General Information

Introduction
Danfoss a world leader in hydraulic power systems has developed a family of axial piston motors.

Description
Danfoss axial pistons fixed displacement motors are of swash plate design with preset displacement suitable for hydrostatic transmissions with closed loop circuit.
The output speed is proportional to the motor's input flow.
The output torque is proportional to the differential pressure applied to the main pressure ports.
The direction of motor (output) shaft rotation depends on flow input to the main pressure ports.

Danfoss axial piston fixed displacement motors are well engineered and easy to handle.
The full-length shaft with a highly efficient tapered roller bearing arrangement offers a high loading capacity for external radial forces.
High case pressures can be achieved without leakage even at the lowest temperatures by using suitable shaft seals.
Danfoss axial piston units are designed for easy servicing. Complete dismantling and reassembly can be carried out with standard hand tools, and all components or sub-assemblies are replaceable.
Axial piston fixed displacement motors of the Danfoss pattern are made by licensed producers worldwide, providing consistent service and fully inter-changeable parts.

Typical markets
• Industrial
• Mining
• Transit Mixer
• Utility Vehicles
Technical Information  Axial Piston Motors Series 20

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General Description

Axial piston fixed displacement motor

Sectional View
General Description

Pump and motor circuit description

Above figure shows schematically the function of a hydrostatic transmission using an axial piston variable displacement pump and a fixed displacement motor.

Motor circuit schematic

Designation:
1 = Fixed displacement motor
2 = Purge relief valve
3 = Shuttle valve
4 = High pressure relief valve

Ports:
A, B = Main pressure ports (working loop)
L1, L2 = Drain ports
MA = Gauge port for port A
MB = Gauge port for port B
M = Gauge port - charge pressure
Technical Specification

Technical parameters

**Design**
Axial piston motor with fixed displacement and swash plate design.

**Type of mounting**
SAE four bolt flanges.

**Pipe connections**
Main pressure ports: SAE split flange
Remaining ports: SAE O-ring boss

**Direction of rotation and flow**
Clockwise or counterclockwise (viewing from the output shaft).

<table>
<thead>
<tr>
<th>Direction of rotation</th>
<th>Port A</th>
<th>Port B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clockwise (R)</td>
<td>Output</td>
<td>Input</td>
</tr>
<tr>
<td>Counterclockwise (L)</td>
<td>Input</td>
<td>Output</td>
</tr>
</tbody>
</table>

**Installation position**
Optional; motor housing must be always filled with hydraulic fluid.

**External drain fluid loss**

![Graph depicting external drain fluid loss vs. Driveshaft speed (min⁻¹) (rpm)]
Technical Specification

Hydraulic parameters

**System pressure range, input \( p_1 \)**
Pressure on port A or B:

- Max. operating pressure \( \Delta p = 420 \text{ bar} \ [6092 \text{ psi}] \)
- Max. high pressure setting \( \Delta p = 460 \text{ bar} \ [6672 \text{ psi}] \)

*Only with POR-valve*

**System pressure range, output \( p_2 \)**
Normal setting for configuration MS and MR: 11.0 - 12.5 bar [160 - 181 psi] above case pressure.

Minimum: 8 bar, intermittent only

**Case pressure**
- Max. rated pressure = 2.5 bar [36.3 psi]
- Intermittent = 5.0 bar [72.5 psi]

**Hydraulic fluid**
Refer to Danfoss publications *Hydraulic Fluids and Lubricants, 520L0463* and *Experience with Biodegradable Hydraulic Fluids, 520L0465*.

**Hydraulic fluid temperature range**
- \( \vartheta_{\text{min}} = -40^\circ \text{C} [-40^\circ \text{F}] \)
- \( \vartheta_{\text{max}} = 95^\circ \text{C} [203^\circ \text{F}] \)

**Viscosity range**
- \( \nu_{\text{min}} = 7 \text{ mm}^2/\text{s} \ [49 \text{ SUS}*] \)
- \( \nu_{\text{max}} = 1000 \text{ mm}^2/\text{s} \ [4630 \text{ SUS}*] \) (intermittent cold start)

Recommended viscosity range: 12 - 60 mm²/s [66 - 278 SUS*]

*SUS (Saybolt Universal Second)*

**Filtration**
Required cleanliness level: ISO 4406-1999 Code 22/18/13 or better.
Refer to Danfoss publications *Hydraulic Fluids and Lubricants, 520L0463* and *Design Guideline for Hydraulic Fluid Cleanliness, 520L0467*.

**Shaft load**
The pump will accept radial and axial loads on its shaft, the maximum capacity being determined by direction and point of application of the load.
Please contact your Danfoss representative.
Technical Specification

Hydraulic parameters (continued)

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Frame size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>070</td>
</tr>
<tr>
<td>Max. displacement</td>
<td>cm³</td>
</tr>
<tr>
<td>Rated speed 1</td>
<td>min⁻¹ (rpm)</td>
</tr>
<tr>
<td>Mass moment of inertia of rotating group</td>
<td>kg m² • 10⁻³</td>
</tr>
</tbody>
</table>

¹ for higher speeds contact your Danfoss representative

Determination of nominal motor size

**Unit:**

**Metric System:**

| Input flow | Qₑ = \frac{Vₑ \times n}{1000 \times \eta_v} | l/min |
| Output torque | Mₑ = \frac{Vₑ \times \Delta p \times \eta_m}{20 \times \pi} | Nm |
| Output power | Pₑ = \frac{Qₑ \times \Delta p \times \eta_t}{600} | kW |
| Speed | n = \frac{Qₑ \times 1000 \times \eta_v}{Vₑ} | min⁻¹ (rpm) |

**Inch System:**

| Input flow | Qₑ = \frac{Vₑ \times n}{231 \times \eta_v} | [gpm] |
| Output torque | Mₑ = \frac{Vₑ \times \Delta p \times \eta_m}{2 \times \pi} | [lbf•in] |
| Output power | Pₑ = \frac{Vₑ \times \eta_m \times \Delta p \times \eta_t}{396 000} | [hp] |
| Speed | n = \frac{Qₑ \times 231 \times \eta_v}{Vₑ} | (rpm) |

Efficiency characteristic curves available on request.

\[ Vₑ = \text{Motor displacement per revolution} \quad \text{cm}³ \quad \text{[in}³]\]
\[ n = \text{Motor speed} \quad \text{min}⁻¹ \quad \text{(rpm)} \]
\[ \Delta p = \text{Hydraulic pressure differential} \quad \text{bar} \quad \text{[psid]} \]
\[ \eta_v = \text{Motor volumetric efficiency} \]
\[ \eta_m = \text{Motor mechanical efficiency} \]
\[ \eta_t = \text{Motor total efficiency} \]

\[ Pₑ = \text{High pressure} \quad \text{bar} \quad \text{[psid]} \]
\[ Pₑ = \text{Low pressure} \quad \text{bar} \quad \text{[psid]} \]
**Dimensions**

– Frame Size 070 and 089 cm³

**Outline drawing, configuration MS**

* Shaft spline data: spline shaft with involute spline, according to SAE handbook, 1963, class 1, fillet root side fit.

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Port A and B</th>
<th>Port L₁ and L₂</th>
<th>Port M₁ and M₂</th>
<th>Port M</th>
</tr>
</thead>
<tbody>
<tr>
<td>070</td>
<td>SAE flange, size 1, SAE split flange boss, 5000 psi, 4 threads, 3/8-16 UNC-2B, 18 deep</td>
<td>7/8-14 UNF-2B, SAE straight thread, O-ring boss</td>
<td></td>
<td>7/16-20 UNF-2B, SAE straight thread, O-ring boss</td>
</tr>
</tbody>
</table>
Dimensions
– Frame Size 070 and 089 cm³

Outline drawing, configuration MS (continued)

View X (for SMF 2/070 only)

View X (for SMF 2/089 only)
### Dimensions - Frame Size 070 and 089 cm³

Outline drawing, configuration MS (continued)

#### Dimensions

|------------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--------|

|------------|----------|----------|----------|----------|----------|-------|-------|-------|-------|---------------------------------|--------|-----|

Outline drawing, basic model

Outline drawing, motor configuration AM 01000

#### Dimensions

<table>
<thead>
<tr>
<th>Frame size</th>
<th>A [mm]</th>
<th>B [mm]</th>
<th>C [mm]</th>
<th>D [mm]</th>
<th>Weight [kg</th>
<th>lb]</th>
</tr>
</thead>
<tbody>
<tr>
<td>070</td>
<td>290 [11.417]</td>
<td>30 [1.181]</td>
<td>12 [0.472]</td>
<td>2 [0.079]</td>
<td>34 [75]</td>
<td></td>
</tr>
<tr>
<td>089</td>
<td>307 [12.087]</td>
<td>44 [1.732]</td>
<td>6 [0.236]</td>
<td>41 [90]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For further dimensions see previous pages.

Outline drawing, motor configuration AM 01000

#### Dimensions

<table>
<thead>
<tr>
<th>Frame size</th>
<th>A [mm]</th>
<th>Weight [kg</th>
<th>lb]</th>
</tr>
</thead>
<tbody>
<tr>
<td>070</td>
<td>315 [12.402]</td>
<td>36 [79]</td>
<td></td>
</tr>
<tr>
<td>089</td>
<td>332 [13.071]</td>
<td>43 [95]</td>
<td></td>
</tr>
</tbody>
</table>

1 Light weight and short options available on request
For further dimensions see previous pages.
Dimensions –
Frame Size 070 and 089 cm³

Outline drawing, motor configuration MR

Dimensions

<table>
<thead>
<tr>
<th>Frame size</th>
<th>A [mm]</th>
<th>B [mm]</th>
<th>Weight [kg]</th>
<th>Port Mₐ and Mₘ</th>
<th>Port M</th>
</tr>
</thead>
</table>

For further dimensions see previous pages.
Dimensions
– Frame Size 070 and 089 cm³

Circuit diagrams

Configuration MR

Basic model and motor configuration AM 01000

Designation:
1 = Fixed displacement motor
2 = Purge relief valve
3 = Shuttle valve
4 = High pressure relief valve
5 = Bypass valve

Ports:
A, B = Main pressure ports (working loop)
L₁, L₂ = Drain ports
Mₐ = Gauge port for port A
Mₖ = Gauge port for port B
M = Gauge port - charge pressure

Return from purge relief valve to motor case
Dimensions

Frame Size 227 and 334 cm³

Outline drawing, configuration MS

Dimensions

|------------|--------|--------|--------|--------|--------|--------|--------|----------|--------|

<table>
<thead>
<tr>
<th>Frame size</th>
<th>M [mm]</th>
<th>Ø N [mm]</th>
<th>Ø O [mm]</th>
<th>Ø P [mm]</th>
<th>Ø R [mm]</th>
<th>Ø S [mm]</th>
<th>T [mm]</th>
<th>U [mm]</th>
<th>V [mm]</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Frame size</th>
<th>W [mm]</th>
<th>X [mm]</th>
<th>Y [mm]</th>
<th>Z [mm]</th>
<th>AA [mm]</th>
<th>BB [mm]</th>
<th>CC [mm]</th>
<th>Diameter for shaft coupling [mm]</th>
<th>Weight [kg]</th>
</tr>
</thead>
</table>

* Shaft spline data: spline shaft with involute spline, according to SAE handbook, 1963, class 1, fillet root side fit.
Dimensions
– Frame Size 227 and 334 cm³

Outline drawing, configuration MS
(continued)

<table>
<thead>
<tr>
<th>Frame size</th>
<th>Port A and B</th>
<th>Port L₁ and L₂</th>
<th>Port M₁ and M₂</th>
<th>Port M</th>
</tr>
</thead>
<tbody>
<tr>
<td>227</td>
<td>SAE flange, size 1 1/2</td>
<td>1 7/8-12 UNF-2B</td>
<td>7/16-20 UNF-2B</td>
<td>7/16-20 UNF-2B</td>
</tr>
<tr>
<td></td>
<td>SAE split flange boss</td>
<td>SAE straight thread</td>
<td>SAE straight thread</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6000 psi</td>
<td>O-ring boss</td>
<td>O-ring boss</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 threads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5/8-11 UNC-2B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35 mm deep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>334</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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