| L                               | Case drain fluid            | ISO 11926 <sup>7)</sup> | 3/4-16UNF-2B; 0.47 (12) deep              | 30 (2)                                     | O <sup>8)</sup> |
| L <sub>1</sub> , L <sub>2</sub> | Case drain fluid            | ISO 11926 <sup>7)</sup> | 3/4-16UNF-2B; 0.47 (12) deep              | 30 (2)                                     | X <sup>8)</sup> |
| X                               | Pilot pressure              | ISO 11926 <sup>7)</sup> | 7/16-20UNF-2A; 0.45 (11.5) deep           | 4600 (315)                                 | O               |

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

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

3) Thread according to ASME B1.1

4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

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

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

7) The spot face can be deeper than as specified in the standard

8) Depending on the installation position, L, L<sub>1</sub> or L<sub>2</sub> must be connected

O = Must be connected (plugged on delivery)

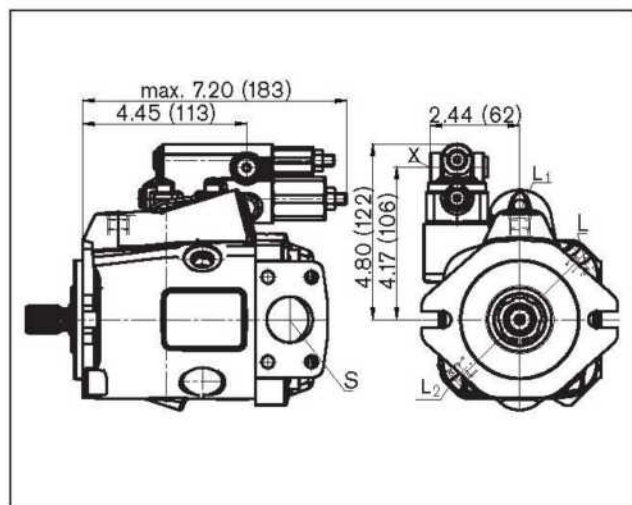
X = Plugged (in normal operation)

### Dimensions, size 18

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

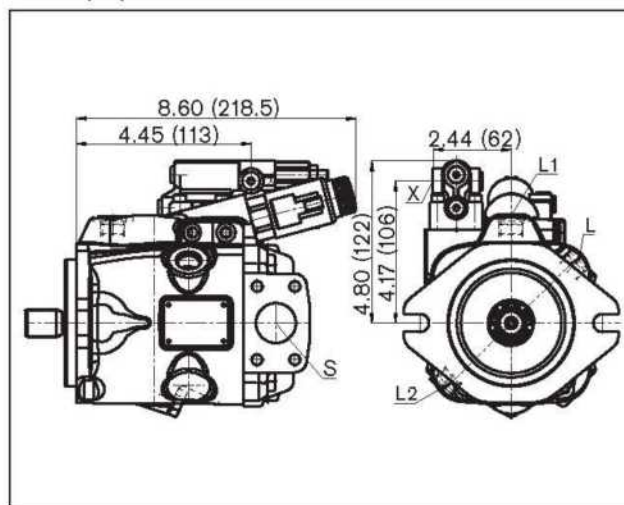
#### DRG

Pressure controller, remote controlled, **series 53**



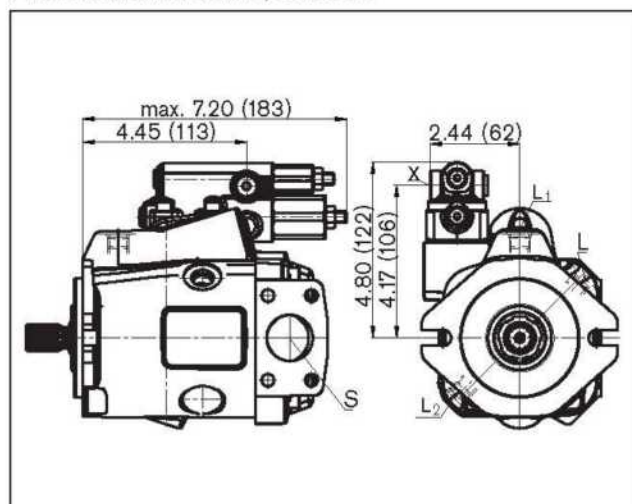
#### EP.D. / EK.D.

Electro-proportional control, **series 53**



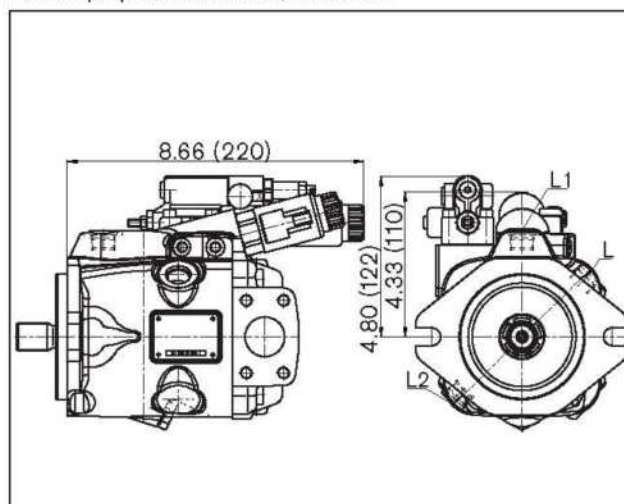
#### DRF/DRS

Pressure and flow control, **series 53**



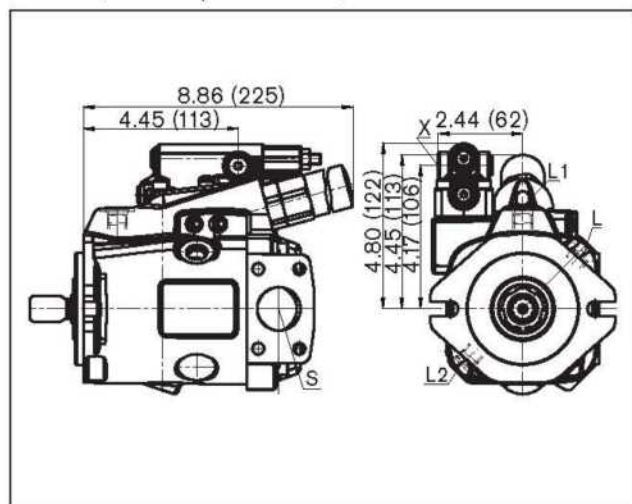
#### EP.ED / EK.ED

Electro-proportional control, **series 53**



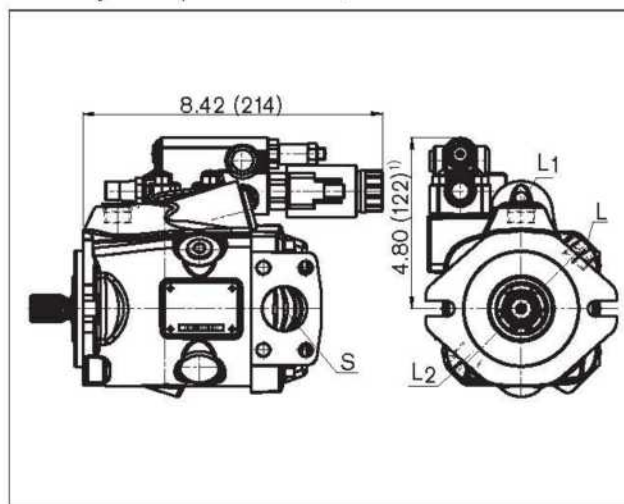
#### LA.D.

Pressure, flow and power control, **series 53**



#### ED7. / ER7.

Electro-hydraulic pressure control, **series 53**



<sup>1)</sup> ER7.: 6.18 inches (157 mm) if using an intermediate plate pressure controller.

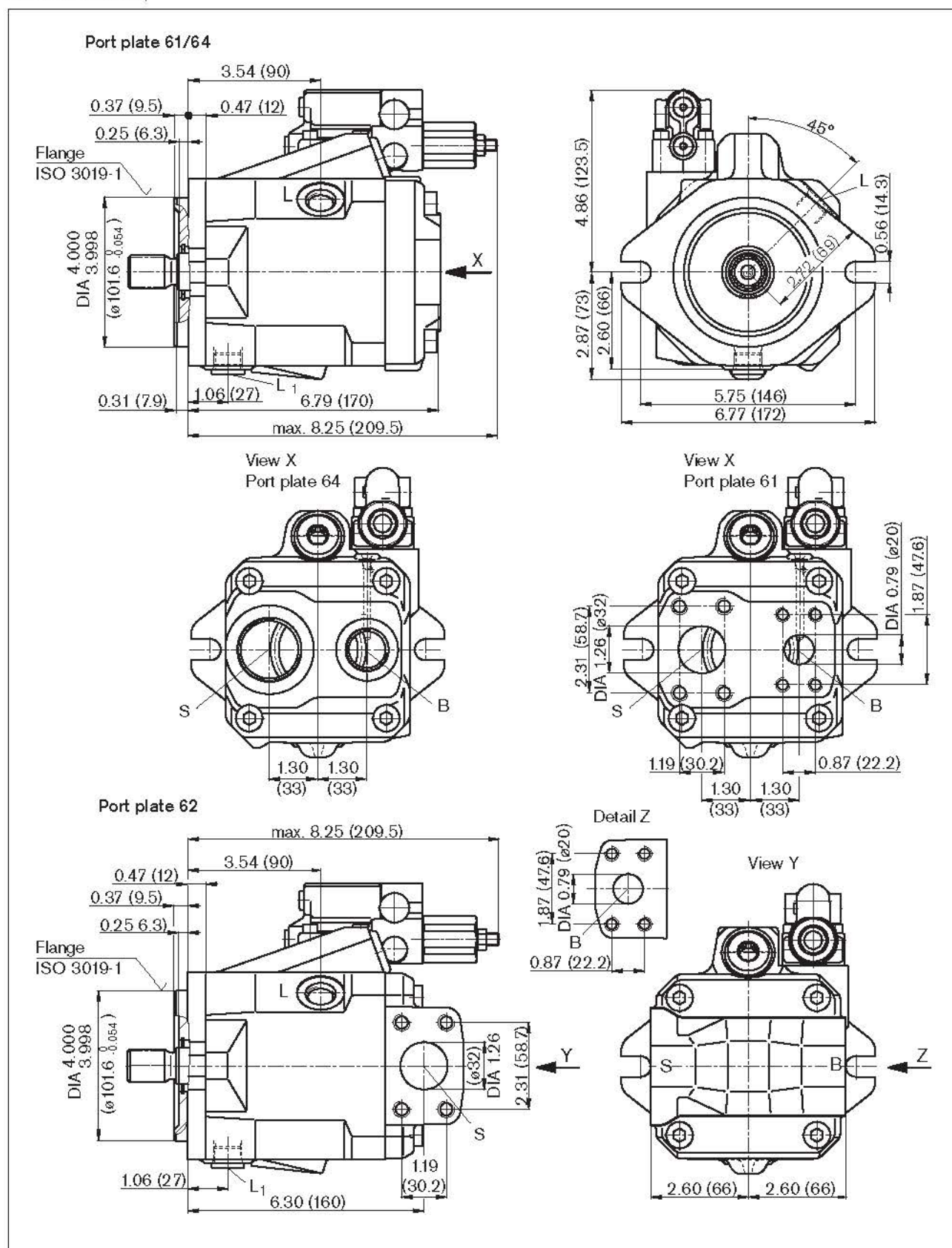


## Dimensions, size 28<sup>1)2)</sup>

### DR – Hydraulic pressure controller

Clockwise rotation.

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).



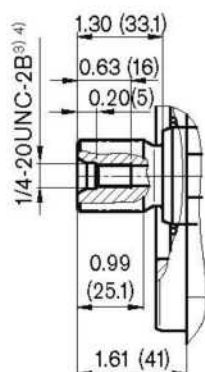
1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

## Dimensions, size 28

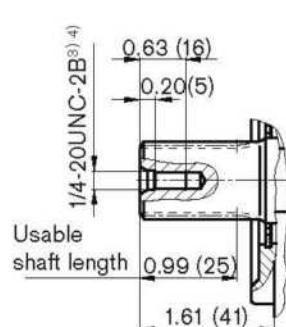
Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

### Drive shaft

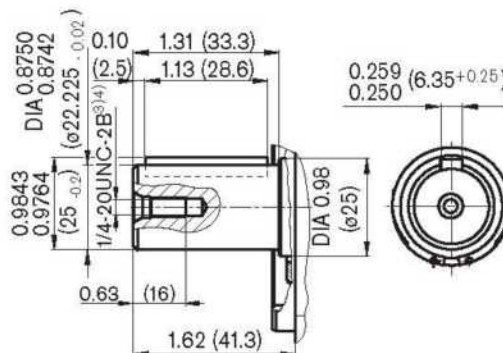
**S** Splined shaft 7/8 in  
13T 16/32DP<sup>1)</sup> (SAE J744)



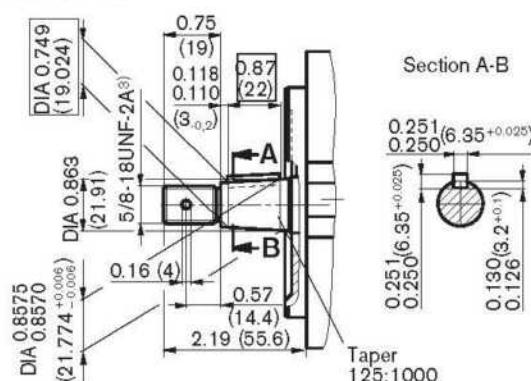
**R** Splined shaft 7/8 in  
13T 16/32DP<sup>1)2)</sup> (SAE J744)



**K<sup>5)</sup>** Parallel keyed shaft



**C<sup>5)</sup>** Tapered with woodruff key  
(ISO 3019-1)



### Ports

| Designation                                   | Port for                    | Standard                | Size <sup>4)</sup>                        | Maximum pressure [psi (bar)] <sup>6)</sup> | State           |
|-----------------------------------------------|-----------------------------|-------------------------|-------------------------------------------|--------------------------------------------|-----------------|
| B; Port plate 61/62                           | Service line, fixing thread | SAE J518<br>ASME B1.1   | 3/4 in<br>3/8-16UNC-2B; 075 (19) deep     | 4600 (315)                                 | O               |
| B; Port plate 64                              | threaded                    | ISO 11926 <sup>7)</sup> | 1 1/16-12UNF-2B; 079 (20) deep            | 4600 (315)                                 | O               |
| S; Port plate 61/62                           | Suction line, fixing thread | SAE J518<br>ASME B1.1   | 1 1/4 in<br>7/16-14UNC-2B; 0.79 (20) deep | 75 (5)                                     | O               |
| S; Port plate 64                              | threaded                    | ISO 11926 <sup>7)</sup> | 1 5/8-12UN-2B; 0.79 (20) deep             | 75 (5)                                     | O               |
| L                                             | Case drain fluid            | ISO 11926 <sup>7)</sup> | 3/4-16UNF-2B; 0.47 (12) deep              | 30 (2)                                     | O <sup>9)</sup> |
| L <sub>1</sub> , L <sub>2</sub> <sup>8)</sup> | Case drain fluid            | ISO 11926 <sup>7)</sup> | 3/4-16UNF-2B; 0.47 (12) deep              | 30 (2)                                     | X <sup>9)</sup> |
| X                                             | Control pressure            | ISO 11926 <sup>7)</sup> | 7/16-20UNF-2B; 0.45 (11.5) deep           | 4600 (315)                                 | O               |

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

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

3) Thread according to ASME B1.1

4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

5) Only series 52

6) Depending on the appl., momentary press. spikes can occur. Consider this when selecting measuring equipment and fittings.

7) The spot face can be deeper than as specified in the standard.

8) Only series 53

9) Depending on the installation position, L, L<sub>1</sub> or L<sub>2</sub> must be connected

O = Must be connected (plugged on delivery)

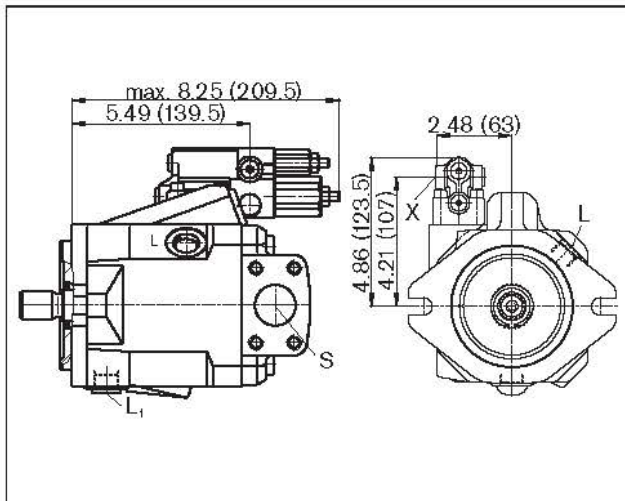
X = Plugged (in normal operation)

## Dimensions, size 28

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

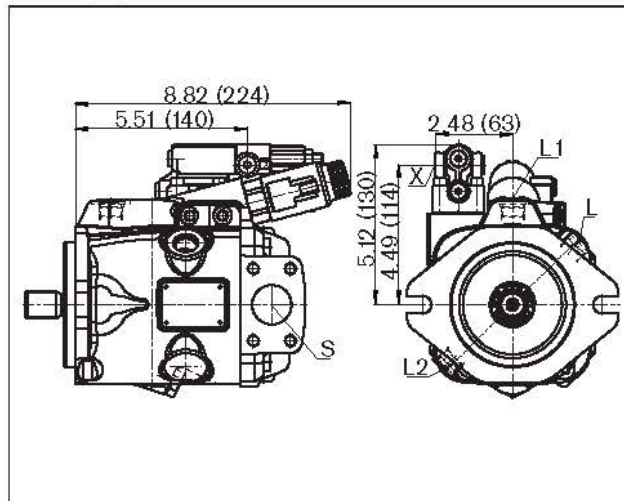
### DRG

Pressure controller, remote controlled



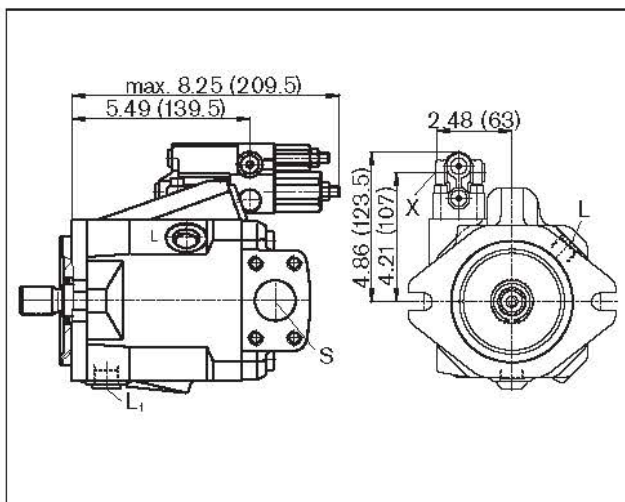
### EP.D / EK.D.

Electro-proportional control



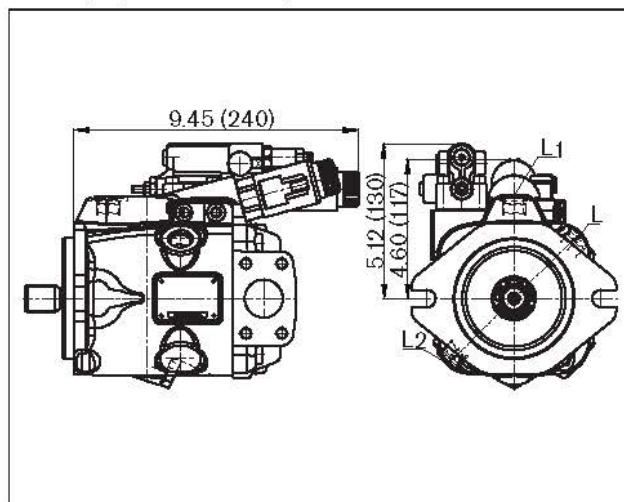
### DFR / DFR1

Pressure and flow control



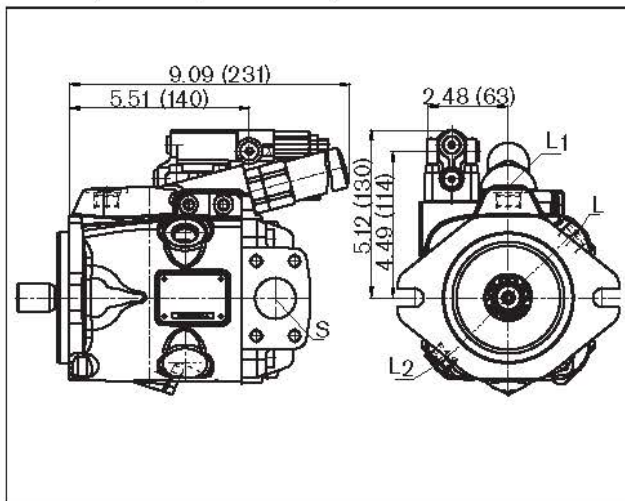
### EP.ED / EK.ED

Electro-proportional control



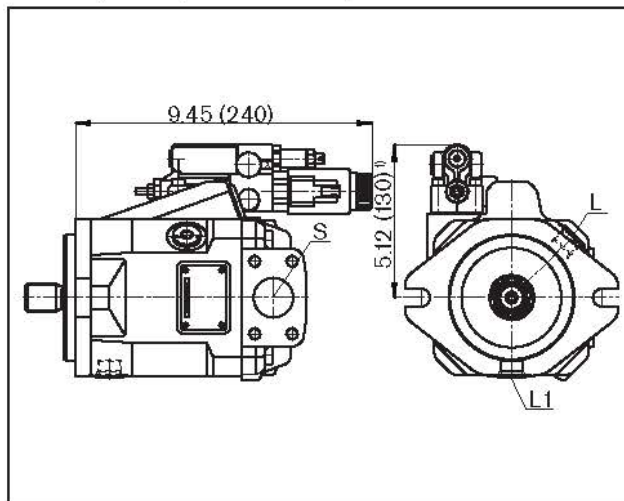
### LA.D.

Pressure, flow and power control, series 53



### ED7. / ER7.

Electro-hydraulic pressure control, series 52



i) ER7.: 6.26 inches (159 mm) if using an intermediate plate pressure controller.

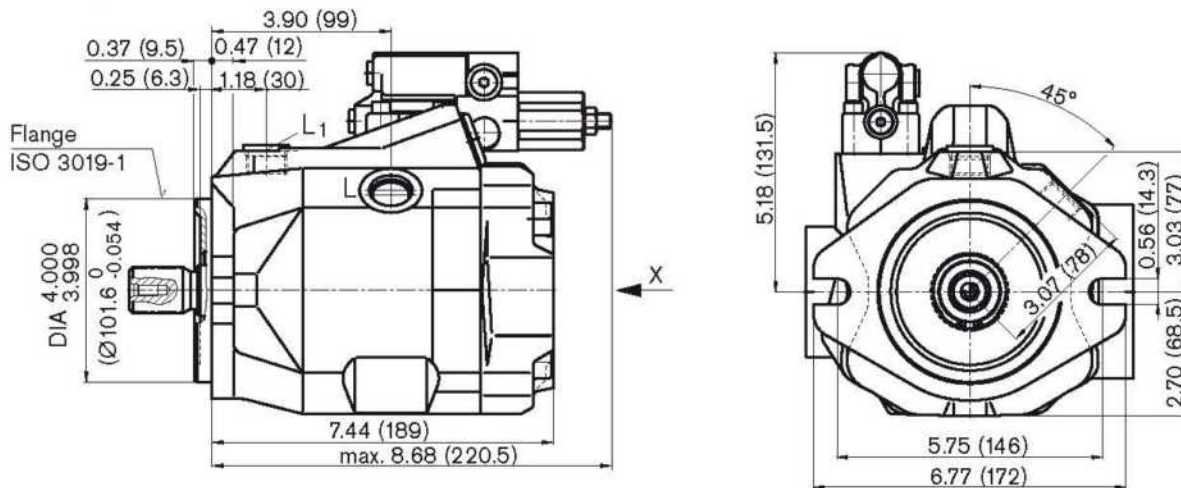


### Dimensions, size 45<sup>1)</sup>

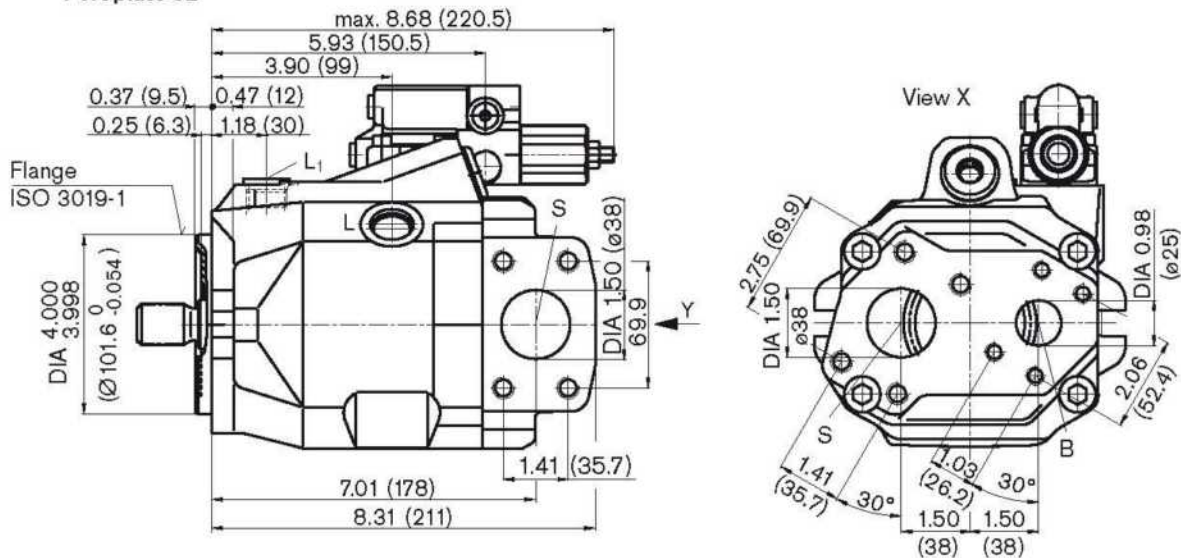
**DR – Hydraulic pressure controller**  
Clockwise rotation, series 52

Before finalizing your design request a certified  
installation drawing.  
Dimensions in inches and (mm).

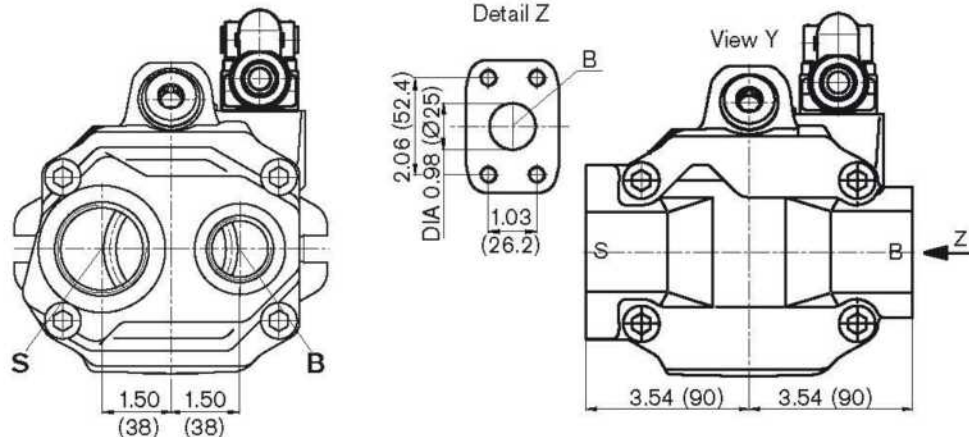
**Port plate 61**



**Port plate 62**



**Port plate 64**



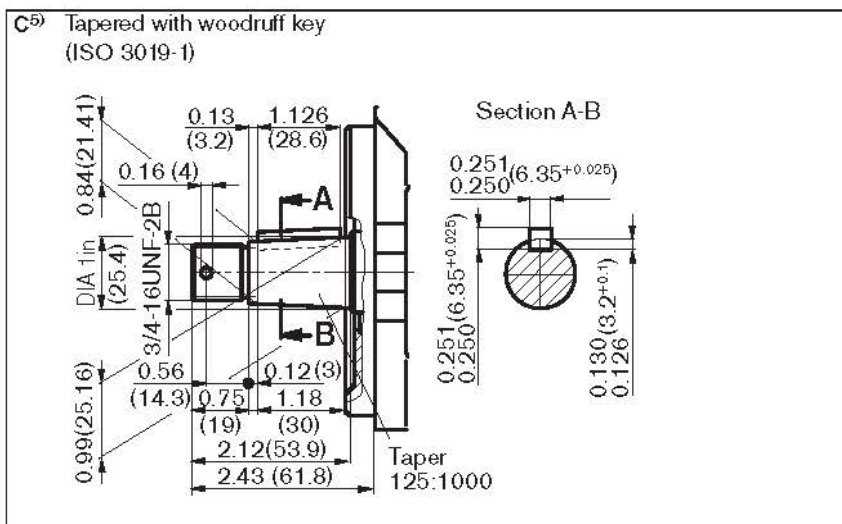
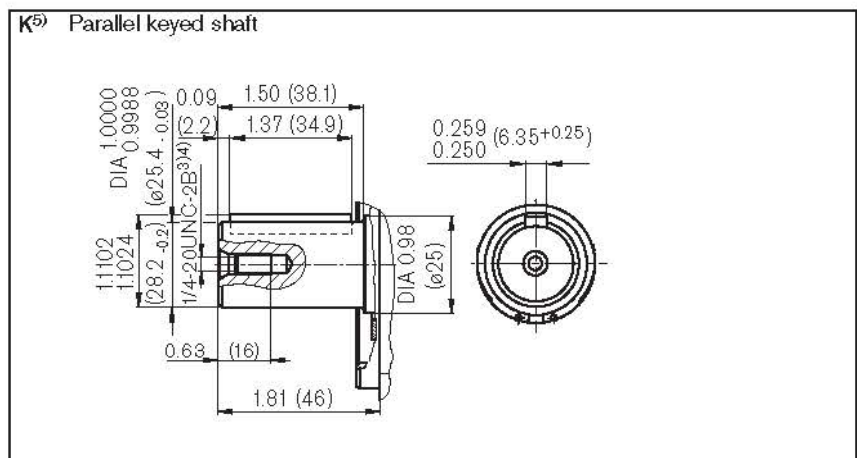
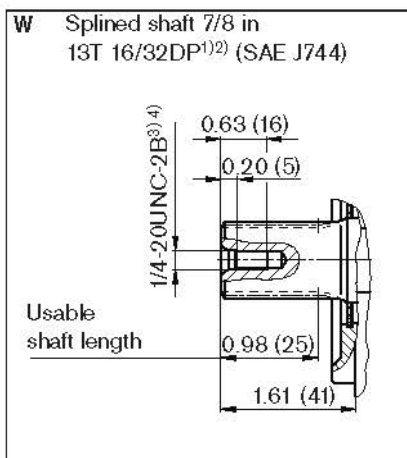
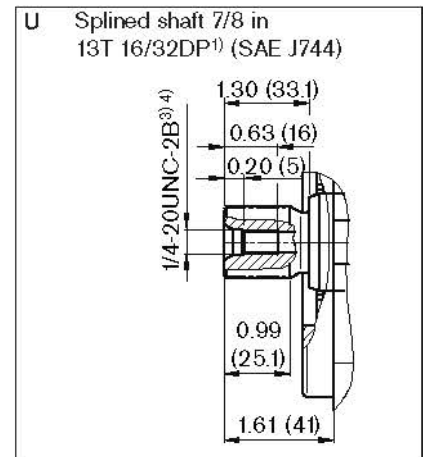
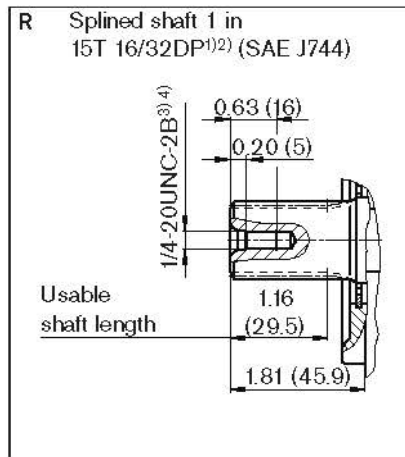
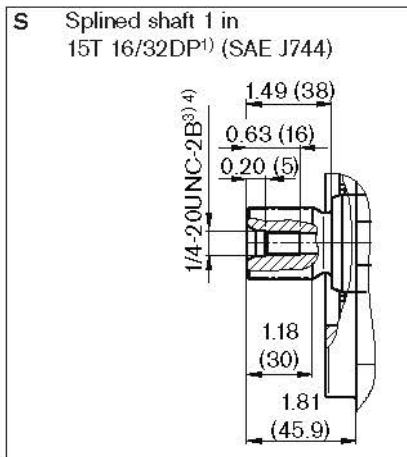
Dimensions of service line ports  
turned through 180° for counter-clock-  
wise rotation

<sup>1)</sup> Primary dimensions for pump apply for series 52 and 53

## Dimensions, size 45

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

### Drive shaft



- 1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.
- 3) Thread according to ASME B1.1
- 4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.
- 5) Only series 52

### Dimensions, size 45

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

#### Ports

| Designation                                   | Port for                       | Standard                | Size <sup>1)</sup>                       | Maximum pressure [psi (bar)] <sup>2)</sup> | State           |
|-----------------------------------------------|--------------------------------|-------------------------|------------------------------------------|--------------------------------------------|-----------------|
| B<br>Port plate 61/62                         | Service line,<br>fixing thread | SAE J518<br>ASME B1.1   | 1 in<br>3/8-16UNC-2B; 0.71 (18) deep     | 4600 (315)                                 | O               |
| B; Port plate 64                              | Fixing thread                  | ISO 11926               | 1 5/16-12UN-2B; 0.79 (20) deep           | 4600 (315)                                 | O               |
| S                                             | Suction line,<br>fixing thread | SAE J518<br>ASME B1.1   | 1 1/2 in<br>1/2-13UNC-2B; 0.87 (22) deep | 75 (5)                                     | O               |
| S; Port plate 64                              | Fixing thread                  | ISO 11926               | 1 7/8-12UN-2B; 0.79 (20) deep            | 75 (5)                                     | O               |
| L                                             | Case drain fluid               | ISO 11926 <sup>3)</sup> | 7/8-14UNF-2B; 13 deep                    | 30 (2)                                     | O <sup>5)</sup> |
| L <sub>1</sub> , L <sub>2</sub> <sup>4)</sup> | Case drain fluid               | ISO 11926 <sup>3)</sup> | 7/8-14UNF-2B; 13 deep                    | 30 (2)                                     | X <sup>5)</sup> |
| X                                             | Control pressure               | ISO 11926 <sup>3)</sup> | 7/16-20UNF-2A; 11.5 deep                 | 4600 (315)                                 | O               |

1) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

2) Depending on the application, momentary pressure spikes can occur. Consider this when selecting measuring equipment and fittings.

3) The spot face can be deeper than as specified in the standard.

4) Only for series 53

5) Depending on the installation position, L<sub>1</sub>, L<sub>2</sub> must be connected

O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

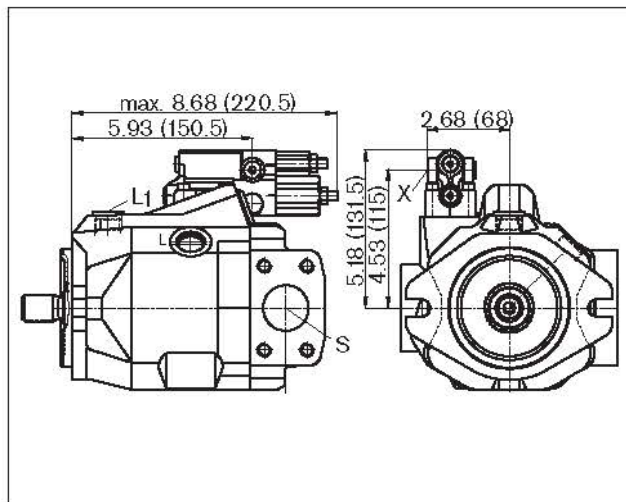


## Dimensions, size 45

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

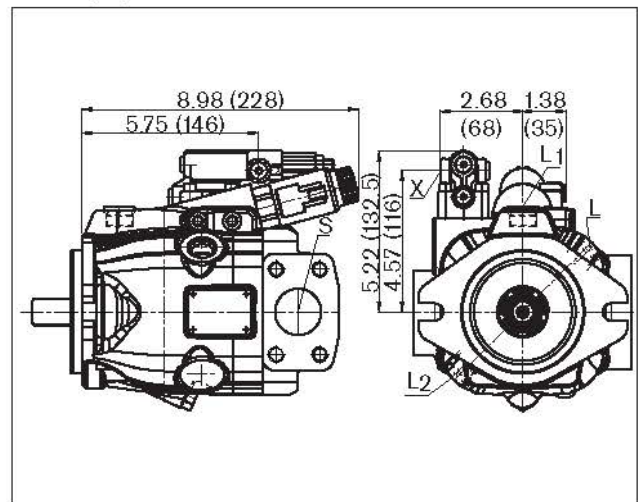
### DRG

Pressure controller, remote controlled, **series 52**



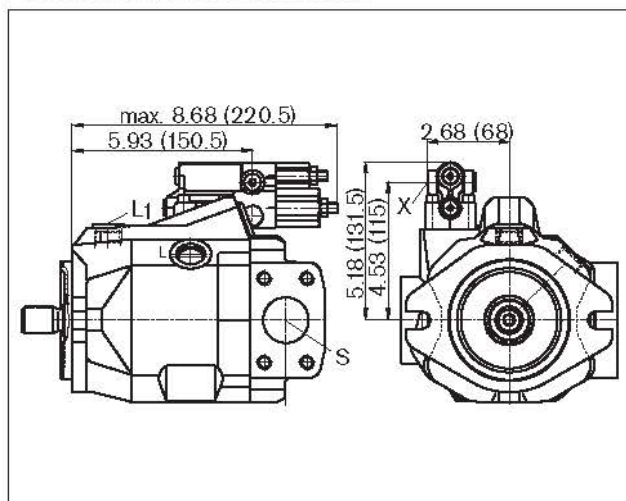
### EP.D. / EK.D.

Electro-proportional control, **series 53**



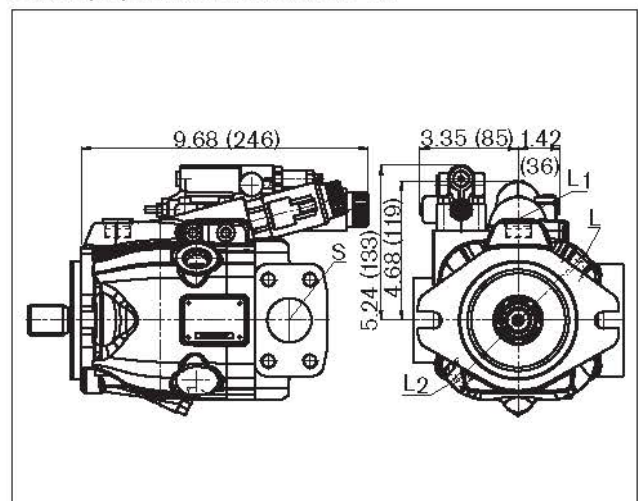
### DFR / DFR1

Pressure and flow control, **series 52**



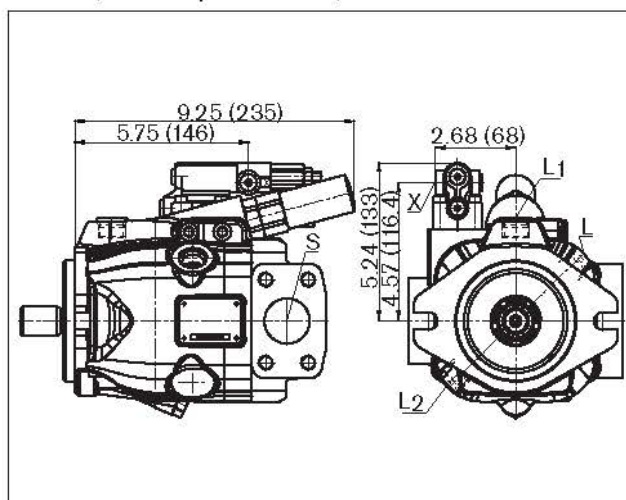
### EP.ED / EK.ED

Electro-proportional control, **series 53**



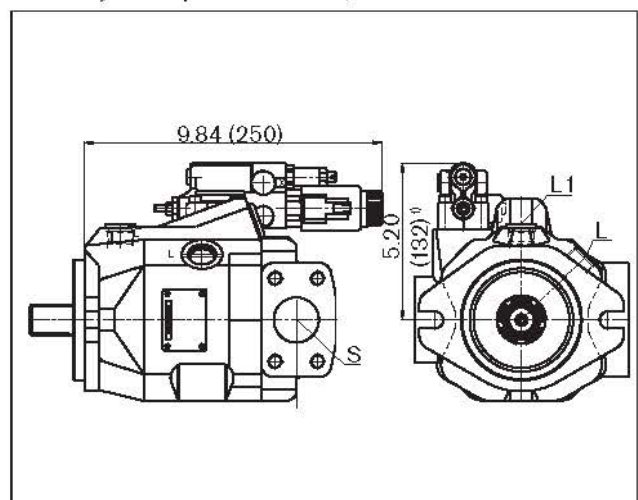
### LA.D.

Pressure, flow and power control, **series 53**



### ED7. / ER7.

Electro-hydraulic pressure control, **series 52**



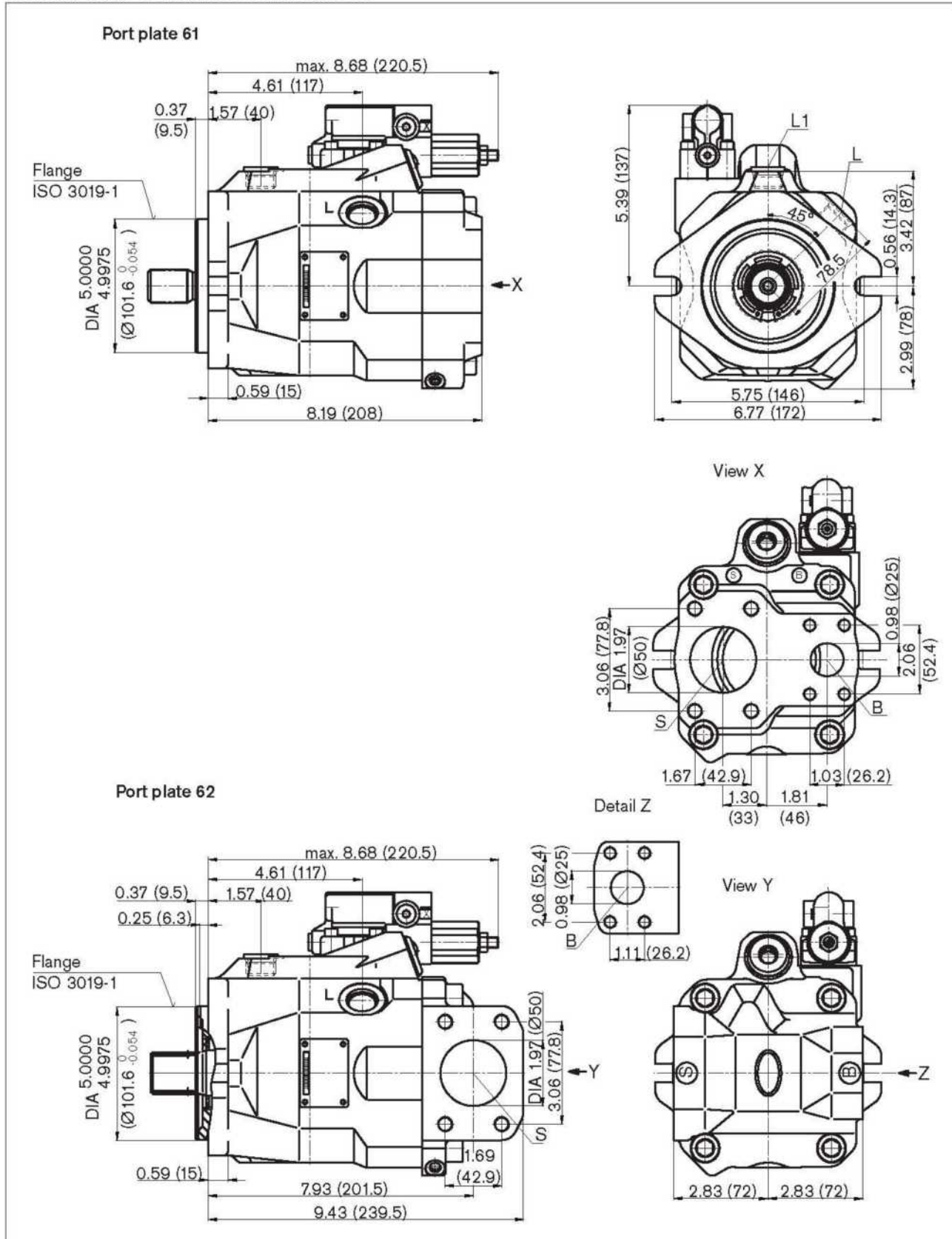
1) ER7.: 6.57 inches (167 mm) if using an intermediate plate pressure controller.

### Dimensions, size 60

DR – Hydraulic pressure controller

Mounting flange C, clockwise rotation, series 52

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).



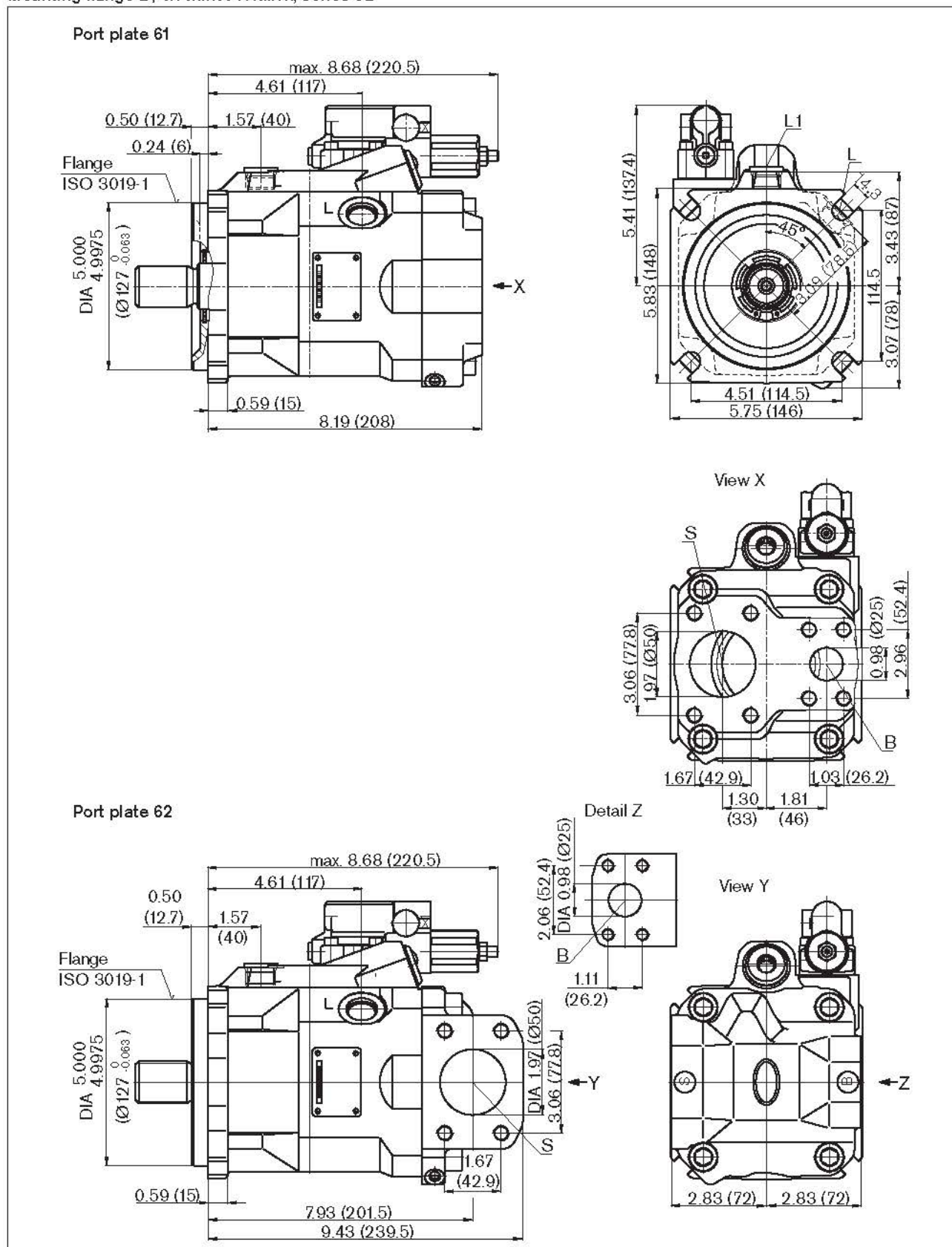
1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

## Dimensions, size 60

### DR – Hydraulic pressure controller

Mounting flange D, clockwise rotation, series 52

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).



1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

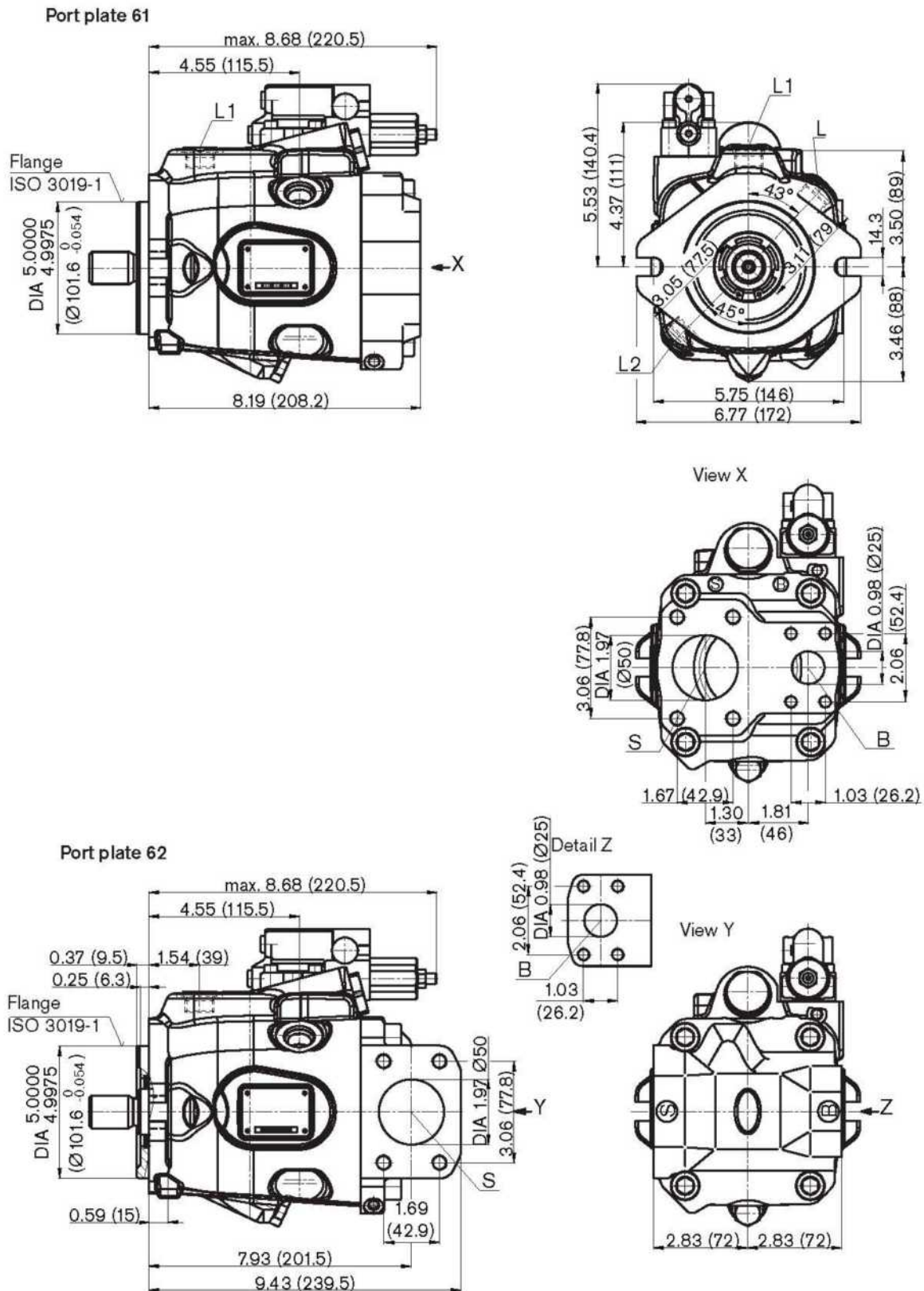


### Dimensions, size 63<sup>1)</sup>

DR – Hydraulic pressure controller

Mounting flange C, clockwise rotation, series 53

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).



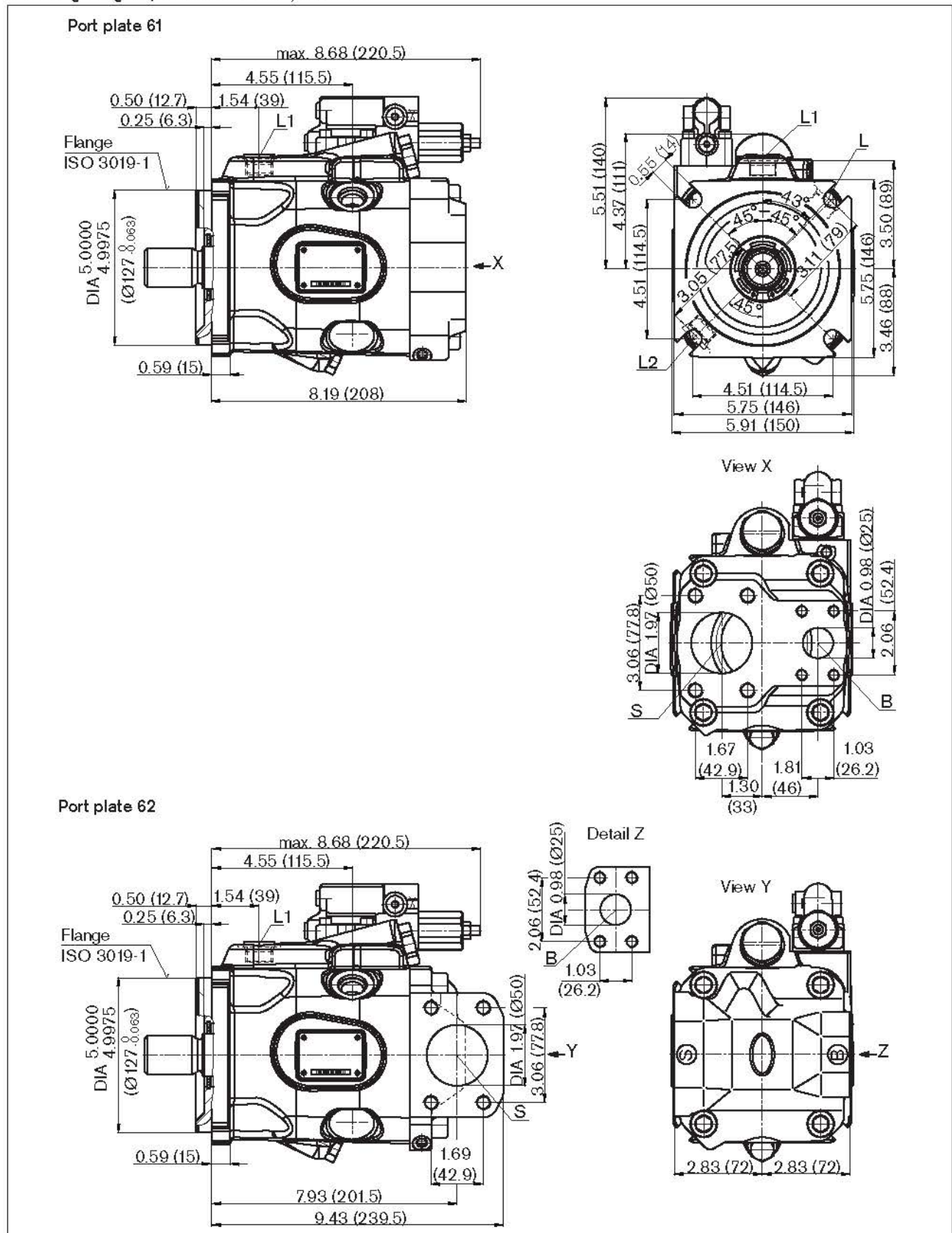
<sup>1)</sup> Dimensions of service line ports turned through 180° for counter-clockwise rotation

## Dimensions, size 63<sup>1)</sup>

### DR – Hydraulic pressure controller

Mounting flange D, clockwise rotation, series 53

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

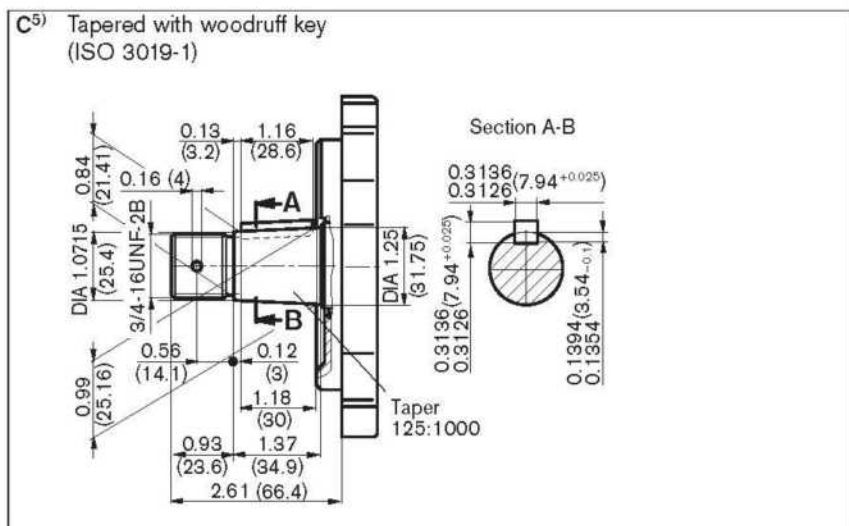
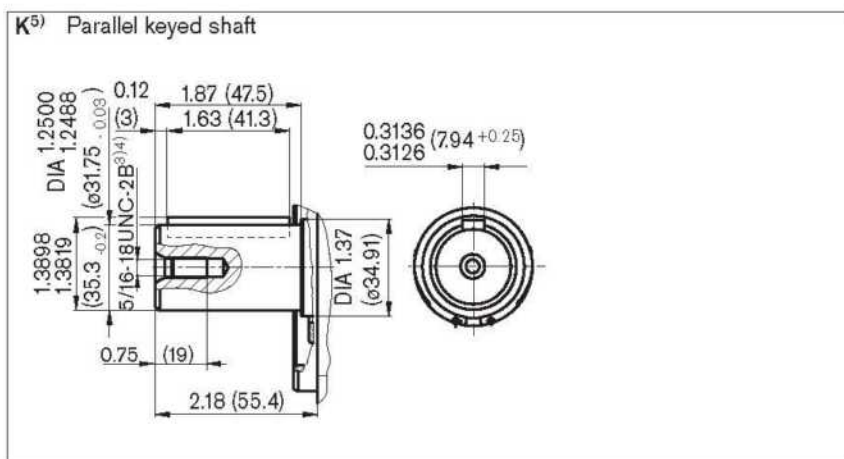
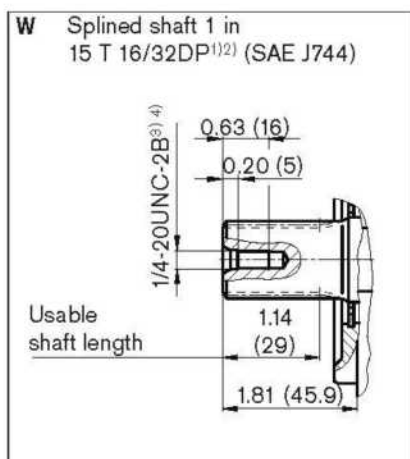
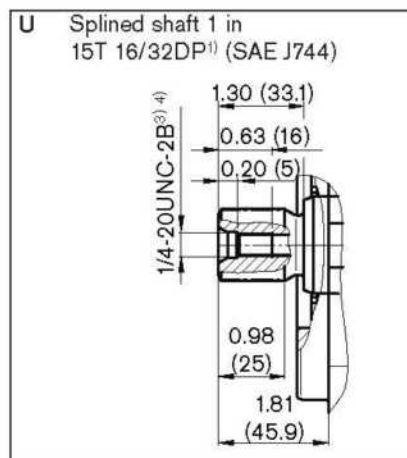
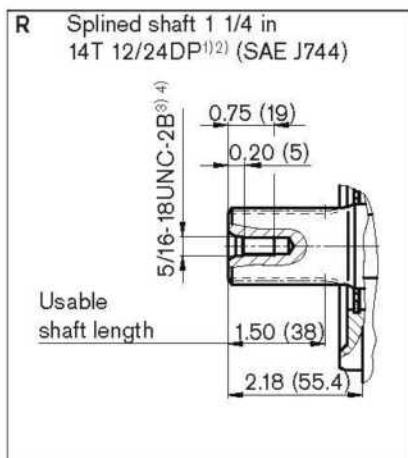
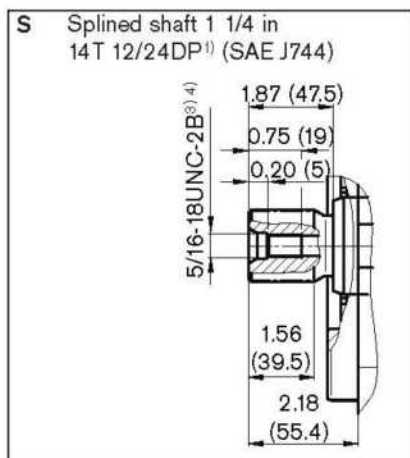


<sup>1)</sup> Dimensions of service line ports turned through 180° for counter-clockwise rotation

## Dimensions, size 60 / 63

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

### Drive shaft



- 1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
- 2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.
- 3) Thread according to ASME B1.1
- 4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.
- 5) Only series 52





## Dimensions, size 60 / 63

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

### Ports

| Designation                                   | Port for                    | Standard                | Size <sup>1)</sup>                   | Maximum pressure [psi (bar)] <sup>2)</sup> | State           |
|-----------------------------------------------|-----------------------------|-------------------------|--------------------------------------|--------------------------------------------|-----------------|
| B                                             | Service line, fixing thread | SAE J518<br>ASME B1.1   | 1 in<br>3/8-16UNC-2B; 0.71 (18) deep | 4600 (315)                                 | O               |
| S                                             | Suction line, fixing thread | SAE J518<br>ASME B1.1   | 2 in<br>1/2-13UNC-2B; 0.87 (22) deep | 75 (5)                                     | O               |
| L                                             | Case drain fluid            | ISO 11926 <sup>3)</sup> | 7/8-14UNF-2B; 0.51 (13) deep         | 30 (2)                                     | O <sup>5)</sup> |
| L <sub>1</sub> , L <sub>2</sub> <sup>4)</sup> | Case drain fluid            | ISO 11926 <sup>3)</sup> | 7/8-14UNF-2B; 0.51 (13) deep         | 30 (2)                                     | X <sup>5)</sup> |
| X                                             | Control pressure            | ISO 11926 <sup>3)</sup> | 7/16-20UNF-2A; 0.45 (11.5) deep      | 4600 (315)                                 | O               |

1) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

2) Depending on the application, momentary pressure spikes can occur. Consider this when selecting measuring equipment and fittings.

3) The spot face can be deeper than as specified in the standard.

4) Only for series 53

5) Depending on the installation position, L, L<sub>1</sub> or L<sub>2</sub> must be connected

O = Must be connected (plugged on delivery)

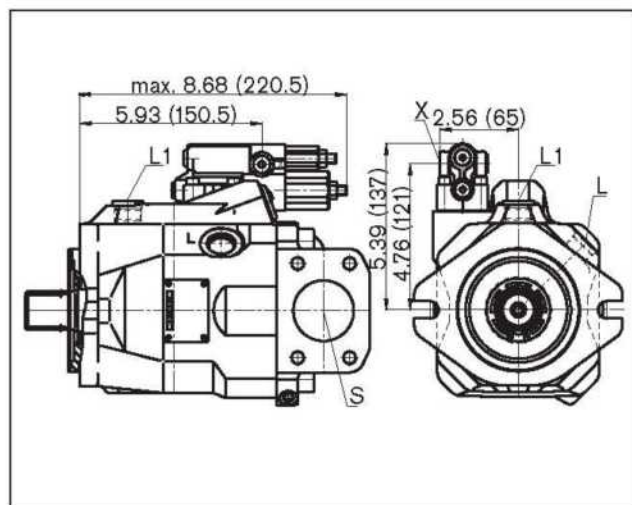
X = Plugged (in normal operation)

## Dimensions, size 60 / 63

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

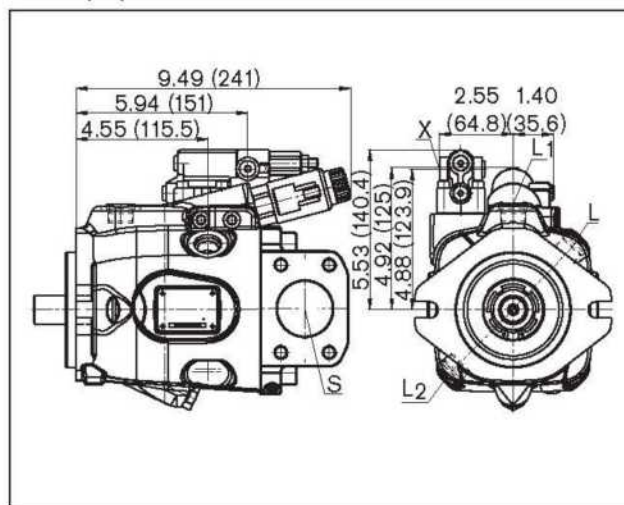
### DRG

Pressure controller, remote controlled, **series 52**



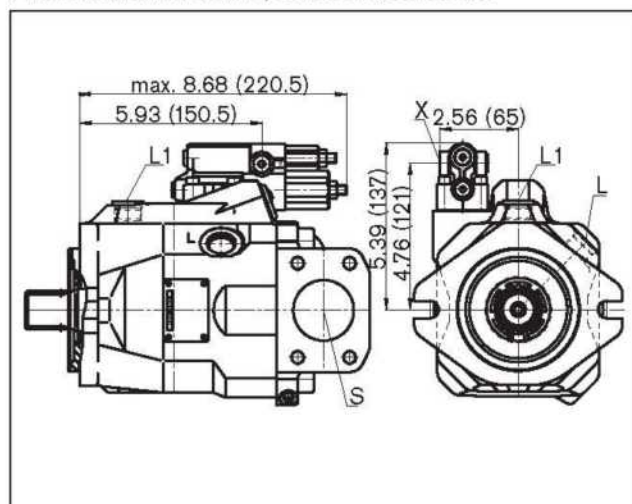
### EP.D. / EK.D.

Electro-proportional control, **series 53**



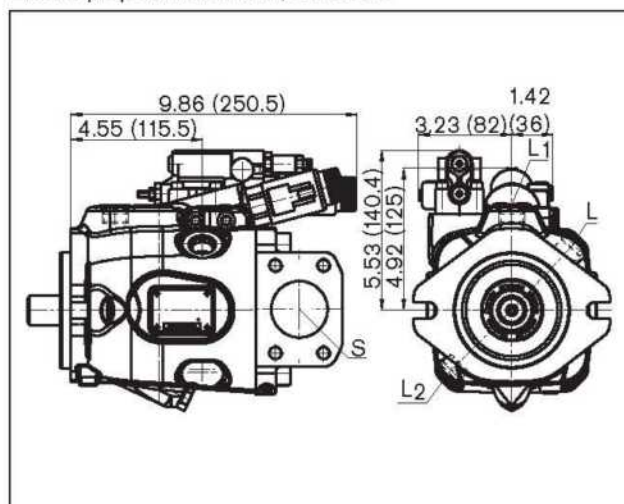
### DFR / DFR1 (DRF/DRS)

Pressure and flow control, **series 52 (series 53)**



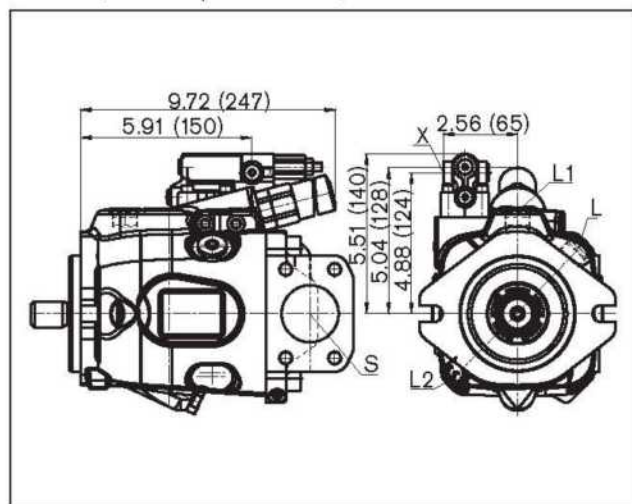
### EP.ED / EK.ED

Electro-proportional control, **series 53**



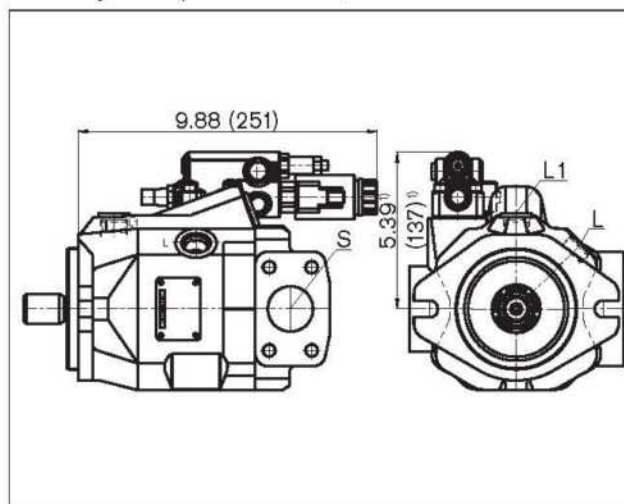
### LA.D.

Pressure, flow and power control, **series 53**



### ED7. / ER7.

Electro-hydraulic pressure control, **series 52**



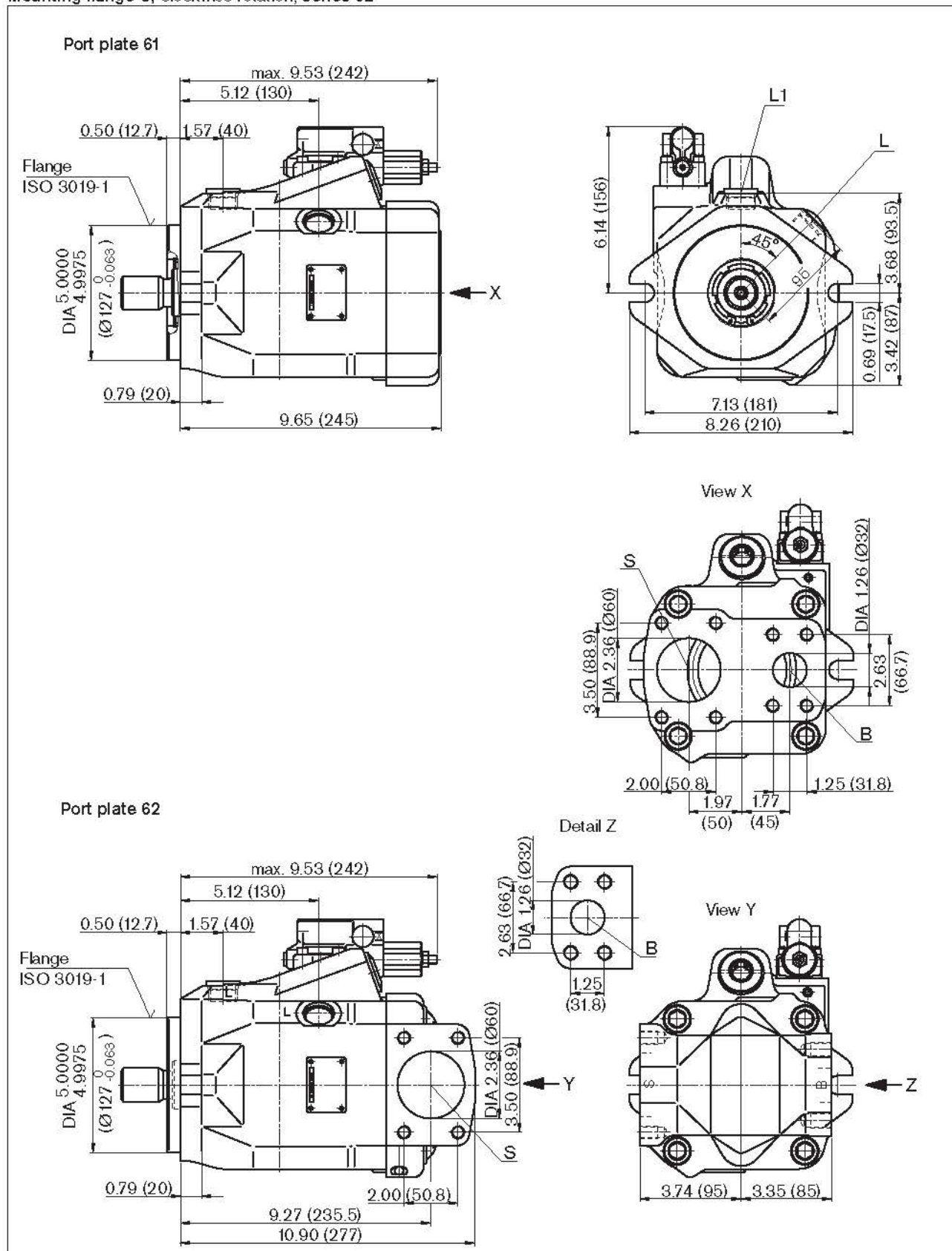
1) ER7.: 6.77 inches (172 mm) if using an intermediate plate pressure controller.

## Dimensions, size 85<sup>1)</sup>

### DR – Hydraulic pressure controller

Mounting flange C, clockwise rotation, series 52

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).



<sup>1)</sup> Dimensions of service line ports turned through 180° for counter-clockwise rotation  
For details of connection options and drive shafts

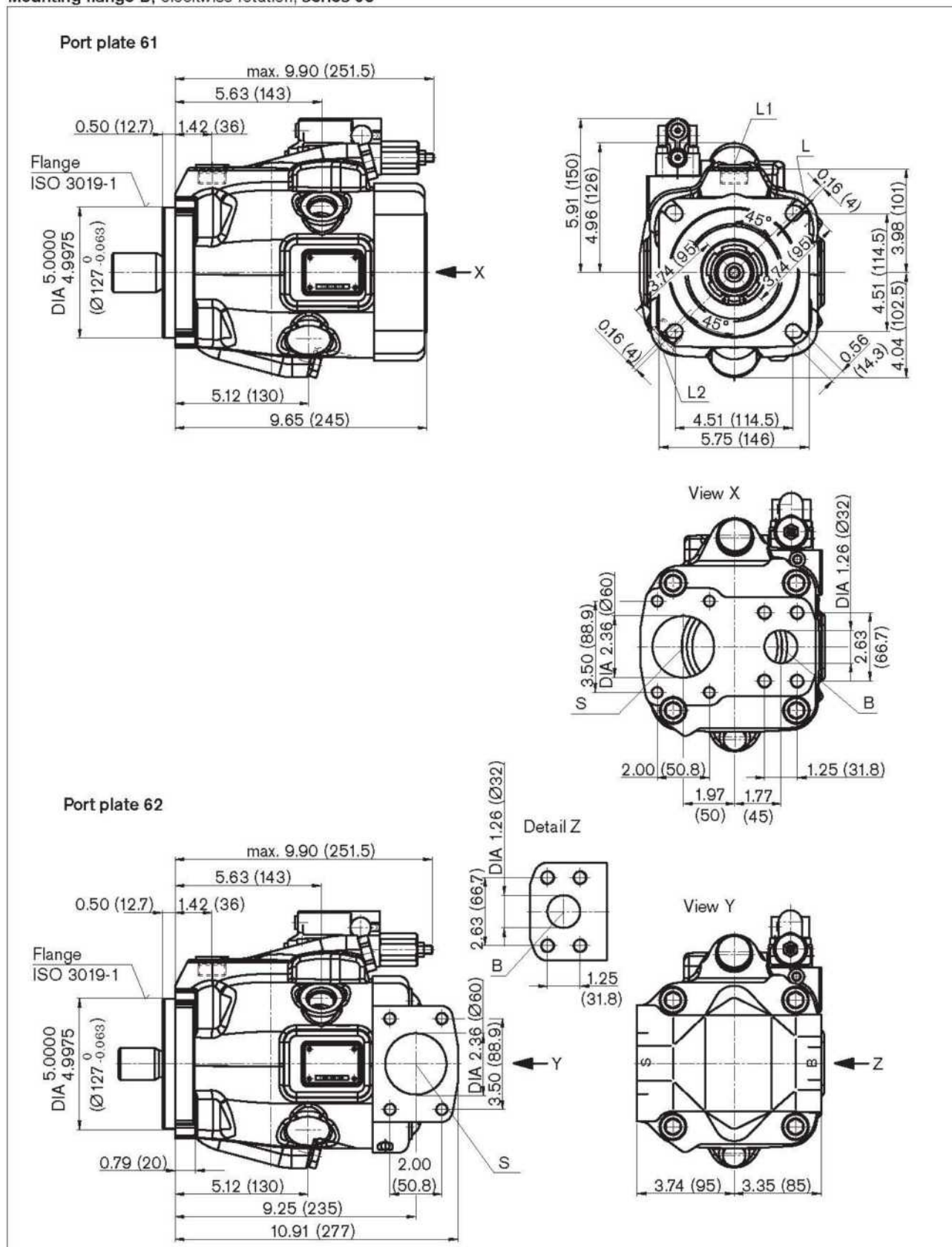


### Dimensions, size 85<sup>1)</sup>

DR – Hydraulic pressure controller

Mounting flange D, clockwise rotation, series 53

Before finalizing your design request a certified  
installation drawing.  
Dimensions in inches and (mm).

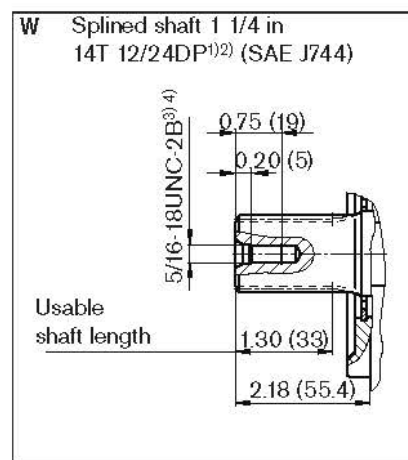
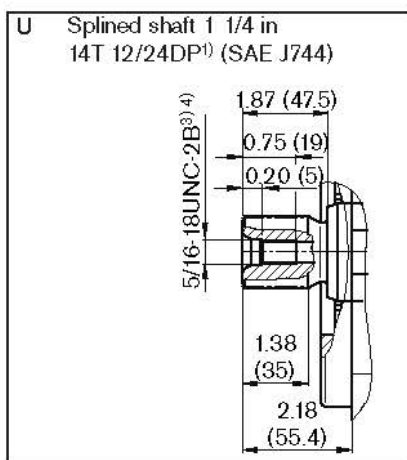
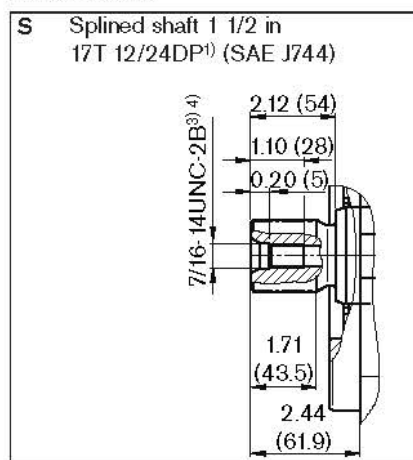


<sup>1)</sup> Dimensions of service line ports turned through 180° for counter-clockwise rotation  
For details of connection options and drive shafts

## Dimensions, size 85

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

### Drive shaft



### Ports

| Designation                                   | Port for                    | Standard                | Size <sup>4)</sup>                       | Maximum pressure [psi (bar)] <sup>5)</sup> | State           |
|-----------------------------------------------|-----------------------------|-------------------------|------------------------------------------|--------------------------------------------|-----------------|
| B                                             | Service line, fixing thread | SAE J518<br>ASME B1.1   | 1 1/4 in<br>1/2-13UNC-2B; 0.75 (19) deep | 4600 (315)                                 | O               |
| S                                             | Suction line, fixing thread | SAE J518<br>ASME B1.1   | 2 1/2 in<br>1/2-13UNC-2B; 1.07 (27) deep | 75 (5)                                     | O               |
| L                                             | Case drain fluid            | ISO 11926 <sup>6)</sup> | 1 1/16-12UNF-2B; 0.59 (15) deep          | 30 (2)                                     | O <sup>8)</sup> |
| L <sub>1</sub> , L <sub>2</sub> <sup>7)</sup> | Case drain fluid            | ISO 11926 <sup>6)</sup> | 1 1/16-12UNF-2B; 0.59 (15) deep          | 30 (2)                                     | X <sup>8)</sup> |
| X                                             | Control pressure            | ISO 11926 <sup>6)</sup> | 7/16-20UNF-2A; 0.45 (11.5) deep          | 4600 (315)                                 | O               |

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

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

3) Thread according to ASME B1.1

4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

5) Depending on the application, momentary pressure spikes can occur. Consider this when selecting measuring equipment and fittings.

6) The spot face can be deeper than as specified in the standard.

7) Only for series 53

8) Depending on the installation position, L, L<sub>1</sub> or L<sub>2</sub> must be connected

O = Must be connected (plugged on delivery)

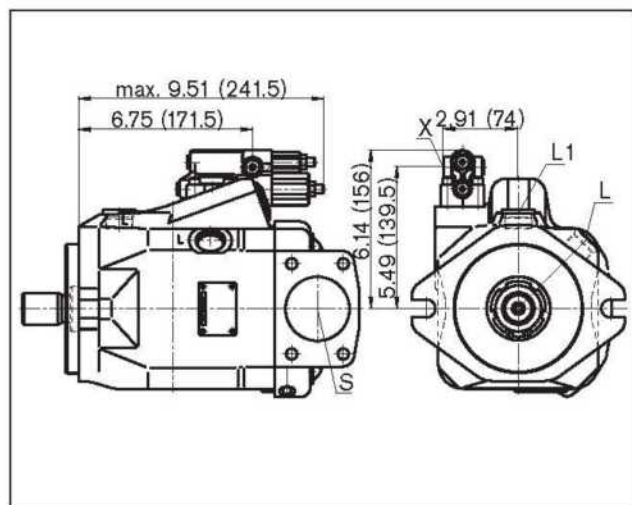
X = Plugged (in normal operation)

## Dimensions, size 85, mounting flange C

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

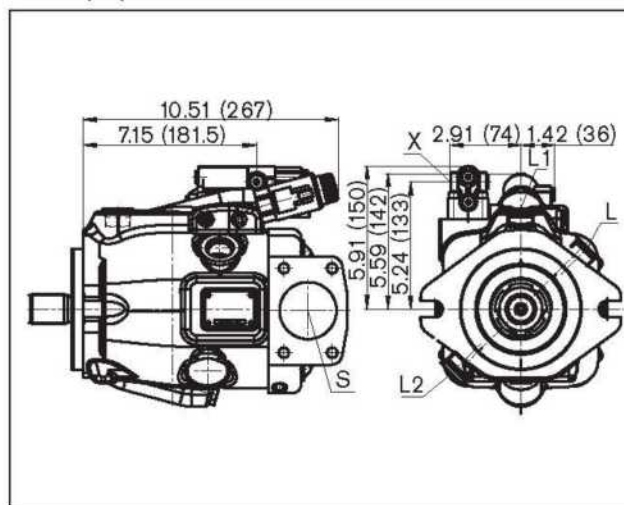
### DRG

Pressure controller, remote controlled, **series 52**



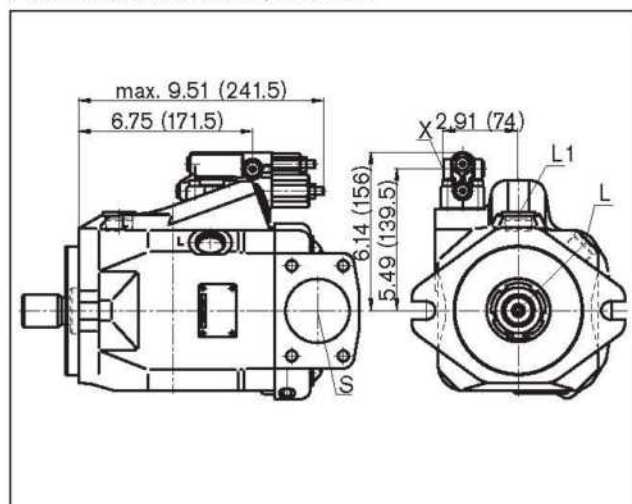
### EP.D. / EK.D.

Electro-proportional control, **series 53**



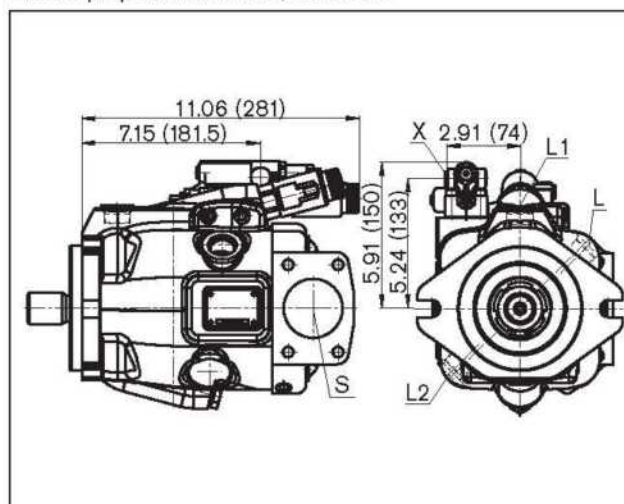
### DFR / DFR1

Pressure and flow control, **series 52**



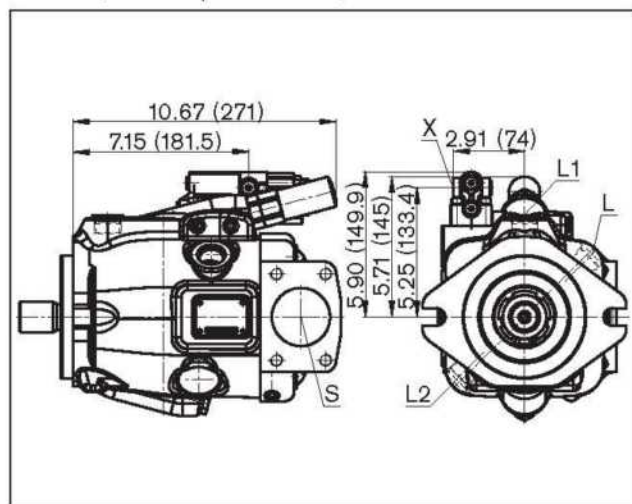
### EP.ED / EK.ED

Electro-proportional control, **series 53**



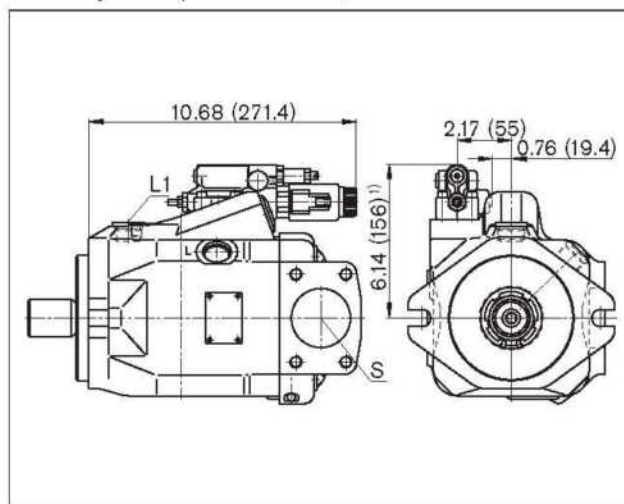
### LA.D.

Pressure, flow and power control, **series 53**



### ED../ ER..

Electro-hydraulic pressure control, **series 52**



1) ER7.: 191 mm if using an intermediate plate pressure controller.

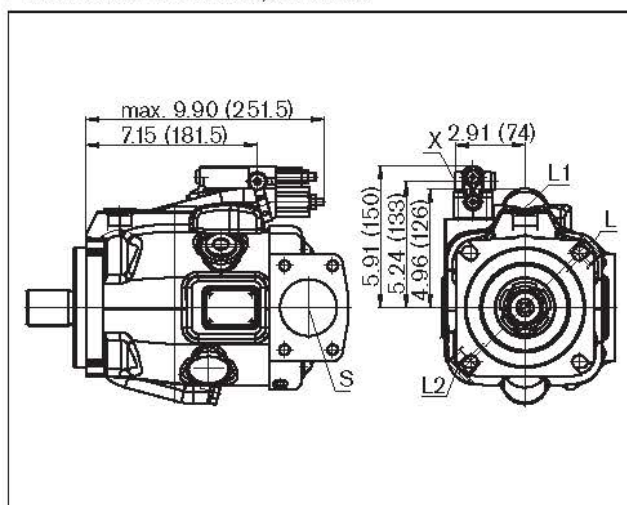


## Dimensions, size 85, mounting flange D

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

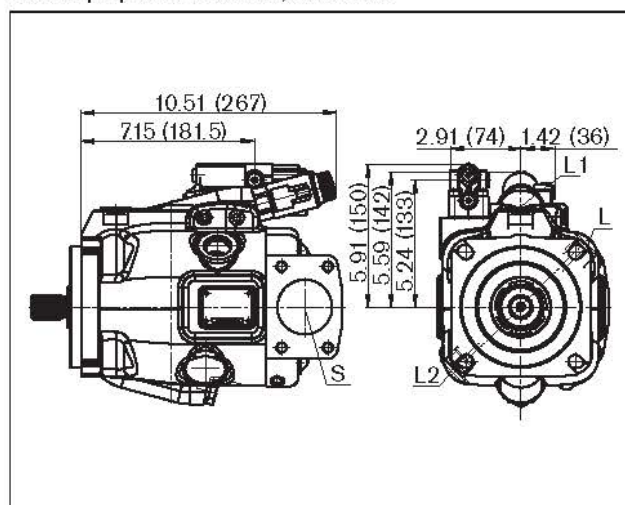
### DRF/DRS

Pressure and flow control, **series 53**



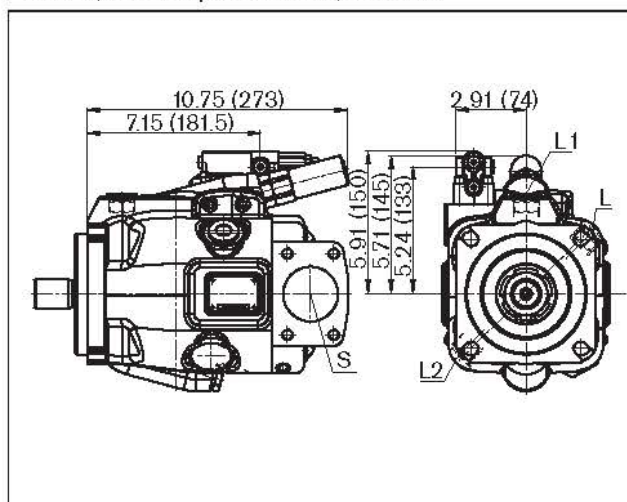
### EP.D. / EK.D.

Electro-proportional control, **series 53**



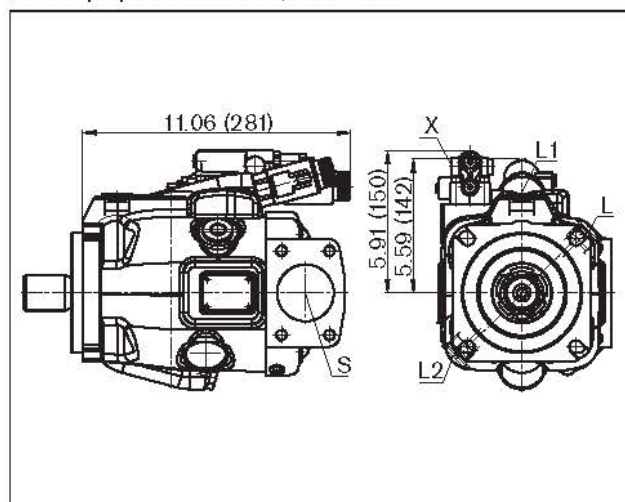
### LA.D.

Pressure, flow and power control, **series 53**



### EP.ED / EK.ED

Electro-proportional control, **series 53**



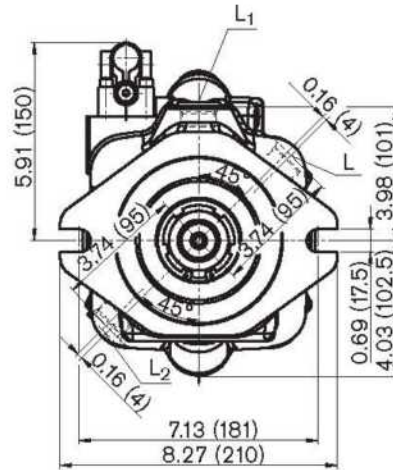
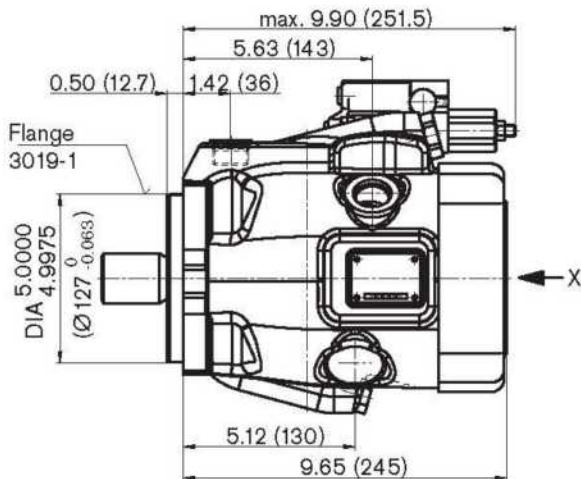
### Dimensions, size 100<sup>1)</sup>

DR – Hydraulic pressure controller

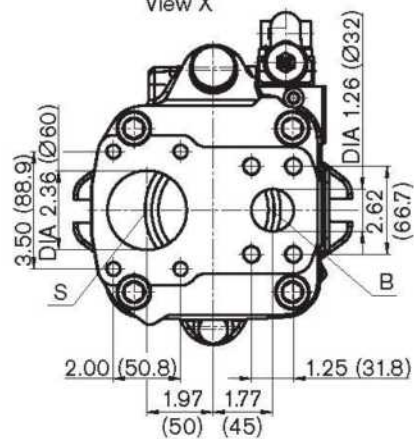
Mounting flange C, clockwise rotation, series 53

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

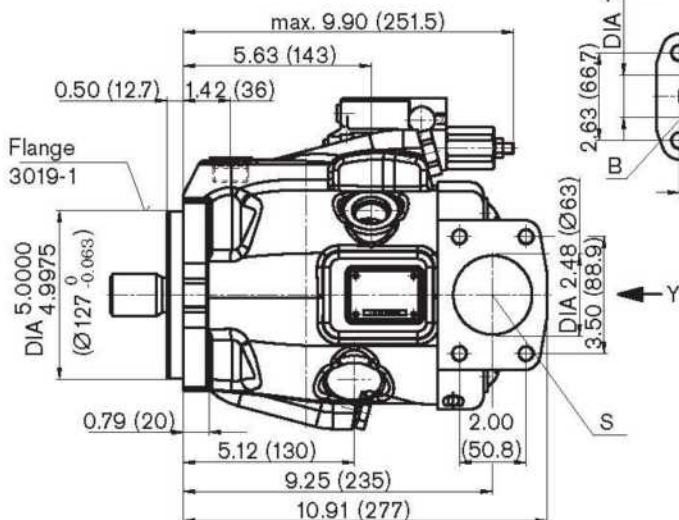
Port plate 61



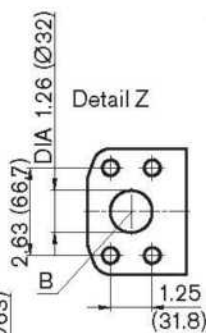
View X



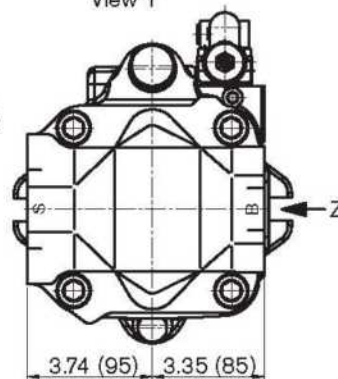
Port plate 62



Detail Z



View Y



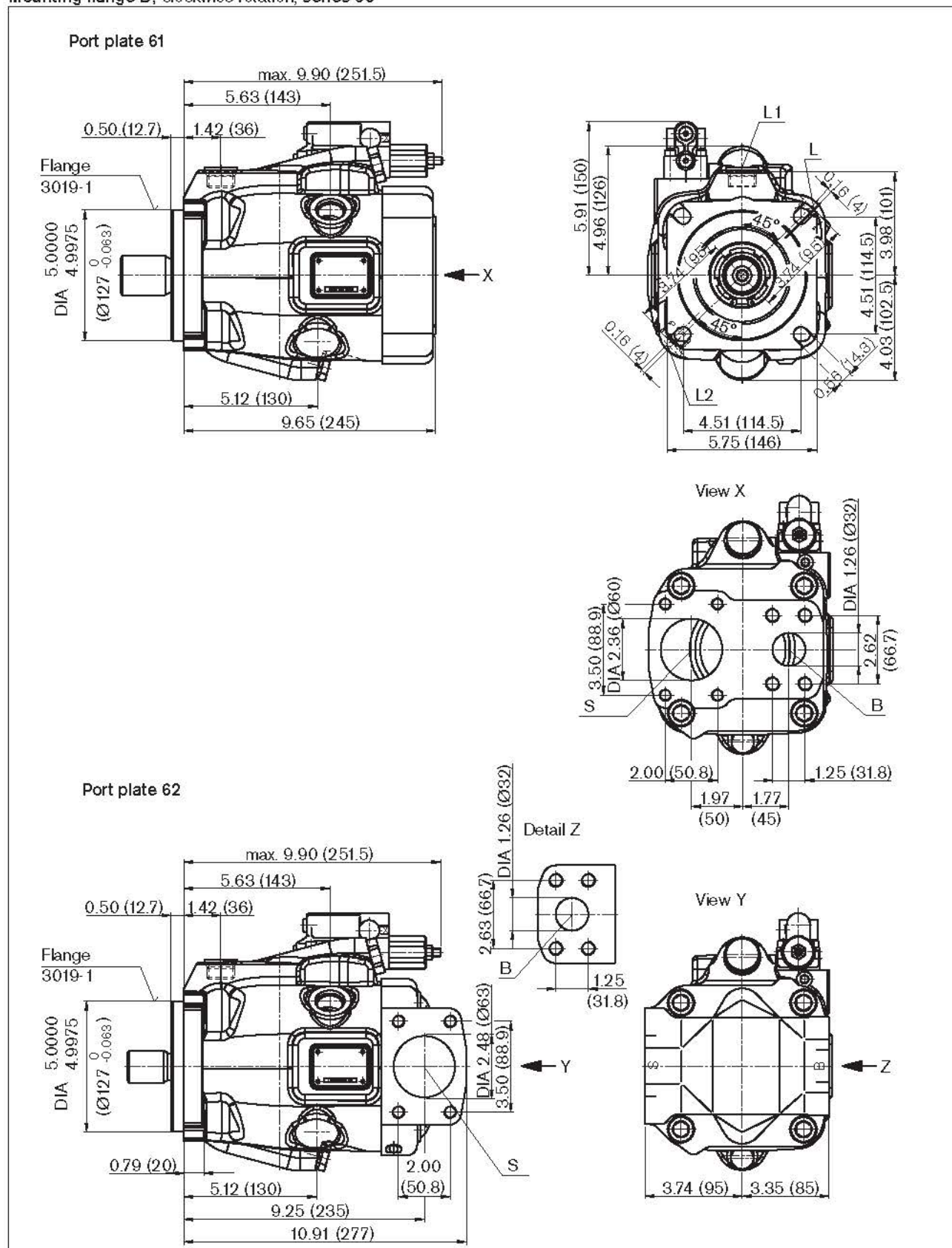
<sup>1)</sup> Dimensions of service line ports turned through 180° for counter-clockwise rotation  
For details of connection options and drive shafts

## Dimensions, size 100<sup>1)</sup>

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

### DR – Hydraulic pressure controller

Mounting flange D, clockwise rotation, series 53



<sup>1)</sup> Dimensions of service line ports turned through 180° for counter-clockwise rotation  
For details of connection options and drive shafts.

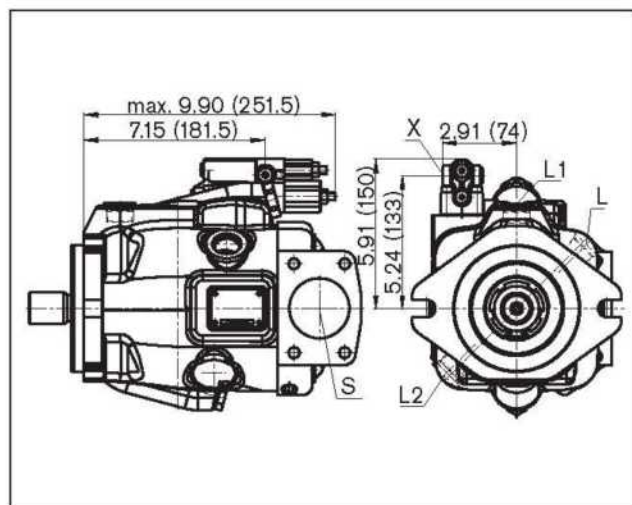


### Dimensions, size 100

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

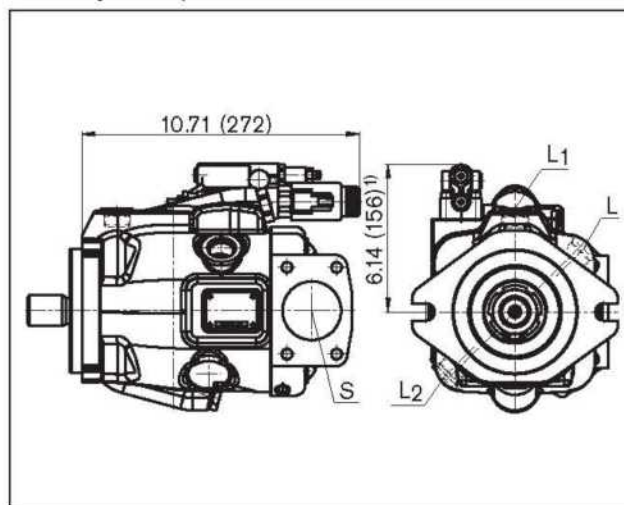
#### DRG

Pressure controller, remote controlled, **series 53**



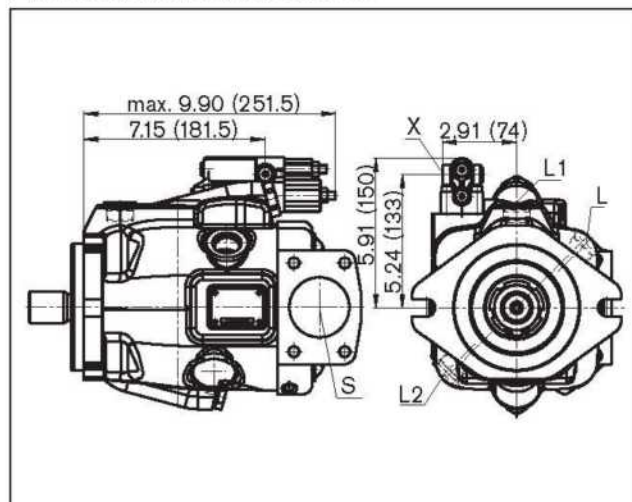
#### ED../ ER..

Electro-hydraulic pressure control, **series 53**



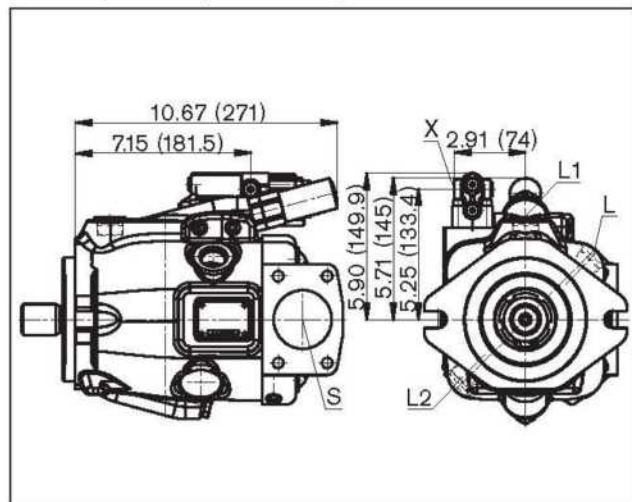
#### DRF/DRS

Pressure and flow control, **series 53**



#### LA.D.

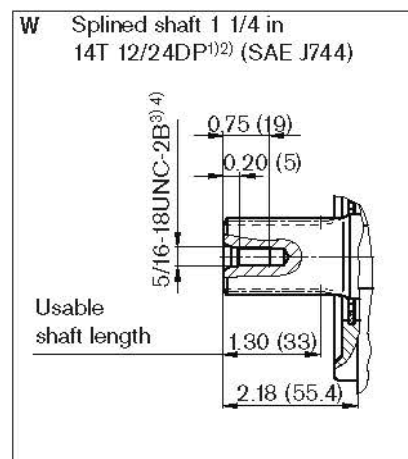
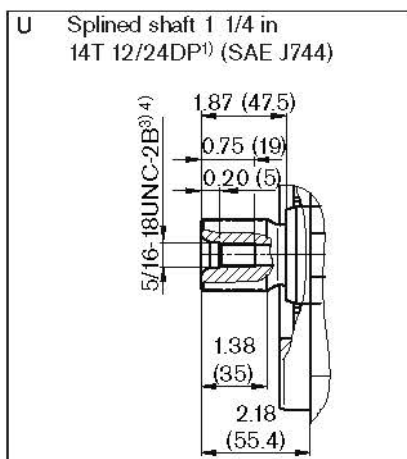
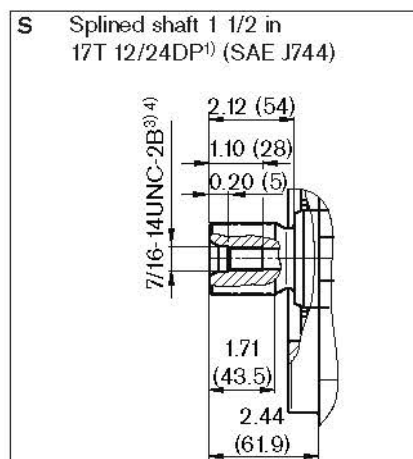
Pressure, flow and power control, **series 53**



<sup>1)</sup> ER7.: 7.52 inches (191 mm) if using an intermediate plate pressure controller.

## Dimensions, size 100

### Drive shaft



### Ports

| Designation                     | Port for                    | Standard                | Size <sup>4)</sup>                       | Maximum pressure [bar] <sup>5)</sup> | State           |
|---------------------------------|-----------------------------|-------------------------|------------------------------------------|--------------------------------------|-----------------|
| B                               | Service line, fixing thread | SAE J518<br>ASME B1.1   | 1 1/4 in<br>1/2-13UNC-2B; 0.75 (19) deep | 4600 (315)                           | O               |
| S                               | Suction line, fixing thread | SAE J518<br>ASME B1.1   | 2 1/2 in<br>1/2-13UNC-2B; 1.07 (27) deep | 75 (5)                               | O               |
| L                               | Case drain fluid            | ISO 11926 <sup>6)</sup> | 1 1/16-12UNF-2B; 0.59 (15) deep          | 30 (2)                               | O <sup>8)</sup> |
| L <sub>1</sub> , L <sub>2</sub> | Case drain fluid            | ISO 11926 <sup>6)</sup> | 1 1/16-12UNF-2B; 0.59 (15) deep          | 30 (2)                               | X <sup>8)</sup> |
| X                               | Control pressure            | ISO 11926 <sup>6)</sup> | 7/16-20UNF-2A; 0.45 (11.5) deep          | 4600 (315)                           | O               |

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

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

3) Thread according to ASME B1.1

4) For the maximum tightening torques the general instructions on FINAL PAGE must be observed.

5) Depending on the application, momentary pressure spikes can occur. Consider this when selecting measuring equipment and fittings.

6) Metric fixing thread is a deviation from standard.

7) The spot face can be deeper than as specified in the standard.

8) Depending on the installation position, L, L<sub>1</sub> or L<sub>2</sub> must be connected

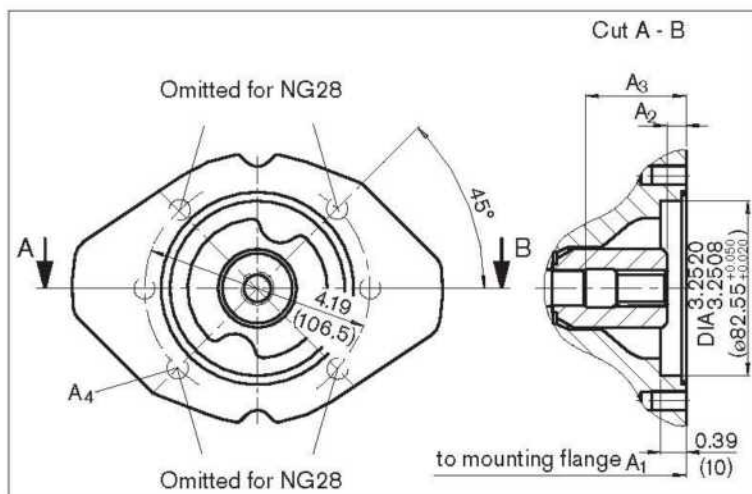
O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

## Dimensions through drive

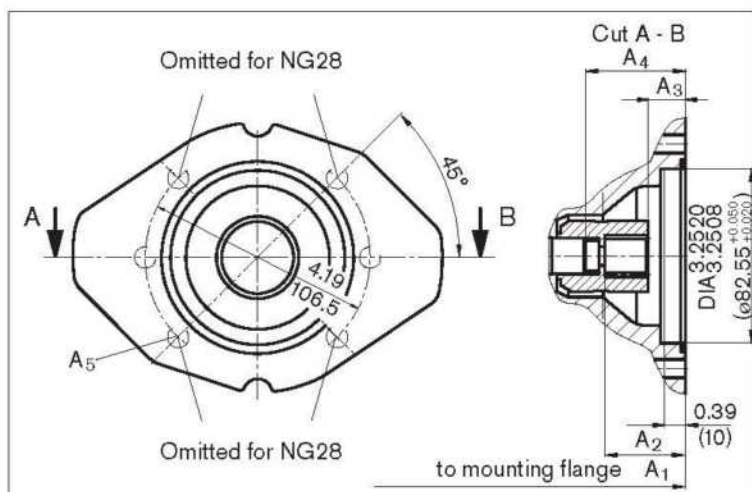
### K01 flange SAE J744 - 82-2 (A)

Coupling for splined shaft in accordance with ANSI B92.1a-1996



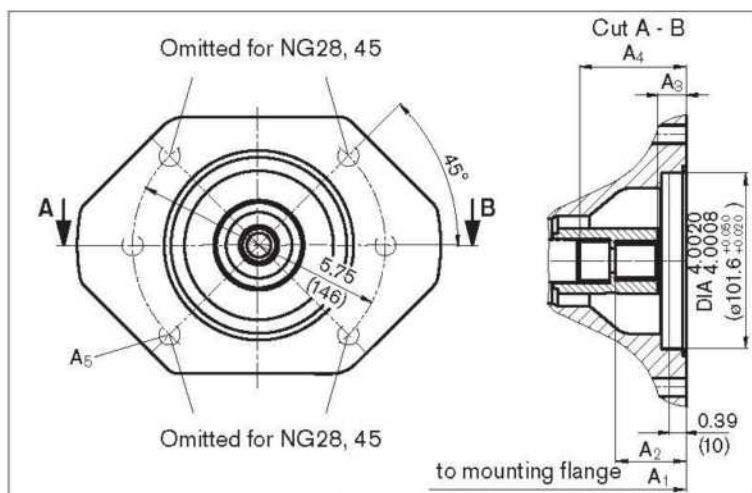
### K52 flange SAE J744 - 82-2 (A)

Coupling for splined shaft in accordance with ANSI B92.1a-1996



### K68 flange SAE J744 - 101-2 (B)

Coupling for splined shaft in accordance with ANSI B92.1a-1996



1) 30° pressure angle, flat base, flank centering, tolerance class 5

2) Thread according to DIN 13, observe the general instructions on FINAL PAGE must be observed.

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

5/8 in 9T 16/32 DP<sup>1)</sup> (SAE J744 - 16-4 (A))

| NG        | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>4</sub> <sup>2)</sup>   |
|-----------|----------------|----------------|----------------|--------------------------------|
| 18        | 7.17<br>(182)  | 0.37<br>(9.3)  | 1.70<br>(43.3) | M10 x 1.5,<br>0.57 (14.5) deep |
| 28        | 8.03<br>(204)  | 0.39<br>(9.9)  | 1.85<br>(47)   | M10 x 1.5,<br>0.63 (16) deep   |
| 45        | 9.02<br>(229)  | 0.42<br>(10.7) | 2.09<br>(53)   | M10 x 1.5,<br>0.63 (16) deep   |
| 60/<br>63 | 10.03<br>(255) | 0.37<br>(9.5)  | 2.32<br>(59)   | M10 x 1.5,<br>0.63 (16) deep   |
| 85        | 11.89<br>(302) | 0.53<br>(13.4) | 2.68<br>(68)   | M10 x 1.5,<br>0.79 (20) deep   |
| 100       | 11.89<br>(302) | 0.53<br>(13.4) | 2.68<br>(68)   | M10 x 1.5,<br>0.79 (20) deep   |

3/4 in 11T 16/32 DP<sup>1)</sup> (SAE J744 - 19-4 (A-B))

| NG        | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>4</sub> | A <sub>5</sub> <sup>2)</sup>   |
|-----------|----------------|----------------|----------------|----------------|--------------------------------|
| 18        | 7.17<br>(182)  |                | 0.37<br>(9.3)  | 1.70<br>(43.3) | M10 x 1.5,<br>0.57 (14.5) deep |
| 28        | 8.03<br>(204)  | 1.54<br>(39.3) | 0.74<br>(18.8) | 1.85<br>(47)   | M10 x 1.5,<br>0.63 (16) deep   |
| 45        | 9.02<br>(229)  | 1.55<br>(39.4) | 0.75<br>(18.9) | 2.09<br>(53)   | M10 x 1.5,<br>0.63 (16) deep   |
| 60/<br>63 | 10.03<br>(255) | 1.55<br>(39.4) | 0.75<br>(18.9) | 2.40<br>(61)   | M10 x 1.5,<br>0.63 (16) deep   |
| 85        | 11.89<br>(302) | 1.74<br>(44.1) | 0.93<br>(23.6) | 2.56<br>(65)   | M10 x 1.5,<br>0.79 (20) deep   |
| 100       | 11.89<br>(302) | 1.74<br>(44.1) | 0.93<br>(23.6) | 2.56<br>(65)   | M10 x 1.5,<br>0.79 (20) deep   |

7/8 in 13T 16/32 DP<sup>1)</sup> (SAE J744 - 22-4 (B))

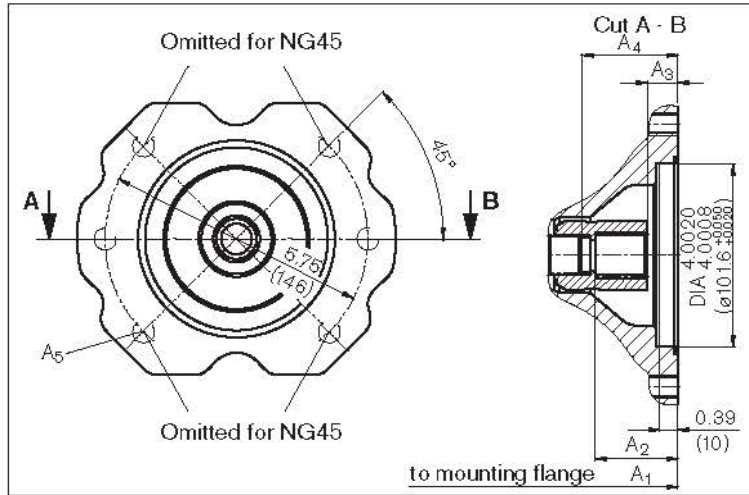
| NG        | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>4</sub> | A <sub>5</sub> <sup>2)</sup>  |
|-----------|----------------|----------------|----------------|----------------|-------------------------------|
| 28        | 8.03<br>(204)  | 1.66<br>(42.3) | 0.70<br>(17.8) | 1.85<br>(47)   | M12 x 1.75,<br>0.71 (18) deep |
| 45        | 9.02<br>(229)  | 1.67<br>(42.4) | 0.71<br>(17.9) | 2.09<br>(53)   | M12 x 1.75,<br>0.71 (18) deep |
| 60/<br>63 | 10.03<br>(255) | 1.67<br>(42.4) | 0.71<br>(17.9) | 2.32<br>(59)   | M12 x 1.75,<br>0.71 (18) deep |
| 85        | 11.89<br>(302) | 1.83<br>(46.5) | 0.87<br>(22)   | 2.72<br>(69)   | M12 x 1.75,<br>0.79 (20) deep |
| 100       | 11.89<br>(302) | 1.83<br>(46.5) | 0.87<br>(22)   | 2.72<br>(69)   | M12 x 1.75,<br>0.79 (20) deep |



## Dimensions through drive

**K04 flange SAE J744 - 101-2 (B)**

Coupling for splined shaft in accordance with ANSI B92.1a-1996



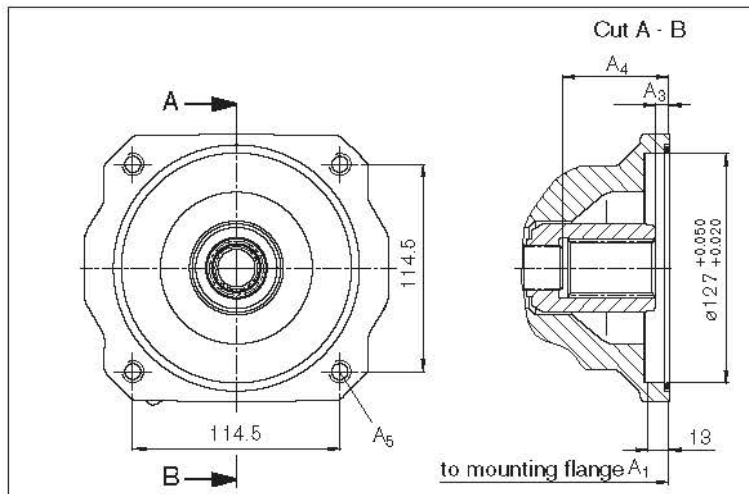
1 in 15T 16/32 DP<sup>1)</sup>

(SAE J744 - 25-4 (B-B))

| NG        | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>4</sub> | A <sub>5</sub> <sup>2)</sup>  |
|-----------|----------------|----------------|----------------|----------------|-------------------------------|
| 45        | 9.02<br>(229)  | 1.88<br>(47.9) | 0.74<br>(18.9) | 2.10<br>(53.4) | M12 x 1.75,<br>0.71 (18) deep |
| 60/<br>63 | 10.03<br>(255) | 1.87<br>(47.4) | 0.72<br>(18.4) | 2.32<br>(58.9) | M12 x 1.75,<br>0.71 (18) deep |
| 85        | 11.89<br>(302) | 2.01<br>(51.2) | 0.87<br>(22.2) | 2.72<br>(69)   | M12 x 1.75,<br>0.79 (20) deep |
| 100       | 11.89<br>(302) | 2.01<br>(51.2) | 0.87<br>(22.2) | 2.72<br>(69)   | M12 x 1.75,<br>0.79 (20) deep |

**K15 flange SAE J744 - 127-4 (C)**

Coupling for splined shaft in accordance with ANSI B92.1a-1996



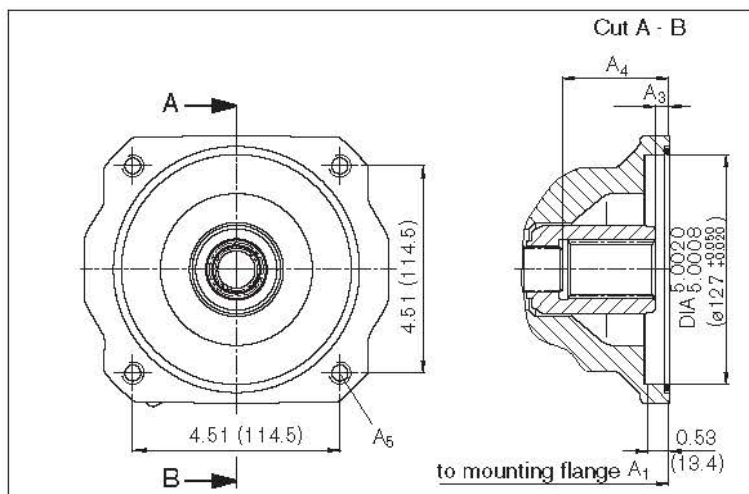
1 1/4 in 14T 12/24 DP<sup>1)</sup>

(SAE J744 - 32-4 (C))

| NG        | A <sub>1</sub>   | A <sub>2</sub> | A <sub>3</sub> | A <sub>4</sub> <sup>2)</sup>  |
|-----------|------------------|----------------|----------------|-------------------------------|
| 60/<br>63 | 10.03<br>(255)   | 0.31<br>(8)    | 2.32<br>(59)   | M12 x 1.75,<br>0.63 (16) deep |
| 85        | 11.87<br>(301.5) | 0.51<br>(13)   | 2.67<br>(67.9) | M12 x 1.75,<br>through        |
| 100       | 11.87<br>(301.5) | 0.51<br>(13)   | 2.67<br>(67.9) | M12 x 1.75,<br>through        |

**K16 flange SAE J744 - 127-4 (C)**

Coupling for splined shaft in accordance with ANSI B92.1a-1996



1 1/2 in 17T 12/24 DP<sup>1)</sup>

(SAE J744 - 32-4 (C))

| NG  | A <sub>1</sub>   | A <sub>2</sub> | A <sub>3</sub> | A <sub>4</sub> <sup>2)</sup> |
|-----|------------------|----------------|----------------|------------------------------|
| 85  | 11.87<br>(301.5) | 0.51<br>(13)   | 2.67<br>(67.9) | M12 x 1.75,<br>through       |
| 100 | 11.87<br>(301.5) | 0.51<br>(13)   | 2.67<br>(67.9) | M12 x 1.75,<br>through       |

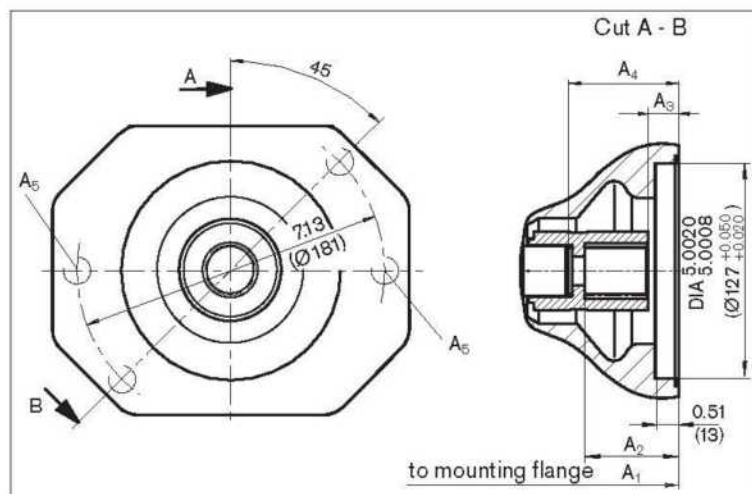
1) 30° pressure angle, flat base, flank centering, tolerance class 5

2) Thread according to DIN 13, observe the general instructions on FINAL PAGE must be observed.

## Dimensions through drive

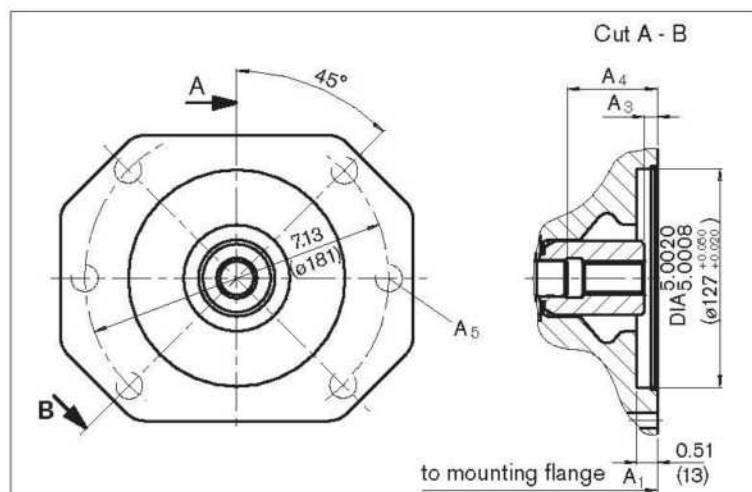
### K07 flange SAE J744 - 127-2 (C)

Coupling for splined shaft in accordance with ANSI B92.1a-1996



### K24 flange SAE J744 - 127-2 (C)

Coupling for splined shaft in accordance with ANSI B92.1a-1996



Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

1 1/4 in 14T 12/24 DP<sup>1)</sup> (SAE J744 - 32-4 (C))

| NG  | A <sub>1</sub>   | A <sub>2</sub> | A <sub>3</sub> | A <sub>4</sub> <sup>2)</sup> |
|-----|------------------|----------------|----------------|------------------------------|
| 85  | 11.87<br>(301.5) | 0.51<br>(13)   | 2.67<br>(67.9) | M12 x 1.75,<br>through       |
| 100 | 11.87<br>(301.5) | 0.51<br>(13)   | 2.67<br>(67.9) | M12 x 1.75,<br>through       |

1 1/2 in 17T 12/24 DP<sup>1)</sup> (SAE J744 - 38-4 (C-C))

| NG  | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | A <sub>4</sub> <sup>2)</sup> |
|-----|----------------|----------------|----------------|------------------------------|
| 85  | 11.89<br>(302) | 0.31<br>(8)    | 2.68<br>(68)   | M16 x 2,<br>0.94 (24) deep   |
| 100 | 11.89<br>(302) | 0.31<br>(8)    | 2.68<br>(68)   | M16 x 2,<br>0.94 (24) deep   |

1) 30° pressure angle, flat base, flank centering, tolerance class 5

2) Thread according to DIN 13, observe the general instructions on FINAL PAGE must be observed.



## Summary mounting options

| Through-drive <sup>1)</sup> |                            |            | Mounting option – 2nd pump               |                        |                       | Through drive available for NG |
|-----------------------------|----------------------------|------------|------------------------------------------|------------------------|-----------------------|--------------------------------|
| Flange                      | Coupling for splined shaft | Short des. | PA10V(S)O/5x NG (shaft)                  | PA10VO/31 NG (shaft)   | Gear pump design (NG) |                                |
| 82-2 (A)                    | 5/8 in                     | K01        | 10 (U)                                   | 18 (U)                 | F (5 to 22)           | 18 to 100                      |
|                             | 3/4 in                     | K52        | 10 (S)<br>18 (U)<br>18 (S, R)            | 18 (S, R)              | –                     | 18 to 100                      |
| 101-2 (B)                   | 7/8 in                     | K68        | 28 (S, R)<br>45 (U, W) <sup>1)</sup>     | 28 (S, R)<br>45 (U, W) | N/G (26 to 49)        | 28 to 100                      |
|                             | 1 in                       | K04        | 45 (S, R)<br>60, 63 (U, W) <sup>2)</sup> | 45 (S, R)<br>–         | –                     | 45 to 100                      |
| 127-4 (C)                   | 1 1/4 in                   | K15        | 60, 63 (S, R)                            | –                      | –                     | 63 to 100                      |
|                             | 1 1/2 in                   | K16        | 85 (S)<br>100 (S)                        | –                      | –                     | 85 to 100                      |
| 127-2 (C)                   | 1 1/4 in                   | K07        | 85 (U, W)<br>100 (U, W)                  | 71 (S, R)              | –                     | 85 to 100                      |
|                             | 1 1/2 in                   | K24        | 85 (S)<br>100 (S)                        | –                      | –                     | 85 to 100                      |

<sup>1)</sup> Not for NG28 with K68

<sup>2)</sup> Not for NG28 with K04



### Combination pumps PA10VO + PA10VO

Before finalizing your design request a certified installation drawing.  
Dimensions in inches and (mm).

When using combination pumps it is possible to have multiple, mutually independent circuits without the need for a splitter gearbox.

When ordering combination pumps the model codes for the first and the second pump must be joined by a "+".

Order example:

PA10VO85DRS/53R-VSC12K04+

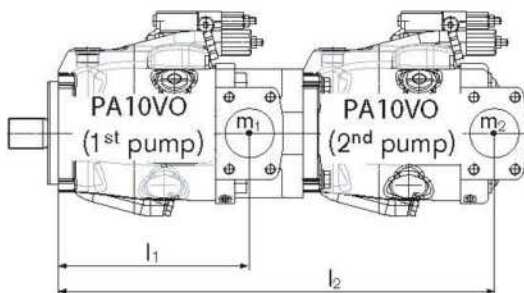
PA10VO45DRF/53R-VSC11N00

The tandem pump comprising two identical sizes is permissible without additional supports taking into account a maximum dynamic mass acceleration of 10 g (= 98.1 m/s<sup>2</sup>).

For combination pumps comprising more than two pumps, the mounting flange must be calculated for the permissible moment of inertia.

#### Permissible moment of inertia

| NG                                                     |       |       | 10  | 18     | 28    | 45    | 60/63  | 85     | 100    |
|--------------------------------------------------------|-------|-------|-----|--------|-------|-------|--------|--------|--------|
| Permissible moment of inertia                          |       |       |     |        |       |       |        |        |        |
| static                                                 | $T_m$ | lb-ft | –   | –      | 656   | 664   | 1010   | 2270   | 2270   |
|                                                        |       | (Nm)  | –   | –      | (890) | (900) | (1370) | (3080) | (3080) |
| dynamic at 10 g (98.1 m/s <sup>2</sup> )               | T     | lb-ft | –   | –      | 65    | 66    | 101    | 227    | 227    |
|                                                        |       | (Nm)  | –   | –      | (89)  | (90)  | (137)  | (308)  | (308)  |
| Mass with through-drive plate                          | $m_1$ | lbs   | –   | –      | 37.5  | 53    | 62     | 99     | 99     |
|                                                        |       | (kg)  | –   | –      | (17)  | (24)  | (28)   | (45)   | (45)   |
| Mass without through drive (e.g. 2 <sup>nd</sup> pump) | m     | lbs   | 18  | 25     | 31    | 40    | 48.5   | 75     | 75     |
|                                                        |       | (kg)  | (8) | (11.5) | (14)  | (18)  | (22)   | (34)   | (34)   |
| Distance center of gravity                             | $l_1$ | in    | –   | 3.23   | 3.19  | 3.74  | 3.94   | 4.80   | 4.80   |
|                                                        |       | (mm)  | –   | (82)   | (81)  | (95)  | (100)  | (122)  | (122)  |



$m_1, m_2, m_3$  Mass of pumps [lbs (kg)]

$l_1, l_2, l_3$  Distance center of gravity [in (mm)]

$$T_m = (m_1 \cdot l_1 + m_2 \cdot l_2 + m_3 \cdot l_3) \cdot \frac{1}{12 \text{ (102)}} \text{ [lb-ft (Nm)]}$$

## 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 empty via the hydraulic lines.

Especially with the installation position "drive shaft upwards" or "drive shaft downward", attention must be paid to a complete filling and air bleeding since there is a risk, for example, of dry running.

The case drain fluid in the case interior must be directed to the reservoir via the highest case drain port ( $L_1$ ,  $L_2$ ,  $L_3$ ).

For combinations of multiple units, make sure that the respective case pressure in each unit is not exceeded. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate drain lines must be laid 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 line and case drain line must flow into the reservoir below the minimum fluid level. The permissible suction height  $h_s$  is a result of the overall pressure loss, but may not be greater than  $h_{s\ max} = 31.50\ in\ (800\ mm)$ . The minimum suction pressure at port S must also not fall below 12 psi (0.8 bar) absolute during operation.

### Installation position

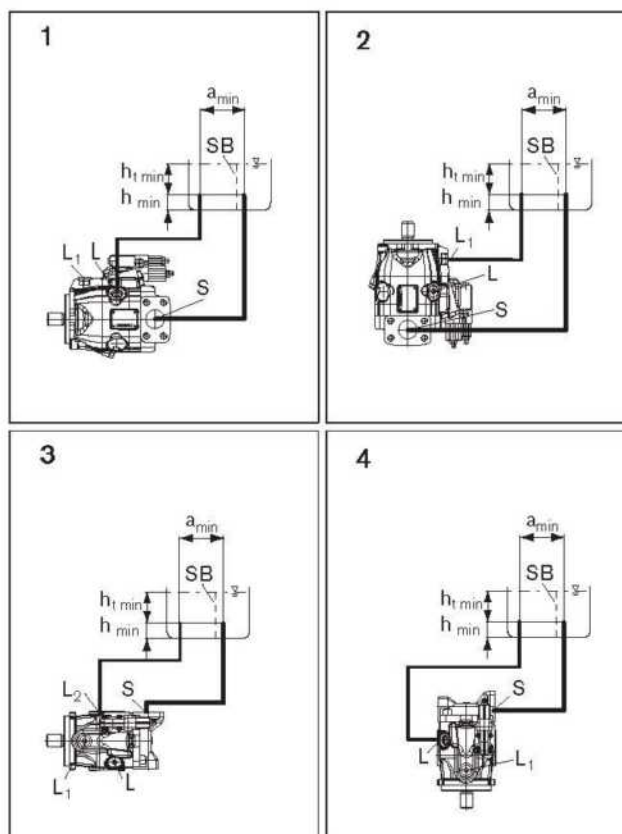
See the following examples 1 to 12.

Additional installation positions are available upon request.

Recommended installation positions: 1 and 3.

### Below-reservoir installation (standard)

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



| Installation position | Air bleed | Filling   |
|-----------------------|-----------|-----------|
| 1                     | L         | S + L     |
| 2                     | $L_1$     | S + $L_1$ |
| 3 <sup>1)</sup>       | $L_2$     | S + $L_2$ |
| 4                     | L         | S + L     |

<sup>1)</sup> Only series 53

## Installation instructions

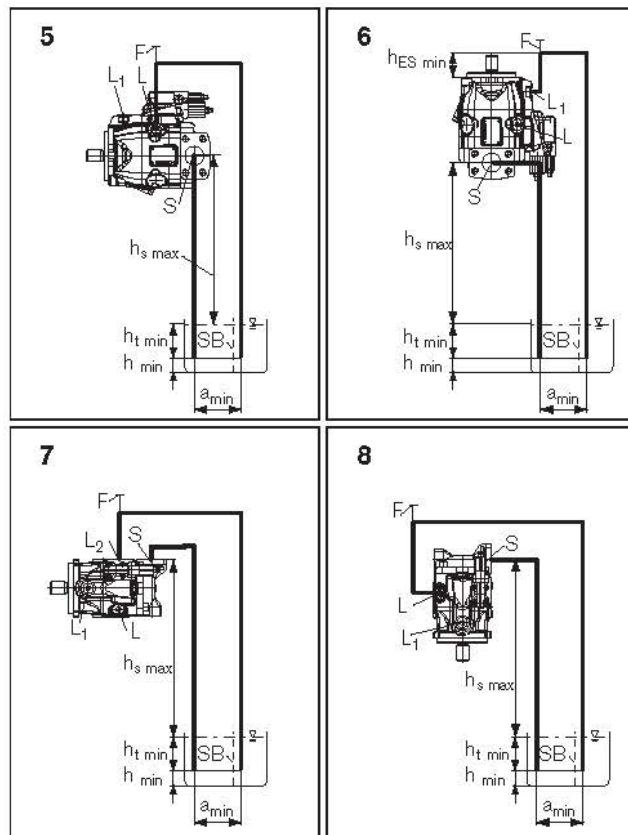
### Above-reservoir installation

Above-reservoir installation means the axial piston unit is installed above the minimum fluid level of the reservoir.

To prevent the axial piston unit from draining, a height difference  $h_{ES \min}$  of at least 0.98 in (25 mm) is required in installation position 6.

Observe the maximum permissible suction height  
 $h_{S \max} = 31.50$  in (800 mm).

A check valve in the case drain line is only permissible in individual cases. Consult us for approval.



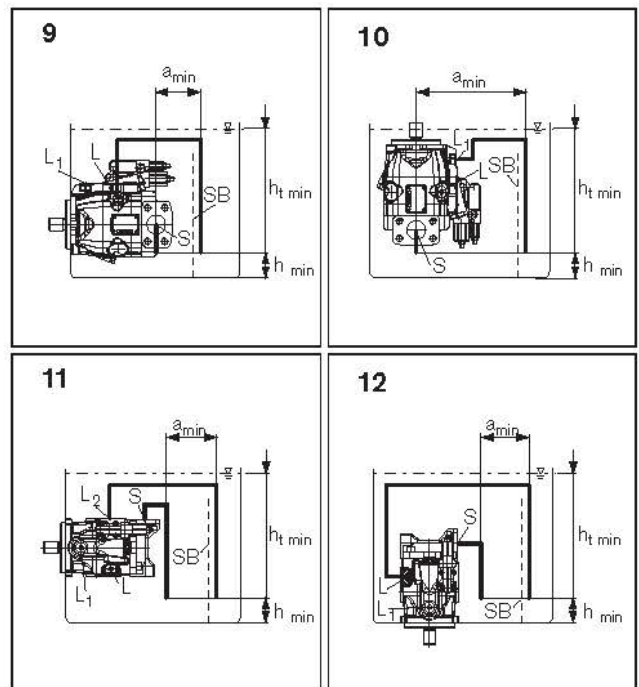
| Installation position | Air bleed | Filling                |
|-----------------------|-----------|------------------------|
| 5                     | F         | L, L <sub>1</sub> (F)  |
| 6                     | F         | L <sub>1</sub> (F)     |
| 7 <sup>1)</sup>       | F         | S + L <sub>2</sub> (F) |
| 8                     | F         | S + L (F)              |

1) Only series 53

### Inside-reservoir installation

Inside-reservoir installation means the pump is installed within the minimum reservoir fluid level.

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           |
|-----------------------|----------------|-------------------|
| 9                     | L <sub>1</sub> | L, L <sub>1</sub> |
| 10                    | L <sub>1</sub> | L, L <sub>1</sub> |
| 11 <sup>1)</sup>      | L <sub>2</sub> | S                 |
| 12                    | L              | S + L             |

- S** Suction port
- F** Filling / air bleeding
- L, L<sub>1</sub>** Case drain port
- SB** Baffle (baffle plate)
- $h_{t \min}$**  Minimum necessary immersion depth (7.87 in (200 mm))
- $h_{\min}$**  Minimum necessary spacing to reservoir base (3.94 in (100 mm))
- $h_{ES \min}$**  Minimum necessary height needed to protect the axial piston unit from draining (0.98 in (25 mm)).
- $h_{S \max}$**  Maximum permissible suction height (21.50 in (800 mm))
- $a_{\min}$**  When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.



### General instructions

- The PA10VO pump is designed to be used in open circuit.
- Project planning, installation and commissioning of the axial piston unit require the involvement of qualified personnel.
- Before operating the axial piston unit, please read the appropriate instruction manual thoroughly and completely. If necessary, request these from YEOSHE.
- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristics may shift.
- Service line ports:
  - The ports and fixing 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 service line ports and function ports are only designed to accommodate hydraulic lines.
  - Pressure cut-off and pressure control do not provide security against pressure overload. A separate pressure relief valve is to be provided in the hydraulic system.
  - The data and notes contained herein must be adhered to.
  - The product is not approved as a component for the safety concept of a general machine according to DIN EN ISO 13849.
  - The following tightening torques apply:
    - Fittings: Observe the manufacturer's instruction regarding the tightening torques of the used fittings.
    - Fixing screws: For fixing screws with metric ISO thread according to DIN 13 or thread according to ASME B1.1, we recommend checking the tightening torque individually according to VDI 2230.
    - Female threads in axial piston unit: The maximum permissible tightening torques  $M_{G \max}$  are maximum values for the female threads and must not be exceeded. For values, see the following table.
    - Threaded plugs: For the metal threaded plugs supplied with the axial piston unit, the required tightening torques of the threaded plugs  $M_W$  apply. For values, see the following table.

| Ports     |                | Maximum permissible tightening torque for female threads $M_{G \max}$ | Required tightening torque for threaded plugs $M_W$ | Size of hexagon socket of threaded plugs |
|-----------|----------------|-----------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------|
| Standard  | Thread size    |                                                                       |                                                     |                                          |
| ISO 11926 | 7/16-20UNF-2B  | 40 Nm                                                                 | 18 Nm                                               | 3/16 in                                  |
|           | 9/16-18UNF-2B  | 80 Nm                                                                 | 35 Nm                                               | 1/4 in                                   |
|           | 3/4-16UNF-2B   | 160 Nm                                                                | 70 Nm                                               | 5/16 in                                  |
|           | 7/8-14UNF-2B   | 240 Nm                                                                | 110 Nm                                              | 3/8 in                                   |
|           | 1 1/16-12UN-2B | 360 Nm                                                                | 170 Nm                                              | 9/16 in                                  |

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