Axial Piston Variable Pump AA11VO

Data sheet

Series 1
Size NG40 to 260
Nominal pressure 5100 psi (350 bar)
Maximum pressure 5800 psi (400 bar)
Open circuit

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Features
- Variable axial piston pump of swashplate design for hydrostatic drives in open circuit hydraulic system.
- Designed primarily for use in mobile applications.
- The pump operates under self-priming conditions, with tank pressurization, or with an optional built-in charge pump (impeller).
- A comprehensive range of control options is available matching any application requirement.
- Power control option is externally adjustable, even when the pump is running.
- The through drive is suitable for adding gear pumps and axial piston pumps up to the same size, i.e. 100% through drive.
- The output flow is proportional to the drive speed and infinitely variable between \(q_{V_{\text{max}}} \) and \(q_{V_{\text{min}}} = 0\).
## Ordering code for standard program

<table>
<thead>
<tr>
<th>AA11V</th>
<th>O</th>
<th>01</th>
<th>02</th>
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### Axial piston unit
- **01** Swashplate design, variable, nominal pressure 5100 psi (350 bar), maximum pressure 5800 psi (400 bar)

### Charge pump (impeller)
- **02**
  - without charge pump (no code)
  - with charge pump

### Operation
- **03** Pump, open circuit

### Size
- **04**
  - ≈ Displacement \( V_g \text{ max} \)

<table>
<thead>
<tr>
<th>cm³/rev.</th>
<th>40</th>
<th>60</th>
<th>75</th>
<th>95</th>
<th>130</th>
<th>145</th>
<th>190</th>
<th>260</th>
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<tbody>
<tr>
<td>42 58.5</td>
<td>74</td>
<td>93.5</td>
<td>130</td>
<td>145</td>
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<td>260</td>
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<table>
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<th>in³/rev.</th>
<th>2.56</th>
<th>3.57</th>
<th>4.52</th>
<th>5.71</th>
<th>7.93</th>
<th>8.84</th>
<th>11.78</th>
<th>15.87</th>
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### Control unit
- **05**

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<thead>
<tr>
<th>Power control</th>
<th>LR</th>
<th>LR.C</th>
<th>LG1</th>
<th>LG2</th>
<th>LG3</th>
<th>LE1</th>
<th>LE2</th>
<th>L.D..</th>
<th>L.E..</th>
<th>L..G.</th>
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<tbody>
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<tr>
<td>cross sensing</td>
<td>negative</td>
<td>LR</td>
<td>C</td>
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<td>high-pressure related</td>
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<td>LR3</td>
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<td>pilot-pressure related</td>
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<td>LG1</td>
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<tr>
<td>pilot-pressure related</td>
<td>positive</td>
<td>LG2</td>
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<tr>
<td>electric</td>
<td>U = 12 V</td>
<td>negative</td>
<td>LE1</td>
<td></td>
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<tr>
<td>electric</td>
<td>U = 24 V</td>
<td>positive</td>
<td>LE2</td>
<td></td>
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<tr>
<td>with pressure cut-off</td>
<td>D</td>
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<tr>
<td>with load sensing</td>
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<tr>
<td>with stroke limiter</td>
<td>negative</td>
<td>characteristic</td>
<td>( \Delta p = 365 \text{ psi} ) (25 bar)</td>
<td>H1</td>
<td></td>
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<tr>
<td>with stroke limiter</td>
<td>characteristic</td>
<td>( \Delta p = 145 \text{ psi} ) (10 bar)</td>
<td>H5</td>
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<tr>
<td>with stroke limiter</td>
<td>( \Delta p = 365 \text{ psi} ) (25 bar)</td>
<td>H2</td>
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<tr>
<td>with stroke limiter</td>
<td>( \Delta p = 145 \text{ psi} ) (10 bar)</td>
<td>H6</td>
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<td></td>
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<tr>
<td>U = 12 V</td>
<td>U1</td>
<td></td>
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<tr>
<td>U = 24 V</td>
<td>U2</td>
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<table>
<thead>
<tr>
<th>Pressure control</th>
<th>DR</th>
<th>DR.S</th>
<th>DRG</th>
<th>DRL</th>
<th>HD1</th>
<th>HD2</th>
<th>HD.D</th>
<th>HD.G</th>
</tr>
</thead>
<tbody>
<tr>
<td>with load sensing</td>
<td>DRS</td>
<td></td>
<td></td>
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<td>remote controlled</td>
<td>DRG</td>
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<tr>
<td>for parallel operation</td>
<td>DRL</td>
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<table>
<thead>
<tr>
<th>Hydraulic control</th>
<th>HD1</th>
<th>HD2</th>
<th>HD.D</th>
<th>HD.G</th>
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</thead>
<tbody>
<tr>
<td>pilot-pressure related</td>
<td>( \Delta p = 145 \text{ psi} ) (10 bar)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(positive characteristic)</td>
<td>( \Delta p = 365 \text{ psi} ) (25 bar)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>with pressure cut-off</td>
<td>D</td>
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<tr>
<td>with pressure cut-off, remote controlled</td>
<td>G</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Electric control</th>
<th>EP1</th>
<th>EP2</th>
<th>EP.D</th>
<th>EP.G</th>
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<tbody>
<tr>
<td>with proportional solenoid</td>
<td>U = 12 V</td>
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<td></td>
</tr>
<tr>
<td>(positive characteristic)</td>
<td>U = 24 V</td>
<td></td>
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<tr>
<td>with pressure cut-off</td>
<td>D</td>
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<tr>
<td>with pressure cut-off, remote control</td>
<td>G</td>
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</tbody>
</table>

In case of controls with several additional functions, observe the order of the columns, only one option per column is possible (e.g. LRDCH2). The following combinations are not available for the power control: LRDS2, LRDS5, L...GS, L...GS2, L...GS5, L...EC and the combination L...DG in conjunction with the stroke limiters H1, H2, H5, H6, U1 and U2.

- ● = available
- ○ = on request
- – = not available
## Ordering code for standard program

<table>
<thead>
<tr>
<th>AA11V</th>
<th>O</th>
<th>/</th>
<th>1</th>
<th>–</th>
<th>N</th>
<th>06</th>
<th>07</th>
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### Series

| 06 | 1 |

### Index

<table>
<thead>
<tr>
<th>07</th>
<th>Size 40 to 130</th>
<th>0</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Size 145 to 260</td>
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</table>

### Direction of rotation

<table>
<thead>
<tr>
<th>08</th>
<th>Viewed from drive shaft</th>
<th>clockwise</th>
<th>R</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>counter-clockwise</td>
<td>L</td>
</tr>
</tbody>
</table>

### Seals

| 09 | NBR (nitrile-caoutchouc), shaft seal ring in FKM (fluor-caoutchouc) | N |

### Drive shaft (see page 8 for permissible input and through drive torques)

<table>
<thead>
<tr>
<th>40</th>
<th>60</th>
<th>75</th>
<th>95</th>
<th>130</th>
<th>145</th>
<th>190</th>
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</table>

- Parallel keyed shaft DIN 6885
- Splined shaft ANSI B92.1a–1976

### Mounting flange

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<th>40</th>
<th>60</th>
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</table>

- SAE J744 – 2-hole
- SAE J744 – 4-hole
- SAE J617² (SAE 3)

### Service line ports

<table>
<thead>
<tr>
<th>40</th>
<th>60</th>
<th>75</th>
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<th>130</th>
<th>145</th>
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- Pressure and suction port SAE, at side, opposite side (with UNC fastening threads)

### Through drive (see page 58 for attachments)

<table>
<thead>
<tr>
<th>40</th>
<th>60</th>
<th>75</th>
<th>95</th>
<th>130</th>
<th>145</th>
<th>190</th>
<th>260</th>
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</table>

- Flange SAE J744³ |
- Coupler for splined shaft

1) S-shaft suitable for combination pump!
2) To fit the flywheel case of the combustion engine
3) 2 △ 2-hole; 4 △ 4-hole
4) Size 190 and 260 with 2 + 4-hole flange

○ = available  ○ = on request  – = not available
## Ordering code for standard program

<table>
<thead>
<tr>
<th>AA11V</th>
<th>O</th>
<th>/</th>
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<th>14</th>
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<th>16</th>
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</table>

### Swivel angle indicator (page 63)

- **without swivel angle indicator (no symbol)**
- **with optical swivel angle indicator**
- **with electric swivel angle sensor**

### Connector for solenoids (page 64)

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

### Standard / special version

- **Standard version**
  - without symbol
  - combined with attachment part or attachment pump
- **Special version**
  - combined with attachment part or attachment pump

---

● = available  ○ = on request  – = not available
Technical data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids) and RE 90223 (HF hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and operating conditions.

The variable pump AA11VO is not suitable for operating with HFA, HFB and HFC. If HFD or environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and seals mentioned in RE 90221 and RE 90223 must be observed.

When ordering, indicate the hydraulic fluid that is to be used.

Operating viscosity range

For optimum efficiency and service life, select an operating viscosity (at operating temperature) within the optimum range of

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

depending on the tank temperature (open circuit).

Limits of viscosity range

The limiting values for viscosity are as follows:

\[ \nu_{\text{min}} = 42 \text{ SUS (5 mm}^2\text{/s)} \]

- Short-term (t < 3 min)
  - At max. perm. temperature of \( t_{\text{max}} = 240 \text{ °F (+115 °C)} \).

\[ \nu_{\text{max}} = 7400 \text{ SUS (1600 mm}^2\text{/s)} \]

- Short-term (t < 3 min)
  - At cold start (p \( \leq \) 435 psi (30 bar), n \( \leq \) 1000 rpm, \( t_{\text{min}} = -40 \text{ °F (-40 °C)} \)).
  - Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Note that the maximum hydraulic fluid temperature of 240 °F (115 °C) must not be exceeded locally either (e.g. in the bearing area). The temperature in the bearing area is – depending on pressure and speed – up to 9°F (5 K) higher than the average case drain temperature.

Special measures are necessary in the temperature range from -40 °F (-40 °C) and -13 °F (-25 °C) (cold start phase), please contact us.

For detailed information about use at low temperatures, see RE 90300-03-B.

Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in an open circuit the tank temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range \((\nu_{\text{opt}})\) – see the shaded area of the selection diagram. We recommended that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X °C an operating temperature of 140 °F (60 °C) is set. In the optimum operating viscosity range \((\nu_{\text{opt}})\) this corresponds to the viscosity classes VG 46 and VG 68; to be selected: VG 68.

Note

The case drain temperature, which is affected by pressure and speed, is always higher than the tank temperature. At no point in the system may the temperature be higher than 240 °F (115°C).

If the above conditions cannot be maintained due to extreme operating parameters, please contact us.

Filtration

The finer the filtration, the higher the cleanliness level of the hydraulic fluid and the longer the service life of the axial piston unit.

To ensure functional reliability of the axial piston unit, the hydraulic fluid must have a cleanliness level of at least 20/18/15 according to ISO 4406.

At very high hydraulic fluid temperatures (195 °F (90 °C) to maximum 240 °F (115 °C), at least cleanliness level 19/17/14 according to ISO 4406 is required.

If the above classes cannot be observed, please contact us.
Technical data

Operating pressure range

Inlet
Absolute pressure at port S (suction port)
Version without charge pump

\[ p_{\text{abs min}} = 12 \text{ psi (0.8 bar)} \]
\[ p_{\text{abs max}} = 435 \text{ psi (30 bar)} \]

If the pressure is > 75 psi (5 bar), please ask.

Version with charge pump

\[ p_{\text{abs min}} = 9 \text{ psi (0.6 bar)} \]
\[ p_{\text{abs max}} = 30 \text{ psi (2 bar)} \]

Maximum permissible speed (speed limit)
Permissible speed by increasing the inlet pressure \( p_{\text{abs}} \) at the suction port S or at \( V_g \leq V_{g \text{ max}} \)

\[
\begin{array}{c|c|c}
\text{Speed } n_{\text{max}}/n_{\text{max}1} & \text{Displacement } V_g / V_{g \text{ max}} & \text{Graph}
\end{array}
\]

Outlet
Pressure at port A or B
Nominal pressure \( p_N \) ______________ 5100 psi (350 bar)
Maximum pressure \( p_{\text{max}} \) ______________ 5800 psi (400 bar)

Nominal pressure: Maximum design pressure at which fatigue strength is ensured.
Maximum pressure: Maximum operating pressure which is permissible for short-term (t < 1s).

Minimum operating pressure
A minimum operating pressure \( p_{\text{b min}} \) is required in the pump service line depending on the speed, the swivel angle and the displacement (see diagram).

Case drain pressure
The case drain pressure at the ports \( T_1 \) and \( T_2 \) may be a maximum of 17.5 psi (1.2 bar) higher than the inlet pressure at the port S but not higher than

\[ p_{\text{abs max}} = 30 \text{ psi (2 bar)} \]

An unrestricted, full size case drain line directly to tank is required.

Temperature range of the shaft seal ring
The FKM shaft seal ring is permissible for case drain temperatures of -13 °F to 240 °F (-25 °C to +115 °C).

Note
For applications below -13 °F (-25 °C), an NBR shaft seal ring is necessary (permissible temperature range: -40 °F to 194 °F (-40 °C to +90 °C).
State NBR shaft seal ring in clear text in the order.

Flushing the case
If a variable pump with control unit EP, HD, DR or stroke limiter (H., U.) is operated over a long period (t > 10 min) with flow zero or operating pressure < 220 psi (15 bar), flushing of the case via ports “T1”, “T2” or “R” is necessary.

<table>
<thead>
<tr>
<th>Size</th>
<th>40</th>
<th>60</th>
<th>75</th>
<th>95</th>
<th>130</th>
<th>145</th>
<th>190</th>
<th>260</th>
</tr>
</thead>
<tbody>
<tr>
<td>qV flush gpm</td>
<td>0.5</td>
<td>0.8</td>
<td>0.8</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.3</td>
<td>1.6</td>
</tr>
<tr>
<td>(l/min)</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Flushing the case is unnecessary in versions with charge pump (AA11VLO), since a part of the charge flow is directed to the case.

Charge pump (impeller)
The charge pump is a circulating pump with which the AA11VLO (size 130 to 260) is filled and therefore can be operated at higher speeds. This also simplifies cold starting at low temperatures and high viscosity of the hydraulic fluid. Tank charging is therefore unnecessary in most cases. A tank pressure of a maximum 30 psi (2 bar) is permissible with charge pump.
# Technical data

## Table of values (theoretical values, without efficiency and tolerances; values rounded)

<table>
<thead>
<tr>
<th>Size</th>
<th>AA11VO</th>
<th>Displacement</th>
<th>Speed</th>
<th>Flow at n&lt;sub&gt;max&lt;/sub&gt;</th>
<th>Power at q&lt;sub&gt;v max&lt;/sub&gt; and Δp = 350 bar</th>
<th>Torque at V&lt;sub&gt;g max&lt;/sub&gt; and Δp = 350 bar</th>
<th>Rotary stiffness</th>
<th>Moment of inertia for rotary group</th>
<th>Angular acceleration, maximum&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Filling capacity</th>
<th>Mass (approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;g max&lt;/sub&gt;</td>
<td>n&lt;sub&gt;max&lt;/sub&gt;</td>
<td>q&lt;sub&gt;v max&lt;/sub&gt;</td>
<td>P&lt;sub&gt;max&lt;/sub&gt;</td>
<td>T&lt;sub&gt;max&lt;/sub&gt;</td>
<td>P&lt;sub&gt;shaft&lt;/sub&gt;</td>
<td>J&lt;sub&gt;TW&lt;/sub&gt;</td>
<td>α</td>
<td>V</td>
<td>m</td>
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<tr>
<td></td>
<td></td>
<td>ln&lt;sup&gt;3&lt;/sup&gt;/rev.</td>
<td>rpm</td>
<td>gpm</td>
<td>kW</td>
<td>lb·ft</td>
<td>lb·ft/rad</td>
<td>lbs·ft&lt;sup&gt;2&lt;/sup&gt;</td>
<td>rad/s&lt;sup&gt;2&lt;/sup&gt;</td>
<td>gal</td>
<td>lbs</td>
</tr>
<tr>
<td>Size</td>
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<td>cm&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
<td>l/min</td>
<td></td>
<td></td>
<td>Nm/rad</td>
<td>kgm&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>193</td>
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<td>2200</td>
<td>213.2</td>
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<td>193</td>
<td>260</td>
<td>74</td>
<td>145</td>
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<td>2100</td>
<td>249.4</td>
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<tr>
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<td></td>
<td>42</td>
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<td>93.5</td>
<td>145</td>
<td>4.52</td>
<td>145</td>
<td>384.3</td>
<td>2200</td>
<td>319</td>
<td>724</td>
</tr>
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<td>0</td>
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<td>0</td>
<td>0</td>
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<td>56</td>
<td>276</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>56</td>
<td>276</td>
<td>259</td>
<td>1448</td>
</tr>
</tbody>
</table>

1) The values apply at absolute pressure (p<sub>abs</sub>) 15 psi (1 bar) at the suction port S and mineral hydraulic fluid.

2) The values apply at V<sub>g</sub> ≤ V<sub>g max</sub> or in case of an increase in the inlet pressure p<sub>abs</sub> at the suction port S (see diagram page 6)

3) The area of validity is situated between 0 and the maximum permissible speed.

Exceeding the permissible limit values could cause a loss of function, reduced service life or the destruction of the axial piston unit. The permissible values can be determined by calculation.
## Technical data

### Table of values (theoretical values, without efficiency and tolerances; values rounded)

<table>
<thead>
<tr>
<th>Size</th>
<th>AA11VLO (with charge pump)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>V&lt;sub&gt;g&lt;/sub&gt;&lt;sup&gt;max&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>ln&lt;sup&gt;3&lt;/sup&gt;/rev.</td>
</tr>
<tr>
<td></td>
<td>7.93</td>
</tr>
<tr>
<td></td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

### Speed

| maximum at V<sub>g</sub><sup>max</sup><sup>1)</sup> | n<sub>max</sub> | rpm | 2500 | 2500 | 2500 | 2300 |
| n<sub>max1</sub> | rpm | 2500 | 2500 | 2500 | 2300 |

### Flow

| q<sub>v</sub><sup>max</sup> | gpm | 85.9 | 95.9 | 127.6 | 158 |
| q<sub>v</sub><sup>max</sup> | l/min | 325 | 363 | 483 | 598 |

### Power

| P<sub>max</sub> | hp | 254.8 | 283 | 376.8 | 468 |
| P<sub>max</sub> | kW | 190 | 211 | 281 | 349 |

### Torque

| T<sub>max</sub> | lb-ft | 534 | 596 | 792.9 | 1068 |
| T<sub>max</sub> | Nm | 724 | 808 | 1075 | 1448 |

### Rotary stiffness

| P shaft | lb-ft/rad | 230417 | 230417 | 282702 | 482244 |
| P shaft | Nm/rad | 312403 | 312403 | 383292 | 653835 |
| S shaft | lb-ft/rad | 174700 | 174700 | 191599 | 259628 |
| S shaft | Nm/rad | 236861 | 236861 | 259773 | 352009 |
| T shaft | lb-ft/rad | - | - | 222691 | 418282 |
| T shaft | Nm/rad | - | - | 301928 | 567115 |

### Moment of inertia for rotary group

| J<sub>TR</sub> | lbs-ft<sup>2</sup> | 0.7997 | 0.8543 | 1.3692 | 2.1238 |
| J<sub>TR</sub> | kgm<sup>2</sup> | 0.0337 | 0.036 | 0.0577 | 0.0895 |

### Angular acceleration, maximum<sup>3)</sup>

| α | rad/s<sup>2</sup> | 10500 | 9000 | 6800 | 4800 |

### Filling capacity

| V | gal | 0.77 | 0.77 | 1.0 | 1.22 |
| V | L | 2.9 | 2.9 | 3.8 | 4.6 |

### Mass (approx.)

| m | lbs | 159 | 161 | 229 | 304 |
| m | kg | 72 | 73 | 104 | 138 |

---

1) The values apply at absolute pressure (p<sub>abs</sub>) of at least 12 psi (0.8 bar) at the suction port S and mineral hydraulic fluid.

2) The values apply at V<sub>g</sub> ≤ V<sub>g</sub><sup>max</sup> or in case of an increase in the inlet pressure p<sub>abs</sub> at the suction port S (see diagram page 6).

3) The area of validity is situated between 0 and the maximum permissible speed.

It applies for external stimuli (e.g. engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency).

The limit value applies for a single pump only.

The loading on the connection parts has to be considered.

### Caution

Exceeding the permissible limit values could cause a loss of function, reduced service life or the destruction of the axial piston unit. The permissible values can be determined by calculation.

### Determining the size

- **Flow** \( q_v = \frac{V_g \cdot n \cdot \eta_v}{231} \) [gpm]
- **Torque** \( T = \frac{V_g \cdot \Delta p}{24 \cdot \pi \cdot \eta_{mh}} \) [lb-ft]
- **Power** \( P = \frac{q_v \cdot \Delta p}{33000} \cdot \frac{2 \cdot \pi \cdot T \cdot n}{6000 \cdot \eta_t} \) [hp]

Where:
- \( V_g \) = Displacement per revolution [cm<sup>3</sup>]
- \( \Delta p \) = Differential pressure [bar]
- \( n \) = Speed [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 loading on drive shaft

The values stated are maximum data and not permissible for continuous operation.

<table>
<thead>
<tr>
<th>Size</th>
<th>Fq max</th>
<th>Fax max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fq max</td>
<td>Fq max</td>
<td></td>
</tr>
<tr>
<td>Size</td>
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<td>60</td>
</tr>
<tr>
<td>lbf</td>
<td>809</td>
<td>1124</td>
</tr>
<tr>
<td>N</td>
<td>3600</td>
<td>5000</td>
</tr>
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<td>in</td>
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<td>0.69</td>
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<td>mm</td>
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<td>17.5</td>
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<tr>
<td>lb</td>
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</tr>
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<td>lb</td>
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<td>mm</td>
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### Permissible input and through drive torques

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<th>60</th>
<th>75</th>
<th>95</th>
<th>130</th>
<th>145</th>
<th>190</th>
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<tbody>
<tr>
<td>Tmax</td>
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<td>240</td>
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<td>384</td>
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<td>596</td>
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<td>Nm</td>
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<td>444</td>
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<tr>
<td>at S shaft end</td>
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<td>715</td>
<td>715</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>970</td>
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<td>–</td>
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<td>1 3/8</td>
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<td>1 1/4</td>
<td>2</td>
<td>2 1/4</td>
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<tr>
<td>at T shaft end</td>
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<td>384</td>
<td>487</td>
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<td>1 3/8</td>
<td>1 3/8</td>
<td>1 3/8</td>
<td>1 1/4</td>
<td>1 1/4</td>
<td>2</td>
<td>2 1/4</td>
</tr>
</tbody>
</table>

1) Efficiency not considered
2) For drive shafts with no radial force
3) Observe maximum input torque for shaft S

### Torque distribution

![Torque distribution diagram](image)
LR – Power control

The power control regulates the displacement of the pump depending on the operating pressure so that a given drive power is not exceeded at constant drive speed.

\[ p_B \cdot V_g = \text{constant} \]

\[ p_B = \text{operating pressure} \]
\[ V_g = \text{displacement} \]

The precise control with a hyperbolic control characteristic, provides an optimum utilization of available power.

The operating pressure acts on a rocker via a measuring piston. An externally adjustable spring force counteracts this, it determines the power setting.

If the operating pressure exceeds the set spring force, the control valve is actuated by the rocker, the pump swivels back (direction \( V_g \min \)). The lever length at the rocker is shortened and the operating pressure can increase at the same rate as the displacement decreases without the drive powers being exceeded (\( p_B \cdot V_g = \text{constant} \)).

The hydraulic output power (characteristic LR) is influenced by the efficiency of the pump.

State in clear text in the order:
- drive power \( P \) in kW
- drive speed \( n \) in rpm
- maximum flow \( q_v \) in l/min

After clarifying the details a power diagram can be created by our computer.

**Characteristic LR**

![Diagram of LR Power Control]

**Circuit diagram LR**

*Size 40 to 145*

![Circuit Diagram 40 to 145]

*Size 190 to 260*

![Circuit Diagram 190 to 260]
**LR – Power control**

**LRC  Override with cross sensing**

Cross sensing control is a summation power control system, whereby the total power, of both the AA11VO and of a same size AA11VO power controlled pump mounted onto the through drive, are kept constant.

If a pump is operating at pressures below the start of the control curve setting, then the surplus power not required, in a critical case up to 100 %, becomes available to the other pump. Total power is thus divided between two systems as demand requires.

Any power being limited by means of pressure cut-off or other override functions is not taken into account.

**Half side cross sensing function**

When using the LRC control on the 1st pump (AA11VO) and a power-controlled pump without cross sensing attached to the through drive, the power required for the 2nd pump is deducted from the setting of the 1st pump. The 2nd pump has priority in the total power setting.

The size and start of control of the power control of the 2nd pump must be specified for rating the control of the 1st pump.

**Circuit diagram LRC**

Size 40 to 145

![Circuit diagram LRC Size 40 to 145](image)

Size 190 to 260

![Circuit diagram LRC Size 190 to 260](image)

**LR3  High-pressure related override**

The high-pressure related power override is a total power control in which the power control setting is piloted by the load pressure of an attached fixed pump (port Z).

As a result the AA11VO can be set to 100 % of the total drive power. The power setting of the AA11VO is reduced proportional to the load-dependent rise in operating pressure of the fixed pump. The fixed pump has priority in the total power setting.

The measuring area of the power reduction pilot piston is designed as a function of the size of the fixed pump.

**Circuit diagram LR3**

Size 40 to 145

![Circuit diagram LR3 Size 40 to 145](image)

Size 190 to 260

![Circuit diagram LR3 Size 190 to 260](image)
LR – Power control

LG1/2 Pilot-pressure related override

This power control works by overriding the control setting with an external pilot pressure signal. This pilot pressure acts on the adjustment spring of the power regulator via port Z.

The mechanically adjusted basic setting can be hydraulically adjusted by means of different pilot pressure settings, enabling different power mode settings.

If the pilot pressure signal is then adjusted by means of an external power limiting control, the total hydraulic power consumption of all users can be adapted to the available drive power from the engine.

The pilot pressure used for power control is generated by an external control element that is not a component part of the AA11VO (e.g. see also data sheet RE 95310, Electronic Load Limiting Control, LLC).

LG1 Negative power override

Power control with negative override, LG1: the force resulting from the pilot pressure is acting against the mechanical adjustment spring of the power control.

Increasing the pilot pressure reduces the power setting.

Circuit diagram LG1
Size 40 to 145

LG2 Positive power override

Power control with positive override, LG2: the force resulting from the pilot pressure is additive the mechanical adjustment spring of the power control.

An increase in pilot pressure increases the power output.

Circuit diagram LG2
Size 40 to 145

Size 190 to 260

Size 190 to 260
LR – Power control

LE1/2 Electric override (negative)

Contrary to hydraulic power control override, the basic power setting is reduced by an electric pilot current applied to a proportional solenoid. The resulting force is acting against the mechanical power control adjustment spring.

The mechanically adjusted basic power setting can be varied by means of different control current settings.

Increase in current = decrease in power

If the pilot current signal is adjusted by a load limiting control the power consumption of all actuators will be reduced to match the available power from the diesel engine.

A 12V (LE1) or 24V (LE2) supply is required for the control of the proportion solenoid.

Technical data - Solenoids

<table>
<thead>
<tr>
<th></th>
<th>LE1</th>
<th>LE2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V (±20 %)</td>
<td>24 V (±20 %)</td>
</tr>
<tr>
<td>Control current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start of control</td>
<td>400 mA</td>
<td>200 mA</td>
</tr>
<tr>
<td>End of control</td>
<td>1200 mA</td>
<td>600 mA</td>
</tr>
<tr>
<td>Limiting current</td>
<td>1.54 A</td>
<td>0.77 A</td>
</tr>
<tr>
<td>Nominal resistance (at 68 °F (20 °C))</td>
<td>5.5 Ω</td>
<td>22.7 Ω</td>
</tr>
<tr>
<td>Dither frequency</td>
<td>100 Hz</td>
<td>100 Hz</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>see connector version, page 60</td>
<td></td>
</tr>
</tbody>
</table>

Overview of power overrides

Effect of power overrides at rising pressure or current
LR – Power control

**LRD  Power control with pressure cut-off**

The pressure cut-off corresponds to a pressure control which adjusts the pump displacement back to $V_g\text{ min}$ when the pressure setting is reached.

This function overrides the power control, i.e. below the preset pressure value, the power function is effective.

The pressure cut-off function is integrated into the pump control module and is preset to a specified value at the factory.

Setting range from 725 to 5100 psi (50 to 350 bar)

**Characteristic LRD**

| Operating pressure $p_B$ [psi (bar)] | Displacement
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting range</td>
<td>$V_g\text{ min}$</td>
</tr>
<tr>
<td>5100 (350)</td>
<td>$V_g\text{ max}$</td>
</tr>
<tr>
<td>725 (50)</td>
<td></td>
</tr>
</tbody>
</table>

**Circuit diagram LRD**

Size 40 to 145

---

**LRE  Power control with pressure cut-off, 2-stage**

By connecting an external pilot pressure to port $Y$, the basic value of the pressure cut-off can be increased by $725 + 290$ psi (50 + 20 bar) and a 2nd pressure setting implemented.

This value is usually above the primary pressure relief valve setting and therefore disables the pressure cut-off function.

The pressure signal at port $Y$ must be between 290 and 725 psi (20 and 50 bar).

**Characteristic LRE**

<table>
<thead>
<tr>
<th>Operating pressure $p_B$ [psi (bar)]</th>
<th>Displacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased pressure cut-off with tolerance range (pressure cut-off deactivated)</td>
<td>$V_g\text{ max}$</td>
</tr>
<tr>
<td>5650 (390)</td>
<td></td>
</tr>
<tr>
<td>5350 (370)</td>
<td></td>
</tr>
<tr>
<td>5100 (350)</td>
<td></td>
</tr>
<tr>
<td>4650 (320)</td>
<td></td>
</tr>
<tr>
<td><strong>Basic value pressure cut-off</strong></td>
<td>$V_g\text{ min}$</td>
</tr>
</tbody>
</table>

**Circuit diagram LRE**

Size 40 to 145

---

**LRG  Power control with pressure cut-off, hydraulically remote controlled**

See page 21 for description and characteristic (pressure control remote controlled, DRG)
LR – Power control

LRDS  Power control with pressure cut-off and load sensing

The load sensing control is a flow control option that operates as a function of the load pressure to regulate the pump displacement to match the actuator flow requirement.

The flow depends here on the cross section of the external sensing orifice (1) fitted between the pump outlet and the actuator. The flow is independent of the load pressure below the power curve and the pressure cut-off setting and within the control range of the pump.

The sensing orifice is usually a separately arranged load sensing directional valve (control block). The position of the directional valve piston determines the opening cross section of the sensing orifice and thus the flow of the pump.

The load sensing control compares pressure before and after the sensing orifice and maintains the pressure drop across the orifice (differential pressure $\Delta p$) and with it the pump flow constant.

If the differential pressure $\Delta p$ increases at the sensing orifice, the pump is swivelled back (towards $V_g_{\text{min}}$), and, if the differential pressure $\Delta p$ decreases, the pump is swivelled out (towards $V_g_{\text{max}}$) until the pressure drop across the sensing orifice in the valve is restored.

$\Delta p_{\text{orifice}} = p_{\text{pump}} - p_{\text{actuator}}$

The setting range for $\Delta p$ is between 200 psi and 365 psi (14 bar and 25 bar).

The standard differential pressure setting is 260 psi (18 bar). (Please state in clear text when ordering).

The stand-by pressure in zero stroke operation (sensing orifice plugged) is slightly above the $\Delta p$ setting.

In a standard LS system the pressure cut-off is integrated in the pump control. In a LUDV (flow sharing) system the pressure cut-off is integrated in the LUDV control block.

(1) The sensing orifice (control block) is not included in the pump supply.

Characteristic LRDS

![Characteristics LRDS](image)
LR – Power control

LRS2  Power control with load sensing, electric override

This control option adds a proportional solenoid to override the mechanically set load sensing pressure. The pressure differential change is proportional to the solenoid current.

Increasing current = smaller Δp-setting

See following characteristic for details (example). Please consult us during the project planning phase.

For solenoid specification, see page 12 (LE2)

Characteristic LRS2

<table>
<thead>
<tr>
<th>Δp LS [psi (bar)]</th>
<th>Control current I [mA) (at 24V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>365 (25)</td>
<td></td>
</tr>
<tr>
<td>260 (18)</td>
<td></td>
</tr>
<tr>
<td>200 (14)</td>
<td></td>
</tr>
<tr>
<td>145 (10)</td>
<td></td>
</tr>
<tr>
<td>75 (5)</td>
<td></td>
</tr>
</tbody>
</table>

Circuit diagram LRS2

Size 40 to 145

Size 190 to 260

LRS5  Power control with load sensing, hydraulic override

This control option adds an external proportional pilot pressure signal (to port Z) to override the mechanically set load sensing pressure.

Increasing pilot pressure = smaller Δp-setting

See following characteristic for details (example). Please consult us during the project planning phase.

Characteristic LRS5

<table>
<thead>
<tr>
<th>Δp LS [psi (bar)]</th>
<th>Pilot pressure pZ [psi (bar)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>365 (25)</td>
<td>0 (5)</td>
</tr>
<tr>
<td>260 (18)</td>
<td>75 (5)</td>
</tr>
<tr>
<td>200 (14)</td>
<td>145 (10)</td>
</tr>
<tr>
<td>145 (10)</td>
<td>220 (15)</td>
</tr>
<tr>
<td>75 (5)</td>
<td>290 (20)</td>
</tr>
<tr>
<td>0 (5)</td>
<td>365 (25)</td>
</tr>
</tbody>
</table>

Circuit diagram LRS5

Size 40 to 145

Size 190 to 260
LR – Power control

LR...  Power control with stroke limiter

The stroke limiter can be used to vary or limit the displacement of the pump continuously over the whole control range. The displacement is set in LRH with the pilot pressure $p_{St}$ (maximum 580 psi (40 bar)) applied to port Y or in LRU by the control current applied to the proportional solenoid. A DC current of 12V (U1) or 24V (U2) is required to control the proportional solenoid.

The power control overrides the stroke limiter control, i.e. below the hyperbolic power characteristic, the displacement is controlled by the control current or pilot pressure. When exceeding the power characteristic with a set flow or load pressure, the power control overrides and reduces the displacement following the hyperbolic characteristic.

To permit operation of the pump displacement control from its starting position $V_{g\ max}$ to $V_{g\ min}$, a minimum control pressure of 435 psi (30 bar) is required for the electric stroke limiter LRU1/2 and the hydraulic stroke limiter LRH2/6.

The required control pressure is taken either from the load pressure, or from the externally applied control pressure at the G port.

To ensure functioning of the stroke limiter even at low operating pressure, port G must be supplied with external control pressure of approx. 435 psi (30 bar).

Note
If no external control pressure is connected at G, the shuttle valve must be removed.

Note
The spring return feature in the controller is not a safety device

The spool valve inside the controller can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).
LR – Power control

LRH1/5 Hydraulic stroke limiter
(negative characteristic)

Control from \( V_g \text{ max} \) to \( V_g \text{ min} \)

With increasing pilot pressure the pump swivels to a smaller displacement.

Start of control (at \( V_g \text{ max} \)), can be set from \(_____________ \) 60 to 145 psi (4 to 10 bar)

State start of control in clear text in the order.

Starting position without control signal (pilot pressure): \( V_g \text{ max} \)

Characteristics H1

Increase in pilot pressure \( (V_g \text{ max} - V_g \text{ min}) \)
\[ \Delta p = 365 \text{ psi (25 bar)} \]

Characteristics H5

Increase in pilot pressure \( (V_g \text{ max} - V_g \text{ min}) \)
\[ \Delta p = 145 \text{ psi (10 bar)} \]
LR – Power control

LRH2/6 Hydraulic stroke limiter
(positive characteristic)

Control from \( V_{g\text{ min}} \) to \( V_{g\text{ max}} \)

With increasing pilot pressure the pump swivels to a higher displacement.

Start of control (at \( V_{g\text{ min}} \)), can be set

__________________________ from 60 to 145 psi (4 to 10 bar)

State start of control in clear text in the order.

Starting position without control signal (pilot pressure):

– at operating pressure and external control pressure
  \(< 435 \text{ psi (30 bar)}: V_{g\text{ max}} \)

– at operating pressure or external control pressure
  \(> 435 \text{ psi (30 bar)}: V_{g\text{ min}} \)

Characteristic H2

Increase in pilot pressure \((V_{g\text{ min}} - V_{g\text{ max}})\)
\[ \Delta p = 365 \text{ psi (25 bar)} \]

Characteristic H6

Increase in pilot pressure \((V_{g\text{ min}} - V_{g\text{ max}})\)
\[ \Delta p = 145 \text{ psi (10 bar)} \]
LR – Power control

LRU1/2 Electric stroke limiter
(positive characteristic)

Control from $V_{g\ min}$ to $V_{g\ max}$

With increasing control current the pump swivels to a higher displacement.

Technical data - solenoids

<table>
<thead>
<tr>
<th></th>
<th>LRU1</th>
<th>LRU2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>12 V (±20 %)</td>
<td>24 V (±20 %)</td>
</tr>
<tr>
<td>Control current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start of control at $V_{g\ max}$</td>
<td>400 mA</td>
<td>200 mA</td>
</tr>
<tr>
<td>End of control at $V_{g\ min}$</td>
<td>1200 mA</td>
<td>600 mA</td>
</tr>
<tr>
<td>Limiting current</td>
<td>1.54 A</td>
<td>0.77 A</td>
</tr>
<tr>
<td>Nominal resistance (at 68 °F (20 °C))</td>
<td>5.5 Ω</td>
<td>22.7 Ω</td>
</tr>
<tr>
<td>Dither frequency</td>
<td>100 Hz</td>
<td>100 Hz</td>
</tr>
<tr>
<td>Actuated time</td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Type of protection</td>
<td>see connector version, page 60</td>
<td></td>
</tr>
</tbody>
</table>

Starting position without control signal (control current):

- at operating pressure and external control pressure
  $< 435$ psi (30 bar): $V_{g\ max}$
- at operating pressure or external control pressure
  $> 435$ psi (30 bar): $V_{g\ min}$

The following electronic controllers and amplifiers are available for actuating the proportional solenoids (see also www.boschrexroth.com/mobile-electronics):

- BODAS controller RC
  Series 20 RE 95200
  Series 21 RE 95201
  Series 22 RE 95202
  Series 30 RE 95203
  and application software
- Analog amplifier RA RE 95230
DR – Pressure control

The pressure control keeps the pressure in a hydraulic system constant within its control range even under varying flow conditions. The variable pump only moves as much hydraulic fluid as is required by the actuators. If the operating pressure exceeds the setpoint set at the integral pressure control valve, the pump displacement is automatically swivelled back until the pressure deviation is corrected.

Starting position in depressurized state: \( V_g \max \)

Setting range from 725 to 5100 psi (50 to 350 bar).

**Characteristic: DR**

<table>
<thead>
<tr>
<th>Operating pressure ( p_B ) [psi (bar)]</th>
<th>Flow ( q_v ) [gpm (L/min)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (0)</td>
<td>max (145)</td>
</tr>
<tr>
<td>725 (50)</td>
<td>max (350)</td>
</tr>
<tr>
<td>5100 (350)</td>
<td>max (145 psi)</td>
</tr>
</tbody>
</table>

**Circuit diagram DR**

- **Size 40 to 145**
- **Size 190 to 260**
DR – Pressure control

**DRS Pressure control with load sensing**

The load sensing control is a flow control option that operates as a function of the load pressure to regulate the pump displacement to match the actuator flow requirement.

The flow depends here on the cross section of the external sensing orifice (1) fitted between the pump outlet and the actuator. The flow is independent of the load pressure below the pressure cut-off setting and within the control range of the pump.

The sensing orifice is usually a separately arranged load sensing directional valve (control block). The position of the directional valve piston determines the opening cross section of the sensing orifice and thus the flow of the pump.

The load sensing control compares pressure before and after the sensing orifice and maintains the pressure drop across the orifice (differential pressure $\Delta p$) and with it the pump flow constant.

If the differential pressure $\Delta p$ increases, the pump is swivelled back (towards $V_{g\ min}$) and, if the differential pressure $\Delta p$ decreases the pump is swivelled out (towards $V_{g\ max}$) until the pressure drop across the sensing orifice in the valve is restored.

$\Delta p_{\text{orifice}} = p_{\text{pump}} - p_{\text{actuator}}$

The setting range for $\Delta p$ is between 200 psi and 360 psi (14 bar and 25 bar).

The standard differential pressure setting is 260 psi (18 bar).

The stand-by pressure in zero stroke operation (sensing orifice plugged) is slightly above the $\Delta p$ setting.

(1) The sensing orifice (control block) is not included in the pump supply.

**Characteristic: DRS**

![Characteristic graph](image)

**Circuit diagram DRS**

Size 40 to 145

![Circuit diagram](image)

Size 190 to 260

![Circuit diagram](image)
**DR – Pressure control**

**DRG  Pressure control, remote controlled**

The remote control pressure cut-off regulator permits the adjustment of the pressure setting by a remotely installed pressure relief valve (1). Pilot flow for this valve is provided by a fixed orifice in the control module.

Setting range from 725 to 5100 psi (50 to 350 bar).

In addition the pump can be unloaded into a standby pressure condition by an externally installed 2/2-way directional valve (2).

Both functions can be used individually or in combination (see circuit diagram).

The external valves are not included in the pump supply.

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

DBDH 6 (manual control), see RE 25402

### Characteristic: DRG

<table>
<thead>
<tr>
<th>Operating pressure $p_B$ [psi (bar)]</th>
<th>Flow $q_v$ [gpm (L/min)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>min 725 (50)</td>
<td>max 145 psi</td>
</tr>
<tr>
<td>max 5100 (350)</td>
<td></td>
</tr>
</tbody>
</table>

### Note

The remote controlled pressure cut-off is also possible in combination with LR, HD and EP.

---

**Circuit diagram DRG**

Size 40 to 145

![Circuit diagram](image)

Size 190 to 260

![Circuit diagram](image)
DR – Pressure control

DRL  Pressure control for parallel operation

The pressure control DRL is suitable for pressure control of several axial piston pumps AA11VO in parallel operation pumping into a common pressure header.

The parallel pressure control has a pressure rise characteristic of approx. 220 psi (15 bar) from \( q_v \text{ max} \) to \( q_v \text{ min} \). The pump regulates therefore to a pressure dependent swive angle. This results in stable control behavior, without the need of “staging” the individual pump compensators.

With the externally installed pressure relief valve (1) the nominal pressure setting of all pumps connected to the system is adjusted to the same value.

Setting range from 725 to 5100 psi (50 to 350 bar).

Each pump can be individually unloaded from the system by a separately installed 3/2-way directional valve (2).

The check valves (3) in the service line (port A) or control line (port X) must be provided generally.

The external valves are not included in the pump supply.

As a separate pressure relief valve (1) we recommend: DBDH 6 (manual control), see RE 25402

Characteristic DRL

![Characteristic DRL Graph]

Circuit diagram DRL

Size 40 to 145

![Circuit Diagram 40 to 145]

Size 190 to 260

![Circuit Diagram 190 to 260]
With the pilot-pressure related control the pump displacement is adjusted in proportion to the pilot pressure applied to port Y. Maximum permissible pilot pressure $p_{St,\text{max}} = 580$ psi (40 bar)

Control from $V_{g,\text{min}}$ to $V_{g,\text{max}}$.

With increasing pilot pressure the pump swivels to a higher displacement.

Start of control (at $V_{g,\text{min}}$) can be set from 60 to 145 psi (4 to 10 bar)

State start of control in clear text in the order.

Starting position without control signal (pilot pressure):
- at operating pressure and external control pressure $< 435$ psi (30 bar): $V_{g,\text{max}}$
- at operating pressure or external control pressure $> 435$ psi (30 bar): $V_{g,\text{min}}$

A control pressure of 435 psi (30 bar) is required to swivel the pump from its starting position $V_{g,\text{max}}$ to $V_{g,\text{min}}$.

The required control pressure is taken either from the load pressure, or from the externally applied control pressure at the G port.

To ensure the control even at low operating pressure $< 435$ psi (30 bar) the port G must be supplied with an external control pressure of approx. 435 psi (30 bar).

Note
If no external control pressure is connected at G, the shuttle valve must be removed.

The spring return feature in the controller is not a safety device

The spool valve inside the controller can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).
HD – Hydraulic control, pilot-pressure related

**HD.D  Hydraulic control with pressure cut-off**

The pressure cut-off corresponds to a pressure control which adjusts the pump displacement back to $V_{g \text{ min}}$ when the pressure setting is reached.

This function overrides the HD control, i.e. the pilot-pressure related displacement control is functional below the pressure setting.

The pressure cut-off function is integrated into the pump control module and is preset to a specified value at the factory.

Setting range from 725 to 5100 psi (50 to 350 bar).

**Pressure cut-off characteristic D**

![Pressure cut-off characteristic D diagram](image-url)

Circuit diagram HD.D

Size 40 to 145

![Circuit diagram HD.D Size 40 to 145](image-url)

Size 190 to 260

![Circuit diagram HD.D Size 190 to 260](image-url)
EP – Electric control with proportional solenoid

With the electric control with proportional solenoid, the pump displacement is adjusted proportionally to the solenoid current, resulting in a magnetic control force, acting directly onto the control spool that pilots the pump control piston.

Control from $V_g_{\text{min}}$ to $V_g_{\text{max}}$

With increasing control current the pump swivels to a higher displacement.

Starting position without control signal (control current):
- at operating pressure and external control pressure $< 435$ psi (30 bar): $V_g_{\text{max}}$
- at operating pressure or external control pressure $> 435$ psi (30 bar): $V_g_{\text{min}}$

A control pressure of 435 psi (30 bar) is required to swivel the pump from its starting position $V_g_{\text{max}}$ to $V_g_{\text{min}}$.

The required control pressure is taken either from the load pressure, or from the externally applied control pressure at port G.

To ensure the control even at low operating pressure $< 435$ psi (30 bar) the port G must be supplied with an external control pressure of approx. 435 psi (30 bar).

Note
If no external control pressure is connected at G, the shuttle valve must be removed.

Note
Install pump with EP control in the oil tank only when using mineral hydraulic oils and an oil temperature in the tank of maximum 180 °F (80 °C).

The following electronic control units and amplifiers are available for actuating the proportional solenoids (see also www.boschrexroth.com/mobilelektronik):
- BODAS controller RC
  Series 20 RE 95200
  Series 21 RE 95201
  Series 22 RE 95202
  Series 30 RE 95203
  and application software
- Analog amplifier RA RE 95230

Note
The spring return feature in the controller is not a safety device

The spool valve inside the controller can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).
EP – Electric control with proportional solenoid

**EP.D Electric control with pressure cut-off**

The pressure cut-off corresponds to a pressure control which adjusts the pump displacement back to \( V_{g\min} \) when the pressure setting is reached.

This function overrides the EP control, i.e. the control current related displacement control is functional below the pressure setting.

The valve for the pressure cut-off is integrated in the control case and is set to a fixed specified pressure value at the factory.

Setting range from 725 to 5100 psi (50 to 350 bar)

**Pressure cut-off characteristic D**

![Graph showing pressure cut-off characteristic D](image)

Circuit diagram EP.D

**EP-D Electric control with pressure cut-off**

Size 40 to 145

![Circuit diagram for size 40 to 145](image)

Size 190 to 260

![Circuit diagram for size 190 to 260](image)
Dimensions size 40

LRDCS

Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).
### Dimensions size 40

**Drive shaft**

- **P** Parallel keyed shaft DIN 6885, AS10x8x56
- **S** Splined shaft SAE J744
  - 1 in 15T 16/32
  - 1 in 1/4 in 14T 12/24DP

### Ports

<table>
<thead>
<tr>
<th>Designation</th>
<th>Function</th>
<th>Standard</th>
<th>Size</th>
<th>Max. pressure [psi (bar)]</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Service line port</td>
<td>SAE J518</td>
<td>3/4 in</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>3/8 in-16UNC-2B; 0.63 (16) deep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Suction port</td>
<td>SAE J518</td>
<td>2 in</td>
<td>435 (30)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>1/2 in-13UNC-2B; 0.67 (17) deep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁, T₂</td>
<td>Tank port</td>
<td>ISO 11926</td>
<td>7/8 in-14UNF-2B; 0.55 (14) deep</td>
<td>145 (10)</td>
<td>5)</td>
</tr>
<tr>
<td>R</td>
<td>Air bleed</td>
<td>ISO 11926</td>
<td>7/8 in-14UNF-2B; 0.55 (14) deep</td>
<td>145 (10)</td>
<td>X</td>
</tr>
<tr>
<td>M</td>
<td>Measurement point, positioning chamber</td>
<td>ISO 11926</td>
<td>9/16 in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>X</td>
</tr>
<tr>
<td>M</td>
<td>Measurement point, service line port</td>
<td>ISO 11926</td>
<td>9/16 in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>Pilot pressure port</td>
<td>ISO 11926</td>
<td>9/16 in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>in version with load sensing (S) and remote controlled pressure cut-off (G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>Pilot pressure port</td>
<td>ISO 11926</td>
<td>9/16 in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>in version with stroke limiter (Η...)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>2-stage pressure cut-off (E) and HD</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>Pilot pressure port</td>
<td>ISO 11926</td>
<td>9/16 in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>in version with cross sensing (C) and power override (LR3) power override (LG1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Port for control pressure (controller)</td>
<td>ISO 11926</td>
<td>9/16 in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>in version with stroke limiter (Η, Λ2), HD and EP with screw union GE10 - PLM (otherwise closed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For maximum tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T₁ or T₂ must be connected (see also page 61)

O= Open, must be connected (closed on delivery)
X= Closed (in normal operation)

Before finalizing your design, please request a certified drawing.
Dimensions in inches and (millimeters).
Before finalizing your design, please request a certified drawing.
Dimensions in inches and (millimeters).
Dimensions size 40

**HD1D/HD2D**
Hydraulic control, pilot-pressure related with pressure cut-off

**EP1D/EP2D**
Electric control with proportional solenoid and pressure cut-off

**DRS/DRG**
Pressure control with load sensing control
Pressure control remote controlled

**DRL**
Pressure control for parallel operation

**LE1S/LE2S**
Power control with electric override (negative) and load sensing control

**LE2S2/LE1S5/LE2S5**
Power control with electric override (negative) and load sensing control, override

Before finalizing your design, please request a certified drawing.
Dimensions in inches and (millimeters).
Dimensions size 60

LRDCS

Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

Before finalizing your design, please request a certified drawing.
Dimensions in inches and (millimeters).
Dimensions size 60

### Drive shaft

- **P** Parallel keyed shaft DIN 6885, AS10x8x56
- **S** Splined shaft SAE J744 1 1/4 in 14T 12/24DP
- **T** Splined shaft SAE J744 1 3/8 in 21T 16/32DP

### Ports

<table>
<thead>
<tr>
<th>Designation</th>
<th>Function</th>
<th>Standard</th>
<th>Size&lt;sup&gt;2)&lt;/sup&gt;</th>
<th>Max. pressure [psi (bar)]&lt;sup&gt;4)&lt;/sup&gt;</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Service line port</td>
<td>SAE J518</td>
<td>3/4 in</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68 3/8in-16UNC-2B; 0.67 (17) deep</td>
<td>435 (30)</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Suction port</td>
<td>SAE J518</td>
<td>2 in</td>
<td>435 (30)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68 1/2in-13UNC-2B; 0.79 (20) deep</td>
<td>5800 (400)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;, T&lt;sub&gt;2&lt;/sub&gt;</td>
<td>Tank port</td>
<td>ISO 11926 7/8in-14UNF-2B; 0.55 (14) deep</td>
<td>145 (10)</td>
<td>5)</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>Air bleed</td>
<td>ISO 11926 7/8in-14UNF-2B; 0.55 (14) deep</td>
<td>145 (10)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Measurement point, positioning chamber</td>
<td>ISO 11926 9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Measurement point, service line port</td>
<td>ISO 11926 9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)</td>
<td>ISO 11926 9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>Pilot pressure port in version with stroke limiter (H..), 2-stage pressure cut-off (E) and HD</td>
<td>ISO 11926 9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>Pilot pressure port in version with cross sensing (C) and power override (LR3)</td>
<td>ISO 11926 9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power override (LG1) (otherwise closed)</td>
<td>ISO 11926 9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM</td>
<td>ISO 11926 9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>

1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For maximum tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T<sub>1</sub> or T<sub>2</sub> must be connected (see also page 61)

O= Open, must be connected (closed on delivery)
X= Closed (in normal operation)

Before finalizing your design, please request a certified drawing.
Dimensions in inches and (millimeters).
Dimensions size 60

**LRDH1/LRDH5**  
Power control with pressure cut-off and hydraulic stroke limiter  
(negative characteristic)

**LRDH2/LRDH6**  
Power control with pressure cut-off and hydraulic stroke limiter  
(positive characteristic)

**LRDU1/LRDU2**  
Power control with pressure cut-off and electric stroke limiter  
(positive characteristic)

**LR3DS**  
Power control with high-pressure related override,  
pressure cut-off and load sensing control

**LG1E**  
Power control with pilot-pressure related override  
(negative) and 2-stage pressure cut-off

**LG2E**  
Power control with pilot-pressure related override  
(positive) and 2-stage pressure cut-off

Before finalizing your design,  
please request a certified drawing.  
Dimensions in inches and (millimeters).
**Dimensions size 60**

**HD1D/HD2D**  
Hydraulic control, pilot-pressure related with pressure cut-off

**EP1D/EP2D**  
Electric control with proportional solenoid and pressure cut-off

**DRS/DRG**  
Pressure control with load sensing control  
Pressure control remote controlled

**DRL**  
Pressure control for parallel operation

**LE1S/LE2S**  
Power control with electric override (negative)  
and load sensing control

**LE2S2/LE1S5/LE2S5**  
Power control with electric override (negative)  
and load sensing control, override

Before finalizing your design, please request a certified drawing.  
Dimensions in inches and (millimeters).
Dimensions size 75

LRDCS
Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

Before finalizing your design, please request a certified drawing.
Dimensions in inches and (millimeters).

Center of gravity

View Y clockwise rotation (counter-clockwise rotation)

Detail W

Detail V

Flange SAE J744 152-4 (D)

DIA6.00 (ø152.4)
### Dimensions size 75

#### Drive shaft

**P** Parallel keyed shaft DIN 6885
- AS12x8x80
- Dimensions: 1.42 (36), 0.42 (12), 3.23 (82)
- Center bore according to DIN 332 (thread acc. to DIN 13)
- For maximum tightening torque, please refer to general notes on page 64

**S** Splined shaft SAE J744
- 1 1/4 in 12/24DP
- Standard: ISO 6889-1
- Size: 1.89 (48)
- E1x0.2, DIN59
- ANSI B92.1-a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

**T** Splined shaft SAE J744
- 1 3/8 in 16/32DP
- Standard: ISO 6889-1
- Size: 1.89 (48)
- ANSI B92.1-a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

#### Ports

<table>
<thead>
<tr>
<th>Designation</th>
<th>Function</th>
<th>Standard</th>
<th>Size</th>
<th>Max. pressure [psi (bar)]</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Service line port</td>
<td>SAE J518</td>
<td>1 in</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>7/16in-14UNC-2B; 0.67 (17) deep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Suction port</td>
<td>SAE J518</td>
<td>2 1/2in</td>
<td>435 (30)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>1/2in-13UNC-2B; 0.67 (17) deep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁, T₂</td>
<td>Tank port</td>
<td>ISO 11926</td>
<td>7/8in-14UNF-2B; 0.55 (14) deep</td>
<td>145 (10)</td>
<td>5)</td>
</tr>
<tr>
<td>R</td>
<td>Air bleed</td>
<td>ISO 11926</td>
<td>7/8in-14UNF-2B; 0.55 (14) deep</td>
<td>145 (10)</td>
<td>X</td>
</tr>
<tr>
<td>M</td>
<td>Measurement point, service line port</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td>Y</td>
<td>Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td>O</td>
</tr>
<tr>
<td>Z</td>
<td>Pilot pressure port in version with cross sensing (C) and power override (LR3)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td>G</td>
<td>Port for control pressure (controller) in version with stroke limiter (H... U2), HD and EP with screw union GE10-PLM (otherwise closed)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td>O</td>
</tr>
</tbody>
</table>

1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For maximum tightening torque, please refer to general notes on page 64
3) ANSI B92.1-a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T₁ or T₂ must be connected (see also page 61)

O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)
Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).

**Dimensions size 75**

**LRDH1/LRDH5**
Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)

**LRDH2/LRDH6**
Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)

**LRDU1/LRDU2**
Power control with pressure cut-off and electric stroke limiter (positive characteristic)

**LR3DS**
Power control with high-pressure related override, pressure cut-off and load sensing control

**LG1E**
Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off

**LG2E**
Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off
Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).

**HD1D/HD2D**
Hydraulic control, pilot-pressure related with pressure cut-off

**EP1D/EP2D**
Electric control with proportional solenoid and pressure cut-off

**DRS/DRG**
Pressure control with load sensing control
Pressure control remote controlled

**DRL**
Pressure control for parallel operation

**LE1S/LE2S**
Power control with electric override (negative) and load sensing control

**LE2S2/LE1S5/LE2S5**
Power control with electric override (negative) and load sensing control, override
Dimensions size 95

LRDCS
Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).

Center of gravity

View Y
clockwise rotation
(counter-clockwise rotation)

1) Center of gravity

Flange SAE J744
152-4 (D)

Flange SAE J617
(SAE 3)

Detail W

Detail V

*) Dimensions according to SAE J617-No. 3, for connection to the flywheel case of the combustion engine
Dimensions size 95

**Drive shaft**

- **P** Parallel keyed shaft DIN 6885 – AS14x9x80
  - DIA: 3.98 (ø101)
  - M16x2 (12)
  - 1.42 (36)
  - 2.17 (55)
  - 2.95 (75)

- **S** Splined shaft SAE J744
  - DIA: 3.98 (ø101)
  - M8x1-11UNC-2B (55)
  - 1.42 (36)
  - 0.47 (12)

**Ports**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Function</th>
<th>Standard</th>
<th>Size³</th>
<th>Max. pressure [psi (bar)]⁴</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Service line port</td>
<td>SAE J518</td>
<td>1 in</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>7/16in-14UNC-2B; 0.67 (17) deep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Suction port</td>
<td>SAE J518</td>
<td>3 in</td>
<td>435 (30)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>5/8in-11UNC-2B; 0.94 (24) deep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁, T₂</td>
<td>Tank port</td>
<td>ISO 11926</td>
<td>1 1/16in-12UNF-2B; 0.63 (16) deep</td>
<td>145 (10)</td>
<td>X</td>
</tr>
<tr>
<td>R</td>
<td>Air bleed</td>
<td>ISO 11926</td>
<td>1 1/16in-12UNF-2B; 0.63 (16) deep</td>
<td>145 (10)</td>
<td>X</td>
</tr>
<tr>
<td>M₁</td>
<td>Measurement point, positioning chamber</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (400)</td>
<td>X</td>
</tr>
<tr>
<td>M</td>
<td>Measurement point, service line port</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td>Y</td>
<td>Pilot pressure port in version with stroke limiter (H..), 2-stage pressure cut-off (E) and HD</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td>O</td>
</tr>
<tr>
<td>Z</td>
<td>Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td>G</td>
<td>Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 · PLM (otherwise closed)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td>O</td>
</tr>
</tbody>
</table>

1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For maximum tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T₁ or T₂ must be connected (see also page 61)

O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)
Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).

**LRDH1/LRDH5**
Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)

**LRDH2/LRDH6**
Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)

**LRDU1/LRDU2**
Power control with pressure cut-off and electric stroke limiter (positive characteristic)

**LR3DS**
Power control with high-pressure related override, pressure cut-off and load sensing control

**LG1E**
Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off

**LG2E**
Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off
Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).

**HD1D/HD2D**
Hydraulic control, pilot-pressure related with pressure cut-off

![HD1D/HD2D Diagram](image)

**EP1D/EP2D**
Electric control with proportional solenoid and pressure cut-off

![EP1D/EP2D Diagram](image)

**DRS/DRG**
Pressure control with load sensing control
Pressure control remote controlled

![DRS/DRG Diagram](image)

**DRL**
Pressure control for parallel operation

![DRL Diagram](image)

**LE1S/LE2S**
Power control with electric override (negative) and load sensing control

![LE1S/LE2S Diagram](image)

**LE2S2/LE1S5/LE2S5**
Power control with electric override (negative) and load sensing control, override

![LE2S2/LE1S5/LE2S5 Diagram](image)
Dimensions size 130/145

LRDCS
Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

Dimensions in inches and (millimeters).

Before finalizing your design, please request a certified drawing.

1) Center of gravity

Dimensions according to SAE J617-No. 3, for connection to the flywheel case of the combustion engine

2) The case or length dimension with flange SAE 3 is 5 mm shorter than the standard case.
Dimensions size 130/145

Drive shaft

P  Parallel keyed shaft DIN 6885, AS14x9x80

S  Splined shaft SAE J744 1 3/4 in 13T 8/16DP

Ports

<table>
<thead>
<tr>
<th>Designation</th>
<th>Function</th>
<th>Standard</th>
<th>Size 2)</th>
<th>Max. pressure [psi (bar)] 4)</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Service line port</td>
<td>SAE J518</td>
<td>1 in</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>7/16in-14UNC-2B; 0.67 (17) deep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>Service line port</td>
<td>SAE J518</td>
<td>1 1/4 in</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>1/2in-13UNC-2B; 0.75 (19) deep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1</td>
<td>Suction port</td>
<td>SAE J518</td>
<td>3 in</td>
<td>435 (30)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>5/8in-11UNC-2B; 0.94 (24) deep</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1, T2</td>
<td>Tank port</td>
<td>ISO 11926</td>
<td>1 1/16in-12UNF-2B; 0.63 (16) deep</td>
<td>145 (10)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Air bleed</td>
<td>ISO 11926</td>
<td>1 1/16in-12UNF-2B; 0.63 (16) deep</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>Measurement point, positioning chamber</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>Measurement point, service line port</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>Pilot pressure port</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>in version with load sensing (S) and remote controlled pressure cut-off (G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>Pilot pressure port</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>in version with stroke limiter (H..., 2-stage pressure cut-off (E) and HD</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>Pilot pressure port</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>in version with cross sensing (C) and power override (LR3) power override (LG1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Port for control pressure (controller) in version with stroke limiter (H..., U2), HD and EP with screw union GE10 - PLM (otherwise closed)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td></td>
</tr>
</tbody>
</table>

1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For maximum tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T1 or T2 must be connected (see also page 61)
6) with charge pump

O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

Before finalizing your design, please request a certified drawing.
Dimensions in inches and (millimeters).
Dimensions size 130/145

**LRDH1/LRDH5**
Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)

**LRDH2/LRDH6**
Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)

**LRDU1/LRDU2**
Power control with pressure cut-off and electric stroke limiter (positive characteristic)

**LR3DS**
Power control with high-pressure related override, pressure cut-off and load sensing control

**LG1E**
Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off

**LG2E**
Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off

Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).
Dimensions size 130/145

**HD1D/HD2D**
Hydraulic control, pilot-pressure related with pressure cut-off

**EP1D/EP2D**
Electric control with proportional solenoid and pressure cut-off

**DRS/DRG**
Pressure control with load sensing control
Pressure control remote controlled

**DRL**
Pressure control for parallel operation

**LE1S/LE2S**
Power control with electric override (negative) and load sensing control

**LE2S2/LE1S5/LE2S5**
Power control with electric override (negative) and load sensing control, override

Before finalizing your design, please request a certified drawing.
Dimensions in inches and (millimeters).
Dimensions size 190

LRDCS
Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).

Dimensions according to SAE J617-No. 3, for connection to the flywheel case of the combustion engine

1) Center of gravity

View Y
clockwise rotation
(counter-clockwise rotation)

without charge pump
Detail W

with charge pump
Detail W

1) Dimensions according to SAE J617-No. 3, for connection to the flywheel case of the combustion engine
2) The case or length dimension with flange SAE 3 is 5 mm shorter than the standard case.
### Dimensions size 190

#### Drive shaft

- **P**: Parallel keyed shaft DIN 6885, AS16x10x100
- **S**: Splined shaft SAE J744
  - 1 3/4 in 13T 8/16DP
  - 2 in 15T 8/16DP
- **T**: Splined shaft SAE J744
  - 1 3/4 in 13T 8/16DP
  - 2 in 15T 8/16DP

#### Ports

<table>
<thead>
<tr>
<th>Designation</th>
<th>Function</th>
<th>Standard</th>
<th>Size</th>
<th>Max. pressure [psi (bar)]</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, A₁</td>
<td>Service line port</td>
<td>SAE J518</td>
<td>1 1/2 in</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>5/8in-11UNC-2B; 0.83 (21) deep</td>
<td>435 (30)</td>
<td>O</td>
</tr>
<tr>
<td>S, S₁</td>
<td>Suction port</td>
<td>SAE J518</td>
<td>3 1/2 in</td>
<td>30 (2)</td>
<td>O</td>
</tr>
<tr>
<td></td>
<td>Fixing thread</td>
<td>ISO 68</td>
<td>5/8in-11UNC-2B; 0.94 (24) deep</td>
<td>145 (10)</td>
<td>O</td>
</tr>
<tr>
<td>T₁, T₂</td>
<td>Tank port</td>
<td>ISO 11926</td>
<td>1 5/16in-12UNF-2B; 0.71 (18) deep</td>
<td>580 (40)</td>
<td>X</td>
</tr>
<tr>
<td>R</td>
<td>Air bleed</td>
<td>ISO 11926</td>
<td>1 5/16in-12UNF-2B; 0.71 (18) deep</td>
<td>145 (10)</td>
<td>X</td>
</tr>
<tr>
<td>M₁, M</td>
<td>Measurement point, service line port</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td>Y</td>
<td>Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>580 (40)</td>
<td>X</td>
</tr>
<tr>
<td>Z</td>
<td>Pilot pressure port in version with cross sensing (C) and power override (LR3)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td>G</td>
<td>Port for control pressure (controller) in version with stroke limiter (H...), HD and EP with screw union GE10 - PLM (otherwise closed)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
</tbody>
</table>

1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For maximum tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T₁ or T₂ must be connected (see also page 61)
6) with charge pump

O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).
Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).

**Dimensions size 190**

**LRDH1/LRDH5**
Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)

**LRDH2/LRDH6**
Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)

**LRDU1/LRDU2**
Power control with pressure cut-off and electric stroke limiter (positive characteristic)

**LR3DS**
Power control with high-pressure related override, pressure cut-off and load sensing control

**LG1EH**
Power control with pilot-pressure related override (neg.), 2-stage pressure cut-off and hydr. stroke limiter

**LG2EH**
Power control with pilot-pressure related override (pos.), 2-stage pressure cut-off and hydr. stroke limiter
Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).

**Dimensions size 190**

**HD1D/HD2D**
Hydraulic control, pilot-pressure related with pressure cut-off

**EP1D/EP2D**
Electric control with proportional solenoid and pressure cut-off

**DRS/DRG**
Pressure control with load sensing control
Pressure control remote controlled

**DRL**
Pressure control for parallel operation

**LE1S/LE2S**
Power control with electric override (negative) and load sensing control

**LE2S2/LE1S5/LE2S5**
Power control with electric override (negative) and load sensing control, override
Dimensions size 260

LRDCS

Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).
**Dimensions size 260**

**Drive shaft**

- **P** Parallel keyed shaft DIN 6885, AS18x11x100
- **S** Splined shaft SAE J744 1 3/4 in 13T 8/16DP
- **T** Splined shaft SAE J744 2 1/4 in 1 7T 8/16DP

**Ports**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Function</th>
<th>Standard</th>
<th>Size</th>
<th>Max. pressure</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, A₁</td>
<td>Service line port Fixing thread</td>
<td>SAE J518</td>
<td>1 1/2 in 5/8in-11UNC-2B; 0.83 (21) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td>S</td>
<td>Suction port Fixing thread</td>
<td>SAE J518</td>
<td>3 1/2 in 5/8in-11UNC-2B; 0.94 (24) deep</td>
<td>435 (30)</td>
<td>O</td>
</tr>
<tr>
<td>S₁</td>
<td>Suction port Fixing thread</td>
<td>SAE J518</td>
<td>4 in 5/8in-11UNC-2B; 0.83 (21) deep</td>
<td>30 (2)</td>
<td>O</td>
</tr>
<tr>
<td>T₁, T₂</td>
<td>Tank port</td>
<td>ISO 11926</td>
<td>1 5/16in-12UNF-2B; 0.63 (16) deep</td>
<td>145 (10)</td>
<td>5)</td>
</tr>
<tr>
<td>R</td>
<td>Air bleed</td>
<td>ISO 11926</td>
<td>1 5/16in-12UNF-2B; 0.63 (16) deep</td>
<td>145 (10)</td>
<td>X</td>
</tr>
<tr>
<td>M</td>
<td>Measurement port, positioning chamber</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>X</td>
</tr>
<tr>
<td>M</td>
<td>Measurement point, service line port</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td>Y</td>
<td>Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td>Z</td>
<td>Pilot pressure port in version with cross sensing (C) and power override (LR3)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
<tr>
<td>G</td>
<td>Port for control pressure (controller) in version with stroke limiter (H, U2), HD and EP with screw union GE10 - PLM (otherwise closed)</td>
<td>ISO 11926</td>
<td>9/16in-18UNF-2B; 0.47 (12) deep</td>
<td>5800 (400)</td>
<td>O</td>
</tr>
</tbody>
</table>

1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For maximum tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T1 or T2 must be connected (see also page 61)
6) with charge pump

O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

Before finalizing your design, please request a certified drawing.
Dimensions in inches and (millimeters).
Dimensions size 260

**LRDH1/LRDH5**  
Power control with pressure cut-off and hydraulic stroke limiter  
(negative characteristic)

**LRDH2/LRDH6**  
Power control with pressure cut-off and hydraulic stroke limiter  
(positive characteristic)

**LRDU1/LRDU2**  
Power control with pressure cut-off and electric stroke limiter  
(positive characteristic)

**LR3DS**  
Power control with high-pressure related override,  
pressure cut-off and load sensing control

**LG1EH**  
Power control with pilot-pressure related override (neg.),  
2-stage pressure cut-off and hydr. stroke limiter

**LG2EH**  
Power control with pilot-pressure related override (pos.),  
2-stage pressure cut-off and hydr. stroke limiter

---

Before finalizing your design,  
please request a certified drawing.  
Dimensions in inches and (millimeters).
Before finalizing your design, please request a certified drawing.
Dimensions in inches and (millimeters).

**HD1D/HD2D**
Hydraulic control, pilot-pressure related with pressure cut-off

**EP1D/EP2D**
Electric control with proportional solenoid and pressure cut-off

**DRS/DRG**
Pressure control with load sensing control
Pressure control remote controlled

**DRL**
Pressure control for parallel operation

**LE1S/LE2S**
Power control with electric override (negative) and load sensing control

**LE2S2/LE1S5/LE2S5**
Power control with electric override (negative) and load sensing control, override
**Through drive dimensions**

**Flange SAE J744 – 82-2 (A)**  
**Coupler** for splined shaft acc. to ANSI B92.1a-1976  
5/8 in 9T 16/32 DP (SAE J744 – 16-4 (A))  

**Flange SAE J744 – 101-2 (B)**  
**Coupler** for splined shaft acc. to ANSI B92.1a-1976  
7/8 in 13T 16/32 DP (SAE J744 – 22-4 (B))  
1 in 15T 16/32 DP (SAE J744 – 25-4 (B-B))

**Note**

The mounting flange may be turned through 90°. Standard position as illustrated. Please state in clear text if required.

1) 30° pressure angle, flat root, side fit, tolerance class 5  
2) O-ring included in the delivery contents  
3) ISO 68, for maximum tightening torque, please refer to general notes on page 64  
4) See page 59
Before finalizing your design, please request a certified drawing. Dimensions in inches and (millimeters).

### Through drive dimensions

**Flange SAE J744 – 127-2 (C) Coupler** for splined shaft acc. to ANSI B92.1a-1976 1 1/4 in 14T 12/24 DP\(^{1)}\) (SAE J744 – 32-4 (C))  
1 1/2 in 1 7T 12/24 DP\(^{1)}\) (SAE J744 – 38-4 (C-C))

<table>
<thead>
<tr>
<th>Size</th>
<th>A1</th>
<th>A2</th>
<th>A3(^{3)}</th>
<th>deep</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>10.71 – 0.51</td>
<td>0.79</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>11.42 – 0.51</td>
<td>0.79</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>95</td>
<td>12.52 (318) (13) 0.51</td>
<td>0.79</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>130/145</td>
<td>12.99 (330) (13) 0.51</td>
<td>0.79</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>130/145*</td>
<td>14.33 (364) (13) 0.51</td>
<td>0.79</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

\(^{1)}\) Version with charge pump

**Flange SAE J744–127-2+4 (A) Coupler** for splined shaft acc. to ANSI B92.1a-19761 1/4 in 14T 12/24 DP\(^{1)}\) (SAE J744 – 32-4 (C))  
1 1/2 in 17T 12/24 DP\(^{1)}\) (SAE J744 – 38-4 (C-C))

<table>
<thead>
<tr>
<th>Size</th>
<th>A1</th>
<th>A2</th>
<th>A3(^{3)}</th>
<th>deep</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td>14.48 (367.8) (13) 0.51</td>
<td>0.75</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>190*</td>
<td>15.75 (400) (13) 0.51</td>
<td>0.75</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>260</td>
<td>15.41 (391.5) (13) 0.51</td>
<td>0.75</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>260*</td>
<td>17.07 (433.5) (13) 0.51</td>
<td>0.75</td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>

\(^{1)}\) Version with charge pump

---

**Note**

The mounting flange may be turned through 90°. Standard position as illustrated. Please state in clear text if required.

1) 30° pressure angle, flat root, side fit, tolerance class 5
2) O-ring included in the delivery contents
3) ISO 68, for maximum tightening torque, please refer to general notes on page 64
4) See page 59
**Through drive dimensions**

*Flange* SAE J744 – 152-4 (D) *Coupler* for splined shaft acc. to ANSI B92.1a-1976 1 1/4 in 14T 12/24 DP1) (SAE J744 – 32-4 (C)) K86

<table>
<thead>
<tr>
<th>Size</th>
<th>A1</th>
<th>A2</th>
<th>A33)</th>
<th>deep</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>11.42</td>
<td>–</td>
<td>0.51</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>(290)</td>
<td>(13)</td>
<td>(28)</td>
<td></td>
</tr>
<tr>
<td>95</td>
<td>12.48</td>
<td>12.87</td>
<td>1.18</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>(317)</td>
<td>(327)</td>
<td>(30)</td>
<td>(25)</td>
</tr>
<tr>
<td>130/145</td>
<td>13.39</td>
<td>13.78</td>
<td>1.18</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>(340)</td>
<td>(350)</td>
<td>(30)</td>
<td>(25)</td>
</tr>
<tr>
<td>130/145*</td>
<td>14.72</td>
<td>15.12</td>
<td>1.18</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>(374)</td>
<td>(384)</td>
<td>(30)</td>
<td>(25)</td>
</tr>
<tr>
<td>190</td>
<td>15.43</td>
<td>15.43</td>
<td>0.51</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>(392)</td>
<td>(392)</td>
<td>(13)</td>
<td>(22)</td>
</tr>
<tr>
<td>190*</td>
<td>16.69</td>
<td>16.69</td>
<td>0.51</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>(424)</td>
<td>(424)</td>
<td>(13)</td>
<td>(22)</td>
</tr>
<tr>
<td>260</td>
<td>16.42</td>
<td>16.42</td>
<td>0.51</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>(417)</td>
<td>(417)</td>
<td>(13)</td>
<td>(22)</td>
</tr>
<tr>
<td>260*</td>
<td>18.07</td>
<td>18.07</td>
<td>0.51</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>(459)</td>
<td>(459)</td>
<td>(13)</td>
<td>(22)</td>
</tr>
</tbody>
</table>

*) Version with charge pump

---


<table>
<thead>
<tr>
<th>Size</th>
<th>A1</th>
<th>A2</th>
<th>A33)</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td>14.83</td>
<td>0.75</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>(376.8)</td>
<td>(19)</td>
<td>(20)</td>
</tr>
<tr>
<td>190*</td>
<td>16.10</td>
<td>0.75</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>(409)</td>
<td>(19)</td>
<td>(20)</td>
</tr>
<tr>
<td>260</td>
<td>16.42</td>
<td>0.75</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>(417)</td>
<td>(19)</td>
<td>(20)</td>
</tr>
<tr>
<td>260*</td>
<td>18.07</td>
<td>0.75</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>(459)</td>
<td>(19)</td>
<td>(20)</td>
</tr>
</tbody>
</table>

*) Version with charge pump

**Note**
The mounting flange may be turned through 90°. Standard position as illustrated. Please state in clear text if required.

1) 30° pressure angle, flat root, side fit, tolerance class 5
2) O-ring included in the delivery contents
3) ISO 68, for maximum tightening torque, please refer to general notes on page 64
4) See page 59
### Overview of attachments for AA11V(L)O

<table>
<thead>
<tr>
<th>Through drive Flange</th>
<th>AA11VO Coupler for splined shaft</th>
<th>Code</th>
<th>Attachment – AA11VO Size (shaft)</th>
<th>2nd pump AA10V(S)O/31 Size (shaft)</th>
<th>AA10V(S)O/53 Size (shaft)</th>
<th>A4FO Size (shaft)</th>
<th>AA4VG Size (shaft)</th>
<th>AA10VG Size (shaft)</th>
<th>External gear pump</th>
<th>Through drive available for size</th>
</tr>
</thead>
<tbody>
<tr>
<td>82-2 (A)</td>
<td>5/8 in</td>
<td>K01</td>
<td>–</td>
<td>18 (U)</td>
<td>10 (U)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>40...260</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4 in</td>
<td></td>
<td>K52</td>
<td>–</td>
<td>18 (S)</td>
<td>10 (S)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>40...260</td>
</tr>
<tr>
<td>101-2 (B)</td>
<td>7/8 in</td>
<td>K02</td>
<td>–</td>
<td>28 (S, R)</td>
<td>28 (S, R)</td>
<td>16, 22, 28 (S)</td>
<td>–</td>
<td>18 (S)</td>
<td>–</td>
<td>40...260</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>45 (U)</td>
<td>45 (U, W)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 in</td>
<td></td>
<td>K04</td>
<td>40 (S)</td>
<td>45 (S, R)</td>
<td>45 (S, R)</td>
<td>–</td>
<td>28 (S)</td>
<td>28, 45 (S)</td>
<td>–</td>
<td>40...260</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60 (U, W)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>127-2 (C)</td>
<td>1 1/4 in</td>
<td>K07</td>
<td>60 (S)</td>
<td>71 (S, R)</td>
<td>60 (S)</td>
<td>–</td>
<td>40, 56, 71 (S)</td>
<td>63 (S)</td>
<td>–</td>
<td>60...260</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100 (U)</td>
<td>85 (U)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1 1/2 in</td>
<td></td>
<td>K24</td>
<td>100 (S)</td>
<td>85 (S)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>95...260</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>152-4 (D)</td>
<td>1 1/4 in</td>
<td>K86</td>
<td>75 (S)</td>
<td></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>75...260</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 3/4 in</td>
<td></td>
<td>K17</td>
<td>95, 130, 145 (S)</td>
<td>140 (S)</td>
<td>–</td>
<td>–</td>
<td>90, 125 (S)</td>
<td>–</td>
<td>–</td>
<td>130...260</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>165-4 (E)</td>
<td>1 3/4 in</td>
<td>K72</td>
<td>190, 260 (S)</td>
<td></td>
<td>–</td>
<td>–</td>
<td>180, 250 (S)</td>
<td>–</td>
<td>–</td>
<td>190...260</td>
</tr>
</tbody>
</table>

1) Rexroth recommends special versions of the gear pumps. Please ask.
2) Only A10VO with 4-hole mounting flange can be mounted to AA11V(L)O 190 and 260.
### Combination pumps AA11VO + AA11VO

#### Total length A\(^1\)

<table>
<thead>
<tr>
<th>AA11VO</th>
<th>2nd pump</th>
<th>Size 40</th>
<th>Size 60</th>
<th>Size 75</th>
<th>Size 95</th>
<th>Size 130/145</th>
<th>Size 130/145(^2)</th>
<th>Size 190</th>
<th>Size 190(^2)</th>
<th>Size 260</th>
<th>Size 260(^2)</th>
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</thead>
<tbody>
<tr>
<td>1st pump</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Size 40</td>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
</tr>
<tr>
<td>Size 60</td>
<td>19.96</td>
<td>19.96</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
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<td>–</td>
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<tr>
<td></td>
<td>(490)</td>
<td>(507)</td>
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<tr>
<td>Size 75</td>
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<td>–</td>
<td>–</td>
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<td>(550)</td>
<td></td>
<td></td>
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<td>Size 95</td>
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<td>–</td>
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<td>–</td>
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<td>(604)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size 130/145</td>
<td>21.96</td>
<td>22.52</td>
<td>23.62</td>
<td>24.69</td>
<td>25.59</td>
<td>27.48</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>(551)</td>
<td>(572)</td>
<td>(600)</td>
<td>(627)</td>
<td>(650)</td>
<td>(698)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size 130/145(^2)</td>
<td>23.03</td>
<td>23.86</td>
<td>24.96</td>
<td>26.02</td>
<td>26.93</td>
<td>28.82</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
</tr>
<tr>
<td></td>
<td>(585)</td>
<td>(606)</td>
<td>(634)</td>
<td>(661)</td>
<td>(684)</td>
<td>(732)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size 190</td>
<td>23.10</td>
<td>24.01</td>
<td>25.67</td>
<td>26.73</td>
<td>27.64</td>
<td>29.53</td>
<td>28.49</td>
<td>30.41</td>
<td>–</td>
<td>–</td>
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</tr>
<tr>
<td></td>
<td>(586.8)</td>
<td>(609.8)</td>
<td>(652)</td>
<td>(679)</td>
<td>(702)</td>
<td>(750)</td>
<td>(723.6)</td>
<td>(772.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size 190(^2)</td>
<td>24.37</td>
<td>25.28</td>
<td>26.93</td>
<td>27.99</td>
<td>28.90</td>
<td>30.79</td>
<td>29.76</td>
<td>31.67</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>(619)</td>
<td>(642)</td>
<td>(684)</td>
<td>(711)</td>
<td>(734)</td>
<td>(782)</td>
<td>(755.8)</td>
<td>(804.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size 260</td>
<td>24.41</td>
<td>24.94</td>
<td>26.65</td>
<td>27.72</td>
<td>28.62</td>
<td>30.51</td>
<td>29.40</td>
<td>31.32</td>
<td>30.39</td>
<td>32.60</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>(620)</td>
<td>(633.5)</td>
<td>(677)</td>
<td>(704)</td>
<td>(727)</td>
<td>(775)</td>
<td>(746.8)</td>
<td>(795.5)</td>
<td>(772)</td>
<td>(828)</td>
<td></td>
</tr>
<tr>
<td>Size 260(^2)</td>
<td>26.08</td>
<td>26.59</td>
<td>28.31</td>
<td>29.37</td>
<td>30.28</td>
<td>32.17</td>
<td>31.07</td>
<td>32.99</td>
<td>32.07</td>
<td>34.27</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>(662.5)</td>
<td>(675.5)</td>
<td>(719)</td>
<td>(746)</td>
<td>(769)</td>
<td>(817)</td>
<td>(789.3)</td>
<td>(838)</td>
<td>(814.5)</td>
<td>(870.5)</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) When using the S shaft (splined shaft ANSI B92.1a - 1976) for the attached pump (2nd pump)

\(^2\) Version with charge pump

When ordering combination pumps, the type designations of the 1st and 2nd pumps must be connected by a "+".

Ordering code 1st pump + Ordering code 2nd pump

Ordering example:

AA11VO130LRDS/10R-NSD62K17 + AA11VO60LRDS/10R-NSC62N00

---

Coupler

Flange

---

Before finalizing your design, please request a certified drawing.

Dimensions in inches and (millimeters).
Swivel angle indicator

Optical swivel angle indicator, V

With the optical swivel angle indicator, a mechanical pointer on the side of the pump case displays the position of the swivel angle of the pump.

Electric swivel angle sensor, R

With the electric swivel angle indicator the swivel position of the pump is measured by an electric swivel angle sensor. It has a robust, sealed case and integrated electronics designed for automotive applications.

As an output the Hall effect swivel angle sensor supplies a voltage signal proportional to the swivel angle (see technical parameters).

Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage $U_b$</td>
<td>10...30 V DC</td>
</tr>
<tr>
<td>Output voltage $U_a$</td>
<td>2.5 V</td>
</tr>
<tr>
<td>Reverse-connect protection</td>
<td>Short-circuit-proof</td>
</tr>
<tr>
<td>EMC stability</td>
<td>Details on request</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-40 °F to +257 °F</td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>10 g / 5...2000 Hz</td>
</tr>
<tr>
<td>Sinusoidal vibration</td>
<td>EN 60068-2-6</td>
</tr>
<tr>
<td>Shock resistance:</td>
<td>25 g</td>
</tr>
<tr>
<td>Continuous shock</td>
<td></td>
</tr>
<tr>
<td>IEC 68-2-29</td>
<td></td>
</tr>
<tr>
<td>Resistance to salt spray</td>
<td>96 h</td>
</tr>
<tr>
<td>Type of protection DIN/EN 60529</td>
<td>IP67 and IP69K</td>
</tr>
<tr>
<td>Case material</td>
<td>synthetic material</td>
</tr>
</tbody>
</table>

Mating connector

AMP Superseal 1.5; 3-pin, Rexroth mat. no. R902602132

Consisting of:
- 1 female connector case, 3-pin 282087-1
- 3 single wire seals, yellow 281934-2
- 3 female connector contacts 283025-1

The mating connector is not included in the delivery contents. This can be delivered by Rexroth on request.

Before finalizing your design, please request a certified drawing.
Dimensions in inches and (millimeters).
Connector for solenoids

**DEUTSCH DT04-2P-EP04, 2-pin**
molded, without bidirectional suppressor diode  
(standard) .................................................. P

*Circuit diagram symbol*

without bidirectional suppressor diode

---

*Mating connector*

DEUTSCH DT06-2S-EP04  
Rexroth mat. no. R902601804

Consisting of:

- 1 case ______________________________ DT06-2S-EP04
- 1 wedge ______________________________ W2S
- 2 female connectors ___________ 0462-201-16141

The mating connector is not included in the delivery contents. This can be delivered by Rexroth on request.

---

**Note for round solenoids:**

The position of the connector can be changed by turning the solenoid body.

Proceed as follows:

- 1. Loosen fixing nut (1)
- 2. Turn the solenoid body (2) to the desired position.
- 3. Tighten the fixing nut

  Tightening torque of fixing nut: 3.69+0.74 lb-ft (5+1 Nm)  
  (width across the flats WAF 26, 12kt DIN 3124)
Installation notes

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This is also to be observed following a relatively long standstill as the system may empty via the hydraulic lines.

The case drain in the case interior must be directed to the tank via the highest tank port (T1, T2). The minimum suction pressure at port S must not fall below 12 psi (0.8 bar) absolute (without charge pump) or 9 psi (0.6 bar) (with charge pump).

In all operational conditions, the suction line and case drain line must flow into the tank below the minimum fluid level.

Installation position

See examples below. Additional installation positions are available upon request.

Below-tank installation (standard)

Pump below the minimum fluid level of the tank.

Recommended installation positions: 1 and 2.

Above-tank installation

Pump above the minimum fluid level of the tank.

Observe the maximum permissible suction height

\[ h_{\text{max}} = 31.50 \text{ in (800 mm)} \]

The version AA11VLO (with charge pump) is not designed for installation above the tank.

Recommendation for installation position 7 (shaft up): A check valve in the case drain line (opening pressure 7.5 psi (0.5 bar)) can prevent the case interior from draining.

For control options with pressure control, displacement limiters, HD and EP control, the minimum displacement setting must be \( V_g \geq 5\% V_{g \text{ max}} \).

When designing the tank, ensure adequate space \( \alpha_{\text{min}} \) between the suction line and the case drain line to prevent the heated, returned fluid from being directly drawn back out.

<table>
<thead>
<tr>
<th>Installation position</th>
<th>Air bleeding</th>
<th>Filling</th>
<th>Installation position</th>
<th>Air bleeding</th>
<th>Filling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>( T_1 )</td>
<td>( S + T_1 )</td>
<td>5</td>
<td>( L_1 + L_2 )</td>
<td>( L_2 (S) + L_1 (T_1) )</td>
</tr>
<tr>
<td>2</td>
<td>( R )</td>
<td>( S + T_2 )</td>
<td>6</td>
<td>( R + L_2 )</td>
<td>( L_2 (S) + L_1 (T_1) )</td>
</tr>
<tr>
<td>3</td>
<td>( T_2/T_1 )</td>
<td>( S + T_2/T_1 )</td>
<td>7</td>
<td>( L_1 + L_2 )</td>
<td>( L_2 (S) + L_1 (T_1/T_2) )</td>
</tr>
</tbody>
</table>
Installation Notes

Tank installation

Pump below the minimum fluid level in the tank.

\[ h_{\text{max}} = 31.50 \text{ in (800 mm)}, \quad h_{\text{min}} = 7.87 \text{ in (200 mm)}, \quad h_{\text{min}} = 3.94 \text{ in (100 mm)}, \quad \text{SB = Silencer plate (baffle plate)} \]

When designing the tank, ensure adequate space \( a_{\text{min}} \) between the suction line and the case drain line to prevent the heated, returned fluid from being directly drawn back out.

<table>
<thead>
<tr>
<th>Installation position</th>
<th>Air bleeding</th>
<th>Filling</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>( T_1 )</td>
<td>automatically via all open ( T_1 ), ( T_2 ), ( R ) and ( S ) ports, though position below the hydraulic fluid level</td>
</tr>
<tr>
<td>9</td>
<td>( R )</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>( R )</td>
<td></td>
</tr>
</tbody>
</table>
Notice
General notes

- The AA11VO pump is designed to be used in open circuits.
- Project planning, assembly and commissioning of the axial piston unit require the involvement of qualified personnel.
- The service line ports and function ports are only designed to accommodate hydraulic lines.
- 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 operational state of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Pressure 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 operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
- The data and notes contained herein must be adhered to.
- The following tightening torques apply:
  - Threaded hole for axial piston unit:
    The maximum permissible tightening torques $M_{G\text{max}}$ are maximum values for the threaded holes and must not be exceeded. For values, see the following table.
  - Fittings:
    Observe the manufacturer’s instruction regarding the tightening torques of the used fittings.
  - Fixing screws:
    For fixing screws according to ISO 68, we recommend checking the tightening torque individually according to VDI 2230.
  - Locking screws:
    For the metal locking screws supplied with the axial piston unit, the required tightening torques of locking screws $M_V$ apply. For values, see the following table.
- The product is not approved as a component for the safety concept of a general machine according to DIN EN ISO 13849.

<table>
<thead>
<tr>
<th>Thread size</th>
<th>Max. permissible tightening torque of the screw thread $M_{G\text{max}}$</th>
<th>Required tightening torque for locking screws $M_V$</th>
<th>WAF Hexagon socket</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/16in-18UNF-2B ISO 11926</td>
<td>80 Nm</td>
<td>25 Nm</td>
<td>1/4 in</td>
</tr>
<tr>
<td>7/8in-14UNF-2B ISO 11926</td>
<td>240 Nm</td>
<td>127 Nm</td>
<td>3/8 in</td>
</tr>
<tr>
<td>1 1/16in-12UNF-2B ISO 11926</td>
<td>360 Nm</td>
<td>147 Nm</td>
<td>9/16 in</td>
</tr>
<tr>
<td>1 5/16in-12UNF-2B ISO 11926</td>
<td>540 Nm</td>
<td>198 Nm</td>
<td>5/8 in</td>
</tr>
</tbody>
</table>