Axial Piston Fixed Motor
AA2FM (A2FM)

Technical data sheet

Series 6
Sizes Nominal pressure/Peak pressure
5 4550/5100 psi (315/350 bar)
10 to 200 5800/6500 psi (400/450 bar)
250 to 1000 5100/5800 psi (350/400 bar)
Open and closed circuits

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Features
- Fixed motor with axial tapered piston rotary group of bent axis design, for hydrostatic drives in open and closed circuits
- For use in mobile and stationary application areas
- The output speed is dependent on the flow of the pump and the displacement of the motor
- The output torque increases with the pressure differential between the high and low pressure sides and with increasing displacement
- Careful selection of the displacements offered, permit sizes to be matched to practically every application
- High power density
- Compact design
- High overall efficiency
- Good starting characteristics
- Economical conception
- One piece pistons with piston rings
## Ordering Code / Standard Program

(ordering code size 5 see page 10)

<table>
<thead>
<tr>
<th>01</th>
<th>02</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>/</th>
<th>06</th>
<th>07</th>
<th>08</th>
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</tbody>
</table>

### Hydraulic fluid

- **01**  Mineral oil and HFD. HFD for sizes 250 to 1000 only in combination with long-life bearing “L” (no code)
- **HFB-**, HFC hydraulic fluid
  - Sizes 10 to 200 (no code)
  - Sizes 250 to 1000 (only in combination with long-life bearing “L”)

### Axial piston unit

- **02** Bent axis design, fixed
  - Version SAE
  - Version ISO

### Drive shaft bearing

- **03** Standard bearing (no code)
  - Long-life bearing

### Operation mode

- **04** Motor (plug-in motor A2FE see RE 91008)

### Size

<table>
<thead>
<tr>
<th>≈ Displacement V₉ (cm³)</th>
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<tr>
<td><strong>Size</strong></td>
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<td>in³/rev.</td>
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### Series

- **06** 6

### Index

| sizes 10 to 180 | 1 |
| size 200       | 3 |
| sizes 250 to 1000 | 0 |

### Direction of rotation

- **08** Viewed from shaft end
  - alternating

### Seals

- **09** FKM (flour-caoutchouc)

### Shaft end

<table>
<thead>
<tr>
<th>SAE Version (AA2F)</th>
<th>SAE</th>
<th>Splined shaft</th>
<th>SAE parallel keyed shaft</th>
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<tr>
<td></td>
<td>10</td>
<td></td>
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<tr>
<td>ISO Version (A2F)</td>
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- **A**
- **B**
- **K**
- **P**
# Ordering Code / Standard Program

(ordering code size 5 see page 10)

## Mounting flange

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<th>12</th>
<th>16</th>
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<th>90</th>
<th>107</th>
<th>125</th>
<th>160</th>
<th>180</th>
<th>250</th>
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<tbody>
<tr>
<td>SAE Version</td>
<td>2-hole – SAE</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>●</td>
<td>C</td>
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<tr>
<td>(AA2F)</td>
<td>4-hole – SAE</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<td>○</td>
<td>○</td>
<td>○</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>ISO Version</td>
<td>4-hole – ISO</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>●</td>
<td>●</td>
<td>B</td>
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<tr>
<td>(A2F)</td>
<td>8-hole – ISO</td>
<td>○</td>
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## Service line ports

### AA2F ¹)

<table>
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<th>Service line ports</th>
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<th>16</th>
<th>23</th>
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<th>32</th>
<th>45</th>
<th>56</th>
<th>63</th>
<th>80</th>
<th>90</th>
<th>107</th>
<th>125</th>
<th>160</th>
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<th>250</th>
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<tbody>
<tr>
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<td>51</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>SAE flange ports A and B, at side, opposite side</td>
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<td>0</td>
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<td>-</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>520</td>
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<td></td>
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<tr>
<td>Threaded ports A and B, at side, opposite side</td>
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<td>0</td>
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<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>530</td>
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<tr>
<td>Threaded ports A and B, at side and rear ²)</td>
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<td>●</td>
<td>●</td>
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<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>540</td>
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<td>SAE flange ports A and B, bottom ²)</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>600</td>
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<tr>
<td>Port plate for mounting a counterbalance valves ³)</td>
<td>18</td>
<td>1</td>
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<td>-</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>-</td>
<td>181</td>
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<tr>
<td>Port plate with pressure relief valve ³)</td>
<td>19</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>●</td>
<td>●</td>
<td>●</td>
<td>-</td>
<td>191</td>
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### A2F ³)

<table>
<thead>
<tr>
<th>Service line ports</th>
<th>200</th>
<th>355</th>
<th>500</th>
<th>710</th>
<th>1000</th>
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</thead>
<tbody>
<tr>
<td>SAE flange ports A and B, rear</td>
<td>01</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>SAE flange ports A and B, bottom</td>
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<td>-</td>
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</table>

## Valves

<table>
<thead>
<tr>
<th>Valves</th>
<th></th>
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<tbody>
<tr>
<td>Without valve</td>
<td>0</td>
</tr>
<tr>
<td>With pressure relief valves (without pressure sequence range)</td>
<td>1</td>
</tr>
<tr>
<td>With pressure relief valves (with pressure sequence range)</td>
<td>2</td>
</tr>
<tr>
<td>With flush and boost pressure valve</td>
<td>7</td>
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</tbody>
</table>

## Speed measurement

<table>
<thead>
<tr>
<th>Speed measurement</th>
<th>10 to 16</th>
<th>23 to 180</th>
<th>200</th>
<th>250</th>
<th>355 to 1000</th>
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</thead>
<tbody>
<tr>
<td>Without speed measurement (no code)</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Prepared for speed measurement (ID) ⁴)</td>
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</tr>
<tr>
<td>Prepared for speed measurement (HDD) ⁴)</td>
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<td>●</td>
<td>-</td>
<td>-</td>
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</table>

## Special design

<table>
<thead>
<tr>
<th>Special design</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Standard version (no code)</td>
<td></td>
</tr>
<tr>
<td>Specific version for slew drive applications (standard for port plate 19)</td>
<td>J</td>
</tr>
</tbody>
</table>

¹) Fastening threads resp. threaded ports are SAE (UN/UNF)
²) Threaded ports at side are plugged with locking screw
³) Fastening threads are metric
⁴) Complete order recommended, speed sensor page 34
⁵) See RE 91001 (ISO-Version)

● = 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 application conditions.

The fixed motor AA2FM is unsuitable for operation with HFA. If HFB, HFC and 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 please indicate the used hydraulic fluid.

Operating viscosity range

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

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

depending on the circuit temperature (closed circuit) and tank temperature (open circuit).

Limits of viscosity range

The limiting values for viscosity are as follows:

Sizes 5 to 200:

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

- short-term (t < 3 min)
  - at max. permitted temperature of \( t_{max} = +240^\circ F (+115^\circ C) \).

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

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

Sizes 250 to 1000:

\[ \nu_{min} = 60 \text{ SUS (10 mm}^2/\text{s))} \]

- short-term (t < 3 min)
  - at max. permitted temperature of \( t_{max} = +195^\circ F (+90^\circ C) \).

\[ \nu_{max} = 4600 \text{ SUS (1000 mm}^2/\text{s)}) \]

- short-term (t < 3 min)
  - at cold start (p ≤ 435 psi / 30 bar, n ≤ 1000 rpm,
    \( t_{min} = -13^\circ F / -25^\circ C \)).
  - Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Note that the maximum hydraulic fluid temperature of \(+240^\circ F (115^\circ C) (+195^\circ F (90^\circ C) \) at size 250 to 1000) 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 22 °F (12 K) higher than the average case drain temperature.

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

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

Selection diagram

![Selection diagram]

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 a closed circuit the circuit 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 \( \nu_{opt} \) - 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 \( X^\circ F (X^\circ C) \) an operating temperature of 140°F (60°C) is set. In the optimum operating viscosity range \( \nu_{opt} \) (shaded area) this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Please note:

The case drain temperature, which is affected by pressure and speed, is always higher than the control temperature or tank temperature. At no point in the system may the temperature be higher than 240°F (115°C) for sizes 5 to 200 or 195°F (90°C) for sizes 250 to 1000.

If the above conditions cannot be maintained due to extreme operating parameters, we recommend flushing the case at port U (size 250 to 1000) or using a flush and boost pressure valve (see page 30).

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 (90°C to max. 115°C, not permitted for sizes 250 to 1000) 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

Operational pressure range

Maximum pressure on port A or B (pressure data in accordance with DIN 24312)

<table>
<thead>
<tr>
<th>AA2F Sizes</th>
<th>10</th>
<th>12</th>
<th>16</th>
<th>23</th>
<th>28</th>
<th>32</th>
<th>45</th>
<th>56</th>
<th>63</th>
<th>80</th>
<th>90</th>
<th>107</th>
<th>125</th>
<th>160</th>
<th>180</th>
<th>250</th>
<th>Nominal pressure</th>
<th>Peak pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaft end:</td>
<td>S</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>5800 psi (40 bar)</td>
<td>6500 psi (450 bar)</td>
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<td></td>
<td>S</td>
<td>●</td>
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<td>5100 psi (350 bar)</td>
<td>5800 psi (400 bar)</td>
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<td>Q</td>
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<td>4350 psi (300 bar)</td>
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<td>4100 psi (280 bar)</td>
<td>4550 psi (315 bar)</td>
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<td></td>
<td></td>
<td>5800 psi (400 bar)</td>
<td>6500 psi (450 bar)</td>
</tr>
<tr>
<td></td>
<td>U</td>
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<td>5800 psi (400 bar)</td>
<td>6500 psi (450 bar)</td>
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<td>●</td>
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<td>●</td>
<td>5100 psi (350 bar)</td>
<td>5800 psi (400 bar)</td>
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<tr>
<td></td>
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<td>5800 psi (400 bar)</td>
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<td>K</td>
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<td></td>
<td></td>
<td></td>
<td>5100 psi (350 bar)</td>
<td>5800 psi (400 bar)</td>
</tr>
</tbody>
</table>

AA2F Sizes 5 200 355 500 710 1000 Nominal pressure Peak pressure

| Shaft end: | Z  | ●  | ●  | ●  | ●  | ●  | ●  | ●  | ●  | ●  | ●  | ●   | ●   | ●   | ●   | ●   | 5100 psi (350 bar)| 5800 psi (400 bar) |
| A          | ●  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 5800 psi (400 bar)| 6500 psi (450 bar) |
| P          | ●  | ●  | ●  | ●  | ●  | ●  | ●  | ●  | ●  | ●  | ●  | ●   | ●   | ●   | ●   | ●   | 5100 psi (350 bar)| 5800 psi (400 bar) |
| B          | ●  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 5100 psi (350 bar)| 5800 psi (400 bar) |
| B          |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 3050 psi (210 bar)| 3600 psi (250 bar) |
| C          | ●  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     | 4550 psi (315 bar)| 5100 psi (350 bar) |

With pulsating loads over $p_N = 4550 \text{ psi} / 315 \text{ bar} (p_{max} = 5100 \text{ psi} / 350 \text{ bar})$; we recommend the use of a splined shaft (AA2FM 10 to 250: S, T or U / A2FM 200: A / A2FM 355 to 1000: Z)
The sum of the pressure at ports A and B may not exceed 10150 psi / 700 bar (A2F5: 9000 psi / 630 bar)

Attention: shaft end with drives of radial force loads at the drive shaft (pinion, V-belt drives) necessitate reduction of the nominal pressure to $p_N = 4550 \text{ psi} (315 \text{ bar})$! Sizes 250 to 1000 please contact us.

Minimum inlet pressure, see page 8

Direction of flow

Direction of rotation, viewed on shaft end
clockwise counter-clockwise
A to B B to A

Speed range

No limit to minimum speed $n_{min}$. If uniformity of motion is required, speed $n_{min}$ must not be less than 50 rpm. See table of values on page 7 for maximum speed.

Long-life bearing (sizes 250 to 1000)

For long service life and use with HF hydraulic fluids. Same external dimensions as the motor with standard bearing. A long-life bearing can be specified. Flushing of bearing and case via port U is recommended.

Flushing volumes (recommended)

<table>
<thead>
<tr>
<th>Size</th>
<th>250</th>
<th>355</th>
<th>500</th>
<th>710</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>$q_v$ flush</td>
<td>2.6</td>
<td>4.2</td>
<td>4.2</td>
<td>4.2</td>
<td>4.2</td>
</tr>
<tr>
<td>L/min</td>
<td>10</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>
Technical Data

Shaft seal ring

Permissible pressure loading

The service life of the shaft seal ring is affected by the speed of the motor and the case drain pressure. It is recommended that the average, continuous case drain pressure at operating temperature 45 psi (3 bar) absolute not be exceeded (max. permissible case drain pressure 90 psi (6 bar) absolute at reduced speed, see diagram). Short-term (t < 0.1 s) pressure spikes of up to 145 psi (10 bar) absolute are permitted. The service life of the shaft seal ring decreases with an increase in the frequency of pressure spikes.

The case pressure must be equal to or greater than the external pressure on the shaft seal ring.

Sizes 10 to 200

Sizes 250 to 1000

Temperature range

The FKM shaft seal ring is permissible for case temperatures of -13°F to +240°F (-25°C to +115°C) at sizes 5 to 200 and
-13°F to +195°F (-25°C to +90°C) at sizes 250 to 1000

Note:
For application cases below -13°F (-25 °C) a Buna-N (NBR) shaft seal ring is necessary (permissible temperature range -40 °F to +195 °F / -40 °C to +90 °C). Please contact us.
## Technical Data

### Table of values

**Theoretical values, ignoring \( \eta_{\text{vax}} \) and \( \eta_{\text{v}} \); values rounded**

<table>
<thead>
<tr>
<th>Size</th>
<th>( V_g )</th>
<th>( \Delta P = 5100 \text{ psi} )</th>
<th>( \Delta P = 350 \text{ bar} )</th>
<th>( \Delta P = 5800 \text{ psi} )</th>
<th>( \Delta P = 400 \text{ bar} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \text{in}^3 )</td>
<td>( \text{lb-ft} )</td>
<td>( \text{Nm} )</td>
<td>( \text{lb-ft} )</td>
<td>( \text{Nm} )</td>
</tr>
<tr>
<td>Displacement</td>
<td></td>
<td>595</td>
<td>25.6</td>
<td>662</td>
<td>0.17</td>
</tr>
<tr>
<td>Max. Speed</td>
<td>( \eta_{\text{max}} )</td>
<td>rpm</td>
<td>4500</td>
<td>4000</td>
<td>3600</td>
</tr>
<tr>
<td></td>
<td>( \eta_{\text{max interm.}} )</td>
<td>rpm</td>
<td>5000</td>
<td>4400</td>
<td>4400</td>
</tr>
<tr>
<td>Max. flow</td>
<td>( q_{V \text{ max}} )</td>
<td>gpm</td>
<td>106.9</td>
<td>72.2</td>
<td>30.6</td>
</tr>
<tr>
<td></td>
<td>L/min</td>
<td>405</td>
<td>41.3</td>
<td>31.0</td>
<td>21.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>( V_g )</th>
<th>( \Delta P = 5100 \text{ psi} )</th>
<th>( \Delta P = 350 \text{ bar} )</th>
<th>( \Delta P = 5800 \text{ psi} )</th>
<th>( \Delta P = 400 \text{ bar} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \text{cm}^3 )</td>
<td>( \text{lb-ft} )</td>
<td>( \text{Nm} )</td>
<td>( \text{lb-ft} )</td>
<td>( \text{Nm} )</td>
</tr>
<tr>
<td>Displacement</td>
<td></td>
<td>50</td>
<td>1.4</td>
<td>2.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Max. Speed</td>
<td>( \eta_{\text{max}} )</td>
<td>rpm</td>
<td>4500</td>
<td>4000</td>
<td>3600</td>
</tr>
<tr>
<td></td>
<td>( \eta_{\text{max interm.}} )</td>
<td>rpm</td>
<td>5000</td>
<td>4400</td>
<td>4400</td>
</tr>
<tr>
<td>Max. flow</td>
<td>( q_{V \text{ max}} )</td>
<td>gpm</td>
<td>106.9</td>
<td>72.2</td>
<td>30.6</td>
</tr>
<tr>
<td></td>
<td>L/min</td>
<td>405</td>
<td>41.3</td>
<td>31.0</td>
<td>21.0</td>
</tr>
</tbody>
</table>

### Notes:

1) Intermittent maximum speed: overspeed at discharge and over-running travel operations, \( t < 5 \text{ s} \) and \( \Delta P < 2200 \text{ psi} \) (150 bar)

2) Torque at \( \Delta P = 4550 \text{ psi} \) (315 bar)

**Caution:** Exceeding the permissible limit values may result in a loss of function, a reduction in service life or in the destruction of the axial piston unit.

Other permissible limit values with respect to speed variation, reduced angular acceleration as a function of the frequency and the permissible startup angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.
Technical Data

Determining the size

Flow
\[ q_v = \frac{V_g \cdot n}{231 \cdot \eta_v} \text{ gpm} \]
\[ q_v = \frac{V_g \cdot n}{1000 \cdot \eta_v} \text{ L/min} \]

Speed
\[ n = \frac{q_v \cdot 231 \cdot \eta_v}{V_g} \text{ rpm} \]
\[ n = \frac{q_v \cdot 1000 \cdot \eta_v}{V_g} \text{ rpm} \]

Torque
\[ T = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{24 \cdot \pi} \text{ lb-ft} \]
\[ T = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot \pi} \text{ Nm} \]

Power
\[ P = \frac{2 \pi \cdot T \cdot n}{33 \,000} = \frac{q_v \cdot \Delta p \cdot \eta_t \cdot 1714}{60 \,000} \text{ HP} \]
\[ P = \frac{2 \pi \cdot T \cdot n}{60 \,000} = \frac{q_v \cdot \Delta p \cdot \eta_t \cdot 600}{600} \text{ kW} \]

\( V_g \) = Displacement per revolution in \( \text{in}^3 \) (\( \text{cm}^3 \))
\( \Delta p \) = Differential pressure in psi (bar)
\( n \) = Speed in rpm
\( \eta_v \) = Volumetric efficiency
\( \eta_{mh} \) = Mechanical-hydraulic efficiency
\( \eta_t \) = Overall efficiency

Minimum inlet pressure on service line port A (B)

To prevent damage to the motor, there must be a minimum inlet pressure in the inlet area. The minimum inlet pressure is dependent on the speed of the fixed motor.

Please contact us if these conditions cannot be satisfied
Technical Data

Permissible radial and axial loading on the drive shaft

The specified values are maximum values and do not apply to continuous operation.

<table>
<thead>
<tr>
<th>Size</th>
<th>5</th>
<th>10</th>
<th>12</th>
<th>16</th>
<th>23</th>
<th>28</th>
<th>32</th>
<th>45</th>
<th>56</th>
<th>63</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial force, max. 1) at distance a (from shaft collar)</td>
<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>( F_{q \text{ max}} ) lbf</td>
<td>( F_{q \text{ max}} ) N</td>
<td>( a ) in</td>
<td>( a ) mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>710</td>
<td>0.47</td>
<td>12</td>
<td></td>
<td>747</td>
<td>2100</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>562</td>
<td>320</td>
</tr>
<tr>
<td>472</td>
<td>2100</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>562</td>
<td>320</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>730</td>
<td>360</td>
</tr>
<tr>
<td>562</td>
<td>320</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>730</td>
<td>360</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>865</td>
<td>400</td>
</tr>
<tr>
<td>730</td>
<td>360</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>865</td>
<td>400</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>1079</td>
<td>500</td>
</tr>
<tr>
<td>865</td>
<td>400</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>1079</td>
<td>500</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>1214</td>
<td>600</td>
</tr>
<tr>
<td>1079</td>
<td>500</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>1214</td>
<td>600</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>1630</td>
<td>800</td>
</tr>
<tr>
<td>1214</td>
<td>600</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>1630</td>
<td>800</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>1832</td>
<td>1000</td>
</tr>
<tr>
<td>1630</td>
<td>800</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>1832</td>
<td>1000</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>2057</td>
<td>1250</td>
</tr>
<tr>
<td>1832</td>
<td>1000</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>2057</td>
<td>1250</td>
<td>0.63</td>
<td>16</td>
<td></td>
<td>2304</td>
<td>2650</td>
</tr>
</tbody>
</table>

| Axial force, max. 3) |  |  |  |  |  |  |  |  |  |  |  |
| \( F_{ax \text{ max}} \) lbf | \( F_{ax \text{ max}} \) N |  |  |  |  |  |  |  |  |  |
| 40 | 180 | 0.71 | 18 |  | 72 | 320 | 0.79 | 18 |  | 72 | 320 |
| 72 | 320 | 0.79 | 18 |  | 72 | 320 | 0.79 | 18 |  | 112 | 500 |
| 72 | 320 | 0.79 | 18 |  | 112 | 500 | 0.79 | 18 |  | 142 | 630 |
| 112 | 500 | 0.79 | 18 |  | 142 | 630 | 0.79 | 18 |  | 180 | 800 |
| 142 | 630 | 0.79 | 18 |  | 180 | 800 | 0.79 | 18 |  | 180 | 1000 |

| Permissible axial force/psi (bar) \( \pm F_{ax \text{ per/psi (bar)} \text{ operating pressure} } \) | 0.023 | 0.05 | 0.05 | 0.05 | 0.08 | 0.08 | 0.08 | 0.11 | 0.13 | 0.16 |
| N/bar | 1.5 | 3.0 | 3.0 | 3.0 | 5.2 | 5.2 | 5.2 | 7.0 | 8.7 | 8.7 | 10.6 |

1) During intermittent operation (sizes 5 to 200)
2) Value for Q-shaft: \( F_{q \text{ max}} = 2023 \) lbf (9000 N)
3) Max. permissible axial force when at a standstill or when axial piston unit working in pressureless conditions
4) When at a standstill or when axial piston unit operating in depressurized condition. Higher forces are permissible when under pressure. Please contact us.
5) Please contact us

When considering the permissible axial force, the force-transfer direction must be taken into account.

\[ -F_{ax \text{ max}} = \text{increase in sevice life of bearings} \]

\[ +F_{ax \text{ max}} = \text{reduction in service life of bearings (avoid)} \]

Effect of radial force \( F_{q} \) on the service life of the bearings

By selecting a suitable force-transfer direction of \( F_{q} \), the stress on the bearings caused by the internal transmission forces can be reduced, thus achieving the optimum service life for the bearings. Recommended position of mating gear is dependent on direction of rotation. Examples:

<table>
<thead>
<tr>
<th>Size</th>
<th>( \theta_{\text{opt.}} ) ( \text{Toothed gear drive} )</th>
<th>( \theta_{\text{opt.}} ) ( \text{V-belt drive} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 180</td>
<td>( \pm 70^\circ )</td>
<td>( \pm 45^\circ )</td>
</tr>
<tr>
<td>200 to 1000</td>
<td>( \pm 45^\circ )</td>
<td>( \pm 70^\circ )</td>
</tr>
</tbody>
</table>

Toothed gear drive

- Alternating direction of rotation
- Counter-clockwise direction of rotation
- Pressure on port B

V-belt drive

- Clockwise direction of rotation
- Pressure on port A
- Counter-clockwise direction of rotation
- Pressure on port B
Ordering Code / Standard Program – Size 5

<table>
<thead>
<tr>
<th>A2F</th>
<th>5</th>
<th>/</th>
<th>60</th>
<th>W</th>
<th>–</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>02</td>
<td>03</td>
<td>04</td>
<td>05</td>
<td>06</td>
<td></td>
</tr>
</tbody>
</table>

Axial piston unit
01 Bent axis design, fixed A2F

Size
02 Size
\[ V_g \approx 0.30 \text{ in}^3/\text{rev.} \]
\[ V_g \approx 4.93 \text{ cm}^3/\text{rev.} \]

Series
03

Direction of rotation
04 Viewed from shaft end alternating W

Shaft end
05 Parallel keyed shaft DIN 6885 B
Tapered shaft with spigot and spring washer DIN 6888 C

Service line ports
06 Threaded ports A und B at side, metric 3

Seals
The fixed motor A2F5 is equipped with Buna-N (NBR) seals in standard design.
In case of need FKM- (fluor-caoutchouc) seals please indicate when ordering in plain text:
"with FKM-seals"

Unit Dimensions, Size 5 – ISO Design

Shaft ends
B Parallel keyed shaft DIN 6885 – A4x4x20 (mm)
\[ p_N = 3050 \text{ psi} \text{ (210 bar)} \]

C Tapered shaft with spigot and spring washer (9x5 mm) DIN 6888
(taper 1:10) \( p_N = 4550 \text{ psi} \text{ (315 bar)} \)

Ports
A, B Service line ports M18x1.5;
DIN 3852 0.47 (12) deep (140 Nm)

T1, T2 Case drain ports M10x1;
DIN 3852 0.31 (8) deep (30 Nm)

1) Center bore according to DIN 332
(thread according to DIN 13)

2) Thread according to DIN 3852,
max. tightening torque: 20 lb-ft (30 Nm)

3) Please observe the general notes for the max.
tightening torques on page 36
Unit Dimensions, Sizes 10, 12, 16 – SAE Design

Port plate 53: Threaded ports, at side

**Shaft ends**

**S** Splined shaft 7/8 in 13T 16/32 DP
(SAE J744 – 22-4 (B))
p_N = 5800 psi (400 bar)

**B** Parallel keyed shaft
DIN 6885 – AS8x7x32 (mm)
p_N = 5100 psi (350 bar)

**Ports**

<table>
<thead>
<tr>
<th></th>
<th>A, B</th>
<th>Service line ports</th>
<th>ISO 11926</th>
<th>1 1/16 in -12 UN-2B; 0.79 (20) deep</th>
<th>265 lb-ft (360 Nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1, T2</td>
<td>Case drain ports (T2 plugged)</td>
<td>ISO 11926</td>
<td>9/16 in -18 UNF-2B; 0.51 (13) deep</td>
<td>60 lb-ft (80 Nm)</td>
</tr>
</tbody>
</table>

1) ANSI B92.1 a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ISO 68
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Please observe the general notes for the max. tightening torques on page 36
Unit Dimensions, Sizes 23, 28, 32 – SAE Design

Before finalizing your design, please request a binding installation drawing.

Dimensions in inches and (millimeters)

Shaft ends

S  Splined shaft 1 1/4 in 14T 12/24 DP ¹
(SAE J744 – 32-4 (C))

pN = 5800 psi (400 bar)

B  Parallel keyed shaft
DIN 6885 – AS8x7x40 (mm)

pN = 5100 psi (350 bar)

Ports

A, B  Service line ports (see port plates)

T₁, T₂  Case drain ports (T₂ plugged)

ISO 11926  3/4 in -16 UNF-2B; 0.59 (15) deep  120 lb-ft (160 Nm) ²

¹ ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
² Thread according to ISO 68
³ Center bore according to DIN 332 (thread according to DIN 13)
⁴ Please observe the general notes for the max. tightening torques on page 36
Unit Dimensions, Sizes 23, 28, 32 – SAE Design

Port plates

51  SAE flange ports, rear

<table>
<thead>
<tr>
<th>Port Type</th>
<th>Dimensions</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>SAE flange ports</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>(high pressure series)</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Service line ports</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>SAE J518</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>1/2 in</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Fastening threads</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>ISO 68</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>5/16 in-18 UNC-2B; 0.71 (18) deep</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>

52  SAE flange ports, at side

<table>
<thead>
<tr>
<th>Port Type</th>
<th>Dimensions</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>SAE flange ports</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>(high pressure series)</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Service line ports</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>SAE J518</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>1/2 in</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Fastening threads</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>ISO 68</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>5/16 in-18 UNC-2B; 0.71 (18) deep</td>
<td>52</td>
<td></td>
</tr>
</tbody>
</table>

53  Threaded ports, at side

<table>
<thead>
<tr>
<th>Port Type</th>
<th>Dimensions</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>Service line ports</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>ISO 11926</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>1 5/16 in -12 UN-2B; 0.79 (20) deep</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>400 lb-ft 1)</td>
<td>53</td>
<td></td>
</tr>
</tbody>
</table>

54  Threaded ports, at side and rear

<table>
<thead>
<tr>
<th>Port Type</th>
<th>Dimensions</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>Service line ports</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>ISO 11926</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>1 5/16 in -12 UN-2B; 0.79 (20) deep</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>400 lb-ft 1)</td>
<td>54</td>
<td></td>
</tr>
</tbody>
</table>

1) Please observe the general notes for the max. tightening torques on page 36

Note: port plates 18 and 19 see pages 31, 32
Unit Dimensions, Size 45 – SAE Design

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

Shaft ends

S  Splined shaft 1 1/4 in 14T 12/24 DP 1)
(SAE J744 – 32-4 (C))
\( p_H = 5600 \text{ psi (400 bar) } \)

P  Parallel keyed shaft
DIN 6885 – AS8x7x50 (mm)
\( p_H = 5100 \text{ psi (350 bar) } \)

Ports

A, B  Service line ports (see port plates)

T₁, T₂  Case drain ports (T₂ plugged)
ISO 11926  3/4 in -16 UNF-2B; 0.59 (15) deep  120 lb-ft (160 Nm) 4)

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ISO 68
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Please observe the general notes for the max. tightening torques on page 36
Unit Dimensions, Size 45 – SAE Design

Port plates

51  SAE flange ports, rear

52  SAE flange ports, at side

A, B  Service line ports (high pressure series)

SAE J518  3/4 in

Fastening threads  ISO 68  3/8 in -16 UNC-2B; 0.82 (21) deep ¹)

Note: port plates 18 and 19 see pages 31, 32

¹) Please observe the general notes for the max. tightening torques on page 36
Unit Dimensions, Sizes 56, 63 – SAE Design

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

Shaft ends

S Splined shaft 1 1/4 in 14T 12/24 DP \(^1\)
(SAE J744 – 32-4 (C))
\(p_n = 5100 \text{ psi (350 bar)}\)
\[\begin{array}{c}
7/16-14 UNC-2B \quad 2) \\
0.37 (9.5) \\
0.31 (8) \\
1.89 (48)
\end{array}\]

T Splined shaft 1 3/8 in 21T 16/32 DP \(^1\)
\(p_n = 5800 \text{ psi (400 bar)}\)
\[\begin{array}{c}
7/16-14 UNC-2B \quad 2) \\
0.37 (9.5) \\
0.31 (8) \\
1.89 (48)
\end{array}\]

B Parallel keyed shaft
DIN 6885 – AS10x8x50 (mm)
\(p_n = 5100 \text{ psi (350 bar)}\)
\[\begin{array}{c}
1.10 (28) \\
0.37 (9.5) \\
0.31 (8) \\
1.89 (48)
\end{array}\]

Ports

A, B Service line ports (see port plates)
T, T Case drain ports (T2 plugged)
ISO 11926 3/4 in -16 UNF-2B; 0.59 (15) deep 120 lb-ft (160 Nm) \(^4\)

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ISO 68
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Please observe the general notes for the max. tightening torques on page 36
Before finalizing your design, please request a binding installation drawing.

Dimensions in inches and (millimeters)

Unit Dimensions, Sizes 56, 63 – SAE Design

Port plates

51  SAE flange ports, rear

52  SAE flange ports, at side

A, B  Service line ports
Fastening threads

SAE J518  3/4 in
ISO 68  3/8 in -16 UNC-2B; 0.82 (21) deep

SAE J518  1 in
ISO 68  7/16 in -14 UNC-2B; 0.87 (22) deep

Note: port plates 18 and 19 see pages 31, 32

Please observe the general notes for the max. tightening torques on page 36
Unit Dimensions, Sizes 80, 90 – SAE Design

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

Shaft ends

**U** Splined shaft 1 3/8 in 21T 16/32 DP ³)
\( p_N = 5800 \text{ psi (400 bar)} \)

**Q** Splined shaft 1 1/4 in 14T 12/24 DP ³)
(SAE J744 – 32-4 (C))
Size 80: \( p_N = 4350 \text{ psi (300 bar)} \)
Size 90: \( p_N = 4100 \text{ psi (280 bar)} \)

Ports

A, B  Service line ports (see port plates)
T₁, T₂  Case drain ports (T₂ plugged)

ISO 11926  7/8 in -14 UNF-2B;  0.67 (17) deep  180 lb-ft (240 Nm) ³)

¹) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
²) Thread according to ISO 68
³) Please observe the general notes for the max. tightening torques on page 36
Unit Dimensions, Sizes 80, 90 – SAE Design

Port plates

51 SAE flange ports, rear

52 SAE flange ports, at side

1) Please observe the general notes for the max. tightening torques on page 36

Note: port plates 18 and 19 see pages 31, 32
Unit Dimensions, Sizes 107, 125 – SAE Design

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

Shaft ends

**S** Splined shaft 1 3/4 in 13T 8/16 DP ¹
(SAE J744 – 44-4 (D))

\[ p_h = 5800 \text{ psi (400 bar)} \]

**U** Splined shaft 1 1/2 in 23T 16/32 DP ¹

\[ p_h = 5800 \text{ psi (400 bar)} \]

**B** Parallel keyed shaft

DIN 6885 – AS14x9x63 (mm)

\[ p_h = 5100 \text{ psi (350 bar)} \]

Ports

A, B  Service line ports (see port plates)

T₁, T₂  Case drain ports (T₂ plugged)

ISO 11926  7/8 in -14 UNF-2B;  0.67 (17) deep  180 lb-ft (240 Nm) ⁴

¹) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

²) Thread according to ISO 68

³) Center bore according to DIN 332 (thread according to DIN 13)

⁴) Please observe the general notes for the max. tightening torques on page 36
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Unit Dimensions, Sizes 107, 125 – SAE Design

Port plates

51  SAE flange ports, rear

<table>
<thead>
<tr>
<th>Port Plates</th>
<th>Dimensions</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE flange ports, rear</td>
<td>10.16 (258)</td>
<td></td>
</tr>
<tr>
<td>Service line ports (high pressure series)</td>
<td>1/4 in</td>
<td></td>
</tr>
</tbody>
</table>
| Fastening threads | ISO 68 | 1/2 in -13 UNC-2B; 0.75 (19) deep

52  SAE flange ports, at side

<table>
<thead>
<tr>
<th>Port Plates</th>
<th>Dimensions</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE flange ports, at side</td>
<td>9.69 (246)</td>
<td></td>
</tr>
<tr>
<td>Service line ports (high pressure series)</td>
<td>1/4 in</td>
<td></td>
</tr>
</tbody>
</table>
| Fastening threads | ISO 68 | 1/2 in -13 UNC-2B; 0.75 (19) deep

60  SAE flange ports, bottom

<table>
<thead>
<tr>
<th>Port Plates</th>
<th>Dimensions</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE flange ports, bottom</td>
<td>10.16 (258)</td>
<td></td>
</tr>
<tr>
<td>Service line ports (high pressure series)</td>
<td>1/4 in</td>
<td></td>
</tr>
</tbody>
</table>
| Fastening threads | ISO 68 | 1/2 in -13 UNC-2B; 0.75 (19) deep

1) Please observe the general notes for the max. tightening torques on page 36

Note: port plates 18 and 19 see pages 31, 32
Unit Dimensions, Sizes 160, 180 – SAE Design

**Shaft ends**

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

(SAE J744 – 44-4 (D))

\( p_n = 5800 \text{ psi (400 bar)} \)

**B** Parallel keyed shaft

DIN 6885 – AS14x9x70 (mm)

\( p_n = 5100 \text{ psi (350 bar)} \)

**Ports**

A, B Service line ports (see port plates)

T1, T2 Case drain ports (T2 plugged)

ISO 11926 7/8 in -14 UNF-2B; 0.67 (17) deep 180 lb-ft (240 Nm)

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ISO 68

3) Center bore according to DIN 332 (thread according to DIN 13)

4) Please observe the general notes for the max. tightening torques on page 36
Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)

Unit Dimensions, Sizes 160, 180 – SAE Design

Port plates

51  SAE flange ports, rear

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>A, B</td>
</tr>
<tr>
<td>Service line ports</td>
<td>SAE J518</td>
</tr>
<tr>
<td>Fastening threads</td>
<td>ISO 68</td>
</tr>
</tbody>
</table>

52  SAE flange ports, at side

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B</td>
<td>A, B</td>
</tr>
<tr>
<td>Service line ports</td>
<td>SAE J518</td>
</tr>
<tr>
<td>Fastening threads</td>
<td>ISO 68</td>
</tr>
</tbody>
</table>

1) Please observe the general notes for the max. tightening torques on page 36

Note: port plates 18 and 19 see pages 31, 32
Before finalizing your design, please request a binding installation drawing.

Dimensions in inches and (millimeters)

**Shaft ends**

A  Splined shaft DIN 5480
   W50x2x30x24x9g
   \( p_N = 5800 \text{ psi} \) (400 bar)

B  Parallel keyed shaft
   DIN 6885 – AS14x9x80 (mm)
   \( p_N = 5100 \text{ psi} \) (350 bar)

**Ports**

A, B  Service line ports (high pressure series)
      SAE J518  1 1/4 in
      Fastening threads
      DIN 13  M14x2; 0.75 (19) deep

T₁, T₂  Case drain ports (T₁ plugged)
       DIN 3852  M22x1.5; 0.55 (14) deep  155 lb-ft (210 Nm)

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Please observe the general notes for the max. tightening torques on page 36
Unit Dimensions, Size 250 – SAE Design

Port plate 51: SAE flange ports, rear

Port plate 52: SAE flange ports, at side

Shaft ends
S Splined shaft 2 in 15T 8/16 DP 1)
(SAE J744 – 50-4 (F))
p_N = 5100 psi (350 bar)

K Parallel keyed shaft
0.5x0.5x3.0 (in) 12.7x12.7x76.7 (mm)
p_N = 5100 psi (350 bar)

Ports
A, B Service line ports (high pressure series)  SAE J518  1 1/4 in
Fastening threads  ISO 68  1/2 in -13 UNC-2B; 0.75 (19) deep 3)
T1, T2 Case drain ports (T2 plugged)  ISO 11926  7/8 in -14 UNF-2B; 0.67 (17) deep  180 lb-ft (240 Nm) 3)
U Port for bearing flushing (plugged)  ISO 11926  9/16 in -18 UNF-2B; 0.51 (13) deep  60 lb-ft (80 Nm) 3)

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ISO 68
3) Please observe the general notes for the max. tightening torques on page 36

Before finalizing your design, please request a binding installation drawing.
Dimensions in inches and (millimeters)
Unit Dimensions, Size 355 – ISO Design

Port plate 01: SAE flange ports, rear

Port plate 10: SAE flange ports, bottom

Shaft ends
Z  Splined shaft DIN 5480
W60x2x30x28x9g
pN = 5100 psi (350 bar)

P  Parallel keyed shaft
DIN 6885 – AS18x11x100 (mm)
pN = 5100 psi (350 bar)

Ports
A, B  Service line ports (high pressure series)
Fastening threads

T1, T2  Case drain ports (T2 plugged)

U  Port for bearing flushing (plugged)

Mx, My  Gauge ports operating pressure (plugged)

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Please observe the general notes for the max. tightening torques on page 36
Before finalizing your design, please request a binding installation drawing.

Dimensions in inches and (millimeters)

Port plate 01: SAE flange ports, rear

Shaft ends

Z Splined shaft DIN 5480

W70x3x30x22x9g

\( p_N = 5100 \text{ psi (350 bar) } \)

P Parallel keyed shaft

DIN 6885 – AS20x12x100 (mm)

\( p_N = 5100 \text{ psi (350 bar) } \)

Ports

| A, B | Service line ports (high pressure series) | SAE J518 1 1/2 in | DIN 13 M16x2; 0.83 (21) deep ² |
| T1, T2 | Case drain ports (T2 plugged) | DIN 3852 M33x2; 0.71 (18) deep 400 lb-ft (540 Nm) ² |
| U | Port for bearing flushing (plugged) | DIN 3852 M18x1.5; 0.47 (12) deep 100 lb-ft (140 Nm) ² |
| \( M_A, M_B \) | Gauge ports operating pressure (plugged) | DIN 3852 M14x1.5; 0.47 (12) deep 60 lb-ft (80 Nm) ² |

¹ Center bore according to DIN 332 (thread according to DIN 13)

² Please observe the general notes for the max. tightening torques on page 36
Unit Dimensions, Size 710 – ISO Design

Port plate 01: SAE flange ports, rear

Before finalizing your design, please request a binding installation drawing.

Dimensions in inches and (millimeters)

Shaft ends

Z  Splined shaft DIN 5480
   W90x3x30x28x9g
   \( P_N = 5100 \text{ psi (350 bar)} \)

P  Parallel keyed shaft
   DIN 6885 – AS25x14x125 (mm)
   \( P_N = 5100 \text{ psi (350 bar)} \)

Ports

\( A, B \)  Service line ports (high pressure series)
            SAE J518  2 in
            Fastening threads
            DIN 13  M20x2.5; 1.18 (30) deep \(^2\)

\( T_1, T_2 \)  Case drain ports (T2 plugged)
               DIN 3852  M42x2; 0.79 (20) deep
               530 lb-ft (720 Nm) \(^2\)

\( U \)  Port for bearing flushing (plugged)
        DIN 3852  M18x1.5; 0.47 (12) deep
        100 lb-ft (140 Nm) \(^2\)

\( M_A, M_B \)  Gauge ports operating pressure (plugged)
               DIN 3852  M14x1.5; 0.47 (12) deep
               60 lb-ft (80 Nm) \(^2\)

\(^1\) Center bore according to DIN 332 (thread according to DIN 13)
\(^2\) Please observe the general notes for the max. tightening torques on page 36
Before finalizing your design, please request a binding installation drawing. Dimensions in inches and (millimeters)

Unit Dimensions, Size 1000 – ISO Design

Port plate 01: SAE flange ports, rear

Shaft ends

Z Splined shaft DIN 5480
  W90x3x30x28x9g
  \( p_N = 5100 \text{ psi (350 bar)} \)

P Parallel keyed shaft
  DIN 6885 – AS25x14x125 (mm)
  \( p_N = 5100 \text{ psi (350 bar)} \)

Ports

A, B Service line ports (high pressure series)  
  SAE J518  2 in
  Fastening threads  
  DIN 13  M20x2.5; 1.18 (30) deep \(^2\)

T1, T2 Case drain ports (T2 plugged)  
  DIN 3852  M42x2; 0.79 (20) deep  530 lb-ft (720 Nm) \(^2\)

U Port for bearing flushing (plugged)  
  DIN 3852  M18x1.5; 0.47 (12) deep  100 lb-ft (140 Nm) \(^2\)

MA, MB Gauge ports operating pressure (plugged)  
  DIN 3852  M14x1.5; 0.47 (12) deep  60 lb-ft (80 Nm) \(^2\)

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Please observe the general notes for the max. tightening torques on page 36
Flush and Boost Pressure Valve

The flush and boost pressure valve is used to remove heat from the closed control and to ensure that a minimum boost pressure is present (opening pressure 230 psi (16 bar), fixed; note when setting primary valve). A side effect is flushing of the case.

Warm hydraulic fluid is directed from the respective low pressure side into the motor case. This is then fed into the tank, together with the case drain. The hydraulic fluid drawn out of the closed control in this way must be replaced by cooled hydraulic fluid that is supplied by the boost pump.

In an open control system, the flush and boost pressure valve is used solely to flush the case from the return line.

On port plate 527, the valve is fitted directly onto the fixed motor (size 45 to 180, 250), while on port plate 017 (size 355 and 500), it is fitted on a plate.

Orifice can be used to adjust the flushing volumes as required.

Standard flushing volumes
(at low pressure $\Delta p_{LP} = 365$ psi / 25 bar)

<table>
<thead>
<tr>
<th>Size</th>
<th>Flushing flow</th>
<th>Mat.-no-orifice</th>
</tr>
</thead>
<tbody>
<tr>
<td>45, 56, 63</td>
<td>0.93 gpm (3.5 L/min)</td>
<td>R909651766</td>
</tr>
<tr>
<td>80, 90</td>
<td>1.32 gpm (5 L/min)</td>
<td>R909419695</td>
</tr>
<tr>
<td>107, 125</td>
<td>2.11 gpm (8 L/min)</td>
<td>R909419696</td>
</tr>
<tr>
<td>160, 180</td>
<td>2.64 gpm (10 L/min)</td>
<td>R909419697</td>
</tr>
<tr>
<td>250</td>
<td>2.64 gpm (10 L/min)</td>
<td>on request</td>
</tr>
<tr>
<td>355, 500</td>
<td>4.23 gpm (16 L/min)</td>
<td>on request</td>
</tr>
</tbody>
</table>

For sizes 45 to 180, orifices for flushing volumes of 0.93 - 2.64 gpm (3.5 - 10 L/min) can be supplied. In the case of non-standard flushing volumes, please specify the desired flushing volume when ordering. The flushing volume without orifice is approx. 3.2 to 3.7 gpm (12 to 14 L) at low pressure $\Delta p_{LP} = 365$ psi (25 bar).

Circuit diagram

Port plate 527: SAE flange ports, at side

<table>
<thead>
<tr>
<th>Size</th>
<th>A1</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>9.72</td>
<td>5.94</td>
</tr>
<tr>
<td>mm</td>
<td>247</td>
<td>151</td>
</tr>
<tr>
<td>56, 63</td>
<td>10.36</td>
<td>6.26</td>
</tr>
<tr>
<td>mm</td>
<td>263</td>
<td>159</td>
</tr>
<tr>
<td>80, 90</td>
<td>11.69</td>
<td>6.83</td>
</tr>
<tr>
<td>mm</td>
<td>297</td>
<td>173.5</td>
</tr>
<tr>
<td>107, 125</td>
<td>12.84</td>
<td>7.56</td>
</tr>
<tr>
<td>mm</td>
<td>326.1</td>
<td>192</td>
</tr>
<tr>
<td>160, 180</td>
<td>13.66</td>
<td>7.91</td>
</tr>
<tr>
<td>mm</td>
<td>347</td>
<td>201</td>
</tr>
<tr>
<td>250</td>
<td>15.20</td>
<td>6.06</td>
</tr>
<tr>
<td>mm</td>
<td>386</td>
<td>154</td>
</tr>
</tbody>
</table>

Port plate 017: SAE flange ports, rear

<table>
<thead>
<tr>
<th>Size</th>
<th>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
</tr>
</thead>
<tbody>
<tr>
<td>355</td>
<td>14.02</td>
<td>4.72</td>
<td>16.57</td>
<td>7.80</td>
</tr>
<tr>
<td>mm</td>
<td>356</td>
<td>120</td>
<td>421</td>
<td>198</td>
</tr>
<tr>
<td>500</td>
<td>15.63</td>
<td>5.12</td>
<td>18.27</td>
<td>8.86</td>
</tr>
<tr>
<td>mm</td>
<td>397</td>
<td>130</td>
<td>464</td>
<td>220</td>
</tr>
</tbody>
</table>

Additional dimensions see page 26 (size 355) and page 27 (size 500).

1) DIN 13, please observe the general notes for the max. tightening torques on page 36
Pressure Relief Valves

The pressure relief valves MHDB (as to RE 64642) protect the motor from excess pressure. When the set opening pressure is reached the hydraulic fluid flows from the high pressure side to the low pressure side.

The pressure relief valves can only be supplied in conjunction with the port plates 181, 191 or 192 (counterbalance valve for fitting on port plate 181, see next page).

Setting range opening pressure 725 - 6100 psi (50 - 420 bar)

At design "with pressure sequence range" (192) a higher pressure setting can be realized by applying an external pilot pressure of 365 - 435 psi (25 - 30 bar) at port P_{St}.

Please indicate in clear text when ordering:
- opening pressure of the pressure relief valve
- opening pressure at pilot pressure applied at P_{St} (for design 192 only)

Design without pressure sequence range "191"

![Diagram of Design without pressure sequence range "191"

Design with pressure sequence range "192"

![Diagram of Design with pressure sequence range "192"

Ports

<table>
<thead>
<tr>
<th>Size</th>
<th>A, B</th>
<th>S_1</th>
<th>M_A, M_B</th>
<th>P_{St}</th>
</tr>
</thead>
<tbody>
<tr>
<td>28, 32</td>
<td>SAE 3/4 in</td>
<td>M22x1,5; 0.55 (14) deep</td>
<td>M20x1,5; 0.55 (14) deep</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>SAE 3/4 in</td>
<td>M22x1,5; 0.55 (14) deep</td>
<td>M20x1,5; 0.55 (14) deep</td>
<td></td>
</tr>
<tr>
<td>56, 63</td>
<td>SAE 3/4 in</td>
<td>M26x1,5; 0.63 (16) deep</td>
<td>M26x1,5; 0.63 (16) deep</td>
<td></td>
</tr>
<tr>
<td>80, 90</td>
<td>SAE 1 in</td>
<td>M26x1,5; 0.63 (16) deep</td>
<td>M26x1,5; 0.63 (16) deep</td>
<td></td>
</tr>
<tr>
<td>107, 125</td>
<td>SAE 1½ in</td>
<td>M26x1,5; 0.63 (16) deep</td>
<td>M26x1,5; 0.63 (16) deep</td>
<td></td>
</tr>
<tr>
<td>160, 180</td>
<td>SAE 1½ in</td>
<td>M30x1,5; 0.63 (16) deep</td>
<td>M30x1,5; 0.63 (16) deep</td>
<td></td>
</tr>
</tbody>
</table>

1) SAE J518 2) DIN 3852 3) DIN ISO 228

Assembly instructions for port plate with pressure sequence range "192":
When fitting the hydraulic line on the P_{St} port, the lock nut must be held in place!
BVD Counterbalance Valve

Function
Driving/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open controls. Cavitation occurs if the motor speed is greater than it should be for the given flow during braking, downhill travel or decrease in motor load.

Please note
- The BVD counterbalance valve must be specified explicitly in the order. We recommend ordering the counterbalance valve and the motor as a set.
- Ordering example: AA2FM80/61W–VUDN181 + BVD20F27S/41B–V03K16D0400S12
- The counterbalance valve does not replace the mechanical service brake and parking brake.
- Note the detailed information about the BVD counterbalance valve contained in RE 95522!

Application example for driving counterbalance valve BVD..F
- Travel drive of wheeled excavators

Application example for winch counterbalance valve BVD..W
- Winch drives in cranes
- Track drives in crawler excavator

Circuit diagram driving counterbalance valve BVD..F

Unit dimensions

<table>
<thead>
<tr>
<th>Size</th>
<th>Motion control valve</th>
<th>A, B</th>
<th>S</th>
<th>MAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>28, 32</td>
<td>BVD20.16</td>
<td>SAE 3/4 in</td>
<td>M 22x1.5</td>
<td>M12x1.5</td>
</tr>
<tr>
<td>45</td>
<td>BVD20.16</td>
<td>SAE 3/4 in</td>
<td>M 22x1.5</td>
<td>M12x1.5</td>
</tr>
<tr>
<td>56, 63</td>
<td>BVD20.17</td>
<td>SAE 3/4 in</td>
<td>M 22x1.5</td>
<td>M12x1.5</td>
</tr>
<tr>
<td>80, 90</td>
<td>BVD20.27</td>
<td>SAE 1 in</td>
<td>M 22x1.5</td>
<td>M12x1.5</td>
</tr>
<tr>
<td>107, 125</td>
<td>BVD25.38</td>
<td>SAE 1 1/2 in</td>
<td>M 27x2</td>
<td>M12x1.5</td>
</tr>
<tr>
<td>160, 180</td>
<td>BVD25.38</td>
<td>SAE 1 1/4 in</td>
<td>M 27x2</td>
<td>M12x1.5</td>
</tr>
<tr>
<td>250</td>
<td>on request</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
### BVD Counterbalance Valve

#### Attaching the counterbalance valve

When delivered, the counterbalance valve is attached to the motor using 2 tacking screws. Do not remove the tacking screws when connecting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be attached to the motor port plate using the provided tacking screws. In both cases, the final attachment of the counterbalance valve to the motor is by the connection of the service lines, e.g. using SAE flanges. A total of 6 screws with thread lengths B1+B2+B3 and 2 screws with thread lengths B3+B4 are required.

When tightening the screws, it is imperative that the sequence (1 to 8) as shown in the adjacent diagram be adhered to and carried out in two phases.

In the first phase the screws should be tightened to 50% of their tightening torque before being tightened to maximum tightening torque in the second phase (see table below).

<table>
<thead>
<tr>
<th>Thread 1)</th>
<th>Property class</th>
<th>Tightening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>M10x1.5</td>
<td>10.9</td>
<td>55 lb-ft (75 Nm)</td>
</tr>
<tr>
<td>M12x1.75</td>
<td>10.9</td>
<td>95 lb-ft (130 Nm)</td>
</tr>
<tr>
<td>M14x2</td>
<td>10.9</td>
<td>150 lb-ft (205 Nm)</td>
</tr>
</tbody>
</table>

1) Fastening screws according to DIN 912

---

---

### Dimensions

<table>
<thead>
<tr>
<th>Size</th>
<th>28, 32, 45</th>
<th>56, 63</th>
<th>80, 90</th>
<th>107, 125, 160, 180</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dim. B1</td>
<td>M10x1.5</td>
<td>M10x1.5</td>
<td>M12x1.75</td>
<td>M14x2</td>
</tr>
<tr>
<td></td>
<td>0.67 deep</td>
<td>0.67 deep</td>
<td>0.71 deep</td>
<td>0.75 deep</td>
</tr>
<tr>
<td></td>
<td>(17 deep)</td>
<td>(17 deep)</td>
<td>(18 deep)</td>
<td>(19 deep)</td>
</tr>
<tr>
<td>Dim. B2</td>
<td>3.07 (78)</td>
<td>2.68 (68)</td>
<td>2.68 (68)</td>
<td>3.35 (85)</td>
</tr>
<tr>
<td>Dim. B3</td>
<td>customer-specific</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dim. B4</td>
<td>M10x1.5</td>
<td>M10x1.5</td>
<td>M12x1.75</td>
<td>M14x2</td>
</tr>
<tr>
<td></td>
<td>0.59 deep</td>
<td>0.59 deep</td>
<td>0.63 deep</td>
<td>0.75 deep</td>
</tr>
<tr>
<td></td>
<td>(15 deep)</td>
<td>(15 deep)</td>
<td>(16 deep)</td>
<td>(19 deep)</td>
</tr>
</tbody>
</table>

Fastening threads according to DIN 13, please observe the general notes for the max. tightening torques on page 36

1) Minimum reach required 1 x DIA, thread
2) With adapting plate
Speed Measurement

The AA2FM...D and AA2FM...F ("prepared for speed measurement", i.e. without sensor) versions have teeth on the rotary group. The rotating, toothed rotary group generates a signal in proportion to the speed. The signal is picked up by a sensor and can be forwarded for evaluation.

The sensor is fitted to the special port D provided for this purpose. The following versions are available:

### Version „D“ (sizes 23 to 180)

Suitable for mounting the inductive speed sensor ID (see RA 95130). The ID sensor is screwed into port D. The spacer ring adapter required for the inductive speed sensor ID is included in the supply volume of the sensor (only when ordering, speed sensor with installation parts).

### Version „F“ (sizes 23 to 250)

Suitable for mounting of HDD Hall effect speed sensor (see RE 95135). The HDD sensor is flange mounted with two fastening screws. In the standard version, the port is plugged with a pressure-resistant flange cover.

We recommend ordering the AA2FM fixed motor complete with mounted sensor. Please specify the ordering code for the sensor separately.

### Version „D“ (sizes 23 to 180): with ID sensor

![Diagram](image)

1) clearance required for attaching/detaching the mating connector: min 0.51 in (13 mm)
2) tightening torque, max.: 37 lb-ft (50 Nm) - ID-Sensor

### Table: Dimensions

<table>
<thead>
<tr>
<th>Size</th>
<th>23, 28, 32</th>
<th>45</th>
<th>56, 63</th>
<th>80</th>
<th>90</th>
<th>107, 125</th>
<th>160, 180</th>
<th>200</th>
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</thead>
<tbody>
<tr>
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<td>45</td>
<td>47</td>
<td>53</td>
<td>59</td>
<td>67</td>
<td>80</td>
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<td><strong>HDD</strong> 3) <strong>A</strong> Insertion depth (tolerance ± 0.004)</td>
<td>in 0.63</td>
<td>0.63</td>
<td>0.63</td>
<td>0.63</td>
<td>0.63</td>
<td>0.63</td>
<td>0.63</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td>(tolerance ±0.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>mm 16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td><strong>B</strong> Contact surface</td>
<td>in 2.19</td>
<td>2.46</td>
<td>2.66</td>
<td>2.85</td>
<td>3.05</td>
<td>3.35</td>
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<tr>
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<td>(tolerance ±0.1)</td>
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</tr>
<tr>
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<td>72.5</td>
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<td>98.8</td>
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<td><strong>C</strong></td>
<td>in 3.69</td>
<td>3.97</td>
<td>4.17</td>
<td>4.36</td>
<td>4.56</td>
<td>4.85</td>
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<td>mm 93.8</td>
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<td><strong>D</strong></td>
<td>in 2.15</td>
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<tr>
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<td>mm 73.7</td>
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<td>111.8</td>
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<td><strong>ID</strong> 4) <strong>A</strong> Insertion depth (tolerance ± 0.004)</td>
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<td><strong>B</strong> Contact surface</td>
<td>in 1.93</td>
<td>2.17</td>
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<td>70</td>
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<td><strong>C</strong> without mating connector</td>
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<td>5.48</td>
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<td>6.79</td>
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<td><strong>C2</strong> with 180° mating connector</td>
<td>in 6.82</td>
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<td>7.25</td>
<td>7.72</td>
<td>7.65</td>
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<td>(tolerance ±0.1)</td>
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<td><strong>D</strong></td>
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<tr>
<td></td>
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<td>111.8</td>
<td>118.8</td>
<td>–</td>
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</tr>
</tbody>
</table>

3) Suitable speed sensor: sizes 23-200: HDD.L16../20 (see RE 95135) resp. IDR18/20–L250 (see RE 95130)
4) For size 250 see RE 91001 (ISO-Version)

Please request a certified installation drawing before finalizing your design.

Dimensions in inches and (millimeters).
Installation Notes

General
The motor case must be completely filled up with hydraulic fluid during startup and during operation (filling the case chamber). The motor must be started at low speed and no load until the system has been bled completely.

If stopped for an extended period, fluid may drain out of the case through the working lines. When restarting, make sure that the case contains sufficient fluid.

The leakage fluid inside the case chamber must be drained off to the tank through the highest case drain port.

Installation position
Optional. At size 10 to 200 with installation position “shaft to the top” use motor with bleeding port R (indicate in clear when ordering; the port U in the bearing section for bleeding is included in production with sizes 250 to 1000).

Installation below tank level
Motors below minimum fluid level in the tank (standard)
- Fill axial piston motor before startup via the highest case drain port
- Run the motor at low speed until the system is bled completely (bleed through service line port A, B if tubing is long)
- Minimum immersion depth of leakage line in tank: 7.87 in (200 mm) (relative to the min. fluid level in the tank)
- Additional measures required for installation position 2 (shaft facing up): with installation position 2, make sure that the motor case is completely full before starting up. Bleed at port R (sizes 10 to 200) resp. U (sizes 250 to 1000). Order port R in clear text. An air pocket in the bearing area can cause damage to the motor.

Installation above the tank
Motor above minimum fluid level in tank
- Proceed in same way as below the tank installation
- Additional measures for installation positions 1 and 2: If stopped for an extended period, fluid may drain out of the case chamber through the service lines (air enters through the shaft seal). The bearings will therefore not be properly lubricated when the motor is started up again. Fill the axial piston motor before restarting via the highest case drain port. Installation position 2: bleed at port R (sizes 10 to 200) resp. U (sizes 250 to 1000). Order port R in clear text.
- Additional measures required for installation position 2 (shaft facing up)
  In this installation position the bearings will not be properly lubricated, even if there is still some fluid in the case chamber. Putting a non-return valve (opening pressure 7.5 psi (0.5 bar)) in the leakage line can prevent the system emptying through the line.

---

Insert diagrams here.
General Notes

- The AA2FM motor is designed to be used in open and closed circuits.
- Project planning, assembly, and commissioning of the motor 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 motor. Take suitable safety precautions, e.g. wear protective clothing.
- There may be shifts in the characteristic depending on the operating state of the motor (operating pressure, fluid temperature).
- Tightening torques:
  - The tightening torques specified in this data sheet are maximum values and must not be exceeded (maximum values for screw thread).
  - Manufacturer’s instruction for the max. permissible tightening torques of the used fittings must be observed!
  - For ISO 68 / DIN 13 fixing screws, we recommend checking the tightening torque individually according to VDI 2230 Edition 2003.
- The data and information contained herein must be adhered to.